VT 005 760

REPORT RESUMES

ED 020 442 VT 005 760

MICROFICHE COLLECTION OF DOCUMENTS REPORTED IN ABSTRACTS OF INSTRUCTIONAL MATERIALS IN VOCATIONAL AND TECHNICAL EDUCATION, SUMMER 1968.

OHIO STATE UNIV., COLUMBUS, CENTER FOR VOC. EDUC.

PUB DATE 68

EDRS PRICE MF-$43.00 HC NOT AVAILABLE FROM EDRS. 14,813P.

DESCRIPTORS- *INSTRUCTIONAL MATERIALS, *VOCATIONAL EDUCATION, *TECHNICAL EDUCATION, BUSINESS EDUCATION, AGRICULTURAL EDUCATION, DISTRIBUTIVE EDUCATION, HEALTH OCCUPATIONS EDUCATION, HOME ECONOMICS EDUCATION, INDUSTRIAL ARTS, TRADE AND INDUSTRIAL EDUCATION, INDEXES (LOCATERS), CLEARINGHOUSES,

DOCUMENTS ANNOUNCED IN THE SUMMER 1968 ISSUE (VT 005 759) OF "ABSTRACTS OF INSTRUCTIONAL MATERIALS IN VOCATIONAL AND TECHNICAL EDUCATION" (AIM), WITH MINOR EXCEPTIONS, ARE INCLUDED IN THIS MICROFICHE SET. THE MICROFICHE SET IS ARRANGED IN THE FOLLOWING SEQUENCE--(1) A VOCATIONAL TECHNICAL (VT) NUMBER INDEX TO DOCUMENTS IN THE MICROFICHE COLLECTION, (2) A VT NUMBER LIST OF 12 DOCUMENTS WHICH WERE LISTED IN AIM BUT ARE NOT IN THE MICROFICHE COLLECTION, WITH A LIST OF ADDRESSES FROM WHICH THESE DOCUMENTS ARE AVAILABLE, (3) THE AUTHOR AND SUBJECT INDEX FROM AIM, AND (4) THE FULL TEXT OF DOCUMENTS LISTED IN THE VT NUMBER INDEX. THE TEXTS ARE FILMED CONTINUOUSLY IN VT NUMBER SEQUENCE. (DS)

Microfiche Collection of Documents Reported in Abstracts of Instructional Materials in Vocational and Technical Education

(AIM)

Compiled and Indexed by The ERIC Clearinghouse
on Vocational and Technical Education

Summer 1968

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Performed Pursuant to a Grant from the U. S.
Office of Education, Department of Health,
Education and Welfare.

ERIC Clearinghouse
The Center for Vocational and Technical Education
The Ohio State University
980 Kinnear Road, Columbus, Ohio 43212

INTRODUCTION

This collection of microfiche includes the documents announced in the Summer, 1968 issue of Abstracts of Instructional Materials in Vocational and Technical Education (AIM) with minor exceptions. The microfiche set is arranged in the following sequence:

1. Vocational Technical (VT) Number Index to Microfiche Collection of Documents Reported in AIM, Summer 1968.

2. VT Number List of Documents Not in Microfiche Collection.

   Copies of these documents may be obtained from the sources indicated in the citations on page 5.

3. Source List of addresses for documents cited on page 4.

4. Selected indexes from AIM, Summer 1968.

   a. Author Index

   b. Subject Index

   The page numbers shown in these indexes refer to the location of the abstracts in AIM, Summer 1968.

5. The full text of documents listed in the VT Number Index on pages 1-2.

   The documents are arranged in numerical order according to VT numbers. The texts of materials in this microfiche set have been filmed continuously in VT number sequence thereby facilitating the purchase of the texts of all documents on microfiche with one order. This filming method also lowers the cost of the entire set as contrasted to the purchase of individual titles on separate microfiche. The frame immediately preceding each document is used to identify the document by VT number, and to present the resume for that document.

The documents identified in this collection of microfiche with an ERIC Document (ED) number are also available as separate documents from ERIC Document Reproduction Service (EDRS) by using the ED number. The documents identified in this collection of microfiche with a Manpower (MP) number are also available as separate documents from ERIC Document Reproduction Service (EDRS) by using the MP number. Items with the ED symbol but without the six numerical digits are unavailable from EDRS at the time of filming until an ED number is assigned and published in Research in Education (RIE). The issue of RIE in which the abstract is scheduled to appear follows the ED prefix in the index on pages 1 and 2. This will enable the reader to easily locate the appropriate six digit ED number by checking the specified issue of RIE. At the time the ED number appears in RIE, individual microfiche of the document will be available from EDRS.

The documents identified in this collection of microfiche without an ED number are titles in the local clearinghouse collection. Microfiche of these items is obtainable only through purchase of this set or from agencies who have this set, and who have the capability of reproducing microfiche.

Vocational Technical (VT) Number

Index to Microfiche Collection of Documents

Reported in AIM, Summer 1968

VT Number	ED[1] or MP[2] Number	VT Number	ED[1] or MP[2] Number
VT 000 484		VT 002 080	
VT 000 549		VT 002 085	
VT 000 573		VT 002 086	
VT 000 574		VT 002 087	
VT 000 697	ED (See Jul '68 RIE)	VT 002 089	
VT 000 860		VT 002 097	
VT 000 894		VT 002 267	
VT 000 923		VT 002 274	ED (See Aug '68 RIE)
VT 000 924		VT 002 310	ED (See Aug '68 RIE)
VT 000 947		VT 002 454	ED (See Aug '68 RIE)
VT 000 951		VT 002 531	
VT 000 955		VT 002 612	
VT 000 956		VT 002 687	
VT 001 006		VT 002 726	
VT 001 031		VT 002 728	
VT 001 111		VT 002 761	
VT 001 133	ED 016 034	VT 002 788	
VT 001 143		VT 002 833	
VT 001 187		VT 002 893	ED (See Aug '68 RIE)
VT 001 203		VT 002 907	
VT 001 234		VT 002 932	ED (See Aug '68 RIE)
VT 001 327	ED (See Aug '68 RIE)	VT 002 940	
VT 001 417		VT 002 990	
VT 001 510		VT 003 0 6	
VT 001 543		VT 003 011	
VT 001 627		VT 003 013	
VT 001 628		VT 003 021	
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VT 001 858		VT 003 186	
VT 001 877		VT 003 187	
VT 001 996		VT 003 188	
VT 002 020		VT 003 190	
VT 002 042		VT 003 191	
VT 002 045		VT 003 192	
VT 002 050		VT 003 193	
VT 002 061		VT 003 265	
VT 002 072		VT 003 266	
VT 002 076		VT 003 267	
VT 002 077		VT 003 268	

VT Number	ED[1] or MP[2] Number	VT Number	ED[1] or MP[2] Number
VT 003 269		VT 003 967	
VT 003 270		VT 003 977	
VT 003 373		VT 003 978	
VT 003 378		VT 003 982	
VT 003 379		VT 003 983	
VT 003 381		VT 003 984	
VT 003 388		VT 003 986	
VT 003 491		VT 003 987	
VT 003 492		VT 003 994	
VT 003 493		VT 003 996	
VT 003 494		VT 004 066	ED (See Jul '68 RIE)
VT 003 495		VT 004 070	
VT 003 503	ED (See Jul '68 RIE)	VT 004 071	
VT 003 509	MP 000 170	VT 004 072	
VT 003 510	MP 000 171	VT 004 073	
VT 003 511	MP 000 172	VT 004 074	
VT 003 512	MP 000 173	VT 004 075	ED (See Aug '68 RIE)
VT 003 514	MP 000 175	VT 004 076	
VT 003 515	MP 000 176	VT 004 077	
VT 003 516	MP 000 177	VT 004 078	ED (See Sep '68 RIE)
VT 003 518	MP 000 179	VT 004 103	
VT 003 534		VT 004 104	
VT 003 565	ED 015 271	VT 004 156	
VT 003 624		VT 004 282	
VT 003 625		VT 004 458	ED (See Aug '68 RIE)
VT 003 626		VT 004 459	ED (See Aug '68 RIE)
VT 003 627		VT 004 460	ED (See Aug '68 RIE)
VT 003 628		VT 004 462	ED (See Aug '68 RIE)
VT 003 629		VT 004 464	ED (See Aug '68 RIE)
VT 003 630		VT 004 465	ED (See Aug '68 RIE)
VT 003 631		VT 004 466	ED (See Aug '68 RIE)
VT 003 713		VT 004 467	ED (See Aug '68 RIE)
VT 003 724		VT 004 468	ED (See Aug '68 RIE)
VT 003 725		VT 004 469	ED (See Aug '68 RIE)
VT 003 727		VT 004 470	ED (See Aug '68 RIE)
VT 003 729		VT 004 471	ED (See Aug '68 RIE)
VT 003 731		VT 004 472	
VT 003 734		VT 004 473	
VT 003 736		VT 004 474	
VT 003 737		VT 004 475	
VT 003 741		VT 004 476	
VT 003 742		VT 004 477	
VT 003 743		VT 004 478	
VT 003 887		VT 004 479	
VT 003 966		VT 004 480	

VT Number	ED[1] or MP[2] Number	VT Number	ED[1] or MP[2] Number
VT 004 491	ED (See Aug '68 RIE)		
VT 004 601			
VT 004 633	ED (See Aug '68 RIE)		
VT 004 654	ED (See Aug '68 RIE)		
VT 004 694	ED (See Aug '68 RIE)		
VT 004 695	ED (See Aug '68 RIE)		
VT 004 697			
VT 004 698			
VT 004 700			
VT 004 701			
VT 004 702			
VT 004 708	ED (See Aug '68 RIE)		
VT 004 777	ED (See Aug '68 RIE)		
VT 004 806			
VT 004 843	ED (See Aug '68 RIE)		
VT 005 040			
VT 005 421	ED (See Aug '68 RIE)		

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[1] Also available from EDRS as individual documents.

[2] Any document with an MP number is available from EDRS by using the appropriate MP number.

VT Number List of Documents[1] Not in Microfiche Collection

Address Code[2]	
C	VT 000 127 Sporting Goods. Texas Univ., Austin. Industrial and Business Training. Texas Education Agency, Austin. Distributive Education Service. November, 1965. Price: $4.00
B	VT 000 440 Supervised Study Guide in Cabinetmaking. Texas Univ., Austin. Industrial Education Department. Texas Education Agency, Austin. Industrial Education Division. July, 1966. Price: $4.70.
D	VT 000 714 Electronics, Learner's Manual. Ohio State Department of Education, Columbus. Trade and Industrial Education Service. 1966. Price: $1.05.
C	VT 003 182 Congratulations on Becoming a Training Sponsor. Texas Univ., Austin. Instructional Materials Laboratory. July, 1966. Price: 35¢.
C	VT 003 184 Newspaper Circulation, Principles and Development of Modern Newspaper Circulation Methods. Texas Circulation Managers Association. Texas Univ., Austin. Instructional Materials Laboratory. October, 1966. Price: $4.00.
D	VT 004 029 Vocational and Technical Education for a Changing World of Work. (Sound Film Strip). Ohio State Department of Education, Columbus. Trade and Industrial Education Service. 1966. Price: $10.40 (includes record and filmstrip) or $15.20 (includes magnetic tape and filmstrip).
D	VT 004 031 Your Future Through Vocational Education. (Sound Film Strip). Ohio State Department of Education, Columbus. Trade and Industrial Education Service. 1966. Price: $10.40 (includes records and filmstrip) or $15.20 (includes magnetic tape and filmstrip).
A	VT 005 422 Microfiche Collection of Documents Reported in Abstracts of Instructional Materials in Vocational and Technical Education, Spring, 1968. Ohio State Univ., Columbus. Center for Vocational Education. 1968. Price: $54.00.

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[1] Copies of these documents may be obtained from the source indicated in the citation.

[2] Correct address to obtain cited items is given in the source list, page 5.

Source List for Documents Not in Microfiche Collection

Address Code

A
ERIC Document Reproduction Service (EDRS)
The National Cash Register Company
4936 Fairmont Avenue
Bethesda, Maryland 20014

B
Industrial Education Department
Division of Extension
The University of Texas
Austin, Texas 78712

C
Instructional Materials Laboratory
Distributive Education Department
Division of Extension
The University of Texas
Austin, Texas 78712

D
Trade and Industrial Education Service
Instructional Materials Laboratory
The Ohio State University
1885 Neil Avenue
Columbus, Ohio 43210

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VT 000 484

VT 000 484
Selected Lists of References and Aids in Teaching Landscaping, Floriculture, Ornamental Horticulture, Suburban Gardening.

New York State Coll of Agr, Ithaca. Dept of Rural Educ.
Pub Date - Jan64
MF AVAILABLE IN VT-ERIC SET 32p.

*AGRICULTURAL EDUCATION, FLORICULTURE, LANDSCAPING, REFERENCE MATERIALS, *INSTRUCTIONAL MATERIALS, *ORNAMENTAL HORTICULTURE, *TEST CONSTRUCTION, HIGH SCHOOLS, *BIBLIOGRAPHIES,

Bulletins, circulars, textbooks, films, filmstrips, slides, and commercial materials for use in teaching landscaping, floriculture, ornamental horticulture, or suburban gardening are listed in the first section of the document. Commercial materials and textbooks, United State Department of Agriculture and university publications are included. The source, cost, and other information are given for each item. The second section is a guide for preparing objective-type test questions for examinations in agriculture. It is intended for classroom teacher use and discusses purpose, classification of the question, difficulty level, item construction, the problem, answers, group questions, multiple choice, master list, matching, and general precautions. Examples are included. (RW)

SELECTED LISTS OF REFERENCES AND AIDS

IN

TEACHING:

LANDSCAPING
FLORICULTURE
ORNAMENTAL HORTICULTURE
SUBURBAN GARDENING

* * * * * * * * * * * *

Bulletins and Circulars
Textbooks
Films, Filmstrips, and Slides
Commercial Material

Cornell University
New York State College of Agriculture
Rural Education Department
Agricultural Education Division

Acknowledgements

The materials appearing in this list were reviewed by Donald Burgett, Part-time Instructional Materials Specialist in the Division of Agricultural Education.

The suggestions of staff members in the Department of Floriculture and Ornamental Horticulture of the New York State College of Agriculture were considered. The list was also reviewed by a practicing landscape gardener. The final list was checked by Prof. Joe P. Bail, Agricultural Education Division, and reproduced by the Instructional Materials Staff in Agricultural Education.

Suggestions for additions to the list are invited from teachers of agriculture.

January 1964

Area: Landscaping
Sub-Area: Lawns

1. BULLETINS AND CIRCULARS

Title	No.	Source	Cost	Comments
Better Lawns	G51	USDA Home & Garden Bul.	Free	Order from Supt. of Documents
Lawn Insects: How to Control Them	G53	USDA Home & Garden Bul.	Free	↓
Manual of the Grasses of the U. S.	200	USDA Misc. Publication	25¢	↓
Controlling Lawn Weeds with Herbicides	79	USDA Home & Garden Bul.	Free	↓
Home Lawns	E922	Cornell Extension Bul.	5¢	Order from Mailing Room, Stone Hall
Ground Covers	E1064	Cornell Extension Bul.	5¢	↓
1963 Cornell Recommendations for Turfgrass				↓
You Can Have A Beautiful Lawn	1079	Cornell Extension Bul.		↓

2. TEXTBOOKS

Title	Author	Publishers	Cost	Year Pub. & No. of Pages
Turf Management	Musser	McGraw-Hill Co.	$7.00	
Ground Cover Plants	D. Wyman	The MacMillan Co.		1956

3. FILMS, FILMSTRIPS AND SLIDES

Title	Description	Source	Cost	Comments
Lawn Care and Lawn Problems	Slide Set L7	Cornell Film Library	30¢/ day	51 slides

4. COMMERCIAL MATERIALS

Title	Description	Source	Cost	Comments
Planting Turf	U. S. Army Corps of Engineers Manual EM 1110-1-321	U. S. Government Printing Office		

5. OTHER SUITABLE REFERENCES

Title	Description	Source	Cost
Grass Identification Charts	Charts 22 x 28 color	Charles Williams, Regional Co., Ag. Agent, 612 State Street, Schenectady, New York	

Area: Landscaping
Sub-Area: Design

1. BULLETINS AND CIRCULARS

Title	No.	Source	Cost	Comments
Development of the Farmstead Landscape	Source Unit	Bureau of Educ. Research	$1.00	College of Education, Michigan State Univ., East Lansing, Michigan
Farmstead Landscaping	Appr. Prac. List	Dept. of Teacher Education	Sgle. free	Michigan State Univ.
Border Planting and Outdoor Living Rooms	E813	Cornell Extension Bul.	10¢	Order from Mailing Room, Stone Hall
Landscape Steep Slopes	E749	Cornell Extension Bul.	5¢	
The Rock Garden	E403	Cornell Extension Bul.	15¢	
Outdoor Fireplaces	E612	Cornell Extension Bul.	5¢	
Driveways and Sidewalks	E693	Cornell Extension Bul.	5¢	

1. BULLETINS AND CIRCULARS (Continued)

Title	No.	Source	Cost	Comments
Landscaping the Farmstead	189	USDA Voc. Educ. Pul.	30¢	Order from the Supt. of Documents
Planning and Construction References for Landscape Architects	Bul. 30	Dept. of Forest Extension	50¢	Order from State Univ. College of Forestry, Syracuse 10, New York

2. TEXTBOOKS

Title	Author	Publishers	Cost	Year Pub. & No. of Pages
The Art of Home Landscaping	G. Ecklo	F. W. Dodge Co.		1956
How To Landscape Your Grounds	Lloyd R. Johnson	A. T. DeLaMare Co.		1945
Budget Landscaping	C. B. Lees	Holt, Rinehart & Winston		1960
Approved Practices in Beautifying the Home Grounds	Norman Hoover	The Interstate		1959
The Permanent Garden	Norman Taylor	D. VanNostrand Co.		
The Everblooming Garden	Norman Taylor	D. Van Nostrand Co.		

3. FILMS, FILMSTRIPS AND SLIDES

Title	Description	Source	Cost	Comments
Basic Techniques in Home Landscaping	16mm sound	Cornell Film Lib.	Rent. $2.50	b/w - 12 min.
Landscaping for the Future	16mm sound	Cornell Film Lib.	$2.50	Color - 14 min.
Home Grounds Improvement	Slide Set L1	Cornell Film Lib.	30¢/ day	15 slides

3. FILMS, FILMSTRIPS, AND SLIDES (Continued)

Title	Description	Source	Cost	Comments
Landscaping the Farm Home	Slide Set L2	Cornell Film Lib.	30¢/ day	17 slides
Landscape Plantings for Homesteads	Slide Set L3	Cornell Film Lib.	30¢/ day	19 slides
Foundation Plantings	Slide Set L4	Cornell Film Lib.	30¢/ day	24 slides

4. COMMERCIAL MATERIALS

Title	Description	Source	Cost	Comments
The Standard for Home Landscaping	Bulletin	American Assoc. of Nurserymen, Inc., 835 Southern Bldg., Washington 5, D. C.	25¢	

Area: Landscaping
Sub-Area: Trees and Shrubs

1. BULLETINS AND CIRCULARS

Title	No.	Source	Cost	Comments
Home Propagation of Trees and Shrubs	80	USDA Home & Garden Bul.		Supt. of Documents
Maple Disease and Their Control	81	USDA Home & Garden Bul.	5¢	↓
Pruning Shade Trees and Repairing Their Injuries	83	USDA Home & Garden Bul.	10¢	↓
Care of Damaged Shade Trees	896	USDA Farmers Bulletin	15C	↓
Dutch Elm Disease and Its Control	AB193	USDA Agric. Inf. Bul.	10¢	↓
Transplanting Trees and Other Woody Plants	1	Tree Preservation Bul.	25¢	↓

1. BULLETINS AND CIRCULARS (Continued)

Title	No.	Source	Cost	Comments
Trees for the Home Grounds	1096	Cornell Extension Bul.	5¢	Mailing Room, Stone Hall
The Planting and Care of Forcing Shrubs and Trees for Indoor Bloom	1030	Cornell Extension Bul.	5¢	
Shade Trees	185	Cornell Extension Circular		
New Shrubs from Old By Layering	E1006	Cornell Extension Bul.	5¢	
1962 Cornell Recommendations for Trees and Shrubs		Cornell Extension Pub.		↓
Notes on Woody Plant Materials for Landscape Planting		Dept. of Floriculture, Cornell University	$1.00	
Recipe for Tree Planting		College of Forestry, Syracuse	Free	
Seedling Forest Trees		College of Forestry, Syracuse	Free	
Your Native Shade Tree		College of Forestry, Syracuse	Free	
Tree Pest Leaflets		College of Forestry, Syracuse	Free	
Tree Diseases in NYS Plantations	44	College of Forestry, Syracuse	80¢	Dept. of Forest Ext., College of Forestry
Nursery Product Marketing	65	Ag. Econ. Res. Bul.	Sgle Free	Dept. of Agric. Econ., Cornell University
Nursery Products and New Homeowners	97	Ag. Econ. Res. Bul.	Sgle Free	↓
Cornell's Home Garden Guide for Ornamental Trees and Shrubs		Cornell Extension Circular	Sgle Free	Mailing Room, Stone Hall

2. TEXTBOOKS

Title	Author	Publishers	Cost	Year Pub. & No. of Pages
Trees for American Gardens	D. Wyman	The MacMillan Co.		1959
Shrubs and Vines for American Gardens	D. Wyman	The MacMillan Co.		1949
Tree Maintenance	P. P. Pirone	Oxford Univ. Press		1959

3. FILMS, FILMSTRIPS, AND SLIDES

Title	Description	Source	Cost	Comments
Evergreen Shrubs for Dooryard Planting	Filmstrip C-47 Slide Set C-47	USDA Photo Lab, Inc., 3825 Georgia Ave, NW, Washington 11, D. C.	$6.00 $8.50	50 frames, color
Forcing Flowering Trees and Shrubs for Indoor Bloom	Slide Set FL8	Cornell Film Lib.	30¢/ day	35 slides
Shrubs that Grow 6 to 8 Feet High and Flowers in Spring and Early Summer	Slide Set PM10	Cornell Film Lib.	30¢/ day	35 slides
Shrubs 6 to 8 Feet High of Interest from Mid-Summer Through Rest of Year	Slide Set PM11	Cornell Film Lib.	30¢/ day	31 slides
Shrubs that Mature 8-15 Feet High	Slide Set PM12	Cornell Film Lib.	30¢/ day	27 slides
Trees That Grow 15-30 Feet High	Slide Set PM13	Cornell Film Lib.	30¢/ day	43 slides

4. COMMERCIAL MATERIALS

Title	Description	Source	Cost	Comments
Trees in Your Comm.	Bulletin	NY Telephone Co.		
Planting & Maint. of Trees, Shrubs and Vines	Corps of Eng. Manual EM1110-1-323	U. S. Government Printing Office	20¢	

Area: Floriculture

1. BULLETINS AND CIRCULARS

Title	No.	Source	Cost	Comments
Growing Annual Flowering Plants	1171	USDA Farmers Bulletin		Order from Supt. of Documents
Growing Azaleas and Rhododendrons	71	USDA Home & Garden Bul.	5¢	
Growing Iris in the Home Garden	66	USDA Home & Garden Bul.	5¢	
Growing Chrysanthemums in the Home Garden	65	USDA Home & Garden Bul.	5¢	
Roses for the Home	25	USDA Home & Garden Bul.	15¢	
Spring-flowering Bulbs	439	USDA Leaflet		
Peony Culture	893	Cornell Extension Bul.	5¢	Order from Mailing Room, Stone Hall
The Culture of Garden Chrysanthemums	894	Cornell Extension Bul.	5¢	
The Culture of Iris	895	Cornell Extension Bul.	5¢	
The Culture of Spring-flowering Bulbs	896	Cornell Extension Bul.	5¢	
The Culture of Garden Roses	897	Cornell Extension Bul.	5¢	
The Culture of Gladiolus	914	Cornell Extension Bul.	5¢	
The Culture of the Delphinium	937	Cornell Extension Bul.	5¢	
Flowers from Seed	981	Cornell Extension Bul.	5¢	
Common Wild Flowers of NYS	990	Cornell Extension Bul.	10¢	

1. BULLETINS AND CIRCULARS (Continued)

Title	No.	Source	Cost	Comments
Bulbous Plants for Indoor Bloom	1021	Cornell Extension Bul.	5¢	Order from Mailing Room, Stone Hall
Corsages from Garden Flowers	1047	Cornell Extension Bul.	5¢	
Recommended Annual Flowers for NYS	1070	Cornell Extension Bul.	10¢	
Culture of Rhododendrons in NYS	1071	Cornell Extension Bul.	5¢	
Solving Cultural Troubles of Rhododendrons	1091	Cornell Extension Bul.	5¢	
A Flower Garden of Annuals	87	4-H Club Bulletin	5¢	
Perennials for A 4-H Flower Border	96	4-H Club Bulletin	5¢	
Flower Arrangement	98	4-H Club Bulletin	5¢	
Sequence of Bloom of Perennials, Biennials and Bulbs	21	Miscellaneous Bulletin	5¢	
An Efficient Labor-Saving Method of Steaming Soil	635	Cornell Extension Bul.	5¢	
Diseases of Bearded Irises	1050	Cornell Extension Bul.	10¢	
New Flash-Flame Soil Pasteurizer	875	Experiment Station Bul.	10¢	
1963 Cornell Recommendations for Commercial Floriculture Crops		Cornell Extension Pub.		
NY Wholesale Florists	107	A. E. Res. Bulletin	Free	A. E. Dept., Cornell
Commercial Floriculture in NY	227	A. E. Ext. Bulletin	Free	A. E. Dept., Cornell

2 TEXTBOOKS

Title	Author	Publishers	Cost	Year Pub. & No. of Pages
American Orchid Culture	E. A. White	A. T. DeLaMare Co., New York		1939
Orchids are Easy to Grow	H. B. Logan and L. C. Cooper	Ziff-Davis Publishing Co., Chicago, Ill.		1949
Orchids and How to Grow Them	A. E. Willoughby	Oxford Printing Co.		1950
ABC Of Orchid Growing, 3rd Ed.	J. V. Watkins	Prentice-Hall		1956
Anyone Can Grow Roses	Cynthia Westcott	D. VanNostrand Co.		
Home Orchid Growing	Rebecca T. Northen	D. VanNostrand Co.		
Lilies in Their Homes	Alice C. Maxwell	D. VanNostrand Co.		
Phlox	B. H. D. Symms	D. VanNostrand Co.		

3 FILMS, FILMSTRIPS AND SLIDES

Title	Description	Source	Cost	Comments
Flowers at Work	16mm sound	Cornell Film Lib.	R'tal $2.00	11 min., color
Growth of Flowers	16mm sound	Cornell Film Lib.	$2.00	10 min., color
Modern Roses	16mm sound	Cornell Film Lib.	Free	25 min., color
Modern Roses on Parade	16mm sound	Cornell Film Lib.	Free	30 min., color
Rosarama	16mm sound	Cornell Film Lib.	$3.00	30 min., color
Story of Modern Roses	16mm sound	Cornell Film Lib.	Free	28 min., color

1. BULLETINS AND CIRCULARS (Continued)

Title	No.	Source	Cost	Comments
Useful and Ornamental Gourds	F1849	USDA Farmers Bulletin	10¢	Order from Supt. of Documents
Home Propagation of Ornamental Trees and Shrubs	G80	USDA Home & Garden Bul.	10¢	↓
Selecting and Growing House Plants	82	USDA Home & Garden Bul.	15¢	↓
Ornamental Horticulture in New York	228	A. E. Extension, Cornell	Sgle Free	A. E. Dept., Cornell

2. TEXTBOOKS

Title	Author	Publisher	Cost	Year Pub. & No. of Pages
Miniature Gardens	Anne Ashberry	D. VanNostrand Co.		
Plants in the Garden	Norman Taylor	D. VanNostrand Co.		

3. FILMS, FILMSTRIPS AND SLIDES

Title	Description	Source	Cost	Comments
Plaques from Dried Material	Slide Set FL4	Cornell Film Lib.	30¢/ day	12 slides
Indoor and Outdoor Christmas Decorations	Slide Set FL10	Cornell Film Lib.	30¢/ day	15 slides
Selection and Care of House Plants	Slide Set FL11	Cornell Film Lib.	30¢/ day	24 slides
Assembling Dish Gardens and Terrariums	Slide Set FL12	Cornell Film Lib.	30¢/ day	30 slides
Decorative Use of House Plants	Slide Set FL16	Cornell Film Lib.	30¢/ day	23 slides

3. FILMS, FILMSTRIPS AND SLIDES (Continued)

Title	Description	Source	Cost	Comments
Ornamental Twining Vines	Slide Set PM8	Cornell Film Lib.	30¢/ day	23 slides
Ornamental Pests	Slide Set PM15	Cornell Film Lib.	30¢/ day	47 slides

4. COMMERCIAL MATERIALS

Title	Description	Source	Cost	Comments
Brooklyn Botanical Garden Handbook		Brooklyn Botanical Garden, Brooklyn 25, New York		

Area: Suburban Gardening

1. BULLETINS AND CIRCULARS

Title	No.	Source	Cost	Comments
Grow Good Potatoes	J80	4-H Club Bulletin	10¢	Order from Mailing Room, Stone Hall
Varieties of Fruit for New York	E733	Cornell Extension Bul.	10¢	↓
Home Storage of Vegetables and Fruits	E846	Cornell Extension Bul.	5¢	
Blueberries in the Home Garden	E900	Cornell Extension Bul.	10¢	
The Home Fruit Planting	E913	Cornell Extension Bul.	10¢	
Suburban Gardening	E1049	Cornell Extension Bul.	5¢	
Growing Strawberries for Home Use	E943	Cornell Extension Bul.	5¢	

1. BULLETINS AND CIRCULARS (Continued)

Title	No.	Source	Cost	Comments
Dwarf Fruit Trees	L407	USDA Leaflet	Sgle Free	Order from Supt. of Documents
Growing Blackberries	F2160	USDA Farmers Bulletin	Free	
Growing Raspberries	F2165	USDA Farmers Bulletin	Free	
Ants in the Home and Garden: How To Control Them	G28	USDA Home & Garden Bul.	Free	
Growing Vegetables in Town and City	G7	USDA Home & Garden Bul.	Free	
Hotbeds and Coldframes	F1743	USDA Farmers Bulletin	Free	
Insects and Diseases of Vegetables in the Home Garden	G46	USDA Home & Garden Bul.	Free	
Storage of Vegetable Seeds	L220	USDA Leaflet	Free	
Asparagus Culture	F1646	USDA Farmers Bulletin	Free	
Growing Table Beets	L360	USDA Leaflet	Free	
Hand Dusters & Sprayers	G63	USDA Home & Garden Bul.	10¢	
How Much Fertilizer Shall I Use?	L307	USDA Leaflet	5¢	↓

2. TEXTBOOKS

Title	Author	Publisher	Cost	Year Pub. & No. of Pages
The Gardener's Bug Book	C. Westcott	Doubleday & Co.		1956

3. FILMS, FILMSTRIPS AND SLIDES

Title	Description	Source	Cost	Comments
Home Food Gardens	16mm sound	Cornell Film Lib.	$2.50	27 min., color
Victory Gardens	16mm sound	Cornell Film Lib.	$2.00	27 min., color
Grow Your Own	16mm sound	Cornell Film Lib.	$1.50	16 min., b/w
Better Gardens for Better Living	Slide Set UC1	Cornell Film Lib.	30¢/ day	27 slides
Garden Diseases	Slide Set UC2	Cornell Film Lib.	30¢/ day	23 slides
Garden Insects	Slide Set UC3	Cornell Film Lib.	30¢/ day	26 slides
Home Storage of Vegetables & Fruits	Slide Set UC6	Cornell Film Lib.	30¢/ day	29 slides
Home Vegetable Garden	Slide Set UC7	Cornell Film Lib.	30¢/ day	36 slides
Vegetable, Fruit and Flower Gardening	Slide Set UC8	Cornell Film Lib.	30¢/ day	59 slides
Special Techniques for the Home Gardener	Slide Set UC11	Cornell Film Lib.	30¢/ day	35 slides
The New Gardener	Slide Set #641	Photo Lab, Inc., 3825 Georgia Ave., N. W., W'ton 11	$2.00	49 slides, b/w
Planning the Home Vegetable Garden	Slide Set #692	↓	$2.00	36 slides, b/w
Backyard Vegetable Garden	Slide Set #657		$2.00	60 slides, b/w
Special Techniques for the Home Gardener	Slide Set #705		$2.00	35 slides b/w

THE UNIVERSITY OF THE STATE OF NEW YORK
The State Education Department
Bureau of Elementary and Secondary Educational Testing
Albany 12224

A GUIDE FOR THE PREPARATION OF OBJECTIVE-TYPE TEST QUESTIONS FOR EXAMINATIONS IN AGRICULTURE

A Guide for the Preparation of Objective-Type Test Questions for Examinations in Agriculture

Purpose

This guide is intended to help New York State classroom teachers to develop objective-type test questions that will efficiently measure important goals of the course in agriculture.

As all teachers know, an examination must be made up of good test questions if it is to provide a fair and reliable measure of that portion of the course that can be measured by paper and pencil tests. Conversely, questions that test trivial material or that operate inefficiently are unfair to both pupil and teacher, because they provide confusing and misleading measures of the pupil and the course.

It is undeniable, too, that the content of any test tends to influence study habits and, consequently, to have an effect on teaching practices. Good test questions that stress understandings and applications encourage pupils to go beyond the mere accumulation of unrelated facts. To the extent that such an examination contains poor questions, however, it has an adverse effect on learning.

As instructional tools, examinations are a very direct way of telling the pupil what is expected of him. This year's examination, thus, has an impact on next year's pupil. This is true of any examination, regardless of its source. To quote from a speech made by Leo Nedelsky at an Educational Testing Service Conference a few years ago:

> "It is an incontestable truth that tests are valuable tools of instruction. What the student is likely to learn from a test, however, is not an isolated fact or generalization, for the test is encompassed in a few pages and a few hours as compared to the hundreds of pages of the text studied over a period of months. The most effective role of the test as a teaching instrument is rather to let the student know in an emphatic manner what the objectives of the course are."

The development of good questions is demanding and time-consuming. Nevertheless, it is well within the capabilities of any teacher who knows his subject well and who is conversant with question-writing techniques.

"Genius," the old cliché tells us, "is an infinite capacity for taking pains." In no task is the statement more pointedly appropriate than in the writing of efficient examination questions.

The Question

Every "item" in a test starts with a question or with instruction addressed by the examiner to the examinee. This is true whether the item actually ends up in question form, as an incomplete sentence to be completed, as a complete sentence to be corrected, or as a series of premises and responses served up as a matching problem.

Usually, therefore, the best way to start constructing the item is to write the question in exactly the same way you would address it to a pupil in your class. Then, below the question, write the correct answer as you would hope to receive it.

At this point, examine the question to determine whether the material it measures is <u>important</u> or <u>trivial</u> within the context of the course and its objectives. Below are a few rules-of-thumb that may help in making this decision:

1. Is the question within the scope of the course and its objectives?

2. In what way will knowing the answer be of value to the pupil?

3. If the question under scrutiny were the entire test, would you be willing to accept it as a measure for discriminating among your pupils? (Bear in mind that, if used in a final examination, the question will probably for some pupils mean the difference between passing and failing.)

If the question survives this kind of scrutiny, it can be said to measure truly important material and is worth the time and effort necessary to complete it in the format (multiple choice, completion, matching, etc.) in which it will be used in the examination.

The question is now ready for classification.

Classification of the Question

Classification will be simplified if we think of test questions as falling generally into either of two categories:

<u>Factual Knowledge</u>: questions emphasizing recall or recognition. These questions deal with knowledge of specific facts, terminology and methods. The material tested is often stated directly in the text, or is commonly taught in the classroom in virtually the same language as the test question.

<u>Understanding</u>: questions requiring the pupil to establish relationships, analyze situations, make judgments, and solve new problems. These questions require that the pupil must not only recall specific facts but must have understood the underlying concept or principle so that he can make use of what he has learned in dealing with unfamiliar situations.

These two classifications (factual knowledge and understanding) refer to increasing levels of refinement in testing on the same materials. They are intended as a convenient means of distinguishing among questions, not as fixed absolutes. The classification of some questions will be readily apparent; others will be borderline cases. Often the classification varies from one group of pupils to another. A question that offers a new problem to one group is simple recall to another group where the teacher has already presented and solved the problem. Sometimes the classification is dependent on the pupils involved. A question that tests factual knowledge for the best pupil may measure understanding for the average or below-average pupil, and one that requires application of knowledge to a new situation early in the course may become rote memory after a period of instruction and discussion.

The relative importance of a question is not necessarily determined by its classification. The emphasis often put on the need for "understanding" questions may appear to imply that "knowledge" questions measure only trivial material. This, of course, is not the case. Many questions of the knowledge type meet the criteria of importance and serve very efficiently as tests of the fundamental knowledge essential to understanding.

Similarly, a question does not automatically become a measure of suitable material because it has been classified as an "understanding" question. This kind of question, too, must be scrutinized carefully to exclude the trivial and inappropriate. It will, of course, be obvious that fact questions are more likely to err by being trivial and understanding questions to err by being inappropriate to the specific subject-matter area being tested.

To put the point in simplest terms, questions asking for knowledge of specific facts are fair to the pupil if knowing these facts is important to the course or to realizing the broad objectives of the course. However, in attempting to construct a challenging test, it is all too easy to include obscure facts that the pupil will know only by chance or by dint of last-minute cramming with passing the test as the primary goal. Facts learned in this way are forgotten soon after the examination is over.

Questions that require understanding of basic concepts, on the other hand, must be so constructed that they test for understanding based on subject-matter knowledge. Too often questions purporting to test understanding are actually tests of reading ability or other general abilities and can be answered by intelligent pupils who have little or no specific knowledge of the subject.

Difficulty Level

Obviously, a final examination should consist of questions of varying degrees of difficulty. In general, the range of difficulty should be such that the more difficult questions will be answered correctly by most of the above-average pupils, and the easier questions will be answered correctly by almost everyone except the pupils whose performance in general has been unacceptable.

Questions that measure understanding will usually be somewhat more difficult than those measuring knowledge, because they require knowledge plus something more. Nevertheless, the question writer must take care not to equate difficulty and quality. The difficulty of a question should, ideally, be based on the difficulty of the concept or the problem, but more often than one might wish it is difficult only because it is measuring obscure or trivial materials, or is written in such a manner that it is ambiguous or misleading for the pupil.

The difficulty of the "factual knowledge" question depends directly on what is stressed in class or in the text. On the other hand, the difficulty of an "understanding" question depends to a large extent on the pupil's ability to deal with an apparently unfamiliar problem but one that can be solved by proper use of what he has learned in class.

Item Construction

So far we have discussed the acceptability of questions primarily from the point of view of the subject-matter specialist, who decides if a question is proper and fair with relation to the course. How the question is presented should be decided from the point of view of the pupil. This is the very heart of the whole study of item-writing techniques. Every test question should be presented in a way that is fair to the pupil and to the purpose that the question is expected to serve in the test.

Appropriate Format: The first step is to decide which format is appropriate to the question and to the examination in which it is to be used. Most questions lend themselves readily to the four-choice format, and the subsequent discussion will, to a great extent, apply most specifically to this format. It must be borne in mind, however, that some questions have only three possible answers: increases, decreases, remains the same; less than, more than, equal to. Still other questions are most appropriately set in the matching question format, if the lists of premises and responses are sufficiently homogeneous and if identifying of relationships is the factor to be tested.

Fortunately, an inappropriate format will usually become apparent early in the writing process. When there are only three possible plausible answers (such as greater than, less than, equal to) the writer will soon become aware that he cannot find a fourth incorrect response without overlapping one or more other answers, or saying the same thing using different words, or contriving a completely implausible distractor. The experienced item writer quickly learns to conserve his energy by switching to the appropriate format or writing the question in a different way, instead of trying futilely to provide an effective fourth response.

The Problem

Each question should have a single central problem, which is clearly and immediately stated in the simplest possible language. It should be so worded that the pupil will know what is expected of him before he reads the suggested answers.

In other words, every pupil qualified to take the course should understand what the question is, even if he has not the vaguest notion what the answer is.

Let us examine the following item, for instance:

Stubble-mulch farming is

1) used in growing wheat
2) a method of draining off excess water
3) a means of killing weeds
4) used to destroy harmful insects

Here is an item that has no clear-cut problem, but is really a slightly disguised collection of four true-false questions about stubble-mulch farming.

What did the examiner have in mind in asking this question? Did he want to find out if the pupil knows for which farm product stubble-mulch farming is used? If so, why not ask? For example:

Stubble-mulch farming is often used to prepare land for growing

1) wheat
2) cotton
3) hay
4) fruit

Or did the examiner want to find out if the pupil knows what stubble-mulch farming is? If so, why not the following:

Stubble-mulch farming is a method of preparing land for seeding by

1) leaving the residue from past crops on the surface of the ground
2) planting short ground-cover shrubs to serve as a wind break for the crops
3) leaving unseeded terraces of plowed soil between the seeded rows
4) draining excess water from one area and diverting it to another drier area

The Correct Answer: Each question should have one and only one correct answer. This is an obvious point, of course. Nevertheless, item-writers do occasionally prepare items with more than one answer.

Let us go back to that stubble-mulch problem again. Suppose we had asked:

Stubble-mulch farming is used in order to

1. improve soil moisture conditions
2. prevent wind erosion
3. yield bigger wheat crops
4. reduce raindrop splash

Here all the answers are correct, but one is more inclusive than the other three. This type of question is tricky and unfair, and does little to evaluate the pupil's knowledge of the subject.

Suggested Wrong Answers: The efficiency of an item is a function not only of the question and the correct answer, but also of the plausibility of the suggested wrong answers. The correct answer should not be outstanding in any way to the pupil who lacks the information or ability supposedly being measured by the question.

Suggested answers may accidentally provide many clues to lead the pupil to the correct answer, especially if he is at all testwise. A few of these are listed below:

a. The correct answer is the only one that is plausible.

For example:

How many gallons of maple sap must be evaporated to obtain one gallon of maple syrup?

1) 0.11
2) 2.2
3) 40
4) 4

b. The correct answer stands out because it is noticeably longer or shorter or more precisely written that the other suggested answers.

c. A "clue" word or phrase appears in both the question and the correct answer, but not in the distractors.

For example:

Stubble-mulch farming is a method of preparing land for seeding by

1) leaving the stubble of past crops on the surface of the soil

d. The correct answer is the only one so expressed that it answers the question.

For example:

Which action results in the formation of carbonic acid?

1) Ground water dissolves the carbon dioxide in certain kinds of rock.
2) Carbon dioxide is not soluble in water.
3) Carbonic acid cannot form unless oxygen is present.
4) The amount of carbon dioxide varies in various kinds of rock

Only alternative 1, the key answer, is a statement of an action. The remaining three alternatives are not actions and, therefore, are irrelevant to the question.

e. The suggested but incorrect answer does not follow grammatically from the question or incomplete sentence.

f. Words such as "never," "only," "must," "always" appear in the incorrect answers, and "may," "usually," "seldom" in the correct answer. It is a good guess that the correct answer is the one that is stated cautiously and recognizes the possibility of an exception to the general rule.

INDUSTRIAL CRAFTS SAFETY

General

Report to the teacher any defective equipment, unsafe conditions, or violations of safety rules.

Report to the teacher immediately any injury, no matter how slight. Infection may result from uncared for minor cuts, scratches, and burns.

Work with tools, machines, and equipment only after having received necessary safety instructions.

Do not lift any equipment or materials that cannot be handled easily. Obtain help of another pupil when carrying long pieces of material six feet or more in length.

Make certain that there are no obstacles in the path when carrying materials or equipment.

Keep aisles and passageways clear of materials and equipment.

Do not allow tools and materials to project over the edges of work benches.

Obtain the teacher's permission before using compressed air.

Walk about the shop carefully.

TOOLS, EQUIPMENT AND MATERIALS

Hand Tools

Always inspect hand tools before using them. Make certain that there are handles on all tanged tools, such as files, wood chisel, scrapers, and soldering irons.

Keep handles of all tools clean and free of oil and grease.

Avoid holding material in the hand while using a screwdriver. Hold material being assembled in a vise or a support if on a bench.

Select screwdriver of proper size to fit the screw slot. Keep hands back of the screwdriver blade.

Kiln

Use asbestos gloves and long-handled tongs to remove hot pieces of enameled material.

Place hot pieces of enameled material on well-insulated surfaces, such as asbestos or transite board.

Do not look into the kiln for a long period.

Do not place moist items in the kiln.

Make sure that kiln is clean before firing.

Keep face and body clear when opening kiln.

Be sure that kiln is turned off and cord unplugged before leaving room.

Lapidary Equipment

Obtain the teacher's approval of the setup before using the slab saw.

PLASTICS

General

Follow the manufacturer's safety instructions carefully to prevent injuries in the use of various plastic products.

Never taste or sniff at an open bottle of chemicals, or at a can of liquid resin or a curing agent, to determine their nature. This is an extremely dangerous practice.

Use protective clothing and rubber gloves to prevent chemical burns or toxic reactions with contacting fumes, chemicals.

Wear heat protective gloves while handling hot molds or hot plastic.

Wear gloves that are rubber or plastic coated and cotton lined. When using liquid resin or solvents, also apply hand cream before putting on the gloves.

Wash gloves daily while still on the hands, using soap and warm water. Do not use solvents.

Avoid contaminating the inside of the gloves when removing them. The safe way is to remove the gloves by pulling at the fingers. Do not put gloves on over dirty hands.

Wear coveralls, or shirt with long sleeves, and change at once if soiled or spilled on.

Avoid wearing rings and wrist watches. The accumulation of chemicals will cause moisture and heat beneath them and contribute to the development of skin irritation.

Do not use plastic materials if you have allergies or skin eruptions.

Be extremely cautious to avoid skin contact with epoxy resins. Precautions should include the wearing of aprons, coveralls, and gloves; adequate washing and use of show facilities; and the use of protective creams and adequate ventilation.

Remove resins, catalysts, curing agents, solvents, uncured mixtures, or fiberglass promptly and thoroughly from the skin to prevent serious skin irritations.

Use special hand creams and cleaners before and after working with fiber glass.

Protect the skin from released glass fibers while sanding cured fiber glass or reinforced plastic.

Wear eye shields or safety glasses.

Wash hands thoroughly, without waiting for the regular wash-up period, immediately after any hardener, caustic material, or resin has touched the skin and after every lay-up job.

Obtain instructions from the teacher regard-

c. Over-Testing of Auxiliary Skills: It is usually impossible, of course, to construct examination questions that do not test the pupil's skills in some factors other than those for which the test is primarily intended. In any written examination, it is taken for granted that the pupil can read, has at least a working vocabulary, has some quantitative ability, and can follow simple directions. Otherwise it would be impossible to give him a written test at all.

Unless testing one or more of these skills is a primary purpose of the written test, however, it is essential that they be "toned down" as much as possible by avoiding unfamiliar words, by using direct, uncomplicated sentences, and by giving clear directions. Care exerted in this area is at least a partial guarantee that these auxiliary skills are not being measured at a level higher than should be expected of any pupil qualified to take the course for which the examination is written.

This is not intended to prohibit testing of the pupils' ability to read, to compute, and to follow directions when these abilities are appropriately required within the discipline being tested.

Group Questions

For the purpose of this guide, the term "group questions" is used to refer to any test exercise in which two or more questions are based on a central theme or concept.

The group of questions is preceded by an introductory statement establishing the central theme and explaining the situation on which the questions are based.

Below are a few rules essential to successful construction of this type of exercise:

a. The central theme should be selected very carefully. Make sure that it is appropriate to the course and to the general level of ability of the pupils, and that it does not demand too much knowledge more properly tested in the mathematics or English class.

b. Each question should refer to the central idea. Solving each problem presented should require reference to the chart or diagram or whatever other uniting device is used. Any question that can be answered without reference to the information provided is not properly a member of the group, and such questions, if included, serve to penalize and perhaps confuse the pupil who is led to look for relationships that do not exist.

c. Each question should be independent of the other questions in the group. That is, the correct answer to one question should not furnish a clue or provide a basis for correctly answering any succeeding question in the group. Failure to observe this rule places the pupil in double jeopardy.

d. All the incorrect answers to each question should be answers that could be arrived at by a misinterpretation of or an erroneous conclusion drawn from the information provided.

e. The central theme should be used as fully as possible in the questions based on it. Before beginning to develop questions, the examiner should study the theme carefully and determine what he would expect it to mean to his pupils at various levels of ability. It is wasteful to spend time selecting and presenting a good chart or table, for instance, and then to use this material as a basis for testing the trivial, the obvious, or the irrelevant.

f. In groups of questions based on a central theme, it is important to know when to stop. If the information provided is a source of four or five good questions but no more, it is inefficient to insist on writing five more questions of indifferent value.

g. Within a group of questions, the format should be consistent. That is, all the questions should be multiple choice, or modified true-false, or completion. To change from one format to another within a group will inevitably confuse some pupils.

h. In a group of questions, the directions are an essential part of the central theme. If the directions are confusing or incomplete, the results may reflect the pupil's confusion rather than the pupil's knowledge.

I <u>Multiple-Choice</u>: This type is based on a central theme set by such devices as a table, graph, chart, diagram, technical reading selection, or description of an experiment.

For example:

<u>Directions</u> (1-3): Write the <u>number</u> preceding the word or expression that best answers each question. Base your answers on the information in the chart below and on your knowledge of agriculture. Assume that the slope is 2% and short, the soil is clay loam, and the organic matter rating is medium for each land use.

	Annual Loss (by Run-Off) per Square Mile	
Kind of Land Use	Tons of Soil	Percent of Rainfall
Woods	0	.12
Pasture	.04	6.9
Small Grains	11.4	16.9
Plowed, Fallow	69.0	48.8
Row Crops	73.2	41.95

1 For which of the following land uses would the loss of rainfall be smallest?

1) pasture
2) corn
3) plowed, fallow
4) small grains

2 With which land use would you expect to have the greatest dust storms?

1) forests
2) grazing land
3) wheat
4) corn

3 Which generalization can be made from studying the chart?

1) Run-off is dependent on the amount of soil cover.
2) The greater the loss of rainfall, the greater is the loss of soil.
3) The amount of run-off is in proportion to the amount of use the soil gets.
4) The less the land is disturbed from its original condition, the greater is the loss of water.

II <u>Master List</u>: This is accually another form of the multiple-choice group. Usually, four possible answers are suggested for a group of five questions. An example follows:

Directions (1-5): Each of these questions consists of a statement concerning reproduction of certain organisms. For each statement, select from the list of four organisms below the organism with which that statement is most closely associated, and write on your answer sheet the <u>number</u> preceding that organism in the list. (A number may be used more than once.)

(1) ameba
(2) frog
(3) horse
(4) robin

1 Fertilized eggs develop completely within the parent's body.

2 With parental care, fertilized eggs develop chiefly outside the parent's body.

3 With no parental care, fertilized eggs develop chiefly outside the parent's body.

4 The parent does not produce eggs.

5 Cross-breeding is used to combine several desirable traits in one organism.

In general, the same rules apply to this format as to the multiple-choice group. There is, of course, no difficulty with overlapping suggested answers, as it is obvious that at least one of the four suggested answers will have to be used more than once in answering five questions.

It is essential, however, that all four suggested answers be plausible, and at least three of them and preferably all four of them, should be a correct answer at least once. A group of questions in which only half of the master list is operative is generally inefficient and often gives the completely uninformed pupil a 50-50 chance to guess the right answer, while the better pupil may be led to the wrong answer because he suspects a "catch" in the questions.

III Matching: This type, as its name implies, presents the pupil with the task of matching five premises to five of seven (or eight) suggested responses. A straightforward example of this type is the following:

Directions (1-5): Column A lists recommended preventions and treatments for certain common cattle ailments. Column B lists seven such ailments. For each prevention or treatment in Column A, write on your answer sheet the number preceding the ailment for which that treatment or prevention should be used.

Column A

1 Fence off stagnant waterholes

2 Keep visitors out of feed alley.

3 Inject glucose.

4 Inject calcium gluconate.

5 Vaccinate.

Column B

(1) bloat
(2) brucellosis
(3) ketosis
(4) leptospirosis
(5) mastitis
(6) milk fever
(7) winter dysentery

You will have noticed that two essential points in matching questions are that, as in other grouped questions, there is a central theme to which all of the material relates, and that there is homogeneity within each list of premises and each list of responses.

Suppose, for instance, that the list in Column B were not limited to ailments of cattle, or even to ailments of animals. Immediately the pupil would have been provided with extraneous clues in eliminating some of the suggested answers and, in effect, factors other than knowledge of the problem would enter into the test.

In writing matching questions, the following rules should be observed:

a. Always have at least two more suggested responses than there are questions.

b. Limit the group to a minimum of five questions with seven responses and a maximum of ten questions with twelve or thirteen responses. If the numbers of questions and responses are too lengthy, it is almost impossible to maintain homogeneity, the pupil's task becomes largely one of finding the right response from a long list, and usually more credit than is desirable must be assigned to a specific area of knowledge.

c. If possible, keep the suggested responses short and arrange them in some logical order, so that the pupil will not be unnecessarily penalized because he is a slow reader or makes clerical errors during the stress of taking the examination.

d. If relationships are to be determined, make it clear to the pupil what kinds of relationship he is to look for. Do not ask him to guess what you have in mind.

A FEW GENERAL PRECAUTIONS

Keep the purpose in mind. Every question in the written test should contribute efficiently to the overall measurement of the pupil's knowledge of the subject for which the test is constructed. The question fails of its purpose if it is poorly written, or measures factors outside the subject, or emphasizes trivialities. And the efficiency of the written test is only as good as the questions that are in it.

Keep the pupil in mind. It is the examiner's responsibility to communicate effectively with the pupil taking the test (assuming, of course, that the pupil is reasonably attentive), so that the pupil has no doubt about what is expected of him. The language of the test should be clear, direct, and as simple as possible. The pupil should be told how many questions he is to answer, how much time he is allowed, how many credits are assigned to each question, and any other information that will help him to understand the task presented by the test.

Finally, the examiner should constantly bear in mind that a written test is not a contest between the examiner and the pupil, in which one wins only as the other loses. The examiner must approach his task with an honest desire to produce a fair measure of the pupil's achievement.

Note:

An internal examination of a fowl after death for the purpose of diagnosing poultry diseases, determining the presence or absence of internal parasites, or finding of other facts is called

1) pre-mortem
2) post-mortem
3) unsex
4) cull

This question breaks many of the rules of good item construction. For instance:

a) The stem is too wordy and even misleading. The same basic question could have been asked as: "Internal examination of an animal after death."

b) Suggested responses 1 and 2 cover all possibilities to the vocabulary-wise students, even if they know nothing about agriculture, and, to the pupils who know what "post" means, there is a definite clue provided by "after death" and suggested response 2.

c) Suggested responses 3 and 4 are not parallel to suggested responses 1 and 2.

d) Suggested response 1 is a contrived word, and suggested responses 3 and 4 are implausible.

For more detailed information about question writing, we recommend a study of "Improving the Classroom Test," a publication of the New York State Education Department.

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Industrial Arts and Vocational Education, Safety Manual.

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Ohio State Dept. of Education, Columbus
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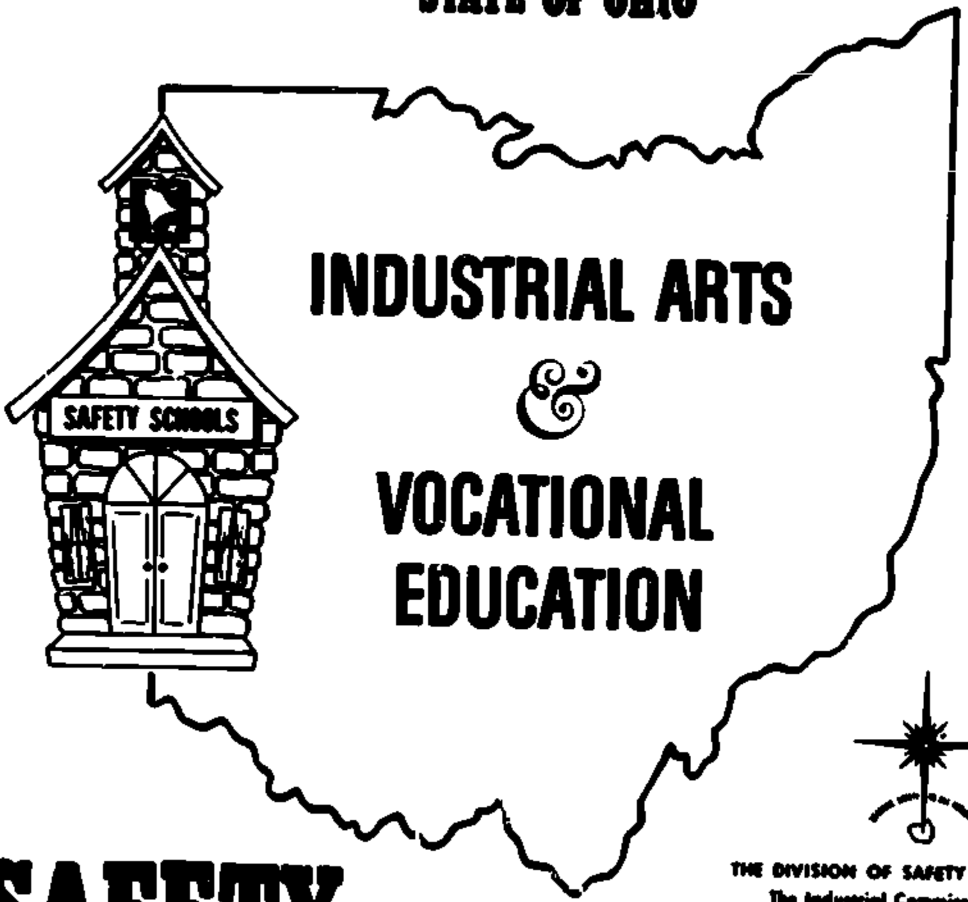
*SAFETY, *INDUSTRIAL ARTS, *TRADE AND INDUSTRIAL EDUCATION,
*RESOURCE UNITS,

Industrial arts and vocational education teachers may use this loose leaf notebook as resource material on shop safety. Safety suggestions are listed for the areas of (1) automotive power and mechanics, (2) drafting, (3) electricity and electronics, (4) general safety, (5) graphic arts, (6) industrial crafts, (7) metals, and (8) wood shop. Also included are a student injury report form, six sample safety posters, and a copy of "Monitor," the Commission's monthly publication. (EM)

STATE OF OHIO



INDUSTRIAL ARTS & VOCATIONAL EDUCATION

SAFETY MANUAL

THE DIVISION OF SAFETY AND HYGIENE
The Industrial Commission of Ohio
IN CO-OPERATION WITH THE
STATE OF OHIO
DEPARTMENT OF EDUCATION

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Governor

M. HOLLAND KRISE
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The Industrial Commission of Ohio

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Superintendent
Division of Safety and Hygiene

THE INDUSTRIAL COMMISSION OF OHIO
COLUMBUS, OHIO 43215

M. HOLLAND KRISE
CHAIRMAN

Teachers and Instructors:

The Division of Safety and Hygiene of The Industrial Commission of Ohio, together with a committee representing the Ohio Industrial Arts Teachers and the Ohio Department of Education have developed the enclosed safety manual and collateral material.

Its purpose is two-fold since it is designed to aid in instructing students in on-the-job safety, thus protecting them while they are learning, and also to create an awareness and concern for safety which will follow them into industry later.

The Commission is confident that much good can be derived from the information and instruction contained in this material, and is certain the effect of the program will be more evident as your students become a part of Ohio's work force.

It has been our experience that similar programs developed for use by industry have reduced the disabling injury rate in Ohio, and we recommend the study and use of this safety manual and the other material related to it.

Very truly yours,

M. Holland Krise, Chairman,
The Industrial Commission of Ohio

[illegible] 7, 1966

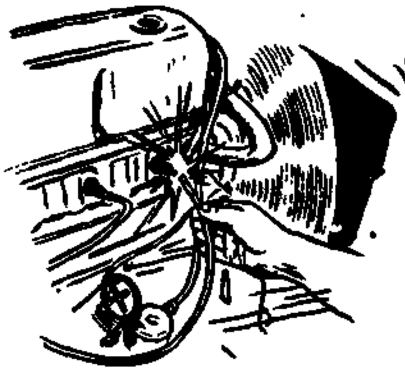
AUTOMOTIVE POWER AND MECHANICS

General

Oil or adjust moving parts only if authorized by instructions and your teacher.

Exercise caution around the fan and belts.

Guard against automatic response. Touching a spark plug or high tension leak may cause you to jerk away and into the fan.



AUTOMATIC RESPONSE

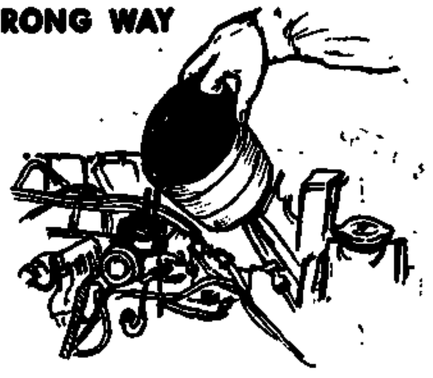
As much as possible work with the engine switch OFF.

Tighten fan belt with the engine stopped.

Exercise caution when disassembling spring loaded parts.

Consider the exhaust system, engine and radiator to be hot until checked and found to be otherwise.

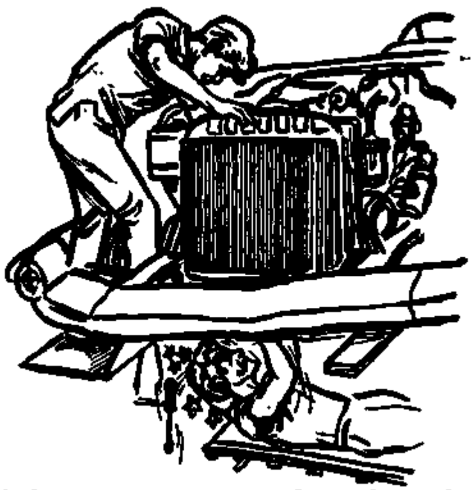
WRONG WAY



Do not pour gasoline from an open container into carburetor throats.

Exercise extreme care when using welding equipment around vehicles.

Use care when working around broken glass, broken headlamps, etc.



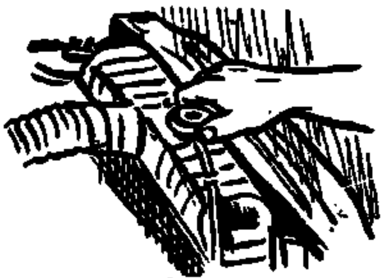
When one person is working above the engine and another below, the former should be careful to avoid dropping parts or tools from above.

Use new lock washers on parts which may shake loose and cause an accident.

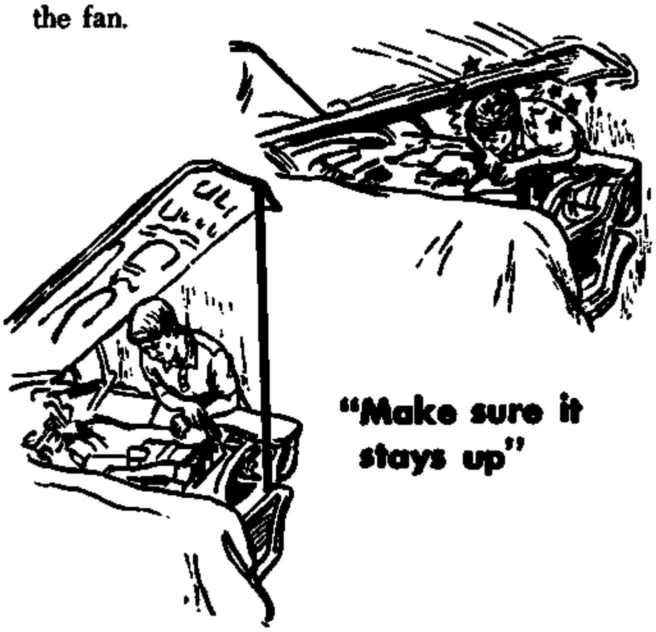
Always tighten immediately those nuts and bolts which may become lost if screwed up finger tight and then forgotten. Steering apparatus could fall apart and cause serious consequences.

Double check for tightness at important points. Make certain cotter pins are replaced as appropriate.

Wait for hot radiators to cool before removing caps.



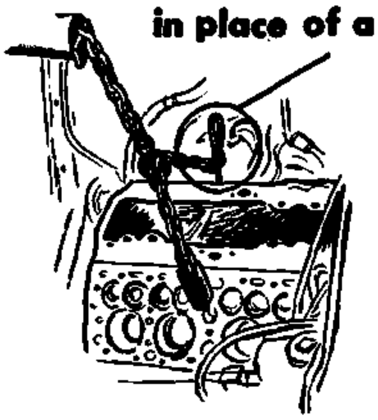
When using strobosopic timing lights, plug scopes and other such electrical apparatus, make sure the wiring does not become entangled in the fan.



"Make sure it stays up"

Make sure hoods and boot lids will stay up before working under them.

When walking between cars, beware of legs and feet of workers under the vehicles.



Never use a screwdriver in place of a bolt!

When pulling engines, make certain the ropes, chains or brackets used to connect the hoist to the engine are adequate. Arrange to prevent slipping. Avoid placing hands in areas where they may be injured.

Personal Health Hazards

Wear respirators while spray painting.

It is a dangerous practice to wash hands in gasoline or thinners. Not only may explosive and toxic fumes result, dermatitis may occur since the natural oils of the skin will be removed and replaced with harmful acids.

Avoid placing your abdominal muscles under excessive strain when removing cylinder heads or when lifting heavy parts or equipment. Know the proper position to lift, placing the load on legs whenever possible.

Never place hands in front of a high pressure greaser. The force of the gun will press grease into and under the skin.

Avoid breathing vapors, exhaust, spray paint mist, fuels, thinners, etc.

Keep your clothing tidy, neat and clean. Accidents "look" for a place to happen around untidy people and equipment.

Keep open wounds properly dressed and covered while working with dirty parts, tools, etc.

Jacking, Hoisting, and Lowering

Do not jack up one end of the car if a person is under the opposite end.

Avoid the use of blocking of questionable safety.

Jack stands should always be placed on flat, level, firm surfaces ONLY. Jack stand bases should be positioned to give maximum stability in the forward-rearward direction and the sideways direction.

Avoid shaking or pulling on long handled wrenches or parts to the extent that the vehicle rocks and may upset off the jack stands.

Hoists must be properly adapted to the kind of vehicle being raised with all cups and lifters firmly in place.

Automobile type jacks are not adequate means of supporting cars under which someone is to work. (The bumper jack is particularly dangerous – others also are not recommended for under-car work). Use heavy duty jack stands capable of handling loads well in excess of your intended load. Allow a safety factor.

Get your instructor's approval on any questionable lifting procedure. Get another person to double check your jacked up car before going under. This way he too shares for its being firmly on jack stands.

Long jack handles constitute a serious tripping hazard. Lift, blocade, or otherwise safeguard any such hazard.

Heavy duty garage type floor jacks are not recommended for under-car work. A bump of the trip mechanism by a fellow student can cause a serious accident. Cement blocks likewise are not recommended.

Operate hoists in strict accordance with manufacturers instructions. Find out the correct operating methods prior to an accident, not afterwards.

Know the lifting capacity of your jack or hoist and do not exceed the safe limit.

Do not run an engine with the car on the hoist.

Make certain no one is under a car at the time it is lowered.

Driving and Locating Vehicle for Work

Do not wear glasses with restricting vision side shields while driving vehicle within the shop or congested areas.

Only licensed drivers may drive vehicle into or out of the shop.

No vehicle should be moved except on the instructor's command.

Licensed drivers should not attempt to drive standard shift cars if they are familiar only with non-standard or automatic shift cars. They will not drive trucks or tractors or other such vehicles if they are not familiar with the operating of same.

Work will never be performed within the street area or even at the curb of a travelled street.

No towing or pushing is recommended. Learn what is wrong and fix it in the shop. A "tight" engine is too tight if it must be towed.

It is good practice to lock the vehicle after it is located if the battery is not disconnected and work is to be done under the car. Someone accidentally engaging the starter (with car in gear) can cause the car to move forward and fall from jack stands. Same accident is possible with someone working in the engine compartment and touching the solenoid with a wrench or part. Rule: Avoid working on an engine or under a vehicle while someone occupys the vehicle.

When parking cars in shop bays or stalls, make certain you do not run over the protruding legs or feet of boys who may be working under adjacent cars. Vision is limited and drivers should use a buddy who directs them from the front or rear outside.

Always move in or out of the shop area with the front windows rolled down in order that the outside buddy directing your movement can talk freely with the driver.

Excessive driving within the shop to locate only creates excessive carbon monoxide within the shop. Use the floor jack to roll the car into any desired tight spot rather than to overdrive.

Greases, Oils, Fuels, Thinners, Vapors

Keep spilled oils, greases, fuels or thinners cleaned up. Ventilate at once.

Wash area with solvent after cleaning oil or grease from a floor.

Use safety solvents for cleaning, never gasoline or other low flash point liquids. Parts may strike together causing ignition.

Dump dirty oil, fuel or solvent a safe distance from buildings, preferably where wastes are burned. Never dump such liquids on hot coals.

Clean parts in the assigned cleaning area. If there is no specific area, avoid indoor areas where vapors may travel thru cold air returns to a furnace room, areas where sparks occur, or areas where other dangers may lurk according to your particular shop situation.

Visitors, customers, other students or adults entering the shop must not smoke or occupy hazardous work areas. Students should request cooperation. (Example: Visiting student standing near a boy at work with a fender grinder and without safety glasses).

Exhaust fumes from operating engines to the outside. If no exhaust system is provided, extend the exhaust outdoors via flexible or solid piping. Take this into account when positioning the car. Make certain tripping hazards are not created.

Remember that fuel will be pumped when the engine is turned over to disconnect rods. Because the carburetor has generally been removed at this point, the fuel line to the carburetor area will spurt fuel. Cold fuel falling down on a hot work light bulb can break the bulb and cause a fire next to a person working under the car – one who often is laying on his back on a creeper.

Avoid using gasoline in open top containers.

Do not pour gasoline from open cans into carburetor throats.

Use caution with hot work light bulbs around fuel or hydraulic leaks.

Gasoline contains dangerous tetraethyl lead. Siphoning with a hose may cause a mouthful of this harmful poison. Obtain fuel in a safe manner.

Brake fluids often spurt from the master cylinder when the cover is removed for manual bleeding. Avoid placing eyes over cylinder during pumping.

Remove oil or fuel soaked clothing. A spark can make a fuel of you!

Follow state codes with regard to storage of fuels, thinners and other similar liquids.

Use only small working quantities of fuels in the shop. If priming an engine, never place a container with fuel on a battery.

Use a flashlight, not a match or lighter to check radiator level. Vapors emitted from radiators are flammable and explosive.

Always check fuel connections for leakage immediately when starting an engine. Fuel leakage on a hot exhaust manifold creates a serious fire hazard.

Air Pressure

Never fill tires by guess. If working with truck type snap ring rims, exercise extra caution to make certain rings are fully seated and secure.

Use caution with air hose so it is never aimed toward another person. Hoses generally throw air line residue in the form of rust, metal particles, water condensate and other materials.

When blowing out spark plugs make certain in the air blast which reflects out of the well does not carry up into the eyes of a person often working on the opposite side of the engine.

If the pressure is unknown, assume it to be high and use caution accordingly.

Batteries

Avoid contact with electrolyte. If acid get on hands, flush and wash before touching fac

Use rubber gloves and face protection whe filling dry charge or wet batteries. Rubber apron are also recommended.

Keep acid from splashing on clothing b pouring slowly.

Never permit sparks or fire to occur around battery. Vapors are explosive.

When connecting or disconnecting, do n permit the wrench to cause a short circuit.

Remove finger rings. A short circuit from th wrench through a ring can cause the ring to heat red hot. Fingers have been lost as a result.

When making electrolyte, always pour ACID INTO WATER, not vice versa.

Disconnect battery for electrical work and where turning the engine could impair the safety of the student mechanic. Inadvertent touching of certain solenoids or wiring can cause starter engagement as well as the starter switch.

Never permit unused electrolyte to sit around where it may be spilled.

Avoid breathing acid vapors.

When charging, turn the charger OFF before disconnecting the cables.

Avoid placing metal objects on a battery or shorting across terminals.

Wrenches and Tools

Grease on a hammer handle may cause it to be thrown unintentionally. Avoid excessively dirty or greasy hands and tools.

Use pertinent safety precautions when grinding, welding or using equipment uncommon to auto shops.

Keep tools and parts off floors. Stepping on a socket can cause a serious fall.

Creepers should be stood on end when no one is on them.

Use the correct tool for the job. Makeshifts of questionable safety should not be used.

Report skinned, frayed or otherwise defective electrical cords to your instructor.

Do not drive over tools or equipment when bringing autos into the shop.

Never pry with a file. Never use a file without a handle.

Grind mushroom heads from chisels or punches.

Remove burrs found on tools or objects being worked upon.

Avoid hammering on wrenches unless designed for this purpose.

Use the correct size wrench for the job. Do not use pipe to extend the leverage.

Make certain the wrench fits properly. Some rusted belts may have to be dressed to allow the wrench to slide on.

Hammers with loose handles should be turned in for repair.

Deposit oily rags in covered metal containers.

Avoid hammering on hardened surfaces with hard faced hammers.

Exercise caution when using hot muffler heater elements. (Tool used to expand the lap where tail pipe or exhaust pipe enters muffler.)

Use care when splitting sheet metal to avoid tearing hands if the chisel slips off the work.

Test — General

Multiple Choice

1. Fan belts should be tightened with the motor
   a. Stopped
   b. Running
   c. Either running or stopped
2. Dirty parts should be cleaned in
   a. Gasoline
   b. Kerosene
   c. High flash point solvent
   d. None of the above answers are correct
3. Work may be performed at the curb
   a. If work is of minor nature
   b. If major or minor
   c. Never
4. When you spray paint, it is best to
   a. Use a face shield
   b. Wear a wet handkerchief "bandit style" over nose and mouth
   c. Wear nose plugs and keep the mouth shut
   d. Use a respirator
   e. None of the above answers are correct
5. If uncertain regarding fuel to an engine
   a. Pour some into the carburetor throat while the engine is cranking, ignition ON
   b. Pour some into the throat of the carburetor, then try to start
   c. Look into the carburetor throat
   d. Look into the carburetor throat and work accelerator pump by means of the throttle linkage.
   e. Any of the above answers are correct
   f. None of the above answers are correct
6. If the radiator is very hot and you wish to add water
   a. Remove the cap at once
   b. Allow the engine to cool somewhat, then remove cap cautiously
   c. Hose down the radiator and engine
   d. None of the above answers are correct
7. Washing hands with gasoline, paint, or lacquer thinner, or solvents, is considered to be
   a. Poor practice because dermatitis may result
   b. Permissible
   c. Permissible except for gasoline, because of low flash point
   d. None of the above answers are acceptable
8. To check the level of fluid in the radiator, use a
   a. Match
   b. Flashlight
   c. Cigarette lighter
   d. Any of the three would be acceptable

9. Dirty oils,
   of by
   a. Pouring them into the street at the curb
   b. Pouring down the floor drain or sink drain
   c. Pouring into an incinerator which is not burning
   d. Asking the teacher for a place to dump it
   e. None of the above answers are correct
10. Visitors, janitors and other personnel coming into the shop and who are unaware of the shop safety rules should
    a. Be permitted to do as they wish since they are guests
    b. Not be permitted to smoke or enter potentially dangerous areas
    c. Be advised of shop rules at once
    d. Be given eye protection and a set of safety rules
    e. Be banished from the shop
    f. None of the above answers are correct

Test – Batteries

Explanation

1. Sparks and flames around batteries are not recommended because
2. Pour acid slowly to prevent splashing. This is important because
3. Rings should not be worn in shop. Under what circumstances could they cause injury when working with batteries?
4. Why is it poor practice to lay wrenches, set oil cans or place other metallic objects on a battery in the engine compartment when working on an engine?
5. Why is it considered good practice to remove a battery cable when working on an engine for an extended period of time, or for some major or minor repairs.

NOTE: Refer to the listed pages for safety instructions concerning machines and equipment:

DRAFTING ROOM SAFETY

Students will carefully remove the excessively sharp tip from pencils. Hard lead points will not only puncture the paper, but on break-off can fly with a possible strike in the eye.

Sharp tools such as compass points will be laid in positions out of the way when not in use.

Keep thumb tacks, pencils and other items out of mouth.

Raise or lower adjustable bench tops carefully to avoid pinching fingers.

Avoid placing fingers into openings of machines where paper is normally fed.

Work the board in a position that does not endanger your elbow. Excessive leaning on one elbow will cause inflammation of the bursa or bursitis.

Make certain light is adequate. Avoid shadows and bright sunlight. Reflect artificial light when such light is required. Avoid eyestrain.

Pencils or sharp objects will be handled carefully when they must be passed from one student to another. Never throw such objects.

Sharpen pencils on one end only, a double point pencil can be dangerous to the eyes.

Do not tilt stool

Students will not lean back or tilt stools or chairs. Falls can result in serious head or back injury.

Pick up immediately any small items, such as pencils or thumb tacks that fall on to the floor.

Drawers in drafting tables should always be kept closed to avoid falls.

Provide adequate aisles and working space.

Fasten file cabinets to avoid tipping when only top drawers are open.

Maintain proper usage and spring tension on all paper cutters.

Recognize the inherent dangers of the reproducing equipment.

- a. adequate ventilation (ammonia vapor)
- b. storing and handling ammonia
- c. always cut master power switch when cleaning or maintaining machine or bulb.

Do not permit ink to enter any open cuts or scratches.

Avoid infections and complications. Treat and report all injuries immediately. EVERY ITEM HAS ITS PLACE – EVERY ITEM IN ITS PLACE.

Test – Drafting

1. Why is good lighting essential when you make a drawing at home or away from school?
2. How can you avoid skin rash from blueprinting chemicals?
3. In what way can a sharp pencil cause an injury to you or others?
4. What condition may arise from excessive leaning on one elbow? Why?
5. What other safety measures can you cite which drafting students must be aware of?
   a.
   b.
   c.
   d.
   e.
   f.
   g.
   h.

ELECTRICITY AND ELECTRONICS SAFETY

This is the time and place to teach the students to think safety. Even though they may be using low voltages for their experiments, they should be required to turn off the power before making any changes in the circuit. This learning will help them in the future when they might be working on a high voltage circuit. The wise technician always checks to see if the power is shut off before beginning his work.

Listen to instructions before using any of the equipment.

Use the least amount of current possible for the experiments.

Complete the circuit before the power is turned on.

Turn the power off before making a change in the circuit.

SAFETY RULES FOR ELECTRICITY AND ELECTRONICS

1. All electrical equipment should have a third wire, or be properly grounded with a wire from the equipment to the ground.
2. The electrical cord attached to the equipment should have moisture-proof insulation.
3. All extension cords should have moisture-proof insulation, and the wire size should be no less than AWG No. 12.
4. Do not overload, or stall the power tool. Serious damage to the equipment may be the results. Heat can cause the insulation to break down and bring about an electrical flash.
5. There is danger of an electrical flash at any time and glasses will help protect the eyes against flash burns and from hot metal sparks.
6. Use conduit to eliminate the danger of hanging wires and the possibility of cutting into them.
7. High voltages are frequently measured in electronic circuits. Make sure your meter connections do not short or touch other parts of the circuit. Use a well insulated test prod to reach difficult and obstructed test points in the circuit.
8. Use no test instrument until you have been properly instructed in its use.
9. Use the test instrument for only the purpose for which it was designed.
10. Transformers may be extremely dangerous. Proper respect and extreme caution must be practiced at all times when working with or measuring voltages.
11. Unknown voltages are measured from the highest range down to the proper range necessary for the most accurate reading.
12. Check and double check any project that you have completed before you energize it. Then, if you aren't still completely sure, have the instructor check it.
13. Take your time. Do not endanger yourself or others by being too hasty.
14. If the power switch for a circuit is remote from the source of trouble, it should be turned off by the electrician. He should hang a tag on the switch warning others to leave the switch in the off position.
15. The operator should be responsible for turning the power on and off on all electrical equipment he is using.
16. Do not have open flames near charging batteries.▼

Do not have open flames near charging batteries.

17. Charge only in a well ventilated room.▼

Charge only in a well ventilated room.

18. Batteries should be first connected to the charger before it is turned on.
19. When mixing acid and water, ALWAYS POUR ACID INTO THE WATER. This is often done when making cut acid for etching printed circuit boards and also when preparing dilute electrolyte for wet cells.
20. Use rubber gloves and a face shield when you are handling acids.
21. Exercise extreme caution when installing radio and TV aerials. Never put them close to power lines.
22. If there is an electrical storm, do not work on TV s or radios that have the lead-in wires still connected to the set. Observe this rule even though the line has a lightning arrester hooked into it.

23. Keep fingers from the "live" metal parts of the test probes while making tests.

24. Never experiment with circuits unless you know what you are doing.

25. When working on TV's or radios, be extremely careful when working in the area of the power supply especially with TV.

ELECTRICITY

Never block safety type switches in the ON position.

Disconnect electricity before working on defective power equipment.

Never substitute for a fuse, using a penny or an oversize fuse.

Hook electrical cords to outlets wired for such use, not to light sockets.

Lamp cords will not be placed under rugs, over thresholds, near hot radiators or other places where insulation may be impaired.

Know how and where to shut off the current on any device you are going to work on.

Use power tools (portable and stationary) only when such equipment is properly grounded and you have dry footing.

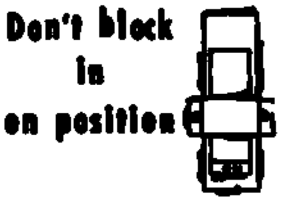
Check out circuits with low voltage; why use 110 volts if six will do the job?

Use a flashlight where it is impossible to replace fuses or operate open type switches with regular illumination.

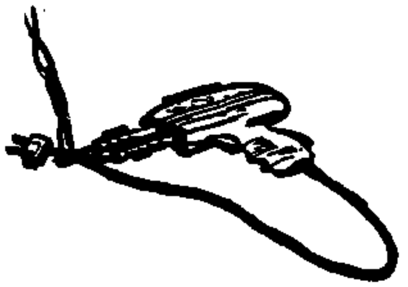
Check for overheating of appliances.

When testing generators, proper guards should be in place for belt drives before starting.

When purchasing an electrical appliance, select tools equipped with the third ground wire and items approved by the Underwriters Laboratory.



Avoid overloading circuits with numerous appliances. Remember – number 14 wire can carry 15 amperes while number 12 wire can carry a maximum of 20 amperes.



Avoid placing a soldering gun on a working surface and allowing the HOT tip to come in contact with the cord.

Always pick up soldering irons by the handle, even when cool.

Treat cuts and burns immediately.

In the event of electrical shock from high voltage make certain the victim is not charged before touching him, lay him on ground, loosen all tight clothing, wrap in warm blanket and call a doctor.

Keep all flammable material away from all electrical devices.

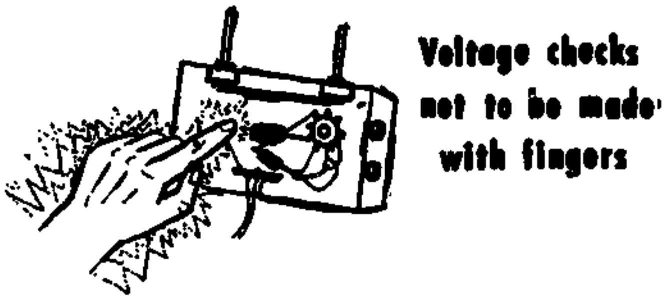
Carbon dioxide (CO_2) fire extinguishers are used for electrical fires since they do not provide conduction back to the user.

Students will not handle or operate radio transmitting equipment which requires U.S. Government F.C.C. license without first securing such documents as required by federal law.

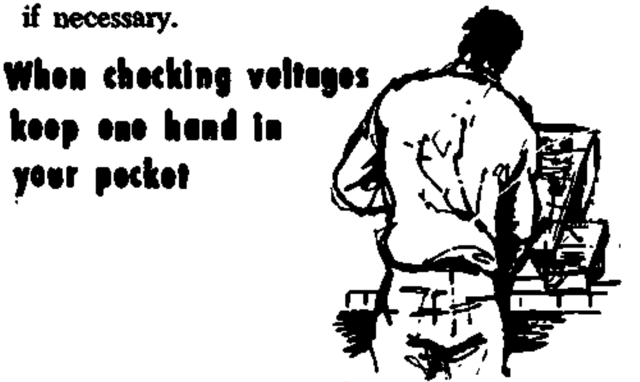
No wiring is to be done in the home or away from school using the teacher or the school as a source of authority for such work.

Never skimp of tape or other insulating materials where safety is involved.

Use pliers, not fingers, to straighten heavier gauge wires.



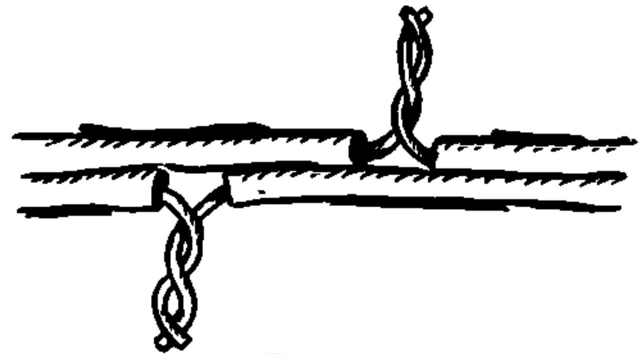
Insulate skinned or frayed wires and replace if necessary.



Disconnect electric cords by pulling the plug, not the cord.

All splices and solder joints must be made without protruding sharp points.

▼ In splicing a duplex cord, stagger the splices.



UNDERWRITERS' KNOT

Use the Underwriters' knot where possible in sockets and plugs.

When removing insulation from wires, do not cut into the wire and always cut away from your body.

Never touch anything electrical which is not known to be safe. DO NOT TAKE ANYONE ELSE'S WORD – check it yourself.

Always treat unknown wires as HOT until proven otherwise.

Do not "jump" across terminals to determine hot or cold conductors.

Voltage checks will not be made by touching charged wires or apparatus with bare hands.

Do not cut "live" wires.

Never operate a switch or electrical tools while one hand is resting on a metal stand, pipe or other metal ground.

When checking voltages, keep one hand in your pocket. (An insulated clip on one test lead is a good safety factor.) All test leads are to be held by insulated handles.

Make certain the AC input line is hooked to the primary side of the transformer when working with transformers.

Beware of transformers with low voltage primaries and a high voltage secondary.

Avoid hooking low voltage equipment to high voltage sources and vice versa.

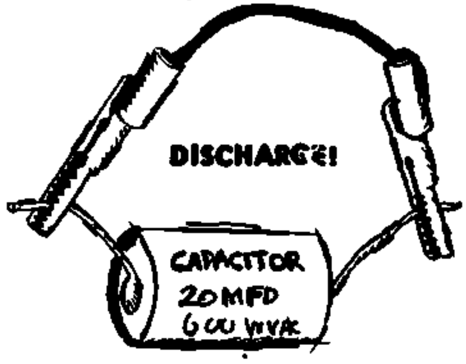
Exercise caution when working with AC radio equipment and television equipment constructed without transformer power supplies.

Voltage checks should not be made by touching charged wires or apparatus with fingers.

Always check circuits with a voltmeter or similar equipment to determine values and dangers involved.

Use the test instrument for only the purpose for which it was designed.

Avoid working around capacitors unless they have been discharged or shorted.



Danger zones on TVs – #1 high voltage anodes; #2 high voltage cage.

Discharging the picture tube properly: the, picture tube has a capacitive nature and can hold a high voltage charge for a rather extensive period of time.

ELECTRICITY TEST

Completion Questions:

The....................type fire extinguisher is the safest kind to use on electrical fires.

A person should first....................the circuit before starting to work on an electrical powered device.

Splices should be....................on a duplex electrical cord.

The ....label is associated with products which have been tested and found to be of safe design and construction when new.

Capacitors should be ....or..................before handling.

Number 14 gauge wire may safely carry a .... ampere load.

All portable and stationary power tools should be.................... to dispose static electricity.

All splices and solder connections must be made without protruding....................

Briefly explain the following:

Why does the Underwriters' knot contribute to safety when used in a standard socket or plug?

GENERAL SAFETY

Conduct and Procedure:

Walk – don't run – in shop areas.

Remain ALERT – report the accident that is "looking for a place to happen."

Remember, horseplay has no place in the shop.

Request teacher approval of special machine set-ups.

Be considerate of the safety of others.

Safety rules pertinent to the specific shop, instituted by the school safety committee or instructor, should be adhered to unless altered or revised by the instructor.

No student should use equipment, including power tools or hand tools, until he has had instruction relative to the safe handling of it by proper authority.

Make adjustments before power is turned on and remove all wrenches, materials and objects not tied down and used for the operation.

Persons not operating power tools or instructed to observe the operation thereof, should keep clear of operators.

Never start or stop a machine for another person except in an emergency.

Machines will be operated by one person only.

Respect human weakness and watch out for others. Report unsafe conditions to the teacher.

Avoid dangerous operations when overtired or ill.

Form correct habits under normal conditions so you will automatically do the correct thing if required to work under pressure.

Read and follow the precautions and information from safety posters.

Don't use machines for trivial operations, or whenever hand tools would best accomplish the task.

Girls working in shop areas must confine their hair and avoid wearing apparel subject to catching on or in machinery. Rings, bracelets, watches, etc., should not be worn.

Never throw object in shop. Distraction or injury can result.

Students will not tamper with adjustments or otherwise play with machinery at any time. Serious accidents have been caused by such action.

Do not lean on machines; you may press a switch or throw a control which, upon starting, could endanger the safety of the operator or the machine.

Wear gloves to handle raw materials such as rough boards, metal subject to burrs or sharp edges, glass and other materials in the rough.

Tools, Equipment and Materials:

Eye protection is mandatory and appropriate eye safety devices must be provided for all students in accordance with the regulations as stipulated in the Ohio Law relating to compulsory eye protection (House Bill No. 492, Section 3313.643 of the revised code).

Compressed air must never be used for [illegible]r than the specific purpose. Never use for cleaning clothes or machinery.

Stop all power machinery to oil, adjust or clean.

Allow revolving machinery to stop on its own. Resist the desire to grab chucks, spindles or other rotating parts with the hand.

Use power tools only when an instructor is present in the room.

Set up shields to stop flying chips, sparks, or particles.

Replace grinding wheels showing cracks, those out of balance or those worn too small to allow proper clearance (not more than ⅛") between tool rest and stone.

Keep cutting tools sharp.

Oily rags and other highly combustible materials must be kept in a closed metal container.

Ground all portable and stationary power tools.

Keep hoses and electrical cords trip-free.

Never mount a grinding wheel unless the speed of the motor and the speed of the wheel are known and the two are appropriate.

Store flammable liquids in approved safety containers.

Avoid using electric drills or other electrical apparatus while standing on wet floors.

Make certain your hands are free of oil or grease and that hammer, screwdriver, chisel, etc., handles are free of oil and grease.

When starting a machine, allow it to reach its proper operating RPM before using.

When finished with a tool, clean and then replace it so it cannot fall.

Disconnect cords when portable tools are not in use.

Vice handles should hang free when not in use.

Know and follow the specific requirements of the kind and type of machine you are going to operate.

Use the correct tool for the job.

Check for frayed electrical cords and for chafed or worn air hoses.

Shop Environment and Housekeeping:

Floors should be of a non-skid type and kept free of accumulation of materials or scrap.

The area should be swept daily and cleaned thoroughly periodically.

Work stations should be cleaned at the end of each class period.

The shop should have a neat and orderly appearance at all times.

Shops which are dirty, cluttered and unsanitary places are good sites for accidents. By helping eliminate these conditions, you promote safety, morale, health, fire prevention, efficiency and good public relations.

Aisles should be kept clear by putting stock away promptly after using.

Ventilating systems must be installed. Serious disorders can be caused by uncontrolled vapors, mists, gases and fumes.

Light is essential for sight. Sight is essential for safety. Keep windows, light bulbs, reflectors and walls bright but without glare. Replace burned out bulbs at once.

Floors must be kept free of objects or materials which may cause falls. This includes oil, grease, bolts, wood blocks, shavings, etc.

Fire extinguishers must be kept handy. Know how to use them.

Fire regulations pertinent to the shop should be studied and familiarized so you can assist in closing windows, make proper exit, etc.

Clothing and Personal Protection:

Wear protective clothing and equipment for the use intended for its wear.

Avoid wearing anything or wearing gloves which may be pulled into machinery.

Keep sleeves rolled up, shirt tails in, long ties and jewelry removed.

Aprons should be secured snugly. They should be able to tear free if accidentally caught.

Hair nets should be worn by those students with long hair.

Wear eye protection as defined under Tools, Equipment and Materials.

Beware of any suspicious fumes or gases which may be toxic and report to proper authority.

A person feeling ill should not operate a machine – report to instructor.

Use proper lifting technique when moving heavy objects.

First Aid and Health Hazards:

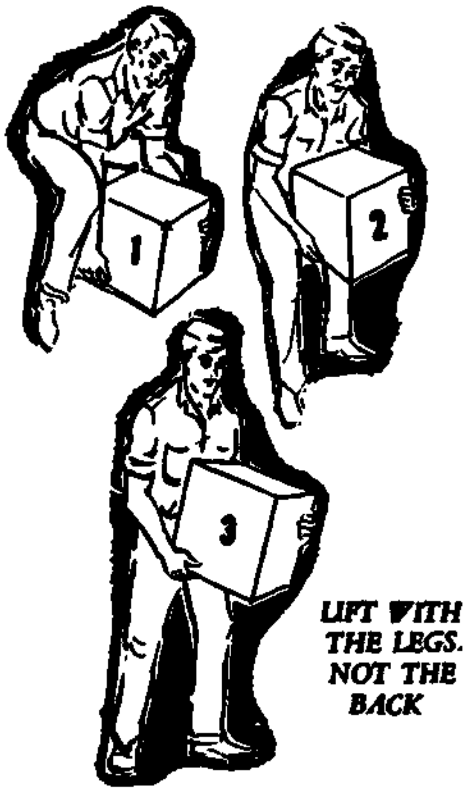
Have cuts, burns or bruises, however minor, treated immediately by the school nurse or another qualified person designated by the school administration.

Report any injuries to instructor immediately.

Neither teachers nor students are to treat or remove particles from the eye.

If the job subjects you to eyestrain, provide additional light. Eyestrain is a frequent cause of accidents.

Avoid placing hands to mouth or eyes while working.



Complete "Student Injury Report" form on each accident and send to Division of Safety and Hygiene, The Industrial Commission of Ohio.

GRAPHIC ARTS SAFETY

Hand Typesetting

Students will not lean back or tilt stools or chairs. Falls can result in serious head or back injury.

A student should stand when setting type.

Do not force type into composing stick. Type can cut your thumb.

Do not throw type.

Secure assistance rather than risk a hernia when carrying heavy type cases.

Grip type case and other apparatus properly when carrying to avoid dropping and causing foot injuries.

Avoid running the fingers or hand over edges of lead, brass or steel rules to test or clean. Sharp edges will cut fingers.

Do not run fingers over perforating or cutting rules.

Discard ink can covers with jagged edges. Open ink cans with care.

Keep hands from mouth and eyes when working with lead or ink.

Clean type cases with vacuum. Do not blow manually or use compressed air.

Keep hands off the proof press track. One person should operate the proof press with no others close. Leave handle up when not in use.

Do not use tweezers with attached bodkin. Bodkins are sharp and can cause injuries.

Pick up type or other objects which may fall to the floor. Small items can cause slipping hazards.

Machine Typesetting and Maintenance

Operate typesetting machine only after you have been properly checked out and understand the procedure.

Lock vise securely; loosely locked handles will break off. A front squirt may also result.

Make certain the vise-automatic is working properly. The vise-automatic will stop the machine if the first elevator is not fully seated.

Advise the instructor of defects. Do not attempt to make repairs unless told to do so.

Never remove a guard. It is placed on the machine to protect you.

If the glass front is not securely locked when raised for removal of the matrix, it may drop, causing an injury.

Remove the plunger pin if the machine stalls just before casting a line to prevent a double squirt.

If hot metal squirts, do not attempt to shut off machine. Get out of the way and call the instructor.

If the machine stops, push on the control lever and do not open it until the problem is corrected by the instructor.

Wrong adjustments may cause injury to you. Make only those changes requested by your instructor.

Never hold the pump-stop lever open to cast a line. If the machine casts, you may be dangerously burned from a squirt (front).

Make certain the space band transfer pawl is locked before making a line transfer by hand.

Over filling the metal pot may cause the heating element to overheat, creating a fire hazard. Avoid over filling.

If a line jams when the assembler is raised, do not open the gate.

Exercise caution in lifting magazines and pigs of metal.

Make-up

Deep painful wounds may be inflicted by running fingers over rule edges.

Keep hands away from mouth and eyes.

Use care to protect fingers when operating the lead cutter.

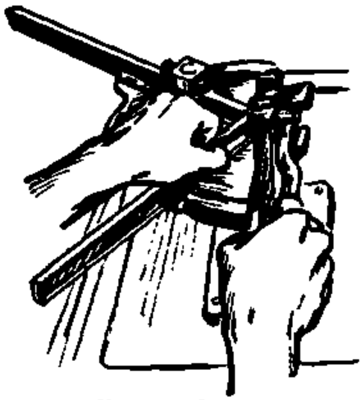
Cut away from the body when using the knife or other sharp objects.

Keep make-up room aisles clear of tripping hazards.

Get assistance to lift heavy forms.

Avoid placing fingers near gears or bearers on a proof-press.

Keep fingers away from mitering machine's blade.



Tweezers will not be carried in trouser pockets.

Only one student at a time will work at the proof press, others will keep clear.

Bend at the knees when lifting heavy forms.

Stonework and Imposition

Always replace a chase when finished with it to avoid tripping hazards. Replace chase carefully so others do not upset it.

Cut away from the body always when using a knife.

Handle ruled forms with care to avoid cuts.

Tighten forms properly. Over-tightening may cause a wedge to buckle or the chase to snap, injuring hands or face.

Secure assistance in lifting heavy objects.

Never carry a job over your head.

Presswork

Never work near a press if you have loose or dangling clothing.

Injury often results from attempts to retrieve misfed sheets.

Keep flammable solvents in fireproof containers and enclosures.

Never attempt to ink the press while it is in motion.

Always shut off the power when putting the form in the press. If the press is started accidentally, you can be injured.

Guards must always be securely in place any time the machine is used.

Always turn off the power to a machine when you are through using the machine.

Wipe up oils which may spill on the floor.

Store oily or dirty rags in proper type containers.

Use care in opening ink cans.

Do not lift heavy forms by yourself. Get help if required.

Use make-ready knife for the purpose intended only.

Store heavy forms so they will not fall on someone's feet.

Avoid paper cuts by using care in handling.

Do not talk to others when you feed the press. Do not talk to others when they are feeding.

Paper Cutter

Never work on the cutter unless safety devices are present and in working condition.

Eye or facial injury may occur if tools or objects left lying on the table surface are cut into with a snap-up resulting.

Arrange paper on the bed with the clamp slightly lower than the blade.

Avoid handling paper by the edges.

Cut material within the capacity of the cutter.

Cut materials within the operator's ability.

The cutter is a one man machine.

Avoid dropping blades during removal or reinstallation.

Do not let a sharp edged blade lie where others may be injured.

Do not over-exert or assume improper positions while pulling cutter handle.

Handle and floor must be free of oils and greases.

Operate power cutters through by hand for one complete revolution.

Double check to make sure all bolts holding the blade are properly tightened after reinstallation.

While cutting, keep both hands on the handle until the knife has come to rest on the top stroke.

Avoid touching the blade at any time, except for replacement.

Before reaching for the cut paper, make sure the handle is in its farthest backward position.

Power cutters must be off when cleaning, oiling or adjusting.

Use care and a jogging blade when jogging stock against back gauge and side so as to avoid cuts by the paper.

Do not use metal rules on the paper cutter.

Proof Press

Only one student may operate the proof press at one time.

Keep hands off the track.

Leave the handle in an upright position when not in use.

Power Stapler

Make certain power is off before cleaning, oiling or adjusting.

Keep fingers away from movable parts of the stapler.

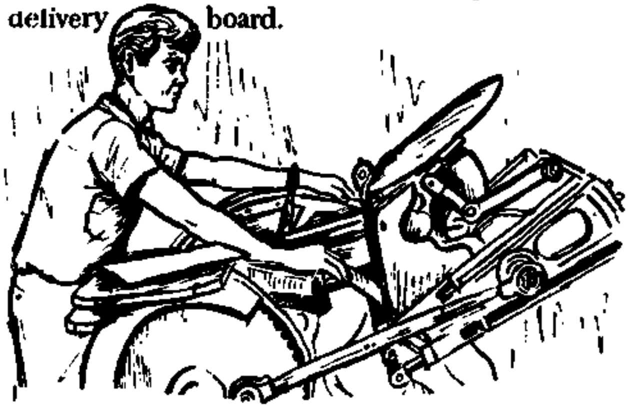
Platen Press

Only one person will operate a press at one time.

Acquire proper stance while operating. Stand erect.

Stop the press any time you are not in the operator's zone.

Stop the press before attempting to retrieve stock that has fallen between the platen and delivery board.



The press must come to a dead stop before oiling is attempted.

Stop the press dead to wash the ink rollers and disc.

Stop the press to apply ink to the disc.

Never talk to an operator or talk to others when you are the operator. Distracting the paper feeder places him in a very dangerous situation.

Stop the machine to remove paper picked up by the ink rollers.

If stock needs adjusting against the gauge pins after the platen has started to close, the operator should use the throw-off lever and make proper adjustments the next time the platen opens.

Gauge the speed of the press according to your ability to feed. Frequent tripping of the press increases your chance of an accident.

Exercise caution around flywheels and other open mechanisms such as those at the right of the platen.

Make certain the form is locked securely in the bed.

Silk Screen Work

Use razor blades only in safety holders.

Wear eye protection to keep splash of paint from causing injury.

Should oils or paints spill on floor, clean up at once.

Materials will not be tested to determine nature or content. Lead in the paint can cause lead poisoning and other ingredients can create other harmful effects.

Exercise particular care in handing sharp edged objects to others or while moving about the shop with some in hand.

Keep flammable liquids in approved containers and enclosure.

True-False – Use Plus for True, Zero for False:

Test – Hand Typesetting

1. ( ) Fingers and hands must be kept from the face when type is handled.
2. ( ) Avoid running hands over perforating or cutting rules.
3. ( ) It is best that one person handle very heavy type cases because his control will be better.
4. ( ) Force type into composing sticks with the thumb if it does not slide freely into place.
5. ( ) Type cases may be best cleaned with high air pressure.

Test – Machine Typesetting and Maintenance

6. ( ) Over-filling the metal pot may cause the heating element to overheat, creating a fire hazard.
7. ( ) Never hold the pump-stop lever open to cast a line.
8. ( ) Guards should be removed whenever they appear to be in the way or are not really necessary.
9. ( ) Remove the plunger pin if the machine stalls just before casting a line to prevent a double squirt.
10. ( ) Use caution when lifting pigs of metal.

Test – Make-up

11. ( ) Tweezers should be carried in trouser pockets so they do not puncture your shirt pockets.
12. ( ) Two students should cooperate while operating the proof press.
13. ( ) Always cut toward the body when trimming with a knife.
14. ( ) Fingers should be kept clear of the mitering machine blade.
15. ( ) Run the finger over the rule to check for sharp edges.

Test – Stonework and Imposition

16. ( ) Carry work as high as possible to avoid bumping into others.
17. ( ) Always return a chase when you are finished with it to its proper place.
18. ( ) Tighten forms to your maximum ability so lead will not fall out on your feet.
19. ( ) Secure assistance when lifting heavy work.
20. ( ) Handle ruled forms carefully.

Test – Presswork

21. ( ) Never work near a press with loose or dangling clothing.
22. ( ) Store oily rags in proper type closed metal containers.
23. ( ) Avoid talking to others when you feed a press; avoid talking with others when they are feeding the press.
24. ( ) Handle paper by the edges whenever possible.
25. ( ) Ink the press when it is in motion.

Test – Paper Cutter

26. ( ) Arrange paper on the bed with the clamp slightly lower than the blade.
27. ( ) Before reaching for the paper, make certain the handle of the cutter is in the closest forward position.
28. ( ) When cutting, keep both hands on the handle.
29. ( ) Cut beyond the capacity of the paper since most tools have an overload designed into the tool.
30. ( ) Clean, oil and adjust with the machine operating if it is power actuated.

Test – Silkscreen Work

31. ( ) Razor blades should be used only in safety razors.
32. ( ) Taste materials to determine contents of paint.
33. ( ) Keep oily or paint soaked rags and flammable liquids in appropriate safe containers.

Folding Machine

Never attempt to remove a misfeed or jammed sheet while the machine is running.

Turn off power when making changes.

Keep all tools off the tables of the folder.

Stitcher (Stapler)

Never attempt to adjust or clear machine with power on.

Keep fingers away from moving parts.

Use caution when removing spool of wire from machine. The end could spring out of the fitting and whip around.

Darkroom

Identify the contents of bottles and containers by label, never trust taste or smell.

When using dry mounting press, to avoid burns, draw the tacking irons away from the hand that is holding the print.

Do not touch electrical switches or equipment with wet hands.

Because there is a danger of explosion, never shake a bottle containing a strong acid or alkali.

Be sure exhaust fan is on and is in proper repair.

Wear rubber gloves when handling chemicals.

BENCH SHEARS! Use safelight when cutting orthochromatic film to protect against cutting fingers. Coat cutting edge with fluorescent or luminescent paint for cutting panchromatic film in total darkness.

Wash sink and trays after using.

Dry hands completely before using darkroom camera, enlarger, dryer, lights, or other powered equipment.

Pour acid into water, never reverse the procedure.

All electrical equipment should be kept dry.

Make sure of formula and mixing procedure before handling chemicals.

Offset Press

Use caution when applying ink to machine. Fingers could be pulled into rollers.

Press should be operated by one student at a time.

Do not try to clean any part of the press while running.

Do not lean on machine when the machine is running.

DON'T LEAN!

ADVOID LOOSE CLOTHING

CLEANING. . .

IS MACHINE OFF?

Keep fingers out of moving parts of press.

Make sure press is disconnected when making major repairs.

Check dampness of water rollers when machine is off.

Roll up sleeves, take off rings, tuck in loose clothing.

General

Do not operate any power equipment or cutting device when the instructor is not in the shop.

If you haven't been instructed in a machine's use, don't use it.

Use tool only for purpose for which it was designed.

Stripping, Layout Table

Use standard stripping knives, or tape unused edges of razor blades.

Use level-type tape dispenser.

Make sure adhesive wax machines are full before heating.

Do not lean on glass table.

Lead-Slug Cutter

Never put fingers on the cutting edges.

Be careful when cutting small sizes.

Cleaning Solvents and Cleaning Rags

Never use a solvent with a flash point of less than 100°.

Keep all solvents labeled.

Keep all cleaning rags in approved safety cans.

Platemaker — Carbon Arc

Disconnect power before adjusting or replacing carbon electrodes.

Vacuum should be drained before lifting glass lid for adjustments.

Exhaust fan should be working and properly vented.

Warn all persons in the area to protect eyes or look away when sparking carbons.

INDUSTRIAL CRAFTS SAFETY

General

Report to the teacher any defective equipment, unsafe conditions, or violations of safety rules.

Report to the teacher immediately any injury, no matter how slight. Infection may result from uncared for minor cuts, scratches, and burns.

Work with tools, machines, and equipment only after having received necessary safety instructions.

Do not lift any equipment or materials that cannot be handled easily. Obtain help of another pupil when carrying long pieces of material six feet or more in length.

Make certain that there are no obstacles in the path when carrying materials or equipment.

Keep aisles and passageways clear of materials and equipment.

Do not allow tools and materials to project over the edges of work benches.

Obtain the teacher's permission before using compressed air.

Walk about the shop carefully.

TOOLS, EQUIPMENT AND MATERIALS

Hand Tools

Always inspect hand tools before using them. Make certain that there are handles on all tanged tools, such as files, wood chisel, scrapers, and soldering irons.

Keep handles of all tools clean and free of oil and grease.

Avoid holding material in the hand while using a screwdriver. Hold material being assembled in a vise or a support if on a bench.

Select screwdriver of proper size to fit the screw slot. Keep hands back of the screwdriver blade.

Kiln

Use asbestos gloves and long-handled tongs to remove hot pieces of enameled material.

Place hot pieces of enameled material on well-insulated surfaces, such as asbestos or transite board.

Do not look into the kiln for a long period.

Do not place moist items in the kiln.

Make sure that kiln is clean before firing.

Keep face and body clear when opening kiln.

Be sure that kiln is turned off and cord unplugged before leaving room.

Lapidary Equipment

Obtain the teacher's approval of the setup before using the slab saw.

PLASTICS

General

Follow the manufacturer's safety instructions carefully to prevent injuries in the use of various plastic products.

Never taste or sniff at an open bottle of chemicals, or at a can of liquid resin or a curing agent, to determine their nature. This is an extremely dangerous practice.

Use protective clothing and rubber gloves to prevent chemical burns or toxic reactions with contacting fumes, chemicals.

Wear heat protective gloves while handling hot molds or hot plastic.

Wear gloves that are rubber or plastic coated and cotton lined. When using liquid resin or solvents, also apply hand cream before putting on the gloves.

Wash gloves daily while still on the hands, using soap and warm water. Do not use solvents.

Avoid contaminating the inside of the gloves when removing them. The safe way is to remove the gloves by pulling at the fingers. Do not put gloves on over dirty hands.

Wear coveralls, or shirt with long sleeves, and change at once if soiled or spilled on.

Avoid wearing rings and wrist watches. The accumulation of chemicals will cause moisture and heat beneath them and contribute to the development of skin irritation.

Do not use plastic materials if you have allergies or skin eruptions.

Be extremely cautious to avoid skin contact with epoxy resins. Precautions should include the wearing of aprons, coveralls, and gloves; adequate washing and use of show facilities; and the use of protective creams and adequate ventilation.

Remove resins, catalysts, curing agents, solvents, uncured mixtures, or fiberglass promptly and thoroughly from the skin to prevent serious skin irritations.

Use special hand creams and cleaners before and after working with fiber glass.

Protect the skin from released glass fibers while sanding cured fiber glass or reinforced plastic.

Wear eye shields or safety glasses.

Wash hands thoroughly, without waiting for the regular wash-up period, immediately after any hardener, caustic material, or resin has touched the skin and after every lay-up job.

Obtain instructions from the teacher regarding the proper type of soap. Low alkaline soap must be used. Never use skin defatting solvents.

Use protective creams after washing. Apply cream to the hands, forearms, neck and face.

Always be sure that there is adequate ventilation when using solvents.

Make certain that all grinding and finishing operations of cured plastic products are done in down-draft ventilated areas.

Conduct the curing of epoxy and similar resins in the exhaust ventilated area.

Mix catalysts and resins under the direct supervision of the teacher. Incorrect mixtures may be explosive or constitute a fire hazard.

Avoid spilling solvents. Vapors may flow along the floor, become ignited and flashback, causing serious burns.

Use chemicals only from labeled bottles and containers.

Isolate and control irritant or hazardous materials in their respective working areas.

Always have a great respect for chemicals, liquid resins, and solvents. Never handle them carelessly.

Thoroughly clean all equipment and tools in areas containing hazardous materials before sharing them with other pupils in other areas.

Store unstable plastic ingredients, such as catalysts, in a cool place. In a location where the temperature is high, they are likely to react chemically.

Spread disposable paper on work benches and on the floor around the working area and replace as soon as it is soiled.

Use clean rags, and discard as soon as soiled, into metal-covered containers.

Use disposable containers while mixing epoxy, liquids and resins; then discard after use into metal-covered containers.

Dispose of used or dried plastic and other combustible waste products into covered metal containers.

Never pour contaminated solvents down a drain or sewer. Used solvents should be carried in a closed container to a safe deposit area.

MACHINES AND EQUIPMENT

Transfer and Compression Presses

Never open or close operating valves or controls without proper instruction.

Keep hands away from a closing press.

Handle hot molds and plaster parts with heat protective gloves.

Do not attempt to close a press until mold alignment has been checked by the teacher.

Injection and Extrusion Presses

Ask teacher to verify that molds are correctly mounted and aligned before operating a press.

Be sure that safety guards are in place and operating properly on the press.

Make certain that cycling valving, temperature control adjustment and press operation are done under the supervision of the teacher.

Scrap Grinder

Check all materials for metal pieces before putting them into machine.

Feed material into hopper only.

Rolls or Plastic Mill

Operate machines under the direct supervision of the teacher.

Keep hands away from operating rolls.

Never attempt to pull out or hand onto material while passing it through the rolls.

Keep tripping devices and safety guards in place and check for proper functioning before using these machines.

Molding

Exercise care when "blow forming" plastics by being sure that material and forms are securely clamped before applying air pressure.

BASIC LEATHER CRAFT

The usual careful use of the several tools used for cutting leather, such as level point knife, sloyd knife, head knife, razor-blade knife and draw gauge knife should be noted and observed.

SHEET METAL WORK SAFETY

General

Large sheets can be unwieldy. Use C-clamps for handles.

Remove slivers, commonly called fish hooks, from edges of sheets.

Keep the work area and floor free of slippery cuttings.

Hold snips and seamers so flesh is not pinched between handles.

When chiseling, riveting, grooving or hand punching, strike the tool squarely with the hammer.

Use care in carrying and using the scriber.

Avoid sliding sheet metal through the hands.

Use corner guards or other devices to protect people using aisles or work areas where large sheets protrude. Beware of corners and edges.

Never wear gloves around rotary machinery.

Guard against shooting the rivet gun by accident. Point to floor.

Use appropriate safe methods when using hand tools, soldering equipment, grinders or other tools.

Punch rather than drill large holes in sheet stock.

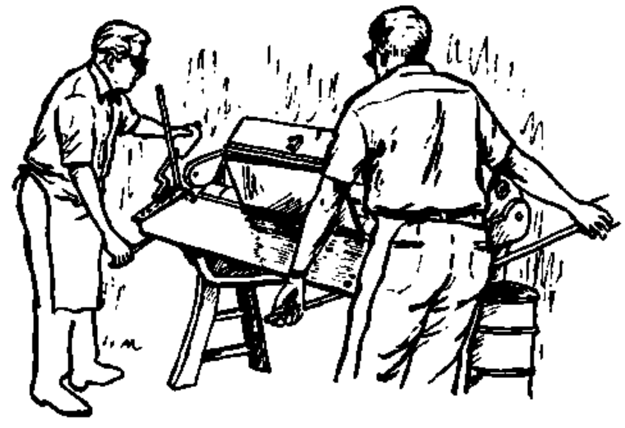
Sheet Metal Brake

Keep fingers clear of the mouth of the machine when closing down on the metal.

Use care when inserting or removing sharp edged sheets.

Make certain counterweight bars do not strike others while working.

Get assistance when bending large thick material to avoid backstrain.



Keep fingers out of the pinch area as the metal is bent, especially on maximum capacity bends.

Shear and Punch

Fingers must be kept out of the cutting or punching area.

Keep your attention on the job; avoid distractions while working.

Always use properly installed guards.

The shear and punch will be operated normally by one person only.

Roll Former

Keep fingers and clothing out of the rolls.

The same person feeding the metal normally turns the crank.

Keep your eyes and your mind on the work; avoid distractions.

Test – Sheet Metal Work – Sheet Metal Brake, Sheet Metal Rolls, Shear and Punch

Completion:

1. The same person who feeds the rolls also operates the ....
2. Always keep your .... out of the cutting and punching area when operating the shear and punch.
3. Small slivers and pieces of metal can create ....hazards if left on the floor.
4. Large holes in sheet metal should be made by..............................
5. Fish hooks often occur along the.................... of sheet stock and should be removed at once.
6. ....are useful when sheet metal must be carried because they form good handles.
7. Backstrain may result if heavy sheet stock is bent in a..............................without the assistance of another person.
8. Counterweights must not be permitted to ....when using the brake.
9. When large sheets of thin sheet are protruding from a bench, make sure others do not become injured by using..............................
10. Always try to hold snips or seamers so flesh is not..............................between the handles.

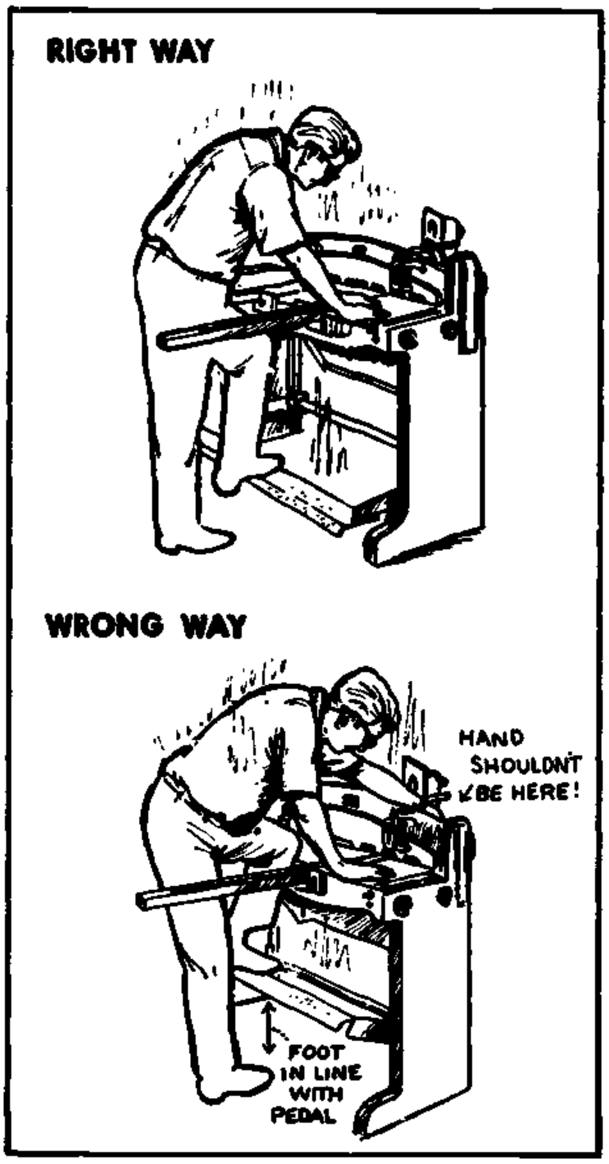
Squaring Shear

Keep fingers clear of the blade and never under the hold down bar.

Never reach behind the shear to support metal. This places you in an awkward position, subject to a fall and puts fingers in a blind area.

To avoid crushing toes, keep feet clear of the pedal.

Use care in handling sheared razor sharp metal.



Never cut excessively small pieces on a shear. Use hand snips.

Allow a portion of the hand to overlap onto the machine so you can prevent sheet from slipping forward toward blade.

The shear is a one man machine; use accordingly.

In leaning forward as blade is depressed, people tend to keep balance by grasping the top of the large outer casting. After the blade has descended, it is possible to insert a finger inadvertently into the slide. As the blade returns, a very serious crush can result.

Test – Squaring Shear

Multiple Choice:

1. Reaching behind the shears to catch a piece of metal as it is cut is
   a. Permissible if the piece is three inches wide
   b. Permissible if the same person who reaches also operates the treadle
   c. Permissible if a and b are both adhered to explicitly
   d. Dangerous at any time and is a violation of safety rules
   e. None of the above answers are correct
2. Squaring shears can injure only the
   a. Hands
   b. Feet
   c. Either hands or feet, or both
   d. None of the above answers are correct

True-False – Use Plus for True, Zero for False:

3. ( ) Use care in handling sheared metal because edges are razor sharp.
4. ( ) The shear has the advantage of being able to safely cut very large or extremely small work.
5. ( ) The shear is best operated by two people one to depress the pedal, the other to adjust the sheet stock.
6. ( ) Allow the hand to overlap onto the machine so you can prevent the stock from slipping forward.
7. ( ) It is poor practice to jump on the treadle.
8. ( ) Never reach forward enough to permit fingers under the hold down bar.

Buffer

Always buff using the bottom half of the wheel (below center).

Use extra care around openings, corners or other areas where the wheel can grab and throw the work.

Exercise caution to avoid overheating and burns on the hands.

Avoid allowing the work to become cramped between the wheel and the machine, the wall or some other object. Freedom of movement is essential to avoid catching.

Make sure the wheel diameter is appropriate for the job.

Never use a rag because the work heats up. Rags catch in revolving arbors.

Always stand to one side of wheel when applying compound.

Test – Buffer

True-False – Use Plus for True, Zero for False:

1. ( ) Always buff on the lower part of the wheel.
2. ( ) Rags should be used to hold hot objects.
3. ( ) Use a wheel of the proper diameter.
4. ( ) Work the buffer well into inside corners, grooves and other confining areas for good buffing action.
5. ( ) Freedom of movement is essential.

Power Hack Saw

Make sure the action of the saw cannot crowd or injure those in front of the moving frame. Stand clear.

Do not reach under the frame or blade when in the raised position.

Make file cuts on sharp edged objects or angular material so blade may proceed into work properly.

Keep blades and stock right.

Support end of long stock in a positive manner so blade will not be pinched.

Do not bear down on the saw frame.

Keep hands clear of the mechanism while in operation.

Clean, oil and adjust when machine has fully stopped.

Do not attempt to cut small pieces in one side of the vise jaws unless a piece of equal size is in the opposite end of the vise, keeping jaws parallel.

Never use a new blade in an old saw kerf.

Install new blades with teeth pointing in the proper direction.

Lower the frame slowly on the work. A sudden drop can shatter a blade.

Test – Power Hack Saw

Completion:

1. Avoid reaching under the saw blade when the frame is in the....................position.
2. Clean, oil and adjust the machine only when it is....................
3. Avoid blade breakage by lowering the ....slowly on the work.
4. Bearing down on the frame during operation is not good practice because the.................... may break, causing ends to flail or small pieces to fly.
5. Clamp or draw the vise tight to prevent .... from tearing loose.

Explanation:

6. Why is it unsafe to use a new saw blade in an old saw kerf?
7. What may happen if a small piece is placed in the saw vise next to the blade without placing a small piece of stock of equal width at the opposite side of the vise?
8. Explain why it is necessary to file off sharp corners before starting the saw.

Soldering

When using gas furnaces, keep flammables away from area.

Do not carry hot soldering coppers around in the shop.

Keep hands away from eyes and mouth.

Avoid overheating the soldering copper. Red hot is too hot.

Never leave hot soldering coppers unattended in the furnace.

Put hot soldering copper and objects where others cannot be burned.

Keep soldering flux in an area where it is safe from spilling.

Use good ventilation and avoid breathing fumes.

Exercise special care when filing a hot soldering copper. Use a vise to hold when filing.

Lay coppers down only on insulated nonflammable surfaces.

Grasp copper by the handle well so hand cannot slip down on metal.

Do not allow molten solder to be placed in or near wet or moist surfaces.

Paste flux cannot splash and is preferable to liquid for general use.

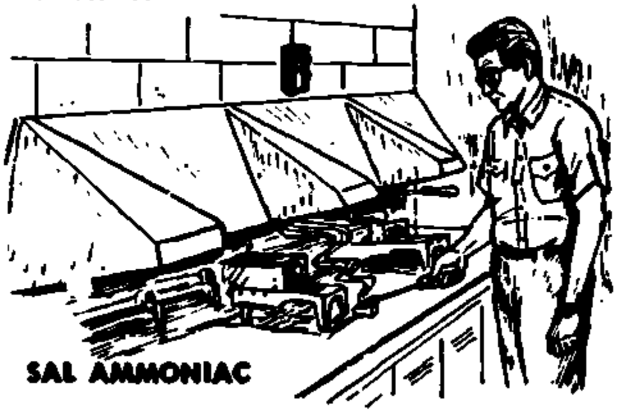
When using sal ammoniac avoid inhaling the fumes.

Report any indication of escaping gas.

If hot soldering equipment is to be returned to the tool room, allow it to cool in a safe place and advise tool room man of its condition.

Never immerse the hot tool in water to cool it.

Check with teacher for permission to light the furnace.



Test – Soldering

True-False – Use Plus for True, Zero for False:

1. ( ) It is dangerous to use molten lead or solder where parts or materials are wet or moist.
2. ( ) It is not harmful to breathe the gasses which result from the soldering process or from cleaning the copper on sal ammoniac.
3. ( ) It is not necessary or wise to heat the copper bright red.
4. ( ) It is well to breathe through the mouth while soldering so vagrant fumes do not irritate sinus membranes.
5. ( ) Cool the soldering iron after use by immersing it in water. to prevent others from being burned
6. ( ) Paste flux or flux core solder is preferable to liquid type for general use.
7. ( ) Good ventilation in the soldering area is desirable.
8. ( ) Carry the soldering copper downward, watching and warning others nearby.
9. ( ) If soldering coppers are returned to the tool room, warn the tool room man when leaving them there.
10. ( ) It is not harmful to touch the mouth or eyes with your hands while performing a solder operation because fluxes are non-toxic.

Hand Tools, General

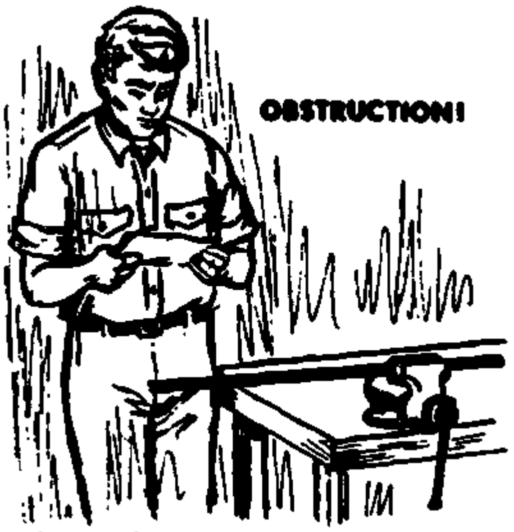
Clamp work securely in vises, but do not hammer on vise handles.

Remove filings and chips from benches with a brush, not the hands.

Do not allow work to project from vise or bench and cause obstructions.

Use the corréct size of wrench for the job.

When using cutting tools, direct the cutting action away from you.



Mushroom heads on chisels, punches, etc., should be eliminated continuously.

All angled hand tools must have handles.

Avoid carrying tools in pockets. Screwdrivers, etc., can injure you if you fall.

Inspect hand tools before using.

When using tin snips or other similar tools, avoid letting flesh come between the handles. Pinches and blisters generally result.

When using a chipping hammer, chip toward wall or shield to protect others from flying chips.

Bench Work

Keep bench drawers closed.

Keep bench dogs flush when not in use.

Avoid piling up tools.

Do not blow dust from bench tops, use a brush.

Hammers

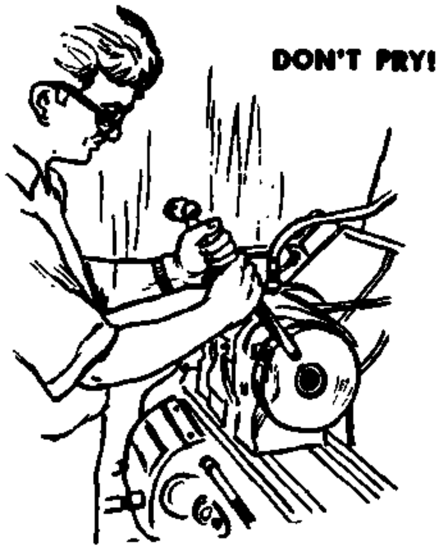
Use the correct size hammer for the job.

Use rawhide, plastic, copper, lead, brass or rubber hammer on hardened surfaces, or where most appropriate.

Report handles which are loose, split, splintered, broken or otherwise defective.

Never use when handles or hands are greasy.

Avoid prying with hammer handles.



Use claw hammers only for pulling nails and driving nails, never for use on metal surfaces.

If hammer has a plastic or soft tip, check tips for tightness.

Screwdrivers

Use the correct size and type.

Avoid placing hands so a slip-off can injure.

Handles should not be splintered or split.

Use for the intended purpose, not as a pry, chisel, drift or punch.

Keep the shank vertical to the screw head while using.

For electrical work, use insulated screwdrivers.

Get correct alignment when using offset screwdrivers.

Avoid the use of pliers or vise grips on general purpose screwdrivers.

Remove burrs from screws or screwdrivers.

Grind screwdriver blade so the end is not wedge-shaped. If sides are parallel, slip-off will not occur.

Do not hold items in your hand when using a screwdriver on them.

Files

Make certain file is tight with the handle.

Files are brittle so should not be dropped, used as prys or otherwise mistreated.

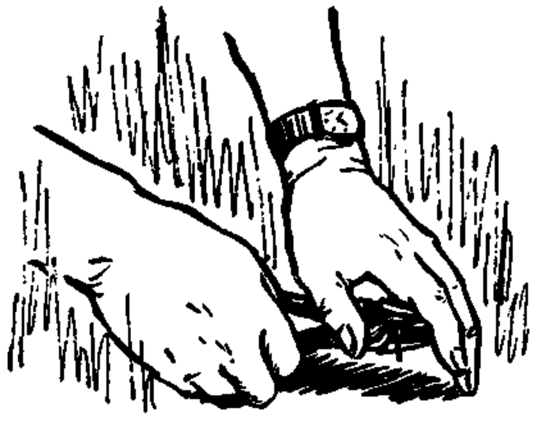
Do not use old files for substitute cutting tools, knives, etc.

Make certain the work to be filed is securely mounted.

Pliers

When using pliers, keep hands clear of the pinch area. This may be at the rear of the bolt as well as ahead.

Place hands over short wire pieces, cotter pins or other small items being cut. Such items tend to fly and may cause eye injury.



Make certain power is off before cutting through live wires.

Keep handles free of grease or oil.

Handles of pliers used for electrical work should be insulated.

Remove any burrs caused by pliers which would cause injury.

Wrenches

Avoid using a wrench as a hammer.

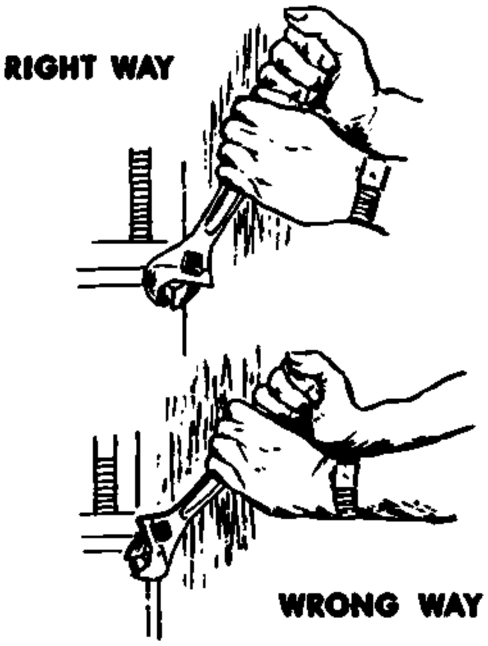
Pull rather than push whenever possible.

Always be prepared in event wrench slips or bolt breaks. Acquire a good stance, especially for hard pulls and in confined areas.

Select socket or box wrenches as first choice and open type wrenches as second choice for work with hex nuts.

Use the adjustable wrench only when others are inappropriate.

Pull on adjustable wrenches so the force is mostly on the stationary jaw. Set the jaws for a close fit.



Do not extend the handle of a wrench by using pipe or other means.

Keep wrenches as free of oil and grease as possible. Slippery wrenches cause skinned knuckles.

Never use wrenches on machine parts which are in motion.

Avoid excessive pressures on ratchets or wrenches not designed to take hard pulls.

Hammer only on striking wrenches which are designed for this use.

Avoid the use of distorted or excessively worn wrenches.

Knives

Cut by pushing away from the body.

Do not stand in front of someone using a knife.

Never throw or play with knives.

When passing knives, give the other person the handle, keeping the blade outward and away from either person.

Use care in checking for sharpness.

Test – Hand Tools

1. ( ) All "T" angled tools must have
2. ( ) When chipping, protect others by setting up a
3. ( ) Never use a hard faced hammer on a
4. ( ) Force on a wrench should be by a steady
5. ( ) Hammering on vise handles, wrenches and handles in general causes injury because
6. ( ) Constantly check and dress chisels and punches to remove
7. ( ) Files and screwdrivers should not be used as
8. ( ) Handles of screwdrivers and hammers must not be
9. ( ) Hand a knife to another by holding so the blade is
10. ( ) Slip-off can be prevented if screwdrivers are
11. Why is it important to make sure current is off before cutting through (a) single wires, and (b) duplex wires?
12. Why is proper stance necessary for hard pulls?
13. Why are socket or box type wrenches preferable to most open type wrenches (open end, adjustable jaw, etc.)?
14. Hammer and wrench handles which are greasy or hands which are oily will contribute to possible injury. Explain.
15. How would you check the cutting edge of a wood chisel, a knife or other sharp tool without cutting yourself?

a. Shield
b. Outward and away from each person
c. Pull rather than a push
d. Burrs will cut hands
e. Prybars
f. Mushroom heads
g. Handles
h. You may strike yourself
i. Hardened surface
j. Sharp cutting edge
k. Hollow ground or ground with sides parallel rather than wedge shaped
l. Push rather than a pull
m. Soft faced surface
n. Inward and toward the other person

Explanation:

Loose

FOUNDRY SAFETY

Good Housekeeping

1. All flasks, weights, metal, bottom boards and jackets should be piled in a neat, orderly and safe manner, so that they will not fall.
2. Aisles between molds must be ample in width so they do not present a hazard in transporting ladles of molten metal to these molds.

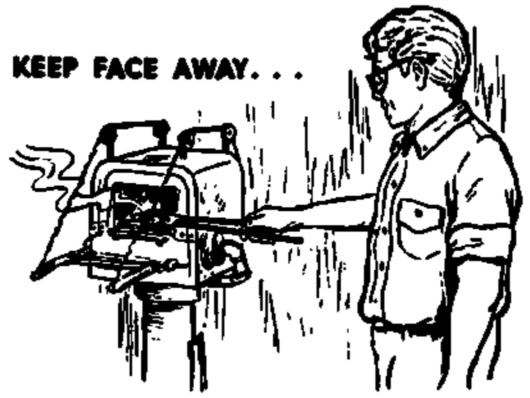
3. Students should know the location of the nearest fire extinguisher and fire blanket, and be instructed in their use.
4. Molding floors should be kept clean and sand heaps shovelled up into neat piles at all times.

Safe Practices on the Molding Floor

1. Advise students at the beginning of the semester to report any physical ailments (hernia, weak heart, allergy, etc.).
2. Lifting – don't overlift. Get additional help.
3. Heavy copes – should be anchored and secured in such a manner that they will not tip over or fall. Do not crawl under a cope!
4. Hoisting equipment – periodic inspection of all cables, chains, hooks and links should be made.

Safe Practices in Melting

1. Keep crucibles in a warm, dry place so they will not gather moisture.
2. To cure a crucible, bring it up to heat gradually and let it cool in the furnace to room temperature before using.
3. Don't pack metal tightly in the crucible when charging. The metal will expand and may break the crucible.
4. In handling a crucible with hand tongs, be careful not to fracture the crucible or spill the metal.
5. When a crucible has been in use for some time it becomes thin and dangerous. Discard it and "break in" a new one.
6. Be sure the crucible fits its shank
7. If crucible tongs are used, be sure they fit the crucible perfectly.
8. A small cast iron ladle may be used to melt such metals as tin, lead, babbitt and aluminum.
9. When charging cold metal into a molten bath of metal, in a crucible, it is well to let the cold metal heat up a little before dropping it into the molten bath.
10. Be sure all ladles and crucibles are free from moisture before pouring molten metal into them.



KEEP FACE AWAY. . .

Lighting Gas-Fired Melting Unit

1. Light a piece of paper and place it in the furnace near the orifice where the gas enters the furnace.
2. Keep the face away from the furnace and turn on the gas.
3. When the gas is burning turn on the air valve gradually until the proper air and gas mixture is obtained.
4. When shutting down a gas furnace shut off the gas first.

Safe Practices in Pouring

1. Inspect all ladles to be used in pouring, and make needed repairs or reline them if necessary.
2. All ladles that have been freshly daubed should be thoroughly dried out before using.
3. All ladles are made to fit the shank in which they are carried. The shank should be turned with the side of the taper up when inserting the ladle. Lips of the ladle should be at right angles to center line of shank.
4. All students who are pouring molten metal should wear approved goggles, gloves and leggings.
5. All hand ladles should be equipped with metal shields when pouring.
6. Bull ladles and hand ladles should not be filled too full.
7. Do not run with a ladle of metal and don't walk backward.

Cleaning and Grinding Castings

1. Always wear goggles when snagging castings on abrasive wheels.
2. Rests should be adjusted within ⅛" of the wheel. Do not adjust rest when wheel is in motion.
3. Don't put the entire weight against a casting when grinding; the casting may slip from the wheel and throw the hand and arm against the wheel.
4. Don't grind on the side of the wheel; a casting may get jammed between the guard and the wheel.
5. Do not adjust the rest below the center of the wheel.

WEAR THAT EYE PROTECTION!

SCHOOL MACHINE SHOP SAFETY

Safety Precautions in the School Machine Shop

Learning safe practice in the school machine shop is as important as learning to run a lathe or any other machine tool.

Safety is an attitude; that is, it is a frame of mind. If the student's attitude toward safety is a good one, he will accept the idea that safe working habits are the ones to learn and practice for the rest of his working life.

A student must also keep in mind that he will not always be working alone, but will constantly be working with other people, and to keep himself, as well as those working with him, free from accidents at all times.

No trade can be learned well until safe working habits have been established and practiced, day in and day out. Safe working habits cannot be bought or manufactured, they must be learned through practice.

Rules and regulations, mechanical guards and devices placed around machinery, posters and lectures are very important, but they will never take the place of intelligent safety procedures and precautions taken by the person doing the work.

The hazardous nature of machine tools, including the mechanical power transmission driving them, has long been recognized. Even with the great effort demonstrated in guarding belts, pulleys and gears in making machines less dangerous, there are still many injuries occurring to those working around machine tools.

Injuries from machine tools may be either from the point of operation or the mechanical power transmission. Injuries to machine tool operators may also occur from other sources, such as handling materials, falls, or difficulties that may be attributed to the job, but not necessarily to the machine.

So, let us look at some of the do's and don'ts that will help to make us safe workers in our school machine shop classes.

Safety Equipment and Clothing in the School Machine Shop

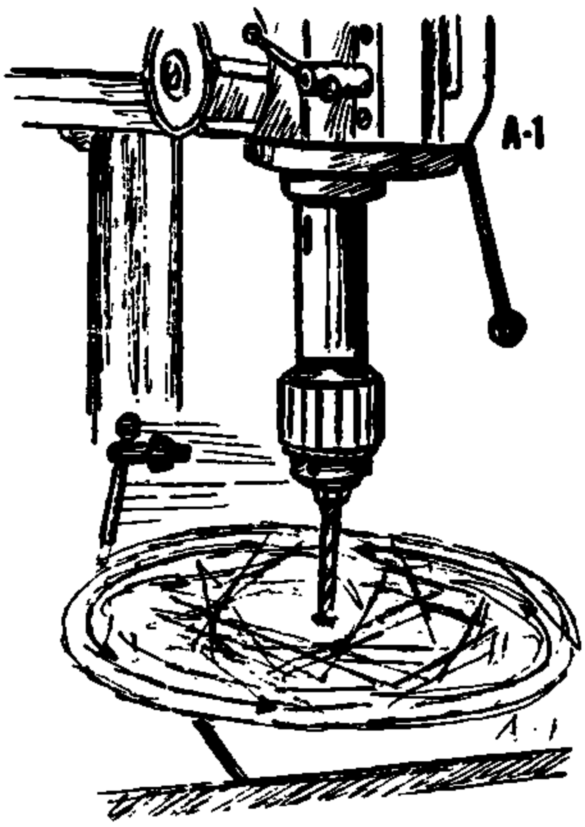
1. Wear safety goggles, or face shields, at all times, which have been specifically designed for the type of work being done.
2. Wear clothing that will give maximum protection, such as asbestos gloves for welding or asbestos leggings around legs, thick shoes when lifting heavy objects, and shirts with sleeves cut off or rolled above elbows. Never wear loose or torn clothing.
3. Do not wear rings, neckties, watches or bracelets that may be caught in moving machinery.

Housekeeping in the School Machine Shop

1. Keep floors free of oil, grease, or any other liquid.
2. Store materials in such a fashion that they cannot become tripping hazards.
3. Do not leave tools on table of machine even though the machine is not running. Tools may fall off and cause foot or toe injuries, and if the machine is running, tools may fall into revolving machinery.
4. Have a place for every tool and every tool in its place, when tools are not in use.

Drill Press

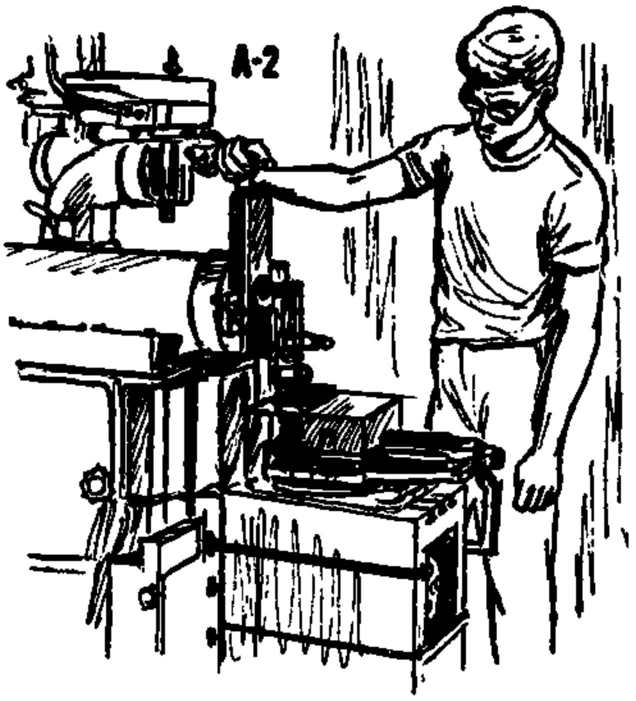
1. Wear goggles at all times.
2. Be thoroughly familiar with all the switches and levers that are used to operate the machine.
3. Remove neckties and tuck in loose clothing so there is no chance of their becoming entangled with the rotating drill.
4. See that all safety guards are in place.
5. Use sharp and properly ground tools or drills at all times.
6. Clamp the work solidly. Do not hold it in your hands. Should the drill break through, a merry-go-round effect may set up, causing serious and painful injuries. Illustration A-1.



7. Always use a wood block beneath the drill being removed to avoid damaging small drills, or to prevent large drills from dropping through on your foot.
8. Remove chuck key immediately after tightening drill in drill chuck.
9. Permit the drill to stop of its own accord after the power has been turned off. Do not try to stop it with your hand.
10. Do not have rags of any kind near drill press while drilling. Rags may get caught in revolving spindle setting up potential hazards that may cause serious injuries to operator.
11. Place all oily and dirty rags in a closed container when the job is finished.
12. Never use bare hands to remove chips from drill press. Always use a brush.
13. Do not reach around or in back of revolving drill.
14. Change belt or speed regulation only when power is off and machine has come to a dead stop.
15. Small drills should revolve at high speed, large drills at low speeds. Reduce speed about 50 per cent when drilling cast iron.
16. Keep your head back and well away from any moving part of the drill press while operating the drill press.

Metal Shaper

1. Wear safety goggles at all times.
2. Before starting the machine—be sure that check ram, tool head, tools, work, table support clamping screws and vise are properly secured in place or position and that the tool head and tool clear the work
3. Do not run the ram at high rate of speed on long strokes.
4. Do not run the ram back into the column with the tool slide at an angle. Check this movement while the tool head is in a vertical position; when adjusted, then turn tool head into angular position. When you have finished, be sure to return tool head to vertical position.
5. Keep your hands away from moving tool. Injuries are frequently caused by getting fingers caught between the tool and work piece.
6. Don't permit chips to accumulate around machine. When this occurs, stop the machine and clean away all chips by means of a brush.
7. Always stand parallel to the direction of stroke of the ram when the machine is running. Illustration A-2.


A-2

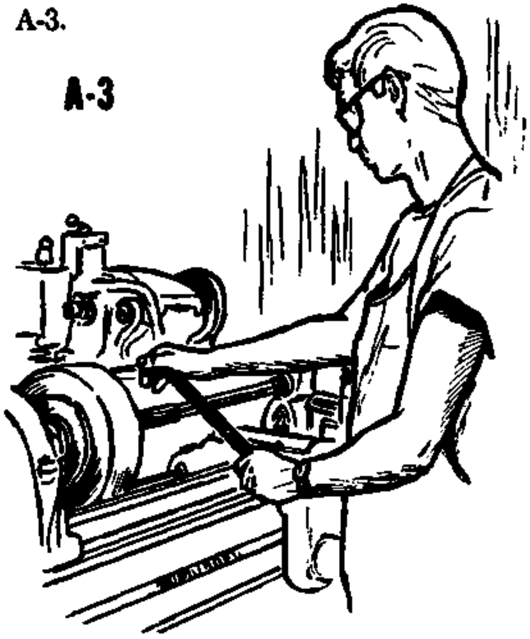
8. Use a heavy wire mesh screen or metal shields over the tool to prevent chips striking you or striking a nearby fellow workman.
9. Do not leave the shaper unattended while it is running.
10. Be sure that your tool bit is sharp at all times. Many accidents occur resulting directly or indirectly from dull tool bits.

Metal Lathe

1. Do not attempt to operate the lathe until you have been checked out on it and are thoroughly familiar with its operation.
2. Remove necktie, sweater, wrist watch and rings. Wear an apron, and by all means wear properly fitted safety goggles.
3. Check to see that all safety guards are in place.
4. Before turning on the power, check to see that the tailstock, toolholder and job are properly clamped.
5. Use hand power only when putting on or taking off chuck or faceplate. Do not use the power that operates the lathe to perform this task.
6. Never leave the chuck wrench or any other tool in the chuck. If the machine is turned on, wrench may fly out and injure the operator or other persons.
7. Do not use wrench on revolving work or parts. This can prove to be a very dangerous urge or temptation which may result in the loss of eye or result in other bodily injuries.
8. When filing, be sure tang of file is protected by a strong wooden handle. File left handed so that no portion of your body is over

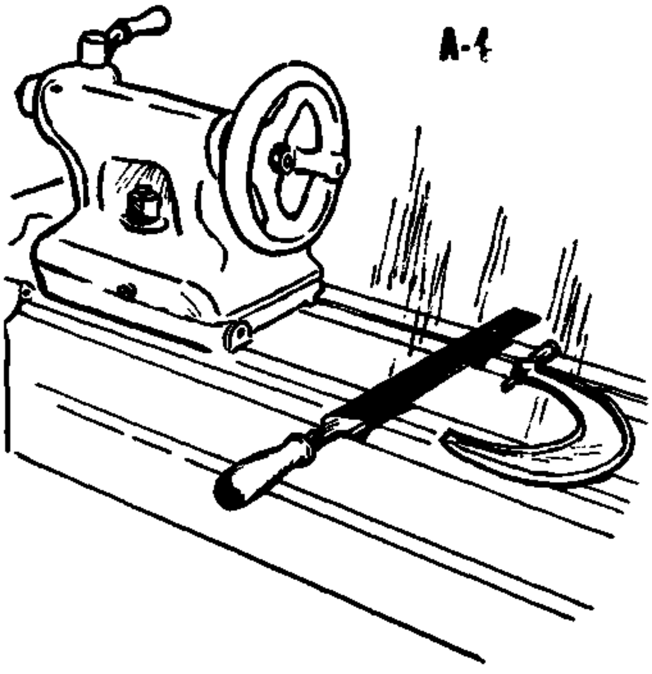
chuck or faceplate as would be the case in right hand filing. Stand to one side so that, if the file is forced upward, it will go past the body rather than against it. Illustration A-3.

A-3



9. Do not attempt to remove chips with fingers. Remember that the chips are razor sharp.
10. Stop the machine before making any measurements or adjustments.
11. Do not permit anyone to start your lathe for you.
12. Do not permit small diameter work to project too far from the chuck without supporting from the tailstock center. Deviating from this particular principle has caused many injuries in school machine shops.
13. Never leave the lathe unattended.
14. Remove all sharp edges and burrs from the piece before removing it from the lathe.
15. Tools must not be placed on the bed ways. Illustration A-4.

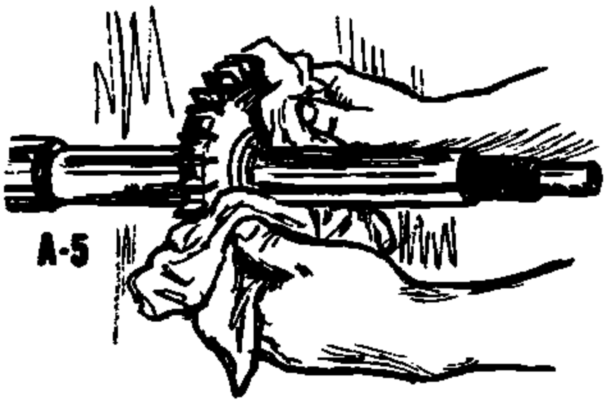
A-4



16. Where air has been installed for cleaning purposes; each student should be instructed as to its proper use. At no times should air be directed toward any person or persons.
17. As a general rule, do not shift gears while the lathe is running.
18. If the work must be removed from the lathe, or repositioned in the chuck, always move the cutting tool clear of the work or reverse it in the toolpost to prevent it from cutting you accidentally.

Milling Machine

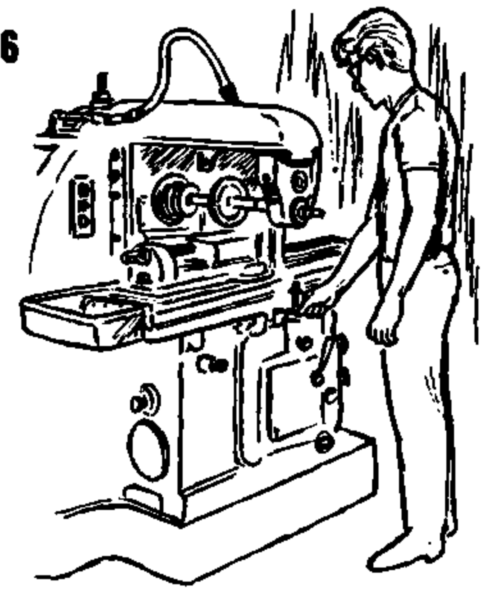
1. Wear safety glasses while operating the milling machine.
2. Do not attempt to operate the milling machine until you are thoroughly familiar with it.
3. Check thoroughly to see if the milling cutter and arbor are secure and that the cutter and arbor are clear of the work before starting the machine.
4. Use only wrenches that properly fit the nut or bolt head. This will obviate the possibility of striking hand against the cutter or other objects, caused by the improper use of wrenches.
5. Never put on the cutter with bare hands. Always use a heavy cloth around the teeth of the cutter. Illustration A-5.



A-5

6. To avoid striking the hands on the cutter while setting up, move the table with the work as far away from the cutter as possible.
7. Never reach over or near the rotating cutter.
8. Stop the machine before removing chips. Never attempt to remove chips with bare hands. Always use a brush.
9. Treat any small cuts and skin punctures immediately as potential infections.
10. Remove all tools from milling machine table before starting machine.
11. Make no adjustments while the cutter is rotating.
12. Never stand in line of the rotating cutter. Always stand erect, parallel with the table. Illustration A-6.

A-6



13. Keep the floor around the machine clear of chips and wipe up spilled cutting fluid immediately.
14. Permit no one to turn-on your machine for you.
15. Keep your mind on your job, and be ready at all times for any emergency.
16. Never attempt to remove heavy milling machine vises or heavy fixtures by yourself. Always solicit the aid of another person in performing this task.

Surface Grinder

1. Always wear goggles or an eye shield when performing any grinding operation.
2. Become thoroughly familiar with all electrical and mechanical equipment necessary for the operation of the machine.
3. Do not attempt to use the grinder unless the wheel guard is in place and well secured.
4. Always check the grinding wheel for soundness before mounting it on the spindle.
5. For all dry grinding operations, be sure to use a good dust collecting system.
6. If a magnetic chuck is used make sure the magnetic chuck is holding the work securely before starting the machine.
7. Never attempt to remove work from magnetic chuck or table of machine until the grinding wheel has come to a complete stop.
8. Keep all tools clear of work table.
9. Do not permit grinding wheel to become too badly loaded or glazed before dressing it.
10. Avoid grinding on the side of wheel. Side pressure may break the wheel.
11. Stop grinder if grinding wheel chatters or vibrates excessively. This may be a signal that the wheel is not balanced properly or is loose on the spindle.
12. Use clamps or vise when grinding small or short pieces on a magnetic chuck.
13. Move the table, using hand wheel for table movement, to see that work clears the wheel before starting the machine.
14. Never operate a grinding wheel at speeds exceeding that recommended by the manufacturer.

Bench Grinder

1. Stand to one side out of line of wheel when starting it, especially if the wheel is new.
2. The face of the wheel should be flat and free from grooves.
3. Work should be fed slowly and gradually to avoid sudden or abrupt pressures on the grinding wheel.
4. Be sure that the tool rest is only ⅛" from the face of wheel. Too much clearance may cause work to jam the wheel and break it, thereby inflicting injuries to operator.
5. Do not adjust the tool rest while the machine is running.
6. Always wear goggles while operating the grinder even though the machine is equipped with protective glass shields.

Metal Saws

1. Wear goggles while operating any type of metal saw.
2. Follow the manufacturer's instructions for tensioning the blade. Too much tension could shatter blade causing particles of steel to fly off that could injure you or some one near by.
3. When turning on power, stand to one side of saw frame to protect yourself in the event of saw breakage.
4. In using the power hack saw, mount work only when the saw is stopped. Be sure to mount work securely.
5. Do not remove chips while the machine is in motion.
6. Support protruding end of long stock so that material being cut will not fall and injure someone.
7. Saws should be installed in such a manner that in cutting long stock the stock will not become a tripping hazard.
8. Keep hands clear of all moving parts.
9. Be sure blade is in good condition before using.
10. Always feed the blade slowly and gradually into the work.
11. If blade breaks in work, stop the machine at once, then remove the blade.
12. Burrs on cut pieces are sharp. Handle the pieces with care until burrs are removed.

WELDING SAFETY

Electric Arc Welding

1. Avoid looking at the arc or flash unless equipped with appropriate dark glasses.
2. Helmets and welding goggles must be free of cracks or holes permitting penetration of intense light.
3. Wear protective clothing to help protect the skin from intense rays.
4. Always wear gloves. Leather gauntlet type that can be thrown off are recommended.
5. Where necessary, wear leather aprons, arm coverings or other protection to protect from molten metal or hot sparks.
6. Where a helper is used, he must be protected the same as the welder.
7. Lenses designed for eye protection during oxy-acetylene welding or cutting are not dependable protection against electric arc rays. (Safety lenses in all goggles and helmets are prescribed in Rule 154 (c), Safety Code for the Protection of Heads, Eyes and Respiratory Organs, American Standard 72.1-1959.)
8. Lenses appropriate to the ampere setting will be used:

Lens Shade	Ampere Range
No. 8	30-75
No. 10	75-200
No. 12	200-400
No. 14	over 400

9. Wear high type shoes rather than undercut shoes.
10. Always wear eye protection when chipping. Never chip if there is a possibility someone nearby without glasses will be struck by flying chips.
11. Keep sleeves and pants cuffs rolled down and collar buttoned up.
12. Never touch a piece of metal in the welding area if uncertain about the temperature.
13. Mark hot metal to read "HOT."
14. Where small work must be handled, have pliers, tongs or other appropriate tools handy. Do not handle excessively hot metal with leather gloves unless cool area beyond the hot spot permits safe handling.
15. Clamp work well so you do not tear it apart and then grab at the hot work.
16. Keep hands off the work until cool.
17. Exercise good judgment in selecting welding jobs. Automotive work is especially hazardous due to fuel tank, fuel line, hydraulic lines, flammable upholstery, etc.
18. Special metals require the use of respirators to protect welders from harmful fumes. Adequate ventilation is always desirable, especially when welding galvanized materials.
19. Toxic gas, phosgene, is formed when the ultraviolet rays of an electric arc come in contact with chlorinated degreasing solvents. Metal cleaned with carbon tetrachloride and trichloroethylene should not be welded until thoroughly dried.
20. Never strike an arc on compressed air cylinders.
21. Gasoline tanks will never be welded in school shops.
22. Oils, greases or other agents which may ignite and splatter will be cleaned from surfaces before welding.
23. Tanks which contained flammable materials will not be welded unless all danger from residue and fumes has been resolved. Check with instructor.
24. Learn the rules pertinent to the type of welder you are using.
25. Work in a dry area.
26. Work in booths or other shielded areas wherever possible.
27. Sparks may fly 25 feet. Make sure there are no open doors or windows through which they may travel to other flammables.
28. Don't get wound up in your work! Keep cables free from your body so you can move freely, especially should your clothing ignite or some other such accident occur.
29. Ground the work before turning on the welder.
30. Where there is a danger of fire. protect flammable surface adequately by wetting thoroughly, protecting with asbestos cloth, sand, sheet metal or other non-flammable materials.
31. Don't change polarity or connections when a welder is being used.
32. Avoid looking directly at the arc. Concentrate on the pattern to be followed and that which was followed, beyond the center of illumination.
33. Keep the floor free of electrodes once you begin to weld. They could cause a slip or fall.
34. Place stubs in a metal container.
35. Do not allow electrode to freeze to the work, bench or other apparatus. Shut off welder if electrode sticks.
36. Internal pressure in a jacketed container or an object with hollow spaces can act like a bomb when heated. Make sure hollow spaces are vented.

37. Never tack weld without the helmet.
38. Stop the welder (pull the plug if AC) to clean oil, adjust or repair.
39. Replace the cables by coiling them to eliminate tripping hazards.
40. Keep clamps and other tools off the floor and put away. They can cause a fall.
41. Be especially cautious of hot metal when cutting with electric arc.
42. Keep splices, frayed or worn places on the cable taped well.
43. Gasoline engine powered welders will only be used where exhaust fumes do not impair the health and safety of personnel in the area.

Oxy-Acetylene Welding

1. Obtain permission from the instructor before using welding equipment.
2. Before attaching a regulator to a cylinder valve, "crack" the valve to blow out dust and dirt.
3. Do not use oil on the torch, blowpipe, valves, regulators or any other portion of the equipment.
4. Check for leaks whenever you change tanks or suspect a leak.
5. Leaks around equipment should be checked with soapy water, never a flame.
6. Should you suspect a leak in any equipment, stop at once and notify the instructor.
7. Avoid the use of pliers on apparatus. Use the torch wrench and turn right for oxygen connections and left for gas connections.
8. Keep the cylinders in an upright position. If they must lay in a horizontal position, keep the valve end raised to keep acetone from running out.
9. Open cylinder valves gradually.
10. Open the oxygen valve wide to prevent leakage.
11. Open acetylene valve only one-eighth of a full turn, approximately and never more than a quarter of a full turn.
12. Keep the wrench on the acetylene tank so it can be shut off quickly if necessary.
13. Under no circumstances will acetylene pressure exceed 15 pounds. If used in excess of this amount, an explosion may result.
14. Make sure connections are tight when you change tips or other apparatus. Do not overtighten or use wrenches on hand tightening devices.
15. Use the maximum amount of gas for a given size welding tip. Cutting down the amount of gas will cause popping and hot metal will be thrown around.
16. Do not weld or cut for at least 15 minutes after contamination of clothing with oxygen.
17. Goggles should be adjusted to fit the welder's face to give maximum protection.
18. Always use the correct type of eye protection to reduce light and provide shielding.
19. Keep your equipment in good, clean, dry condition.
20. Keep the welding area neat, clean and dry.
21. Use ventilating system or means of ventilation provided.
22. Make certain the fire extinguisher is in place and that you know how to use it.
23. Do not permit autos or equipment to be run over the hoses. Protect them from sharp objects, kinks, etc.
24. Keep the hose out of the way so it does not become a tripping hazard.
25. Make certain you do not drag the hose over hot metal scrap when cutting.
26. Use flint spark lighters, never matches or cigarette lighters.
27. Purge oxygen and acetylene lines before lighting.
28. The tip should be pointed away from personnel, equipment and flammables when being lit.
29. Weld small pieces on a fire brick welding table.
30. Clamp or otherwise secure pieces which may fall or tumble from the welding table.
31. Keep the tip out of heat reflecting areas or holes.
32. Keep the end of the tip out of the molten metal while welding or cutting.
33. Never weld or cut into a container that had gasoline, oil or other explosive, combustible or toxic fumes in it. Such work should be done only under direct supervision of your instructor.
34. Use special care when cutting so hot pieces do not fall or tumble onto the feet. Do not stand with feet so close to the cutting that they are subject to intense heat, sparks and molten metal.
35. Exercise extreme caution when working around automotive type vehicles or machinery. Hydraulic tanks and lines, fuel lines, flammable upholstery, oil and grease covered parts all create fire hazards. Secure teacher's permission and advice before working on such projects.
36. Avoid using filler rods that are too short.
37. Never work from both ends of a rod. Use the same end to work from so you will not have to guess which end is the cool end when you pick up the rod after laying it

down. The squared-off end will always be cool.

38. Never leave the tip of a lighted torch inserted in a tank or barrel.
39. Always have pliers or tongs handy when small pieces must be handled hot. Tidy up hot pieces used for blocking or set-up work so others are not burned while attempting to clean up your work area.
40. When a torch backfires or pops out with a screeching sound, shut off the oxygen valve immediately. Then shut off the acetylene valve and relight and adjust the flame.
41. Never lay down or hand up a lighted blowpipe or torch.
42. Always shut off the equipment at the tank, regulator and hose valve.
43. Hot metal should be marked HOT with chalk or soap stone.
44. Avoid confined areas and positions, so you can work freely without endangering others or yourself, or from loss of balance.
45. Adjusting screws on the regulators should always be released when not in use. Turn the screw out counter clockwise.
46. Never allow a cylinder to fall. They are under high pressure internally and can explode if ruptured by a sudden shock. Secure cylinder to a stationary object.
47. Screw the proper protective cover on the tank intended. Place on tank when not in use to protect the valve.
48. Warm water, never boiling water or a flame, must be used to thaw a frozen outlet valve.
49. Never use oxygen or acetylene directly from the tanks without the use of regulators.
50. Never "crack" a cylinder in the vicinity of an open flame or fire source.
51. Never use oxy-acetylene directly from the tanks without the use of regulators.
52. Cylinders should not come in contact with electric wires.
53. Never tamper with the fusible safety plugs.
54. Acetylene piping, hoses and fittings should be color coded red.
55. Oxygen piping, hoses and fittings should be color coded green.
56. If you have reason to believe equipment may be defective, advise your teacher.

Forge and Forging

1. Never light the furnace without knowledge of proper procedure and without the instructor's permission.
2. Light the furnace by first turning the air blower on to eliminate any accumulation of gas; use a lighting rod or torch long enough to keep the face and hands out of danger.
3. Stand to one side of the furnace opening. Never look directly into the fire box while lighting a gas-fired furnace.
4. When turning off the furnace always turn off the gas first and then the air.
5. Use the correct type tongs and grip securely to prevent slipping.
6. Wear gloves to protect hands from heat.
7. Wear dry gloves to handle cyanide. Instructor must approve use of cyanide.
8. Be sure that a properly located and well-covered annealing pan is near the heat-treating furnace.
9. Exercise care while quenching hot metal in oil. Plunge the metal quickly below the surface, and keep it there. Raising it to the top may cause the hot oil vapor to ignite.
10. Make sure that the quenching oil container has enough oil to cool off the work without permitting the oil to overheat. Repeat quenching in the same oil may overheat the oil, causing it to foam and boil over. This creates an extreme fire hazard.
11. In working with cyanide solutions, use rubber gloves.
12. Never permit cyanide to touch open wounds or skin abrasions.
13. Wash hands thoroughly after handling cyanide.
14. Place parts being case-hardened in the pot before the furnace is lit.
15. Prevent moisture from coming into contact with the case-hardening compound and causing an explosion.
16. Remember that case-hardening materials are dangerous chemicals. Use them with extreme caution under the direct supervision of the teacher.
17. To avoid burns or injury resulting from the stock's slipping, fit tongs properly to the piece being forged.
18. Use caution in hammering hot or cold metal on stakes or anvil.
19. Use care in cutting hot metals with the hardy, blacksmith chisel, or other means so cut stock does not fly or fall on feet.
20. Keep the anvil clear of scraps and flakes of metal oxide.
21. Never strike a hard hammer on the face of the anvil. Chips may fly at bullet speed.
22. Knock oxide off metal before attempting to forge. In this way you prevent hot particles from flying.
23. Keep mushroom heads from forming by constant attention to tools.
24. Mark all hot metal "HOT" if within range

of others who may touch it.

25. Be especially careful when handling pipe or tubing that is being heated. Flame may travel through the tube.
26. Be sure that anvils are mounted securely to base mounts so as to prevent them from falling or upsetting.
27. Quench hot tongs before putting them away.
28. Keep your work area free of clutter.
29. Make certain no flammables are near the area.
30. Warn others in the work area when walking with a hot piece of metal.
31. Give the operation your full attention. Avoid distractions.

WOODWORKING SAFETY

Sanders – Spindle, Horizontal or Vertical Belt, Portable Belt, Disc, Drum, Flat Vibrating or Oscillating and Metalworking Fender Grinder.

General Safety Precautions:

Clean, oil and adjust only when the machine is at a dead stop.

Clamp all work pieces securely; never attempt to hold with your hands.

Make certain the switch is off when plugging portable sanders to outlet.

Shut off the machine if you must leave the work area.

Be sure the machine has stopped running when you set it down.

Use dust control measures.

Keep your hands at least two inches from the abrasive materials.

Use belts or abrasive pieces that are not torn. Run the belt in the proper direction and track it before operating the machine.

Do not work with pieces that are too thin or too short or can't be controlled. Use jigs or fixtures for small objects.

Be careful that the tool does not "get away" and fall on the feet or floor.

Use a brush, not the hands, to remove dust and chips.

Keep your mind and your eyes on the operation. Avoid distractions.

Keep loose aprons, loose or torn clothing, rags, etc., away from the work area.

Make certain your hands are dry. Operate the sander only when you are standing on a dry floor.

Know the special requirements of the make and model of the machine you are using.

Do not permit equipment to run over portable sander cords.

Arrange cord to eliminate tripping hazards.

When using table equipped sanders, keep table within ⅛ inch of the abrasive. Use guides, fences and other assists.

Permit sander to reach full operating speed. Keep moving to avoid burning the sheet, belt or disc.

If a piece of material becomes caught in a machine, do not try to save the stock, but stop the machine.

Disc Type Sanders

All previous considerations.

Sand only on the downward travel.

Keep a firm grip on the sander to avoid losing control.

Avoid allowing portable disc type tools from getting near your clothing.

Spindle Type Sanders

Select the proper size spindle for the job.

To spindle sand the inside of a hole, take a firm grip with both hands on the work piece and work slowly. Have the instructor check your set-up before starting.

All previous general safety precautions.

Horizontal Belt Sanders

All previous general safety precautions.

Do not sand any material unless it is at least six inches long.

Sand on the downward travel of the belt only.

Make certain the stock is against the end stop before starting.

Use a wooden trowel type holder to hold material against the belt.

Allow the belt to come to a stop before removing the stock.

Test – Sanders

Multiple Choice:

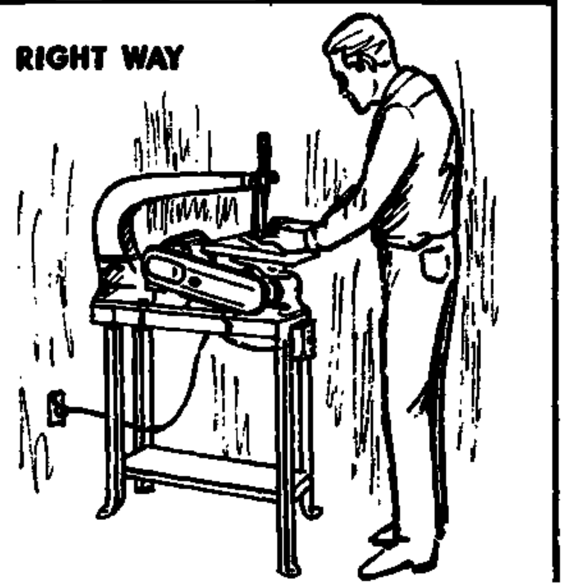
1. It is well to have the work being sanded
   a. Held securely so it cannot move
   b. Held by hand
   c. Held loosely
   d. None of the above answers are correct
2. It is well to keep the hands at least
   a. 12 inches from the abrasive
   b. 2 inches from the abrasive
   c. ½ inch from the abrasive
   d. None of the above answers are correct
3. Sawdust should be removed from benches and projects with
   a. Rags
   b. Bench brush
   c. The hand
   d. Either of the above answers are correct
4. If a piece becomes caught in a machine, you should
   a. Try to release the work from the machine at once
   b. Try to control the sander so the work will be thrown clear
   c. Stop the machine without trying to save the stock
   d. Either of the above answers are correct

5. It is best to start sanding
   a. As soon as the machine is turned on
   b. After the motor has reached its maximum RPM
   c. Neither of the above answers are correct
   d. Either a or b would be correct

True-False – Use Plus for True, Zero for False:

1. ( ) It is permissible to run sanders over electric cords since such cords are designed to be indestructible.
2. ( ) Always track the belt before using the machine.
3. ( ) It is unwise to work material which is small or which is difficult to control with the type of sander being used.
4. ( ) Electric cords can be tripping hazards and must be placed in a manner that is not hazardous to others.
5. ( ) Portable disc type sanders must be kept well away from your body and clothing.

JIG SAW



1. Jig Saw
   a. good stance c. hands clear of cutting area
   b. eyes on work d. guard properly adjusted

Jig Saws

Use the proper blade for the job at hand.

Make all adjustments, clean, oil, etc., before turning on the power.

Keep your eyes and mind on the work being performed.

Your hands should be kept well beyond the intended or possible cutting path.

Keep a firm grip on the wood; do not crowd or turn without cutting.

Plan your cuts to avoid back-cuts as much as possible.

Keep hold-down rest firmly on the stock.

The belt guard should be in place.

The proper blade speed should be selected and the table locked securely in place.

The table should be free of all objects except the material being cut.

Clear scraps from the table only after the machine has made a dead stop.

Acquire the proper stance for operation of the jig saw.

Cut cylindrical stock only with approved jigs and set-ups.

Get the instructor's approval for all special set-ups.

Test – Jig Saw

True-False – Use Plus for True, Zero for False:

1. ( ) It is well to back out of the cut wherever possible.
2. ( ) Cutting speed is of minor importance.
3. ( ) Keep the tilt-top table loose so quick adjustments may be made while cutting.
4. ( ) It is permissible to have wrenches and other items on the saw table as long as they do not strike the blade when the saw is in operation.
5. ( ) The hold-down rest should be placed well above the stock.
6. ( ) Keep hands and fingers well beyond the intended or possible cutting path.
7. ( ) Special set-ups are required for cylindrical stock to be cut.
8. ( ) It is important to keep your eyes and mind on the job being accomplished.
9. ( ) Hold wood lightly with finger tips for good control.
10. ( ) Get the approval of your instructor for special set-ups or when in doubt about the way to perform a certain operation.

Mortising Machine

Clean, oil and adjust only when the machine has come to a complete stop.

Clamp or secure work in position firmly.

Check bit and chisel for proper and secure setting. Use sharp bits.

Hand turn machine one complete revolution before turning on the power.

Keep hands away from chisel while machine is operating.

All mortising machines, except hollow mortisers, should have thumb stops at each side of the chisel.

Operators should not leave the machine while the power is on.

Do not brush chips or cuttings away with the hand.

Give your full attention to the operation Avoid distractions.

Test – Mortising Machine

Matching:

1. ( ) Clean away chips with
2. ( ) Hand turn machine one revolution before
3. ( ) Never leave the machine
4. ( ) Clamp or secure the
5. ( ) All mortising machines except hollow mortisers should be equipped with
6. ( ) Give the machine your
7. ( ) Always make sure the bit and chisel are

a. turning on the power
b. stock before cutting
c. thumb stops at each side of chisel
d. a brush
e. machine is operating
f. the hand
g. full attention
h. before stopping the machine
i. mounted securely
j. loose for maximum freedom
k. machine to the bench

Portable Router-Shaper

Clean, oil and adjust machine only when it is at a dead stop. Disconnect the cord.

Fasten stock securely in a vise or clamp.

Tighten all of the bits and cutters with proper wrenches.

Ask the instructor to approve your set-up.

Make certain the switch is off when connecting cord to the outlet.

Keep a firm grip on the machine.

Do not allow your fingers or body to come near the revolving cutter.

Exercise caution around knots or irregular hard spots.

Place the machine in a safe place when it is not in use.

Avoid using the machine if it has a frayed or defective cord.

Keep cords from becoming a tripping hazard.

Keep the students observing the operation clear of the work area.

Test – Portable Router-Shaper

True-False – Use Plus for True, Zero for False:

1. ( ) Always disconnect the cord before cleaning, oiling or adjusting the tool.
2. ( ) Have the switch turned OFF when connecting the cord.
3. ( ) Feed rapidly into the material, especially through knots and hard spots.
4. ( ) Do not allow fingers or body near the revolving cutter.
5. ( ) Material must be mounted loosely in a vise to allow for movement while cutting.
6. ( ) Grip the machine firmly while using it.
7. ( ) The instructor must approve your set-up before working.
8. ( ) Small pipe wrenches and vise grips are generally well suited for making adjustments.

Shaper – Wood

Use a ring guard around and over knives to help protect your fingers. This may not be less than the maximum diameter of the cutter.

Use safety cutters (three lip, solid).

Utilize hold-down clamps to secure work to the table. They help reduce chatter and the chance of kick-back.

Use guide pins, collars, jigs, etc., where appropriate.

Use a pusher stick when necessary.

Do not attempt to shape stock that is too short or extra thin.

Make certain that knives are correctly seated before tightening lock nut.

Knives must be correctly balanced and sharpened.

Run all material against direction of rotation of spindle.

Use the fence and pressure bar whenever possible.

Examine all wood for knots, splits, checks, warp or wind, surly or cross-grain or other minor defects. Any of these situations can cause dangerous working conditions.

Do not use short knives because collars will not get sufficient bearing to hold knives securely. Knives must extend back at least two-thirds the length of the grooves.

Acquire good footing and a good physical stance.

Keep your mind and your eyes on the operation. Don't become distracted.

Remove all blades from the shaper spindle if one must be removed. (If machine is started accidentally, remaining blades will not be hurled out.)

Set up the shaper so the wood covers the blade.

Remove all loose objects from the table and machine area.

Allow no one else inside the operators area.

Keep hands well away from revolving cutters. Use spring guard wherever possible.

Hold the board down against the guide with the palms of hands, not extended fingers. Your fingers should be together lying on the board out of the path of the cutter.

End grain of boards less than eight inches in width should not be run unless the shaper is equipped with a sliding guide with a board clamp.

Avoid deep cuts and do not feed rapidly.

Never back up the work. If necessary, stop the machine dead, remove the material and start over.

Get the instructor's approval and then test your set-up on a piece of material which is of a safe size.

Stay with the machine when the power is on.

Remove and store the cutter-head when the operator is finished using the machine.

Clean, oil and make adjustments only when the machine is stopped.

Never start on a corner on a collar job.

Cover guards should be used whenever possible.

Bring the spindle speed up to a safe operating speed in a series of short starts and listen for chatter. Watch for signs of the knives being out of balance.

Make sure that the cutters rotate in the proper direction.

Double spindle shapers should have individual switches so one may be started at a time.

Only precision ground blades and collars may be used. They apply uniform pressure on all knife blades, thus helping to eliminate breakage. When thrown, steel blade segments travel with force great enough to kill a man.

Test – Shaper

True-False – Use Plus for True, Zero for False:

1. ( ) Use the fence and pressure bar whenever possible.
2. ( ) Keep hands close to the revolving cutters for good control.
3. ( ) Run all material "against" direction of rotation of spindle.
4. ( ) Work should be held down with palms of hands, not fingers.
5. ( ) Avoid deep cuts, but feed the material rapidly.
6. ( ) Clean, oil and adjust the machine while it is running.
7. ( ) Start the machine at top speed, then reduce to required operating speed.
8. ( ) Only precision ground blades and collars may be used.
9. ( ) Use a push stick when necessary.
10. ( ) Because of the speed of the machine, knots, splits, warped wood, cross grain and other defects are not very important.

Complete the sentence, explaining the procedure:

1. Never back up the work. If necessary to remove material we must ....
   ....
2. Utilize hold-down clamps to secure the work on the table. This is necessary because ....
   ....
3. Make certain the line of work is clear of others. Why is this important?......................
   ....
4. What should be done when a cutter is removed from a spindle?..............................
   ....
5. Why must knives extend back at least two-thirds the length of the grooves? ....
   ....

Planer or Surfacer

Use only clean wood, free of sand, paint, nails or other materials.

Inspect for cracks, loose knots, warp, wind or other defects.

The minimum length of stock run through the planer must be equal to the distance between the center of the feed and delivery rools. Ordinarily this should be not less than 18 inches in length.

The wood must be planed "with the grain" never against the grain.

For most work it is not necessary to remove more than 1/16" at a time.

Always allow the planer motor to reach full speed before starting to plane.

If a board stalls, never look into either end of the planer. Serious eye and face injury can result from a flying splinter or kickback. Turn off the machine and allow it to come to a complete stop before adjusting.

Always keep any guards in place over cutting heads, belt drives, etc.

Never reach into the machine.

Avoid feeding work of different thicknesses at the same time. Kickback will probably result.

Operators will not stand in-line with board travel.

Make certain no one is opposite the machine and that the area is free for the board to travel out of the machine.

Make sure the machine is at a dead stop to clean, oil or adjust.

"Walk" boards hand-over-hand rather than sliding them in your hands.

Avoid pinched fingers under or at the side of the board by giving the process your undivided attention.

Have a helper assist with long pieces, but only to hold and support a board at the proper height. Never reach over the machine.

Shut off the machine when you are not in the operator's zone.

Use the correct feed speed and always start the feed rolls after the planer has started.

Do not wear gloves.

Harder woods require lighter cuts.

Adjust cut to measurements taken on thickest part of the board.

Make certain you are the only person in the operator's safety zone.

Allow the material to proceed all the way through the machine before making any additional depth of cut adjustment.

Turn off the power and call the instructor if the machine does not seem to operate correctly.

Test – Planer or Surfacer

Multiple Choice

1. Ordinarily the minimum safe length of stock is
   a. 6 inches
   b. 12 inches
   c. 18 inches
   d. 24 inches
   e. None of the above answers
2. Planning may be done as soon as
   a. Power is turned on
   b. The machine has warmed up to room temperature
   c. The motor has reached full speed
   d. None of the above answers are correct
3. Feeding boards should be done by
   a. Sliding boards through by your hands
   b. Walking the boards hand over hand
   c. Either above method but wear gloves
   d. Neither of the above answers are correct
4. Work should always be planed
   a. With the grain
   b. Across the grain
   c. Either with or across, but never diagonal
   d. None of the above answers are correct
5. Harder woods require
   a. Heavy cut machine settings
   b. Light cut machine settings
   c. Neither of the above answers is correct
6. It is advisable to
   a. Reach into the machine if work sticks
   b. Reach over the machine if you wish
   c. Clean, oil and adjust the machine while it is running
   d. Let material proceed all the way through the machine before making an additional depth of cut adjustment
   e. None of the above answers are correct
7. Should the work stick in the machine, you should not
   a. Look into the machine from either end
   b. Press the reverse button to back out the stock
   c. Stop the machine, release pressure on feed rolls and remove work
   d. None of the above answers are correct
8. The operator must avoid
   a. Feeding two pieces of different thicknesses at one time
   b. Standing beside the board; he should be in-line with board travel
   c. Taking cuts of less than 1/16 inch
   d. Feeding two pieces of equal thickness at one time
   e. None of the above answers are correct

Wood Lathe

Make certain the wood is free of checks, cracks, loose knots, metallic substances or other defects.

Inspect glued work to see that the glue is thoroughly dry and the work will withstand turning.

Mount the work correctly and securely in the lathe.

Clean, oil and adjust only with the lathe at a dead stop.

Cutting tools should be sharp and have tight fitting handles.

Never use a file or rasp for cutting; never use a tool without a handle.

Avoid top speeds. Select the correct speed by the size and condition of the object being turned.

Stand to one side when power is first turned on.

Grasp the turning tool firmly but not excessively tight with both hands when cutting stock.

Keep fingers and hands away from revolving stock.

Use the correct amount of tool pressure against the stock.

Stop the lathe to use inside or outside calipers.

Keep the tool rest as close to the stock as reasonably possible by making frequent adjustments. Adjust the tool rest only when the lathe is completely stopped. After adjustment of the tool rest give the stock a trial spin with the power off.

Remove the tool rest for sanding and finishing operations.

Use only a small rag folded into a pad for polishing.

Allow only the operator in the work area when the lathe is in operation.

Turn off the power any time you must leave the lathe.

Check occasionally to see if the stock has loosened between centers. Do not tighten enough to burn or split the wood.

Keep the lathe bed free of miscellaneous objects – wood, tools, etc.

Rough down stock to cylindrical form before using higher speeds.

Cut stock to circular shape on the band saw or jig saw where possible.

Place the turning chisels in racks when not in actual use to prevent their falling.

Keep rags, waste, loose clothing, etc., away from lathe areas.

All unusual set-ups should be checked by the teacher.

Advise your teacher if the machine vibrates unnecessarily, if the tool seems to grab or other peculiar conditions exist.

Always make certain no one else operates the switch or the speed control.

Make all adjustments and check them every time you set-up. Don't rely on others or on yesterday's adjustments. Start all work at the slowest speed and increase as it is necessary.

Remember that table tops of considerable size have a high periphery speed. Make certain you do not exceed the safe operating spindle speed.

Make certain the tailstock is securely locked to the lathe bed before turning on the power.

The gouge is dangerous when used on the inside of a cup-shaped faceplate job and should not be used.

Avoid finger burns when sanding by exercising patience.

Keep the rear end of the tool below the center of the work.

Lubricate the dead center.

When using faceplates:

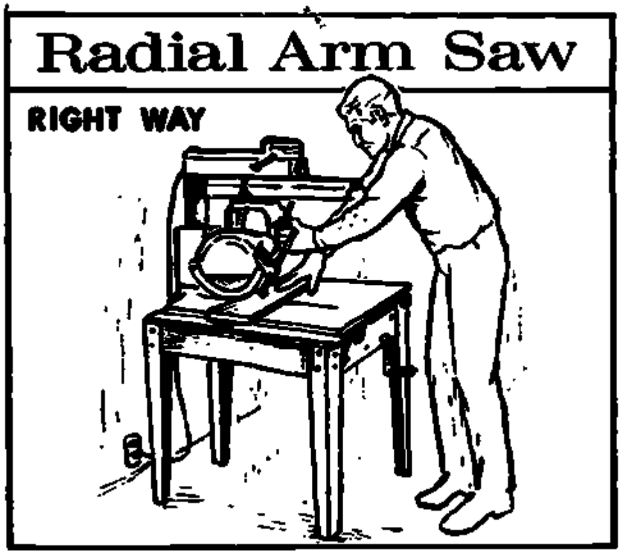
1. Use screws large enough to hold the work securely.
2. Keep an accurate check on the depth of cut to avoid striking the faceplate screws.
3. Inspect work frequently to see that the screws have lot loosened.
4. Use the correct type and size of faceplate.

Test – Wood Lathe

Multiple Choice

1. Before turning on the power, the operator must
   a. Make certain the lathe will come on at top speed
   b. Remove miscellaneous items from the lathe bed
   c. Place the tool rest as far from the work as possible
   d. None of the above answers are correct
2. To polish or sand, always
   a. Leave the tool rest close to the work
   b. Use loose rags or waste to apply polish
   c. Use light pressure to avoid finger burns
   d. None of the above answers are correct
3. Which of the following would not disqualify a piece of material as being suitable for turning
   a. A piece of clear stock
   b. Stock with loose knots, cracks, nails, etc.
   c. A long warped piece of wood
   d. None of the above answers are correct
4. While you are turning, you should always
   a. Permit others in the operator's area
   b. Use excessive tool pressure against the stock
   c. Turn OFF the lathe if you must leave the operator's zone
   d. None of the above answers are correct
5. When starting a job, make certain you
   a. Stand to one side when power is first turned on
   b. Permit considerable play at the tailstock end
   c. Rough down at high speed
   d. None of the above answers are correct
6. It is always recommended that you should
   a. Use inside or outside calipers with the lathe operating
   b. Clean, oil and make adjustments with the lathe operating
   c. Inspect glued work to make certain it will withstand turning
   d. Grip the turning tool up close to the cutting end
   e. None of the above answers are correct
7. It is necessary for the
   a. Cutting tool to have a handle
   b. Operator to check occasionally to see if stock has loosened between centers
   c. Operator to revolve the work by hand to check for obstructions before starting
   d. Teacher to check unusual or special set-ups

   e. Stock to be cut to a circular shape on the band or jig saw where possible
   f. None of the above answers are correct
8. When doing faceplate turning, make sure to
   a. Use small screws for large work
   b. Use nails for small work
   c. Use the correct type and size of faceplate
   d. None of the above answers are correct



Radial Arm Saw c. stock held firmly against fence
a. good stance d. hands clear of cutting path
b. eyes on work e. work area clear around saw path

Radial, Swing and Cut-Off Saw

Keep hands out and away from the direction of the saw. Cut only one piece at a time.

Hold stock solidly against the fence.

Get the instructor's approval before working special set-ups.

Stay at the machine when it is running.

Do not force the saw into the material faster than the saw is able to cut, maintaining normal operating RPM. Go slow through hard wood, knots and tough spots.

Inspect wood first to make certain there are no nails or foreign objects imbedded in the material.

Cut along stock only; the radial or swing saw is not intended for short pieces.

At the completion of each cut, return the saw to its position behind the fence. Lock it there to prevent its moving forward on starting.

Do not use the saw for wood with warp or wind, or which would be best cut with a hand saw.

Never reach into the track to remove scraps, sawdust, etc. Stop to clean, oil or adjust.

Secure the instructor's approval for work requiring other than a normal 90° swing, for radial saws.

Maintain proper physical and mental stance. Avoid nearby distractions while saw is running. Make certain no one working nearby can bump you and cause an accident. Look out for others in handling long pieces for sawing.

Keep all guards in proper positions.

Swing cut-off saws will be restricted by use of chain to stop the forward motion at the desired point. Chain will be inspected for wear and replaced when worn.

Avoid a tendency to measure boards with the saw running.

Allow the blades to coast to a stop. Cutting with power off may crack or warp the blade or cause it to heat and lose its temper.

Beware of the "bounce back" tendency. Return saws to rearward position slowly and carefully.

Clean, oil or adjust behind the saw only if the blade is stopped completely.

Always have the straight edge against the fence.

Hazards Pertaining Specifically to Radial Saws

Improper alignment of machine may cause binding, creeping or excessive vibration. Continuous inspection for correct alignment is recommended.

When using a dado head, ripping or crosscutting thick stock, the saw has a tendency to "ride up" or move forward without pulling. To cut thick hardwood, guide saw slowly and return carriage in the same manner.

When ripping, rabbeting or grooving, the blade is exceptionally open to the hands of the operator. If possible, rip, rabbet or groove thin stock (less than three inches) in some other way.

When making a second cut for a rabbet, a strip of wood cut loose may shoot back at the operator. To eliminate this hazard, hold down with a pusher board and always stand to the side of the cut being made.

Anti-kickback designs are not yet totally satisfactory (especially for student operation). When questionable, use jigs or other means to assist.

Make certain you have a thorough knowledge of saw operation, use of antikickback devices and safety guards.

When cutting large panels, the operator may tend to take a position which is in improper relationship with the saw. In this event, have a helper and an extended work surface so you are not placed in jeopardy.

Use of the shaper cutter is a dangerous operation. Use extreme caution and never back up the work or it may be thrown from your hands. Do not force the work or cut too deeply.

To rip, make certain the saw is locked into position.

Test – Radial, Swing and Cut-Off Saw

Multiple Choice

1. The cut-off saw is used after
   a. Inspecting the wood for nails or other foreign materials
   b. Removing the guard
   c. Unlocking the saw from its normal position
   d. None of the above answers are correct

2. Chips, scraps and sawdust are removed from the table by
   a. Use of compressed air
   b. A brush
   c. The hand or fingers
   d. A stick
   e. A rag
   f. Stopping the saw, waiting for the blade to stop turning and then brushing away the waste
   g. None of the above answers are correct

3. The radial or swing saw is intended for
   a. Long pieces
   b. Short pieces
   c. Both long and short pieces
   d. None of the above answers are correct

4. It is permissible to
   a. Cut more than one loose piece at a time
   b. Measure while the saw is running
   c. Apply more pressure to cut fast through knots, hard spots, etc.
   d. Keep the straight edge of the stock against the fence
   e. None of the above answers are correct

5. It is incorrect to
   a. Clean, oil and adjust while the saw is stopped
   b. Leave the machine while the saw is turned on
   c. Keep hands out and away from direction of saw travel
   d. None of the above answers are suited to the question

6. It is recommended procedure to
   a. Cut with the power turned off and the saw coasting
   b. Reach into the track to remove chips or small blocks
   c. Saw badly warped boards with a radial saw
   d. Seek instructor's approval for unusual, other than 90° cuts
   e. None of the above answers are correct

BAND SAW

Band Saw
a. good stance
b. hands in proper position
c. safety goggles in place
d. floor area clear
e. guard adjusted
f. apron neat

Band Saw

Students will not permit their hands to be placed "in line" with the intended cut or a possible cut.

Never allow fingers to come within two inches of the saw blade while cutting.

The saw guide should be adjusted when the blade is stopped to within ⅛ inch of the stock. Upper and lower guides must be properly adjusted. Cylindrical stock will not be cut unless a special jig is made and approved by the instructor.

Stock will always be supported against the downward thrust of the saw blade. Do not saw into toe of a long bevel unless the toe is on the table.

If the blade should break or bend, an adjustment loosen, or any other such occurrence, shut off the power and advise the instructor.

Do not stand to the right of the band saw machine. A broken blade can cause serious injury.

Restrain the urge to clean off small blocks with the machine in motion. If you must, use a long stick.

If the work binds, stop the saw and back out.

Keep your eyes and mind on the operation. Don't allow minor disturbances to distract you.

Beware of blades that "click." This is often a sign of a cracked blade which obviously must be repaired or replaced. This can also be a poorly ground weld.

Don't try to stop the machine by putting a block against the moving blade or make excessively tight cuts which may pinch or snap the blade.

Make certain there are no nails or other objects imbedded in the wood which the blade may strike.

Have proper light, good stance and sufficient elbow room to work.

Do not use band saws at temperatures of less than 45°.

For safe and efficient operation, keep the band saw wheels clean and free of sap, rum or resins.

Keep extra blades stored where they cannot fall or be otherwise injurious to persons coming into contact with them.

Stop the machine slowly when using the brake.

When stopped, check to see that the blade has proper tension.

Stand clear of the machine to start.

Use proper blade for work to be done; make certain the work is within the capacity of the machine.

Door type guards will be closed, all other guards in place.

Guard against the temptation to reach across, behind or in some peculiar relation with the blade.

Use flat wood rather than pieces with warp, wind, projecting knots, etc.

Make certain the table is free of all wrenches and objects other than the material being worked.

Adjust guides and other parts only when the machine is stopped and the power is off

Stop the machine when you leave.

Maintain a good hold on the stock. Don't tail the piece with only a thumb or finger.

Allow saw to reach its effective and proper operating RPM before cutting.

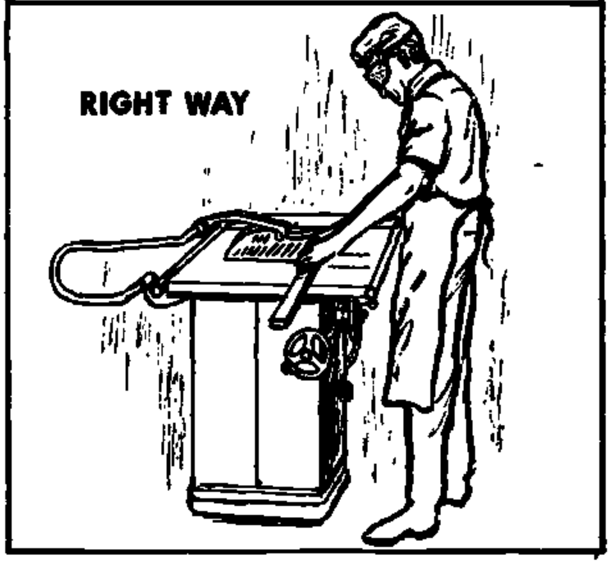
Band Saw
a. guard not properly adjusted
b. hands in line of cutting path
c. safety goggles not in place
d. floor safety zone cluttered up with wood

Test – Band Saw

Multiple Choice

1. When using the band saw, adjust the upper guide and guard before turning on the power to
   a. Just allow the stock to pass through
   b. Well above the stock so sawdust can escape up and out
   c. In the position it was last used by the instructor
   d. Either up or down, its position is not very important
2. To avoid possible injury from broken blades never stand
   a. To the right of the saw
   b. To the left of the saw
   c. Directly behind the saw
   d. None of the above answers are correct
3. The band saw adjustments should never be played with because
   a. Tampering causes unnecessary wear on threads
   b. It is a waste of your time
   c. The machine will be improperly adjusted when next used, with a possible accident as a consequence
   d. None of the above answers are correct
4. Irregular based stock and cylindrical stock will be
   a. Cut only after devising proper holding jigs or supports
   b. Cut only after completing "A" and securing instructor's approval
   c. Cut by adjusting the tilt-top table
   d. Cut by other means – not on the band saw
   e. None of the above answers are correct
5. To back out of a saw cut, always
   a. Stop the saw and then remove the stock
   b. Saw forward making an arc and proceed outward by cutting forward
   c. Back out slowly with the saw in motion
   d. None of the above answers are correct
6. If you hear a "click" it is a sign that
   a. The cutting operation is normal
   b. The blade is cracked and should not be repaired or replaced
   c. The teeth are cutting on the table insert
   d. None of the above answers are correct
7. Band saws should be stopped by
   a. Sawing into scrap
   b. Pinching the blade by sawing a sharp arc
   c. Use of the brake if so equipped, with gradual pressure
   d. By a sudden heavy foot on the brake
   e. None of the above answers are correct

Circular Saw



Circular Saw
a. good stance
b. apron very neat
c. eye protection in place
d. guard in proper position

Table Saw (Universal Rip and Crosscut)

You must secure permission unless authorized to do general sawing.

Always ask the instructor's advice for special work (dadoing, grooving, etc.).

The saw guard must always be in place on the saw except when the teacher has authorized its removal for special set-ups.

Adjust saw so the blade cuts through the stock but does not extend upward more than ⅛ inch through the stock.

Stop the saw and allow it to make a dead stop before adjusting, oiling or cleaning.

The splitter guard must be in place and raised above the table at least as high as the saw blade when you are ripping stock.

Use a push stick for ripping pieces 4 inches or less in width.

Freehand sawing (ripping without the fence or crosscutting without the sliding crosscutting fence) is forbidden.

Never stand directly behind the blade, stay to the left.

To rip short stock, the salvage should be to the left of the blade to reduce the possibility of kickback.

Never have your fingers in line with the saw cut. Develop safe habits.

Arch your fingers when feeding stock instead of laying your hands flat.

Reaching over the saw or passing wood over the saw blade is prohibited.

Saw blades with holes larger than the arbor will not be used.

Students will not clear scrap from the saw with fingers or hand. Use a stick approximately 24 inches long or a brush, after the saw has stopped rotating.

Do not cut cylindrical stock or other objects subject to rolling unless special cutting jigs are made and authorized.

Students with work to be lowered on a rotating saw will secure approval before engaging in this hazardous operation.

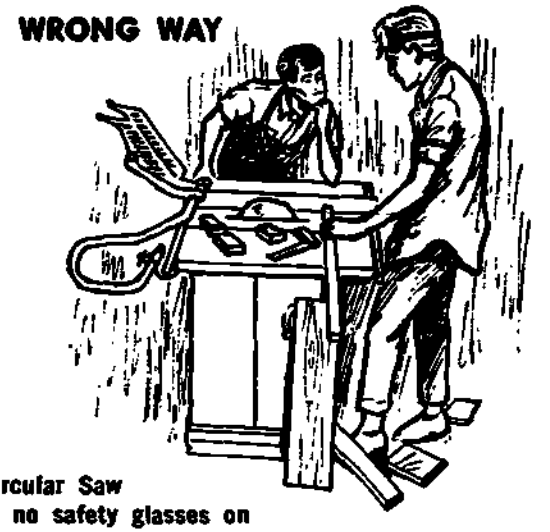
Make certain no fence, jig or other tool is in line with the saw cut before turning on the power.

Sliding or hinged tables will be kept locked except when being adjusted.

When helping to "tail-off" a helper will support and help maintain alignment; he will not pull the stock. The operator will push the stock.

Stop the saw if you must back out the work. To do so while running will tend to throw the wood toward you.

Make certain wood is in suitable condition for sawing, free of warp, wind, nails, paint, sand, etc.



Circular Saw
a. no safety glasses on
b. shirt tail out
c. apron not tied
d. guard not in place
e. blade too high
f. floor work area cluttered
g. eyes not on work
h. talking to friends
i. saw table cluttered

Inspect blade to locate cracks or other defects. Report any defects found. Check for wobble.

Fasten a clearance block to ripping fence when multiple cutting stock to length (when ripping fence is used as a gauge).

Stop the saw and move out of the operating zone before responding to anyone who seeks your attention.

Feed stock only as fast as the saw will freely cut.

Reset saw adjustments to a normal position when completing an operation requiring a special set-up.

Use the correct saw blade for the operation you wish to accomplish.

Don't make the power saw do a job that would best be done with a hand saw.

Make sure the edge which runs against the rip fence is smooth and true when ripping.

Make sure you know exactly what you want to do and how you are going to do it before starting the cut.

To rip narrow stock, cut half way from one end, turn the board around and rip from the opposite end.

Balance your weight evenly on both feet when sawing; proper stance helps avoid accidents.

Never operate a saw other than its rated speed. Belt tension should be correct. A correct sharp saw will sing through its work.

Store spare blades where there is no danger of accidental contact with other blades or students.

Avoid sawing pieces so small that you cannot exercise proper control.

Adjust the fence only when the saw is at a complete stop.

Be careful not to bump others at potentially dangerous machines in person or with materials you are sawing.

Be aware of others around you, but keep your mind on your work.

Grip long pieces firmly and press on short pieces enough to eliminate a chance of the stock "getting away."

Never have the hand above the blade – as in grooving.

Allow the saw to reach its operating RPM before starting the cut.

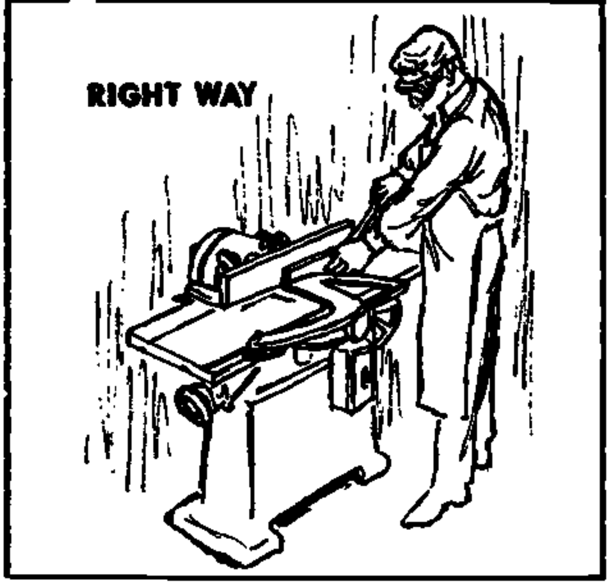
Fasten a clearance block to the fence when cutting off short pieces of block.

Test – Table Saw
Multiple Choice

1. When sawing the circular saw blade should not reject through the stock more than
   a. 1 inch
   b. ½ inch
   c. ¼ inch
   d. ⅛ inch
   e. None of the above answers are correct
2. A push stick should be used when you are
   a. Removing scrap
   b. Ripping short or narrow pieces
   c. Turning the switch on or off
   d. making adjustments
   e. None of the above answers are correct
3. Freehand cutting (cutting without the aid of a rip fence or crosscut guide) is
   a. Permitted when stock is too large for the table
   b. Permitted if the operator has assistance
   c. Never permitted because it is dangerous
   d. Generally accepted practice because it is fast
   e. None of the above answers are correct
4. Assistants who help with "tailing off" should remember
   a. To support the work from underneath but not to grasp it
   b. To pick up all tailings which might cause an accident
   c. To hold the stock firmly and gently pull it through the saw
   d. To hold the two pieces close together as you pull
   e. None of the above answers are correct
5. We never back the work out of the saw
   a. Without first making sure chips and sawdust behind the wood has cleared away
   b. Without first turning off the power and waiting for the saw to stop turning
   c. Without first removing the fence or crosscut guide
   d. Without giving a signal for assistance
   e. None of the above answers are correct
6. The saw guard must always be in place over the saw except
   a. When cutting large stock
   b. When short pieces tend to get caught under the guard
   c. When the teacher has authorized its removal for special set-ups
   d. When using wide dado heads
   e. None of the above answers are correct
7. When you crosscut pieces of equal length
   a. A clearance block must be fastened to the rip fence
   b. Use care to insure all pieces are of equal length
   c. Use the crosscut guide and the fence to guide the stock
   d. Measure and mark each piece individually and cut separately
   e. None of the above are correct
8. When using the saw, the operator will stand to the
   a. To the rear of the saw
   b. Right of the saw
   c. Left of the saw
   d. In any of the above positions
   e. In none of the above positions
9. When you are ripping, the waste shall be
   a. Toward the ripping fence
   b. To the left of the blade
   c. On either side

10. If it is necessary to clear the table of lumber scraps while the saw is revolving, you must
    a. Use the brush
    b. Use the hand
    c. Use the push stick
    d. Use a stick about two feet long
    e. Not use any of the above listed items

JOINTER



Jointer
a. good stance
b. work area clear
c. using pusher stick
d. stock at least 12" long
e. apron neat
f. eye protection in place

Jointer

Use only clean wood, free of sand and paint, nails or other materials.

Inspect for cracks, loose knots, warp, wind or other defects.

Always see that a guard covers the knives.

Never use the jointer for work which is less than four times the width of the bed opening and never less than 12 inches in length.

Take a smaller cut for hardwood than for softwood and never over ⅛ inch.

Use a push stick, wooden mitten or pusher block which is appropriate to the job.

Seek approval from your instructor for set-ups involving stop-cuts, beveling, tapering, chamfering, rabbeting or other unusual work.

Keep hands and fingers at a safe distance from the revolving knives.

Hands must be above the material; fingers or hands will never extend down over the top of the fence when the push stick is not being used.

Feed the stock slowly – consider the grain, depth of cut and kind of wood.

No stock less than ¾ inch should be faced on the jointer.

Allow the material to pass the knives far enough so the guard will close before you pick up the stock.

Clean, oil and adjust with the power off and the knives stopped.

Students will not adjust the rear table unless authorized.

End grain jointing is dangerous, especially for small pieces. Use a plane and work by hand. For large panels, get instructor's approval.

Acquire the proper stance. Keep your mind and eyes on your work.

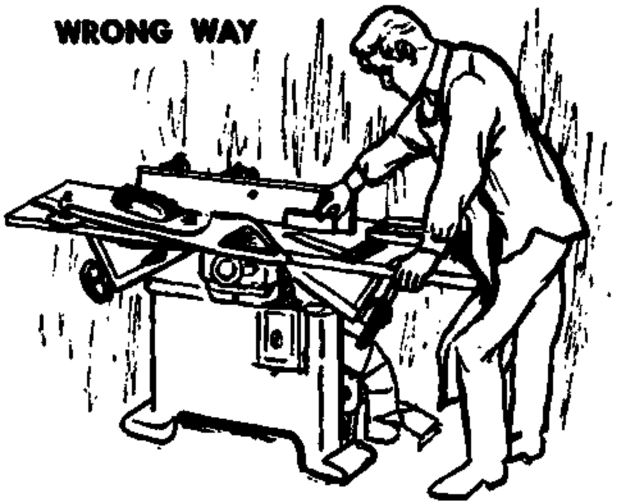
Stand to the left of the machine when turning on the power. Allow the machine to reach full operating speed for a few moments before starting the work.

Advise the instructor if the machine vibrates. Dull knives or improper balance can cause kickback or other unsafe conditions.

Avoid standing directly behind the stock. Stay to the left.

Never lean things against a jointer or pile wood or other tools on the table.

Make certain you have good control of the material you are handling.



Jointer
a. shirt tail out
b. apron sloppy
c. tools on table
d. Standing in wrong position
e. stock too short
f. no pusher stick

Scrapers

Scrapers in the hands of inexperienced students can be hazardous.

Keep scrapers sharp so they cut instead of slipping.

Place in racks where corners or edges are covered.

Hand Saws

Keep saw teeth when not protected in use so they do not cut others.

Use proper cutting techniques when using hand saws or hack saws.

Test – Jointer

Multiple Choice

1. Always set the fence
   a. As close to the operator as the stock will permit
   b. As far from the operator as possible
   c. At any position on the table
   d. None of the above answers are correct
2. The operator should keep hands
   a. On top and at the rear edge of the board
   b. At the top and sides of the piece being pushed
   c. Above material, without extending fingers or hands down over front or rear edge of the material
   d. None of the above answers are correct
3. The operator will
   a. Travel with the work, when feeding long boards
   b. Stand to the right of the machine to feed the work
   c. Clean, oil and adjust with the machine in operation
   d. Not travel with the work, but will work from a position beside the front table to the left of the machine
   e. None of the above answers are correct
4. Before picking up the finished stock, always
   a. Shut off the power and wait for the machine to stop running
   b. Put on gloves
   c. Allow work to pass the knives far enough to permit guard to close
   d. Make the next adjustment for depth of cut
   e. None of the above answers are correct
5. It is poor practice to
   a. Run material less than two inches thick
   b. Allow at least two fingers to ride over the top of the fence
   c. Advise the instructor because the machine vibrates
   d. Joint the end grain on small pieces
   e. None of the above answers are correct
6. When you are facing work, you should
   a. Exercise caution
   b. Use a feather board for safety
   c. Take a light cut and use a mitten
   d. Remove the guard
   e. None of the above answers are correct
7. Material to be faced which is warped must
   a. Not be worked on the jointer
   b. Be free of knots, cracks, sand, paint, and nails
   c. Be at least ¾ inch thick and 12 inches long
   d. Be worked only by your instructor
   e. None of the above answers are correct
8. The out-feed table or rear table adjustment is made
   a. Only by the teacher
   b. Whenever thickness of cut is to be changed
   c. When the machine is operating
   d. None of the above answers are correct

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Place in racks where corners or edges are covered.

Hand Saws

Keep saw teeth when not protected in use so they do not cut others.

Use proper cutting techniques when using hand saws or hack saws.

WHITE
Please mail to:
Statistical Section
Division of Safety and Hygiene
700 West Third Avenue
Columbus 12, Ohio

BUFF
For your Building's Administrator's File

GOLDENROD
For Instructor's File

The Industrial Commission of Ohio
Division of Safety & Hygiene
700 W. Third Ave.
Columbus 12, Ohio

STUDENT INJURY REPORT

NOTE TO SCHOOL SHOP INSTRUCTOR

The purpose of this injury report is to enable the Industrial Commission of Ohio, Division of Safety and Hygiene, to compile injury statistics on a state-wide level, for all students sustaining personal injury while in the course of school shop activities.

This report is not intended to pinpoint the shop injury experience of any particular school unit, but rather, to enable those charged with the responsibility of accident prevention in this particular field to evaluate the over-all effectiveness of the Ohio school shop accident prevention program.

GENERAL INSTRUCTIONS

1. Complete this report for all school shop accidents that are reported to the Industrial Arts Teacher and result in personal injury to the student involved, regardless of whether or not the student was absent from school as a result of the injury.
2. When a pupil is still absent at the end of the first semester as a result of accidental injuries, this report should be retained until the student returns to school, recording the number of school days lost in the space provided.
3. When a pupil is still absent at the end of the school year as a result of accidental injuries, the report should then be submitted counting the school days lost to the end of the school year.
4. Please be specific and complete every phase of this report.
5. The completed "Student Injury Report" should be submitted as soon as possible following the accident to—The Industrial Commission of Ohio, Division of Safety and Hygiene, 700 W. Third Avenue, Columbus 12, Ohio.

Student's Age ____ Sex ____ Grade ____

County in Which School is Located ____

Date of Injury . Month ____ Day ____ Year ____

DESCRIPTION O ACCIDENT (Be specific What was student doing? How did accident occur?)

TYPE OF SHOP (Check On ,

Drawing ☐
Graphic Arts ☐
Wood Shop ☐
Industrial Crafts ☐
Machine Shop ☐
Sheet Metal Shop ☐
Welding Shop ☐
Foundry ☐
Forge Shop ☐
Electricity ☐
Automotive ☐
General Shop ☐

Other Type Shop ____

Total Student Enrollment in Class Where Injury Occurred ____

NATURE OF INJURY (Be specific Lacerated index finger, amputated one-third middle finger, fractured toe, etc)

Did injury become infected? ☐ Yes ☐ No

Number of days absent from school as a result of injury ____

Was injury treated by doctor? ☐ Yes ☐ No

Number of semesters student has participated in school shop training ____

DO NOT WRITE IN THIS COLUMN
AGE
SEX
GRADE
GEO. LOCATION
DATE REPORT FILED
DATE INJURY
LAG TIME
TYPE SHOP
STUDENT ENROLL.
AGENCY
TYPE OF ACCIDENT
NATURE OF INJURY
PART OF BODY
INFECTION
DEGREE OF INJURY
DAYS LOST
PROF. TREATMENT
SEMESTERS
CODED BY

THE DIVISION OF SAFETY AND HYGIENE
The Industrial Commission of Ohio
IN CO-OPERATION WITH THE
STATE OF OHIO
DEPARTMENT OF EDUCATION

BOB DOTY-

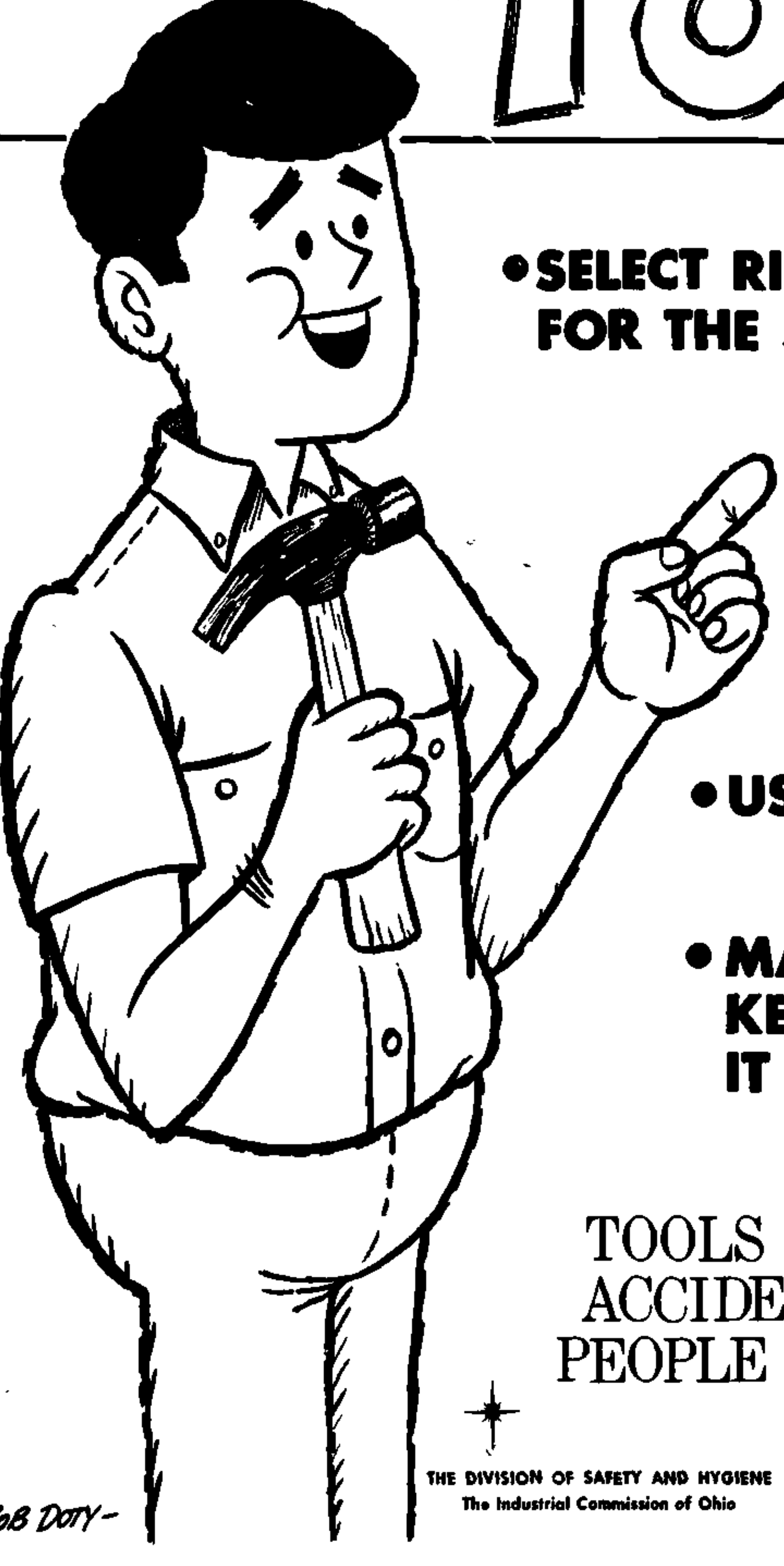
CLEAN UP WET OR GREASY SPOTS PROMPTLY!

GUARDS CAN [illegible]

SAVE YOURS

THE DIVISION OF SAFETY AND HYGIENE
The Industrial Commission of Ohio
IN CO-OPERATION WITH THE
STATE OF OHIO
DEPARTMENT OF EDUCATION

SAFE RULES for... TOOLS



- **SELECT RIGHT ONE FOR THE JOB.**
- **KEEP IT IN <u>GOOD</u> CONDITION.**
- **USE IT CORRECTLY.**
- **MAKE SURE IT'S KEPT WHERE IT BELONGS.**

TOOLS DON'T CAUSE ACCIDENTS!-IT'S THE PEOPLE WHO USE THEM.

BOB DOTY-

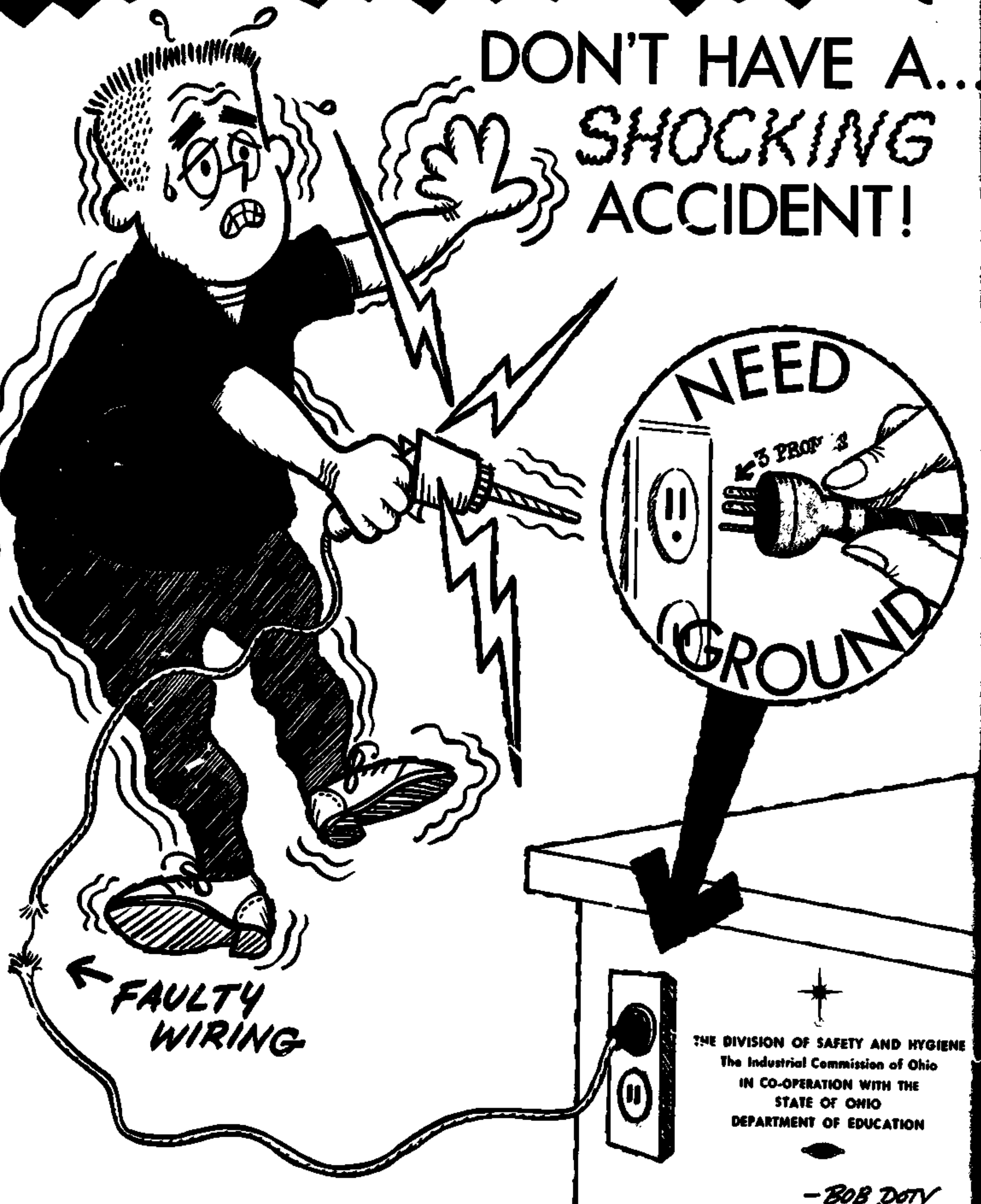
THE DIVISION OF SAFETY AND HYGIENE
The Industrial Commission of Ohio

IN CO-OPERATION WITH THE

STATE OF OHIO
DEPARTMENT OF EDUCATION

GROUND-IT!

DON'T HAVE A...
SHOCKING
ACCIDENT!



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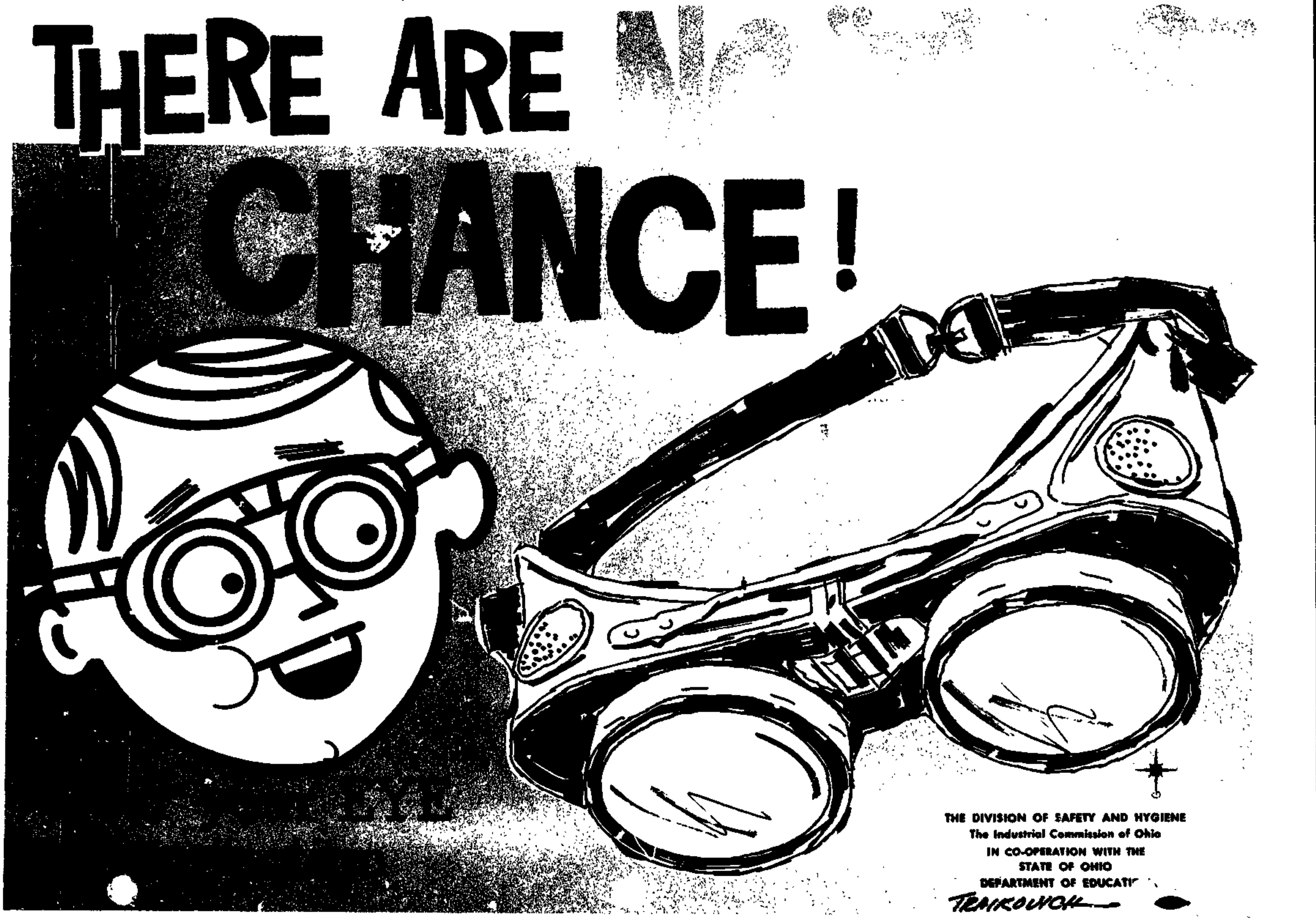
—BOB DOTY



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TRAIKOVICH

GOOD

HOUSEKEEPING MAKES...

GOOD WORK

GOOD GRADES

GOOD SENSE

THE DIVISION OF SAFETY AND HYGIENE
The Industrial Commission of Ohio
IN CO-OPERATION WITH THE
STATE OF OHIO
DEPARTMENT OF EDUCATION

MONITOR

DIVISION OF SAFETY AND HYGIENE
THE INDUSTRIAL COMMISSION OF OHIO

AUGUST
"19-SAFETY-6"

INDUSTRIAL ARTS SAFETY
...A BRIGHTER FUTURE

See Editorial...Page 3

MONITOR

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THE DIVISION OF SAFETY AND HYGIENE

[illegible]

Printed under the administration of
Hon. James A. Rhodes, Governor

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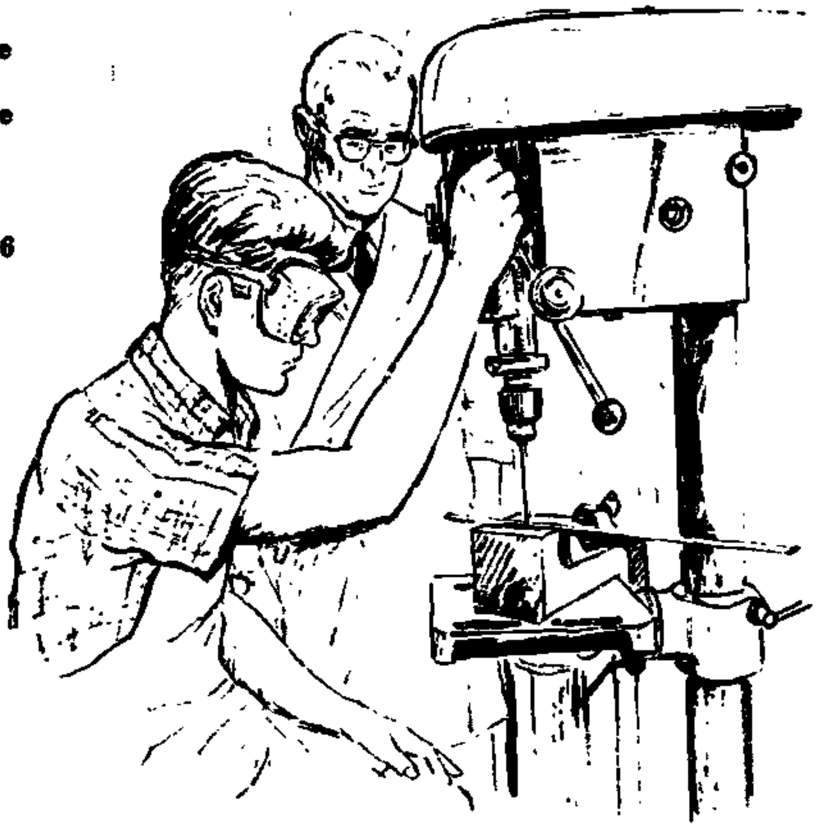
THE WAY THEY SHOULD GO

"Train up a child in the way he should go and when he is old he will not depart from it."

Proverbs 22:6

by M. Holland Krise, Chairman, The Industrial Commission of Ohio



An Editorial . . .

Ohio's Division of Safety and Hygiene believes that in order to establish an attitude of safety awareness in its people, indoctrination must begin early. The first step in this direction is being taken.

New Shop Safety Program Ready

A new Industrial Arts and Vocational Education Safety Program at the high school level will be ready for distribution to Ohio schools before the fall term. The new program consists of a Manual, with illustrations, covering on-the-job safety in the following areas:

1. Drawing
2. Graphic Arts
3. Wood Shop
4. Industrial Crafts
5. Electricity and Electronics
6. Automotive
7. *Metals*:
    - Welding & Forge
    - Sheet Metal
    - Machine Shop
    - Foundry
8. General Safety

Some 3,000 teachers and instructors concerned with the above courses will be furnished the program.

Appropriate Wall Posters Supplement Manual

A series of six attractive shop wall posters has been designed to provide constant safety reminders related to information in the manual. The colored posters are done in a style to appeal to students.

Safety Carry-Over To Industry Is Goal

Not only is the program designed to provide an immediate benefit but also to carry safety awareness over to industry later.

Students will know, right from their first jobs, if safe practices are being followed, if proper guarding and personal protective equipment are provided and if there is adequate fire safety. Further, the job of safety orientation for new employes will be lighter on the employer.

How the Program Was Created

In past years the Division of Safety and Hygiene conducted a shop safety poster contest for schools but it was felt that, while certain benefits were derived, there was not sufficient continuity nor solid safety information being distributed in an effective and organized manner. In view of this, a Committee composed of some 25 instructors from over the state, members of the Division of Safety and Hygiene and Ohio Department of Education was formed to develop, write and produce an effective, continuing program.

Ohio's Program Is First In the Nation

The results of the work of this Committee have made Ohio's school shop safety program unique and first of its type in the nation. It will be furnished to schools in Ohio without charge.

The Division's next step is to develop similar effective programs for all educational levels.

LET US TRAIN THEM IN THE WAY THEY SHOULD GO!

For further information contact:

Division of Safety and Hygiene
700 West Third Avenue
Columbus, Ohio 43212

You wipe the perspiration from your forehead, shield your eyes from the blinding sun and take a long soothing swallow of tangy, iced soda pop. You stare through the store window at a beautiful body. A gleaming red and white beverage truck pulls in and a uniformed driver starts unloading more cases of pop. You inquire where the body beautiful is from—Timmons Metal Products Co.—Timpco—845 Harrisburg Pike in Columbus.

You get permission, and start to enter the plant. A gray-haired man wearing glasses stops you, points to a white, red-lettered sign on the plant entrance door and hands you a pair of safety glasses. The sign reads: DON'T FORGET SAFETY GLASSES.

Inside there is a flurry of activity—truck beds and huge metal bars being hoisted, grinding of metal, spewing of blow torches and foremen giving instructions above the din. You smell burning metal and welding fumes. You watch them take drab sheet metal and transform it into a beverage truck body that is a work of art.

"Tremendous" Accident Rate Cut "65%" in 13 Months

The thing that impresses you most—next to this incredible transformation—is the amazing number of workers who are wearing eye protection. "Do all these men have bad eyes?" you ask a blond young foreman. "No, most of them are wearing safety glasses, prescription safety glasses, or glasses with snap-on safety lenses."

Administrative Assistant E. W. Burwell says: "From March 1, 1965, when we started our Safety Program, to the end of March, 1966 we reduced our accident rate more than 65 per cent. We had the necessary guards on machines and other equipment, but we were having a tremendous amount of eye injuries—flash burns from welding; getting pieces of slag in the eye, or steel from the grinding-down operation, etc.

"Our president, Mr. K. K. Timmons, one of the founders who started the business about 20 years ago, is a humanitarian. He feels that when a man is hurt it affects the whole family; he's very much behind our Safety Program."

Issuing Eye Protection A Big Step In Stairway to Safety

"So we issued eye protection, free of charge," Mr. Burwell continues, "to all employes who needed it—safety glasses, special goggles, etc. And we insisted that they wear the eye protection, not only on the job, but when they went near other work areas in the plant."

You want to know how they got such good cooperation from the employes.

"We told our foremen or lead men it was their responsibility to see that their men wore eye protection, and that other safety conditions were met.

In well lighted area, cutoff saw operator A. Dempsey holds metal bar securely by pressing pedal with his foot—pedal is attached to one end of heavy chain; the other end of chain is securely fastened, and hooked over metal bar he is cutting. Cutoff saw is well guarded; Dempsey is wearing prescription safety glasses, plastic face shield, gauze mask and protective gloves and apron. Sign in upper left corner reads: "NO ONE PERMITTED TO USE TNIS MACHINE UNLESS SO DESIGNATED."

W. Booker, wearing coveralls with upturned collar, gauze mask, safety glasses and head covering, undercoats beverage-truck body, a Timpco product.

The plant displays many safety signs and slogans. Here is one example.

Fred Blackburn, wearing safety glasses, uses remote-controlled cable hoist to move stacks of sheet metal.

Paint-storage building is kept locked when not in use, and is a "NO SMOKING AREA," as indicated by red-and-white sign above door.

"The Union was more than willing to cooperate in our Safety Program," Burwell says. "We met monthly with a Union Safety Committee.

"We have our men work in teams, not alone."

Getting Some Employes To Work Safely Requires Pressure, Work on Emotions

Burwell explains that the same people were having accidents; that when an employe had two accidents "we would have our plant superintendent write to the foreman to watch the employe—also to say to the man, 'Look, you've got to be more careful; you don't want your family to suffer because you lose an eye, or both eyes.'

"We also advised the Union to watch him. The Union Stewards would say to him, 'You be careful, because the fellow working next to you might get hurt.'

"And we saw that the man who worked with him told him, 'I want you to be careful, because I don't want anything to happen to me.' "

Burwell says Timpco's Safety Program "represented a concentrated effort—every day we concentrated on it . . . and we're still pushing constantly."

Timpco insisted that ALL accidents be reported, and that accident reports be filled out completely. The company found out *why* and *how* the accidents occurred, and took measures to prevent similar occurrences.

"We had to watch our men carefully," says Burwell, "because they did not want to report a slight scratch on the hand, for example."

New Employes Need Training In ABC's of Safety

Burwell brings up another safety problem: "Our personnel has increased about 100 per cent—we have some 246 employes now—but the new employes are the ones we have to worry about.

"We use the Division of Safety and Hygiene's safety programs and signs, also the Kelly Reed Program; we plastered the place with safety signs and slogans."

Regarding fire safety Burwell says, "We haven't had any fires but we're ready for them. We watch constantly that things which cause fires don't develop."

Employes Rewarded For Accident-Free Work

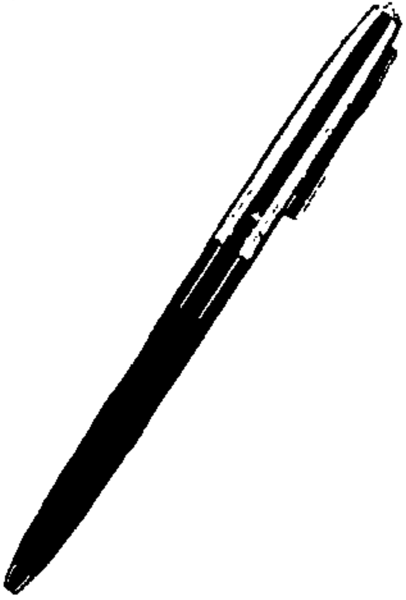
In an effort to keep employes constantly aware of safety, and to help motivate them safety-wise, Timpco started a Safety Award Program. Some of the employes wear eye-catching, half-dollar size green, white and silver "SAFETY AWARD" badges—with a white cross in the center; several have attractive gold and maroon "SAFETY AWARD" pens.

(Continued on next page)

Acetylene cylinders and oxygen cylinders are chained to wall.

Oxygen and acetylene tanks are capped and stored outside the building, chained to the wall; full tanks are kept separated from empties.

When employes at Timpco see something that can cause accidents, they correct it immediately. Here Harold Seymour cleans up paint that has just been spilled—so no one will slip and fall.



Gold-engraved, maroon and gold ball-point pens were given to employes who worked for one year, from the time the Safety Program was started, without an accident.

Employes who worked six consecutive accident-free months received green, white and silver badges like this one—safety awards that they would be proud to wear at work.

At Timpco's First Annual Safety Award Dinner, "SAFETY AWARD" pens are presented to oldest employes, from point of service; they have worked there for a combined total of more than 80 years. The pens are awarded for having worked one year without an accident—from March 1, 1965 to March 1, 1966. Plant Superintendent Carl Helmbrecht (second from left), is presenting the awards. From left to right are Bob Stump, Sup't Helmbrecht, Ray Harris, Dick Mathews and Bill Timmons.

(Continued from page 5)

Also at Safety Award Dinner, K. K. Timmons, Timpco President (extreme right), has just presented "SAFETY AWARD" pens to some of the other employes who have worked the previous year without an accident. From left to right: Odas Nelson, Herman Westfall, Ben Sparks, Carl Smith and President Timmons.

Any employe who worked six months without having a reportable accident received one of the safety-award badges; if he worked safely for one year he was awarded the gold-engraved ball-point pen.

Employes who worked one year accident-free were also treated to a buffet dinner—they could bring their wives. Fine door prizes were given.

Timpco plans to reward safe-working employes with even nicer gifts, and more buffet dinners in the future.

Now the only thing the rapidly growing plant needs is space, Burwell says, and a new plant is going to be built.

Quick Action Prevents Accidents

On your tour of the plant with Personnel Manager Irvin Taylor, you freeze in your tracks, in spite of the heat. A man is bent over a lake of blood-red liquid on the floor. What a terrible accident! you think. But as you approach you see him mopping up just-spilled red paint with a rag, so no one will slip and fall.

One of the many safety signs in the plant is illustrated, and reads "FUNNY? JOKES THAT CAN INJURE OTHERS ARE NO JOKE."

Another—a green, black and white pictorial sign on machine guarding: "ON GUARD—MEANS SAFETY"; still another shows how to "LIFT SAFELY."

Mr. Taylor points out guards on machinery, and workers wearing various types of personal protective equipment. "Now, everyone is pretty conscientious about our Safety Program," he says. "Nobody wants to get hurt.

"When a machine breaks down we put a ('DO NOT USE') red tag on it; nobody uses it until it is repaired, OKd and the red tag removed.

"Also, for safety, our chain hoists are inspected at least twice a week by the Maintenance Department."

If Someone Stops Breathing . . .

Just inside the plant entrance door, in a closed container is a Brook Airway "for use in emergency mouth-to-mouth resuscitation without mouth-to-mouth contact—on victims over four years of age." Taylor explains that the airway is for use in cases of "stoppage of breath due to heart attacks, shock, etc.," and that Timpco has six of these airways in the plant. Civil Defense left them for the plant after giving a three-day resuscitation course to three foremen and nine safety men at Timpco—using a "Resusci-Anne" manikin. Those who took the course were "all enthused" about it; it might enable them to save lives, maybe the lives of their children.

Another Beautiful Body

"Our project engineers design Timpco products from the ground up," says Taylor. "Very low chassis go through here—low for driver comfort and safety—and to facilitate loading and unloading; the driver does not have to climb up so high or down so far."

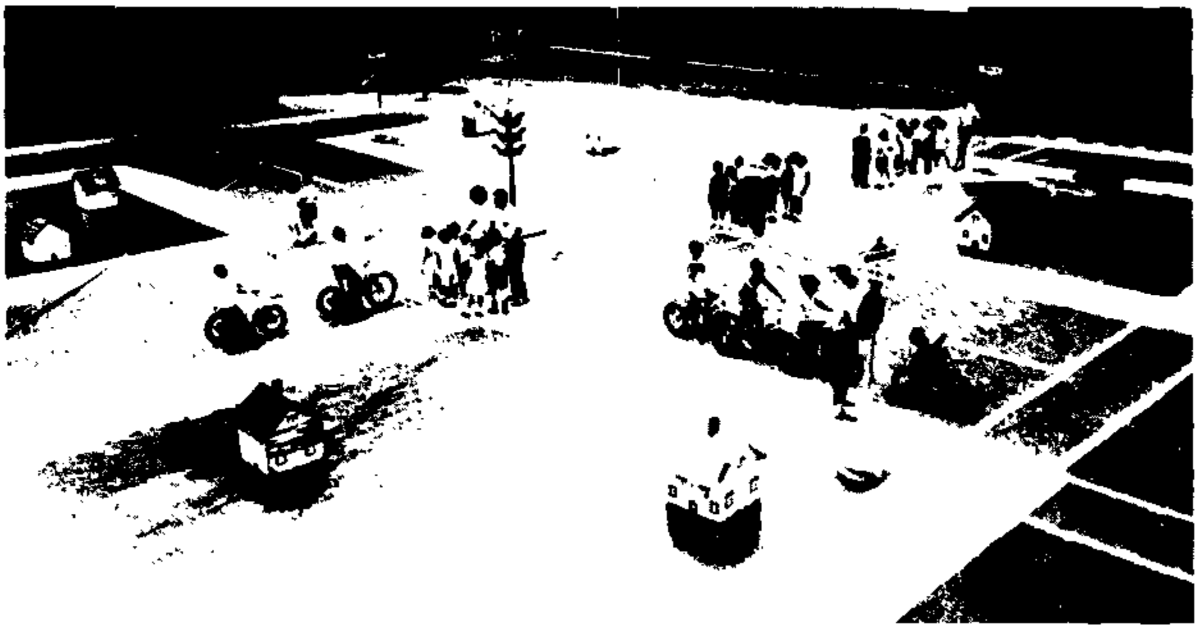
Once more you admire a long, low, shiny fire-engine red beverage truck body with yellow wheels—thankful that Timpco workers are able to create such beauty in safety.

You leave the burning-torch artists and walk once more under the blazing sun to the grocery store. As you drink another bottle of bubbly ice soda pop, a long wolf whistle comes from the young clerk. You look out the window and see . . . another beaooooh! tiful body!

A.S.S.E. CONFERENCE SET

The American Society of Safety Engineers will hold its 5th Annual Conference Monday, Oct. 24 at the Sheraton-Chicago Hotel, Chicago, Ill. The Society's Annual Meeting and Awards Luncheon will also be held on the same day in the Sheraton-Chicago Hotel. For details write to A. C. Blackman, Managing Director, American Society of Safety Engineers, 5 N. Wabash Ave., Chicago, Ill. 60602.

TINY DRIVERS AND WALKERS IN 'SAFETY TOWN' WILL HELP CUT TRAFFIC ACCIDENT TRAGEDIES



In Mansfield's "Safety Town," some prospective first-graders learn traffic safety as they ride tricycles—simulating motor vehicles—through a miniature town; other tots are taught pedestrian safety. Mansfield started "Safety Town" in 1937, and has helped other cities and towns start similar projects.

In the never-ending attack to cut traffic-accident tragedies, a different approach to traffic safety must be used with pre-school and kindergarten children—an approach that is both didactic and demonstrative, to bring full dramatic focus on the young mind.

Ingenuity in its citizens, its police department and its schools has placed Mansfield in the forefront in the nation, in providing a tangible plan to meet the particular approach and needs of these younger children. It is called "Safety Town."

Traveling to and from school is a big part of a child's school day. It is therefore essential for children to learn safety rules *before* they attend school.

"Just as the twig is bent, the tree's inclined" (Pope, in "Moral Essays") . . . this quotation could be said to be the theme and basis for "Safety Town." It is set up to teach or school prospective first graders in traffic safety and safety in general. The school authorities, health department and the city police department cooperate in the project, with the Police Traffic Department operating the school.

With the officers in uniform, the children soon learn that a policeman is their friend and guardian.

The school creates interest and imparts safety knowledge and training that will be valuable to the children for a good while to come. It is basic training that comes when the recipient is eager, alert, learns fast and retains what has been taught. Also, he has not acquired habits that must be corrected.

Taken from

A Guide for a Program to Meet the Needs of Traffic Safety for Ohio's Younger Children . . .

Advanced by Ohio Department of Highway Safety

James A. Rhodes — *Governor*
Warren C. Nelson — *Director*

History of "Safety Town"

"Safety Town" was founded in 1937 in Mansfield by Frend Boals, the first mounted traffic police officer there, and has been operated every summer since. It is now an established function of the city and its government. It is still open for improvement suggestions. It is amply financed by grants from city funds, Police Recreation Club donations and other sources.

Officer Thomas C. Hempfield, of the Mansfield Police Department, was in charge of "Safety Town" there for the 15 years prior to his retirement in 1965. Captain James J. Goldsmith has been in charge since last December.

Captain Goldsmith says that "Safety Town" has definitely contributed to the reduction of traffic accidents involving Mansfield's school children.

Dedication and Credits

Citizens of Mansfield say: "We are proud of and grateful for our 'Safety Town.' We have helped others in starting ones in their communities, and are only sorry that more towns and cities don't have them. We want only to share."

Warren C. Nelson, Director of the Ohio Department of Highway Safety, says: "Our state, this Department . . . all citizens of 'This Wonderful World of Ohio' are proud of this pioneering and pace-setting program of Mansfield and its agencies and leaders, who have helped develop 'Safety Town.' We are therefore proud to have a part in disseminating information of this vital traffic safety program through this preparation.

"So, to the citizens of Mansfield, to other 'Safety Town' cities in Ohio, to all little children everywhere . . . our state and Department dedicate this preparation as a guide to 'Safety Towns' in all of our communities.

"For information and material about Mansfield's 'Safety Town,'" Director Nelson continues, "we are indebted to Frend Boals and Thomas C. Hempfield and the city's Police Department; to the Honorable Paul Bush, its Mayor; and particularly to George H. Calhoun, Retired Field Representative of The Industrial Commission of Ohio's Division of Safety and Hygiene, member of national Veterans of Safety, and an indefatigable worker for a vital public cause."

Suggestions for Successful "Safety Town"

Since "Safety Town" is usually operated on school and public playgrounds during the summer, schools

(Continued on page 14)

STUDENTS WORKING IN SCHOOL
AND SAFER IN INDUSTRY LATE

Ohio schools will have a new, effective Industrial Arts and Vocational Education Safety Program at the high-school level, starting this fall.

Last October 22 a Committee—consisting of Ohio teachers, and members of the Ohio Department of Education and the Division of Safety and Hygiene—met in Columbus to start work on this Safety Program. The material illustrated here is the result of their combined efforts. Most of the members of that Committee are pictured above. Present for the meeting were:

Edgar Hare—State Department of Education, Columbus; Ray Mangus and Howard C. Ater—Chillicothe High School; .Frank Darling—Mt. Logan Junior High, Chillicothe.

Stan Spring—Circleville High School; Glenn Botdorf—Bedford Senior High School; George Swindell and Eugene P. Rannigan—Canton Public Schools; Dorwin J. Laessle—Sandusky Public Schools; Robert Poling—Lancaster Public Schools; John C. Vair and Robert A. Banzhaf—Kettering Fairmont East High, Kettering; Wallace Barry—South High School, Akron; Jerry M. Froebe—Kenmore High School, Akron.

James Reynolds—Dayton Public Schools; Ted Wiley—Paul Laurence Dunbar High, Dayton; Joseph Sposato—West Junior High School, Youngstown; Dennis Zinz—Volney Rogers Junior High, Youngstown; William Jas. Burns—Toledo Bowsher High School, Toledo. The following members from the Division of Safety and Hygiene are also in the picture: William S. Coulter and Arthur W. Moon.

The purpose of the Safety Program is two-fold in that it is designed to aid in instructing students in on-the-job safety and thus protect them while they are learning, and to create and instill an awareness and concern for safety that will carry over into industry later on.

The Safety Program will consist of an illustrated Manual covering safety on-the-job in the following areas—those who prepared the different sections are also listed:

(1) DRAWING
Frank Darling and Joseph Sposato
(2) GRAPHIC ARTS
Robert Banzhaf, George Swindell and Eugene Rannigan
(3) WOOD SHOP
Wallace Barry and Jerry Froebe
(4) INDUSTRIAL CRAFTS
Glenn Botdorf and Howard Ater
(5) ELECTRICITY and ELECTRONICS
William Burns, John Vair and Ray Mangus
(6) AUTOMOTIVE
William Harsh of Hilliard, and Stan Spring
(7) METALS
Welding & Forge, Robert Poling
Sheet Metal, Dennis Zinz
Machine Shop, Ted Wiley
Foundry, Dorwin Laessle
(8) GENERAL SAFETY
James Reynolds

A series of six colorful, eye-catching shop safety posters, pertaining to material in the Manual, will also be distributed to all Industrial Arts and Vocational Education teachers in Ohio.

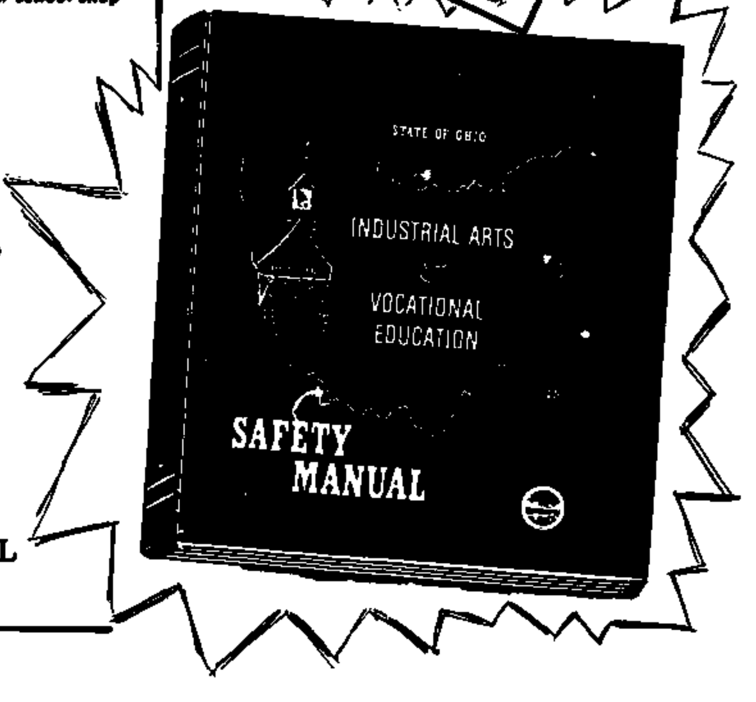
For further information contact:
Division of Safety and Hygiene
700 West Third Avenue
Columbus, Ohio 43212

[illegible] SAFER NOW,
AT • • •

by Thomas W. Gallagher, Sup't, Division of Safety and Hygiene

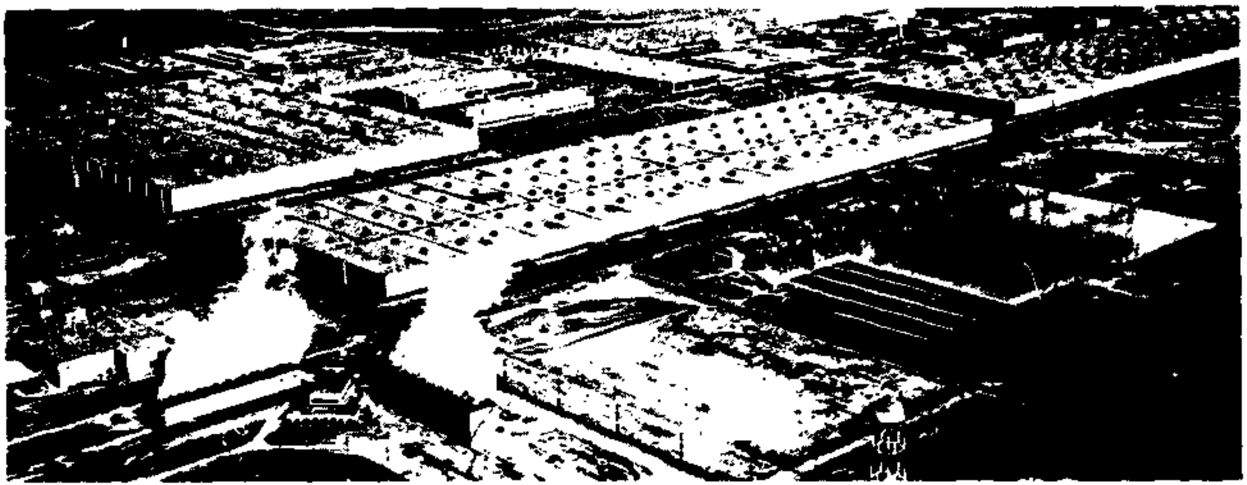
Typical shop safety posters supplementing Manual in new school shop Safety Program.

OHIO'S
NEW INDUSTRIAL ARTS
&
VOCATIONAL EDUCATION
SCHOOL SHOP SAFETY MANUAL

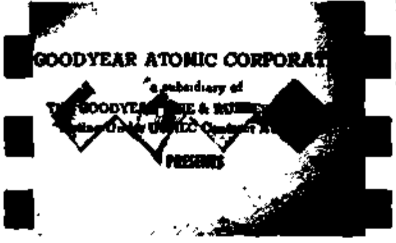


GOODYEAR ATOMIC WAR ON ACCIDENTS CAPTAINED BY COMPANY-UNION SAFETY REVIEW COMMITTEE

The following narrated sound-slide presentation, developed for Goodyear Atomic Corp. employes, may serve as a guide for your business.



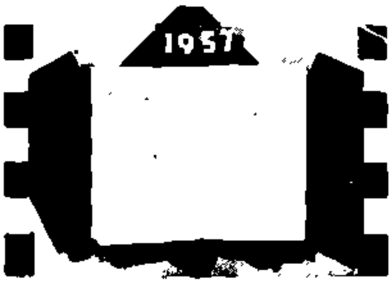
AERIAL VIEW OF GOODYEAR ATOMIC CORPORATION'S PLANT AT PIKETON



(5 SECONDS OF MUSIC)

THIS PROGRAM HAS BEEN DEVELOPED TO REMIND YOU OF A UNIQUE UNION-MANAGEMENT AGREEMENT—WHICH AT THE TIME OF ITS CONCEPTION REPRESENTED ONE OF THE FIRST ATTEMPTS OF UNION AND MANAGEMENT IN AN ATOMIC ENERGY COMMISSION-OWNED CONTRACTOR-OPERATED PLANT WORKING TOGETHER COLLECTIVELY IN THE AREA OF SAFETY—WITH THE PRIMARY GOAL OF MAKING THIS AN ACCIDENT-FREE PLANT.

WE AT GOODYEAR ATOMIC FEEL THAT THE CREATION OF THE "SAFETY REVIEW COMMITTEE" INAUGURATED A PROGRAM WHICH MAY ONE DAY BECOME COMMONPLACE IN INDUSTRY—ONE WHICH WILL FURTHER THE ALL IMPORTANT GOAL OF REDUCING INDUSTRIAL ACCIDENTS TO A MINIMUM.

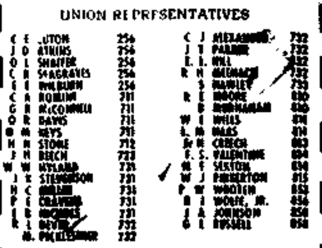


IN 1957—NINE YEARS AGO—IN THE AGREEMENT BETWEEN GOODYEAR ATOMIC CORPORATION AND THE OIL, CHEMICAL AND ATOMIC WORKERS UNION, PROVISIONS WERE MADE FOR A JOINT SAFETY REVIEW COMMITTEE, UNDER ARTICLE XIV, SECTION 4, WHICH READS AS FOLLOWS:

"... A SAFETY REVIEW COMMITTEE SHALL BE ESTABLISHED CONSISTING OF SEVEN (7) MEMBERS: THREE (3) MEMBERS TO BE SELECTED BY THE COMPANY, THREE (3) TO BE SELECTED BY THE UNION FROM THE FIVE SHIFT SAFETY REPRESENTATIVES (WITH THE REMAINING TWO ACTING AS ALTERNATES), AND A NON-VOTING CHAIRMAN TO BE SELECTED BY THE COMPANY ..."

AS A RESULT, C. L. STEWART, SUPERINTENDENT OF THE SAFETY AND FIRE PROTECTION SUBDIVISION, WAS DESIGNATED BY THE COMPANY TO SERVE AS THE NON-VOTING CHAIRMAN. THE UNION PRESIDENT APPOINTED REPRESENTATIVES FROM A, B, C, D and O SHIFTS—R. L. DEVER AND W. W. HYLAND REPRESENTING THE 700 DIVISION; R. E. MOORE AND P. W. WOOTEN REPRESENTING THE 800 DIVISION; AND C. E. EUTON FROM THE 200 DIVISION. REPRESENTATIVES APPOINTED BY THE COMPANY WERE C. L. JENKINS OF THE 400 DIVISION; W. F. CULP OF THE 700 DIVISION; AND J. B. MITCHELSON OF THE 800 DIVISION.

THE FIRST MEETING WAS HELD ON OCTOBER 18, 1957 IN THE OLD TRAINING BUILDING. A TENTATIVE SCHEDULE OF MEETING DATES WAS SET TO AFFORD SHIFT SAFETY REPRESENTATIVES EQUAL OPPORTUNITY TO ATTEND MEETINGS WHEN THEIR SHIFT WORKED DAYS.

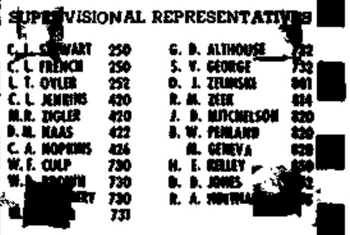


UNION REPRESENTATIVES

C E [illegible]UTON	256	C J ALEXANDER	732
J D ATKINS	256	J T PARKER	732
O L SHAFFER	256	E. L. HILL	732
C R SEAGRAVES	256	R H [illegible]	732
[illegible] WILBURN	256	S HAWLEY	733
C A ROBLIN	711	R E MOORE	800
G R McCONNELL	711	B BUCHANAN	800
O R DAVIS	711	W E WELLS	811
O M KEYS	711	L M HAAS	811
H H STONE	712	Jr H CREECH	803
J H BEECH	723	F. S. VALENTINE	804
W W HYLAND	731	M E SEXTON	810
J K STEVENSON	731	W J PEMBERTON	815
H C [illegible]	731	P. W WHOTEN	851
P E CRAVENS	731	B J WOLFE, JR.	856
L B HUGHES	731	J A JOHNSON	856
R L DEVINE	732	G L RUSSELL	856
M. PICKLESIMER	732		

UNION MEMBERS

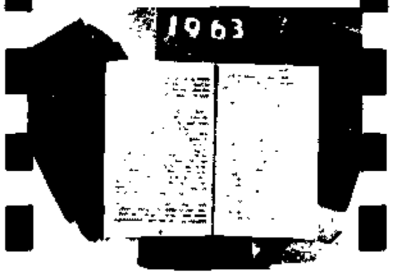
BEN KALMON, SUPERVISOR OF THE INDUSTRIAL HYGIENE AND HEALTH PHYSICS DEPARTMENT, WAS ASKED TO ACT AS SECRETARY TO THE NEWLY ORGANIZED SAFETY REVIEW COMMITTEE. HE HAS ACTED IN THIS CAPACITY SINCE THAT DATE, WITH H. M. McINERNEY OF THE SAME DEPARTMENT SUBSTITUTING IN HIS ABSENCE.



SUPERVISIONAL REPRESENTATIVES

C. L. S[illegible]WART	250	G. D. ALTHOUSE	732
C. L. FRENCH	250	S. V. GEORGE	732
L. T. OYLER	252	D. J. ZELINSKI	801
C. L. JENKINS	420	R. M. ZEEK	814
M.R. ZIGLER	420	J. D. HUTCHELSON	820
D. M. HAAS	422	B. W. PENLAND	820
C. A. HOPKINS	426	M. GENEVA	820
W. F. CULP	730	H. E. KELLEY	850
W. [illegible] BROWN	730	D. D. JONES	[illegible]
[illegible]ERY	730	R. A. [illegible]	[illegible]
[illegible]	731		

COMPANY MEMBERS



THE 1963 AGREEMENT ALTERED THE COMPOSITION OF THE COMMITTEE'S REPRESENTATION. ARTICLE XIV, SECTION 4 WAS CHANGED TO READ AS FOLLOWS:

"... A SAFETY REVIEW COMMITTEE SHALL BE ESTABLISHED CONSISTING OF SIX (6) MEMBERS: THREE (3) MEMBERS TO BE SELECTED BY THE COMPANY, THREE (3) TO BE SELECTED BY THE UNION FROM THE FIVE SHIFT SAFETY REPRESENTATIVES (WITH THE REMAINING TWO ACTING AS ALTERNATES) . . ."

CURRENT UNION REPRESENTATIVES ARE JIM FOSTER OF THE 200 DIVISION; BILL FARLEY, BUCK MILLER AND EDGAR NICHOLS OF THE 700 DIVISION; AND HUGH BURNETT OF THE 800 DIVISION. REPRESENTING SUPERVISION ON THE PRESENT SAFETY REVIEW COMMITTEE ARE: CLYDE FRENCH OF THE 200 DIVISION; JERRY ALTHOUSE OF THE 700 DIVISION; AND BOB ZEEK OF THE 800 DIVISION.

MEETINGS ARE SCHEDULED TO BE HELD MONTHLY. THE ONLY TIME A MONTHLY MEETING IS NOT HELD AS SCHEDULED IS WHEN NEW MEMBERS ARE BEING TRAINED, SUCH AS IS SHOWN HERE. EACH NEW SHIFT SAFETY REPRESENTATIVE APPOINTED TO THE COMMITTEE IS GIVEN BRIEF TRAINING BY THE SAFETY DEPARTMENT, BY FIRE PROTECTION, AND BY THE INDUSTRIAL HYGIENE AND HEALTH PHYSICS DEPARTMENT. THESE TRAINING SESSIONS ARE INFORMAL AND AFFORD NEW MEMBERS OF THE COMMITTEE THE OPPORTUNITY TO ASK QUESTIONS AND OFFER SUGGESTIONS. THE FIVE PRESENT MEMBERS HAVE RECENTLY RECEIVED TRAINING.

1957-1965 MEMBERS

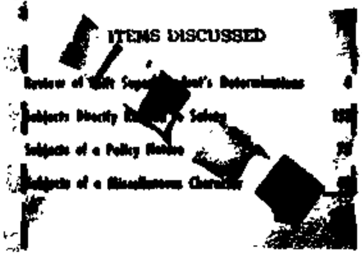
UNION		SUPERVISION
200- 5		200- 3
700- 18		400- 4
800- 12		700- 6
		800- 8
35	Total 56	21

SINCE 1957—56 EMPLOYES HAVE SERVED ON THE COMMITTEE EITHER AS REGULAR OR ALTERNATE MEMBERS —35 AS SHIFT SAFETY REPRESENTATIVES AND 21 MEMBERS OF SUPERVISION.

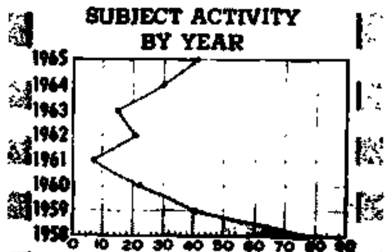
GENERALLY—SUBJECTS, PROBLEMS, OR INCIDENTS WHICH ARE PRESENTED FOR DISCUSSION BY THE COMMITTEE FALL INTO TWO CATEGORIES—THE REVIEW OF SAFETY RELATED DECISIONS, AND SAFETY RELATED OBSERVATIONS OF COMMITTEE MEMBERS OF REFERRED INCIDENTS OR OBSERVATIONS BY EMPLOYES.

(Continued on next page)

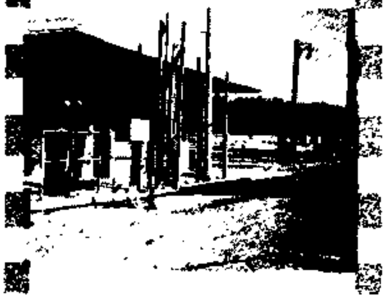
(Continued from page 11)



TO DATE, THE COMMITTEE HAS DISCUSSED AND ATTEMPTED TO RESOLVE 273 QUESTIONS, PROBLEMS, AND/OR INCIDENTS PRESENTED IN REGULAR MEETINGS. THESE QUESTIONS, PROBLEMS, ETC., INVOLVED THE FOLLOWING: (a) REVIEW OF SHIFT SUPERINTENDENT DETERMINATIONS—4; (b) SUBJECTS DIRECTLY RELATED TO SAFETY—153; (c) SUBJECTS OF A POLICY NATURE—73; AND (d) SUBJECTS OF A MISCELLANEOUS CHARACTER—43.

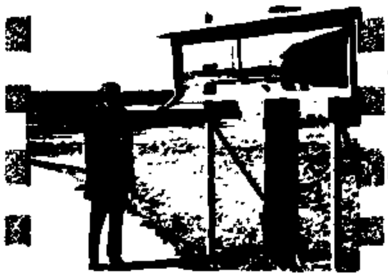


ITEMS DISCUSSED BY THE COMMITTEE THROUGH THE YEARS HAVE FLUCTUATED CONSIDERABLY, WITH THE PEAK YEAR BEING 1958 FOLLOWED BY 1959 AND 1965. WE FEEL THIS GRAPH CLEARLY INDICATES THE ACTIVITY OF THE SAFETY REVIEW COMMITTEE.



THERE ARE MANY, MANY EXAMPLES OF AN INFINITE VARIETY WHICH COULD BE SHOWN TO ILLUSTRATE THE FINE WORK THE SAFETY REVIEW COMMITTEE HAS DONE. A GOOD EXAMPLE IS THE GUARD RAIL INSTALLED AT THE X-108A PORTAL AND VEHICLE ENTRANCE TO SAFEGUARD PEDESTRIANS.

ANOTHER SIGNIFICANT CONTRIBUTION HAS BEEN ADDITIONAL GUARDING OF ROTATING EQUIPMENT IN THE X-600 FACILITY AND THE GUARDING OF THE SHAFT OF THE SLUDGE PUMP AT X-611.

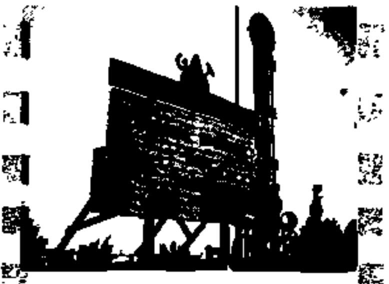


VEHICLE AND TRAFFIC SAFETY REPRESENTS A NATIONAL PROBLEM. THE NORTHWEST CORNER OF X-746 HAD A BLIND SPOT FOR TRAFFIC HEADING NORTH AND SOUTH AROUND THE BUILDING. THIS WAS CORRECTED WITH THE USE OF A MIRROR.

GOOD, SOUND SAFETY PRACTICES NEVER LEAVE ANYTHING TO CHANCE OR LUCK. THEREFORE, THE COMMITTEE FELT IT WISE TO LOWER THE BOOMS OF ALL MOBILE CRANES NOT IN FREQUENT USE.

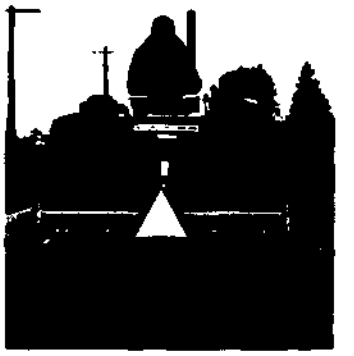
TRAFFIC AGAIN—AFTER THE RESURFACING OF THE 108-A AND 108-B PARKING AREAS, MANY CHANGES WERE MADE. AS A RESULT, THE COMMITTEE'S ATTENTION WAS IMMEDIATELY CALLED TO THE FACT THAT A "STOP HERE ON RED" SIGN WAS NEEDED AT THE INTERSECTION OF THE RAMP AND NORTH EXIT LANES.

WHEN RE-MARKING THE PARKING AREA, THE COMMITTEE ALSO RECOMMENDED AN INCREASE IN THE WIDTH OF PARKING SPACES.



IN THESE PAST YEARS AT GOODYEAR ATOMIC, WE HAVE SEEN MANY ACCOMPLISHMENTS AND MUCH PROGRESS IN ALL AREAS. WE, AT ONE TIME, REPRESENTED THE SAFEST GOODYEAR PLANT WORLD-WIDE. BUT—RECORDS ARE MADE TO BE BROKEN. WE SIMPLY HAVE TO ESTABLISH OTHERS. WE HAVE RISEN TO EVERY OCCASION. THE BLOODMOBILE—WE GIVE MORE BLOOD PER VISIT THAN MOST SURROUNDING CITIES—THE UNITED FUND—YOUR EFFORTS ALWAYS REPRESENT A MAJOR CONTRIBUTION IN YOUR COMMUNITIES. ALL THESE THINGS CAN BE ATTRIBUTED TO BUT ONE THING—THE DESIRE AND WILLINGNESS TO COOPERATE AND WORK TOGETHER. ALL IN ALL—WE FEEL THAT THESE THINGS EXEMPLIFY THE SAFETY REVIEW COMMITTEE.

THIS SMV EMBLEM MAY SAVE YOUR LIFE



New slow-moving vehicle emblem is displayed on this farm tractor and disc to alert motorists approaching from behind. The fluorescent, reflecting triangle can be seen from a great distance, day or night. It was developed and designed at OSU under a grant from the Automotive Safety Foundation.

Motor vehicle (MV)-slow moving vehicle (SMV) collisions are a 'round-the-clock problem. They occur mostly on good, open highways, during daylight, nice weather, and *without* the motorist's view being obstructed. *Rear-end collisions predominate*, and account for most of the fatalities, injuries and property damage. Positive recognition of the SMV by the motorist at a safe distance will reduce the number of such accidents.

The foregoing was taken from "Pertinent Facts Regarding the Slow-Moving Vehicle Emblem" by W. E. Stuckey, Leader, Safety and Emergency Preparedness, Cooperative Extension Service, The Ohio State University and K. A. Harkness, Instructor, Agricultural Engineering, OSU. The bulletin was prepared in cooperation with the U. S. Department of Agriculture, Cooperative Extension Service, Roy M. Kottman, Director.

The bulletin further stated that, to establish an effective and practical means of identifying SMVs, research was conducted by OSU's Department of Agricultural Engineering and the Ohio Agricultural Experiment Station. The project was sponsored by the Automotive Safety Foundation. Research consultants included professional staff of: National Safety Council; Ohio State Highway Patrol; Ohio Bureau of Motor Vehicles; OSU's Institute for Research in Vision, Department of Civil Engineering, Department of Industrial Engineering and Cooperative Extension Service.

The product of this research was a unique, triangular SMV emblem which communicates to motorists the lurking danger through *unique color and shape recognition.*

According to the Ohio Farm & Home Safety Committee, Inc., during daylight, when most of the MV-SMV collisions occur, the bright fluorescent orange of the SMV emblem is the most visible color available; at night the reflective red border of the emblem glows brilliantly in the path of approaching auto headlamps.

The 106th General Assembly of the State of Ohio enacted legislation requiring the use of this SMV emblem. The legislation was effective starting April 1 of this year.

The use of this emblem is restricted to slow moving (25 mph or less) vehicles —farm machinery, other machinery and horse-drawn vehicles—and its use on any other type of vehicle or stationary objects on the highway is prohibited.

As a result of the Ohio research, the Stuckey-Harkness bulletin continues, many adult and youth organizations have "organized SMV safety programs, and are working to gain adoption of the emblem throughout the United States and Canada. Everyone's support is needed. . . .

"Whether we are MV or SMV operators, the (SMV) emblem is an important safety aid which some day, or night, may save our life."

CHILPACO SETS RECORD, SETS SIGHTS ON ANOTHER ALL-TIME SAFETY MARK

When employes of the Chillicothe Paper Co. recently surpassed two million manhours without a lost-time injury, officials of The Mead Corporation offered a new challenge—"Why not break the all-time safety mark for the entire corporation?" That was set several years ago by Mead's Chillicothe Division, some 2,863,186 manhours without a lost-time injury. Holding a sign acknowledging that mark is Chilpaco Operations Manager O. C. Christiansen. He is flanked (left to right) by Corporate Director of Safety Francis Wagner; Area Manager Warren Henricks; Plant Security Manager Ralph Myers; John McHarg and Dale Shoemaker, representatives of the plant Safety Committee. On the table are awards earned by Chillicothe Paper Co. recently, including two from The Industrial Commission of Ohio.

RECORD-SMASHING OHIO SAFETY CONGRESS SET

Here are miniature samples of many of the excellent pictures taken by Division of Safety and Hygiene photographers Don Eddie and Dennis Cherry—at the 36th All-Ohio Safety Congress and Exhibit in Columbus, and published in the June MONITOR.

Some 4,400 people attended the section meetings at this year's bigger-than-ever Safety Congress, sponsored by the Division of Safety and Hygiene.

However, 5,000 are expected at the 37th Annual All-Ohio Safety Congress—to be held next May 2, 3 and 4—at the Sheraton-Columbus Motor Hotel in Columbus.

Also, several new section meetings will be added, the exhibit area will have a new look and will again be jammed to capacity.

Over the past several years the following conferences and sections have been added to the Congress:

Conferences—

All-Ohio Industrial Fire Prevention Conference; Annual Meeting of Ohio Committee for Highway Safety in Cooperation with Ohio Department of Highway Safety.

Sections—

Plastics; Campus Health and Safety; Machine Shop; Printing and Publications; Tree Services; Hospitals.

The outstanding success of the All-Ohio Safety Congress is due to the excellent cooperation between labor, management, trade groups and associations concerned with on-the-job safety.

(Continued from page 7)

and city playground departments are the most likely groups to sponsor the activity. However, other civic organizations might well sponsor it.

"Safety Town" seems to be most suited for children about ages 4-8. Programs are carried on chiefly for children 4½ to 6 years of age.

Since "Safety Town" is usually held out of doors, the weather must be favorable. Aside from that, the activity can be carried on during any period of the year. Class periods should be short.

The space used should be away from traffic. The ground must be hard and smooth. School playgrounds are the most satisfactory. The setup might also be laid out on a gymnasium floor during inclement weather.

Staff

At Mansfield's "Safety Town" two supervisors are needed. A patrolman is responsible for the transportation, equipment and teaching on "Safety Town." A second supervisor, with teacher training, is needed to work with the teachers.

A classroom teacher is needed for every 30 children.

"Safety Town" personnel, who should be young, are trained by the patrolman in charge.

Layout

Mansfield's "Safety Town" layout includes grass plots, sidewalks, streets, together with the standard method of marking crosswalks, intersections and traffic lanes. A standard traffic light, at the main center intersection, operates in the proper sequence. Miniature buildings are placed at various spots to provide a realistic appearance. This is laid out to represent a segment of a modern city's streets and associated traffic pattern.

Sample Schedule

Mansfield's training program includes the use of tricycles simulating motor vehicles, pedestrian training and other traffic safety measures.

1:30 p.m. Group A outside on "Safety Town." Part of the children on "Safety Town" while the teacher has the rest of the group playing games. Group B inside the building has roll call, safety lesson, safety songs, art work and a story period.

2:30 p.m. Group B outside
Group A inside

On rainy days the lesson must be emphasized since there is no practical application of that day's work on "Safety Town." Quiet games, stories, drama and finger plays replace outside activities unless you have access to an activity room or gym.

Safety talk given by police officer on week of graduation.

Objectives

Children are taught how to behave as pedestrians and as drivers; they are taught the basic attitudes toward living and working with people and caring for things. These attitudes are important in helping them later when they are taught to drive.

For realism, cars must be brought into the picture in the same manner traffic is found on city streets.

One group of children can take the part of motorists to drive the cars or tricycles back and forth between intersections. The rest of the group remain on the sidewalks and act out the part of pedestrians in crossing the streets at the proper time.

What They Should Learn

Before any of the acting takes place it is desirable to discuss with the children the proper way to cross the street, the meaning of signs, signals, and certain courteous habits which should be formed by drivers and pedestrians. A discussion of these points should cover completely the following:

- The meaning of the red, amber and green in a traffic signal and what drivers and pedestrians should do when they see these signals. Illustrate with lights or colored cardboard.
- Drivers should stop before they get to the crosswalk.
- Drivers should always yield the right-of-way to the pedestrian. Even when the pedestrian is going against the red light, the driver should be careful not to hit him.
- Pedestrians, when waiting for cars to go by, should wait on the curb.
- Pedestrians should cross only in the crosswalk.
- Pedestrians should watch for cars in both directions when crossing.
- Children operating cars as drivers should stop for a red or caution light back of the crosswalk.
- Children as drivers making turns on green should wait for pedestrians to cross.
- Children as drivers making turns or stopping should give proper hand signals.

The more realistic the adventure is made, the greater will be the interest of the children and the more likely they are to learn.

Awards and punishment may be used to a certain extent. Those who follow best the traffic rules taught should be permitted to operate the toy cars. Those who are driving cars and violate any of the rules should have the privilege of driving taken away from them while other children who have been pedestrians should then be allowed to drive.

When tricycles or cars tangle, teachers should point out why they upset and explain how other people have rights and each driver must be aware of them. Instilling in the children that they must be responsible for their own actions is one of the most important principles of "Safety Town."

Children can be taught at "Safety Town" to play out the rules they should have been taught at home about riding in the family car. They should be taught to respect a parent who must have complete freedom to handle the car and who should not have to be preoccupied with disciplining children. Children can be taught how to play the old game of "I See." And they should always be strapped into seat belts or harnesses.

Equipment Necessary

Much of the instruction can be given by means of a few lines on the ground and some wheel toys brought by the children from home. A lack of money need not hinder the putting on of a very effective program. If toy cars are to be used, at least six or eight should be obtained.

About half-size replicas of standard street and highway signs should be used.

The children should be taught the meaning of each sign and they should act out situations which would show that they know what the various signs mean.

It is important to have a traffic signal. The complete signal cycle should be shortened to about 30 seconds. If an electrical traffic light cannot be obtained or made, a square cardboard box, two opposite sides of which are painted red and the other two green, can be mounted on a 4-foot stick. A traffic light can be simulated by having a person stand and hold the box, turning it a quarter of a turn about every 15 seconds.

Stage settings which represent buildings and store fronts add realism to the setting.

GRADUATION DAY
Parents of "Safety Town" Children Invited

1. The classroom supervisor gives a brief talk on the origin and purposes of "Safety Town."
2. Under the direction of their teachers the children give the safety rules and sing safety songs. The art work is displayed in the classroom.
3. Introduction of the staff.
4. Certificates of attendance are presented by a member of the Police Department.
5. A demonstration on "Safety Town" of the children riding and walking.

QUESTION & ANSWER

Division of Safety and Hygiene
Gentlemen:

Under your Bulletin No. 202 for "Specific Safety Requirements Relating to Building and Construction Work," dated Jan. 2, 1953, Section 331, I am inquiring whether a portable step ladder with two sections used in painting a house and placed upon a concrete base requires safety shoes surfaced with cork, etc., material with equivalent friction.

The "Exception" is step ladders.

I would be pleased to be informed as to this particular ladder. Awaiting the courtesy of your response, I am

very truly yours,
Oscar B. Scherrer

Dear Mr. Scherrer:

This is in reply to your letter regarding step ladders, and referring to the requirements of State of Ohio Bulletin No. 202: "Specific Safety Requirements Relating to Building and Construction Work," Section 331, on portable step ladders. I presume you have reference to the standard step ladder as mentioned in our Section 332.

Section 332 states that "All ladders with spreading bases such as step and trestle ladders shall be equipped with spreaders to hold bases rigid when in open position." If such is the case, then it is not a requirement that they be equipped with safety shoes as per Section 331.

The stability of a step ladder which would be used on a concrete base, as you state, will depend upon the operating mechanism and the tightness of these points rather than safety shoes. However, if a step ladder would be used on soft ground, then safety shoes would distribute the load on the ground a bit better and would not be so apt to tip in the direction of a soft spot in the ground. This is merely an opinion and is not a requirement. It is just plain common sense.

Yours very truly,
John F. Ridenour, Chief
Engineering and Hygiene

HOME TRAINING, SCHOOL SAFETY PATROL CAN REDUCE DANGER TO CHILD FOR LIFE

by Warren C. Nelson, Director,
Ohio Dep't of Highway Safety

Safety education is the best "preventive medicine" against your child having an accident. Safety isn't "inborn"; it must be taught.

The trip to and from school is a big part of a child's school day. It can be dangerous if the child has not received proper instruction in safety practices.

Parents have the responsibility to teach their children basic safety practices *before* they begin school. Crossing properly at intersections, obeying signals and police officers and being orderly are important—for your child's safety and your own peace of mind.

The School Safety Patrol, sponsored by the American Automobile Association since 1922, provides an invaluable service to your community. Patrol members make travel to and from school safer for your child. At the same time, they remind schoolmates of safe walking rules by constantly setting good examples. The rules of safe walking are formed and become automatic for the other school children.

In many communities, our State Highway Patrolmen assist in the formation and training of School Safety Patrol members. The prestige of being selected a Patrol member encourages children to know and practice pedestrian safety.

The School Safety Patrol benefits not only the child and school but also every person in the community. Studies show that traffic accidents involving children ages 5-14 decrease where there is a School Safety Patrol in operation.

Encourage your child to follow the example set by Patrol members. The lessons he learns will last a lifetime.

PERSONALITY PROFILE

Wilfred L. Wilson

Wilfred Wilson of Columbus is a Division of Safety and Hygiene Representative on Schools and Villages for 25 counties in southern and north-central Ohio.

Wilfred was educated in the Smithfield public schools. He was an outstanding football player at Steubenville High School.

After graduating from the Curtis-Wright Training Program in Labor and Industrial and Public Relations in Aircraft, Wilfred was promoted to Foreman and remained for a period of six years. He supervised instructions for employes in the various phases of Aircraft Assembly from start to completion involving many departments of the plant.

A congenial fellow with a strong interest in human relations, Wilfred joined the Division in 1951—to assist Industrial Arts Instructors in Pupil Safety.

He has two daughters and 12 grandchildren. He enjoys athletics and sports, particularly football and baseball.

DIVISION OF SAFETY & HYGIENE
The Industrial Commission of Ohio
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Pattern For Progress \ AUGUST THEME:

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GET HELP FOR THOSE HEAVY LOADS!

VT000 573

VT 000 573
Farm Business Management, A Sample Procedure for Organizing
Course Outlines.

Fuller, Gerald R.
Illinois Univ., Urbana. Div. of Agricultural Education
Pub Date - Jul63
MF AVAILABLE IN VT-ERIC SET 23p.

*FARM MANAGEMENT, *CURRICULUM GUIDES, *CURRICULUM PLANNING,
*VOCATIONAL AGRICULTURE, INSERVICE TEACHER EDUCATION,

The purpose of this material is to stimulate thinking in inservice teacher education courses, and to illustrate one way in which the subject area could be organized. It was developed by a teacher educator for use in a 3-day course for 10 vocational agriculture teachers. Guiding principles in organizing a course emphasize good objectives, teaching procedures, and learning experiences. The degree of emphasis placed on farm business management instruction in the total vocational agriculture program increases from beginning to advanced groups. Emphasis changes from the individual farming program to the total farm business. The organizational approach is related to the financial aspects and profit motive of farming. The sample 4-year course outline is arranged by years, and the units or problem areas include management abilities, resource inventory, efficiency measurement, data gathering, business analysis, business inventory, accounts, account summarization, alternative income possibilities, credit, success measurement, budgeting, property transfer, and insurance. A sample outline for adult farmer classes covers similar material more briefly. (JM)

A

5/13

FARM BUSINESS MANAGEMENT

A Sample Procedure For Organizing Course Outlines

July, 1963

G. R. FULLER

Division of Agricultural Education
College of Education
University of Illinois

MEMORANDUM

TO: The ERIC Clearinghouse on Vocational and Technical Education
The Ohio State University
980 Kinnear Road
Columbus, Ohio 43212

FROM: (Person) Gerald R. Fuller (Agency) Votec. Dept., University of Illinois

(Address) 361 Education Building, Urbana, Illinois 61801

DATE: 2-16-68

RE: (Author, Title, Publisher, Date) Gerald R. Fuller, Farm Business Management, A Sample Procedure for Organizing Course Outlines. Votec. Dept., University of Illinois, July, 1963.

Supplementary Information on Instructional Material

Provide information below which is not included in the publication. Mark N/A in each blank for which information is not available or not applicable. Mark P when information is included in the publication. See reverse side for further instructions.

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Level of Group Assistant Professor, Voc. Tech. Educ.
Method of Design, Testing, and Trial Teacher Educator with subject-matter specialty.

(3) Utilization of Material:
Appropriate School Setting Comprehensive and/or area vocational high school
Type of Program High school class
Occupational Focus Production farming, Farm management
Geographic Adaptability National
Uses of Material Course Planning
Users of Material Teacher

(4) Requirements for Using Material:
Teacher Competency Agricultural Background, B.S. Teacher Educ.
Student Selection Criteria 14 years and older, M and F, 9th grade through Adult Ed., Agricultural Orientation, Agricultural Production
Time Allotment Variable

Supplemental Media --
Necessary ☐
Desirable ☐ (Check Which)

Describe

Source (agency)
(address)

FOREWORD

The author prepared this material for use in a three-day course on farm business management conducted at the University of Illinois for ten teachers of vocational agriculture. Each of these teachers then conducted a similar one-day course which was attended by teachers of vocational agriculture in Illinois. This material was presented as a sample procedure for organizing course outlines in the area of farm business management. The main purposes of this material were to: (1) stimulate thinking and (2) provide a guide which illustrated one of the many possible ways in which farm business management instruction could be organized.

TABLE OF CONTENTS

FARM BUSINESS MANAGEMENT

A SAMPLE PROCEDURE FOR ORGANIZING COURSE OUTLINES

INTRODUCTION

The need for systematic instruction in farm business management is greater today than it has ever been. The farmer, off-farm agricultural worker, and agricultural leader of the future must know more than just how to raise livestock, grow crops, or operate and maintain farm machinery. These people must also know how such technical knowledge and ability can be organized for the most efficient operation of a farm business. As you look at farmers today, it is often possible to identify several individuals who possess about the same amount of technical "know how," but the farmer who is best able to understand and apply sound farm business management decisions is the most successful farmer.

This sample procedure is presented as a guide and should not be considered as a complete plan for a course outline. However, teachers should find this material helpful in planning course outlines for their communities.

GUIDING PRINCIPLES

The development of guiding principles for teaching farm business management is essential in planning a course outline. The identification of such principles gives purpose and direction to the farm business management phase of the vocational agriculture program.

Good guiding principles take into account both educational procedures and subject matter content. The following principles illustrate one possible guide for developing the farm business management phase of a course outline.

Instruction in Farm Business Management Should:

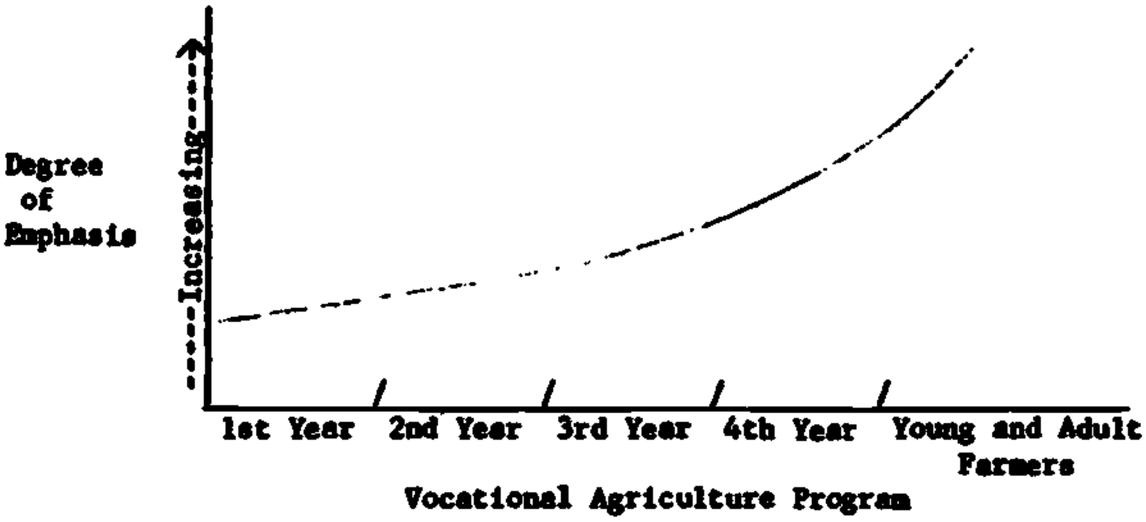
1. Contribute to the training of future farmers, future off-farm agricultural workers, future students of post high school agricultural education institutions, and present farmers.
2. Be continuous throughout the total vocational agriculture program, developing basic knowledge and abilities during the four year in-school program and advanced knowledge and abilities in the adult and young farmer phases of the program.
3. Be organized by years, taking into account the needs, abilities, readiness, and opportunities of in-school students, young farmers, and adult farmers.
4. Be taught in terms that in-school students, young farmers, and adult farmers can understand and relate or apply to their own situation.
5. Be integrated into the farm production and farm mechanics phases of the vocational agriculture program.
6. Provide for learning experiences by starting with the "simple" and progressing in a logical sequence to the "complex."
7. Provide for learning experiences through farming program productive enterprises and planned agricultural experiences related to the home farm business.
8. Relate the farming program productive enterprise to the study of the home farm business.
9. Use the study of farm business management at the adult and young farmer level as the basis for identifying problems of management, production, and farm mechanics.
10. Place emphasis on educational outcomes rather than on providing service to students and farmers.

DEGREE OF EMPHASIS

The degree of emphasis placed on farm business management instruction would vary throughout the total vocational agriculture program. The following two charts illustrate this idea.

Figure 1

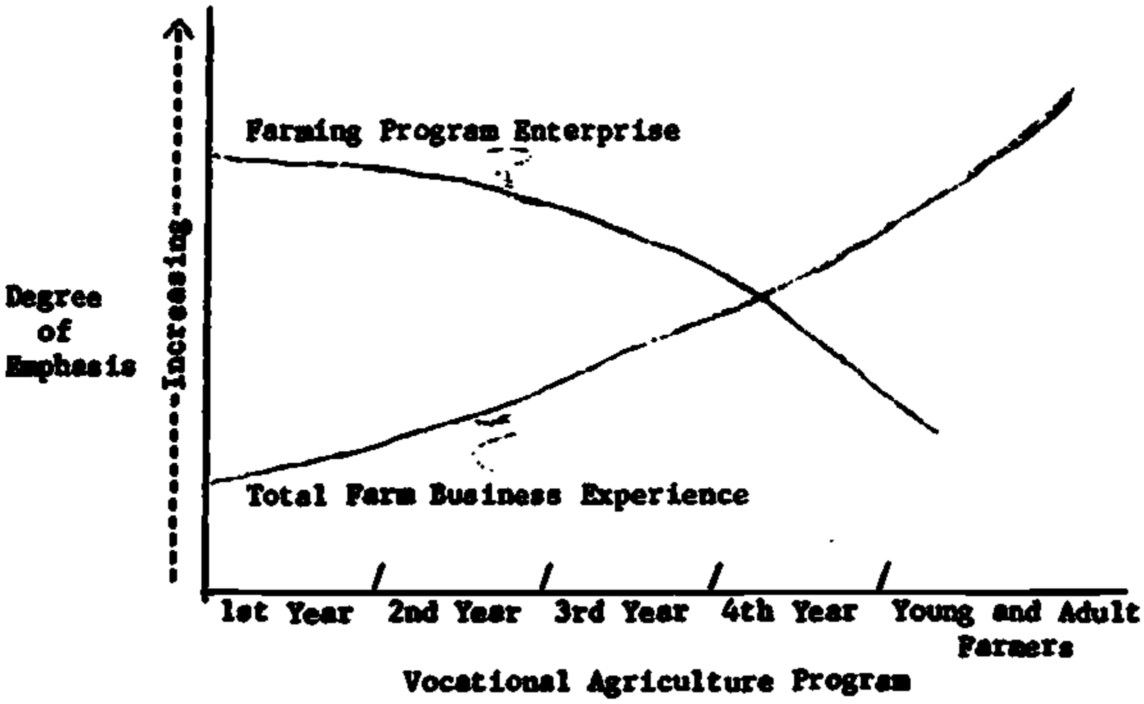
DEGREE OF EMPHASIS PLACED ON FARM BUSINESS MANAGEMENT INSTRUCTION THROUGHOUT THE TOTAL VOCATIONAL AGRICULTURE PROGRAM



Farm business management instruction should be included throughout the in-school phase of the vocational agriculture program. As students develop the needed knowledge and abilities through classroom instruction and agricultural experiences, the emphasis on farm business management should increase (see Figure 1). The greatest emphasis on farm business management instruction should occur when students are most closely associated with the management of a farm business, i.e. the adult and young farmer programs.

Figure 2

DEGREE OF EMPHASIS PLACED ON FARM BUSINESS MANAGEMENT INSTRUCTION THROUGH FARMING PROGRAM PRODUCTIVE ENTERPRISES AND THE TOTAL FARM BUSINESS



Instruction in farm business management should be most closely related to the student's farming program productive enterprises during the early phases of the vocational agriculture program. An introduction to the management of the whole farm business should begin early in the program as part of the planned agricultural experiences of the student. As the student progresses, farm business management instruction should increasingly emphasize the total farm business and its relationship to the farming program productive enterprise. Young and adult farmer farm business management instruction should be primarily concerned with the total farm business.

ORGANIZATIONAL APPROACH

Farm business management has been defined as, "The ability to organize a farm business to provide high continuous profits consistent with family welfare." The success of a farm business is usually measured in terms of financial prosperity. Farmers are in business to make money, and the degree to which they accomplish this goal usually indicates to them how well they are operating their farms. Financial success is the core around which instruction in farm business management can be developed.

A farmer generally approaches the problem of farm business management by considering:

1. What there is to work with (business resources).
2. How well these resources are being managed (business efficiency).
3. Where the money came from (business receipts).
4. Where the money went (business expenses).
5. How successful the farm business was (financial success).
6. How the farm business can be improved (business analysis).

This approach is well adapted to farm business management instruction in the total vocational agriculture program. The use of this approach provides the basis for developing problem areas in farm business management appropriate to the learner's level of knowledge, ability, and opportunity. Furthermore, it is possible to logically integrate farm business management instruction with farm production and farm mechanics.

SAMPLE FOUR-YEAR COURSE OUTLINE

The following sample four-year course outline is provided as a means for further clarifying the foregoing materials. Some samples of content have been included, but they are not complete. Teachers should develop their course outlines to meet their local situations and to be compatible with their methods of teaching. This sample is but one way in which instruction could be organized.

The problem areas listed in this sample course outline attempt to provide for learning through agricultural experiences. The student's experiences with farming program productive enterprises and the total farm business have been integrated. An attempt has been made to provide for the integration of business management instruction with production agriculture and farm mechanics. The four-year program begins at the student's level and progressively develops to the point where he has the knowledge, abilities, and opportunities to relate instruction to the home farm business. A student who has limited or no opportunity to relate the instruction to a home farm should be helped to make arrangements so these experiences will become available on a cooperating farmer's farm.

There are several problem areas which are listed but once in this outline. This does not mean the students would not continue to gain these experiences. Rather, these experiences would be gained as part of other problem areas, through farming programs, and the like.

First Year (Voc. Agr. I)

Problem Area: Determining the farm business management abilities a farmer or off-farm agricultural worker must possess.

1. What is farm business management?
    a. Definition: The ability to organize a farm business to provide high continuous profits consistent with family welfare.
    b.
2. How can a knowledge of farm business management help us?
    a. Combination of crops to grow.
    b. Kinds of livestock to produce.
    c. Level of crop yield and animal production to attain.
    d. Size of enterprise.
    e. Efficient use of labor and machinery.
    f. Buildings to fit the farm business.
    g. Soil conservation program for the farm.
    h. Use of farm business capital.
    i. Insurance protection for the farm business.
    j.

3. What do we need to know about the farm business?

    a. What farm business resources are available (what there is to work with),
    b. How well these resources are being used (business efficiency).
    c. How much money is being received (business receipts).
    d. How much money is being spent (business expenses).
    e. How much money the business is making (financial success).
    f. How the business might be improved (business analysis).
    g.

4. What farm business information do we need?

    a. Resources (land, buildings, livestock, machinery, labor, capital).
    b. Management (rates of production, size of business, labor efficiency).
    c. Receipts (crop, livestock and livestock products, other).
    d. Expenses (crop, livestock, machinery, labor, capital, other).
    e. Financial success (farm income, labor income, return on capital).
    f. Business analysis (strengths, weaknesses).
    g.

5. How can this information be obtained?

    a. Inventory of farm resources.
    b. Crop and livestock production records.
    c. Farm receipt and expense accounts.
    d.

6. When will we obtain this information for our productive enterprise?

    a. Inventory of enterprise resources--begin winter, freshman year.
    b. Production records--begin winter, freshman year.
    c. Receipts and expenses--begin winter, freshman year.
    d. Enterprise analysis--begin fall, sophomore year.
    e.

7. When will we obtain this information for the home farm?

    a. Partial farm inventory--fall, freshman year.
    Total farm inventory--winter, sophomore, junior, senior years.
    b. Simple measures of farm business efficiency--fall, freshman year.
    Additional measures of farm business efficiency--winter, sophomore year.

Advanced measures of farm business efficiency--winter, junior and senior years.

c. Partial record of farm business receipts and expenses--begin spring, sophomore year.
Total record of farm business receipts and expenses--begin spring, junior year.

d. Simple analysis of home farm business--fall, freshman year.
Additional analysis of home farm business--winter, sophomore year.
Advanced analysis of home farm business--winter, junior year.
Complete analysis of home farm business--winter, senior year.

e.

<u>Problem Area</u>: Taking a partial inventory of the home farm business resources.

1. What resources should we inventory?

   a. Acres and use of land.
   b. Numbers and kind of livestock.
   c. Amount, kind, and condition of machinery.
   d. Size, type, use, and condition of buildings.
   e. Farm labor force.
   f.

2. What forms should we use?
   a.

3. How should we record this information?
   a.

4. How can we use this information to plan our productive enterprise?
   a.

<u>Problem Area</u>: Determining simple measure of the home farm business efficiency.

1. What information do we need this year?

   a. Crop production.
   b. Livestock production.
   c. Number of farm workers and months worked.
   d.

2. Where can this information be obtained?
   a.

3. How can this information be recorded?
   a.

4. What does this information show?

a. Size of business.
b. Rates of production.
c. Labor efficiency.
d.

5. How can we use this information to plan our productive enterprise?
a.

Problem Area: Gathering data for the analysis of a productive enterprise.

1. What do we need to know about the livestock enterprise?

a. Size.
b. Rate of production.
c. Returns and feed costs.
d. Marketing data.
e. Feeding efficiency.
f. Death loss.
g.

2. What do we need to know about the crop enterprise?

a. Soil class.
b. Yield per acre.
c. Fertilizer cost per acre.
d. Labor costs.
e. Machinery cost.
f. Crop return per acre.
g. Value of product per acre.
h. Average price per unit.
i.

3. What records do we need to keep?

a. Inventory.
b. Record of receipts and expenses.
c. Record of production.
d. Record of labor.
e.

4. How can we record this data?

a. Farming program record book.
b. Illustrations of entries.
c.

5.

Second Year (Voc. Agr. II)

Problem Area: Analyzing the productive enterprise.

1. How do we summarize the inventory?

a. Depreciation schedules.
b. Total returns.
c.

2. How do we summarize expenses?

   a. Total expenses.
   b.

3. How do we summarize receipts?

   a. Total income.
   b.

4. How do we complete the financial summary?

   a. Expenses.
   b. Receipts.
   c. Summary.
   d.

5. How do we analyze our productive enterprise?

   a. Size of enterprise.
   b. Rates of production.
   c. Labor efficiency.
   d. Cost control.
   e. Marketing.
   f. Feeding efficiency.
   g. Death loss.
   h. Strong and weak points.
   i. Problems to study.
   j.

6. How can we use this information to plan and improve the productive enterprise?
   a.

<u>Problem Area</u>: Taking an inventory of the home farm business.

1. How can we use a farm inventory?

   a. Capital investment.
   b. Increase or decrease in inventory.
   c. Net worth.
   d. Business efficiency factors.
   e. Financial summary.
   f.

2. What information do we need?

   a. Same as for partial inventory.
   b. Land class.
   c. Values.
   d. Depreciation.
   e.

3. How can we obtain this information?
   a.

4. How can we use this information to plan and improve the productive enterprise?
   a.

Problem Area: Determining additional measures of home farm business efficiency.

1. What measures can we determine, using the information we have?
    a. Livestock numbers, crop acres, products sold, man equivalent, capital investment.
    b. Milk per cow, eggs per hen, yield per acre.
    c. Products sold per man, crop acres per man, livestock per man.
    d.

2. What does this information indicate?
    a. Size of business.
    b. Rates of production.
    c. Labor efficiency.
    d.

3. How can we use this information to plan and improve the productive enterprise?
    a.

4. What additional information do we need for further analysis?
    a. Crops sold during year.
    b. Livestock sold during year.
    c. Receipts and expenses.
    d. Feed used during year.
    e.

5. How can we obtain this information?
    a. Partial record of receipts and expenses.
    b. Production records.
    c.

Problem Area: Determining partial receipts and expenses for the home farm business.

1. What information do we need?
    a. Feed costs for livestock.
    b. Machinery costs.
    c. Prices paid and received for livestock.
    d. Value of products sold.
    e.

2. How can we obtain this information?
    a. Select an important home farm enterprise.
    b. Cash account of receipts and expenses.
    c. Production record.
    d. Begin in January.
    e.

3. What form should we use?
    a.

4. How do we make entries?
    a. Refer to productive enterprise record.
    b.

<u>Problem Area</u>: Continuing the analysis of the home farm business.

1. What information do we have?
    a. Size of business.
    b. Rates of production.
    c. Labor efficiency.
    d. Farm inventory.
    e.

2. What do these figures indicate?
    a. Compare with other farms.
    b. Strong and weak points.
    c. Problems to be studied.
    d.

3. How can this information be used in planning and improving the farming program productive enterprise?
    a.

<u>Third Year</u> (Voc. Agr. III)

<u>Problem Area</u>: Summarizing the partial record of receipts and expenses for the home farm business.

1. How do we summarize the expenses?
    a. Refer to farming program productive enterprise record.
    b.

2. How do we summarize the receipts?
    a. Refer to farming program productive enterprise record.
    b.

3. What do these figures show?
    a. Where the money came from.
    b. Where the money went.
    c. Use in calculation of measures of business efficiency.
    d.

4. How can this information be used to plan and improve the farming program productive enterprise?
    a.

Problem Area: Determining advanced measures of the home farm business efficiency.

1. What measures can we determine from the information we have?

   a. Livestock, crop acres, man equivalent, capital investment, total production.
   b. Milk per cow, eggs per hen, pigs per litter, livestock gain, crop yield.
   c. Animals per man, products sold per man, crop acres per man, work units per man.
   d. Returns per $100 feed cost, feed cost per unit, crop expense per acre, fertilizer cost per acre, machinery cost per man.
   e.

2. What do these measures show?

   a. Size of business.
   b. Rates of production.
   c. Labor efficiency.
   d. Cost control.
   e. Feeding efficiency.
   f.

3. How can this information be used to plan and improve the farming program productive enterprise?
   a.

4. What additional information do we need to further analyze the home farm business?

   a. Complete receipts.
   b. Complete expenses.
   c. Production records.
   d.

5. How can we get this information?

   a. Begin cash account and production records in January.
   b.

Problem Area: Continuing the home farm business analysis.

1. What information do we have?

   a. Two farm inventories.
   b. Business efficiency measures for three years.
   c. Pertial record of receipts and expenses.
   d.

2. What do these figures show us?

   a. Compare with other farms.
   b. Strong and weak points.
   c. Problems to be studied.
   d.

3. How can this information be used to plan and improve the farming program productive enterprise?
   a.

Problem Area: Keeping more complete records of home farm business receipts and expenses.

1. Why do we need this information?

    a. Advanced measures of business efficiency.
    b. See where the money came from.
    c. See where the money went.
    d. Determine financial success.
    e.

2. What information do we need?

    a. Complete farm business expenses.
    b. Complete farm business receipts.
    c.

3. How can we obtain this information?

    a. Keep cash account.
    b. Record information from farm accounts.
    c. Begin in January.
    d.

4. How do we make the needed entries?

    a. Refer to farming program enterprise records.
    b.

Problem Area: Comparing income possibilities of the home farm crop and livestock system with an alternative system.

1. What home farm information do we need?

    a. Information already collected.
    b.

2. What are the present long range income possibilities of the home farm business?

    a. Complete necessary forms using home farm date.
    b.

3. How does this income compare with other farms?
    a.

4. What possible alternatives might be selected?

    a. Review strong and weak points.
    b. Consider logical alternatives.
    c. Compare alternative plan with present program.
    d.

5. What farm business adjustments might be made?

   a. Fertility.
   b. Cropping.
   c. Livestock.
   d. Labor.
   e. Conservation.
   f. Buildings.
   g. Machinery and equipment.
   h.

Problem Area: Determining how to secure money for making home farm business adjustments.

1. When should we borrow money?
   a.

2. Where can we borrow money?
   a.

3. How much money should we borrow?
   a.

4. How much does it cost to borrow money?
   a.

5. What laws apply to borrowing and lending money?
   a.

Fourth Year (Voc. Agr. IV)

Problem Area: Summarizing the receipts and expenses for the home farm business.

1. How do we summarize the expenses?

   a. Refer to previous instruction.
   b. Advanced instruction.
   c.

2. How do we summarize receipts?

   a. Refer to previous instruction.
   b. Advanced instruction.

3. What do these figures show?

   a. Where the money was spent.
   b. Where the money was earned.
   c. Measures of business efficiency.
   d. Financial success.
   e.

4. How can this information be used to help improve the home farm business?
   a.

Problem Area: Determining the financial success of the home farm business.

1. What are the common measures of financial success?

   a. Farm income.
   b. Labor income.
   c. Return on capital.
   d.

2. What information is needed to determine these measures?

   a. Farm receipts.
   b. Farm expenses.
   c. Farm inventory.
   d.

3. How do we calculate these measures?
   a.

4. How do these measures compare with other farms?

   a. All farms.
   b. Similar enterprise.
   c. Similar size.
   d.

5. How can this information be used to improve the home farm business?
   a.

Problem Area: Determining the efficiency of the home farm business.

1. What measures of efficiency can we determine?

   a. Refer to previous instruction.
   b. Advanced instruction.
   c.

2. What do these measures show?

   a. Refer to previous instruction.
   b. Advanced instruction.
   c.

3. How can this information be used to help improve the home farm business?
   a.

Problem Area: Completing the analysis of the home farm business.

1. What information do we have?

   a. Three farm inventories.
   b. Business efficiency measures for four years.
   c. Account of farm receipts and expenses.
   d.

2. What do these figures show?

    a. Compare with other farms. c. Problems to be studied.
    b. Strong and weak points. d.

3. How can this information be used to help improve the home farm business?
    a.

<u>Problem Area</u>: Determining a budget for the home farm business.

1. What information do we need?

    a. Refer to records. b.

2. How should the money be budgeted?

    a. Business efficiency factors.
    b. Proposed plan (third year).
    c. Budget form.
    d.

3. How does this compare with the present budget?
    a.

4. How can this information be used to improve the home farm business?
    a.

<u>Problem Area</u>: Planning for the transfer of the home farm.

1. How can real estate and personal property be transferred?
    a.

2. How do we prepare for transferring real estate?
    a.

3. How do we prepare for transferring personal property?
    a.

4. When should these preparations be made?
    a.

5. What plans should we have for our home farm?
    a.

<u>Problem Area</u>: Planning an insurance program to protect the home farm business and the family.

1. Why do we need insurance?
    a.

2. What types of insurance are available?
    a.

3. What should we consider when planning an insurance program?
    a.

4. Where can we buy insurance?
    a.

5. What insurance program would be suitable for our home farm and our family?
    a.

SAMPLE COURSE OUTLINE FOR

YOUNG AND ADULT FARMER CLASSES

Young and adult farmers are making business management decisions which effect the financial success of their businesses. These men are interested in determining which decisions would most likely improve their farm businesses. Programs of instruction in farm business management should have as their goal the development of the knowledges and abilities needed to analyze the farm business, make sound management decision, and implement those decisions. Farm record keeping ability is necessary if this goal is to be reached.

Farm business management instruction in the vocational agriculture young and adult farmer programs should emphasize analyzing the farm businesses, determining how the businesses might be improved, examining possible alternative decisions, developing knowledges and abilities needed in implementing the final decisions, and evaluating the results of the actions taken. Farm record keeping then becomes a part of the total instructional program and the record keeping experiences are directly related to the farmer's own situation.

The course outline presented here is only a sample of one of the many ways farm business management instruction could be organized. This outline immediately involves the farmers in the study of their businesses. Record keeping instruction begins where the farmers are and progresses as the farmers develop the needed knowledges and abilities. Emphasis is placed on a record keeping experience program similar to the high school farming program.

Farmers are sometimes reluctant to reveal the dollar and cent figures for their businesses. It should be made clear that no one but the teacher will know these figures without their approval. The only figures published will be averages, thus no individual farmer could be identified.

Teachers might develop individual workbooks in which each farmer could enter from his records the figures needed to analyze his business. These workbooks would provide the teacher with the figures required for the group summary as well as organizing the information in a useful form for the farmer.

This outline would allow teachers to initiate and conduct a new beginning class each year. As the farmers completed the first year, they would then enter the advanced classes. If a beginning class was not conducted each year, a few new farmers could be enrolled in the advanced class if they were interested.

Beginning Farm Business Management (First Year)

Problem Area: Identifying the facts and information I will need in order to analyze my farm business.

1. What do I have to work with?
    - a. Land
    - b. Buildings.
    - c. Livestock.
    - d. Machinery and equipment.
    - e. Labor.
    - f. Capital.
    - g.
2. Where did the money come from?
    - a. Farm business receipts.
    - b.
3. Where did the money go?
    - a. Farm business expenses.
    - b.
4. How much money did the business make?
    - a. Farm income.
    - b. Labor income.
    - c. Return on capital.
    - d.
5. How efficiently did I manage the business?
    - a. Size of business.
    - b. Labor efficiency.
    - c. Rates of production.
    - d. Cost control.
    - e. Feeding efficiency.
    - f. Marketing.
    - g. Death loss.
    - h.
6. How can I obtain this information?
    - a. Farm inventory.
    - b. Cash account.
    - c. Production records.
    - d.

Problem Area: Determining what I have to work with in my farm business.

1. How should land be inventoried?
2. How should buildings be inventoried?
3. How should livestock be inventoried?
4. How should machinery and equipment be inventoried?
5. How should labor be inventoried?
6. How should capital be inventoried?

Note: Each farmer should have a beginning inventory and an ending inventory for the past year. There may be farmers who have some type of inventory record. Those who have no organized record should make an ending inventory and then estimate what the beginning inventory would have been. The second year of this program each member would have a more complete and accurate record as a result of this instruction.

Problem Area: Determining where the money came from in my farm business.

1. What are the receipts I need to record?
2. How should these receipts be grouped?
3. How should these receipts be recorded?

Note: Each farmer should have a record of receipts for the past year. Those who have no organized record should use their income tax information to estimate the needed receipts. The second year of this program each member would have a more complete and accurate record as a result of this instruction.

Problem Area: Determining where the money went in my farm business.

1. What expenses do I need to record?
2. How should these expenses be grouped?
3. How should these expenses be recorded?

Note: Each farmer should have a record of expenses for the past year. Those who have no organized record should use their income tax information to estimate the needed expenses. The second year of this program each member would have a more complete and accurate record as a result of this instruction.

Problem Area: Determining how efficiently I managed my farm business.

1. What is the size of my farm business?
2. What were the rates of production?
3. What was the labor efficiency?
4. How well did I control costs?
5. How well did I manage feeding efficiency?
6. How well did I manage my marketing?
7. How well did I control death losses?

Note: Each farmer should have sufficient information to calculate the measures of business efficiency for last year's operation. Those who lack complete information might estimate the figures from the limited data they have. The second year of this program each member would have a more complete and accurate record as a result of this instruction.

Problem Area; Analyzing my farm business.

1. What are the strong points?
2. What are the weak points?
3. What additional information do I need for next year?
4. What problems need to be studied this year?

Note: The important inventory, receipt, expense, and efficiency data could be averaged for this group and a report prepared by the teacher. The farmers could then compare their individual farms with the averages for the class, county, and other appropriate groups of farms. By using the group average, no individual farmer would have to disclose his business information to others unless he so desired. This analysis would provide the necessary information for developing a series of classes to study the most important problem identified by the farmers.

Advanced Farm Business Management (Following Years)

Problem Area: Preparing to analyze my farm business.

1. What do I have to work with (inventory)?
2. Where did the money come from (receipts)?
3. Where did the money go (expenses)?
4. How well did I manage the business (efficiency)?

Note: It would be possible to have a few new students in the class. These farmers would need some individual assistance in getting started.

Problem Area: Analyzing my farm business.

1. What are the strong points?
2. What are the weak points?
3. What changes have occurred since last year?
4. What might account for these changes?
5. What additional information do I need for next year?
6. What problems need to be studied this year?

Note: Again, important information could be averaged and a report prepared by the teacher. The farmers could then compare their individual farms with the averages for the class, county, and other appropriate groups of farms. A series of classes could be developed to study the most important problem or problems identified by the farmers.

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Farm Business Managment, Financing Production Agriculture, Source Materials for Providing Systematic Instruction to Farmers, Agricultural Businessmen and High School Students.

Fuller, Gerald R.
Illinois Univ., Urbana. Div. of Agricultural Education

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*FARM MANAGEMENT, *CURRICULUM GUIDES, *VOCATIONAL AGRICULTURE, *TEACHING GUIDES, HIGH SCHOOLS, ADULT VOCATIONAL EDUCATION, CREDIT,

The course was developed for high school and adult farmer classes by a teacher educator. Specific course objectives are related to 10 problem areas--(1) financial analysis, (2) operating credit, (3) expansion credit, (4) consumer credit, (5) credit and marketing, (6) lender selection, (7) acquiring loans, (8) managing credit and taxes, (9) business insurance, and (10) personal insurance. Unit areas in the course parallel the problem areas. Teacher objectives, interest approaches, anticipated questions, possible activities, references, and teaching aids are listed for each problem area or unit. The units are planned for young and adult farmer groups in greater detail with modifying suggestions for classes of high school students and agricultural businessmen. Sources of references and teaching aids are listed. (JM)

FARM BUSINESS MANAGEMENT

Financing Production Agriculture

Source Materials for Providing Systematic
Instruction to Farmers, Agricultural
Businessmen and High School Students

July, 1964

G. R. FULLER

Division of Agricultural Education
College of Education
University of Illinois

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G. R. Fuller
Division of Agricultural Education
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University of Illinois

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TO: The ERIC Clearinghouse on Vocational and Technical Education
The Ohio State University
980 Kinnear Road
Columbus, Ohio 43212

FROM: (Person) Gerald R. Fuller (Agency) Votec Dept., University of Illinois
(Address) 361 Education Building, Urbana, Illinois 61801

DATE: 2-16-68

RE: (Author, Title, Publisher, Date) Gerald R. Fuller. Farm Business Management, Financing Production Agriculture; Source Materials for Providing Systematic Instruction to Farmers, Agricultural Businessmen and High School Students. Votec Dept., University of Illinois, July, 1964.

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During the summer of 1964, the writer assisted in conducting a three-day workshop on agricultural business management for ten Illinois teachers of vocational agriculture. These teachers, in turn, served as instructors for one-day courses attended by teachers of vocational agriculture throughout Illinois. This publication was prepared to aid teachers in organizing and presenting, through systematic instruction, the subject matter of these one-day courses to farmers, non-farm agricultural businessmen and high school students enrolled in agricultural education courses.

Much credit must be given to Professor John Herbst, Vocational Agriculture Service, College of Agriculture, for his assistance in the preparation of this publication. Also, acknowledgment must be given for the helpful suggestions of Professors Lloyd J. Phipps, A. H. Krebs, Paul E. Hemp and J. R. Warmbrod of the Division of Agricultural Education, College of Education, and Professor John W. Matthews, Vocational Agriculture Service, College of Agriculture.

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INTRODUCTION

Financing the production of crops, livestock and livestock products is a critical aspect of farm business management. Financial management is often the "weak link" in an otherwise sound farming operation. Farmers, businessmen, and high school students interested in a career in agriculture all need to understand the most advantageous methods of financing production agriculture. Systematic instruction provided by teachers of agriculture can help meet this need.

These source materials are presented as a detailed guide for teaching adult farmers and young farmers. Suggestions have been included to aid the teacher in modifying these materials for use with agricultural businessmen and for use with high school students. Each of these three groups has a different background of knowledge and experience thus each requires a somewhat different instructional approach.

The materials presented are suggestions only and should be used as a guide. Teachers will need to develop a program of systematic instruction appropriate for the group they have in class and the community in which they teach.

COURSE OBJECTIVES

The course objectives for systematic instruction in financing production agriculture might include:

A. Adult Farmers and Young Farmers

1. Develop an appreciation for conducting a sound program of financial management.

2. Develop the ability to analyze a financial management program.
3. Develop an understanding of the place of credit in a farm business.
4. Develop the ability to use available financial resources most advantageously for the operation, improvement, and/or expansion of a farm business.
5. Develop the ability to select the most advantageous source of cash loans and/or credit.
6. Develop an understanding of the relationship of family financial management and business financial management.
7. Develop an understanding of the need for protecting the business and family against financial loss.
8. Develop the ability to plan a marketing program which is financially advantageous.
9. Develop an understanding of the relationship of income taxes and financial management.
10.

B. Agricultural Businessmen

1. Develop an appreciation for the need to analyze a prospective customer's financial management program.
2. Develop the ability to analyze a financial management program.
3. Develop the ability to determine whether the financial success of the farm business will be sufficiently improved as a result of a purchase and/or the extension of credit.
4. Develop the ability to assist the farmer in advantageously managing family and business finances.
5. Develop an understanding of the farmer's need for protection against financial loss.
6.

C. High School Agriculture Students

1. Develop an appreciation of the need for sound financial management.
2. Develop an understanding of how a financial management program can be analyzed.

3. Develop an understanding of how a farmer can determine whether credit will be of advantage in the operation, improvement, and/ or expansion of a farm business.

4. Develop an understanding of the process involved in securing a cash loan or credit.

5. Develop an understanding of the need for protection against financial loss.

6. Develop an understanding of the relationship between family financial management and business financial management.

7. Develop an understanding of the affect marketing has on financial management.

8.

ADULT FARMERS AND YOUNG FARMERS

This section of the materials has been developed in detail and should serve as a guide for planning systematic instruction for adult or young farmer courses. The materials have been designed to meet the course objectives previously stated.

Problem Areas

Some of the problem areas which may be appropriate for an adult farmer or a young farmer class are:

I. Determining the success of the farm business financial management program.

II. Determining whether money can be borrowed to advantage for operating a farm business.

III. Determining whether money can be borrowed to advantage for expanding operations or establishing improved methods of operation.

IV. Determining whether money can be borrowed for family activities and/or home improvements without unduly interfering with the farm business financial program.

V. Adjusting the marketing program to take maximum advantage of credit.

VI. Selecting an appropriate lender or lending agency.

VII. Obtaining cash loans or credit.

VIII. Managing credit in relation to income tax regulations.

IX. Protecting the farm business through an insurance program.

X. Protecting the family's welfare through a personal insurance program.

XI.

Teacher Objectives, Possible Interest Approaches, Anticipated Problems, Possible Activities and Partial List of References

A list of possible teacher objectives for each of the above problem areas is presented to aid the teacher in developing a suitable lesson plan. Examples of possible interest approaches have been included to assist the teacher in developing proper student motivation; a critical aspect of planning. Anticipated problems and possible class activities are also included to help guide the teacher. A partial list of references appropriate for each problem area has also been included to facilitate planning.

I. Determining the success of the farm business financial management program

A. Teacher objectives: Develop in the students an affective ability to--

1. Interpret farm business financial records

2. Complete a net worth statement

3. Analyze a net worth statement

4. Complete a profit and loss statement or farm business summary

5. Analyze a profit and loss statement

6.

B. Possible interest approaches

1. Distribute a farm business financial summary which provides the information needed to calculate profit, loss and net worth (See pages 16 and 17, Farm and Family Business Management--Part IV). Lead a group discussion to determine the different conclusions arrived at concerning the financial success. Use this example as a source of information for teaching the problem area; <u>and/or</u>

2. Ask such questions as: (a) Has your financial management increased or decreased your business profits? (b) How much? (c) Has your financial management program been successful? (d) How successful?

3. Develop class objectives and a list of problems to be studied.

C. Anticipated questions, problems and concerns:

1. How can you determine whether the total farm business is financially successful?

2. How does financial management affect the rate of financial growth of the farm business?

3. What is a net worth statement?

4. How do you determine net worth?

5. What do net worth statements tell about financial management of a farm business?

6.

D. Possible activities:

*1. Have each class member complete a profit and loss statement (or farm business summary) from his records.

*2. Have each class member complete a net worth statement using his farm business records.

3. Provide class with a summary of continuous net worth statements for a three year period and discuss the interpretations.

4. Provide class with sample profit and loss statements or farm business summaries. Using charts or chalkboard as a visual aid, discuss the interpretations of these business records.

5. Provide class with one year's entries for a net worth statement and have each member calculate the net worth.

6. Use an overhead projector to illustrate the making of entries on a net worth statement.

7.

E. Partial list of references and teaching aids:

Farm and Family Business Management - Part IV. Farm Business Adjustments, Alternative plans, . . .

Our Net Worth Statement

VAS Unit 2008a, Record Keeping on the Farm

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*Possible activity for individual on-farm instruction

VAS Unit 2024, The Use of Credit to Increase Farm Earnings
VAS Unit 2025, Credit Needs on the Farm
VAS Unit 2026, Farmer Jones' Plans for Repayment of Loans

Annual Summary of Farm Business Records, 1962. Cir. 874

II. Determining whether money can be borrowed to advantage for operating a farm business

A. Teacher objectives: Develop in the student an affective ability to--

1. Identify decisions to be made

2. Select proper farm business records

3. Complete a partial and/or total budget

4. Analyze a partial and/or total budget

5. Determine a repayment program

6. Identify needed management adjustments

7.

B. Possible interest approaches

1. Using the same farm business as in I, distribute a summary containing the information needed to complete several partial budgets (see pages 18 and 19, Farm and Family Business Management - Part IV). Lead a group discussion to determine the class members opinions as to whether the proposed changes will increase net income "sufficiently." Use the example as a source of information when teaching; <u>and/or</u>

2. Ask such questions as: (a) How much money do you need to borrow? (b) When should you borrow it? (c) When should you pay it back?

3. Develop class objectives and a list of problems to be studied.

C. Anticipated questions, problems and concerns

1. What important decisions need to be made when borrowing money for operating expenses?

2. What farm business records are needed as a basis for making a sound decision?

3. Does the complete (or partial) budget show if money can be borrowed to increase net income?

4. What adjustments need to be made to make the farming operation more profitable?

5. How much money will be needed to meet expenses?

6. When will the money be needed?

7. When will the money be available for repayment?

8.

D. Possible activities:

1. With the aid of a flannel board, identify the important decisions needed when borrowing money.

2. Refer to 1963 course material on record analysis and develop a list of farm business records needed plus the reasons for keeping these records.

*3. Have each class member develop a complete budget for his farm business or a partial budget for changes in the business. (Use Income Possibilities form or Partial Budget form)

4. Have class analyze sample budgets and determine where adjustments can be made to improve profits.

5. Provide class members with sample entries for a cash flow budget and have them determine how much money is required, when the money will be needed, and when the money can be repayed.

6.

E. Partial list of references and teaching aids:

Farm and Family Business Management - Part IV (also in I - E)
   Farm Business Adjustments for Improved Efficiency
Farm Management Manual
Income Possibilities Form
Partial Budget Form
Farm and Family Financial Budget form
Farm and Family Financial Planning Problem

III. Determining whether money can be borrowed to advantage for expanding operations or establishing improved methods of operation.

A. Teacher objectives: Develop in the students an affective ability to--

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*Possible activity for individual on-farm instruction

1. Determine optimum size of expansion
2. Estimate capital expense for expansion
3. Estimate operating expense as a result of expansion
4. Estimate capital expense for establishing an improved method
5. Estimate operating expense as a result of an improved method
6. Plan a repayment program
7.

B. Possible interest approaches

1. Lead a group discussion to determine the opinions of the class members concerning expansion or improvement; <u>and/or</u>
2. Ask such questions as: (a) Which would be most profitable for you, expanding an enterprise or improving an enterprise? (b) Would increased returns justify the change?
3. Develop a list of class objectives and problems to be studied

C. Anticipated questions, problems and concerns:

1. How much volume is needed for an improved method to be economical?
2. How much capital will be needed to establish the improved method?
3. How much capital will be needed for changing the corn harvesting method?
4. How much capital will be needed for expanding the size of a hog enterprise?
5. How much capital will be needed for expanding the size of a beef enterprise?
6. Will the change be profitable?
7. When will the money be needed?
8. When will the money be repaid?
9.

D. Possible activities:

*1. Have each class member determine the capital expenses and major operating costs for improving or expanding the major farm enterprise. (ex. Changing the corn harvesting method for 15,000 bushels, adding facilities for 100 steers or 120 litters.)

*2. Have each class member estimate the returns for the increased volume and how long it will take him to repay the borrowed money.

3. Using a large chart, illustrate some of the differences in capital outlay and operating expenses for different enterprises.

4.

E. Partial list of references and teaching aids:

AERR-63, Economic Considerations in Choosing a Corn Harvesting Method
Problem: How Much Capital is Needed to Change the Method of Harvesting Corn?
Sheet: Costs of Alternative Corn Harvesting Methods
AE-3971, Guides for Use in Planning Beef Feeding Systems
AE-3973, Guides for Use in Planning Hog Production Systems

IV. Determining whether money can be borrowed for family activities and/or home improvement without unduly interfering with the farm business financial program.

A. Teacher objectives: Develop in the students an affective ability to--

1. Plan a family budget

2. Plan a home improvement budget

3. Coordinate business and family expenses

4. Plan a repayment program

5.

B. Possible interest approaches:

1. Prepare a large chart, perhaps on wrapping paper, to illustrate examples of family expenses and home improvement

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*Possible activity for individual on-farm instruction

expenses. Using a sample business as an illustration, lead a group discussion to obtain opinion of class members concerning the effect of these expenses on the farm business; and/or

2. Ask such questions as: (a) Do you give as much consideration to family expenses as you do to business expenses? (b) Which come first, business expenses or family expenses?

3. Develop class objectives and a list of problems to be studied.

C. Anticipated questions, problems and concerns

1. What are family consumption loans and home improvement loans?

2. How do these loans affect the farm business financial program?

3. What factors need to be considered when planning for these loans?

4. How much money will be needed?

5. When will the money be needed?

6. When will the money be available for repayment?

7.

D. Possible activities:

*1. Have each class member determine the "esential" family consumption and home improvement expenses.

*2. Have each class member determine the "needs" and "wants" for the family's consumption and for home improvements.

*3. Have each class member plan a family budget to determine how much money is needed, how much money will be available, what loans are needed, and when the money can be repaid.

4. Invite the wives to attend the class.

5. Provide samples of budgets for family living needs and home improvement needs.

6.

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*Possible activity for individual on-farm instruction

E. Partial list of references and teaching aids:

Farm and Family Business Management - Part IV. (also in I - E)
Money Management Library
Illinois Family Incomes and Expenditures
Illinois Family Account Book

V. Adjusting the marketing program to take maximum advantage of credit.

A. Teacher objectives: Develop in the students an affective ability to--

1. Anticipate seasonal price variation in determining future income

2. Anticipate price cycles of swine and beef in determining future income

3. Plan an advantageous marketing program

4. Decide whether to sell or store corn

B. Possible interest approaches:

1. Outline an example of a marketing program for hogs, (see Feeder Pig Problem), on the chalkboard. Have class determine returns based on seasonal prices. Lead discussion to obtain class members opinions about the program; and/or

2. Ask such questions as: (a) Does a good marketing program increase the availability of credit? (b) Does a good marketing program reduce the amount of credit needed?

3. Develop class objectives and a list of problems to be studied.

C. Anticipated problems, questions, and concerns

1. How does a marketing program affect credit?

2. How does a marketing program affect loan repayment?

3. What seasonal price variations can be advantageous?

4. What additional costs are necessary to get higher prices?

5. What changes in procedures may be advantageous in the marketing program being followed?

6. How can hedging be used to advantage?

7.

D. Possible activities:

1. Have class examine the sample budget form (Problem Area II) to determine how marketing affected the credit program.

2. Have class determine if the sample marketing program takes best advantage of the seasonal marketing variations.

*3. Have each class member consider his marketing situation to see if it is advantageously organized.

4. Use a large chart to illustrate how seasonal price variations affect income.

5. Show hedging filmstrip and discuss.

6.

E. Partial list of references and teaching aids:

Some Reference Materials on Marketing (a list of over 20 references and their sources)

VI. Selecting an appropriate lender or lending agency

A. Possible teacher objectives: Develop in the students an affective ability to--

1. Identify the type of loan needed

2. Calculate interest rates

3. Compare lenders or lending agencies

4. Select an appropriate source of credit

5.

B. Possible interest approaches

1. Illustrate, using a chalkboard, how the amount of interest actually paid differs when secured from a "low cost" source and from an "expensive" source. Lead a group discussion to determine class members opinions of different sources of credit; <u>and/or</u>

2. Ask such questions as: (a) Do you know how much interest you actually pay? (b) How much money can you save by

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*Possible activity for individual on-farm instruction

careful selection of lenders or lending agencies?

3. Develop class objectives and a list of problems to be studied.

C. Anticipated problems, questions, and concerns:

1. What types of cash loans and credit are available to farmers in this area?

2. What are the loan policies of these lenders or lending agencies?

3. What interest rates are common?

4. How do you calculate interest rates?

5. What characteristics should a lender or lending agency possess?

6.

D. Possible activities:

1. Have class members discuss types of loans available.

2. Secure and distribute policy brochures for local lending agencies.

3. Calculate a simple interest rate problem with the class.

4. Distribute "interest calculators" and have class members check the interest rate calculated in 3.

5. Use VAS Unit 2027, Securing Farm Credit, as a teacher guide, lead a group discussion on characteristics of a lender.

6. Use a flannel board as a visual aid and develop a list of important characteristics of lenders or lending agencies.

7.

E. Part. list of references and teaching aids:

Folders from PCA and FHA
Your Illinois Banks
Farm and Family Business Management - Part V. Financing the Farm Business
Michigan State, Interest Rate Calculator
VAS Unit, 2027, Sources of Farm Credit

VII. Obtaining cash loans or credit

A. Possible teacher objectives: Develop in the students an affective ability to--

1. Provide necessary farm business information

2. Provide necessary personal information

3. Complete necessary legal papers

4. Become a good credit risk

5.

B. Possible interest approach:

1. Have the class role play a situation where a farmer wants to secure a loan and the class must make the decision. The teacher takes the role of the farmer. Provide, using charts or chalkboard, a minimum amount of business and personal information. Have the class decide if the loan should be made; <u>and/or</u>

2. Ask such questions as: (a) What makes you a good credit risk? (b) What information can you provide a lender?

3. Develop class objectives and a list of problems to be studied.

C. Anticipated problems, questions and concerns:

1. What farm business information should be available?

2. What personal information should be available?

3. What characteristics would the lender or lending agency seek in a potential client?

4. What legal papers are usually completed?

5. What are the purposes of the legal papers?

6.

D. Possible activities:

1. Lead a class discussion about the information needed to secure a loan. Emphasize the use of farm business records.

2. Using VAS Units as teacher references, lead a discussion on characteristics of a borrower.

3. Use a flannel board to develop a list of appropriate characteristics of borrowers.

4. Use a banker, PCA fieldman, or FHA fieldman as a resource person to discuss how to obtain a loan.

5. Collect samples of common legal papers related to credit and distribute to class.

6. Using VAS Unit 2034, Credit Instruments, as a teacher reference, lead class discussion.

7.

E. Partial list of references and teaching aids:

VAS Unit 2027, Sources of Farm Credit (also in VI - E)
VAS Unit 2028, Factors Involved in the Borrowing Process
VAS Unit 2034, Credit Instruments
AE - 3796, The New Illinois Commercial Code and Farm Financing
Common credit instruments obtained locally

VIII. Managing credit in relation to income tax regulations

A. Possible teacher objectives: Develop in the students an affective ability to:

1. Take advantage of end-of-year credit

2. Take advantage of depreciation regulations

3.

B. Possible interest approach:

1. Illustrate, using the chalkboard, how the cost of borrowing money for certain purchases can be reduced by taking advantage of tax regulations. Lead a group discussion to determine the opinions of class members as to the need for tax management in relation to credit; and/or

2. Ask such questions as: (a) Is it possible to borrow money and by taking advantage of tax regulations, pay the loan off sooner than would normally be possible? (b) Can you reduce the cost of credit by taking advantage of tax regulations?

3. Develop class objectives and a list of problems to be studied.

C. Anticipated problems, questions and concerns:

1. What tax regulations apply to borrowed capital?

2. How can credit be used to take advantage of income tax regulations?

3. What income tax regulations can help improve your credit standing?

4. What farm business information is needed to plan a tax management program?

5. What adjustments in the farm business are in line with good tax management?

6.

D. Possible activities:

1. Discuss the major depreciation methods, especially the straight line method. Also, include investment credit and additional first year depreciation in the discussion

2. Discuss the use of Schedule D for breeding stock and stock held for 12 months or more.

3. Use a large chart or overhead projector to show how to fill in Schedule D for a sale of sows.

4.

E. Partial list of references and teaching aids·

Farmer's Tax Guide
North Central Regional Publication on Income Tax Management
(Being revised at this time)
1964 Revenue Act -- Provisions of Significance to Farmers

IX. Protecting the farm business through an insurance program

A. Possible teacher objectives: Develop in the students an affective ability to:

1. Identify major business risks affecting financial success

2. Select appropriate methods for protecting against loss

3. Select the most advantageous protection program

4.

B. Possible interest approach:

1. Lead a group discussion to determine class members opinions of business risks which need to be covered, how the risks can be covered and the cost of securing the needed protection; <u>and/or</u>

2. Ask such questions as: (a) How have you protected business against an "act of God" that would reduce your ability to meet credit obligations? (b) Would your farm business recover from a major loss of buildings, livestock, crops, or equipment?

3. Develop class objectives and a list of problems to be studied.

C. Anticipated problems, questions and concerns:

1. What business risks need to be insured?
2. What are the major ways in which these risks can be covered?
3. Why are these procedures effective?
4. What are the common types of insurance policies available to cover these risks?
5. What important points should be checked in an insurance policy?
6.

D. Possible activities

1. Invite wives to the meeting.
2. Use a flannel board to develop a list of major farm business risks.
3. Use the same flannel board and add ways in which risks may be protected.
4. Collect samples of common insurance policies and use in class as references.
5. Show film strip(s) about the major types of insurance for the farm business.
6. Have a good insurance agent serve as a resource person to discuss policies available to meet the major risks (be sure agent knows what questions you want him to discuss.)
7.

E. Partial list of references and teaching aids:

Slidefilm, Insurance in the Farm Business
Teacher's Manual for Insurance in the Farm Business (available with filmstrip)
Ill. Circ. 832, Insurance for Farmers -- Property, Liability, Medical

X. Protecting the family's welfare through a personal insurance program

A. Possible teacher objectives: Develop in the students an affective ability to:

1. Identify the major risks which would affect family welfare

2. Select appropriate methods for protecting against these risks
3. Selecting the most advantageous protection program
4.

B. Possible interest approaches:

1. Lead a group discussion to illustrate how an "act" of God" such as serious illness could affect the business financial program and family welfare; <u>and/or</u>
2. Ask such questions as: (a) Where would money be obtained to pay doctor and hospital bills if you had no personal insurance? (b) How would this affect the business?
3. Develop class objectives and a list of problems to be studied.

C. Anticipated problems, questions and concerns:

1. Is the family protected against major farm business losses?
2. What family risks need to be insured?
3. What are the major ways in which the family can be protected against these risks?
4. How much protection is needed?
5. What common types of insurance policies are available?
6. What major points should be checked in an insurance policy?
7. How can an insurance program be evaluated?
8. How can insurance be used for saving money or getting a loan?

D. Possible activities

1. Invite wives to the meeting.
2. Use a flannel board to develop a list of family risks which need to be protected.
3. Use the same flannel board as above and add ways the risks may be protected.
4. Collect samples of common insurance policies and use in class as references.
5. Show film strip(s) on personal insurance.

6. Have a good insurance agent serve as a resource person to discuss available forms of personal insurance (be sure the agent knows what questions you want him to discuss).

E. Partial list of references and teaching aids:

Michigan State Ext. Folder F-320, Planning Family Insurance
Cornell Ext. Bull. 1002, Life Insurance for Farm Families
Catalog of Teaching Aids, Institute of Life Insurance
The Farm Family Looks at Life Insurance
Social Security Materials
Slidefilm, Insurance in the Farm Business (also in IX E)

AGRICULTURAL BUSINESSMEN

This section of the materials has been developed to guide a teacher in planning systematic instruction for agricultural businessmen. Most of the subject matter included in the young and adult farmer outline would be appropriate for businessmen. However, agricultural businessmen have a different interest in the subject. They would primarily be interested in identifying the credit capacity of potential customers and how credit supervision might be provided. A large group of agricultural businessmen could be best taught by offering a course designed specifically for them. A small number of agricultural businessmen would probably be best taught in the young or adult farmer course.

A list of possible problem areas has been developed to aid the teacher. Interest approaches, anticipated problems, teaching activities, and references mentioned in the young and adult farmer section can be adapted for use in teaching agricultural businessmen.

Problem Areas

I. Determining the financial success of a farm business.

II. Determining whether a farm business will be improved through extending credit to meet operating expenses.

III. Determining whether a farm business will be improved through extending credit for expanding or changing an enterprise.

IV. Determining whether a farm business and the family will be benefited through the extension of credit.

V. Understanding how income tax regulations affect farmers use of credit.

VI. Determining a minimum insurance program for a farm business.

VII. Determining a minimum insurance program for a farmer's family.

VIII.

HIGH SCHOOL STUDENTS

This section of the materials has been developed to guide the teacher in planning systematic instruction for high school students. Problems related to the financial management of an entire farm business are generally of no immediate concern to high school students. It would appear that emphasis should be placed on developing basic understandings at the junior or senior level. More detailed instruction would be provided later through young farmer courses, adult farmer courses or courses for agricultural businessmen.

A list of possible problem areas and teacher objectives has been prepared to aid the teacher in planning. Interest approaches, teaching activities and references included in the younger farmer and adult farmer section should provide ideas that can be adapted for use with high school students. Anticipated problems, questions and concerns would need to be developed based upon the students experiences and knowledge of their home farm and/or farming program. Problem areas I, V, and VI are explained in more detail in the publication Farm Business Management, A Sample Procedure for Organizing Course Outlines, distributed at the 1963 summer workshop on farm management.

Problem Areas and Teacher Objectives

I. Determining the financial success of the home farm business

    A. Possible teacher objectives: Develop in the students an affective ability to--

        1. Calculate measures of financial success

        2. Analyze a profit and loss statement

        3. Analyze net worth statements

        4.

II. Determining whether it would be profitable to borrow money to operate a particular farm enterprise on the home farm

    A. Possible teacher objectives: Develop in the students an affective ability to--

        1. Analyze operating expenses

        2. Complete a budget

        3. Plan a repayment program

        4.

III. Determining whether it would be profitable to borrow money to expand operations on the home farm

A. Possible teacher objectives: Develop in the students an affective ability to--

1. Analyze projected costs and returns based on new volume

2. Recognize major capital expenses

3. Recognize major changes in operating expenses

4. Plan a repayment program

5.

IV. Determining whether it would be profitable to borrow money to improve a particular enterprise on the home farm

A. Possible teacher objectives: Develop in the students an affective ability to--

1. Analyze projected costs and returns based on new method

2. Recognize major changes in operating expenses

3. Recognize major changes in capital expense

4. Plan a repayment program

V. Determining how to secure money for making home farm adjustments

A. Possible teacher objectives: Develop in the students an affective ability to--

1. Calculate interest rates

2. Identify important characteristics of lender or lending agency

3. Identify important characteristics of a borrower

4. Recognize important legal documents

5.

VI. Planning an insurance program to protect the home farm business and family

A. Possible teacher objectives: Develop in the students an affective ability to--

1. Appreciate the need for protection

2. Recognize major business risks

3. Recognize major risks affecting family welfare

4. Identify appropriate insurance programs

5. Understand important parts of insurance policies

6.

VII. Determining how family and home improvement expenses affect the farm business financial program

A. Possible teacher objectives: Develop in the students an affective ability to--

1. Determine fixed personal expenses

2. Plan a personal budget

3. Recognize where the money comes from to meet family expenses

4.

VIII. Determining how the marketing program followed on the home farm affects the farm business financial program

A. Possible teacher objectives: Develop in the students an affective ability to--

1. Understand seasonal price variations

2. Understand long run price cycles

3. Recognize influence of marketing on income

4.

SOURCES OF REFERENCES AND TEACHING AIDS

This section of the material contains a listing of all references and teaching aids mentioned previously and where they may be obtained. This list supplements Farm Business Management, Partial List of Sources of References and Teaching Aids distributed at the 1963 summer short courses.

AE-3796, The New Illinois Commercial Code and Farm Financing (Included in Nov. 1962 Ag. Releases)*

AE-3971, Guides for Use in Planning Beef Feeding Systems *

AE-3973 Guides for Use in Planning Hog Production Systems *

AERR-63, Economic Considerations in Choosing a Corn Harvesting Method *

Annual Summary of Farm Business Records (The 1962 report was issued as Cir. 874)**

Catalog of Teaching Aids, Institute of Life Insurance, 488 Madison Ave., New York (Distributed at 1964 summer short course)

Cornell Ext. Bull. 1002, Life Insurance for Farm Families *

Farm Business Adjustments for Improved Efficiency *

Farm Business Management, Sample Procedure for Organizing Course Outlines ***

Farm Business Management, Partial List of Sources of References and Teaching Aids ***

Farm and Family Business Management - Part III, Family Economics *

Farm and Family Business Management - Part IV, Farm Business Adjustments, Alternative Plans, ... *

Farm and Family Business Management - Part V, Financing the Farm Business *

Farm and Family Financial Budget Form *

Farm and Family Financial Planning Problem *

Farmer's Tax Guide (Local Internal Revenue Offices and Farm Advisers should have current materials about January 1 of each year. Single copy sent in Ag. Releases)

Farm Management Manual *

FHA materials (See local organizations for copies of available materials)

Ill. Cir. 832, Insurance for Farmers - Property, Liability, Medical **

Illinois Family Account Book (50 cents) **

Illinois Family Incomes and Expenditures (In Ag. Releases, late fall or early winter)

Income Possibilities Form *

Michigan State Ext. Folder F-320, Planning Family Insurance *

Michigan State Ext Folder F-322, Interest Rate Calculator *

Money Management Library (Available from Money Management Institute of Household Finance Corporation, Prudential Plaza, Chicago 60601. Order List handed out at 1964 summer short course.)

North Central Regional Publication on income tax management (Being revised. Check future Ag Releases or mailings from Extension Service.)

Our Net Worth Statement *

Partial Budget Form *

PCA materials (See local agency for copies of available materials.)

Problem: How Much Capital is Needed to Change the Method of Harvesting Corn? *

Sheet: Costs of Alternative Corn Harvesting Methods *

Slidefilm, Insurance in the Farm Business (Country Life and Country Mutual Insurance Companies in cooperation with Vocational Agriculture Service. A 25 cent charge to cover handling)**

Social Security materials, OASI-35A, Your Social Security (See your local Social Security Office)

Some Reference Materials on Marketing *

Teacher's Manual for slidefilm, Insurance in the Farm Business (Available with the slidefilm)**

The Farm Family Looks at Life Insurance (Single reference copy only from Institute on Life Insurance for use in 1964 summer short course)

VAS Unit 2008a, Record Keeping on the Farm **

VAS Unit 2024, The Use of Credit to Increase Farm Earnings **

VAS Unit 2025, Credit Needs on the Farm **

VAS Unit 2026, Farmer Jones' Plans for Repayment of Loans **

VAS Unit 2027, Sources of Farm Credit **

VAS Unit 2028, Factors Involved in the Borrowing Process **

VAS Unit 2034, Credit Instruments **

Your Illinois Banks (See local bankers for copies)

1964 Revenue Act - Provisions of Significance to Farmers (Distributed at 1964 summer short course)

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* On Vocational Agriculture Service Order Blank for 1964 summer short course. Contact Vocational Agriculture Service, 434 Mumford Hall, College of Agriculture, University of Illinois, Urbana 61803 (Cost varies according to item. Limited copies of some items)

** Order from Vocational Agriculture Service, 434 Mumford Hall, College of Agriculture, University of Illinois, Urbana 61803 (Cost varies according to item)

*** Write Agricultural Education Division, 361 College of Education Building, University of Illinois, Urbana 61803

VT000 697

VT 000 697 ED (See July 1968 RIE)
Emergency Victim Care and Rescue, Textbook for Squadmen.

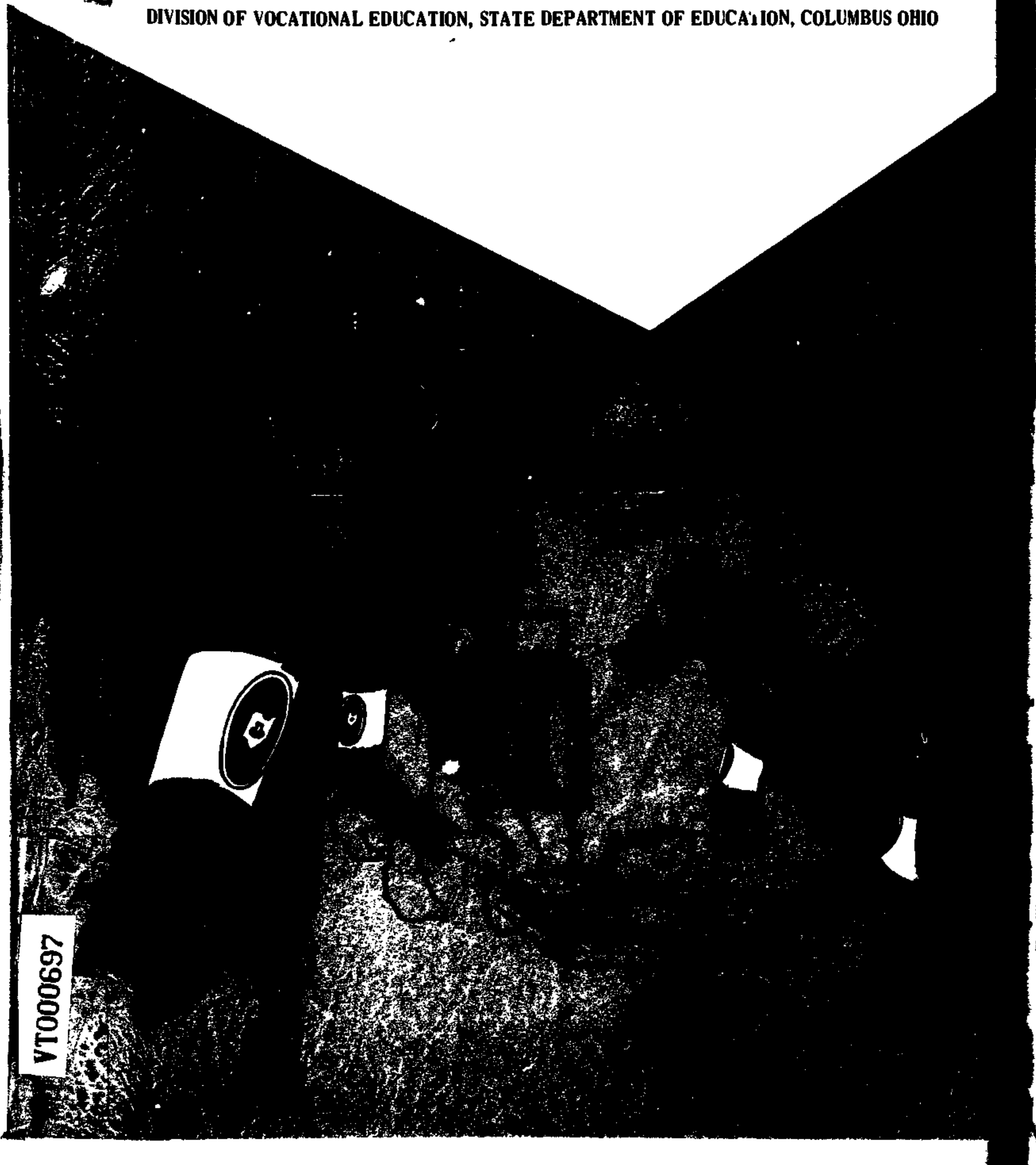
Ohio State Dep of Educ, Columbus. Trade and Ind Educ Serv
Pub Date - 65
EDRS PRICE MF-$1.25 HC-$13.32 332p.

*TEXTBOOKS, *HEALTH OCCUPATIONS EDUCATION, *EMERGENCY SQUAD PERSONNEL, FIRST AID, MEDICAL SERVICES, *RESCUE, ADULT VOCATIONAL EDUCATION,

Designed for training emergency squad personnel in rescue procedures and victim care beyond basic first aid, this textbook was developed by a committee of squadmen, doctors, nurses, firemen, and state trade and industrial personnel to be used in adult training classes of full-time or volunteer squadmen. The instructional material includes 26 chapters with photographs and drawings. New medical findings regarding closed-chest heart compression, artificial respiration, first aid for laryngectomy victims, and other phases of first-aid work including the most recent rescue procedures and techniques are presented. Representative chapter titles are (1) Childbirth, (2) Common Squad Emergencies, (3) Oxygen Therapy, (4) Electrical Emergencies, (5) Waterfront Operations, (6) Records and Reports, (7) Post-Mortem Conferences, and (8) Legal Aspects. Each chapter provides an introduction to the emergency, defines terms, lists symptoms, and explains the equipment, methods, and procedures needed to adequately handle the situation. The course should be taught by a qualified squadman. An instructor's manual (VT 004 066) is available. This textbook is available for $4.15 from Ohio Trade and Industrial Education Service, Instructional Materials Laboratory, The Ohio State University, 1885 Neil Avenue, Columbus, Ohio 43210. (HC)

EMERGENCY VICTIM CARE AND RESCUE

DIVISION OF VOCATIONAL EDUCATION, STATE DEPARTMENT OF EDUCATION, COLUMBUS OHIO



EMERGENCY VICTIM CARE AND RESCUE

TEXTBOOK FOR SQUADMEN

OHIO TRADE AND INDUSTRIAL EDUCATION SERVICE

DIVISION OF VOCATIONAL EDUCATION
STATE DEPARTMENT OF EDUCATION
COLUMBUS, OHIO

SECOND EDITION

Edited and distributed by the:
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MEMORANDUM

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(Address) 1885 Neil Avenue, Columbus, Ohio 43210

DATE: August 10, 1967

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PREFACE

The Trade and Industrial Education Service within the Division of Vocational Education, The State Department of Education, has assisted public schools to provide training in Trade and Industrial occupations to the citizens of Ohio since 1918. Its purpose has been to prepare young men and women for employment in all types of industrial and service work, as well as to upgrade adult workers for greater efficiency in their chosen field.

Ohio can be truly proud of the vocational instruction provided to local communities in fire service training. This training has undoubtedly been responsible for saving many lives and preventing much property loss in the state. Emergency rescue training has been developed to further serve the citizens of Ohio by providing well-qualified persons to deal with emergency situations. The personnel trained may be members of fire departments, police departments, or other agencies who are involved in the emergency treatment and rescue of people.

This revised and expanded volume is designed to serve as a text for emergency rescue training and includes the latest information on sound practices in emergency squad work.

E. E. Holt, Superintendent of
Public Instruction

Byrl R. Shoemaker
Director of Vocational Education

FOREWORD

The importance of adequate training for emergency squad personnel, in rescue procedures and victim care beyond basic first aid, has been obvious for some time. International as well as national medical and rescue associations have expressed a dire need for a solution to this training problem.

The Ohio Trade and Industrial Education Service, Division of Vocational Education, of the State Department of Education has taken an active part in the training of fire department personnel since 1939. Through the training and utilization of part-time instructors, the Trade and Industrial Education Service has been able to make fire service training available to all fire departments in the state. This training has given assistance to paid departments, and has been of particular help to volunteer departments. More recently a similar program has been developed for training emergency squad personnel in victim care and rescue procedures. Some of these emergency squads are parts of local fire departments and some are not.

In 1959 the Ohio Trade and Industrial education Service published an Emergency Rescue Squad Manual as a part of its training program. This comprehensive text was a pioneer in its field. A survey of literature had failed to disclose adequate materials for a complete training program. The materials available were fragmentary; each omitted vital phases of emergency and rescue squad work. The Emergency Rescue Squad Manual therefore filled a critical need. It has been widely distributed and has been reprinted every year since its publication.

Meanwhile new medical findings about closed-chest heart compression, artificial respiration, first aid for laryngectomy victims, and other phases of first-aid work have been introduced into Ohio's training program for emergency squadmen, along with the most recent rescue procedures and techniques. These new materials have been incorporated in this major revision of the original manual for squadmen titled "Emergency Victim Care and Rescue."

It is sincerely hoped that this revised text will become a part of all training programs for emergency squads within the State of Ohio.

Harry F. Davis, Supervisor
Trade and Industrial Education Service

ACKNOWLEDGMENT

This revised textbook has been a cooperative effort involving many persons concerned with emergency squad training.

The State Fire Service Advisory Committee for Trade and Industrial Education has given its support toward providing for an adequate training program. The organizations represented on this committee are: The Ohio Fire Chiefs' Association; The Ohio State Fire Marshal's Office; The Ohio State Firemen's Association; The Ohio Association of Professional Fire Fighters; The International Association of Fire Fighters; The Ohio Inspection Bureau; and The International Fire Chief's Association.

The first emergency rescue squad manual (1959 edition) was developed by the Ohio Fire Service Training Coordinators and a registered nurse with much rescue experience. The new text was prepared by Jack B. Liberator, R.N., former Emergency and Rescue Squad Training Coordinator for Trade and Industrial Education.

The present staff of Fire Service Training Coordinators are: C.J. Getz, Harry Ohlrich, Joe Heinzen, Frank Potts, and Rocco Morando, Emergency and Rescue Squad Training Coordinator.

A Medical Advisory Committee has given assistance on the chapters dealing with victim care, in order to provide the latest recommendations for care by squadmen. The committee consisted of the following: C. Joseph Hatfield, M.D., and Vol K. Philips, M.D., Internal Medicine; Walter Haynes, M.D., and Jack Tetirick, M.D., General Surgery and Chest Surgery; Charles R. McClave, M.D., and William Baldock, M.D., Pediatricians; John G. Boutselis, M.D., and William Merryman, M.D. Obstetrics; William Hamelberg, M.D., Anesthesiology; Robert R. Kessler, M.D., Orthopedic Surgery. All are staff members or chairmen of departments of the College of Medicine of the Ohio State University.

The Trade and Industrial Education Service also wishes to acknowledge the following persons, institutions, associations, and manufacturers for permission to use pictures, illustrations and certain other material used in this manual: Abbott Laboratories; American Druggist; American Heart Association, Inc.; Blackhawk Manufacturing Company; A.B. Chance Company; E & J Manufacturing Company; The Gerstenslager Company; Greenfield Township Fire Department; Linde Company; Division of Union Carbide Corporation; J.B. Lippincott Company; Loudonville Fire Department; Lynhurst Fire Department; McKesson Appliance Company; Maryland Civil Defense Agency; Mifflin Township Fire Department; Mine Safety Appliances Company; Motorola, Inc.; National Board of Fire Underwriters; National Welding Equipment Company; Northern Hills Fire Department; Ohio State Highway Patrol; Pleasantville Fire Department; Prairie Township Fire Department; Safety Clothing and Equipment Company; W. H. Salisbury & Company; Scott Aviation Corporation; Superior Coach Corporation; Sylvania Township Fire Department; Toledo Fire Department; White Rubber Company; Columbus Fire Department Emergency Squads; Franklin County Firemen's Association; Licking County Firemen's Association; Fairfield County Firemen's Association; Ohio State Fire Marshal's Office; International Rescue and First Aid Association; Medical Advisory Committee; Trade and Industrial Education Services, for Emergency and Rescue Squad Training; St. Anthony Hospital, Columbus; Mount Carmel Hospital, Columbus; Sharon Township Fire Department; Eastern Greyhound Lines; Convaire Aviation Corporation; Dr. Robert M. Reese for photography; Lost Cord Club of Columbus; Clinton Township Fire Department; Yorkville Fire Department; Dr. R. L.Dickinson; Dr. G. P. Shears; Zabriski-Eastman.

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CHAPTER I

EMERGENCY AND RESCUE VEHICLES

INTRODUCTION

Many of the residents of our communities today are the unfortunate and innocent victims of tragedies and disasters which, needless to say, are increasing in alarming numbers. As more and more traffic accidents, drownings, fires, explosions, tornadoes, floods, airplane crashes, and many other misfortunes occur, there is a tremendous need for well trained men and special equipment to handle these situations. It is a recognized fact that saving lives is of paramount importance where these emergencies occur. But it also must be recognized that the necessary equipment must be on hand to do the job. Emergency rescue units are being organized in steadily increasing numbers throughout the nation, to cope with these new demands. Encouragement to groups of men trying to organize such units is of vital importance. One way to do this is to make certain they are provided with the best training and the best equipment to make them into an efficient life-saving and rescue unit.

LOCAL NEEDS

Local needs for equipment will vary in accordance with the present as well as the future physical and financial conditions and circumstances in each community. It is well to analyze the local situation, to avoid jumping to any hasty conclusions. A number of important preliminary factors must be taken into consideration before attempting to organize an emergency rescue unit which is to provide the facilities normally relevant to its operation. Some of these factors are as follows:

1. Present and potential needs of community or area to be served
2. Topography of land and condition of roads
3. Terrain to be covered, including lakes and rivers
4. Number and availability of personnel to complement apparatus
5. The present and future road and industrial hazards
6. Financial situation relative to buying, maintaining, and providing necessary and additional tools and equipment
7. Continuing future community support of this operation
8. Type of service to be provided
9. Kind and amount of equipment to be carried on vehicles

After determining which of these factors are pertinent to the service you plan to offer the community, it can tentatively be decided what kind of apparatus and equipment is desired.

Now, what further information is needed which might influence a choice in this selection? Here are a few examples which will explain the thinking in this respect.

Where transportation to a hospital is to be carried out for victims of accidents, possibly an apparatus in the ambulance classification might be considered. If, however, local police, fire, or other sources provide such transportation, a greater need might exist for a light panel-type vehicle.

When bodies of water are present in the area to be served, it would be well to consider the possibility of towing or carrying a boat. This would also have some bearing on the size and type of vehicles to be selected.

Busy highways, expressways, turnpikes where major traffic accidents are apt to occur involving heavy tractors, trailers, and various large trucking operations, would probably indicate the need for a heavy rescue vehicle equipped with heavy rescue tools and appliances.

TYPES OF EMERGENCY AND RESCUE VEHICLES

Now let us assume that the need for a vehicle has been tentatively decided, and the selection of a vehicle is in order. What is available? In brief, here is a collective description and explanation of the potential units to choose from, to satisfy local needs.

There are three main styles of vehicles used by emergency and rescue units. Each style is suited for a particular emergency or rescue operation.

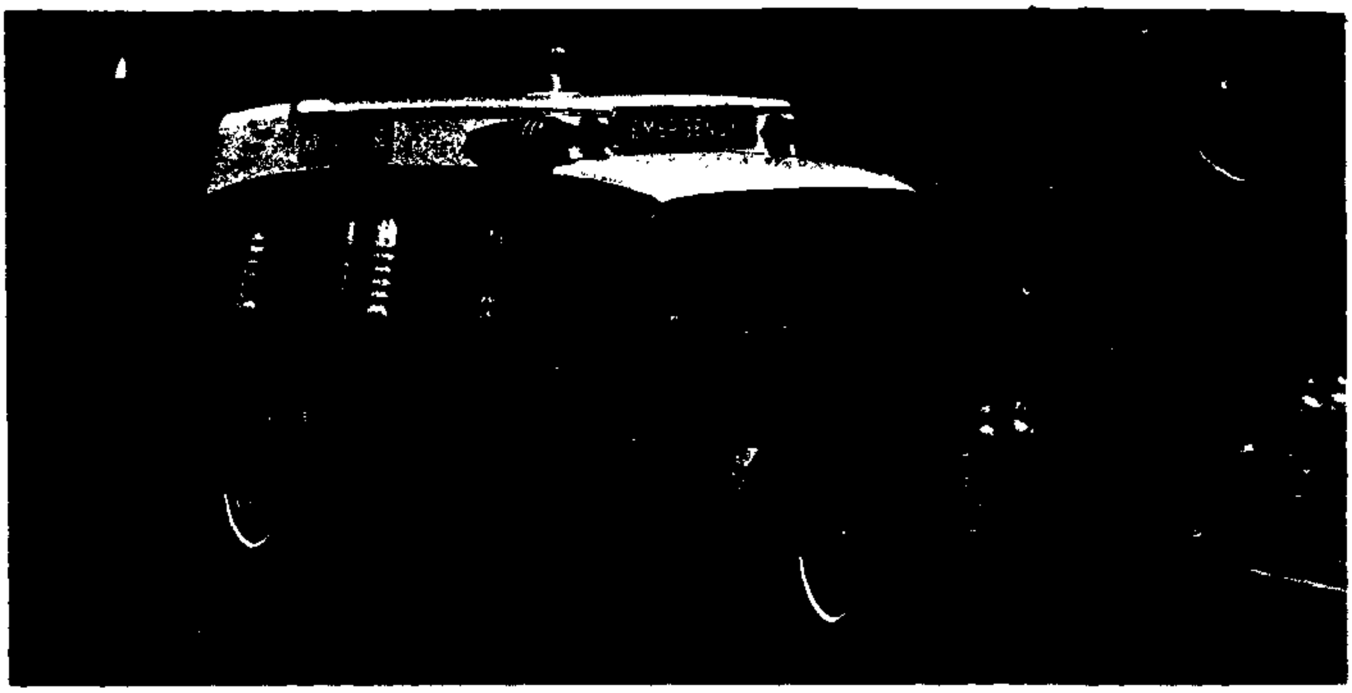
AMBULANCE

The ambulance is used almost entirely for transportation, but it may be designed for light rescue work.

There are various designs of ambulances built today by reputable manufactures. Many of these are "stock models". but others are built according to a buyer's specifications. Before a rescue squad decides which ambulance is best suited for their needs, the expected use of the vehicle must be established, along with the necessary tools and accessories which will be included. Although ambulances are used primarily for transportation, many of them carry first aid appliances, supplies and accessories including oxygen bréathing apparatus. (See Figures 1 and 2.)

Figure 1

Small ambulance



Courtesy Superior Coach Corp.

Figure 2
Large ambulance

This equipment is generally arranged to permit its use as follows:

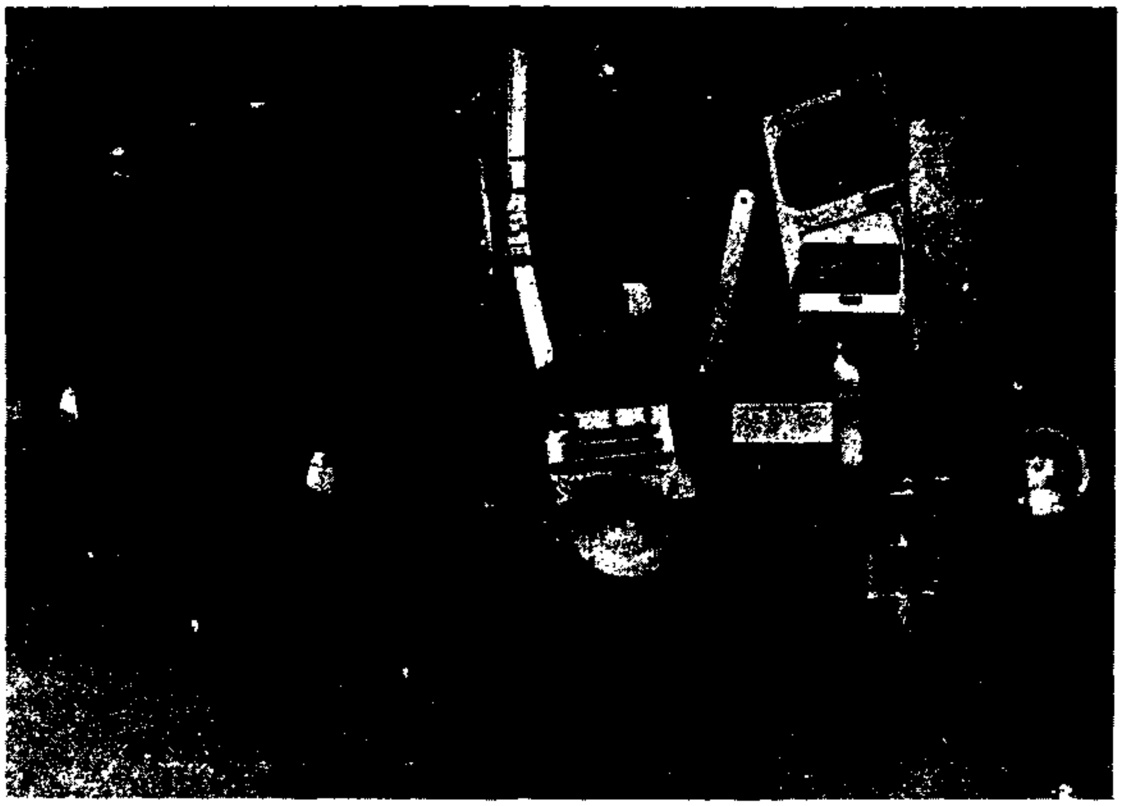
1. At the scene of an accident
2. Enroute to a hospital
3. While transporting a victim to or from the ambulance

It is important, however, that the buyer make a careful study to determine exactly what is needed. This will aid in drawing up the specifications which subsequently can be presented for bids. It is equally important to select the proper automotive chassis, in order to satisfactorily fulfill the needs in respect to safety, ease of handling, and the terrain to be traveled.

LIGHT RESCUE

The light rescue vehicle is adapted mainly for light rescue operations because of its restricted carrying capacity. However, in some instances these units are designed so they may also be used for transporting a victim or victims if necessary.

This type of equipment is generally built along the "panel" or "semi-panel" design, having a road capacity from one-half to one and one-half tons. One of the many functions it must often perform is to transport a boat, either on the top of the truck or by the aid of a trailer. In either case such an arrangement demands careful planning. These trucks are also designed to carry light rescue tools and equipment such as forcible-entry tools, jacks, breathing apparatus, masks, protective clothing, etc., plus the normal first aid supplies. In selecting this type of equipment for a rescue unit, prime consideration must be given to load limits so that the vehicle will not be overloaded beyond the weight for which it was built. (See Figure 3.)



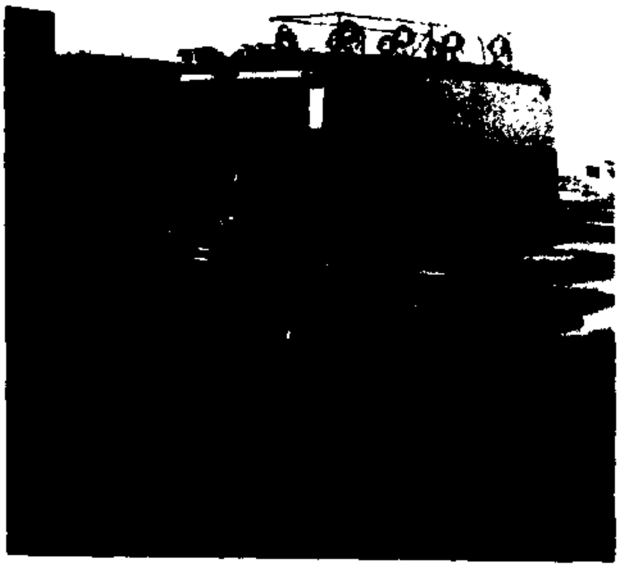
Courtesy Doylestown F.D.

Figure 3
Light rescue vehicle

HEAVY RESCUE

The heavy rescue vehicle is designed primarily for heavy-duty operations where a maximum carrying capacity is required, to transport all the tools, appliances and equipment to perform such operations. Some carry portable generators that operate saws, drills, hammers, and forced-air ventilating systems. Many of these heavy-duty units are equipped with a winch and cable for pulling heavy objects and/or "frame hooks" to be used with a tow-chain. Where these "straining" operations are to be demanded of the equipment, specifications should so state these provisions and include the necessary power units to perform such functions. (See Figures 4 and 5.)

Such a truck normally carries three to five tons above the weight of the truck itself. It is well to have a 20 per cent to 25 per cent weight allowance above the total weight of present equipment and men, because as time goes on, new and additional tools will be added and only a few will be discarded. Specifications should present instruction to the manufacturer to build a heavy-duty rescue truck having an engine and correlated parts designed to produce safe road-speed performance at safe engine revolutions per minute on the terrain it will normally travel. An extensive study of rescue trucks should be made before arriving at a final decision. Heavy-duty rescue trucks are not used for transportation of victims except in extreme emergencies.



Courtesy Northern Hills F.D.

Figure 4A

Courtesy Northern Hills F.D.

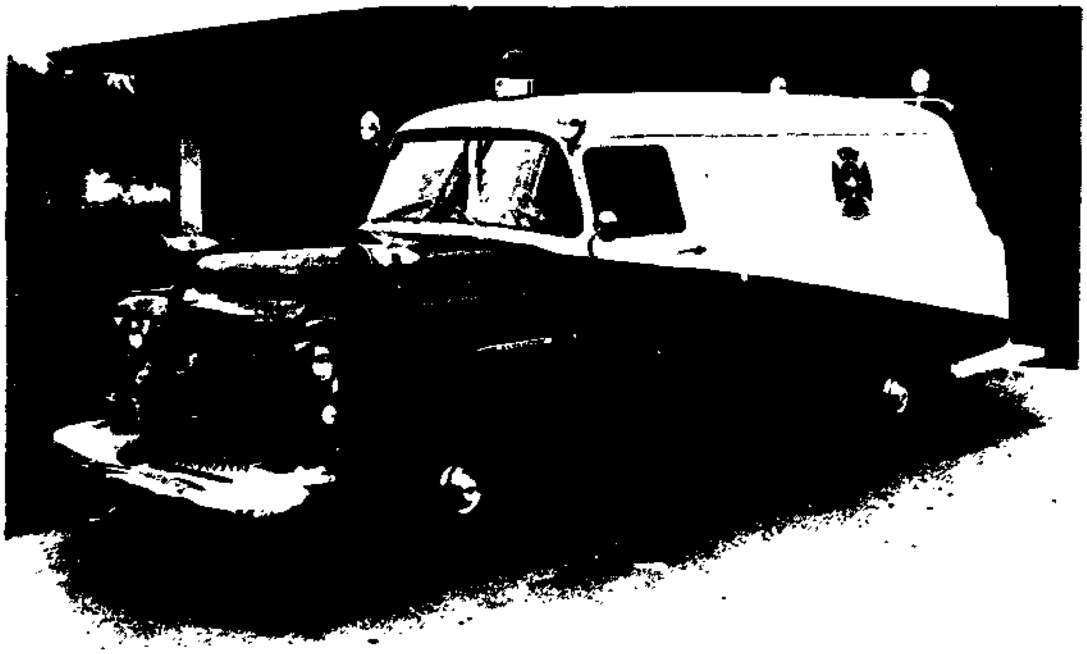
Figure 4B

Two views of a heavy rescue vehicle

Courtesy The Gerstenslager Co.

Figure 5

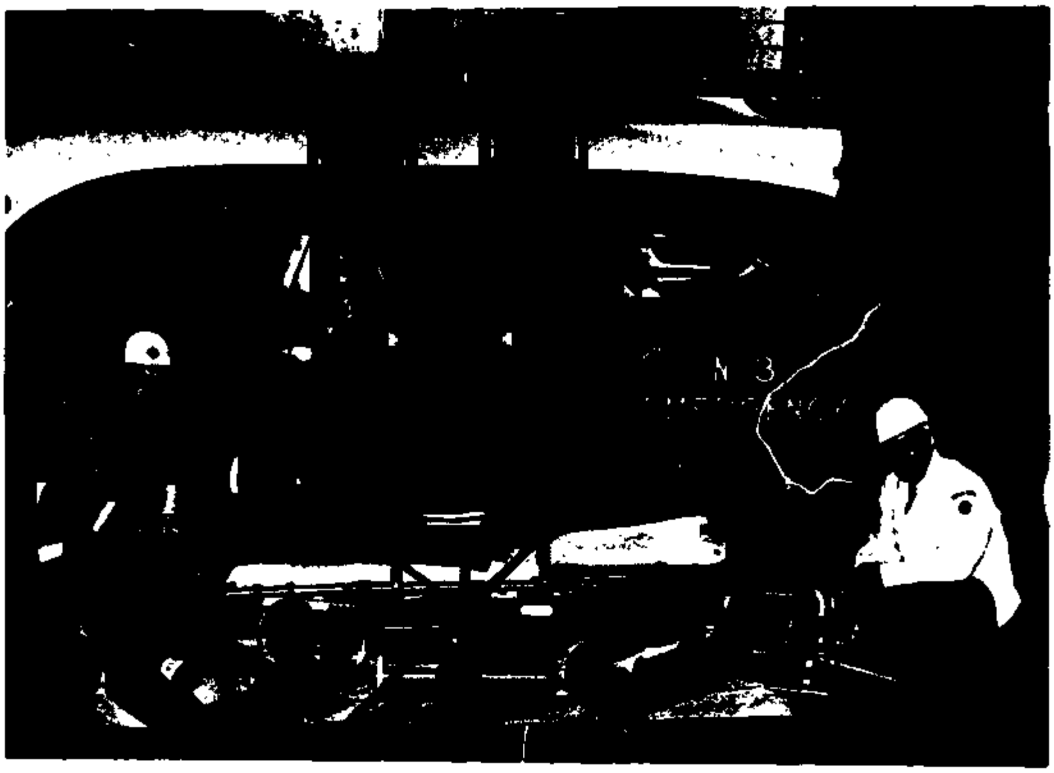
Heavy rescue vehicle



Courtesy Moorefield F.D., Piedmont, O.

Figure 6

A unique squad vehicle. It can transport, carry rescue tools, and also carry a tank of water for fire-fighting or stand-by. The vehicle shown above has all of these features plus a 500 g.p.m. front-mount pump. It can play many roles in emergency service.



Courtesy Canton Twp. F.D., Canton, O.

Figure 7

One might think that an ambulance is too small to do a proper emergency rescue squad job. As this photo shows, a great deal of equipment can be carried in an ambulance.

CONCLUSION

In conclusion it may be well to emphasize certain points which should be considered in the specifications before the selection and purchase of any vehicle, regardless of its classification:

1. Weight of chassis
2. Weight of equipment
3. Hauling weight (trailer and boat)
4. Horsepower
5. Type of wheels (single or dual)
6. Load limit established by manufacturer
7. If a used vehicle is considered, what is its mechanical and physical condition?

Overloaded vehicles result in breakdowns which render the unit unusable and unable to provide the service for which it was intended. Do not make the mistake of attempting to haul three tons of equipment on a one-ton truck.

CARE AND MAINTENANCE OF A VEHICLE

The care and maintenance of any emergency unit and every piece of equipment it carries is the direct responsibility, function, and obligation of those assigned to carry out this duty. Such responsibility should be delegated to dependable and reliable officers or men. But, regardless of who performs the clean-up operation, the officer in charge should direct the work and inspect the results. This procedure is not meant to infer that the men who did a clean-up job cannot be relied upon, but rather it places the different levels of responsibility where they belong. After all it is the officer's duty to see that this unit is ready to respond at all times.

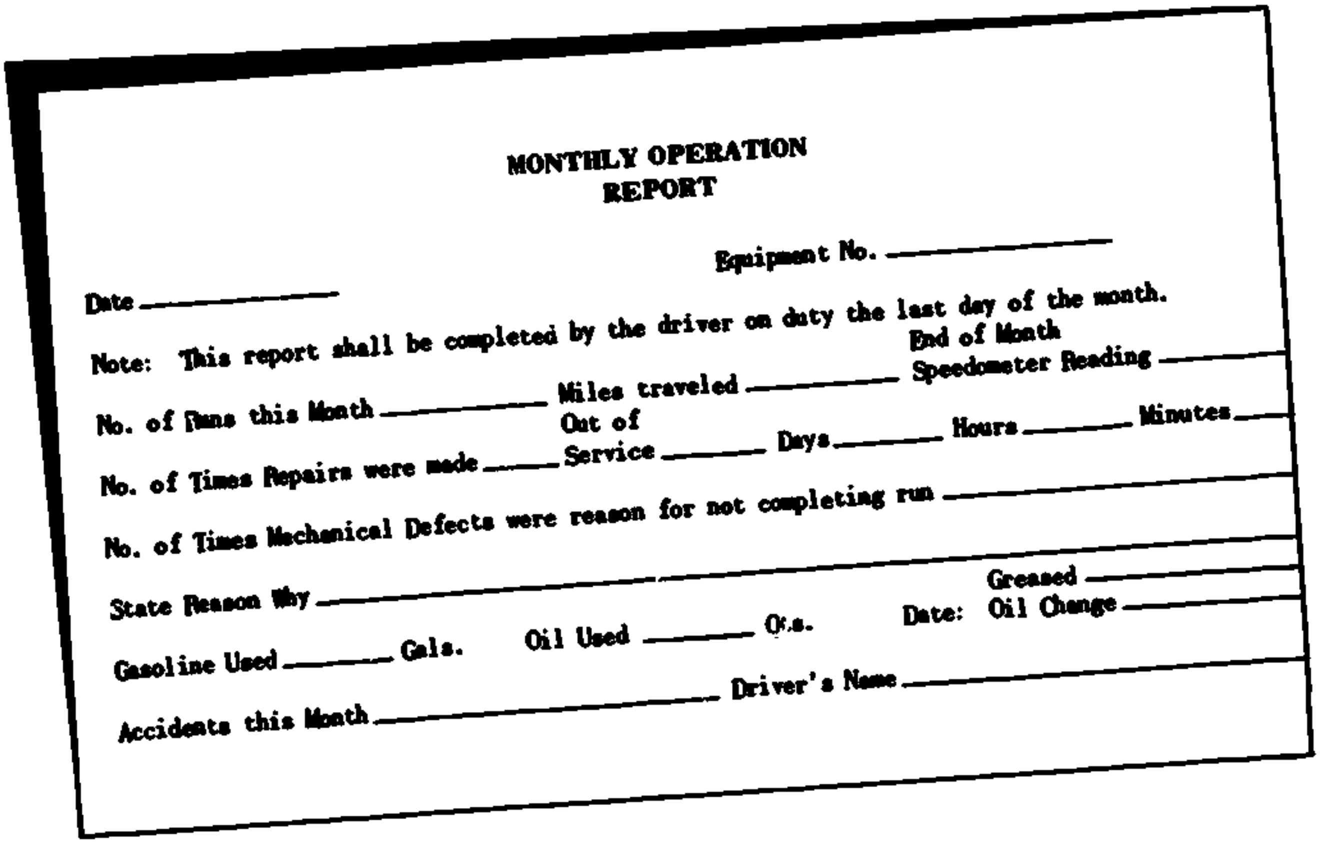
Therefore, in order to insure instant and efficient performance by an apparatus, it is imperative that certain items be checked and inspected after each run. The following list can be used as a guide to direct this inspection service. Other items can be added by the local department in accordance with existing policies, rules, and regulations.

The following items should be checked after each run for defects and services needed:

1. Brakes and their related parts
2. Gasoline and oil levels - Replenish if necessary and look for leaks.
3. Tires - Check for foreign bodies, for cuts, and for air pressure.
4. All gauges and instruments of the dash board
5. Battery, especially on radio-equipped vehicles
6. Radiator - Check water level of cooling system.
7. Safety belts, if so equipped
8. Lights - Head, tail, stop, directional, dash, dome, and warning lights
9. Steering mechanism
10. Mirrors - Rear and side(s)
11. Siren - Check for proper operation.

While on the subject of care and maintenance, one very important factor in this respect which must not be overlooked is CLEANLINESS. It has been very well established that one of the trademarks of any good emergency unit is its appearance. The squad truck must be kept clean inside and out, to protect patients as well as squadmen. The handling of contagious diseases is a good example of a reason for keeping the squad unit clean.

In addition to the routine inspection, it is advisable to have a complete and thorough periodic check of the automotive equipment. It is recommended that this be made on at least a monthly basis. An inspection record should be maintained on a report form, which will be filed for reference. The driver, a mechanic, or whoever is qualified or detailed to do this work as stipulated by local policy, should be held responsible for this job. Figures 8 and 9 are copies of forms used at the present time by some departments. Please note that only the signature of the person making the inspection is included on one of these, while on the other an additional signature by the officer is required. The latter definitely indicates to the officer the defects reported and his signature certifies he is aware of them. However, local policy shonld determine the procedure to be followed.



MONTHLY OPERATION
REPORT

Equipment No. ____________

Date ____________

Note: This report shall be completed by the driver on duty the last day of the month.

No. of Runs this Month ________ Miles traveled ________ End of Month Speedometer Reading ________

No. of Times Repairs were made ______ Out of Service ______ Days ______ Hours ______ Minutes ______

No. of Times Mechanical Defects were reason for not completing run ____________

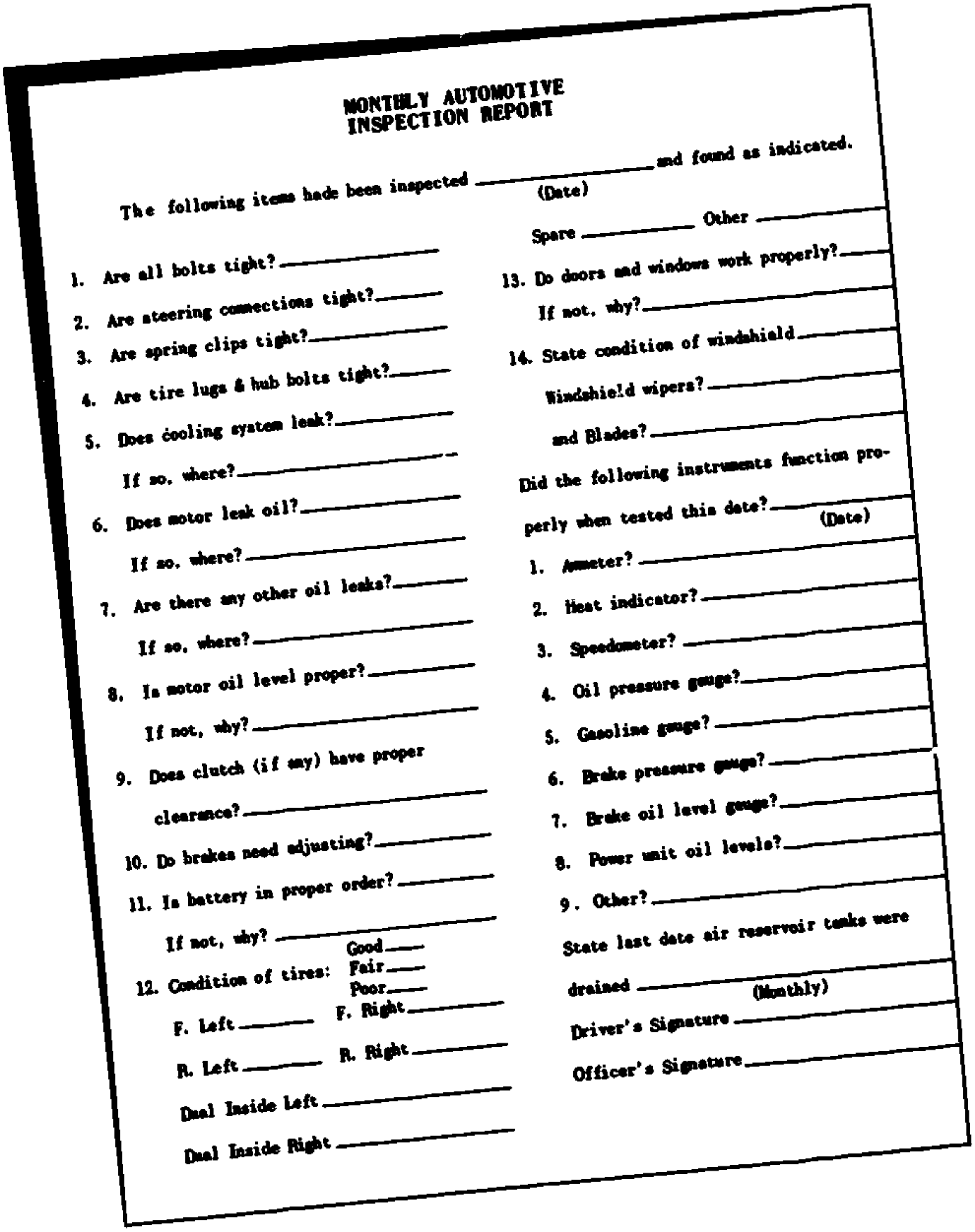
State Reason Why ____________

Gasoline Used ______ Gals. Oil Used ______ Qts. Date: Greased ______ Oil Change ______

Accidents this Month ____________ Driver's Name ____________

Figure 8

Monthly operation report



MONTHLY AUTOMOTIVE INSPECTION REPORT

The following items hade been inspected ____________ and found as indicated.
(Date)

1. Are all bolts tight? ____________
2. Are steering connections tight? ____________
3. Are spring clips tight? ____________
4. Are tire lugs & hub bolts tight? ____________
5. Does cooling system leak? ____________
   If so, where? ____________
6. Does motor leak oil? ____________
   If so, where? ____________
7. Are there any other oil leaks? ____________
   If so, where? ____________
8. Is motor oil level proper? ____________
   If not, why? ____________
9. Does clutch (if any) have proper
   clearance? ____________
10. Do brakes need adjusting? ____________
11. Is battery in proper order? ____________
    If not, why? ____________
12. Condition of tires: Good ____ Fair ____ Poor ____
    F. Left ________ F. Right ____________
    R. Left ________ R. Right ____________
    Dual Inside Left ____________
    Dual Inside Right ____________

Spare ________ Other ____________

13. Do doors and windows work properly? ____________
    If not, why? ____________
14. State condition of windshield ____________
    Windshield wipers? ____________
    and Blades? ____________

Did the following instruments function properly when tested this date? ____________
(Date)

1. Ammeter? ____________
2. Heat indicator? ____________
3. Speedometer? ____________
4. Oil pressure gauge? ____________
5. Gasoline gauge? ____________
6. Brake pressure gauge? ____________
7. Brake oil level gauge? ____________
8. Power unit oil levels? ____________
9. Other? ____________

State last date air reservoir tanks were drained ____________
(Monthly)

Driver's Signature ____________

Officer's Signature ____________

Figure 9

Monthly automotive inspection report

CHAPTER II

EQUIPMENT

INTRODUCTION

No greater service can be provided by any emergency or rescue squad than the saving of human lives. When an emergency occurs in which life is in danger, it is the duty of the emergency unit to be so equipped and trained that it will be able to render efficient and effective service.

To meet this obligation, squadmen must carry in their vehicle sufficient rescue and life-saving equipment to meet these situations. The equipment must be maintained in first class condition at all times, and everyone assigned to the rescue unit must be thoroughly trained in and familiar with its use.

Basic tools and equipment can be divided into two categories: those used for life saving and those used for rescue work.

NOTE: The following list of tools and equipment, although very comprehensive in nature, does not include every piece of equipment that might be used. Additional items pertinent to this operation can be added in accordance with local needs. The items chosen, and the quantities, must be in keeping with the type and size of vehicle.

LIFE-SAVING TOOLS AND EQUIPMENT

These include appliances necessary to save life and/or sustain life until the arrival of medical assistance or while enroute to a hospital.

FRACTURE EQUIPMENT

Fracture kit
- 12 Triangular bandages
- 6 Large safety pins
- 6 4 x 4 sterile compresses
- 6 4 x 12 inch splint boards
- 1 Roll 1-inch tape
- 6 Wooden tongue blades
- 1 Roll 2-inch gauze

This equipment should be assembled and carried in a container marked "Fracture Kit."

Additional equipment
- 2 Traction splints
- 4 Straps (5' x 4") to secure the patient to stretchers or backboards

OXYGEN - ADMINISTERING EQUIPMENT

Straight inhalator

Combination resuscitator, inhalator, aspirator with 50 ft. extension

Two extra tanks for each

FIRST AID KITS

Squad first aid kit (See Figure 1)
Large commercial first aid kit
(See Figure 2)

Courtesy Shaton Twp. F.D.

Figure 1

Many squads use a physician's bag or one similar as their first aid kit. These bags are durable and convenient. Note that one compartment holds emergency supplies for a physician. These supplies can be chosen on the recommendations of your local physician. The remaining part of the kit is filled with first aid supplies.

BLANKET ROLL SPLINT

This is made with a small blanket folded until it is 12 inches wide. It is then rolled from each end to the middle. It should be rolled very tight. Three cravat bandages can be tied around it to keep it in place. (Pictures on page 59.)

BLANKETS

Wool blankets should be available, to place under a victim or to wrap around him.

Courtesy Mine Safety Appliances Co.

Figure 2

Large commercial first aid kit

STERILE SHEETS

These sheets should be of white cotton material and be kept sterilized. Note: Local hospitals in some areas cooperate in providing sterilization service. Sheets can also be purchased pre-sterilized.

RUBBER SHEETS

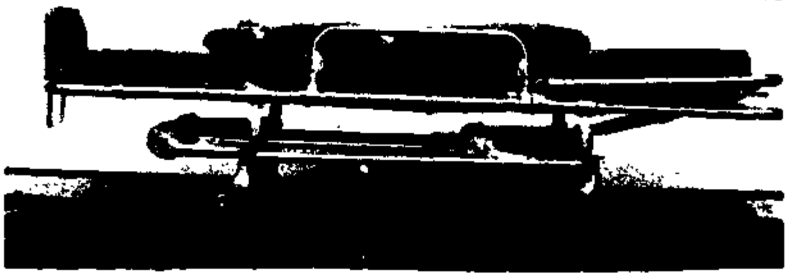
These sheets are used for protection of blankets, cots, etc.

O.B. (OBSTETRICAL) KIT

4 Hemostats (straight)
2 Foot-long pieces of umbilical tape
3 Pairs of sterile gloves
(assorted sizes)
1 Pair of sterile scissors
1 Ear syringe
Sterile towels
Soft baby blankets
Silver nitrate for installation into eyes
(Pictures on page 43.)

STRETCHERS

Ambulance-type (See Figure 3 and 4)
Collapsible stretcher (See Figure 5)
Adult backboard (See Figure 6)
Child backboard (See Figure 7)
Backboard foot rests (See Figure 6)



Courtesy Sharon Twp. F.D.

Figure 3

Courtesy Sharon Twp. F.D.

Figure 4

The newest type of stretcher is adjustable. It can be carried in the squad vehicle as shown in Figure 3. Upon arrival at the hospital, this stretcher can be raised to the height of the hospital cart, table, or bed, as shown in Figure 4. This permits transferring the patient with a minimum of movement, and eliminates lifting.

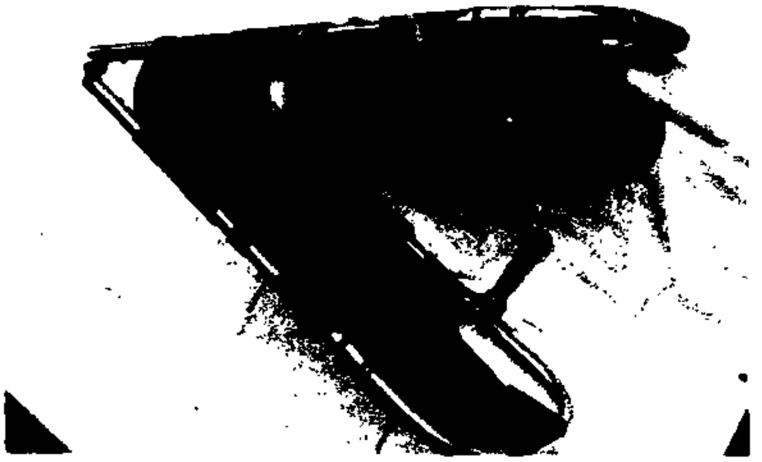
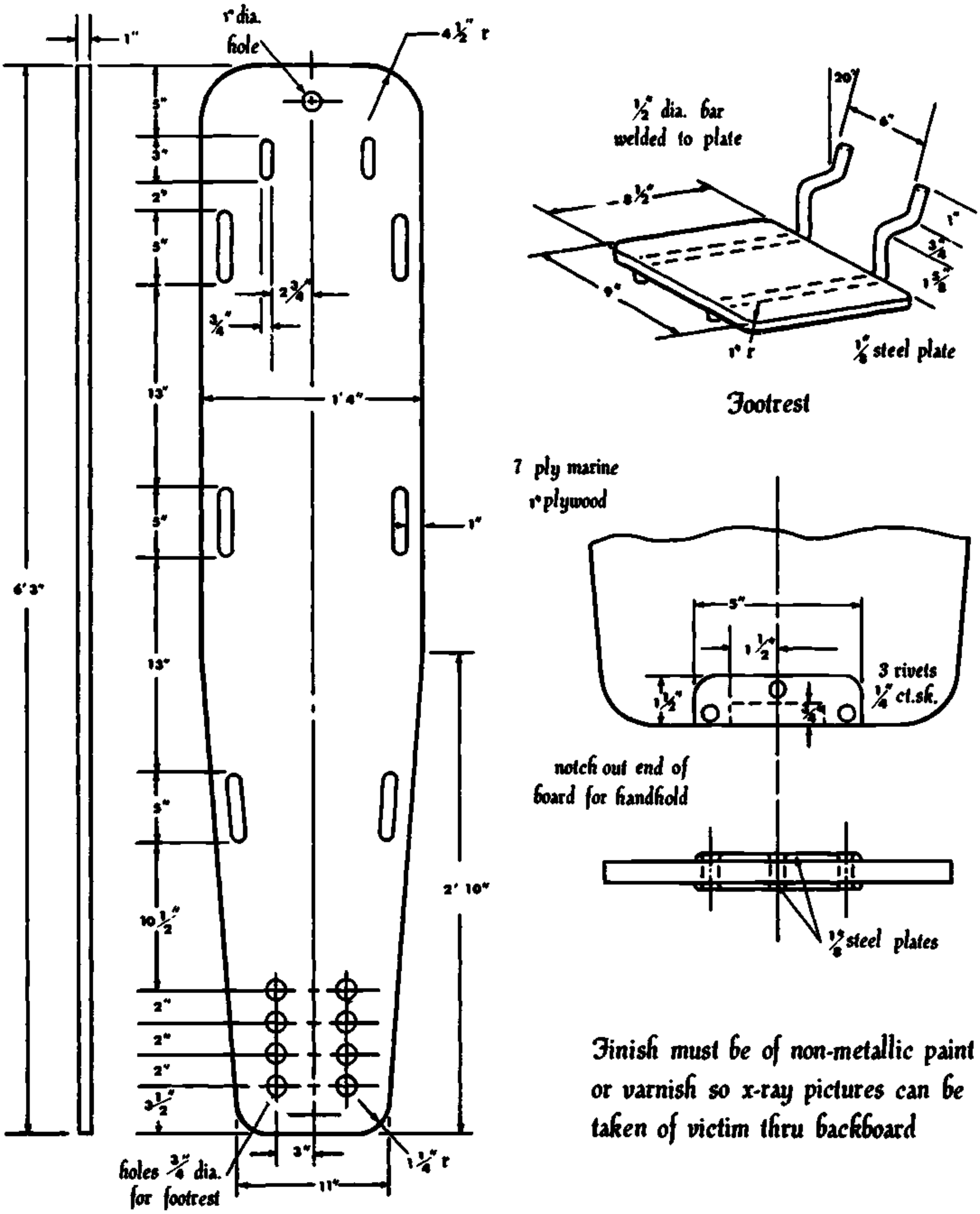


Figure 5

Courtesy Sharon Twp. F.D.

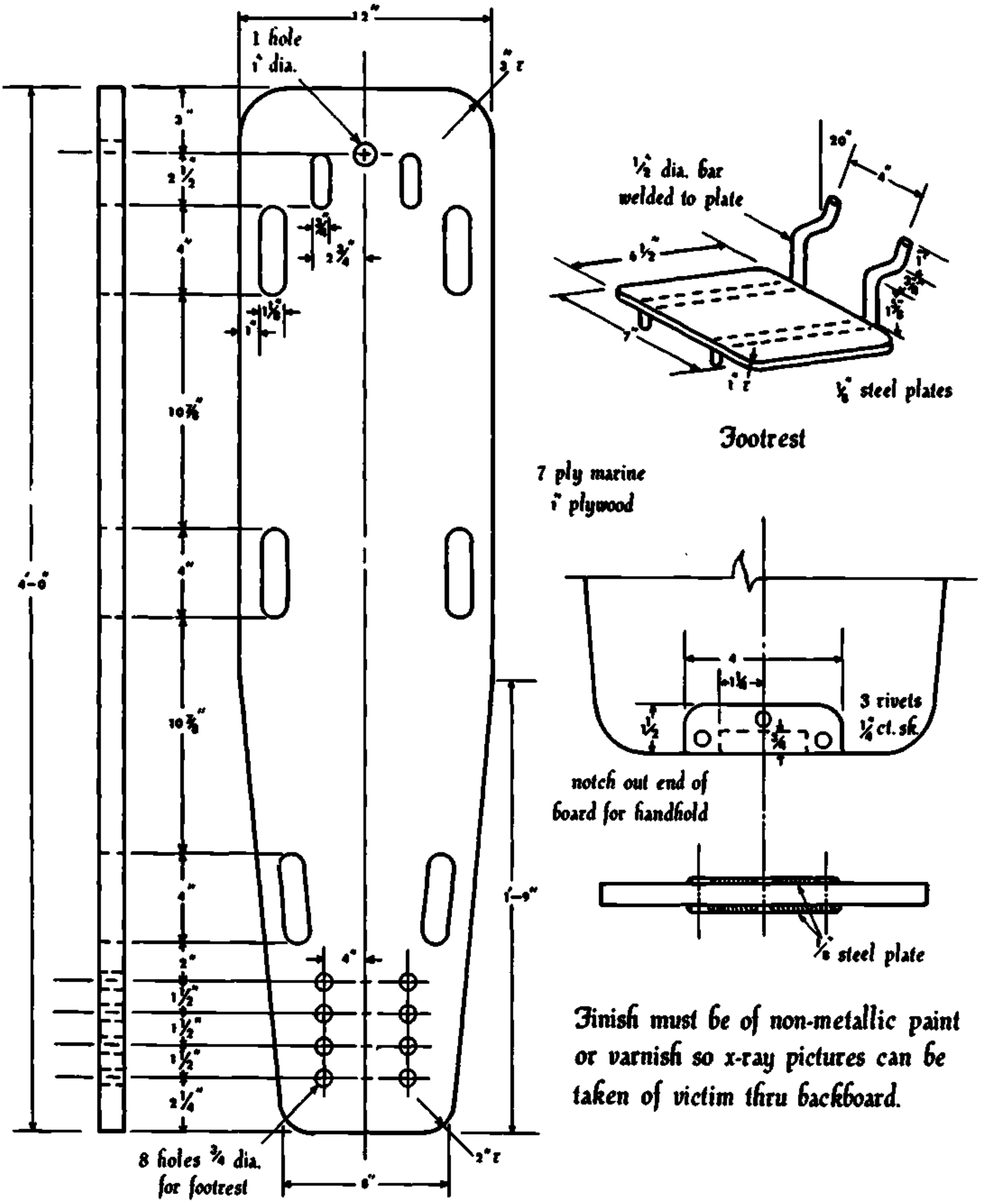
It is good practice to have an additional stretcher available on the squad truck. Multiple-injury accidents require the squad to transport more than one patient. The stretcher shown here is collapsible; it can be stored in the squad truck until needed.



Finish must be of non-metallic paint or varnish so x-ray pictures can be taken of victim thru backboard

Figure 6

Adult backboard



Finish must be of non-metallic paint or varnish so x-ray pictures can be taken of victim thru backboard.

Figure 7

Child backboard

FIRE BLANKETS

These are primarily for the protection of a victim: for example, during the use of a cutting torch. (See Figure 8)

Courtesy Safety Clothing & Equip. Co.

Figure 8

Fire blanket

MASKS

Self-contained (demand, supplied air, or oxygen generating)

SPECIAL PROTECTIVE CLOTHING

Asbestos or heat-resistant suits
Asbestos or heat-resistant gloves and mittens
Ammonia suit

ARM BANDS, COATS, ETC.

These serve not only as a means of identifying the squadmen, but also afford protection for the squadmen and the victim. When protective cover-alls, shop coats, or jackets are worn, it should be mandatory that they be kept clean.

BODY STRAPS

These can be made of leather or of webbing. They are used to lash the victim to the stretcher during rescue or to restrain the victim when such action becomes necessary.

CLOTH FACE MASKS

These are used for protection against contagious diseases.

LINEN SUPPLY

Storage at headquarters for extra blankets, sheets, coats, cloth face masks, etc. will facilitate replacement of materials in the emergency or rescue units.

RESCUE TOOLS AND EQUIPMENT

These involve appliances used to rescue people trapped in various critical circumstances, such as automobile accidents, drownings, cave-ins, explosions, etc.

ELECTRICAL SAFETY EQUIPMENT

Rubber gloves and protectors
    (See Figures 9 and 10)
Wire cutters (See Figure 11)
Firemen's cutters (insulated)
Wire holding stick (See Figure 12)
Pipe wrench (large)

Courtesy W.H. Salisbury & Co.

Courtesy White Rubber Co.

Figure 9 Figure 10

Rubber glove, glove protectors

Courtesy A.B. Chance Co.

Figure 11

Wire cutters

Courtesy A.B. Chance Co.

Figure 12

Wire-holding stick

STRIKING TOOLS

Axes (pick head, flat head, hand axe, etc.)
Hammer (sledge, rubber head, mallet, etc.)
Picks (hammer head, mattock, plain, etc.)

CUTTING TOOLS

Wood cutting (electric or manual saw, air hammer, chisel)
Masonry cutting (electric or manual saw, air hammer, chisel, star drill, etc.)
Metal cutting (electric saw, hack saw, cold chisel, tin roof cutter, bar cutter, oxy-acetylene torch, tin snips, finger-ring cutters, bolt cutters)

BATTERING TOOLS

Battering ram
Ball on chain

PRYING AND LIFTING TOOLS

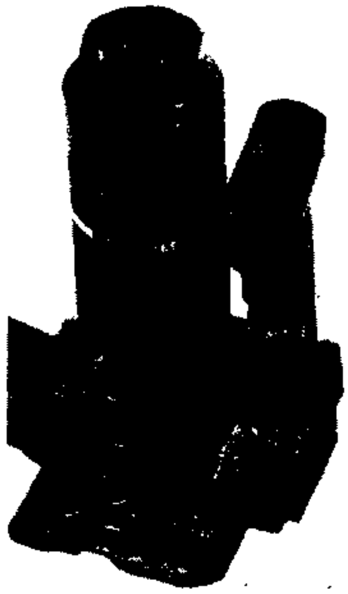
Claw tool
Door opener
Hux bar
Crow bar

BORING AND DRILLING TOOLS

- Electric
- Breast
- Brace and bit
- Metal and wood drills in assorted sizes

HOISTING, PULLING AND LIFTING EQUIPMENT

- Rope (½" to 1")
- Block and tackle
- Sheave block
- Assorted rope
- Pike pole
- Ratchet jack
- Hydraulic jack (See Figure 13)
- Log chain
- Cable
- Hydraulic rescue kit (See Figure 14)



Courtesy Blackhawk Mfg. Co.

Figure 13

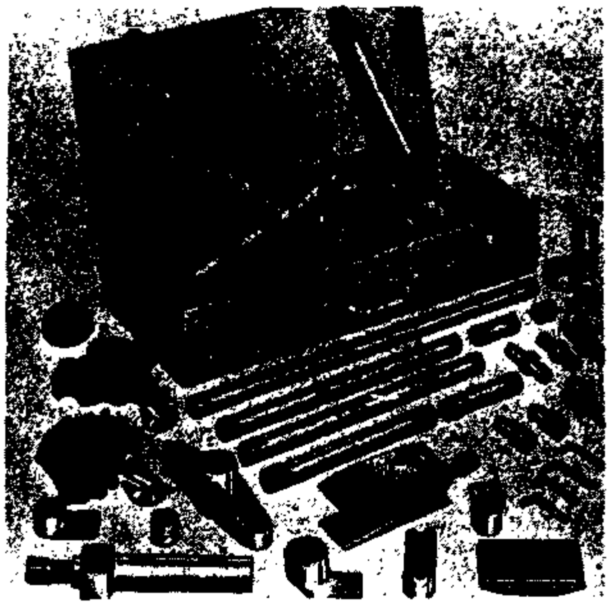
Hydraulic jack

CUTTING TORCH

- Oxy-acetylene

LADDERS

- Rope
- Collapsible



Courtesy Blackhawk Mfg. Co.

Figure 14

Hydraulic rescue kit

LIGHTING EQUIPMENT

- Flashlight (one per man)
- Hand lamp
- Portable electric generator with lights (See Figure 15)

Figure 15

Portable electric generator

FIRST AID FIRE-FIGHTING APPLIANCES

- Pressure-type water extinguishers
- Soda and acid
- Foam
- Carbon dioxide
- Dry powder

MISCELLANEOUS TOOLS AND EQUIPMENT

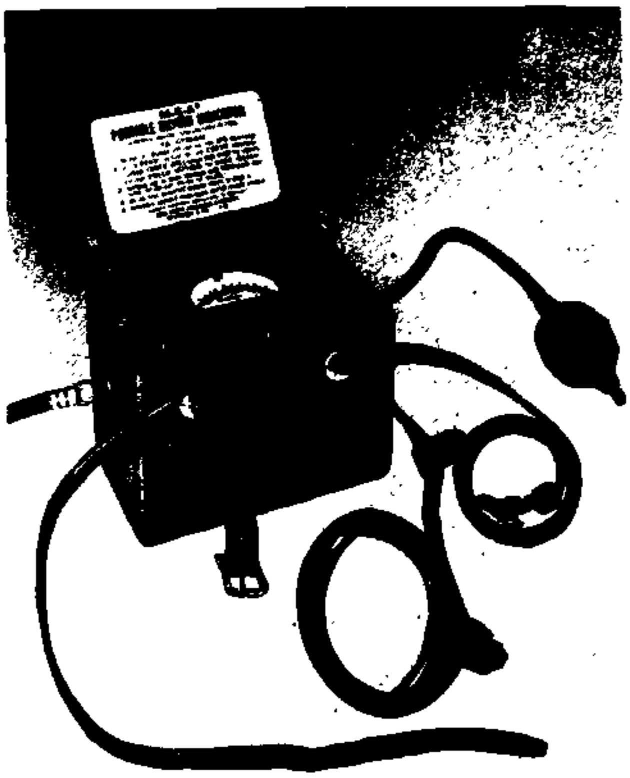
The following is a list of tools and equipment which do not fall directly into previous classifications, but which may be important in equipping your emergency or rescue squad.

Salvage covers
Pike poles
Fire helmets
Rubber body wrapper
Ditch jacks
Rescue harness
Life jackets
Small hose roller
Small folding ladder
Large screwdriver
Long and short-handled shovels
Walkie-Talkie radios (See Figure 16)

Courtesy Motorola Inc.

Figure 16

Walkie-talkie radio



Courtesy Mine Safety Appliances Co.

Figure 17

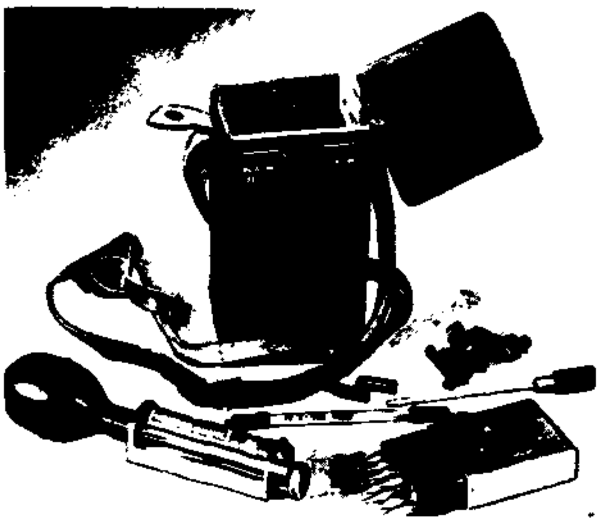
Portable oxygen indicator

Portable oxygen indicator
  (See Figure 17)
Well-equipped tool box
Spanner wrench
Hydrant wrench
Shut-off keys (gas, water, etc.)
Lyle gun
Tool kit (small tools)
Flags and flares
Brooms and mops
Atmosphere testing equipment
Explosimeter (See Figure 18)
Carbon monoxide tester
  (See Figure 19)

Courtesy Mine Safety Appliances Co.

Figure 18

Explosimeter



Courtesy Mine Safety Appliances Co.

Figure 19

Carbon monoxide tester

SPECIAL EQUIPMENT

Some rescue operations require use of the heavy-duty mobile equipment designed for earthmoving or wrecking jobs: power shovels, scrapers, bulldozers, cranes, dump trucks, highway wreckers, etc. Specially qualified, trained men operate these machines. A squadman cannot be expected to be familiar with their use and operation, unless he is employed in these areas on a full-time basis.

It is wise to contact the owners or operators of such equipment, in the squad's area of service, asking for their cooperation in the event that a sudden emergency creates a need for their services.

In communities that maintain service departments, or where the service departments of the State, County, Township, or public utilities are available, it is well to enlist their equipment and manpower in developing a local program. This creates a sound public relations bond among all parties concerned, for the safety, good, and welfare of the citizens in the area.

The control of a cooperative rescue operation is important and must not be overlooked at the development stage. It must be established at the inception that the person who commands the department or emergency unit will have complete authority to request and command auxiliary equipment when it is needed. There is no time for "red tape" during an accident or disaster, when life depends on efficient dispatching and control of equipment.

For equipping a squad that must serve a waterfront area, see Chapter XXII.

CHAPTER III

PERSONNEL

INTRODUCTION

The successful operation of an emergency or rescue squad unit depends on every man assigned to it. Only when this is recognized and accepted can satisfaction and efficiency be obtained. The saving of life is a serious business in itself and it should be handled by trained and qualified personnel. A small amount of first aid knowledge is not enough to assure the safety and welfare of a victim, under many circumstances. It should be mandatory that only personnel who have successfully completed the Advanced First Aid Course offered by the American Red Cross, or any other similarly qualified agency, and have passed the state emergency rescue training course, be considered for this important duty.

Good public relations are extremely important in any department. The services of the squad must sell themselves through the conduct and efficiency of individual squadmen. Therefore, it is imperative that squadmen be selected with great care in order that they will obtain respect from the public. Following are more specific recommendations to be used in the selection of personnel.

QUALIFICATIONS

Note: The following items are not listed in any special order of importance. They are to be used comprehensively and collectively and will merely serve as a guide to determine the over-all capability of each person to be considered as a squadman.

1. He must have volunteered for the job. This is primarily an indication that the person wants to take part in the performance of this particular duty at his own request. As a rule, no one cares to do a job, or carry out the duties of a job, if he has a physical or mental aversion to the obligation involved.
2. He must be available. There is no point in having a man assigned to lifesaving units when it may be questionable as to whether he will, or will not be in a position to respond to the alarm. For example, a man whose private work takes him out of the community would not be a good choice here. However, if there are a number of men involved in the same situation, it might be well to give some thought to the idea of organizing the personnel on a so-called day or night platoon basis. Thus squad personnel would be available on a round-the-clock basis.
3. He must be dependable. Dependability is of the utmost importance. This virtue gives assurance that the squadman will carry out assignments to the best of his ability.
4. He must have a good reputation. A person's good name and standing in public esteem must definitely fit into the analysis. This type of public work will present many delicate situations, especially when the confidence of the victim in his benefactor is sorely needed. (In short, is he a good citizen?)

5. He must present a good appearance. A slovenly, dirty and unkempt individual will immediately cause the victim, as well as the general public, to look with disfavor on his benefactor. Even a stranger, when carefully groomed, is an asset when dealing with others. Many emergency and rescue units have a type of white shop coat available to their squadmen. Such a coat is easily donned and gives the men that look of neatness and cleanliness which is always so desirable.
6. He must have a pleasant personality. Arrogance and superiority will be quickly resented. Courtesy and understanding will always open the door for a better relationship with the victim. The public will also react and cooperate more favorably when treated in a firm but courteous manner.

7. He must be cooperative. This is a characteristic which calls on a person's ability to harmonize, pull together, work shoulder to shoulder, and go along with others. It may be said that people do not think together, but under emergency situations, they should act together. There is no time for bickering at the scene of an emergency. Orders and methods must be carried out even if they are not to individual liking. As a rule the end result is the same.

8. He must be definitely interested in the job. This is fundamentally a specialized field. Consequently, there will always be new and different approaches, techniques and procedures offered on the subject. If the enthusiasm is there to learn, study, and keep abreast of the times, such an individual will definitely be an asset to the squad. Then again, it must be realized that each person's interests are different. There are many firemen who are happy just to be good firemen because they love firefighting. On the other hand, the same answer is also applicable to squadmen. Personnel once placed on emergency units often make it their life's work. Whichever job it may be, however, the deciding factor is controlled by the man's interest in the job at hand.

9. He must have initiative. The ability of a person to determine for himself what has to be done, and then having the capability of going ahead and doing it, is an important qualification in this line of work. The necessity to deal with unusual situations, conditions and circumstances, makes it imperative that squad and emergency personnel have this qualification.

10. He must be cool, level-headed and have the ability to exercise common sense. Emergency situations call upon the individual to use these qualities because of the turmoil which exists during the time of an emergency. The situation, when handled wisely and properly, will make matters easier for everyone concerned.

11. He must have an aptitude for training. The study and training time involved in learning to be a good squadman is in substance not a long-term indoctrination of practice and knowledge. First aid and life saving courses are outlines to supply the utmost in information and training in a practical and reasonable length of time. Therefore, the ability to learn quickly and have natural talent to apply this training is an important factor in personnel selection.

12. He must have leadership ability. "As ye lead, so shall they follow", may be a safe axiom in this case. These emergency situations always call for

an immediate show of authority and command. When used wisely, this quality will make it easier to control the emergency.

13. He must be in good health and physical condition. One never knows, when responding to an emergency alarm, exactly what is involved. A man may be called upon to climb, run, dig, pull, push, etc. Therefore, it is very important that a selectee have the normal good health and recognized physical abilities to perform his duties in a manner that is not detrimental to victims, his fellow squadmen, or himself.

COMPLEMENT OF EMERGENCY AND RESCUE UNITS

Determining the number of officers and men who are to man an emergency squad is somewhat controversial. The number of squad members often is based on the size of the area served and/or the available manpower. It must be borne in mind that not all of a department's personnel should be deployed in an emergency, in view of the possibility of another call.

There are basically three different types of equipment, namely Ambulance, Light Rescue, and Heavy Rescue. These recommendations are based on the absolute minimum requirements for operating them safely and efficiently.

AMBULANCE

Officers - At least one officer, or a man in charge, must be assigned to respond to an alarm with this unit at all times.

Squadmen - A minimum of two men should be assigned to respond with the apparatus. This number can include the man as stipulated in the preceding paragraph. If, however, the department is large enough to be able to detail more than two, without sacrificing its fire fighting strength, well and good. However, in order to secure the minimum of two for response, additional personnel should be delegated and available to meet this requirement.

LIGHT RESCUE

Officers - At least one officer, or a man in charge, must be assigned to respond with the apparatus on every alarm.

Squadmen - A minimum of three men should be assigned to respond with this apparatus. This number can include the man stipulated in the preceding paragraph. As the unit will be larger and carry more life saving equipment, tools and appliances, a larger complement of men will be necessary. With this in mind, additional personnel should be delegated and available for duty.

HEAVY RESCUE

Officers - Compliance with the obligation of having a minimum of one officer with the apparatus on every alarm is recommended. As a much larger unit with more manpower is included, an appointed officer should be in command.

Squadmen - This full-scale life saving operation with large and heavy equipment, many more tools and appliances, calls for a minimum complement of five men to respond with the apparatus. This number can include the officer as stipulated in the preceding paragraph. It is imperative, however, that more men be actually assigned and delegated for duty in order to assure a minimum crew of five.

CHAPTER IV

OPERATIONS

INTRODUCTION

It is advisable to give some thought to an efficient and practical method of alerting emergency and rescue squad units. The nature of this particular operation certainly calls for a somewhat different approach than the customary notification to signify an alarm of fire.

ALERTING SYSTEM

Our goal can be achieved by keeping several factors in mind, namely (1) The emergency must be identified so that both fire-fighting and emergency personnel will immediately recognize its nature; (2) Response must be rapid, only by the personnel assigned to the rescue units; (3) Unnecessary confusion and disorder which delay response to this type of alarm must be avoided.

As a rule, in paid departments these problems are circumvented by having a coded alarm system on their fire-house bell. By merely changing the number of rings, the personnel can immediately ascertain the type of alarm, and report to the apparatus floor accordingly. The problem is not that simple in volunteer fire departments. In some cases, a siren mounted on the top of the fire station or on a nearby pole is the only type of general alarm which can be given. These are set in action by telephones, relays, or manual controls. A series of wails is emitted which signifies the alarm of fire or emergency. If, however, these wails can be controlled to definitely distinguish a difference in the nature of the alarm, our purpose is accomplished. This problem should be discussed with local agencies involved in the installation of the alerting system to determine whether or not this is possible.

An alerting system that is used by many squads today employs a transmitter and individual home receivers. A receiver is placed in the home of each squad member.

The transmitter is located where the squad alarms are received. The dispatcher can immediately transmit a particular tone that opens all home receivers. The dispatcher can then alert the squad members as to the location and type of emergency.

There are many types and styles of notification systems now in operation. We recommend that a study be made of the situation from the standpoint of local needs, conditions, and circumstances. Expert advice and information will be offered by representatives of the various firms in this field.

Regardless of the kind of system which is finally selected, it is deemed advisable to give additional thought to establishing a "stand-by" routine for alarms involving only the emergency and rescue squad units. This is where the extra men mentioned in Chapter III fit into the picture. Thus, a call from the squadmen at the scene for additional equipment, apparatus, doctors, nurses, etc., can be expedited immediately, instead of going through the entire alarm routine a second time.

RESPONSE

The main concern here is to facilitate an efficient and orderly "all out" by the personnel assigned to the emergency and rescue apparatus. There is no point in cluttering highways and adding confusion to local traffic with excess private vehicles trying to reach the scene, or the apparatus headquarters. If only the members assigned to these units respond, it is apparent that many of these problems will be eliminated. In addition, valuable seconds will be saved, thus enabling the apparatus to leave the station more quickly. There is bound to be a greater degree of delay when waiting for a larger complement of personnel to arrive for duty.

Here, again, the possible need is for response by the "stand-by" or extra men assigned to these units. Their availability at headquarters in the event of additional calls on the same alarm will aid tremendously in expediting efficiently any type of emergency service.

COMMUNICATIONS

It is recommended that some type of communication system be incorporated in the over-all operation of emergency and rescue squad units. In many instances, when arriving at the scene, it is necessary to call back for additional equipment and personnel, contact the sheriff's office, call the State Highway Patrol, etc. When this can be done directly from the unit, much valuable time can be saved by squadmen. Furthermore, there is nothing more discouraging or inopportune, especially when in the public eye, than a situation in which men and equipment stand by helpessly because circumstances demand additional apparatus or manpower, and nothing can be done about getting it there. Modern emergency squads utilize two-way radio communications to a great advantage. In many cases, this equipment is installed on every emergency vehicle in operation in the department, to take care of unexpected situations.

CODING CALLS

It is a good practice to code most information transmitted over a two-way radio. This is especially true when the condition of the patient is involved. For example, if the patient's condition is critical this fact might be communicated over the radio as "code signal 95." If the patient were to hear the squadmen state that his condition was critical, it might cause his shock to become more severe.

Additional code signals can be used for many other patient conditions. These coded messages might include:

a. Have hospital prepare oxygen
b. An O.B. case
c. Condition fair
d. Condition good
e. Condition critical
f. Severe bleeding, uncontrolled

Using this type of coding, the squad can notify the dispatcher, who in turn can call the hospital to be prepared. This procedure will result in better reception of the patient at the hospital.

It must be emphasized that this system of alerting the hospital should not be abused, but used only for critical patients.

CHAPTER V

SAFE DRIVING PRACTICES

INTRODUCTION

Most drivers possess a natural inclination to drive at excessive speeds. Sound thinking should tell us it is better to drive slower, and arrive safely at a given destination, than not to arrive there at all.

When dealing with the problem of "safe speeds" vs. "excessive speeds", definite facts must be included, such as: (1) a person's physical and mental ability to drive the vehicle; (2) the condition and type of motor vehicle used; (3) the weather; (4) the road condition.

It can be said that a speed considered to be a safe speed for one driver may be an excessive speed for another. Inexperienced and excitable drivers often become overzealous, a characteristic which will cause them to drive at unreasonable and unsafe speeds.

RESPONDING TO THE EMERGENCY

DRIVER'S RESPONSIBILITY

The driver of an emergency vehicle is responsible for the safe operation of that vehicle; therefore it is necessary for him to understand the limitations involving the use of red warning lights and sirens, mounted on the emergency equipment.

RED LIGHT

The flashing red light is of more value as a warning device to oncoming traffic than it is when used to alert drivers of vehicles being approached from the rear. When no visual obstruction exists, a red flasher-light mounted on the emergency unit is often more effective than a siren as a warning device, because it can attract the attention of oncoming drivers from a greater distance straight ahead. A small red light is ineffective.

SIREN

The siren is an excellent warning device, but it too has limitations caused by high noise levels, closed automobile windows, and the fact that sound waves created by a vehicle-mounted siren are directional. In certain instances, test results proved that the sounds could be heard approximately three times as far to the front as was possible to either side or to the rear. When ideal conditions prevail, a person with normal hearing and seated in an automobile with only the driver's window open, will hear the siren at a position approximately 1,000 feet to the front of the emergency vehicle. This distance, of course, is subject to changes due to the variation of street noises from trucks, buses, and other sound-producing obstacles. However, the approximate distance that the sound waves of a siren may be heard is reduced roughly by two-thirds when the listener's position is at right angles to the path of the emergency vehicle.

There are also some techniques and precautions which, if observed, will result in a more effective use of the siren and reduce the danger of accidents to emergency vehicles.

When the siren is not automatically controlled, it should be turned on and off alternately in such a manner as to utilize the full range of sound from the lower to the highest pitch. The varying sound pitch will attract attention more effectively. Many persons are deaf to high or low pitches but can hear other tones adequately.

In some states totally deaf persons are issued driving licenses. This is true in Ohio.

DRIVING AN EMERGENCY VEHICLE

The driver of any emergency vehicle cannot depend on the flashing of the red light or the sound from a siren on the emergency vehicle to guarantee safe passage or "right of way" through any intersecting street or cross roads. There is a greater danger of accidents at intersections where traffic control lights are in operation than at intersections with "Stop" or "Yield Right of Way" signs, or where intersections have no controls at all.

The public has a right to expect the emergency siren to be used only when a genuine emergency exists. The use of the siren for escorts of distinguished persons, caravans, parades, and other non-emergency uses can lead to resentment and eventual disregard. These practices are becoming less prevalent. They should be not only discouraged but prohibited.

To gain the "right of way" over other vehicles traveling in the same direction, a siren should be actuated sufficiently in advance before overtaking the vehicle so that the driver will have had adequate warning of the approach. The sudden use of a siren immediately behind another vehicle may cause an excited motorist to stop suddenly or swerve so abruptly that his car may be struck by the emergency vehicle, or possibly it may strike other automobiles or pedestrians.

When an emergency vehicle is preparing to pass another vehicle, it must be done with caution, especially when it is necessary to drive across the center line of the roadway. In such cases when a motorist is alerted to the situation he should, if possible, drive to the nearest curb or roadway limit and stop. Such results cannot be expected from all motorists in all situations; therefore, the safety of these people rests in the hands of the emergency unit driver.

No emergency vehicle should pass another emergency vehicle while responding to an alarm except when an "all clear" signal has been received from the driver or the officer in charge of the first vehicle, and then only when in the judgment of the second vehicle's driver it is safe to proceed. A safe distance of five hundred feet should be maintained between emergency vehicles when two or more units are responding together to the same alarm.

The careful selection of sound-thinking and intelligent drivers, properly trained, will help solve this problem; however, it is essential that all drivers understand speed in relation to "reaction distance", "braking distance", and "stopping distance", explained herein:

Speed: The miles per hour a vehicle travels.

Reaction Distance: The distance a vehicle will travel while a driver is transferring his foot from the accelerator to the brake pedal after he perceives danger.

Braking Distance: The distance a vehicle will travel from the place where the first application of the brake was made to the place where the vehicle stopped.

Stopping Distance: The sum of the reaction distance plus the braking distance

These distances will vary due to the physical and mental alertness of the driver, the speed, type and condition of the vehicle, the number, type and condition of the brakes, the tire sizes, and the weight of the vehicle when fully equipped, plus the type and condition of the road surface.

For example, at 40 m.p.h. a vehicle is traveling approximately 59 feet per second. This requires a distance of 44 feet (reaction distance) for the average driver to react and apply the brakes. In most cases the vehicle will have traveled an additional 88 feet (braking distance) before it stops. This adds up to a total of 132 feet (stopping distance) which is the approximate total number of feet required to halt the vehicle. At speeds lower than 40 m.p.h., it is possible to control the apparatus with some degree of safety. With higher speeds, such as 60 m.p.h., the stopping distance increases to an approximate 264 feet.

Drivers should remember that they are responsible for the lives of their fellow squadmen, the victims, and others.*

TRANSPORTING VICTIM TO THE HOSPITAL

Few, if any, emergencies require the need for excessive road speeds when transporting the victim. Along with this, poor driving practices such as swerving, fast turns, and sudden changes often increase the extent of the injury and create an adverse effect on the victim.* This action is improper in all respects.

Another major danger associated with a speeding or carelessly operated rescue squad vehicle is the possibility of being in a traffic accident. Such a situation would cause a delay in assisting those involved in the original emergency, plus the possibility of obtaining more victims and often destroying services for which the rescue vehicle was purchased.

The safe speed for any emergency run must be established while the run is being made, and it must be based on the weather, streets, traffic, the driver, and the victim's condition. Because of the seriousness of this situation, there must be adequate planning and wholehearted cooperation of all persons concerned in order to make any rescue squad a successful operating unit.

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* Chapter XXVI covers legal aspects of operating emergency vehicles in more detail.

CHAPTER VI

CONTROLLING THE SITUATION

INTRODUCTION

A squadman's first responsibility in any emergency is to the victim. However, since squadmen are often the first trained personnel to arrive at an emergency, it is sometimes necessary for them to do other things which are not, strictly speaking, victim care, in order to perform their function adequately without endangering their own safety and the safety of others.

HIGHWAY ACCIDENTS

In certain situations a victim should receive "on the spot" emergency care before being moved for any purpose. Often immediate assistance to a highway victim is essential before adequate warning signals are set out to alert oncoming traffic. In such instances, the warning lights on the rescue vehicles can be used to excellent advantage. They will provide some protection to the victim and the squad personnel against injuries or death. When it is permissible to move a victim safely a short distance from the danger zone, the traffic situation will be less serious. The procedure to follow must be decided for each individual case by the squadman-in-charge at the accident. Squadmen should not deviate from the "victim care", outlined elsewhere in this manual, when considering whether to move the victim to safer area.

Unless some plan of action is set up, practiced, and understood by squad personnel, there may be confusion at the scene of a highway emergency. Figure 1 shows efficient, pre-planned handling of a highway accident.

FLAGS AND FLARES

Section 4513.28 R.C. of Ohio states that in case of a highway emergency, warning signals shall be placed forty paces or approximately one hundred feet both to the front and to the rear of the vehicle.

If the spot of emergency is near a curve, crest of a hill, or place where the vision of oncoming traffic may be obstructed, the warning signals should be placed to give ample warning.

This code directs all emergency squad units to provide for the protection of all persons directly or indirectly concerned with highway emergencies. These warning devices must be used with due regard for the common hazards each may present in a particular situation. For example, open flames, lights, or non-vapor-proof lanterns must not be used in an area filled with gasoline or other flammable vapors.

When the job of caring for the victim demands the squad members' entire personal attention, it is then necessary for the squadman in charge to direct some other person to set out whatever signaling device is suitable for the existing condition.

CLEAN - UP

The Ohio Driver's Manual states, "Any person removing a wrecked or damaged vehicle from a highway shall remove any glass or other injurious substance dropped upon the highway from such vehicle."

The above quotation is not to imply that the rescue squad members are responsible for the removal of such substances dropped upon the highway, but rather to point out with whom this responsibility lies. Some of the most common substances found in a clean-up situation are:

Gasoline: This must be flushed from the highway with large quantities of water. Consideration must be given to where the gasoline and water will run and what additional action, if any, is necessary. For example: Should the gasoline be flushed to a nearby creek, what are the potential dangers and what lies within its path? When the gasoline is flushed into a sewerage system that leads to a sewage disposal plant, the person on duty at the disposal plant should be notified immediately. When it is flushed into a sewerage system in a closely populated area, it is wise to inspect these buildings for gasoline fumes and advise the occupants to discharge water into their floor drains to assure having adequate water in the "trap". This will close off a drain and lock the fumes out of a house.

Both a powder and a liquid are available for use on gasoline to reduce the fire danger. The powder is spread on the gasoline and then flushed with water. The liquid is sprayed over the gasoline and then flushed away. Either of these materials will make a nonflammable emulsion that is easily flushed away.

Glass: Broken glass in most cases presents no special hazard in having it removed from the highway but, as in many other highway situations, a constant watch for approaching vehicles must be maintained. A reasonable signal such as those previously mentioned should be given in advance to stop or slow down the traffic, to prevent injury or possible death to members of the clean-up crew.

Blood: This provides a somewhat different problem than that encountered in similar situations. Removing the blood from the highway is a simple operation when done by flushing. But the difficulty arises when a "weak-stomached person" is an unwanted spectator who must get all the details first hand. Then just about the time the job is completed, this person "passes out" and a new problem is encountered.

Miscellaneous Situations: There are numerous situations that could be described here, such as one where a large milk supply transport truck overturned and spilled the entire contents over the highway. Another is where a farm produce truck was involved in an accident and most of the contents were distributed across the highway. Regardless of the situation there are many factors to be considered, such as the substance involved, where it occurred, and how it can be corrected. Weather conditions also play an active part in deciding on a course of action. During freezing weather a method not involving water may be neccessary. But when water is necessary to do the job, a supply of salt, sand or other like substance may be needed to make the area safe for both motorists and pedestrians. This, as previously stated, is not a direct function of a rescue squad but it is their responsibility to request assistance through certain local authorities by stating the need for additional personnel and supplies.

COOPERATION BY PREPLANNING

A rescue squad will, in many cases, request cooperation from the local police department, county sheriff's office, State Highway Patrol, and the highway department. Rescue squad personnel should attend to the emergency as it concerns first-aid and rescue, and let the law enforcement agency handle the other people and traffic problems.

Rescue squad personnel supervisors should seek cooperation through preplanning with the local police, county sheriff, State Highway Patrol and the highway department. Each has a definite place and each group should cooperate with the other to develop a plan, before the emergency rather than at the scene of the emergency. To best accomplish the desired cooperation, it is suggested planning be done with the top officials of the organizations concerned. At this level, definite agreement can be made which will not be contradicted later. (See Figure 1.)

Courtesy Sharon Twp. F.D. & Worthington, O., P.D.

Figure 1

Cooperation at an accident scene. The police agency was notified of the accident and requested an emergency squad to respond. At the scene, the victims are being cared for by the squadmen while police officers are controlling the bystanders and traffic. Note that one squadman is examining a victim on the road and another is examining a victim in the car. The other squadmen are preparing equipment that probably will be needed. Only by good preplanning between the squad officers and the local police agencies will such effective handling of an accident be possible.

HOME SITUATIONS

Squadmen must have the ability to handle the relatives and friends of the victim, to the end that they will not interfere with the victim's care or the squadmen. This responsibility might be delegated to one member of the squad while the others proceed with the care of the victim. Hysterical mothers, wives, sisters, and grandmothers always create an added problem for the squadmen. This problem is important and in some cases must be eliminated before the squadmen can give attention to the victim. If this problem is not eliminated, it is very possible to have two victims in place of one. There is no set rule for the squadmen to use to cope with this problem; however, the following situation will present an example which may be helpful.

EXAMPLE

Husband has heart attack. His wife is hysterical.

PROCEDURE

1. Take wife to another room.
2. Ask her questions, to keep her mind occupied.
   a. Has your husband had these attacks before?
   b. Is he taking medicine? (If so, ask to see it.)
   c. What is his medical background?
   d. Who is his doctor?
   e. What is his parents' medical background?
   f. How many children do you have?
   g. How old are they and are they away? (Army, college, etc.)
   h. What is your husband's age?

Little help will be required by the relative who remains calm in the face of an emergency; however, a word of sympathy and encouragement is well worth while.

Do not blame or ridicule a person for feeling as he does. Your job is to help him cope with his feeling.

COOPERATION OF THE VICTIM

Every effort must be made to secure the cooperation of the victim. Often a problem is the additional embarrassment to the victim caused by curious bystanders. It is to the best interest of the squad and the victim to protect the victim from these prying eyes.

For example, if a woman should break her leg in a crowded area, she should be covered with a blanket. The examination should be made and the splint put in place by feeling under the blanket. With practice, this can be readily accomplished.

If possible, the area in which the victim or victims are located should be blocked off and shielded from the sight of onlookers.

COOPERATION WITH HOSPITAL PERSONNEL

Giving the best possible care to victims is of primary importance in emergency squad work. One means of doing this is to establish good relationships with the hospital personnel with which the squadmen come in contact, and most especially the emergency-room personnel.

If there is a working agreement between the emergency squad and the regular personnel in the emergency room, the care of the patient from the time he is seen by the squadmen until the time he is admitted to the hospital will not be disrupted. This can only be accomplished if all people who come in contact with the patient work as a team.

The officer in charge of the emergency squad or the chief of the department should meet periodically with the supervisors of the emergency rooms with which his squad comes in contact. This will lead to a better understanding of the objectives of both groups. The emergency-room supervisors are most willing to cooperate with those who transport victims to the hospital.

Figures 2 and 3 and their captions show how squadmen can bring about good rapport with emergency-room personnel.

Courtesy St. Anthony Hosp.

Figure 2

Upon arrival at the hospital emergency room, tell the nurse just what type of emergency you have and the suspected injuries. In the above case, the victim has a suspected fracture. He is left on the backboard and placed on a movable stretcher. Good rapport with the 'entire team' means working well with all who come in contact with the victim, especially the emergency room personnel.

Courtesy St. Anthony Hosp.

Figure 3

After the victim is made as comfortable as possible and after any lifesaving procedures are carried out, squadmen should give the emergency room nurses all possible information:

1. The exact location from which victim was taken.
2. The type of accident.
3. The victim's condition from the time squadmen arrived until victim arrived at hospital.
4. The care given by the squad.
5. Whether the proper law enforcement agencies were notified.

CHAPTER VII

CHILDBIRTH

INTRODUCTION

A growing problem confronting the emergency and rescue squad service is emergency childbirth. The squadmen often have to decide whether to transport the expectant mother to where medical help is available, or whether to keep the mother in her home and attend the birth of the child. Because squadmen must solve this problem, it is of the utmost importance that all squadmen have at least some fundamental knowledge about the conditions surrounding childbirth.

NORMAL DELIVERIES

A woman in labor and/or a new-born child can certainly present many difficult situations. Unless the squadmen have proper knowledge and training in this particular area of emergency care, great harm may be done to the mother and/or the child.

Although it is not the intention of this book to perfect the squadmen in the art and science of obstetrics, there is a real need to give such personnel a working knowledge of what to expect. Because lives may be in the balance, the squadmen must decide quickly either to transport or not to transport a mother to a hospital. The decision should depend upon certain evidence which the squadman has to evaluate at once.

The expectant mother is to be transported only before the evidence of crowning is apparent. If crowning is apparent, childbirth will follow soon after. In such a case, the mother should not be moved at all, unless the squadmen are otherwise directed by a physician.

The squadmen must have some concept of what takes place before, during, and after labor to be able to best care for the mother and child. However, this material will deal mainly with the period during labor since this is usually the period in which victim care arises. Therefore, the squadmen should have some knowledge of what is normal and abnormal in childbirth.

DEFINITIONS

Obstetrics: The care of the childbearing woman and her new-born baby. Obstetrics deals basically with three distinct periods:

1. Pregnancy: The period from conception through the period of labor to birth of the child.
2. Labor: The period during which the baby and the placenta are expelled from the mother's body into the outside world.
3. The Puerperium (Post Delivery): The period during which the organs of reproduction are restored to approximately their former size and condition. This usually takes about six weeks.

Internal Organs: The internal organs of reproduction are: (a) the ovaries, (b) the fallopian tubes, (c) the uterus, and (d) the vagina.

Ovaries: The ovaries are the glands in the female producing the reproduction cell known as the ovum.

Fallopian Tubes: The fallopian tubes are two thin, trumpet-shaped, flexible muscular tubes, about four and one half inches long and somewhat thinner than a lead pencil. They have two openings, one into the uterine cavity and the other into the abdominal cavity. The abdominal opening is somewhat larger and is surrounded by a large number of fringes; hence the term "fimbriated end". The fallopian tubes act as a passage from the ovaries to the uterus.

Uterus: The uterus, or womb, is a thick-walled, muscular, hollow, pear-shaped organ. Fully developed, in nonpregnant state, it is approximately three inches long, two inches wide, one inch in thickness, and weighs from one to two ounces. It is composed of involuntary muscle fibers, running in different directions, making its expansion possible up to the size of a pumpkin. At termination of pregnancy it weighs about two pounds. The muscles of this organ are arranged so as to make it able to expel its fetus (infant) by contraction at the termination of normal labor. (See Figure 1.)

Amnion (Bag of Waters): The thin transparent sac which holds the fetus suspended in the fluid called amniotic fluid. This sac is lined with a smooth, slippery, glistening membrane. The space, or the amniotic cavity filled with fluid, is often called "the bag of waters." Here is where the child floats and moves. At full-term pregnancy this cavity normally contains from one half to one quart of water. The important functions of this fluid are:

1. To protect the fetus from blows
2. To allow the fetus freedom of motion
3. To keep the child at an even temperature
4. To help to enlarge the vaginal canal during labor so the child may be born more easily.
5. When membranes rupture, to flush the birth canal, thereby cleansing, lubricating, and disinfecting it

Placenta (Afterbirth): By the third month another important structure, the placenta, has formed. The placenta is a fleshy, dish-like organ. Late in pregnancy it measures about eight inches in diameter and one inch in thickness. It receives its name from a Latin word meaning cake, which this structure resembles somewhat in shape.

A tree or a plant sends its roots into a bed of earth for nourishment, and when the plant is removed a certain amount of the earthy bed clings to the interlocking roots.

Similarly, a thin layer of the uterine bed clings to the branching projections and together they make up this organ, which supplies food to the fetus as the roots and the earth provide nourishment for a plant. At term a placenta weighs about one pound. Its surface is smooth and glistening, and beneath this membrane may be seen a number of large blood vessels.

The placenta and the child are connected by means of the umbilical cord. This cord is fastened to the center of the placenta and from there enters the abdominal wall of the child. It is usually about twenty inches in length and three quarters of an inch in diameter. It contains two arteries and one large vein, which are twisted upon each other and are protected from pressure by a transparent, bluish-white, gelatinous substance called jelly.

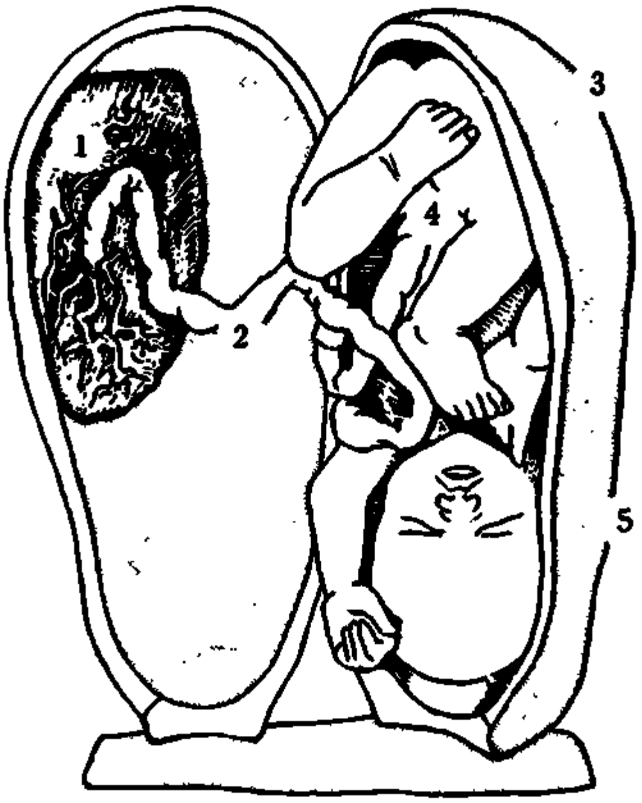
LABOR

Labor is the process by which the child is expelled from the uterus. It is divided into three stages: dilation, expulsion, and placental.

First Stage - The first stage of labor (dilating stage) begins with the first symptoms of true labor and ends with the complete dilation of the vaginal canal.

Squadmen's Care

1. Encourage the victim. The squadman should display an attitude of cheerfulness, sympathy, and encouragement toward the expectant mother.
2. Observe the character of the pains. The frequency, the duration, and the intensity of the pains should be watched closely and recorded. The presence of "show" in substantial amounts (bloodstained



1. **Placenta: usually attached on rear wall**
2. **Umbilical cord: it is about 20 inches long**
3. **Fundus of uterus**
4. **Infant's navel**
5. **Front wall of uterus**

Figure 1

Unborn child

mucus, not actual bleeding) suggests that rather rapid progress may be taking place and should be reported, particularly if associated with frequent severe pains.

3. Urge the victim not to bear down. During the first stage of labor, uterine contractions are involuntary and uncontrolled by the victim. Not only is it futile for her to bear down, this leads to exhaustion and may tear parts of the birth canal.

If the squadman determines that the mother is in the first stage of labor, preparation should be made to transport her to the hospital.

Second Stage - Watch for signs of the second stage. These signs are as follows:

1. The victim begins to bear down on her own accord.
2. There is a sudden increase in vaginal discharges; sometimes there may be slight actual bleeding. This indicates that the child's head is passing through the completely dilated birth canal.
3. The victim thinks that she needs to evacuate; this symptom is due to pressure of the head on the perineal floor and consequently against the rectum.
4. The membrane ruptures with discharge of fluid. This, of course, may take place at any time but occurs most frequently at the beginning of the second stage.
5. The vaginal opening begins to bulge and the anal orifice to dilate. This is a late sign, but if 1, 2, 3, and 4 occur, the appearance of the infant should be watched for, with every pain. Only the appearance of the head (crowning) can definitely confirm this suspicion. Vomiting at this time is not unusual. If vomiting occurs, take precautions against strangulation.

Crowning - The vaginal opening will bulge and the top of the child's head will actually be seen. This is called crowning. Crowning is the very last symptom before the head and then the child are actually delivered. (See Figure 2.)

Courtesy After Bumm, Robert L. Dickinson, M.D.

Figure 2

Crowning

If examination of the birth canal during labor pain reveals that the mother is crowning, this will indicate that the infant may be born almost immediately. In this case, squadmen should not attempt to transport the mother to a hospital, but should be prepared to deliver the baby in the next few minutes, If she is not crowning during a labor pain, squadmen will probably have time to reach a hospital. In such case, the mother should be transported.

Care at Delivery - If it is established that the squad must help in the delivery, one squadman should obtain the following equipment from the squad vehicle: (a) O. B. kit, (b) first aid kit, (c) combination resuscitator-aspirator. This equipment should be brought to the delivery area and made ready. (See Figures 3A and 3B.)

Figure 3A

An open O.B. kit. The gloves (in the back) are separate so that the squadmen may put them on without contaminating the other sterile materials.

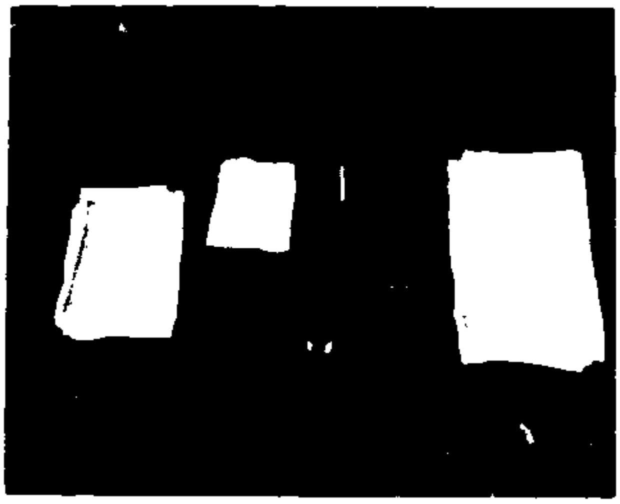


Figure 3B

Materials needed in an O.B. pack:

1. 4 towels
2. 12 gauze compresses, 4 x 4 size
3. cord tape or ties
4. soft rubber ear syringe
5. 4 large, straight hemostats
6. 3 pairs of rubber gloves
7. 1 pair of scissors

Towels are used to protect the area. The 4 x 4 compresses are used to absorb any liquid materials. The ear syringe is used to suction the child's nose and mouth.

Figures 4 through 9 show stages in the normal delivery of an infant's head. The head usually is delivered with the face toward one of the mother's legs. It should be supported by the rubber-gloved hand of a squadman. Gloves should be sterile if possible.

Courtesy Dr. George P. Shears

Figure 4

Crowning has occurred; delivery is starting.

Courtesy Dr. George P. Shears

Figure 5

This is a normal presentation.

Courtesy Dr. George P. Shears

Figure 6

Courtesy Dr. George P. Shears

Figure 7

Courtesy Dr. George P. Shears

Figure 8

Be prepared to support the baby's head as soon as it is delivered.

While supporting the head, check to find out if the cord is wrapped around the neck. If it is, run your finger between the cord and the child's neck to loosen the cord. If the cord is too tight, clamp it twice and cut between clamps.

After the head is delivered, contraction of the uterus will continue until the shoulders are delivered. Do not pull. The mother sometimes has difficulty delivering the shoulders because of their width. The top shoulder is usually the first one to present itself. Slight traction on the head toward the floor will help deliver the upper shoulder: see Figure 8. Slight traction on the head toward the ceiling will help deliver the bottom shoulder: see Figure 9. Then apply slow, straight outward traction very gently on the head. Continue to support the child and be ready for sudden expulsion. After both shoulders are delivered, the baby will follow very quickly. Guard the cord so as not to tear it.

Courtesy Zabriski-Eastman, "Nurses' Handbook of Obstetrics

Figure 9

Delivery of bottom shoulder. Note that sterile gloves are worn.

Care of the Child - The child is now on his own and should be able to start to breathe. To safeguard the child, the squadmen should:

1. Turn the child on his side across the mother's abdomen. This will facilitate the flow of mucus out of his mouth.

2. Pull the tongue forward. This can be done by grasping the tongue, top and bottom, and pulling out to the lower lip.

3. Clear his air passage. Wipe his mouth inside and out with a gauze bandage (4 x 4). By placing another gauze compress (4 x 4) over your index finger and placing your finger in the child's mouth, gently clean out all foreign bodies and mucus.

All three of the above should be carried out in all deliveries whether the child breathes immediately or not.

4. If the child starts to breathe, your attentions should then be turned to the mother and the cord.

IF THE NEWBORN DOES NOT BREATHE - If 30 seconds to one minute have elapsed without the newborn breathing, and steps 1, 2, and 3 above have been completed, the squadman must start some type of resuscitation.

5. Stimulate the child. This can be done by rubbing the child with your hand. Do not slap the child. You may also snap him on the bottom of his feet with your index finger. The child should be left on his side for this.

6. Use manual artificial respiration. Leave him on his side and aerate him by mouth-to-mouth breathing. This should be done once or twice. If the child is able to breathe on his own he will. If he does not:

7. Use mechanical artificial respiration. This is done by using a commercial resuscitator. Put the mask in place using the resuscitator stage of the machine. Let the machine breathe for the child once or twice and discontinue. If he is able to breathe on his own, he will. If he does not, it is evident that he is not able to do so.

8. Keep up the mechanical resuscitation. This must be kept up until the child starts to breathe or until he is pronounced dead by a physician. Transport him as soon as possible.

The Cord - After the child is breathing, attention should be turned to the cord. The squadmen need to know the procedure for cutting the cord, as a safety measure when the mother must be moved under awkward conditions. Those who have tried to carry a new mother down three flights of stairs with a newborn balanced on her abdomen know the safety problem. There are instances when the child should be separated from the mother.

1. Milking the cord - Before cutting the cord, the squadman must "milk" it. At approximately nine inches from the child, grasp the cord between index finger and thumb of one hand. With the index and second finger of the opposite hand grasp the cord in a scissors fashion. Milk the cord toward the baby for only two inches. It is in these two inches that the cord will be cut.

2. Tying the cord - Place a sterile clamp (hemostat or tie) approximately six to nine inches from the baby's abdomen. Cord ties can be purchased through drug stores or hospital supply companies. Each tie is 1/8" x 12". Ties are made of cotton and can be purchased sterile.

Approximately one inch further away from the tie or clamp, place another tie or clamp. When tying the cord, use square knots and put at least three knots in place.

3. Cutting the cord - Between these two clamps or ties, cut the cord with sterile scissors. This physically separates the living and breathing child from the mother.

Put the child in a soft blanket and place him in the care of some competent person. The child should be kept on his side with his head slightly lower than his body.

The emergency squad should check with local physicians as to the desired procedure to be carried out when cutting the cord in an emergency delivery.

Third Stage - From the time the child is delivered until the placenta is delivered is the third stage of labor. The placenta usually appears within 30 minutes. There will be one to two cups of blood delivered with the placenta. This is a normal amount.

After the after-birth (or placenta) is delivered, it should be preserved in some type of container or wrapped in a newspaper. This must be kept and brought into the hospital with the mother and child, so that it can be examined to see if any particles have been left in the uterine cavity.

A sterile sanitary napkin can be placed in position at this time. Be sure it is sterile. A squad should not carry an open box of sanitary napkins and use these at this time. Individually wrapped sterile napkins should be carried. If they are included in the O. B. pack, they will be sterile.

FINAL STEPS IN EMERGENCY CHILDBIRTH

The mother and child must be in the hands of medical personnel before the squadmen leave them, for the following reasons:

1. The child must have a physical examination.

2. The mother must have a physical examination including the checking of her birth canal for lacerations.

3. The newborn's eyes must be cared for, to prevent any serious eye infection. (This is a state law in Ohio.) Silver nitrate is usually used and this function is to be performed only by the experienced and trained squadman; usually it is done by a physician.

4. The cord must be checked by competent medical personnel.

5. Baby and mother must be observed for a period of time.

If the physician should ask the squadman to make out the birth certificate, he may do so. Many times the physician may ask that this be done because the squadman was present at the actual delivery.

Birth certificates can be obtained at the local county health office. They must be made out as soon as possible after the birth and be filed with the proper registrar in the county health office.

UNUSUAL DELIVERIES

DEFINITION

The term "Breech", in connection with childbirth, refers to the birth of the infant in a reverse position, as contrasted with normal head-first delivery.

In normal childbirth, the child will usually start to breathe as soon as his chest is exposed, or shortly afterwards. Because of the nature of the breech type of birth, the child's chest is delivered before his head. It is impossible for the child to take in air, as his air passages are blocked; his head is still within the vaginal canal.

SQUADMEN'S CARE

As soon as the squadman finds that it is going to be a delivery in a breech position, he must be ready to support the child. This can be done by letting the child rest on the squadman's hand and arm, thus allowing the infant's legs to straddle the squadman's arm.

The legs, hips, stomach, and chest will be delivered at this point. Sometimes it will be harder for the mother to deliver the head, and in more severe cases, the delay is quite long. If this happens, the child may suffocate, as the result of a poor air passage.

An air passage may be created by the squadman supporting the body of the infant with one hand and inserting the index and second finger of his other hand into the vaginal canal in such a way that the palm faces the baby. He should run his fingers around the child's neck until the chin is found. At this point the two fingers should be run between the child's chin and the vaginal canal. As the child's nose is reached, the squadman should separate his fingers enough so as to run one on each side of the child's nose. When in this position the squadman's fingers should be pushed away from the infant's face, in turn, facilitating a good air-way. The squadman should keep his fingers in this position until the entire head is delivered.

This is the only time the squadman should touch the vaginal area. The squadman should have sterile gloves on for this procedure.

OTHER CHILDBIRTH EMERGENCIES

On arrival, squadmen may find that the cord, a foot, or a hand is protruding from the birth canal. Transport this mother at once, taking special care not to injure the prolapsed part. Do not try to replace the prolapsed part in the vaginal canal!

If a hand or foot is protruding, cover it with a sterile towel or as clean a piece of material as is available.

If the cord should be protruding, the child may be in danger. This danger is caused by the cord being under direct pressure due to its position between the head and the birth canal. While the cord is in this position, the child might not be receiving an adequate amount of blood and oxygen.

SQUADMEN'S CARE

Transport this mother at once! In case the cord is protruding, place the mother on her back with her hips elevated on two or three pillows or folded blankets. This will cause the child to drop a little into the uterus. If the mother can be maintained in a knee-chest position, balance supported by squadman, it is preferred to elevated-hip position. However, this is a very difficult position to maintain during transport, and special precautions must be taken to safeguard the mother if this position is used. These positions will relieve some of the direct pressure pinching the cord.

ABORTION OR MISCARRIAGE

DEFINITION

This is the giving off of the membranes and the unborn child before the child is able to live on its own. This usually occurs before twenty-eight weeks of pregnancy have passed. Such an abortion or miscarriage can take place any time between conception and the time just before the child is able to live on his own. Although the outward symptoms may vary, the following symptoms will be present.

SYMPTOMS

1. Fast pulse
2. Perspiration
3. Pallor (pale skin)
4. Weakness - inability to stand
5. Cramping pain in the abdomen
6. Moderate to severe vaginal bleeding
7. Discharge of large or small particles from the vaginal canal

In other words, there will be all the symptoms of shock, plus, in most cases, bleeding from the vagina.

SQUADMEN'S CARE

1. Place victim in shock position.

2. Conserve body heat.

3. Squadmen may moisten the patient's lips if she requests it.

4. Do not touch the vaginal area, as the victim is prone to infection.

5. Squadmen may put sterile towels or vaginal pads (sanitary napkins) at the vaginal opening.

6. Keep any particles that are discharged and take them to the hospital with you, since this fleshy material may have form.

CHAPTER VIII

COMMON SQUAD EMERGENCIES

INTRODUCTION

This chapter will deal with victim care. It is slanted specifically toward the squadmen's care of a victim, not treatment which will be given by a physician. For the most part, therefore, the material presented here presupposes that the reader has had adequate training in first aid.

The squadman's responsibility in the area of victim care is a great one. His ability to give emergency care may often mean the difference between life and death to the victims. Very difficult rescues may be in vain if adequate emergency care is not carried out during and after the rescue.

For these reasons, the material in this chapter goes far beyond that found in advanced first aid texts. Where applicable, each section follows the pattern of giving the symptoms of the condition, and the preferred squadmen's care.

The procedures given follow the recommendations of a competent medical committee which is listed in the acknowledgment pages of this book. However, if squadmen should find that local medical personnel in the area in which the squad operates recommend a different procedure, we urge that their recommendations be followed. Squadmen should take every opportunity to increase their knowledge in victim care and should rely heavily on local medical personnel for assistance in keeping up to date on the latest procedures recommended locally.

BURNS

DEFINITIONS

Burns are injuries to the skin and/or underlying tissues and may be the results of such causes as the following:

1. Heat: This may be moist (steam or boiling water) or dry, such as flame, hot metals, or hot water bottles.
2. Chemicals: Strong acids or alkalies can cause burns. Acid burns may be caused, for example, by sulfuric or nitric acid. Alkali burns may be caused by lye or caustic soda.
3. Electricity: The effects of electricity vary widely, depending on the type, the voltage and the amperage of the current. Burns are usually noted where the current enters and leaves the body. In addition to these local effects, changes may be produced in the respiratory, circulatory and central nervous system.
4. Radiation: Sources of radiation burns include ultraviolet rays, X-rays and radium. Sunburn and burns from ultraviolet lamps usually are superficial and produce short-lived effects.

CLASSIFICATION OF BURNS

First Degree: Only redness of the skin
Second Degree: Blistered tissues or destruction of the same. Blisters may be broken.
Third Degree: Charred tissues or destruction of the same.

SQUADMEN'S CARE

First degree - Apply a bland ointment and a snug dressing.
Second degree - Sterile dry dressing; snug bandage; do not open blisters.
Third degree - Sterile dry dressing. This can be accomplished with 4 x 4 gauze dressing kept in place by a wide roller bandage. The use of a sterile burn sheet is also indicated. (See Figures 1, 2, and 3.)

Courtesy St. Anthony Hosp. & Pleasantville F.D.

Figure 1

The squadmen on this call are confronted with a burn of all three degrees which involves the entire left side of the back. The victim is being treated for shock by one squadman as the other man readies the burn sheet.

Courtesy St. Anthony Hosp. & Pleasantville F.D.

Figure 2

The outside wrapper having been opened, the burn sheet is very carefully unfolded. Notice that the squadman is touching only the very corners of the sheet. This will make for a sterile area covering the burns. The sheet is handled in the same manner as when removing a sterile compress from its wrapper.

Courtesy St. Anthony Hosp. & Pleasantville F.D.

Figure 3

With the utmost care, cover the burn area and wrap the rest of the sheet around the victim. Do not use ointments or sprays of any kind on second-degree or third-degree burns.

Chemical - In most cases, dilution by flushing with large amounts of water is the best emergency care.

Electrical - Treat the local burn the same as above, depending on the degree. Watch the victim for stoppage of breathing and treat for severe shock.

Do not apply ointments to second- and third-degree burns. Remember, pain induces more shock. Physicians usually remove all ointment that has been previously applied. Removing this ointment will cause the victim to have more pain and in turn make his shock more severe.

A victim's family (or others) may apply ointment to a second- or third-degree burn before the squad arrives. If this happens, a squadman should notify the emergency room nurse as to who applied the ointment. This is important because the hospital medical team otherwise may wrongly think the ointment was applied by the squad.

If a person is burned extensively and will require surgery to dress the burns, it is wise to have his stomach empty while giving an anesthetic. So do not give liquids by mouth to a patient who has extensive burns.

The extent of a burn is estimated as a percentage of the victim's whole skin surface. The total care of a burn patient in a hospital is carried out according to the amount of the body burned.

The "Rule of Nines" is heard often in the care of burns. Figure 4 shows how the percentages are established. Squadmen should know this method so they can estimate the extent of a burn by the time the patient arrives at the hospital, and can inform emergency room personnel.

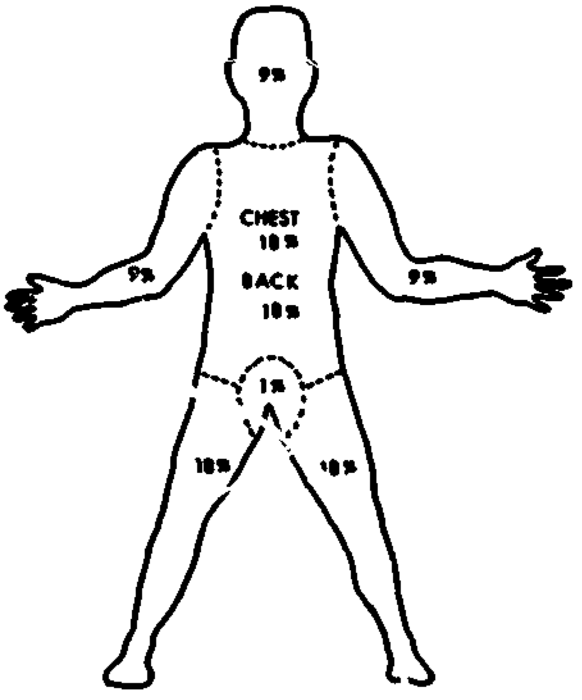


Figure 4

Body burns expressed in percentage of total skin surface.

COMPLICATIONS

The two major complications of burns are shock and infection. Shock is caused by any of the following:

1. Loss of body fluids from the denuded area. This loss is usually in the form of plasma.
2. Electricity. Brain or heart damage, seen particulary in electric shock, will disturb or destroy the breathing or blood-pressure regulating organs of the body.
3. Pain due to the burn.
4. Psychological distress.

To help prevent infection, sterile materials should be applied next to burns.

In the prevention of shock, heat is the first consideration. Conserve the victim's body heat and elevate his feet.

PENETRATING WOUNDS OF THE EYE

DEFINITION

Penetrating wounds of the eye include any wounds in which the eyeball has been cut or penetrated.

SQUADMEN'S CARE

The eyeball contains a vital fluid. If this fluid is lost, the eyeball will collapse and the victim may lose his sight in that eye. Therefore squadmen should do whatever is possible to prevent the escape of the vital fluid from an injured eye.

1. If there is an object penetrating the eyeball, do not remove it.
2. If the object is protruding from the eye, support it by wrapping and tying bandages carefully.
3. If there is no object protruding from the injured eye, cover it with a metal eye shield. Do not put compresses or cotton eye patches on the injured eye; they might cause harmful pressure.
4. Cover the good eye. This will help the victim to keep his eyes at rest.
5. Keep the victim on his back. This will help to keep the fluid in the injured eye.
6. Explain all procedures to the patient.

ABDOMINAL INJURIES

DEFINITION

The abdomen is the cavity in the body between the diaphragm and the pelvis. Care of abdominal injuries is usually of considerable magnitude and often requires emergency surgery. The time element between injury and operation is vital in maintaining a minimal mortality rate. This time element is called a <u>time lag</u>. Speed of transport to the place of definitive treatment is of utmost importance. Speed should be used, but not with lost motion or at the sacrifice of safety.

If there is a large catastrophe with many injured, transport priority should be given to the victim with an abdominal wound. Abdominal, head, and chest injuries are given priority over all other injuries, even though the patients may not appear to be seriously wounded at the time. Often the goriest of the injured or the obvious fracture are sent on, while the abdominal injury is detained. This mistake contributes to needless deaths.

SYMPTOMS

1. Shock
2. Difficult breathing
3. Protruding organs
4. Fast, weak pulse
5. Hemorrhage (arterial or venous)

EMERGENCY CARE

For protruding of the bowel or other organs through abdominal wounds, the care depends upon the facilities at hand. At the scene of the accident the care should be similar to that of a compound fracture. Do not return the organs manually, but cover them with sterile gauze or linen. If this is not available, use clean cloths.

If sterile water, plasma, or some other non-irritating sterile or "reasonably" sterile liquid is available, moisten the cloth and keep it moist. If water can be boiled for fifteen minutes, it can be used to moisten the cloths, after it returns to room temperature. If transportation will take over thirty minutes, it is worthwhile to spend the time to boil water and keep the dressing moist. The wet dressings are then covered with a large sterile (or clean) pad. This is not pulled tight, but is kept snug.

If this care is carried out in an emergency room, sterile materials will be on hand; they should and will be used. The dressings can be moistened with a sterile salt solution or sterile water. Bleeding is rarely severe and is best not cared for at a first aid station unless a spurting artery is present. More harm than good is done by manipulation.

Time should be taken to put a compression bandage over the abdomen before transporting the victim. This can be done with the so-called scultetus or "many-tailed" binder (Figure 5).

Figure 5

The scultetus binder or many-tailed binder can be used for several kinds of emergencies.

The binder consists of a square of heavy muslin or flannel material about twelve inches square, to which a series of straps, each two inches wide and eighteen inches long, have been sewn on two opposite sides. The square is placed over the injury on top of the dressing. The straps are then alternately brought around the victim and tied. The straps are pulled snug, each strap overlapping the previous one, to hold it and the moist dressing in place. This will prevent any additional loop of intestines, or other organs, from protruding.

Binders can be made by a squad auxiliary and sterilized by a local hospital. If no binders are available, an ordinary bath towel will serve as a fairly effective substitute. The towel is placed around the abdomen, and the ends, one upon the other, are pinned loosely together.

Some kind of binder should be applied as soon as an abdominal injury is suspected by the squadman. This type of bandage also may be of service to victims who have sustained rib fractures, because it serves to immobilize the chest.

If the victim is having difficulty in breathing, he will be most comfortable in a semi-sitting position. On the other hand, if shock is present, the best position is with the head lowered and the feet elevated with knees bent. In general, if the victim's skin is dry and warm and if his pulse is strong, it is advisable to put him in a position with head and chest slightly elevated. The victim should be kept warm by the use of blankets, rather than with hot water bottles or heating pads, to prevent possible burning.

Don't give the victim anything by mouth.

In summary, we may say that the care of abdominal injuries consists of:

1. Discovering that an abdominal injury may exist
2. Caring for shock
3. Caring for any protruding organ
4. Applying moist dressing
5. Applying a snug binder
6. Securing surgical aid as rapidly as possible, by priority of transport, so that definitive care (consisting particulary of operative treatment) may be carried out.

OPEN CHEST WOUNDS

DEFINITIONS

A chest wound is any opening into the chest cavity from the outside.

CAUSES

Chest wounds may be the result of an opening caused by any object that has penetrated through the soft tissues of the chest, such as: (1) a bullet, (2) a knife, (3) any other cutting object.

SIGNS AND SYMPTOMS

In a normal chest the lung remains in a position of expansion. Any leak of air through the chest wall results in collapse of the lung. If this air pressure from the outside is not stopped as soon as possible, the lung collapse will cause the area around the heart to shift. If this shift occurs, the large blood vessels leading from the heart will be twisted, causing them to shut off the supply of blood from and to the heart. This condition can cause a type of heart failure.

A sucking sound may or may not be heard in chest wounds. These wounds are usually called "sucking chest wounds." This is because a sucking sound is sometimes made by the air rushing into the chest cavity from the outside each time the victim breathes.

These factors point out the absolute necessity for instantaneous emergency care by the squadmen in such chest wound cases,

SQUADMEN'S CARE

The squadman's first step should be to seal off the open wound to the outside air. Tape a large piece of wide adhesive over the opening. Be sure the surrounding area is well covered to prevent seepage in breathing. (All squads should carry wide tape, 4" to 6", in their supplies.)

Any non-porous material, (i.e. plastic) may be placed over the opening and sealed with tape. If the opening is large, there may be need to apply more than one piece of tape in order to close the wound completely. Have tape extend two or three inches beyond the edge of the wound on all sides. If gauze is used before taping, be sure it is large enough so that there is no danger of the gauze being sucked into the wound.

Be sure to have the victim take a deep breath before applying the tape.

Where too much time is needed to get equipment ready, the squadman should place his hand directly over the wound.

Place the victim in a sitting position if possible, or on his injured side, if nothing is protruding. Supportive treatment before and during transport is the administration of oxygen.

NOTE: If there is an open chest wound from which there protrudes a foreign object of some kind, <u>do not remove the object</u>.

Review of pertinent points to remember:

1. Seal the wound from the outside as quickly as possible.
2. Place the victim in a sitting position, or on his injured side.
3. Apply oxygen therapy.
4. Transport the victim to area of definitive treatment.

FRACTURES

DEFINITION

A fracture is any break in the continuity of a bone.

VARIETIES OF FRACTURES

1. The break may be incomplete with only a line in the bone. This type is frequently found in the skull.
2. The break may be part-way through the bone, splintering the fibers on one side and bending them on the other as with a green twig. This is common in children at any age where the bones are soft and pliable.
3. There may be a completely broken bone, broken transversely or in a spiral direction, and very often it is broken into several fragments.

If the fractured surfaces are protected from contamination with the outside air, or the skin remains intact, it is called a simple or closed fracture. On the other hand, if an open wound occurs at the time of the fracture so that air and bacteria may be admitted, it is called a compound or open fracture. There is a connecting wound to the outside.

A compound fracture is more difficult to treat than a simple fracture because of the open wound, since the possibility of infection must be considered as well as the fracture itself.

A complicated fracture is one in which other structures or organs such as nerves, blood vessels, joints, lungs, or bladder are injured by the force or by the fracture fragments, such as a broken rib puncturing a lung.

An impacted fracture is one in which the bone is broken and one end is wedged into the interior of the other.

SYMPTOMS

The signs and symptoms of a fracture may be visualized easily by picturing what happens when a bone is broken:

1. When a break occurs, it allows an unnatural movement of a normally rigid part.
2. The displacement of the fragments of the fracture area causes a deformity of the limb.
3. There is loss of power of movements. The limb cannot function properly because normal function of a muscle is dependent upon the bones to which it is attached.
4. Upon examination of the injured part, a grating sensation is imparted to the fingers; this is due to the rubbing of the fragments one upon the other. Correct terminology for this sign is crepitus.
5. There may be shortening of the bone at the site of the fracture.
6. Pain occurs with acute tenderness over the site of the fracture.
7. Swelling and discoloration of skin develop, due to the injury causing the fracture and the hemorrhage which follows into the tissue.

All of these symptoms are not necessarily present in every fracture. The signs observed will indicate the type of fracture present.

SQUADMEN'S CARE

The fractured part should be rendered as immobile as possible by the temporary application of well-padded splints held firmly in place by bandaging. This type of emergency care will help decrease pain and additional injury associated with a fractured bone by the immobilization of the joints above and below the fracture.

Figure 6 depicts the proper care of a patient with a severe fracture.

Courtesy Prairie Twp. F.D.

Figure 6

These squadmen are properly applying a traction splint. The patient has been treated for shock; blankets have been placed over and under her. A backboard is ready to be placed. Also, notice that a soft object has been placed under her head to make her comfortable. It is only through an examination such as that carried out in this emergency that squadmen can be sure of finding fractures.

In case regular splints are not available, other materials can be used: well-padded pieces of wood, magazines, blankets or any other materials that will immobilize the injured part. Figures 7 through 20 show various ways of improvising splints.

If a compound fracture is present, the wound should be covered with a sterile dressing. No attempt should be made to reduce the fracture, even though one of the bone fragments is protruding through the skin. Splints should be applied as in any other type fracture. A pressure dressing should be applied over the wound to control bleeding.

As a rule, victims with fractures should not be moved until the injured part has been supported by temporary splints. There are times, however, when moving is necessary. In those cases the limb should be supported both above and below the site of the fracture, and traction should be applied in the direction of the long axis of the bone in order to prevent rotation as well as angular motion.

Victims with fractures can best be transported on a backboard. See Chapter XIII for detailed information on the use of the backboard.

THE FRACTURE LESION

DEFINITION

A lesion is any change in tissue formation. Fracture lesions may vary from a simple crack in the bone with mild disturbance of surrounding tissues to severe lesions with marked displacements of the fragments and much damage to all of the neighboring tissues.

The actual conditions at the site of the fracture are of the greatest importance, since they will help establish the general principles of care to be used by the squadman. In examining the victim the squadman should observe (1) the character of fracture and nature of soft-part damage, and (2) the stage of changes present.

Ordinarily when a bone is broken, the covering of the bone is torn and the surrounding soft parts are damaged to some extent. Blood vessels and glands are ruptured and the tissues become swollen and engorged with blood, lymph, and waste products. This causes swelling, pain and circulatory disturbances, all of which are increased by handling of the extremity and movement of the bone fragments.

The blood, lymph, and waste rapidly begin to form a clot at the site of the injury. The bone ends at the fracture site and some of the soft tissues are killed by the injury, and in their disintegration they yield chemicals that break up the dead cells resulting in their being removed from the dead and dying bone. Later this calcium is used in the formation of a callus at the fracture site, a type of body-made splint.

The swelling and inflammation of the soft parts increases rapidly during the first eight to twelve hours. By the end of this time the muscles and other soft parts have lost their elasticity and have become waterlogged. Reduction by a physician at this late stage is more difficult to accomplish, and results in more damage to surrounding tissues. The fluid in the tissues occurs as the result of circulatory disturbance due to pressure from swelling.

At the scene of an emergency, the squadman should not only give emergency care to the obvious fracture lesion. He should be on the alert for symptoms of any other injury and must consider that a fracture may cause severe pain and hemorrhage with complicating shock.

The fracture lesion description was presented here to show the seriousness of fractures. It has become an increasing problem in squad training to impress on the squadman the importance of good fracture care.

The old expression, "We are close to a hospital and do not need to splint," is absolutely senseless. A person who falls within a hospital is splinted first and then taken to the emergency room. Splint all suspected fractures.

Courtesy St. Anthony Hosp. & Greenfield Twp. F.D.

Figure 7

Courtesy St. Anthony Hosp. & Greenfield Twp. F.D.

Figure 8

Board splints should be padded before they are put into service. See Figure 7. This small arm or leg splint will be more comfortable when applied, due to its being padded. After a padded splint board is in place, it is tied securely. See Figure 8. Splint boards should go beyond the adjacent joints: in this case, the elbow and wrist.

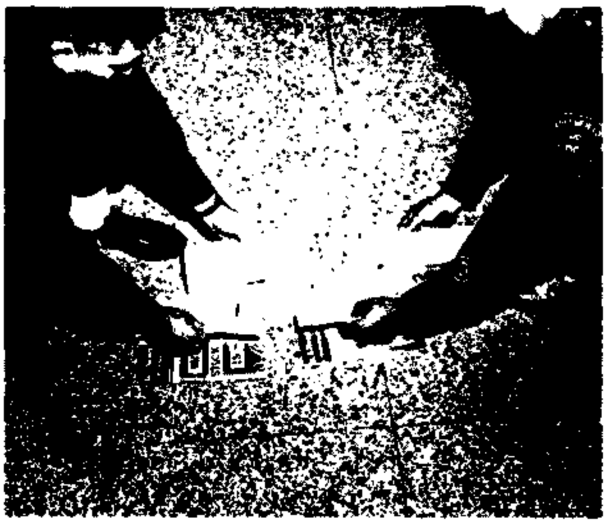
Courtesy St. Anthony Hosp. & Greenfield Twp. F.D.

Figure 9

Courtesy St. Anthony Hosp. & Greenfield Twp. F.D.

Figure 10

A splint can be improvised from household or squad pillows. Figure 9 shows one squadman supporting the victim's foot, while the other applies a two-inch roller bandage to secure the splint. After securing a pillow splint, the foot must be supported. Pinning the overlap of the pillow case, as shown in Figure 10, keeps the foot in an upright position and in the best alignment for transportation.



Courtesy St. Anthony Hosp. & Greenfield Twp. F.D.

Figure 11

Courtesy St. Anthony Hosp. & Greenfield Twp. F.D.

Figure 12

Improvised splints may be made from large magazines, interwoven as shown in Figure 11. An entire leg or arm could be immobilized this way and might require many magazines. Large magazines should be carried in all fracture kits. Figure 12 shows a magazine splint being applied. The knot is tied on one side, so as to make the splint as comfortable as possible for the victim. The splint runs above and below the joints adjacent to the fracture: in this case, the ankle and knee.

BLANKET ROLL SPLINT

Many things can be used for improvising splints. A blanket roll is one of the most common. Figures 13 through 20 deal with making and applying blanket roll splints.

Two sizes should be carried on the squad truck: a short roll (12" to 16") for possible neck fractures, and a long roll (22" to 26") for arm and leg fractures.

Courtesy Sharon Twp. F.D., Worthington, O.

Figure 13

Courtesy Sharon Twp. F.D., Worthington, O.

Figure 14

To make a blanket roll splint, fold a blanket until it is 12" to 16" wide. Roll it from both ends toward the center, tucking all wrinkles under (Figure 13.) Then tie it with 3 cravat bandages (Figure 14.) When the splint is needed, the cravats will be immediately available.

Courtesy Sharon Twp. F.D., Worthington, O.

Figure 15

Courtesy Sharon Twp. F.D., Worthington, O.

Figure 16

The long blanket roll splint can be applied to the extremities. Figure 15 shows the proper supporting of a suspected fracture and the application of the splint. Figure 16 shows the splint in place.

Courtesy Sharon Twp. F.D., Worthington, O.

Figure 17

Courtesy Sharon Twp. F.D., Worthington, O.

Figure 18

Figure 17 shows the proper way to hold a head when a fracture of the neck is suspected. One squadman is preparing the short blanket roll splint. Figure 18 shows how to place the blanket roll splint gently under the victim's head. The rolls on each side of the head must be placed firmly on the victim's shoulder and next to his head.

Courtesy Sharon Twp. F.D., Worthington, O.

Figure 19

Courtesy Sharon Twp. F.D., Worthington, O.

Figure 20

The cravats are pushed under the blanket with a flat, thin blade (Figure 19.) They can be brought down the splint from the top. Figure 20 shows the splint in place. It is positioned tightly against the victim's shoulders and head, to immobilize his head and neck.

CONVULSIONS IN CHILDREN

DEFINITION

A convulsion is a loss of consciousness with a generalized twitching of the muscles.

CAUSES

General convulsions in children have various causes.

In very young infants (two to four months) convulsions may be due to birth injuries. In older infants and young children a convulsion may mark the onset of an infectious disease, epilepsy, drug poisoning, or a nutritional disease. The cause may be unknown.

In children that the squadman will see, the usual cause of a convulsion is a high fever. (This is true 95% of the time.) This can be determined by just the touch of your hand on the child's skin.

SQUADMEN'S CARE

If a high fever is the cause of the convulsion, the cause must be eliminated. The child's temperature must be lowered.

This can be accomplished by sponging the child's body with cold applications. The solution used should be tap water, not ice water.

The proper way to "sponge" or cool a child's body is:

1. Obtain two large bath towels.
2. Fill a basin with cold tap water.
3. Take off all of the child's clothing.
4. Submerge towel in cold water and apply completely open, on one side of the child's body. (Front or back of the child).
5. Pat the towel; do not rub it. When the towel becomes warm, remove it and place a cold one under the child.
6. Repeat this procedure during transportation to a hospital or until a physician arrives.
7. An airway should be inserted to keep the victim's tongue forward. which will maintain a good exchange of air.

Remember to cool only one side of the body at a time. An ice bag can be placed on the child's head if desired. Also some physicians recommend the addition of an ounce of 70% alcohol (rubbing alcohol) to the water. Add this only on a physician's order.

The squadman should start this entire procedure as soon as possible and continue it until the convulsion stops or a physician arrives. He will probably recommend that this work be continued.

These children should be in the hands of medical personnel before the squadmen leave them.

CONTAGIOUS DISEASES

NEED FOR SPECIAL CARE

Sometimes, after an emergency squad has answered a call, has had direct contact with the victim, and has transported him to the hospital, it is found that the patient suffers from a contagious disease. Since there are many ways in which contagious diseases are transmitted, it is a must for all squadmen to take certain special care not only of their person and personal clothing, but of their equipment, apparatus, and vehicle.

PRECAUTIONS

The special precautions that must be taken, to prevent the spread of common communicable diseases, are listed in Table 1.

Some of the statements in the chart should be defined. When the squad truck is to be "aired for 12 hours" it should be out of service for that time. All windows and doors of the vehicle should be opened.

To "boil linens" means that the water should boil before adding the linens and the water should boil for at least 20 minutes after adding them. Be sure to tell the laundry that the linens you are having washed have already been boiled.

To "scrub car" means to wash the inside of the squad vehicle and any equipment with which the patient came in contact. Soap and warm water should be used. After washing, wipe down the vehicle with aqueous Zephiran solution 1:750. This solution can be bought at any drug store. Just moisten a cloth with this solution and go over all the parts that were washed.

LOCAL AUTHORITY

If there is any question at all about the contagious disease patient, you should call your county or city health physician. He is your local authority on contagious diseases.

All squadmen should wash their hands at the hospital after each run.

Table I HANDLING OF CONTAGIOUS DISEASES

COMMON NAME	MEDICAL SYNONYMS	INCUBATION PERIOD	MODE OF TRANSMISSION	CARE OF SQUAD VEHICLE AND LINENS *	CARE OF PERSONNEL **
Diphtheria	Membranous croup	1 to 7 days	Droplet infection and direct contact with cases or with a healthy carrier.	Air car 12 hours. Launder linens.	Schick test. Immunize.
Scarlet fever	Scarlatina	1 to 7 days	Droplet infection, fomites, carriers, pets occasionally.	Air car 12 hours, and scrub. Boil linens.	Dick test. Shower. Change and boil clothes.
Measles	Rubeola or Red measles	7 to 18 days; usually 9 to 11 days	Secretions from respiratory tract and eyes, droplet infection.	Air car 12 hours. Launder linens.	Wash hands.
German measles	Rubella	5 to 21 days	Direct contact, droplet infection from nose and mouth.	Air car 12 hours. Launder linens.	Wash hands.
Whooping cough	Pertussis	2 weeks	Droplet infection, carriers.	Air car 12 hours and scrub. Isolate and boil linens.	Shower. Change and boil clothes.
Mumps	Parotitis epidemic	12 to 24 days; usually 16 to 18 days	Direct contact, droplet infection from nose and mouth.	Air car 12 hours. Air and change linens.	Wash hands.
Chicken pox	Varicella	10 to 20 days; usually 14 days	Droplet infection from nose and mouth; direct or indirect contact.	Air car 12 hours and scrub. Boil linens.	Shower. Change clothes.
Smallpox	Variola	3 to 18 days; usually 10 to 12 days	Direct or indirect contact.	Scrub car. Burn linens.	Burn clothes. Re-vaccinate all exposed persons immediately.
Spinal meningitis or Cerebro-spinal fever	Meningococcus meningitis	3 to 7 days	Droplet infection from nose and mouth of patients or carriers.	Air car 12 hours. Launder clothes.	Shower. See M.D. for possible medication.
Typhoid fever	Enteric fever	10 to 15 days	Fecal contamination of food, water, or milk.	Air car 12 hours. Boil linens if contaminated with urine or feces.	Wash hands and face.
Tuberculosis	Koch's disease or TB	Varies	Infected sputum.	Use sputum cups and burn. Scrub car. Boil clothes and linens.	Avoid close facial contacts.
Syphilis	Lues VD	3 weeks	Usually sexual contact.	Air and launder linens. (No special car care.)	Wash hands. If scratched call M.D.
Infantile paralysis	Poliomyelitis	7 to 14 days	Uncertain: possibly nose and throat.	Air car 12 hours. Launder linens. Wash equipment with soap and warm water.	Shower. Change clothes.
Hepatitis	Serum hepatitis or Infectious hepatitis	10 to 14 days	Infected blood.	Air car 12 hours. Boil linens if contaminated with blood or feces.	Wash hands.

* When a car is being "aired," it is not to be in service. To "scrub car" means to wash the entire inside of the squad car with soap and water.

** In all of these conditions, except syphilis, the squadmen should use cloth, contagious-disease masks.

POISONS

DEFINITIONS

Demulcent: An agent that will soothe a part. (Olive oil, glycerin, milk)

Emesis: Act of vomiting

Emetics: Materials that produce vomiting

Extremities: Usually refers to the arms and legs

Gastric: Pertaining to the stomach

Lavage: To wash out a cavity (stomach)

Stomach tube: Refers to a stomach pump. Squadmen never use these.

SQUADMEN'S CARE

The United States Pharmacopeia (U.S.P.) encourages all manufacturers of poisonous material to print the antidote on the container. Look for such information first and carry out instructions if possible.

Figure 21 lists telephone numbers for centers in Ohio that provide emergency information about poisons. Figure 22 describes counterdoses for many poisons.

If a victim is unconscious, do not try to give fluids. If he is even a little dizzy or resistive, be cautious in trying to dilute the stomach contents.

If you are to dilute the substance in the stomach and cannot obtain the antidote, use water. Dilution, or washing out of the stomach, can be carried out enroute to the hospital. Have the radio dispatcher notify the hospital that you are coming.

Squads should carry a carbon dioxide-oxygen mixture, but the mixture should be used only on a physician's prescription. He can prescribe in person, in writing, or by phone.

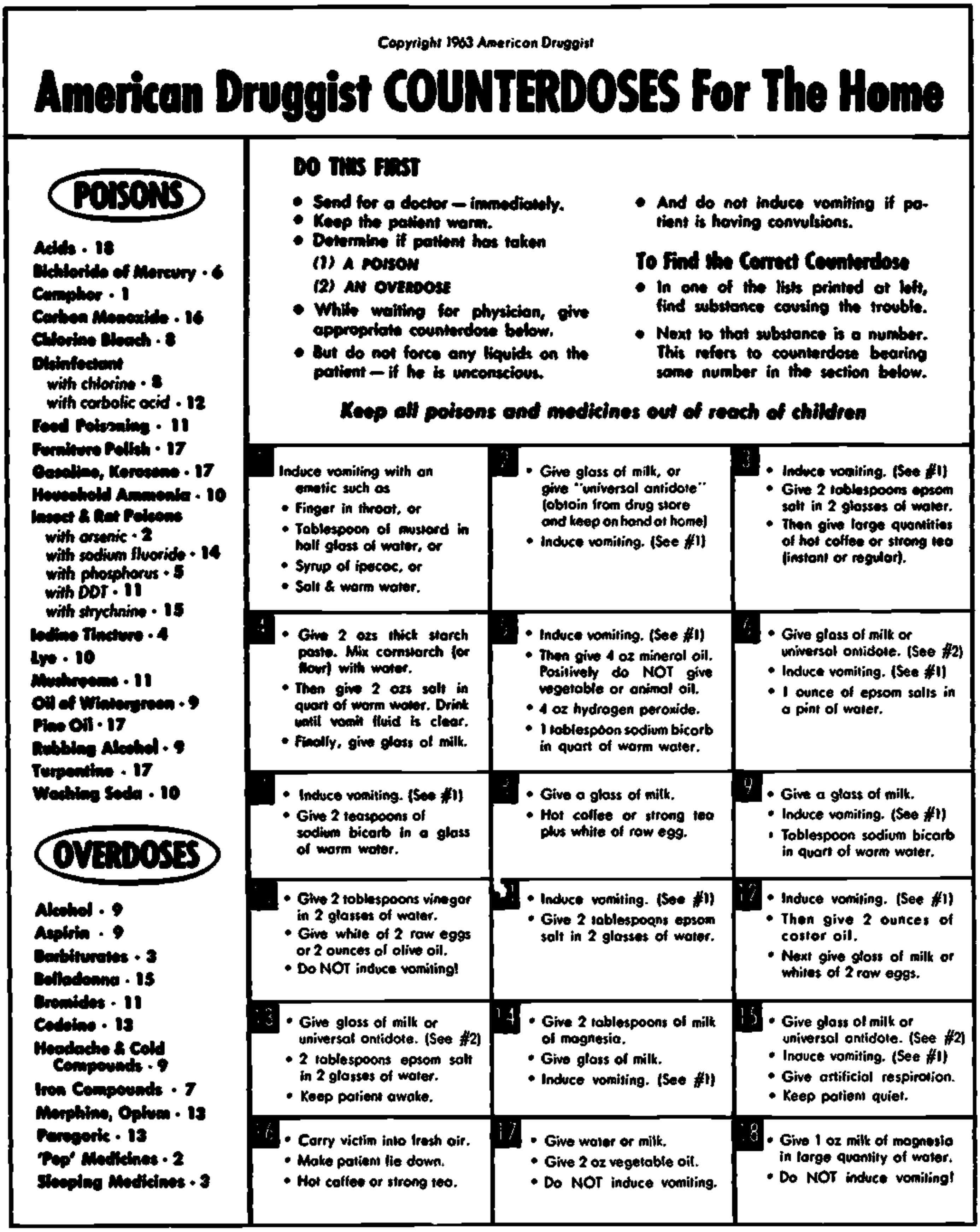
These centers have agreed to cooperate in a program to extend their services to any physician requesting information from them. When a center is called the physician should have four basic facts in mind (1) The full name or brand of the product ingested or inhaled; (2) An accurate estimation of the amount of the particular agent ingested; (3) The time of ingestion; (4) The age and weight of the patient.

LOCATION	FACILITY	TELEPHONE
AKRON	Children's Hospital W. Bowery and W. Bechtel	BL 3-5531, EXT. 246
CINCINNATI	The Academy of Medicine of Cincinnati 320 Broadway	PA 1-2345
CLEVELAND	Cleveland Academy of Medicine 10525 Carnegie Ave.	CE 1-4455
COLUMBUS	Children's Hospital 561 S. 17th St.	CL 8-9783
DAYTON	Poison Information Office United States Air Force Hospital Wright-Patterson-Air Force Base, Ohio	253-7111, EXT. 78335
MANSFIELD	Mansfield General Hospital 335 Glessner Ave.	LA 2-3411, EXT. 248
SPRINGFIELD	City Hospital E. High and Burnett Rd.	FA 3-5531, Ext. 226
TOLEDO	Toledo Health Department 635 N. Erie St.	CH 4-1961—(Day) EV 5-4661—(NIGHT)
YOUNGSTOWN	Emergency Room Dept. St. Elizabeth Hospital 1044 Belmont Street	RI 6-7231, EXT. 220

Courtesy American Druggist

Figure 21

Poison information centers in Ohio.



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American Druggist COUNTERDOSES For The Home

POISONS

- **Acids** · 18
- **Bichloride of Mercury** · 6
- **Camphor** · 1
- **Carbon Monoxide** · 16
- **Chlorine Bleach** · 8
- **Disinfectant**
  - *with chlorine* · 8
  - *with carbolic acid* · 12
- **Food Poisoning** · 11
- **Furniture Polish** · 17
- **Gasoline, Kerosene** · 17
- **Household Ammonia** · 10
- **Insect & Rat Poisons**
  - *with arsenic* · 2
  - *with sodium fluoride* · 14
  - *with phosphorus* · 5
  - *with DDT* · 11
  - *with strychnine* · 15
- **Iodine Tincture** · 4
- **Lye** · 10
- **Mushrooms** · 11
- **Oil of Wintergreen** · 9
- **Pine Oil** · 17
- **Rubbing Alcohol** · 9
- **Turpentine** · 17
- **Washing Soda** · 10

OVERDOSES

- **Alcohol** · 9
- **Aspirin** · 9
- **Barbiturates** · 3
- **Belladonna** · 15
- **Bromides** · 11
- **Codeine** · 13
- **Headache & Cold Compounds** · 9
- **Iron Compounds** · 7
- **Morphine, Opium** · 13
- **Paregoric** · 13
- **'Pep' Medicines** · 2
- **Sleeping Medicines** · 3

DO THIS FIRST

- **Send for a doctor — immediately.**
- **Keep the patient warm.**
- **Determine if patient has taken**
  - ***(1) A POISON***
  - ***(2) AN OVERDOSE***
- **While waiting for physician, give appropriate counterdose below.**
- **But do not force any liquids on the patient — if he is unconscious.**
- **And do not induce vomiting if patient is having convulsions.**

To Find the Correct Counterdose

- **In one of the lists printed at left, find substance causing the trouble.**
- **Next to that substance is a number. This refers to counterdose bearing same number in the section below.**

Keep all poisons and medicines out of reach of children

1

Induce vomiting with an emetic such as
- Finger in throat, or
- Tablespoon of mustard in half glass of water, or
- Syrup of ipecac, or
- Salt & warm water.

2

- Give glass of milk, or give "universal antidote" (obtain from drug store and keep on hand at home)
- Induce vomiting. (See #1)

3

- Induce vomiting. (See #1)
- Give 2 tablespoons epsom salt in 2 glasses of water.
- Then give large quantities of hot coffee or strong tea (instant or regular).

4

- Give 2 ozs thick starch paste. Mix cornstarch (or flour) with water.
- Then give 2 ozs salt in quart of warm water. Drink until vomit fluid is clear.
- Finally, give glass of milk.

5

- Induce vomiting. (See #1)
- Then give 4 oz mineral oil. Positively do NOT give vegetable or animal oil.
- 4 oz hydrogen peroxide.
- 1 tablespoon sodium bicarb in quart of warm water.

6

- Give glass of milk or universal antidote. (See #2)
- Induce vomiting. (See #1)
- 1 ounce of epsom salts in a pint of water.

7

- Induce vomiting. (See #1)
- Give 2 teaspoons of sodium bicarb in a glass of warm water.

8

- Give a glass of milk.
- Hot coffee or strong tea plus white of raw egg.

9

- Give a glass of milk.
- Induce vomiting. (See #1)
- Tablespoon sodium bicarb in quart of warm water.

10

- Give 2 tablespoons vinegar in 2 glasses of water.
- Give white of 2 raw eggs or 2 ounces of olive oil.
- Do NOT induce vomiting!

11

- Induce vomiting. (See #1)
- Give 2 tablespoons epsom salt in 2 glasses of water.

12

- Induce vomiting. (See #1)
- Then give 2 ounces of castor oil.
- Next give glass of milk or whites of 2 raw eggs.

13

- Give glass of milk or universal antidote. (See #2)
- 2 tablespoons epsom salt in 2 glasses of water.
- Keep patient awake.

14

- Give 2 tablespoons of milk of magnesia.
- Give glass of milk.
- Induce vomiting. (See #1)

15

- Give glass of milk or universal antidote. (See #2)
- Induce vomiting. (See #1)
- Give artificial respiration.
- Keep patient quiet.

16

- Carry victim into fresh air.
- Make patient lie down.
- Hot coffee or strong tea.

17

- Give water or milk.
- Give 2 oz vegetable oil.
- Do NOT induce vomiting.

18

- Give 1 oz milk of magnesia in large quantity of water.
- Do NOT induce vomiting!

Courtesy American Druggist

Figure 22

Counterdoses for common poisons and overdoses.

PROPER EXAMINATION

People who have not been trained sometimes wrongly think that a victim is under the influence of alcohol, when actually he needs medical care. Squadmen should not accept the opinion of a casual bystander that a victim is "drunk" but should examine carefully for symptoms of diabetes, epilepsy, and other conditions.

UNCONSCIOUS PERSONS

DEFINITION

Unconsciousness is the state of being insensible or without conscious experiences.

CAUSES

To describe here all the causes of unconsciousness in not feasible; they are too many and too complex.

ESSENTIAL POINTS TO REMEMBER

1. The air passage is usually poor at some time during the illness.
2. The inhaling of any foreign material may cause death.
   a. Check closely for any foreign material in the patient's mouth.
   b. Check closely for any vomiting which may bring foreign material to the mouth from the stomach.
3. Since a state of unconsciousness means that all body functions are impaired, respiration may be slower.
4. Always remember that the unconscious person is breathing, while the asphyxiated person is unconscious and not breathing.

SQUADMEN'S CARE

Check the victim for any difficulty in air exchange. If difficulty is noted, you must do the following:

1. Check his air passage. If a good air passage is needed, the squadman must insert a plastic, hard rubber, metal or improvised airway immediately. This will keep the paralyzed tongue out of the way of the windpipe. The unconscious person can still have a gag reflex.
   If there should be any sign of gagging on the airway, remove it immediately. Do not cause the complication of vomiting with the airway. The squadman can then lift up on both sides of the angle of the jaw to create a good air passage.

2. If there is any sign of vomiting or coughing up of any foreign material, the victim must be turned on his side immediately. This will facilitate the flow of any foreign materials out of the mouth.

3. It is always a safe practice to support these people with a flow of oxygen. If they should stop breathing, resuscitate them.

DIABETES

DEFINITION

Diabetes is a chronic disorder of the metabolism, the basis of which is an inability of the cells to use sugar. This defect probably is due to a deficiency of insulin production by the cells of the pancreas. The diabetic can go into either of two conditions: diabetic coma or insulin shock.

(A) DIABETIC COMA

This condition is caused by the incomplete oxidation of fatty acids, which produces acetone bodies and is common in uncontrolled diabetes.

Clothing of any person in a coma should be checked for a card which states that he is a diabetic. Relatives or friends may volunteer the information.

SIGNS OR SYMPTOMS

1. The victim can be confused and unable to cooperate.
2. Nausea and vomiting may be present.
3. The breathing is characterized by very deep, yet not labored respiratory movements. There is no evidence of obstruction of the air passages or any blueness.
4. The skin is dry and cold.
5. The breath has a sweetish or fruity odor which is acetone.

SQUADMEN'S CARE

Since this victim needs insulin and the squadmen are not permitted to administer it, transport him to a hospital immediately. He requires careful, expert, and immediate attention from a physician.

(B) INSULIN SHOCK

Insulin shock is likely to occur in a diabetic when, for any reason, the blood sugar falls. It results usually from the omission of a meal or the vomiting of a meal after taking insulin. Some attacks follow undue exertion. The majority of attacks occur in the morning and in the early evening. An individual whose store of blood sugar is depleted as a result of emotional excitement, exertion or exposure to cold has an increased sugar tolerance and reacts to insulin with a comparatively greater blood-sugar drop than would otherwise be the case. He is, therefore, a candidate for insulin shock; that is, he is temporarily insulin-sensitive.

These reactions begin in five to twenty minutes following an injection of regular insulin, but not for several hours after other types are given. The symptoms and signs should be familiar to every squadman.

SIGNS OR SYMPTOMS

1. General muscular weakness, together with mental confusion
2. Restlessness
3. Profuse sweating
4. Dizziness
5. Pallor or flushing of the face
6. Trembling
7. Hunger pangs in the upper stomach

The victim may lapse into a coma. Some victims' blood sugar lowers so rapidly that the symptoms progress almost without warning to those of epileptiform convulsions.

SQUADMEN'S CARE

When the warning symptoms appear, the victim should take a drink containing sugar or consume a piece of candy at once. All persons taking insulin should carry sugar in some form in their pockets. Such sugar checks the reaction within a few minutes. If the sudden attack progresses to convulsions, care for the victim as you would any convulsing person.

If untreated, a reaction may result in death, but this seldom occurs. These people should be transported as soon as possible to the closest emergency room.

CRITICAL QUESTIONS

Two questions that can be asked of the diabetic to determine which state he might be entering are as follows:

1. Have you eaten today?
2. Have you taken your insulin today?

If the person has taken his insulin and has not eaten, he is going into insulin shock. If he has eaten and has not taken his insulin he is entering diabetic coma. These two questions should be memorized and be ready for use at any time by the squadman.

EPILEPSY

DEFINITION

Epilepsy is a disease characterized by attacks of loss of consciousness, with or without convulsions. Some of the most pronounced epileptics have few convulsions - possibly none at all - while violent convulsions, in every way similar to those of epilepsy, may be due to other conditions. The mildest cases of true epilepsy also may have no true convulsions, but merely attacks of momentary unconsciousness, although these have the same significance as the most violent seizures.

The epileptic attack should be called a <u>seizure</u> - never a "fit."

SQUADMEN'S CARE

Cool presence of mind and prompt action are important in caring for any type of convulsion. One of the first steps indicated is to insert some object between the victim's teeth to prevent him from biting his tongue. This cannot be done during a seizure, but should be carried out when it appears that the victim will be entering a seizure momentarily. If the victim is experiencing a series of seizures, the mouth gag can be inserted during the relaxed state between seizures.

An effective mouth gag can be fashioned quickly by binding together several tongue depressors with adhesive tape, wrapping one end with gauze. (See Figures 23 and 24.) This gag should be placed between upper and lower teeth at the back of the mouth. <u>Never put your fingers in an epileptic's mouth</u>.

Figure 23

To make a padded tongue blade, tape two large tongue blades together with ½-inch tape. Also needed is a 4x4 compress.

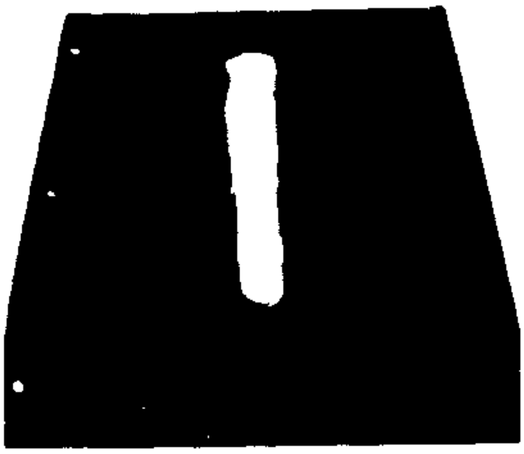


Figure 24

The compress is wrapped completely around one end of the tongue blades and made secure with two pieces of ½-inch tape.

The victim should be stretched out full-length on the floor or a bed. The clothing around his neck and chest should be removed or loosened. His movements should be guided to prevent him from injuring himself.

Victims sometimes become quite blue and may not breathe for long periods. This is not usually a problem, as they will start to breathe as soon as the relaxation period starts after the initial attack.

The head of the epileptic should be protected at all times. This can be accomplished by placing some soft material under his head. It is not at all uncommon for an epileptic to receive a fractured skull during his seizure due to striking his head on hard objects.

Never apply restraint. The duration of the convulsion and the general reaction following it should be observed and included in the notes for the doctor. Most epileptic victims following a seizure will go into a deep sleep. Close observation should be kept for the few who will have maniacal or homicidal tendencies.

The squadmen should make a victim comfortable and move him as needed. He should then be taken to medical attention.

STROKE

DEFINITIONS

A stroke is loss of consciousness and paralysis due to hemorrhage into the brain or spinal cord which forms a clot cutting off the blood supply. It is often called apoplexy or a stroke of paralysis.

Cerebral hemorrhage (escape of blood into the tissues of the brain) generally occurs in elderly victims who have had high blood pressure for some time.

Arteriosclerosis (hardening of the arteries) with a low blood pressure often leads to a cerebral thrombosis (a blood clot obstructing a blood vessel) in which the onset is gradual. There may be a feeling of numbness in one extremity, mental confusion, and inability to concentrate. Later the victim may lapse into unconsciousness with or without paralysis.

SQUADMEN'S CARE

1. Elevate the victim's head slightly.
2. Place cold cloths or ice bag on victim's head.
3. Do not move the victim any more than is necessary.
4. Do not attempt to give the victim anything by mouth and do not give stimulants.
5. Give oxygen by mask as an inhalator; if the victim should stop breathing, the use of the resuscitator should immediately be initiated.
6. Constant watch by the squadmen must be maintained at the side of any breathing, unconscious victim. You must especially facilitate a good air-way in a stroke victim, as they are prone to accidental asphyxiation.
7. Transport as soon as possible. If the hemorrhage is massive the victim may die within a short time.

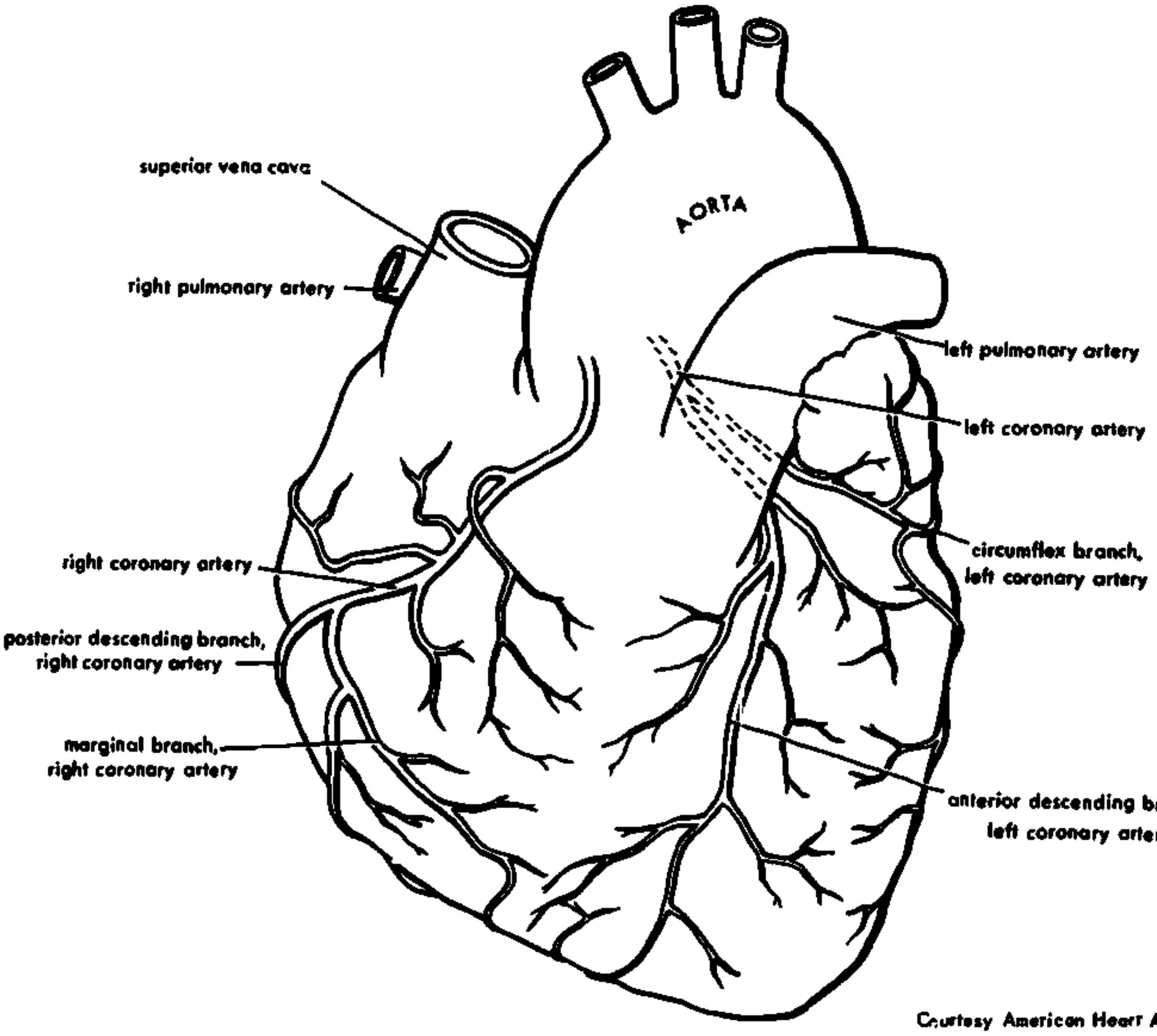
GENERAL INFORMATION ABOUT HEART ATTACK

CORONARY THROMBOSIS

Usually a "heart attack" means an acute condition that doctors call coronary thrombosis. It is a sudden blocking of one of the coronary arteries: the arteries that supply the heart muscle with blood.

(See Figure 25.)

Although a heart attack itself is sudden, it is the result of atherosclerosis: a slowly developing disease process of the coronary arteries. Atherosclerosis causes most heart attacks and the chest pain called angina pectoris. It is a form of arteriosclerosis (hardening of the arteries).



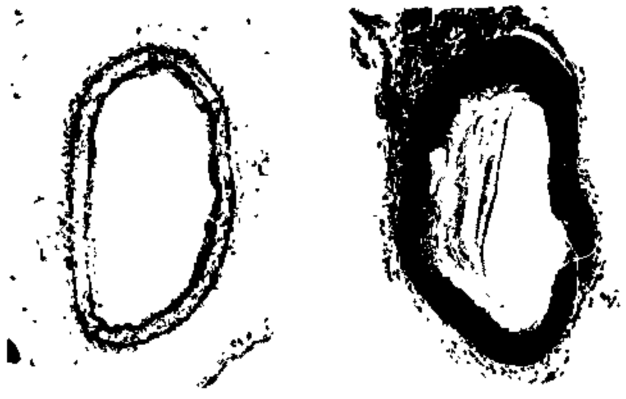
Courtesy American Heart Assoc.

Figure 25

The main coronary arteries with their many branches come down over the top of the heart like a crown (corona) and send tinier branches or twigs down into all parts of the heart muscle to supply it with oxygen-carrying blood.

In atherosclerosis, the passageway through the arteries becomes roughened and narrowed by fatty deposits that harden into patches along the inner lining of the artery. This process has been compared to the formation of lime deposits in a water pipe. Around the patches scar-like fibrous tissue forms in the artery wall so that the channel is narrowed and there is less room for blood to flow through.

(See Figures 26A and B.)



Courtesy American Heart Assoc.

Figure 26A **Figure 26B**

Figure 26A shows a cross-section of a normal artery greatly enlarged. Figure 26B shows deposits found in the inner lining.

A blood clot can form in an artery narrowed by atherosclerosis. This blocks the channel and cuts off the blood flow to the part of the heart supplied by the artery. (See Figures 27A and B.)

Courtesy American Heart Assoc.

Figure 27A **Figure 27B**

Deposits harden, then a blood clot blocks the narrowed channel.

When a clot (thrombus) cuts off the blood supply to a section of heart muscle, the result is a heart attack. Physicians call it a coronary thrombosis, coronary occlusion, or myocardial infarction. The usual symptoms are:

1. Severe painful sensation of pressure under the breastbone, often lasting for hours. (Mild attacks are sometimes mistaken for acute indigestion.)
2. Sudden intense shortness of breath
3. Sweating
4. Loss of consciousness (occasionally)

COLLATERAL CIRCULATION

Luckily the coronary artery system has a life-saving method of growth and repair. When some of the coronary arteries become narrowed by the gradual development of atherosclerosis so that they cannot carry enough blood to the heart muscle, nearby arteries get wider and even open up tiny new branches to deliver blood to the area of muscle that needs it. This is called collateral circulation.

This collateral or substitute circulation often develops while the main coronary arteries are becoming narrowed. This explains why many of us who have narrowed arteries are not troubled with angina pectoris or heart attacks. Once a heart attack occurs, the development of the collateral circulation may help the heart to mend itself.

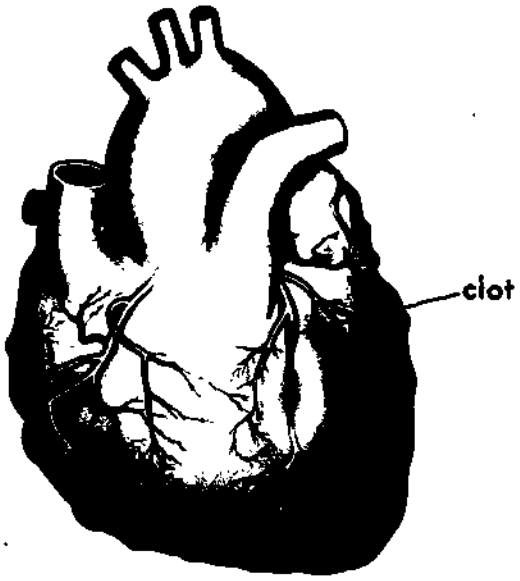
RECOVERING FROM CORONARY THROMBOSIS

When a clot suddenly shuts off the supply of blood to a part of the heart muscle, the central part of the area deprived of blood may die. The affected area must heal to form strong scar tissue. At the same time, a new blood supply to the area develops by means of the collateral circulation just described. (See Figures 28 and 29.)

Treatment is aimed at giving the heart time to mend itself. Even though the patient feels well after the first week, he must continue to rest in bed or chair to give the heart time to heal.

The time required for the patient to get back on his feet will depend on the extent of the heart injury, the rate of healing, and whether or not complications develop. Although medicines are helpful, the patient's cooperation and understanding play a large part in his recovery.

Coronary Heart Disease



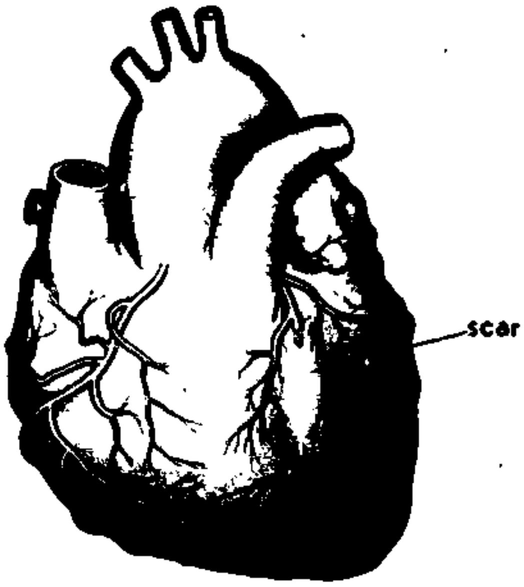
4 days after the attack

Courtesy American Heart Assoc.

Figure 28

White cells are clearing away the dead tissue. Scar tissue is beginning to form at the edges of the damaged area (just below the clot). The patient must remain quiet because during the first two weeks or so there is danger that this weak spot will rupture.

Coronary Heart Disease



8 weeks or so after the attack

Courtesy American Heart Assoc.

Figure 29

Tough scar tissue has formed. The patient begins to resume activities. He must keep his weight down, avoid severe mental and physical strain. Moderate physical activity is encouraged.

MOST PATIENTS RETURN TO WORK

Most patients are able to continue with their usual job once they have recovered from a heart attack. Some may have to make job adjustments and changes in their manner of living. The patient who has had a heart attack is advised to:

1. Keep his weight down.
2. Eat frequent small meals rather than a few heavy meals. (Digesting a heavy meal makes heavy demands on the heart.)
3. Get plenty of rest and take moderate exercise.
4. Avoid overexertion and overexcitement.

Sometimes a patient who has recovered from a coronary heart attack has anginal pains. (See below.) This is a signal for him to consult his doctor.

HOW TO HELP IN CASE OF A HEART ATTACK

1. Call the doctor at once.
2. Help the patient take the position that is most comfortable for him. (This will probably be halfway between lying and sitting. He usually cannot breathe comfortably if he lies flat.)
3. Do not attempt to carry or lift a patient without the physician's supervision.
4. Loosen tight clothing such as belts and neckties.
5. See that the patient does not become chilled, but do not induce sweating with too many blankets.
6. Do not give stimulants such as whiskey or brandy.

ANGINA PECTORIS

Angina pectoris is a severe chest pain that signifies that the heart muscle is not getting enough oxygen through its blood supply. It usually means that some of the coronary arteries have become so narrowed by atherosclerosis that they do not let enough blood through to supply the demands of the heart muscle.

The individual may complain of severe chest pain with a sensation of oppression under the breastbone or strangling. The pain may be accompanied by numbness and often spreads to the left shoulder, arm, or hand. This is a typical anginal attack or episode. It is usually brought on by effort or excitement, or after a heavy meal. The pain does not last long. As a rule, it is relieved within a short time by rest or by nitroglycerine tablets.

Sometimes anginal pains occur in persons who have recovered from a heart attack. Sometimes they occur in people who never had a heart attack and who may never have one. However, chest pain may be due to other causes. It should always be reported to a physician.

LIVING WITH ANGINA PECTORIS

The same process of collateral circulation that increases the blood supply to the heart muscle after a heart attack can also come to the aid of the patient with angina pectoris. Given time, some branches of the coronary arteries may enlarge and new branches open to deliver enough blood to the heart muscle to enable the individual to carry on his usual activities.

That is why most persons can be comfortable and lead productive lives even though they must cope with angina pectoris. Each case is individual; only the patient's own doctor can determine the course he should follow and the medicine he should take.

Regulating habits of life is important in controlling anginal attacks. Physician and patient must work out a program together.

As a rule, patients who have had angina pectoris should avoid overexertion, rushing, worrying, intense cold, and overweight. They are advised to eat four small meals daily rather than three heavy meals, and should rest twenty minutes or so after eating.

Certain drugs are helpful, too. The physician almost always prescribes nitroglycerine tablets. The patient is told to let a tablet dissolve under the tongue to relieve the pain of angina. Often, if he expects to be in a difficult or exciting situation, the patient is told to take a tablet beforehand to avoid an attack of anginal pain.

TECHNICAL INSTRUCTIONS FOR SQUADMEN CONCERNING CORONARY ATTACK

THE TISSUES INVOLVED

The bloodvessels of the body are made up of three layers: (1) an outer protective layer, (2) a muscular center layer and (3) a smooth inner layer. The center muscular layer is the one which is most highly involved in the coronary heart attack.

BLOOD SUPPLY SHUT OFF

A person who experiences fear or pain becomes very tense; all his muscles tend to tighten. The pain that a victim experiences due to the formation of a clot within the coronary artery, and associated fear, cause the muscular layer of the blood vessels around the clot to clamp down. If this muscular layer does not relax, blood will be unable to pass the affected area. The part of the heart that is involved will die.

It follows then that it is of the greatest importance to do everything possible to help a victim to relax.

SYMPTOMS

The following symptoms will be exhibited by a heart attack victim.

<u>Severe Pain</u> - This pain will be over the front of the chest. It may radiate to the shoulder, arm, and hand. The victim may complain of pain or just a numbness in the above-mentioned parts.

<u>Shortness of Breath</u> - This is a usual symptom for any heart victim. Shortness of breath is due to the diminished supply of blood to the lungs. This is a very dramatic and severe symptom.

<u>Apprehension or Fear</u> - This is due to the pain and the thought of impending death. The face will show fright, and the eyes will be opened wide.

<u>Activity and Restlessness</u> - The victim will continuously try to move about and will try to get up. If he is able to be up, he will pace up and down.

<u>Shock</u> - All of the symptoms of shock may be evident. Actually, some victims are in shock during the entire attack.

<u>Passing Out</u> - This may occur in the beginning or later in the attack. It sometimes is the first sign and will be followed by the other symptoms mentioned.

SQUADMEN'S CARE

Severe Pain - For heart attack victims, physicians administer medicine which not only relieves pain but which also relaxes the victim as well as the muscle layer of the blood vessel around the clot. Squadmen are not permitted to give medication. However, if the patient is under medical care the squadmen may assist in administering prescribed medicine which is carried by the victim or is in the household. The squadman can alleviate coronary attack pain by carrying out the steps described in the following paragraphs.

Shortness of Breath - The victim should be given oxygen in the highest concentration possible. The coronary victim is often so afraid and desperate that he will fight the squadman who approaches with the mask, since the victim feels that the mask will smother him. Do not fight with the victim. This only causes the victim's fear to become greater, and in turn, his condition more critical.

If the victim will not take oxygen by mask, disconnect the mask from the outlet and hold the outlet under the victim's chin or in front of his nostrils. In this way the victim will be given a high concentration of oxygen which will tend to make him rest more easily.

Apprehension or Fear - The three big words in squadman care at this time are, "Talk to him." Tell him exactly what will be done and why. Understanding what is being done will tend to alleviate his fear and thus make him relax. The result for which one should strive is the relaxation of the muscular layer of the involved coronary artery.

Activity and Restlessness - There are three words to remember in the care of the victim in this condition: "Do for him." Every effort should be made to keep a heart victim from being active or restless. Being active will put additional stress on his heart. The squadman must not allow the victim to move more than is absolutely necessary. The victim must be kept at rest.

Shock - The care of a heart victim under shock is somewhat different than usual. The three important words to remember are (1) heat, (2) position, and (3) fluids.

1. Heat - Conserve body heat by use of a blanket, but do not make the victim too warm. If the victim experiences a smothering effect from the blanket, do not put the blanket further up than is comfortable. Do not fight the victim.

2. Position - The victim should be placed in the most comfortable position possible. Some victims will feel best lying flat, others in a partial or definite sitting position. Do not fight with them. Care for and transport the victim in the most comfortable position possible.

3. Fluids - Give only small amounts of water to sip, or just moisten the victim's lips. If a victim is given too much fluid, it may cause him to vomit. This in turn will place an additional strain on his heart. The water should not be ice water.

Passing Out - If this should occur during care of the victim, keep a careful watch of the victim's air passage. If the victim should stop breathing, apply artificial respiration immediately, unless mechanical respiration equipment is set up ready to be used. If artificial respiration is applied, it should be replaced by mechanical respiration as soon as the equipment can be checked and put in service.

TRANSPORTATION

In the care of coronary victims it has been stressed that everything possible should be done to make the victim comfortable and to keep him at rest. Transportation of a victim should be carried out at a moderate speed with no siren. It is obvious that a fast trip to the hospital with a blaring siren would not contribute to the well-being of the victim, since it would probably cause him additional fear. The use of oxygen during transportation of heart victims is often very desirable, since it makes breathing easier.

CHRONIC HEART FAILURE

CAUSES

Chronic heart failure is usually due to old age or to a former heart condition that has weakened the heart. Actually, the condition is a weak heart.

The heart is unable to do its usual work. With the lessened supply of blood and poor blood pressure, the victim will have the following symptoms:

1. Wet respiration (noisy)
2. Swollen feet and hands caused by fluid in the tissues
3. Continuous fatigue

The swollen feet and hands are due to the poor circulation. The waste products or materials given off by the body are not carried away from the feet and hands, since the blood pressure from the weakened heart is too poor to push these waste products back up to the heart. These products are then pooled in the tissues of the feet and hands.

With the continual pooling of this waste material, the circulation is further impaired and causes more strain on the heart. The heart tries to pump faster and harder and, then, actually tires out or fails.

SYMPTOMS

Severe Fatigue - The victim may hardly be able to move around. He may be scarcely able to talk. He may look like a person who has just run a long distance.

Shortness of Breath - The shortness of breath is due to congestion in and poor circulation to the lungs by the heart in failure. Since it does not pump enough blood to the lungs, enough oxygen is not supplied to the body. Therefore, the body has a constant need for adequate oxygen. The victim will have long inspirations and long expirations. They will be slow at times and fast at other times. The victim will also have "noisy" respirations due to the poor circulation to and congestion in the lungs.

Swelling of Hands, Ankles, and Feet - This swelling is due to the accumulation of the body waste products in the tissues.

Shock - The victim will be in a condition of shock during the attack; he will exhibit extreme perspiration.

SQUADMEN'S CARE

Severe Fatigue - Since any activity on the part of the victim will cause the attack to become worse, the squadman should attempt to anticipate the victim's every need so that it will be unnecessary for the victim to move.

Shortness of Breath - Oxygen should be used. This type of victim will exhibit oxygen hunger rather than fear or avoidance of it.

Noisy Respiration - This condition can be overcome somewhat by the squadman using the following procedure if the inhalator in service contains a breathing bag.

1. When giving the victim oxygen, let the inhalator bag fill to its capacity.
2. On the next inspiration, squeeze the inhalator bag, keeping the face piece snug to the victim's face.
3. Keep up this procedure, if possible, until the victim is under medical care.

This practice will cause the oxygen to push the excess fluid in the air sacs of the lungs back into the circulating blood. If the inhalator does not contain a breathing bag, it will be impossible to carry out the procedure.

Shock - The usual shock care must be varied for this particular condition.

1. Heat - Because of the usual old age of the victim, do not chill him. Cover the victim and conserve body heat. Do not over-heat him.
2. Position - The victim will want to stay in a position in which his chest is elevated, or in an actual sitting position. Do not force him to lie down; the fluid in his lungs can cause him to drown.

The chronic heart failure victim usually has lived with his condition for years. He may even sleep in a chair, so that his chest will be elevated at all times.

3. Fluids - Give only small amounts of water. The victim will usually want his lips moistened.

After the victim is prepared for transportation, try to keep him comfortable at all times. If his head and chest must be lowered for a short time to carry out transportation, explain this before doing it.

CHAPTER IX

THE MENTALLY DISTURBED PATIENT

INTRODUCTION

Many mildly disturbed persons are about us daily. It is only when their actions are especially unusual that attention is brought to them.

On many occasions the emergency squad is called to attend someone who is behaving oddly. It is paramount that the squadman remember he is to assist disturbed people and not judge or punish them.

This chapter will be divided into two sections. One describes the care of victims who are emotionally disturbed because of disasters and accidents. The other describes victim care for the more usual emotional disturbances that the squad might see.

CARE OF EMOTIONALLY DISTURBED PEOPLE IN LARGE-SCALE EMERGENCIES

The American Psychiatric Association has divided the reactions to large-scale emergencies into 5 categories: (1) normal reaction, (2) individual panic or blind flight, (3) depressed reaction, (4) overly active response, and (5) bodily reaction. Each squadman must understand these individual reactions to an emergency and how to cope with them.

NORMAL REACTION

Symptoms - The experienced squadman has often seen this reaction to emergencies. In fact, a squadman himself may have a normal reaction to an emergency. The signs of this reaction are trembling, profuse perspiration, nausea, and weakness. A victim may be confused. He may experience what is sometimes called "temporary state of shock."

Squad Care - Reassure these people. If you encourage them often, they usually will recover in a short time. They then may be able to assist the squadmen, in the case of a large-scale emergency.

BLIND FLIGHT OR INDIVIDUAL PANIC

Some laymen describe this disturbance as "running wild."

Orderly Exit - It is not thought to be panic if a person or group remove themselves in an orderly way from a dangerous or supposedly dangerous situation. A good example of proper control of panic is fire-drill practice in schools. If children did not practice orderly exits, many might panic in a real emergency, causing the whole class or school to panic. But because of practice drills there is a quick, orderly, normal reaction.

Symptoms - There are a variety of symptoms of individual panic. The victim may attempt to flee from the scene. Squadmen have found uninjured persons running about a scene or away from it. The victim may lose all judgment. He may want to do unreasonable things at the scene which could be done later. He may weep uncontrollably. This sign may come on with little stimulus. For example, at the scene of a home accident someone may be running about wildly and weeping. It may later be found that this victim is not part of the family, but a distant neighbor who happened by and reacted to the injured person in this way.

Squad Care - Be firm but gentle at first. If the victim is so upset that he might cause other people to panic, he should be isolated. This may require the effort of several people.

A panic-stricken victim sometimes can be isolated in the emergency squad vehicle or a police car. If there are injured persons involved, another squad should be called to take the person suffering from individual panic to the hospital. To put this victim in the same vehicle with severly injured people could increase the shock of the injured.

To bring the person with individual panic under control upon your arrival may have a reassuring or calming effect upon many other people. This will contribute to better patient care for all concerned.

Do not strike the panicky victim, or slap him, or throw cold water on him. These methods have been found to be of little help.

DEPRESSED REACTIONS

Symptoms - In the midst of a bad accident scene or disaster, this victim may behave as though there is no one around him. He seems to be "in another world". This behavior has been witnessed many times at large-scale accidents such as explosions, tornadoes, train and bus accidents, etc.

The accident is more than the victim can take mentally, so he shuts the outside world out. He may have a vacant expression, showing no emotions. He may sit or stand without moving or talking.

Squad Care - Do not rush this victim of depression. Your contact must be gentle. Try to get the victim to talk. Ask him what happened.

Finding a routine, simple job for him might help to bring him back to normal. He might help you with simple jobs in caring for patients, such as holding a flashlight, bandages, reports, etc. In a short time he may realize that the disaster is not as great as it seemed, or that he is making a positive contribution by helping the squadmen.

Do not tell the victim to "snap out of it." Do not feel resentful toward him or show resentment. Do not pity him verbally.

OVERLY ACTIVE RESPONSE

Symptoms - This person will be exploding with energy and ideas at the scene. He cannot sit or stand still. He will jump from job to job, hardly ever finishing one. He may joke inappropriately, talk very rapidly, and be argumentative.

Upon arrival, the squadmen may at first think this person is being helpful, but in a short time it will be found that his activities are useless.

By insisting on their own ideas and going from one place to another, these acutely active victims may be a source of opposition to your sound, practiced rescue and emergency procedures.

Squad Care - Under proper supervision these victims can become somewhat composed.

Do not agree with them. Tell them that the rightness or wrongness of your order can be dealt with later. These persons are the first to find fault with anything, and may be very disturbing to the squad members if not supervised.

Their need for physical activity is very urgent. Find jobs for them that use physical activity.

Give them some personal attention. Talk with them for a short time. If they think they are "on your side", they will be of some help to you.

Do not tell them that they "should not feel the way they do."

BODILY REACTIONS

Symptoms - These reactions are different from the normal reactions described in this section. The symptoms include severe nausea and vomiting. Victims may also lose the ability to move their limbs. Loss of sight, hearing, or speech may also occur. These are forms of conversion hysteria: the victims sub-consciously convert their anxiety to a part of their body.

Do not assume that someone who shows symptoms of conversion hysteria is not physically injured, until he has been examined thoroughly.

Squad Care - If a victim believes that a part of his body is injured, treat it as though it is. A splint or other measures may help temporarily.

Show the victim that you are interested in helping him.

Sometimes having a job will help him to forget his disability, and this may lead to recovery and use of the part.

Do not blame or ridicule the victim. Conversion hysteria is not under conscious control.

Do not tell him that there is nothing the matter with him. A victim can be functionally blind or paralyzed, even though the involved structure is uninjured.

SUMMARY

In dealing with any of the five described kinds of reactions, the squadman must establish an effective contact with the disturbed person. Once this contact is made it is reasonably easy to help him.

A victim may exhibit one reaction, and later another. The squadmen must be able to care for all reactions exhibited.

The following general approaches should produce positive results:

1. Accept every person's right to have his own feelings. People do not always act as we want them to.
2. Accept a casualty's limitations (or reactions) as real.
3. Size up a casualty's potentialities as accurately and as quickly as possible.
4. Accept your own limitations in disaster or accident situations.

COMMON MENTAL DISTURBANCES

There are medical conditions commonly seen by squadmen, pertaining to the mentally disturbed patient, and not necessarily related to an accident. Delirium tremens, hysteria, and amnesia are among the most common.

DELIRIUM TREMENS

Delirium tremens is a mental disorder, involving hallucinations both visual and in hearing, commonly called "D. T.s."

This acute type of insanity may be brought on by (1) a prolonged alcoholic drinking spree or a sudden withdrawal of alcohol, (2) an acute infectious disease, or (3) trauma (injury), especially fractures and severe crushing injuries.

Symptoms - The victim usually experiences depression, uneasiness, and insomnia for a day or two. Then coarse shaking develops along with hallucinations, usually involving nonexistent things "seen".

Squad Care - Transport the victim to medical as well as psychiatric care at once, so as to protect him and those with whom he may come in contact. He may see or hear things that are not actually present, and may strike out at these imaginary objects or start to run from them. Squadmen should remember this and not assume that the victim is striking at them.

Try to engage the victim in general conversation. While talking with him, get him into the squad vehicle and transport him. If violence is encountered, you may be forced to restrain him for his own protection as well as that of the squadmen.

HYSTERIA

Symptoms - Hysteria is manifested in many ways. It may be as mild as a headache, or so violent that it brings on self-destruction or personal injury.

The causes of hysteria stem usually from nervous disorders or a sudden psychological shock. Persons in a state of hysteria are usually not aware of their actions. The arrival of an emergency vehicle and the squadmen may cause hysteria to become much worse. Because of this, the proper approach to hysterical patients is most important.

Squad Care - In your speech and movements try to convey a reassuring calmness.

1. Your actions should not be hasty, but deliberate and meaningful.

2. Talk to the victim softly and slowly. All motions should be slow and deliberate.

3. After talking to the hysteria patient in order to win his confidence, arrange to transport him to medical help.

4. Many times, the victim will not consent to ride in a squad car, but will go with members of the family in a private car. If the victim is quiet and acts normally, letting him go with members of the family might be the best move.

5. If the victim is violent upon the squadman's arrival, the squadman must take precautions to prevent harm to himself or the victim. The method of approach described above may be used to get close to the victim. As soon as the squadman is able to grasp the victim, he should do so, but he should first make sure there is plenty of additional help at hand. Some feel it is better to approach the violently ill in numbers from the very beginning.

6. The squadman should try to get these people to medical help quickly.

AMNESIA

Symptoms - The true amnesia victim will act very much like an unconscious person who has been suddenly awakened. The victim may be able to give his name, but he will not remember anything about his past. Some victims will obviously be dazed and will recall neither their names nor their whereabouts. Furthermore, the victim will be slow to move.

The cause of amnesia may be either physical or psychological shock. Usually it is the latter.

Squad Care - Transport the victim to the nearest medical help. He may need psychological care. A physician will be able to arrange appropriate treatment for him.

CHAPTER X

RESUSCITATION

INTRODUCTION

There are two basic methods for administering artificial respiration: manual artificial respiration and the use of mechanical breathing apparatus.

MANUAL ARTIFICIAL RESPIRATION

Over the years, different types of manual artificial respiration have been used. The most common reason for artificial respiration not working is due to the victim's tongue dropping back in the throat or the chin dropping down. These two problems are overcome with the mouth-to-mouth method of artificial respiration. Research has proven that the mouth-to-mouth method is the best type to use. The reason for this is that attention is continually given to the mouth, tongue, and throat area.

MOUTH-TO-MOUTH AND MOUTH-TO-AIRWAY RESUSCITATION

This method of resuscitation is not new. However, it has received acceptance by other than hospital personnel only in recent years. The text and illustrations that follow have been adapted from "A Manual For Emergency Artificial Respiration" by Peter Safar, MD, Chief, Department of Anesthesiology, Baltimore City Hospitals, and Martin C. McMahon, Captain, Baltimore Fire Department, Ambulance Service. The manual was based on research conducted at the Baltimore City Hospital's Department of Anesthesiology, which was supported by the Research and Development Division of the Surgeon General's Office, Department of the Army.

The following information was obtained from recent experiments:

1. The first consideration in any method of artificial respiration is that the air passageway be open; otherwise it is impossible for any air to get into the lungs, regardless of the method used. The air passageway of the unconscious victim is blocked when the neck is bent (chin on chest). The air passageway can be maintained open by holding the chin extended ("sniffing position") and by holding the lower jaw forward.

2. Mouth-to-mouth breathing is superior to all other manual methods of artificial respiration.

3. A pocket-sized S-shaped breathing tube (mouth-to-mouth airway) eliminates the direct mouth-to-mouth contact, and makes mouth-to-mouth breathing more effective, easier, and more acceptable.

4. Mouth-to-mouth and mouth-to-airway breathing can move breaths of 1000 to over 2000 cc of air because (a) the rescuer's hands can hold the victim's head in the "sniffing position" and can support the victim's lower jaw, thus providing an open air passageway, (b) the rescuer can watch the victim's chest and listen to the victim's expirations from which he can determine with each breath whether or not any air is entering the lungs, and, (c) the air can be moved with enough force so that adequate amounts can be moved into the lungs even in obese victims or in a victim whose chest is stiff.

5. Untrained rescuers can perform mouth-to-mouth and mouth-to-airway breathing successfully if certain technical details, described in this manual, are observed.

Some people may wonder how air which has been "used" by the lungs of one person will be any good in artificial respiration. Although the air which the rescuer exhales after a normal breath has slightly less oxygen and more carbon dioxide than the air which he inhales, there is enough oxygen remaining in the rescuer's exhaled air to keep the non-breathing victim alive. During mouth-to-mouth breathing, however, the rescuer is breathing more deeply than normally. As a result of this deep breathing (1) the air which the rescuer blows into the victim's lungs is as good as room air and (2) in addition, the victim receives breaths of a greater volume than he normally breathes. When the rescuer sees the victim's chest move during mouth-to-mouth or mouth-to-airway breathing, the breaths are usually so large that the oxygenation of the victim and the removal of carbon dioxide from the victim are better than when he is conscious and breathing on his own.

RESCUE OF THE UNCONSCIOUS VICTIM

OUTLINE OF METHOD

When the unconscious victim does not breathe, or when he appears to be breathing but his air passageway is blocked (for instance, because his head is not held in the "sniffing position"), his brain dies from oxygen lack within minutes. Therefore, when a victim is found, act within a matter of seconds as follows:

1. Positioning the Victim and Clearing His Throat - Place the unconscious victim on his back, as you must be able to see his face. Move an injured victim cautiously. If there is foreign matter (for instance vomit) visible at the mouth, clear the mouth and throat. (See Figure 1.)

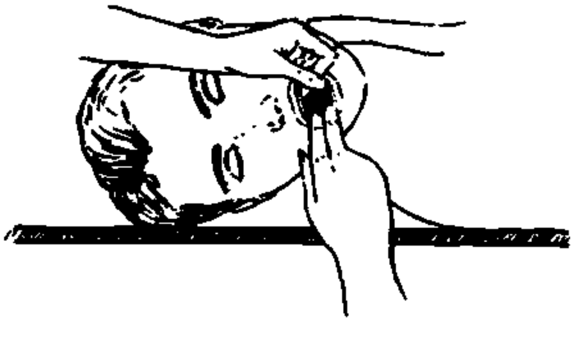


Figure 1

Clearing the victim's mouth and throat.

If no foreign matter is visible, proceed immediately to 2.

2. Opening the Air Passageway (Figure 2 or 3) - Place the victim's head in the "sniffing position" and hold his lower jaw upward. Figure 2 shows the method that is preferred. Figure 3 is the alternate method to be used when the victim's mouth cannot be opened for insertion of the thumb.

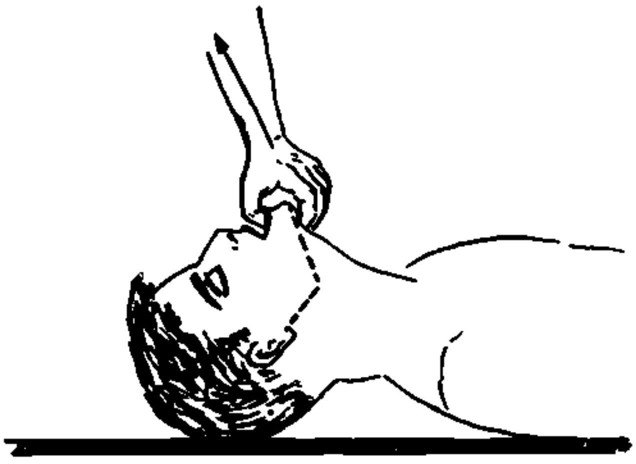


Figure 2

Bringing jaw forward (preferred)

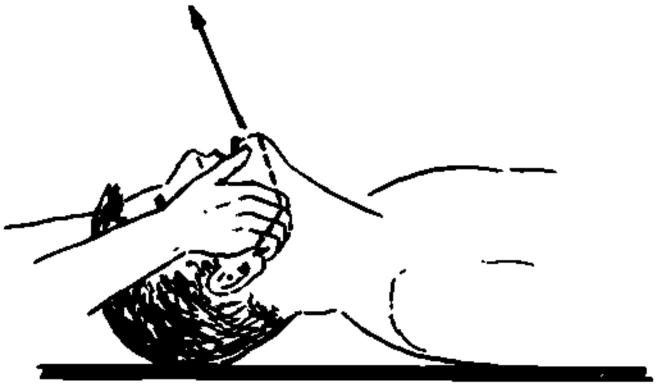


Figure 3

Bringing jaw forward (alternate)

If the victim appears to be breathing naturally, maintain the support of his air passageway until he wakes up. (See Figure 3). When he appears to be breathing naturally, but his tongue is blue or gray rather than pink, start mouth-to-airway or mouth-to-mouth assisted breathing immediately.

3. Artificial Respiration - When the victim is not breathing (chest and abdomen not moving) start mouth-to-airway or mouth-to-mouth breathing immediately and continue until the victim starts breathing naturally or a doctor declares him dead.

If you are carrying a mouth-to-mouth airway, use mouth-to-airway breathing in both child and adult.

If you are not carrying a mouth-to-mouth airway, use the preferred mouth-to-mouth method as shown in Figure 4.

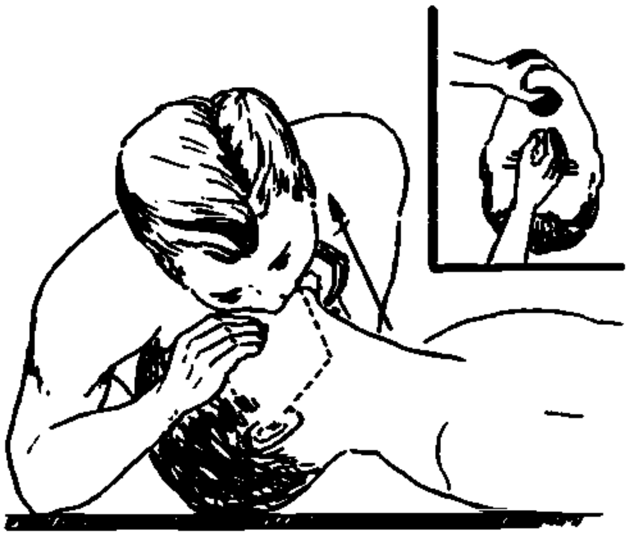


Figure 4

Position of rescuer's hands and mouth on the victim (preferred)

Exceptions - The preferred mouth-to-mouth method cannot be used in the following two instances:

a. In a child less than 3 years in whom your thumb would interfere with mouth-to-mouth contact, because of the small size of the child's mouth.

b. In an adult whose mouth you cannot open for insertion of your thumb.

In these two instances use the alternate mouth-to-mouth method (Figure 5).

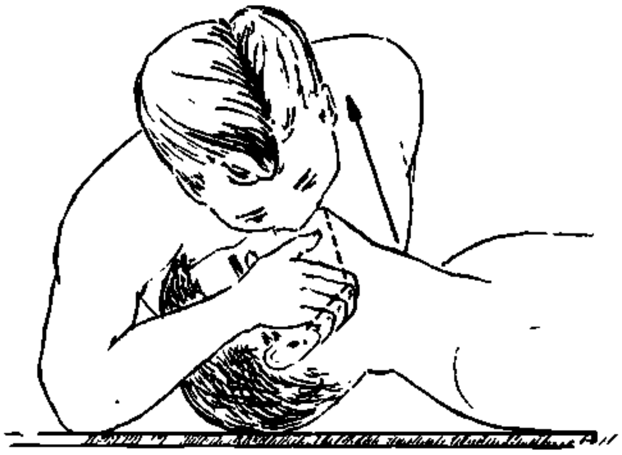


Figure 5

Position of rescuer's hands and mouth on the victim (alternate)

POSITIONING THE VICTIM AND CLEARING HIS THROAT

1. Place the victim on his back (supine). Move injured victim cautiously.

2. Remove foreign matter from the throat. If foreign matter (vomit, blood, phlegm, etc.) is visible in the victim's mouth, turn his head to the side, force his mouth open, and quickly wipe out his mouth and throat with your fingers or a piece of cloth (Figure 1).

You should not spend more than a few seconds doing this, as little time should be lost in getting air into the victim's lungs. If the mouth appears clean, start mouth-to-airway or mouth-to-mouth breathing at once. Whenever it seems necessary, you may repeat the cleaning procedure after either mouth-to-airway or mouth-to-mouth breathing has been started.

OPENING THE AIR PASSAGEWAY

<u>Preferred Method</u>

1. Place the head in the "sniffing position" (Figure 2). Place the head as far back as possible, so the neck is extended. The chin must "lead" and the front of the neck must be stretched.

2. Hold the lower jaw up (Figure 2).
   a. Approach the victim's head from his left side.
   b. Insert the thumb of your left hand between the victim's teeth and grasp his lower jaw at the midline.
   c. Lift the lower jaw forcefully upward so that the lower teeth are higher than the upper teeth.
   d. Hold the jaw in this position as long as the victim is unconscious.

<u>Alternate Method When The Victim's Mouth Cannot Be Opened</u>

1. Place the head in the "sniffing position" (Figure 3). Place the head as far back as possible, so the neck is extended. The chin must "lead" and the front of the neck must be stretched.

2. Hold the lower jaw up (Figure 3).
   a. Approach the victim's head from his left side.
   b. With both hands grasp the angles of the lower jaw just beneath the ear lobes.
   c. Lift the lower jaw forcefully upward so that the lower teeth are higher that the upper teeth.
   d. If the lips are shut, pull the lower lip down gently with the thumbs, but never drop the chin.
   e. Hold the jaw in this position as long as the victim is unconscious.

MOUTH-TO-MOUTH BREATHING

Preferred Method

1. Open the air passageway as shown in Figure 2.

2. Blow air into the lungs (Figure 4).
   a. Close the victim's nose with your right hand (Insert for Figure 4).
   b. After taking a deep breath, place your mouth over the victim's mouth with airtight contact. Do not hold the victim's mouth open widely, as you must take the entire mouth of the victim inside your lips.
   c. Blow into the victim's mouth. Blow forcefully into adults and gently into children.
   d. While blowing, watch the victim's chest. When the chest rises, stop blowing and quickly remove your mouth from the victim's mouth.
   e. Let the victim exhale passively by the elasticity of his lungs and chest.
   f. When the chest does not rise, improve the support of the air passageway (1) and blow more forcefully.
   g. Repeat these inflations 15 to 20 times per minute.

Alternate Method

(For children under three years or for any victim whose mouth cannot be opened.)

1. Open the air passageway as shown in Figure 3.
2. Blow air into the lungs (Figure 5).
   a. After taking a deep breath, place your mouth over the victim's mouth with airtight contact. Cover the nose with your right cheek in order to prevent air leakage. In a baby, cover both the mouth and nose with your mouth.
   b. Blow into the victim's mouth. Blow forcefully into adults and gently into children. In a baby, blow only with small puffs from your cheeks, not from your lungs, to prevent damage to the baby's lungs.
   c. While blowing, watch the victim's chest. When the chest rises, stop blowing and quickly remove your mouth from the victim's mouth.
   d. Let the victim exhale passively by the elasticity of his lungs and chest.
   e. When the chest does not rise, improve the support of the air passageway (1) and blow more forcefully.
   f. Repeat these inflations 15 to 20 times per minute.

MOUTH-TO-AIRWAY BREATHING

This is the method of choice if you are carrying mouth-to-mouth airways. There are two sizes of airways available:

a. Combined child-infant size

b. Combined adult/large-child size

The size of the victim determines which one to use and which end is inserted into the mouth (Figure 6).

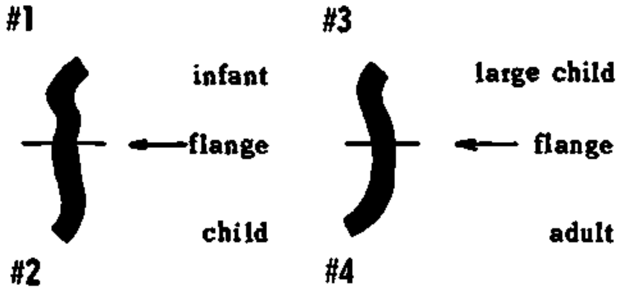


Figure 6

Mouth-to-mouth airways. Note two sizes on each.

Basic Method

1. Insert the airway (Figure 7).

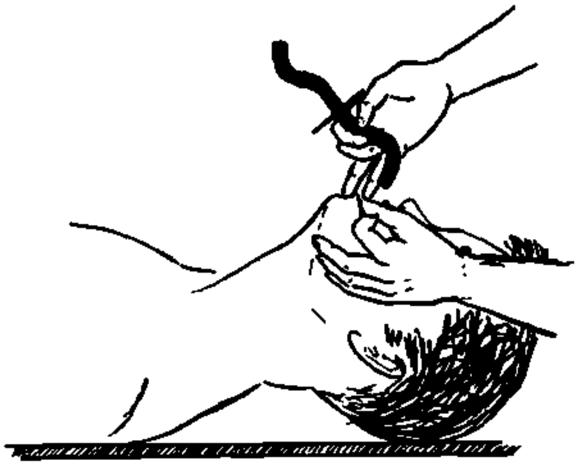


Figure 7

Inserting the airway

a. Approach the victim from the top of his head (vertex).

b. Force the mouth open with one hand.

c. Insert the proper end of the airway along the curve of the tongue with the other hand until the flange comes to rest at the victim's lips. Do not push the tongue back into the throat. If the tongue is in the way, push its base forward with the finger. If the victim is an adult, insert the long end of the large airway (#4); if he is a large child, insert the short end of the large airway (#3); if he is a small child or a baby, insert the short end of the small airway (#1). The part of the airway which remains outside serves as a mouthpiece for the rescuer.

2. Place the head in the "sniffing position" and prevent air leakage (Figures 8,9).

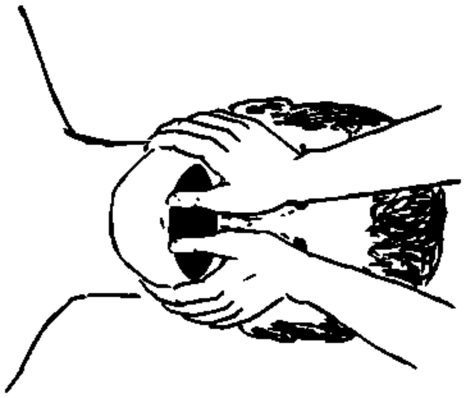


Figure 8

Flange over victim's lips

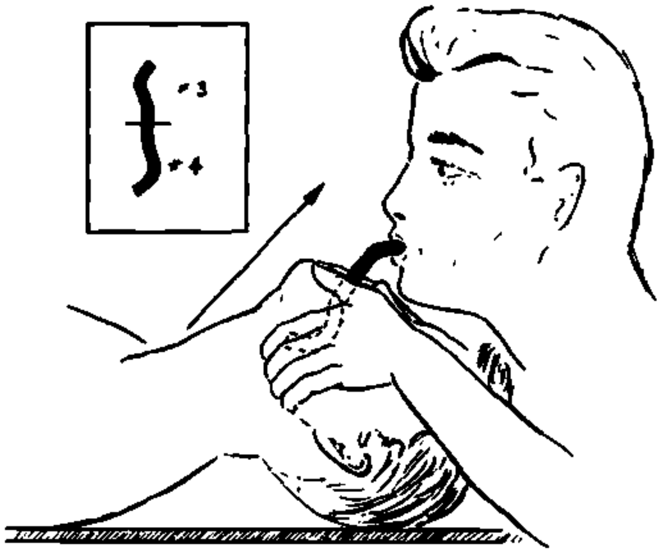


Figure 9

Rescuer is (a) holding victim's jaw up, (b) holding flange airtight, and (c) applying mouth-to-airway breathing.

a. Grasp the jaw with both hands firmly and pull upward (Figure 9). This must extend the neck so the chin is "leading" and the front of the neck is stretched.

b. Close the victim's nostrils by pressing them together with the large part of your thumbs (Figure 8).

c. Close the corners of the victim's mouth by pressing the flange firmly against the victim's lips with your thumbs (Figure 8).

You may prevent air leakage through the victim's nose and through the corners of the victim's mouth by any other desired position of your thumbs and fingers, as long as the victim's head is held in the "sniffing position", so the front of the neck is stretched.

3. Blow air into the lungs (Figure 9).

a. After taking a deep breath, blow into the mouthpiece of the airway. Blow forcefully into adults and gently into children.

In a baby, blow only small puffs from your cheeks, not from your lungs, to prevent damage to the baby's lungs. In a premature baby, insert the #1 end of the baby airway only partially.

b. While blowing, watch the victim's chest. When the chest rises, stop blowing and quickly remove your mouth from the mouthpiece of the airway.

c. Let the victim exhale passively by the elasticity of his lungs and chest.

d. When the chest does not rise, improve the "sniffing position", prevent air leakage, and blow more forcefully. If the chest still does not rise, readjust the position of the mouth-to-mouth airway.

e. Repeat these inflations 15 to 20 times per minute.

FURTHER CONSIDERATIONS

When Air is Blown Into the Stomach - After either mouth-to-airway or mouth-to-mouth breathing has been performed for a period of time, the victim's stomach may be bulging. This bulging is due to air which is blown not only into the victim's lungs but also into his stomach. Air inflation of the stomach rarely occurs when the correct technique is applied, but rather will occur more frequently (1) if the air passageway is blocked by improper support of the head and lower jaw, and (2) if the blowing is too forceful.

Air inflation of the stomach is not dangerous, but inflation of the lungs is easier when the stomach is empty. Therefore, when the rescuer sees the stomach bulging, he should interrupt blowing for a few seconds and press with his hand between the victim's navel and breastbone which causes the air to be "burped". Since this maneuver may also make the victim vomit, the rescuer must be ready to clear the throat at once, as shown in Figure 1.

Infection - Experience has shown that there is very little danger of the rescuer becoming infected by the victim. Rescuers who consider direct mouth-to-mouth breathing not to be "sanitary" should use the mouth-to-airway method.

Apparent Natural Breathing

a. The victim may only appear to be breathing naturally by movements of his chest and abdomen, while actually no air may be moving into his lungs due to complete blockage of the air passageway from improper positioning of the head and jaw. Therefore, it is most important to determine whether or not there is any movement of air in and out of the mouth and nose by listening closely or feeling with the fingers in front of the victim's mouth and nose.

b. The victim may breathe noisily (snoring), which indicates partial blockage of the air passageway.

Therefore, even if the unconscious victim appears to be breathing naturally, the rescuer must hold the victim's head in the "sniffing position" and hold the jaw upward at all times (Figures 2 or 3). If an artificial airway is available (for instance the mouth-to-mouth airway), it should be inserted provided that the victim can tolerate it without gagging or coughing (Figure 7). The victim's head must still be held in the "sniffing position". If the victim vomits, the rescuer must clear the throat and mouth swiftly with the fingers (Figure 1). It is extremely important that the rescuer remains at the victim's head during transportation at all times, in order to keep the victim's air passageway open by the methods described above and to start mouth-to-airway or mouth-to-mouth breathing at once when the victim ceases to breathe.

Shallow Breathing and Assisted Breathing

When the victim breathes shallowly, he may not be getting sufficient amounts of air into his lungs. His lips and tongue may appear blue or gray instead of pink. In such cases, the rescuer may deepen the victim's shallow breaths by blowing into the mouth-to-mouth airway or directly into the mouth immediately after the victim starts inspiring. This is called "assisted respiration". The rescuer uses deep inflations of short duration and removes his mouth from the airway or from the victim's mouth rapidly, so as not to interfere with the victim's natural exhalation.

MECHANICAL RESUSCITATION

MAJOR CLASSIFICATIONS OF MECHANICAL BREATHING APPARATUS

Resuscitator

Action - Positive and negative pressure on the inside of the lungs and air passages, accomplished by air-tight circuit with mask and resuscitator.

Used - Only on victims who have stopped breathing.

Inhalator

Action - A steady flow of oxygen from a tank through a reducing valve by way of a mask, catheter or prongs.

Used - Usually (a) on the victim who is just having trouble breathing, or (b) following the use of a resuscitator, when the patient is able to breathe on his own. This inhalator does not breathe for the victim.

Respirator (Iron Lung)

Action - Positive and negative pressure on the outside of the chest. Usually a tank iron lung with pressure on the entire chest wall. It is portable.

Used - Usually on victims who are unable to breathe on their own.

Aspirator (Suction Machine)

Action - As an aid in the use of mechanical breathing apparatus.

Used - To suction out liquids and foreign materials from the victim's mouth and upper respiratory tract. Many times, resuscitation cannot be accomplished without this machine.

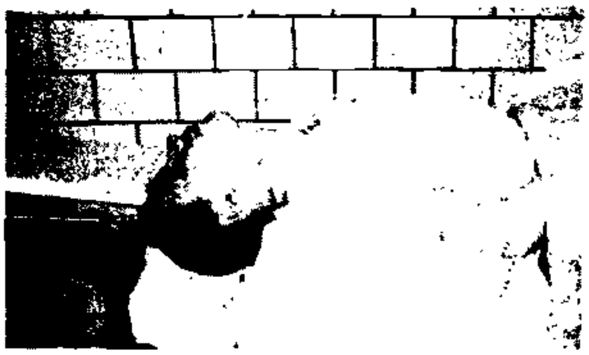
USING THE RESUSCITATOR

Although resuscitators may vary in their operation, the manufacturers are in agreement as to the techniques to be used in applying mechanical artificial respiration.

If manual artificial respiration is being applied at the scene, do not stop until a squadman checks the mechanical resuscitator to see if it is operating properly.

The operation of most machines may be checked by placing the hand over the face piece to see if the blockage signal is obtained.

After the machine has been checked and found to be operating properly, proceed to place the proper size face piece over the nose and mouth of the victim. Stop manual artificial respiration then, and put the machine into service. It is of the utmost importance to place the victim in a position that will tend to keep fluids and other materials out of the breathing passages. This position should allow the operator of the resuscitator to have full access to the victim's face. The inside of the mouth and back of the throat should also be visible so they can be examined easily. To accomplish this, place the victim in a supine position with the head held back and the chin in the "sniffing position". A pillow, folded blanket, or some other object placed under the victim's shoulder blades will help facilitate a satisfactory position for mechanical resuscitation (Figure 10).



Courtesy St. Anthony Hosp.

Figure 10

Position of victim for receiving mechanical resuscitation

Be sure that the victim's mouth and throat are clear. Remove all foreign matter, such as gum, chewing tobacco, loose dentures, or other materials that could block his air passage. If considerable mucus is present, aspirate it immediately to provide a clear air passage.

The efficiency of mechanical resuscitation depends on the successful maintenance at all times of the so-called "closed circuit". This means that an air-tight connection must be maintained between the machine and the victim's lungs. This, in turn, means that there must be air-tight connections within the machine itself, that the mask valves must be closed, and that the mask be air-tight to the victim's face. If the face piece is the type that can be inflated, it should be kept so at all times.

Since most commercially made resuscitators have rubber cushion face pieces, it is relatively easy to create an air-tight connection, provided the position of the squadman's hands upon this mask and the victim's face is the correct one. The thumb and index finger of each hand should encase the mask on the victim's face. This is done by placing them on their respective sides of the mask. (See Figure 11.)

Figure 11

Position of operator's thumbs and index fingers on mask

The other three fingers of each hand grasp the victim's chin from beneath, thus creating a good air passage by opening the windpipe. (See Figure 12.)

Courtesy St. Anthony Hosp. & Millersport F.D.

Figure 12

Position of operator's hands on victim during resuscitation

If the victim has such an injury that parts of the face are missing, or the person's face is sunken from illness or age, or possibly the victim may have his false teeth out at the time of the emergency, the squadman is confronted with a problem. The face piece will not fit tightly against the face, and a closed circuit cannot be obtained. In this case the squadman can secure a closed circuit by applying a moist hand towel or cloth around the face piece. After it is in place, the squadman will put his hands in the usual position, placing them around the cloth and mask. The most desirable position for the operation is, then, at the head of the victim directly behind his forehead.

PROPERLY WORKING MACHINES

If the machine is breathing adequately for the victim, a series of two separate clicks will be audible to the operator. There will be a click from the machine when the oxygen goes in, and another click when the carbon dioxide is pulled out. This positive and negative pressure going in and out of the lungs is called an interval. A regular rhythm of intervals results after the machine begins to breathe for the victim. This is the same kind of rhythm maintained during manual artificial respiration. This rhythm of intervals is the clue which lets the operator know that the machine is working properly, accomplishing the life-saving purpose for which it was manufactured.

BLOCKAGE

Oftentimes when mechanical respiration is first started, there may occur a fast tripping or clicking sound instead of the regular rhythm. This is caused by blockage. As soon as the blockage signal is heard, remove the face mask and look into the mouth for the possible cause of the blockage. Such blockage or obstruction of the positive and negative pressure may be due to one or more of four things.

A. Presence of Foreign Bodies (Solids) - This includes broken dental plates, gum, chewing tobacco, broken teeth, sea-weed, or any other foreign object in the breathing passages.

It is imperative that such foreign bodies be removed immediately. Since a non-breathing victim is unable to bite, the easiest procedure is to introduce the thumb and index fingers into the victim's mouth to pull out the foreign body. Many squads carry some type of small narrow clamp or forceps that can be used to pick out foreign bodies from the throat (curved Kelly forceps).

B. Presence of Liquids - This includes any form of liquid material that may be in the mouth or breathing passages. It may be blood, water, clear liquid vomitus, or any other liquid material.

As soon as the presence of liquids is noticed in the air passages, the mechanical apparatus should be turned to aspiration if the resuscitator is provided with an aspirator. When suctioning mucus out of a victim's mouth, the suction catheter must be moved about so as to include all areas of the mouth, and so that it will not attach itself by means of suction to the inside of the victim's mouth, thus preventing it from fulfilling its purpose. (See Figure 13.)

Courtesy St. Anthony Hosp. & Greenfield Twp. F.D.

Figure 13

When suctioning a victim, you should have proper lighting (as shown). The victim's mouth should be open wide. The suction catheter should be held securely between the index and second fingers. The catheter should be moved around so it will get all materials and not attach itself against the inside of the mouth.

Different sizes of suction catheters should be carried by all squads as additional equipment for resuscitators. A good practice exercise is to use a glass of water and have each squadman practice suctioning water by holding the catheter between the thumb and index finger. The catheter should be held in the same way when suctioning mucus from a victim.

A soft rubber ear syringe may be used instead of a catheter. By squeezing out all the air from the syringe, inserting the tip in the victim's mouth and releasing the bulb, suction is produced and the syringe will act as an improvised aspirator.

C. Tongue - When a person is unconscious or has stopped breathing, he becomes so relaxed that the tongue drops further back in the throat than usual. A common example of this is when a sleeping person snores. The tongue has dropped back in the throat causing a poor air passage which is denoted by a loud sound. In asphyxia victims the tongue actually falls back over the air passage and prevents oxygen from entering the lungs.

To alleviate this blockage, the squadmen must be able to keep the tongue elevated in the mouth, so as not to block the windpipe. This can be accomplished by inserting an airway. (See Figure 14.)

To install an airway properly, the victim's mouth is opened, and the tongue is grasped firmly top and bottom and gently pulled out beyond the lower lip. With the mouth open and the tongue out, the proper size airway is inserted into the victim's mouth. A tongue clamp is a good instrument to use in extracting the tongue; furthermore, the clamp can be carried right in the resuscitator box. In the event a tongue clamp is unavailable, the squadman can pull the tongue out with his fingers.

Courtesy St. Anthony Hosp. & Millersport F.D.

Figure 14

Proper insertion of airway

The best way to ascertain the correct size of an airway is to hold the airway to the side of the face. The lower tip should touch the angle of the chin (just below the ear lobe) and the other end should extend beyond the lips.

The best way to insert an airway is to put its tip against the roof of the mouth, just behind the upper teeth, and slide it down a distance determined by the size of the victim's throat. All airways should be inserted according to the contour of the victim's air passage. Always remember to keep the victim's tongue out of the way while inserting the airway. If the type of airway available is one without lips, tie a six- to eight-inch string or gauze to the end of it.

As soon as the airway is in place, resuscitation should be started.

D. Spasm of the Throat - The vocal cords, which are encased in the "Adam's Apple", are very delicate muscles. Consequently, all respiration problem victims are prone to spasms of the vocal cords. These spasms are known as laryngeal spasms.

Even hospital personnel are at a loss when a patient goes into a laryngeal spasm, and they are forced to take drastic measures by inserting a tube below the vocal cords. This, of course, cannot be carried out by emergency squadmen, and the only last measure that can be used is to give life-saving oxygen to those victims by applying the face mask and leaving the machine on resuscitation. If this is done, a continuous blockage signal will be heard. While holding the face piece in place and receiving the blockage signal, the squadman should pull the head into a backward position and turn it from side to side very slowly. As soon as the machine is able to get past the spasm, it will indicate so by returning to the normal resuscitation sounds. The head position mentioned should be maintained until the victim begins to breathe on his own.

Continual attempts should be made to resuscitate the victim until the victim is pronounced dead by a physician.

SUMMARY

Blockage Cause	Squad Care
Foreign bodies	Pull them out with finger or clamp.
Liquids	Suction with aspirator.
Tongue	Insert an airway.
Spasm of the throat	Turn victim's head slowly from side to side.

USING THE INHALATOR

After the victim starts to breathe on his own, the machine should be turned to inhalation. (See Figure 15.)

Courtesy Northern Hills F.D.

Figure 15

Fire department emergency squadmen administering oxygen by means of an inhalator to young victim of a near drowning. The mask is held snug to the face and the apparatus is set to administer a sufficient amount of oxygen.

The squadman must watch the victim very closely at this time. If there is an inhalator bag on the apparatus, watch it closely. The rise and fall of the bag will denote the size and rate of the victim's respirations. If there is no bag on the machine, you must watch the victim's respirations by the rise and fall of his chest and abdomen. (See Figure 16.)

Courtesy St. Anthony Hosp. & Millersport F.D.

Figure 16

This picture illustrates the use of an inhalator after resuscitation. The mask is held lightly but not too tightly on the face. Notice that the squadman is watching the victim closely and has the machine in a position to reach and to watch.

As the victim's pulse, respirations, color, and general condition improve, wean him from the oxygen. This can be done by turning the flow of oxygen down slowly. Let the victim breathe for two or three minutes, then turn the flow down further. If the victim's pulse does not increase, his color stays the same, and his respirations do not increase, the squadman may continue the same routine until the flow of oxygen is nearly off. Take the mask away from the face slightly. This will allow the outside air to mix with the resuscitation oxygen, so that the victim becomes adjusted to breathing outside air.

After he is breathing normally, the victim should be kept prone and remain under observation until he is transferred to the care of a physician or of hospital personnel. (See Figure 17.)

Courtesy St. Anthony Hosp. & Millersport F.D.

Figure 17

After resuscitation, inhalation, and aspiration, the victim is put in a flat positior and watched.

EMERGENCY CARE OF THE LARYNGECTOMY VICTIM

The victim who has had his larynx (voice box, also "Adam's Apple") removed requires special emergency care. In Ohio alone there are 2000 people who have undergone laryngectomy. These are people who because of some disease, accident, or other medical condition, have had surgery performed on their voice box with the end result of its being partially or totally removed.

From the time of surgery, these people will never again breathe through their mouths. At the time of the removal of the "Adam's Apple", an opening is made at the lower part of the neck, just above the breast bone. It is through this opening that the "laryngect" must breath for the remainder of his life. They are commonly referred to as "the neck breathers".

As shown in Figure 18, a patient's neck is exposed and the "stoma" (permanent opening in the neck to the windpipe) is visible.

If his shirt were closed, or he had on a T-shirt or a shirt and tie, the stoma would not be easily seen.

Women with stomas wear high necklaces. These partially cover the opening and unless closely investigated, it might be overlooked.

A side view of this man (Figure 19) shows that he does not have an "Adam's Apple". This is one good way to tell a "neck breather". You could obstruct this man's mouth and nose for hours and it would not disturb him, as he does not breathe through them.

Courtesy Clinton Twp. F.D. & Franklin Co. Cancer Soc.

Figure 18

After laryngectomy, man receives air into his lungs through neck opening (stoma).

Courtesy Clinton Twp. F.D. & Franklin Co. Cancer Soc.

Figure 19

The absence of an "Adam's Apple" indicates that this man may be a neck breather.

RESUSCITATING THE VICTIM

If this type of victim should stop breathing, the squadman would use the manual or mechanical artificial respiration that is used routinely, but it must be applied over the stoma.

As shown in Figure 20, the squadman must give mouth-to-stoma resuscitation with the victim on his back and the chin up out of the way of the stoma. Placing his mouth over the stoma, he would give mouth-to-stoma resuscitation following the procedure he has learned for the mouth-to-mouth method.

Courtesy Clinton Twp. F.D. & Franklin Co. Cancer Soc.

Figure 20

Mouth-to-stoma resuscitation is given.

There is no problem of air going into the stomach because the squadman breathes directly into the windpipe. The tongue cannot obstruct the air flow, as the stoma is below it.

If the mechanical resuscitator is readily available, the use of the BABY mask over the stoma followed by mouth-to-mask resuscitation will aerate the victim adequately. The squadman in Figure 21 is carrying out this procedure until the resuscitator can be readied.

Courtesy Clinton Twp. F.D. & Franklin Co. Cancer Soc.

Figure 21

A baby-size mask must be used over the neck opening for mechanical resuscitation.

If the mask will not fit airtight, a moistened towel can be placed around the mask to seal off any openings. All face pieces of your resuscitation equipment should be inflated at all times.

When the resuscitator is put into service, it should be held over the stoma as it is over the face, with the index fingers and thumbs. A folded blanket can be used under the shoulder blades. The blanket or other material helps to keep the windpipe straight and the head back.

Elevation of the chin by use of the blanket under the shoulder blades will also make the procedure easier. The squadman in Figure 22 has the victim positioned correctly and is holding the mask properly.

Courtesy Clinton Twp. F.D. & Franklin Co. Cancer Soc.

Figure 22

The resuscitator breathes for the patient.

This type of victim is much easier to aspirate (suction) than the average resuscitation victim. If the resuscitator gives the blockage signal, mucus will be the usual cause.

The squadman must be sure to rotate the catheter as he suctions. The squadman in Figure 23 is doing so by rotating the aspirator tube between his thumb and index finger. The catheter should be pinched off as it is inserted into the stoma preventing damage of it.

Courtesy Clinton Twp. F.D. & Franklin Co. Cancer Soc.

Figure 23

An aspirator tube, inserted through the stoma, will remove mucus.

There are clubs throughout the nation called the "Lost Cord Clubs". These clubs are sponsored by the American Cancer Society. They are very interested in each squadman being keenly aware of their problem. When patients are released from the hospital with stomas, they are told to make themselves known to their local squad.

When a laryngectomy victim is released from the hospital, he may be cured and live a normal life. The victim who posed for these pictures has had a stoma for many years.

There is always the additional problem of visitors to your area who might be "neck breathers". The theme for the squadmen is becoming "CHECK THE NECK FOR THE LARYNGECT".

ADJUNCTS TO RESUSCITATION

BAG RESUSCITATOR

Figure 24 shows a new type of resuscitator. It is light in weight and reinflates itself. A flow of oxygen can be added to the tip on the end of the bag. It can be brought into use quickly.

Figure 24

Bag resuscitator

MOUTH-TO-MASK RESUSCITATOR

An adjunct to mechanical resuscitation is shown in Figure 25. This type of apparatus does away with the direct contact in mouth-to-mouth breathing. It is light and can be put into use before the larger mechanical resuscitator can be brought to the victim.

Figure 25

Mouth-to-mask resuscitator

EXTRA EQUIPMENT

There are six extra items of equipment that should be carried with each resuscitator:

1. Flashlight - A light is needed to examine the victim's throat when blockage is encountered.
2. Suction Catheters - Each resuscitator should carry a variety of whistle-tip suction catheters. The recommended sizes are: 12, 14, 16, 18 and 20 French. With these sizes the squadman should be able to handle all problems of suctioning.

3. Airways - Each resuscitator should be provided with seven airways, as follows: Large, medium, and small adult; large medium, and small child; and the newborn size. Measuring from the edge of a victim's mouth to the end of his jawbone (under the ear) will indicate the needed size. Plastic or rubber airways are preferred. (See Figure 26.)

Figure 26

Airways: three adult sizes, three child sizes, and a newborn size.

4. Cloth hand towel - A small tea towel or hand towel should be available (not a turkish towel.) The towel can be used as a seal around the face mask of the resuscitator, for cases when the mask will not fit tight around the face. Moisten the towel and fold it; then fit it between the mask and the rescuer's hands.

5. Curved Kelly Hemostat - When the squadman cannot remove a foreign body in a victim's throat with his fingers, an instrument should be available for reaching into the throat to grasp the object. The curved Kelly Hemostat (sometimes called Kelly clamp) is the proper instrument. (See Figure 27.)

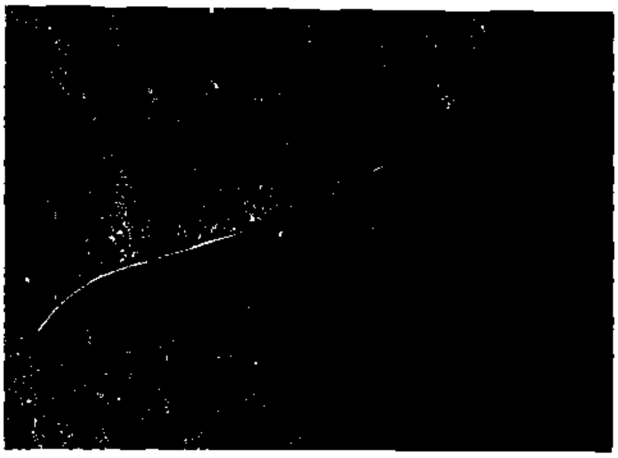


Figure 27

Each resuscitator should have a medium curved Kelly Hemostat or clamp. This instrument is curved to match the contour of the throat. It will easily grasp a foreign object so that it can be pulled out.

6. Aspirator Bottle - One extra aspirator bottle should be carried on the squad vehicle at all times, in case the bottle that is in use should crack or break.

RESUSCITATION WHILE TRANSPORTING

If all the appropriate steps in resuscitation, as previously described, are carried out properly, the patient can be resuscitated during transportation without difficulty. (See Figure 28.)

Courtesy Sharon Twp. F.D., Worthington, O.

Figure 28

Squadmen continue resuscitation while victim is being loaded into vehicle for transportation to hospital.

CHAPTER XI

OXYGEN THERAPY

INTRODUCTION

Among the most basic equipment to be placed in the average emergency squad vehicle is the apparatus for administering oxygen. Many of the victims cared for by squadmen have a great need for highly concentrated oxygen. Alone or in support of other measures, it is important in emergency care of such conditions as heart attacks, severe burns, loss of blood, respiratory distress and shock. Oxygen administered with an inhalator or resuscitator can prevent the condition of victims from being much worse, or may even ward off death.

BASIC PROCEDURE

SETTING UP THE APPARATUS

In preparing a cylinder of oxygen for use, the protective cap must be removed (Figure 1). Then, with the valve outlet pointed away from the operator and with a firm grip on the cylinder, open the valve slightly (Figure 2), then close it quickly (Figure 3). This is called "cracking" the valve. In this manner dust which has lodged in the valve opening is cleaned out, so it will not enter the regulator.

Courtesy Linde Co.

Figure 1

Remove protective cap.

Courtesy Linde Co.

Figure 2

Open valve slightly.

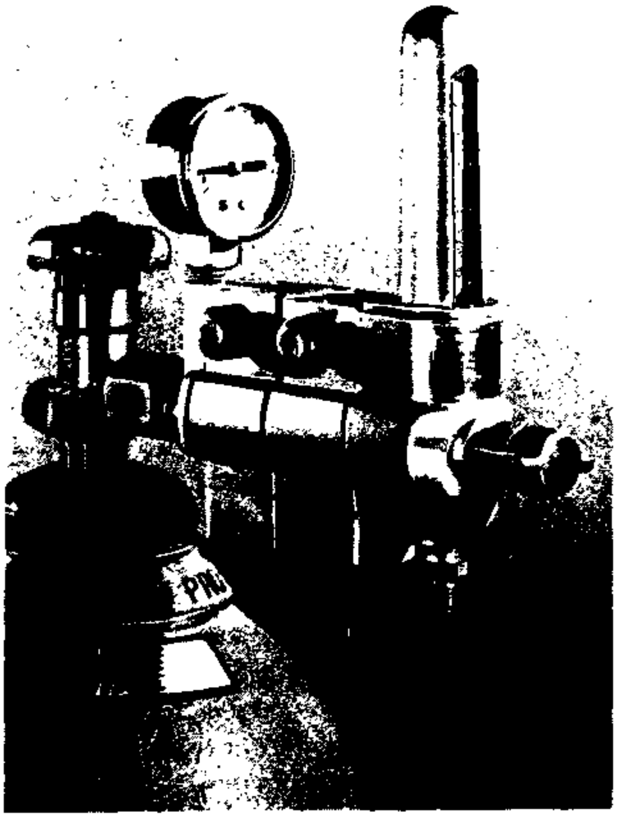
Courtesy Linde Co.

Figure 3

Close valve quickly.

Reducing Pressure - When an oxygen tank is full, it is under a pressure of more than 2,000 pounds per square inch. Before we may use it safely, a pressure-reducing regulator must be attached to the tank. This will permit giving oxygen to the victim at a much lower pressure.

Controlling Flow - Figure 4 shows one widely used type of regulator. After the oxygen leaves the pressure-reducing valve, it flows through an adjustable flowmeter (Figure 4). This permits administering oxygen to a victim at the rate desired.

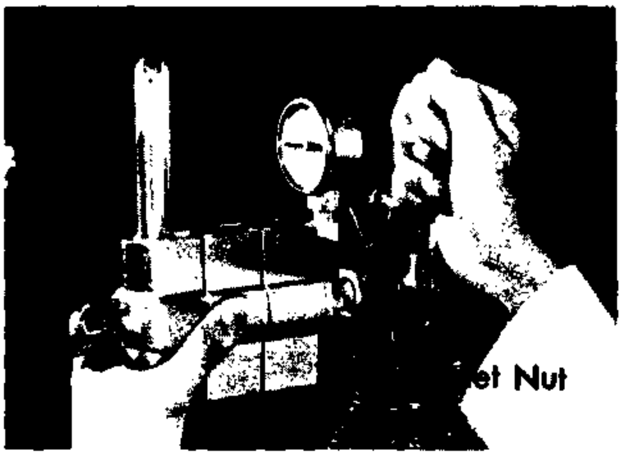


Courtesy Linde Co.

Figure 4

A pressure-reducing regulator must be attached to the cylinder before oxygen can be administered to the patient.

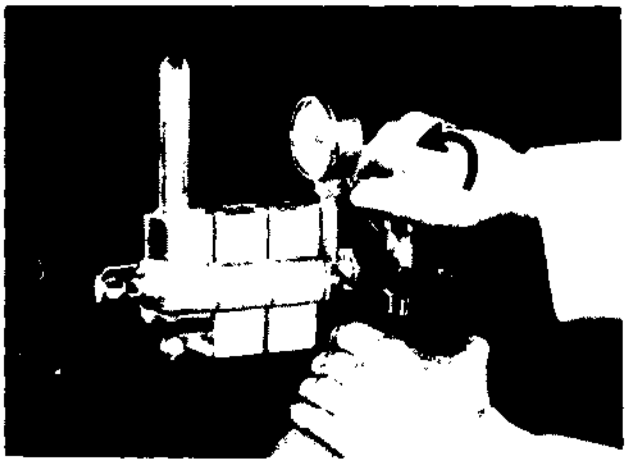
Figure 5 shows the regulator-flowmeter being attached to an oxygen tank. Figure 6 shows the regulator ready for use.



Courtesy Linde Co.

Figure 5

Insert regulator inlet in cylinder valve outlet and tighten the inlet nut with a wrench.

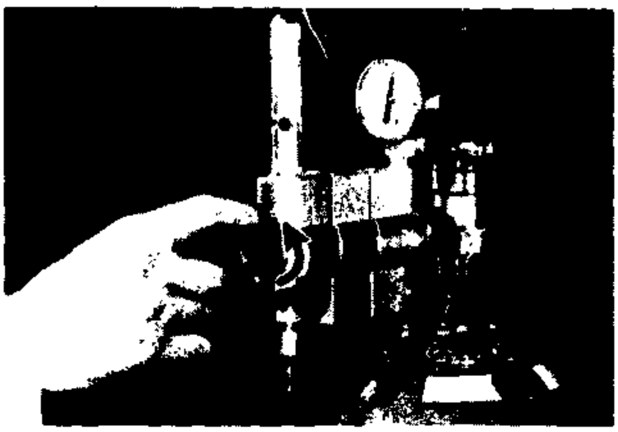


Courtesy Linde Co.

Figure 6

Stand to one side of the regulator—opposite relief valve—not in front or in back of it. Open cylinder valve very slowly—the slower the better—until needle on cylinder-contents gauge stops moving. The ball float will rise in the tube for a moment and then quickly return to zero. This indicates that oxygen has entered the flow indicator tube.

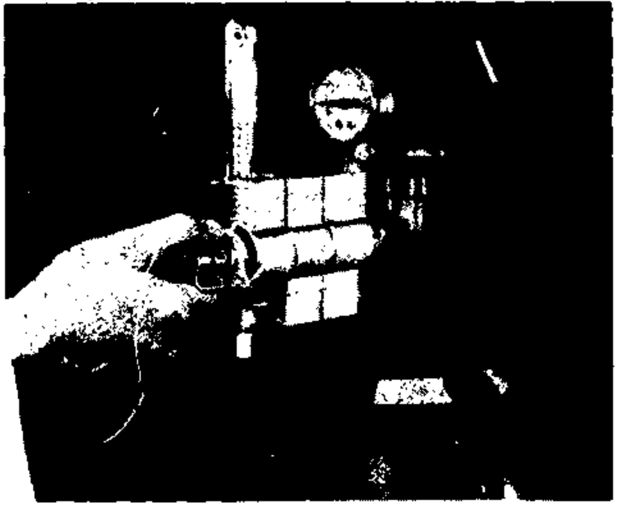
To administer oxygen, attach the administering apparatus to the regulator outlet and adjust the oxygen flow (Figure 7) to produce the desired concentration. To stop the flow for short periods - less than one-half hour - simply close the flow adjusting valve (Figure 8). Cylinder content will continue to register.



Courtesy Linde Co.

Figure 7

Open the flow-adjusting valve. The ball float will rise in the tube. The position of the top of the float indicates the rate of flow in liters per minute.

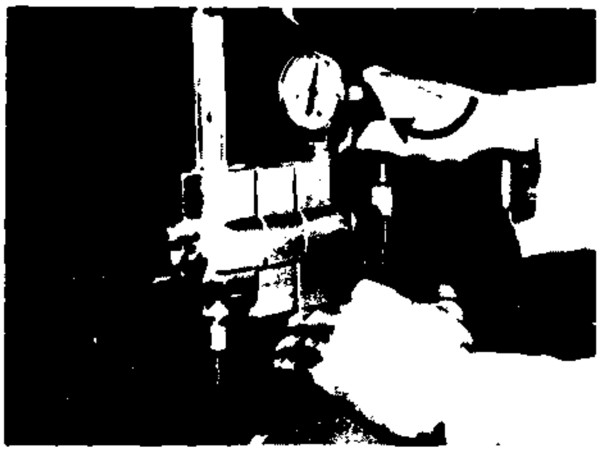


Courtesy Linde Co.

Figure 8

Stop flow by closing the flow-adjusting valve. The float will drop to zero.

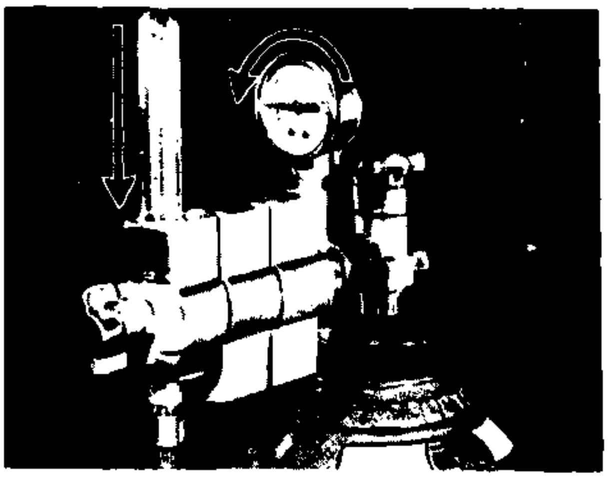
When the flow of oxygen is to be discontinued for one half hour or more, or when the regulator is to be disconnected from the cylinder, follow the steps outlined in Figures 9 and 10. Then close the flow-adjusting valve as in Figure 8.



Courtesy Linde Co.

Figure 9

Close the cylinder valve tightly. Then open the flow-adjusting valve.

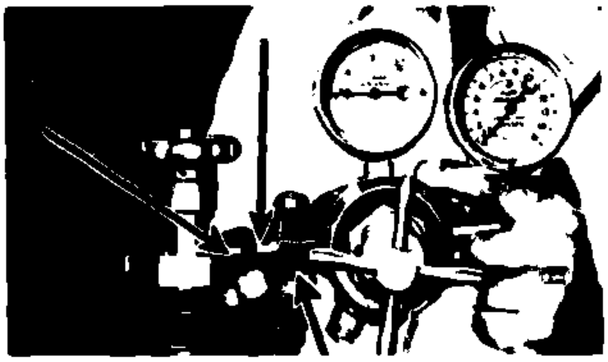


Courtesy Linde Co.

Figure 10

Wait until both cylinder-contents gauge and liter-flow indicator have returned to zero. Then close flow-adjusting valve.

Cross-Arm Regulators - Another type of regulator in wide use operates somewhat differently. It has two gauges; one shows cylinder contents and the other shows the rate of flow. Figure 11 shows how to install one of these regulators on a tank.

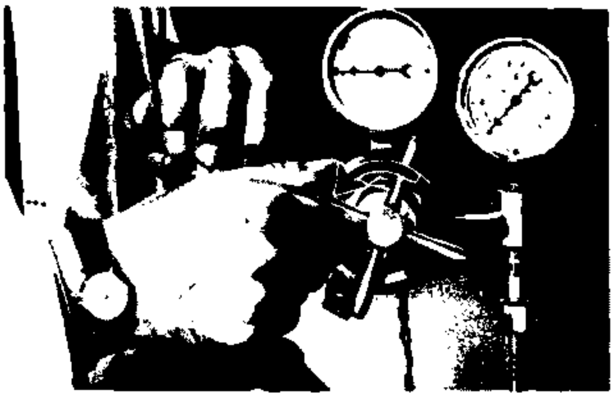


Courtesy Linde Co.

Figure 11

Insert regulator inlet into cylinder outlet and tighten inlet nut with a wrench.

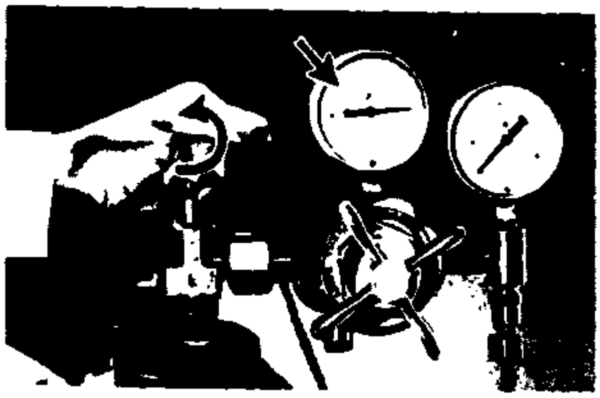
Before oxygen is administered, the flow-adjusting handle must be loosened (Figure 12), and the cylinder valve must be opened very slowly (Figure 13).



Courtesy Linde Co.

Figure 12

Loosen regulator flow-adjusting handle. This is important and should be done before opening the cylinder valve.

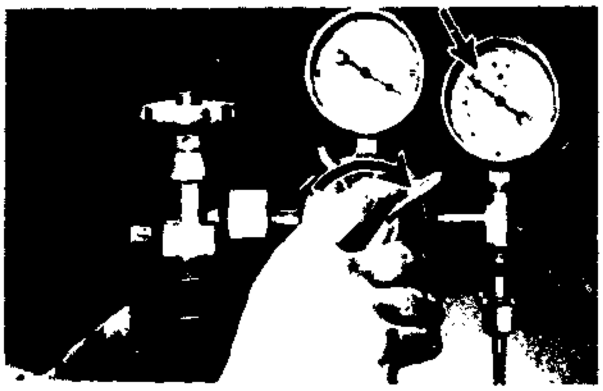


Courtesy Linde Co.

Figure 13

Stand on side of cylinder opposite regulator side. Do not face either front or back of regulator. Open cylinder valve very slowly until needle on cylinder-contents gauge stops moving.

To administer oxygen as needed, follow the directions under Figure 14.



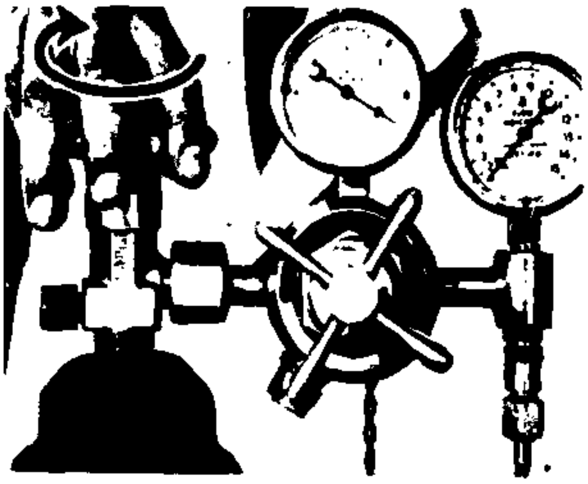
Courtesy Linde Co.

Figure 14

Tighten flow-adjusting handle by turning it to the right until the flow-indicator gauge registers the desired rate of flow in liters per minute.

To stop the flow of oxygen for short periods - less than one-half hour - simply loosen the flow-adjusting handle by turning it to the left until the flow indicator returns to zero. Cylinder contents will continue to register.

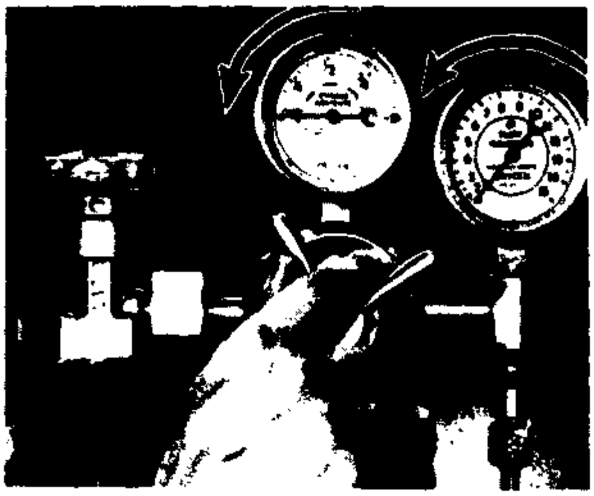
When the oxygen flow is to be cut off for $\frac{1}{2}$ hour or more, or when the regulator is to be disconnected from the cylinder, proceed as in Figures 15, 16, and 17.



Courtesy Linde Co.

Figure 15

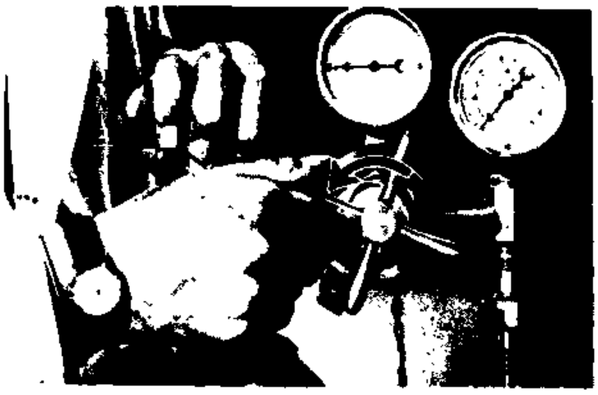
Close cylinder valve tightly. Then ope the flow-adjusting valve.



Courtesy Linde Co.

Figure 16

Wait until both cylinder-contents and liter-flow needles have returned to zero.



Courtesy Linde Co.

Figure 17

Loosen regulator flow-adjusting handle. This is important and should be done before opening the cylinder valve.

ADMINISTERING OXYGEN

Methods - Oxygen may be given in four ways: (1) full face mask, (2) catheter, (3) nasal prongs, or (4) tent.

The preferred method of administration by a squad is by mask. The reason is that a mask gives the highest possible concentration to the victim. A problem in the use of this method is that some victims have fear of the mask.

The next preference is the catheter. This method is being used more frequently by squads today that in the past. The catheter does not provide the highest concentration of oxygen, but the victim is more comfortable and is not frightened, as he may be by a mask.

Another method sometimes used is the nasal cannulas or prongs. This method is least desirable due to the low percentage of oxygen the victim can receive.

Few squads use tents. This method lends itself to use over long periods of time and needs close supervision; therefore it is seldom used by squadmen.

The concentration of oxygen possible with each type of administering apparatus is as follows:

Mask - approaching 100% concentration
Catheter - 40% to 60% concentration
Nasal Cannulas - 30% to 50% concentration
Tent - 40% to 60% concentration

It can readily be seen that the use of a mask is the best method, since it provides the highest concentration of oxygen. An emergency squad need have no fear of over-oxygenating an acute victim.

Humidity - Since squads give oxygen for relatively short periods of time, they are not required to use humidifiers. However, when oxygen is given over a prolonged period, it has a tendency to dry the membranes of the nose and throat. If oxygen is to be administered for many hours by squadmen, it is a good idea to run the oxygen through water to humidify it (Figure 18). Membranes will not dry as fast this way and the victim will remain more comfortable.

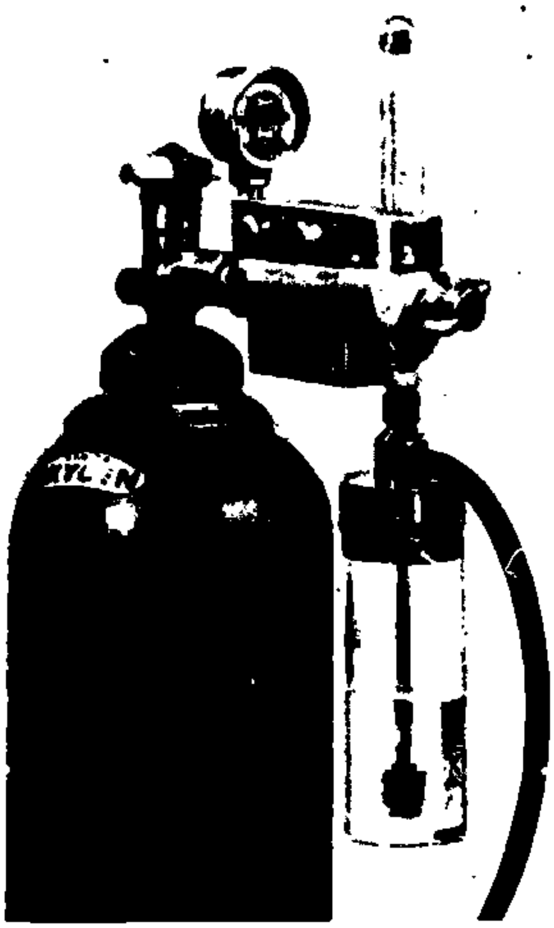
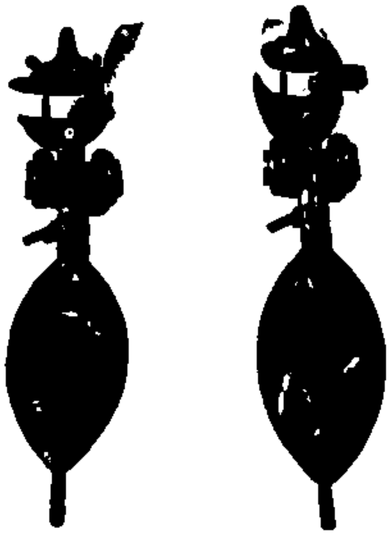

Courtesy Linde Co.

Figure 18

A humidifier with a diffuser head.

Face Masks - Figures 19 through 22 show how to choose a mask, connect it, set the oxygen flow, and apply the mask.



Courtesy Linde Co.

Figure 19

Choose a mask of the correct size. There are two sizes each, of the nasal and oronasal type (small or large). If the patient is unconscious, uncooperative, or a mouth breather, use the oronasal type facepiece.

Courtesy Linde Co.

Figure 20

Leave the hose connection and nut on the flowmeter outlet. Attach rubber tubing from the partial-rebreathing mask to the outlet of the flowmeter.

Courtesy Linde Co.

Figure 21

Set oxygen flow at 6 to 8 liters per minute. If the patient is large or is breathing heavily, 10 to 12 liters may be necessary at first to keep the bag from collapsing. Otherwise the patient may have difficulty in completing his first few inhalations.

It is important to overcome fear before a mask is applied. This can be done by letting the patient put the mask on himself or by letting him breathe a few times with it and then a few times without it.

After the mask is in place, the oxygen should be started at a high rate so as to give the victim an ample amount to overcome the acute need for oxygen in the blood.

When a victim is inhaling oxygen, the breathing bag should never completely collapse. If it does, the amount of oxygen flow should be increased.

Courtesy Linde Co.

Figure 22

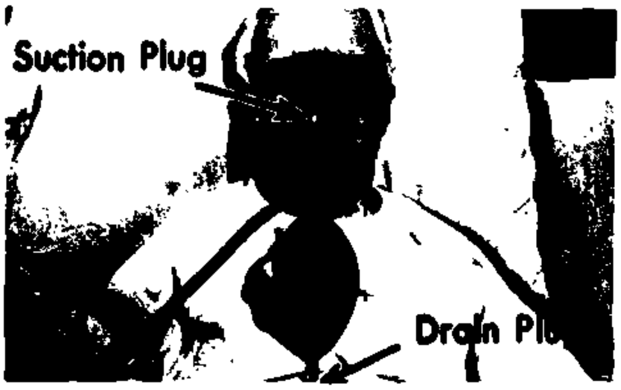
Have the patient exhale into the mask as it is applied. Adjust the headband so that the mask is snug but not tight. Clip the tubing to the bed clothes.

Courtesy Linde Co.

Figure 23

The sponge rubber disks at either side of the facepiece act as inhalation as well as exhalation valves. If these disks become moist or obstructed, air will not move freely through them and the mask will not function properly. The patient will usually complain of increased resistance to breathing. When this happens, remove the sponge rubber disks and replace them with dry ones. Or, rinse them thoroughly, squeeze them dry in a towel, and reinsert them.

Figure 23 shows how to remove and replace the sponge rubber disks if they become moist or obstructed. Figure 24 shows where to attach a suction tube and where to drain off accumulated moisture.



Courtesy Linde Co.

Figure 24

A partial-rebreathing mask usually has two plugs. One in the facepiece permits the use of a suction tube and the other, at the bottom of the breathing bag, allows drainage of accumulated moisture. Except for the purposes mentioned, these plugs must not be removed unless the mask is being washed.

A victim who is receiving oxygen by mask must be attended constantly (Figure 25).

Courtesy St. Anthony Hosp.

Figure 25

A squadman watches to see that the victim breathes freely and that the breathing bag does not collapse completely during inhalation.

Disposable Masks - Disposable face masks, such as that shown in Figure 26, are now available. There are partial-rebreathing and non-rebreathing types that operate in the same way as similar permanent masks. There are also face pieces without any rebreathing features. In all cases follow the manufacturer's instructions. These light-weight plastic masks can be discarded after each use. Therefore, the time ordinarily required for cleaning and sterilizing is saved.

Courtesy Linde Co.

Figure 26

One of the many types of disposable masks now available.

Nasal Cannulas - These are pronged metal or plastic tubes, the ends of which are inserted a short distance into the nostrils (Figure 27). Oxygen should be administered by this method only when the other methods described herein are not deemed advisable. The concentration of oxygen possible by this method is relatively low.

Courtesy Linde Co.

Figure 27

Metal nasal inhaler with adjustable headband for self-administration.

Nasal Catheters - The equipment needed for giving oxygen by nasal catheter is shown in Figure 28.

Courtesy Linde Co.

Figure 28

Set-up for deep catheter technique. (Glass of water, flashlight, and tongue depressor not shown.)

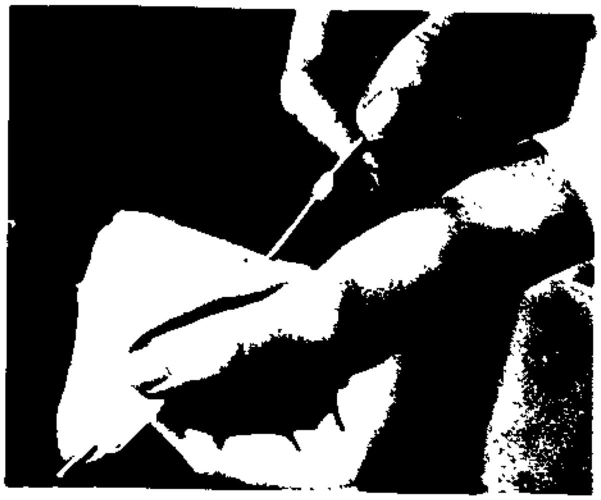
The two methods of nasal catheter administration are the shallow and the deep techniques. The shallow method (nasal catheter inserted just inside the nostril) is seldom used by squads.

Figures 29 through 35 with their captions show and describe the techniques of inserting a deep nasal oxygen catheter.

Courtesy Linde Co.

Figure 29

Determine the approximate depth to which the catheter will be inserted by measuring the distance from the tip of the nose (external nares) to the ear lobe (tragus). Mark this point on the catheter with a small piece of tape.



Courtesy Linde Co.

Figure 30

While oxygen is flowing, lubricate the catheter sparingly. Latex catheters should be lubricated with a water-soluble lubricant. Oil or fatty substances should not be used since these are a safety hazard. Also they may cause latex rubber to deteriorate. A water-soluble lubricant can be used with plastic catheters, although they are sometimes lubricated with water alone.

Courtesy Linde Co.

Figure 31

Hold the tip of the catheter in a glass of water, to be sure that the discharge holes are not plugged with lubricant.

Courtesy Linde Co.

Figure 32

Determine the direction of the natural droop of the catheter by holding the taped part with thumb and forefinger and then slowly rotating it until its tip hangs at the lowest level.

Courtesy Linde Co.

Figure 33

Hold the catheter in the position of its greatest droop, then WITH OXYGEN FLOWING, insert it slowly to the measured depth. It is easier to insert the catheter if you elevate the tip of the patient's nose. Observe the position of the catheter through the patient's open mouth. The tip should rest approximately opposite the uvula. Set the liter flow to deliver the desired concentration.

Courtesy Linde Co.

Figure 34

To assure that the catheter is in the correct position, insert it beyond the measured depth until the patient swallows oxygen; then withdraw it to a point where swallowing stops. This procedure can be followed only when the patient is conscious.

Courtesy Linde Co.

Figure 35

Tape the catheter firmly at the end of the nose; then bring it across the cheek and tape it to the temple. Be sure to tape it so that it lies on the inner 'floor' of the nose and cannot loop up inside, causing discomfort to the patient.

MAINTENANCE OF EQUIPMENT

Masks - Soak all parts in a detergent-disinfectant solution for twenty minutes. Then rinse thoroughly and dry.

Catheters - Rubber catheters should be washed thoroughly, with care given to the holes on the tip. These should not be obstructed. Catheters can then be left for twenty minutes in detergent-disinfectant solution. After twenty minutes, rinse and dry. Wrap them in clean materials to be ready for later use.

The preferred catheter for squads is the plastic disposable type. Since it is used only once, the cleaning problem is eliminated. It is also inexpensive.

Hospital emergency-room personnel are very co-operative in that they will often exchange a clean rubber nasal catheter for a soiled one. They have the proper facilities to sterilize rubber goods.

Nasal Prongs - The same care should be given to these as to a face mask.

SAFE PRACTICES

For safety, never use oil or grease on or in a cylinder valve, oxygen regulator or any oxygen connection.

All tanks should be held secure in the apparatus. The constant motion of the squad vehicle during calls will cause a dangerous situation if oxygen tanks are not held in place by straps, tank wells, blocks, or some other type of fixtures.

Smoking should be prohibited during the entire time oxygen is being administered. Oxygen does not burn, but it supports combustion.

The cushion of the face mask should be inflated at all times.

The resuscitator control valve should be set in the resuscitation position at all times when not in use.

All oxygen tanks must have a pressure test (hydrostatic test) at least once every five years. All tested tanks have the date stamped into them. Oxygen distributors will test tanks at a minimal cost.

Many squads fill smaller tanks from larger tanks. These smaller tanks must have the hydrostatic tests within a five-year period.

MASS OXYGEN THERAPY

In a special emergency oxygen in substantial quantities may be required, to care for large numbers of victims. It is not expected that local hospitals or squads will have on hand enough oxygen-therapy equipment or oxygen to take care of such an emergency. Therefore, supplemental equipment and oxygen will be required.

COMMERCIAL SOURCES

Oxygen is available from distributors of oxygen, oxygen-producing plants, industrial plants, welding shops, automobile repair shops, scrap yards, and oxygen-therapy rental services. See the yellow pages of your telephone directory under "Oxygen".

NOTE: Cylinders of oxygen obtained from the above sources may not be as clean outwardly as cylinders prepared especially for medical use, but their contents will be U. S. P. oxygen unless stated differently on the cylinder. Be sure that the word "oxygen" is on the cylinder. Cylinders of similar size, shape, and color might contain other gases that would be harmful.

Pressure-reducing regulators must be used on all high-pressure cylinders of oxygen. Hospital-type regulators and other oxygen-therapy equipment, such as tents, masks, and catheters, can be obtained from the manufacturers of such equipment and oxygen-therapy rental services. Regulators of the industrial type can be obtained from most of the places where oxygen is available. See the yellow pages of your telephone directory under "Oxygen".

NOTE: Industrial-type regulators differ from hospital-type regulators in that they do not have a restricted outlet and are calibrated in pounds per square inch instead of liters per minute. However, such regulators can be used in an emergency by opening the control valve very slightly, or by attaching a liter-flow adapter to the regular outlet. Liter-flow adapters can be obtained from suppliers of hospital regulators.

IMPROVISED EQUIPMENT

1. Oxygen can be administered by inserting a piece of tubing or welding hose through the bottom of an ordinary paper bag and holding the top of the bag over the victim's face. Use a generous flow of oxygen.
2. Make a cone of cardboard, old X-ray film, stiff paper, or similar material. Insert the oxygen hose through the bottom of the cone and hold the top over the victim's face.
3. In a cardboard carton about twenty inches square, cut a hole about nine inches in diameter in the center of the bottom. Slide the victim's head through the hole. Insert the oxygen hose through the side of the carton opposite the victim's head. Leave the top of the carton open or cut the top off entirely.

EMERGENCY HELP

Persons familiar with oxygen and equipment can be located at any of the places where oxygen is available. These persons are not necessarily familiar with oxygen-therapy techniques but they should understand the mechanics of attaching a regulator to a cylinder.

CHAPTER XII

CLOSED-CHEST HEART COMPRESSION

INTRODUCTION

For years the physicians of our nation were coping with heart stoppage by opening the chest wall and actually massaging the heart by hand. This was done in all situations, even outside of hospitals.

Then a group of researchers found that applying pressure with the hands on the outside of the chest could create the same results. This led to a whole new technique for resuscitative procedures. It was a technique that did not necessarily need a physician on the spot to carry it out. A well trained emergency squad can carry out this new procedure until the patient can be brought to definitive care in a well equipped hospital emergency room.

Some persons are concerned about the possibility of causing injuries by this technique. Close investigation has shown that no damage to victims resulted when emergency personnel who applied this technique had received formal classroom instructions, including correct demonstrations.

An emergency squadman is usually the first trained person to reach the heart-stoppage victim, except in a hospital. It is imperative that each and every squadman be completely trained in this new technique.

The following text and series of pictures with captions deal with this life-saving procedure. However, studying the chapter is not sufficient. Each step must be practiced and carried out many times, so that all members of the squad are proficient in all maneuvers.

SYMPTOMS

Upon arrival at an emergency scene, the squadman must be able to establish whether the victim is in need of closed-chest heart compression. The need can be established by the three following findings:

1. The victim is not breathing.
2. The victim does not have a carotid, or neck pulse.
3. The pupils of the victim's eyes do not react to light.

EXAMINATION

To determine whether the victim is breathing, place one hand over his abdomen in the area of the diaphragm (just below the chest.) If there is no motion, no air is being exchanged.

To establish whether a neck pulse is present, place the four fingers of one hand between the large muscle at the side of the neck and the windpipe. (See Figure 1.) If the heart is not beating, there will not be a pulse.

Courtesy Sharon Twp. F.D., Worthington, O.

Figure 1

Examining for a neck pulse.

The pupils of the eyes usually constrict (get smaller) if a light is directed on them. This is normal. If the heart is not beating, the pupils will not react to light: they will be dilated (enlarged) and stay dilated.

To examine the pupil, raise the eyelid quickly and direct the light of a flashlight, for a few seconds, at the pupil. If the pupil does not react, closed-chest heart compression is indicated. (See Figure 2.)

Courtesy Sharon Twp. F.D., Worthington, O.

Figure 2

Examining for pupil action.

With these three symptoms present, the victim must be given closed-chest heart compression immediately.

PROCEDURE

For this technique to be successful, the victim <u>must</u> be on a firm or hard surface. If he is left on a soft surface, the rescuer will be pushing the victim into this soft surface and not compressing the heart. Lay the victim on a floor or any other hard surface. While he is in transport, place him on a backboard especially if there is a mattress on the squad stretcher.. It may even be necessary to place the victim on a board and then place the board on the floor of the squad vehicle, to be able to give successful closed-chest heart compression.

Mouth-to-mouth resuscitation and closed-chest heart compression must be given together. As soon as it is found that closed-chest heart compression must be given, four or five breaths of mouth-to-mouth resuscitation should be administered.

If two rescuers are present, one can give the mouth-to-mouth while the second measures the chest. If only one is present, the initial mouth-to-mouth breathing must be performed first. Then the squadman proceeds to measure the victim's chest region.

LOCATING THE HEART

The heart lies directly under the sternum or "chest bone".* Pressure on this bone will compress the heart and force the blood out of it. Relieving the pressure will allow the heart to refill.

To locate the region where pressure is to be applied, place a finger of one hand, (preferably the index finger) at the top of the chest bone and a finger (index) of the other hand at the bottom. (See Figure 3.) The lower half of the chest bone is the exact area wanted.

Courtesy Sharon Twp. F.D., Worthington, O.

Figure 3

Measuring the sternum, or chest bone.

PLACING THE HANDS

Kneel beside the victim. Place the butt or heel of one hand on the lower half of his chest bone. (See Figure 4.) The butt of your hand should lie along his chest bone, with fingers extending toward his ribs.

Place the second hand over the first. The direction of the second hand is whichever is comfortable to the rescuer.

Courtesy Sharon Twp. F.D., Worthington, O.

Figure 4

Placing the hands

APPLYING THE PRESSURE

With hands on the victim's chest bone, straighten your arms until the elbows hurt. Bend forward until your shoulders are directly over your hands. Now begin to apply pressure: Push directly down until the chest bone moves 1½ to 2 inches. (See Figure 4.)

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* Although squadmen commonly call it the "chest bone", in medical terminology it is the sternum or breastbone.

Hold your fingers up off the victim's chest. This will help to keep your hands in the proper place.

The rate is 60 compressions per minute. Practice this procedure alone, and also with another rescuer, until you are sure of maintaining your rate at 60 times per minute.

If the rate is too slow, not enough blood will be pumped out of the heart to sustain the victim's life. If the rate is too fast, the heart will not fill properly. Each squadman should develop a technique that will sustain the right rhythm and rate.

METHOD FOR TWO RESCUERS

There is a definite ratio that must be maintained between heart compressions and lung inflations. For two squadmen working together it is five closed-chest heart compressions and one mouth-to-mouth inflation. As one rescuer's hands are coming up at the end of the fifth compression, the second rescuer should be inflating the victim's lungs. The chest will rise as the hands come up. Close cooperation will maintain a rhythm and will also save time. (See Figure 5.) If the two rescuers tire, they can change positions.

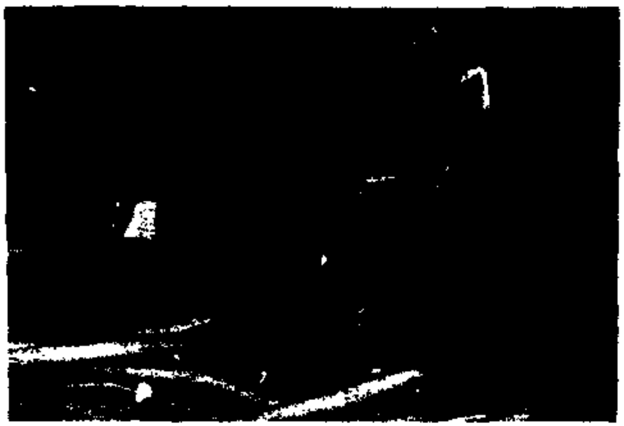
Courtesy Sharon Twp. F.O., Worthington, O.

Figure 5

Two rescuers working together. The rhythm is five closed-chest heart compressions and one mouth-to-mouth resuscitation.

METHOD FOR ONE RESCUER

One squadman working alone should maintain a ratio of 15 chest compressions followed by two mouth-to-mouth resuscitation breaths. When working alone, the squadman cannot take time to place his thumb in the victim's mouth, to extend the chin and head. Air should be given as shown in Figure 6.



Courtesy Sharon Twp. F.O., Worthington, O.

Figure 6

One rescuer working alone. With one hand under the victim's neck, he supports the head in proper position for mouth-to-mouth breathing.

USE OF THE RESUSCITATOR

If a mechanical resuscitator is available, it should be put into play as soon as possible. In this procedure the rescuers give ten closed-chest heart compressions and then one inflation with the resuscitator. Hold the mask as described in Chapter X of this text. Put it on the face but not airtight. At the tenth compression push on the mask to make it airtight and it will inflate the lungs. The 10 - 1 ratio can be continued even during transport. (See Figure 7.)

Courtesy Sharon Twp. F.D., Worthington, O.

Figure 7

Use of the resuscitator during closed-chest heart compression.

MANUAL OVER-RIDES

Mechanical resuscitators that incorporate the negative and positive pressure manual over-rides can be used to assist in ventilation of the victim's lungs in conjunction with closed-chest heart compression.

This manual over-ride feature permits the operation to manually resuscitate with pressures higher than the normal, but not high enough to injure the victim's lungs.

Other resuscitation devices can be used, such as the mouth-to-mask resuscitator (Figure 10) or bag-mask resuscitator.

CARTILAGE SEPARATION

In older persons (60 and older) there may be a separation of the cartilage between the ribs and the chest bone due to the pressure of closed-chest heart compression. This is not unusual and is not considered a complication.

CHILD VICTIMS

This technique is the same for children, except that the use of one hand on a child's breastbone, or two fingers for an infant, is adequate. The compression rate for children should be 80 to 100 times per minute.

TRANSPORTATION

With the victim on a backboard, closed-chest heart compression and resuscitation can be carried out and continued while loading into the squad vehicle, and while en route to the hospital. (See Figures 8 through 11.)

The hospital to which the squad is en route should be notified of the patient's pending arrival. This will allow time for the emergency room team to prepare equipment and drugs before the victim arrives.

Courtesy Sharon Twp. F.D., Worthington, O.

Figure 8

With the victim on a backboard, both life-saving procedures can still be carried out.

Courtesy Sharon Twp. F.D., Worthington, O.

Figure 9

Loading the victim into squad ambulance.

Courtesy Sharon Twp. F.D., Worthington, O.

Figure 10

Both procedures being continued in the squad ambulance.

CONCLUSION

This newest resuscitation procedure can not be learned just by reading material in a text. Continual practice and experience are necessary. The procedure should be reviewed often.

CHAPTER XIII

USE OF BACKBOARDS

INTRODUCTION

The backboard is a versatile tool. Its primary purpose is the immobilization of fractures of the neck and back. But this rigid board is also ideal for moving victims of other conditions such as fractures of the pelvis or both legs.

To carry a large unconscious patient down three flights of stairs is a real job. Strapping the patient securely to a backboard makes the job much easier.

After using the backboard for a short time, squadmen will recognize many other types of situations in which it is useful.

Victims should be moved onto a backboard by the method known as "logrolling".

LOGROLLING

DEFINITION

Logrolling is the turning of a victim's body by several people working in unison. Its purpose is to protect a victim who must be moved onto (or off of) a backboard or stretcher, when his back or neck may be injured.

The procedure has been used for many years in hospitals. It should always be used by squadmen on accident victims with suspected neck and back injuries.

Logrolling is also a wise practice whenever squadmen are preparing to transport an unconscious victim.

Figures 1 through 12 and their captions show logrolling procedures. The position of the squadman's hands should always be, as nearly as possible, that shown in the pictures. When a victim is to be removed from a car or truck, these same hand positions can be used.

PREPARING TO ROLL

Emergency care should be given to the victim before he is logrolled.

After emergency care, when you are ready to move the victim onto a backboard, establish on which side he is to be rolled: it should be his least injured or non-injured side. Next, raise the victim's arm, on the side onto which he is to be rolled, above his head. (See Figure 1.)

Figure 1

Raising the victim's arm prior to rolling. In this case he will be rolled onto his right side.

POSITION OF HANDS

The exact position of each squadman's hands on the victim is very important in logrolling.

1. The top man's top hand is to be under the neck, supporting the head. His bottom hand grasps the clothing (or skin) at the shoulder (See Figure 2.)
2. The center man's top hand is to be around the victim's distant arm and grasping the clothing. His bottom hand grasps the clothing at the belt region.
3. The bottom man's top hand grasps the victim at the hip region. His bottom hand grasps the distant leg at the calf.

ROLL

At a signal from the top man, all three roll the victim toward them. (See Figure 3.) Note that four of the six hands of the squadmen are grasping the trunk of the victim's body. Also note that the victim's head is supported by the top squadman. All squadmen should be on the same knee.

Figure 2

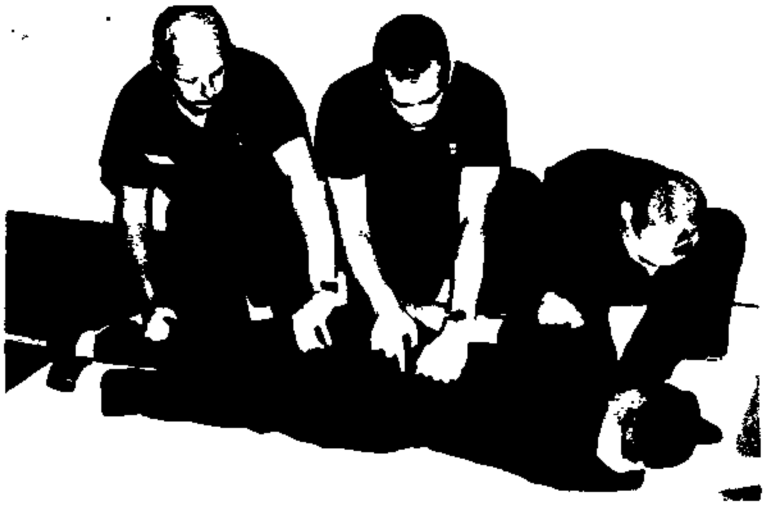


Figure 3

Figure 2 shows the location of each squadman's hands on the victim before logrolling. In Figure 3 the victim has been logrolled onto his side.

PLACING THE BOARD

While the victim is held on his side, the board is placed flat on the ground or floor next to the victim. (See Figure 4.)

Again on a signal from the top man, the victim is lowered on the board. His arm is returned to his side.

SLIDING THE VICTIM

The victim usually is centered when placed on the board. If he is not centered on the board, he can be slid over by the rescue team, working in unison. While the man who placed the board holds it, the other three squadmen remain where they were and place their hands on the victim's body, in the same positions, but on the opposite side. (See Figure 5.)

At the signal of the top man, the victim is slid over with a gentle, even motion.

Figure 4

Figure 5

A backboard is placed behind the victim (Figure 4). After he is lowered onto the board he can be slid gently toward the center if necessary (Figure 5).

BOARD WITH FOOTREST

If it is determined a footrest will be needed on the backboard, insert it prior to logrolling the victim.

The squadman who will place the board should measure the board by placing the board and footrest as shown in Figure 6. The board is then placed on the floor and the victim is logrolled as previously described.

Figure 6

If a footrest will be needed, place it against the victim's feet with the backboard in place.

POSSIBLE NECK INJURY

If a neck injury is suspected, one squadman must attend the head and neck at all times until it is immobilized.

Figures 7 and 8 show the proper way to logroll a neck injury.

Note that the squadman caring for the neck is applying slight traction, supporting the chin and keeping the nose in line with the "belly button" at all times. Also note that the man at the shoulder uses only one hand during this procedure. The man caring for the neck should give all signals. The victim's neck should then be immobilized with a blanket-roll splint as shown in Chapter VIII.

Figure 7

Figure 8

Four men logroll a suspected neck-injury victim.

ROLLING VICTIM FACE DOWN

When a victim is found face down and should be transported that way (severe bleeding at the face, secretions and mucus from the mouth, vomiting, etc.) the procedure is much the same.

Figure 9 shows the placement of the hands for this procedure.

Figure 10 shows the same victim on his side.

Figure 11 shows the placing of the board.

Figure 12 shows the victim, face down on the board.

Figure 9

Figure 10

Squadmen's hands are placed for logrolling a victim face down (Figure 9). Then the victim is rolled onto his side (Figure 10).

Figure 11

Figure 12

The board is placed in front of the victim (Figure 11). After he is lowered to a face-down position he can be slid gently to the center of the board (Figure 12).

HANDLING OF BACKBOARDS

The following series of pictures (Figures 13 through 20) illustrate how to use backboards.

Specifications for two backboards, child and adult sizes, can be found in Chapter II of this manual.

STRAPPING A VICTIM TO A BOARD

If a victim must be carried for some distance on a backboard, he should be strapped to it.

Placing Straps - The positions of the three straps on the victim are most important.

1. The bottom strap must be placed around the board and around the victim just above his knees. This will prevent him from raising his legs off the board.
2. The middle strap must be placed around the board, and across the victim's hip region. His hands should be at his sides; the strap passes over his wrists.
3. The top strap must be placed around the board and across the victim's chest region, just below the shoulders.

All three of these strap positions can be seen in Figure 13. Note the straps do not go through the holes in the board, but around the board. The straps would not be located properly if they were put through the board holes.

Securing Feet and Head - If the victim must be carried up or down any distance, a footrest must be put in place and his feet must be tied to it with a cravat. The victim's head can be kept secure with a cravat. Figure 14 shows how the cravats are tied.

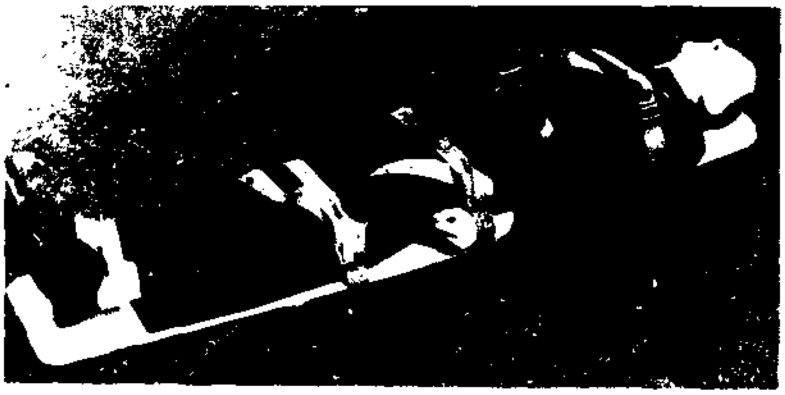


Figure 13

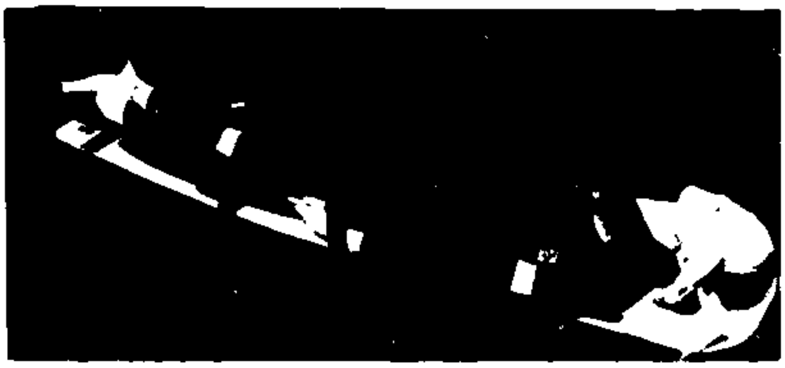


Figure 14

Figure 13 shows proper strap placement. The bottom strap passes just above the knees; the middle strap passes across the thighs and over the wrists; the top strap passes across the upper chest. Figure 14 shows proper placement of straps, footrest, and cravat bandages.

Figure 15

Squadman places one hand on board handhold.

RAISING THE BOARD

To raise a backboard, one squadman places four fingers of one hand into the handhold in the bottom of the board. (See Figure 15.) He then lifts the board and places it on one foot. (See Figure 16.)

Then he takes hold of the board with both hands, bends his knees, and lifts with his legs, not his back. He lifts the board just to his knees. (See Figure 17.)

Figure 16

Squadman places board on his foot.

The top man places himself at the top of the board. He stoops, places each hand on one edge of the board, and slides his hands along the board toward him until they touch the ground. (See Figure 17.)

He then straightens his legs and lifts with his leg muscles, not his back. If both men keep their arms straight, the board can be carried easily. (See Figure 18.) Squadmen should not bend their arms while carrying a patient on a backboard, as it is very tiring.

Figure 17

Figure 18

Figure 17 shows the proper first step in raising the board. Figure 18 shows the proper way to carry the board.

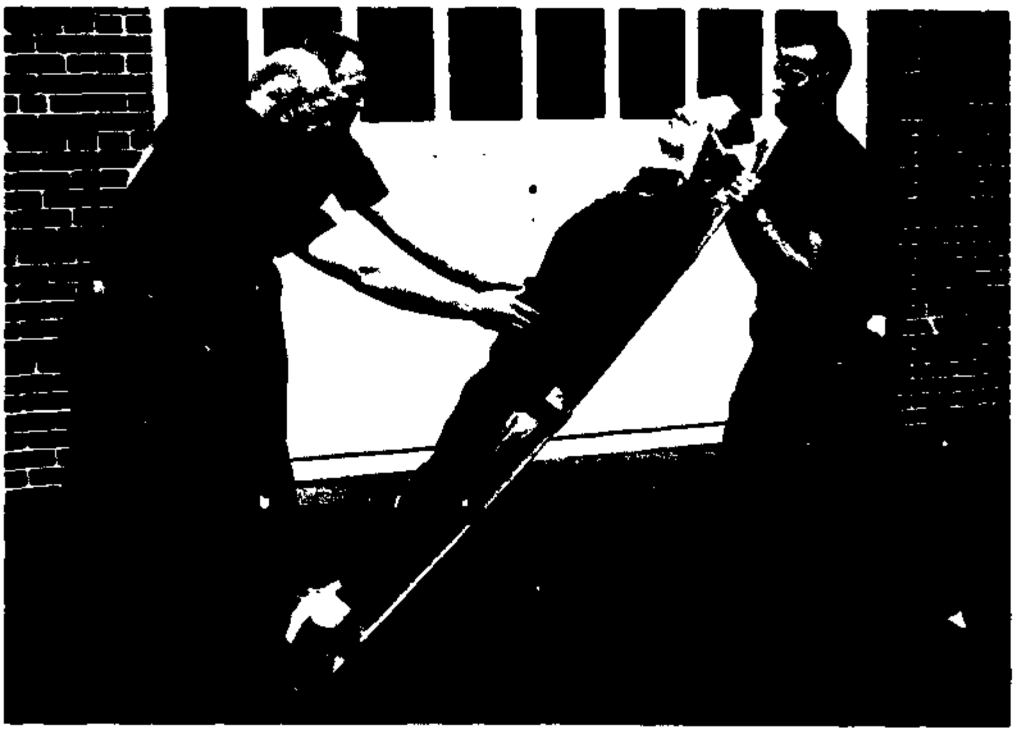


Figure 19

Squadmen raise the victim to a vertical position.

<u>Raising Victim's Head</u> - If the victim must be carried in a vertical position while strapped to the board he must be raised properly:

1. After the board is lifted to the normal (horizontal) carrying position, the foot end of the board is lowered again.

2. Two squadmen then "foot" the board; that is, each braces it with a foot.

3. The top man then raises the board to his chest, places it on his chest, changes the direction of his hand position, and pushes away.

4. The bottom two men then receive the board. (See Figure 19.)

The victim who is properly secured to a backboard can safely be raised to a vertical position using this procedure. He will not slide off or fall away from the board (See Figure 20.)

Courtesy Yorkville Vol. F.D.

Figure 20

The victim is secure in a vertical position.

REMOVING VICTIMS FROM AN AUTOMOBILE

Victims of auto accidents are especially likely to have head, neck, and back injuries. Moving these victims carelessly has resulted in needless deaths and permanent paralysis. Every squadman should learn the procedure for removing a victim from a car: (1) from the driver's seat, (2) from under the dashboard, (3) from a prone position on the front seat, and (4) from the back seat.

PRELIMINARY STEPS

All emergency first aid--control of bleeding, the splinting of all fractures, etc.--must be carried out before the victim is removed. (If danger of explosion or uncontrolled fire is imminent, the victim should be pulled from the car by the long axis of his body.)

The squadmen's hand positions on a victim in a car are the same---or as close as possible to the same---as in regular logrolling.

The victim should not be moved until all are ready, and then only on the directions of one man.

Some of the procedures shown here require more men than usually are on a squad run. Other persons---policemen, family, or bystanders---could quickly be shown how to help. Do not hesitate to call for more help, if it is needed to carry out these procedures.

In the following pictures removal of a victim from each of the four locations is described and shown. The pictures do not show first aid treatment because they were posed: in an actual accident, the victim would have been splinted, etc.

REMOVAL FROM THE DRIVER'S SEAT

Rescuers often forget to make as much room as possible to work. Sliding the front seat back gently will give the squad more room. (See Figure 21.)

Figure 21

A car seat can be slid back.

A squadman positions himself behind the victim, in the back seat. (See Figure 22.) He slides his hands under the victim's armpits, grasps the victim's wrists, and crosses the victim's arms.

Figure 22

The victim is grasped by his arms.

As this is being done, one squadman stands ready with the backboard and another squadman stands at the opposite door.

The squadman in the car then arches his back against the car roof, and raises the victim just enough to slide the board under the victim. (See Figure 23.)

Figure 23

One squadman slides the board.

The victim is then pivoted on the board. Both his feet are kept together at all times. The squadman in the back seat then "gives" the victim to the squadman at the opposite door, who lowers him to a horizontal position. (See Figure 24.)

All three squadmen then come to the driver's side. Together they slide the victim out of the car. (See Figure 25.) He can then be transferred to the squad stretcher.

Figure 24

The victim is pivoted.

Figure 25

The victim is removed.

REMOVAL FROM UNDER DASHBOARD

A victim might typically be found in the position shown in Figure 26. Four squadmen will be needed, to remove him.

After the victim is given first aid, a board is placed on the front seat. (See Figure 27.)

Figure 26

Figure 27

Figure 26 shows a victim lying under the dashboard of an auto. Squadmen, after giving him first aid, will place a backboard on the front seat as in Figure 27.

Then the rescuers prepare to roll the victim onto the board, as follows:

1. One squadman places himself so that he can support the victim's head. He controls its movement at all times during the maneuver.

2. One squadman places himself where he can support the victim's legs.

3. Two squadmen get into the back seat, reach over the front seat, and grasp the victim's clothing at the shoulder, chest, belt, and thigh. (See Figure 28.)

Figure 28

Squadman at left is attending the victim's legs. Squadman at right, reaching from the back seat, is grasping the victim's belt and thigh.

On a signal all four squadmen gently lift the victim, keeping his back and hips against the front of the front seat. (See Figure 29.)

Figure 29

Four rescuers lift the victim from the car floor. One man in back, not visible here, holds the victim's chest and shoulder. Another is outside the car on the opposite side.

The victim is then placed on the board. (See Figure 30.)

The victim on the backboard is slid out of the car. (See Figure 31.) He can be transferred to the squad stretcher.

Figure 30

The victim is slid on a backboard.

Figure 31

The victim, on the board, is removed from the car.

REMOVAL FROM FRONT SEAT

Many times a victim is injured and falls across the front seat.

Four men are also needed for this rescue procedure, as follows:

1. Two men get into the back seat. The top man supports the victim's head and grasps the clothing at the shoulder. The second man grasps the victim's clothing at the belt and thigh. (See Figure 32.)
2. One man outside the car prepares to guide the victim's feet.
3. One man handles the board. Later he will attend the victim's head.

Figure 32

Rescuers are preparing to move the victim. Note positions of each squadman's hands.

The victim is rolled slightly away from the back of the seat, and the board is slid behind him. (See Figure 33.)

After the board is in place, the man who handled it becomes top man. He supports the head of the victim against the board with his arm, and grasps the bottom edge of the board. (See Figure 34.)

The two men in the back seat then reach across the victim, grasping his clothing under the ribs, waist, hip, and thigh. Together they hold the victim snugly against the board (See Figure 34.)

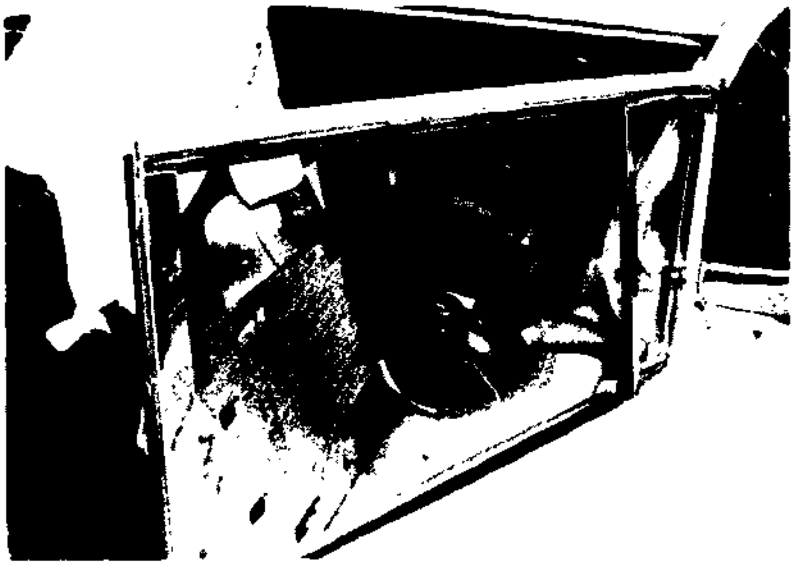


Figure 33

Figure 34

The victim is slightly rolled while one man places a board behind him (Figure 33). One squadman holds the victim's head against the board with his lower arm, as his hand grasps the backboard edge (Figure 34).

The bottom man (on the outside of the car) grasps the top of the board with his top hand. He reaches around the victim's ankles and grasps the board at its bottom edge, at the same time keeping the victim's feet against the board. (See Figure 35.)

On a signal all four men turn the board, keeping the victim tight against the board. (See Figure 36.)

The board is now resting on the front seat. The victim can be removed as previously shown.

Figure 35

Figure 36

With his left hand another squadman grasps the backboard below the victim's ankles (Figure 35). His right hand grasps the hand hole. Lowering the board onto the car seat is a joint maneuver (Figure 36).

REMOVAL FROM THE BACK OF CAR

People riding in the rear seat of a car can as easily be injured in a wreck as those in the front seat. They sometimes are found in the position shown in Figure 37.

To remove this victim, four squadmen grasp him using the same hand position as those shown in Figure 32. However, the two squadmen in the car are in the front seat. These two men grasp the victim as shown in Figures 38 and 39.

Figure 37

Figure 38

A victim lies on the floor between the front and back seats (Figure 37). Two squadmen, working from the front, grasp the victim as in Figure 38.

Figure 39

Squadmen place their hands on the victim as shown.

A board is placed on the seat and the victim is raised to the board. His back should be kept against the front of the back seat as support. His head, neck, legs, and back must be continually supported.

The back seat can be removed and the board put on the floor. The victim can then be supported and logrolled onto the board more easily. (See Figure 40.)

Figure 4C

Rescuers place the victim on the board. In this view, the back seat has been removed from the car.

CONCLUSION

Other uses of the backboard---raising, lowering, aerial-ladder rescue, etc.---are shown in other parts of this text.

This versatile tool should be handled frequently in squad practice sessions, so that it will become an intrinsic part of your team operation.

A wrecked car should be obtained by every squad, and it should be used often at drills to practice removal of victims. The car can be turned on its side or top, and the victims can be brought out through side windows, and through the windshield or back window.

All pictures in this chapter, except Figure 20, were taken in cooperation with the Sharon Township Fire Department, Worthington, Ohio.

CHAPTER XIV

RESCUE CARRIES AND DRAGS

INTRODUCTION

Earlier chapters of this text have dealt with first aid. The next several chapters will describe rescue procedures.

An important aspect of rescue work is the successful removal of victims in situations where a stretcher or backboard cannot be used. Squadmen must be able to carry and drag victims quickly to safety in a variety of emergency situations, with minimum risk to the victims and to themselves. They must be prepared to rescue people who are injured or unconscious. This chapter describes rescue carries and drags.

RESCUE PRINCIPLES, PRACTICES AND EQUIPMENT

THE RESCUE SCENE

Rescue is the removal of humans from places involved in fire or other disaster. The factor of life saving or "life hazard" decides the first or immediate operating procedure at a fire or other emergency. Rescue is the first action to be taken on arrival at a scene. Therefore, each officer and squadman should thoroughly understand the principles governing rescue.

In case of emergencies within a building, the first questions to be considered regarding rescue are as follows:

1. Are there any people in the building?
2. If so, are they in danger?
3. Have there been cries for help?
4. Can the people be rescued?
5. How can they be rescued?
6. Has any information been given by persons who have escaped from the building regarding persons in the involved building?
7. Has any information been given by neighbors or bystanders regarding persons in the involved building?

The officer in charge should determine whether anyone is trapped in the building. The information secured from answers to the questions above will help greatly in making rescue.

Children may try to escape from flames or smoke by hiding in closets, under beds or furniture. Persons may be found beneath a window which they have tried to open. A careful search should be made when there is any chance of anyone having failed to escape from the involved building. It must be remembered that it only takes a small amount of heated air, smoke or gases to render a person unconscious.

PREVENTING PANIC

In such places of public assembly as schools, churches, hospitals, dormitories, theaters, factories and stores, the actual emergency is not the only factor causing a serious rescue problem. Panic has been the major cause of death in places of public assembly. A false shout of fire, the discovery of smoke, some incident such as an explosion, collapse of part of the building, or any other unexpected event can cause the necessary spark of excitement which can cause panic. The best method of panic prevention is for the assembled people to be trained to perform a well disciplined emergency exit drill. This is the reason that systematic emergency exit drills should be conducted. Where it is not possible or practical to train occupants in emergency exit drills, the only safeguard against panic is for the buildings to have adequate exits. All exits should conform with accepted standards.

COMPLICATING FACTORS

Weather conditions at the time of the emergency have an important bearing on the problem of rescue. Zero weather accompanied by snow and ice will slow up rescue operations. Low temperature, plus exposure, may endanger the health of persons who have been removed from the building.

The use of the new type metal window frames in buildings has increased the difficulty of bringing occupants out through window openings.

The time and nature of occupancy has a direct relationship to the problem of rescue. A hotel fire is a more serious problem in the early morning hours than at any other time. In the early morning, most of the occupants are asleep and a fire may have made considerable headway before discovery. A school building presents an entirely different problem during the time classes are in session than when they are not. So, time and nature of occupancy must be given proper consideration in rescue.

The age, sex and physical condition of the inhabitants of the involved building will also enter into the problem of rescue. Women, children, and the physically disabled will make operations more difficult.

BEING READY

Squadmen should make community surveys to determine where disasters or grave emergencies are most likely to strike. A complete record should be kept at all times as to location of homes for the aged, children's homes, jails, hospitals and other institutions.

Squadmen must know the life hazards found in public, commercial and apartment buildings under their protection. Squadmen should know the construction, interior layout, nature of contents, number of persons likely to be found in the building, location of interior and exterior stairways, other avenues of escape, and any other information of value in conducting rescue operations.

Squadmen should also know the exact location of all exits from the involved building and the openings in the roofs of the adjoining buildings which could be used in an emergency. Porch roofs, balconies, and in many instances, the roof of the involved building may provide a means of temporary escape from immediate danger for the occupants.

Periodic surveys of the area squadmen are to protect should be made by both officers and men to determine the type of rescue tools and equipment that would be required for any emergency that may arise.

Rescue equipment will vary in different locations. For instance, an area with railroad tracks creates the possibility of a train wreck. The presence of lakes, ponds, and other bodies of water may indicate the chance of future drownings. Asylums, jails, etc., constitute places of confinement where iron bars would have to be removed from the windows. All of these would pose different problems in attempting rescue. Discussions should be held regarding these possible rescue problems.

Squadmen must be trained in the use of rescue equipment such as ladders, ropes, and gas masks in order to protect their own lives and the lives of others. A knowledge of the chemistry of fire, gases, ventilation and first aid is a must for the squadman.

There can be no set rules for rescue, as conditions may differ from case to case. Generally the time factor is always pressing, for people must be rescued quickly and taken to a place of safety. The methods used may employ one or a combination of rescue practices.

In order to be ready for any emergency, squadmen must be drilled regularly to develop teamwork in rescue practices.

CARRIES AND DRAGS

Persons who have been subjected to intense heat, heavy smoke, gases, or falling materials may become injured or unconscious. Squadmen should know the methods for carrying and dragging people to safety in such emergencies. Some common methods are described here.

Chair Carry - This is a good method. It is even better than a stretcher in places where sharp turns must be made or where steep stairways are encountered. The chair should be tested before use, to make sure it is solid and will support the victim. After the victim is placed in the chair, the man in the rear tilts the chair back to enable the man in front to get into his position. Carry as shown in Figure 1.

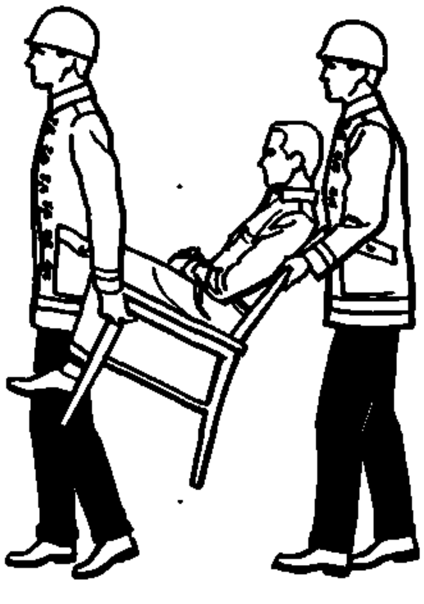
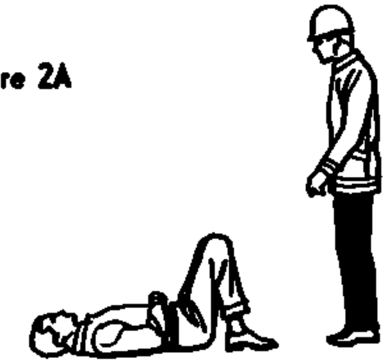


Figure 1
Chair carry

Fireman's Carry - To get the victim on the shoulder for this carry, balance and coordination of movement are very important. With this method, a squadman can raise any victim that he is able to carry. He places the victim on his back, knees up, and feet against buttocks, as shown in Figure 2a.

Figure 2A



He then grasps the victim's wrists with his palms down. See Figure 2b.

Figure 2B

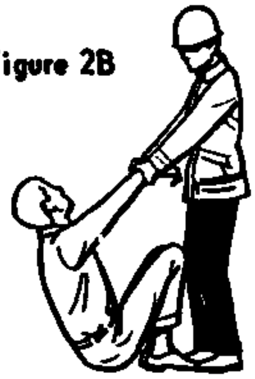
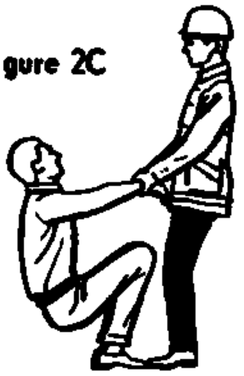


Figure 2C



The rescuer places his feet and legs against the victim's feet and legs, as shown in Figure 2c. Then, by leaning back and pulling the victim forward and up at the same time, he enables the victim to fall across his shoulder. See Figures 2d and 2e.

Figure 2D

Figure 2E

Fireman's carry

Carrying in Arms - To carry a patient in the arms, lift him, if he is unconscious, to an erect position as described in the fireman's carry. Support the patient with one arm about the body. Kneel on one knee and allow him to rest on your other knee. Pass your other arm under his thighs. Roll the patient into the hollow of the elbows and rise. See Figure 3.

Figure 3

Carrying in arms

Carrying Astride Back - Carrying astride the back is a comfortable one-man method of transportation, but is limited to carrying a conscious victim who can at least partially stand alone. The rescuer assists the victim to a standing position. Standing in front of the victim, he turns his back to him, taking the victim's arms over his shoulders and crossing them. He then bends forward until the victim rests on his back. He grasps each thigh, and with a humping motion, raises him well upon his back. Passing the forearms under the victim's legs, the rescuer then takes a wrist in either hand and the victim is loaded. This carry is so secure that the victim may become unconscious and yet be carried safely and easily. See Figure 4.

Figure 4

Carrying astride back

Pack Strap Carry - The pack strap method is a one-man carry that has two applications, one for a conscious and one for an unconscious victim. For a conscious victim, the loading is done exactly as described in the first part of the "astride back" method. See Figure 5a. When the victim is on the rescuer's back, the rescuer grasps his crossed arms at the wrists, bends forward, humping the victim well up on his back and proceeds in the manner shown in the illustration. Note that the rescuer has one hand free.

If the victim is unconscious, the loading is more difficult, likewise the carry. To make the carry, an improvised "pack strap" is used. The carry gets its name from the pack strap used. The pack strap consists of a loop of some type of material. A rope hose tool is excellent for this purpose, but a bed sheet or any other similar material may be used. The rescuer turns the victim on his back and passes the loop through, under his shoulders at the arm pits. He then places his body on that of the victim with his face up, slipping each arm through an end of the loop. The rescuer then rolls himself and the victim over, gets to his knees, then to his feet and from this squatting position rises to an erect position. See Figure 5b. Since both hands are free, the rescuer may proceed down a ladder or through difficult passages. Although the dangling legs of the victim are awkward, he cannot slip from the load. Also, the rescuer can shift the load from his back to leg muscles by bending forward.

Figure 5A

Figure 5B

Pack strap carry (conscious and unconscious)

Front Piggy Back - This one-man carry is excellent for carrying a conscious victim. To get the victim in position, face him and place hands under his arm pits. Lift as he jumps up putting his legs around your midriff, above the hips. The victim wraps his arms around the rescuer's neck. The rescuer has both hands free to climb or descend a ladder, open a door, etc. If trouble develops while descending a ladder, the rescuer can pin the victim against the ladder until help arrives or the trouble is eliminated. See Figure 6.

Figure 6

Front piggy back

Two-Man Seat Carry - The seat carry seen in Figures 7a and 7b is a two-man means of carrying an injured or unconscious person. It consists of making a seat rest of one pair of arms and a back rest of the other pair. Figure 7a shows how the arms are arranged when completed. The rescuers kneel, one on either side of the victim near the hips, and raise him to a sitting position steadying him with the arm nearest his head around his neck.

Each rescuer then slips his other arm under the victim's thighs, clasping the wrist of the other rescuer. Both arise slowly, in unison, lifting the victim from the ground. When erect, they adjust their upper arms to form a comfortable back rest and to make the victim secure. See Figure 7b. If conscious, the victim assists the rescuers by grasping them around the necks with either or both arms.

Figure 7A

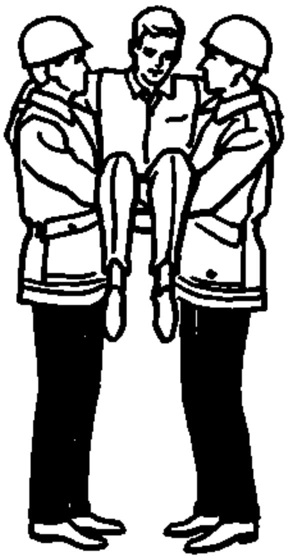


Figure 7B

Two-man seat carry

Carrying By the Extremities - This is a good method, but should not be used if the victim has any fractures. The victim is laid straight on his back, feet apart. One rescuer takes his place between the victim's legs and the other at his head, facing each other. The rescuer at the victim's feet turns his hands palms down, grasps the victim's wrists, and pulls him to a sitting position. The man at the victim's head assists in raising him to a sitting position by lifting his shoulders. See Figure 8a.

Figure 8A

The rescuer at the head position kneels on one knee and supports the victim's back with the opposite knee and leg. Then he extends his hands, palms down, under the victim's armpits from back to front. The rescuer at the victim's feet, who has been holding the victim's wrists, places them in the extended hands of the other rescuer, who grasps them firmly. See Figure 8b.

Figure 8B

The rescuer at the victim's feet turns his back to the victim, kneels on one knee, and passes his hands under the victim's knees from the outside. The rescuer at the head position gets into a baseball catcher's position, keeping his back vertical. At the order "Rise", by either of the two rescuers, both rise by straightening their legs, and move forward. See Figure 8c.

Figure 8C
Carrying by the extremities

Three-Man Carry - The three-man carry is used for badly injured persons. See Figures 9a , 9b and 9c . The carry is accomplished as follows: Three men line up on one side of the victim and the leader gives the command, "Prepare to lift." Each man kneels on the knee nearest the victim's feet, so that one man is at his shoulders, one at his hips, and one at his knees. Without further orders, they pass their hands and forearms under the victim, as shown in Figure 9a . The one at the head places his hands under the victim's neck and back, the second under the pelvis and hips, and the third under the knees and ankles. At the command, "Lift," they raise the victim and place him on their knees, but without releasing their hands. See Figure 9b.

Figure 9A

At the command, "Prepare to rise," they slowly turn the victim on his side, toward them, until the victim rests in the bend of their elbows. At the command, "Rise," all rise to a standing position, holding the victim against their chests, as in Figure 9c. To move directly forward, the command, "March," is given and all three step off on the left foot and continue until the command, "Halt" is given. To move sideways, the command, "Side step left", (or "... right",) is given. The rescuers step off with the foot according to the command, bringing the other foot up to it in even, short steps. The victim is then lowered by reversing the operations but always at the command of the leader.

Figure 9B

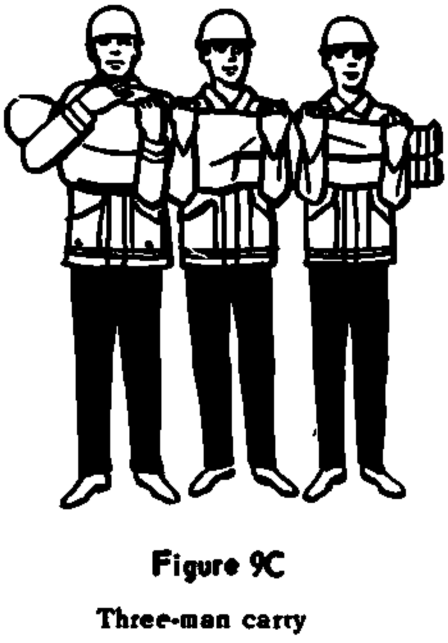


Figure 9C

Three-man carry

In actual practice, however, it should not be necessary to give detailed commands. The men should be so well trained that they can move and act in unison with a minimum of commands.

Clothes Drag - When a squadman must rescue a victim who is too heavy to be carried, other means must be used to get the victim to safety. The clothes drag, Figure 10, is one method that can be used. The rescuer's hand should grasp the victim's collar with the victim's head resting on the rescuer's arm for protection.

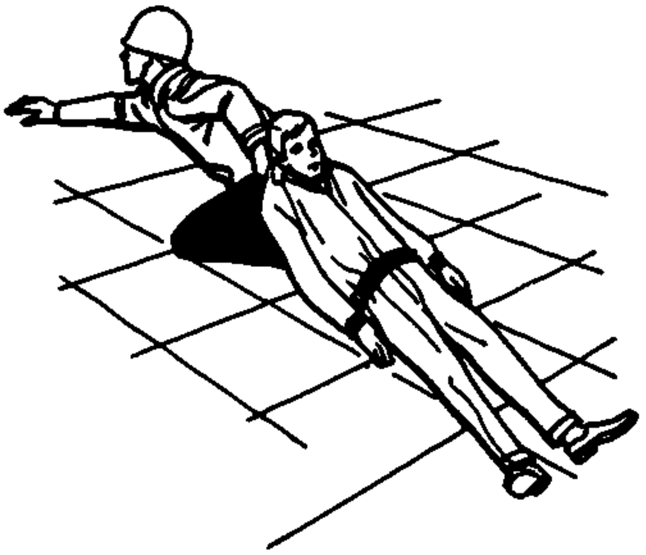


Figure 10
Clothes drag

Fireman's Drag - In making a fireman's drag, the victim's wrists are tied together with a square knot as shown in Figure 11.

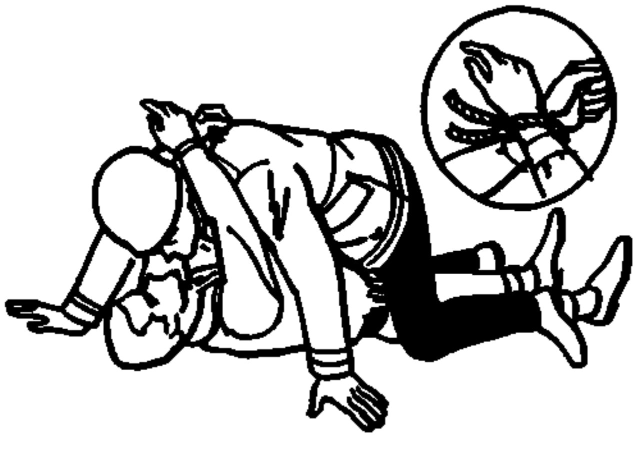


Figure 11
Fireman's drag

The rescuer then straddles the victim and passes his head between the arms, raises the victim's head and shoulders just off the floor, and then, by crawling, drags the victim out.

For descending a stairway when using the fireman's drag, the rescuer's position is reversed and he descends the stairs backwards. This prevents the victim's head from hitting the steps.

The Blanket Drag - The blanket drag can be used in place of the clothes drag when the victim is nude or the clothing being worn is too flimsy to be used to drag the victim. Place a blanket on the floor and roll victim onto the blanket. The victim can then be removed to safety as shown in Figure 12.

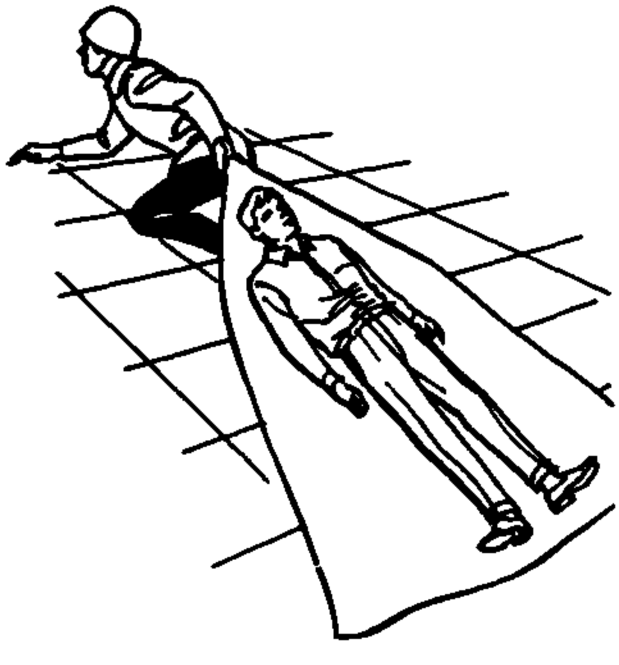


Figure 12
Blanket drag

LADDER RESCUES

SLIDING AN UNCONSCIOUS VICTIM DOWN A LADDER

Generally this evolution, illustrated in Figure 13, is started from a crotch-hold position. The rescuer unlocks his own leg, works up until his arms are beneath the victim's armpits, grasps the rungs in front of the victim's face, while the rescuer's knee is beneath the victim's crotch. The victim's feet are positioned outside the beams and he is slowly slid down the ladder. The rescuer should be backed up by an extra man.

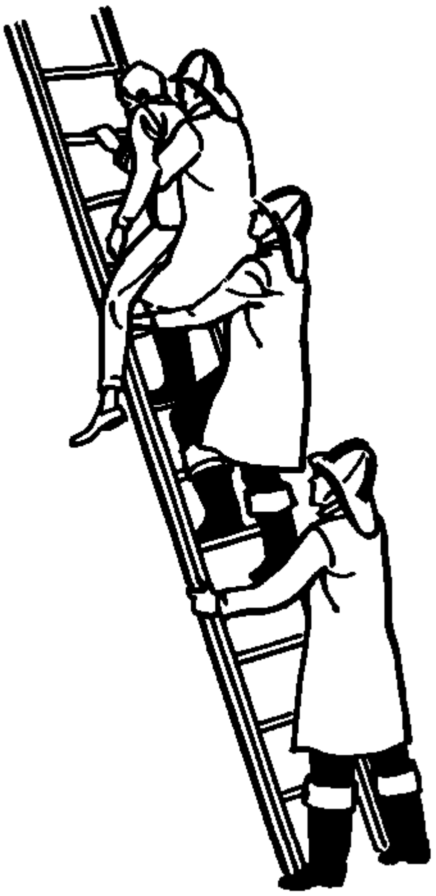


Figure 13

Sliding an unconscious victim down a ladder

WALKING A VICTIM DOWN A LADDER

As shown in Figure 14, this evolution is executed by taking a position immediately behind and parallel to the victim, but one rung below him. Place the arms around the victim's body below the armpits and grasp a rung. Using one rung at a time, descend slowly. As a precautionary measure the rescuer should keep one knee between the victim's legs to prevent him from sliding through.

Figure 14

Walking a victim down a ladder

WALKING A WOMAN OR CHILD DOWN A LADDER

This evolution differs from the preceding method because the rescuer's knee is not placed between the legs of the woman or child. The rescuer's arms are placed around the victim's body below the armpits. The resucer graps the rung immediately below the rung the victim is grasping. He comes down slowly, descending one rung at a time.

Figure 15 shows the proper way to walk a victim down an aerial ladder.

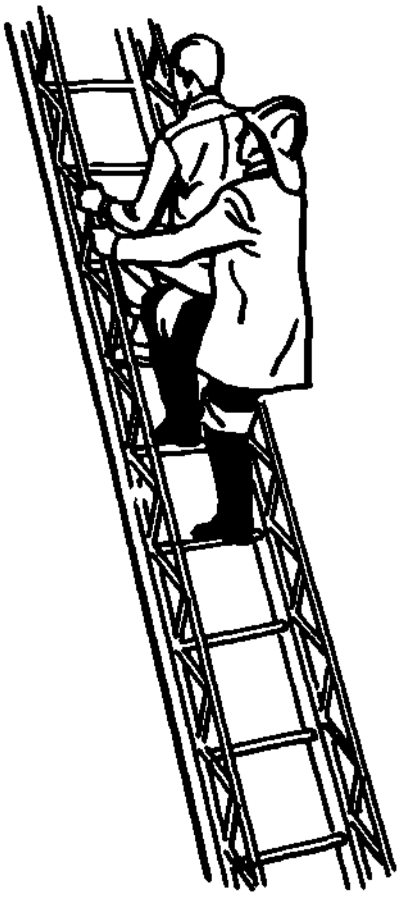


Figure 15

Walking a victim down an aerial ladder

SLIDING A VICTIM DOWN A LADDER)ER ACROSS ARMS

The rescuer who is to slide the victim down the ladder stands on the ladder just below the door, window, or roof, grasping the ladder with both hands on the underside of the beams. The other rescuer places the victim across the first rescuer's arms, as shown in Figure 16a. The first rescuer then descends the ladder one step at a time with the victim's buttocks resting on each rung of the ladder during descent. The rescuer's hands are slid along the underside of the beam. The rescuer on the ladder should be backed up by an extra man. See Figure 16b.

Figure 16A

Figure 16B

Sliding a victim down a ladder across arms

CARE OF VICTIMS AFTER RESCUE

NEED FOR SPECIAL CARE

The persons referred to in this section are those taken from or removed from danger who are not injured. Care should be taken to prevent persons who have escaped from a burning building from re-entering to obtain clothing or other possessions left in the building if the conditions are such as to endanger their lives or interfere with fire-fighting operations. Many times, rescue is a difficult and dangerous operation even for trained and experienced firemen or squadmen. Therefore, care must be exercised by squadmen to prevent untrained persons from exposing themselves to unnecessary danger

The duty of the rescue squad does not always end after persons are brought to a place of safety. Infants, children, the sick and the aged all need care and supervision after being brought to safety.

CARE OF INFANTS

When infants are subjected to a sudden drop in temperature after being removed from a heated building, they are likely to incur pneumonia or some other illness. The rescuer should protect them by being sure that they are properly covered and their face protected. They should, if possible, be delivered to some competent person who will see that proper care is given to them.

CARE OF CHILDREN

If left on their own, children may wander around a fire area and become injured. They may even re-enter a burning building seeking a toy or something left behind. For these reasons, they should always be placed in the custody of a competent person who will give them proper care and protection.

CARE OF THE SICK

People taken from a sick bed may suffer a relapse causing the illness to become worse. If the illness is not contagious, refuge for them may be found in a neighbor's home. If the sickness is contagious, provisions must be made as soon as possible to have the patient sent to a hospital. A heated garage may provide temporary shelter, but attendance and care must be given to the patient until removed to the hospital. As a precaution, as few squadmen as are absolutely necessary should expose themselves to a contagious disease. Those squadmen that were exposed should receive a doctor's attention and their clothing should be treated to prevent the spread of the disease. Since not all hospitals will admit contagious cases, the squad should prepare itself for this emergency by listing hospitals or agencies that will accept such cases. Refer to section on contagious diseases on page 62.

CARE OF THE AGED

On many occasions, aged people have lost their lives after being taken to safety. Not realizing the danger, they re-enter the involved building for their possessions which might have been only a picture, the contents of a dresser drawer or some other object they have had for a long period of time. If possible, squadmen should bring these cherished objects out with the person. In every case, however, after rescue the person should be placed in the custody of competent persons.

ROPE SLIDE

On some occasions ladders or other tools are not available and the squadman must use a rope slide to save himself and/or the victim.

PLACING THE SLIDING ROPE IN SERVICE

The rope is either carried to the roof or upper story of a building or pulled up with the aid of a small line such as used on the life gun which shoots the line to the upper story or roof.

Fasten one end of the sliding rope to some solid object within the building or on the roof. It should be tied at the same level as the edge of the roof or window sill over which it is passing, and directly above the center of the window from which the slide is to be made. Place a pad, such as a coat, under the rope where it passes over these edges to prevent damage to the rope. Be positive that the sliding rope is long enough to reach the ground or a place of safety. The following method is used to slide the rope with the hands and feet.

1. Stand erect in window if possible.
2. Grasp the rope with both hands high above the head and pull on rope. This will test the rope and take the slack and stretch out of it.
3. Still pulling with the hands, and with the lower part of the rope hanging down in front of the body between the legs, pass the right leg forward on the right side of the rope, backward on the left side of the rope, and forward on the right side again, far enough that the rope is hanging down on the inside of the instep of the right foot. See Figure 17a.
4. Extend the right leg out of the window just below the sill and suspend the full body weight with the hands and at the same time pass the left foot under the right foot and press it tightly to the outside of the right foot. Elevate toes of the left foot and lower toes of the right foot. See Figure 17b.
5. By pressing the feet together enough friction is created to hold a man stationary. By releasing the pressure slightly he can slide slowly and safely down the rope. Do not slide hands on rope but use hand-over-hand method. If the rope slips out from between the feet while sliding, suspend the body by the hands and work the rope back to proper position with the feet.
6. When getting on a sliding rope from the level where the rope is secured, as from a roof top, grasp the rope with both hands and lie on the stomach, over the rope, with the lower part of the body hanging down over the roof ledge. Work the rope into position as shown in Figure 17b and then lower yourself over the edge with the hands until you are in proper position for the slide.

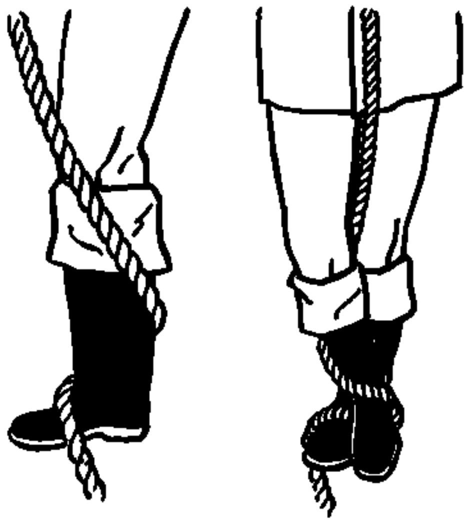


Figure 17A **Figure 17B**

Foot positions on sliding rope

TO SLIDE ROPE WITH A LIFE BELT-ONE MAN

Strap a life belt snugly about the waist (not so tight as to cause discomfort) with the buckles on the left side and the hook hanging directly in front. Put a leather sliding glove on the right hand. Stand erect in the window, facing the outside. Grasp the sliding rope with both hands, above the head, and pull down hard to test the rope for security and to take out some of the stretch.

Reach down with the gloved hand (right) and take hold of the rope just above the knees and raise it to about the level of the waist to give enough slack to work with. Hold the rope in the palm of the right hand, thumb up. Raise the life belt hook with the left hand so that it is pointing upward. Still holding the rope in the palm, grasp the base of the hook with the right hand and hold them firmly together just above the waist. The hinged or opening part of the hook should be on the left. Grasp the rope a bit above the hook with the left hand, thumb pointing down. See Figure 18a.

Looking at the left hand from underneath, wrap the rope clockwise one and a half turns around the hook, forcing the rope to the inside of the hook through the hinged part each time. The rope will be entwined one complete turn about the hook on its right side. See Figure 18h.

Hold the left side of the hook with the left hand and, with the right hand on the rope below the hook, pull the rope through until all the slack is out of the rope above.

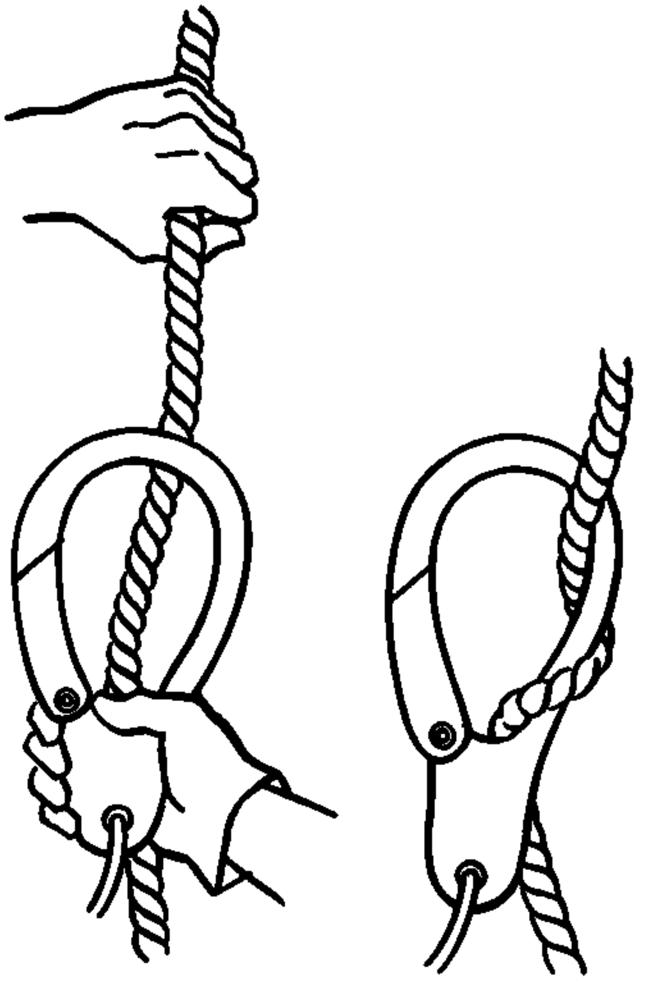


Figure 18A **Figure 18B**

One-man slide

Grasp the rope with the gloved right hand, thumb up; straighten the right arm and move it around to the rear of the body and hold the hand (thumb side toward the body) pressed firmly against the center of the buttocks. Have the rope gripped tightly and pulled taut around the right hip.

Remove the left hand from the hook. Bend slightly at the knees and allow the rope to suspend part of the body weight. Turn to the right until the back is to the outside and at the same time ease down until the body is suspended entirely by the rope and the legs are holding the body out from the building with the feet resting against the edge of the sill.

When ready to descend, kick out away from the building slightly and ease the right hand grip on the rope just enough to allow the rope to slide through the hand. The speed of descent is controlled by the amount of friction created by the righthand grip. To slow up or stop sliding it is only necessary to grip the rope more tightly.

During the slide keep facing the building. Keep the left hand off the rope and hook. Use the left hand and the feet to keep from striking the building during the descent. It may be necessary to kick out from the building several times on the way down, depending on the length of the slide and speed of descent.

Should the right hand become dislodged from its position in the rear of the body and be pulled up to or near the hook, stop at the most convenient place, such as the next lower sill, and work it back into position.

When the ground is reached, bend at the knees and allow the hook to slide down the rope as low as possible; then stand erect. By holding the hinged part of the hook open with the right hand, the rope is removed from the hook with the left hand, in reverse of the manner of putting it on.

Not more than one sliding life belt can be in use on one rope at one time.

TO SLIDE ROPE WITH A LIFE BELT - TWO MEN

Although no more than one life belt can be in use on the rope at one time, it is possible for two men to descend the rope at the same time. This is performed as follows:

They can both start the slide from the same window, or one man can start from above and pick the other man up at a lower level.

If both men are to slide from the same window, the first man wraps the rope two and a half turns around the hook instead of one and a half. See Figure 19. This extra turn is necessary to create enough friction for the added weight of the second man. He then gets into position with his back toward the outside and his feet holding himself out away from the building the same as in the one-man slide.

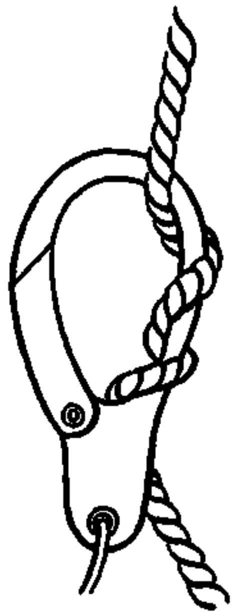


Figure 19

Two-man slide

When the first man is in position, the second man sits on the sill with his legs out the window and between the legs of the first man.

The second man holds onto the first man's belt toward the front with his left hand; with his right hand he snaps his own life belt hook into the ring at the base of the first man's hook. Then he holds onto the first man's belt with his right hand and holds his head and shoulders in close to the first man's waist.

He then eases himself out the window, off the sill, until he is entirely suspended by his hook from the first man.

As he eases himself out off the sill, the first man kicks out away from the building and they descend to the ground in the same manner as in the one-man slide. The second man may also assist in protecting both of them from striking the building during descent if necessary.

If the first man is to pick the second man up at a lower window, he gets on the rope and slides down to that window the same as in the one-man slide. He stands erect in that window, facing the outside, gets the necessary slack in the rope, places the extra turn around the hook, and takes the position with his back to the outside again. The second man then hooks onto the first man as previously described and they descend to the ground.

Upon reaching the ground the second man unhooks from the first man; then the first man stands erect and removes the rope from his hook.

A 5/8" cotton braided rope is recommended for this evolution.

RADIATION RESCUE

The atomic age promises many benefits to man, but with these benefits come added responsibilities and dangers to the squad service -- namely, to protect the public and squadmen from the dangers of radiation and contamination. More information on this subject will be found in Chapter 26 of the Ohio Fire Service Training Manual.

In case of an emergency where radioactive material is present, the victim must be removed from the area with as little contact with the rescuer as possible. The rescuer may use the clothes drag, a pike pole, or a rope effectively to remove the victim to a safe place. He should take any necessary measures to save life, but carry out a minimum amount of first aid until a doctor can be called to the scene. A squadman's protections against radiation are time, distance, shielding, and gas masks.

CHAPTER XV

AERIAL LADDER RESCUE PROCEDURES

INTRODUCTION

There are rescues in which the squadmen are unable to bring the victim up from a low place or down from a high spot in the usual way. Roofs of buildings and the bottoms of cliffs are two examples of such locations. In many such situations, where conventional rescue procedures are unsafe, the skillful use of an aerial ladder and appropriate rigging will permit squadmen to reach and rescue a victim with minimum risk.

If on arrival squadmen find that an aerial ladder will be needed, it should be sent for immediately. The squad should be prepared for this kind of emergency by learning the location of all aerial ladders that can be summoned to the area that the squad serves.

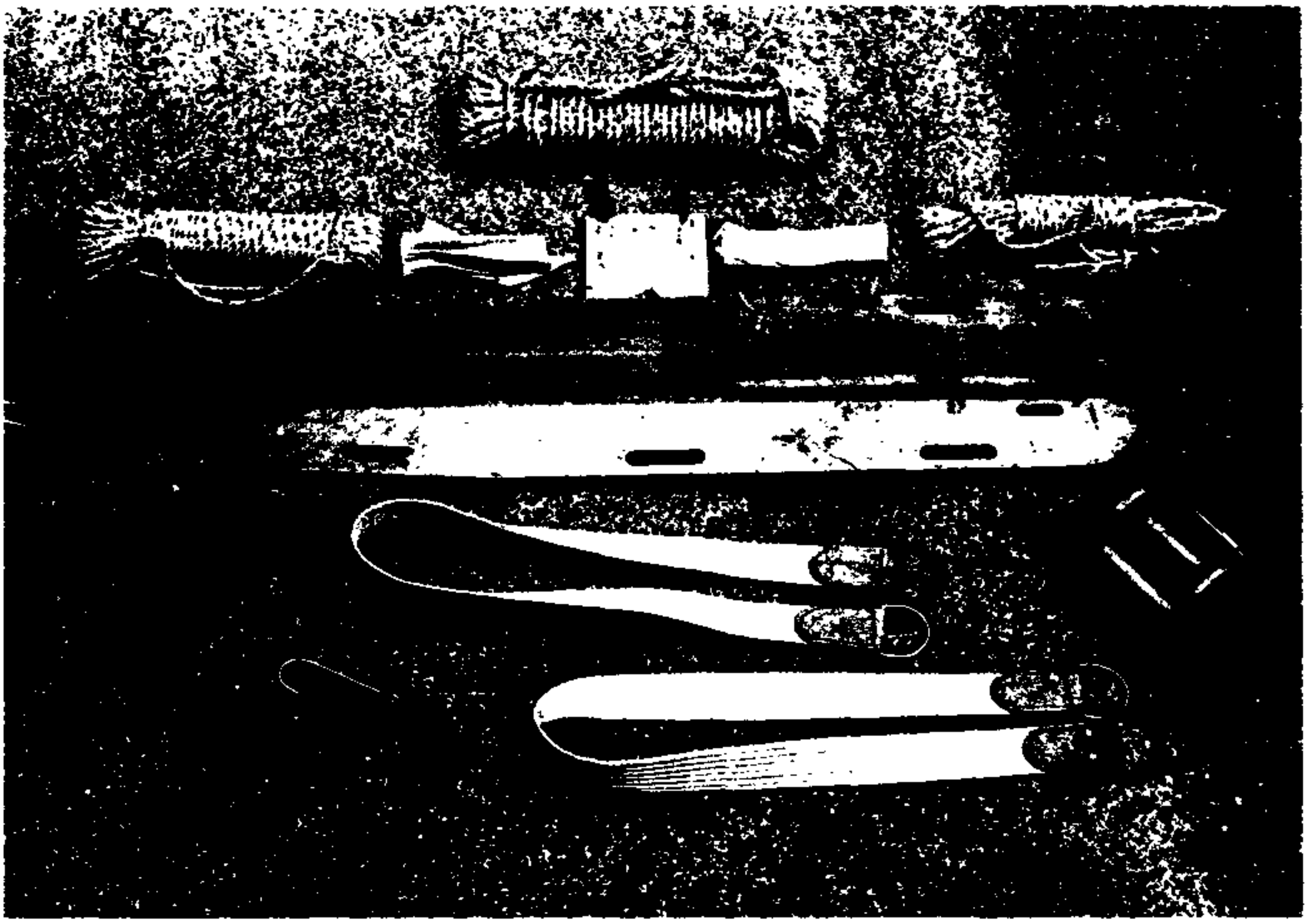
EQUIPMENT

The equipment needed for aerial ladder rescue includes:

1	Backboard and footrest
2	Long web belts (7-foot)
3	Leather straps
1	Blanket
2	Triangle bandages
1	Hose roller
2	1/4-inch or 1/2-inch ropes
1	5/8-inch rope

Some departments carry all this special equipment in a particular part of their rescue truck or ladder truck. Some even make a special container for the equipment, so it can be taken up a ladder easily and quickly.

Figure 1 (next page) shows the basic equipment. Figure 15 at the end of this chapter shows specifications for a rescue belt.



Courtesy Sharon Twp. F.D., Worthington, O.

Figure 1

Equipment needed for aerial ladder rescues

PROCEDURE

One squadman should be in charge of the whole rescue procedure. In the case of a roof-top operation, he directs from the roof.

PREPARING THE VICTIM

Any needed first aid should be given to the victim immediately. Then he should be logrolled onto a backboard, as shown in Chapter XIII of this text. He must be strapped to the board before the ladder rescue procedure is carried out, with his feet secured to the footrest. Figure 14 in Chapter XIII shows a patient properly secured to a backboard.

USING THE LADDER

The use of an aerial ladder rescue truck for both horizontal and vertical rescues is described and pictured on the pages that follow.

When the ladder truck arrives, the turntable should be lined up with the center of the victim's body. This can be directed by a squadman who places himself where he can be seen easily by the truck driver. All obstacles such as wires, trees, etc. should be observed by both the squadman in charge on the roof and the officer in charge of the ladder truck.

As soon as the truck is positioned, the outriggers should be placed. The fly of the ladder should be extended four rungs while still in the bed.

The hose roller is then secured to the top rung of the ladder as shown in Figure 2.

One end of the large rope is tied to the top rung of the ladder with a clove hitch. (See Figure 3.) The remainder of the rope is brought down the center of the ladder and put on the turntable or ground.

Courtesy Sharon Twp. F.D., Worthington, O.

Figure 2

Securing a hose roller to the top rung of an aerial ladder.

Courtesy Sharon Twp. F.D., Worthington, O.

Figure 3

Hose roller and large rope in place on top rung.

At the direction of the man in charge (on the roof in this example) the ladder is extended to him. (See Figure 4.) The top rung of the ladder is brought directly over the victim. Meanwhile, squad members are preparing the victim on the board. (See Figure 5.)

Courtesy Sharon Twp. F.D., Worthington, O.

Figure 4

Courtesy Sharon Twp. F.D., Worthington, O.

Figure 5

The man operating the ladder cannot see the victim. He must be completely directed from above. Figure 4 shows the ladder fly as he extends it toward the man in charge. The ladder is directed up until it is positioned squarely over the middle of the victim. (See Figure 5.) Note the squadmen preparing the victim.

After the victim is secured to the board, the two large web belts are put through the top and bottom holes on the side of the board. (See Figure 6.)

Courtesy Sharon Twp. F.D., Worthington, O.

Figure 6

Large belts in place. In order to show all straps and their placement, the victim in this posed picture was not wrapped in a blanket as he would have been in an actual rescue.

The large rope is now removed from the top rung, placed over the hose roller, and put through all four "D" rings of the large web belts. (See Figure 7.)

Courtesy Sharon Twp. F.D., Worthington, O.

Figure 7

Large rope placed through "D" rings.

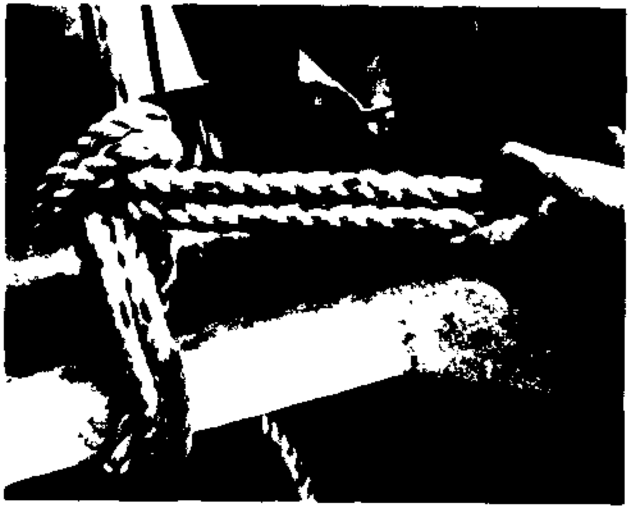
A bowline and a half hitch are then placed in the rope. (See Figure 8.)

Courtesy Sharon Twp. F.D., Worthington, O.

Figure 8

Bowline and half hitch

The men of the ladder company then pull up all the slack possible and tie the rope doubled to the metal foot bar or plate at the bottom of the ladder. (See Figure 9.)



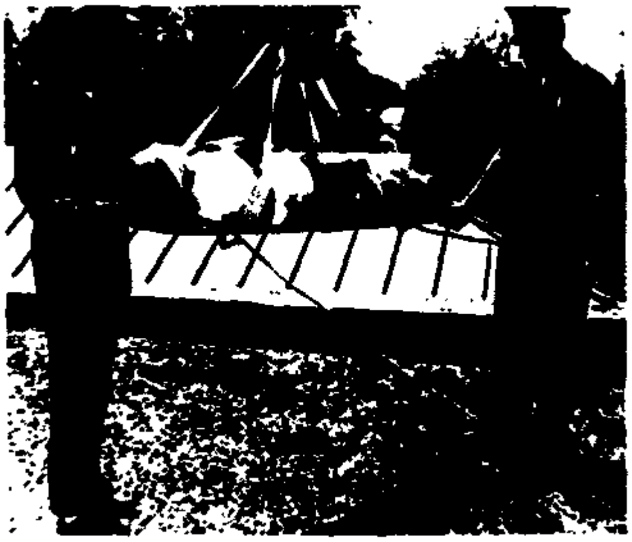
Courtesy Sharon Twp. F.D., Worthington, O.

Figure 9

Tie at bottom bar or plate

Then the fly is extended or the ladder is raised, whichever is best for the particular rescue. This is continued until the victim is lifted three to four feet from the surface. (See Figure 10.) Then the lifting procedure is stopped. This is to test all knots.

The two small ropes are put through the same holes as the large belts, and are thrown over the side of the building to two laddermen. (See Figure 10.) These ropes guide the board and prevent undue movement. The ladder is retracted or the turntable is rotated, or both, until the victim is free of the building and all obstacles. (See Figure 11.)



Courtesy Sharon Twp. F.D., Worthington, O.

Figure 10

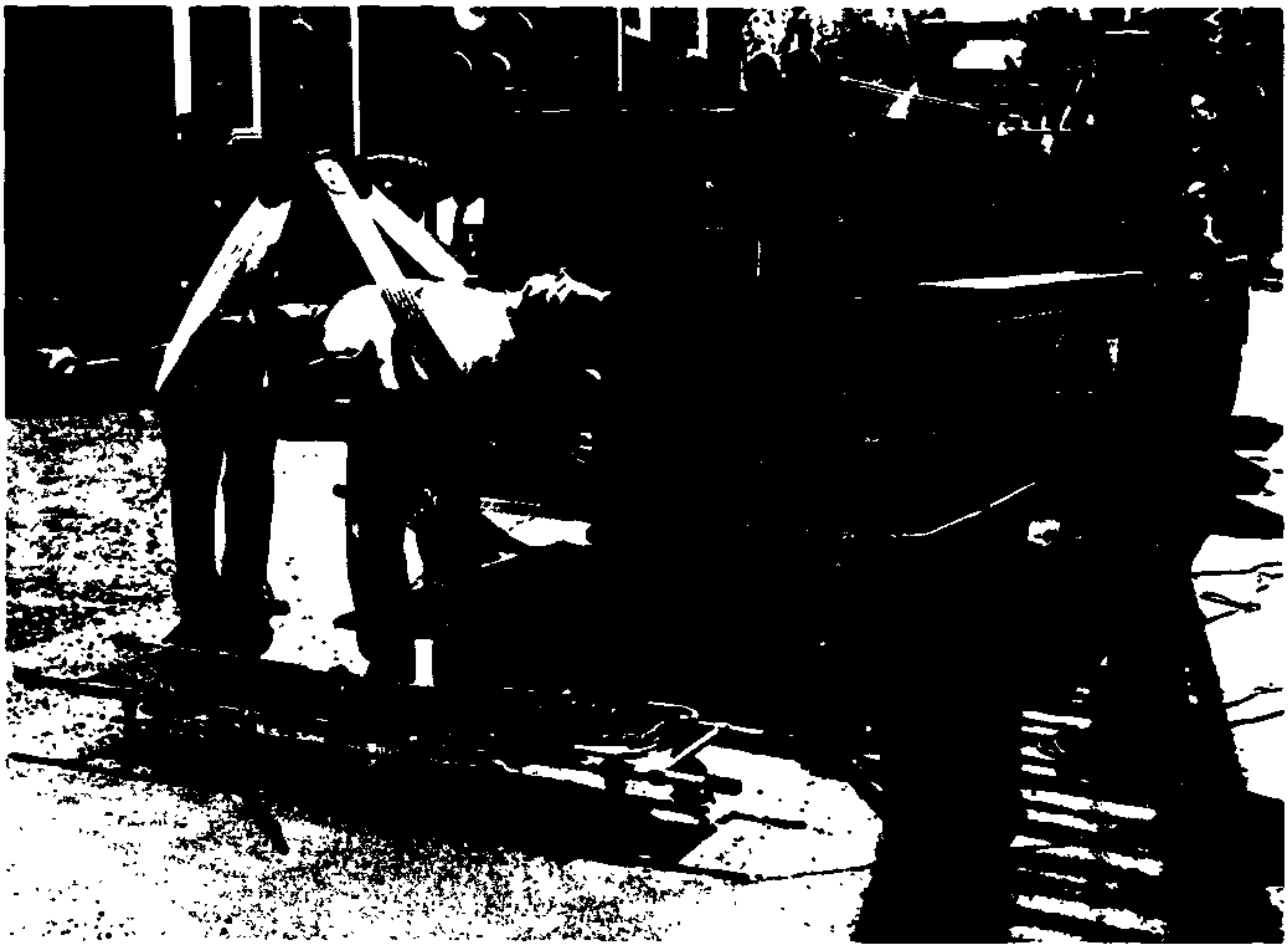
Testing knots and placing guide ropes

Courtesy Sharon Twp. F.D., Worthington, O.

Figure 11

Victim is lifted free of all obstacles and lowered toward the ground.

The procedure can become so smooth with practice that the stretcher can be placed on the ground and the ladder operator can deliver the victim to it. (See Figure 12.)



Courtesy Sharon Twp. F.D., Worthington, O.

Figure 12

Experienced rescue team lowers victim directly onto waiting stretcher.

VERTICAL RESCUE POSITION

Sometimes in an aerial ladder rescue a victim must be removed in a vertical position. In this case first aid is given and the victim is strapped to a backboard, as previously described. The ladder crew prepare as they would for a horizontal rescue procedure. The rope placement is different. After the fly is brought to a position over the victim, the large rope is put through the top two hand holes in the board. It is most important that the rope is placed with the knot to the front of the board. (See Figure 13.)

Courtesy Sharon Twp. F.D., Worthington, O.

Figure 13

Correct knotting of large rope for moving victim in vertical position

After the board is raised three to four feet off the surface, guide ropes are placed at the bottom holes of the board. The two truck men can then control the board. (See Figure 14.)

Courtesy Sharon Twp. F.D., Worthington, O.

Figure 14

Guiding descent of victim by means of ropes through bottom backboard holes

RESCUE BELT

Figure 15 shows specifications for a rescue belt that an emergency squad can make.

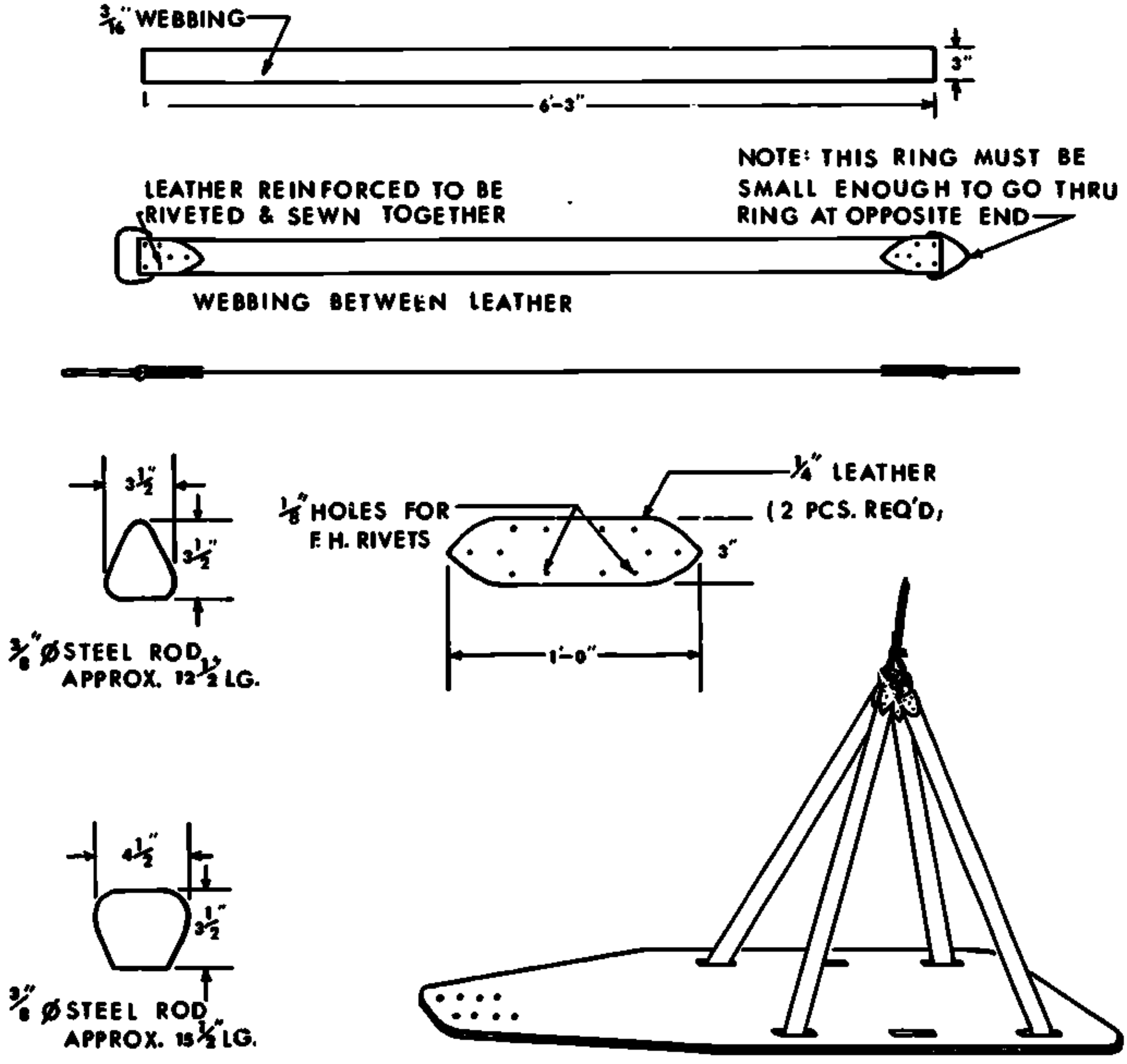


Figure 15

Rescue belt

PRACTICE

Both these procedures must be practiced often. Your squad and ladder companies can become proficient to the point of being able to complete them in just a few moments.

If your squad does not have a ladder company, you should practice with the ladder company nearest you so that victims will receive prompt, safe care.

CHAPTER XVI

FORCIBLE ENTRY

INTRODUCTION

Squadmen must have means of getting into a building that is closed and locked. Admission sometimes must be gained by forcible entry. A building is entered forcibly only when all accessible doors and windows are locked and it is impossible to enter the building through normal means. This chapter explains the different methods of forcible entry and the ways of using the tools of the rescue squad in making a forced entry. The knowledge of how to use them is invaluable when the squadmen, upon arrival, find the normal entrance into the building either blocked or locked. Efficient methods of forcible entry can save property, reduce hazards to life, and create good public relations. Forcible entry tools are a "must" for every emergency or rescue squad.

MAKING ENTRY BY BREAKING GLASS

Glass in either a door or window may be broken easily by using the flat side of a fire axe. The man breaking the glass should stand to one side and strike the upper part of the glass first, as shown in Figure 1. In this way, broken glass cannot slide down the axe bandle and cut the hands.

After the glass is broken out, all jagged pieces should be removed from the sash starting at the top to avoid injury. This may be done with the pick end of the axe. Removing all pieces will avoid cutting the man who enters through the sash and will prevent damage to hose, ropes or other material that may be passed through the opening. This procedure is recommended where any difficulty is encountered in opening windows, whether in a factory, residence, or commercial building. When encountering wire glass, cut at the edge of the sash with the cutting edge of the axe.

Figure 1
Making entry by breaking glass

MAKING ENTRY THROUGH VARIOUS TYPE OF DOORS

Doors are constructed of various materials and are of various types. Examples of some types are the ledge panel, slab, double sliding, single sliding, overhead lift, overhead roll and revolving doors.

Some types of steel doors offer great resistance to forcible entry. Every squad should know, by previous inspections, where these types of doors are located; the men should be instructed as to how to open them. It is often advisable to find other means of entry if possible. It should be emphasized that in gaining entrance, glass is the most easily broken material and, in most cases, the most easily replaced.

Single-hinged doors that open out may be opened from the swing side with an axe, as shown in Figure 2. The blade of the axe is inserted between the jamb and the door, just above or below the lock. By prying with the handle to one side away from the door, the jamb can usually be sprung enough to let the lock bolt pass under the keeper. The Kelly tool may also be used for this purpose (Figure 3). The Buster bar or Hux bar may be used for prying open a door in a manner similar to the Kelly tool. Either the straight or the cross head of this tool may be used where a door is near a partition, permitting a better leverage with the tool.

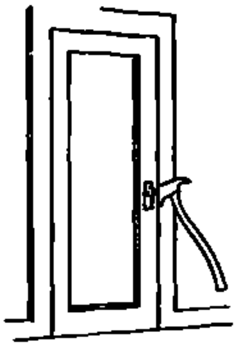


Figure 2
Opening door with axe

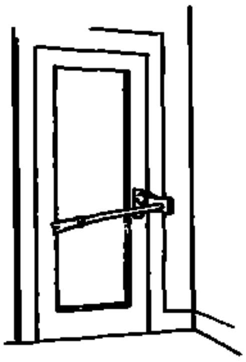


Figure 3
Opening door with Kelly tool

In opening a door that swings in from the operator, greater difficulties are presented. If the door is in a stopped frame, the straight head of the Kelly tool may be inserted between the door and the jamb (Figure 4). Then prying toward the door should spring it past the lock bolt.

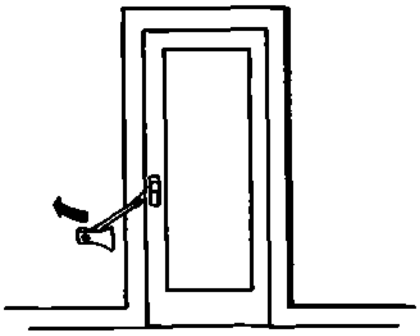


Figure 4
Kelly tool used for door that swings in

If the door is in a rabbeted frame, there is little chance of springing the frame. The cross head of the Kelly tool may be inserted between the door and the jamb as shown in Figure 5; prying against the door will break the door, the jamb or the lock. <u>If the door has glass in it, it is better to break the glass and manipulate the lock from the inside</u>.

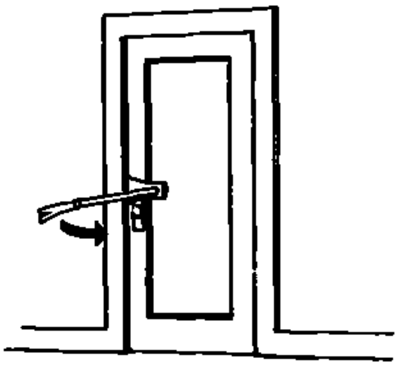


Figure 5
Kelly tool used for rabbeted jamb

The Detroit door opener may be used for forcing doors in, as shown in Figure 6, by either breaking the door or spreading the jambs. Double-hinged doors may be opened either with an axe or with the Kelly tool, as shown in Figure 7.

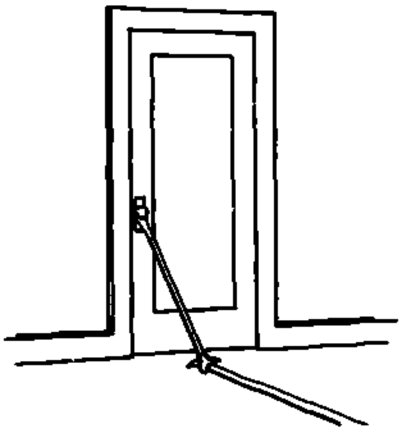


Figure 6

Using "Detroit" door opener

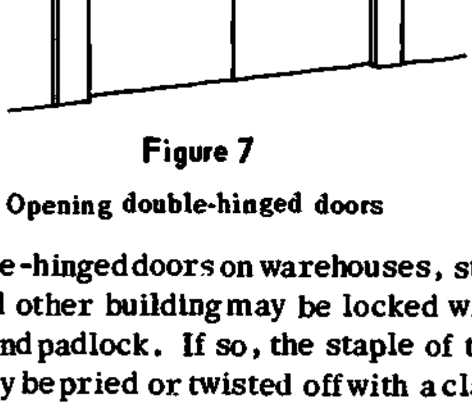


Figure 7

Opening double-hinged doors

Single-hinged doors on warehouses, stables and other building may be locked with a hasp and padlock. If so, the staple of the hasp may be pried or twisted off with a claw tool such as shown in Figure 8. The point of the claw is inserted in the staple end and if a pry will not remove it, it may be twisted off, taking the lock with it.

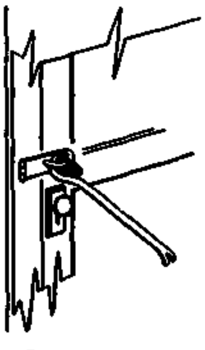


Figure 8

Prying off staple

Overhead lift doors are easily operated once the lock is released. Generally, they are locked with sliding bars that must be broken or sprung to release the door. Overhead lift doors may be forced by prying upward at the bottom of the door with a crow bar, claw tool, or other good prying tool. Once the lock bar is broken, the door will open easily. Overhead rolling doors are made of steel and offer the greatest resistance of all to forcible entry. Since an overhead door is operated with a worm gear, the door cannot be raised except by operating the worm with the chain which is provided. Prying the door is liable to spring it so that it cannot be operated even with the worm gear. The only alternative is to knock out bricks along side of the door, making a hole large enough to operate the chain.

If doors are locked so securely that no other method of forcing them is successful, they should be battered in. This may be done with a battering ram. Use the blunt end of the ram and see that it strikes just below the lock, on the rail or solid portion of the door.

The only means of forcible entry through a solid glass door is a sharp pointed tool, such as an axe point. Using this point, hit the lower corner of the door a hard blow. This will cause the door to shatter and permit entry. Caution must be taken to protect the eyes and other exposed portions of the body from the shattering glass. It is a good practice to back up to the door.

MAKING ENTRY THROUGH VARIOUS TYPES OF WINDOWS

Residence windows are of these general types: sliding, awning type, double hung, casement and basement. The double hung window consists of two sashes that meet horizontally. If the sashes are hung with weights, they will be locked at the center of the check rail; that is, the upper and lower sash will be locked together. If the window has no weights, the sash will be locked with bolts in the window sill.

Casement sash are hinged to the window jambs and meet vertically. They are either locked together or each is locked to the window frame. Basement sash generally are hinged at the top and locked at the bottom, or vice versa. Factory-type windows are generally constructed with metal sash. The sash is set solidly in the frame and only part of it may be opened (Figure 9). The movable part is generally pivoted at the center and latched on the inside.

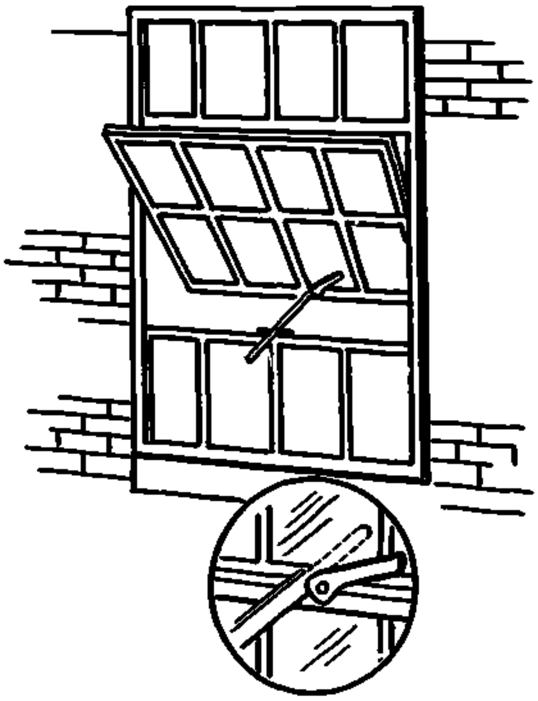


Figure 9

Factory-type windows

Double-hung windows may be opened by prying upward on the lower sash rail. See Figure 10. If they are locked on the check rail, the screws of the lock will give and the sash will operate. If they are locked with bolts, the bolts must be broken or bent before the sash will rise. Caution should be taken that the prying is done at the center of the sash, or else the glass may be broken.

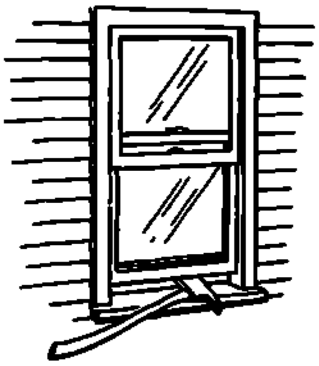


Figure 10

Opening double-hung windows

Casement windows may be opened in the same manner as double doors. See Figure 11. Generally, they are locked quite securely and it may be necessary to break the glass.

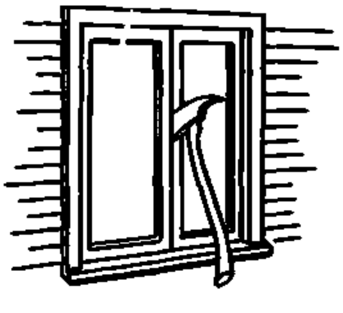


Figure 11

Opening casement windows

Casement windows may be opened with a Kelly tool, much the same as a door in a rabbeted frame. If the prying is done at the center of the lower rail, the lock may be pulled off or sprung. Any of the prying tools such as the Buster Bar or Hux Bar may be used. Chisels, spanners, etc., can be used for prying in this same manner.

FACTORY WINDOWS

It is practically impossible to open factory-type windows from the outside and, since they are glazed with small size glass, it is easier and less destructive to break a glass near the latch and reach in to unfasten it.

STORM DOORS AND STORM WINDOWS

There has been much discussion on the proper procedure to follow when encountering locked storm doors and windows. The wooden doors or windows, in most instances, can be pried open without too much difficulty and little or no damage to the wood itself. When encountering metal storm doors or windows, the general procedure is to break the glass to open the locked door or window. In this instance, remember to remove the broken glass from the frame before putting the hand through to unlock the door or window. It is not recommended that the metal storm door or window be pried open because of the costly damage to the metal framing.

MAKING ENTRY FROM ROOF

Quite often this means of entry becomes necessary. If the roof covering is of tin, the rotating or can-opener type of roof cutter is used. After the metal has been cut and rolled back, the squadman proceeds with his cutting of roof boards to gain entrance. Tar paper, tar and/or gravel should be removed before the cutting procedure. Any hole, whether it be in a floor, roof or wall, should be cut properly --- as though it had been done by a mechanic --- by a squadman who knows how to do the job.

When cutting with a fire axe, the axe should not be swung as a wood cutter would use it, but with short quick strokes. Figure 12 shows the method of holding the axe when cutting. By using this method, danger of hitting other men, catching the axe in overhead obstructions, and other such hazards will be avoided and the axe will be under complete control at all times.

Figure 12

Holding the axe to cut floor hole

When cutting flooring, roofing or sheathing, the cut should be made diagonally to the grain of the wood of each board, rather than straight across. Figure 13 shows the method to use.

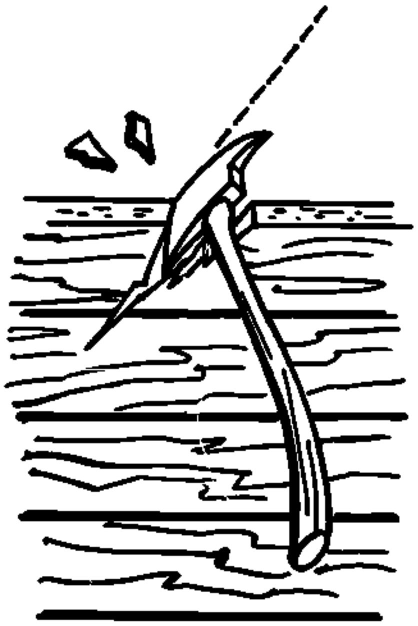


Figure 13
Cutting across wood grain diagonally

Diagonal sheathing should be cut when possible in the direction toward which it runs. When cut in this manner, the chips have a tendency to split out, while if the cutting is done across the grain of the sheathing, the axe is apt to bind and extra effort will be required to achieve results. Wherever possible, the cutting should be sloped at an angle of 45° to the board instead of vertically. This will provide a firmer base to cut against. Also. cut as close to a joist or rafter as possible.

In cutting roof boards always stand on the windward side of the boards to be cut, then cut along the inside edge of the roof rafter. In cutting holes to a size wider than one span of rafters, the center rafter or rafters will hold the boards in place until all cuts are completed. All cutting must be completed before any boards are removed. When the cutting has been completed, again standing on the windward side, use the pick end of the axe or pike pole to rip up the boards, starting at a point farthest away from you.

A squadman should be able to cut either right- or left-handed. Cutting in difficult corners and under obstructions can be done in a workmanlike manner by men who have been trained in the proper way to use a fire axe. Good axes and good axemen are important to efficient squad operations.

In some cases a pike pole may be needed to remove plaster and lath from the ceiling below the place at which the hole has been cut in the roof. (Figure 14).

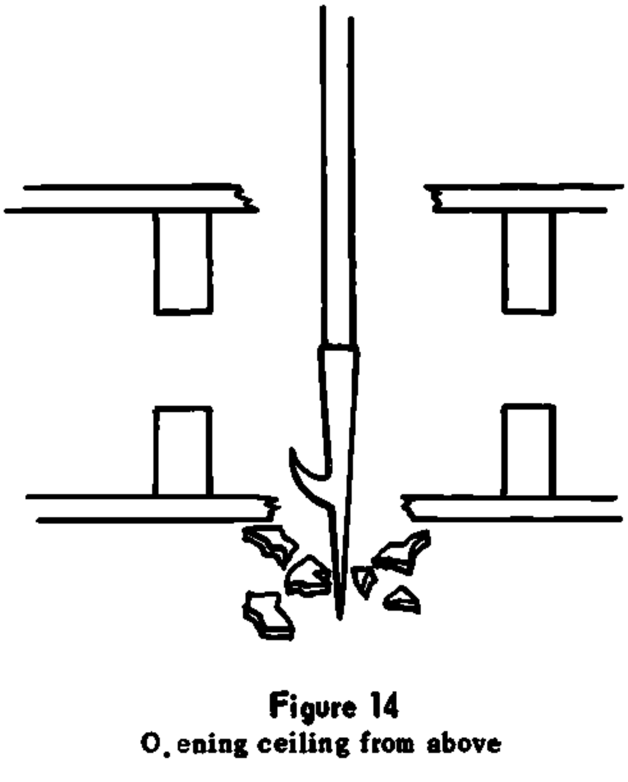


Figure 14
O,ening ceiling from above

MAKING ENTRY THROUGH SKYLIGHT, COCK LOFT, OR SCUTTLE HOLE COVER

In making forcible entry through a skylight a pick-headed axe is often used. The point is placed beneath the edge of the frame (Figure 15). Prying action produced by pulling on the axe handle exerts pressure to raise the edge of the frame. If the skylight is not raised readily, it is advisable to break the glass, remove broken glass, reach inside, and release hooks or bolts. For removal of cock loft cover or scuttle hole cover, the same prying procedure is used. If the cover does not remove readily, it must then be cut open by use of the cutting edge of the axe.

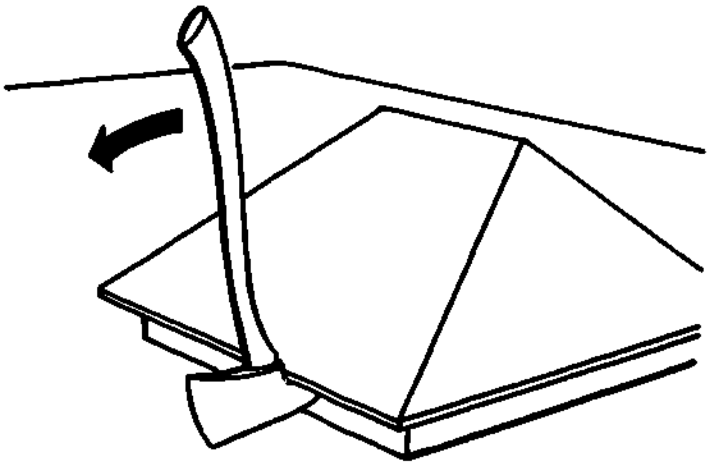


Figure 15
Making entry through a skylight

MAKING ENTRY THROUGH GRATINGS, DEAD LIGHTS, AND BARRED WINDOWS

Iron gratings may be fastened in several different ways. They may be merely held in position by friction of the grating against the sill or they may be pivoted on hinges at the rear. They may also be set in masonry and locked in position with hasp and padlock. They may be opened by using the pick end of the axe, forcing it between the sill and the grating and prying up, care being exercised not to break the axe handle.

Dead lights are placed in sidewalks under which basements extend. They serve both as a sidewalk and as a ceiling for that part of the basement. They contain heavy glass discs which permit light to enter and are sealed into a steel framework with waterproof material. The steel framework is likewise sealed into the concrete, and to remove the dead light the seal must be broken. Any good, sharp prying tool may be used for this purpose. After the seal is broken the dead light may be lifted and removed.

Iron bars on windows are usually set in masonry. The sledge hammer can be used to free bars set in masonry by striking the bar with the sledge about ten inches above the sill until the bar is sufficiently bent for removal. Another method is to strike the masonry sill with the sledge directly in front of the bar, breaking away the masonry.

MAKING ENTRY BY BREACHING WALLS

To breach brick walls with the battering ram, (Figure 16), first remove one brick with the hammer head pick, pick-headed axe, sledge or other suitable tool. After the first brick has been removed, two men grasp the handles on each side of the ram, with the forked end toward the wall. They swing the ram back at arm's length, then quickly thrust it against the wall, giving it a slight lifting motion just as it strikes the brick. Remove the bricks one at a time, starting just below where the first brick was removed. The hole should be made diamond-shaped as this does not weaken the wall.

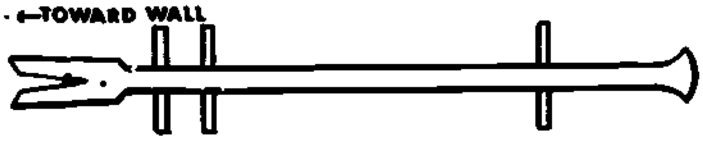


Figure 16
Battering ram

MAKING ENTRY THROUGH OPENINGS IN PARTITIONS AND CEILINGS

When cutting a hole in a partition, care should be taken to make it as neat as possible. Spread a tarpaulin on the floor beneath the place where the hole is to be made; then, with the blade of an axe, cut down along the stud. Do not tear off the lath, as this will make a ragged edge and ruin the plaster on both sides of the hole. See Figure 17.

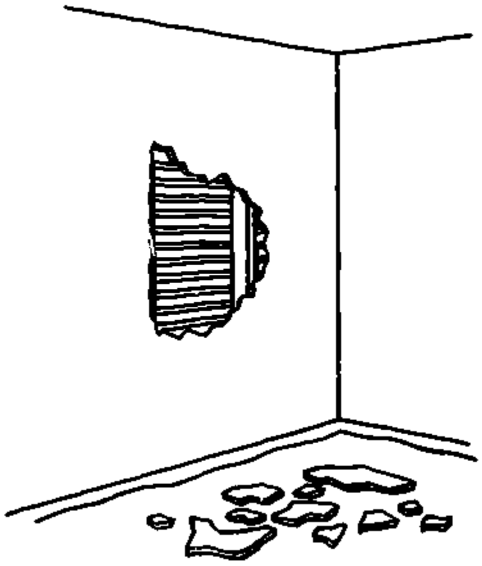


Figure 17A
Cutting through partition walls: correct method

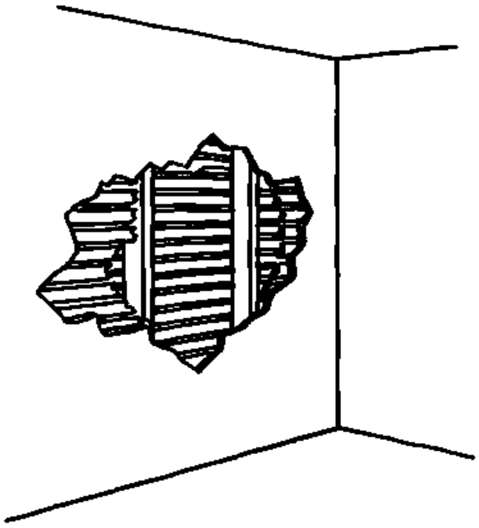


Figure 17B
Incorrect method

To open ceilings from below, the pike pole or the plaster hook (Figure 18) is used.

Figure 18
Plaster hook

When pulling down lath and plaster from ceilings and walls with a pike pole, never stand directly beneath the hook after the point and hook have been driven through the plaster. The hook on the pike pole should be pointed down and away from the squadman while pulling down the ceiling. This will prevent the lath and plaster from falling on the squadman. See Figure 19.

When metal lath has been used in the construction of a room or office, the operation of pulling down the plaster with a pike pole is often extremely hazardous. The metal lath is usually suspended from the rafter by means of soft iron wire, and when a portion of the plaster is pulled with the pike pole, the weight of the plaster will often cause a whole section, or sometimes several sections, to drop. For this reason it is important that a squadman, when pulling plaster from a ceiling known to be plastered on metal lath, be close to an open door or window that will enable a hasty, unobstructed retreat from the room if necessary. Several cases of injury have occurred because this precaution was not observed.

In pulling down metal ceilings, the pike pole is particularly effective. The point is driven through the ceiling with the hook pointing downward and the operator standing well away from beneath the section of metal to be torn down (Figure 20).

Figure 19
Pulling down lath and plaster from ceiling with pike pole

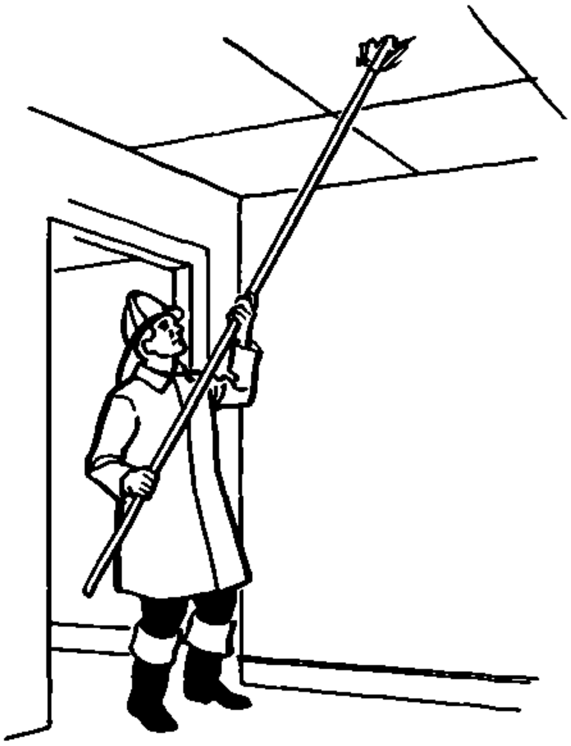


Figure 20
Pulling down metal ceiling: the pike pole can be used like a can opener to cut through sheet metal

When removing sheet metal from a ceiling with a pike pole, if the metal holds tight, the hook part of the pole can be used as the fulcrum for prying the metal loose. The same principle can be applied in removing sheet metal from roofs.

The point of a pick-headed axe or a hammer-headed pick can also be used for pulling off lath and plaster from walls in an emergency.

CHAPTER XVII

GAS MASKS

INTRODUCTION

Although a gas mask is not the most commonly used piece of equipment carried on an emergency vehicle, it can without reservation be considered the most important. Too often the life of a rescuer has been sacrificed in an effort to rescue someone trapped or overcome in a gas-filled area because the rescuer did not protect his respiratory system while attempting the rescue. In this modern age of chemicals, plastics, refrigerants, industrial processes, and developments, protecting those who must operate in these atmospheres during emergencies is a fundamental duty.

It would be impossible to list or discuss every hazardous gas encountered today. A few of the most common with which the squadman may come in contact are described in chart form on the following pages. (See Figure 1.) This chart indicates certain properties, characteristics, effects, and treatment with which the squadman should become familiar.

In addition to the hazard caused by a poisonous gas, squadmen must be aware of the possible explosion hazard. If there is doubt as to whether or not the gas involved is explosive, every precaution must be taken to prevent a spark. Light switches should not be turned on or off. Equipment or tools made of ferrous metals should be handled so as not to make sparks.

It is suggested that emergency squad personnel survey the industrial, manufacturing, and commercial areas of their community, to determine whether any additional hazardous gases may be encountered.

In cooperation with the chemists, engineers, or other responsible persons in charge of these operations, a supplementary chart can be prepared and used for reference. This is an excellent way to gain good public relations with the people in your community. They will be pleased to help when they learn of your interest in their safety and welfare.

Section 3737.31 of the Ohio Revised Code requires self-contained oxygen breathing apparatus in each fire department operated by a political subdivision. The applicable section of the law is reproduced below:

> (A) "Gas mask" means any self-contained oxygen breathing apparatus using oxygen or air in suitable containers that enable their wearers to live in atmosphere containing less than sixteen percent oxygen and poisonous gases in excess of two percent by volume and having been approved by the United States Bureau of Mines for use in irrespirable atmosphere.
>
> (B) Every political subdivision which operates a fire department shall provide at least two gas masks for each fire station and shall further provide that the chief of the fire department give adequate instructions to each member of the fire department in the use of such gas masks.

GAS AND RADIATION HAZARDS

One of the fundamental rules of squad work should be that no one, unless equipped with self-contained or self-generating air supplying apparatus, be allowed in an involved area. The ordinary filter-type mask will stop the passage of toxic fire gases such as ammonia or carbon monoxide not exceeding 2% by volume, but the masks are definitely not suitable for conditions where a deficiency of oxygen exists.

Providing for the life and safety of squadmen should be a paramount responsibility of the officers in charge. In addition to the duty of training the men in the use of respiratory equipment, the officers should see that squadmen use this equipment whenever and wherever necessary.

In recent years, another hazard has been added to the problem; that is, the use of atomic energy in the various areas of our industrial, commercial and educational structure. It is predicted that this problem will become more and more complicated because of the widespread use of radioactive materials.

Instructions from the U.S. Atomic Energy Commission relative to radiation hazards state, "Masks should be worn from the time of arrival at the emergency where radiation contamination hazard exists, until the hazard no longer exists." Preference indicated as to the type of mask to be worn in such a situation is the self-contained unit.

POISONOUS GASES

It would be impossible to list or discuss every hazardous gas encountered today. A few of the most common with which squadmen may come in contact are shown on the chart, Figure 1. This chart indicates for each gas its specific properties, characteristics, effects, and treatments with which squadmen should become familiar.

It is suggested that squads make a survey of the community to determine any additional hazardous gases which could be encountered in industrial, mercantile or commercial areas. Then in cooperation with the chemists, engineers or other responsible persons in charge of these operations, a supplementary chart can be prepared and also used for reference. This would be an excellent method by which to gain good public relations with the people in the community. The community will be pleased to cooperate when informed that the emergency squad is interested in the community's safety and welfare.

THE EXPLOSION HAZARD

In addition to the hazard caused by a poisonous gas, squadmen must also be aware of the potential explosion hazard involving some of these gases. If in doubt as to whether or not the gas is explosive, every precaution must be taken to prevent a spark. Light switches should not be turned on or off. Equipment and tools made of ferrous metals should be handled carefully so as not to create sparks.

TYPES AND USES OF GAS MASKS

In general, respiratory protective equipment is classified as follows: (1) the filter-type canister mask, (2) mask supplied with air or oxygen from an outside source, and (3) self-contained breathing apparatus. Each of these types of masks is designed for protection of the respiratory tract. It should be kept in mind, however, that for many gases protection of the respiratory tract is not enough, since some gases may harm the body on contact. For these gases it is necessary to wear protective clothing in addition to the proper respiratory protection.

GAS	WHERE FOUND OR USED	WEIGHT COMPARED WITH AIR	VISIBLE?	ODOR	TASTE?
Acetylene	Welding shops and factories	Lighter	No	Sweet	No
Ammonia	Large cooling plants	Lighter	No	Yes	Yes
Carbon Monoxide	Result of incomplete combustion	Lighter	No	Usually not noticed	No
Chlorine	Purification plants laundries	Heavier	Yes: greenish-yellow	Pungent	Yes
Hydrogen Cyanide	Exterminating buildings	Lighter	No	Bitter almond	Yes
Hydrogen Sulphide	Cesspools	Heavier	No	Rotten eggs	Yes
Methyl Chloride	Refrigeration	Lighter	No	Yes	No
Natural and Bottled Gas	Home and industrial use	Lighter	No	Yes	No
Nitrous Oxide Fumes	Fires and electrical welding	Heavier	Yes: deep orange	Pungent	Yes
Phosgene	Dry cleaners and fires	Heavier	No	New hay	No
Sulphur Dioxide	Bleaching and fumigating	Heavier	No	Bitter	Acid

Figure 1 Poisonous gases and their properties

WILL BURN SKIN?	WILL BURN EYES?	WILL BURN THROAT?	ACTION AND EFFECT ON VICTIM	EXPLOSIVE OR FLAMMABLE?	REMOVE FROM CAUSE AND TREAT FOR-
No	No	Yes	Slow or delayed	Yes	Shortness of breath or asphyxia; shock
Yes	Yes	Yes	Quick and delayed	Yes	Shortness of breath or asphyxia; shock; eye irritation; burns
No	No	No	Quick	Yes	Shortness of breath or asphyxia; shock. Keep victim inert.
Yes	Yes	Yes	Quick and delayed	No	Shortness of breath or asphyxia; shock; eye irritation; burns
No	No	No	Quick	Yes	Shortness of breath or asphyxia; shock
No	Yes	Yes	Quick	Yes	Shortness of breath or asphyxia; shock; eye irritation
No	No	No	Slow and delayed	No	Shortness of breath or asphyxia; shock
No	No	No	Quick	Yes	Shortness of breath or asphyxia; shock
No	No	No	Slow and delayed	Yes	Shortness of breath or asphyxia; shock
No	Yes	Yes	Slow and delayed	No	Shortness of breath or asphyxia; shock; eye irritation. Keep victim inert.
No	Yes	Yes	Quick	No	Shortness of breath or asphyxia; shock

FILTER-TYPE CANISTER MASKS

The filter-type canister mask is designed to provide protection against some kinds of smoke and poisonous gases, including carbon monoxide. Models are manufactured by several firms. It should be borne in mind, however, that all filter-type models have definite limitations. They can be worn only in atmospheres containing sufficient oxygen to support life.

The best way to detect a dangerous deficiency of oxygen is to observe the flame of a safety lamp. The flame will go out when the oxygen content of the atmosphere falls below sixteen percent. A man should not enter or remain in an atmosphere in which a flame will not burn unless he is protected by a self-contained or supplied-air or oxygen breathing apparatus. Although the use of the flame safety lamp is recommended, active combustion is an indication of sufficient oxygen to support life.

Another limitation of the filter-type masks is that they cannot be worn in atmospheres containing more than two percent by volume of poisonous gases. In addition, heavy-bodied smoke, such as that given off from burning plastic, will clog or gum the intake and interior of the canister. This causes the mask to be inoperative.

CANISTER MASK WITH TIMER

The major parts of a filter-type canister mask with a timer are: (1) the canister, with harness and carrying case; (2) the facepiece, with headbands and flexible tubing; and (3) the timer. See Figure 2.

Courtesy Mine Safety Appliances Co.

Figure 2

All-service mask

Canister - The smoke-type canister is painted red. A canister painted any other color is designed for a definite and specific group of gases. The red canister is approved for two hours of constant or intermittent use for protection from carbon monoxide. When working where carbon monoxide is present, there is a tendency for the canister to become warm. The degree of warmth will depend upon the concentration of the gas. This is due to the fact that while the chemical is acting as a catalyst in changing the carbon monoxide to carbon dioxide, heat is formed. Canisters should be stored in a cool, dry place. Seals should never be removed from a canister until it is put into service. After a canister has been put into service, it should be replaced at least once a year, even though never used.

When the mask is to be assembled, the canister is prepared for service by removing the seals. The canister can be tested by inhaling and exhaling; remember that inhalation is possible only from the top opening and exhalation into the bottom opening. An audible click will indicate that these valves are opening and closing properly.

Facepiece - The facepiece must be cleaned after wearing. The inside should be sterilized by cleaning thoroughly with a germicidal solution such as aqueous Zephiran P.750 solution, or Staphene solution.

Headbands must be maintained in good working order. Broken or defective bands must be replaced. A facepiece with a defective band should not be used; it can not be adjusted to fit the wearer's face properly.

The flexible tubing must be examined carefully for cuts or breaks. Any impairment or defect in this tubing may jeopardize the safety and protection of the wearer.

Timer - This device indicates approximately how long the mask can be worn safely. It is actuated by the respirations of the user. The pointer rotates on a dial face. It makes a complete revolution in approximately two hours of continuous or intermittent service. After the pointer has made one complete revolution, the canister must be removed and a fresh one inserted.

The timer is connected to the canister, and the facepiece is connected to the timer. In assembling the mask, it must be made certain that the gaskets are in place at both couplings. The facepiece is then fitted to the wearer by adjusting the headbands. At this point it should be tested for airtightness by holding a hand over the opening in the bottom of the canister and inhaling. If there is no leakage the facepiece will collapse and the mask is ready for use.

In the past, the timer has been used as an indicator to show approximately two hours of breathing time. This period coincided with the Bureau of Mines requirement that the canister must contain enough drying agents to adequately protect the catalyst (Hopcalite) from water vapor during a two-hour period of use. Since the life of the canister for protection against carbon monoxide is directly related to the ability of the canister to remove water vapor, it follows that the canister will protect against carbon monoxide for a two-hour period.

Although the Bureau of Mines test for two hours of protection against water vapor is a realistic test, there are extreme conditions which will render an approved canister ineffective against water vapor absorption in less than two hours. Some of these conditions are as follows:

1. Relative humidity exposure greater than 85%, particularly at elevated temperatures.
2. Extended periods of high demand (over 25 liters per minute) of continuous breathing by a person having a large breathing capacity and performing strenuous work in atmosphere of high relative humidity.
3. Exposure of the canister to modern techniques of fire fighting where "Wet Water" and fog are used. These techniques greatly increase the amount of water vapor dispersed in the air compared with that encountered by previous techniques.
4. Accidental introduction of water into the canister by a fire hose, squadmen crawling through water on a floor, failure to completely dry the facepiece and breathing tube prior to assembling the breathing tube to the canister, or failure to replace the top and bottom seals of the canister after each use.

CANISTER MASK WITH WINDOW INDICATOR

The major parts of a window-indicator type of filter canister masks are: (1) the canister, with harness and carrying case; (2) the facepiece with headbands and flexible tubing; and (3) the check valve.

One model contains a round glass window located in the center of the canister, approximately one-third of the way down from the top of the canister. See Figure 3.

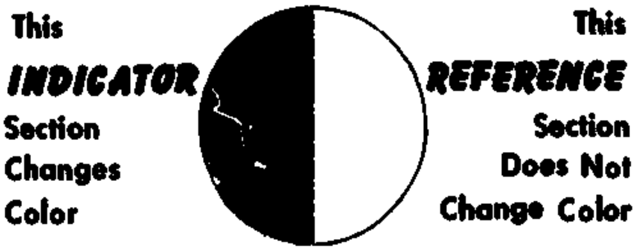


Figure 3

Indicator paper inside glass window of the canister

Inside the glass window are two half circles of paper. The right half, stamped "R" (facing the canister) is the reference color and is a very light blue. The left half is the indicator paper which is a darker blue. When the indicator half of the paper fades to a blue which approaches the color of the reference half, the canister is to be discarded since it will no longer effectively oxidize carbon monoxide to carbon dioxide. The color difference between the panels will exist as long as the canister has not absorbed enough water vapor to render the "Hopcalite" ineffective against carbon monoxide. Once excessive moisture has penetrated the "Hopcalite" the colors of the panels will match and the canister must be discarded. The color match should be observed under fluorescent lights or natural daylight when possible.

In the window-indicator canister a check valve fits into the assembly formerly occupied by the timer. The check valve assembly is threaded top and bottom to provide a positive attachment to the canister and the breathing tube. The valve will provide an effective seal at all times against moisture entering the canister from the top. It closes automatically after each inhalation, regardless of the position of the canister. It remains closed, regardless of the position of the mask, in storage or maintenance. The threaded fitting at the top of the valve provides for disassembly of the breathing tube and facepiece for cleaning, while the valve remains on the canister guarding it against moisture penetration from the top. If all the water is not drained from the facepiece and tube after cleaning, the valve prevents the entry of the water into the canister.

The window-indicator type of canister will more accurately indicate the actual service time than will the timer type. It is imperative that the canister be kept as free of moisture as possible to obtain maximum service life. The check-valve assembly eliminates the necessity of replacing the rubber formerly used.

PUTTING ON THE FILTER TYPE CANISTER MASK

Suspend the mask on the chest by means of the neck strap. Next, tighten the body strap so that the canister is drawn snugly against the chest. Check to make sure the headband straps are fully extended. Then grip the facepiece between thumb and fingers as illustrated in Figure 4.

Courtesy Mine Safety Appliances Co.

Figure 4

Putting on mask

Insert chin well into lower part of facepiece, and pull headbands back over the head. To obtain a firm and comfortable fit against the face at all points, adjust headbands as follows:

1. See that straps lie flat against head.
2. Tighten lower or "neck" straps.
3. Tighten the "side" straps. (Do not touch forehead or "front" straps).
4. Place both hands on headband pad and position it on the crown of the head.
5. Repeat operations 2 and 3.
6. Tighten forehead or "front" straps as needed.

PRECAUTIONS AND PRACTICES

1. Do not enter any contaminated atmosphere with this mask unless you know all of the following are true:
   a. Canister is of a filter type, Bureau of Mines approved.
   b. Concentration of the contaminants does not exceed the concentration for which the canister is approved.
   c. Amount of oxygen is sufficient; that is, at least 16% oxygen.
   d. Mask does not leak.
   e. Canister does not need replacing.
2. Register the date the canister is placed in service.
3. Keep a record on the time the mask is used.

NOTE: There is a popular misconception that filter-type canisters will afford two hours of protection against 2% concentrations of all kinds of gases; this is not true. The statement applies only to protection against carbon monoxide. The Bureau of Mines Approval Schedule #14 E requires a man-test service life of only 25 minutes in 2% concentrations of organic vapors, and only 15 minutes for 2% concentrations of acid gases or 3% concentrations of ammonia. Naturally, in lower concentrations longer life can be expected. However, the filter-type smoke canister, just like the filter-type industrial canister, must be replaced as soon as organic vapors, acid gases or ammonia penetrate the facepiece and are detected by the senses.

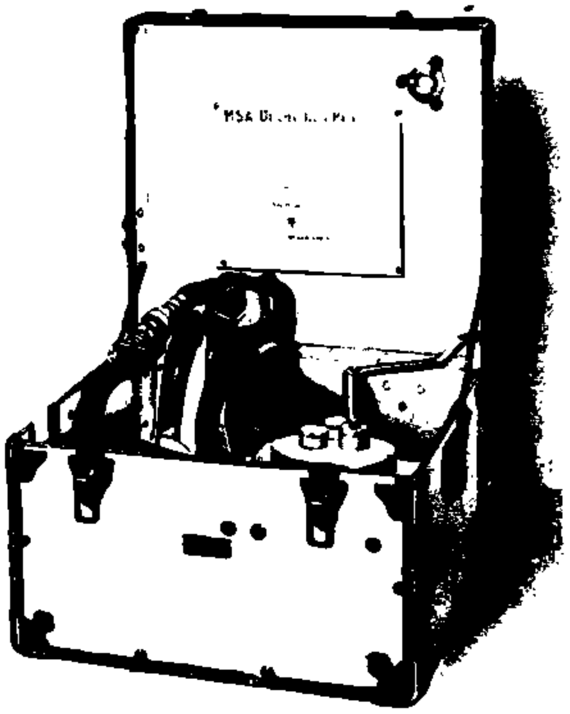
4. The top and bottom seal on the timer-type canister, and the bottom seal only on the window-indicator-type canister, should be replaced after each use.
5. Squadmen using masks should always work in pairs.
6. It is more difficult to breathe when wearing this mask because the filter restricts the rate of air flow to the facepiece.

FRESH AIR OR HOSE MASKS

The fresh-air or hose mask is suitable for respiratory protection against all atmospherical contaminants. The air-line mask belongs to this category. Air-line masks depend entirely upon a mechanical air supply which is not carried by the wearer of the mask; therefore, the failure of such an air supply would prevent escape from deadly atmospheres.

The facepiece of the air-line mask is attached to an air system by a hose. Clean air is fed to the facepiece in sufficient quantity to provide the wearer with an adequate air supply. There is little or no resistance to inhalation, and surplus air usually provides a cooling and refreshing effect. The only disadvantage is the necessity of trailing the hose which is connected to the facepiece from the air source.

Figure 5 illustrates a typical hose-mask unit. The facepiece, harness, air hose and blower are usually packed in a trunk which serves to transport the equipment and to provide the blower operator with a convenient seat. The air hose must be highly resistant to petroleum liquids and vapors, and be able to withstand crushing weight. Heavy wire reinforcing is incorporated into the construction of the hose for this purpose. Up to 150 feet of hose can be used on this type of equipment. The air hose connection is supported on the body by means of a heavy-duty harness. The facepiece is of the full-face type and is connected to the air hose by means of flexible corrugated tubing.



Courtesy Mine Safety Appliances Co.

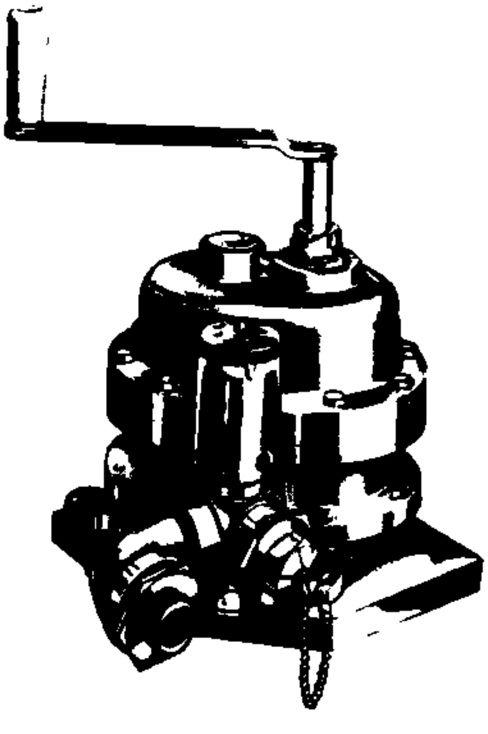
Figure 5

Typical hose mask assembly

There are two methods for supplying air to the mask. In the "constant flow" type, the breathable air is continuously fed to the facepiece. By this method there is always a slight positive pressure present in the facepiece to assure against inward leakage. Pressure is maintained by a compressor-system operated "blower". The blowers are of a low-pressure type, mostly of centrifugal design, and are available in various sizes depending upon the number of masks to be operated at any one time. The pressure on the air line should be maintained at respirable levels as recommended by the equipment manufacturer.

On U.S. Bureau of Mines approved air-line respirators, the manufacturer may specify any range of operating pressure up to a maximum of twenty-five pounds per square inch, as long as a sufficient amount of air is fed to the facepiece within the range specified. Pressure-reducing valves, as well as relief or blow-off valves, are used to control this factor. Precautions must be taken to make sure that a supply of clean air is available at the blower.

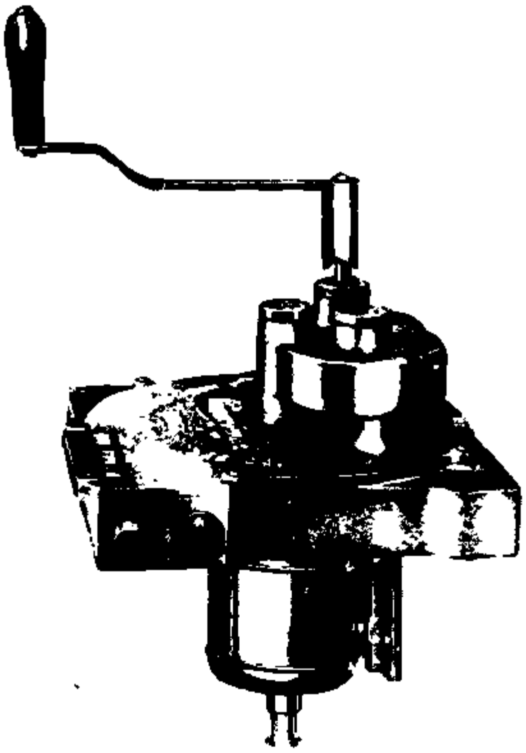
Figures 6 and 7 show two different styles of centrifugal blowers used to supply fresh air to the facepiece. Although combined motor and hand operated blowers are available, this type of unit is not approved by the U.S. Bureau of Mines.



Courtesy Mine Safety Appliances Co.

Figure 6

Centrifugal blower for fresh air mask



Courtesy Mine Safety Appliances Co.

Figure 7

Centrifugal blower for fresh air mask

In the "demand flow" type, a cylinder of compressed air or oxygen is used in place of the blower. By the inclusion of a small demand regulator, air is fed to the facepiece only upon inhalation of the wearer. The flow ceases upon exhalation. This conserves the air supply and permits one man several hours of service from a standard 220 cubic foot cylinder of air.

SELF-CONTAINED BREATHING APPARATUS

Self-contained breathing apparatus provides complete respiratory protection against any concentration of toxic gases, under any condition of oxygen deficiency. The wearer's breathing is independent of the surrounding atmosphere, since the wearer is breathing in a system in which no outside air is admitted, and the oxygen or air supply of the apparatus itself takes care of all respiratory requirements. Such devices enable men to work in places where they normally would not be able to stay alive. Self-contained breathing apparatus are divided into three basic types: (1) oxygen cylinder rebreathing apparatus, (2) demand-type apparatus, and (3) self-generating-type apparatus. Only two of these will be discussed here.

DEMAND-TYPE APPARATUS

All demand-type apparatus use the same principle of operation. However, some use compressed oxygen while others use compressed air.

Several different models are available. A man wearing the demand-type mask never inhales the atmosphere in which he is working. The man breathes oxygen or air supplied by a cylinder carried on the person. (See Figure 8) The flow of oxygen or air, regulated by the wearer's breathing, always assures sufficient protection. A pressure gauge indicating the amount of oxygen in the cylinder is generally provided within the wearer's view. The U.S. Bureau of Mines has issued approvals for the use of compressed air or oxygen in the different makes of masks. All are listed as one-quarter-hour and one-half-hour self-contained breathing apparatus, which indicates the length of time that the cylinders may be expected to last. The detailed instructions or information accompanying each type of mask must be carefully studied and followed before attempting to use it.

Courtesy Scott Aviation Corp.

Figure 8

Scott air pack

PUTTING ON DEMAND-TYPE APPARATUS

The following consecutive steps should be followed in putting on the apparatus before entering a toxic atmosphere:

1. Check the pressure gauge on the cylinder valve to insure that the cylinder is full (1800 p.s.i. on small units, 1980 on large units).

2. Put on the apparatus using either of the following methods; in either case caution must be used at all times to protect the regulator assembly from damage:
   a. Connect chest-strap buckle, leaving side strap unhooked; swing the apparatus over the head; and snap the side strap to the "D" ring. Fasten the waist belt snugly; pull the side straps until the apparatus is supported comfortably; and then tighten the chest strap as much as desired.
   b. Leaving the chest strap unbuckled, snap the side strap in place and put the apparatus on like a vest. First the left arm is inserted in the harness, then the right arm. Fasten the chest-strap buckle and the waist belt as securely as desired, then adjust the side straps snugly.

3. Open the cylinder valve handwheel fully (at least three turns) and close the bypass (red) handwheel on the demand regulator.

4. Open fully and lock open with the locking lever the main line (yellow) handwheel. Observe the pressure gauge on the demand regulator. The gauge indicates continually the pressure in the cylinder; it should read approximately 1800 p.s.i. on small units and 1980 p.s.i. on large units if fully charged. If there is less pressure in the cylinder, the service life will be reduced accordingly. Turn off the cylinder valve and watch the pressure gauge on the regulator. There should be no drop in pressure if the equipment is leak-tight. If there is noticeable deflection of the needle, the equipment should be checked and the leak corrected before entering a toxic atmosphere. Again open the cylinder valve handwheel fully and lock in place with the locking lever.

5. Put on the facepiece using the following method: Check to make sure the headband straps are fully extended. Then grip the facepiece between thumb and finger. Insert the chin into the facepiece and pull headbands back over the head. To obtain a firm and comfortable fit against the face at all points, adjust headbands as follows:
   a. See that straps lie flat against the head.
   b. Tighten lower or "neck" straps.
   c. Tighten side straps (do not adjust forehead or "front" straps).
   d. Place both hands on headband pad and position it on the crown of the head.
   e. Repeat operations b and c.
   f. Tighten forehead or "front" strap as needed.

   Check the tightness of the facepiece by sealing the breathing tube with the palm of hand and inhaling gently. The facepiece should collapse on the face if the seal is satisfactory. Connect mask hose to regulator before entering contaminated area. If the facepiece is left disconnected until ready to enter the toxic area, the breathing supply will be conserved to some extent. However, if the ambient temperature is low, the facepiece will tend to fog, but will not if connected to the demand regulator.

6. Breathe normally, as the apparatus automatically satisfies any breathing requirement.

PRECAUTIONS AND PRACTICES

The apparatus furnishes complete respiratory protection for a period of time governed by the amount of exertion, but approximately 15 minutes (small units) and 30 minutes (large units), at hard work. Therefore, it is necessary periodically to check the pressure gauge on the demand regulator, as it continually indicates the pressure in the cylinder. When the needle approaches the solid-colored section of the pressure gauge, always return to fresh air because the remaining 300 p.s.i. will last only two or three minutes in the small units, and only four minutes in the large units. During normal use the by-pass (red) valve is closed; it is used only if the automatic demand regulator becomes inoperative. It provides a continuous flow and should be opened first, the main line (yellow) handwheel closed, and the by-pass valve adjusted to provide the flow desired.

REMOVING THE MASK

1. Disconnect the mask hose from the regulator.
2. Remove the facepiece by grasping the snout, pulling down and out. then up over the head.
3. The headstraps should then be fully extended and the facepiece should be adequately cared for.
4. Unlock the lever on the cylinder valve and close the valve using normal pressure. This valve closes leak-tight with little effort.
5. Remove the apparatus from the body and place properly in carrying case.
6. Place facepiece in the proper place in the carrying case.

CARE OF BREATHING APPARATUS AT STATIONS

1. Sterilize facepiece by cleaning thoroughly with a germicidal solution such as aqueous Zephiran 1:750 solution or Staphene solution.
2. Replace cylinder:
   a. Disconnect the coupling nut of the high-pressure hose from the cylinder valve, using the open-end wrench provided with the apparatus.
   b. Release the cylinder clamp drawbolt and remove the cylinder.
   c. Replace cylinder with a fully charged one and connect the apparatus high-pressure hose, making certain that the regulator is positioned properly.
   d. Before putting in case, make sure the pressure is released from the regulator and hose by opening and closing the by-pass valve, making sure the main line (yellow) handwheel is locked open.
3. Place the apparatus in the case with the back plate flat at the bottom, folding the harness over the cylinder. Arrange the high-pressure hose so that it is not distorted, and put the facepiece on the side.
4. NEVER USE ANY LUBRICANT ON ANY PART OF THE APPARATUS, AND ALWAYS KEEP ALL PARTS ENTIRELY FREE FROM OIL AND GREASE.

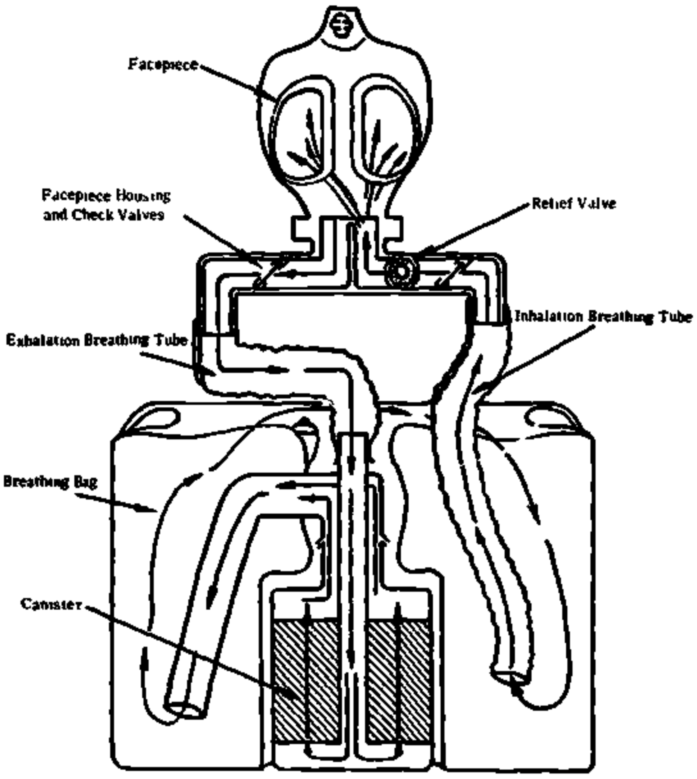
SELF-GENERATING OXYGEN MASK
FORTY-FIVE MINUTE

Unlike the conventional type of breathing apparatus which employes cylinders of oxygen or compressed air under high pressure, this apparatus evolves or generates its own oxygen. It operates independently of the outside air and provides complete respiratory protection in oxygen-deficient or highly gaseous atmospheres. The wearer breathes into the facepiece through the exhalation tube into the canister. The exhaled breath is purified of carbon dioxide and replenished with oxygen as it passes through the canister, and is then rebreathed. This mask provides protection for forty-five minutes. (See Figures 9 and 10).

Courtesy Mine Safety Appliances Co.

Figure 9

Chemox 45-minute mask



Courtesy Mine Safety Appliances Co.

Figure 10

Cross-section diagram of Chemox 45-minute mask

The apparatus consists of a facepiece, breathing tubes, breathing bag, breastplace, canister holder, harness straps and a manual timer, all focalized around a central casting just above the canister. The facepiece valve assembly, located immediately below the facepiece, is equipped with a pressure-relief valve. This is a one-way valve that acts as a manual pressure-release valve when the breathing bag becomes over-inflated. This assembly also contains the exhalation and inhalation valves which control the directional flow into and out of the breathing bag. The breathing bag serves as a reservoir for the evolved oxygen, and at the same time acts as a cooler for the air coming from the canister.

The chemicals in the canister purify the exhaled breath by absorbing the carbon dioxide and generating fresh oxygen for breathing. The resultant chemical action liberates considerable heat in the canister. The wearer is protected from this heat by insulation on the breastplate.

The chemicals in the canister are capable of releasing a high percentage of oxygen when they become damp from the moisture in the breath. The rate of release is governed by the amount of moisture introduced by breathing. For breathing purposes, the water vapor in the exhaled breath is sufficient to liberate enough oxygen for comfortable breathing. Any excess moisture that enters the canister will cause a sudden reaction and rapid liberation of oxygen. Therefore, do not introduce water into either a used or unused canister except to dispose of it, and then only in a manner which will be described later.

Courtesy Mine Safety Appliances Co.

Figure 11

Putting on apparatus

PUTTING ON SELF-GENERATING OXYGEN MASK

The following are the consecutive steps in putting on the apparatus before entering a toxic atmosphere. The apparatus must always be put on in fresh air.

1. Unfasten and straighten all harness straps.
2. With one hand, grasp the apparatus by the central casting and drop the facepiece over the hand holding the apparatus. With the other hand, grasp the D-ring assembly where the two large web straps join; place the breastplate of the canister holder on the chest and slip the head through the V-shaped opening formed by the two web straps. See Figure 11.
3. Continue to hold the apparatus on the chest with one hand, and with the other reach around the body at one side and grasp the free end of the web strap on that side. Bring the end of the strap under the arm and snap into the D-ring located on the top side of the breastplate. Repeat this procedure for the other strap.
4. Adjust the position of the apparatus on the body by means of metal slides located on the web harness straps. This adjustment can also be accomplished by twisting the straps to obtain the proper length. The position of the apparatus on the body should be such that when the facepiece is put on the breathing tubes will permit free head movement.

5. Attach the waist strap to the small D-ring located on the lower corner of the breastplate and pull to a snug fit. Then tuck in the waist strap loop.

6. Remove the metal tear-off cap of the canister by pulling the metal tab straight out, then straight back across the top of the cap, exposing the copper foil seal which is the air-tight seal for the canister. Make sure that the metal and cardboard discs are removed exposing the copper foil seal. (See Figure 12).

   Screw the handwheel down far enough for the bail to be swung outward, swing the bail outward and swing the canister fully into the canister holder with the smooth side toward the front. The canister should be inserted sufficiently so that the cooper foil seal is punctured and the rubber gasket fits snugly against the V-shaped recess in the plunger casting. Screw the handwheel clockwise until it is tight against the canister. The canister must be inserted with the smooth side to the front. See Figure 13.

Courtesy Mine Safety Appliances Co.

Figure 12

Removing metal tear-off cap of canister

Courtesy Mine Safety Appliances Co.

Figure 13

Inserting canister in apparatus

7. Pull out the facepiece straps so that the ends are at the buckles; grip facepiece between thumb and fingers. Insert chin well into the lower part of the facepiece and pull the headbands back over the head. See Figure 14.

Courtesy Mine Safety Appliances Co.

Figure 14

Putting on facepiece

Courtesy Loudonville, O., F.D.

Figure 15

Adjusting headband pad

To obtain a firm and comfortable fit against the facepiece at all points, adjust headbands as follows:

a. See that straps lie flat against head.
b. Tighten lower or "neck" straps.
c. Tighten the "side" straps. (Do not touch forehead or front straps).
d. Place both hands on headband pad and push it toward the neck. See Figure 15.
e. Repeat operations b and c.
f. Tighten forehead or "front" strap a few notches if necessary.
g. Check the tightness of the facepiece fit by squeezing the breathing tubes and inhaling. The facepiece should collapse on the face if the seal is satisfactory.

8. Squeeze both breathing tubes with one hand, and break the seal of the facepiece against the cheek with fingers of the other hand. Inhale; then releasing facepiece with breathing tubes, exhale into the apparatus. See Figure 16. <u>This must be done in fresh air</u>. Repeat this procedure until the breathing bag is inflated. In order to be certain the canister is generating oxygen, depress the pressure-relief valve and force the air from the breathing bag; then reinflate the breathing bag by the method described above. In cold weather, starting the proper chemical reaction in the apparatus will require more inhalations from the outside air, with exhalations into the canister. The best procedure is to continue alternately inflating the breathing bag fully, then deflating it with the elbows, until a total of about 15 exhalations have been put through the canister.

Courtesy Mine Safety Appliances Co.

Figure 16

Starting apparatus

9. To check the complete apparatus for tightness:

   a. Grasp the lower end of the inhalation (left) breathing tube and squeeze it tightly. Inhale. If the facepiece collapses the facepiece seal is tight enough and the exhalation valve is functioning properly. This will also test the upper part of the inhalation breathing tube for leaks.

   b. Continue to squeeze the lower end of the inhalation (left) breathing tube. Depress the pressure-relief valve button. It should then be possible to exhale through the valve. While holding the button down, inhale; if the facepiece collapses as above, the relief valve is functioning properly.

   c. Release the inhalation (left) tube and squeeze the lower end of the exhalation (right) breathing tube. Inhale and then exhale forcibly. The exhaled air should be forced out between the face and the facepiece only; this will indicate that the inhalation valve is functioning properly and the upper end of the exhalation tube is free of leaks.

   d. With the bag well inflated, grasp the upper ends of both breathing tubes and depress both sides of the breathing bag with the elbows. If the breathing bag does not deflate, the complete apparatus is airtight.

IF A LEAK OR DEFECT IS INDICATED IN ANY PART OF THE APPARATUS, IT SHOULD BE CHECKED AND THE CONDITION CORRECTED BEFORE USE.

10. Breathe normally; the apparatus will furnish enough oxygen to meet most breathing requirements.

11. Since the apparatus has a forty-five minute service life at hard work in an irrespirable atmosphere, it will be necessary to determine the length of time required to return to fresh air from the working place and set the timer accordingly. The timer dial is calibrated in minutes. Turn the pointer clockwise to the number of minutes left after deducting the time for exit; the timer will then be properly set. For example, if it will take ten minutes to return to fresh air, deduct ten minutes from forty-five and set the timer at thirty-five. The bell on the timer will ring when the pointer returns to zero, at which time the wearer has ten minutes to return to fresh air.

PRECAUTIONS AND PRACTICES

1. There is no need to purge nitrogen manually from this apparatus, since more oxygen is produced than will be used. To relieve excess pressure, depress the pressure-relief valve on the valve housing at the bottom of the facepiece.

2. In addition to the timer there are two other indications that the canister is becoming expended: fogging of the lenses on inhalation and increased resistance on exhalation. These two indications will not normally appear until after forty-five minutes of use, but under conditions of extreme hard work may become noticeable. The lenses will clear on inhalation until the canister is almost expended; then the lenses will begin to fog. Do not confuse excess breathing-bag pressure with canister resistance. If the pressure-relief valve relieves excess breathing-bag pressure, and exhalation resistance is still present, the canister is about expended. If either of these two indications appear, return to fresh air.

Courtesy Loudonville, O., F.D.

Figure 17A

AFTER USE

As soon as it is safe to remove the facepiece, this should be done by grasping it at the "snout" with the hand and pulling forward and upward off the head and face. (See Figures 17a and 17b.)

To remove the canister, turn the handwheel down, swing bail outward and remove the canister with the hand suitably protected by a glove or other covering, since the canister may be hot.

Courtesy Loudonville, O., F.D.

Figure 17B

Removing mask

Upon return to quarters, after the mask has been in service, the used canister may be disposed of as follows:

1. Allow the canister to cool. Ordinarily this will take place while returning to quarters.

2. Place the canister on the floor, smooth side up, and gash it with an axe that has been wiped clean of oils, greases or other materials. Two cuts can be made with the axe, one on each side of center. Keep your face away from the open canister; it contains caustic chemicals.

3. Place the canister in a bucket 2/3 full of clean water. When the chemical reaction or agitation stops, rinse the canister off with clean water. Pour the bucketful of water carefully down a sewer or drain. This water will now be a caustic solution and will irritate the skin if allowed to come into contact with it.

After use, the facepiece of the apparatus should be sterilized using a germicidal solution such as aqueous Zephiran 1:750 solution or Staphene solution. Allow the facepiece to hang down while cleaning, so no liquid enters the valve assembly or tubes. Immediately after sterilization, wipe the facepiece dry and replace on the apparatus for service.

GENERAL CARE

A canister should not be carried in the canister holder while it is in the carrying case. Each carrying case should contain two canisters and the mask at all times. When a canister has been removed from the canister holder it should not be used again. Care should also be taken that canisters do not come in contact with oils and greases: The chemicals in a canister are capable of generating and releasing highly concentrated oxygen that could start combustion.

Do not tie a rope to the D-ring on the harness strap of the mask.

The inhalation and exhalation check valves can be removed from the facepiece and breathing tube by disconnecting the toggle clamps, removing the breathing tubes, and sliding the valves out. The valves should be checked periodically for corrosion and replaced if necessary, These valves are marked "in" for inhalation and "ex" for exhalation, and should be inserted in the respective openings in reassembly.

This type of breathing apparatus should not be used under water, such as in pools, lakes or ponds.

As a part of the general care, there should be a periodic check of the plunger and plunger casting (the part which pierces the canister) for cleanliness and free movement of the plunger. The tightness of the apparatus should also be checked periodically, using the procedure outlined in 9 under "Putting On Self-Generating Oxygen Mask".

When any part shows evidence of failure, it should be replaced immediately with a new part. Damaged apparatus should be returned to the factory for repair.

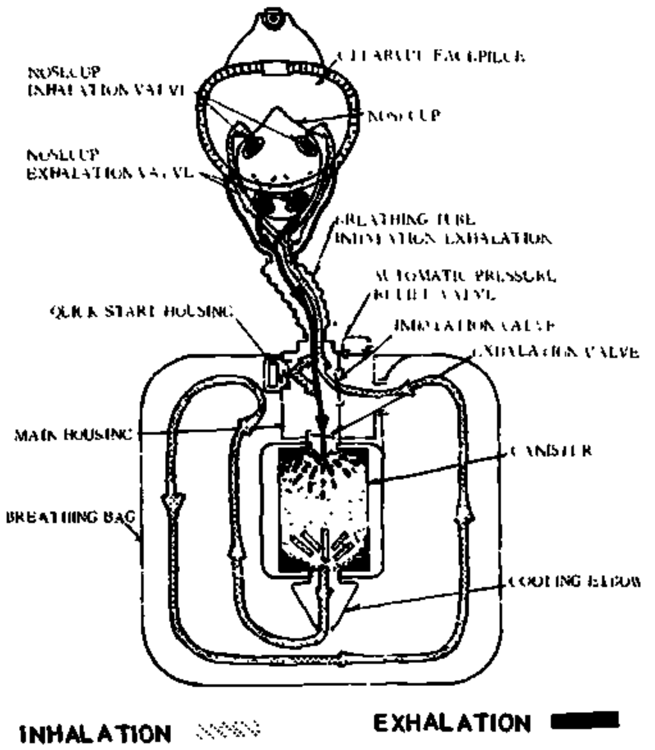
SELF-GENERATING OXYGEN MASK
THIRTY MINUTE

This mask, like the one previously described, is a canister type which evolves or generates its own oxygen. (See Figure 18.) Thus it is independent of the outside air. The wearer's breath passes into the facepiece and through the exhalation tube, into the canister. The exhaled breath is purified of carbon dioxide and replenished with oxygen as it passes through the canister and is then rebreathed. (See Figure 19.) This mask will provide respiratory protection for thirty minutes.

Courtesy Mine Safety Appliances Co.

Figure 18

Chemox 30-minute mask



Courtesy Mine Safety Appliances Co.

Figure 19

Cross-section diagram of Chemox 30-minute mask

The apparatus consists of a facepiece, breathing tube, (both the inhaled and exhaled air pass through this one tube), breathing bag, breastplate canister holder, manual timer, and harness straps, all focalized around a central housing just above the canister. An automatic pressure-relief valve is located in the central housing on the inhalation side of the breathing bag. This is a one-way valve; it operates automatically when the breathing bag becomes over-inflated. Also located in the central housing are the quick-starting housing -- a unit that activates the apparatus instantly in low temperatures -- and the exhalation and inhalation valves which control the directional flow into and out of the breathing bag. The breathing bag serves as a reservoir for the evolved oxygen.

The timer, located in the central housing, is a safety device to inform the wearer how long the canister has been in service. Since the mask is good for thirty minutes, the timer dial is calibrated in minutes from one to thirty. Turning the timer knob clockwise to thirty winds it. If left untouched in this position it will automatically unwind with a continuous movement to zero. This will indicate the end of thirty minutes and the bell will ring continuously for 17 seconds. The timer is entirely independent of the apparatus and will continue to unwind even though the apparatus is not in use.

The canister on this mask is different in appearance than the canister used on the regular self-generating type in that it is cylindrical in shape and has an opening on each end. The chemical in this canister is the same as in the other canister, so the same precautions should be taken as to introduction of water or moisture into the canister.

The chemical in the canister purifies the exhaled breath by absorbing the carbon dioxide and generating fresh oxygen for breathing. This chemical action generates considerable heat in the canister. The wearer is protected from this heat by insulation on the breastplate and by a cooling elbow incorporated in the canister holder to cool the evolved oxygen before it enters the breathing bag.

PUTTING ON THE MASK

The following are the consecutive steps in putting on the apparatus before entering a toxic atmosphere:

1. Unfasten and straighten all harness straps.
2. Grasp the apparatus at the top of the canister holder with one hand. With the other hand grasp the harness D-ring assembly where the two large nylon straps join. Place the breastplate canister holder over the chest and slip the head through the V-shaped opening formed by the straps.
3. Continue to hold the apparatus on the chest with one hand and with the other reach around the body and grasp the free end of one strap. Bring the end of the strap under the arm and snap into the D-ring located on the top side of the breastplate. Repeat this procedure for the other strap.
4. Adjust the position of the apparatus on the body by means of the metal slides located on the harness straps. This adjustment can also be accomplished by twisting the straps to obtain the proper length. The position of the apparatus on the body should be such that when the facepiece is put on, the breathing tube will permit free head movement.
5. Attach the waist strap to the small D-ring located on the lower corner of the breastplate and pull it up to a snug fit, tucking in the loose ends.
6. Open the canister holder by pressing on both the pawls at the top and pulling the lever arms outward.
7. Remove the two canister caps by inserting each end in the opener at the bottom of the canister holder and pulling upward (as in removing a bottle cap).
8. Make sure the canister-holder lever arms are fully at their bottom position and insert the canister in the canister holder with the top of the canister at the top of the canister holder. Note: The canister label has an arrow pointing to the top and reads: This end up.
9. Close the canister lever arms securely.
10. Connect the coupling nut on the facepiece tube to the mating thread on the upper main housing.

11. After the facepiece has been donned, check the tightness of the fit by squeezing the breathing tube tightly and inhaling gently. The facepiece should collapse on the face if the seal is satisfactory.

12. The apparatus is started by one of two methods, depending upon whether a quick start cartridge is used. For either method leave the automatic pressure-relief valve (on side of upper main housing) in the normal starting position.

    Without a quick-start cartridge proceed as follows in fresh air.

    a. Squeeze breathing tube with one hand, break the seal of the facepiece at the cheek with a finger of the other hand, and inhale deeply.
    b. Release facepiece, then breathing tube, and exhale into the apparatus.
    c. Repeat a. and b. until the automatic pressure-relief valve dumps air.
    d. Force the air from the breathing bag through the pressure-relief valve by squeezing the bag with both hands.
    e. Repeat operations a., b., and c. until breathing bag is fully inflated.

    If normal starting is to be used, the apparatus should be stored and started at temperatures above 32° F. When the apparatus is stored and started at temperatures above 32° F., the wearer may enter and wear the apparatus down to a temperature of -20° F. When starting the apparatus at temperatures near freezing, more inhalation from the outside air, with the exhalation into the canidter, may be required to produce the proper chemical reaction. The best procedure is to keep fully inflating and deflating the bag until a total of about 15 exhalations have been put through the canister.

The quick-start cartridge may be used with the following procedure:

a. Remove cartridge from metal container.
b. Remove cartridge-holder cover from front of main housing by unscrewing it.
c. Insert cartridge: the solid side with the brass percussion cap goes to the front (away from body).
d. Replace cover, screwing it in tight.
e. With facepiece well fitted, strike the cartridge cover a sharp rap with the heel of the hand. (See Figure 20.) Oxygen will evolve automatically to inflate the bag fully, and some excess will vent automatically. Nothing further is necessary to start the apparatus.

Courtesy Mine Safety Appliances Co.

Figure 20

Starting the half-hour Chemox

13. Regardless of the starting method, a tightness test should be performed on the unit as follows:

    a. Set relief valve in the test position. This closes the valve so that automatic venting does not take place.
    b. With the bag fully inflated, grasp the breathing tube tightly and depress both sides of the breathing bag with the elbows. If the bag does not deflate, the complete apparatus is tight.

IF A LEAK IS DETECTED, IT SHOULD BE CORRECTED BEFORE USE IN A TOXIC ATMOSPHERE.

    c. Reset relief valve to normal position.

14. Breathe normally; the apparatus will furnish enough oxygen to meet any breathing requirements.

15. Set the knob of the timer at 30. When the pointer end of the knob returns to zero, the bell will ring continually for 17 seconds. The wearer should then return to fresh air.

16. The facepiece of this mask contains a speaking diaphragm permitting communications.

PRECAUTIONS AND PRACTICES

The proper care of this apparatus and safe disposal of the canister are the same as with the regular self-generating oxygen mask previously described.

AUDIBLE COMMUNICATION WITH RESPIRATORY PROTECTIVE EQUIPMENT

Most facepieces on respiratory protective equipment of late manufacture are furnished with a speaking diaphram. Without such a speaking diaphragm, audible communication between wearers of respiratory equipment is inadequate at best, and at times may be impossible. Facepieces with an exhalation valve provide some measure of voice transmission through this valve, and even those without exhalation valves permit an extremely limited transmission through the rubber facepiece. However, a greater degree of audible transmission is provided by modern scientifically designed speaking diaphragms.

TRAINING SUGGESTIONS

1. Wear mask for a short period in fresh air, and do some work or exercise. This will allow you to become accustomed to the mask and learn the breathing technique.

2. Wear mask in gas and smoke to become familiar with conditions where gas and smoke exist.

3. While wearing mask in gas and smoke, do some work. It is under these conditions that the mask will be used.

4. Practice donning mask with helper and without helper.

SUMMARY

It is recommended that squadmen using gas masks always work in pairs and be in constant audible communication with each other.

The squadman who needs a mask should not run to the truck for it; the mask should be brought to him if possible. A mask should not be donned when a person is short of breath.

The harness straps, on all masks, should be previously extended to fit the largest man who may wear the apparatus. Masks having the slower type of adjusting harness strap can be quickly adapted to fit a smaller man by twisting these straps.

After working in areas of highly toxic chemicals, gases or radioactive material, it is advisable not to remove the mask upon return to fresh air until the contaminant has been removed from the clothing.

In donning the facepiece of any mask the headband straps should be tightened by pulling these straps straight back as shown in Figure 21, and not outward from the side of the head as shown in Figure 22.

Extra tanks and/or canisters should be carried on emergency apparatus. A guide line or rope should not be tied to the harness or D-ring of the mask. When a guide line is used, it should be fastened around the squadman's body before the mask is donned.

Where gas masks are not in regular use, they should be removed from their carrying cases periodically and donned by personnel. This will prevent the materials in the mask assembly from becoming stiff or hardened from lack of use, and keep them pliable.

Courtesy Loudonville, O., F.D.

Figure 21

Tighten straps like this.

Courtesy Loudonville, O., F.D.

Figure 22

Do not tighten straps like this.

CHAPTER XVIII

ELECTRICAL EMERGENCIES

INTRODUCTION

A squadman is not presumed to be an electrician nor an electrical lineman, but his duties may require him to face situations involving electrical equipment or wiring. Therefore he should be able to recognize electrical hazards and should know the proper action to take.

Saving property alone never justifies the risk of a man's life. Where life is involved, the urgency is greater; necessity prompts the squadman to act in the face of great danger. However, he should THINK before he ACTS. Moreover, unless he KNOWS what he is doing, he should seek help from a qualified person. Electric power has become so common that facilities for supplying electricity are present in almost every part of every community. Emergency and rescue squad personnel can prepare themselves to deal with electrical hazards by learning methods for handling electrical equipment and wiring.

The information in this chapter is merely suggestive. It is the responsibility of the department head, or the emergency squad officer, to reach an agreement with the appropriate officials of the local power company as to procedures to be followed in an emergency involving the company's property and equipment, or any other property where electrical equipment or wiring is concerned. All squadmen, and all power-company employees who are subject to call when an emergency occurs, should be thoroughly familiar with whatever procedure has been mutually approved. In many cities a power-company unit responds to each emergency where electrical hazards may be encountered. Regardless of this policy, someone must call the power company immediately when any emergency involves electrical hazards within the company's area. The squadman requesting assistance from the power company must clearly inform the receiver of the call as to the electrical equipment involved (transformer, overhead wires, underground cables, etc.) and its location. This will facilitate service and make for maximum cooperation.

RECOGNIZING THE DANGER

All wires are potentially dangerous. Fallen, energized wires are an extreme hazard to anyone who is not familiar with electrical behavior in wires under the stress of a ground or short circuit. The actual threat to life is determined by the amount of current or amperage that flows through a person's body.

The pressure applied to cause a current or amperage to flow is called voltage. Under some circumstances, a very low voltage can send enough current through a person's body to cause serious injury or death. This is particularly true if the person is standing on the ground or on a well-grounded structure. The flow of current is from a wire to the ground. Anything or anyone within this path may become the conductor for the current from the point of contact on the wire or electrically charged object to the point of contact on the ground.

CHARGED GROUND NEAR A FALLEN WIRE

It is dangerous even to approach a fallen wire. Distribution or transmission wires, in particular, may energize the ground for a considerable area around the point where they make contact. It is impossible to give specific rules or distances, since the danger area will vary with the voltages involved and with ground conditions. The hazard is much greater during damp or rainy weather.

CIRCUIT BREAKERS

Wires lying on the ground may be de-energized one moment and energized the next. While energized they may whip around, and this is an additional hazard. Self-operating devices protect most power systems from surges and grounds. These devices open a circuit when it is overloaded or shorted and then, in a matter of seconds, automatically close the circuit. The setting on this equipment may vary from one to four seconds.

INVISIBLE DANGER

Energized wires lying on the ground or across a vehicle may show no evidence of being live, yet touching the wire or the vehicle may be fatal. If an electric wire should fall across a fence or telephone wire, they are as dangerous as the live wire itself and the same precautions must be taken.

ACTING IN AN EMERGENCY

The only completely safe thing to do with fallen wires is to stay clear of them and call the power company. In some cases, however, waiting for the power company crew may mean the difference between life and death. Therefore, it is essential for rescue squad personnel to have a reasonable working knowledge of the electrical hazards and emergency situations that may confront them in each community they service.

If wires are down, on arrival at an emergency proceed as follows:

Radio for the power company and move the crowd back from the danger zone (at least one span each way from the break or the sagging wire.) This is necessary for several reasons.

1. The spans of wire adjacent to the trouble may have been weakened.

2. Any movement of the wires in trouble, caused by the wind or rescue work, may burn other wires down.

3. Wires on the ground may burn through at some point and the ends may curl up, roll along the ground, and cause injury to someone.

4. Burns, electric shocks, or eye injuries from electric flashes may occur even though a person is not in direct contact with the wires. Therefore, do not permit anyone to stand near weak or broken wires.

EMERGENCIES INVOLVING VEHICLES

In case of a motor vehicle, the rubber tires may insulate the vehicle from the ground, so that although the vehicle itself may be charged, there will be no current flowing from the vehicle to the ground. In such case, passengers in the vehicle will be relatively safe if they remain in it. A person touching the vehicle while standing on the ground will complete the circuit from the vehicle to the ground, creating a path of current flow through his body which can often prove fatal.

An example is that of a woman whose car became energized from a fallen wire as the result of hitting a light pole. In her fright, she jumped out of her car. After moving away from the car, she realized she had left her purse in the seat of the car. She returned to the car and, upon touching the door, was instantly electrocuted.

Charged Emergency Apparatus

If either metal or wood aerial ladders come in contact with overhead electric wires, or should these wires fall across the apparatus, a person will be relatively safe providing he DOES NOT make contact with the apparatus and the ground at the same time. If the equipment is believed to be in contact with a live wire, and you must get off, DON'T STEP OFF - JUMP OFF. Your hands, feet, and body must clear the vehicle completely before you touch the ground. From the moment that you contact the ground, you must not again touch the vehicle.

HANDLING ENERGIZED WIRES

If a dry rope is thrown from a reasonable distance over wires carrying high voltage, the person throwing it will not be harmed. If the rope is wet when placed in contact with energized wires, the man can receive a shock which may prove fatal.

Polypropylene rope is completely non-conductive. It will not absorb moisture. This type of rope is ideal for use with electrical hazards.

ROPE-AND-WEIGHT TOOL

If action is necessary to remove a wire from a victim, a rope-and-weight tool can provide a means to handle wires safely in any weather. However, the squadmen must be thoroughly trained in its use. Men who can throw the weights efficiently will be able to pick up a live wire with relative safety, regardless of the position in which it falls.

This rope tool consists of two weights, each weighing approximately one-half pound, attached one to each end of a 100-foot, one-quarter-inch rope. (See Figure 1.) The rope must be free of any metallic substance, to be safe in use. Any emergency unit can make this devices for little cost. It is recommended that one be in service on each unit in operation.

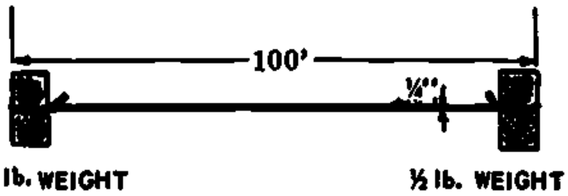


Figure 1

Tool made with rope and two weights, for handling live wires

USING THE ROPE

Emergency squadmen should be trained in the use of the weighted rope. Only practice can make them proficient in handling live wires safely in this manner.

Figure 2

Hot stick

With this tool a squadman can gain control of a fallen wire without getting near the wire. After the rope is in contact with the wire, approved and adequate insulating equipment will allow him to move the wire by pulling on the rope. A pair of approved lineman's rubber gloves and glove protectors, and a lineman's "hot stick", tested for use on high voltage, are required. (See Figure 2.) With this equipment the wire may be moved as follows:

1. Clear all persons out of the danger area, as described earlier.

2. Put on lineman's rubber gloves and glove protectors.

3. Stand opposite the point to which you want to move the wire and approximately thirty feet from the wire.

4. Toss one end of the weighted rope under the wire to a point about equal to your distance from the wire, on the other side. (See Figure 3.)

5. Toss the other end over the wire so that it lands near the first weight thrown.

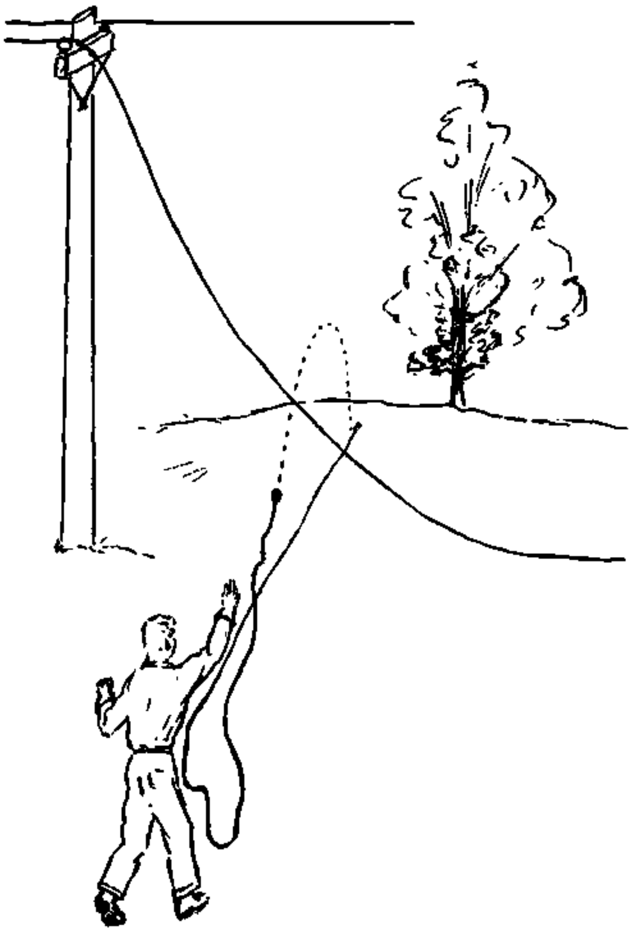


Figure 3

Man throwing rope with weights

6. Pick up the two weighted ends with the hot stick, and drag the wire out of the way. (Be sure the wire is guarded.)

7. Keep in mind at all times that the ground may be energized for some distance around the fallen conductor.

It must be remembered that any fallen wire is dangerous and that it can mean instant death to the poorly trained emergency rescue squadman. However, when a human life is involved, squad personnel will have to take immediate rescue action. In such situations the action taken will be founded on past experiences and training. Here every second counts, yet caution must be exercised so that the seriousness of the original emergency is not increased because of the over-zealous action taken by a squadman or other person nearby.

HOT STICKS

Hot sticks are specially designed tools used principally by electric company linemen to manipulate energized conductors into a desired position. They are specially treated by the manufacturer to prevent moisture from penetrating the wood. They should be kept in a compartment or other container on the rescue truck to prevent damage while in storage. They should be inspected at regular intervals by someone who knows their construction even if they have not been used since the last inspection.

REMOVING VICTIM FROM WIRE

When a person is found lying on an energized wire, and the wire is not entangled around the victim, a quick method to rescue him is to employ a hot stick to push or pull him from the wire. While the victim is being removed from an energized line he may receive additional burns, but this is not as serious as having him remain in contact with the energized conductor.

The rescue worker should stay as far away from the victim or the wire as the hot stick will permit. If additional help and another hot stick are available, they may be employed in the rescue operation. One man may hold the live wire immobile while the other man moves the victim from contact with the wire. This additional assistance can prevent the end of a live wire from whipping in a manner similar to that of an unattended garden hose that is discharging water from an open nozzle. Also, by keeping the wire in contact with the ground, the exposure of a victim to additional shock and burns is kept to a minimum.

In cases where hot sticks are not available, an alternate procedure may be applied.

Use a long, dry rope (of a type referred to in Figure 1) to loop around some part of the victim's body in a manner that will permit dragging the victim from the danger area. This alternate procedure may require the squadman to perform the rescue operation from a position much closer to the victim and/or the wire than the maximum distance allowable when hot sticks are employed. Here the rescue worker must perform this act, taking all necessary precautions to prevent his body or clothing from making contact with the victim's body, or clothing, or the wire itself. These precautions are necessary until the victim has been removed from the danger area. Bystanders should be ordered to remain at least a minimum of one hundred feet away from the victim. This will prevent them from coming into contact with anything which may be energized, thus eliminating the chance of additional victims.

FIRST AID AFTER RESCUE

In cases where artificial respiration is required, it should be started at once after the victim has been released from contact with the wire. Resuscitation should continue until the victim has recovered or until a member of the medical profession has pronounced him dead. The treatment of any burns from electric shock should be the same as that described for any burn case.

Closed-chest heart compression may also be needed. The signs that establish when to start this procedure are described in Chapter XII, "Closed-Chest Heart Compression".

CHAPTER XIX

CUTTING TORCHES

INTRODUCTION

On many occasions, rescue and emergency squads are called upon to rescue victims trapped or confined by metal. The cutting torch provides a method of making an effective rescue. In view of the evident importance of this tool, it is essential that every squadman be familiar with its correct use, with its limitations, and with its care. The following paragraphs provide this information.

CUTTING TORCHES AND EQUIPMENT

The oxy-acetylene cutting torch can be used for cutting steel, wrought iron, and other ferrous metals. The equipment is usually portable. It includes two separate tanks: one for oxygen and one for acetylene. Hose, regulators, gauges, cutting torch, lighter, goggles, extra tips, tip cleaners, wrench, leather gloves, and yellow and white chalk must be included in the equipment.

There are several companies which manufacture good cutting torches and equipment. However, since space is limited, this manual cannot list all of them.

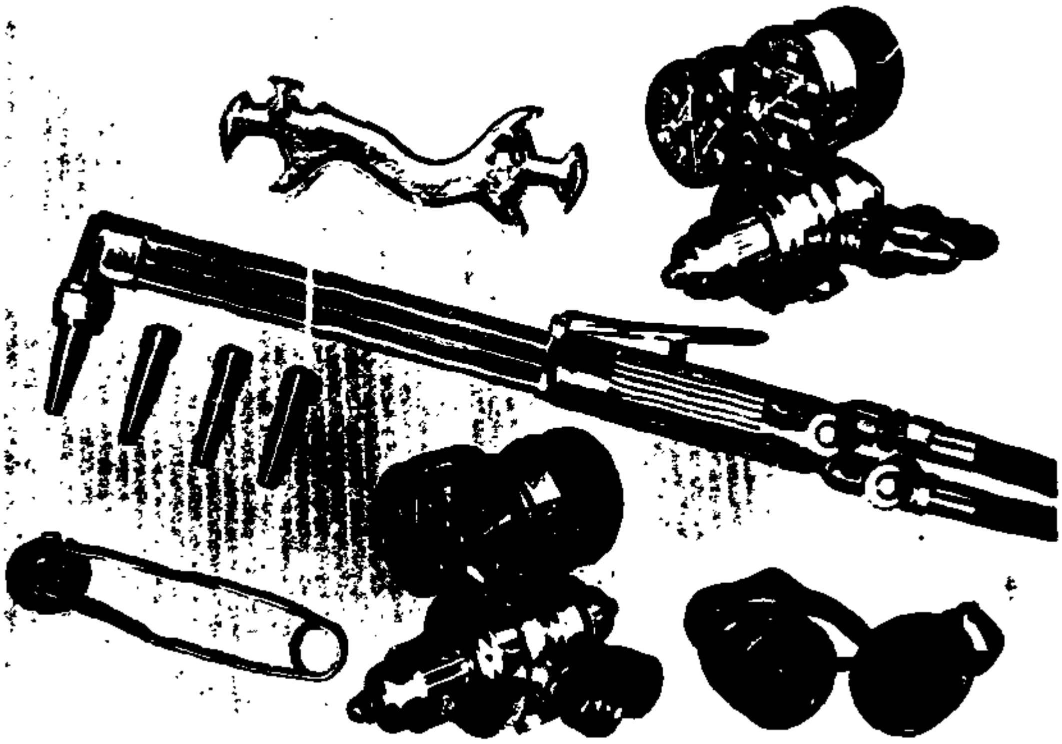
In selecting cutting equipment for the emergency squad, it is advisable to obtain one similar to the assembly shown in Figure 1. This is a sturdy outfit which will cut efficiently and economically. Its tough construction gives it a long life, and it can be used with the small portable tanks.

The complete outfit includes:

1 Cutting Torch (90° head)
4 Cutting Tips, sizes 1, 2, 4, and 6
1 Two-Stage Oxygen Regulator (0-200 lb. and 0-3000 lb., with 2-$\frac{1}{2}$-inch gauges)
1 Two-Stage Acetylene Regulator (0-30 lb. and 0-400 lb., with 2-$\frac{1}{2}$-inch gauges)
1 Wrench (5-way)

RECOMMENDED ACCESSORIES

1 Pair of Goggles
1 Flint Lighter
25' 1/4" Twin Line Hose
4 Hose Connections (2 oxygen and 2 acetylene.)
4 Hose Ferrules



Courtesy National Welding Equipment Co.

Figure 1

Cutting outfit

ASSEMBLING CUTTING TORCH AND HOSE

The cutting torch consists of a handle, or torch body, to one end of which may be attached any one of the various cutting tips, which range in size from 0 to 8. (See Figure 1). On the opposite end are two valves which control the rate of flow of oxygen gas and acetylene gas into the torch. The rubber hoses supplying the two gases are attached to these valves.

The acetylene tanks and hose connections of all makes of torches have left-hand threads. Oxygen connections have right hand threads.

A good wrench should always be used to tighten torch parts and hose connections; never use pliers. It is important to keep the packing nuts fairly tight on the torch valves so that the valve setting does not change while the torch is in use. Always use an open-end wrench. Valves that turn too easily are likely to be accidentally thrown out of adjustment when they brush against something.

OPERATING PRESSURE REGULATORS

The rubber hoses from the torch fasten to two pressure regulators, one regulating the pressure of the acetylene gas in the acetylene hose, and one regulating the pressure of the oxygen gas in the oxygen hose. It is necessary to keep the pressures of the two welding gases constant at all times and low enough not to overload the nose. It must be remembered that the pressure of gases in the cylinders decreases constantly while in use.

By turning the cross bar or handle of either pressure regulator, the desired hose pressure can be obtained. The usual pressures are 10 lbs. of acetylene and 30 lbs. of oxygen. This pressure is shown on the pressure gauge on the regulator. Screwing the cross bar in (clockwise) increases the hose pressure. Both oxygen and acetylene regulators have cross bars with right-hand threads.

Regulators connect directly on the oxygen and acetylene cylinders; a second pressure gauge on each cylinder indicates the pressures within the cylinders.

Some manufacturers of welding regulators provide a small storage space in the center of the cross bars in which are kept extra seats, to be used as replacements as wear occurs inside the regulators.

Two rules, if followed, will greatly prolong the life of regulators. It should be stated here that if the torch "acts up" it is quite possible that the regulators are at fault. First, always screw the cross bars out until they are loose, before opening the cylinder valves which are located on the tops of the oxygen and acetylene cylinders. This prevents the suddenly released pressure from overloading and damaging the delicate valve mechanism inside the regulator. Second, lubricate the threads on the cross bars with beewax occasionally. Never use oil or grease anywhere around a gas welding outfit, that is, on any of the parts of the apparatus itself. Oxygen under pressure will occasionally cause oil to ignite if conditions are just right. Oxygen alone does not burn.

SAFE HANDLING OF OXYGEN AND ACETYLENE CYLINDERS

THE OXYGEN CYLINDER

Commercial oxygen used in cutting is stored in steel cylinders. The manufacture of all commercial oxygen is controlled by the United States Department of Commerce to insure safety. The cylinders are made of seamless steel with a fusible plug near the valve at the top. This plug allows the gas to escape at a safe rate in the event that the cylinder should be subjected to a dangerously high temperature. Oxygen gas is pumped into the steel cylinders to a pressure of about 1800-2000 poinds to the square inch. Cylinders are made in various sizes, the two most common having a capacity of 110 and 220 cubic feet of gas, respectively. The shut-off valves mounted on the tops of the cylinders are of special design because of the extremely high pressure they have to hold. They have a right-hand thread, and when opened should be turned as far as they will go. This prevents leakage by causing the valve to seat in the top of the valve body. Commercial oxygen is usually obtained from air and seems much like air in many ways, since it is odorless, harmless to breathe, and non-inflammable.

THE ACETYLENE CYLINDER

Acetylene gas is stored safely by pumping it into special steel cylinders. It is also controlled in its manufacture by the Department of Commerce. Unlike the oxygen cylinders which have no liquid or solid material whatever inside, the acetylene cylinders are loosely filled with an asbestos absorbent which is saturated with a liquid called acetone. Acetone has the ability to dissolve acetylene gas under pressure. The result is that when 220 cubic feet of acetylene gas is pumped into a cylinder of approximately the same size as the one used for oxygen, the pressure is only 250 pounds to the square inch. This greatly increases the safety of handling and transporting compressed acetylene. The acetone remains in the cylinder as the acetylene is allowed to escape during welding, and is used repeatedly with practically no loss. Fusible plugs in both the bottom and the top of each cylinder are an additional safety factor. The acetylene cylinder valves are not subjected to as much pressure as the oxygen valves and do not require the special sealing feature - the packing used in the valves being ample to prevent leakage. These valves have right-hand threads and should be opened only one and one-half turns to allow for rapid shutting off in an emergency. They require a special square socket wrench which can be obtained from the firm supplying the gas. The diameter of the threaded outlet for the regulator is smaller than that on the oxygen cylinder.

ATTACHING CYLINDERS

Before attaching fresh cylinders of gas to the welding outfit, the valves should be opened slightly and a small amount of each gas allowed to escape. This is called "cracking" a tank. Oxygen will not burn but acetylene will. One should be certain that no open flame is near when the acetylene valve is opened. The escaping gas blows out any dust or particles of grit that may have lodged in the valves during shipment. All fitting must be perfectly clean before screwing them on the cylinders.

As before mentioned, be sure all regulators are in the "off", or loose, position before turning the gas on at the cylinders.

In turning the gas off at the cylinders extreme care should be exercised to make certain the valves are completely closed. The two torch valves should then be opened to "bleed off" the remaining gas in the hose. The pressure regulators should then read zero.

USING THE CUTTING TORCH

All types of cutting torches operate on the same principle and are provided with tips of various sizes for cutting metals of different thicknesses.

In contrast with the welding torch which has a single orifice at the tip, the cutting torch has five or more. The center orifice is for oxygen only, and is supplied with a quick-acting oxygen valve. This central oxygen orifice is surrounded by four or more orifices for the oxy-acetylene preheating flames. These pre-heating flames are adjusted independently of the oxygen cutting valve and, once adjusted, keep burning steadily regardless of whether the oxygen cutting valve is opened or closed.

One can use the oxygen cutting torch with excellent results on any kind of steel or wrought iron. Cast iron is somewhat more difficult to cut.

First select a cutting tip of suitable size for the thickness of metal which is to be cut. A tip with an oxygen orifice drilled at the factory with a No. 66 drill is suitable for cutting steel one quarter of an inch in thickness; No. 52 for one inch, and No. 48 for three inch. The larger the wire gauge drill size number, the smaller the orifice.

The torch, valves, and connections should be checked for leaks before the torch is lighted. This can be done by passing the face near and around the torch, valves, and connections. If an acetylene gas leak is present it can be detected by smell. If any oxygen gas leak is present it can be heard or felt blowing upon the face.

Next, adjust the acetylene hose pressure as for cutting.

The oxygen hose pressure required depends upon the tip used and the thickness of the steel being cut, and varies from 10 pounds to 150 pounds. Tables supplied with torches indicated oxygen and acetylene pressure for each tip and thickness of metal to be cut. These pressures vary with different makes of torches and sizes of tips. (See Figure 2)

The oxygen valve on the torch body should be opened far enough to give full oxygen pressure through the torch for cutting. This is an important point for beginners.

Adjust the pre-heating flames to neutral and try the cutting valve to see that full oxygen pressure is feeding through to the oxygen orifice in the tip. It is important also to keep the orifice clean and round.

Cutting TIP SELECTOR CHART—including tip drill sizes

(1) IF . . . . the metal thickness you want to cut is as shown below. . . . .

(2) THEN . . . . select the cutting tip size shown on the same line for your model of torch. . . .

(3) SET YOUR REGULATOR . . working pressures as indicated below, in pounds per square inch. . . . .

(4) TO KEEP YOUR TIPS CLEAN . . . . use tip cleaners of the correct drill size for each hole or orifice of the various tip types as shown below. . . . .

In Inches	400	300 310	210	28	Oxygen	Acetylene	Center Hole All Types	Preheating Holes for Types: AA-D	AS	SC	Others
1/16 to 1/2	0	0	0	0	10-20	3	60	73	66		63
1/8 to 3/4	1	1	1	1	15-30	3	57	72	68		62
1/4 to 2	2	2	2	2	15-50	5	54	70	64		61
1/2 to 4	3	3	3	3	20-60	5	51	68	63	66	60
2 to 6	4	4	4		30-70	5	46	66		61	59
4 to 8	5	5	5		60-80	8	42	64			58
6 to 10	6	6			70-100	8	37	61			57
8 to 12	7				100 and up	10	32	58			56
10 to 14	8				150 and up	10	30	56			55

(1) The most desirable metal thickness to be cut by any given tip size will depend partially upon the condition of the metal surface and how advanced your skill in flame cutting.

(2) Select that cutting tip size and type which gives YOU the best results. Do not use larger tip size than that recommended for your model of torch.

(3) The wide latitude of suggested Oxygen pressures for each tip size is related to the thickness to be cut. The highest pressure, of course, for the thickest metal. Here, too, the oxygen pressure will depend greatly upon your skill, surface condition and type of ferrous metal to be cut, and how WELL you handle the cutting starting time.

(4) A clean cutting tip will do much better work for you than a neglected one. Suitable tip cleaners will keep your tips at top operating efficiency. Wire and make shift methods may damage the tip ports. Make your tips cut cleaner over a longer period by taking good care of them. Neglect costs money.

Figure 2

Courtesy National Welding Equipment Co.

Cutting tip selector chart

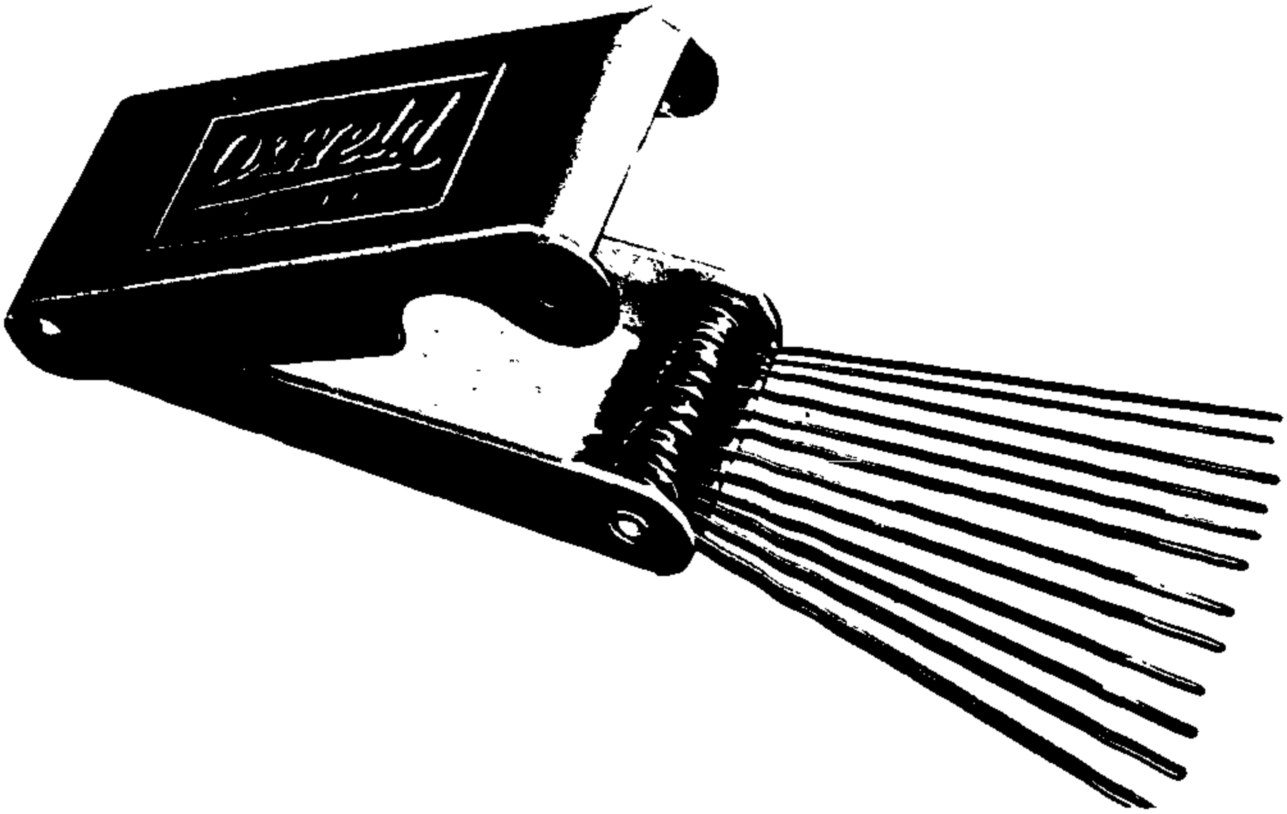
Tip cleaners of correct size should be used. Slag that sticks to the end of the tip can be loosened with pocket knife without damaging the tip. If the flames do not burn properly, shut them off and clean the tip. Figure 3 shows tip cleaners.

With the luminous pre-heating cones of the cutting tip just touching the steel to be cut, heat the edge or other point where the cut is to begin. Be sure to have the torch well supported and pointed at the work.

When the steel begins to melt, the cut can be started by slowly pressing down the cutting-oxygen-valve lever.

During the cut the tip of the torch should be kept at a constant distance from the work. This will vary from 1/16 inch to 3/16 inch depending upon the thickness of the metal. This gap should not change as the torch is moved along the cutting line. The bottom of the kerf or cut should be kept a little ahead of the top.

It is important to move the torch at a uniform speed and at a speed which is slow enough to allow the oxygen to cut all the way through. In turning off the gas at the cutting torch, the acetylene should be turned off first.



Courtesy Linde Co.

Figure 3

Tip cleaners

CARE OF CUTTING TORCHES

Following is a list of safety precautions in using and maintaining the equipment:

1. Always use a good wrench to tighten torch parts and hose connections.
2. Never use oil or grease on any part of the torch or tanks.
3. Always check tank, hose and torch for acetylene leaks before lighting torch.
4. Be sure all regulators are in off position before turning on the gas cylinders.
5. Hose and equipment should be kept free of oil or dirt.
6. Caution should be taken to protect hose from being cut by glass, sharp metal, or hot molten metal.
7. Keep torch in box provided for its storage.
8. Check hose for deterioration.
9. See that goggles are not broken and are clean.
10. Inspect tanks frequently for leaks, and also to see that pressure is maintained.

RESCUE PROCEDURE

Care must be taken to protect the victim from the dangers of heat, smoke, and burns which he might receive from the flame, torch, molten metal or sparks. A fire-resistant, or wet blanket is very useful for protecting the victim from these dangers.

The operator of the cutting torch should wear heavy leather gloves for protection.

A squadman should be assigued to stand by with the proper extinguisher (do not use carbon tetrachloride) or hose line, during cutting operation, to protect people and property.

Thorough inspection should be made after the victim has been removed, to make sure all fire and sparks have been extinguished.

As portable tanks will contain only enough gas to cut for a limited time, it is a good policy to have a list of owners of larger tanks that can be made available for long cutting operations.

The following staged pictures show steps and proper precautions in the use of oxy-acetylene cutting equipment for freeing accident victims.

SITUATION

There is an automobile wreck and the victim's left foot is trapped in the wreckage. Figures 4 through 7 show the rescue procedure.

Figure 4

A compress has been applied to the victim's head to stop bleeding.

Figure 5

A portable cutting torch is obtained from the squad car.

Figure 6

The victim is covered with an asbestos blanket and a chalk mark is drawn where the cut is to be made.

Figure 7

Squadman No. 1 cuts with the torch. Squadman No. 2 stands by with an extinguisher. Squadman No. 3 holds a blanket over the victim's head to prevent breathing of fumes and smoke. Squadman No. 4 supervises the operation.

CHAPTER XX

ROPE AND RIGGING

INTRODUCTION

Rigging is essential to many rescue operations which necessitate lifting or hoisting. It is imperative that rescue personnel know how to use ropes, cables, blocks, ladders, gin poles, and other rigging equipment in rescue operations. Mastery in the use of ropes and rigging can come only after much practice and drill. This chapter describes basic rigging equipment and explains some applications.

Rescue equipment is always carried on heavy rescue vehicles. However, light rescue vehicles also should carry the basic equipment for hoisting and lowering victims.

ROPE

Although rope is made of different fibers, manila, sisal and hemp are used most extensively. In rope-making, fibers are first twisted together to make a yarn. The yarns are then twisted together to make a strand and the strands are twisted together to make a rope. Reversing the twist in every step of building up a rope locks it together. The twist in one direction offers an equal resistance to the twist in the opposite direction, which balances the rope and keeps it in proper shape. The direction of twist is indicated by the terms "left hand" and "right hand" or, "with the sun." To determine the direction of twist, face and point a portion of the yarn or strand of rope toward the sun. If the direction of twist is the same as that of the sun's motion it is said to be "right hand" or "with the sun," but if it is in the opposite direction it is said to be "left hand."

Rope has a tendency to untwist and lengthen if a weight is suspended from its end. Because of this tendency, it is recommended that new rope be hung from a tower for several days with sufficient weight attached to stretch it before use. This stretching can be done by fastening the top end with a clamp, then attaching a weight to a clamp at the lower end of the rope. This does away with the kinking that would result if knots were tied in the rope itself.

See Figure 1a and 1b. Rope may also be straightened by having a man walk back and forth around two stationary poles, dragging the rope until it straightens out. See Figure 1c.

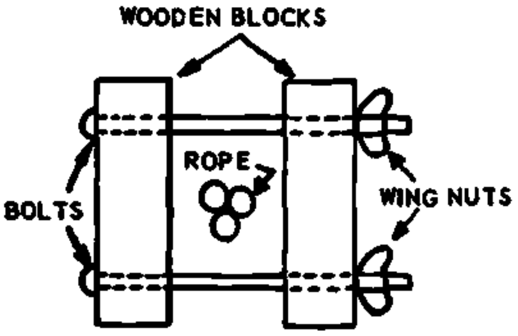


Figure 1a

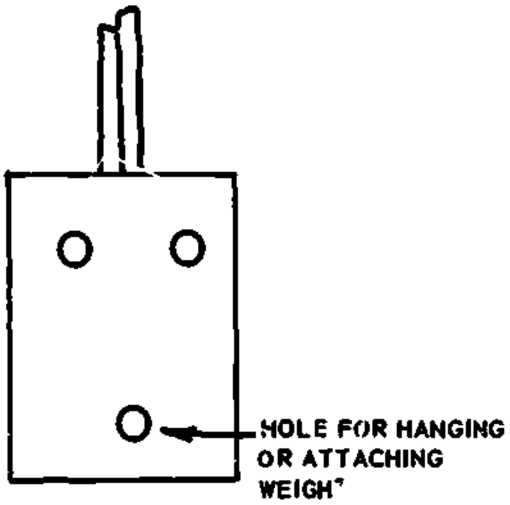


Figure 1b

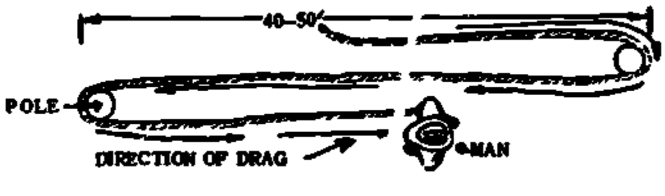


Figure 1c

Straightening and stretching the rope

A rope so treated will handle much easier when put into actual service. Figure 2 shows the manner in which this tendency to untwist and lengthen is overcome. A number of fibers are twisted in a "right hand" direction as shown at C. From two to twenty yarns are formed "left hand" into a hawser-laid rope as shown at A. In each of these successive steps, the twisting has been in opposite directions. As soon as the rope, as a whole, begins to untwist, the individual strands forming it are twisted tighter. The rope can untwist only far enough to bring those opposing forces to an equilibrium.

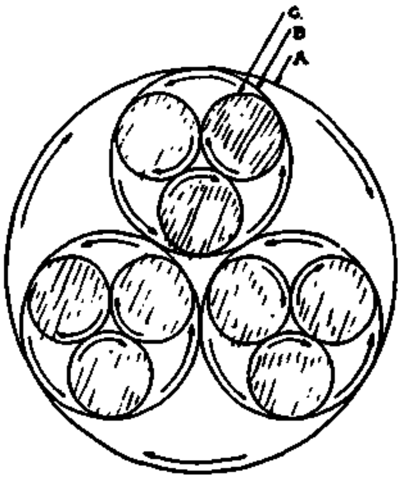


Figure 2

Twisted rope

TYPES OF ROPE

Three strands laid up in a "right hand" direction, as shown in Figure 3, form a hawser-laid rope. Four strands laid up in a "right hand" direction, having a central core as illustrated in Figure 4, form a shroud-laid rope. Three hawser-laid ropes laid up in a "left hand" direction form a cable-laid rope.

Most of the rope used in rescue work is hawser-laid. The principal use of shroud-laid rope is for power transmission. Larger ropes used in well drilling and mining are cable-laid.

Figure 3
Hawser laid rope

Figure 4
Shroud laid rope

SIZE OF ROPE

Rope of all kinds is usually described by giving its diameter in inches. Rope is purchased by giving the diameter and the number of feet desired but is sold by the pound. The size of a given type of rope is varied by changing the number of yarns in a strand.

STRENGTH OF ROPE

In choosing rope for a given purpose, a large measure of safety should be used. As an example, to elevate 775 pounds at a time, do not select a rope with a maximum or breaking strength of 775 or even 1,000 pounds but rather one with about seven times this amount of breaking strength.

Figure 5 shows the breaking strength of a new 7/8" manila rope to be 5,440 pounds. One-seventh of 5,440 pounds is 777 pounds, or about the same as the load to be lifted. Therefore, a 7/8" rope is the proper size for the present problem.

For a new manila rope, the breaking strength in pounds may be roughly calculated as follows: Square the diameter in inches and multiply the product by 7,200. The safe load can be found by dividing the breaking strength by seven.

Exposure and wear are the most important factors in deteriorating the strength of rope and a liberal allowance should be made for both when estimating the strength of old rope for any purpose.

Diameter, in inches	Circumference, in inches	Weight of 100 feet, in pounds	Length of Each Pound in feet & inches		Safe Load, in pounds	Breaking Load, in pounds	Diameter of Pulley, in inches
3/16	9/16	2	50	0	35	230	1-1/2
1/4	3/4	3	33	4	55	400	2
5/16	1	4	25	0	90	630	2-1/2
3/8	1-1/8	5	20	0	130	900	3
7/16	1-1/4	6	16	8	175	1240	3-1/2
1/2	1-1/2	7-2/3	13	0	230	1620	4
5/8	2	13-1/3	7	6	410	2880	5
3/4	2-1/4	16-1/3	6	1	520	3640	6
7/8	2-3/4	23-2/3	4	3	775	5440	7
1	3	28-1/3	3	6	925	6480	8
1-1/8	3-1/2	38	2	7	1260	8820	9
1-1/4	3-3/4	45	2	2	1445	10120	10
1-3/8	4-1/4	58	1	8	1855	13000	11
1-1/2	4-1/2	65	1	6	2085	14600	12
1-3/4	5-1/4	97	1	0	3070	21500	14
2	6	113	0	10	3600	25200	16
2-1/2	7-1/2	184	0	6-1/2	5630	39400	20
3	9	262	0	4-1/2	8100	66700	24

Figure 5
Facts about three strand manila rope

INSPECTION OF ROPE

A length of rope may appear badly worn on the outside and still be much better than another length which looks good on the surface. Chafing occurs in rope; the inner fibers rub or chafe against each other, especially where a rope bends when going through a pulley. Many of the central fibers become broken into dust and short pieces. Because of this, rope should be checked each time after being used, for this check may save a life. In view of the many conditions that can affect the strength of rope, and since only a part of the rope may be affected, an examination of the entire length should be made at least once every six months.

If, upon examination, any of the following conditions are found to exist, and if the condition of the rope is such that there is any doubt as to its being safe to use, the condition should be reported to a superior officer.

On the surface of the rope:

1. Abrasions (broken fibers)
2. Cuts
3. Extreme softness (badly worn rope is extremely soft and has lost its stretch)
4. Decay or burns (caused by high temperatures or chemicals)

To examine the inside of rope, separate the strands at three-foot intervals and observe the inner parts for:

1. Broken fibers
2. Fine powder (indicates the presence of grit)
3. Mildew or mold
4. Change in color of the fibers

Rope should not be carried in a truck compartment that is damp or contains sharp-edged tools. It must always be carried coiled, ready for use.

USE OF ROPE

Because rope is such a necessary and important item of equipment, it should be carried on all apparatus. The number of ropes, and size, will vary according to the squad's requirements. Generally, the sizes vary from one-quarter inch to one inch and the length from 100 to 150 feet.

Among the purposes for which rope can be used to good advantage are:

There are a number of purposes for which rope can be used to good advantage, some of which are:

1. To hoist ladders, tools and appliances
2. As a life line in rescue work
3. To aid in maintaining bystander lines
4. To lash ladders together to extend the length
5. For wrecking operations
6. As guy lines when hoisting equipment or patients

KNOTS, BENDS AND HITCHES

A knot is a knob in a piece of rope which serves as a stopper or a button and is formed by interweaving the rope. A bend is a method of fastening one rope to another, to a ring or to a loop, etc., by passing the rope through a loop and fastening it back upon itself. A hitch is a temporary knot or noose with which a rope is fastened around a timber, pipe, or post in such a manner that it can be easily untied. These definitions or distinctions are very loose in their application, and it should be remembered that most of the knots ordinarily used are, strictly speaking, bends.

Knots stay tied due to the frictional resistance of the rope which prevents its parts from slipping and thus untying the knot. A knot or hitch must be so devised that the taut part of the rope bears on the free end in such a manner as to pinch and hold. In a knot, the free end is held against another part of the rope; in a hitch, against the object to which the rope is attached.

The usefulness of a knot should be judged by the following essential factors:

1. Rapidity with which it can be tied
2. Ability to hold fast when pulled tight
3. Ease with which it can be undone

In forming knots, bends and hitches, the rope used assumes the following shapes which are described as the "round turn," the "open bight" or "loop," and the "bight" as shown in Figures 6, 7, and 8, respectively.

Figure 6
Round turn

Figure 7
Open bight
or loop

Figure 8
Bight

EFFECT ON THE STRENGTH OF ROPE E

Rope has its maximum strength when the strain from a load is applied evenly to all fibers. When a knot is tied in a length of rope, the weakest part of the rope is at the knot. In all knots, some more than others, the rope is cramped or has a very short bend which throws an overload on those fibers that are on the outside of the bend. This causes the fibers to break, and the rope may eventually part. The shorter the bend, the less the tensile strength of the rope.

The following list shows the decrease in tensile strength according to various knots:

1. Square knot - 50% loss
2. Bowline - 40% loss
3. Clove hitch - 35% loss
4. Short splice - 20% loss

WHIPPING THE END OF THE ROPE

The end of a rope that is to pass through pulleys or other small openings should be finished by whipping. The whipping is done with a very stout linen or cotton cord as follows: Make a loop in one end of the cord, hold the loop along the rope as shown in Figure 9a, and wrap the long end B of the cord tightly around the rope in the same direction in which the strands are twisted, as in Figure 9b. When within about ½ inch of the end of the rope, slip the end of B cord through the loop, as shown in Figure 9c. With the end A, pull the loop beneath the whipping as far as possible, as shown in Figure 9d. Both ends may now be cut close to the rope. The finished end is shown in Figure 9e.

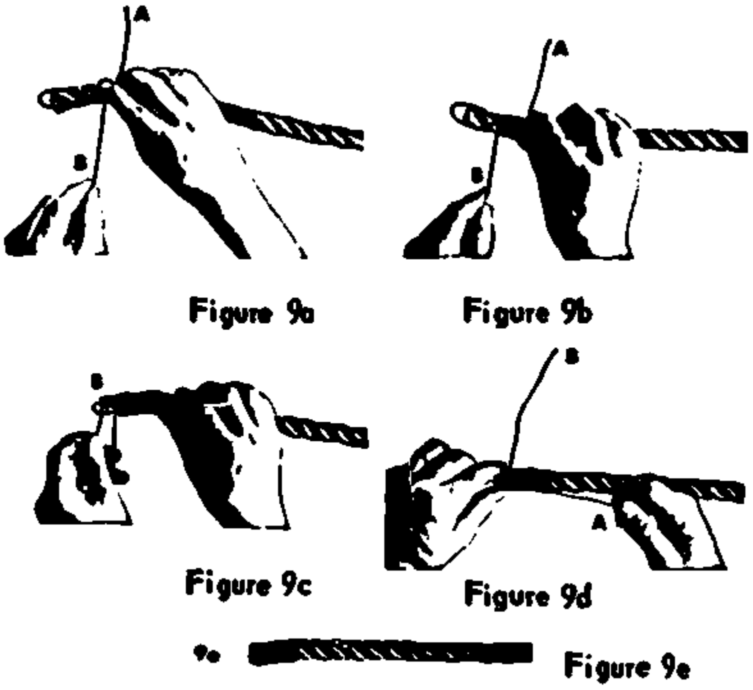


Figure 9a
Figure 9b
Figure 9c
Figure 9d
Figure 9e

Whipping the end of the rope

THE HALF HITCH

Of all the hitches, the "half-hitch" is most widely used, both alone and in combination with a variety of other knots. It is very easy to make. As shown in Figure 10, the rope is fastened to a timber by a single half-hitch. In tying the half-hitch, the free end of the rope is brought around the tension end and then brought under itself.

Figure 10
Half hitch

THE SQUARE KNOT

The square knot is used in tying two ropes of the same size together. It will not slip when drawn tight and is easily untied. It is tied as follows: Bring the two ends together and cross them as shown in Figure 11a. Place end A across B as shown in Figure 11b, and then move A around B as shown in Figure 11c. Care should be taken that the knot is tied and assumes a final shape as shown in Figure 11d; otherwise a granny knot rather than a square knot will result. See Figure 12. Be sure to observe this difference.

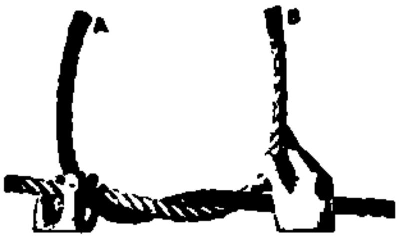


Figure 11a
First step in tying a square knot

Figure 11b

Figure 11c **Figure 11d**
Completing a square knot

Figure 12
Incorrect square knot (granny knot)

THE CLOVE HITCH

The clove hitch is used to fasten a rope to a stake, pipe or post. It is a hitch commonly used for raising or lowering small equipment. It may be tied by using either of the following two methods:

First Method - Give one end of the rope two turns around the post, cross over the long portion and place the short end beneath the second turn, as shown in Figures 13a and 13b.

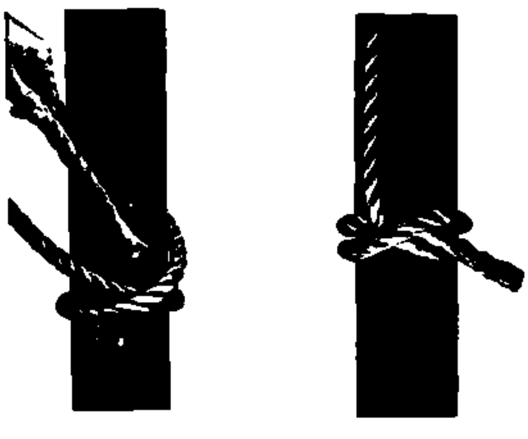


Figure 13b **Figure 13a**
Clove hitch around post

Second Method - Throw one bight in the rope to the right and another to the left, as shown in Figure 14a. Move bight A over on bight B as indicated by the arrow and shown in Figure 14b. Place the hitch over the end of the object and pull the long end in any direction.

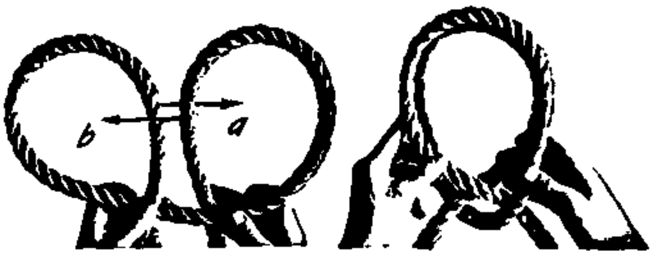


Figure 14a Figure 14b

Slip-over clove hitch

THE BOWLINE

The bowline has been rightfully called the king of knots. See Figures 15a - 15e. This knot is probably used more than any other, for it never slips and is always easily untied. It can be used wherever a loop is desired in the end of a rope. It may be tied as follows: Place the end of the rope through a ring or around an object. Throw a bight, having the long portion of the rope on the side of the bight nearest you, as shown in Figure 15a. Move the end of the rope through the bight in the direction shown in Figure 15b. Bring the end of the rope around the long portion, as shown in Figure 15c. Next, push the end of the rope up through the bight, as illustrated in Figure 15d. The finished knot is shown in Figure 15e.

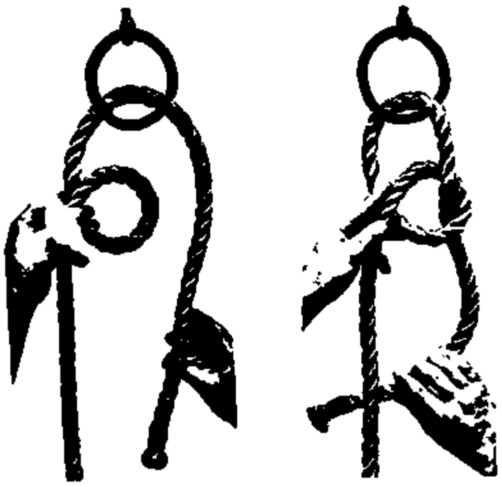


Figure 15a Figure 15b

First steps in tying a bowline knot

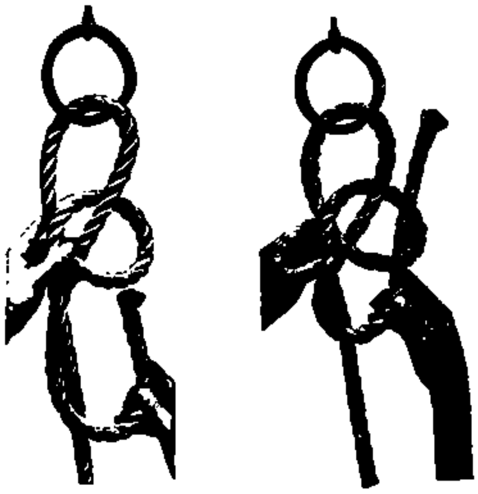


Figure 15c Figure 15d

Completing a bowline knot

THE BOWLINE ON A BIGHT

The bowline on a bight is used to form a loop at some point on a rope other than at the end. Like the ordinary bowline, it is easily untied. It is made as follows: Tie an overhand knot in a doubled portion of the rope, as shown in Figure 16a. Bring the loop back over the knot, as shown in 16b, and then pull the loop out through the knot as shown by the hand in 16c. The finished knot is shown in 16d. This knot is extensively used for rescue work and also to form a saddle sling for lowering men into manholes and similar places.

Figure 16a

Figure 16b

Figure 16c

Figure 16d

Bowline on a bight

THE CHIMNEY HITCH

The chimney hitch, shown in Figure 17, is used to obtain a tight line, or to rescue objects. It is made as follows: After the free end of the rope is passed around an object, it is brought back alongside the standing line. The free end is then passed over the standing line and between the lines. This is repeated, but on the third time around, the free end is cinched in behind the first turn. A "safety" or "binder" is then put out in front on the single line. The entire knot, thus formed, can be slipped along the main rope to take in or let out slack; it will hold its position wherever it is set.

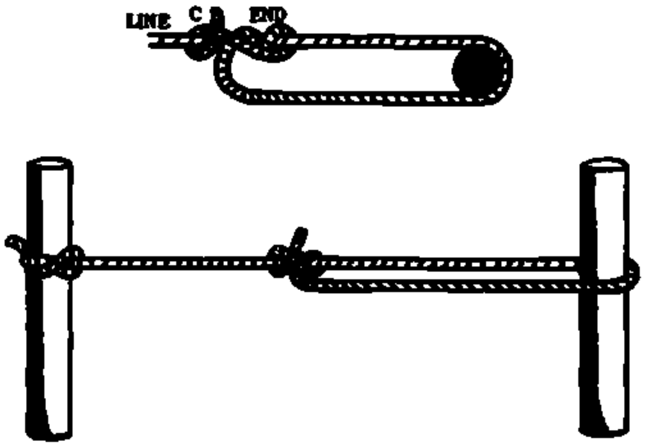


Figure 17

Chimney hitch

THE SHEEP SHANK

The sheep shank, shown in Figure 18, is a hitch used to temporarily shorten or strengthen a defective section of rope. It is tied in the following manner: Make two loops in the rope as shown in Figure 18a. Make a bight in the main part of the rope near the loop A. Push A through this bight, as shown in Figure 18b. Likewise, make a bight in the main part of the rope near loop B, and push B through this bight. The complete hitch is shown in Figure 18c.

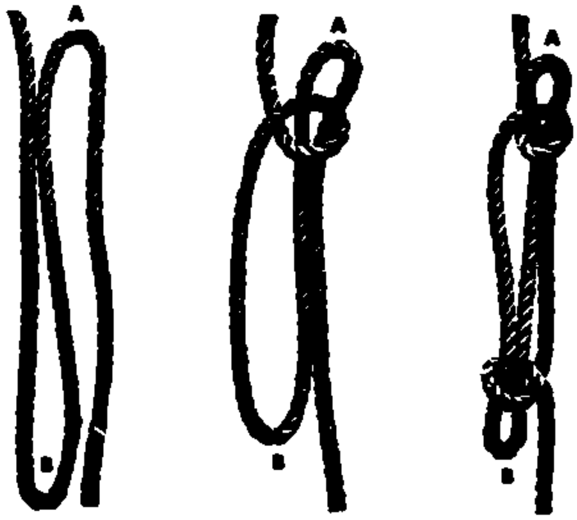


Figure 18a Figure 18b Figure 18c
Sheep Shank

THE BECKET KNOT

This tie is usually used to fasten two ropes of different sizes together. The procedure is shown in Figure 19. Make an open bight with large rope A. Take small rope B around back of rope A, bring rope B over rope A, and pass beneath original rope B. Draw knot tight.

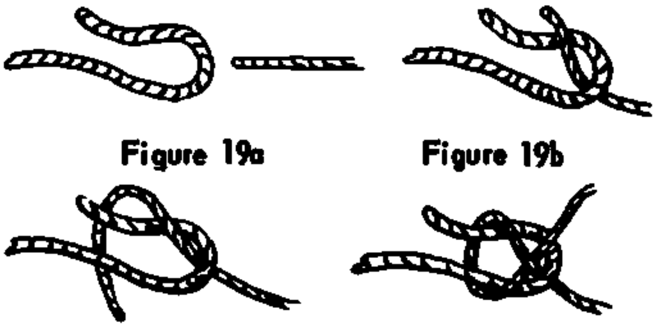


Figure 19a Figure 19b
Figure 19c Figure 19d
Tying a Becket knot

ROPE SPLICING PRINCIPLES AND TECHNIQUES

It has been found that a rope that breaks usually has weak spots other than at the point at which it broke. Rope that has become weakened in small areas can be reclaimed by removing the weak portion and splicing the remainder together. Only in case of dire need should a rope be spliced for use in the rescue service. For general use, other than for emergencies, ropes may be spliced.

This section describes how to follow the principles of rope splicing:

1. Unlaying the strands
2. Placing the ends together
3. Tucking the ends of the strands

In the short splice, the long splice, and spliced crown, the ends of the strands are tucked in exactly the same way. Therefore if the making of one splice is mastered, the others are easily learned.

THE SHORT SPLICE

Where it is not necessary for a rope to pass through a small pulley, or where only a small amount of rope can be spared for making a splice, the short splice is very satisfactory as it is as strong as the long splice. The method of making it is as follows: Count seven turns of the strands from the ends to be spliced and tie strings around the ropes at these points. One turn of a rope is that part shown in Figure 20a at A. Unlay the ends back to the points where the strings are tied, as shown in Figure 20a.

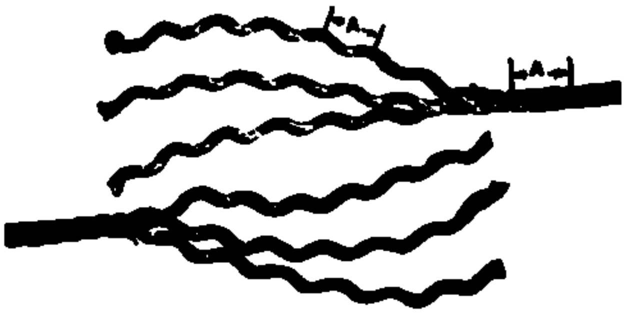


Figure 20a

Before placing the two parts together, be sure to open each end as shown in Figure 20b and not as shown in Figure 20c.

Figure 20c

Figure 20b

Bring the two parts together so that each strand of one part alternates with a strand of the other as shown in Figure 20d.

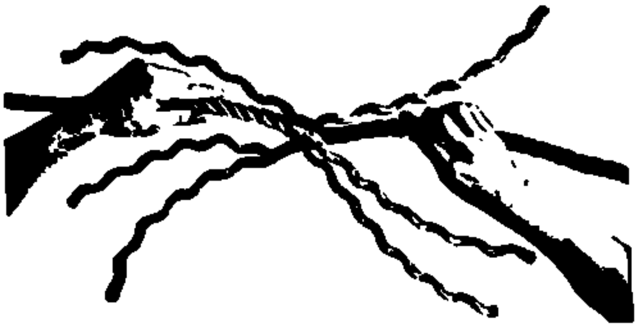


Figure 20d

With a string, tie one set of strands around the rope, as shown in Figure 20e at A.

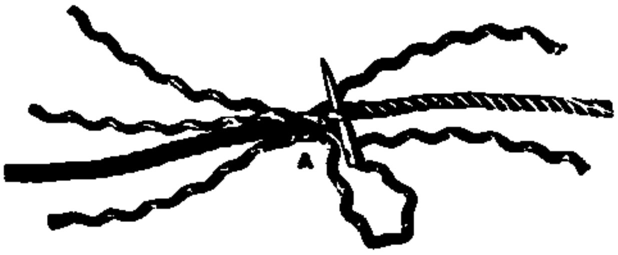


Figure 20e

Next, begin tucking the strands from the left side by bringing a strand from the right side down under the next, as shown by the marline spike in Figure 20e. The tucking should be done at right angles to the direction of twist in the rope.

Give each of the other two strands from the left side one tuck in exactly the same manner. The splice should now appear as shown in Figure 21a.

Figure 21a

Next, cut the string shown in Figure 21a at A and give each strand from the right side one tuck, just as was done with the strand from the left.

Figure 21b shows all the strands tucked once. Give each of the six strands two more tucks, always remembering to bring the strand to be tucked over the one nearest to it and under the second, in a direction about at right angles to the direction of the twist in the rope.

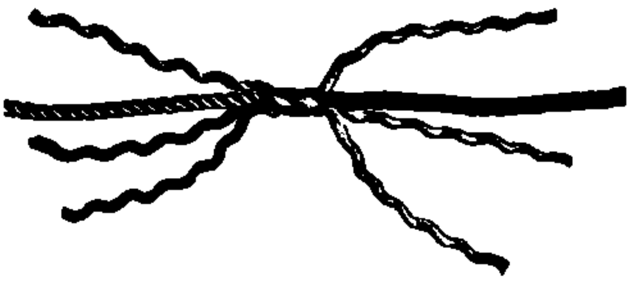


Figure 21b

Next, divide each strand into two parts, as shown in the left of Figure 21c. Give one part of each strand two more tucks.

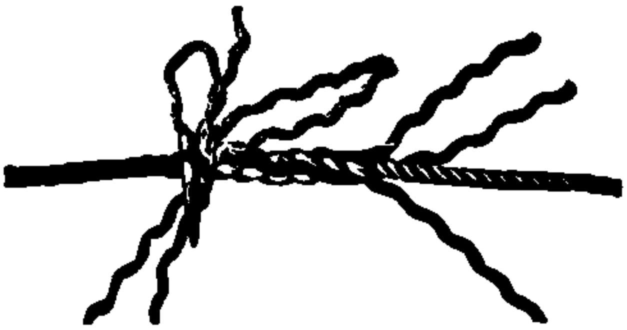


Figure 21c

Cut all the ends off and roll the splice beneath the foot on the floor or between boards to give it a smooth appearance. The finished splice should appear as shown in Figure 21d.

Figure 21d

THE LONG SPLICE

The long splice is more desirable than the short splice when it is necessary for the rope to pass through small pulleys. It also has a neater appearance. To make a long splice in a three-strand rope, count fifteen turns from the ends to be spliced and tie strings around the rope at the points thus determined. Unlay the strands back to the strings, as shown in the lower part of Figure 22a.

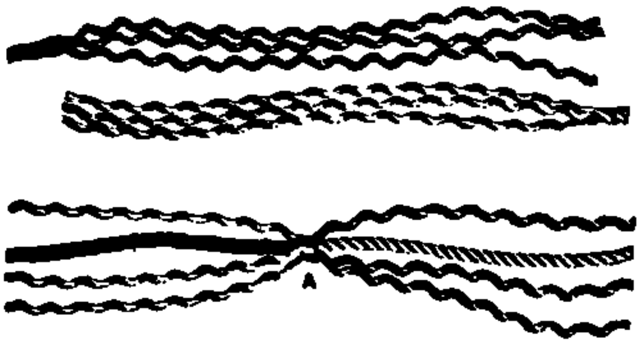


Figure 22a

Long splice

Before bringing the two parts together, be sure to open each end as shown in Figure 21b of the short splice and not as shown in Figure 21c; that is, no strand should cross between the other two.

Bring the two parts together, making each strand from one end alternate with a strand from the other, as shown in Figure 22a at A.

Next, beginning at the point where the two parts are placed together, unlay one of the strands to the right. Lay carefully in its place the corresponding strand from the left. This latter operation should follow closely the unlaying of the strands to the right. Stop at five turns from the end of the strand from the left, as shown in Figure 22b at B.

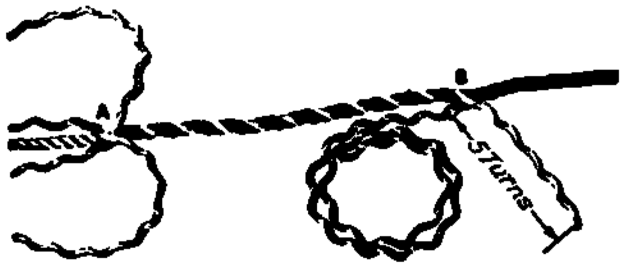


Figure 22b

There are still two pairs of strands left at point A where the two ends were placed together. Run one of these pairs to the left exactly as the first pair was run to the right. This is shown in Figure 22c at C.

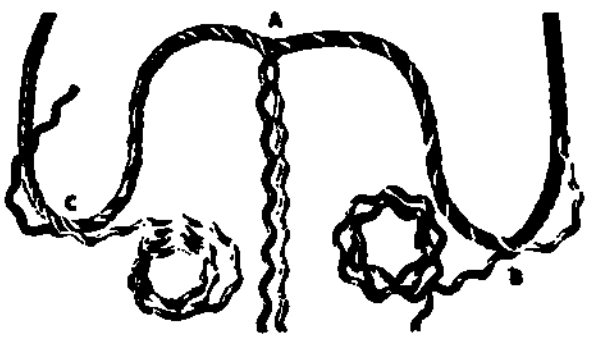


Figure 22c

Before starting to unlay toward C, Figures 22c and 22d fit together as a pair. Next, cut off all the long ends of the strands about five turns from the main rope, as shown in Figure 22d.

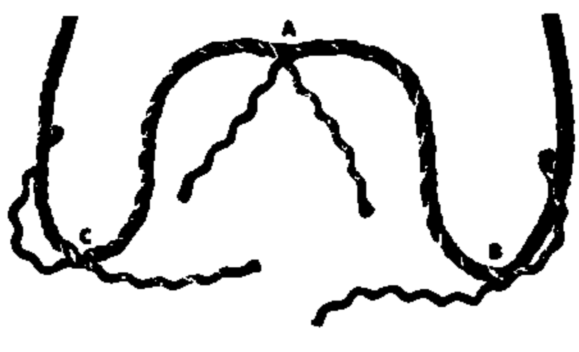


Figure 22d

The next part of the splicing consists of tucking the ends of the strands. There are three strands. All are tucked in exactly the same way, which is as follows: Be sure that the ends of the strands pass each other as illustrated in Figure 22e at A and not as at B.

Figure 22e

Bring the strand from the right up over the nearest strand from the left and under the next strand, as in Figures 22f and 22g.

Figure 22f

Figure 22g

Give the strand from the left one tuck, as shown by the marline spike in the upper part of Figure 22h.

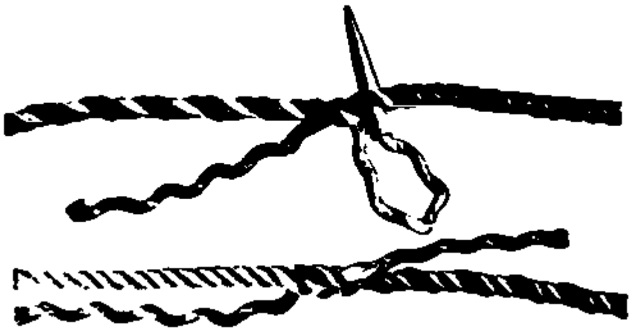


Figure 22h

Each strand should now be given two more tucks in a direction almost at right angles to the direction of twist in the rope as shown in Figure 22i.

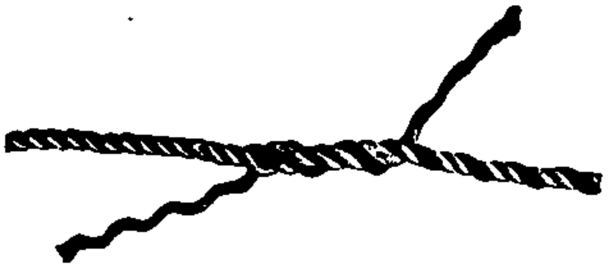


Figure 22i

When all three pairs of strands have been tucked, cut the ends off and smooth by rolling beneath the shoe or between two boards. The finished splice should appear as shown in Figure 22j.

Figure 22j

THE SPLICED CROWN

Where a slight enlargement is not objectionable, the spliced crown is a desirable way to finish the end of a rope. See Figure 23. It is made as follows: Unlay six turns of the rope. Form a loop in strand A, bringing the end between strands B and C, as shown in Figure 23a. Next, move strand C between the loop in strand A and strand B, as shown in Figure 23b. Pull strand B through the loop in strand A, as indicated in Figure 23c. Draw up tight the crown thus formed, as in Figure 23d. Give each strand one tuck by bringing it over the strand nearest to it and under the second as in rope splicing. This is shown in Figure 23e. Figure 23f shows the first tuck complete. Give each strand two more tucks and cut off the ends of the strands. Smooth the crown by rolling beneath the foot on the floor. The finished crown is shown in Figure 23g.

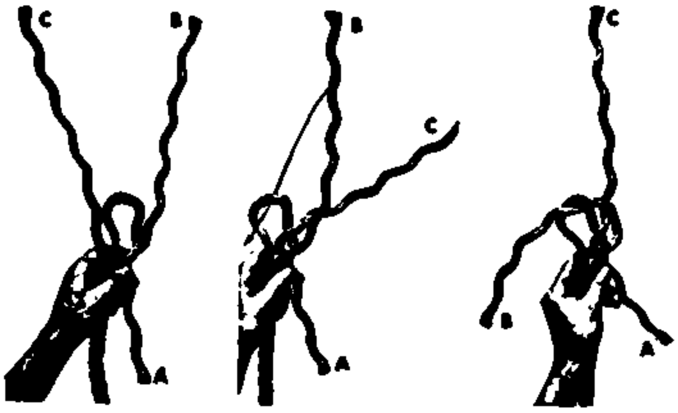


Figure 23a Figure 23b Figure 23c

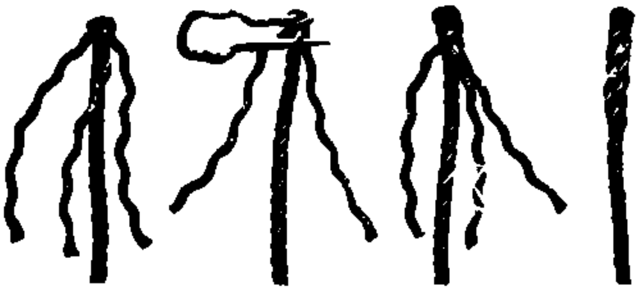


Figure 23d Figure 23e Figure 23f Figure 23g

Spliced crown

ROPE COILS

In the rescue service, a knowledge of how to coil a rope correctly is essential. Many times an improperly coiled rope may result in the failure of an evolution. A rope coiler should be made and should be in service at squad headquarters at all times. Figure 24 shows a method of making a convenient rope coiler. However, any type of coiler may be used.

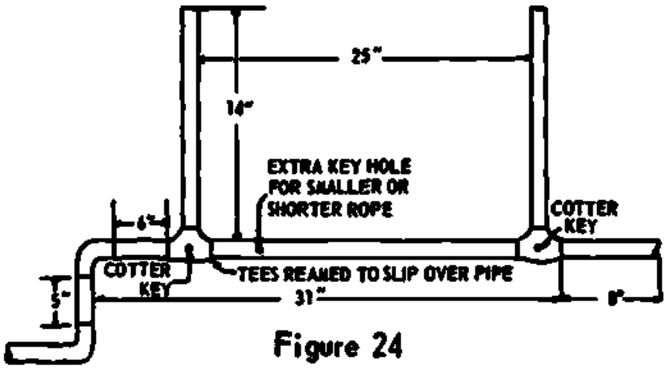


Figure 24

Detail of rope coiler

In starting the coil, face the "coiler," but somewhat to the right. See Figure 25. Hold a short length of the free end of the rope inside the left coiler shaft with the heel of your left hand resting on the shaft. Take one short turn around the left shaft, then make long loops over and under both shafts.

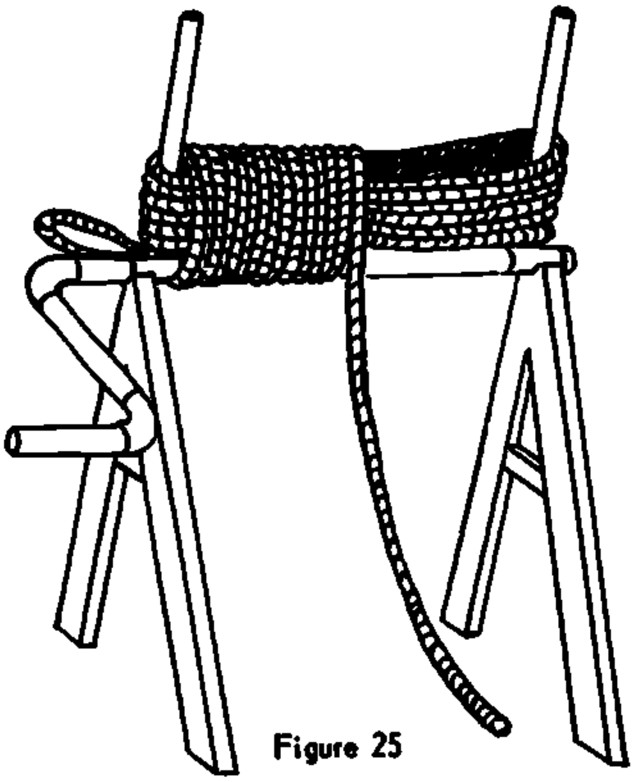


Figure 25

Rope coiler

Coil the rope around the shafts of the coiler until a sufficient amount of rope is used. See Figure 26. This amount can be determined only by trial.

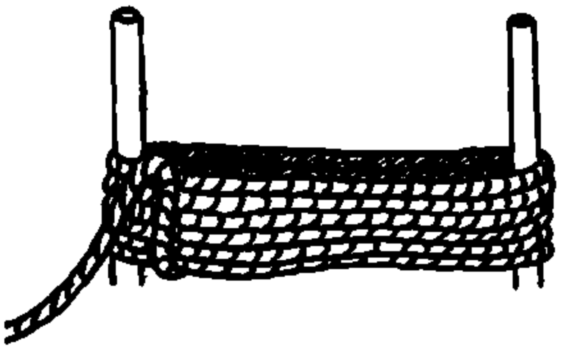


Figure 26

Begin to coil

Next, coil the rope in the opposite direction, as shown in Figure 27, by turning the coiler in the frame.

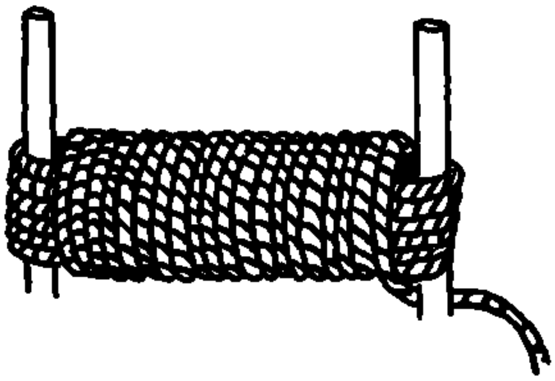


Figure 27

Coil in opposite direction

When the wrap is finished, as shown in Figure 28, remove the coiler shafts, handling the coil with care. Now double the remainder of the rope and pass the loop through the opening in the end of the coil, as shown in Figure 28, then through the opposite end of the coil.

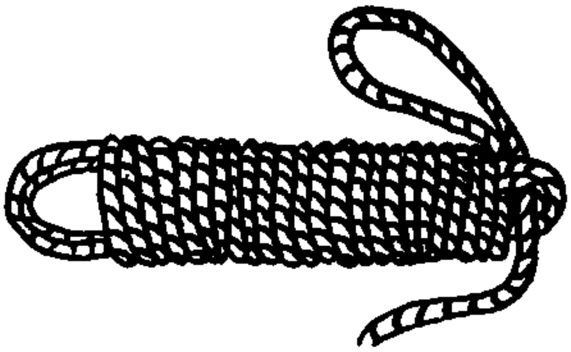


Figure 28

Finished coil

Next, insert the loose ends of the rope through the loop and pull the loop up tight. See Figure 29.

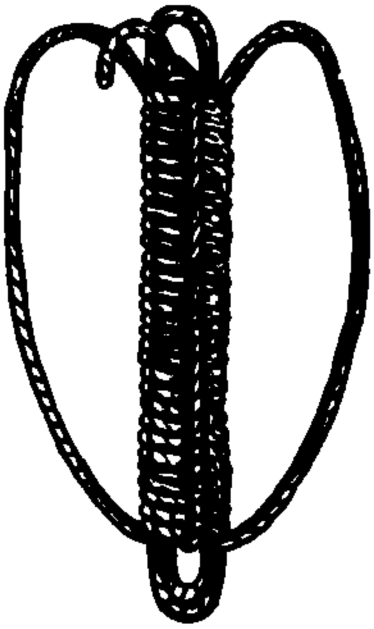


Figure 29

Coil finished and ready for carrying

If the lengths are right, the loops formed will be large enough to permit a man to load the coil on his shoulders, as shown in Figure 30. The shoulder loops may be adjusted by shortening the loose end of the rope. To undo the shoulder loops quickly, grasp the free end near the center of the coil and pull away from the coil, thus unlocking the end, and continue pulling until the shoulder loops come clear of the coil. This long end is dropped with the coil.

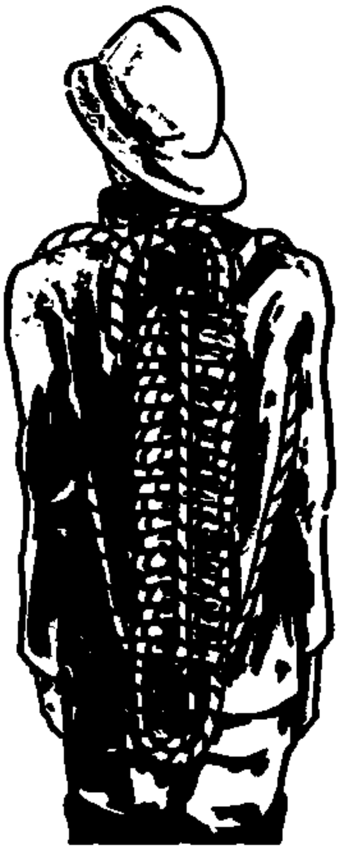


Figure 30

Carrying coil

When dropping the coil from a height, grasp the inside free end and pull several feet out from the core. Retain this aloft. When pulling out on the ground, also pull out the core first.

COIL FOR THROWING ROPE

At times it becomes necessary to throw a rope from a roof, upper story, or over an object. There are several ways in which rope can be coiled for throwing. A good method is as follows: Coil several loops not over 18 to 20 inches long, like A in Figure 31. Carry the next loop through the slack and up to make loop B. Then hold loop B in the right hand with loop A hanging in loop B at D. Next, coil a series of small loops about 12 inches in diameter on top of loop B in the right hand. The rope is now ready to throw. Practice is necessary to throw accurately and to determine the amount of coiled rope necessary for the distance to be covered. Rope will straighten out completely on the throw.

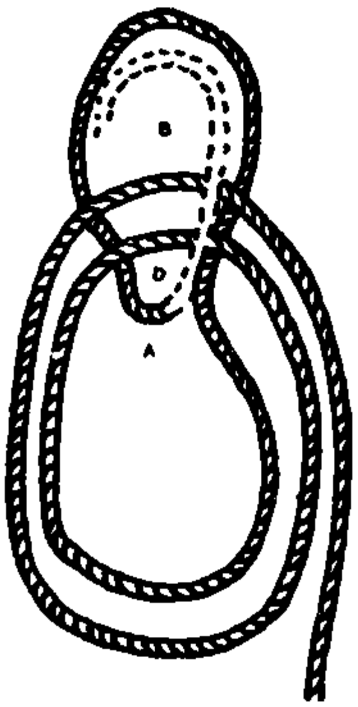


Figure 31
Coil for throwing rope

SUPPLEMENTARY ILLUSTRATIONS OF KNOTS AND HITCHES

In the preceding section, detailed instructions were given on tying the various knots and hitches used in rescue service. Very little information was given, however, as to their actual use. Figures 32 to 38 illustrate actual usage of several of the knots and hitches as well as additional ways of making some of them.

Figure 32
Hoisting uncharged line with running bowline

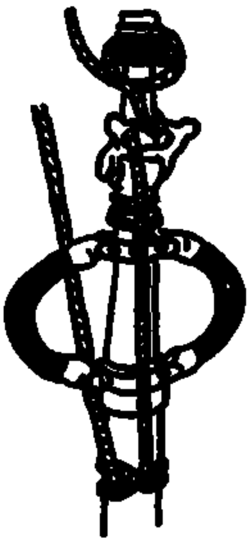


Figure 33
Hoisting charged line with clove hitch & half hitch - Method 1

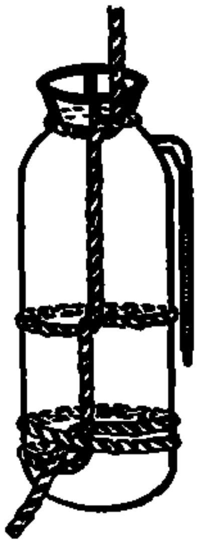


Figure 35
Hoisting extinguisher

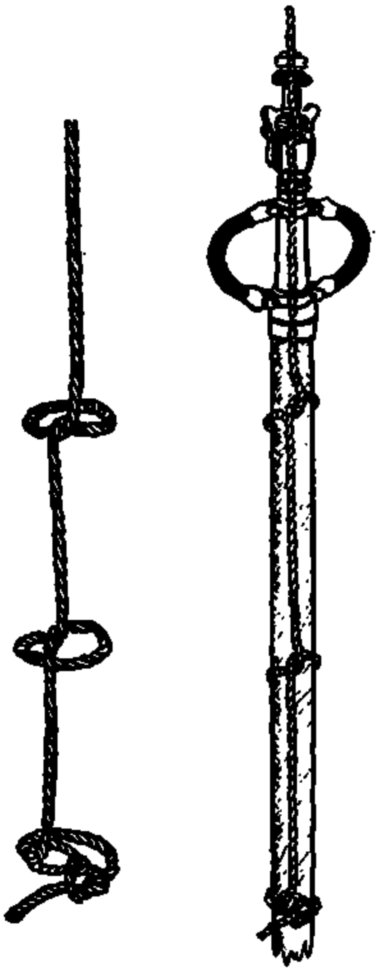


Figure 34
Hoisting charged line with bowline and half hitches - Method 2

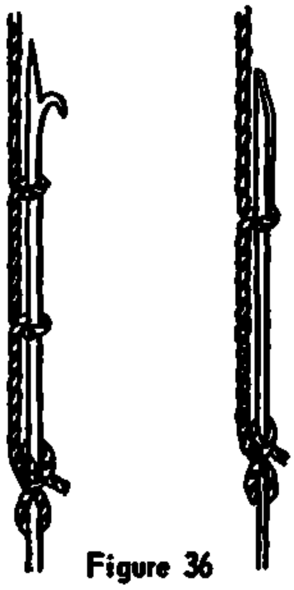


Figure 36
Hoisting pike and bar

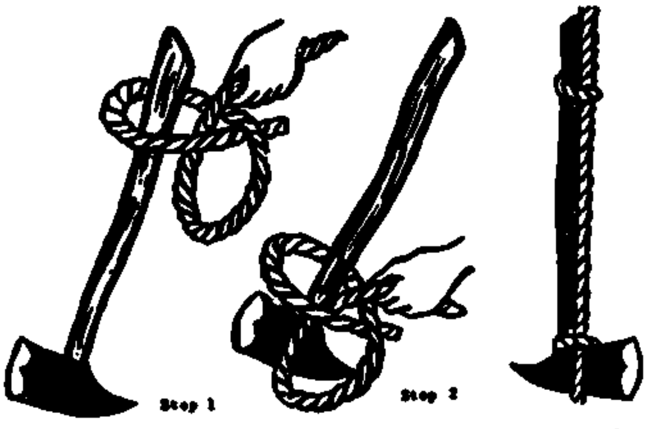


Figure 37
Hoisting axe

The tackle knot shown in Figure 38 is a hitch used for pulling operations when blocks are not available, or for stretching a tight line. If used for the latter purpose, the pull rope should be taken back and tied around both parts A and B using the chimney hitch.

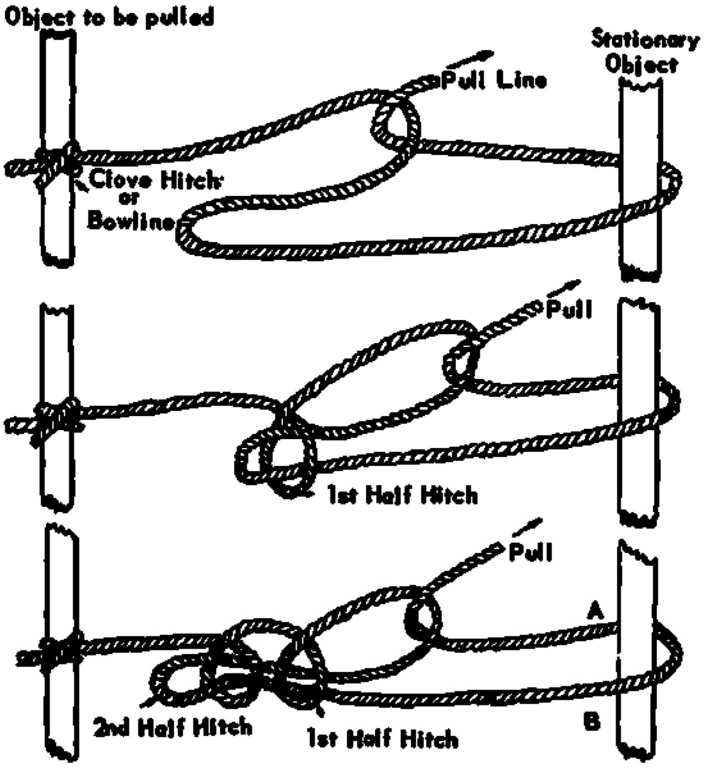


Figure 38

Tackle knot

For hoisting ladders with a bowline, follow the procedure in Figure 39. The tie is made at about one-third of the length of the ladder from the top end. Start rope around beam and out the front side and continue with rope around opposite beam, bringing it out behind the cross rope.

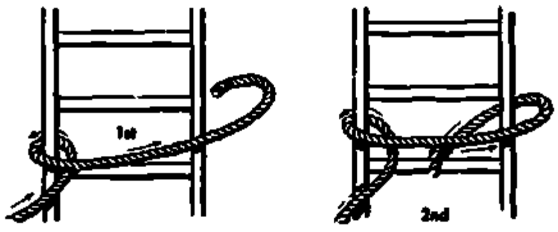


Figure 39a Figure 39b

First steps in hoisting ladder using bowline

Next, a bowline is made with the hand next to the ladder while facing the top.

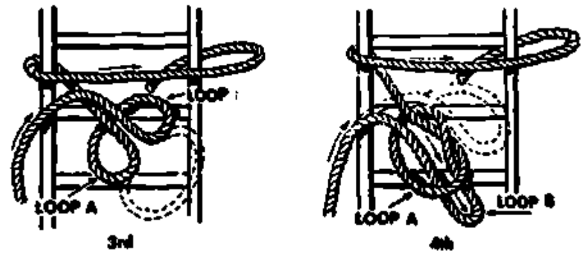


Figure 39c Figure 39d

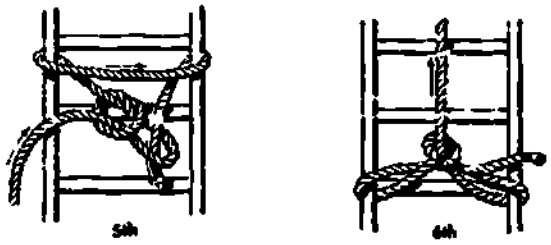


Figure 39e Figure 39f

Completing hoisting ladder using bowline

Pull the knot taut. It will lie just above the cross rope. When using this hoist, turn the ladder over so the knot is between the ladder and the building. When hoisting roof ladders the tie should be made on the third rung above center.

CABLE

Cable, sometimes called "wire rope", is usually made of iron or steel. To obtain the maximum usefulness, economy, and safety from a cable, several simple rules must be observed.

It is normal for iron or steel to corrode or rust when exposed to the air for long periods. Therefore it is necessary to take precautions to protect iron cable from the elements. Some manufacturers do this by galvanizing and other coating processes, which make the cable less susceptible to atmospheric conditions.

Although lubrication is applied to cable during fabrication, it is not sufficient to last during the cable's entire useful life. A good grade of oil or grease, free from acids and alkalies, should be applied periodically.

A wire cable is a machine of many moving parts. Each time the cable bends or straightens, the wires in the cable slide on each other. The lubricant must be able to penetrate between these strands. A rusty cable is a liability; therefore cables should be kept clean and free of rust by the use of scrapers and wire brushes.

Contact with chemicals, alkalies, and acids which destroy the metal or internal core, should be avoided. Cable should be stored in a dry place and must be inspected periodically for breaks, damage, weakness, and wear.

BLOCK AND TACKLE

This equipment is used in rescue work to provide a mechanical advantage in raising or moving heavy objects. A block and tackle consists of two blocks, usually connected together by as many strands, or reeves, of rope as there are sheaves in the blocks. (See Figures 40 and 41 .)

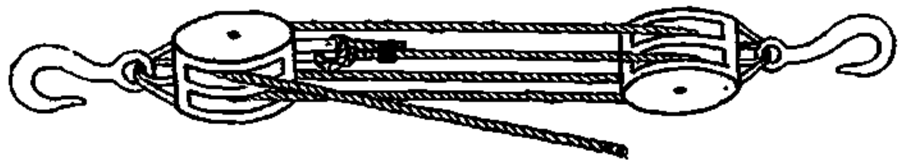


Figure 40
Block and tackle with double-to-double reeving

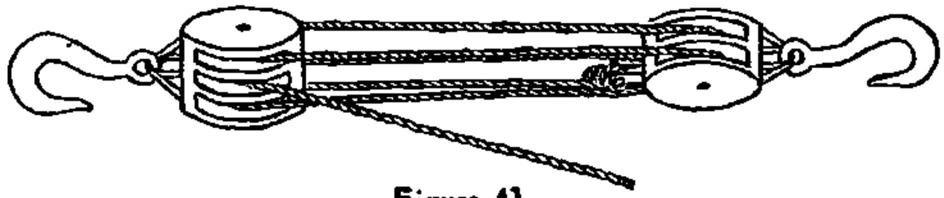


Figure 41
Block and tackle with triple-to-double reeving

The number of strands of rope which support the weight or load determine the mechanical advantage ratio. For example, to raise a 500-pound load, the effort required on the pull line of a three-and-two combination tackle (excluding friction) is 100 pounds.

An ordinary or straight block and its component parts are shown in Figure 42.

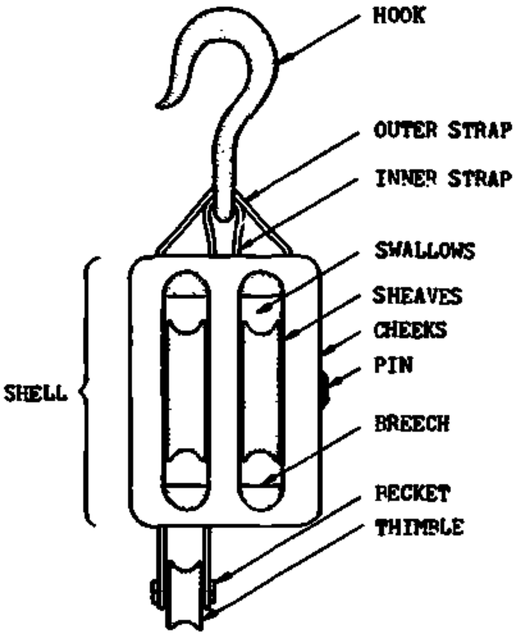


Figure 42
Straight block

Figure 43 shows a snatch block, generally used in rigging operations to achieve a change of direction in pulling. It consists of a single block with an opening and locking device on one side to permit the rope to be inserted.

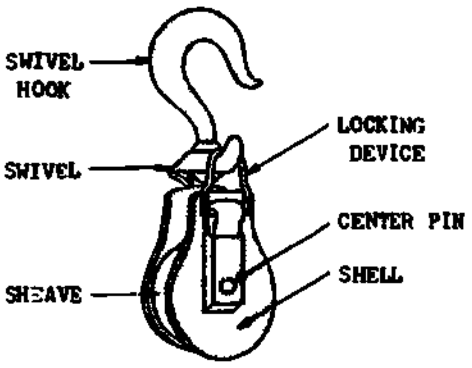


Figure 43
Snatch block

Often additional precautions must be taken to prevent a rope or sling from slipping or jumping out of a hook. Precautions are needed when a person is being raised or lowered, when his weight might surge during an operation, or while he is being supported temporarily before beginning the operation. This safety practice is called "mousing" a hook. A piece of cord or heavy twine is wrapped around the opening in the hook and is secured by a square knot. (See Figure 44.)

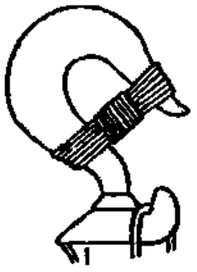


Figure 44
Moused hook

POLES

GIN POLE

The lifting of heavy loads or victims in rescue operations is often accomplished by the use of a gin pole. (See Figure 45.)

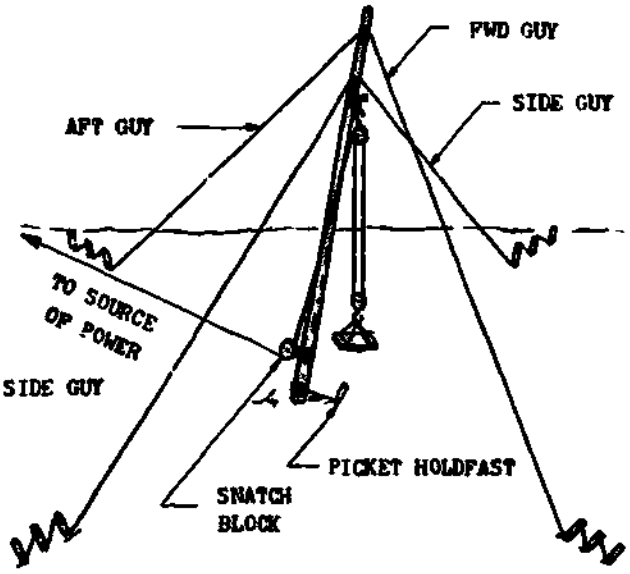


Figure 45
Gin pole

A gin pole usually consists of a single pole held in a nearly upright position by four guy lines. The tackle is attached to the single pole. The pole may be made from any timber, which must be chamfered at the top or designed in some other manner for the attaching of the tackle. In general, the shorter the length of the pole bearing the load, the greater will be its capacity.

A block and tackle is lashed to the top of the pole. The hauling part of the tackle leads through a snatch block at the base of the pole to the source of power. Details of typical lashings are shown in Figures 46 through 48.

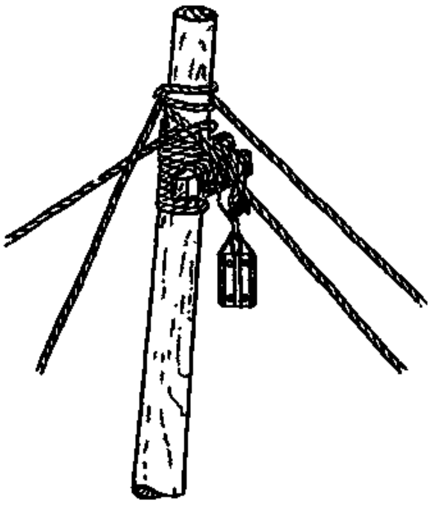


Figure 46
Square lashing top of gin pole

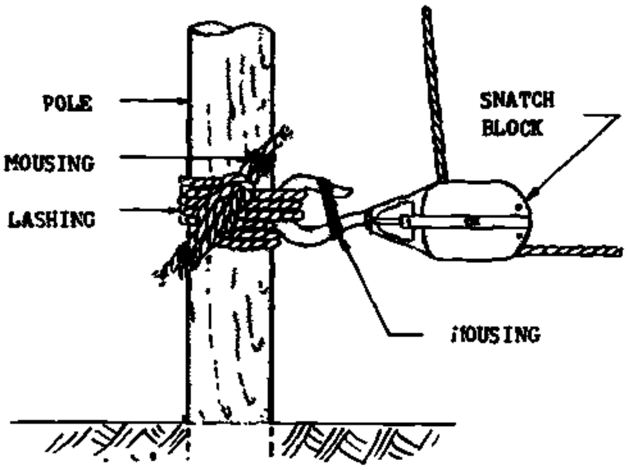


Figure 47
Round lashing base of gin pole

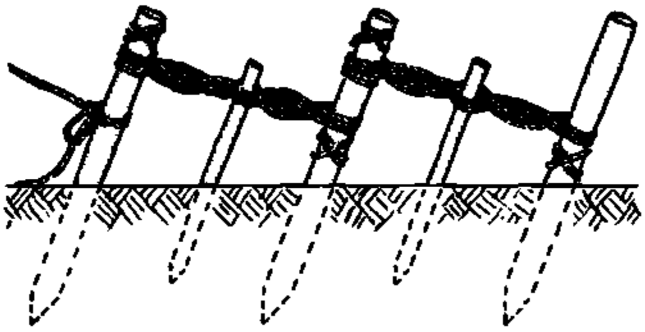


Figure 48
Pickets or holdfasts

LADDER GIN POLE

When suitable poles and timbers are not available, ladders may be used to rig gin poles and sheerlegs.

Figure 49 shows a ladder gin pole. It can be set up as follows:

1. Attach a rope or sling around the rails near the top of the ladder to support a block and tackle.
2. Fasten two guy lines to the ladder, one on each rail where the sling is secured.
3. Raise the ladder to the desired position, and anchor the guy lines. (See Figure 49.) If necessary, anchor the ladder at the bottom to keep it from slipping.

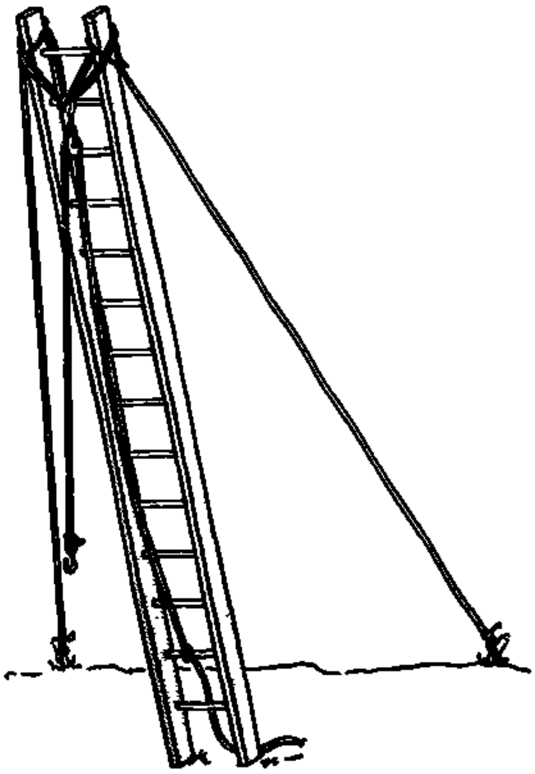


Figure 49

Ladder gin pole

LADDER SHEERLEGS

To erect sheerlegs with ladders, as shown in Figure 50:

1. Place one ladder on top of another and lash the beams together loosely at the top.
2. Turn the ladders on their beams and spread the unlashed ends to form a "V".
3. At the lashings, attach a sling to support the block and tackle, and fasten guy lines at the lashing around the beams on each side.
4. Raise the ladders and anchor the guy lines. Anchor the ladders at the bottom to prevent spreading.

Sheerlegs constructed with ladders cannot be drifted and, like tripods, they are restricted to vertical lifting.

In both of these operations, if speed is of importance, the lines need not be staked out as shown. Men could be assigned to hold the guy lines.

A stepladder can be easily and quickly assembled by tying two straight ladders together, as shown in Figure 51. A tie line must be used at the bottom to keep the ladders from spreading. The rope should be attached to the bottom rungs of each ladder and fastened securely with clove hitches at each end.

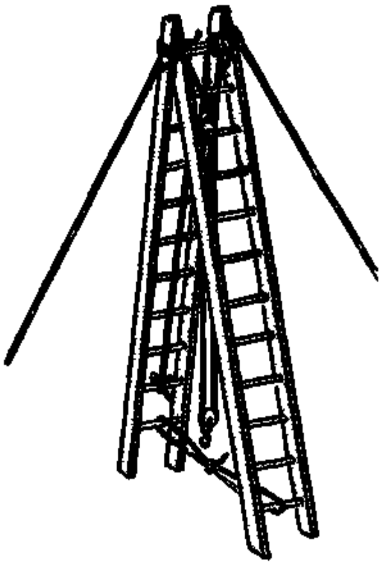


Figure 50

Ladder sheerlegs

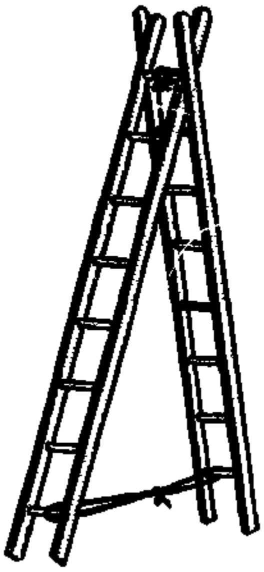


Figure 51

Assembling stepladder

VICTIM RESCUE

BODY TIE AND HARNESS

A good method for securing a victim, when he is to be either raised or lowered, during rescue, is the "Approved Body Tie". (See Figure 52.)

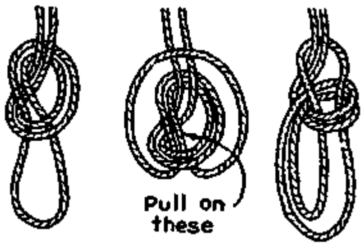


Figure 52a

Bowline on a bight adapted for body tie

This tie is an adaptation of the bowline on the bight. In tying it, about three feet of free end must be left outside the knot. Either loop of the bowline is slipped over each leg of the victim to be rescued. Take care to draw these loops as far up to the crotch as possible. Then, throw a half-hitch under the arms. Throw a bight in the standing line in front of the chest. Then pass the loose end of the rope through the bight. The line is then drawn tight, making a firm knot.

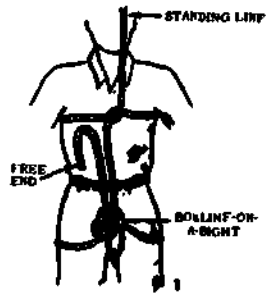


Figure 52b

Start of body tie

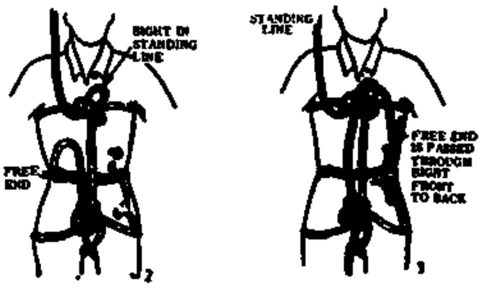


Figure 52c **Figure 52d**

Body tie complete

Another method for raising or lowering victims is by the use of a body harness. The harness has the advantage of being easier and less time-consuming to place on the victim. Figure 53 shows a sketch of one type of harness. Figure 54 shows the harness in place.

Courtesy Lynhurst F.D.

Figure 53

Body harness

Courtesy Lynhurst F.D.

Figure 54

Body harness in place

SUSPENDING VICTIM HORIZONTALLY ON STRETCHER

A victim on a stretcher may be raised or lowered while in a horizontal position, using either a one-point suspension method or a four-point suspension method. The first method is especially useful when lowering or hoisting victims several floors, and when using lifting devices such as derricks and gin poles. (Fire department aerial ladders can sometimes be used for this purpose. A separate section on aerial ladder rescue can be found in this manual.) The four-point method is more useful for shorter distances.

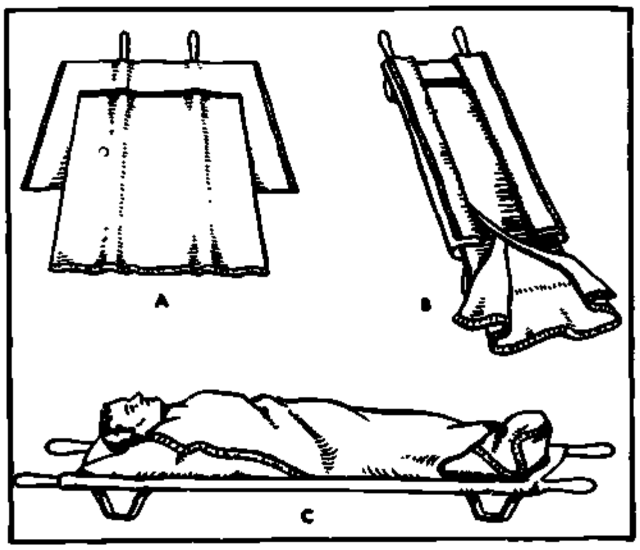


Figure 55

Method of wrapping victim

In preparing to lower a victim horizontally, first wrap him in a blanket or salvage cover. (See Figure 55.) Lash him securely to the stretcher, starting with a clove hitch on one of the handles near the head. Then pass the rope partway down one side of the stretcher, taking a complete turn underneath and back over the victim's chest, and making a half-hitch at the side. Extend the rope on down the side of the stretcher, making at least two more turns, one just above the knees and one just at the wrists with hands at side. Then pass the rope around the victim's feet, bring it up on the opposite side of the stretcher, and secure it with a clove hitch. (See Figure 56.)

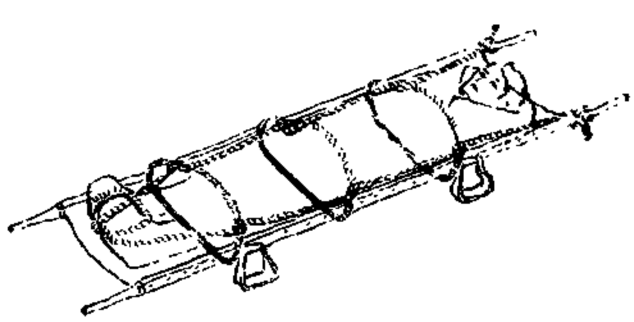


Figure 56

Victim tied on stretcher

After a victim is securely lashed, he may be moved by the one-point suspension method using another rope. Measure three times the length of the stretcher, plus one arm's length. Double the rope and tie a bowline on a bight. Lay the rope on the middle of the stretcher and draw the two loops even. Then pass the large loops over each end of the stretcher and put smaller loops over each handle. Secured in this manner, the stretcher may be raised or lowered without tilting. Guide lines may be attached to the stretcher when necessary. (See Figure 57.)

To use the four-point suspension method, first lash the victim as previously explained. Instead of using the bowline on a bight, fasten a lashing line to each handle of the stretcher with a half-hitch and secure the line to the "D's" with a bowline. Four men are needed in hoisting or lowering, one man to control each line. Men should wear gloves to prevent the ropes slipping or burning their hands. Where a stretcher is to be hoisted or lowered only a short distance, forty-foot lashing lines may be used. (See Figure 58.)

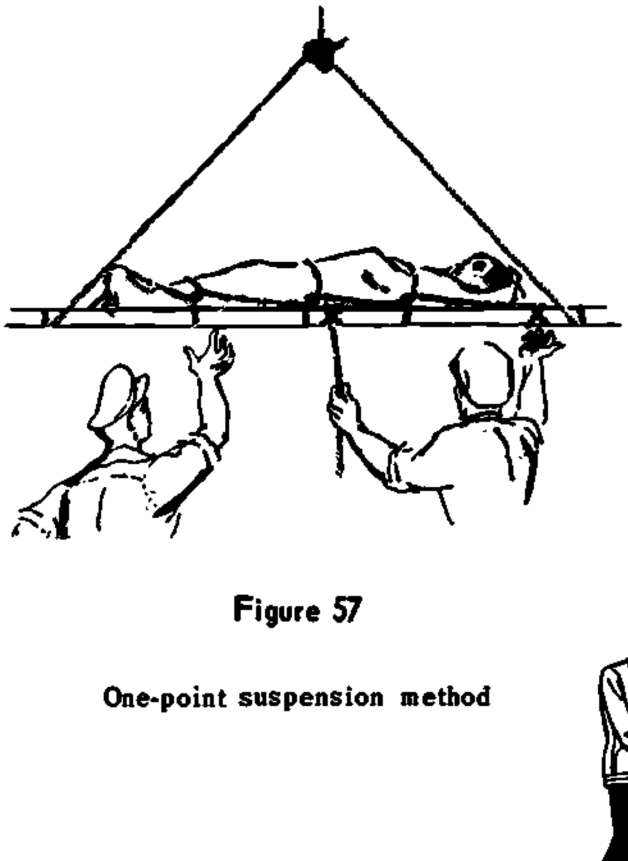


Figure 57

One-point suspension method

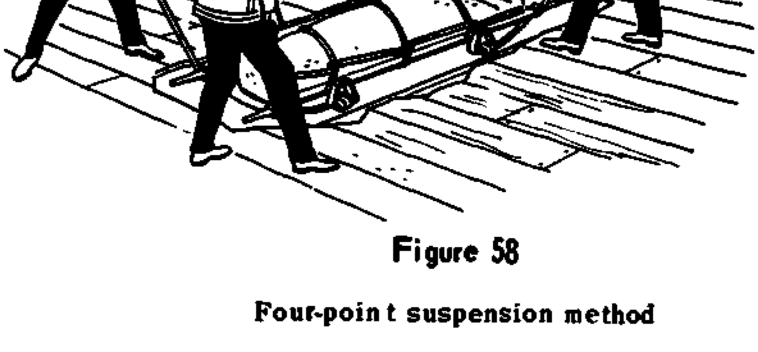


Figure 58

Four-point suspension method

If a ladder is substituted for a stretcher, either the one-point or four-point suspension method may be used. In either case, the victim must be lashed securely, as shown in Figure 59.

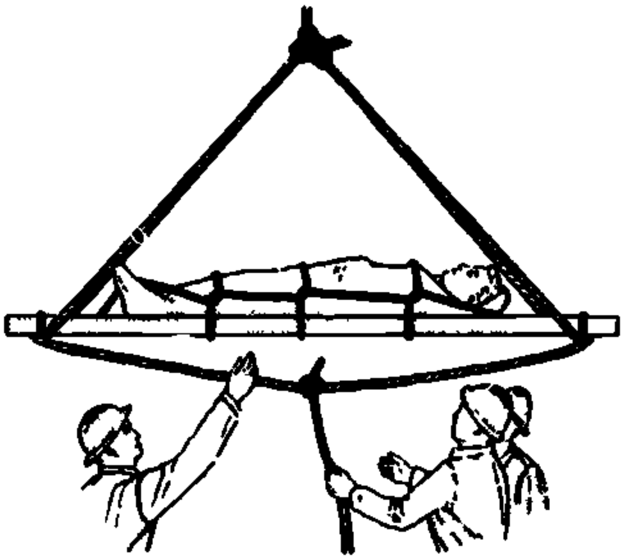


Figure 59

Secure lashing of victim

SUSPENDING VICTIM VERTICALLY

Frequently victims must be lowered feet first because the only available opening is narrow. Several methods may be used to raise and lower victims in a vertical position. The backboard is best for this type of rescue, since the victim can be secured in it and a lowering rope fastened to the head end. When lowering a backboard, attach a guide rope to the lower end sufficient in length to reach the ground.

To lower a victim vertically, first lash him to a backboard as described in Chapter XIII. Secure the lowering line to the hand holds at the head of the backboard by tying a bowline. Attach a guideline to the hand holes at the foot of the backboard.

Figure 60 illustrates the use of a ladder in place of a backboard for lowering a victim vertically.

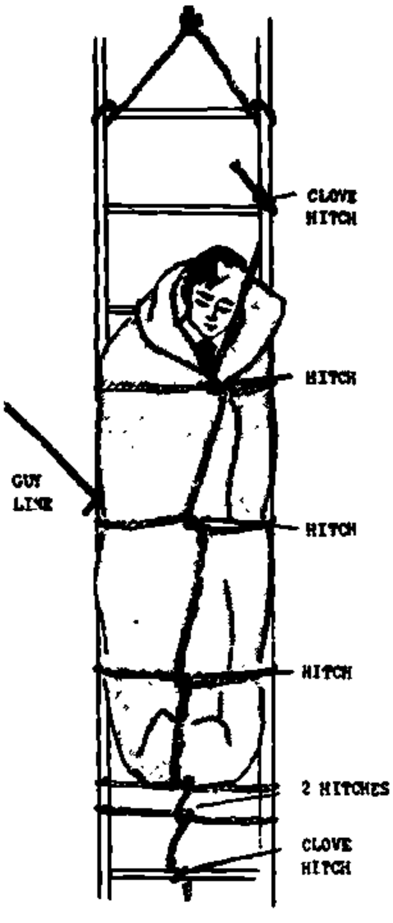


Figure 60

Use of a ladder

Figure 61 shows how a ladder can be used in connection with the vertical method of lowering a victim on an army stretcher. Two poles are run through the "D's" to serve as skids on the ladder beams. Stakes should be driven into the ground at the base of the ladder, and the beams should be lashed to these stakes.

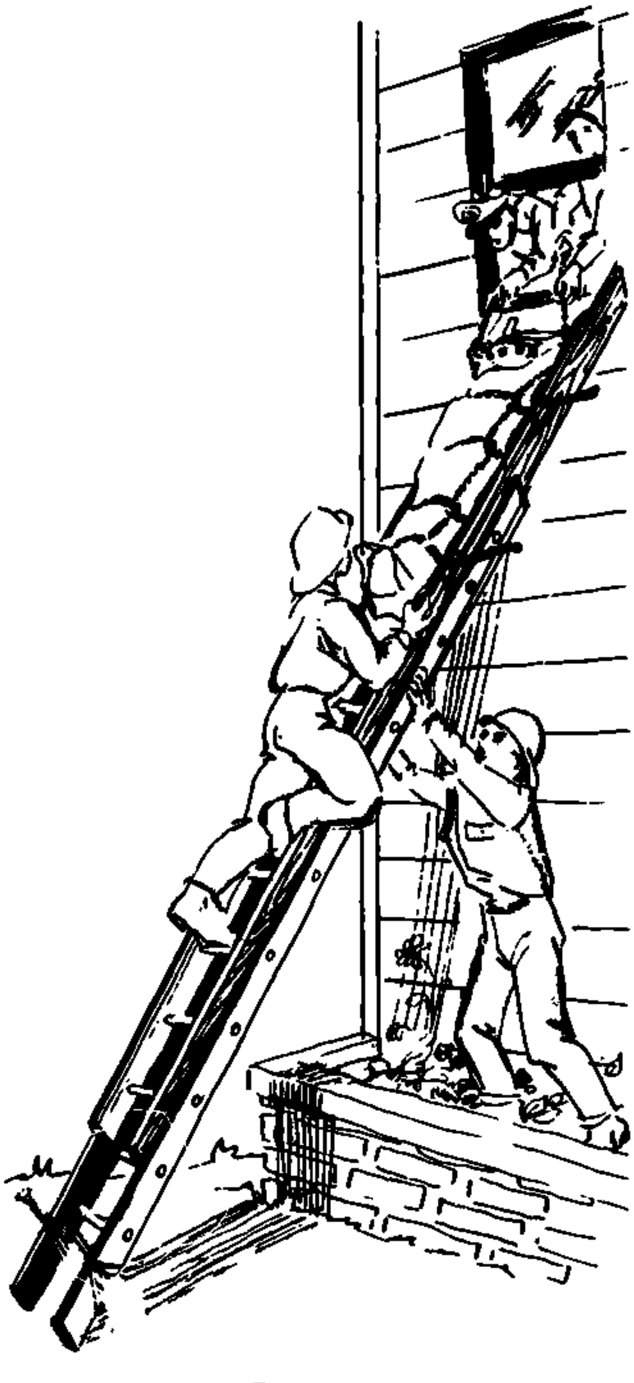


Figure 61

Using a ladder in connection with lowering a victim vertically

MAKING A WIRE RESCUE

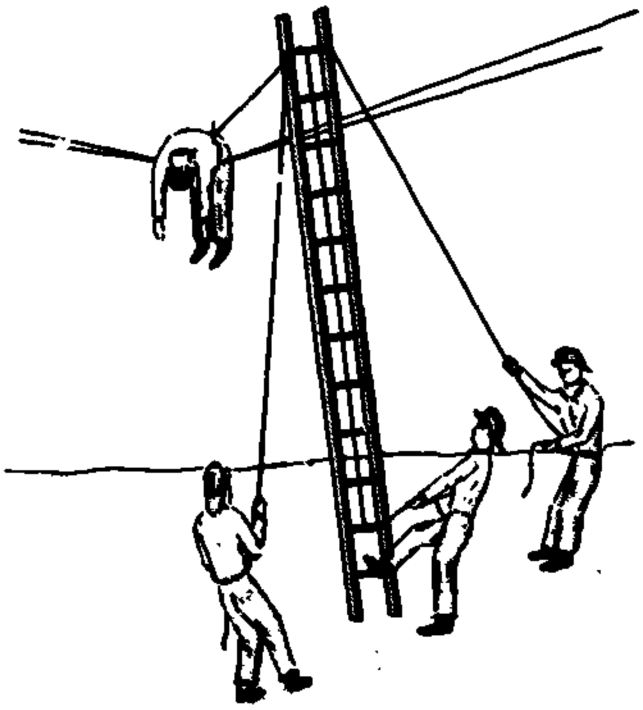


Figure 62

Making a wire rescue

To take an unconscious man off overhead wires, as shown in Figure 62, use a ladder that extends at least five feet above the victim. The ladder is placed climbing side down, with the heels some distance out from the spot directly below the victim. One man doubles a long rope and places the middle of it across the top of the ladder, then tucks it under the top rung, pulls through some slack, and nakes a partial cat's paw over each top end of the ladder beams. Trailing ends of the rope then come off outside of the beams. The rope should be spread to make an angle of about ninety degrees, and the ladder top should be laid in toward the victim. Two squadmen heel the ladder. A third man passes another rope beneath a low rung, pulls it back through at the second rung above, ties a running bowline in the end, and throws this over his shoulder. He climbs above the victim, leg-locks in, passes the rope over a high rung, then drops a lasso loop over the victim. The rescuer then rapidly descends. While he is coming down, the ladder is laid in as closely as possible to the victim. The rescuer pulls the slack out of the rescue rope and snubs it on a low rung. The other rope men slowly pull back on the top of the ladder until the victim is pulled clear of the wires. Care should always be taken so that the ladder does not go past the vertical position.

A metal ladder should not be used for this operation because of the danger of touching the conductor or the possible arcing from a live line.

LOWERING VICTIM FROM A HEIGHT

Emergencies sometimes occur which make it necessary to lower victims from high places. Figure 63 shows one satisfactory method for doing this which is used particularly when the base of the structure is not suitable for lowering the victim vertically. In this method, a sheave block is used on a rope or wire cable sloping from a high part of a building and anchored at or near the ground. A backboard, with the victim, is suspended from the running pulley. A backboard with footrest is the most desirable type for this operation because it facilitates the lashing of the victim securely. Two guide lines are attached at the lower hand holes at the ends of the backboard during its descent. This technique is sometimes referred to as a "breeches buoy" or "Telfar line".

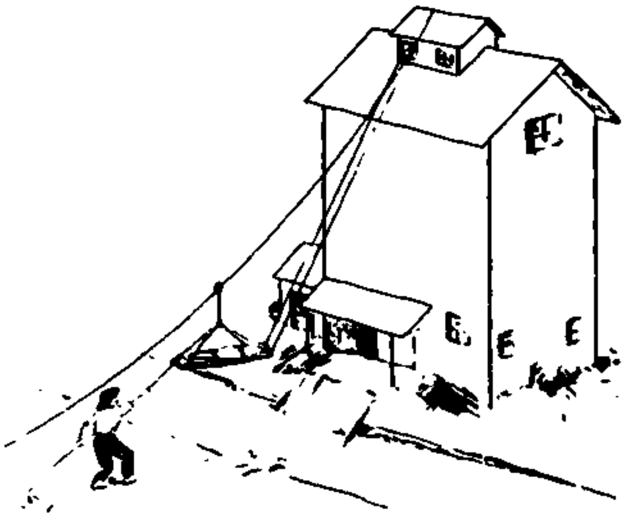


Figure 63

Lowering victim from high places

ACTUAL RESCUE OPERATION

The following is an account of an actual rescue operation as reported by the Chief of the Sylvania Fire Department, Sylvania, Ohio.

On September 7, 1956, the Sylvania Township Fire Department received a call from an elevator company. When we arrived we were told that three men were in a grain pit. The elevator was approximately seventy-five feet high, and the trapped men were about forty feet below the top of the elevator which was also the level of the grain. We had to use a vertical belt conveyor to arrive at the floor. A long five-eighths-inch rope, self-contained masks, and three resuscitators were taken immediately to the floor. A squadman was lowered into the pit by use of a body tie. Since it was suspected, and later verified by test, that there was not enough oxygen to support life in the pit, the squadman wore a self-contained mask.

Another line was used with a body tie to raise the men out of the pit. As we got them out of the pit, we used resuscitators on them. The first two men responded satisfactorily, and were fastened to the belt conveyor and lowered to the ground floor where they were taken to a hospital.

We were unable to bring the third man around. A physician had arrived and was working with firemen on the third victim while the others were being lowered. The victim was strapped on an army stretcher with two-inch-wide webbing. The physician in the meantime, cut an opening into the victim's windpipe to induce breathing. A one-tank resuscitator was strapped on him.

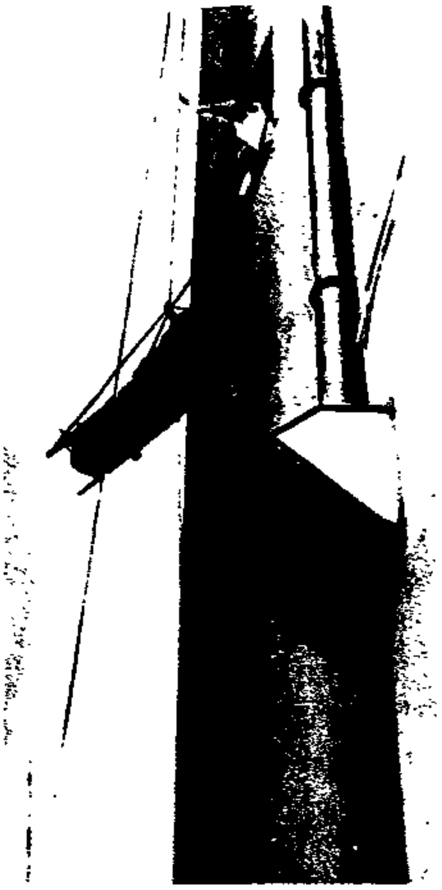


Figure 64

Victim being lowered from grain elevator

To lower him by use of the belt conveyor would mean having to lower him in a vertical position. Therefore, we placed a snatch block to the side, and above a window a three-eighths-inch steel cable about two hundred feet long was placed in the block. A stretcher tie was used on the stretcher and this was attached to the cable. Using one-half-inch and five-eighths-inch, one-hundred-foot lengths of rope as guide lines, the victim was lowered to the ground from this elevator. (See Figures 64 and 65.)

Figure 65

Victim lowered to ground level with improvised rig

The victim was placed in the ambulance, accompanied by the physician, and taken to the hospital. He was pronounced dead-on-arrival. The other two survived.

CHAPTER XXI

SHORING AND TUNNELING

INTRODUCTION

In emergency rescue operations it sometimes is necessary to support a damaged structure or a cave-in, or to provide bracing for walls and ceilings. A squad may have to construct tunnels to rescue trapped victims. The shoring or tunneling must be done rapidly, but safety must not be sacrificed for speed.

Only the amount of shoring or tunneling required for the safe removal of victims and workers should be carried out by a rescue squad. No attempt should be made to restore any structure to its original position; restoration should be left to the guidance of skilled craftsmen

SIZING UP AN EMERGENCY

At a cave-in the squadman may be confronted with two types of rescue problems:

(1) The head of the victim is not covered.

(2) The victim is completely covered by some type of material. In either case care must be taken to protect the victim from added injury. Size up the situation and plan your approach before action is taken.

When a victim is partially buried with his head exposed, start administering oxygen. Use the inhalator if he is breathing. Use the resuscitator if he is not breathing.

If a victim is completely buried (e.g. under loose gravel), the man in charge of rescue must, if able, find the approximate location of his head and chest. A squadman should be prepared to begin administering oxygen as soon as the victim's head is exposed.

APPROACHING A VICTIM

When you approach a cave-in victim on foot, be sure to distribute your weight over the largest area possible. Do not increase the amount of weight that is already present on the victim's chest cage. It may be necessary to crawl on your hands and knees or stand with your legs wide apart. Long-handled shovels are of great assistance in this situation, since the material covering the victim can be removed and at the same time the squadman can stand at a distance away from the victim. All squads should be equipped with long-handled shovels.

Many times, a squadman will be required to lie flat on his stomach and reach the victim with just his hands. The squadman should approach the victim from behind to administer oxygen, if possible, so that other personnel can relieve pressure from the victim's chest.

SHORING

When a victim is under loose debris it may be necessary to clear a path slowly and carefully to him, shoring with the progress of the path, as is done in mining operations.

Shoring is also necessary sometimes after traffic and railroad accidents. Heavy weights must sometimes be supported while cutting through metal wreckage; or the wreckage must be raised by means of jacks, and then supported, so that progressive access can be made to where the victim is pinned or trapped.

To brace a wall that is bulging or in danger of collapse, a raked shore can be built. (See Figure 1.) Raked shoring is usually built up from ground level.

A flying shore can be used to brace one wall from another support across a space. (See Figure 2).

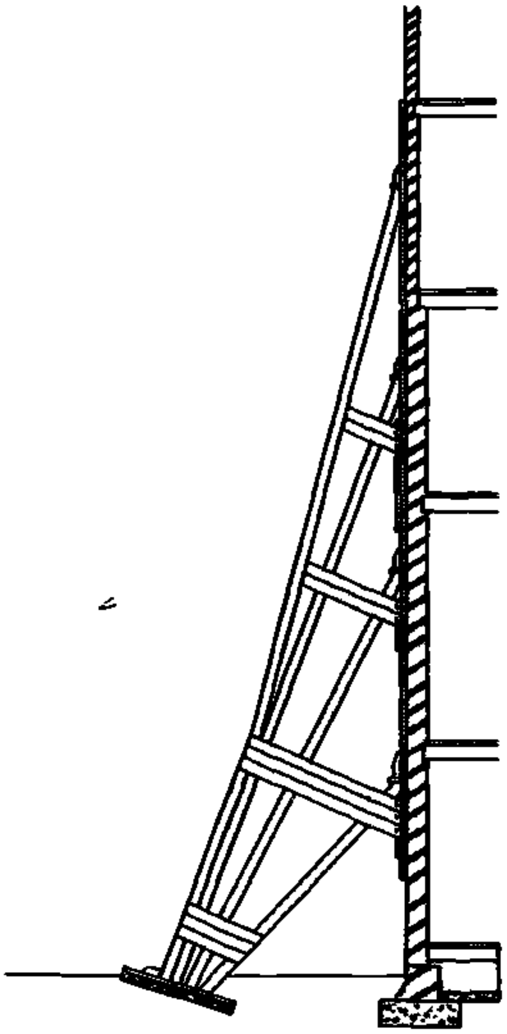


Figure 1

Raked shore

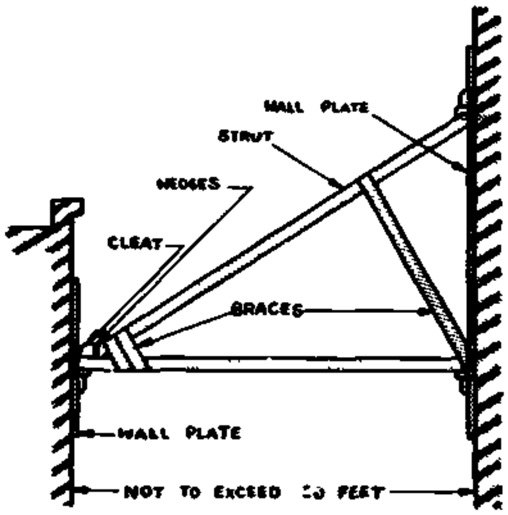


Figure 2

Flying shore

BULKHEADS AND COFFERDAMS

In cave-in accidents involving ditches or wells, and in other similar accidents, it is sometimes necessary to sink bulkheads or cofferdams for shoring.

TUNNELING

Tunneling becomes necessary when the rescue workers must remove victims trapped either near the surface or in voids underneath collapsed structures or ditches, or under sand, gravel, coal, grain, etc. (See Figures 3 and 4.) In these rescue operations, tunneling requires exceptional skill and should be guided by trained personnel.

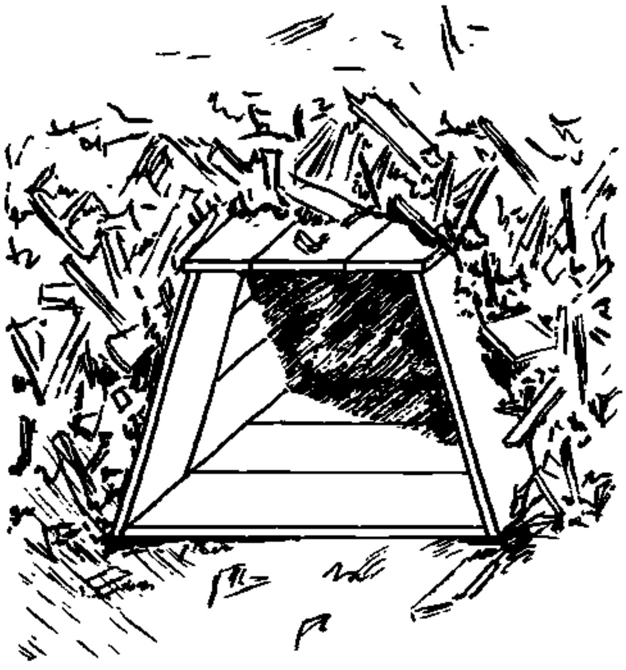


Figure 3

Tunneling through debris

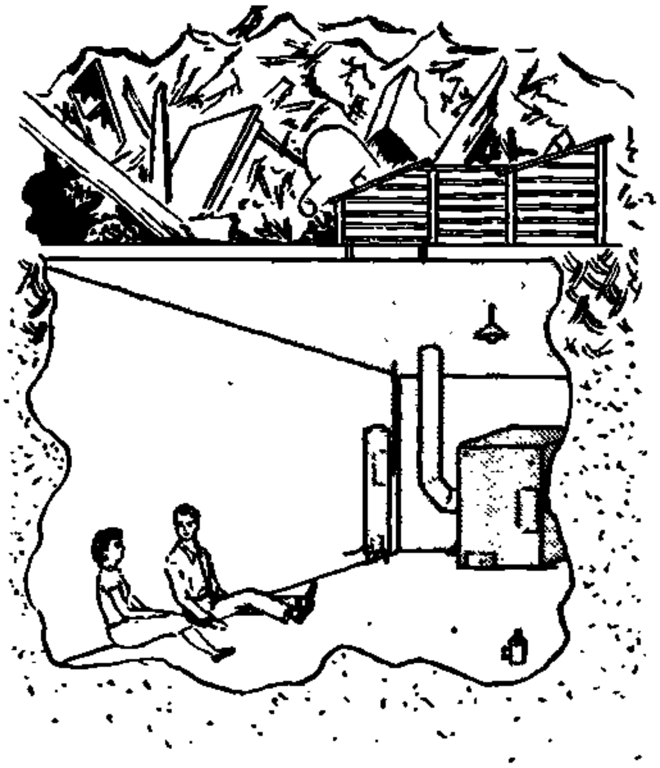


Figure 4

Rescue from a basement where ceiling remains almost intact

TECHNIQUES AND TOOLS

Shoring and tunneling are best accomplished with the use of timbers and wedges. The construction work sometimes has to be done gently and without jarring, to prevent further collapse. Figure 5 shows a damaged wall supported by a shoring of heavy timber.

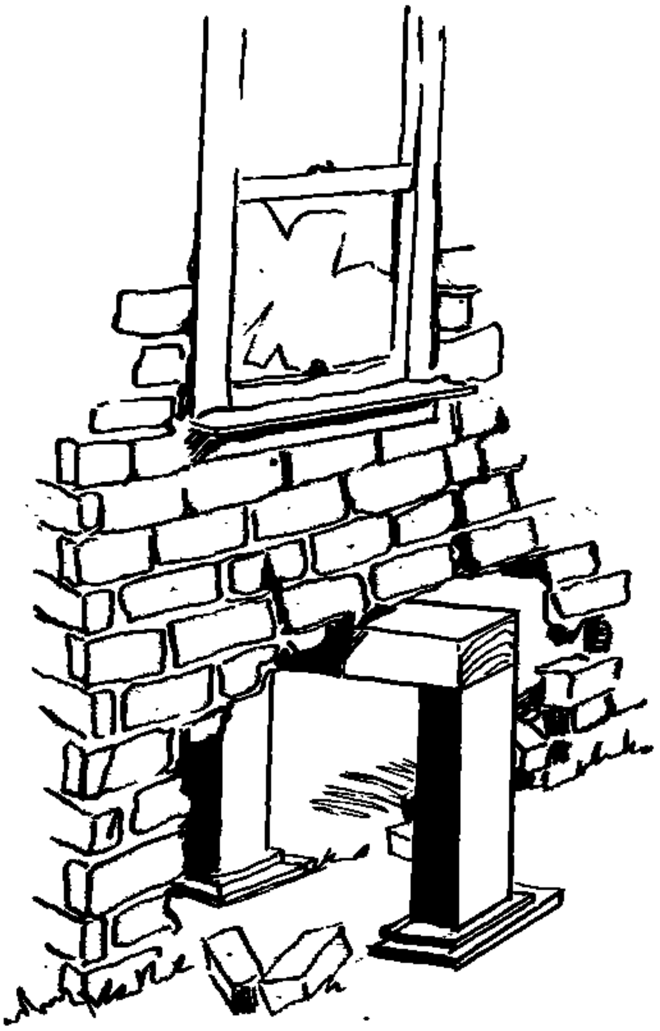


Figure 5

Use of heavy timber for shoring

Cut the supporting timbers short, then make them fit snug with wedges. Unnecessary jarring can be avoided, yet a snug fit can be accomplished when this method is used.

Shoring and tunneling should, of course, be safe and secure, to protect both the victim and rescuers. It is often necessary for rescue teams to work in relays. This may require several trips in and out.

Minor accidents may involve only the use of rope, shovels, pails and carpentry tools needed for shoring. Accidents of major proportions and those involving large buildings may demand the use of bulldozers, power shovels, drag-lines, trucks, and other heavy-duty equipment, with skilled operators. At the scene of a rescue if the squad leader finds conditions that require the use of heavy equipment, he should not hesitate to request the services of such equipment. In many communities this means putting into effect a pre-arranged plan to meet such situations, prepared long before the emergency arises.

DANGER OF FURTHER INJURY

When a victim is buried, extreme care must be exercised in the use of power equipment. The rescue activities could injure the victim further, or kill him. Speed is important for many reasons, but not important enough for over-zealous digging. Squadmen and operators should be constantly alert to observe any part of the victim's body as it is revealed. When observation reveals the body of a victim, the rescue operation should proceed cautiously and carefully with a minimum use of power tools.

AVOIDING CAVE-INS

When raising victims from cave-ins, ditches, or voids, it is important to prevent the edges from caving in under the weight of squadmen or equipment. A tripod (Figure 6) a ladder laid horizontally, or an aerial ladder can be used very successfully and safely in this operation.

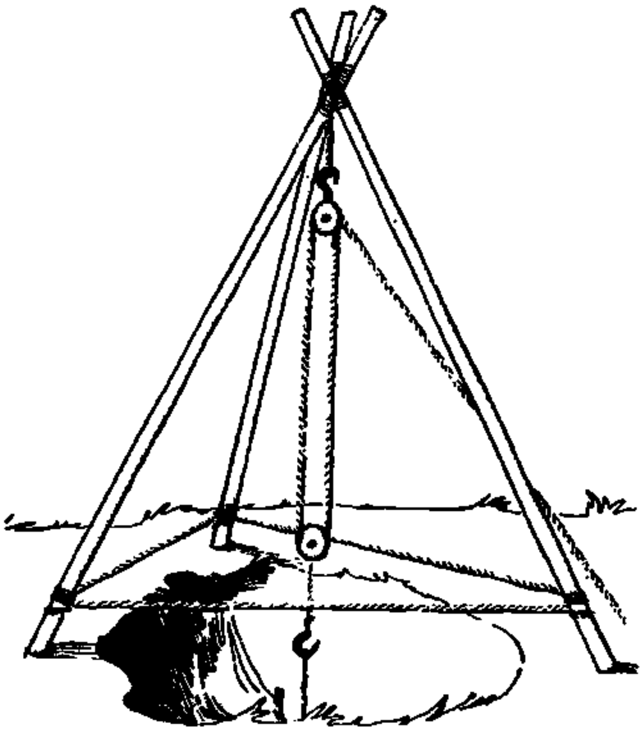


Figure 6

Use of tripod

HAZARDS TO THE SQUADMAN

In cave-in situations where gas lines may have been broken, rescue personnel must consider their personal safety. Accumulated toxic or asphyxiating gases can render squadmen helpless and unable to perform the rescue operations. Self-contained gas masks are indicated.

In emergency situations where hazards from utilities exist or may exist, call the utility company's emergency service for proper handling.

VICTIM CARE

Victims may require resuscitation, first aid, or professional attention before being moved. Also some trapped victims may request spiritual assistance.

Figures 7 through 12 show a typical rescue operation involving a victim nearly buried under loose dirt.

Courtesy Loudonville Vol. F.D.

Figure 7

Two men were working in a trench. As one man climbed out to get a drink of water, the side of the ditch came rolling in, covering the man working at the bottom of the ditch. A workman ran to a nearby home and called the emergency squad.

Courtesy Loudonville Vol. F.D.

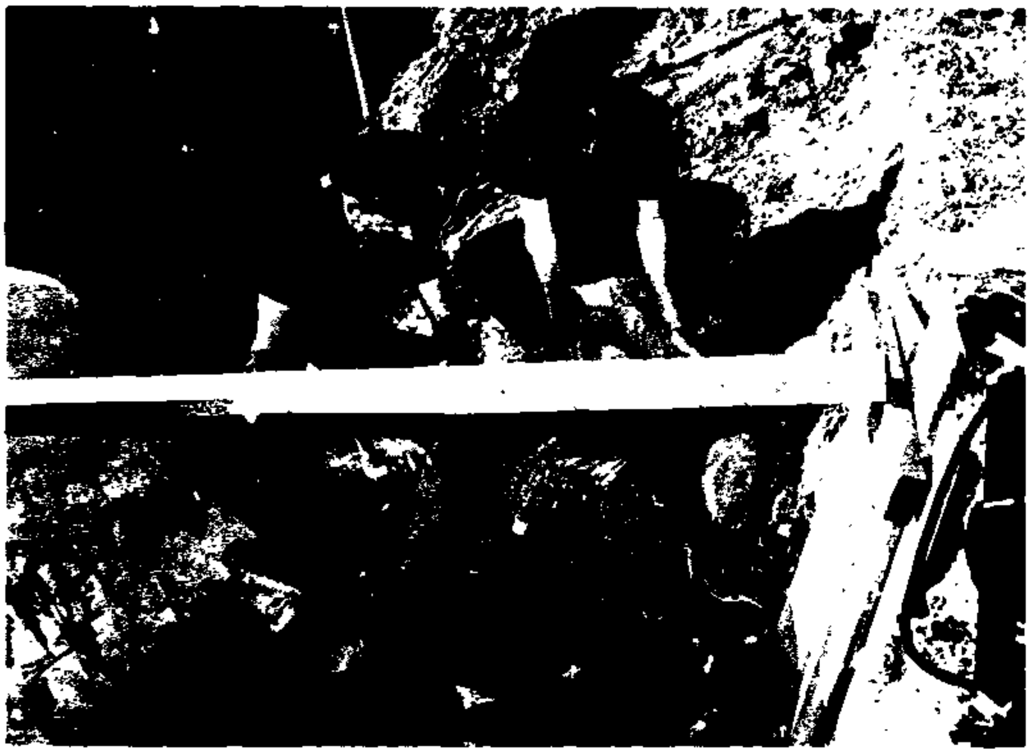
Figure 8

As the resuscitator could not be placed near the victim, the extension unit was set up. In this picture Squadman No. 1 opens the tank valve and connects the extension unit to the resuscitator. Squadman No. 2 turns the unit to resuscitation and places a face mask on the victim. (Squadman No. 2 is standing with feet apart, and to the rear of the victim, so he will not add more weight to the dirt covering the victim.) Squadman No. 3 starts removing the dirt from above the victim's chest area so the victim can breathe for himself. Squadman No. 4 brings a backboard and other equipment from the squad car.

Courtesy Loudonville Vol. F.D.

Figure 9

As the weight of the dirt is removed from the victim's face he is able to breathe for himself. Squadman No. 1 continues to supervise the machine. Squadman No. 2 adjusts the face mask and micro unit for inhalation. He supports the victim's head with his hand, and the victim's back with his knee and leg. Squadman No. 3 continues to remove dirt to free the victim. Squadman No. 4 has completed a shoring job to prevent further cave-in.



Courtesy Loudonville Vol. F.D.

Figure 10

The victim is placed on a backboard.

Courtesy Loudonville F.D.

Figure 11

Web straps are used to secure the victim to the backboard.

Courtesy Loudonville Vol. F.D.

Figure 12

The victim is carried up out of the ditch. He was transported to a hospital, at a slow and careful speed.

CHAPTER XXII

WATERFRONT OPERATIONS

INTRODUCTION

Authoritative information tells us that most drowning victims must be brought to the surface within ten minutes if they are to have a reasonable chance to survive. Beyond that time, the efforts of the squadmen will be largely devoted to the matter of recovering the victim's body. Past records indicate that this is usually the case in most of the responses to this type of rescue emergency.

If, however, recovery is made within a reasonable length of time, manual or mechanical respiration should be started at once. It must be continued until the victim is either revived or pronounced dead by a physician or coroner. Such practice should not be treated lightly, as it has been reported that a man was revived after being submerged for thirty minutes.

It is a perfectly natural trait to persist in trying to recover the body of a drowned person, even though all hope of revival may be gone. However, the squadmen's responsibility stops when all hope of life is gone! The officer in charge should not lose sight of the fact that squadmen occupied in body recovery operations are not available to serve the living public.

All operations at the scene of a drowning should be directly in the charge of the emergency squad. This includes not only the recovery operations but the physical control of the scene as well.

Proper education and training will help to insure a maximum degree of safety for squadmen who must participate in waterfront operations. The material in this chapter is based on the assumption that its reader has had an approved course in water safety, sponsored by a nationally recognized authority or agency. Such instruction is absolutely essential to emergency rescue squad work. The following pages will describe some of the equipment and methods used in waterfront operations.

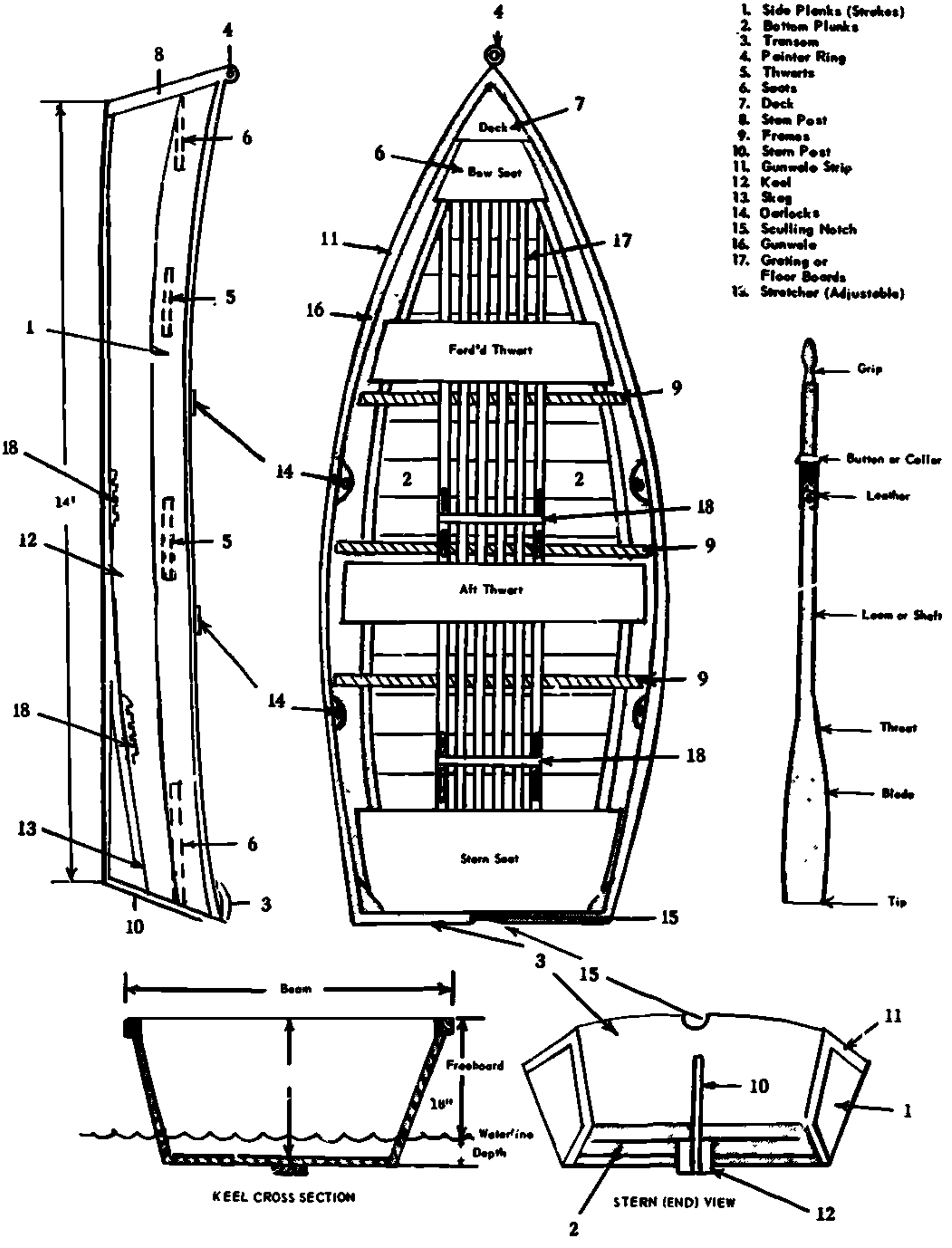


Figure 1
Parts of a rowboat and an oar

BOAT HANDLING

Elementary boat handling is important to emergency squads. They are called upon to rescue stranded victims in time of floods as well as other emergencies where the only means of rescue is by the use of a boat.

While there is much material available on small boat construction, there is not a great deal to be found on the safe handling of small boats. This section, then, is intended to give some brief, basic information on boat handling and boating safety.

PARTS OF A ROWBOAT

Bow: The front, or forward part, of the hull.

Deck: The small triangular filling of wood at the bow of the boat, fitting level with and between the gunwales.

Frames: The narrow cross-sections, placed edgewise in the boat from gunwale to gunwale, down the sides and across the bottom, to hold the shape of the boat and to provide the form over which it is built; there are usually three or four frames.

Grating or Floorboards: Wood slats, cleated together in sections, to form a false flooring. They serve to protect ribs and planking and also to keep occupants' feet dry in a leaky craft.

Gunwales: (Pronounced gun'ls.) The top edges of the hull, on either side, from bow to stern.

Keel: The main backbone of the boat, extending along the bottom from the stem (at the bow) to the stern post.

Oarlocks: The metal crutches, pivoted in metal sockets on the gunwales of the boat, in which the oars rest in rowing; accepted patterns are either U-shaped or ring-shaped, with a metal shank to which a chain and toggle are attached to prevent loss.

Painter: The line, usually about 6 feet long, spliced to a ring in the bow and used for towing or for tying up the boat. A similar line in the stern is a sternfast.

Planking: Long narrow boards (also called strakes), laid up and fastened tightly to the ribs, edge to edge, and running lengthwise from bow to stern; they form the watertight outside covering of the hull, including the bottom.

Port: The left-hand side of the boat as you face forward.

Ribs: The narrow flat strips, usually steamed and bent to shape, spaced between the frames to aid in holding the shape of the boat; they also provide a foundation on which the outside planking can be fastened.

Risings: The strips of wood, secured to the frames and ribs, upon which the ends of the thwarts are secured.

Sculling notch: The half-round notch or depression in the upper edge of the transom, to hold the loom of a long oar for propelling the boat by sculling.

Seats: The small platforms or seats built into the stern and the bow of the boat.

Skeg: The small triangular piece of wood which fills the space between the end of the straight keel and the upsweeping stern of the hull; it serves to hold the stern on a steady straight course when the boat is rowed.

Starboard: The right-hand side of the boat as you face forward.

Stern: The back, or aft, part.

OARS AND THEIR PARTS

Oars: The flat-ended wooden levers by which a rowing boat is propelled.

Blade: The wide flat portion that is dipped in the water, when rowing.

Button: A ridge, built up of leather, at the inboard end of the leather, to prevent the oar sliding through the oarlock.

Grip: The handle portion held in the rower's hand.

Leather: A protective collar of horsehide attached to the loom at the point where the oar rests in the oarlock.

Loom: The long tapering shaft between the grip and the blade.

Throat: The narrowest part of the loom where it joins the blade.

Stretcher: A short crossbar held by two parallel cleats attached to the gratings or directly to the ribs, at suitable distance from each rowing position, to provide necessary foot-bracing for the oarsmen; crossbars are usually adjustable in any one of three notched positions, for length of legs.

Thwarts: The wide boards extending across the boat, located lower than the gunwales, for the oarsmen to sit on; there are usually a midship thwart, and f'wd thwart.

Transom: The broad flat plank, or planking, fitted to the extreme aft ends of the side and bottom planking, to close the stern end of the boat.

Figure 2 shows a rowboat in which rescue and first aid gear have been stowed, ready for emergency use.

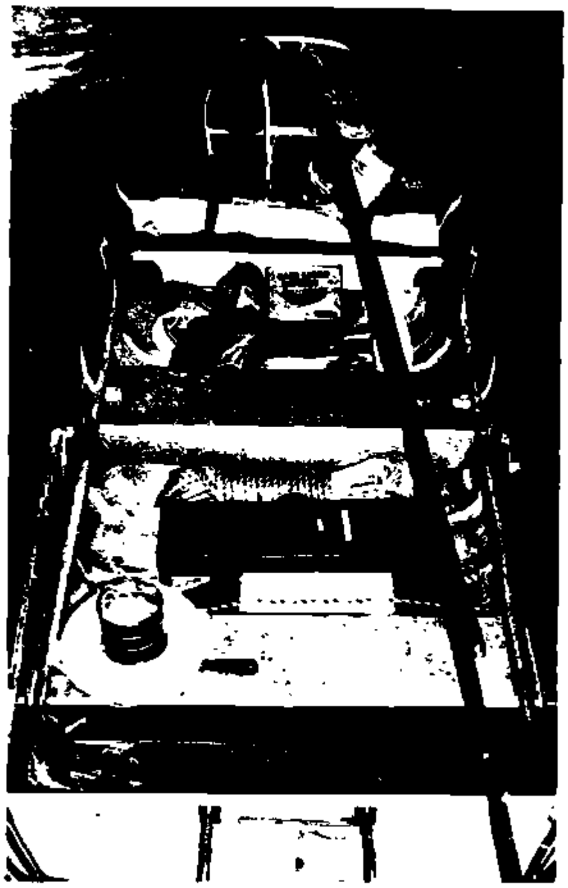


Figure 2

Rowboat equipped with rescue and first aid gear

BOARDING AND ROWING A BOAT

Making Ready - If at a shore, push the boat afloat by partially lifting the beached end. Before boarding it, make certain that the bottom is not resting on a stone or anything sharp that might injure the planking; also make certain that the bow is not so far ashore that you cannot "shove off" when your weight is aboard, and that the bow is not resting on anything that will make the boat "teeter" as you board it.

Before shoving off, the painter should be neatly stowed in the bow or on the bowseat, oars lying fore and aft along the outer ends of the thwarts, with blades aft; oarlocks unshipped and hanging inside below the gunwales by their chains. Be sure all gear is neatly stowed and in its proper place.

If at a landing stage or dock, cast off and stow the painter, and bring the boat parallel alongside the front of the pier, holding it by the gunwale.

Boarding - Board the boat by stepping in the middle, on the bottom boards or on the gratings; do not step on the seats or thwarts. Keeping your weight low and with at least one hand constantly touching a gunwale, move to your position and seat yourself in the center of the seat or thwart. Passengers sit facing forward, oarsmen face aft. If rowing alone and the boat has two rowing positions, use the aft one.

Seating the Oars - Adjust the stretcher in the proper notch to suit the length of your legs. Ship the oarlocks by raising them until the chain feeds downward through the socket and until the shank of the lock itself is firmly seated in the socket. Lift each oar at its balancing point, drop the loom into the oarlock and slide the oar outboard until the button bears against the oarlock; or, if there is no leather or button, until the oar feels "balanced" in the lock. If oars are of correct length for the boat, the ends of the grips will be very near touching, or they may actually overlap up to 2 or 3 inches when the oars are held horizontally.

Rowing Position - The correct rowing position is important for efficiency and endurance. Seated erect, face squarely astern. Head should be up, feet together and braced against the stretcher, knees together and slightly bent. It the boat has no stretcher, feet may have to be somewhat spread to brace against a frame or rib; knees would be correspondingly spread and slightly bent. Hands grasp the oar grips with the knuckles uppermost; thumbs may encircle the underside of the grips, or may cap the ends, but should not rest on the upper surface of the grips alongside the fingers. (See Figure 3.) Elbows should hang close to the body, without strain.

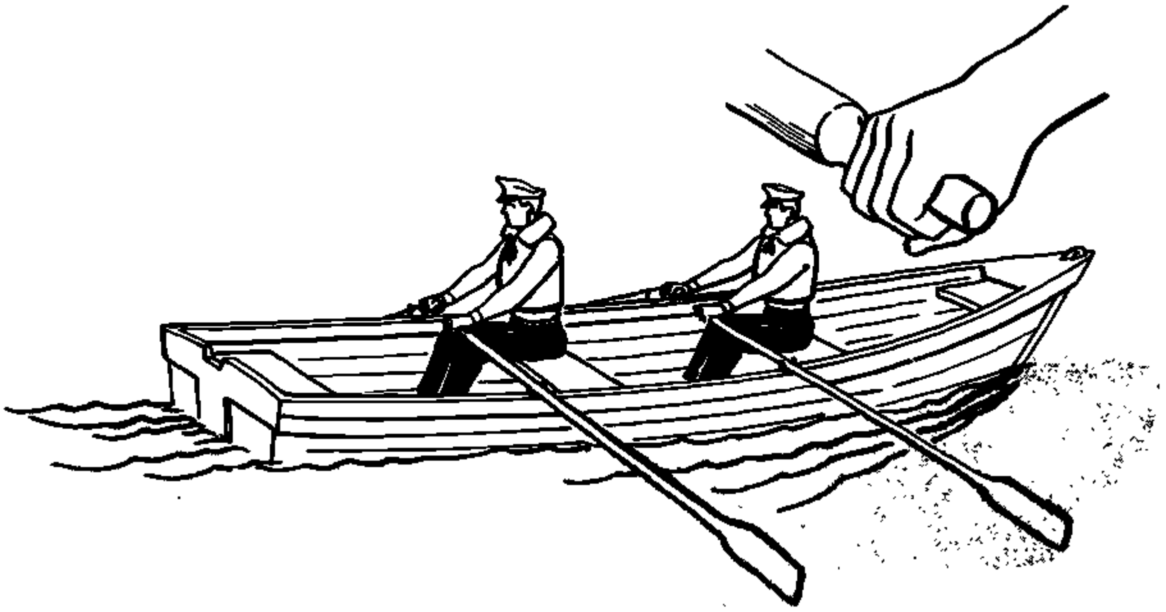


Figure 3

Rowing position and grip

With both oars resting horizontally in the oarlocks and their length at right angles to the centerline of the boat, turn them until the plane of the blades is absolutely vertical. Then adjust your hand grasp without disturbing the vertical setting of the blades, so that your wrist joint is absolutely straight in a horizontal plane with your forearm. This is your basic grip of the oars.

Without relaxing or shifting your grip, bend your wrists in a manner that will cause your hands and knuckles to rotate upward and toward you; (in rowing parlance this action is termed "dropping" the wrists.) This will tip the oar blades about 30 degrees into "feathered" position, with the forward edge of the blade higher than the aft edge. If you now raise your hands slightly to lower the blades until they are skimming just an inch above the water, you are in the position "Rest Oars" or "Oars."

To prepare for rowing, glance over your shoulder toward the bow, to make certain that the way is clear ahead of you.

The Stroke - Move the oar blades forward close to the water in feathered position, by extending your arms as you sway your body aft toward your knees. Sway from the hips, keeping your back erect. As you approach the limit of your reach, gradually straighten your wrists; then pause in this position. The flat of the blades is thus returned slightly past the vertical setting, close to the water and everything is in readiness to make the "catch", which starts the power portion of the stroke. This position is that of "ready".

Do not shift your grip or release control of the oars, but relax the downward pressure of your hands until the blades drop into the water as far as their own weight will immerse them. (See Figure 4.) As you feel the blades "catch" begin to apply power by moving your whole upper body, from the hips, toward an upright position. Use the full combined strength of your leg and back muscles to apply maximum pulling power smoothly, without jerk or splash. While your body moves, your arms should be maintained extended. Let the oar blades float at their own normal depth; never force them deeper.

Figure 4

The catch

When your body has passed the vertical position sufficiently to tighten abdominal muscles perceptibly, you have reached the maximum desired degree of "layback". At this point the arms smoothly start their contribution of power. Arms are drawn powerfully toward you, with elbows comfortably close to your body, until your hands are practically touching your chest. (See Figure 5.)

Figure 5

Pull nearly completed

Figure 6

The recovery: blades are feathered

The oars now are slanted toward the stern at such an angle that the blades have slipped clear of the water without tossing any of it in a spurt or splash. This is the completion of the "power portion" of the stroke.

The recovery is the final phase of the stroke cycle. This is done with the blades in "feathered" position, to reduce wind resistance; also to assure the blade gliding over the crests of whitecaps in choppy water. (See Figure 6.) As the "pull" or "power" portion of the stroke is completed, drop your wrists smartly to flip the blades into feathered position. Smoothly and simultaneously with the dropping of your wrists, extend your arms. As the arms approach their full extension, start the sway of your body from the layback position, through the vertical position and toward your knees. Level your wrists as you attain your maximum reach without rounding your back. You are now in the "ready" position, poised with blades facing squarely for the "catch" of the next stroke.

Correcting Course - The oarsman should correct his boat's course by pulling somewhat harder on one oar than on the other, without any interruption in the smooth rhythm of the stroke.

A more drastic correction can be made --as when a heavy gust of wind or a sudden cross-current veers the bow off course-- by poising one oar in "rest" position, or by "trailing" it, while one or more strong pulling strokes are taken with the other oar.

Hold - To stop a boat, drop the blades into the water at the end of a stroke. Then sit upright, hold one knee beneath the thwart (as a purchase), press firmly toward the stern with your hands, and thus gradually force the blades forward in the water against the forward motion of the boat.

Stern All - To propel the boat astern, after stopping it, repeat and continue the sternward pushing action with your arms, adding the weight of your body to the final portion of each push. In choppy water the blades should be feathered on the recovery portion of each of these "backwater" strokes, but this feathering is done by raising the wrists, instead of dropping them.

Turning - When it is necessary to make a sharp turn and at the same time retard the progress of the boat, the action is opposite to the foregoing. The turn is made by executing a backwater stroke with one oar, while "resting" or "trailing" the other.

Approaching a Landing - The turning technique is used when coming alongside a landing. The approach and momentum are judged by looking continuously over one shoulder. At the right moment the oar on the landing side is deftly unshipped and boated; the other oar then is used for backing water to just the degree necessary to slide the boat to a broadside, motionless position at the landing.

Pivoting - Turns are executed by backing water with one oar, while simultaneously pulling with the other.

ADVICE TO THE BEGINNER

Beginning oarsmen often have trouble with one oar: it repeatedly fails to grip the water, or slices too deep and jumps out of the oarlock. Either occurence is termed "catching a crab". An incorrect grip on the oar may be the cause. Check your grip while holding the plane of the blades absolutely vertical; if necessary, readjust your hand grip. A "crab" may also be caught because of tenseness and consequent failure to level your wrists equally, as you make the "catch".

As you become an experienced oarsman, you will develop the ability to check your grip during each pulling stroke, by the "feel" of the blade as it bites the water; any slight adjustment is then made during the rowing rhythm.

The good oarsman periodically glances over one shoulder, without breaking the rowing rhythm, to make certain that the course ahead is clear of any other traffic.

Take your time. Think out each move before attempting it. Then move slowly, easily, in a relaxed manner. With persistent practice you will become an excellent oarsman. Keep your full attention on what you are doing. Don't dip the blades too deep: the water should not wet the shaft above the throat. Keep your hands low. Don't lift the blades too high on "recovery"; they should just clear the water. Keep your head up. Get a full breath of air every stroke. Pull evenly; a zig-zag course is caused by uneaven pulls.

BOATING SAFETY

All boats out on the water should be under watch of a guard at all times. This guard should remain on shore.

At night always carry a bright flashlight or lighted lantern visible all around if rowing on a waterway where other vessels or boats are used. The light should be shown at the approach of other boats.

Keep out of the way of power boats of all kinds in ordinary water traffic. Power boats carry white lights in the stern only or in bow and stern; sailboats do not. Green lights are on the starboard, red lights on the port side.

Waves from a large power vessel can upset a small craft that is not being handled properly. Keep at least 300 feet away from such vessels until the stern has passed. Head your boat into an approaching wash and remain stationary until it subsides.

Any boat equipped with a motor or other sinkable dead weight should have airtight compartments capable of supporting this weight.

All metal craft should have airtight compartments to float their occupants if swamped. Metal boats should be swamped and tested every two weeks for pin-hole leaks in their airtight compartments.

If two squadmen must exchange seats away from shore, first "boat the oars". Then one man sits forward on the bottom; the other crouches with one hand on each gunwale, passes alongside, and is seated. Then the man on the bottom moves to the vacated place.

When dropping or retrieving the anchor, a squadman should be sitting in the boat. If he is standing, he may lose his balance.

Two small persons can row in unison sitting in the same seat (double banked). Each pulls one oar. A better way is single-banked sweep rowing, with one man in each seat, pulling one oar.

Whether they use one or two oars each (called "pair-oar rowing"), the two oarsmen should keep absolutely together. The aft oarsman or "stroke" sets the rhythm.

In waves or choppy water row with regular, steady strokes. If possible take the waves at a slight angle rather than directly bow-on or stern-on. Keep a level boat by spreading weight evenly. In a high wind, seat passengers flat on the bottom and keep the bow headed into the wind.

If one oar is lost, face the bow and use the other as a paddle or scull.

It is a violation of good seamanship and unwise to do the following:

1. Overload a boat by taking more people than its marked capacity.
2. Abuse an oar by splashing water with it, digging in the sand with it, or using it as a fender.
3. Expose yourself to injury by standing in a boat, rocking it, or skylarking in a boat.
4. Deliberately or carelessly allow your boat to bump another or crash the landing.
5. Create a false alarm by needlessly calling "HELP", or by making a sound that can be thus interpreted.
6. Risk being run down through failure to carry a light, if out at night on waters used by other craft.

OPERATION AT SCENE OF DROWNING

SQUAD SAFETY

It is well at this point to stress certain factors pertinent to the safety and welfare of the squadmen. Diving into the water is indicated when the victim can be seen and is moving, or when there is substantial evidence that the victim has been under the water only a few minutes. It is obvious that only trained and qualified water-safety men should be selected for this assignment.

The use of life jackets should be emphasized. They are standard equipment for squadmen to wear during all boating operations. This rule should apply to swimmers as well as non-swimmers, especially when entering swift or rough waters.

A squadman should be assigned to shore duty, and should remain there, as long as squadmen are working in boats. His main responsibility will be to keep the occupants of the boats under surveillance. In the event they run into trouble or encounter some difficulty, he can quickly secure help to assist them. He can also gather information from witnesses on shore which can aid the boatmen in their size-up and search.

SIZE-UP

Proper size-up at the scene of a drowning, before and during the operation, will be of great assistance in making a rapid and successful recovery. In making the size-up, the squadman in charge should consider the following factors:

1. How long the victim has been submerged
2. Where he was last seen
3. How the victim was dressed (in swim suit or clothed)
4. Survey of the body of water as to:
    - Character of bottom
    - Currents
    - Snags and obstructions
    - Depth and width of water
    - Conditions of banks (undergrowth, trees, etc.)
    - Direction of wind

GENERAL INFORMATION ON DROWNED BODIES

A body will remain in the immediate vicinity of where the drowning occurred. Even though there is a strong current on the surface of the water, the body will not move very far from the spot where the victim was last seen. It has been noted that a body in a swimming suit, when sinking, will not be more than 1-1/2 times the depth of the water from the spot.

Example: Water is 20 feet deep.
1-1/2 x 20 = 30 feet from the spot.

Sometimes bodies of victims who are very fat and bodies of small children do not sink after drowning, but remain floating on the surface. A body will rise to the surface when enough gas is formed in the intestinal tract to make the body buoyant. The time needed to generate the necessary gas will depend on the temperature of the water and the content of the victim's stomach when drowned. In summer, the average time is from 18 to 24 hours. However, in winter, or when the water is very deep and cold, the time will be much greater. A body will not rise suddenly from the bottom, but gradually as more gas is formed and the body becomes buoyant. After the body rises to the surface, its movement is affected by the current or wind; it may be found several miles downstream.

A victim drowning in a rapids probably will be carried to the first deep hole downstream. If manpower is available, it is advantageous to send one detail downstream to search the eddies and center of the stream.

Equipment carried in Rescue Boats

- Oars (2 sets)
- Anchor
- Life jackets
- Ring buoy
- Torpedo buoy
- Flashlight with extra batteries
- Pike poles
- Drag hooks
- 3/4-inch rope, 100 feet
- 3/8-inch rope, 100 feet
- Life gun and extra line

DRAGGING

In the early stages of any body search, dragging and probing with grappling irons, grappling hooks, and pike pole irons are the usual means employed. Even under the best circumstances, dragging is a blind operation.

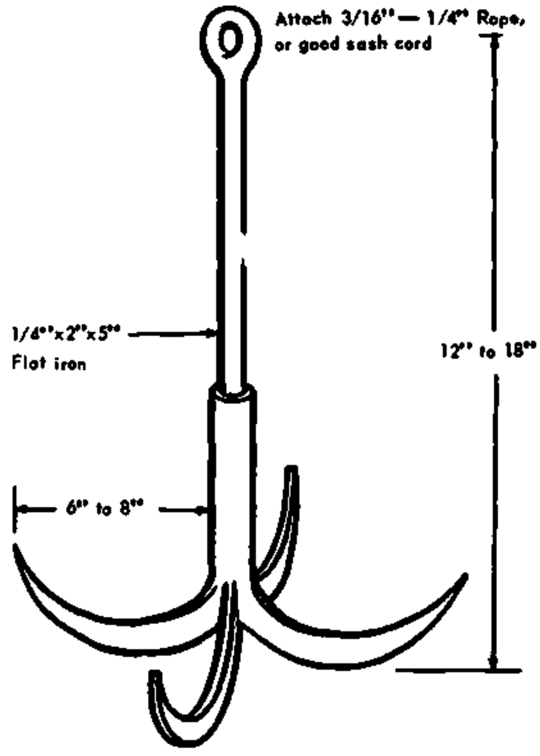


Figure 7
Grappling iron

Very useful types of grappling equipment can be made by a squad. These include: grappling irons, pike pole irons, and grappling hooks.

The grappling iron shown in Figure 7 is not too practical for rescue work, but may be used in very deep water, not only for body recovery but for equipment, etc. The iron weighs from five to ten pounds.

The pike pole iron is the only type that can be used in waters with stumps. (See Figure 8.) The pole should be in four-foot sections and not to exceed twenty to twenty-five feet in length.

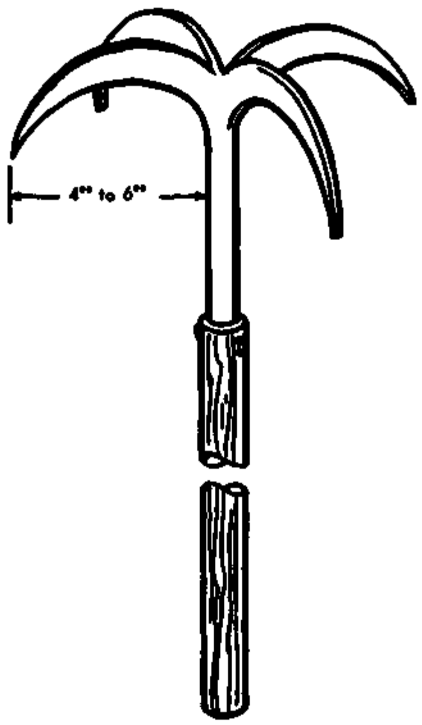


Figure 8
Pike pole iron

Grappling hooks are made of No. 9 iron wire. Two pieces 18" long are bent in half and twisted as four strands, forming an eye at one end and four prongs at the other end. Space the hooks along lines and attach the lines to a tow bar as illustrated in Figure 9, on the next page.

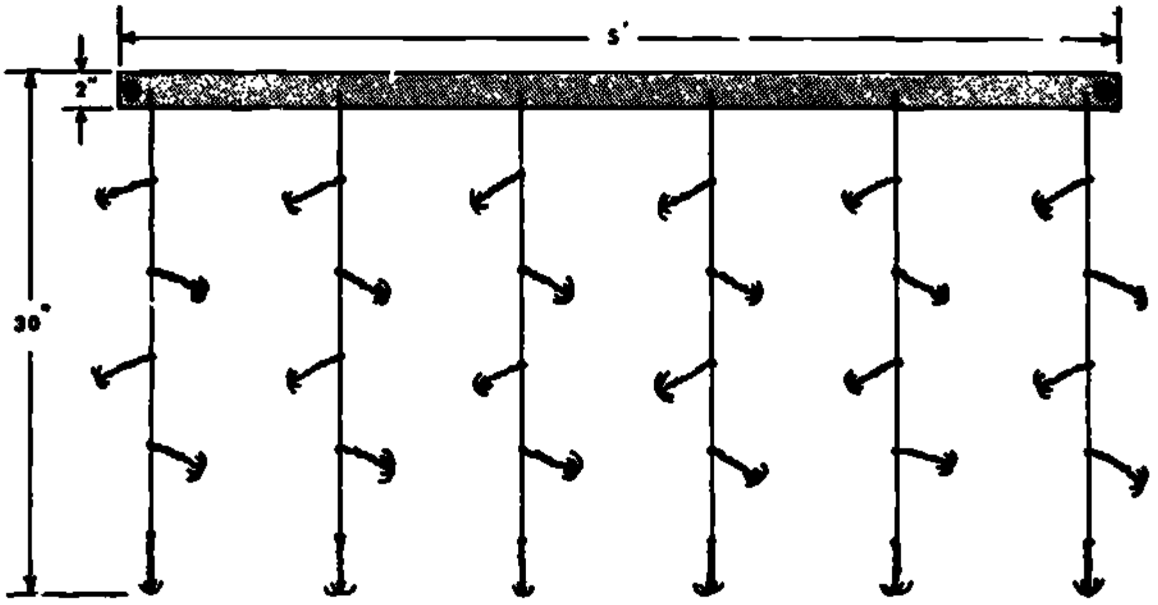


Figure 9

Grappling hooks on a towbar. A cable or chain attaches to each end of the towbar, for dragging operations.

LOCATING A BODY FOR GRAPPLING PURPOSES

A witness at point "A" last saw victim in line with tree "X". (See Figure 10.)

A witness at point "B" last saw victim in line with tree "Y".

Then, by "drawing" imaginary lines between point "A" and landmark "X", and between point "B" and landmark "Y", the squadman can locate the point where the lines cross or intersect. Search for the body should focus on that point.

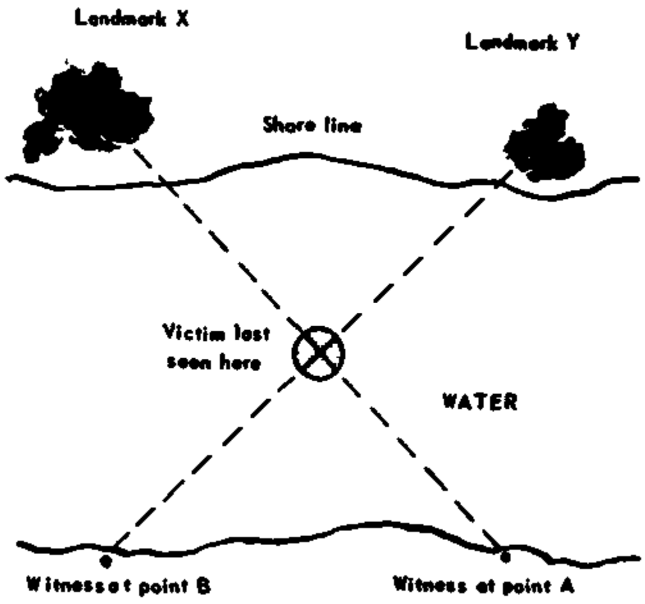


Figure 10
Locating a body

DRAGGING METHODS

There are many dragging methods which may be used; some of the more successful ones are described here. Grappling may be done from shore to shore, dock to dock, boat to shore, or boat to boat.

The following procedure is used in shore-to-shore grappling. (See Figure 11.)

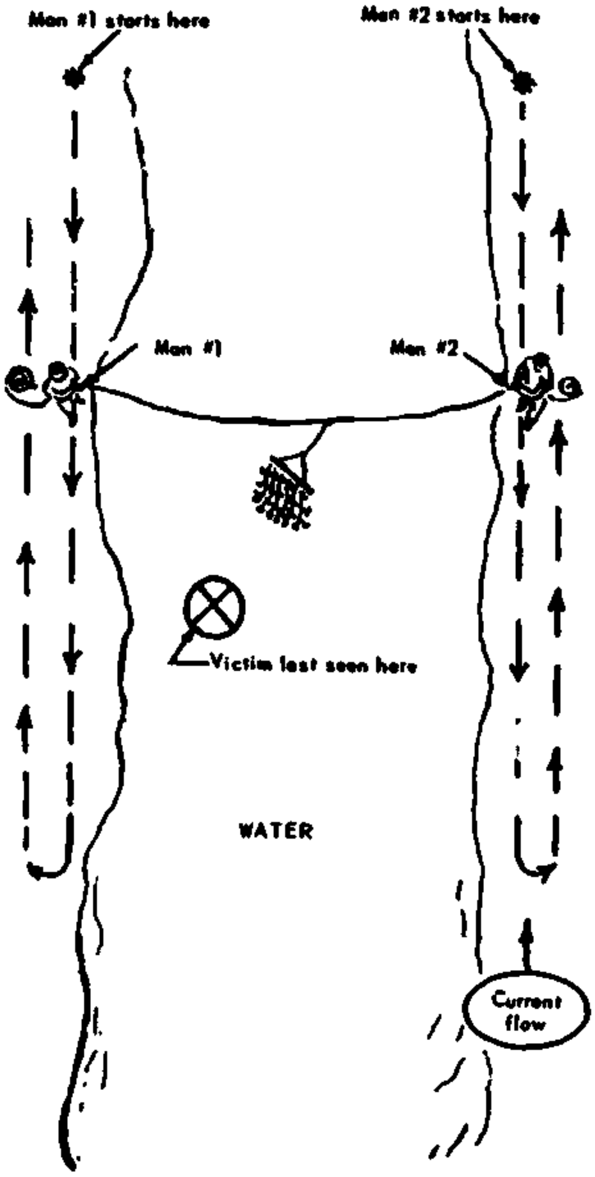


Figure 11

Shore-to-shore grappling. In flowing water a body may be carried with the current a short distance, Note that the dragging operation here starts downstream from where the victim was last seen.

Shore-to-Shore Grappling -

1. The rope should be more than twice the width of the area to be covered.
2. Secure hooks to center of rope.
3. Squadman #1 will drop hooks straight down until they hit bottom. He then signals #2 squadman to draw hooks slowly toward him, allowing them to drag the bottom across the entire width of the body of water.
4. If nothing is hooked, #2 side-steps one-half the length of the grappling bar in the direction the victim was last seen.
5. #1 then side-steps the same distance in the same direction.
6. #2 then lowers the hooks straight down to the bottom, and signals #1 to pull hooks slowly to him.
7. This procedure is continued until the entire area is covered. Procedure is then reversed so area will be covered twice.
8. If the body is not then recovered, the area should be extended in both directions, and the procedure repeated.

Boat-to-Shore Grappling - Figure 12 shows the recommended procedure.

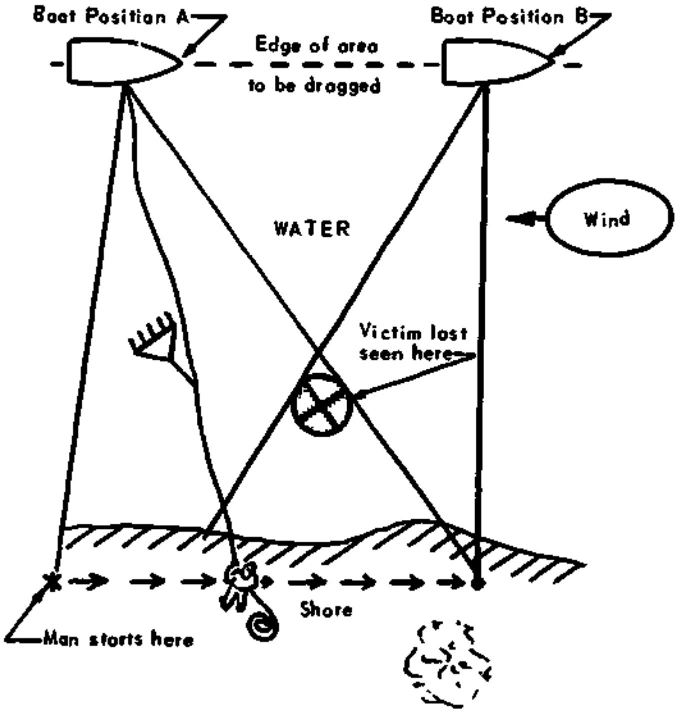


Figure 12

Boat-to-shore grappling

1. The boat must be anchored securely.
2. The man on shore does all the moving, side-stepping one-half the length of the grappling bar.
3. If the victim is not hooked after procedure from boat position A, the boat should then be moved to position B, and anchored securely. The procedure is then repeated from this new position.

Dock-to-Dock Grappling - The procedure is the same as in shore-to-shore grappling. (See Figure 13.)

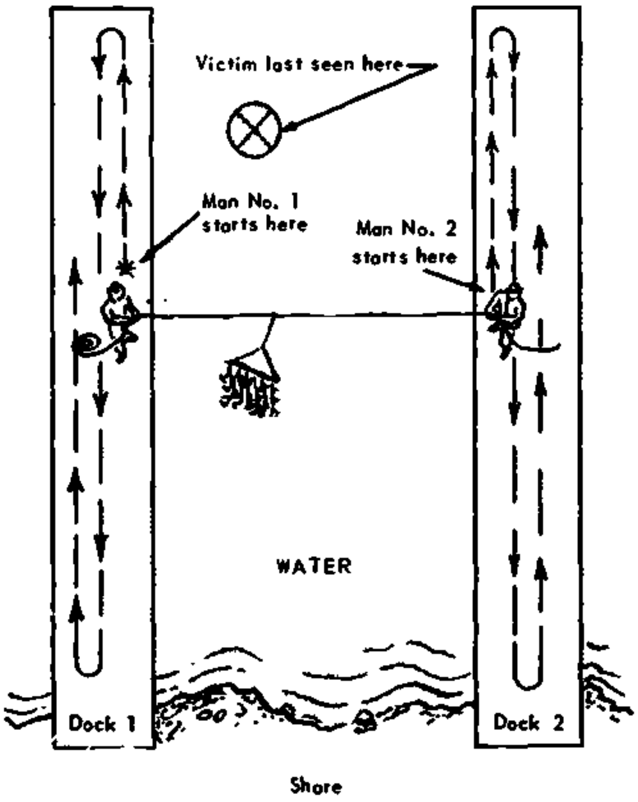


Figure 13

Dock-to-dock grappling

Boat-to-Boat Grappling - The following procedure is recommended. (See Figure 14.)

1. Place four buoys to mark the area to be covered.
2. Boats should be anchored from bow and stern.
3. Boats should be headed in the same direction.

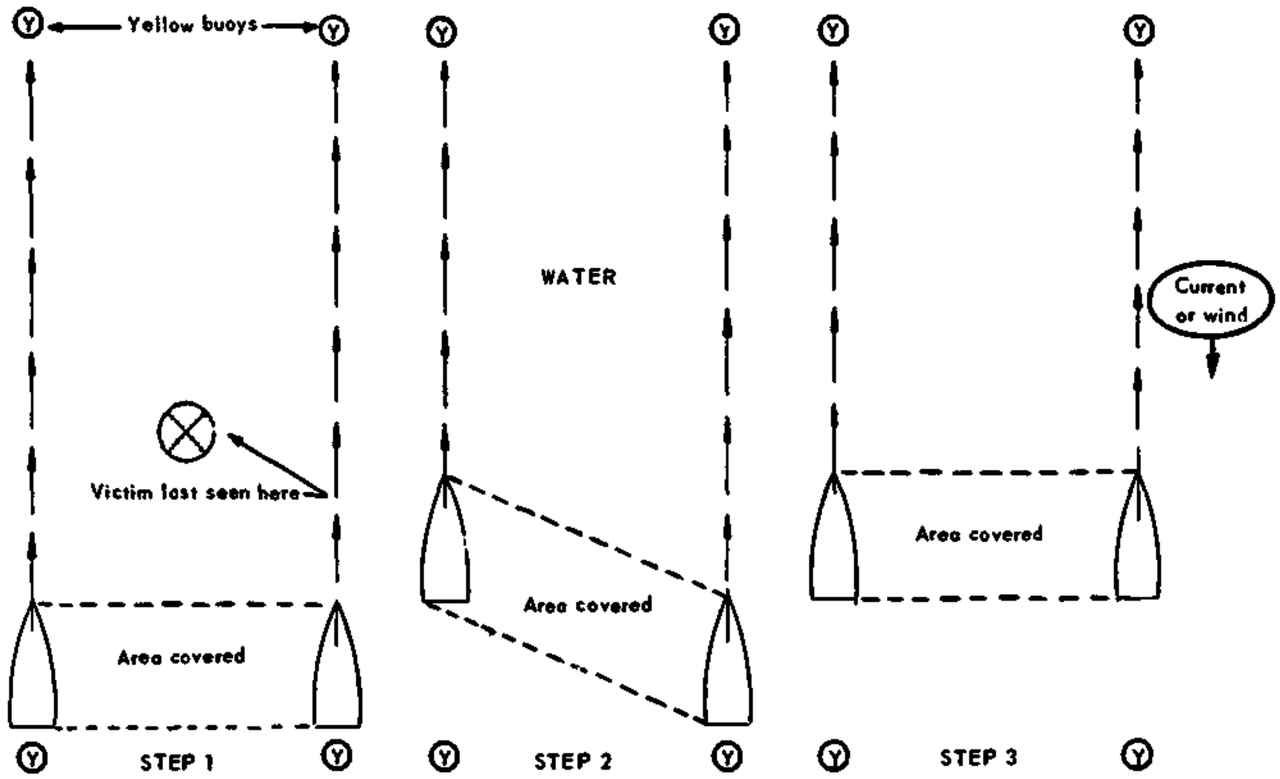


Figure 14

Boat-to-boat grappling

4. Boats should be broadside to the area being dragged at all times.
5. The entire length of the boat is grappled. Boat #1 moves forward one boat length. Then boat #2 moves in line with boat #1.

GRAPPLING FROM A MOVING BOAT

The least advantageous method of grappling is from a moving boat. The movement of the boat cannot be controlled perfectly, so the entire bottom of the area may not be covered.

When grappling from a moving boat, it is best to move with the current. This will keep the hooks on the bottom. If the current is very strong the oarsman should back water; otherwise the movement of the boat will be so swift that it may pull the hooks off the bottom.

The squadman using the hooks should kneel on the stern seat of the boat and operate the hooks over the stern of the boat.

In rough waters a motor may be used. It is best to use the motor to move the boat upstream with hooks out of the water. The boat should then be allowed to float slowly downstream with hooks on bottom.

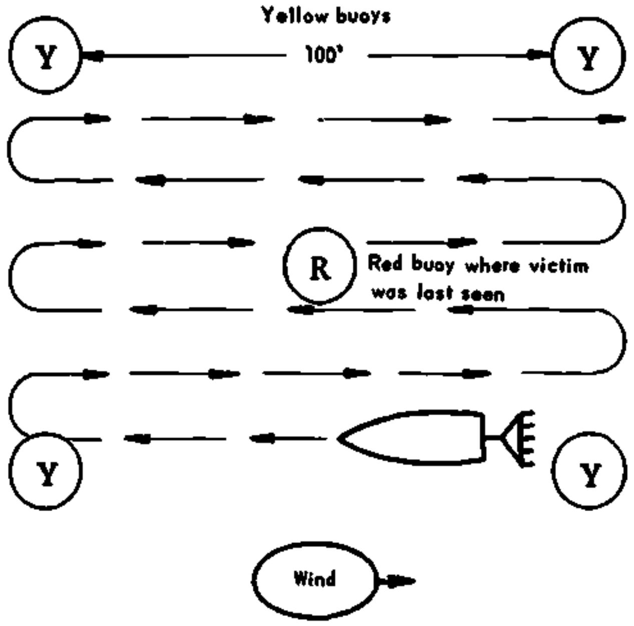


Figure 15
Dragging from a moving boat

Figure 16
Grappling hooks correctly used. They should drag the bottom.

For dragging from a moving boat, the following procedure is recommended. (See Figures 15 and 16.)

1. Upon arrival at the scene, remove all equipment from the boat that is not needed to start operations.
2. Launch boat (with two men).
3. Place red buoy where victim was last seen and start dragging at once.
4. If body is not recovered within one hour, place four yellow buoys in a square approximately 100 feet apart, and start systematic dragging operations.
5. Row boat into the wind; it is easier to keep on a straight course.
6. Do not start rowing until hooks hit the bottom.
7. Hold the dragging rope in your hand at all times, so you can feel when an object is hooked. The slack end of the rope should be tied to the boat as a precaution against losing hooks if the rope is pulled from your hands.
8. Boat must be rowed slowly and must not get too far ahead of the hooks.

OUTBOARD MOTORS

While the use of a motor on a boat is not recommended for dragging operations, it can be used successfully by squadmen under certain conditions.

Advantages

1. Time and effort are saved in getting to the spot to start dragging operations.
2. Time and effort are saved in rescue of victims stranded in flood waters.

Disadvantages

1. Motor gets in the way of dragging operations.
2. Motor moves boat too swiftly for dragging, pulls hooks off bottom.
3. Motor is sometimes difficult to start.
4. Time is lost refueling motor.
5. Mechanical failures occur, such as shearing off of the pin or motor stoppage.

DRAGGING WITH SEVERAL BOATS

Sometimes several boats are used in a dragging operation. Figure17shows a recommended procedure.

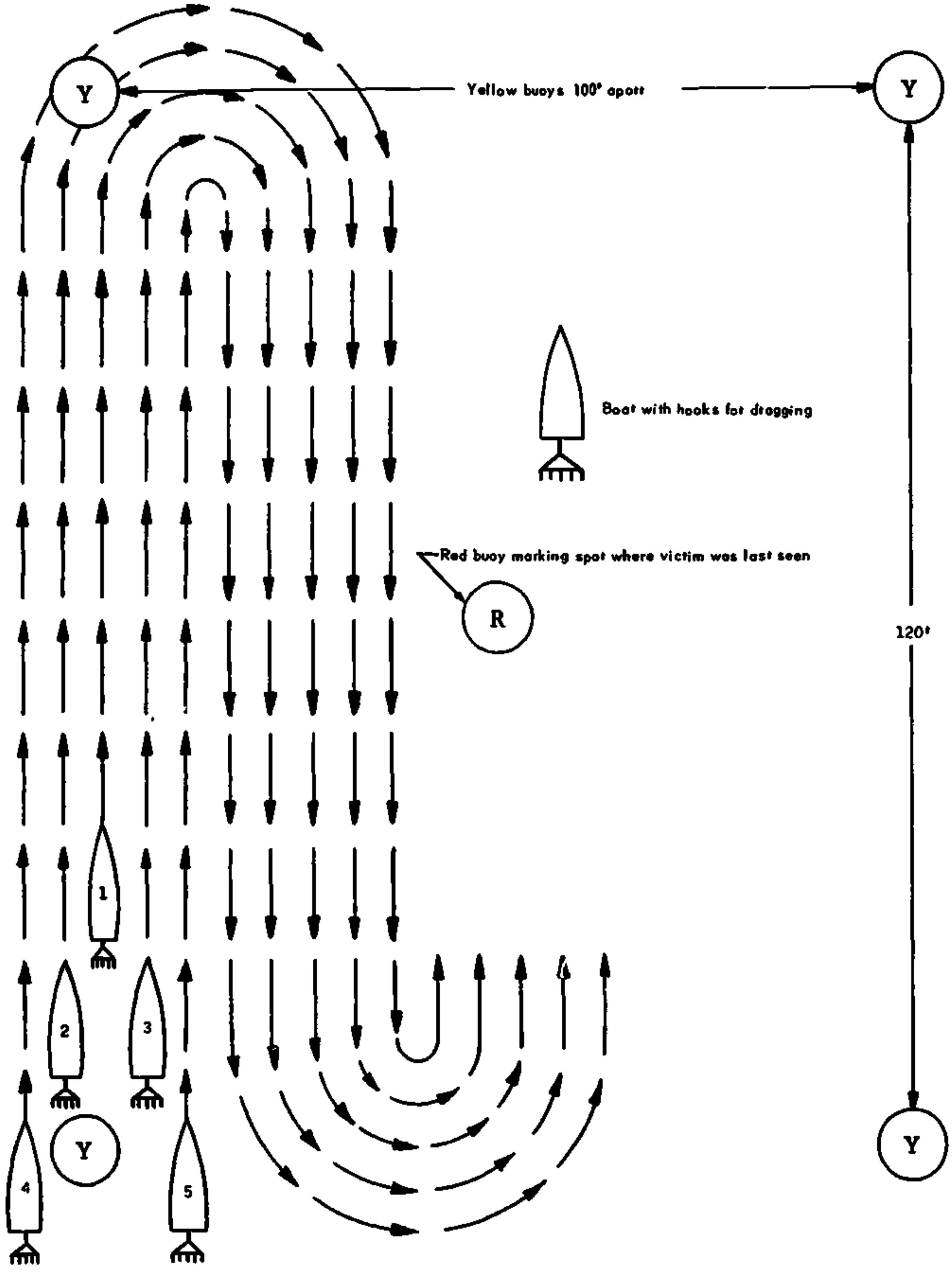


Figure 17

Dragging operation, using more than one boat

GRAPPLING WITH PIKE POLE IRON

Use the method shown in Figure 15 to cover the area. This method is very good when the bottom is full of tree stumps and heavy brush.

Grappling for a body with pike pole irons differs somewhat from the actual dragging methods usually associated with a body recovery operation. Pike pole irons are not dragged or pulled along the bottom. The squadman holds the pole in a vertical position and tamps the bottom with quick up-and-down strokes while the boat is moved along. (See Figure 18.) This probing action enables the operator to feel or determine what is being struck, on the bottom, by the end of the pole. This action also eliminates the possibility of the iron becoming fouled with debris on the bottom. The boat must continue to move very slowly during the searching operation until the entire area has been thoroughly covered. When the body is "struck" or located, the boat must be stopped and held stationary until the body has been securely hooked and raised to the surface.

SITUATIONS

Situation #1

A boy starts to swim a large lake on a dare; about one-quarter mile offshore he tires and sinks. He is noticed by his pal who calls the life guard and lake manager. The manager calls the emergency squad at once. They arrive within four minutes and start dragging at once. (Time was not taken to set out buoys.) See Figures 20 through 24.

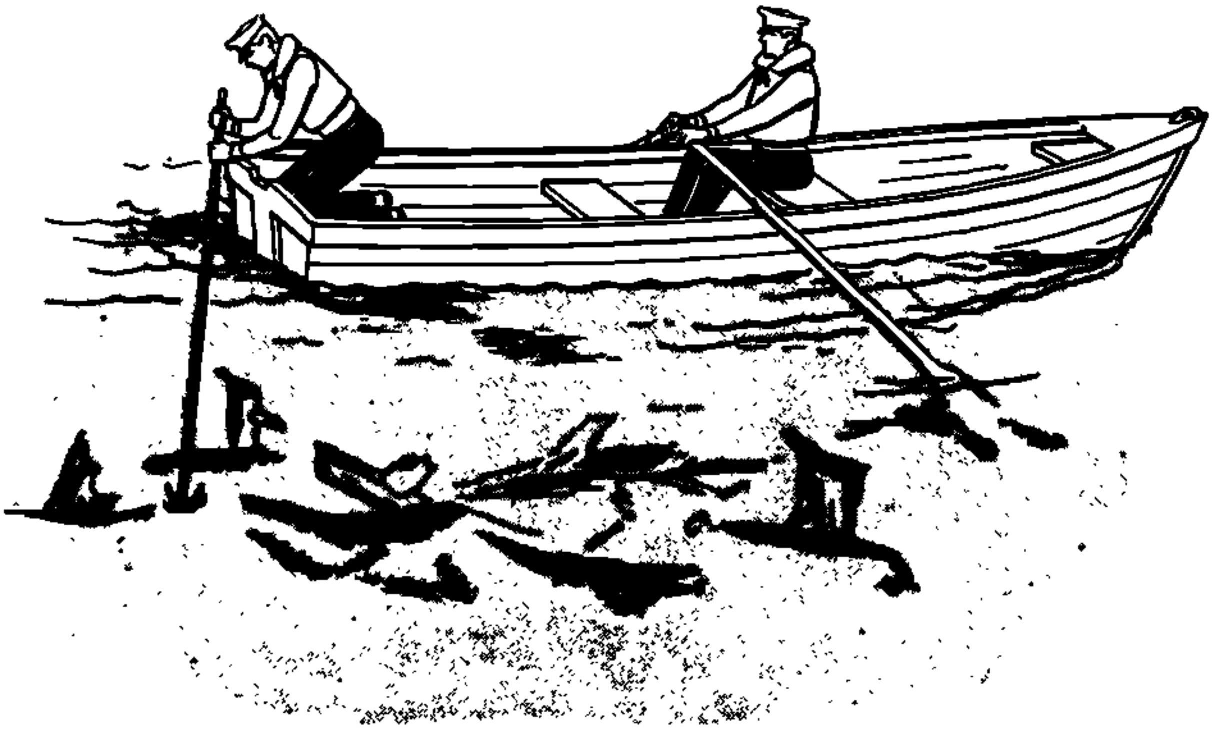


Figure 18

Grappling with pike pole iron

Courtesy Yorkville Vol. F.D.

Figure 19

On the second pass over the area the boy's arm is hooked by the grappling equipment. The squadman gently raises the boy to the surface and lifts him over the stern into the boat.

Courtesy Yorkville Vol. F.D.

Figure 20

Artificial respiration is started at once. With two rescuers and the victim in the boat, rowing would be awkward. Therefore another boat, manned by a squadman and a lifeguard, will tow the rescue boat to shore.

Courtesy Yorkville Vol. F.D.

Figure 21

On shore the body is covered with a blanket and mechanical resuscitation is started.

Courtesy Loudonville Vol. F.D.

Figure 22

The boy recovers after 20 minutes. Although he feels fully recovered, squadmen load him into the ambulance for transportation to a hospital. He remains there for 24 hours under careful observation, then is released. This is the happy ending of a serious situation.

Situation #2

Fisherman rents a boat from a park manager at 11 p.m., for all-night use. When the manager arrives at the park at 7 a.m. he sees the empty boat and investigates. Evidence indicates the fisherman fell into the lake.

The manager calls the sheriff and the highway patrol. After one hour of consultation, they call the emergency squad and the coroner.

Courtesy Loudonville Vol. F.D.

Figure 23

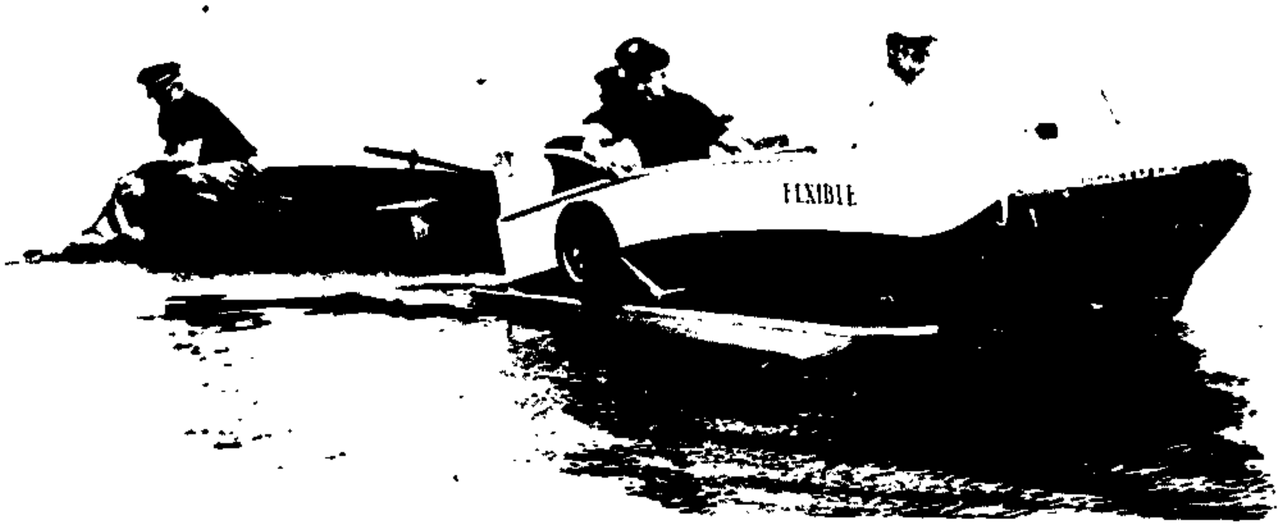
As the boat is still anchored it is not necessary to place a red buoy; the boat serves as a marker. The victim's wife arrives. The squadmen start to drag at once. After twenty-five minutes of dragging, they are about to take the time to use the systematic method when the body is hooked by the right leg.

Courtesy Loudonville Vol. F.D.

Figure 24

Squadman #1 secures the body with rope under the arms, as Squadman #2 removes hooks.

* In these posed pictures squadmen did not wear life jackets. In an actual rescue men would be wearing life jackets during the boating operation.



Covrtesy Loudonville Vol. F.D.

Figure 25

As it is a long distance to the shore, the coroner in his boat tows the boat and body to shore. (Note body is not pulled into boat, but is floated to shore.)

Courtesy Lovdonville Vol. F.D.

Figure 26

The body is wrapped in a blanket to conceal it from onlookers, With the assistance of squadmen, the coroner makes his examination. He takes charge of the body.

SUMMARY OF OPERATIONS AT SCENE OF DROWNINGS

Authority

An emergency squad should be in charge of the scene and operations.

Procedure

In most instances, rescue operations should be based on use of a boat and other equipment. NO ONE SHOULD ENTER THE WATER UNLESS HE IS A QUALIFIED RED CROSS WATER SAFETY MAN, SENIOR LIFE SAVER OR INSTRUCTOR. Personal entry into the water is indicated when the victim can be seen and is moving and when there is substantial evidence that the victim has been in the water for only a few minutes.

Life jackets must be worn by any non-swimmer working in a boat. In swift water EVERYONE who works in the boats must wear life jackets. Remove all equipment from the rescue boat except that needed to start operations, before launching it.

In a two-man boat, one man should row while the other uses the dragging equipment. The man who is dragging should kneel on the stern seat and use the equipment over the stern of the boat.

If recovery is made within a reasonable length of time, artificial respiration should be started immediately. The resuscitator should be put into service as soon as possible.

If at all possible, recovered bodies should be put into body wrappers while in the water.

In the event of a drowning, the coroner and the police must be notified.

SKIN DIVING

Skin diving should be limited to experts who have approved aquatic equipment.* It is recommended that the local skin diving club be contacted, and an emergency plan of operation be set up with club members so that squadmen may call for their services in an emergency. After a plan is agreed upon, the telephone numbers of the club members should be available at all times.

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* As is taught in other areas, when a special situation arises, call in a specialist. Utility companies are frequently called in for the use of their special skills. The same policy should be followed when rescue work involves skin diving.

WATER RECOVERY PROCEDURES DURING ICE CONDITIONS

The following information is included as a guide to the rescue squad in supervising efficient recovery operations during ice conditions. The skin divers called in will do the actual recovery, but the squad may have to supply much equipment, to enable divers to work swiftly and safely.

Keep everyone off the ice until the safety factor has been ascertained.

The point of entrance of the victim into the water probably will be readily ascertainable. Any current of water movement should be noted.

Special Equipment

The following equipment should be available:

- Ice chisels
- Ice saws or chain saws
- Crowd-control ropes, with stakes
- Creepers
- Pike poles
- Ice tongs
- Skidway for sliding chunks onto ice or shore
- Power megaphones
- Anchor and ring on line
- Five-foot snap and ring lines for divers underwater

This equipment can be kept together at squad headquarters for use when needed.

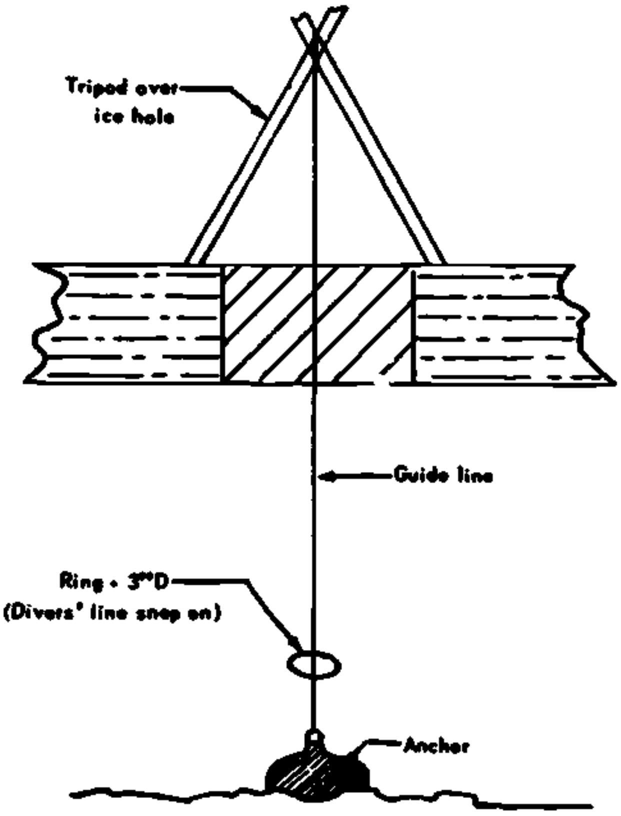


Figure 27

Guide line with ring attached, connected to tripod and anchor.

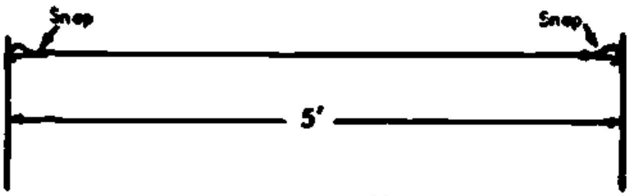


Figure 28

Five-foot snap line or distance line. Diver snaps one end of line onto ring and other end onto his gear.

Use of Divers

In a pond or lake, if divers are to be used and the ice is sufficiently thick to sustain man's weight, the chief preparation will be the opening of a four-foot-square hole at the point of entrance. Anchor line, ring and tripod should be gathered and set in place. Preparations for arrival of divers should then be started. All pertinent information (water movement, etc.) should be available to them on their arrival.

Adequate dressing facilities must be arranged. These must be warm and comparatively near to the scene.

Hot coffee and/or chocolate should be available for divers at all times, at the water area and in the dressing room. Hot chocolate is preferable to coffee in many instances, as it is a very rapid body-heat builder.

As soon as manpower permits, the diving area should be roped off so that bystanders or sightseers will not be endangered or hamper the operations of the crew.

Because of the danger involved, nighttime operations should be limited.

The resuscitator should be kept standing by, during the time men are on or near the ice or water.

A recommended pattern of search is shown in Figure 27. Note that all areas are searched twice when this pattern is followed. Divers underwater on any one hole should be limited to a maximum of three. For each of these divers there should be a tender at the surface, manning the safety line.

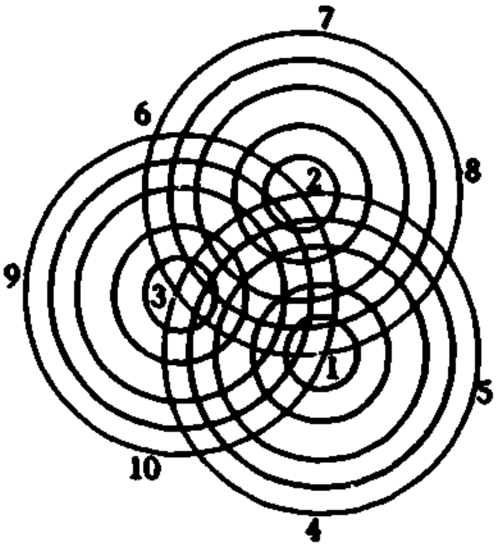


Figure 29

Pattern for under-ice search. The holes are 5 feet apart. Divers enter holes No. 1, No. 2, and No. 3 first. If the body is not recovered, additional holes for searching can be made at locations No. 4 through No. 10, and the same recovery procedures followed.

Opening Ice

If ice is less than two inches thick, it probably will be better to break a channel with the boat. The boat proceeds in the channel and the divers fan out underwater (not more than five to cover an area on both sides of the channel. There should be no problem in adequately running parallel lines on this type of operation.

Methods of opening the ice will depend on thickness. Ice between one and three inches thick may be cut with a chain saw off the side of a boat or other support. Ice thicker than three inches may be cut with a chain saw while walking on the adjacent ice. Under one inch it will be more practical to break the ice with axes or chisels.

Initially as much ice as possible should be removed from the critical area, and pulled a safe distance away by the use of ropes and tongs. This will allow working space. This could be done as much as possible by the squad before the arrival of the divers.

Operations in Flowing Current

A barrier of snow fence, goat fence, chicken wire, etc., should be placed well downstream (one-half mile) from the point of entrance. Search operations should start at this barrier and proceed back upstream toward the point of entrance.

Approximately 50 feet of the river or stream should be cleared of ice, and the bottom thoroughly searched. Be sure to search the underside of this removed ice. Than the ice upstream may be cut into small manageable chunks and floated down into the cleared area. Again the bottom should be searched as the removal of ice progresses upstream.

If sufficient searchers are available and the water depth is not too great, a solid line of men can be formed across the stream. By slow prodding and removal of ice, the entire stream should be adequately covered back toward the point of entrance.

CHAPTER XXIII

UNUSUAL SITUATIONS

INTRODUCTION

Previous chapters have explained various rescue techniques, giving in many instances examples and illustrations of their use. This chapter describes unusual situations which could not be classified with material in previous chapters. In each example a problem is presented and appropriate procedures are suggested.

It is not practical to attempt to show or discuss in this manual every possible type of accident, or the unlimited number of circumstances which might surround an accident. However, from examples shown, squadmen should foresee many of the situations in which they may find themselves. In this way the necessary plans can be made not only within their squad, but with cooperating agencies and individuals, to meet situations which may arise.

HIGHWAY ACCIDENTS

Figure 1 shows a truck and automobile which collided on a very busy highway. Before the emergency squad arrived, some motorists removed the injured truck driver from his truck and placed him on the ground near his vehicle. Gasoline leaked from the damaged tank of the truck, contaminating the immediate area. Just before the emergency squad arrived a "non-thinking" bystander lit a cigarette and carelessly tossed his match to the ground.

The area was immediately engulfed in flames. The victim died of severe burns. It was later found that he had suffered only fractured wrists in the accident.

There are several lessons to be learned from this unfortunate event. The following precautions should have been taken:

1. The victim should have been removed a safe distance from the spilled gasoline.
2. A fire department should have been called to eliminate the hazard caused by spilled gasoline.
3. Bystanders should have been kept back from the contaminated area.

Courtesy Northern Hills F.D.

Figure 1

Highway accident

HOME EXPLOSIONS

Figure 2 shows a home which has been ripped by an explosion. Squadmen on arrival must take the following action.

1. Give first aid to victims with burns, cuts, and puncture wounds.
2. Give care for shock and hysteria.
3. Transport victims who need medical attention.
4. Check neighboring homes for persons who may also have been injured.
5. Notify law enforcement agencies so that property will be protected from vandals and so that help will be available to control possible crowds.
6. See that utilities are cut off, and that utility companies are notified.

If a fire department responds to the call, firemen may assume responsibility for Items 5 and 6, and may assist squadmen in Item 4.

Courtesy Mifflin Twp. F.D.

Figure 2

Home explosion

STORE BUILDING EXPLOSIONS

In a public building or store explosion the problems will be quite different from those resulting from a home explosion, for the following reasons:

1. The building will be larger and usually will be located near other large buildings. Since the debris will be confined by other buildings, it will fall back, covering victims who are in or near the building at the time of the explosion.
2. The number of victims probably will be greater.
3. The problem caused by spectators will be more difficult, due to the greater number of them and the crowded surroundings.
4. When utility services to the building are cut, large numbers of people in the area will be affected.
5. To cope with a disaster of this type, preplanning is essential. Heavy-duty equipment will be needed to remove debris, so that trapped victims can be rescued. It may be desirable to call neighboring squads, and local and neighboring ambulance services.

Figure 3

Store building explosion

In Figure 3 note the following:

1. A fire truck and charged hose line are on location to extinguish smoldering embers when they are encountered.
2. Emergency squads are standing by to transport the injured.
3. A high-lift loader is available to help in moving debris.
4. A truck and personnel from a utility company are on the scene.

SPECIAL EQUIPMENT

Figure 4 shows a large clam shovel being operated by a construction company. Preplanning made it possible to acquire the services of this piece of equipment rapidly.

In Figure 5, a bulldozer has been put into service. In the foreground, firemen are removing the cable from the shovel so that the hook may be used to remove a steel beam.

Figure 4

Clam shovel

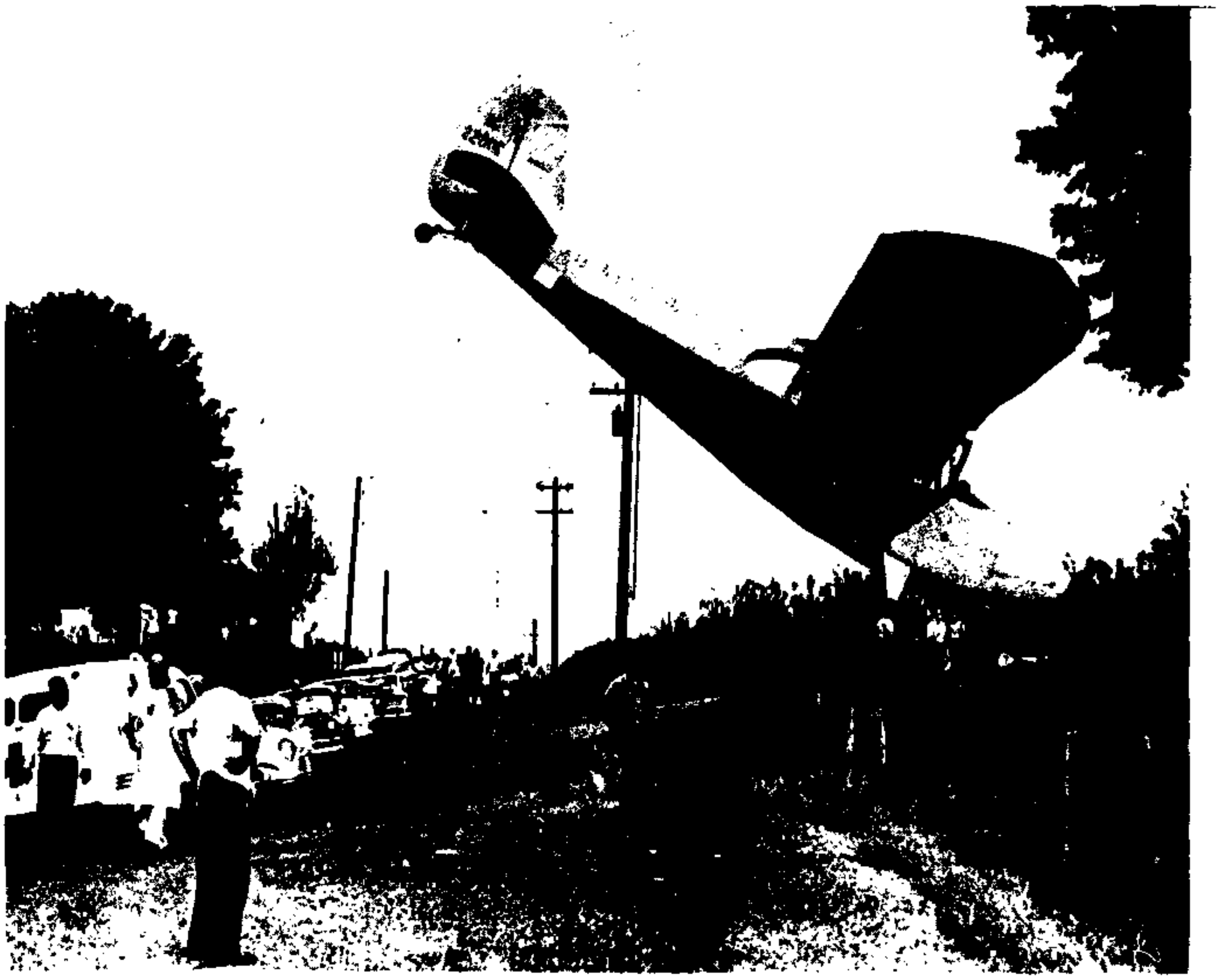
Figure 5

Bulldozer

AIRPLANE ACCIDENTS

Figure 6 shows another unusual situation. Squadmen acted wisely by taking the following action:

1. Passengers and pilot were told to remain in plane. Victims and rescuers might have been electrocuted if a rescue was attempted without having power disconnected.
2. The power company was contacted, to have electric lines de-energized. Due to pre-planning, the company responded rapidly.
3. Occupants of the plane were then rescued by use of a short ladder carried on the rescue squad vehicle.
4. Even though no injuries were apparent, victims were treated for shock.
5. Victims were then transported to the hospital.



Courtesy Ohio State Highway Patrol

Figure 6

Airplane accident

It appears that not all proper precautions were taken, since cars and pedestrians were allowed to move into the danger area caused by the electric lines. The lines could break or be burned down at any moment, turning the situation into a major disaster.

NOTIFYING AUTHORITIES

In Ohio the law requires the squad dispatcher to notify the Ohio State Highway Patrol of all airplane accidents, regardless of the size of the plane.

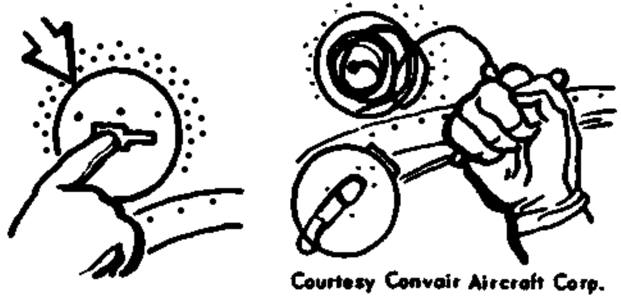
JET COCKPIT ENTRY PROCEDURES

All emergency squadmen should know what to do when confronted with the task of rescuing an injured pilot from a jet plane that is down. Squadmen who have not been trained to extract pilots properly have been killed because of their improper approach to a downed jet plane.

CANOPY EJECTION

WARNING: When fumes are present do not use the canopy ejection mechanism.

1. Remove access door on left side of fuselage, just forward of wing leading edge. Press with thumb or finger on center of circular door to open. (See Figure 7A.)
2. Reach inside, grasp exposed lanyard handle, and extend about six feet, and jerk. (See Figure 7B.)

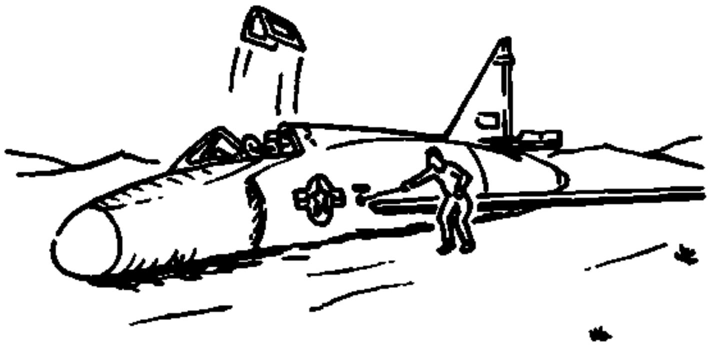


Courtesy Convair Aircraft Corp.

Figure 7a **Figure 7b**

Opening access door and ejecting canopy

3. Watch path of canopy during ejection to avoid being hit. Canopy will normally fall adjacent to tail section. (Figure 8.)



Courtesy Convair Aircraft Corp.

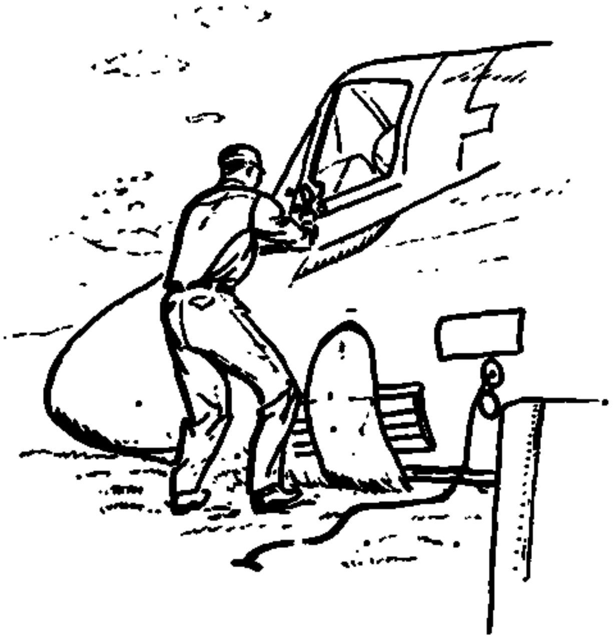
Figure 8

When lanyard is jerked, canopy usually ejects toward tail of plane.

4. Caution all rescue personnel to avoid area around tail section during canopy ejection.

Canopy Break-In - If canopy does not eject, proceed as follows:

1. Break canopy glass in lower forward corner on either side of the airplane. Use heavy (approximately eight-pound) maul. (See Figure 9 .)



Courtesy Convair Aircraft Corp.

Figure 9

Breaking canopy glass

2. Strike blows close to canopy frame.

3. Break out sufficient glass to permit removal of pilot.

4. CO_2 from a fire extinguisher can be applied to the canopy to facilitate a faster entry. This causes the material to break more easily.

PILOT RELEASE PROCEDURE

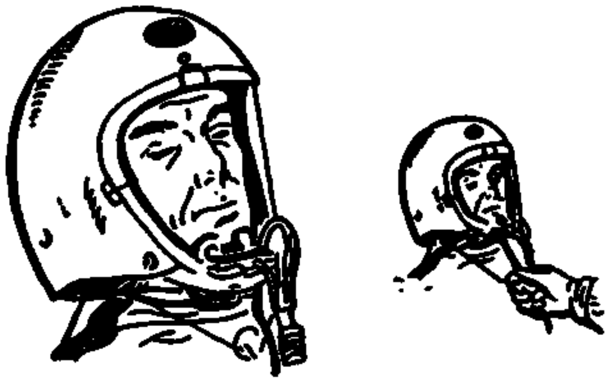
Seat Ejection Mechanism - Disarm ejection seat by cutting tube behind pilot's head. Cut all tubes to the rear of the pilot's head. Some trainers and newer aircraft have more than one tube. (Figure 10.)

Courtesy Convair Aircraft Corp.

Figure 10

Disarming seat ejector mechanism

Helmet Face Plate - Remove pilot's face plate by pulling downward on green cord beneath his chin and lifting face plate free. This must be done before detaching the oxygen supply hose. (Figure 11.)

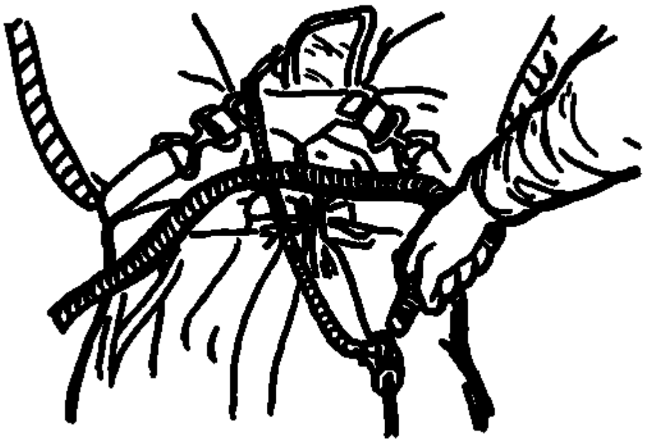


Courtesy Convair Aircraft Corp.

Figure 11

Removing pilot's face plate

Oxygen Supply Hose - Detach or cut oxygen hose which is attached to pilot's suit. (Figure 12.)

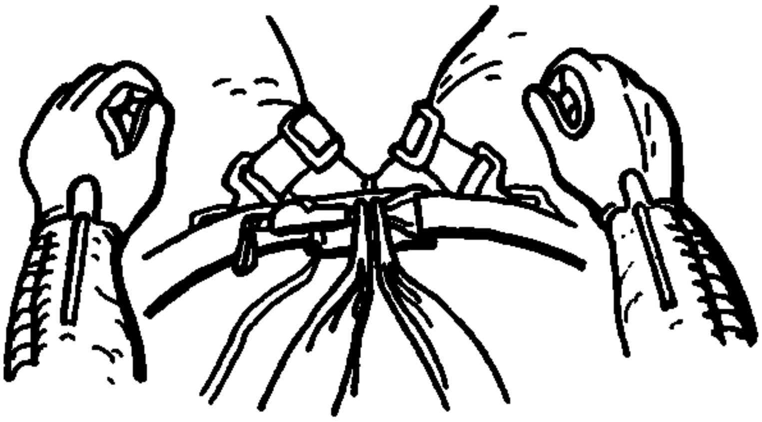


Courtesy Convair Aircraft Corp.

Figure 12

Cutting oxygen supply hose

Seat Belt and Shoulder Harness - Release pilot's seat belt and shoulder harness by unlocking buckle at pilot's waist. (Figure 13.)



Courtesy Convair Aircraft Corp.

Figure 13

Releasing seat belt and shoulder harness

Removing Victim - The victim should be lifted out by the shoulders. The squadmen should stand on the plane just behind the pilot to lift him out.

PREPLANNING FOR AIRPLANE ACCIDENTS

Because many commercial, military, and private planes are continually in the air, all squads should have a well defined plan to execute in case of aircraft accidents.

The latest military transport plane is believed to be able to carry 700 to 800 personnel on board. Does your squad have pre-plans to meet such an accident?

BUS ACCIDENTS

Modern buses have special construction features which must be understood by emergency squadmen for the successful rescue of trapped bus occupants, as well as their own safety. Critical design features of a typical modern cross-continental bus* are described here.

RESCUING PASSENGERS

This bus is 10 feet, 11½ inches high and 40 feet long. The coach weighs 30,000 pounds empty and 40,000 pounds loaded. Forty-three passengers can be seated in the coach: thirty-three on the upper deck and ten on the lower level.

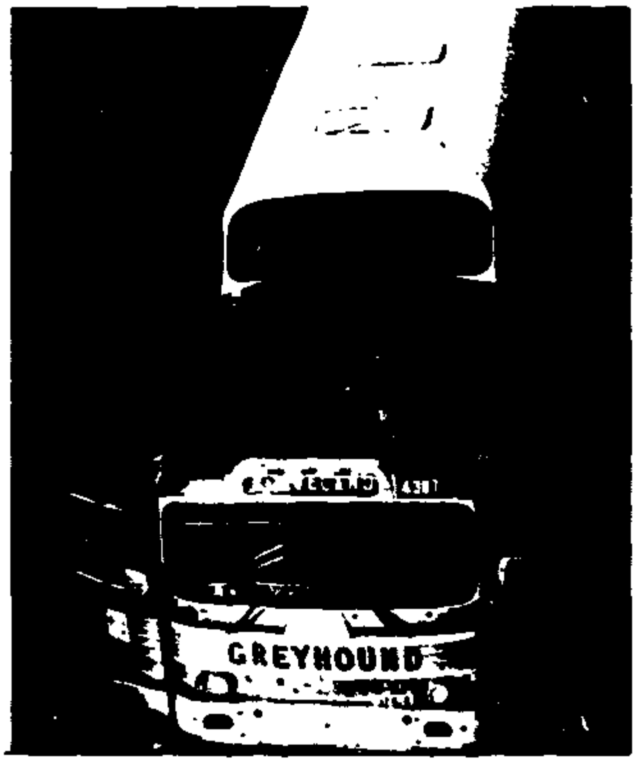
There is no emergency door. In case of an accident damaging the entrance door, rescue must be effected through the windows or the skylights. The windows are marked on the inside by a metal plate and the skylights by decals.

The windows are held in place by a metal frame, and are hinged at the top. To open a window from the outside, place a large screwdriver or pinch bar at the bottom of the metal frame and force the window out. To open the front windshield and skylights, take out the rubber locking strip which runs around the windshield and the skylights. The windshield, frame, and glass will all come out, leaving a smooth opening for the removal of any injured passengers. (See Figures 14 and15)

Courtesy Eastern Greyhound Lines

Figure 14

To remove a window, pry out the locking strip.



Courtesy Eastern Greyhound Lines

Figure 15

The skylights can be removed without breaking them.

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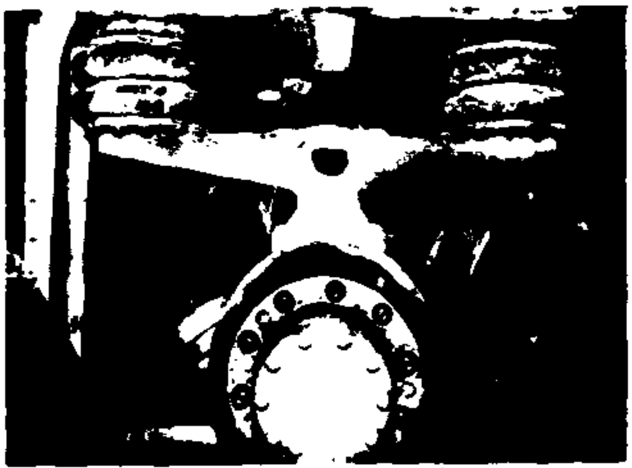
* This is a description of the Greyhound Scenicruiser, adapted from information supplied by Eastern Greyhound Lines.

This coach is equipped with a rest room located on the lower level next to the steps on the driver's side. In case of an emergency in the rest room, it may be entered from the outside by opening the large window on the driver's side. It will be necessary to prop or hold the window open, as it is hinged from the top.

BLOCKING THE COACH BODY

In case of a fire or an accident, NO PERSONNEL SHOULD BE ALLOWED TO GO UNDER THE COACH OR TO PUT THEIR HEAD OR SHOULDERS UNDER THE WHEEL HOUSING WITHOUT FIRST BLOCKING THE BUS BODY SECURELY.

The coach uses an air-suspension system for flotation, rather then metal springs. This air-suspension system consists of rubberized nylon bellows at each wheel. (See Figure 16) The bellows use from forty to fifty pounds of air, depending on the load on the coach and the road conditions; they are inflated through air chambers from the compressor. The coach is kept on an even keel by the use of leveling valves.



Courtesy Eastern Greyhound Lines

Figure 16

Nylon bellows support the weight of the coach body.

When a bellow is damaged, a coach can drop without warning to within three to three and one-half inches of the ground. Therefore the body must be blocked before anyone goes underneath, or puts his head or shoulders under a wheel housing.

This coach has no frame; it is equipped with jack plates located under the body behind the rear wheels. If it is necessary to jack or block under the body of the coach, jack under a solid bulkhead. These bulkheads are located in front and rear of the wheels. You may also jack under the short engine supports. Always place a support under the body before jacking, because these bodies are made of aluminum, which will tear easily.

DISCONNECTING BATTERIES

The individual circuits of the electrical system are protected by circuit breakers. However, if it is necessary to disconnect the batteries from the electrical system, push up on the battery-disconnect switch handle which is located at the rear of the battery compartment. Access to the switch is through the center engine door. (See Figure 17) To connect batteries, lower the switch handle to a horizontal position.

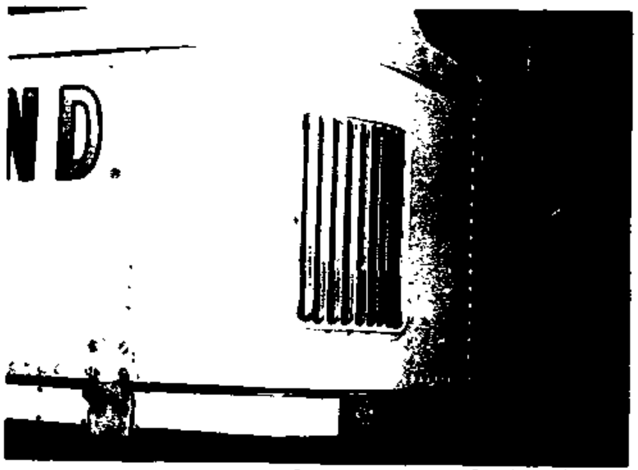
Courtesy Eastern Greyhound Lines

Figure 17

This switch will disconnect the batteries.

ENGINE AND FUEL

This coach is equipped with an eight-cylinder diesel engine which does not need electrical current to keep it running after it is started. In case of an accident, if fire department or rescue personnel arrive on the scene and find the engine running, it can be shut off with an emergency stop button located on driver's left switch panel. If for any reason the engine does not stop when the button is pushed, it may be stopped by discharging CO_2 into the air intake located at the right rear corner of the coach. (See Figure 18) This method should be used ONLY after all other procedures have failed. It is important that ONLY CO_2 be used, as other extinguishing agents may damage the engine and may cause injury to personnel.



Courtesy Eastern Greyhound Lines

Figure 18

Discharging carbon dioxide into this air intake will stop an engine that cannot be shut off manually.

IT IS VERY IMPORTANT TO BE CAREFUL when opening the rear engine compartment doors. There are no safety guards around the fans, and speed of rotation makes them difficult to see.

The fuel tank holds 180 gallons of diesel fuel. The tank is located back of the front wheels, running across the coach. The filler cap is located on the right side. The tank has no shut-off controls. There is no gasoline carried on the coach.

EXTINGUISHING FIRES

The most vulnerable places for fires to start in this coach are the brakes on the trailing axle, the transmission, and the engine compartment. In extinguishing a fire around the transmission, attack the fire over the rear wheels on either side with fog. Make sure that fire or rescue personnel do not place their head or shoulders between the wheels and the body of the coach. An applicator is desirable.

This coach is equipped with two fire extinguishers. The Dugas extinguisher is mounted behind the glass door to the right of the operator's seat. The other fire extinguisher is located in the heater compartment. It is a liquid type, intended for use with tire fires.

Safety flares and flags are carried in a tube at the left of the operator. A fire axe is mounted inside the dash compartment. A first-aid kit is mounted in front of the operator, above the left windshield.

AIR-SUSPENSION SYSTEMS IN OTHER VEHICLES

Air-suspension systems of flotation are being used now on many inter-city buses, city-type buses, trucks, trailers, and on one type of train. Air suspension will be used more and more as time goes on, because of the lower cost of repairs on body parts and springs, and the smoother riding qualities. Squad members should become thoroughly familiar with the operation of air-suspension systems in all the types of vehicles based in their area, as well as those which may pass through their area.

FARM ACCIDENTS

Squads that operate in rural areas are often involved in farm accident rescues. Figures 7 through 12 show the steps taken to rescue a man whose hand was caught in a corn picker when he attempted to unclog it.

Courtesy Loudonville Vol. F.D.

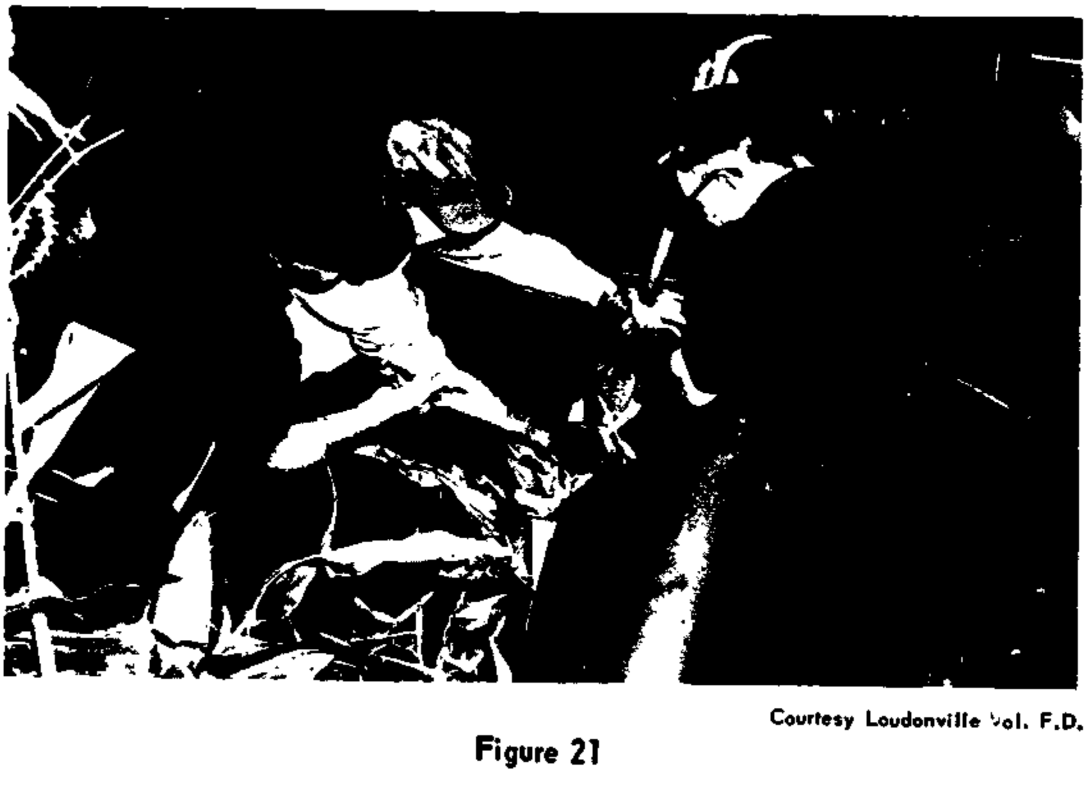
Figure 19

Squadman No. 1 is using an adjustable end wrench to remove a belt, so rollers can be spread. Squadman No. 2 sizes up the problem. Note gloved hand between rollers.

Courtesy Loudonville Vol. F.D.

Figure 20

Squadman No. 1 helps the victim inhale from an ammonia capsule. Squadman No. 2 applies a tourniquet. Squadman No. 3 pries with hux bar.



Courtesy Loudonville Vol. F.D.

Figure 21

Squadman No. 1 assists in removing victim's hand. Squadman No. 2, not shown, has gone to make up a cot. Squadman No. 3 continues to pry with hux bar.

Courtesy Loudonville Vol. F.D.

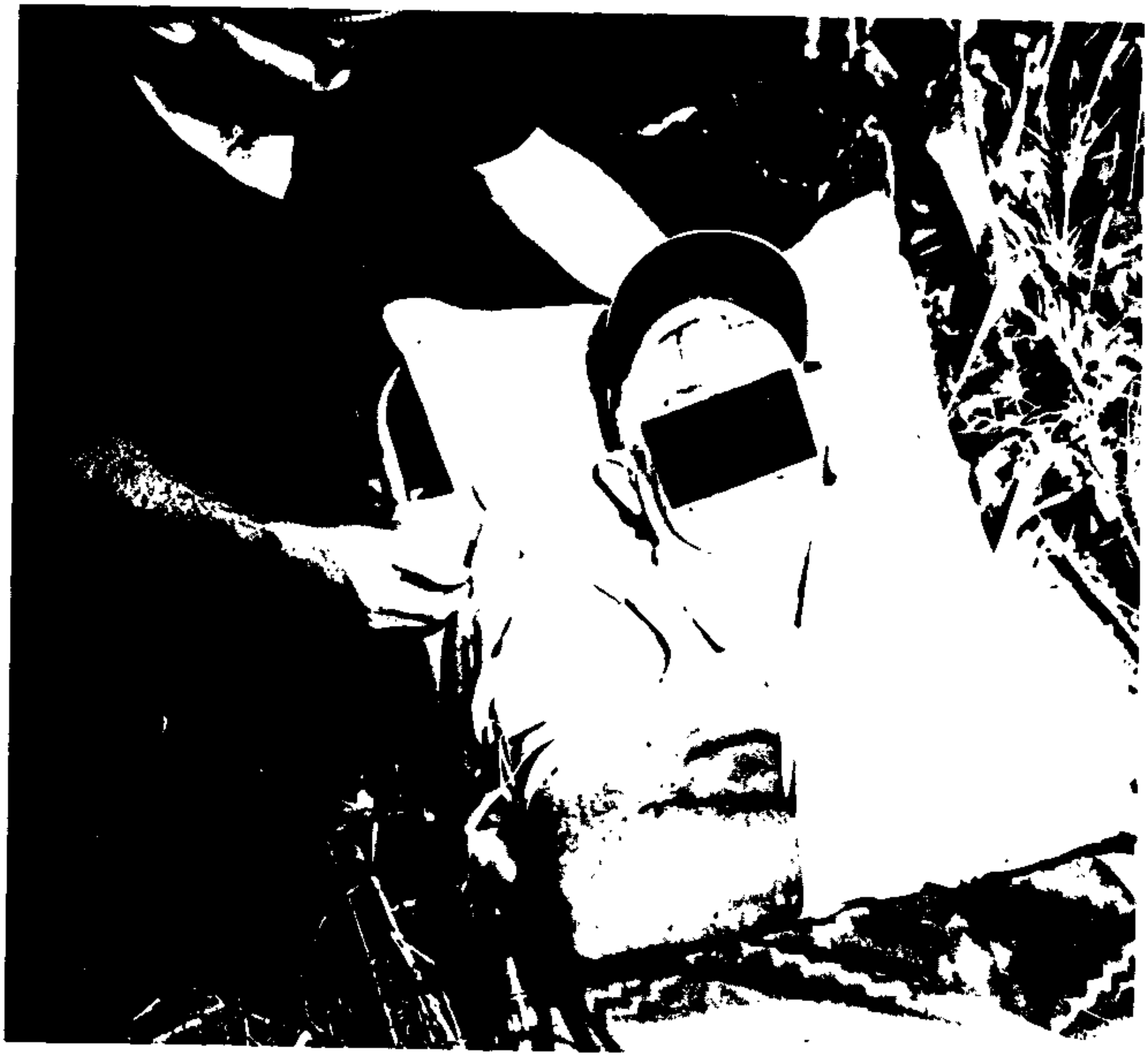
Figure 22

The victim's hand is freed. He is supported and reassured by squadmen.

Courtesy Loudonville Vol. F.D.

Figure 23

Squadmen give first aid. They wrap the victim's hand and treat him for shock.



Courtesy Loudonville Vol. F.D.

Figure 24

This victim will be covered with one more blanket, and transported to the hospital. Since the tourniquet and injury will be concealed under the blanket, the letters TK are written on the victim's forehead with an iodine swab.

OPERATIONS AT A CRIME SCENE

The following information should be of help to all squads. The outlined procedure should be followed at all suspected crime scenes.

Emergency care should not be jeopardized or sacrificed at any time. If there is any thought whatsoever that life may still be present, the care of the patient must take precedence over all other things.

Protecting The Scene

The scene of any unusual death such as at a fire, accident, explosion, unnatural death, etc., should be treated as a crime scene until proven otherwise. If squadmen arrive ahead of any law officers, they should assume the responsibility of protecting the scene.

1. The primary object to be guarded may be a body, an automobile, a room, or an entire building.
2. An area around the primary object may also require protection, depending on the type of crime.

Authority should be turned over to the police agency as soon as a representative arrives. If a patient must be transported to a hospital, one squadman could be left at the scene to await the arrival of the police agency.

Typical Procedure

All crime scene investigations more or less follow the same general pattern. The example treated here is a possible homicide. Parts of this procedure, of course, are not applicable in other types of crime.

The following information should be obtained promptly and transmitted to a police agency.

1. Name of deceased, if possible.
2. Exact address and location of the body.
3. Telephone number where squadman can be reached or is calling from.
4. Apparent cause and time of death, if known.
5. What assistance, if any, is needed.

Duties of the first squadmen at the scene are as follows:

1. If the victim must be moved for emergency care, mark in some manner an outline of the body.
2. KEEP THE SCENE INTACT--AS IS. Never touch, change, or alter anything until investigators arrive.
3. Get the names and addresses of witnesses and persons at the scene.
4. Get the name and address of the person who summoned the squad.
5. Note the weather condition at the time of your arrival.
6. Note the exact position of the body and the condition of the victim's clothing.
7. Note the condition of the victim's hands and any objects in his hands.
8. Note the size and condition of blood stains, if any.
9. If a weapon is found, do not touch it - push it aside or pick it up with a cloth. The weapon should be touched only in the most extreme emergency.

10. All persons found on the scene should be detained for examination, and no unauthorized persons should be admitted to the scene.

11. Do not remove a dead body unless so authorized by the coroner or officer in charge of squad.

12. At least one squadman should reamin with the body at all times, until he is relieved by a police agency.

13. Squadmen should not theorize or gossip with citizens about facts of the case. All such information should be given to investigating officers.

14. Note the time of arrival at scene and the names of squad officers present.

Records

All pertinent information should be kept on the squad report at squad headquarters. It may be subpoenaed later, as evidence.

CHAPTER XXIV

RECORDS AND REPORTS

INTRODUCTION

Proper reporting and record keeping are extremely important in the operation of an emergency or rescue squad. This chapter discusses important items of information that should be included on reports for successful operation and future reference. Sections of a squad report sheet are shown one at a time, and important items are discussed. Each section extends across both columns with the explanatory text running consecutively from column to column. The complete report form is shown on page 313, together with several other sample run reports and a typical monthly summary report. (Figures 1 through 6 .)

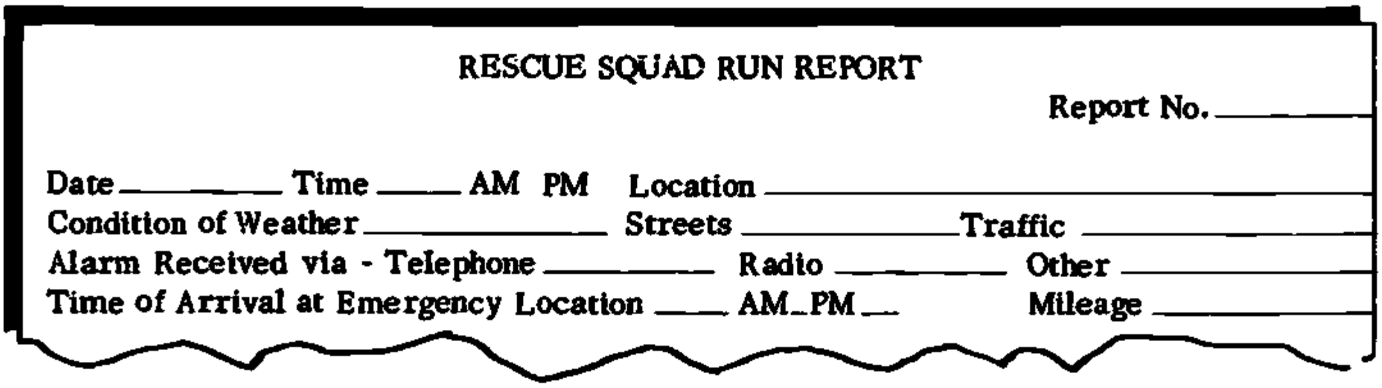
RESPONSIBILITY FOR REPORTS

The responsibility for reports is determined by local authority, such as the squad chief or fire chief. It is his duty to designate who is to be responsible. In many rescue squad organizations the chief responds to most calls. If this is the practice, the chief will usually complete the necessary reports. In any case it should be established who is responsible for filling out a complete squad report.

IMPORTANT ITEMS ON SQUAD REPORTS

RECEIVING AND RESPONDING TO ALARM

The date, time of receiving alarm, and location should be placed at or near the top of the report. Many squad reports provide a place to record "How the Alarm Was Received", that is, by telephone, messenger, police, radio, alarm system, etc. Some rescue squad run reports include "Time of Arrival at Emergency Location" and "Mileage".



RESCUE SQUAD RUN REPORT

Report No. ________

Date _______ Time ____ AM PM Location ________________

Condition of Weather __________ Streets _________ Traffic _________

Alarm Received via - Telephone _______ Radio _______ Other _______

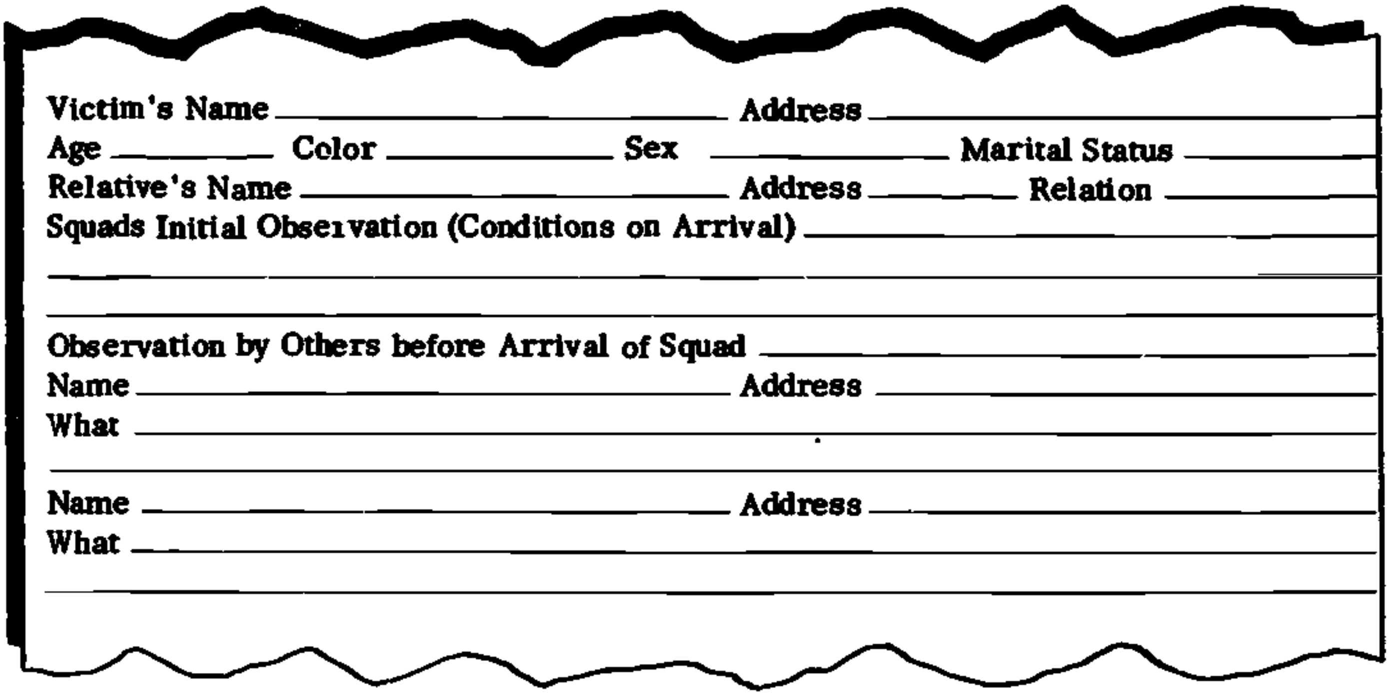
Time of Arrival at Emergency Location ____ AM_PM __ Mileage _______

OBSERVING THE CONDITION OF A VICTIM WHEN FOUND

Space should be provided for the name and address of the victim, plus a brief but complete explanation of the squadman's initial observation of the situation.

Space should also be provided to record the names and addresses and important information received from persons who were at the scene before the squad's arrival.

On many report forms the back of the sheet is blank, allowing ample room to include additional information. If data are recorded on a separate sheet of paper, it should be securely attached to the report form for reference.



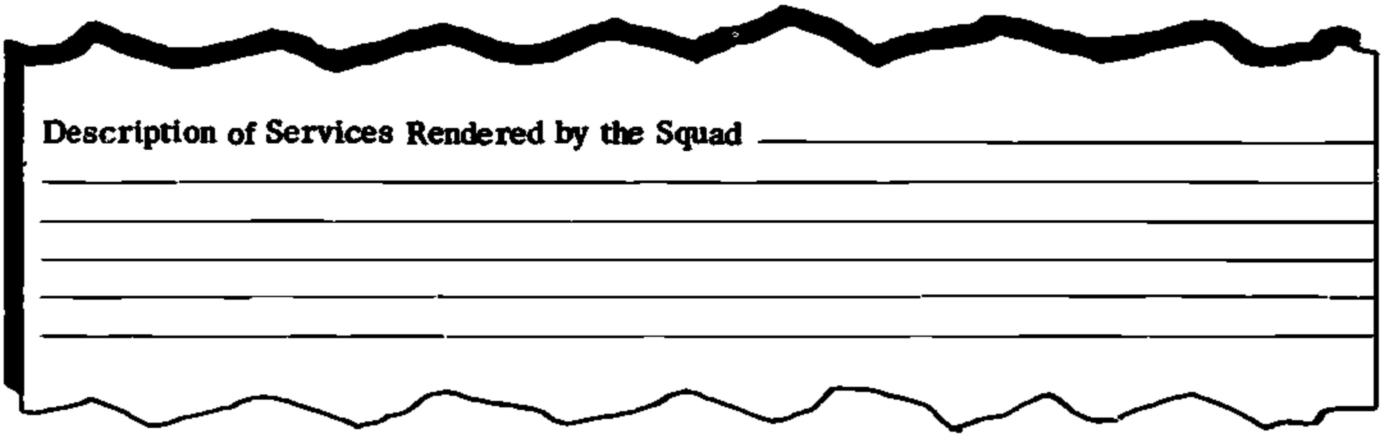
Victim's Name ____________________ Address ____________________
Age ________ Color ____________ Sex ____________ Marital Status ________
Relative's Name ____________________ Address ________ Relation ________
Squads Initial Observation (Conditions on Arrival) ____________________
____
____

Observation by Others before Arrival of Squad ____________________
Name ____________________ Address ____________________
What ____________________
____

Name ____________________ Address ____________________
What ____________________
____

FIRST AID GIVEN BY THE SQUAD

A description of the first aid and other important services given by the squad should be included on the report. Here too, the reverse side of the report or a separate sheet of paper may be used.



Description of Services Rendered by the Squad ____________________
____
____
____
____
____

MEDICAL SERVICES PROVIDED BY A PHYSICIAN AT THE SCENE

This information should be requested from the attending physician and be entered on the report. Space should be provided for the attending physician's name and address, the services he provided, and his instructions or suggestions either to the squad or to hospital personnel. Presenting a scratch pad with pencil to the physician at an appropriate time may assist a squadman to obtain this information.

Name of Attending Physician ____________________ Address ____________________

Services Administered ____

____

____

Physician's Instruction: ____

____

____

HANDLING OF VALUABLES

Proper handling of valuables at an emergency is extremely important, and all personal items should be treated as valuable. An item which has little monetary value may be regarded by someone as extremely valuable because it is a gift or keepsake.

It is very important to make out an itemized list, properly signed and witnessed, when valuables are put in the trust of a squadman or others. Usually valuables are not taken from victims who are conscious. (Usually this is left up to the police or hospital.)

Valuables and their Disposition: ____

____

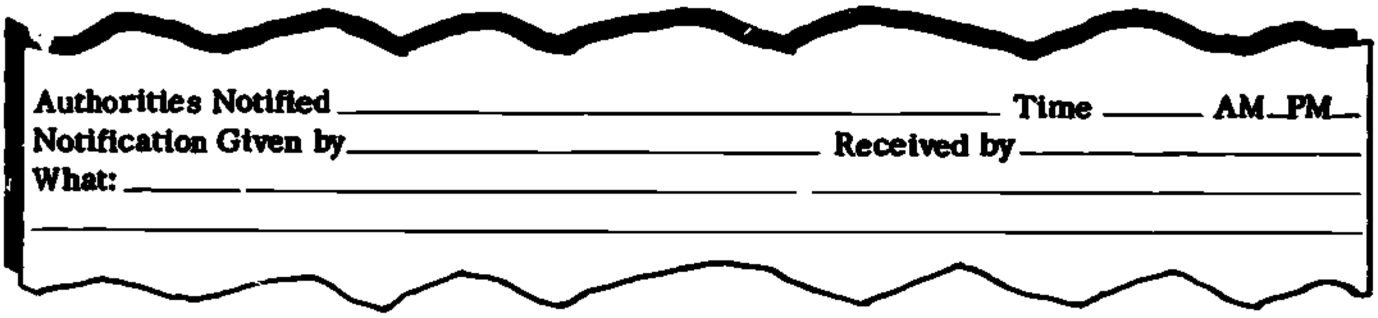
Receiver's Signature ____________________ Address ____________________

Witnesses Signature ____________________ Address ____________________

Witnesses Signature ____________________ Address ____________________

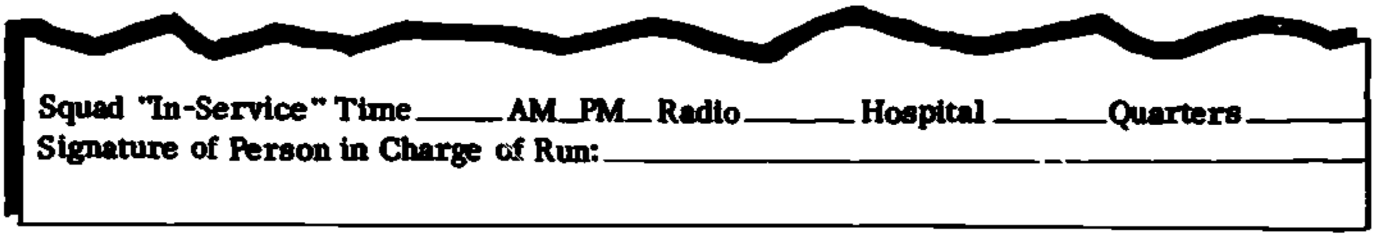
NOTIFYING PROPER AUTHORITIES

In some situations squadmen may be required to notify the coroner, a police agency, or the state fire marshal's office. In this case the name and title of the person receiving the information should be requested and made a part of the report, along with the hour of the day when he was notified. Sometimes the dispatcher obtains this information, rather than the squadman at the scene. Whatever action is taken, it must conform with the local, state, and federal laws.


Authorities Notified ______________________________ Time ______ AM__PM__
Notification Given by ______________________ Received by ______________
What: ____
____

SIGNATURE OF PERSON MAKING REPORT

No report is complete without the signature of the person who made it. Local department rules may require more than one signature.


Squad "In-Service" Time ______ AM__PM__ Radio ______ Hospital ______ Quarters ______
Signature of Person in Charge of Run: ______________________________________

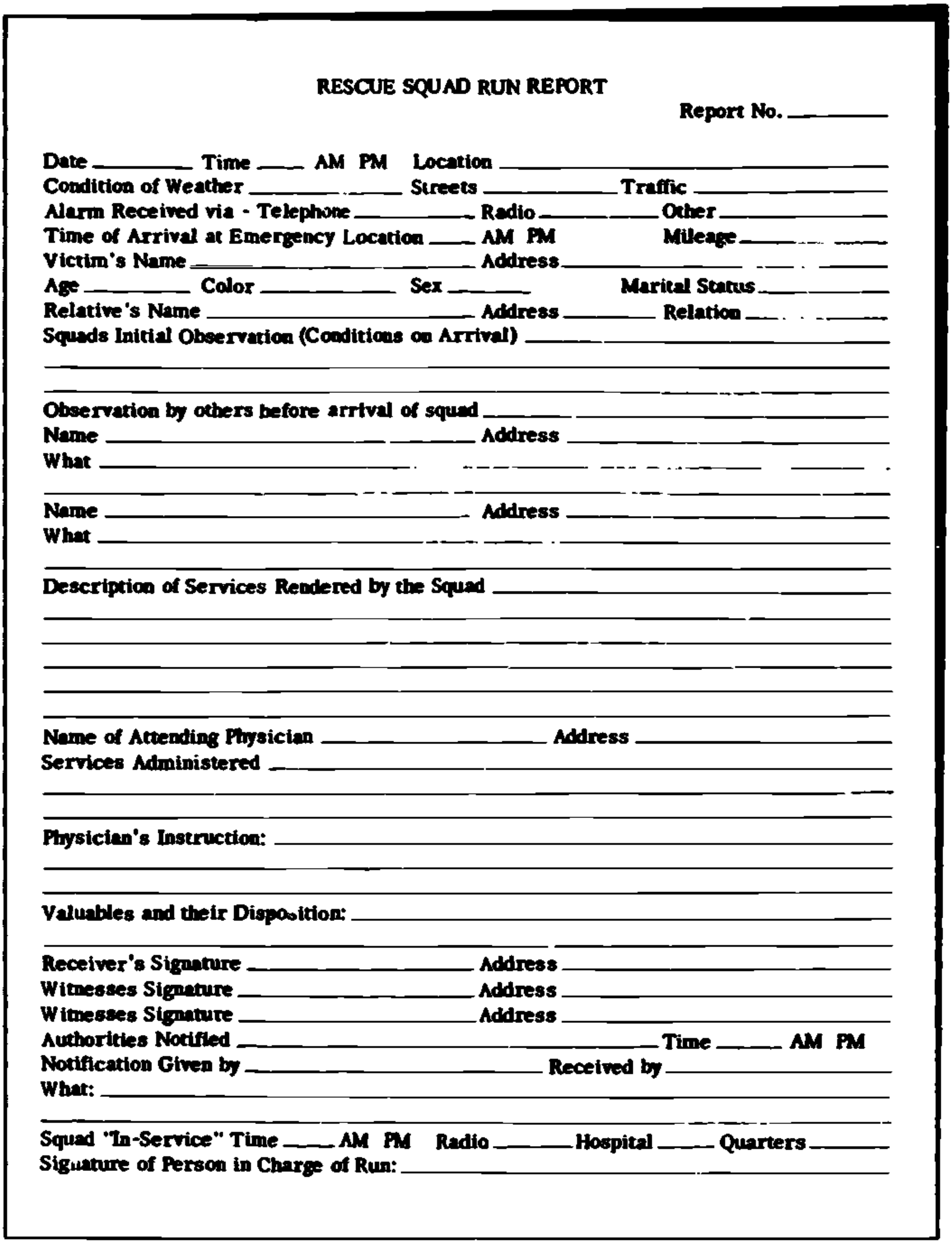
SAMPLE REPORTS

Several sample reports are shown here to assist rescue squad officers in selecting or developing a report best suited to their needs. Some of these samples ask for additional kinds of information, which various squads have found to be helpful.

SUMMARY

Gathering data and completing a report must not take priority over victim care or transportation of victims to a hospital. There may be occasions when information for a report must be obtained after the victim has been removed from the scene. The need for accurate and complete reports should never be minimized; however, reports must never take precedence over victim care.

Rescue squad records can be subpoenaed into court. A complete and accurate report reflects the efficiency and professional competence of the squad.

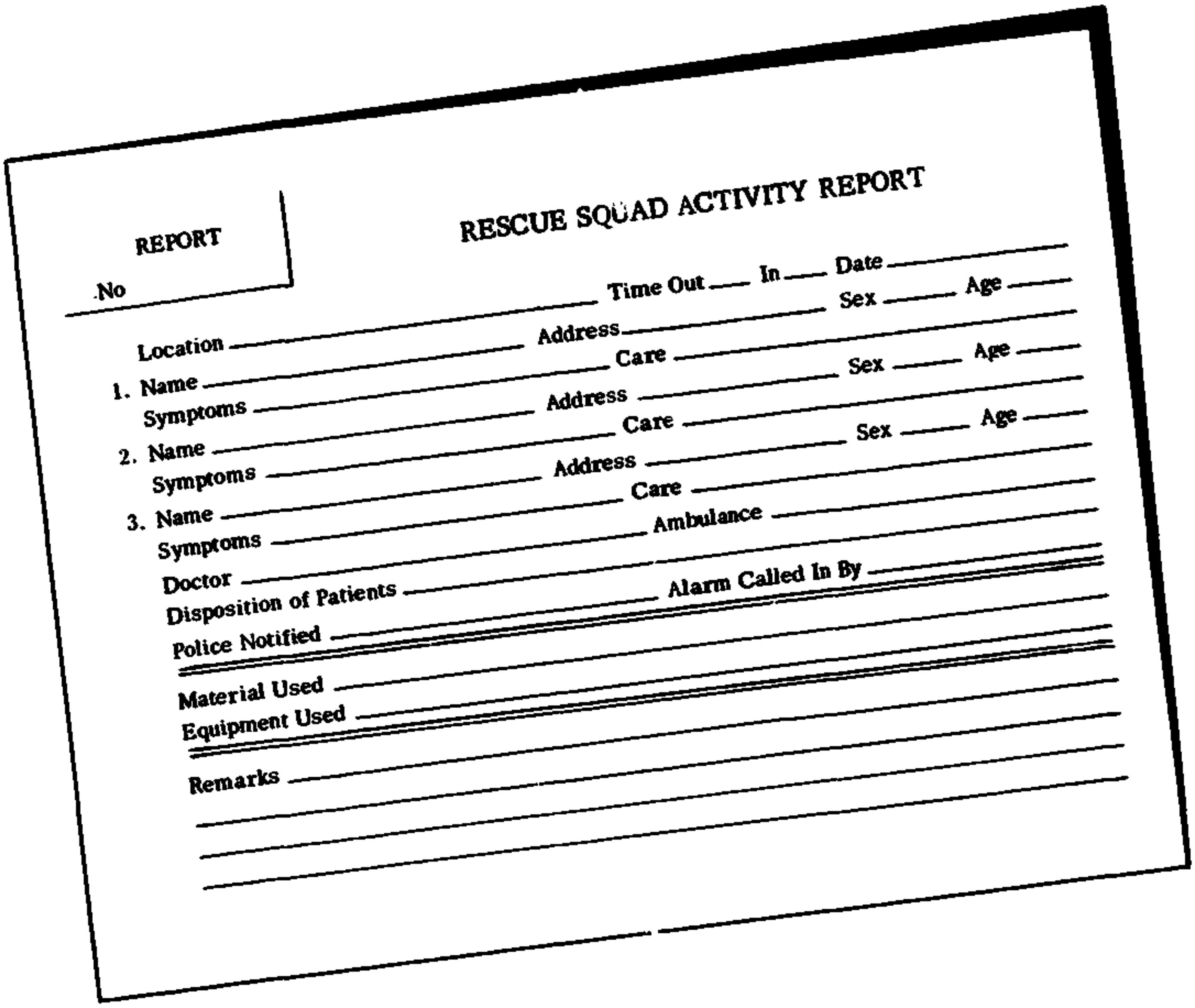


RESCUE SQUAD RUN REPORT

Report No. ______

Date ______ Time ____ AM PM Location ______________________
Condition of Weather __________ Streets __________ Traffic __________
Alarm Received via - Telephone __________ Radio __________ Other __________
Time of Arrival at Emergency Location ____ AM PM Mileage __________
Victim's Name ____________________ Address ____________________
Age ______ Color __________ Sex ______ Marital Status __________
Relative's Name ____________________ Address ________ Relation ________
Squads Initial Observation (Conditions on Arrival) ____________________
____
____
Observation by others before arrival of squad ____________________
Name ____________________ Address ____________________
What ____
____
Name ____________________ Address ____________________
What ____
____
Description of Services Rendered by the Squad ____________________
____
____
____
____
____
Name of Attending Physician ______________ Address ______________
Services Administered ____
____
____
Physician's Instruction: ____
____
____
Valuables and their Disposition: ____
____
Receiver's Signature ____________________ Address ____________________
Witnesses Signature ____________________ Address ____________________
Witnesses Signature ____________________ Address ____________________
Authorities Notified ______________________________ Time ______ AM PM
Notification Given by ____________________ Received by ____________________
What: ____
____
Squad "In-Service" Time ____ AM PM Radio ______ Hospital ____ Quarters ______
Signature of Person in Charge of Run: ______________________________

Figure 1



REPORT

No ______ Time Out ____ In ____ Date ______

RESCUE SQUAD ACTIVITY REPORT

Location ______ Address ______ Sex ____ Age ____

1. Name ______ Care ______

Symptoms ______ Address ______ Sex ____ Age ____

2. Name ______ Care ______

Symptoms ______ Address ______ Sex ____ Age ____

3. Name ______ Care ______

Symptoms ______ Ambulance ______

Doctor ______

Disposition of Patients ______ Alarm Called In By ______

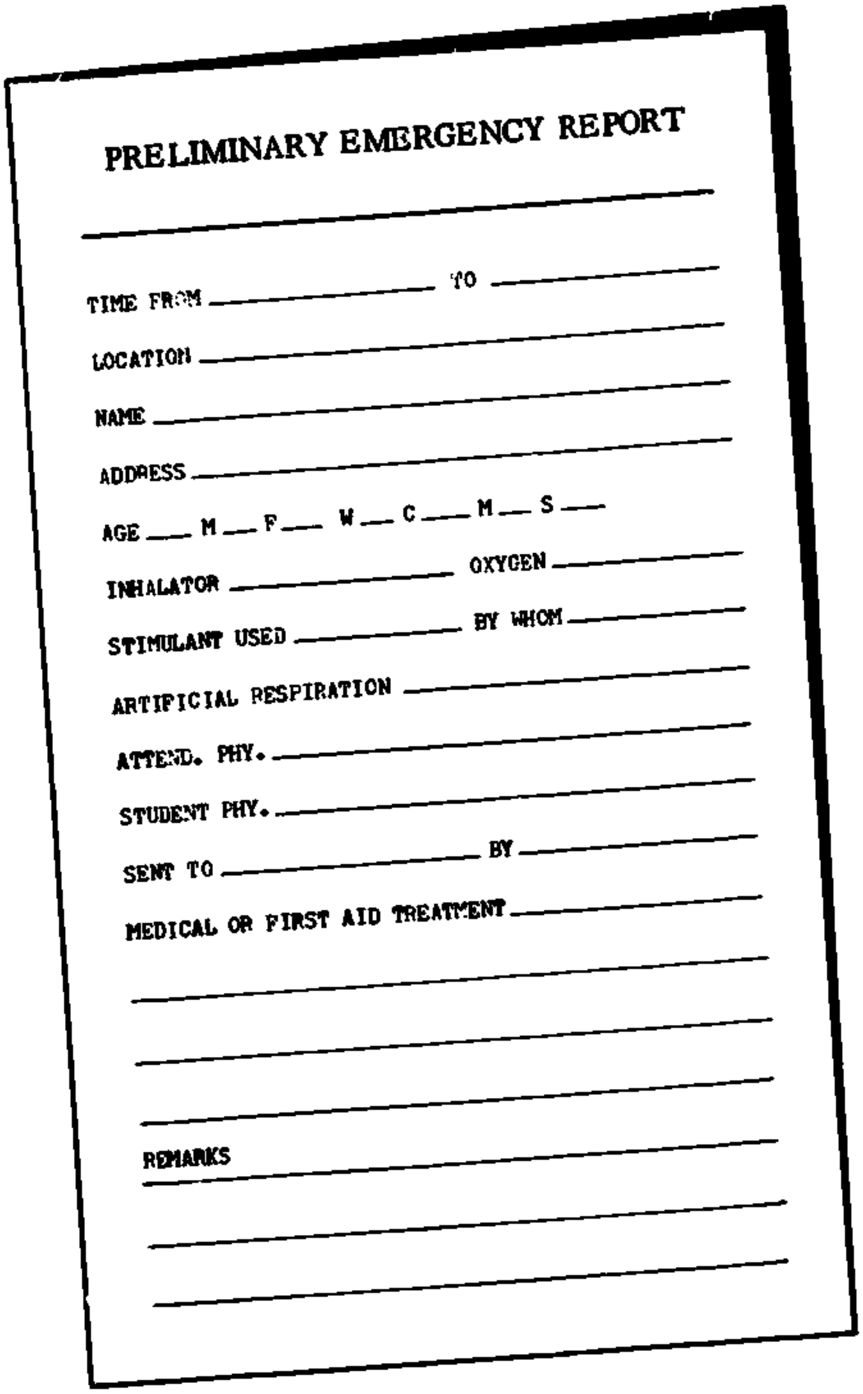
Police Notified ______

Material Used ______

Equipment Used ______

Remarks ______

Figure 2



PRELIMINARY EMERGENCY REPORT

TIME FROM ______ TO ______

LOCATION ______

NAME ______

ADDRESS ______

AGE ___ M ___ F ___ W ___ C ___ M ___ S ___

INHALATOR ______ OXYGEN ______

STIMULANT USED ______ BY WHOM ______

ARTIFICIAL RESPIRATION ______

ATTEND. PHY. ______

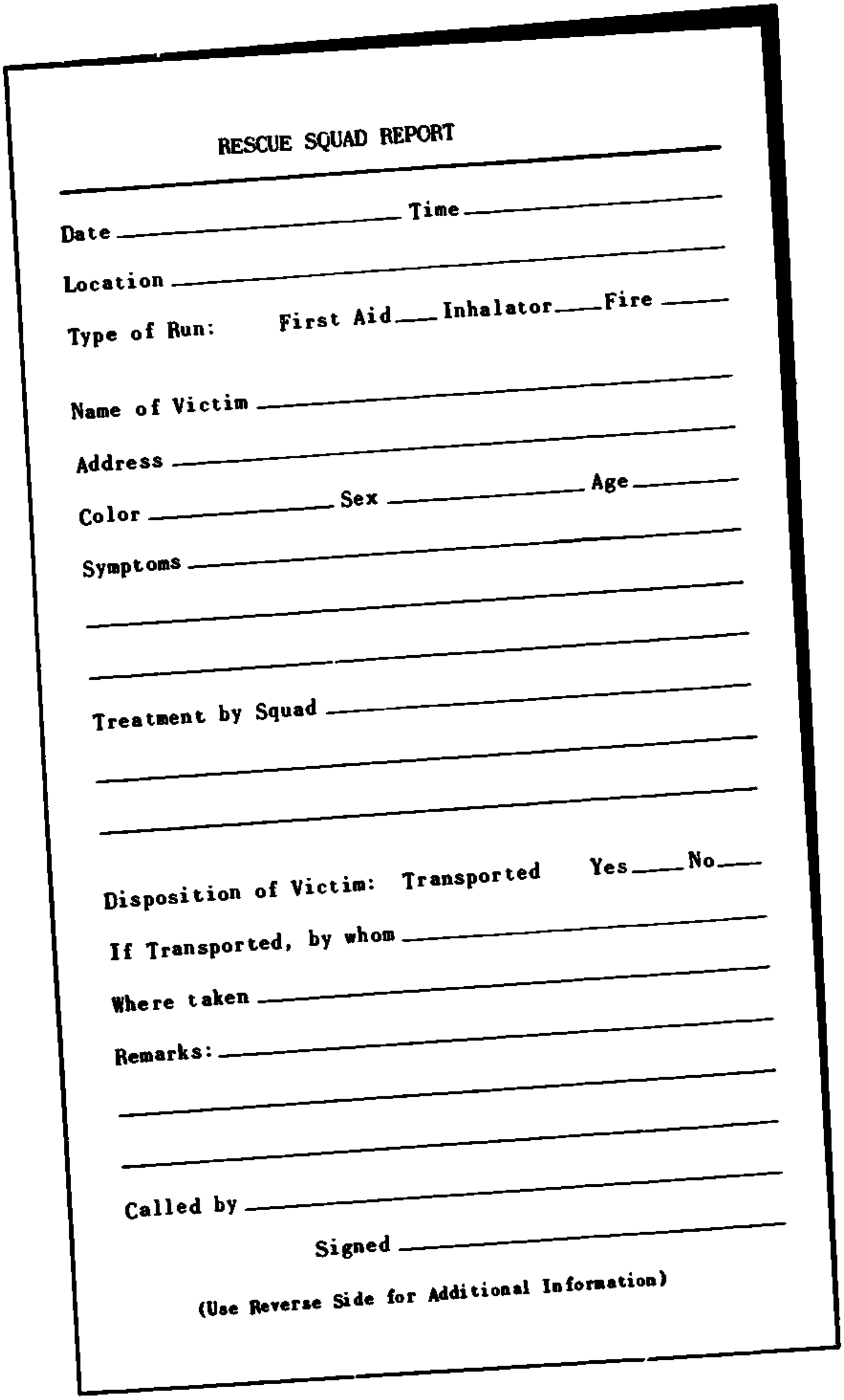
STUDENT PHY. ______

SENT TO ______ BY ______

MEDICAL OR FIRST AID TREATMENT ______

REMARKS ______

Figure 3



RESCUE SQUAD REPORT

Date ____________ Time ____________

Location ____________

Type of Run: First Aid ___ Inhalator ___ Fire ___

Name of Victim ____________

Address ____________

Color ____________ Sex ____________ Age ____________

Symptoms ____________

Treatment by Squad ____________

Disposition of Victim: Transported Yes ___ No ___

If Transported, by whom ____________

Where taken ____________

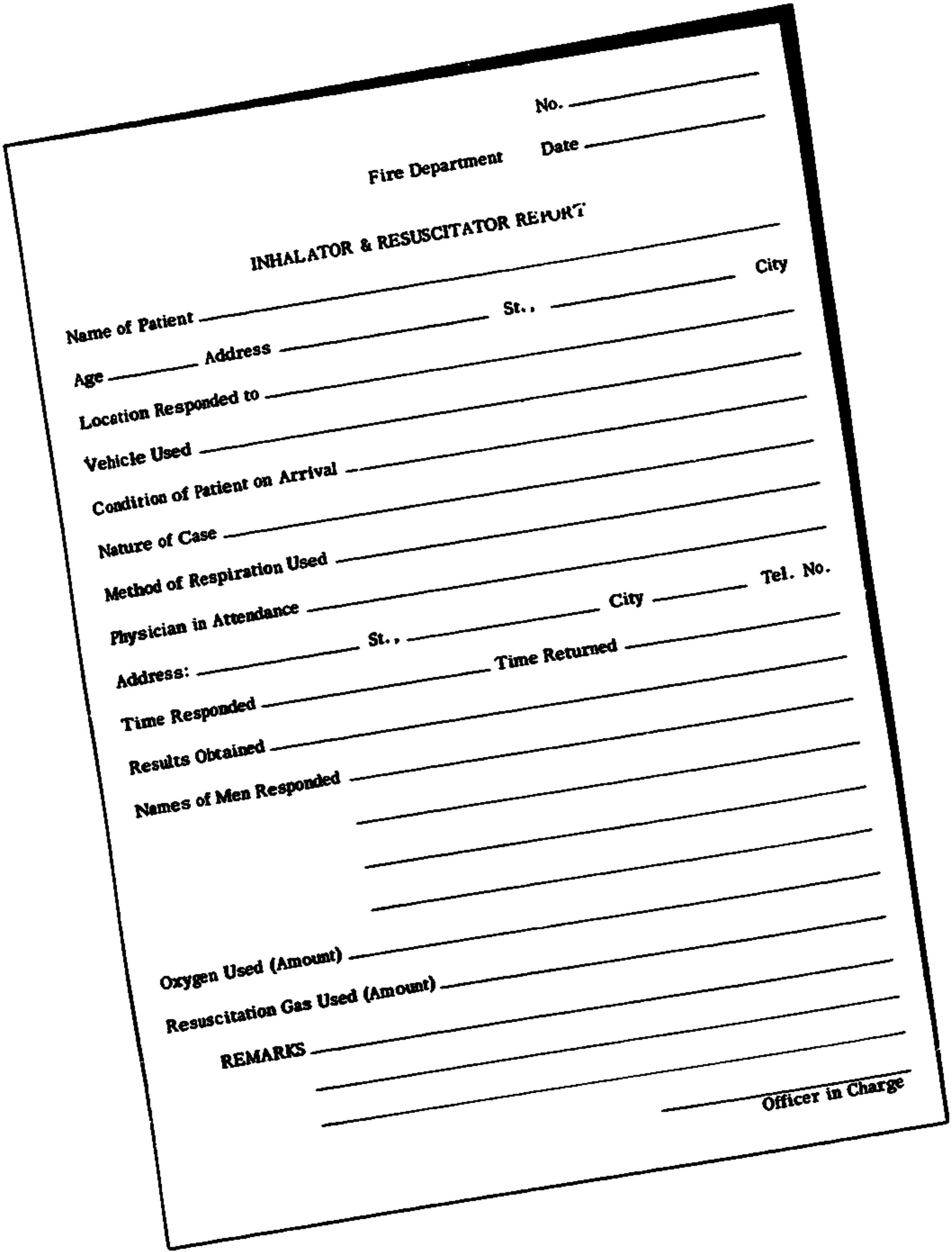
Remarks: ____________

Called by ____________

Signed ____________

(Use Reverse Side for Additional Information)

Figure 4



No. ____________

Fire Department Date ____________

INHALATOR & RESUSCITATOR REPORT

Name of Patient ____________

Age ______ Address ____________ St., ____________ City

Location Responded to ____________

Vehicle Used ____________

Condition of Patient on Arrival ____________

Nature of Case ____________

Method of Respiration Used ____________

Physician in Attendance ____________

Address: ____________ St., ____________ City ________ Tel. No.

Time Responded ____________ Time Returned ____________

Results Obtained ____________

Names of Men Responded ____________

____

____

____

Oxygen Used (Amount) ____________

Resuscitation Gas Used (Amount) ____________

REMARKS ____________

____

____

____________ Officer in Charge

Figure 5

MONTHLY RESCUE SQUAD SUMMARY

RESCUE UNIT NO.__________ **FOR THE MONTH OF**________________ **19**___

NO.	DATE	ALARMS		SQUAD NO.	WORKING TIME		LOCATION	NATURE OF EMERGENCY	DISPOSITION
		TEL	RAD		HRS.	MIN.			
1									
2									
3									
4									
5									
6									
7									
8									
9									
10									
11									
12									
13									
14									
15									
16									
17									
18									
19									
20									
21									
22									
23									
24									
25									
							TOTALS		

MILEAGE__________ MILES GASOLINE __________GALS.

____
OFFICER IN CHARGE

Figure 6

CHAPTER XXV

POST MORTEM CONFERENCE

INTRODUCTION

A post mortem conference is an evaluation of what has taken place during the course of an emergency.* It will point out what can be done in the future to expedite procedures and achieve a more efficient operation.

A definite pattern for scheduling post mortems cannot be established for all emergency and rescue units, as methods of operation within each department may differ.

WHY CONDUCT A POST MORTEM CONFERENCE?

In emergency squad work a second chance to save a life is never guaranteed. However, an evaluation of past performance often yields information that will make the handling of future problems more efficient. Emergencies are not always routine, and squad procedures cannot always be spelled out in detail, in advance. If during an emergency something happens for which the squadman's training and instructions have not prepared him, he should not "pass the buck" afterward. Rather, he should welcome constructive criticism, opinions, advice, and ideas. He should treat this phase of squad work as one involving "fact finding", not "fault finding".

Pre-planning has been emphasized and referred to many times in this text. A combination of pre-planning and post mortems is essential to efficient operation. If a squad carries out post mortems conscientiously mistakes made in the past will be the stepping stones to success in the future.

HOW TO CONDUCT THE CONFERENCE

Post mortems must be based on facts, not hearsay. The report on the case in question should always be used. Such a report should indicate action taken from the time the squad left the station until it returned to service. A review of this action should form the basis for the post mortem discussion. As materials are reviewed, new ideas which may be of value on future calls may be introduced for consideration and evaluation.

These discussions must not reflect on the judgment of the squadmen involved. The officer in charge must stress the importance of honest, constructive criticism if he wishes to obtain the full cooperation of his men. The post mortem must be treated open-mindedly by all concerned.

---

* The term post mortem as used in emergency squad work refers to a conference held to discuss any completed squad operation. It does not imply a death, as in the more restrictive medical use of the term.

SCHEDULING A CONFERENCE

The time for conducting a post mortem must be arranged in compliance with the rules, regulations and methods of operation of the squad. In general, however, post mortems should be held as soon after the run as practical so that the facts will still be fresh in the minds of those who were involved in the emergency. In a paid department, it is usually possible to hold discussions immediately after the run is completed. The informal discussion which often takes place in both paid and volunteer squads, while equipment is being checked and cleaned, can be of much value. In paid departments post mortems may be held at the time of the change of shifts. Often run reports are reviewed by officer personnel going on and off duty.

Some volunteer squads have regular meetings where matters of interest and importance are thoroughly discussed. This is an excellent time to conduct the post mortem. Thus, personnel not on duty when the emergency took place can be filled in and briefed on the situation; their opinions and ideas can be evaluated.

In setting up a plan for carrying out post mortems, the results will justify the efforts expended.

Post mortems held in conjunction with training sessions are excellent proving grounds for technique and methods which can be tried and practiced.

RESPONSIBILITY AND PARTICIPATION

The responsibility for post mortems rests with the person who is in charge of the squad or its operation.

The underlying purpose of a post mortem is to gain the most benefits for all personnel. At one time the usual procedure was to include only the officer personnel in a squad. However, no officer is any more efficient - in a general sense - than the degree of efficiency of his men. Enlisting the cooperation of all personnel creates a feeling of trust and confidence resulting in a mutual net gain to all concerned. The surest way to gain a person's cooperation is to ask for his help. If a satisfactory conclusion or evaluation is to be expected, all personnel involved should have a part. They will be affected by most decisions regarding policy change or the need for training.

ITEMS TO BE EVALUATED

A pattern should be established and followed in conducting such a session. The following items should be covered:

1. Receiving the call
    - a. Was there anything unusual about it?

2. Answering the call
    - a. Was a different route taken?
    - b. Was there an unusual traffic problem?
    - c. Is there a better route?

3. On arrival
    - a. Were there any unusual circumstances?

4. Care given victim
    - a. What?
    - b. When?
    - c. How?
    - d. Reaction of victim?
    - e. Results of care?

5. Equipment
    - a. What equipment was used?
    - b. Was equipment in place?
    - c. Was it in good working order?

6. Control of family and/or public
    - a. Outstanding difficulties
    - b. Action taken to handle difficulties in control

7. Medical assistance
    - a. Was physician called?
    - b. Family or other physician?
    - c. Success or failure in obtaining a physician

8. Transportation
    - a. Problems encountered

9. Hospital
    - a. Condition of victim
    - b. Problems encountered at hospital

10. Law-Enforcement agencies
    - a. Were they notified?
    - b. Were there any problems with officers?

11. Actions that merit special praise
    - a. Were there any regular personnel (medical, hospital, police) who made any extra or special effort to help the squad in meeting the emergency?
    - b. Did the squad receive special help from a utility company, heavy equipment operator, etc.?
    - c. Have any such personnel been thanked for their special cooperation?

CHAPTER XXVI

LEGAL ASPECTS

INTRODUCTION

This chapter contains statutes taken from the Revised Code of Ohio having reference to emergency squads. It is by no means complete; many more can be found in the index to the Revised Code of Ohio.

Whenever there is a question of legal interpretation involved in a particular case, such legal interpretation should be left to the county prosecutor or city solicitor.

NOTE: References are keyed as follows:

R. C. - Refers to the Revised Code of Ohio

G. C. - Refers to the Ohio General Code which antedated the Revised Code. References to the General Code are for historical purposes only.

STATUTES

DEFINITIONS OF EMERGENCY VEHICLES

R. C. Section 4511.01 (D)

(G. C. Section 6307-2)

"Emergency Vehicle" means fire department, police, and state highway patrol vehicles, vehicles of salvage corporations organized under Sections 1709.01 to 1709.07, inclusive, of the Revised Code, emergency vehicles of municipal or county departments or public utility corporations when identified as such as required by law, the director of highways, or local authorities, motor vehicles when commandeered by a police officer, ambulances, and motor vehicles when used by volunteer firemen responding to emergency calls in the fire department service when identified as required by the director.

To make the identification of a vehicle complete, a windshield decal is necessary. A list of all men who are entitled to receive decals, to get the protection given to an "emergency vehicle", should be prepared and certified by the association secretary or fire chief and mailed to the State Fire Marshal's Office in Columbus, Ohio. The decal is to be placed in the lower right-hand corner of the windshield. If the auto is exchanged, a new registration is required and the decal must be removed from the old car. Only men who are members of fire departments may obtain decals.

EMERGENCY VEHICLES HAVE RIGHT OF WAY

R. C. Section 4511.45

(G. C. Section 6307-44)

Upon the approach of an emergency vehicle, equipped with at least one flashing red light visible under normal atmospheric conditions from a distance of five hundred feet to the front of such vehicle and the driver is giving audible signal by siren, exhaust whistle, or bell, the driver of every other vehicle shall yield the right-of-way, immediately drive to a position parallel to, and as close as possible to, the edge or curb of the highway clear of any intersection, and stop and remain in such position until the emergency vehicle has passed, except,when otherwise directed by a police officer.

Upon the approach of an emergency vehicle, as stated in the first paragraph of this section, the operator of every street car or trackless trolley shall immediately stop such car clear of any intersection and keep it in

This section does not relieve the driver of an emergency vehicle from the duty to drive with due regard for the safety of all persons and property upon the highway.

EMERGENCY VEHICLE TO PROCEED CAUTIOUSLY PAST RED OR STOP SIGNAL

R. C. Section 4511.03

The driver of any emergency vehicle, when responding to an emergency call, upon approaching a red or stop signal or any stop sign shall slow down as necessary for safety to traffic, but may proceed cautiously past such red or stop sign or signal with due regard for the safety of all persons using the street or highway.

EMERGENCY VEHICLE EXCEPTED FROM SPEED LIMITATIONS

R. C. Section 4511.24

(G. C. Section 6307.24)

The prima-facie speed limitations set forth in section 4511.21 of the Revised Code do not apply to emergency vehicles when they are responding to emergency calls, and when the drivers thereof sound audible signals by bell, siren, or exhaust whistle. This section does not relieve the driver of an emergency vehicle from the duty to drive with due regard for the safety of all persons using the street or highway.

HORNS, SIRENS, AND WARNING DEVICES

R. C. Section 4513.21

(G. C. Section 6307-93)

Every motor vehicle or trackless trolley when operated upon a highway shall be equipped with a horn which is in good working order and capable of emitting should audible, under normal conditions, from a distance of not less than two hundred feet.

No motor vehicle or trackless trolley shall be equipped with, nor shall any person use upon a vehicle, any siren, whistle, or bell. Any vehicle may be equipped with a theft alarm signal device which shall be so arranged that it cannot be used as an ordinary warning signal. Every emergency vehicle shall be equipped with a siren, whistle, or bell, capable of emitting sound audible under normal conditions from a distance of not less than five hundred feet and of a type approved by the director of highways. Such equipment shall not be used except when such vehicle is operated in response to an emergency call or is in the immediate pursuit of an actual (or) suspected violator of the law, in which case the driver of the emergency vehicle shall sound such equipment when it is necessary to warn pedestrians and other drivers of the approach thereof.

LIABILITY OF MUNICIPAL CORPORATIONS FOR OPERATION OF VEHICLES

R. C. Section 701.02

(G. C. Section 3714-1)

Any municipal corporation shall be liable in damages for injury or loss to persons or property and for death by wrongful act caused by the negligence of its officers, agents, or servants while engaged in the operation of any vehicles upon the public highways of this state, under the same rules and subject to the same limitations as apply to private corporations for profit, but only when such officer, agent, or servant is engaged upon the business of the municipal corporation.

The defense that the officer, agent, or servant of the municipal corporation was engaged in performing a governmental function, shall be a full defense as to the negligence of:

(A) Members of the police department engaged in police duties;

(B) Members of the fire department while engaged in duty ay a fire, or while proceeding toward a place at where a fire is in progress or is believed to be in progress, or in answering any other emergency alarm.

Firemen shall not be personally liable for damages for injury or loss to persons or property and for death caused while engaged in the operation of a motor vehicle in the performance of a governmental function.

Policemen shall not be personally liable for damages for injury or loss to persons or property and for death caused while engaged in the operation of a motor vehicle while responding to an emergency call.

Opinions of the Attorney General

#1043 - Year, 1933

1. The proviso of section 3714-1, General Code enacted by the 90th General Assembly, operates to limit the general liability which is imposed upon municipalities by section 3714-1, General Code.

2. A municipal corporation is liable for the negligence of members of the fire department in operating fire apparatus when returning from a fire or other emergency alarm.

PURCHASE OF FIRE FIGHTING EQUIPMENT

R. C. Section 505.37

(G. C. Section 3298-54)

The board of township trustees may establish all necessary regulations to guard against the occurrence of fires, protect the property and lives of the citizens against damage and accidents and may, with the approval of the specifications by the prosecuting attorney, purchase or otherwise provide such fire apparatus, mechanical resuscitators or other equipment, appliances, materials, fire hydrants, and water supply for fire fighting purposes as seems advisable to the board....

Opinions of the Attorney General

#2416 - year 1953

Under the provisions of Section 3298-54, (R. C. Section 505.37) township trustees, in addition to being authorized to guard against the occurrence of fires, are further authorized to protect property and lives against damages and accidents; and under such authority may acquire and operate emergency vehicles or "rescue cars" for such purposes.

Township trustees may enter into an agreement with a volunteer fire company for the operation of any such equipment as the township itself is authorized to operate, designed to protect against fires, damages and accidents.

CONTRACTS FOR FIRE PROTECTION; STATUS OF MEMBERS OF FIRE DEPARTMENT

R. C. Section 505.44

(G. C. Section 3298-60) (G. C. Section 3298-60a)

In order to obtain fire protection, or to obtain additional fire protection in times of emergency, any township may enter into a contract, for a period not to exceed three years, with one or more townships, municipal corporations, or private fire companies, upon such terms as are agreed to by them, for services of fire departments, or the use of fire apparatus, or the interchange of the service of fire departments or use of fire apparatus, within the several territories of the contracting subdivisions and private fire companies, if such contract is first authorized by the respective boards of township trustees or other legislative bodies.

Section 701.02 of the Revised Code, as far as it is applicable to the operation of fire departments, applies to the contracting political subdivisions and fire department members when such members are rendering service outside their own subdivision pursuant to such contract.

Such contract may provide for a fixed annual charge to be paid at the times agreed upon and stipulated in the contract, or for compensation based upon a stipulated price for each run, call, or emergency, or the number of members or apparatus employed, or the elapsed time of service required in such run, call, or emergency. Such contract may provide for compensation for loss or damage to equipment or apparatus while engaged outside the limits of the subdivision or private fire company owning and furnishing it, and for the reimbursement of the subdivision or private fire company, in which the fire department members are employed, for any pension or indemnity award or premium contribution assessed against the employing subdivision or private fire company for workmen's compensation benefits or casualty insurance premiums for injuries or death of its fire department members occurring while engaged in rendering service pursuant to such contract.

As used in this section, "private fire company" means any group or organization not for profit owning and operating fire-fighting equipment not controlled by any township or municipal corporation.

Under R.C. Section 717.02, municipal corporations may similarly enter into contracts for services and for the use of apparatus.

NOTIFICATION IN CASE OF DEATH BY VIOLENCE OR SUICIDE

R. C. Section 313.11

(G. C. Section 2855-12)

Any person who discovers the body or acquires the first knowledge of the death of any person who died as a result of criminal or other violent means, or by casualty, or by suicide, or suddenly when in apparent health, or in any suspicious or unusual manner, shall immediately notify the office of the coroner of the known facts concerning the time, place, manner, and circumstances of such death, and of any other information which is required by Sections 313.01 to 313.22, inclusive, of the Revised Code.... No person shall willfully refuse to report such a death, or shall, without an order from the coroner, willfully touch, remove, disturb the body of any such person, or disturb the clothing or any article upon or near such body.

NOTIFICATION BY PHYSICIAN IN CASE OF DEATH BY VIOLENCE OR SUICIDE

R. C. Section 313.12

(G. C. Section 2855-5)

When any person dies as a result of criminal or other violent means, or by casualty, or by suicide, or suddenly when in apparent health, or in any suspicious or unusual manner, the physician called in attendance shall immediately notify the office of the conorer of the known facts concerning the time, place, manner, and circumstances of such death, and any other information which is required pursuant to Sections 313.01 to 313.22, inclusive, of the Revised Code.

The first responsibility of a squadman is to care for the living. If he finds, on arriving at an emergency, that death or injury is apparently due to unnatural causes, he should take precautions not to touch anything except to take charge of the emergency so far as the injured are concerned. In Chapter XXIII, the section "Operations at a Crime Scene" gives further suggestions for procedures in this kind of situation.

LIABILITY FOR EMERGENCY CARE THE "GOOD SAMARITAN" LAW

R. C. Section 2305.23

No person shall be liable in civil damages for administering emergency care or treatment at the scene of an emergency outside of a hospital, doctor's office, or other place having proper medical equipment, for acts performed at the scene of such emergency, unless such acts constitute willful or wanton misconduct.

Nothing in this section applies to the administering of such care or treatment where the same is rendered for remuneration or with the expectation of remuneration.

VT 000 860
A List of Teaching Materials.

Pennsylvania State Univ, University Park. Dept of Agr Ed.
Pub Date - 67
MF AVAILABLE IN VT-ERIC SET 5p.

*VOCATIONAL AGRICULTURE, *BIBLIOGRAPHIES, *INSTRUCTIONAL MATERIALS,

Vocational agriculture instructional materials, available from the department and listed in the form of an order sheet, are organized under the subjects of farm business management, soil science, plant science, animal science, agricultural mechanics, and miscellaneous categories. A list of materials available from other agencies is also included. (JM)

The Pennsylvania State University
Department of Agricultural Education
University Park, Pennsylvania

1967

A LIST OF TEACHING MATERIALS

The publications listed below are available from the Department of Agricultural Education at the prices quoted. Each price <u>includes</u> a small charge to cover handling and postage. Use this list for placing your order, and another copy will be mailed to you when your order is filled and returned.

Orders totaling less than $10 must be accompanied by a check or money order made payable to The Pennsylvania State University. For larger orders a bill will be mailed to the school district or other authorized office or person. Please indicate to whom the bill should be sent. Orders should be placed on school stationery and preferably in the form of a purchase order. Prices may change without notification.

Quantity	Publication	Total Cost
	FARM BUSINESS MANAGEMENT	
______	Budgetary Analysis Worksheets for Reorganizing a Farm Operation @ .25	______
______	Crop and Livestock Production Goals @ .50	______
______	The Application of Selected Business Principles to Farming Program Record Keeping @ .50	______
	SOIL SCIENCE	
0 ______	Exploring Careers in Modern Agriculture Related to Land Use and Conservation (A Teacher's Unit Plan for Use with Ninth and Tenth Grade Classes) @ $1.00	______
C ______	Exploring Careers in Modern Agriculture Related to Land Use and Conservation (A Student Handbook for Ninth and Tenth Grade Classes) @ .50	______
______	Farm Field Mapping, Soil, Water, and Fertility Management (A Teacher's Unit Plan) @ .25	______
______	Land Use and Management Program @.30	______
______	Land Use and Management Scorecard, Pack of 100 @ $2.00	______
	PLANT SCIENCE	
______	Using the School Greenhouse, A School-Year Unit to Teach Environmental Principles of Plant Science Through Production of Crops of Chrysanthemums, Daffodils, and Vegetable Transplants @ $1.00	______
______	Corn Growing Suggestions (No Charge) Also available in quantity at no charge from U.S. Steel, 525 William Penn Place, Pittsburgh, Pennsylvania 15200.	

Quantity	Publication	Total Cost
	Approved Practices for Spring Oats @ .30	
	Approved Practices for Wheat @ .30	
	Tobacco Growing Suggestions @ .30	
	Approved Practices for Vegetable Gardening @ .25	
	Approved Practices for the Tomato Enterprise @ .25	
	Approved Practices for the Pea Enterprise @ .25	
	Approved Practices for Onion Growing @ .25	
	Approved Practices for the Small Fruit Enterprise @ .25	
	ANIMAL SCIENCE	
	Quality Milk Production (A Teacher's Unit Plan) @ .40	
	Quality Milk Production (A Student Handbook) @ $1.00	
	Quality Milk Production Examination, 5 cents each or set of 30 @ $1.00	
	Dairy Cattle Nutrition (A Teacher's Unit Plan) @ .40	
	Dairy Cattle Nutrition (A Student Handbook) @ $1.00	
	Beef Marketing (A Teacher's Unit Plan) @ .40	
	Beef Marketing (A Student Resource Handbook) @ $1.00.	
	Approved Practices for the Dairy Calf Enterprise @ .25.	
	Approved Practices for the Dairy Cow Enterprise @ .25	
	Approved Practices for the Beef Enterprise @ .25...	
	Swine Production Suggestions @ .50	
	Approved Practices for the Baby Chick Enterprise @ .25.	
	Approved Practices for the Laying Hen Enterprise @ .25.	
	Approved Practices for the Poultry Meat Enterprise @ .25	
	Some Considerations in Dairy Cattle Performance Pedigree Evaluation @ .30	
	Selecting, Fitting, and Showing a Beef Steer @ .25	
	AGRICULTURAL MECHANICS	
	Tractor Maintenance Project (record) @ .25	
	Principles of Farm Tractor Selection, Operation, General Maintenance and Storage @ .50	
	Job Sheets in Tractor Maintenance @ .50	
	Suggested Problem Set-ups and Answer Sheets for Learning Principles of Farm Engine Maintenance @ .50	
	Farm Mechanics Plans @ .50	
	Information and Suggestions for Planning and Constructing New Milk Houses @ .50	
	Approved Practices for the Pick-up Hay Baler @ .50	
	Farm Mechanics Plans for Vocational Agriculture, Cattle - Hogs - Sheep @ .50	
	Agricultural Mechanics and Automation Class Record @ .10.	
	Milk House Score Card, 34 slides and script @ $5.50	
	What is Your CASE with Electricity, 44 slides and script @ $6.50	
	CASE Scorecard, Pack of 50 @ $1.00	

Agricultural Mechanics

Quantity	Publication	Total Cost
0	Selection, Operation, & Maintenance of Electric Motors (Teacher's Unit Plan) @ .25	
0	Quality Concrete Construction (Student Handbook) @ .25	
	Sharpening The Twist Drill (Job Sheet) Pad of 25 @.50 Single copies @ .05	
	Cleaning A Paint Brush (Job Sheet) Pad of 25 @ .50 Single copies @ .05	
	Tool Sharpening Gauge (Job Sheet) Pad of 25 @ .50 Single copies @ .05	
	Drawbar Hitch Pin (Job Sheet) Pad of 25 @ .50 Single copies @ .05	
	Cleaning and Servicing an Electric Motor (Job Sheet) Pad of 25 @ .50 Single copies @ .05	

The following construction plans, not included in any of the above plan booklets, are available at $.05 per sheet.

Quantity	Publication	Total Cost
0	Christmas Tree Stand	
0	Sheep Judging Rack	
0	Grinder Stand	
0	Caster Wheel	
0	Battery Terminal Puller	
0	Feed Mixer	
0	Radial Arm Attachment for Portable Saw	
0	Snag Free Boat Anchor	
0	Portable Loading Ramp	
0	Solar Farrowing House	
0	Jack Stand (Pipe)	
0	Soil Sterilizer	
0	Anvil and Stand	
0	Post Hole Digger	
0	Pipe Bending Tool	

MISCELLANEOUS

Quantity	Publication	Total Cost
	Approved Practices for Beekeeping @.25	
	Attitude Inventory for Beginning Hunters, pack of 50 @ .50	

Single copies of the following list of materials will be provided free of charge upon request. Check only those copies you need to complete your file.

Quantity	Publication
	FFA Public Speaking Contest
	A Contest in FFA Chapter Parliamentary Procedure
0	Organizing a Local Young Farmers Association
0	Local Policy Statements for Vocational Agriculture
0	Outlines for Preparing a Course of Study in Vocational Agriculture and a Teacher's Unit Plan
0	Agricultural Course for Area Vocational-Technical Schools
0	Floor Plan for Facility for Agriculture in Area Vocational-Technical Schools

Teacher's Name____________________Address____________________________

____

Mail Bill to______________________Address____________________________

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FOR TEACHER'S INFORMATION ONLY

THESE PUBLICATIONS ARE NOT AVAILABLE FROM THE DEPARTMENT OF AGRICULTURAL EDUCATION. THEY ARE LISTED BECAUSE OF THE MANY REQUESTS WHICH THE DEPARTMENT MISTAKENLY RECEIVES. PLACE YOUR ORDER AS NOTED BELOW.

1. Reporter Argus Press, Port Allegany, Pennsylvania.
    - a. Single Enterprise Record Book
    - b. Analysis Sheets for Individual Enterprises
    - c. High School Student Activity Record Folder
    - d. Young and Adult Farmer Activity Record Folder
    - e. Ten Enterprise Student Project Record Book
    - f. Teacher's Manual for the Ten Enterprise Record Book
2. Department of Public Instruction, Division of Agricultural Education, Harrisburg, Pennsylvania.
    - a. Determining the "Efficiency Score" for Productive Enterprises
    - b. Farming Program Scorecard
    - c. Single Enterprise Project Scorecard
    - d. Supervised Occupational Experience Scorecard
    - e. Scrapbook Scorecard
    - f. Cost Account Charges for Farming Program Records
3. Educators Progress Service, Randolph, Wisconsin.
    - a. Educators Guide to Free Films
4. Audio-Visual Aids Library, Forestry Building, The Pennsylvania State University, University Park, Pennsylvania 16802
    - a. U.S.D.A. Films and Film Strips (also available through your county agent's office).
5. Agricultural Mailing Room, The Pennsylvania State University, University Park, Pennsylvania 16802
    - a. Lessons in Farm Electrification, Miscellaneous Publication No. 2, 3 copies for $1.

6. Small Business Administration, Washington 25, D.C. 20202

   a. Woodworking Shops, Bul. No. 46, single copy free
   b. Painting and Decorating, Bul. No. 60, single copy free

7. Farm Credit Banks of Baltimore, Baltimore, Maryland.

   a. Financing the Farm Business, A Teacher's Unit Plan

8. U.S. Steel Corporation, 525 William Penn Place, Pittsburgh, Pennsylvania 15200

   a. Corn Growing Suggestions, ADUCO 81066-60, free
   b. Four Year Field Management Record of Crop Production, ADUCO 81110-62, free
   c. Grass Forage Growing Suggestions, ADUCO 81077-60, free
   d. Confinement Housing for Hogs, ADUCO 83070-61, free
   e. Modern Livestock Systems, free
   f. 100 Cow Dairy System, free
   g. Pole Type Poultry Houses, ADUCO 83033-63, free
   h. Pole Buildings for Machinery Storage, ADUCO 83843-61, free
   i. How to Figure Nitrogen, ADUCO 72019-60, free
   j. 6 Reasons Why Fall Fertilization Pays, ADUCO 72060-60, free

9. Interstate Printers and Publishers, Danville, Illinois.

   a. Vocational Agriculture Interest Inventory
   b. An Introduction to Agricultural Business and Industry (Teacher's Guide) @ $2.50
   c. An Introduction to Agricultural Business and Industry (Student Guide) @ $3.25
   d. Handbook of Agricultural Occupations @ $4.75

10. French-Bray Printing Co., Candler Building, Baltimore, Maryland 21202

    a. Records of Supervised Occupational Experience and Training in Vocational Agriculture (Single copies @ $.50, four copies @ $1.00, five or more copies @ $.14 each).
    b. Teacher's Guide for Effective Use of Records of Supervised Occupational Experience and Training in Vocational Agriculture (Single copies @ $.50, four copies @ $1.00, and five or more copies @ $.25 each).

VT000 894

VT 000 894
Forestry, Two-Year High School Course in Vocational Agriculture--Competencies, Course Outline, Tools, and Equipment, Consumable Supplies, and References.

Clemson Univ., S.C. Dept. of Agricultural Education
South Carolina State Dept. of Education, Columbia
Pub Date - Jul65
MF AVAILABLE IN VT-ERIC SET 13p.

*CURRICULUM GUIDES, HIGH SCHOOLS, *VOCATIONAL AGRICULTURE, JOB SKILLS, *FORESTRY, *FORESTRY AIDES,

The purpose of the guide is to assist vocational agriculture teachers plan a course to prepare high school juniors and seniors for occupations in forestry. It was prepared by a teacher educator in consultation with state forestry commission personnel, teachers, and other teacher educators upon the basis of a survey. The 360-hour course includes units on--(1) occupational opportunities, (2) the importance of forests, (3) relation of forestry to other natural resources, (4) the importance of good management practice, (5) forestry educational programs in South Carolina, (6) forest land ownership, (7) tree reproduction and growth, (8) forest environment, (9) tree and wood identification, (10) hand tool and small equipment maintenance and use, (11) artificial reproduction of forests, (12) natural reproduction of forests, (13) fire protection, (14) intermediate cuttings, (15) harvest cuttings, (16) estimates and measures, (17) insect control, (18) protection against disease and other enemies, (19) power equipment operation, (20) chart, map, and tracing preparation and interpretation, (21) mathematics, and (22) forestry employment. Each unit includes a brief outline of subject matter. Competencies needed in forestry aide training, suggested tools, equipment, and references are listed. Single copies of this document are available without charge from Agricultural Education Department, Clemson University, Clemson, South Carolina 29631. (JM)

FORESTRY

Two-year High School Course in Vocational Agriculture

Competencies, Course Outline, Tools, and Equipment,
Consumable Supplies, and References

Prepared By

Agricultural Education Department, Clemson University,
Clemson, South Carolina

and

State Department of Education
Columbia, South Carolina

July 1965

MEMORANDUM

TO: The ERIC Clearinghouse on Vocational and Technical Education
The Ohio State University
980 Kinnear Road
Columbus, Ohio 43212

FROM: (Person) F. E. Kirkley (Agency) Agricultural Education Department

(Address) Clemson University, Clemson, South Carolina 29631

DATE: December 13, 1967

RE: (Author, Title, Publisher, Date) F. E. Kirkley, Forestry--Two-Year High School Course in Vocational Agriculture, Agricultural Education Department, Clemson University, June, 1967.

Supplementary Information on Instructional Material

Provide information below which is not included in the publication. Mark N/A in each blank for which information is not available or not applicable. Mark P when information is included in the publication. See reverse side for further instructions.

(1) Source of Available Copies:
Agency Agricultural Education Department, Clemson University
Address Clemson, South Carolina 29631
Limitation on Available Copies 1 per teacher Price/Unit no charge
(quantity prices)

(2) Means Used to Develop Material:
Development Group State Forestry Commission, Teachers & Teacher Educators
Level of Group State and usable by other states
Method of Design, Testing, and Trial based on survey of teachers of forestry Agricultural Education

(3) Utilization of Material:
Appropriate School Setting Designed for occupational courses in forestry
Type of Program High School classes
Occupational Focus Preparation for a cluster of jobs below the professional level.
Geographic Adaptability Southeastern United States
Uses of Material for course planning
Users of Material for teachers

(4) Requirements for Using Material:
Teacher Competency Qualified Agricultural teachers
Student Selection Criteria for 11th and 12th grade boys who desire employment in forestry
Time Allotment 360 hours plus laboratory work

Supplemental Media --
Necessary X
Desirable
(Check Which)

Describe Related information

Source (agency) State Commissions of Forestry
(address)

COMPETENCIES NEEDED IN FORESTRY-AIDE TRAINING

FORESTRY	Extent the Competency is Desirable (check the appropriate column)		
Knowledge and Understanding of:	Very Desirable	Helpful	Little or No Value
1. Job opportunities in forestry			
2. Organizations which employ forestry workers			
3. Importance of our forests			
4. Relationship of forests to other nat.resources			
5. The importance of good management practices			
6. Basic enemies of the forest			
7. Forest land ownership in the U.S. and S.C.			
8. Educational programs in forestry in S.C.			
9. Organization of S.C. StateForestry Commission			
10. Services rendered by professional foresters			
11. Forest products industries and uses of wood			
12. Tree growth			
13. Soil requirements and adaptation of trees			
Develop the Ability to:			
1. Identify common trees			
2. Harvest and store tree seeds			
3. Grow seedlings from seed			
4. Set out seedlings			
5. Carry out natural reforestation			
6. Use and maintain hand tools & small equipment			
7. Construct firebreaks			
8. Prevent and control forest fires			
9. Determine the rate of growth of timber			

FORESTRY (continued)

	Very Desirable	Helpful	Little or No Value
10. Thin a stand of timber			
11. Improve a stand by making cuttings			
12. Mark trees for selective cutting			
13. Make harvest cuttings			
14. Control of weed trees			
15. Estimate vol. bd. ft. in standing timber			
16. Estimate vol. bd. ft. in logs			
17. Measure lumber and pulpwood			
18. Recognize and control forest insects			
19. Recognize and control forest diseases			
20. Operate trucks, tractors, plows, planters, etc			
21. Work math problems related to forestry			
22. Read, interpret, & make tracings, maps & charts			
23. Apply for a job			
24. Accept job responsibilities			

Course Outline

A suggested course of study for Forestry-Aide training is presented on the following pages. This includes the major topics to be taught in the two-year course. This outline is based on the competencies which the students should acquire. The proposed teaching time is listed as "number of days" for each major topic. Much laboratory or field work will be needed in addition to classroom instruction. When one hour class periods are followed, the teacher should arrange for the necessary laboratory time.

FORESTRY-AIDE COURSE OUTLINE

(Two-year Course)

Approximate No. Days

I. Exploring Occupational Opportunities in Forestry 15

- A. Types of employment in forestry
  - 1. Professional foresters, technicians, aides, clerical workers, skilled workers, laborers
  - 2. Duties and responsibilities
  - 3. Training and experience requirements
  - 4. Work conditions
  - 5. Salary potential
- B. Major sources of employment
  - 1. U. S. Forest Services
  - 2. State Forestry Commissions
  - 3. Pulp and paper companies
  - 4. Lumber companies
  - 5. Recreational agencies
- C. Employment available (non-professional)
  - 1. Local employment
  - 2. Employment outside of training area

II. Importance of Our Forests 15

- A. Importance in South Carolina (detail)
  - 1. Land use
  - 2. Economic value
  - 3. Employment
  - 4. Recreational value
- B. Importance in the U. S. (general)
  - 1. Percentage of land in forests
  - 2. Location of major forest lands
  - 3. Economic value
  - 4. Recreational value

III. Relationship of Forests to Other National Resources 10

- A. Inter-dependence of natural resources
  - 1. Forests
  - 2. Soils
  - 3. Water
  - 4. Wildlife

IV. The Importance of Good Management Practices 15

- A. Present conditions of timberland in South Carolina
  - 1. Types of forests
  - 2. Trends in timber production

3. Trends in reforestation

B. Need for improved practices
1. Reforestation
2. Control of diseases and insects
3. Cutting practices
4. Fire prevention and control
5. Marketing

C. Results of improved practices

V. Educational Programs in Forestry in South Carolina 15

A. S. C. State Commission in Forestry
1. Organization
2. Duties and responsibilities

B. Extension Foresters
1. Organization
2. Duties and responsibilities

C. Wood-using industries
1. Services

D. Consulting foresters

E. Vocational Agriculture teachers
1. Forestry program

F. Soil conservation Service Foresters

VI. Forest Land Ownership 10

A. Ownership in the U. S.
1. National and state
2. Individual owners

B. Ownership in S. C.
1. National and state
2. Wood-using industries
3. Farmers
4. Others

VII. How Trees Grow and Reproduce 15

A. Parts of a tree and functions
1. Roots
2. Trunk
3. Crown

B. How growth takes place

C. How trees reproduce

VIII. The Forest Environment 15

A. Growth factors
  1. Moisture
  2. Soil
  3. Temperature
  4. Light
  5. Tolerance and hardiness

B. Tree and forest classification
  1. By size
2. 2. By composition
  3. By stand density

C. Location of various species in South Carolina

IX. Identifying Trees and Wood (common trees) 15

A. Methods of identifying trees
  1. Leaf
  2. Twig
  3. Bark
  4. Fruit

B. Wood identification
  1. Softwoods and hardwoods
  2. Identifying features

X. Using and Maintaining Hand Tools and Small Equipment 10

A. Hand tools
  1. Kind and use
  2. Safety practices
  3. Maintaining

B. Small equipment
  1. Sprayers
  2. Chain saws

XI. Reproducing Forests Artificially 15

A. Method of reproduction
  1. Direct seeding
  2. Using natural seedlings
  3. Planting nursery seedlings

B. Growing seedlings
  1. Collecting and storing seed
  2. Preparing seed beds
  3. Planting seed
  4. Caring for nursery stock
  5. Lifting seedling
  6. Care for seedling until setting

C. Planting seedlings
   1. Preparing site for seedlings
   2. Hand planting of various kinds of seedlings
   3. Using a tree planter

D. Studying the Tree Improvement Program

XII. Reproducing Forests Naturally 15

A. Selection of seed trees
   1. Type, size and number per acre

B. Preparing soil
   1. Clearing
   2. Weed trees
   3. Furrowing
   4. Scarifying

C. Care and management of young seedlings
   1. Fire prevention
   2. Grazing control
   3. Logging

XIII. Protecting Forests Against Wild Fires 20

A. Damage caused by fires
   1. Effects of fire in woodlands
   2. Prevalence of woods fires and damage in S. C.

B. Fire prevention
   1. Causes
   2. Why people burn woods
   3. Forest fire prevention and control program in S. C.
   4. Fire laws
   5. Classes of fires

C. Firebreaks
   1. Types
   2. How established
   3. Using fire plows
   4. Using hand equipment in controlling fires
   5. How to suppress a fire

D. Prescribed burning (Sandhills and Coastal Plains)
   1. Purpose
   2. When to burn
   3. Precautions

XIV. Improving a Stand by Making Intermediate Cuttings 20

A. Types of intermediate cuttings and when used
   1. Thinnings
   2. Cleaning

    3. Liberation
    4. Improvement
    5. Salvage

B. Thinning
  1. Purpose
  2. Determining need
  3. Spacing
  4. Various species

XV. Making Harvest Cuttings 15

A. Kinds of harvest cuttings
  1. Selection
  2. Clear cutting
  3. Seed-tree system
  4. Shelterwood system
  5. Marking trees to be cut

XVI. Controlling Weed Trees 15

A. The weed trees in South Carolina
  1. Nature of hardwood growth
  2. Acreage in South Carolina
  3. Damage by weed trees

B. Methods of control
  1. Size and types of weed trees
  2. Control by cutting
  3. Use of chemicals
  4. Prescribed burning

XVII. Estimating and Measuring 20

A. Tree measurements
  1. Diameter
  2. Height
  3. Determining growth
  4. Estimating standing timber
  5. Using volume tables

B. Measuring logs, lumber, and pulpwood

C. Cruising and estimating timber

D. Land measurements
  1. Methods
  2. Instruments needed
  3. Determining slop, elevation and area
  4. Survey and plot a given area

XVIII. Controlling Insects of the Forest 15

A. Classification of forest insects

    1. Bark beetles
    2. Wood-borers
    3. Leaf eaters
    4. Gall makers
    5. Seed and tip-feeders

B. Identifying insects and damage

C. Control measures
    1. Mechanical control
    2. Chemical control
    3. Good management practices

XIX. Protecting the Forest Against Diseases and Other Enemies 15

A. Diseases
    1. Recognizing common diseases
    2. Control measures

B. Domestic animals
    1. Effects of grazing
    2. Controlling grazing

C. Damage by other enemies
    1. Ice
    2. Wind
    3. Lightning

XX. Operating Power Equipment 20

A. Types of equipment

B. Purposes and uses of each

C. How to operate

D. How to maintain

XXI. Interpreting and Preparing Charts, Maps, and Tracings 15

A. Graphs
    1. Study and interpret various types of graphs
    2. Prepare various types of graphs

B. Maps
    1. Study land and woodland maps
    2. Prepare simple sketches
    3. Lettering

C. Tracings
    1. Interpret
    2. Prepare tracings and sketches

XXII. <u>Working Mathmatical Problems</u>	10
A. Review of arithmetic	
B. Basic algebra	
C. Applied geometry	
D. Work math problems in forestry	
XXIII. <u>Employment in Forestry</u>	10
A. Determining places of employment	
B. Applying for a job	
C. Accepting job responsibilities	
D. Desirable work habits	
E. Getting along with other employees	
TOTAL	340

TOOLS AND EQUIPMENT

Name	Size	No.	Approximate Cost
Altimeter		1	$ 40.00
Axe (Scout)	1¼ lb.	2	6.00
Axe (single-bit)	2½ lb.	4	16.00
Bark Thickness Measuring Gauge		1	18.00
Bars, planting	37"	4	20.00
Bow saw	30"	2	12.00
Bush hook		2	9.00
Calipers, wood		1	15.00
Chain saw	5 HP-16"	1	175.00
Compass, Selva Rambler		1	4.00
Cruising stick	(Biltmore)	2	16.00
Diameter tape		1	7.00
Drawing boards	12" x 17"	12	34.00
Fire pump	(Pumpak)	1	35.00
Fire rake	5'	4	18.00
Fire swatter	15"	4	18.00
Gauge, Basal Area Angle		1	3.00
Grid, form line		6 sets	24.00
Increment borer	12"	1	30.00
Sprayer, compression	3½ gal.	1	15.00
Steel tape	75'	2	10.00
Tree and log scale stick	(International Rule)	6	10.00
Tree injector		1 (see S.C. State For. Com.)	30.00
Tree marking gun	1 qt.	2	7.00
Triangular scale		6	5.00
Total			$577.00

Certain tools and equipment needed in teaching forestry may be obtained from--Forestry Supplies, Inc., 205 Rankin Street, Jackson Mississippi 39202 --or--The Ben Meadows Company, 1423 Dutch Valley Place, Atlanta 24, Georgia.

CONSUMABLE SUPPLIES

Item	Quantity	Approximate Total Cost
Weed (tree) killer	2-4, 5 T and others	$20.00
BHC	15-20 lbs.	3.00
Paint (marking trees)	1 gal.	5.00
Insect repellant		2.00
Files, flat	several	5.00
Aerial photos, tracing paper, and mapping sheets		5.00
Tables for estimating board-feet volumes of timber (Supt. of Documents, U. S. Government Printing Office, Washington, D. C.		.30
Total		$35.30

REFERENCES

The teacher of the forestry occupational course will need teaching materials for himself and the students. Ample materials for the students will encourage reading and study of this subject. It is suggested that one copy of each publication (students reading level) be made available for each student.

I. Sources of Printed Materials

*1. South Carolina State Forestry Commission, Columbia, South Carolina

*2. Clemson University, Office of Publications, Clemson, South Carolina

*3. American Forest Products Industries, Inc., 1816 N Street, N. W., Washington, D. C.

*4. Southern Pulpwood Association, 1365 Peachtree Street, N. E., Atlanta, Georgia

5. Office of Information, U. S. Department of Agriculture, Washington, D. C.
    (1) Air Attack on Forest Fires. 1960 AB 229
    (2) Chemical Control of Brush and Trees. 1961 F 2158
    (3) Grazed Firebreaks in Southern Forests. 1960 10¢ AB 226
    (4) Growing Loblolly and Shortleaf Pine in the Mid-South. 1956 F 2102

*These sources should be contacted for their list of: publications, movies, and filmstrips.

(5) Growing Loblolly Pine in the South Atlantic States. 1956 F 2097
(6) Growing Slash Pine. 1956 F 2103
(7) How a Tree Grows. (Poster) 16 by 21 inches. Colored. (M 5159)
(8) How to Control Southern Upland Hardwoods with Ammate. (M 5296) 1949
(9) National Parks and National Forests. 1956
(10) Program for the National Forests. 1959. M 794
(11) Protecting the Forests From Fire. 1958 AB 130
(12) Littleleaf of Pine. 1957 FPL 20
(13) Pitch Canker of Southern Pines. 1959 FPL 35
(14) Southern Pine Beetle. 1960 FPL 49

6. Farm Forestry Practices for Students of Vocational Agriculture. Volume I, Revised (Vocational Division, State Department of Education, Columbia, South Carolina, may have some on hand)

7. Books

"Manual of Southern Forestry," by Weaver and Anderson, The Interstate Printers and Publishers, Inc., Danville, Illinois

VT000 923

VT 000 923
Tips for Teaching Life and Health Insurance.

Inst. of Life Insurance, New York, N.Y. Educational Div.
Health Insurance Inst., New York, N.Y.
Pub Date - 63
MF AVAILABLE IN VT-ERIC SET 23p.

*HOMEMAKING EDUCATION, HIGH SCHOOLS, HOME MANAGEMENT, *INSURANCE, *TEACHING TECHNIQUES,

One of the 12 competencies described in 1959 by American home economists as fundamental to effective homemaking, to establish long range goals for financial security and to work toward their achievement, is the foundation for this booklet. Suggestions are presented for including family finances in the homemaking curriculum. The outlined material covers (1) the areas, the units, and the problems within the program where life and health insurance might be appropriately taught, (2) the objectives which might be adopted, (3) the concepts suitable for grades 7 to 12, (4) techniques for motivation, concept development, and evaluation, (5) a glossary of terms, and (6) a list of references. (MS)

TIPS
FOR TEACHING LIFE AND HEALTH INSURANCE

SUGGESTIONS AND IDEAS
FOR THE BEGINNING HOME ECONOMICS TEACHER

Developed with the Assistance of
DR. ALEENE CROSS, Chairman
Home Economics Education
University of Georgia
Athens, Georgia

Revised, 1963

Prepared by:
Educational Division, INSTITUTE OF LIFE INSURANCE
488 Madison Avenue, New York 22, N. Y.
with the cooperation of: HEALTH INSURANCE INSTITUTE

TIPS
FOR TEACHING
LIFE AND HEALTH INSURANCE

WHAT THIS IS ABOUT

- This material, designed for the teacher-in-training and the beginning teacher, is an example of how one problem in family finance – namely personal insurance – might be included in the homemaking curriculum.

- In ***New Directions,*** the AHEA report released in June, 1959, twelve competences are described as fundamental to effective living. These goals are shaping the homemaking curriculum to an increasing degree. Our immediate concern is the sixth competence: *"To establish long-range goals for financial security and to work toward their achievement."* The report concludes: "As home economists we can measure the success of our work by the extent to which we contribute to the development by individuals and families of these competences."

- The reason for this booklet, therefore, is to give you some help in developing this sixth competence insofar as life and health insurance are related to it.

- Much of your teaching will be devoted to the use of family income. You will deal with it in foods, clothing, housing, equipment, and management units. The financial security of the family rests on how effectively it uses income. At some point, you will wish to consider what alternatives the family has if its income is cut off. This is a risk common to every family. Income can suddenly be stopped by illness or disability, by death, or by retirement.

- To protect families economically against this risk and to provide the family with at least a degree of financial security, we have insurance. Because six out of seven American families now own some type of life insurance, and more than four out of five families own health insurance, it is apparent that most families today rely on personal insurance for at least some financial security. What can these families expect personal insurance to do for them? What family needs will be met through insurance? In what way does life insurance help families achieve certain goals? These are questions you and your pupils may want to explore.

- The material that follows will outline for you:

  1. the areas, units, and problems within your program where life and health insurance might have meaning;
  2. the objectives you and your class might adopt;
  3. the concepts that may be suitable at each grade level;
  4. techniques for motivation, development of concepts and evaluation;
  5. glossary of terms;
  6. references.

AREAS, UNITS, AND PROBLEMS WITHIN THE HOMEMAKING PROGRAM WHERE LIFE AND HEALTH INSURANCE MAY BE INCLUDED

No two curriculum guides are identical, but they do share much in common. After examination of a representative collection of state and city homemaking guides, a list was prepared, by grade levels, of those units of instruction in which can be incorporated material on personal insurance. On the following pages several units are suggested; however, only one unit at any grade level would include insurance subject matter. For logic and ease in teaching and learning, keep discussions of life and health insurance in context with discussions of money management and family finance.

OBJECTIVES FOR TEACHING LIFE AND HEALTH INSURANCE

Also on the following pages are set forth some intermediate objectives which might be suitable for each grade level, 7th through 12th. In listing these objectives we recognize that teaching goals must be based on the interests, needs, and abilities of pupils. Perhaps some of the objectives will be representative of your pupils' needs. If not, our list may suggest other objectives more suitable for your particular group. We have related each objective to the problem listed in the previous column.

Our ultimate objective for teaching about life and health insurance is the sixth competence: *"To establish long-range goals for financial security and to work toward their achievement."* You can see from the chart on pages 6 and 7 how each area, unit, problem, and intermediate objective leads toward the accomplishment of this ultimate objective.

SUGGESTED AREAS, UNITS, PROBLEMS, AND OBJECTIVES

Grades and Areas	Typical Units	Problems
7th & 8th: Family Relationships	Understanding My Place in the Family	How is family income used?
9th: Family Relationships	Getting Along with My Family	What is my place in the financial set-up of the family?
10th: Family Relationships	Achieving Personal Maturity	What responsibilities do I have in helping manage our family money?
Home Management	Managing Family Resources	What are some financial obligations of the family?
Home Nursing	Caring for the Sick	How can the family meet the costs of illness?
11th & 12th Family Relationships	Preparing for Marriage	What should an engaged couple understand about buying protection against financial loss?
Home Management	Planning and Maintaining a Functional Home	Why should the family be prepared for the unexpected?
Family Living	Planning to be a Better Consumer	How can financial protection be purchased?
	Making Marriage a Success	How can the family secure satisfaction from use of family income?
Child Care and Guidance	Planning for Parenthood	How much does it cost to have a baby?

FOR TEACHING ABOUT LIFE AND HEALTH INSURANCE

Intermediate Objectives	The Ultimate Objective
To develop an understanding of why financial security must be planned. To develop an understanding of the need for insuring family income if family goals are to be achieved.	The sixth competence: *"To establish long-range goals for financial security and to work toward their achievement."*
To develop an understanding of the financial needs of the family that insurance is designed to meet.	
To develop an appreciation for the concept of thrift which is basic to financial security.	
To develop an appreciation for the services performed by the life insurance and health insurance agent in helping families plan and carry out long-range financial programs. To develop an understanding of the dual role of life insurance: a. as protection for the family in case of the death of the breadwinner, b. as savings which are available for emergency use or for some special need or purpose.	
To develop an awareness of the costs of sickness and accident, and how most families prepare to meet these costs through insurance.	
To develop an appreciation for the role of life and health insurance in the family economy, and its relationship to the whole financial structure of the family.	
To develop an understanding of the kinds of health insurance and how each meets a particular need.	
To develop a recognition that each family's needs for life and health insurance differ.	

CONCEPTS ABOUT LIFE AND HEALTH INSURANCE AT SUGGESTED GRADE LEVELS

Here are suggested some concepts about life and health insurance which may be suitable at varying grade levels as we have indicated. We are suggesting that the concept be at least introduced during the earliest mentioned grade level. Any concept or idea suitable for the 7th and 8th grades will naturally be carried through the 12th, and the concept will be broadened and deepened as the students gain increased ability to understand. In addition, the teacher may want to add new concepts as the students' learning progresses.

	GRADES					
	7	8	9	10	11	12
1. Effective money management involves meeting everyday needs and providing for long-range goals.	✓	✓	✓	✓	✓	✓
2. Families own insurance in order to protect themselves financially against the unexpected.	✓	✓	✓	✓	✓	✓
3. Good money management makes provision for periods when income is stopped.	✓	✓	✓	✓	✓	✓
4. Life and health insurance are an important part of the modern American family's financial security program.	✓	✓	✓	✓	✓	✓
5. Both life and health insurance are purchased on the basis of the needs of the particular family.			✓	✓	✓	✓
6. Families may create greater financial security for themselves by budgets, savings and investments, and carefully planned insurance programs.			✓	✓	✓	✓
7. In planning a personal insurance program, the family needs the services of a reliable agent.				✓	✓	✓
8. To fit the needs of the family, there are a variety of life insurance policies to choose from.				✓	✓	✓
9. Life insurance is designed to furnish necessary funds when family income is cut off by death or retirement. It also provides a source of emergency funds.				✓	✓	✓
10. Health insurance is designed to pay bills incurred by illness or accident and to provide for loss of income during the period of illness and convalescence.				✓	✓	✓

	GRADES					
	7	8	9	10	11	12
11. Health insurance is available from three kinds of organizations: insurance companies; hospital-and-doctor affiliated groups, such as Blue Cross and Blue Shield; and independent groups. It may be obtained by buying an individual policy or by participating in a group plan.				✓	✓	✓
12. In planning a health insurance program, it is wise to budget for the minor illnesses and to insure against the more serious or financially crippling losses.				✓	✓	✓
13. Life insurance is available in three forms: ordinary, industrial, and group.					✓	✓
14. A family's life insurance program may contain four basic kinds of life insurance policies: term, straight life, limited payment, and endowment.					✓	✓
15. Changing family needs and changing economic conditions may require a re-examination of established life insurance programs.					✓	✓

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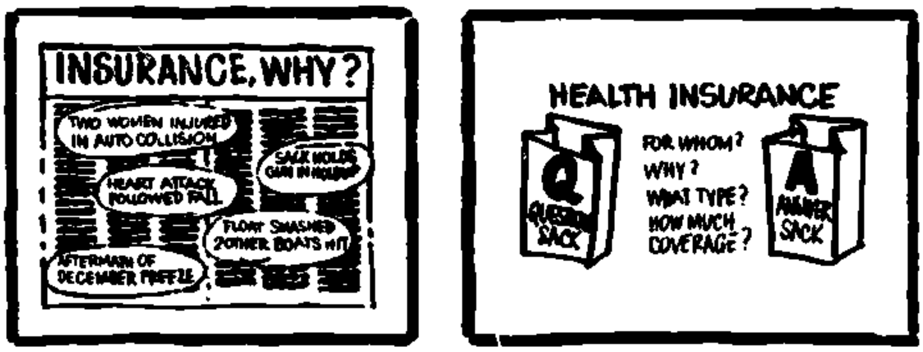
TECHNIQUES FOR MOTIVATION, DEVELOPMENT OF CONCEPTS, AND EVALUATION

MOTIVATION

In brief, creating interest and motivating learning is simply a matter of guidance. You are guiding your pupils toward a choice of objectives or goals, and in so doing you are focusing attention on a new problem. The method of motivation you choose will depend on your class, the maturity of your pupils, their needs and concerns, their previous experience (and yours). Here are some suggestions, however, to stimulate your own thinking.

Bulletin Boards or Exhibits: Several days before you plan to introduce the topic of family financial security, create a bulletin board display designed to arouse curiosity. In Figure I (p. 10) are two suggestions:

FIGURE I. TWO IDEAS FOR BULLETIN BOARDS:



Relating Insurance and Family Security to a Previous Unit: In the course of your teaching, many opportunities will present themselves to integrate much information about family finance into your program. At the point where you have been examining the family income and how it is used, for instance, you can raise some questions: What will happen if the income stops? What things other than unemployment might cause the family income to stop? What can the family do to protect itself against such an emergency?

Self-rating (opinionnaire or some form of checklist). This technique readily lends itself to family finance topics, and is a quick means of determining student attitudes and background experience. Here are some statements typical of an opinionnaire on life and health insurance. Other ideas may be found in the teaching aids listed on pages 22 and 23.

Directions: Circle A if you agree, D if you disagree, and U if you are undecided.

A D U 1. A person should buy life insurance only if he has dependents.

A D U 2. If a person owns life insurance, he would not need health insurance.

A D U 3. Health insurance pays for only the expenses incurred in a hospital.

A D U 4. Newly married couples can postpone planning for their financial security until they get their home and furnishings paid for.

A D U 5. Life insurance is one of the most important assets a family owns.

A D U 6. If a family has a long history of no illnesses or accidents, that family would have no need for health insurance of any kind.

A D U 7. A person can decide how much personal insurance he needs by duplicating what his neighbor owns.

A D U 8. A family needs more personal insurance as the number of children increases.

A D U 9. A good program of financial security is planned early in family life and is developed gradually over the years.

A D U 10. Life insurance should be purchased only on the life of the father.

Visual Aids: There are several motion pictures and filmstrips that will present situations for class discussions and will involve pupils in cases typical of their own experience. Following the presentation of the films, the class can help plan the next steps in developing learning experiences. [*Note:* We list only those visual aids that have been developed by the Institute of Life Insurance. However, there are other filmstrips and motion pictures which will serve the same purpose. We suggest that you consult film catalogs. An especially useful bibliography is available from the National Committee for Education in Family Finance. See reference on page 22.]

Motion Pictures

Life Insurance – What It Means and How it Works: A film showing the flexibility and diversity of life insurance through a variety of animation techniques and live action. Several illustrations show how people, of differing ages and occupations from various parts of the country, have used life insurance to meet their individual financial needs. A basic film for all audiences. 13 min., color.

Measure of a Man: A dramatic study in human relationships, attitudes, and personal values, contrasting the characters and personalities of two men. Throughout the story are sketched the living benefits of life insurance which show how the use of life insurance has helped one family realize goals and meet responsibilities. 27½ min., black and white.

The above pictures may be secured on a free loan basis by writing to:

Association Films, Inc.
347 Madison Avenue
New York 17, New York

Filmstrips

Marriage and Money: a new filmstrip showing how a young married couple learns to manage financial affairs. Defines the goal-setting and decision-making processes in case study approach. Illustrates principles of money management as developed in Educational Division publications. 67 frames, 15 min., color.

The Dollar Series: three 35 mm. filmstrips designed especially to motivate pupil interest. Each filmstrip provides problem material for class discussion as developed in cooperation with educators. Series consists of *Directing Your Dollars,* describing the money management problems of typical teenagers; *Dollars for Health,* showing how family medical costs affect the lives of three high school students, and *Dollars for Security,* the story of three high school pupils whose lives have been intimately touched by life insurance.

These filmstrips may be secured on a FREE LOAN BASIS or purchased from the Educational Division, Institute of Life Insurance.

Using sources within the community may provide a starting place. Here are some suggestions:

Parents' Committee

With your pupils, select several parents to serve as a committee to work with the class on development of an insurance unit. This will be of value in providing the class with an authentic picture of family insurance programs, why families own insurance, what benefits can be expected, etc. It might add real interest if one person in the group has received the benefits of either health or life insurance, and can tell his own story.

Community Leaders

Select a committee of representative community leaders whose work brings them into contact with peoples' financial problems and needs. The committee may include a social worker, a banker, insurance man, hospital administrator, and possibly others. Invite this group to meet with the class if possible. Or gain their permission to be interviewed by pupil committees who in turn will report to the class. With their help, the pupils may gain an insight into some of the problems they can prepare themselves to meet. The question can then be raised, "How can life and health insurance help families meet some of these problems?"

DEVELOPMENT OF CONCEPTS

If you are successful in motivating interest, the development of concepts will be relatively simple. Your pupils will work with you in planning projects which will lead to their adopted goals. Here are a few suggested projects and activities which can be adapted to the individual interests and abilities of your pupils. Each project is related to certain concepts as listed earlier and to the suitable grade level.

ACTIVITIES

Class Discussion

List on the blackboard some of the hazards a family may encounter which can be covered by insurance. Informally check the members of the class to find out which of these hazards are actually covered by insurance in their families. (concepts 2, 3 – grades 7 & 8, 9)

Guest Speaker

Have a committee investigate your school's insurance plan and the benefits it provides, or invite the principal of your school to discuss it with the class. (concept 2 – grades 7 & 8, 9)

Study of Application Forms

Have students obtain blank life insurance and health insurance application forms from local agents and bring to class for examination and discussion. (concepts 4, 7 – grades 10, 11 & 12)

Interview

Obtain information about the available Blue Cross and Blue Shield services in your community. (concepts 10, 11 & 12)

Survey

Ask a group of students to survey local business firms to find out whether they have:

a. group life insurance for employees
b. an employee pension plan
c. group health insurance for employees.

(concepts 3, 4 – grades 10, 11 & 12)

The Case Study Method

In using case studies, you may first want to refer students to *A Date With Your Future* or some other resource material for definitions and descriptions of the "basic four" types of life and health insurance policies. After students are familiar with the various types of policies, simple case studies, such as the following examples, may be used for discussion.

Alice Young is 25 years of age and earns $65 a week as a typist-secretary. She buys a $2,500 endowment policy which will mature when she is 65. Whether she marries or not, Alice knows this sum will be useful when she reaches retirement age. Until that time, she is insured for the full $2,500 which will take care of final expenses and any debts she might leave.

1. Why is an endowment policy better for Alice than a term policy?
2. What should Alice do with her policy when she gets married?
3. In what other situations would a policy similar to Alice's be of particular help?

The Bill Smiths have two children. Bill, age 30, has just been advanced to foreman in an electronics plant and will be earning $125 a week. The Smiths already own $10,000 worth of life insurance. Bill and his wife talk about this promotion and they decide that they now can afford more life insurance protection. They want long range protection for their young family, so they buy a $5,000 straight life insurance policy.

1. Why should Bill buy straight life instead of an endowment policy?
2. Do the Smiths have adequate life insurance at the present time?

Joan Wilson is 24 years of age. Recently she moved to Middletown and is teaching home economics in the Middletown High School. Her salary is $4,800 per year. Joan has no relatives there and so far, few friends. She wants some type of health insurance protection in case she should become ill.

1. What health insurance policies would you suggest for her and why?
2. Because Joan is new in the community, how would you suggest that she get in touch with a health insurance agent who could give her sound advice?

Another way to use the case study method, and perhaps a more meaningful way, is to have the class develop its own case problems. One advantage in this approach is that case problems will be devised that are more nearly typical of families in your community. In addition, it will be a means of further studying your community.

One way to obtain material for case studies is through student interviews. Have students interview representative single adults, young married couples with no children, families with one or more preschool-age children, families with school-age and adolescent children, and families whose children are now independent.

The purpose of the interview will be to learn what kind of life and health insurance is owned, and if possible to find out why, in each case, a particular policy was selected. The interview teams will report their findings to the class and from these you and the students can develop a case study situation for each of the categories of families mentioned above. If several classes use this same case study writing approach, it may be helpful to exchange the case studies among the several classes.

You may need to help students select whom they will interview and what approach they will use. Several role playing situations may help them develop their interview skills. Also, make it clear to students that this assignment is *not* to find out how much insurance the various families own. Rather it is to determine *what kinds* of insurance policies each family has and why they chose these particular types of coverage.

PROJECTS

Individual Report

Discuss the reasons for buying life insurance while young. Have a student report on individual and family needs for insurance. (concepts 10, 15 — grades 10, 11 & 12)

Group Report

Divide the class into small groups and ask each group to prepare a report on the following situations:

a. The life insurance needs for a young career girl, with no dependents, who is just starting out on her first job.

b. The life insurance needs of a young married couple, both of whom are working. They rent their home; they are paying for furniture and for the husband's law school training.

c. The life insurance needs of a family of four — the parents in their early 30's and two children, ages four and seven. They own their own home; the father is a dentist and earns about $7,500 a year; he has two life insurance policies for a total of $11,000 of protection. He is covered by Social Security. He has made no provision for retirement, nor for sending his children to college. (concepts 5, 8 — grades 11 & 12)

Interview and Report

Invite an insurance agent to speak to the class on "Planning for Family Security through Insurance." If this is not possible, perhaps a committee of pupils could interview the agent and then report to the class. (concepts 9, 10, 11, 12, 13, 14, 15 — grades 11 & 12)

Bulletin Boards

Bulletin boards can make valuable contributions to the learning experiences of a class, but as with an effective lesson plan, an effective bulletin board must present only a *single* important idea or theme. It should be offered as a learning experience in which the students participate actively, and is particularly useful in providing work and study opportunities for less articulate class members. The bulletin board project, either assigned by the teacher or suggested by students, is geared to specific lesson needs. It can be used to:

1. Pretest or test student attitudes and understandings.
2. Serve as a springboard for lecture-discussion.
3. Spark classroom discussion.
4. Present a problem to be solved.
5. Record committee reports.
6. Communicate each of several student-committee reports.
7. Record results of interviews.
8. Make student assignments.
9. Evaluate student progress.
10. Summarize major points in an area of study.

Some ideas for bulletin boards are:

- Collect several kinds of insurance policies. On each policy, outline in crayon:
    1) the agreement between the company and the policyholder.
    2) the general policy provisions. (concept 2, grades 11 & 12)
- Suggest title "After 65 – Where's Your Money Coming From?" Include income from Social Security, life insurance, pension, annuity, savings and investments. (concept 10, grades 10, 11 & 12)
- Illustrate the benefits of the 5 types of health insurance policies. Suggested title might be "Meeting the Costs of Medical Care." (concept 9, grades 10, 11 & 12)
- Plan a board on "The Uses of Life Insurance" to show such uses as a life income for a widow, a fund for a college education, protection for a mortgage, etc. (concept 10, grades 10, 11 & 12)
- Use title "The Best Way to Meet Trouble is to be Prepared for It." Show family group with savings and essential insurance protection, including a health insurance program. (concepts 1, 2, 3, 6; grades 7, 8, 9, 10, 11 & 12)

EVALUATION

Evaluation is part of the learning process and is effective only when it is related to those goals or objectives with which you began the unit.

There will be times when you will wish to use conventional paper and pencil tests. And there will be times when less formal techniques for evaluating growth, progress, and changes in attitudes are in order. Here are some *sample questions* for conventional tests which are often helpful in determining pupil strengths and weaknesses and in measuring growth. However, they cannot do the total job of evaluation.

Discussion or essay questions:

Slow learners have trouble with essay questions, but questions of this type do provide the better student with opportunities for practice in organizing his thinking and in communicating his ideas.

1. What are some occasions in family life which might make desirable some changes in the family insurance program?
2. Why does a life insurance program have to be tailor-made? Why couldn't a standard program be devised which would fit everybody?
3. In buying health insurance, which expenses are most important to insure against? Why?

Open-end questions:

1. Some new things I have learned about uses for family income are: ____________________
____________________.

2. It is wise for a family to have a plan for financial security because ____________________
____________________.

3. Families can protect themselves against financial loss due to illness, accident, death or retirement by____________________
____________________.

Multiple choice questions:

Read each statement and place an X before each phrase that will correctly complete the statement. One or more answers may be correct.

1. The most widely used type of health insurance is:

_______ a. loss of income
_______ b. surgical expense
_______ c. hospital expense
_______ d. major medical expense

2. The main reason most families own life insurance is to provide:

_______ a. credit at the bank so that they can borrow money
_______ b. protection against the loss of income, whether by death or retirement
_______ c. a fund for the future college education of the children
_______ d. a continued source of ready cash

3. When your life insurance agent helps you plan an insurance program, he takes into consideration:

_______ a. the needs for which your life insurance must provide
_______ b. the assets you already own
_______ c. the amount you can afford to pay for insurance
_______ d. your ability to handle money wisely

Matching questions:

Read the column of statements, select the correct answer, and write the number of the answer in the space given.

1. Annuity	_______	a. A fund to call on in case of serious need
2. Cash values	_______	b. Pays the costs of doctor's calls, either at home, hospital or his office
3. Emergency fund	_______	c. Savings element of a life policy
4. Endowment	_______	d. Life and health insurance covering the employees of a company or members of a union
5. Face value	_______	e. A savings plan which also provides life insurance protection while the plan is in force
6. Group plans		
7. General medical expense policy		

Another matching question, more suitable for the 7th and 8th grade level, might be as follows:

Match the need for insurance protection, in column A, with the kind of insurance designed to meet that need in column B. Write your answer in the space given.

A	B
1. Your father's car is damaged in a collision.	______ a. Crop insurance
2. Smith's house burns down.	______ b. Life insurance
3. A farmer's wheat field is destroyed by a storm.	______ c. Burglary insurance
4. Mr. Brown dies and leaves his wife and three young children.	______ d. Health insurance
5. Jerry has to be in the hospital for several days because he was seriously burned.	______ e. Fire insurance
6. Mrs. Sullivan's silverware and jewelry are stolen from her house.	______ f. Automobile insurance
7. Rain cancels the concert in the park.	

Situational questions:

Tom and Mary Webb are both 27 years old and have been married for five years. Tom is a teller in the local bank, where he earns $480 a month. Mary stays at home to take care of their two-year-old boy. They have finally saved enough money to make a down payment on a house which will cost $12,500. Their insurance agent comes in one evening to help them plan their insurance program. At present, Tom belongs to the bank's group health insurance plan which pays hospital expenses for a limited period for the family. He also has a $5,000 straight life insurance policy which his parents started for him and a $5,000 family income policy which he purchased when their son was born. Mary has no insurance. She believes that it isn't necessary for her to have any. "Insurance is only necessary for the breadwinner of the family," she says.

Do you agree with Mary's point of view? Why?

Which members of this family should be insured?

Should Tom have more health insurance than his bank's hospitalization plan? What factors will he have to consider in making his decision?

What type of life insurance policies might the insurance agent recommend to Tom and Mary? Why?

GLOSSARY OF TERMS

Accidental Death Benefit A provision added to a life insurance policy for payment of an additional death benefit in case of death as a result of accidental means. It is often called "Double Indemnity."

Actuary A technical expert on insurance and related fields, particularly on the mathematics of insurance, including the calculation of premiums, policy reserves, and other values.

Agent A sales and service representative of an insurance company.

Annuitant The person during whose life an annuity is payable, usually the person to receive the annuity.

Annuity A contract that provides an income for a specified period of time, such as a number of years or for life.

Application A statement, signed by the applicant, requesting life insurance. It gives information used by the insurance company to determine the acceptability of the risk and the basis of the policy contract.

Automatic Premium Loan A provision in a life insurance policy that any premium not paid by the end of the grace period (usually 31 days) be automatically paid by a policy loan if there is sufficient cash value.

Beneficiary The person named in the policy, to whom the insurance money is to be paid at the death of the insured.

Cash Surrender Value The amount available in cash upon surrender of a policy before it becomes payable by death or maturity.

Convertible Term Insurance Term insurance which can be exchanged, at the option of the policyholder and without evidence of insurability, for a permanent plan of insurance.

Disability Benefit A provision added to a life insurance policy for waiver of premium, and sometimes payment of monthly income, if the insured becomes totally and permanently disabled.

Double Indemnity An accidental death benefit providing for payment of double the face amount of the policy in case of death as a result of accidental means.

Endowment Insurance A plan of insurance payable after a specified number of years if the insured is then living. If the insured dies during the endowment period, payment is made to a beneficiary.

Extended Term Insurance A form of insurance available as a nonforfeiture option. It provides the original amount of insurance for a limited period of time.

Face Amount The amount stated on the face of the policy that will be paid in case of death or at maturity.

Grace Period A period (usually 31 days) following the premium due date, during which a premium may be paid. The policy remains in force throughout this period.

Group Life Insurance Life insurance issued, usually without medical examination, on a group of persons under a master policy. It is usually issued to an employer for the benefit of employees. The individual members of the group hold certificates as evidence of their insurance.

Industrial Life Insurance Life insurance issued in small amounts, usually not over $500, with premiums payable on a weekly or monthly basis. The premiums are generally collected at the home by an agent of the company.

Insured The person on whose life an insurance policy is issued.

Level Premium Insurance Insurance for which the cost is distributed evenly over the period during which premiums are paid. The premium remains the same from year to year, and is more than the actual cost of protection in the earlier years of the policy and less than the actual cost in the later years. The excess paid in the early years builds up the reserve.

Limited Payment Life Insurance A plan of whole life insurance with premiums payable for a specified number of years or until death if death occurs before the end of the specified period.

Nonforfeiture Option The value, if any, either in cash or in another form of insurance, available to the policyholder upon failure to continue the required premium payments. The other forms of insurance available are extended term insurance and reduced paid-up insurance.

Non-Participating Insurance Insurance on which no dividends are payable. The premium is calculated to cover as closely as possible the anticipated cost of the insurance protection.

Ordinary Life Insurance Life insurance usually issued in amounts of $1,000 or more with premiums payable on an annual, semiannual, quarterly, or monthly basis. The term is also used to mean the straight life plan of insurance.

Paid-Up Insurance Insurance on which all required premiums have been paid. The term is frequently used to mean the reduced paid-up insurance available as a nonforfeiture option.

Participating Insurance Insurance on which the policyholder is entitled to share in the surplus earnings of the company through dividends which reflect the difference between the premium charged and actual experience. The premium is calculated to provide some margin over the anticipated cost of the insurance protection.

Policy The printed document issued to the insured by the company stating the terms of the insurance contract.

Policy Dividend A refund of part of the premium on a participating life insurance policy representing its share of the surplus earnings apportioned for distribution. It reflects the difference between the premium charged and actual experience.

Premium The payment, or one of the regular periodical payments, a policyholder is required to make for an insurance policy.

Reduced Paid-Up Insurance A form of insurance available as a nonforfeiture option. It provides for continuation of the original insurance plan, but for a reduced amount.

Settlement Option One of the several ways, other than immediate payment in a lump sum, in which the insured or beneficiary may choose to have the money from a policy paid.

Straight Life Insurance A plan of whole life insurance with premiums payable until death.

Term Insurance A plan of insurance payable at death provided death occurs within a specified period.

Waiver of Premium A provision that under certain conditions an insurance policy will be kept in full force by the company without the payment of premiums. It is used most often as a disability benefit.

Whole Life Insurance A plan of insurance for the whole of life payable at death. It may be either straight life or limited payment life.

REFERENCES, TEXTS AND TEACHING AIDS ON LIFE AND HEALTH INSURANCE

For the teacher:

Bradley, Joseph F., and Ralph H. Wherry, *Personal and Family Finance,* New York, Holt, Rinehart, and Winston, Inc., 1957, 581 pages, illus.

Cohen, Jerome B., and Arthur W. Hanson, *Personal Finance: Principles and Case Problems,* rev. ed., Homewood, Illinois, Richard D. Irwin, Inc., 1958, 819 pages, illus.

Donaldson, Elvin F., and John K. Pfahl, *Personal Finance,* 3rd ed., New York, Ronald Press, 1961, 720 pages, illus.

Gross, Irma and Elizabeth Walbert Crandall, *Management for Modern Families,* New York, Appleton-Century-Crofts, Inc., 1954, 579 pages, illus.

Lasser, Jacob Kay and Sylvia F. Porter, *Managing Your Money,* rev. ed., New York, Holt, Rinehart, and Winston, Inc., 1962, 427 pages.

Nickell, Paulena and Jean Muir Dorsey, with the collaboration of Marie Budolfson, *Management in Family Living,* 3rd ed., New York, John Wiley and Sons, Inc., 1959, 551 pages, illus.

Phillips, E. Bryant and Sylvia Lane, *Personal Finance,* New York, John Wiley and Sons, Inc., 1963, 511 pages, illus.

Springer, John L., *Make the Most of Your Income,* Englewood Cliffs, New Jersey, Prentice-Hall, Inc., 1961, 214 pages.

The following publications may be secured from the National Committee for Education in Family Finance, 488 Madison Avenue, New York 22, New York:

Free and Inexpensive Materials for Teaching Family Finance, #532, 1963, 47 pages. Free. An annotated bibliography of teaching aids.

Teaching Family Finance More Effectively, #518, rev. 1958, 88 pages. Price: 50¢. A handbook for homemaking teachers.

For the students:

Barclay, Marion S., and Frances Champion, *Teen Guide to Homemaking,* New York, McGraw-Hill Book Company, Inc., 1961, 516 pages, illus.

Craig, Hazel Thompson, *Thresholds to Adult Living*, Peoria, Illinois, Charles A. Bennett Co., 1962, 416 pages, illus.

Fitzsimmons, Cleo and Nell White, *Management for You*, New York, J. B. Lippincott Company, 1958, 422 pages, illus.

McDermott, Irene Elizabeth and Florence Williams Nicholas, *Homemaking for Teen-Agers*, Book 2, Peoria, Illinois, Charles A. Bennett Co., Inc., 1962, 703 pages, illus.

McDermott, Irene Elizabeth and Florence Williams Nicholas, *Living for Young Moderns*, New York, J. B. Lippincott Company, 1956, 396 pages, illus.

Starr, Mary Catharine, *Management for Better Living*, Boston, D. C. Heath and Company, 1956, 451 pages, illus.

Wilhelms, Fred T., and Ramon P. Heimerl, *Consumer Economics: Principles and Problems*, 2nd ed., New York, McGraw-Hill Book Company, Inc., 1959, 534 pages, illus.

Wilson, W. Harmon and Elvin S. Eyster, *Consumer Economic Problems*, 6th ed., Cincinnati, Ohio, South-Western Publishing Co., 1961, 682 pages, illus.

The following publications may be secured from the Educational Division, Institute of Life Insurance, 488 Madison Avenue, New York 22, New York. Write for Catalog of Teaching Aids and ask for examination copies of:

A Date with your Future, 1963, 36 pages, illus., free in classroom quantities. Especially prepared for 11th and 12th grade homemaking students. Discusses all areas of family finance, including life and health insurance.

Policies for Protection, 1963, 36 pages, illus., free in classroom quantities, accompanied by Teacher's Manual. Designed for use in basic business courses, secondary level.

Sharing the Risk, 1960 ed., 31 pages, free in classroom quantities. Prepared for consumer economics or social studies classes and accompanied by Teacher's Guide.

Cohen, Jerome B., *Decade of Decision*, rev. ed., New York, Educational Division, Institute of Life Insurance, 1961, 56 pages, illus. Single copy free to secondary school teachers. Free in classroom quantities to college and university educators. Designed for college level courses; describes life and health insurance by means of the case study approach.

VT000 924

VT 000 924
Tractor Operation and Maintenance, Special Course in Vocational Agriculture for Adults, Suggested Course Outline for Teachers of Agriculture in South Carolina.

Clemson Univ., S.C. Dept. of Agricultural Education
South Carolina State Dept. of Education, Columbia
Pub Date - Oct64
MF AVAILABLE IN VT-ERIC SET 9p.

*VOCATIONAL AGRICULTURE, *ADULT FARMER EDUCATION, *TEACHING GUIDES, *CURRICULUM GUIDES, *TRACTORS, REPAIR, MAINTENANCE,

The purpose of the guide is to assist vocational agriculture teachers to plan and conduct 20- to 30-hour tractor operation and maintenance courses for adult farmers. It was developed by a committee of agriculture teachers. Outlines are included for units on (1) servicing and lubricating the tractor, (2) maintaining the cooling, hydraulic, ignition, electrical, fuel system, and the chassis, (3) locating and repairing malfunctions, and (4) operating cleaning, and storing the tractor. Each unit contains suggestions for discussions, demonstrations, practice, and materials. Suggested references are listed. Single copies of this document are available without charge from Agricultural Education Department, Clemson University, Clemson, South Carolina 29731. (JM)

TRACTOR

OPERATION AND MAINTENANCE

SPECIAL COURSE IN VOCATIONAL AGRICULTURE

FOR ADULTS

Suggested Course Outline for Teachers of Agriculture
in
South Carolina

Prepared by

Department of Agricultural Education, Clemson University, Clemson, South Carolina

and

State Department of Education, Columbia, South Carolina

October 1964

M E M O R A N D U M

TO: The ERIC Clearinghouse on Vocational and Technical Education
The Ohio State University
980 Kinnear Road
Columbus, Ohio 43212

FROM: (Person) F. E. Kirkley (Agency) Agricultural Education Department

(Address) Clemson University. Clemson, South Carolina 29631

DATE: December 13, 1967

RE: (Author, Title, Publisher, Date) F. E. Kirkley, Tractor Operation and Maintenance

Agricultural Education Department, 1964

Supplementary Information on Instructional Material

Provide information below which is not included in the publication. Mark N/A in each blank for which information is not available or not applicable. Mark P when information is included in the publication. See reverse side for further instructions.

(1) Source of Available Copies:
Agency Agricultural Education Department
Address Clemson University, Clemson, South Carolina 29631
Limitation on Available Copies 1 upon request Price/Unit No charge
(quantity prices)

(2) Means Used to Develop Material:
Development Group Committee of Agriculture teachers
Level of Group State
Method of Design, Testing, and Trial Based on experience of teachers

(3) Utilization of Material:
Appropriate School Setting Vocational Agriculture Departments
Type of Program for adult farmers
Occupational Focus Specific jobs in tractor maintenance
Geographic Adaptability United States
Uses of Material Course Planning
Users of Material Qualified Farm Mechanics teachers

(4) Requirements for Using Material:
Teacher Competency Experience in teaching Agricultural Mechanics
Student Selection Criteria Tractor owners & operators

Time Allotment 20 to 30 hours

Supplemental Media --
Necessary X
Desirable
(Check Which)

Describe Operator's Manuals

Source (agency) Tractor Companies
(address)

TABLE OF CONTENTS

Note to Teacher:

The ten teaching jobs presented in this outline are intended for a course of 20 to 30 hours. The jobs and hours allotted as well as the sequence of teaching the jobs can be easily changed by the instructor if he so desires.

Each job or lesson is broken down into: (1) What the teacher should do (discuss and demonstrate); (2) What the student or trainees should do (practice); and (3) Materials needed for the lesson.

Every effort should be made to provide practice (experience) for the students. Discussion by teacher should be based on "showing" through the use of objects, charts and other aids. This type of teaching will necessitate several tractors on hand as teaching aids.

JOB I -- SERVICING AND LUBRICATING THE TRACTOR -- 2-3 HOURS

A. Discuss and Demonstrate:

1. Explain and discuss how to use the service manual
2. Point out moving parts of tractor to be lubricated
   (a) Importance of regular maintenance of tractor
3. Explain oil system
4. What, how and where to use: crankcase oil, gear oil, hydraulic oil and greases
5. Crankcase oil: purpose, grade and classification
6. Selecting gear oil, hydraulic oil and grease
7. Explain oil filter: purpose, when and how to change
8. Crankcase breather: purpose, types and cleaning

B. Practice:

1. Check need for lubricating various parts
2. Drain oil (used) and examine
3. Replace oil filter
4. Check and replace gear oil
5. Check hydraulic oil
6. Use manual
7. Clean breather cap

C. Materials Needed:

1. Several tractors that need servicing
2. Oil filters - new and old
3. Various types of oils
4. Grease guns
5. Dope guns
6. Solvent
7. Rags

JOB II -- MAINTAINING THE COOLING SYSTEM -- 2-3 HOURS

A. Discuss and Demonstrate:

1. Use charts to explain details and importance of the cooling system
2. Importance of proper engine temperature
3. Causes of overheating
4. Systems of water cooling
5. Check: hose, radiator cap, temperature, water pump and fan belt tension
6. Use of anti-freeze and rust inhibitors
7. Demonstrate action of thermostat and water pump

B. Practice:

1. Check cooling systems

2. Clean dirty systems - use commercial or home-made cleaning mixture

C. Materials Needed:

1. Several thermostats
2. Hose fittings - new and old
3. Cleaning materials for radiator
4. Pressure caps

JOB III -- MAINTAINING THE HYDRAULIC SYSTEM -- 2-3 HOURS

A. Discuss and Demonstrate:

1. Types of hydraulic systems
2. How system operates - demonstrate use
3. Use of manual
4. How to service hydraulic systems

B. Practice:

1. Operate various systems
2. Check manuals for servicing systems
3. Follow manual: remove drain plug, remove oil and filter
4. Clean and re-install

C. Materials Needed:

1. Hydraulic fluid
2. Rags
3. Solvent

JOB IV -- MAINTAINING THE IGNITION SYSTEM -- 2-3 HOURS

A. Discuss and Demonstrate:

1. Explain and illustrate battery and magneto systems
2. Functions of coil, distributer and spark plugs
3. Check condition of distributor - points and condensor
4. File or replace points
5. Examine and service cam and adjust points
6. Re-assemble distributor
7. Importance of timing the ignition
    (a) breakter-point method
    (b) timing light method
8. Spark plugs: construction, types, checking, cleaning and adjusting

B. Practice:
1. Remove parts of distributor and examine

2. Service and re-assemble
3. Practice timing ignition
4. Clean and adjust spark plugs

C. Materials Needed:

1. Various spark plugs - used, new, hot and cold
2. Rags
3. Solvent
4. Points for different tractors
5. Ignition file
6. Feeler gauge
7. Spark plug tester

JOB V -- MAINTAINING THE ELECTRICAL SYSTEM -- 2-3 HOURS

A. Discuss and Demonstrate:

1. Parts of system and functions (battery, starter, generator, voltage regulator, switches and lights)
2. Battery: service, check with hydrometer and test
3. Check starter and generator and lubricate
4. Replace worn brushes on starter and generator
5. Clean commutator

B. Practice:

1. Explain functions of all parts of the electrical system
2. Test batteries
3. Service batteries
4. Replace brushes in starters and generators

C. Materials Needed:

1. Battery syringe
2. Baking soda and vaseline
3. Hydrometer
4. Sandpaper (No. 00)

JOB VI -- MAINTAINING THE FUEL SYSTEM -- 2-3 HOURS

A. Discuss and Demonstrate:

1. Systems in gasoline and diesel engines
2. Types of fuels and storage
3. Importance of clean fuel
4. Service the sediment bowl
5. Service fuel line and screen

6. Parts and functions of carburetor
7. Adjust carburetor
8. Diesel fuel system - filters and injection pumps
9. Clean filters - bleed air from fuel line
10. Examine and service air cleaner

B. Practice:

1. Disassemble and clean sediment bowls and filters
2. Make adjustments of carburetor
3. Service the air cleaner

C. Materials Needed:

1. Solvent
2. Rags
3. Several carburetors
4. Air cleaners
5. Oil filters
6. Hose and fittings

JOB VII -- MAINTAINING THE CHASSIS AND OTHER PARTS OF THE TRACTOR -- 2-3 HOURS

A. Discuss and Demonstrate:

1. Manual steering gear
   (a) check steering, adjust gears and check front end
2. Power steering
   (a) check lubricant, refill and check front end
3. Clean and repack front wheels
4. Check rear wheel bearings
5. Tires - under and over inflation
6. Tire and wheel weights
7. Brakes - adjusting and replacing lining
8. Frame - inspect and tighten

B. Practice:

1. Check both types of steering
2. Clean and repack front wheels
3. Adjust brakes
4. Replace brake lining

C. Materials Needed:

1. Screws and bolts
2. Grease
3. Air guage

JOB VIII -- TROUBLE SHOOTING EXERCISE -- 2-3 HOURS

A. Discuss and Demonstrate:

1. Failure to start
2. Overheating
3. Missing and backfiring
4. Lack of compression
5. Engine knocks

B. Practice: (Note: Several tractors should be available to give trainees actual experience (practice) in determining and correcting common troubles.)

1. Have tractors prepared (fixed) to give trouble before class begins
2. Assign several trainees to each tractor
3. Allow time for trainees to:
   (a) locate trouble
   (b) correct trouble
   (c) report to group
4. Rotate small groups

C. Materials Needed:

1. All tools and equipment essential for determining and correcting troubles.
2. A tractor for each two or three trainees.

JOB IX -- TROUBLE SHOOTING EXERCISE -- 2-3 HOURS

A. Discuss and Demonstrate:

1. Low oil pressure
2. Defective ignition
3. Lack of fuel
4. Smoky exhaust
5. Excessive fuel consumption

B. Practice: (Note: Several tractors should be available to give trainees actual experience (practice) in determining and correcting common troubles.)

1. Have tractors prepared (fixed) to give trouble before class begins
2. Assign several trainees to each tractor
3. Allow time for trainees to:
   (a) locate trouble
   (b) correct trouble
   (c) report to group
4. Rotate small groups

C. Materials Needed:

1. All tools and equipment essential for determining and correcting troubles.
2. A tractor for each two or three trainees.

JOB X -- OPERATING THE TRACTOR SAFELY, CLEANING AND STORING -- 2-3 HOURS

A. Discuss and Demonstrate:

1. Safety
    - (a) highway operation
    - (b) night operation
    - (c) stopping, speed, towing and refueling
    - (d) Hitches and overloading
    - (e) operating near ditches and on steep slopes
    - (f) power take-off and pulleys
2. Clean and store (where tractors will not be used for at least two or three months)

B. Practice:

1. Clean tractor (steam cleaner if available)
2. Prepare for storage
    - (a) remove plugs and oil cylinders
    - (b) oil valve stems and tappets
    - (c) cooling system
    - (d) Service oil and air cleaner

C. Materials Needed:

1. Rags
2. Solvent (kerosene)
3. De-grease
4. Steam cleaner
5. Putty knives

REFERENCES

1. G. E. Henderson, Coordinator, SAAE & VA, University of Georgia, Athens, Georgia.

    (a) Tractor Operation and Daily Care $2.00
    (b) Tractor Maintanance $2.50
    (c) Farm Tractor Tune-up and Service Guide $1.85
    (d) Tractor Fuels and Lubricants $1.00
    (e) Filmstrips: Set of four strips (63, 64, 66 and 76 frames) in color $20.00 (Above prices are less to schools in this State.)

2. The Interstate Company, 19-27 North Jackson Street, Danville, Illinois

    (a) Farm Tractor Maintenance, by Brown and Morrison, 1962, $3.65

3. Office of Education, United States Department of Health, Education and Welfare, Washington, D. C.

    (a) Instruction in Farm Mechanics, Bulletin No. 267.

4. Local farm equipment dealers

    (a) Service manuals (one for each student)
    (b) Charts and other aids

VT000 947

VT 000 947
Learning Experiences in Agricultural Occupations for Students of Vocational Agriculture, Poultry Processing Plants.

Clemson Coll., S.C. Dept. of Agricultural Education
South Carolina State Dept. of Education, Columbia
Pub Date - Apr64
MF AVAILABLE IN VT-ERIC SET 5p.

*VOCATIONAL AGRICULTURE, *POULTRY PROCESSING OCCUPATIONS, HIGH SCHOOLS, *COOPERATIVE EDUCATION, *LEARNING EXPERIENCE, *JOB SKILLS,

Designed for use by high school teachers as course planning material in vocational agriculture, this publication contains a list of learning experiences and activities needed by employees in poultry processing plants. It was developed by an individual author from a survey of poultry processors. Major divisions are (1) Experiences in Producing Broilers which includes selecting breeds for broilers, preparing brooder houses, maintaining proper temperature, following sanitary practices, and feeding before marketing, and (2) Experiences in Poultry Processing which includes killing chickens, sizing and weighing, packing for marketing, taking orders, and keeping records. Space to check performance of each activity is provided. The suggested time allotment is 160 hours. Qualified agriculture teachers may use this material with students interested in poultry processing. Single copies of this document are available without charge from Agricultural Education Department, Clemson University, Clemson, South Carolina 29631. (WB)

LEARNING EXPERIENCES IN AGRICULTURAL OCCUPATIONS

FOR

STUDENTS OF VOCATIONAL AGRICULTURE

POULTRY PROCESSING PLANTS

Prepared by

Agricultural Education Department, Clemson College, Clemson, South Carolina

and

State Department of Education, Columbia, South Carolina

April 1964

MEMORANDUM

TO: The ERIC Clearinghouse on Vocational and Technical Education
The Ohio State University
980 Kinnear Road
Columbus, Ohio 43212

FROM: (Person) F. E. Kirkley (Agency) Agricultural Education Department

(Address) Clemson University, Clemson, South Carolina 29631

DATE: December 13, 1967

RE: (Author, Title, Publisher, Date) F. E. Kirkley. Learning Experiences in Agricultural Occupations for Students of Vocational Agriculture--Poultry Processing Plants, Agricultural Education Department. 1964

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(quantity prices)

(2) Means Used to Develop Material:
Development Group Individual authorship
Level of Group State
Method of Design, Testing, and Trial Survey of poultry processors

(3) Utilization of Material:
Appropriate School Setting Vocational Agriculture Department
Type of Program High School Class
Occupational Focus cluster of jobs in poultry processing
Geographic Adaptability United States
Uses of Material Course planning
Users of Material teachers

(4) Requirements for Using Material:
Teacher Competency Qualified Agriculture Teachers
Student Selection Criteria Students interested in poultry processors

Time Allotment 160 hours

Supplemental Media --
Necessary X
Desirable
(Check Which)

Describe Appropriate bulletins and books on poultry processors

Source (agency) local states
(address)

FOREWORD

This publication contains a list of learning experiences and activities which a student of vocational agriculture may get in poultry processing plants. Since some processing plants grow out their own chickens these experiences are listed: Part One - Experiences in Producing Broilers; and, Part Two - Experiences in Poultry Processing.

For these activities to be real learning experiences, the student must give some thought and study to each job he performs. In poultry processing, employees usually perform the same job each day. For the most learning, the student should get experience in as many activities as possible. After he has learned to do one job well, he should, with employer's permission, learn another one.

Experiences in producing broilers will vary according to the size and scope of the enterprise. Here the student has an opportunity to learn much by reading and studying as he performs the various jobs in growing out broilers.

The right column: "Check Performance" should be used by the employer to check the jobs as they are satisfactorily completed.

PART ONE - PRODUCING BROILERS

Kind of Experiences	Check Performance
1. Selecting breeds for broilers	
2. Locating sources of baby chicks	
3. Procuring baby chicks	
4. Preparing brooder house	
a. Cleaning house	
b. Providing clean litter	
c. Determining needed floor space	
d. Determining needed equipment	
e. Arranging equipment	
f. Checking brooder	
g. Operating brooder	
5. Placing chicks in brooder house	
6. Maintaining the proper temperature	
7. Feeding	
a. Feeding baby chicks	
b. Feeding growing chicks	
c. Methods of feeding	
d. Kinds of feeds	
8. Following sanitary practices	
a. Waterers and feeders	
b. Litter	
9. Symptons of common diseases	
10. Preventing diseases	
11. Controlling diseases	
12. Preventing cannibalism	
13. Feeding before marketing	

PART TWO - POULTRY PROCESSING

Kind of Experiences	Check Performance
1. Hauling chickens to processing plant	
2. Hanging chickens by feet on shackles (conveyer)	
3. Killing chickens	
4. Reversing the position on conveyer for picking	
5. Scalding	
6. Automatic picking	
7. Removing pin feathers by hand	
8. Singeing	
9. Cutting around vent and abdomen	
10. Removing viscera	
11. Removing head, feet, crops, lungs and kidneys	
12. Washing carcass	
13. Removing gizzard, heart, liver and neck	
14. Splitting and skinning gizzards	
15. Wrapping giblets	
16. Hanging carcass on shackles for inspection	
17. Stuffing giblets into carcass	
18. Placing carcasses in chilling vats	
19. Icing chilling vats	
20. Sizing and weighing	
21. Cutting fryers	
22. Assembling packing boxes	
23. Packing for marketing	
24. Placing in storage	
25. Delivering to retailers	

	Check Performance
26. Taking orders	
27. Collecting money	
28. Record of deliveries and sales	

VT000 951

VT 000 951

Electricity on the Farm, Special Course in Vocational Agriculture for Adults, Suggested Course Outline for Teachers of Agriculture in South Carolina.

Clemson Univ., S.C. Dept. of Agricultural Education
South Carolina State Dept. of Education, Columbia
Pub Date - Nov64
MF AVAILABLE IN VT-ERIC SET 8p.

*VOCATIONAL AGRICULTURE, *ADULT FARMER EDUCATION, *TEACHING GUIDES, *CURRICULUM GUIDES, *ELECTRICITY,

The purpose of this teaching guide is to assist vocational agriculture teachers in planning and executing a 30-hour course in farm electricity. It was developed by a committee of teachers and electricians for use in adult farmer and high school vocational agriculture classes. Outlines are included for the units (1) electrical fundamentals and terms, (2) homestead wiring system planning, (3) circuit installation, (4) electrical system maintenance, (5) farm motor selection, and (6) other uses of electricity. Each unit contains suggestions for discussion, demonstration, practice, and teaching materials. References and teaching aids are listed. Single copies of this document are available without charge from Agricultural Education Department, Clemson University, Clemson, South Carolina 29631. (JM)

ELECTRICITY ON THE FARM

SPECIAL COURSE IN VOCATIONAL AGRICULTURE
FOR ADULTS

Suggested Course Outline for Teachers of Agriculture
in
South Carolina

Prepared by
Agricultural Education Department, Clemson University, Clemson, South Carolina
and
State Department of Education, Columbia, South Carolina

November 1964

MEMORANDUM

TO: The ERIC Clearinghouse on Vocational and Technical Education
The Ohio State University
980 Kinnear Road
Columbus, Ohio 43212

FROM: (Person) F. E. Kirkley (Agency) Agricultural Education Department

(Address) Clemson University, Clemson, South Carolina 29631

DATE: December 14, 1967

RE: (Author, Title, Publisher, Date) F. E. Kirkley, Electricity on the Farm, Agricultural Education Department, Clemson University, 1964

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(quantity prices)

(2) Means Used to Develop Material:
Development Group Committees, teachers, and electricians
Level of Group State
Method of Design, Testing, and Trial Based on experienced teachers

(3) Utilization of Material:
Appropriate School Setting High school agricultural & vocational area centers
Type of Program For adults
Occupational Focus Basic training
Geographic Adaptability United States
Uses of Material Course outline
Users of Material Teachers

(4) Requirements for Using Material:
Teacher Competency Agriculture teacher or experience in electricity
Student Selection Criteria High school and adults

Time Allotment 30 hours

Supplemental Media --
Necessary X
Desirable
(Check Which)

Describe Material related to an understanding of basic student

Source (agency)
(address)

TABLE OF CONTENTS

Note to Teacher:

It is suggested that at least 30 hours of instruction be devoted to these ten sessions or lessons. If three-hour sessions are not convenient for the class, the number of sessions should be increased.

Each session in this suggested outline is divided into three parts: A - What the Teacher Should Do; B - What the Students Should Do; and C - What Materials Are Needed. Any part of any session or the teaching sequence may be easily changed.

For effective teaching of this course, considerable teacher preparation is necessary. Teaching aids - objects, charts, diagrams, etc. for each session should be obtained well in advance of the class meeting. These aids are essential for effective discussion and demonstration, by the teacher, and for meaningful practice or experience by the student.

If the filmstrips, listed on the reference page, cannot be purchased, the use of the four manuals (a, b, c, and d) from the Coordinator's Office, SAAE & VA, University of Georgia, Athens. Georgia, should be emphasized.

SESSION I -- FUNDAMENTALS OF ELECTRICITY AND ELECTRICAL TERMS -- 2-3 HOURS

A. Discuss and Demonstrate:

1. The atom, protons and electrons
2. Circuits, conductors and resistance
3. Volts, amperes, watts and grounds
4. AC and DC currents
5. Single phase and 3 phase
6. Nameplates on electrical equipment
7. Calculating cost of using electrical equipment
8. Reading a meter
9. Safety rules with electricity

B. Practice:

1. Learn electrical terms
2. Explain relationship of: volts, amperes and watts
3. Explain nameplates on electrical equipment
4. Read a meter
5. Calculate costs of using certain equipment

C. Materials Needed:

1. Volt, ampere and watt meter
2. Nameplates
3. Posters and charts

SESSION II -- PLANNING THE HOMESTEAD WIRING SYSTEM -- 2-3 HOURS(1)

A. Discuss and Demonstrate:

1. Use of electricity in each room or part of the home
2. Locating outlets and switches -- kind and number
3. Number of branch circuits needed
4. Size of service panel and service entrance
5. Distribution panel
6. Size of wire and load

B. Practice:

1. Use house floor plans to:
    (a) Locate outlets and switches
    (b) Determine number of branch circuits
    (c) Size of wire

C. Materials Needed:

1. Floor plans of homes or other buildings
2. Symbol rules
3. Chalkboard or flannel board
4. Wire - size board

(1) It may require two sessions, 4-6 hours, for this lesson

SESSIONS III and IV -- INSTALLING A CIRCUIT -- 4-6 HOURS

A. Discuss and Demonstrate:

1. Installing lighting circuit
2. Installing outlets
3. Installing a 3-way and a 4-way switch

B. Practice:

1. Have students install lighting circuit and outlets
2. Have students install different kinds of switches

C. Materials Needed:

1. Wiring board or panel
2. 30-ampere switch - different types
3. Outlet boxes, receptacle and light sockets
4. 2-wire and 3-wire cable
5. Switches - 2, 3, and 4-way

SESSION V -- MAINTAINING THE ELECTRICAL SYSTEM -- 2-3 HOURS(2)

A. Discuss and Demonstrate:

1. Making a test lamp
2. Replacing service cords, plugs and sockets
3. Repairing cords

B. Practice:

1. Make and use a test lamp
2. Replace cords, plugs and sockets
3. Repair cords

C. Materials Needed:

1. Water-proof sockets (two per test lamp)
2. Electrical cord, plugs, sockets and bulbs

3. Tape and solder

(2) For practice in Sessions V and VI -- Maintaining the Electrical System -- students could bring from their homes electrical appliances which need checking and repair.

SESSION VI -- MAINTAINING THE ELECTRICAL SYSTEM -- 2-3 HOURS

A. Discuss and Demonstrate:

1. Fuses -- types and use
2. Replacing fuses or resetting a circuit breaker
3. Splicing broken wires
4. Replacing heater plugs
5. Removing sag from wires between buildings
6. Grounding procedures for safety

B. Practice:

1. Splice wires
2. Replace heater plugs
3. Have students check and repair home appliances

C. Materials Needed:

1. Tape and solder
2. Wire nuts
3. Squeeze-on connectors
4. Various kinds and sizes of fuses

SESSION VII -- SELECTING FARM MOTORS(3) -- 2-3 HOURS

A. Discuss and Demonstrate:

1. Advantages of electric motors
2. Types of motors
3. Sizes of motors
4. Construction of motors
5. Motor protection and controls
6. Dual - voltage and reversing
7. Types of pulleys, belts and drives

B. Practice:

1. Determine size of motor for various jobs
2. Ways of mounting motors
3. Determine belt length and adjustment
4. Determine speed adjustment

C. Materials Needed:

1. Pulleys, belts and drives
2. Different types of motors

    (a) Split-phase induction
    (b) Capacitor-start
    (c) Repulsion-start

(3) Electric motors, if available, in the local farm shop can be used in this session.

SESSIONS VIII and IX -- CARE AND REPAIR OF FARM MOTORS(4) -- 4-6 HOURS

A. Discuss and Demonstrate:

1. Disassemble motor

    (a) Remove pulley
    (b) Loosen bolts and end plates
    (c) Avoid breaking leads between starting switch and windings

2. Remove all dirt and gum - (use carbon tetrachloride on cloth to remove gum - use air hose to blow out dust
3. Check contact points on split-phase and capacitor motors
4. Check commutator brushes on repulsion-induction motors
5. Clean air and oil passages
6. Check bearings and shaft for grit and we
7. Re-assemble

B. Practice:

1. Have students disassemble motors
2. Clean and check for needed repairs
3. Make repairs
4. Reverse direction of motor
5. Change from 120 volt to 240 volt operation if applicable

C. Materials Needed:

1. Each student should have a motor to work on for practice. (Students could bring these from their homes)
2. Rags
3. Test lamps
4. Carbon tetrachloride

(4) To effectively teach this lesson it will likely require two sessions totaling four to six hours.

SESSION X -- OTHER USES OF ELECTRICITY ON THE FARM -- 2-3 HOURS

A. Discuss and Demonstrate:

1. Electric hotbeds
   - (a) Use and advantages
   - (b) Materials needed, voltage
   - (c) Establishing a bed
2. Home-farm shop
3. Feeding equipment
   - (a) Cattle
   - (b) Poultry
   - (c) Swine
4. Crop drying and curing
5. Unloading equipment

B. Practice:

The practice or doing phase of this session would depend on the interest and needs of the class. Some might be interested in constructing an electric hotbed, others in establishing a farm shop, etc.

C. Materials Needed:

1. Materials for constructing a hotbed
2. Diagram of the home-farm shop
3. Charts of other uses of electrical equipment on the farm

REFERENCES

1. G. E. Henderson, Coordinator, SAAE & VA, University of Georgia, Athens, Georgia.

   Publications:

   a. Electrical Terms - Their Meaning and Use, $.85.
   b. Planning the Farm Home Wiring System, $.40.
   c. Maintaining the Farm Wiring and Lighting System, $.45.
   d. Selecting Farm Electric Motors, $.65.

   Filmstrips:

   e. Electrical Terms - Their Meaning and Use - 89 Frames, Color - $11.00
   f. Farm Electric Motors, Selection, Protection and Drives - 68 Frames, Color - $5.50.
   g. How Electric Motors Start and Run - 86 Frames, Color - $11.00

2. Rural Electrification (Revised), by J. P. Schaenzer, Bruce Publishing Company, Milwaukee, Wisconsin, 1955. $3.75.

3. All About Home Wiring, by Mix and Pritchard, Goodheart-Willcox Company, 18250 Harwood Avenue, Homewood, Illinois, 1962. $1.88 plus postage.

4. Simplified Electric Wiring Handbook, Sears Roebuck & Company. $.35.

5. Electric Power Companies. These companies -- Duke Power, South Carolina Electric and Gas Company, and Carolina Power and Light -- have prepared certain materials on electricity which are very worthwhile for this course.

A number of teachers have "electric boards" or "wiring panels" which have proven to be effective aids in teaching electricity. The Electro-Tech, Incorporated, 690 Murphy Avenue, Atlanta 10, Georgia, has for sale a similar aid called the "Electric Demonstration Kit" which is recommended for instructional purposes.

VT000 955

VT 000 955
Learning Experiences in Agricultural Occupations for Students of Vocational Agriculture, Plant Nurseries.

Clemson Coll., S.C. Dept. of Agricultural Education
South Carolina State Dept. of Education, Columbia
Pub Date - Apr64
MF AVAILABLE IN VT-ERIC SET 4p.

*VOCATIONAL AGRICULTURE, *COOPERATIVE EDUCATION, *NURSERY WORKERS (HORTICULTURE), *JOB SKILLS, *LEARNING EXPERIENCE, HIGH SCHOOLS,

The purpose of this guide is to assist the vocational agriculture teacher and student in planning and evaluating work experiences in plant nurseries. It was developed by a teacher educator for use in a 150-hour placement experience. Listed are 26 experiences common to work in a plant nursery such as propagating plants, preparing and maintaining cold frames, preparing and maintaining hot beds, sterilizing soil, taking soil samples for testing, applying plant nutrients, operating a greenhouse, growing plants in the open, maintaining ornamentals, marketing plants, landscaping, and establishing a lawn. Space to check the performance of each activity is provided. Single copies of this document are available without charge from Agricultural Education Department, Clemson University, Clemson, South Carolina 29631. (JM)

LEARNING EXPERIENCES IN AGRICULTURAL OCCUPATIONS

FOR

STUDENTS OF VOCATIONAL AGRICULTURE

PLANT NURSERIES

Prepared by

Agricultural Education Department, Clemson College, Clemson, South Carolina

and

State Department of Education, Columbia, South Carolina

April 1964

M E M O R A N D U M

TO: The ERIC Clearinghouse on Vocational and Technical Education
The Ohio State University
980 Kinnear Road
Columbus, Ohio 43212

FROM: (Person) F. E. Kirkley (Agency) Agricultural Education Department

(Address) Clemson University, Clemson, South Carolina 29631

DATE: December 14, 1967

RE: (Author, Title, Publisher, Date) F. E. Kirkley, Learning Experiences in Agricultural Occupations for Students of Vocational Agriculture - Plant Nurseries, Agricultural Education Department, Clemson University, 1964

Supplementary Information on Instructional Material

Provide information below which is not included in the publication. Mark N/A in each blank for which information is not available or not applicable. Mark P when information is included in the publication. See reverse side for further instructions.

(1) Source of Available Copies:
Agency Agricultural Education Department, Clemson University
Address Clemson, South Carolina 29631
Limitation on Available Copies 1 upon request Price/Unit No charge
(quantity prices)

(2) Means Used to Develop Material:
Development Group Individual
Level of Group State
Method of Design, Testing, and Trial By subject matter specialist with aid of ornamental horticulturist

(3) Utilization of Material:
Appropriate School Setting High school agriculture
Type of Program Placement for experience in plant nurseries
Occupational Focus Prepare for job entry
Geographic Adaptability South Carolina
Uses of Material List of jobs or skills
Users of Material Teachers

(4) Requirements for Using Material:
Teacher Competency Agriculture teacher
Student Selection Criteria high schools

Time Allotment 150 hours

Supplemental Media --
Necessary ☐
Desirable ☒ (Check Which)

Describe Related materials for local state

Source (agency) Local state Agricultural Experimental Stations
(address)

FOREWORD

To The Teacher:

Plant nurseries should be considered when attempting to provide supervised practice in agricultural occupations for agriculture students. In certain areas of the State it is likely a good number of boys, who have limited home-farm resources, can find profitable part-time employment and obtain valuable training in plant nursery work.

You should carefully review -- "Teacher's Guide, Supervised Practice in Agricultural Occupations for Students of Vocational Agriculture," October 1963, when placing students in this type of training. Be sure to have students keep the records as suggested in this guide.

To The Student:

You have probably studied many things in your agriculture class about plant growth. This will help you in your work in the nursery with plants. In each of your jobs or responsibilities, you should be interested in the why as well as the how. You will have an opportunity to make good use of study materials, books, bulletins, etc. in learning more about the many phases of plant nursery work.

This publication lists some of the learning experiences you may have in the nursery. Attempt to learn to do well as many activities as possible. These should be checked (✓) in the right-hand column by your employer.

PLANT NURSERIES

Kind of Experiences

Check Performance

1. Propagate plants
    - a. Seeds
    - b. Cuttings
    - c. Layering
    - d. Budding
    - e. Grafting
2. Preparing soil for pots and flats
3. Sterilizing soil
4. Prepare cold frames
5. Maintain cold frames
6. Prepare hot beds
7. Maintain hot beds
8. Soil requirements of ornamental plants
9. Moisture requirements of ornamental plants
10. Need and use of organic matter
11. Need and use of shade
12. Fertilizer requirements of ornamentals
13. pH requirements of ornamentals
14. Taking soil samples for pH testing
15. Interpreting soil test reports
16. Maintain desirable pH
17. Apply needed plant nutrients
18. Greenhouse operation
    - a. Understand types of structure
    - b. Heating systems
    - c. Maintaining temperature
    - d. Maintaining moisture
    - e. Controlling humidity
    - f. Controlling diseases and insects
    - g. House arrangements

Check Performance

19. Growing plants in the open
    - a. Select site
    - b. Provide drainage
    - c. Prepare soil
    - d. Use of fertilizer
    - e. Control nematodes
    - f. Control weeds
    - g. Use of shade
    - h. Setting out plants
    - i. Moving large plants
    - j. Irrigate plants

20. Maintaining ornamentals
    - a. Prune evergreens
    - b. Prune deciduous plants
    - c. Fertilize ornamentals
    - d. Use and value of mulches
    - e. Care of plants during the winter
    - f. Care of plants during the summer
    - g. Recognize common insects
    - h. Know and use insecticides
    - i. Recognize common diseases
    - j. Know and use fungicides

21. Marketing plants
    - a. Balling and burlapping
    - b. Labeling and tagging
    - c. Prices and discounts
    - d. Displaying for sale
    - e. Selling plants
    - f. Shipping regulations

22. Identify common evergreen plants

23. Identify common deciduous plants

24. Know growth habits of nursery plants

25. Landscaping
    - a. Know uses of various plants
    - b. Set out plants
    - c. Care for after setting

26. Establishing a lawn
    - a. Prepare soil
    - b. Fertilize and lime
    - c. Select grasses
    - d. Seed lawn
    - e. Maintain lawn

VT 000 956
Learning Experiences in Agricultural Occupations for Students of Vocational Agriculture, Farm Supplies.

Clemson Coll., S.C. Dept. of Agricultural Education
South Carolina State Dept. of Education, Columbia
Pub Date - Mar64
MF AVAILABLE IN VT-ERIC SET 7p.

*VOCATIONAL AGRICULTURE, *COOPERATIVE EDUCATION, *AGRICULTURAL SUPPLY OCCUPATIONS, *JOB SKILLS, *LEARNING EXPERIENCE, HIGH SCHOOLS,

The purpose of this guide is to assist the vocational agriculture teacher and student in planning and evaluating work experiences in the farm supply businesses. It was developed by a teacher educator for use in a 150-hour placement experience. It contains the things the student must learn to do and the things he must learn about. A list of 89 experiences with feeds, seeds, pesticides, poultry, pets, fertilizers, hardware, advertising, selling, servicing, and records and space to check performance of each are provided. Single copies of this document are available without charge from Agricultural Education Department, Clemson University, Clemson, South Carolina 29631. (JM)

LEARNING EXPERIENCES IN AGRICULTURAL OCCUPATIONS

FOR

STUDENTS OF VOCATIONAL AGRICULTURE

FARM SUPPLIES

Prepared by

Agricultural Education Department, Clemson College, Clemson, South Carolina

and

State Department of Education, Columbia, South Carolina

March 1964

MEMORANDUM

TO: The ERIC Clearinghouse on Vocational and Technical Education
The Ohio State University
980 Kinnear Road
Columbus, Ohio 43212

FROM: (Person) F. E. Kirkley (Agency) Agricultural Education Department

(Address) Clemson University, Clemson, South Carolina 29631

DATE: December 14, 1967

RE: (Author, Title, Publisher, Date) F. E. Kirkley. Learning Experiences in Agricultural Occupations for Students of Vocational Agriculture.- Farm Supplies, Clemson Agricultural Education Department. 1964.

Supplementary Information on Instructional Material

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(1) Source of Available Copies:
Agency Agricultural Education Department, Clemson University
Address Clemson, South Carolina 29631
Limitation on Available Copies 1 upon request Price/Unit No Charge
(quantity prices)

(2) Means Used to Develop Material:
Development Group Teacher educators and farm supply businesses
Level of Group State
Method of Design, Testing, and Trial N/A

(3) Utilization of Material:
Appropriate School Setting Vocational Agriculture
Type of Program Placement for supervisor in sales & services
Occupational Focus Prepare for job entry
Geographic Adaptability United States
Uses of Material List of jobs or skills
Users of Material Teachers

(4) Requirements for Using Material:
Teacher Competency Agriculture teachers
Student Selection Criteria High school

Time Allotment 150 hours.

Supplemental Media --
Necessary ____
Desirable X
(Check Which)

Describe Any related material

Source (agency) local
(address)

FOREWORD

To The Teacher:

This publication contains a listing of some of many learning experiences in which a vocational agriculture student may participate while employed in a farm supply business or what we commonly speak of as a feed and seed store. The nature of the business, goods handled and services rendered, of such stores varies considerably and determines the kind and scope of experiences available for the student.

You should carefully study -- "Teacher's Guide, Supervised Practice in Agricultural Occupations for Students of Vocational Agriculture," October, 1963, when planning to place students in farm supply stores. You may also be of considerable help to student-employees by providing needed study materials and familiarizing them with this outline.

Each section has some blank spaces where additional experiences may be inserted. This list of experiences, if accurately kept, would be a valuable record and should be maintained as a part of the students' permanent record.

To The Student:

For satisfactory employment in a farm supply store you will need a rather broad knowledge of agriculture. This outline includes many of the learning experiences which will be available for you. These experiences include (1) the things you must learn to do, and (2) the things you must study and learn about.

For example: let's take No. 2 a., "Functions of Nutrients." To be able to intelligently discuss and sell the kind of feed your customer needs you must know something about what carbohydrates, fats, proteins, etc. do for the animal and why they are needed.

Another example: look at No. 3, "Power Equipment," under the Hardware Section. The more you know about lawn mowers and garden tractors the better service you will be able to render to both your employer and customer.

Most likely you will not be able to take full responsibility for all of these experiences. You should learn as much as possible about as many experiences as your employer will allow.

The right hand column, "Check Performance," is for keeping a record of your completed jobs and experiences. Your employer should discuss the progress of your work and check (✓) the activities which you have satisfactorily completed.

FEEDS

Check Performance

Kind of Experiences

1. Animal requirements for feed nutrients
    a. Beef cattle
    b. Dairy cattle
    c. Swine
    d. Poultry
    e. Others

2. Composition of mixed feeds
    a. Functions of nutrients (carbohydrates, fats, proteins, minerals, vitamins)
    b. Sources of various nutrients
    c. Feed additives (trace elements, parasite control, etc.)
    d. Sources of proteins
    e. Importance of mineral mixtures and salt
    f. Understand and explain feed tags

3. Methods of feeding
    a. Dry-lot and pasture
    b. Hand and self-feeding
    c. Breeding or fattening
    d. Protein supplements in home mixtures
    e. Balancing grains and proteins

4. Quantities needed for certain animal units

5. Storage of grains and feeds

6. Having feeds analyzed

7. Checking feed deliveries

8. Arranging feed for sale

9. Sale prices for different size purchases

10. Inventory of feeds on hand

SEEDS (GARDEN AND FIELD)

1. Packaging and displaying seeds

2. Weights of various seeds

3. Recommended varieties

4. Rates of seeding for different crops (plots, acres)

FEEDS

Check Performance

Kind of Experiences

1. Animal requirements for feed nutrients

    a. Beef cattle
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SEEDS (GARDEN AND FIELD)

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2. Weights of various seeds

3. Recommended varieties

4. Rates of seeding for different crops (plots, acres)

Check Performance

5. Chemical treatments of seeds
6. Noxious weeds
7. Germination tests
8. Seed laws for South Carolina
9. Common cultural practices in seeding crops
10. Purchasing seeds (sources, prices, terms)
11. Storage of seeds

PESTICIDES

1. Use of insecticides
    - a. Household
    - b. Field crops
    - c. Livestock
2. Use of fungicides
3. Use of weed killers
4. Control of livestock parasites
5. Safety precautions in using pesticides
6. Insecticides in fertilizer
7. State Experiment Station recommendations
8. Storing and handling pesticides
9. Laws governing use of pesticides

BABY CHICKS AND POULTRY SUPPLIES

1. Caring for baby chicks
2. Breed recommendations
3. Quantities of feed necessary for chicks
4. Equipment, feeders, waterers, etc., needed
5. Disease prevention
6. Methods of feeding

Check Performance

PET SUPPLIES

1. Feeds for: cats, dogs, birds, fish
2. Equipment for: cats, dogs, birds, fish
3. Disease and parasite control

FERTILIZER AND LIME

1. Know major plant nutrients
2. Know minor plant nutrients
3. Fertilizer recommendations for field crops
4. Fertilizer recommendations for garden crops
5. Special fertilizer for plant beds, ornamentals, etc.
6. Economic value of fertilizer
7. Explanation of fertilizer tags
8. Liming recommendations
9. Applying fertilizers and lime
10. Custom rates
11. Storage of fertilizers

HARDWARE AND OTHER ITEMS

1. Farm tools and use
2. Fencing: types, cost, etc.
3. Power equipment: mowers, garden tractor, etc.
4. Water pumps and plumbing fixtures
5. Irrigation equipment
6. Roofing and sheet metal
7. Paints and wood preservatives
8. Sporting supplies and equipment
9. Dynamite

Check Performance

10. Lawn equipment
11. Seasonal plants

ADVERTISING AND SELLING

1. Receiving and storing supplies
2. Pricing: mark-up and discounts
3. Displays: window dressing
4. Advertising: radio, television, mail, etc.
5. Handbills and printed matter
6. Sales policies: guarantee, exchange, etc.
7. Handling "shopworn" merchandise
8. Knowledge of all merchandise sold
9. Putting on sales demonstrations
10. Maintaining mailing lists
11. Ability to sell
12. Ability to collect

SERVICING

1. Manufacturer's warranty
2. Local dealer's responsibility for servicing
3. Registering sales with manufacture
4. Use of service manuals
5. Servicing and adjusting equipment before selling
6. Use of catalogue for parts
7. Maintaining needed parts for repair

KEEPING RECORDS

1. Maintaining inventories
2. System of handling invoices, sale slips, etc.

	Check Performance
3. Posting ledger	
4. Mailing statements	
5. Record of equipment -- serial and model number	
6. Social security	
7. Insurance	
8. Sales tax	
9. Employee benefits	

VT001 006

VT 001 006
Small Gas Engines--Maintenance and Repair, Special Course in Vocational Agriculture for Adults. Suggested Course Outline for Teachers of Agriculture in South Carolina.

Clemson Univ., S.C. Dept. of Agricultural Education
South Carolina State Dept. of Education, Columbia
Pub Date - Oct64
MF AVAILABLE IN VT-ERIC SET 8p.

*ADULT FARMER EDUCATION, HIGH SCHOOLS, *VOCATIONAL AGRICULTURE, *TEACHING GUIDES, MECHANICS (PROCESS), *ENGINES,

The purpose of the guide is to assist vocational agriculture teachers in planning and conducting a 30-hour course on small gasoline engines for high school students or adult farmers. It was developed by a teacher educator in consultation with a committee of teachers and mechanics. Units in the course include (1) Use, Kinds, and Types of Small Gasoline Engines, (2) Fundamentals of Internal Combustion, (3) Fuels and the Fuel System, (4) The Ignition System, (5) Lubrication and Cooling Systems, (6) Valves, Pistons, Rings, and Crankshaft, (7) Trouble Shooting--Ignition Trouble, (8) Trouble Shooting--Carburetor and the Fuel System, (9) Trouble Shooting--Lack of Compression and High Oil Consumption, (10) Trouble Shooting--Overheating and Engine Noise. Each unit is divided into discussion and demonstration by the teacher, and practice by the students. Suggested books, materials, and slides are listed. Single copies of this document are available without charge from Agricultural Education Department, Clemson University, Clemson, South Carolina 29631. (JM)

SMALL GAS ENGINES

MAINTENANCE AND REPAIR

SPECIAL COURSE IN VOCATIONAL AGRICULTURE

FOR ADULTS

Suggested Course Outline for Teachers of Agriculture

in

South Carolina

Prepared by

Agricultural Education Department, Clemson University, Clemson, South Carolina

and

State Department of Education, Columbia, South Carolina

October 1964

M E M O R A N D U M

TO: The ERIC Clearinghouse on Vocational and Technical Education
The Ohio State University
980 Kinnear Road
Columbus, Ohio 43212

FROM: (Person) F. E. Kirkley (Agency) Agricultural Education Department

(Address) Clemson University, Clemson, South Carolina 29631

DATE: December 14, 1967

RE: (Author, Title, Publisher, Date) F. E. Kirkley, Small Gas Engines--Maintenance and Repair, Clemson Agricultural Education Department, 1964

Supplementary Information on Instructional Material

Provide information below which is not included in the publication. Mark N/A in each blank for which information is not available or not applicable. Mark P when information is included in the publication. See reverse side for further instructions.

(1) Source of Available Copies:
Agency Agricultural Education Department, Clemson University
Address Clemson, South Carolina 29631
Limitation on Available Copies 1 upon request Price/Unit No Charge
(quantity prices)

(2) Means Used to Develop Material:
Development Group Committee of teacher educators & Mechanics
Level of Group N/A
Method of Design, Testing, and Trial Based on experience in area

(3) Utilization of Material:
Appropriate School Setting Vocational agriculture departments & area vocational Ctr
Type of Program Adults and high school
Occupational Focus Specific - small engines
Geographic Adaptability United States
Uses of Material Course outline
Users of Material Teachers

(4) Requirements for Using Material:
Teacher Competency Agriculture teachers or mechanics
Student Selection Criteria High school & adults

Time Allotment 30 hours

Supplemental Media --
Necessary X
Desirable
(Check Which)

Describe Materials(bulletins & texts) on small engines

Source (agency)
(address)

TABLE OF CONTENTS

Note to Instructor:

The ten jobs, or lessons, as suggested in this outline are intended for a 20 to 30 hour course. Since the maintenance of small gas engines is rather simple, considerable time may be spent on repairs which are not too complicated.

Each job is divided into two parts: Discuss and Demonstrate by the instructor and Practice by the trainees. The instructor should make full use of charts, drawings and objects in his demonstrations. Parts and service manuals from various manufactures of small engines should be on hand.

The Practice session is probably the most important learning period. Here the instructor should carefully observe and guide the learners. How to: locate the trouble, disassemble, lay out machine parts, use proper tools, use service manuals and re-assemble are problems which require close supervision. Insist on and encourage high quality of work at all times. For the Practice period to be most meaningful, a number of small engines must be available for the "trouble shooting" lessons. There should be little difficulty in obtaining the needed number of lawn mowers, chain saws and other engines.

JOB I -- USE, KINDS AND TYPES OF SMALL ENGINES -- 2-3 HOURS

A. Discuss and Demonstrate:

1. Uses of small gasoline engines on the farm
2. Kinds and types of small engines
3. Component parts and functions of each
4. Tools and equipment needed for maintenance and repair
5. Use of service manuals

B. Practice:

1. Have trainees name parts and explain functions of each
2. Allow trainees to disassemble engine
3. Hold question session as to functions and relation of all parts

JOB II -- FUNDAMENTALS OF INTERNAL COMBUSTION -- 2-3 HOURS

A. Discuss and Demonstrate:

1. The 2 stroke cycle
2. The 4 stroke cycle
3. Intake, compression, power and exhaust
4. Comparison of the 2 and 4 stroke engines
5. Piston and cylinder design
6. Fuel, lubrication, cooling and valve action
7. Crankshaft, bearings and flywheel

B. Practice:

1. Have trainees illustrate differences in 2 and 4 cycle engines
2. Have trainees (in groups) to disassemble engines
3. Study parts: identify, functions and relationships
4. Assemble engines

JOB III -- FUELS AND THE FUEL SYSTEM -- 2-3 HOURS

A. Discuss and Demonstrate:

1. Principles and parts of the fuel system
2. Types of fuels
3. Mixtures of gasoline and oil
4. Types of carburetors
5. Functions of carburetor parts
6. Icing and vapor lock of carburetors
7. Air cleaner
8. Adjustment of carburetor
9. Fuel pumps

B. Practice:

1. Allow trainees to disassemble fuel system
2. Disassemble different types of carburetors

3. Discuss functions of parts and re-assemble
4. Make carburetor adjustments
5. Service air cleaner

JOB IV -- THE IGNITION SYSTEM - 2-3 HOURS

A. Discuss and Demonstrate:

1. Systems - battery and magneto
2. Types of magnetos
3. Parts of ignition system (coil, distributor, armature, switch, plugs and wiring)
4. Functions of each part
5. Maintaining the system
6. Timing the system
7. How to check: plugs, points, condenser and flywheel

B. Practice:

1. Have trainees explain ignition system
2. Check spark; clean and adjust plugs
3. Check or replace points
4. Replace condenser
5. Service and time the magneto

JOB V -- LUBRICATION AND COOLING SYSTEMS -- 2-3 HOURS

A. Discuss and Demonstrate:

1. Types of oil systems
2. Principles of operation
3. Component parts of the system
4. Types of oil pumps
5. Types of friction in small engines
6. Use of oil and grease
7. Types of cooling systems
8. Maintaining different cooling systems

B. Practice:

1. Change oil and service filters
2. Check (water) cooling system
3. Clean (air) cooling system

JOB VI -- VALVES, PISTONS AND RINGS AND CRANKSHAFT -- 2-3 HOURS

A. Discuss and Demonstrate:

1. Kind of valves
2. Checking valves
3. Removing and seating
4. Adjusting tappets

5. Timing
6. Checking compression
7. Checking pistons
8. Checking connecting rods
9. Checking and installing rings
10. Checking end play of crankshaft
11. Removing and replacing crankshaft

B. Practice:

1. Allow trainees to check engine that needs repair
2. Practice in checking: valves, timing, compression and rings

JOB VII -- TROUBLE SHOOTING: IGNITION TROUBLE -- 2-3 HOURS

A. Discuss and Demonstrate:

1. Bad plugs
2. Correct armature setting
3. Breaker point gap
4. Points dirty or burned
5. Sheared flywheel key
6. Ground wire shorted
7. Condenser and armature failure

B. Practice:

1. Have several engines on hand for this lesson. These engines should be prepared, before class starts by instructor, to illustrate the more common ignition troubles.
2. Have trainees: identify trouble, explain and make needed corrections

JOB VIII -- TROUBLE SHOOTING: CARBURETOR AND THE FUEL SYSTEM -- 2-3 HOURS

A. Discuss and Demonstrate:

1. How to disassemble a carburetor
2. Carburetor adjustments
3. Common troubles
4. Governor adjustments

B. Practice:

1. Have trainees to disassemble different types of carburetors
2. Explain parts and functions and re-assemble
3. Have several engines prepared with carburetor trouble
4. Allow trainees to: identify trouble, explain and correct

JOB IX -- TROUBLE SHOOTING: LACK OF COMPRESSION AND HIGH OIL CONSUMPTION -- 2-3 HOURS

A. Discuss and Demonstrate:

1. Lack of compression:

    (a) Loose spark plug
    (b) Loose cylinder head bolts
    (c) Head gasket blown
    (d) Damaged valves
    (e) Worn bores or worn rings
    (f) Warped cylinder head
    (g) Broken connecting rod

2. High oil consumption:

    (a) Damaged rings
    (b) Worn cylinders
    (c) Worn or loose bearings
    (d) Damaged crankshaft
    (e) Broken oil line
    (f) Cracked crankcase
    (g) Leaking gaskets

B. <u>Practice</u>:

1. Have one or more engines which illustrate lack of compression and high oil consumption.
2. Allow trainees in groups to identify trouble
3. Make needed repairs as time will allow

JOB X -- TROUBLE SHOOTING: OVERHEATING AND ENGINE NOISE -- 2-3 HOURS

A. <u>Discuss and Demonstrate</u>:

1. Overheating:

    (a) Scale and rust in cylinder head and in water passages
    (b) Head gasket blown
    (c) Incorrect timing
    (d) Overload
    (e) Dirt and trash on cooling fins
    (f) Loose fan belt
    (g) Worn fan belt
    (h) Extreme high speed
    (i) Valves not properly functioning

2. Engine noise

    (a) Loose connecting rods
    (b) Loose piston pins
    (c) Worn timing gears
    (d) Valve noise
    (e) Loose flywheel

B. **Practice**:

1. Have one or more engines which illustrate overheating and making noises
2. Allow trainees to identify trouble
3. Make needed repairs

REFERENCES

1. All About Small Gas Engines, by Jud Purvis, The Goodheart-Willcox Company, 18250 Harwood Avenue, Homewood, Illinois, 1963. ($3.38)

2. Small Engine Service Manual, Technical Publication, Incorporated, 1014 Wyandotte Street, Kansas City 5, Missouri, 1961. ($4.95).

3. A Power Primer, Public Relations Staff, General Motors, Detroit 2, Michigan. (Free).

4. Materials (charts, operation booklet, repair instructions) from Briggs and Stratton Corporation, Milwaukee, Wisconsin.

   Note to teachers: This corporation has a school-engine program where a small engine and the above mentioned materials are provided free of charge. About one-third of the vocational agriculture departments in South Carolina are in this program and have the free teaching aids including the small engine. If you are interested in this program, write to J. M. Gerathy, Service Production Manager.

5. The following sets of slides (Briggs and Stratton) are available from Ray Keplinger, Automotive Electric Association, Incorporated, Charlotte, North Carolina.

Set # 1	68 Slides	"Complete Overhaul"	---	$6.80
Set # 2	27 Slides	"Check - up"	---	2.70
Set # 3	11 Slides	"Resizing Cylinder"	---	1.10
Set # 4	12 Slides	"Valves and Seats"	---	1.20
Set # 5	12 Slides	"Bearing Replacement"	---	1.20
Set # 7	28 Slides	"Start, Stop, Store"	---	2.80

6. Service manuals from various manufactures of small gas engines.

VT001 031

VT 001 031
List of Recent Bulletins Selected for Use in Arizona Departments of Vocational Agriculture.

Arizona Univ., Tucson. Dept. of Agricultural Education
Service Bull-5
Pub Date - Jun65
MF AVAILABLE IN VT-ERIC SET 25p.

*VOCATIONAL AGRICULTURE, *BIBLIOGRAPHIES, *INSTRUCTIONAL MATERIALS,

An annual service to vocational agriculture teachers, this list includes 179 bulletin titles from 47 sources. Bulletins are classified by the filing system for the state's vocational agriculture departments, and the probable usefulness in vocational agriculture classes is indicated for each one. Some of the general subjects are meats, animal disease, beef, sheep, dairy, agricultural mechanics, and vegetables. The source for each bulletin is keyed to a master list. (JM)

LIST OF RECENT BULLETINS SELECTED FOR USE IN ARIZONA DEPARTMENTS OF VOCATIONAL AGRICULTURE

Service Bulletin
Number Five

Department of
Agricultural Education
University of Arizona
Tucson, Arizona

June 1965

LIST OF RECENT BULLETINS SELECTED FOR USE IN ARIZONA DEPARTMENTS OF VOCATIONAL AGRICULTURE

Service Bulletin
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June 1965

FOREWORD

This publication is the fifteenth annual number in the series of selected bulletins for Arizona departments of vocational agriculture. Lists of U. S. Government publications, state agricultural experiment station and extension bulletins and circulars were used as the main sources of bulletins in compiling the list.

Although publications from the best known sources were reviewed in making the selections for the list, it obviously does not contain all bulletins which would be useful in a department library. Teachers should therefore supplement this list with any other appropriate references available.

The asterisk has been used to indicate the probable usefulness of the bulletins in classes of vocational agriculture. The list has been classified into three groups as follows:

1. Bulletins that should be in every department library in sufficient quantities for student use are marked with two asterisks (**).
2. Those of value as a single copy reference for teacher and student are marked with one asterisk (*). Multiple copies of bulletins marked with one or no asterisk may be needed if the content is of particular importance in the community.
3. Bulletins with no asterisk are not considered as an essential part of the minimum library for a department. They are useful bulletins and may be used to enrich and expand the scope of the library. In some cases these bulletins are of value as teacher references only.

The numbers listed under the first column in the bulletin list "File No." refer to the decimal system used in the latest revision of the Arizona bulletin filing system, dated June 1957.

This department maintains copies of all publications in the list, filed according to the bulletin filing systems for Arizona departments of vocational agriculture. Copies of recent bulletins are also displayed at teachers' conferences and during the visits of staff members to departments of vocational agriculture in the state.

Suggestions concerning bulletins which should be included in the next edition of this list will be appreciated.

R. W. Cline, Head
Department of Agricultural Education
The University of Arizona

Sources	Number Guide
Allis-Chalmers Mfg. Company, Tractor Group Products, Advertising and Sales Promotion Dept., Milwaukee, Wisconsin	1
American Brahman Breeders Association, 4815 Gulf Freeway, Houston, Texas	2
American Feed Manufacturers Association, 53 W. Jackson Blvd., Chicago, Illinois	3
American Hereford Association, Hereford Drive, Kansas City 5, Missouri	4
American Sheep Producers Council, 520 Railway Exchange Bldg., Denver 2, Colorado	5
American Welding Society, Inc., United Engineering Center, 345 E. 47th Street, New York, N. Y.	6
The University of Arizona, College of Agriculture, Tucson, or County Agricultural Agent in your county	7
Association of Casualty and Surety Companies, Accident Prevention Dept., 110 Wellion Street, New York, N. Y.	8
Caterpillar Tractor Co., Peoria, Illinois	9
Colorado State University, Fort Collins, Colorado	10
Crescent Tool Company, Jamestown, New York	11
DeKalb Agricultural Association, Inc., DeKalb, Illinois	12
The DeLaval Separator Company, Millbrae (S.F.), California	13
Downey Fertilizer Company, 9447 E. Imperial Highway, Downey, California	14
Farm Film Foundation, 1425 H. Street, N.W., Washington, D. C.	15
General Motors Corporation, Educational Relations Section, Public Relations Staff, Warren, Michigan	16
B. F. Goodrich Company, 500 So. Main Street, Akron 18, Ohio	17
The Holstein-Friesian Association of America, Brattleboro, Vermont	18

Sources	Number Guide
Ignition Manufacturers Institute, 1008 Standard Building, Clevelsnd 13, Ohio	19
The Industrial Commission of Arizona, Accident Prevention Department, Phoenix, Arizona	20
Iowa State University, Cooperative Extension Service, Ames, Iowa	21
Leadership Resources, Inc., 1025 Connecticut Avenue, Washington 6, D. C.	22
The James F. Lincoln Arc Welding Foundation, P. O. Box 3035, Clevelsnd 17, Ohio	23
National Academy of Science, National Research Council, 2101 Constitution Ave., Washington, D. C.	24
National Cotton Council of America, P. O. Box 9905, Memphis 12, Tennessee	25
National Livestock and Meat Board, 36 S. Wabash Ave., Chicago, Illinois	26
New Holland Machine Company, New Holland, Pennsylvania	27
Oregon State University, Cooperative Extension Service, Corvallis, Oregon	28
Milo J. Peterson, Dept. of Agriculture Education, University of Minnesota, St. Paul, Minnesota	29
H. K. Porter Company, Inc., 601 Grand Street, Pittsburgh 19, Pennsylvania	30
Portland Cement Association, 33 W. Grand Avenue, Chicago 10, Illinois	31
Poultry Science Dept., Room 324, Agriculture Science Bldg., University of Arizona, Tucson, Arizona	32
Republic Steel, Agricultural Extension Bureau, Birmingham 13, Alabama	33
Southern Association of Agriculture Engineering and Vocational Agriculture, Agriculture Engineering Bldg., Athens, Georgia	34

Sources	Number Guide
State Department of Vocational Education, 412 Arizona State Building, Phoenix, Arizona	35
Swift and Company, Public Relations Dept., 115 W. Jackson Blvd., Chicago, Illinois	36
U.S. Department of Agriculture, Agricultural Research, Washington, D. C.	37
U.S. Department of Agriculture, Farmer Cooperative Service, Washington, D. C.	38
U.S. Department of Agriculture, Forest Service, Washington, D. C.	39
U.S. Department of Agriculture, Statistical Reporting Service, Washington, D. C.	40
U.S. Department of Agriculture, Soil Conservation Service, Washington, D. C.	41
U.S. Department of Agriculture or Superintendent of Documents, U.S. Government Printing Office, Washington 25, D. C.	42
United States Steel, American Steel and Wire Division, Literature Dept., Rockefeller Bldg., Cleveland 13, Ohio	43
Victor Animatograph Corporation, Division of Kalart, Plainville, Connecticut	44
Washington State University, Agricultural Extension Service, Pullman, Washington	45
Westinghouse Electric Corporation, P. O. Box 2278, Pittsburgh 30, Pennsylvania	46
University of Wisconsin, Agricultural Extension Service, College of Agriculture, Madison, Wisconsin	47

SELECTED AGRICULTURAL BULLETINS

Classified according to the filing system for Arizona Departments of Vocational Agriculture, and evaluated on the basis of their use in these departments.

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File No.	Publication No.	Title	Source
1.03	Tech. Bull. 160	Advertising Meat, Poultry and Fish at the Retail Level (1964) 29 pp.	7
1.03	Tech. Bull. 164	*Relevance of Livestock and Meat Imports to the United States (1964) 32 pp.	7
1.03	Stations Circular 440	Your Money's Worth of Fryers and Red Meat (1964) 8 pp. This publication includes information on nutrient values of various meats and a slide rule for buying meat.	45
1.1	Farmers Bull. 2198	*Automatic Feeding Equipment for Livestock and Poultry (1964) 28 pp. Drawings and plans as well as pictures of existing feed mills and rather complete descriptions are included in this publication.	42
1.21	Special Circular 94	*Rabies in Animals (1964) This circular is very thorough in describing the disease rabies and how to handle live and dead animals. Although this publication is written for Wisconsin, many of the general principles apply to Arizona.	7
1.22	Leaflet 392	Fleas--How to Control Them (revised 1964) A general leaflet on kinds of fleas, development, and control with insecticides (contains guide for mixing).	42
1.22		**The Screwworm (1965) 8 pp.	7
1.3	Bulletin A-36	*A Survey of the Production and Marketing of Cattle Manure in Arizona (1964) 14 pp.	7
1.41	Farmers Bull. 2031	*Raising Rabbits (1964) 24 pp. Included in this bulletin are: Selecting a breed; Housing and equipment; Feeds; Feeding, Breeding, Herd Management; and Marketing of Rabbits.	42

File No.	Publication No.	Title	Source
1.51		*American Brahman Cattle (1964) 15 pp. A general booklet written by a breed association indicating the advantages of their particular breed of beef cattle	2
1.51	Ag.Info. Bull. 286	**Beef Cattle Breeding (1964) 43 pp. This publication deals with the selection and mating of beef cattle and also includes a short course in genetics.	10
1.51		*The Brahman Handbook (1964) 19 pp. This booklet describes the history, characteristics, judging, selecting, managing, and use in crossbreeding of Brahman cattle.	2
1.51		*The Brahman Hybrid (1964) 23 pp. This booklet discusses hybrid vigor and its advantages in the beef cattle industry. Brahman crosses are stressed.	2
1.51	Bulletin 523-S	*Goals and Methods in Beef Cattle Improvement (1965) 22 pp. A general bulletin on beef cattle improvement.	10
1.51		**Plan and Profit with Hereford (reissue) 48 pp. This booklet is a complete outline of all phases of beef cattle production. Very good for management units.	4
1.53	Series P-3	*Arizona Cattle Feeders' Day--Tucson (1965) 56 pp.	7
1.53	Farmers Bull. 2196	**Finishing Beef Cattle (1964) 30 pp. This bulletin explains cattle feeding systems, kinds of cattle to feed, when to buy feeder cattle, roughages and pasture, feeding procedures and getting cattle on feed, finishing feeds, cattle supplements, feed additives, preparing feeds and balancing rations.	42
1.55	Ag. Res. Bull. 15	*Cattle and Calves--Where They're Raised and Beef is Eaten (1965) 16 pp. A good illustrated booklet on beef cattle production and marketing.	36

File No.	Publication No.	Title	Source
1.56	Leaflet 527	How to Control Cattle Grubs (1965) 8 pp. (Supersedes Farmers Bulletin 1596, Cattle Grubs and Heel Flies with Suggestions for Their Control.) This little leaflet covers the life cycle of the grub and methods of controlling the grub.	42
1.7	Educ. Phamphlets 1-9	**Educational Pamphlets--American Sheep Producers Council (no date) 9 separate leaflets. This set of 9 pamphlets includes wool and fabric terms, history of sheep, breeds, grades of wool, and sheep production in the United States. They are factual, well-written pamphlets, and contain some pictures.	5
1.7		Sheep in America--The Story of Wool and Lamb (no date) 14 pp. This booklet is a general story of the sheep industry in America.	5
2.11		**The DeLaval Handbook of Milking (revised 1963) 39 pp. This booklet presents in a concise manner some important considerations in the care and handling of dairy cows, milking machines, and other dairy tools essential to the farmer.	13
2.11	Special Circular 97	Milking Machine Care (1964) folded sheet. This little circular discusses operation of milking machines in regard to vacuum pump, line, controller, pulsator, and inflations.	47
2.12		Arizona Dairy Herd Improvement Association's Annual Summary (1963-1964) 39 pp. Gives results of tests conducted by DHIA in cooperation with dairy herdsmen in Arizona. Gives information about amount of milk and butterfat produced by each dairy in the test as well as results on individual cows.	7
2.13	Farmers	**Feeding Dairy Cattle (1962) 32 pp. (Supersedes Farmers Bulletin 1626, Feeding Dairy Cows.) Explains the feeding needs of dairy cattle, the types of feeds, and methods of feeding both forage and concentrates.	42

File No.	Publication No.	Title	Source
2.14		*Judging Registered Holstein-Friesian Cattle (1963) 24 pp. This publication includes a scorecard for judging dairy cows and bulls, with pictures to illustrate important points.	18
2.15	Bulletin A-37	**A Milker's Manual (1965) 56 pp.	7
2.15		*Milking for Profit (1964) 19 pp. (35¢ each) This booklet points out 18 ways to profitable "cowmanship." These rules involve the actual milking procedures needed for good management.	27
2.23	Tech. Bull. 86	Cost Analysis of Fluid Milk Processing and Distribution in Colorado (1964) 30 pp. The bulletin deals with the relationship between size of plant and unit processing costs, the unit distribution costs for both a wholesale and retail delivery route, and the total costs of dairy products delivered to the customer.	10
3.11		**Disston Saw, Tool and File Manual (1963) 63 pp. This booklet describes briefly some of the more important tools used by the craftsworker, how to use these tools to the best advantage, and how to care for them and keep them in good serviceable condition.	30
3.11		*Educational Charts (no date) 6 charts. The charts include information on how to use a hand saw, how it cuts, hack saw chart, choosing and using a file, turning chisels, and special all-purpose saws. Although these charts are commercial, they contain excellent pictures.	30
3.11		How to Select and Apply Steel Roofing on Farm Buildings (no date) 28 pp. Illustrated booklet explaining how to select, lay, care for, and paint steel roofing material. Also shows safety practices.	33

File No.	Publication No.	Title	Source
3.13	Home and Garden Bull. 100	Equipment for Cooling Your Home (1964) 8 pp. This bulletin discusses four ways to cool a house, i.e., with fans, water, air conditioner, and a heat pump.	42
3.13		*Planning Water Systems for Farm and Home (revised 1963) 105 pp. ($2.60 single copy) Combines practical information from several different specialized fields into one book for those interested in the overall problem of a properly installed farm water system. Includes information on water needs, possible water cources, purification, water conditioning, selecting a water system to meet particular needs, where to place water outlets, how to meet pollution problems, what weather protection to provide, what size and type pipe to use, and what wiring to use. Film strip available.	34
3.15		*Building Farm Fences (revised 1962) 36 pp. (80¢ single copy) Gives step-by-step procedures for building woven-wire fences, barbed-wire fences, movable fences (including electric), and board fences. Shows how to provide lightning protection, and fence across gullies, streams, and marshes. Each step is illustrated so instructions can be easily followed. Film strip available.	34
3.16	Circular 213	*Home Storage of Vegetables (1965) 8 pp.	7
3.16	Circular 233	How to Process Your Ripe or Green Home-Grown Olives (revised 1965) 7 pp.	7
3.17		Plans for Four Projects on Your Farm (1965) folded sheet. This folder contains plans for used baler-twine back-rubber, salt and mineral feeder, covered feedlot bunks, and livestock shade.	27
3.2		*What You Should Know About Farm Tires A general booklet about tire fundamentals, proper tire maintenance, safety, with load and inflation tables.	17

File No.	Publication No.	Title	Source
3.21	Misc. Pub. 810	Farm Silos (1964) 28 pp. This bulletin deals with the various types of silos, general construction methods for each type, including foundations, walls, roofs, chutes, and wall treatment.	42
3.24	Leaflet 470	Mr. Field Crops Producer: It Pays to Use Chemicals Safely (slightly revised 1964) This leaflet tells the reasons for using chemicals and how to use them safely.	42
3.25	Farmers Bull. 2177	**Single-Phase Electric Motors for Farm Use (1964) 24 pp. Explanation about all types of single-phase motors. Selection, installation, motor protection and servicing are all included.	42
3.25		*Standby Electric Power Equipment for the Farm (1965) 8 pp. Discusses standby electric power equipment (generator) for the farm--type, size, installation, and operation.	42
3.27		*Tune-Up Manual (1962) 36 pp. ($1.00 single copy) A well-illustrated manual describing fundamental principles and troubleshooting of ignition and carburetion systems. Testing equipment and tune-up procedures are explained.	19
3.28		*Farm Tractor Tune-Up and Service Guide (revised 1964) 19 pp. ($1.85 single copy) A complete reference for on-the-farm tractor maintenance, giving critical adjustment data and lubrication recommendations. Includes maintenance information for gasoline, diesel, and LP Gas standard farm tractors built since 1948.	34
3.31	Tech. Bull. 83	Evaluation of Colorado Clay for Sealing Purposes (1964) 36 pp. This bulletin's purpose is to evaluate 321 samples of clay and 132 clay installations in canals and ponds. Various methods are expounded, with complete cost data for evaluation.	10
3.34	Popular Bull. 522-S	*Weed Seed and Trash Screens for Irrigation Water (1964) 18 pp. Excellent bulletin for those who are interested in removing trash and weed seed from irrigation water. Explains the many different possible ways of accomplishing this job.	10

File No.	Publication No.	Title	Source
3.51		Farm Welding Electrodes (1964) This chart gives the description of different Lincoln electrodes and how they are used.	23
3.52		*Cement and Concrete Reference Book (1964) 137 pp. A complete handbook on how to make and use concrete, whether you are building a bridge or a sidewalk.	31
3.52		**Recommended Practices for Laying Concrete Block (1963) 16 pp. This booklet illustrates and describes some practices in building a concrete block wall which experienced masons are following and which will result in the highest type of workmanship.	31
3.54		*Electrical Equipment You Can Build (no date) 31 pp. This booklet illustrates more than 50 suggested pieces of farm and home electrical equipment which can easily be constructed.	47
3.54	Circular 142	**Household Equipment--Its Care and Repair (reprinted 1965) 40 pp.	7
3.56	Farmers Bull. 2202	**Simple Plumbing Repairs for the Home and Farmstead (1964) 16 pp. This bulletin explains repair of water faucets, valves, leaks in pipes and tanks, and water closets. It also explains how to handle "water hammer," frozen pipes, and clogged drains. Tools and spare parts are listed.	42
3.59	Farmers Bull. 2130	**Rope on the Farm (1964) 16 pp. A revised edition. Very little change	42
3.60		*How to Use Hand Tools (no date) 36 pp. This booklet contains information on mechanical hand tools with useful how-to-do-it ideas, proper selection, use, and care of tools.	11
3.61		*Manual of Carpentry (1958) 65 pp. This manual provides a quick-reference source of fundamental carpentry, tools, and materials knowledge. In addition, useful information is incorporated in various tables.	43
4.1		*Fact Book of U.S. Agriculture (revised 1965) 169 pp. This book was designed as a reference for anyone who talks about agriculture. Chapters include agriculture and changing times, use of agricultural land, farm production, income and cost, etc.	42

File No.	Publication No.	Title	Source
4.11	Bulletin A-38	**Arizona Agriculture 1965 (1965) 30 pp.	7
4.2	Educ. Circ. 18	*How to Start a Cooperative (1965) 18 pp. This circular is intended to be a simple guide t groups interested in a step-by-step approach to organizing a cooperative.	38
4.3	Misc. Pub. 705	*A Graphic Summary of World Agriculture (1964) 63 pp. Includes maps and charts showing the worldwide distribution of vegetation, cropland, population, food crops, livestock, and oil crops.	42
4.3	Ag. Ec. Report 49	Our 100,000 Biggest Farms and Their Relative Position in American Agriculture (1964) 28 pp. Filled with charts, graphs, and tables. Information is for period 1949-59.	42
4.4	Ag. Info. Bull. 290	The Balance Sheet of Agriculture 1964 (1964) 24 pp. This bulletin brings together the assets and liabilities of agriculture as though it were one large enterprise.	40
4.4	Statistical Bull. 233	Changes in Farm Production and Efficiency (revised 1964) 50 pp. This is an annual publication designed specifically to present major statistical series on farm production, production inputs, and efficiency.	42
4.4	Tech. Bull. 154	*Farm Machinery Cost in the Western States (1964) 91 pp.	7
4.4		**Tables for Estimating Costs of Owning and Operating Farm Machinery (published by U.A. & U.S.D.A. March 1965)	7
4.42	Farmers Bull. 2137	**Insurance Facts for Farmers (slightly revised 1963) 20 pp. This bulletin describes fully the types and kinds of insurance available and when and what to buy.	42
4.44	Leaflet 510	Zoning for Rural Areas (1962) folded sheet. This folder explains why, when, and how to zone rural areas.	42
4.5	Tech. Bull. 161	Political Interest in Agricultural Exports Surplus Disposal Through Public Law 480 (1964) 60 pp.	7
5.0	Bulletin A-35	*Arizona Range Resources--II Yavapai County (reprint 1964) 55 pp.	7

File No.	Publication No.	Title	Source
5.0	Farmers Bull. 2180	Equipment for Clearing Brush From Land (slightly revised 1963) 12 pp. This bulletin describes some common types of equipment used to clear brush--small, medium, or large--from areas of various sizes.	42
5.0	Bulletin A-34	*Forage Production on Arizona Ranges--III Mohave County (1964) 77 pp.	7
5.1		*From Brush to Grass (1963) 8 pp. This booklet points out some ways mechanical brush control gets water management off to a good start, making such programs a practical answer to reclaiming depleted range.	9
5.2	Special Circ. 93	Pest of Young Conifers (1964) folded sheet Contains names, clues, identification, injury, and controls of insect, disease, and animal pest of young conifers.	47
5.5	PA-637	*What Is a Ranch Conservation Plan? (1964) 8 pp. A general bulletin outlining the essential steps of planning: appraisal of resources, physical problems, alternative practices, and evaluation of treatments. Gives an example of a western ranch conservation plan.	41
6.0	Bulletin A-4	**Field Crop Varieties for Arizona (1965) 23 pp.	7
6.02	Bulletin 460-A	*Guide to Chemical Control of Plant Diseases in Colorado (1965) 24 pp. General guide to controlling plant diseases by the use of chemicals, including seed treatment, foliage protectants, soil treatment, and chemicals for flowers.	10
6.10		*Field and Seed Crops: Usual Planting and Harvesting Dates by States in Principal Producing Areas (1965) 84 pp. This report contains information on the usual planting and harvesting dates for major field and seed crops. Information is arranged by states. In addition, dot maps show major areas of production and isomaps show periods of planting and harvesting.	42
6.10	Farmers Bull. 2201	Growing Ginseng (1964) 11 pp. A general cultural breakdown of another crop for cool areas.	42

File No.	Publication No.	Title	Source
6.11	Farmers Bull. 2211	*Controlling Dodder in Alfalfa (1965) 16 pp. An extensive bulletin on controlling dodder in the seed and hay crop with suggested cultural practices.	42
6.112	Leaflet 529	The Pea Aphid on Alfalfa--How to Control It (1964) This leaflet describes the damage to alfalfa, appearance and development, and control with insecticides of the pea aphid.	42
6.12	Bulletin A-15	**Barley in Arizona (revised 1965) 19 pp.	7
6.13		Cotton Production--Mechanization (1965) 28 pp. This publication contains the proceedings of the 1965 Beltwide cotton production-mechanization conference. Much of this information could be used for reference.	25
6.132	Bulletin A-28	**Chemical Control of Annual Weeds in Cotton (revised 1963) 12 pp.	7
6.132	Misc. Pub. 310	*The Classification of Cotton (1965) 53 pp. An excellent bulletin on the grading of cotton; very complete.	42
6.134	Farmers Bull. 2207	*Controlling the Pink Bollworm on Cotton (1965) 12 pp. This bulletin presents the occurrence, development and habits, nature of damage, and control measures of pink bollworms on cotton.	42
6.134		**Cotton Diseases and Their Control (1965) 15 pp. A very colorful bulletin on cotton disease, including most of the prevalent diseases attacking cotton.	25
6.134		*1965--Cotton Pest Control Guide (1965) 33 pp. This publication contains information on insect control, cottonseed treatment, chemical weed control, and harvest-aid chemicals.	25
6.134	Tech. Bull. 166	Lygus Bug Injury to Presquaring Cotton (1964) 28 pp.	7
6.134	Bulletin A-26	**Protect the Cotton Plant From Insect Injury (revised 1965) 20 pp.	7
6.135		Western Cotton Production (1965) 24 pp. Summary of the proceedings of the Western Cotton Production Conference held in Lubbock, Texas, in 1965.	25

File No.	Publication No.	Title	Source
6.21	Ag. Handbook 253	*Insects Affecting Sugarbeets Grown for Seed (1963) 29 pp. A comprehensive booklet containing pictures and descriptions of foliage feeders, seed feeders, and virus vectors.	37
7.0	Leaflet 445	*Electric Heating of Hotbeds (1964) 8 pp. A good general bulletin on the hows and whys of heating hotbeds with electricity.	42
7.01	Circular 122	**Control Vegetable Garden Insects (revised 1964) 15 pp.	7
7.01	Home and Garden Bull. 67	**Insects and Related Pests of House Plants (slightly revised 1964) 16 pp. Tells how to recognize and control the most common insects and related pests that attack plants in homes and home greenhouses.	42
7.01	Home and Garden Bull. 61	**Lawn Diseases--How to Control Them (revised 1964) 16 pp. This bulletin will help solve lawn disease problems. Only the most common diseases are discussed. Illustrated with color pictures.	42
7.02	PNW Bull. 62	**Grafting Fruit Trees (1965) 18 pp. An excellent bulletin which discusses grafting tools and these grafts: cleft, side, bridge, inarch, veneer, whip, and budding. Contains pictures and illustrations.	45
7.02	Leaflet 220	Storage of Vegetable Seeds (slightly revised 1964) 8 pp. This leaflet explains the general principles of seed storage, moisture content of seeds, and the viability of seed under various storage conditions.	42
7.11	Folder 108	**Strawberries in Arizona Gardens (1965) 15 pp.	7
7.12	Circular 282	**Home Citrus in Arizona (revised 1964) 16 pp.	7
7.14	Bulletin A-33	**Growing Grapes in Arizona (1964) 24 pp.	7
7.15	Circular 247	**Pecans in Arizona (revised 1964) 15 pp.	7
7.16	Farmers Bull. 1897	Establishing and Managing Young Apple Orchards (1964) 29 pp. This is a slight revision of a previous bulletin. Includes importance of young orchards, selection of site planning and planting, and pruning.	42

File No.	Publication No.	Title	Source
7.2	Circular 130	**Arizona Home Gardening (revised 1964) 40 pp.	7
7.2	Home and Garden Bull. 9	**Suburban and Farm Vegetable Gardens (1964) 46 pp. A good general bulletin on vegetable gardening, including material on site, preparation, equipment, planning, seed, plants, care, time of planting, and culture of special crops.	42
7.23	Farmers Bull. 2060	Sugarbeet Culture in the North Central States (revised 1964) 41 pp. A complete bulletin on sugarbeet culture, many of which principles will apply to Arizona.	42
7.25	USDA Ag. Res. Svc. Handbook 267	*Commercial Potato Production (1964) 59 pp. This publication covers the production of potatoes from the history of potatoes through potatoes for special purposes.	37
7.27	Farmers Bull. 2200	*Controlling Tomato Diseases (1964) 12 pp. This bulletin describes the most common diseases that affect tomatoes and the four general control methods used. Pictures are used to illustrate disease symptoms.	42
7.28	Leaflet 528	*Watermelons for the Garden (1964) 8 pp. This leaflet explains varieties, fertilizers, cultural practices, and pest control of watermelon.	42
7.3		**Your Best Guide to Better Gardening--Pocket Garden Guide (1963) 72 pp. This comprehensive booklet includes information on classes of plants, soils, fertilizers, pests and diseases, propagation, seasonality, flowers and flowering shrubs, lawns and ground covers, and fruit trees. It includes detailed cultural practices of specific western landscaping plants.	14
7.31	Ag. Handbook 270	Evaluation of Bermuda Grass Varieties for General Purpose Turf (1964) 54 pp. A good general bulletin on Bermuda grass, including classification, description of species, establishing a turf, and fertilizing.	42
7.31	Circular 242	*Flowers for Northern Arizona (revised 1964) 24 pp.	7
7.31	Leaflet 199	Gardenia Culture (slightly revised 1965) 8 pp. A general leaflet about outdoor, greenhouse, and home culture of gardenias. Includes common pests and controls.	42

File No.	Publication No.	Title	Source
7.31		**<u>1964 Report on Turfgrass Research</u> (1964) 28 pp.	7
7.32	Bulletin A-29	**<u>Native Trees and Shrubs for Landscaping for Use in Southern Arizona</u> (reprinted 1964) 15 pp.	7
7.32	Bulletin A-8	**<u>Pruning Hedges, Shrubs and Trees</u> (revised 1964) 20 pp.	7
7.32	Folder 103	<u>Rose Varieties for Arizona--1965</u> (1964) 6 pp.	7
8.11	Leaflet 530	*<u>Shade and Water for the Honey Bee Colony</u> (1964) 8 pp. This leaflet describes different types of shades and watering devices for bees raised under high temperature conditions.	42
8.11	Station Circ. 442	<u>Using Alkali and Leafcutting Bees to Pollinate Alfalfa</u> (1964) 8 pp. This bulletin explains life history and management of wild bees.	45
8.13	Farmers Bulletin 2204	*<u>Selecting and Operating Beekeeping Equipment</u> (1965) 24 pp. This bulletin indicates the main items of equipment needed in the honey house and apiary. Commercial and homemade equipment is discussed.	42
8.2	USDA Leaflet 430	*<u>Cockroaches--How to Control Them</u> (1964) 8 pp. This leaflet gives general control measures for cockroaches.	42
8.2	Ext. Bull. 472	**<u>Household Insects and Their Control</u> (1964) 19 pp. This bulletin deals with the common household pests; it includes black and white drawings of external features; lists general methods of control.	45
8.4	Bulletin A-14	**<u>Arizona Insect Control Recommendations</u> (1964) 67 pp.	7
8.4	Bulletin A-18	**<u>Control Insects of Flowers, Shrubs and Shade Trees</u> (revised 1964) 16 pp.	7
8.4		<u>Diazinon Handbook</u> (1965) 128 pp. This handy guide will be useful in making recommendations about control measures to fruit growers, vegetable growers, dairymen, lawn spraymen, nurserymen, pest control operators, and all others interested in insect control.	10

File No.	Publication No.	Title	Source
8.4	Farmers Bulletin 2193	Grasshopper Control (1964) 12 pp. A general bulletin which discusses control measures, rates, and application procedures. Companion to Ag. Info. Bull. 287.	42
8.4	Pamphlet 309	*Use Farm and Home Chemicals Safely (1964) 16 pp. Good general pamphlet on safe use of chemicals, including methods of treatment, toxic dosage, how sold, type of carrier, common usage, and type of chemical.	21
8.51	Ag. Info. Bull. 287	Grasshoppers--Their Habits and Damage (1964) 28 pp. This bulletin was designed to assist agricultural leaders. It describes the damage grasshoppers do; what different species look like; how they develop and where and how they live; explains how outbreaks occur so that effective controls may be found.	42
9.1	Farmers Bull. 2197	**Farm Poultry Management (1964) 32 pp. A comprehensive bulletin explaining profitability, farm laying flock, housing, equipment, feed snd water, brooding, pullets, egg and meat production, diseases, parasites, and pests of farm poultry. Well written, with practical information for starting and maintaining a poultry enterprise. Supersedes Farmers Bulletin 1524.	42
9.14	Leaflet 402	*Intestinal Coccidiosis of Chickens--How to Control It (slightly revised 1964) folded sheet. This leaflet explains how chickens get intestinal coccidiosis, what to look for, getting a diagnosis, handling an outbreak, and prevention.	42
9.14	Leaflet 383	Poultry Mites--How to Control Them (revised 1964) folded sheet. A leaflet with specific controls and methods of application.	42
10.0	Bulletin A-39	**Minimum Tillage in the Southwest (1965) 16 pp.	7
10.0	Ag. Info. Bull. 283	**Salt Tolerance of Plants (1964) 23 pp. A semitechnical bulletin explaining salinity, how it is measured, its effect on plants, tolerance data, effects on crop quality and composition, and management in relation to control.	42
10.0	Bull. A-11	**Soil Management (revised 1964) 18 pp.	7
10.21	Folder 107	*Fertilizer Recommendations for Arizona (1964) folded sheet.	7

File No.	Publication No.	Title	Source
10.22	Bulletin A-40	**Soil Organic Matter (1965) 20 pp. Replaces Bulletin 240.	7
10.4		*Soils of the Western United States (1964) 69 pp. This publication reports on the occurrence and distribution of soils in the 11 western states. It consists of a generalized soil association map and an explanatory text. The text describes 36 great soil groups and 8 miscellaneous land types which occur in the Western Region. Their occurrence and distribution and their relationships to physiography, climate and vegetation are discussed.	45
11.1	Bulletin A-1	**Chemical Weed Control Recommendations for Irrigated Areas of Arizona (revised 1965) 18 pp.	7
11.1	Bulletin 514-S	*Weeds of Colorado (1964) 218 pp. This bulletin is very similar to the one published at University of Arizona (Circular 265).	10
11.2	Farmers Bull. 2158	*Chemical Control of Brush and Trees (1964) 23 pp. Contained within this bulletin are kinds of herbicides, ways to kill plants, methods of application, selecting herbicides, cleaning spray equipment, and susceptibility of plants to herbicides.	42
11.3	Farmers Bull. 2106	**Sixteen Plants Poisonous to Livestock in the Western States (slightly revised 1964) 49 pp. This is a revision of a bulletin by the same name. It has color pictures showing the 16 poisonous plants, how they affect livestock, and some general preventative measures.	42
12.1		Youth Leadership and Group Effectiveness (1961) 14 pp. An illustrated monograph describing actions of groups and patterns of positive leadership.	22
12.3	PNW Ext. Pub. 61	Family Communication (1964) 12 pp. This pamphlet discusses word and action communications and how to improve them.	28
12.5		**The Future Farmers of America Organization--Questions and Answers (1965) 23 pp. This publication is a compilation of questions and answers about the FFA program.	35
13.0	Ag. Info. Bull. 175	*More Wildlife Through Soil and Water Conservation (slightly revised 1963) 15 pp. Tells how farmers and ranchers can, through conservation, produce more of a wildlife "crop."	41

File No.	Publication No.	Title	Source
13.0		New Opportunity in Soil and Water Conservation for Farmers and Contractors (no date) 23 pp. Pictures and words are used to explain conservation activity in the Small Watershed Program, contracting and farming practices. The use of heavy equipment is stressed.	1
13.1		Agriculture Conservation Program--Summary by States (1964) 71 pp. This is the annual summary of the Conservation Program by States.	42
13.2	U.S.D.A. PA-348	**Soil and Water Conservation Activities for Boy Scouts (1964) 30 pp. This publication is a good teacher-helper as it explains a number of simple classroom demonstrations in soil conservation.	42
13.5	Leaflet 452	*Replenishing Underground Water Supplies (1964) 8 pp. A general leaflet explaining some of the methods being used to recharge underground water supplies.	42
14.1		*American Welding Society--Publication Order Form (1964) folded sheet. A list of publications available in fundamentals, inspection, process, and industrial applications of welding.	1
14.1		*Arc Welding Education (no date) folded sheet. Contains list of teaching aids and film strips that would be helpful in teaching arc welding.	23
14.1	Folder 68	**Arizona Farm and Home Publications (revised 1965) 16 pp.	7
14.1		Available Reports and Publications of the Agricultural Stabilization and Conservation Service (1964) 7 pp. Latest list of ASCS related publications and films.	42
14.1	Misc. Pub. 959	*A Consumer's Guide to U.S.D.A. Services (1964) 49 pp. Contains general information about the U.S.D.A. services to the consumer in food shopping, cooking, health, clothing, house and home, pest control, gardening, recreation, family finances, and emergencies. It provides a list of bulletins available in each area.	42
14.1		*Free Booklets and Films (1963) 10 pp. Selected list of industry and company literature and films by Swift & Co. Also contains list of teaching material offered by American Meat Institute and National Livestock and Meat Board.	36

File No.	Publication No.	Title	Source
14.1		*How to Obtain General Motors Educational Aids (no date) folded sheet. A list of booklets, charts, and films on vocational, economic, and guidance aspects of mechanics.	16
14.1		*Publication and Film Catalog of Meat (1964) 25 pp. Complete price list of teaching aids on meats.	26
14.1		*Southern Association for Agricultural Engineering and Vocational Agriculture--Publications and Filmstrips (1965) 20 pp. A list of up-to-date farm mechanics booklets and filmstrips with their descriptions and prices.	34
14.2		*Catalog of Educational Material on Cotton and Cotton Products (1964) 37 pp. Charts, pamphlets, booklets, books, motion pictures, and other visual aids on cotton and cotton products are described in this catalog which is published annually.	25
14.2	Ag. Handbook 275	*Handbook of Agricultural Charts (1964) 164 pp. This lists available charts from U.S.D.A. It states that the charts are in the form of black and white slides and glossy prints only.	42
14.2		Teaching Aids (1964) single sheet. Contains a list of A-C teaching aids. Commercial products is the main theme.	1
14.3	.	*Educational Film Service (1964) 3 pp. A list of current product films--good for agricultural mechanics and plant science courses.	1
14.3		Educational Materials (no date) folded sheet. A list of filmstrips, movies, and teaching aids available from DeKalb.	12
14.3	U.S.D.A. Handbook 14	*Films of the U.S.D.A. (1964) 87 pp. Here, in a catalog of more than 300 titles, is a film on almost every important subject in agriculture.	42
14.3		**16mm Sound Motion Picture Available From Farm Film Foundation (1965) 14 pp. This publication contains a list of films on agriculture. All are free of charge except for return postage.	15
14.3		*A Treasure Chest of Audio-Visual Ideas (1961) 22 pp. Presents steps in skillful use of films, ways to use films, how to train projectionists, and sources of A-V information.	44

File No.	Publication No.	Title	Source
14.4		*Farm Safety Check List (no date) folded sheet. Check lists on ladders, animals, machinery, hand tools, trees, home, vehicles, and work areas.	20
14.4	Farmers Bull. 2156	*Safe Use and Storage of Flammable Liquids and Gases on the Farm (slightly revised 1964) 16 pp. How to use various flammable liquids, their proper storage, and how to extinguish small fires is the theme of this bulletin.	42
14.41	Circular 632	*Plan to Meet Emergencies (1964) 14 pp. A good general bulletin explaining how to protect yourself against fires, tornadoes, fallout, and other emergencies.	47
14.42		**Your Guide for the Safe Use and Care of Hand Tools (1963) 30 pp. This is a brief booklet on safe practices for wood and metal hand tools.	8
14.42		*Your Guide to Safety in Woodworking Shops (1963) 27 pp. Illustrates safety procedures on hand and power woodworking tools.	8
14.6		Feed Manufacturing Industry (1964) 21 pp. Explains the growth, service, and importance of the feed industry.	3
14.6		*Fifty Million Tons of Opportunity in Tomorrow's Animal Agriculture (no date) 15 pp. This bulletin presents seven major career areas of the feed industry.	3
14.6	Misc. Pub. 843	*A Job With the Forest Service--A Guide to Nonprofessional Employment (1964) 13 pp. Contains description, qualification, schooling, and salaries of nonprofessional forestry personnel. Also furnishes addresses for further information.	39
14.6		*Let's Talk About a Poultry Science Career (no date) folded sheet. This folder indicates the career opportunities in poultry genetics, nutrition, pharmaceuticals, engineering, production, and agri-business.	32

File No.	Publication No.	Title	Source
14.6		**Opportunities for You in Agricultural Education (1965) folded sheet. (5¢ per copy) Explains the qualifications, training, and opportunity for individuals in Agricultural Education. Very good for guidance.	29
14.6		*Opportunities in the Welding Industry (revised 1963) 23 pp. This publication describes the education needed, wages received, and opportunities in various jobs in the welding industry. This would be good for guidance.	6
14.6		**Threads of Life (1964) 16 pp. A well-illustrated booklet on the career field of agricultural science. It contains a series of research questions and the biological scientist's answers to them. Job opportunities and preparation for them through the land-grant college system is the major theme of this publication.	24

VT001 111

VT 001 111
Introduction to the Fundamentals of Fire Behavior.

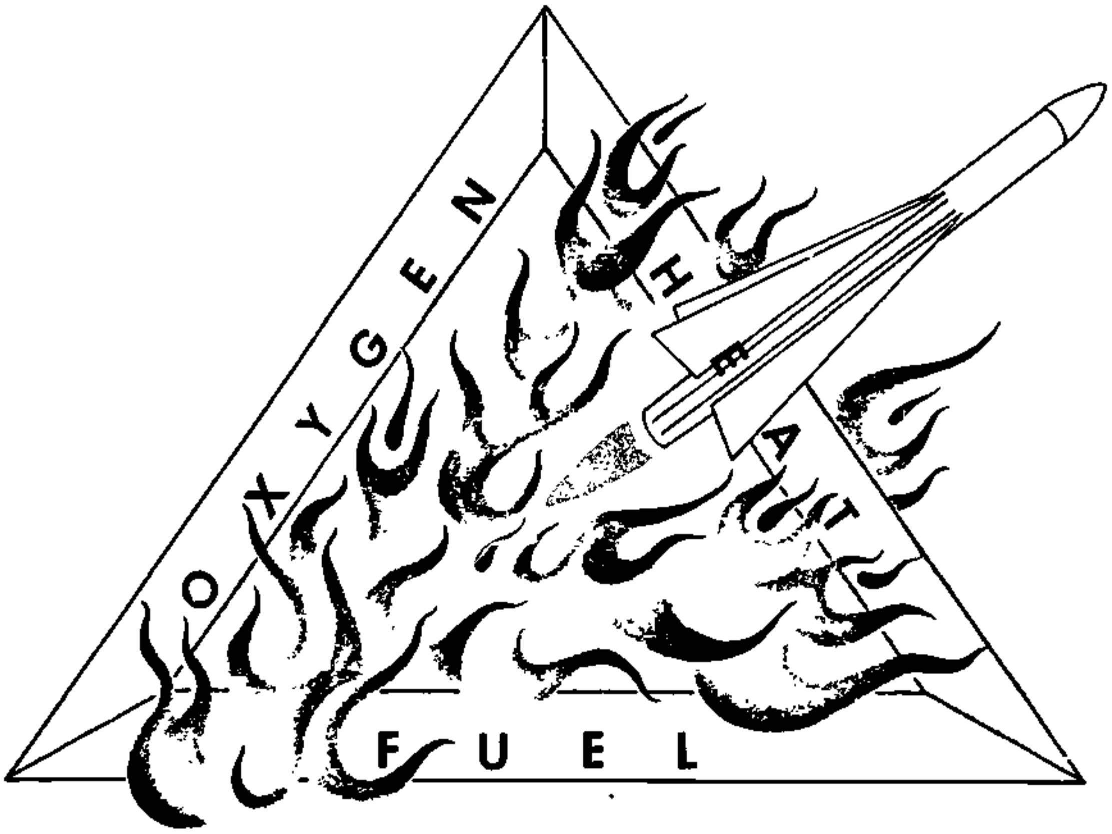
Forest Service, Washington, D.C. Div. of Fire Control
Pub Date - 64
DOCUMENT NOT AVAILABLE FROM EDRS 44p.

*PROGRAMED UNITS, *FORESTRY, *FIRE PROTECTION, *FIRE FIGHTERS,

This programed course was designed for training forest fire fighters by providing knowledge of fire behavior. The use of the programed material is explained. Units covered in 158 frames include (1) The Fire Triangle, (2) Ignition Temperature, (3) Sources of Heat, (4) Heat Transfer, (5) Weather Factors, (6) Forest Fuel Factors, and (7) Topography. Most of the program frames are illustrated by line drawings. A summarized reference of the seven units which reviews the essential points presented in the program is included. The time required to complete the course is 1½ to 2 hours. This document is available as A13.2--F51/45 for 45 cents from Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402. (JM)

INTRODUCTION
TO THE
FUNDAMENTALS OF FIRE BEHAVIOR

Programed Learning
A Powerful New Training Tool



FOREST SERVICE, DEPARTMENT OF AGRICULTURE

Under the technical direction of the Division of Fire Control, U.S. FOREST SERVICE
UNITED STATES DEPARTMENT OF AGRICULTURE

Programed Learning

A Powerful New Training Tool

INTRODUCTION
TO THE
FUNDAMENTALS OF FIRE BEHAVIOR

Produced under the technical direction of the Division of Fire Control, Forest Service, U.S. Department of Agriculture in cooperation with Training Systems, Inc., 12248 Santa Monica Blvd., Los Angeles, Calif., 91125.

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INTRODUCTION

INTRODUCTION TO FUNDAMENTALS
OF
FIRE BEHAVIOR

This introductory course is designed to teach you, the fireman, fundamental fire behavior terms and concepts. This is important to you because successful firefighting is based on a knowledge of fire behavior. Why does a fire burn fast? Why does it slow down? Why does it burn intensely at times? Why does it burn faster in one direction than another? You must know the answers to questions such as these to be an effective firefighter.

There are many reasons for fires acting as they do. When you finish this course you will know the primary factors which influence the start and spread of fire. You will learn about combustion, the fire triangle, heat transfer, and how weather, fuel, and terrain affect fire behavior. Keep in mind, however, this is only a beginning course; it needs to be followed with additional fire behavior training.

The information presented here makes use of a powerful new training approach, programed learning. Small amounts of information are presented in logical sequence and you will make frequent written responses.

It will take you about 1½ to 2 hours to complete this course. Before starting, keep in mind the definition of fire behavior, "the manner in which fuel ignites, flame develops, and fire spreads."

Merle S. Lowden
Director, Division Fire Control
U.S. Forest Service

HOW TO USE THIS BOOK

This is a programed course which allows each person to learn at his own individual rate. It is presented in a series of small steps called "Frames." Each frame will present information and ask a question. The answer to the question will appear on the next page.

1. To use this book, read the information and question, and look at the illustration.

2. Write your answer to the question on the answer sheet or on a different piece of paper. Your answer must be written. If there is a blank, write the missing word. If you are asked to make a choice of several answers, write the letter of your choice. Follow all instructions in answering the questions.

3. After you have written your answer, turn the page to reveal the correct answer in the shaded portion of the next page.

4. Compare your answer with the correct answer.

5. Now continue with the next frame.

6. There are five frames per page. Read through the top frames of each page, then through to second row of frames and continue until you finish the bottom row of frames.

7. Each frame is numbered. The correct answer to the frame (on the next next page) bears the same number. To be sure that you are reading the frames in the proper order, start with Frame 1 and continue to Frames 2, 3, 4, etc., until the course is complete.

A Summarized Reference is provided at the end of this course. It may be readily referred to as a review when you have completed the course.

CONTENTS

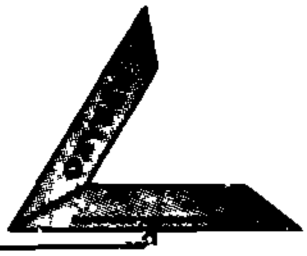
8

oxygen

9

And, as we have said, oxygen alone cannot produce combustion --- there must be some ________ present.

(also print it here)



40

41

We will first discuss DIRECT APPLICATION OF FLAME.

A lit match is an example of a DIRECT APPLICATION OF ________.

72

ⓐ
ⓑ
ⓒ
ⓓ
ⓔ
ⓕ

73

We have said that WIND brings ________ to support combustion. In addition:

(a) WIND produces a pressure due to its speed.
(b) WIND pressure can increase burning in one direction.

104

dry

105

Dry ________ are ________ in weight and ________ burning.

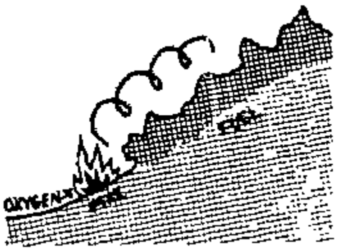
136

(a) 16
(b) heated

137

If a fire begins at the bottom of a slope, what size of burn will be produced in most cases?

(a) large (b) small (c) none
(d) not possible to say



6

(any other reply is incorrect)

7

In addition to FUEL, to have combustion we must also have oxygen. The FUEL will burn only if oxygen is present.

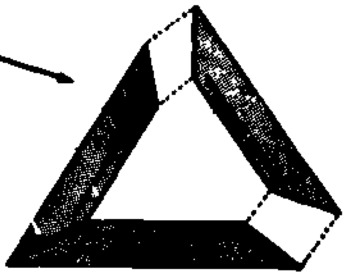
GO TO NEXT FRAME

38

A
heat

39

(a) complete this FIRE TRIANGLE.
(b) the break shows that a substance must be at __________ TEMPERATURE or it will not start to combust and __________ to burn.
(c) once a substance is burning by itself, the ______ which is produced will be sufficient for the fire to continue.



70

any
air
oxygen

71

Now we see why WIND is important. It is a movement of _____, and this _____ contains _________ which supports ______________.

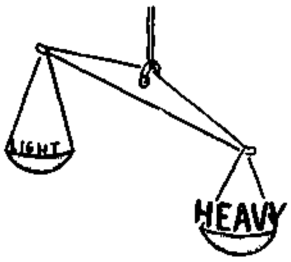
(Draw the Fire Triangle above)

102

103

① SIZE OF FUELS

In the Forest Service we think of SIZE OF FUELS as being →



Yes, forest fuels are either __________ or _________.

134

① heat, rises
② heated, convection
③ heated, ignition

135

EXPOSURE

(a) Northern __________ is the ______ of a hill facing to the __________.
(b) Side of a hill is often called the ________; side of a canyon is the ________.
(c) During the year, the __________ exposure is most dangerous.

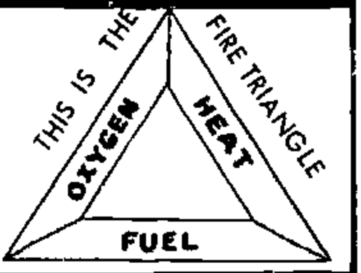
2

combustion

3

THE FIRE TRIANGLE

In order to have COMBUSTION,
________, __________ and
________ are needed.

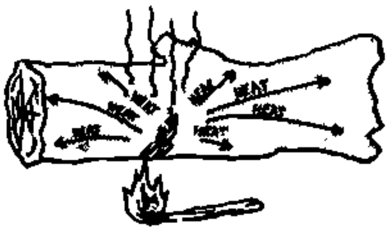


34

35 The small log is heated with a match.

CIRCLE ONE

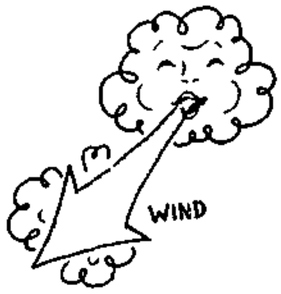
(a) the log will burst into flame.
(b) the log will burn for a few moments with a good flame and then be extinguished.
(c) the log will not burn because the match loses all of its heat in the air.
(d) the log will nct burn since the heat will be absorbed along the log.



66

67

Of all the things making up weather, the one which changes most often and most quickly is



GO TO NEXT FRAME

98

dangerous
little

99

Here are relative humidity readings. Circle the ones considered dangerous for fire conditions.

(a)

(b)

(c)

(d)

(e)

(f)

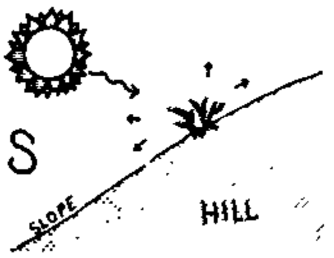
(g)

130

southwestern

131

The heat from the sun raises the temperature of the ground and aerial fuel. This heat reduces the ________ in the fuel, which then evaporates into the air.



FUEL
OXYGEN
HEAT

4

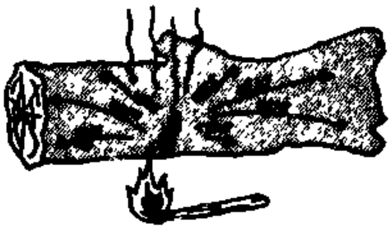
Here is a diagram marked FUEL. Substances which burn are called ________.

35

ⓓ is the correct answer.

36

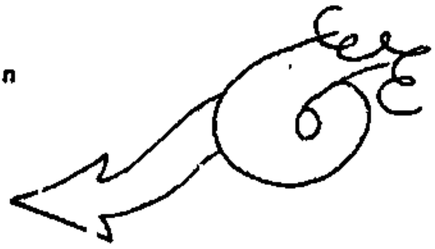
This match will not produce enough heat to cause the small log to _____. There isn't enough heat to bring the log up to its _____ __________.



67

68

The thing which changes most in weather is the ________.



99

ⓒ ⓓ ⓔ ⓖ

Remember: below 30% relative humidity is dangerous in wooded areas.

100

(a) Forest fuels when heated lose ____________.

(b) Water vapor in air is also called ______________.

(c) Air with little water vapor is _____ air.

(d) Dry air has a ______ relative humidity.

131

moisture

132

In the Forest Service, there is a rule which states

FIRE BURNS FASTEST UPHILL

In fact, on a steep slope it burns uphill 16 times faster than downhill.

GO TO NEXT FRAME

4

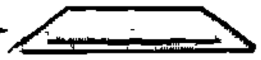
FUEL

5

It is never possible to have combustion without fuel.

What do we call substances which burn?

Answer this question by printing in here ——————→



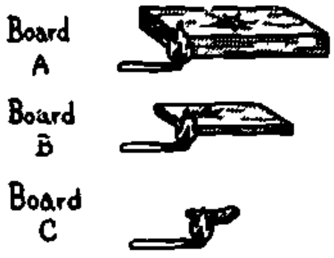
36

burn
ignition temperature

37

Here are three wooden boards. The same heat is applied for the same time.

Board ___ will probably combust and continue to burn without any _______ from another source.

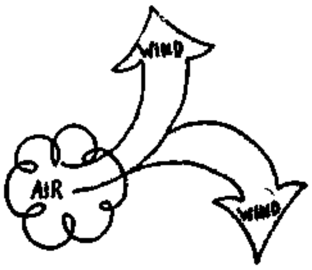


68

wind

69

You may think of WIND as a movement of air. This ___________ of _____ may be in any direction, UP DOWN or SIDEWAYS.



100

(a) moisture
(b) moisture
(c) dry
(d) low (or small)

101

(a) Dangerous conditions exist in wooded areas when relative humidity is below ____

(b) Air is actuall [illegible] hen the relative humidity is 95%.

132

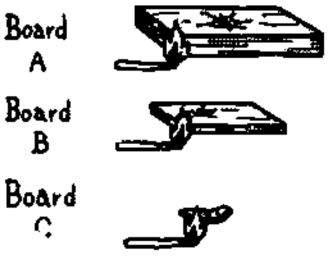
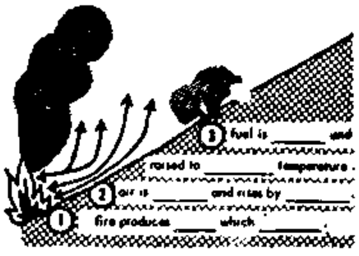
133

Think about the remarkable speed of fire uphill. It burns 16 times faster going up the slope than if it burned down the slope.

Can you think of the two main reasons for this? Write:

____

____

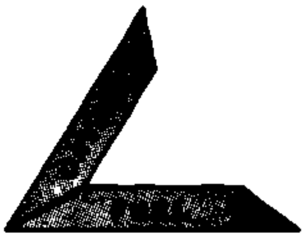
5 FUEL	6 In order to have combustion, we have learned that one thing we must have is ——(print)——→
37 C	38 Board ____ will probably not burn because the ______ from the match will be carried away due to the size of the board. 
69 movement air	70 Air can move in _____ direction. WIND is really a movement of ____. Air contains _________ which is part of the Fire Triangle.
101 (a) 30% (b) wet	102 FOREST FUEL FACTORS Let us now consider FOREST FUELS. FOREST FUEL FACTORS ① Size of Fuels ② Arrangement ③ Volume GO TO NEXT FRAME
133 (1) Heat from fire rises and heats the fuel just above by convection to ignition temperature. (2) Radiation is greater.	134 Fill in the events on the diagram starting with ① 

6

(any other reply is incorrect)

7

In addition to FUEL, to have combustion we must also have oxygen. The FUEL will burn only if oxygen is present.



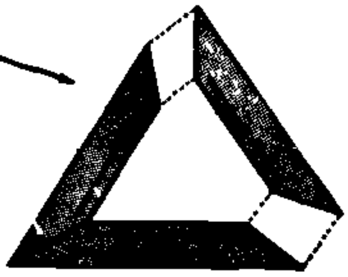
GO TO NEXT FRAME

38

A
heat

39

(a) complete this FIRE TRIANGLE.
(b) the break shows that a substance must be at ________ TEMPERATURE or it will not start to combust and ________ to burn.
(c) once a substance is burning by itself, the ______ which is produced will be sufficient for the fire to continue.



70

any
air
oxygen

71

Now we see why WIND is important. It is a movement of _____, and this _____ contains ________ which supports ______________.

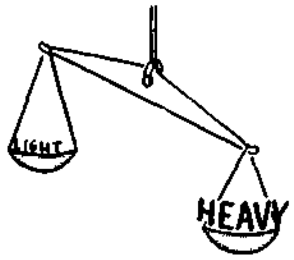
(Draw the Fire Triangle above)

102

103

① SIZE OF FUELS

In the Forest Service we think of SIZE OF FUELS as being →



Yes, forest fuels are either __________ or ________.

134

① heat, rises
② heated, convection
③ heated, ignition

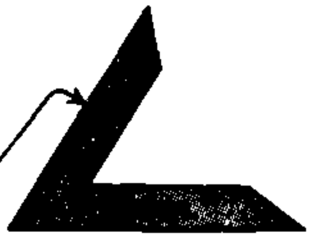
135

EXPOSURE

(a) Northern __________ is the _____ of a hill facing to the __________.
(b) Side of a hill is often called the ________; side of a canyon is the ________.
(c) During the year, the __________ exposure is most dangerous.

8

Here is a substance which is combustible called FUEL. However, it cannot burn by itself. To burn, __________ must be present.



39

(a)

(b) IGNITION
continue
(c) heat

40

[illegible] HEAT

There are five Main SOURCES OF HEAT that <u>start</u> fires.

(1) Direct Application of Flame.
(2) Direct Application of Embers.
(3) Electrical Arcing.
(4) Friction.
(5) Spontaneous Combustion.

We will study each of these now.

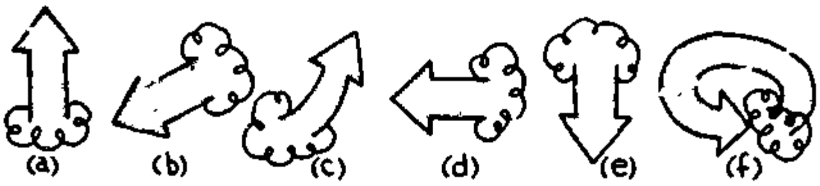
GO TO NEXT FRAME

71

air
air
oxygen
combustion (fire, or burning)

72

Examine these WIND directions. Circle those which show the direction WIND can take.



103

light
heavy

104

A LIGHT fuel is FAST-BURNING.
For example . . . .

One fast-burning forest fuel is _______ leaves.

These dry LEAVES are <u>light</u> in weight and FAST BURNING.

135

(a) exposure, slope (or side), north
(b) slope, slope
(c) southwestern

136

STEEPNESS

(a) Fire travels about ____ times faster upslope.

(b) On a steep slope, fuel above a fire is __________ by the heat of the fire below.

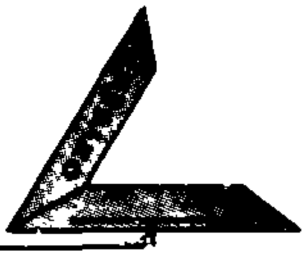
8

oxygen

9

And, as we have said, oxygen alone cannot produce combustion --- there must be some ________ present.

(also print it here)



40

41

We will first discuss DIRECT APPLICATION OF FLAME.

A lit match is an example of a DIRECT APPLICATION OF ________.

72

ⓐ
ⓑ
ⓒ
ⓓ
ⓔ
ⓕ

73

We have said that WIND brings ________ to support combustion. In addition:

(a) WIND produces a pressure due to its speed.
(b) WIND pressure can increase burning in one direction.

104

dry

105

Dry ________ are ________ in weight and ________ burning.

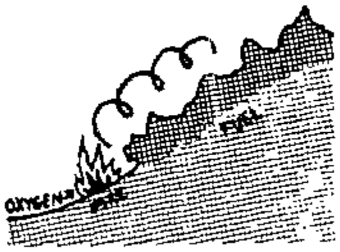
136

(a) 16
(b) heated

137

If a fire begins at the bottom of a slope, what size of burn will be produced in most cases?

(a) large (b) small (c) none
(d) not possible to say



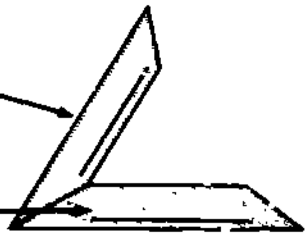
9

fuel

10

Yes, air contains ______ (print)

and this supports the combustion of ______ (print)

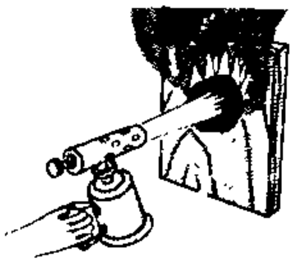


41

HEAT

42

This blowtorch indicates that one source of Heat is the Direct ____________ of ____________.

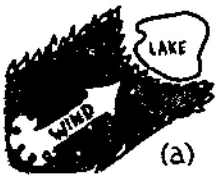


[illegible]

oxygen

74

Only one of these burns on <u>flat land</u> would be caused by the WIND as shown. Which is it?



(a)

(b)

(c)

(d)

105

leaves
light
fast

106

Which of the fuels shown are fast-burning? If you believe it is fast-burning, copy the name next to the letter.

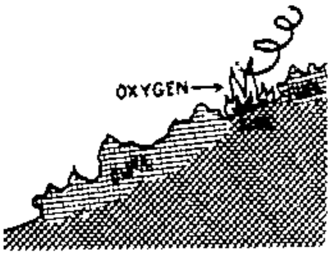
(a) ______ (b) ______ (c) ______ (d) ______

137

(a) large

138

If a fire begins somewhere midway on a slope, the burn will be __________ (smaller, larger) than if it had started at the bottom.

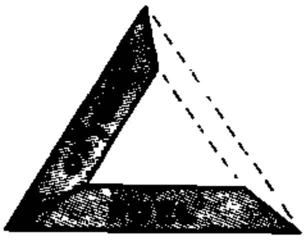


10

11

Fuel and oxygen alone, when combined, do not result in fire.

Something is missing.
The Fire Triangle is not complete!



GO TO NEXT FRAME

42

Application Flame

43

Hot glowing embers, blown by the wind, can fall on some dry leaves and start a fire.

The second Source of Heat is DIRECT APPLICATION OF ________.

74

(b)

75

From this, we may depend upon _______ to control the shape of the burn.

106

(a) tree needles
(b) dry leaves
(c) dry grass

107

The fast-burning fuels are ______ in weight and cause a rapid spread of ______. They also create heat to raise the IGNITION TEMPERATURE of HEAVY fuels.

138

smaller

139

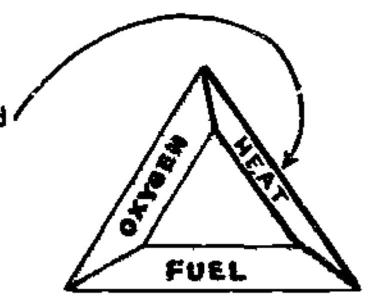
During the thunderstorm shown, a fire is started due to ____________________ near the top of a steep slope. Within a short time, a second fire is observed near the bottom of the slope.

11

12

The Fire Triangle is complete when we add

In order for FUEL to burn, both OXYGEN and ________ have to be present.



43

[illegible]

44

A lighted cigarette could ignite a dried out rotten log. This would be an examp' of a direct application of ________.

75

wind

76

Under normal conditions, where do you believe the sparks and embers would land? CIRCLE one or more letters.

107

light fire

108

HEAVY fuels are ususally not fast-burning. HEAVY fuels are ________ burning. Once a HEAVY fuel is burning, it ignites ________ and produces a great amount of heat.

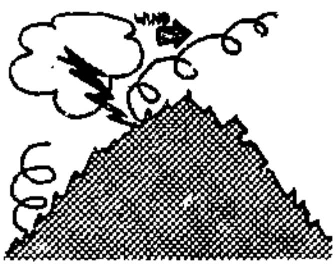
139

electrical arcing

140

The second fire observed near the bottom of the slope can best be explained by:

(a) a second bolt has hit at the bottom.
(b) sparks and embers are carried to the bottom by spotting.
(c) burning logs and cones roll to the bottom.
(d) spontaneous heating.
(e) conduction.



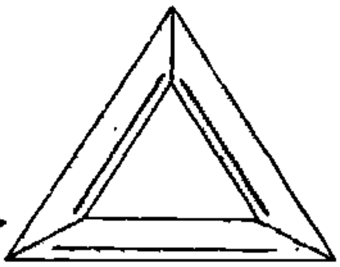
12

HEAT

13

Combustion occurs only when the Fire Triangle is complete.

Complete all three parts of this FIRE TRIANGLE. ——————(print)——→



44

embers

45

In this forest scene, the rider is flicking live cigar ashes onto quick-burning fuel. This illustrates the DIRECT __________ OF ________.

76

You should have circled all the letters. Ⓐ Ⓑ Ⓒ Ⓓ and Ⓔ.

77

The condition when WIND causes sparks and embers to be blown ahead of the main fire into unburned fuel is called spotting. Such new fires are spot fires.

GO TO NEXT FRAME

108

slow
slowly

109

Which of the fuels shown are slow-burning? If you believe it is slow-burning, copy the name next to the letter.

(a) ________ (b) ________ (c) ________ (d) ________

140

(c) burning logs and cones roll to the bottom.

141

Let's concentrate now on hill and canyon fire behavior, since the Forest Service is responsible for many large areas which are not flat or built-up with man-made structures.

Fires burn about _____ times faster upslope than down.

13

14

The Fire Triangle consists of FUEL, OXYGEN and HEAT. Combustion is produced when all three are present. After the fire has started, from where does the additional HEAT come? Select one answer from those shown.

CIRCLE THE LETTER WHICH YOU BELIEVE BEST ANSWERS THE QUESTION:

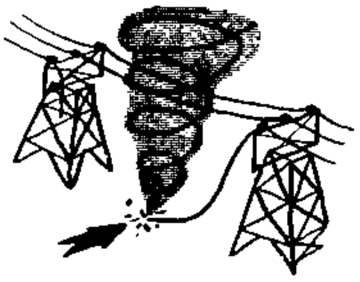
a. heat comes from surrounding atmosphere.
b. heat comes from the fire itself.
c. heat comes from some outside source.
d. heat comes from the oxygen.
e. none of these.

45

APPLICATION
EMBERS

46

The third SOURCE OF HEAT can occur when a high tension power line has snapped and is dangling on the ground. This demonstrates fire caused by ______________ ARCING.



77

78

If WIND blows sparks ahead to areas of unburned _______, then it is likely that small ______ fires will start.

109

(a) log
(b) stumps
(d) large limbs

110

FOREST FUELS

(a) Light fuels are ______-burning. A log is an example of a ______-burning fuel.
(b) Slow-burning fuels produce _______ amounts of ________ during combustion.
(c) Dry leaves are ______-burning and are ________ fuel.
(d) Large limbs are ______-burning and are ________ fuel.

141

16

142

The actual speed of fire on a slope will depend upon the SIZE of fuel: _______ fuel will burn faster than _______ fuel. It will also depend upon CONTINUITY: fuel which is patchy will burn more _______ than fuel which is _________.

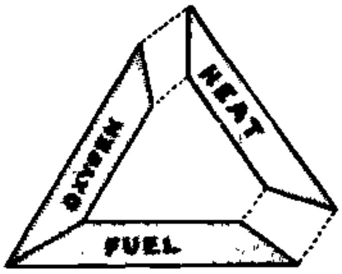
14

the most correct answer is

ⓑ heat comes from the fire itself.

15

Fire results from the proper combination of FUEL + OXYGEN + HEAT. By breaking the Fire Triangle, we can stop combustion. One way to do this is to reduce HEAT.



GO TO NEXT FRAME

46

ELECTRICAL

47

We often think of electric-powered equipment in connection with electrical arcing. However, LIGHTNING produces heat and causes many fires.

Lightning is a form of ____________ energy and it produces heat and causes ____________

78

fuel
spot

79

In this case, the Forest Service has established the control line show .

Suddenly a WIND increases over the burn. Write what you believe could happen.

____
____
____
____

110

(a) fast, slow
(b) large, heat
(c) fast, light
(d) slow, heavy

111

So far we have talked about the speed that forest fuels burn.

Light fuels burn ______ while heavy fuels burn ________.

142

[illegible]

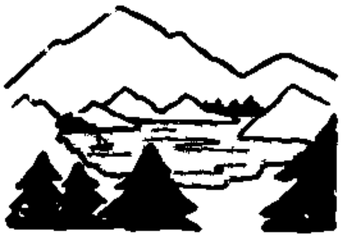
143

In addition to SIZE and CONTINUITY of fuel, we must also consider the COMPACTNESS. If the fuel is ________ arranged it will have a small amount of ________ mixed with it, but if it is ________ arranged, then much more ________ will be available for rapid burning.

15

16

To reduce HEAT, the Forest Service often uses a liquid which is available in most places and is used for washing and drinking. __________ is used on fires to reduce the HEAT.



47

48

So far we have discussed three SOURCES OF HEAT; (1) direct application of __________, (2) direct application of __________ and (3) ______________ arcing. The fourth is heat caused by FRICTION. Moving machinery which is not lubricated or properly cooled will produce heat.

79

[illegible] and embers [illegible] over the control [illegible] spotting [illegible] fires.

80

WIND can cause embers to produce ______ fires. When the control line is jumped by these fires, then __________ has occurred.

fast
slowly

112

② ARRANGEMENT

The second FOREST FUEL FACTOR that we will consider is the ARRANGEMENT of the fuel. By arrangement we mean:

1. GROUND OR AERIAL . . . 2. CONTINUITY . . . 3. COMPACTNESS

GO TO NEXT FRAME

tightly
oxygen
loosely
oxygen

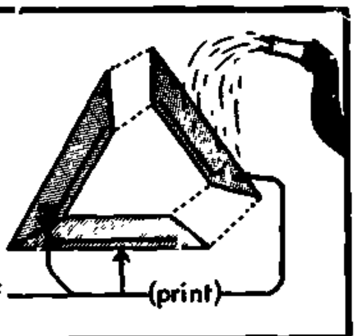
Also, the position will have some control over the speed of the fire. Ground fuels will burn ________ than ________ fuels which have a greater oxygen supply.

16

water

17

One way to reduce HEAT and break the Fire Triangle is by applying water. The effect of water is to COOL the fuel and lower its temperature. The diagram illustrates reduction of heat by the process of ________. The FIRE TRIANGLE consists of ——(print)

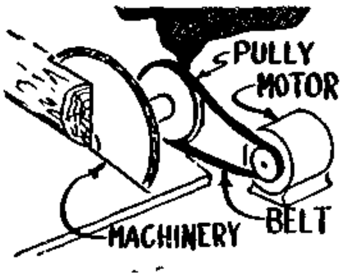


48

flame
embers
electrical

49

Suppose that a belt drive is used to run a piece of machinery. The belt slips on the pulley. Heat is produced due to ________ and a fire can be the result.



80

spot
spotting

81

The Forest Service halts a fire along a ________ line. However, if a ______ comes up suddenly over the burn, it is possible for ______ and ________ to be blown over the ________ line causing ________. This produces _______ fires.

112

113

ARRANGEMENT (1. Ground or Aerial)

Fuel on the ground is called GROUND fuel.

GROUND fuel does not have much movement of air around and through it.

GO TO NEXT FRAME

144

slower
aerial

145

Use your pencil and, below the heavy line, CIRCLE the words which stand for high-speed, up-slope fires.

POSITION	SIZE	CONTINUITY	COMPACTNESS	VOLUME
Ground	Light	Patchy	Tightly Arranged	Large
Aerial	Heavy	Uniform	Loosely Arranged	Small

17

cooling

18

CIRCLE ONE

Heat can be reduced by cooling with water. How would OXYGEN be removed?

(a) applying dirt.
(b) cooling with water.
(c) closing the valve and thereby removing the fuel.
(d) none of these.

49

friction

50 The fifth SOURCE OF HEAT is Spontaneous Combustion.

The dictionary defines this as "coming from within, or self-acting". In this pail of oily rags, we see some paper and wisps of smoke. The oil, cloth and paper have combined with oxygen in the air to produce combustion which caused the fire and smoke. We call this ________________ combustion.

81

control
wind
sparks
embers
control
spotting
spot

82

In our study of WEATHER FACTORS we have seen the effect of WIND.

We will now study the effect of TEMPERATURE.

GO TO NEXT FRAME

113

114

Fuel in the air is called AERIAL fuel.

AERIAL fuel does allow air to circulate around and through it.

Air contains ____________.

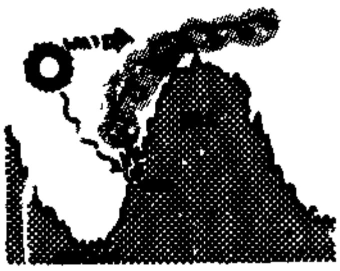
145

Aerial
Light
Uniform
Loosely Arranged
Large

14

CANYON FIRE BEHAVIOR

During the d[illegible] the heated air and smoke will ______ this fire, and oxygen will feed the fire from _________ (above, below).



18

(a) applying dirt.

19

Draw the FIRE TRIANGLE here ⟶
to illustrate that APPLYING DIRT
can break the triangle. Be
careful to select the proper
side to be broken.

50

spontaneous

51

If a chemical is on a table by itself and the sunlight causes a chemical reaction, the resulting fire was produced by ______________ combustion.

82

83

To study temperature in "weather factors" we must briefly review IGNITION TEMPERATURE.

A substance is at IGNITION TEMPERATURE when it starts to _____ and continues without any _____ from ________ ___ source.

114

oxygen

115

Air contains OXYGEN. Which fuel will have more oxygen around it?

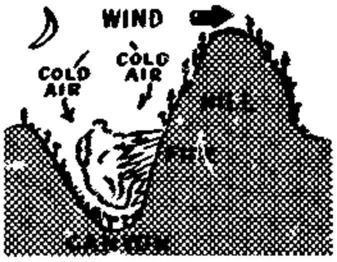
(a) ground
(b) aerial
(c) can't tell

146

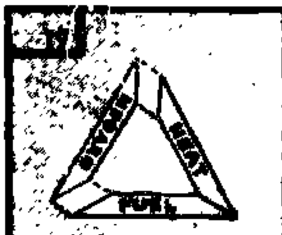
rise
below (or beneath)

147

During the night, as the land cools, cold air will descend into the canyon along the slopes. The fire will change direction and go ______ slope into the _______.



19



(any other diagram is incorrect)

20

CIRCLE THE MOST CORRECT ONE

If OXYGEN can be removed by applying dirt, then what can be done with FUEL to break the Fire Triangle?

(a) cooling with water.
(b) closing the valve of a gas line and thereby removing the fuel.
(c) clearing with a bulldozer.
(d) two of these are correct.

51

[illegible]

52

Combustion, in which heat is created from the fuel itself, is called

__________ __________.

83

fuel
heat
another

84

We must also review our old friend, the Fire Triangle.

DRAW THE FIRE TRIANGLE ——→

115

(b) aerial

116

ARRANGEMENT (2. Continuity)

By CONTINUITY, we mean:
is the fuel connected — UNIFORM ——→

. . . or is the fuel not connected —
←——PATCHY

GO TO NEXT FRAME

147

down
canyon

148

A canyon is a deep valley with high, steep slopes. Here is a narrow canyon. The wind causes turbulent, or confused, drafts as it blows across this _______ canyon.

20

Answer is ⓓ; two of these are correct.
(b) closing valve of gas line, removing the fuel.
and
(c) clearing with a bulldozer.
are correct.

21

Closing a gas valve and clearing with a bulldozer are examples of ________ the Fire Triangle by removing the ______.

Draw the triangle here ——————→ to illustrate this.

52

spontaneous combustion

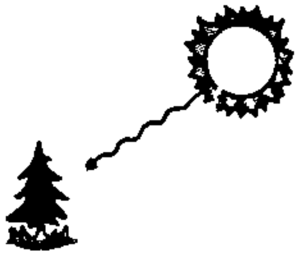
53

We have learned that HEAT is necessary for combustion. The Fire __________ shows this is true. We have learned that heat is produced by fuels on fire but the fuel must be hot enough to burn by itself --- it must be at __________ temperature. Finally, we just learned there are five sources of ________.

84

85

The weather can make it easier for fires to start. The sun can heat the fuel and __________ its temperature. This is heat transfer by __________.



116

117

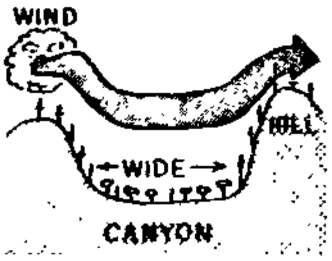
If the fuel is connected it is ____________ while if it is spread out and ______ connected it is patchy.

148

narrow

149

Here is a wide canyon. Notice that the wind across it normally is steady and the violent up and down drafts are absent.



GO TO NEXT FRAME

21

breaking fuel

22

Combustion may be stopped by:

(a) __________ the HEAT; _________ is often used for this.
(b) __________ the FUEL; in a forest area this is sometimes accomplished by using a __________.
(c) __________ the OXYGEN; in a mountain area this consists of __________ dirt.

53

Triangle
ignition
heat

54

Five sources of HEAT that cause fires are:

(1) ______________________________
(2) ______________________________
(3) ______________________________
(4) ______________________________
(5) ______________________________

85

[illegible]

86

The sun or a hot wind can _________ the forest fuel and cause its ____________ to increase.

117

[illegible]

118

The continuity of this fuel ⇨

is __________.

149

150

Air currents in a canyon are similar to water currents in a river. Here is a diagram of currents in a river. Notice the whirlpools near the sides as the water becomes turbulent and confused.

GO TO NEXT FRAME

22

(a) reducing; water
(b) removing; bulldozer
(c) removing; applying

23

IGNITION TEMPERATURE

We are now ready to discuss IGNITION TEMPERATURE. IGNITION TEMPERATURE is the temperature of a substance at which it will ignite and burn.

Every substance has an IGNITION ____________.
At this ____________ the substance will burn.

54

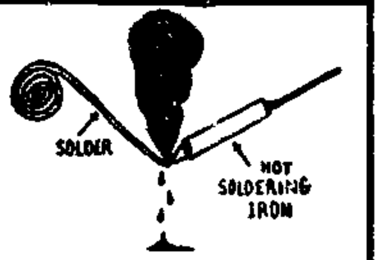
(1) Direct Application of Flame.
(2) Direct Application of Embers.
(3) Electrical Arcing.
(4) Friction.
(5) Spontaneous Combustion.

55

HEAT TRANSFER

Let us examine HEAT TRANSFER, now.

HEAT is a form of energy which can be moved or transferred from one substance to another. In this example, a hot iron is transferring HEAT to cold solder. The solder is heated and it melts.



GO TO NEXT FRAME

86

heat
temperature

87

When a WIND blows across forest areas, the fuel becomes dried-out. The wind actually causes the moisture in the fuel to leave by evaporation.

GO TO NEXT FRAME

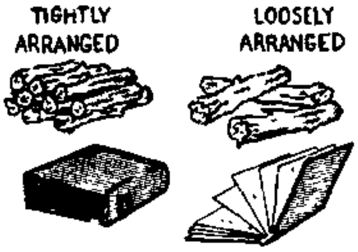
118

uniform

119

ARRANGEMENT (3. Compactness)

The COMPACTNESS of a fuel refers to whether it is TIGHTLY ARRANGED and has little oxygen in with it, or LOOSELY ARRANGED with a large amount of oxygen mixed with it.



GO TO NEXT FRAME

150

151

And here is a canyon of the same shape. Wind blowing along, through it, produces turbulent currents and confused drafts.

Think what this can do if a fire starts on a slope!

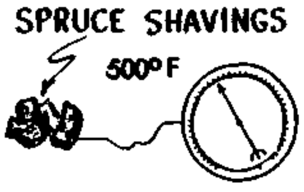
GO TO NEXT FRAME

23

TEMPERATURE
temperature

24

Spruce shavings ignite at 500° F. This is the ______ TEMPERATURE of spruce shavings.



55

56

HEAT is TRANSFERRED in three ways:

1. Radiation
2. Convection
3. Conduction

GO TO NEXT FRAME

87

88

Sun will ______ forest fuel and ______ its temperature. Hot wind will remove ______ from the forest fuel. Together, these will bring the fuel temperature ______ to its IGNITION TEMPERATURE.

119

120

Loosely arranged fuel has a ______ amount of ______ mixed with it. It therefore burns ______. It is not as COMPACT as tightly arranged fuel. Tightly arranged fuel has a ______ amount of ______ mixed in with it.

151

152

If wind blows across a narrow canyon, the currents will be ______. The same wind across a wide canyon will be calmer.

24

IGNITION

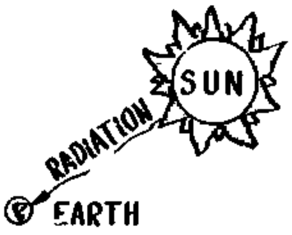
25

The IGNITION TEMPERATURE is the temperature of a substance when it just starts to ________.

56

57

The sun is hot and the HEAT which leaves the sun travels to the earth. It heats the earth. This is an example of RADIATION.



GO TO NEXT FRAME

88

heat
increase (or raise)
moisture
close (or up)

89

We have said many times that the Fire Triangle consists of ____________, ____________, and __________.
Air contains ____________.

120

large
oxygen
quickly
small
oxygen

121

Fuel with large air spaces between particles is called __________ ____________.

152

turbulent
(or confused)

153

If wind blows along and through a narrow canyon, the currents are similar to water currents in a _________ of the same shape. The air currents will be ________ and a fire on a slope will have large amounts of _________ fed to it and probably produce sparks and then _____ fires.

25

burn

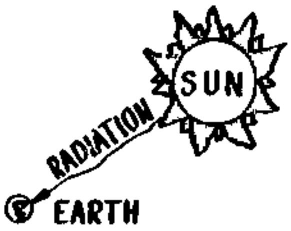
26

Look at the thermometer. It reads ______.
This is spoken as "800 degrees Fahrenheit".
The abbreviation for degrees is ____, and
for Fahrenheit it is____.

57

58

In radiation, the hot substance does not have to be in direct contact with the cold substance. The heat is transferred through the air.
Heat which is transferred through the air from one substance to another is an example of __________.

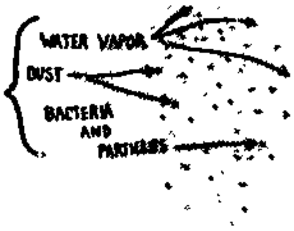


89

fuel
oxygen
heat
oxygen

90

Air contains oxygen and it also contains



We will be studying the WATER VAPOR in air.

GO TO NEXT FRAME

121

loosely arranged

122

Loosely arranged fuel is ______ compact than
___________ ___________ fuel.

153

river
turbulent
oxygen
spot

154

Electrical arcing at high elevations results from storms and the ________ they produce. This is almost always followed by thunder.

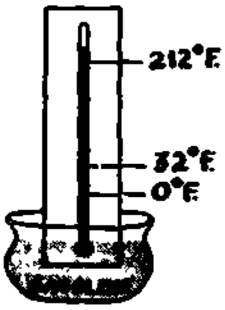
26

800° F
(if F is left out,
the answer is
incorrect)
a
F

27

Regular gasoline has an IGNITION TEMPERATURE
of about 700° ______________.
(spell out)

The FUEL in this illustration is not
at its ______________
and therefore will not ________
even though both HEAT and __________ are present.



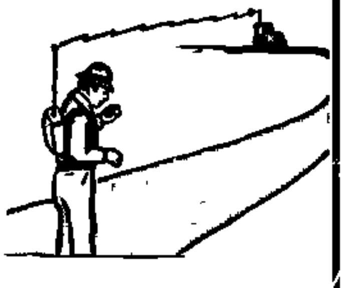
58

radiation

59

In the Forest Service, two-way radio is
used to communicate. Radio energy is
transferred through the air from one
radio unit to another.

Radiation of HEAT is transferred through
the ______ from one substance to
________.



90

91

WATER VAPOR is invisible in the air. WATER VAPOR is
moisture in the air which is around us.

Can we see water vapor in the air? ______ (Yes, No)

122

less
tightly arranged

123

③ **VOLUME**

Finally, we come to the third Forest Fuel Factor, the VOLUME
of forest fuel. You recall that once a fire begins, it produces
its own ______ so combustion may continue. Therefore, more
fuel is used, more oxygen is used, more heat is produced, and
so on! If a large VOLUME of fuel is available, the fire will
____________ in size.

154

lightning

155

At very high elevations, more fires
are caused by these storms and the
____________ they produce than
by anything else.

27

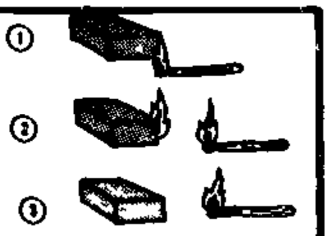
Fahrenheit
IGNITION
TEMPERATURE
burn
OXYGEN

28

① A FUEL is raised in temperature by applying HEAT.

② As soon as it starts to burn, the HEAT is removed.

③ With HEAT removed, the fire goes out.



The FUEL was not really at IGNITION TEMPERATURE. It must continue to burn using its own HEAT to be at IGNITION TEMPERATURE.

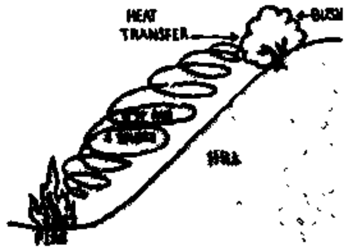
GO TO NEXT FRAME

59

air
another

60

The second way that HEAT may also be TRANSFERRED is by convection. In this diagram we see the movement of hot air and smoke from the fire rising along the hill. The hot air heats the bush. This is an example of heat transfer by convection.



GO TO NEXT FRAME

91

No

92

The meter is measuring a "moist" air, but notice it is not "wet" air.

Water vapor is __________ in the air. The amount will change from day-to-day.

The meter

123

heat
increase

124

Now, combine all of these ideas on FOREST FUELS to complete this: When we talk of fast-burning fuel we also mean ______ fuel. If fuel is connected continuously it is __________, while if it is separated it is ________. A compact fuel is called __________ because it has very little __________ mixed with it. If a large ________ of fuel is available, the fire will enlarge.

155

lightning

156

At very high elevations, smaller fires usually occur because:

(a) fuel is uniform.
(b) fuels there are less likely to combust because they hold moisture.
(c) not true -- larger fires occur.
(d) none of the above.

28

29

IGNITION TEMPERATURE is when FUEL ___ ______ and continues to ______ without adding ______ from an outside source.

60

61

If air is warm and it moves to another location --- then gives off some heat to the surrounding area, this is heating by ____________.

92

moisture

93

Air which has little water vapor has a low __________ content. It is dry air.

124

light
uniform
patchy
tightly arranged
oxygen
volume

125

TOPOGRAPHY

The last topic in this INTRODUCTION TO THE FUNDAMENTALS OF FIRE BEHAVIOR will deal with the physical features of the earth's surface . . . this is known as topography. This is easy to remember since it refers to the "top of" the earth --- topo-graphy = topography.

GO TO NEXT FRAME

156

(b)

157

VERY HIGH ELEVATION

(a) The size of fires at very high elevations is ________.
This is due to the _____ which holds its __________.

(b) The main cause of fire at very high elevations is ______________.

29

burns
burn
heat

30

From the chart, what can you conclude about the IGNITION TEMPERATURES of different FUELS? (write) ____________

____

____

____

FUEL	IGNITION TEMPERATURE *
Woolen Blanket (roll)	400° F
Short-Leaf Pine (shavings)	440° F
Spruce (shavings)	500° F

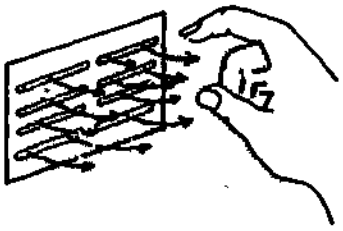
(* approximate)

61

convection

62

The hot air heater you see is transferring heat by ____________.



93

water (or moisture)

94

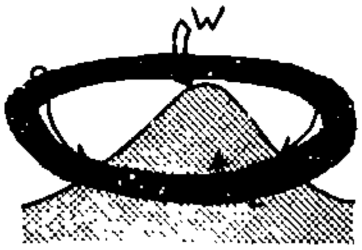
The measuring of the amount of water vapor in the air is called finding the relative humidity. It is in % (PERCENT).

GO TO NEXT FRAME

125

126

Here is a hill. The side of the hill facing the south is called the southern exposure. Therefore, the side facing the north is called the ____________ exposure, the side facing east is the ____________ exposure, and the side facing west is the ____________ exposure.



157

(a) small. fuel, moisture
(c) lightning (or electrical arcing)

158

Well, sir, you have just completed

"INTRODUCTION TO THE FUNDAMENTALS OF FIRE BEHAVIOR"

Assignment Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Plant Growth and Classification

TOPIC: Respiration

OBJECTIVE: To learn about the process of respiration and to study its relation to photosynthesis

INTRODUCTION: All cells must carry on respiration in order to stay alive. Most of us understand less about the process of respiration in the plant as compared to our knowledge of respiration in the animal. Yet the processes are very similar in the animal and plant cell.

EFERENCE: Required:
Crop Production in the South, Klingman, pp 29-32

QUESTIONS or ACTIVITIES

1. Define respiration
2. What two materials are formed when food is decomposed with the addition of oxygen?
3. How much do the chemical equation for photosynthesis and respiration differ?
4. What gas do plants release at night?
5. What are the raw materials needed for respiration?

31

different

32

Woody fuels of the forest have different ______ temperatures.

GO TO FRAME 33, PAGE 1

63

conduction

64

HEAT TRANSFER:

(a) from a far-away object, such as from the sun, is transfer by ______.
(b) due to a heated substance moving, such as heated air, is by ______.
(c) inside an object, such as from the hot end of a log to the cool end, is by ______.

95

dry
water

96

If the relative humidity is 80%, the air is ______ and has considerable ______.

127

exposure
west

128

A common term for "side" of a hill or of a canyon is SLOPE.

A SLOPE is the ______ of a hill. The side of a canyon is also the ______.

SUMMARIZED REFERENCE

1. THE FIRE TRIANGLE

The act of burning is called COMBUSTION.

In order to have combustion, FUEL, OXYGEN and HEAT are needed.

Needed for Combustion	Breaking the Fire Triangle
Fuel	Constructing a fire line
Oxygen	Apply dirt
Heat	Cool by applying water

2. IGNITION TEMPERATURE

The IGNITION TEMPERATURE is the temperature of a substance at which it will ignite and continue to burn without adding heat from an outside source.

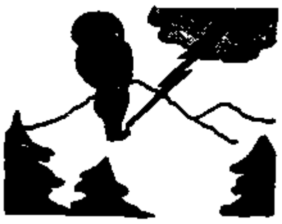
Different fuels have different ignition temperatures.

3. SOURCES OF HEAT

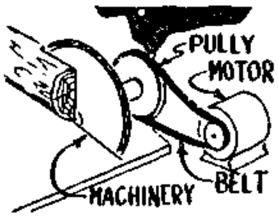
(1) Direct Application of Flame
(matches, blowtorch)

(2) Direct Application of Embers
(lighted cigarette, cigar ashes)

(3) Electrical Arcing
(snapped high tension power line, lightning)



(4) Friction
(slipping pulley on machinery, moving machinery)

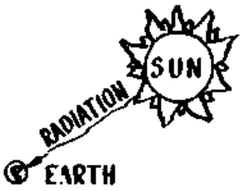


(5) Spontaneous Combustion
(pail of oily rags)

4. HEAT TRANSFER

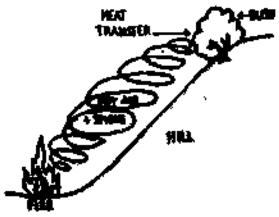
(1) Radiation

Heat is transferred from its source, through the air, to an object.



(2) Convection

Heat is transferred by the movement of hot air and smoke rising and heating the fuel above.



(3) Conduction

Heat is transferred within the fuel, or from one fuel to another, by direct contact (from the hot point to the cold point).

5. WEATHER FACTORS

(1) Wind

Wind is a movement of air. This air contains oxygen which supports combustion.

Wind pressure can increase burning in one direction or another.

Wind can blow sparks and embers ahead of the main fire into unburned fuel. This is called SPOTTING. Such new fires are called spot fires.

(2) Temperature

The sun or a hot wind can heat the forest fuel and cause its temperature to increase. As the fuel temperature approaches the ignition temperature, less heat is required to start a fire.

(3) Humidity

Humidity is moisture.

Relative humidity is the amount of moisture in the air.

Moisture in the air is called Water Vapor.

The measuring of the amount of water vapor in the air is called finding the relative humidity. It is in % (PERCENT).

Wind blowing across forest areas will dry out the forest fuel by causing the moisture in the fuel to leave by evaporation. This makes the forest fuel more susceptible to burning.

b. FOREST FUEL FACTORS

(1) Size of Fuel

In the Forest Service we think of size of Fuel as being light or heavy.

a. Light fuel is fast burning.
(examples: dry leaves, dry grass, tree needles)

b. Heavy fuel is slow burning.
(examples: logs, tree stumps, large limbs)

(2) Arrangement

The arrangement of fuel also determines how fast the fuel will burn due to the oxygen in the air around it. The more oxygen around the fuel, the faster it will burn.

a. Ground or Aerial

1 Ground fuel will burn slower. (less air around it)

2 Aerial fuel will burn faster. (more air around it)

b. Continuity - by continuity we mean, is the fuel:

1 Uniform (fuel connected) - fast burning.

2 Patchy (fuel not connected) - slow burning.

c. Compactness - by compactness we mean, is the fuel:

1 Tightly arranged - slow burning.

2 Loosely arranged - fast burning.

(3) Volume

With a large amount of fuel available, the fire will burn with large amounts of heat.

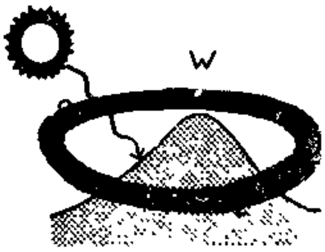
7. TOPOGRAPHY

Topography deals with the physical features of the earth's surface.

SLOPE - is the "side" of a hill or canyon.

(1) <u>Exposure</u>

The southwest exposures receive most of the sun during the year. It is the most hazardous exposure, since it also receives the most heat.

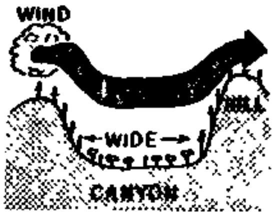


(2) <u>Steepness</u>

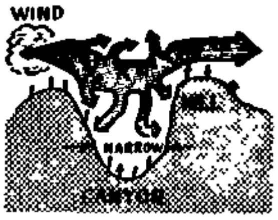
On a steep slope, fires burn about 16 times faster upslope than down.

(3) <u>Canyon fire behavior</u>

Wind across a wide canyon is normally steady and the violent up and down drafts are absent.



Wind across a narrow canyon causes turbulent, or confused, drafts.



If wind blows along and through a narrow canyon, the currents are similar to water currents in a river of the same shape. The air currents will be turbulent and a fire on a slope will have large amounts of oxygen fed to it and probably produce sparks and then spot fires.

(4) Very High Elevation

The main cause of fire at very high elevation is lightning.

Usually the size of fires at very high elevations is small. This is due to the fuel which holds its moisture.

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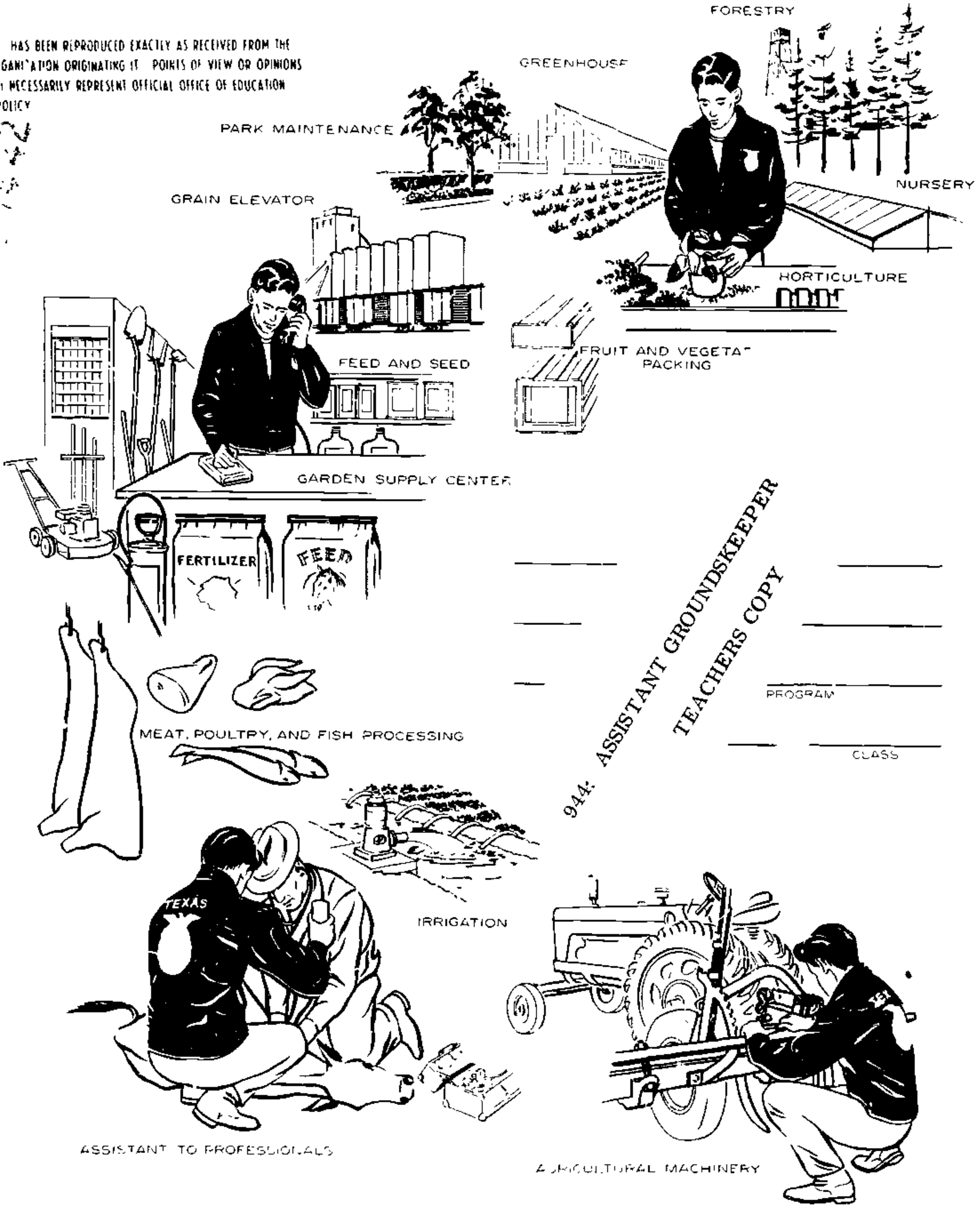
*STUDY GUIDES, *VOCATIONAL AGRICULTURE, *COOPERATIVE EDUCATION, *GROUNDS KEEPERS, TESTS, ANSWER KEYS, *ORNAMENTAL HORTICULTURE, GRADE 11, GRADE 12, LANDSCAPING,

The purpose of this document is to provide a study guide for vocational agriculture cooperative education students preparing to become assistant groundskeepers. It was prepared by vocational agriculture teachers in consultation with subject matter specialists. Sections in the guide include (1) introduction to horticulture, (2) plant growing media, (3) plant growth and classification, (4) plant propagation, (5) nursery plant production, (6) floral crop production, (7) lawn establishment and care, (8) plant insect, disease, and pest control, (9) equipment operation and maintenance, and (10) landscape development and maintenance. Each section includes information sheets, assignment sheets, assignment answer sheets, topic tests, and topic test answer sheets. A qualified vocational agriculture teacher may use the material as a 180-hour course of study with junior and senior boys with occupational goals as assistant groundskeepers. Necessary supplementary materials are cited in the document. This document is available for $4.50 from Agricultural Education Teaching Materials Center, Texas Agricultural and Mechanical University, College Station, Texas 77843. (JM)

AGRICULTURAL · EDUCATION

Agricultural Coöperative Training

VOCATIONAL AGRICULTURE



944. ASSISTANT GROUNDSKEEPER

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PROGRAM

CLASS

AGRICULTURAL

• EDUCATION •

Agricultural Cooperative Training

VOCATIONAL AGRICULTURE

ACKNOWLEDGEMENT

This course of study is designed for the Texas vocational agriculture student who is enrolled in a Cooperative Part-Time Program in agriculture

Appreciation is expressed to the members of the Texas Nurserymen's Association who assisted in developing the course outlines for the horticultural occupations.

Front, left to right Tom Shelton, Bill Fritzpatrick, Bill Fullingim, Carroll Wilson; Back, left to right: L C House, Steve Dodd, Albert Biggio, Raymond Tate

Credit for the material contained herein is largely due to James Fitts, Vocational Agriculture Teacher, Victoria, Texas, and Johnny M Johnson, Subject Matter Assistant, Texas A&M University,

Assignment Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT. Constructing, Maintaining, and Using Structures That Aid Plant Growth

TOPIC. Humidity and Watering

OBJECTIVE To become familiar with the effect of humidity on the development of plants and to learn how to determine water requirements

INTRODUCTION Humidity, moisture found in the air, and the amount of soil water can greatly affect the growth of plants Overwatered plants will be stunted, yellow in color, and defective in root development The amount of humidity can reduce the food production process of the plant or cause excessive wilting

REFERENCES

Required:

1 <u>The Ball Red Book</u>, George J Ball, Inc pp 111-114

QUESTIONS or ACTIVITIES

1 What means of watering is best for commercial pot plant crops?
2. How are the majority of bedding plants watered?
3 What are three disadvantages of an overhead watering system in a greenhouse?
4 Explain how a Rainbird-type nozzle system operates?
5. Explain how the Skinner irrigation system operates.

COURSE OUTLINE

DEVELOPED BY STATE ADVISORY COMMITTEE
ORNAMENTAL HORTICULTURAL OCCUPATIONS

Unit I	Introduction to Horticulture	1. Horticulture as an Industry
		2. Exploring Occupational Opportunities
Unit II	Plant Growth and Classification	1. Introduction
		2. Photosynthesis
		3. Respiration
		4. Water Absorption and Loss--Nutrient Absorption--Movement of Water and Nutrients in the Plant
		5. Plant Food
		6. The Plant Kingdom
Unit III	Constructing, Maintaining, and Using Structures that Aid Plant Growth	1. Types of Greenhouses
		2. Size and Arrangement of Greenhouses
		3. Cooling the Greenhouse (Summer and Winter)
		4. Heating the Greenhouse (Space and Bench Heating)
		5. Winter Protection Structures
		6. Structures for Summer Heat Protection
		7. Humidity and Watering
		8. Ventilation
		9. Lighting
		10. Wiring and Electrical Controls
Unit IV	Plant Growing Media	1. Origin, Composition and Importance of the Soil
		2. Soil Moisture
		3. Soil Mixtures
		4. Mulches and Their Use
		5. Fertilizer Nutrients
		6. Soil Organisms
		7. Soil Sterilization
		8. Growing Media Other Than Soil

Unit V	Plant Propagation	1. Introduction to Propagation 2. Propagation from Cuttings 3. Propagation by Layering 4. Propagation by Division 5. Propagation by Grafting and Budding 6. Propagation from Seed 7. Developing a Plant Breeding Vocabulary 8. Plant Selection and Fundamentals of Plant Breeding 9. Heredity 10. General Breeding Techniques
Unit VI	Nursery Plant Production	1. Transplanting Ornamental Trees and Shrubs 2. Care and Maintenance of Plants
Unit VII	Floral Crop Production	1. Introduction to Floral Crop Production 2. Growing Annuals 3. Perennials 4. Bulbs 5. Characteristics, Identification, and Use of Important Pot Plants 6. Poinsettia 7. Chrysanthemum 8. Geranium 9. Hydrangea
Unit VIII	Establishing and Caring for Lawns	1. Turf Grasses for Texas 2. Establishing a New Turf 3. Managing an Established Turf 4. Turf Problems
Unit IX	Controlling Plant Insects Plant Diseases, and Other Pests	1. Causes of Plant Diseases 2. Identifying Plant Diseases 3. Application and Safety Precautions of Horticultural Chemicals 4. Controlling Stem, Branch, and Trunk 6. Controlling Root Diseases 7. Controlling Diseases Affecting the Entire Plant

Unit IX	Controlling Plant Insects, Plant Diseases, and Other Pests (continued)	8	Controlling Lawn and Turf Diseases
		9	Identifying Plant and Soil Insects and Methods of Control
		10	Nematodes
		11	Control of Moles, Gophers, Birds, Deer, and Ants
		12	Controlling Weeds
Unit X	Operating and Maintaining Horticultural Equipment	1	Principles Used to Prevent Personal Injury and First Aid Principles
		2	Selecting and Maintaining Horticultural Hand Tools
		3	Maintaining Small Power Equipment
		4	Operating and Maintaining Lawn Mowers Safely and Effectively
		5	Operating Rotary Tillers Safely and Effectively
		6	Operating Garden Tractors Safely and Effectively
Unit XI	Developing and Maintaining the Landscape	1	Introduction to Home Landscaping
		2	Selecting the Site
		3	Scheduling Landscape Development and Beginning Plans
		4	Analyzing Problems and Determining Needs
		5	Developing the Landscape Plan
		6	Selecting Plants
		7	Grading, Drainage and Landscape Structures
Unit XII	Merchandising Horticultural Plants and Supplies	1	Developing Personal Traits
		2	Displaying
		3	Advertising
		4	Labeling and Pricing
		5	Understanding Customers and Making Sales

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Assignment Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT Introduction to Horticulture

TOPIC Horticulture as an Industry

OBJECTIVE To become aware of the importance of Horticulture and to develop an understanding of the fields of study involved

INTRODUCTION. Horticulture is an important branch of agriculture The first definition of horticulture limited the field to cultivation of gardens Flowers. vegetables. fruits and ornamentals that were grown primarily in gardens soon acquired the name of "horticultural plants" in contrast to "field crops" such as corn and cotton We now think of horticulture as the production of flowers, vegetables. fruits. and ornamentals in the garden on a large scale basis It also includes the many services which are auxiliary to the production and marketing of horticultural crops.

REFERENCES Required

1 Information Sheet. "Horticulture as an Industry"

QUESTIONS or ACTIVITIES

1 With what type of crop is the olericulturist concerned?
2 With what type of crop is the pomologist concerned?
3 What four major types of crops are included in horticulture?
4 In which group of fruits do grapes belong?
5 In which group of fruits do apples belong?
6 What caused the expansion of vegetable growing?

Information Sheet
on
HORTICULTURE AS AN INDUSTRY

There are three major fields of horticulture Floriculture is the cultivation and management of ornamental and flowering plants Landscaping has also become an important function of the floriculturist Pomology is the science and practice of fruit growing Olericulture is the production, processing and distribution of vegetable crops

Floriculture was well developed thousands of years ago by the civilizations of Asia Their beautiful gardens required much knowledge and skill A landscape designer must have a knowledge of the principles of design along with a thorough understanding of plants Plant breeding has become very popular in the floriculture field. Patience and care are needed in this tedious task of developing new and improved plants

Pomology is a very demanding field Fruit trees are under constant attack from diseases and insects The fruit producer must be able to control these pests effectively. The pomologist also has to have a thorough understanding of plant growth There is a great deal of specialization in the field of fruit growing Many choose to work only with citrus, others concentrate on small fruits such as grapes. and still others deal with deciduous tree fruits such as apples There are countless jobs to be found in the field of pomology

Olericulture is a gigantic enterprise that is quite distinct from any other phase of plant production The annual farm value of vegetable crops in the United States is well over a billion dollars The big expansion in the vegetable industry was due primarily to an increase in production of out-of-season vegetables in the South and West The production, processing, and marketing of this huge crop requires a great number of personnel

As we can readily see, horticulture is a giant industry. If you are interested in plant growing and are willing to work hard in gaining new knowledge. a good future awaits you

Assignment Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Introduction to Horticulture

TOPIC: Exploring Occupational Opportunities

OBJECTIVE: To develop an understanding of the requirements of some specific occupations and to determine the factors to consider in selecting an occupation

INTRODUCTION: This lesson is designed to help you decide upon an occupation in the field of horticulture In this lesson we will explore only five major occupations, all of which are available to cooperative part-time students in agriculture. In addition, instructional materials have been prepared for these occupations to assist you in developing into a skilled worker with potential for advancement in your chosen occupation

In recent years the need for trained workers in these occupations has increased greatly. If you like the work and apply yourself on the job and in your studies a world of opportunity awaits you

REFERENCES: Required.

1 Information Sheet, "Exploring Occupational Opportunities"

Supplemental

2 Handbook of Agricultural Occupations", Hoover

QUESTIONS or ACTIVITIES:

1. List the steps of advancement in a horticulture career
2 If possible, what is the best way to answer self appraisal questions concerning a certain job?
3 If you wanted a horticultural job which allowed you to work both inside and outside, which would you choose?
4 Prepare a list of businesses in your community which raise or sell horticultural products
5. Study the 18 factors to consider in selecting a job and be prepared to apply these factors in selecting your occupation

Information Sheet
on
EXPLORING OCCUPATIONAL OPPORTUNITIES

The selection of a vocation in horticulture is similar to that of other fields Basic questions arise in the mind of the person who is trying to select a vocation These questions or factors must be dealt with before a satisfactory selection can be made The following list points up some of these questions

Factors One Should Consider in Selecting a Job

1 What is the nature of the work? What kind of jobs will I be expected to do?
2 Does the occupation require chiefly mental or physical effort? Will my health allow me to do this work?
3 Is the work inside or outside work, or both?
4 What are the working conditions? With whom will I be working?
5 What personal qualifications are required for entry into the occupation?
6 What are the educational and training requirements for the job?
7 Is there opportunity for doing a variety of jobs?
8 Will the work require considerable travel and time away from home?
9 What financial earnings can one expect?
10. Are any fringe benefits provided by the business?
11 Is there a great deal of risk involved in performing the job?
12. What security and benefits are offered in the occupation?
13 Are there opportunities for advancement and self-betterment?
14. Is the employment on a regular or seasonal basis?
15. Does one work regular hours? Eight ten, or twelve hour day? Day or night shift?
16. Is there stability of residence or must one make frequent moves?
17 Will the job necessitate that one get along well with others or will one work pretty much alone?
18 How much personal expense is involved in clothing. transporation and meals?

Another very important question in the selection of a vocation is that of advancement Usually a person who cannot advance in his chosen field will become unhappy and fail to do his best. This question should be investigated before choosing a vocation in the field of horticulture.

The opportunity for advancement is fairly good in this field The following sketch demonstrates an example of the possible steps in the advancement of the horticulturist who applies himself to his work

Advancement in Horticultural Occupations

1 Laborer
2 Foreman or Supervisor
3 Assistant Manager
4 Manager or Owner

Exploring Occupational Opportunities
(Information Sheet continued)

As you can see from this example, application. education and experience can determine the speed and degree of advancement

Probably the most important question of all is, "am I personally suited for a career in horticulture"? It can only be answered after you have investigated the field and have a good knowledge of what it is and what it offers The answer probably lies in self appraisal

This self appraisal can be achieved by asking yourself the following questions.

1 Do I prefer working with things?
2 Do I prefer working with facts, figures, and ideas?
3. Do I have a love for growing things?
4 Do I like to work with people?
5 What kind of work experiences have been most enjoyable to me?
6 What kind of work would I like to be doing five, ten, or fifteen years from now?
7 Will my health permit me to make the choice I want?

Probably the best way to determine the answer to these questions is by actually working on a job for a while However, this cannot always be done Circumstances do not always permit this

There are other good ways to determine some answers Your fondness for certain subjects in school, your interest in certain activities, study of the field of horticulture, talks with your teachers, guidance counselors and others may indicate interests and abilities that will help you to partially answer the questions Such things as cooperativeness, willingness to work, dependability, willingness to assume responsibility resourcefulness and self-reliance are all basic qualifications that you will need in ornamental horticulture as well as other occupations

A close look at some of the jobs in horticulture will reveal many opportunities and requirements As you look at each job try to decide if you are interested and qualified

Job Title - Greenhouse Worker

Job Description

A greenhouse worker grows plants in an artificially heated glass or plastic greenhouse. The plants grown may be vegetables or flowers, and the work may include the propagation of trees or ornamental shrubs from seeds of cuttings Greenhouse specialties include producing out-of-season vegetables such as tomatoes. cucumbers. or leaf lettuce, producing cut flowers or pot plants, growing bedding plants for sale. or starting plants for outdoor nursery beds In many cases a greenhouse is a part of a nursery operation In such cases, a worker may be performing the duties of a nursery worker as well as

Exploring Occupational Opportunities
(Information Sheet continued)

those of a greenhouse worker An employee in the greenhouse screens, mixes, sterilizes soil, and places it in growing containers He sows seeds, starts cuttings, and transplants seedlings and plants He waters, feeds, weeds, thins prunes, and sprays growing plants He may control the greenhouse temperature and humidity. He also maintains the greenhouse structure and equipment He should know the names and the culture of the plants with which he works.

Job Title - Nursery Worker

Job Description

A nursery worker grows seedlings and plants for landscaping, fruit farming, and forest replanting. He may work in one of several kinds of nurseries. Some nurseries specialize in producing fruit trees and small fruit transplants, some in ornamental trees and shrubs, and some in forest replanting materials Some nurserymen operate greenhouses and produce their own seedlings and plants from cuttings Some produce planting stock of two or more major lines of plants, trees, or shrubs

A nursery worker prepares seedbeds, plants seedlings, weeds, cultivates, fertilizes, waters, prunes, and performs other cultural practices such as spraying and grafting He digs, grades and packs plants for shipment He may cut, lift, and lay sod He transplants shrubs and trees, and in a tree nursery, gathers and processes forest tree seeds He helps with the maintenance and repair of buildings and equipment

A nursery employee assists customers in selecting plants for home landscaping He also makes recommendations on maintenance to the customer and may work at a nursery where he will be required to make periodic checks on customer's lawns and to maintain the beauty of the landscape

Job Title - Garden Center Employee

Job Description

A garden center employee performs many jobs including caring for ornamental plants, moving plants and supplies into selling areas, arranging plants and supplies for display purposes, and selling the various products handled by the garden center A garden center may be part of a large retail store, a part of a nursery or greenhouse operation, or a retail establishment separate from any other business

Exploring Occupational Opportunities
(Information Sheet continued)

The work of a garden center worker includes cleaning, stocking, and arranging garden supplies on shelves, counters, and in windows He cares for ornamental plants by watering, feeding, trimming, spraying, and controlling temperatures The worker unloads and unpacks supplies as they arrive from wholesalers, loads orders on trucks, makes deliveries, and loads orders into customer's cars He gives information to customers on care of plants, care of lawns, plant varieties, and merits of different garden supplies and equipment

Job Title - Assistant Groundskeeper

Job Description

An assistant groundskeeper cares for the area surrounding an industry or business, church, school, airport apartment building, private estate, cemetery, or shopping center. The employee plants and cares for lawns and ornamental plants. The work involves mowing grass, reseeding, controlling weeds, and planting and spraying ornamental plants He rakes and disposes of leaves and other refuse Year round employment is provided through maintenance and repair of walks, drives, and equipment The work may also involve making minor repairs to buildings

Job Title - Parks and Landscape Employee

Job Description

A parks and landscape employee performs the work necessary for proper maintenance of landscapes and park area

The work of this occupation includes mowing grass, trimming, the edges of walks and driveways, planting, pruning and caring for trees, shrubs, hedges, lawns, and flower beds; controlling insects, diseases, and weeds; and caring for the soil The work may also include such jobs as removing trash or snow, maintenance of swimming pools, care of boating facilities, general maintenance of buildings and equipment, and repair of roadways and drives.

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Material for this information sheet was partially taken from Ornamental Horticulture for Vocational Agriculture in Alabama

Assignment Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Plant Growth and Classification

TOPIC: Introduction

OBJECTIVE: To develop an understanding of the importance of studying the properties and life phenomenon exhibited by a plant

INTRODUCTION. There are over 350,000 different kinds of plants in the world No one person can know all of them. but he can learn the characteristics that are common to all of them Without a knowledge of botany a plant grower is lost If he does not know how plants grow, how can he possibly be successful in raising them?

REFERENCE: Required·
Crop Production in the South, Klingman, pp. 13-19

QUESTIONS or ACTIVITIES.

1. What is botany?
2. How many different kinds of plants are known to exist?
3. Name two carbohydrates.
4. What is the major difference between plants and animals other than the ability to move and to think?
5. What was the wrong conculsion that Van Helmont made after his experiment concerning plant growth?

Assignment Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Plant Growth and Classificati

TOPIC: Photosynthesis

OBJECTIVE: To learn how plants produce their food.

INTRODUCTION: Van Helmont failed in his experiment to determine why plants grow. He thought that water alone was responsible for the growth. Van Helmont did not know about photosynthesis; so his conclusion was wrong.

REFERENCES: Required:
Crop Production in the South, Klingman, pp. 19-24

QUESTIONS or ACTIVITIES:

1. What does photo mean?
2. Define synthesis.
3. What is a more complete definition of photosynthesis?
4. What is a calorie?
5. What is a molecule?
6. What is the term used to describe the movement of gas or liquid from an area of high concentration to an area of low concentration?

Assignment Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Plant Growth and Classification

TOPIC: Respiration

OBJECTIVE. To learn about the process of respiration and to study its relation to photosynthesis.

INTRODUCTION: All cells must carry on respiration in order to stay alive Most of us understand less about the process of respiration in the plant as compared to our knowledge of respiration in the animal. Yet the processes are very similar in the animal and plant cell

REFERENCE. Required:
Crop Production in the South, Klingman, pp 29-32

QUESTIONS or ACTIVITIES

1 Define respiration
2 What two materials are formed when food is decomposed with the addition of oxygen?
3. How much do the chemical equation for photosynthesis and respiration differ?
4. What gas do plants release at night?
5 What are the raw materials needed for respiration?

Assignment Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Plant Growth and Classification

TOPIC: Water Absorption and Loss- Nutrient Absorption- Movement of Water and Nutrients in the Plant

OBJECTIVE: To understand how water and nutrients are absorbed by the plant to understand how water is lost, and to study the transportation system of the plant

INTRODUCTION: One of the necessary functions of plants is to absorb water and nutrients from the soil For proper management one must understand these absorption processes and also the transporting of these materials by the plant

REFERENCES: Required
<u>Crop Production in the South</u>. Klingman pp 32-35

QUESTIONS or ACTIVITIES

1 What will happen to a plant if its inside pressure is greatly reduced?
2 What is the term used to describe cells that are filled tight and result in plants standing straight?
3 Explain how an over supply of fertilizer around a plant's roots affect its water absorption process
4 What is transpiration?
5 What are nutrients?
6 What two conductive tissues make up a vascular bundle?
7 Explain why girdling a tree causes it to die

Assignment Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT Plant Growth and Classification

TOPIC: Plant Food

OBJECTIVE: To learn the different plant foods and their functions.

INTRODUCTION A food is any substance which can be used as a source of energy for carrying on the life processes. To really understand plant growth, one must understand the basis for life --- food

REFERENCE. Required.
<u>Crop Production in the South</u>. Klingman, pp. 24-29

QUESTIONS or ACTIVITIES:

1. What is food?
2. What are the 3 foods used for energy and growth?
3. What elements make up carbohydrates?
4. What is the primary function of fats?
5. Where in the plant are fats most commonly found?
6. What is the process called by which hydrogen is added to oils?
7. What are the components of protein?
8. What 4 elements make up aroung 97% of the dry weight of most plants?

Assignment Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT Plant Growth and Classification

TOPIC. The Plant Kingdom

OBJECTIVE. To become familiar with the system used to classify plants.

INTRODUCTION People in West Texas may call a certain plant "dove weed" while an East Texas farmer may call it "croton" Names vary with localities. The only way to solve this problem was to develop a unified method of classification

REFERENCE Required.
<u>Crop Production in the South</u>, Klingman, pp 35-40

QUESTIONS or ACTIVITIES

1 What is taxonomy?
2 What are the four divisions of plants?
3. In which division do we find most of the disease causing plants?
4. What are some examples of beneficial bacteria?
5. What plant causes smut, rust, mildew. and scab?

Assignment Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT Constructing, Maintaining, and Using Structures that Aid Plant Growth

TOPIC: Types of Greenhouses

OBJECTIVES To learn how greenhouses are constructed, used, and maintained.

INTRODUCTION Greenhouse production of horticultural plants is an enormous industry Driving a few miles across Texas. one can usually count several greenhouses that are in full operation It is interesting to note the various shapes of these structures and the different materials used in construction.

REFERENCES Required:
Flower and Plant Production in the Greenhouse, Nelson,pp 19-32

QUESTIONS or ACTIVITIES

1 What are the two most used materials for greenhouse coverings?
2 What time of year is best for repairing or replacing slipped or broken glass?
3 What properties should an ideal greenhouse plastic possess?
4 What are some of the advantages and disadvantages of polyethylene and vinyl?
5 How is the ventilation problem handled in greenhouses where there are no ventilators?

Assignment Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Constructing, Maintaining, and Using Structures that Aid Plant Growth

TOPIC: Size and Arrangement of Greenhouses

OBJECTIVE: To learn how to select the proper size and arrangement before constructing the greenhouse

INTRODUCTION: A careful study of greenhouse arrangement should be made before construction begins. The bench arrangement for the crops to be grown should be considered first Then the greenhouse that fits this arrangement should be built. If these factors are done in reverse and a structure is erected before working out bench plans, many inconveniences and headaches will be the result

REFERENCE: Required.
Flower and Plant Production in the Greenhouse, Nelson, pp 33-38

QUESTIONS or ACTIVITIES:

1 What should be considered first in deciding the size and type of greenhouse?
2 Why should boiler rooms be centrally located?
3 What are the requirements of good greenhouse benches?
4. What is the best height for pot plant benches?
5 What should be the minimum depth of cut flower benches?

Assignment Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT. Constructing. Maintaining. and Using Structures that Aid Plant Growth

TOPIC. Cooling the Greenhouse

OBJECTIVE To learn the different methods of cooling the greenhouse and how to use these methods most effectively

INTRODUCTION The weather in Texas during the summer months is usually very hot This presents a problem to the greenhouse owner A successful producer must have an effective cooling system or he may well lose every plant he owns

REFERENCES Required.

1 "Greenhouse Cooling". Texas Agricultural Experiment Station, MP-163

Supplemental

2 Flower and Plant Production in the Greenhouse, Nelson, pp 44-48

QUESTIONS or ACTIVITIES

1 What is plant respiration?
2 How many CFM should be exhausted for a greenhouse which is 40' wide and 70' long?
3. How many square feet of pad area would be needed in the above greenhouse? (nearest tenth)
4 How can debris and trash be kept out of the drip conductor and return gutter?

Assignment Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT Constructing, Maintaining and Using Structures that Aid Plant Growth

TOPIC Heating the Greenhouse

OBJECTIVE. To become aware of the problems involved in heating the greenhouse and how to handle these problems

INTRODUCTION There are two major systems of heating a greenhouse Each system has its advantages All factors involved should be considered before a choice is made

REFERENCES: Required

1 Information Sheet. "Heating the Greenhouse"
2 <u>Flower and Plant Production in the Greenhouse,</u> Nelson. pp 39-44

QUESTIONS or ACTIVITIES.

1. What is the oldest and most conventional type of greenhouse heating system layout?
2. What are the two sources of heat used in this system?
3. Where are the coldest spots in a greenhouse?
4. What are the two classifications of heaters according to the type of heating unit?
5. What are the two classes of heaters based on direction of air flow?

Information Sheet
on
HEATING THE GREENHOUSE

A dependable heating system is second only in importance to the efficient design and structural soundness of a greenhouse Any heating system employed in a greenhouse must be economical, efficient, and of sufficient size to maintain desirable greenhouse temperatures during anticipated extremes in outdoor temperatures.

An important consideration for any greenhouse operation is to operate the heating system at the lowest possible cost consistent with maintaining the temperature desired This requires that the heating system be designed correctly for the purposes intended, that it be operated properly and that careful and intelligent maintenance of the system be provided

GREENHOUSE HEATING DESIGN STANDARDS

The standard practice followed in the past has been to specify the design of a greenhouse heating system on the basis of a requirement to maintain a given temperature within the greenhouse at some given outdoor winter temperature It is comparatively simple to specify such a differential

Today the temperature required for the production of various crops grown in the greenhouse is general knowledge and is usually readily available

Recorded temperatures in historical records in nearly every climatic area are available and will provide considerable information on the outdoor winter temperatures, including both the extreme winter temperatures that have occurred in that particular area, and those that should be considered in regard to the type of design that is economically feasible for the greenhouse heating system

The acceptable standard for the design of a greenhouse heating system should go beyond this basic requirement, however A clarification of the greenhouse temperature requirements of the crop to be grown is very necessary

Greenhouse temperature requirements for the crop should not mean the temperature prevailing in the aisle space

The common practice that now prevails in determining the temperature requirements of the crop is to measure the temperature at the point where the crops are growing. One of the requirements of a well-designed greenhouse heating system should be the provision of a uniform temperature within allowable variations throughout the plant-growing area.

These requirements are rather complex and the average greenhouse operator is usually not well enough versed in heat engineering to make sure he is going to have the type of heating system that meets his requirements In most cases he does not have the skill, nor the time to plan such a system and he should depend upon someone well versed in this field

Heating The Greenhouse
(Information Sheet continued)

The most logical approach to the installation of a modern, up-to-date, economical and dependable greenhouse heating system is to seek the knowledge and experience that is available from a dependable greenhouse manufacturer Heating greenhouses is a specialized field which varies greatly from heating standards used for other type buildings

The National Greenhouse Manufacturers Association, a newly formed organization comprised of most of the major greenhouse manufacturers in the country has recognized this need on the part of the average greenhouse operator, and has been spending considerable time, effort, and funds and utilizing the best knowledge and experience available from it's various member organizations, to establish standards of design that will insure the greenhouse owner of the proper installations to meet his particular requirements

GREENHOUSE HEATING LAYOUTS

Pipe Coil Systems

The most conventional and the oldest type greenhouse heating system layout and the one most commonly accepted by greenhouse growers is the pipe coil system

This system employs the use of standard pipe which carries either steam or hot water The pipes are laid out around the greenhouse in various patterns to distribute the heat

In recent years the use of extended surface pipe has been introduced This pipe is commonly referred to as "finned pipe" This uses the extended surface or fins on the pipe for greater heat transfer from any given length of pipe The pattern of behavior, however, is similar to that of plain pipe coils, which makes the layout patterns fall into the same category

The proper layout of a pipe coil heating system is dependent upon an understanding of the basic laws of natural air movement to insure uniform temperature distribution throughout the greenhouse Any pipe coil system supplies the heat from a concentrated heat source in the immediate area of the pipe. and depends upon convection currents of air moving past the pipe to pick up this heat and convey it to all parts of the greenhouse

The coldest spots in the greenhouse are the gable ends and the exterior side walls, so pipe coils are suspended in these areas The warm air emitted from the pipe coils raises and sweeps along the glass, conteracting the rapid loss of heat through the glass This movement sets up the basic convection pattern of warm-air movement throughout the greenhouse for uniform heat distribution

A finned pipe has the concentrated heat effect of several lines of bare pipe so that any restriction of air movement or reduction of temperature difference is magnified.

Unit Heater Systems

In recent years the use of unit heaters for heating greenhouses has increased considerably. Most of these unit heaters are so designed that they not only take care of the heating requirements but air movement as well

One reason for the increase in popularity of unit heaters has without a doubt been the increasing interest in air movement within greenhouses Many greenhouse operators are of the opinion that the movement of air in the plant zone in the greenhouse (providing that the air moves at a low velocity) has the effect of preventing the building of excess humidity within the foliage that leads to the development of certain conditions. Air movement brings in and replenishes the supply of carbon dioxide At the present time also, there is considerable interest in installations to activate air movement and break up air stratification.

Many types of unit heaters are available Basically they all contain some type of heating device and a fan to force the air across the heating surface and out into the area to be heated.

These heating units are classified as direct-fired or indirect-fired, dependent upon the type of the heating unit Direct-fired units are those which contain a combustion unit right in the unit itself in which fuels such as oil or gas are burned Then this type of unit is used for greenhouse heating, the combustion chamber should be totally enclosed and should be vented to the outside air for the products of combustion

Indirect-fired unit heaters utilize steam or hot water circulated through coils as the heating elements.

Unit heaters are also classified according to the direction of air flow. This flow is designated as vertical blow or horizontal blow

In vertical blow heaters the shaft is vertical and the fan blade is horizontal and the warm air is blown downward. Deflectors suitable for this purpose spread the air out in a horizontal direction in a complete circle. Normally these units are mounted up near the peak of the sidewalls. This of course is against the natural direction of warm air flow, and the distance of flow is limited. Frequently the warm air does not move down along the side walls where it is required When this type of unit heater is installed a line or two of perimeter piping along all walls exposed to the outside should be installed to insure uniform heat distribution.

Heating The Greenhouse
(Information Sheet Continued)

In narrow greenhouses coils located on the side and end walls may be sufficient to provide the uniformity needed In wider houses however, additional piping is required across the house.

Experience over the years has proven that pipe coils suspended overhead provide the uniform temperatures required

The standard practice followed is to suspend the pipe coil overhead, with one line of pipe running lengthwise over each bench The coil should be placed high enough so that the tips of the tallest plant to be grown will not come in direct contact with the pipes. The rule of thumb standard used by most greenhouse operators. is to suspend one third of the number of lines of pipe required overhead and one third of the number along each side. In general this has given a satisfactory uniform heat distribution

An older method of installation, still preferred by many commercial growers, is to distribute the cross house piping by installing the pipe lines under the benches. Such installations keep the soil in the benches warmer, and for this reason may be desirable for those crops which require warm soil for optimum growth.

The amount of heat provided by a pipe coil depends in part upon the temperature difference between the air and the pipe surface and the rate of air movement past the pipe. These basic facts should always be kept well in mind when pipe coils are suspended along greenhouse side walls. The pipe should be suspended far enough away from the wall so that air can move up freely on both sides of the pipe. When side benches are installed in the greenhouse they should be spaced at least six inches from the wall to allow free upward movement of the warm air without "boxing" it in under the bench.

The bottom pipe of a pipe coil should be placed a minimum distance of four to six inches above the ground to permit the free flow of the cooler air in and under the coil. A pipe buried in the ground or covered with soil is practically ineffective as a heating unit.

When pipe coil heating systems are installed it is usually necessary to stack the pipes vertically to obtain the necessary number of coils This installation makes each pipe less effective than it would be if installed separately or alone. This, of course, results in less temperature difference between the air and the pipe surface for transmitting heat. Therefore, when the pipes can be spaced as far apart as possible in the coils this reduction of heating effect can be kept at a minimum.

When finned, or extended surface pipe is installed these rules of spacing, height of pipe from the ground surface, and spacing of side benches from the walls become even more important.

Heating The Greenhouse
(Information Sheet continued)

In horizontal blow heaters the shaft is horizontal and the fan blades are in a vertical position. The air is blown out of the face of the heater in a horizontal direction. When several of these units are used in the same greenhouse they should be mounted so they are suspended overhead near the side walls of the greenhouse. The units on one side should face toward one end and those on the other side should face toward the opposite end This will establish a pattern of air movement around the greenhouse. Adjustable horizontal louvres should be installed on the face of each heater so the direction of air movement can be adjusted upward or downward to prevent direct drafts or air blasts on the plants and to provide proper warm-air distribution.

Temperature control with unit heaters in the greenhouse is normally accomplished by leaving the fans operating continually and turning the heat on and off so that there is a continuous movement of air. Whenever the fans are operated only intermittently when the fans are off the air can become stratified. This will result in conditions detrimental to good plant growth.

Automatic Control Systems

The trend toward the use of automatic controls in greenhouse operations to reduce costs and increase efficiency has led to the wide-spread adoption of automatic controls on greenhouse heating systems.

Automatic systems also perform better than manual controls since they control temperature constantly rather than intermittently.

To perform the job effectively, however; the control system must be properly designed to fit the individual heating system or they may do more harm than good. Therefore, in any installation the location of automatic valves and thermostats should be left to the discretion of a greenhouse engineer who has the competence to adjust the controls to the system being employed.

HEATING ACCESSORIES

The accessories installed are important features in properly operating and maintaining an efficient heating system.

Pipe hangers should be installed so that the proper grade can be maintained in the pipes to prevent pockets or sags that reduce the flow of steam or hot water.

Traps of the proper size and located in the correct place are essential to the efficient operation of a steam heating system.

Heating The Greenhouse
(Information Sheet continued)

Air vents must be strategically located in the system to prevent air locks.

The more extensive the heating system the more the list of accessories could be extended. When automatic controls are used the importance of proper accessories and their location increases

EFFICIENCY AND MAINTENANCE

Unless a sound, sensible and almost constant program of proper maintenance is installed as soon as a greenhouse is put into operation, all of the time and money invested in the design and the installation of an efficient greenhouse heating system may be lost Maintenance of heating systems is an item of greenhouse operation that is most often neglected. Traps must be kept in working order, pipe hangers kept tight to prevent pipe sagging and air vents must be kept cleaned out or operating costs will increase and the heating system will become very inefficient. A sound maintenance program should be instituted in the overall greenhouse operation program and should be adhered to in a very consistent manner.

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Material for this information sheet was taken from short course mimeograph prepared by Floriculture Section, Department of Soil and Crop Science, Texas A&M University and presented by A F DeWerth

Assignment Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Constructing, Maintaining, and Using Structures that Aid Plant Growth

TOPIC: Winter Proctection Structures

OBJECTIVE: To learn the various techniques involved in protecting plants from winter damage.

INTRODUCTION: A hard freeze can ruin a whole year's work. Plants that have been cared for and protected all year can be killed in just a short period of time by the freezing winds of winter.

REFERENCES: Required.
<u>Basic Gardening Illustrated</u>, pp. 72-73

QUESTIONS or ACTIVITIES:

1. What should you notice during the first couple of light frosts?
2. Why should soil be kept damp during a frost?
3. How do notcaps work?
4. How do you arrange outdoor heaters in a small orchard?
5. What are four telltale signs of a coming frost?

Assignment Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT. Constructing. Maintaining, and Using Structures that Aid Plant Growth

TOPIC: Structures for Summer Heat Protection

OBJECTIVE. To learn how to protect plants from damage by summer heat.

INTRODUCTION. The subject of shade for plants is often neglected by beginning horticulturists. Many people who are said to have a "green thumb" are excellent plant producers because they properly care for their plants during the summer months.

REFERENCE. Required.
<u>Basic Gardening Illustrated,</u> pp 70-71

QUESTIONS or ACTIVITIES

1 What are the 3 main functions of shades?
2. Which direction should a permanent shade structure face in hot summer areas?
3. What are 2 good materials that can be stretched over lath frames to lean against walls to protect seedlings in flats?
4 What direction should the laths run on a sunscreen?
5 How can you stiffen the frame when making a lath screen?

Assignment Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT. Constructing, Maintaining, and Using Structures That Aid Plant Growth

TOPIC. Humidity and Watering

OBJECTIVE To become familiar with the effect of humidity on the development of plants and to learn how to determine water requirements

INTRODUCTION. Humidity, moisture found in the air, and the amount of soil water can greatly affect the growth of plants Overwatered plants will be stunted, yellow in color, and defective in root development The amount of humidity can reduce the food production process of the plant or cause excessive wilting

REFERENCES
Required:
1. <u>The Ball Red Book.</u> George J Ball, Inc pp 111-114

QUESTIONS or ACTIVITIES

1 What means of watering is best for commercial pot plant crops?
2. How are the majority of bedding plants watered?
3. What are three disadvantages of an overhead watering system in a greenhouse?
4 Explain how a Rainbird-type nozzle system operates?
5. Explain how the Skinner irrigation system operates.

Assignment Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Constructing, Maintaining, and Using Structures That Aid Plant Growth

TOPIC: Ventilation

OBJECTIVE: To become familiar with the importance of proper greenhouse ventilation and to understand the methods of moving air in a greenhouse.

INTRODUCTION: Greenhouse ventilation is designed to provide a change of air to growing plants and to prevent overheating on clear days. Overheating can be disastrous or result in the production of low quality plants.

REFERENCES

Required:

1. Electrical Applications for Greenhouses, Foy Page, pp. 31-33

QUESTIONS OR ACTIVITIES:

1. Why would a greenhouse operator not use exhaust fans in cooling systems during the winter without convection tubes?
2. Describe the characteristics of a good ventilation system.
3. What is the purpose of circulating air with turbulators during the heating season?
4. How may exhaust fans in cooling systems be used during the winter months?
5. What are two advantages of using a humidistat for fan control?

Assignment Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Constructing, Maintaining, and Using Structures That Aid Plant Growth

TOPIC: Lighting

OBJECTIVE: To develop an understanding of how light affects plant growth, and how to control this light

INTRODUCTION: With electric light and control of wave length, intensity, and photoperiod, it is now possible to hasten or retard growth, cause germination to begin and stop, control time of flowering, and influence tuber size. It is economically feasible to grow and control electrically certain plants

REFERENCES

Required:

1. Resource material for Lesson Plans in Greenhouse Management - Electrical Applications for Greenhouses, Foy Page, pp 40-47

QUESTIONS or ACTIVITIES

1. In regard to light, which direction do roots and stems grow?
2. What should be the maximum number of hours per day that plants should receive light?
3. What happens to chlorophyll when light is too bright?
4. Research studies have shown that plants use mainly two wave lengths of the light spectrum. What are they?
5. What does photoperiod mean?

Assignment Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT Constructing, Maintaining, and Using Structures That Aid Plant Growth

TOPIC: Wiring and Electrical Controls

OBJECTIVE To understand how electricity is used and controlled in a greenhouse.

INTRODUCTION The use of single and groups of controls make electric greenhouse production and management easier and more profitable.

REFERENCES:
Required
1 Electrical Applications for Greenhouses, Foy Page, pp. 48-65

QUESTIONS or ACTIVITIES

1 What does U L indicate?
2. What should be the maximum number of outlets per circuit on general lighting circuits?
3 Which tables in the required reference would you use to determine the proper wire size? (Indicate your answer by listing the table numbers.)
4 How many two-horsepower motors should be put on one circuit?
5 What are the basic requirements of any well-planned wiring system?

Assignment Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Plant Growing Media

TOPIC: Origin, Composition, and Importance of the Soil

OBJECTIVE: To develop an understanding of how soil is formed, what it is made up of, and its importance to horticultural plants

INTRODUCTION: From ancient times man has strived to understand more about soil. No doubt the reason for this is that man's very existence depends upon the soil. Look around you. Probably you will see that not many items in your room came from anywhere other than the soil. Even this sheet of paper you are now reading is a product of the forestry industry which depends on soil for tree growth.

Once we take time to learn how soil is formed, what it is made up of, and how it affects plants, we can do a better job of making it work for us.

REFERENCES: Required:

1. Information Sheet, "Origin, Composition, and Importance of the Soil"

Supplemental:

2. *Our Land and it's Care*, National Plant Food Institute, pp. 6-13
3. Home Garden Leaflet No. LA 8, Department of Floriculture and Landscape Architecture, A&M University
4. *Crop Production in the South*, Klingman, pp. 43-51

QUESTIONS or ACTIVITIES:

1. Name the three layers of soil
2. What causes these three horizons to develop?
3. Which of the three layers is usually darker in color?
4. When does young soil begin to collect its plant nutrients?
5. What factors are responsible for the difference in soil colors?
6. What three components does a good soil provide to plants?
7. What are the three types of soil in regard to particle size?
8. Which is the largest of the three soil particles?
9. What governs the rate of soil development?
10. What is organic matter?

Information Sheet
on
ORIGIN COMPOSITION AND IMPORTANCE OF SOIL

The climate, especially rainfall and temperature indirectly controls the rate of soil development The climate acts slowly taking thousands of years for the soil to reach a stage of balance with its environment

A soil that has reached this degree of development usually has three distinct layers of horizons. As you dig downward in soil you can notice differences in color structure and texture of the soil This is especially noticeable along road cuts

The topsoil is the first layer It is usually richer and is of greater importance to plant growth This layer contains most of the organic matter and is usually darker in color

Next, we come to the subsoil This layer does not contain as many nutrients as topsoil, but it is still important because of root development

The third layer is the parent material and is generally less important to plant growth It usually is below the area of heavy root growth and is seldom tilled.

These three layers are developed from weathering or wearing down of rocks. Wind water, and ice break and crush the rocks Eventually a small plant begins to grow in this young soil. When the plant dies, it decays and gives the soil its first nutrients,

Other plants begin to grow and finally a rich soil is developed Once the soil becomes productive, it provides three important components to a plant These are fertilizer elements air for the roots, and an adequate water supply

You have noticed probably that there are several different soil colors These are caused by different amounts of air being present as the soil is formed, the amount of organic matter, (decayed plant or animal matter), and the types of rocks from which the soil is formed.

You may have also noticed the different textures in soil This is caused by the size of the soil particles Sand is the largest and therefore, is course to the touch Silt and clay are the other two with clay being the smallest. It feels like flour when rubbed between the fingers.

Assignment Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT Plant Growing Media

TOPIC Soil Moisture

OBJECTIVE To understand the importance of moisture to plants and how this moisture becomes available from the soil

INTRODUCTION Soil moisture can be a limiting factor in plant growth No matter how many minerals the soil contains, it will not be productive unless it holds an adequate supply of water for optimum (best) plant development It should be kept in mind that too much moisture can be as harmful as too little By learning more about soil moisture, one can use his knowledge to change the environment of plants in small areas such as in the horticulture industry

REFERENCES Required

1 Information Sheet, "Soil Moisture"

Supplemental

2 Soil Yearbook of Agriculture, 1957, USDA, pp 49-60

QUESTIONS or ACTIVITIES

1 What part of the plant takes in water from the soil?
2 The process by which water leaves the plant in the form of vapor is called what?
3 What material helps soil hold water?
4 When is water holding capacity of vital importance?
5 What affects the speed at which capillary water can move through the soil?
6 Why does it harm soil to work it when it is wet?
7 What can be added to soil to make it hold more water?
8 Why will overwatering a plant kill the root system?
9 What happens to rainfall which falls to the earth's surface?

Information Sheet
on
SOIL MOISTURE

The moisture in the soil represents an important part of the plant environment It is common knowledge that many plants tend to wilt when lacking in water. If water is not supplied to the plants soon after the wilting point is reached, they often die. Water is used by the plant in many ways The needed water is taken from the soil by the roots If plants are to remain healthy and grow well, water must be made constantly available to the plants The type of soil in which the plants grow has a definite influence upon the frequency of watering

Soil water is very important

1 Large amounts of water lost by plants in transpiration must be replaced. (Transpiration - loss of water in the form of vapor)
2 Water acts as a solvent for dissolved minerals
3 Water affects soil aeration (Movement of air through the soil.)
4. Water affects soil temperature

What happens to rain which falls to the earth's surface?

1 Runs off
2 Soaks in
3 Evaporates

Water absorption is very important to the growth of plants

Rain water is absorbed and rapidly passes downward through a porous soil. When the upper surface of the subsoil has a slope, much of the water flowing over its surface seeps out of the hillsides in springs and quickly contributes to stream flow.

Why do different soils have different capacities to hold or "soak up" water? When organic matter is used up. soil packs together Thus a cloddy soil has fewer air spaces, its particles do not cling together in granules, and the lack of organic matter means that it weighs more than an equal volume of crumbly soil from a well-managed plot

A crumbly soil can take in water faster than a cloddy one, and it can hold more water The thoroughly decomposed soil organic matter (humus) in a crumbly soil, can hold lots of water Organic matter acts as a sponge in holding water In addition, to the water held by the organic matter itself, is the water held in the pores between the soil particles and between the soil granules Hundreds of very fine soil particles are glued together by the organic matter to form granules or crumbs

The increased water-holding capacity of soils high in organic matter under natural conditions makes a big difference in the intake of water This is extremely important during droughty seasons

Soil Moisture
(Information Sheet continued)

Moisture moves through the soil in all directions even against gravity by capillary movement This movement is caused by the attraction water molecules have for each other as well as the attraction between water molecules and soil particles Water molecules cling together and form droplets in the air or on a greasy surface where there is nothing to interfere But when a drop of water falls on soil particles, it spreads out as a thin film over the soil particles, because the attraction between the soil particles and the water molecules themselves Water that moves through the soil in this way is known as capillary water

How far and how fast capillary water will move in a soil depends on the size of the soil particles and the condition of the soil If the spaces around the soil particles are large. the attraction between the water molecules and the soil particles will not be enough to overcome the weight of the water and it will not rise too much The movement that does take place however. will be rapid because there is little friction This is true in sandy soils

In fine-textured soils, the particles are closer together and the attraction between soil and water is greater Water may be expected to rise more slowly, but higher in soils of fine texture

Under field conditions, moisture moves from wetter soil to drier soil The difference is not always great, therefore, capillary water moves slowly and not far Even so, even moisture moves a short distance to the roots of growing plants to make it an important plant-soil relationship

Much soil moisture can be lost when capillary water moves to the surface and evaporates

All living cells carry on respiration Roots are made of living cells In order for respiration to occur, oxygen must be present Oxygen is normally formed in the air occupying the pore space of soils having good aeration As water fills the pore space of these soils, however, the air is forced out (no two things can occupy the same space at the same time) and consequently. the supply of oxygen in the soil is lost This means that root cells die and the root system decays away

Some principles of understanding of soil-water relationships for the horticulture service worker:

1 Many soils cannot be worked when wet except at the expense of desirable soil structure. This is more true for heavy clay-like soils, and is less important for sandy soils Structure is the arrangement of the soil particles
2 Plants can be easily overwatered or underwatered Sandy soils require more frequent waterings than heavy clay soils especially during periods of prolonged sunny days.
3 If soils do not have desirable moisture-holding capacities. they should be modified to make them more desirable

Soil Moisture
(Information Sheet continued)

4 It is more critical to overwater plants growing in heavy soils during periods of prolonged cloudy weather than it is to overwater plants growing in light soils, during this type of weather condition Soil type and the amount of sunlight affect plant-watering practices

5 Loose, porous soils having a good structure soak up and hold more water than hard, compact soils. This has an important influence on plant-watering practices

6 Overwatering causes decreased aeration and subsequent root decay and death of the plant

7 Underwatering causes wilting, dehydration, and subsequent death of the plant.

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Material for this information sheet was taken from Ornamental Horticulture for Vocational Agriculture in Alabama, pp 79-81

Assignment Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT. Plant Growing Media

TOPIC. Soil Mixtures

OBJECTIVE To learn some of the most widely used soil mixtures and to become familiar with the methods used to produce soil mixes for growing horticultural plants.

INTRODUCTION. Not all plants grow best in the same type of soil mixture. Water-holding capacity, aeration, and drainage of the soil often determines a plant's value. By studying the different types of soil and how to increase their productivity, we can grow healthier and more profitable plants

REFERENCES: Required.

1 Information Sheet, "Soil Mixtures"

Supplemental.

2 Plant Propagation. Hartman & Kester, Prentice Hall, N.J., 1959, pp 26-30

QUESTIONS or ACTIVITIES.

1 What are the advantages of mixing organic matter and other soil "lightening" materials with loam soils?
2 Name the characteristics of an ideal soil mix.
3 Why is soil screened before mixing?
4 What equipment is required for large scale mixing operations?
5 What would be a good mixture for general container-grown nursery stock?

Information Sheet
on
SOIL MIXTURES

The Significance of Soil Mixtures

1 Loam soils by themselves are generally unsatisfactory for growing plants for various reasons
  - a Often "heavy"
  - b Often poorly aerated
  - c Often tend to become sticky after watering
  - d Often have a low moisture-holding capacity
  - e Often tend to shrink upon drying

2. Advantages of incorporating organic matter and soil "lightening" materials with loam soils include
  - a Better aeration
  - b Greater ease of working
  - c. Better drainage
  - d Better moisture-holding capacity

Some Typical Soil Mixtures

1 For potting rooted cuttings and young seedlings:
  1 or 2 parts sand
  1 part loam soil
  1 part peat moss (or leaf mold)

2. For general container grown nursery stocks:
  1 part sand
  2 parts loam soil
  1 part peat moss or leaf mold
  1/2 part dried or well-rotted manure

3 For plants which do best under acid soil conditions:
  2 parts sand
  2 parts loam soil
  2 parts peat moss
  1 part leaf mold
  1/2 dried or well-rotted manure

4 The University of California (U C) mix
  50% sand
  50% peat moss
  Fertilizer additives (a or b)
  - a If the mix is to be stored for an indefinite period before using. This furnishes a moderate supply of available nitrogen, but the plants will soon require supplemental feeding To each cubic yard of the mix add:

4 oz	potassium nitrate	2-1/2 lb.	single superphosphate
4 oz	potassium sulfate	7-1/2 lb	dolomite lime
2-1/4 lb	calcium carbonate lime		

Soil Mixtures
(Information Sheet continued)

b if the mix is to be planted within one week of preparation, This furnishes available nitrogen as well as moderate nitrogen reserve. For each cubic yard of the mix add

2-1/2 lb	horn and hoof or blood meal (13% nitrogen)
4 oz	potassium nitrate
4 oz	potassium sulfate
2-1/2 lb	single superphosphate
7-1/2 lb	dolomite lime
2-1/2 lb	calcium carbonate lime

5 In making the U C mix for,
  a Bedding plants and nursery container-grown stocks use --75% sand, --25% peat moss
  b Potted plants use --50% sand, --50% peat moss
  This mixture, including the fertilizer, can be safely sterilized by steam or chemicals without resulting in the subsequent harmful effects to the plants that often occurs when other soil mixes are sterilized.

The Ideal Soil Mix has These Characteristics.

a Uniformity
b. Freedom from disease
c. Low soluble salts
d. Good drainage
e. Good moisture retention
f. No shrinkage
g. Ease of preparation and storage
h Complete availability

Equipment Used in preparing Soil Mixtures Includes.

1 Soil screen (may be a powered rotary screen)
2. Soil shredder (either gas or electric powered)
3 Wheel barrow
4 Scoop shovel
5 Cement mixer
6. Water hose

Steps in Preparing Soil Mixture:

1 Screen the soil to make it uniform and to eliminate large particles.
2 Slightly moisten extremely dry materials (especially peat)
3 Mix smaller quantities by putting the ingredients in a pile in layers, and turn the pile with a shovel until uniformity of the mixture is attained.
4 For large scale mixing operations, use a power driven cement mixer or shredder.
5 Prepare the mixture at least one day in advance of use so that the moisture will tend to become equalized throughout the mixture. The soil mixture should be slightly moist at the time of use so that it forms a ball when squeezed in the hand at the time of use.

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Material for this information sheet was taken from Ornamental Horticulture for Vocational Agriculture in Alabama, pp 81-84.

Assignment Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT. Plant Growing Media

TOPIC Mulches and Their Use

OBJECTIVE To learn more about the kinds of mulches and how they are used. Also, to learn some common mulches and how to apply them.

INTRODUCTION. There are many places in the landscape where mulches can and should be used Rose and flower beds, trees and shrubbery, and newly seeded lawn areas are good examples of where mulches are needed

REFERENCES Required.

1 Information Sheet, "Mulches"

Supplemental

2 Soil, 1957 Yearbook of Agriculture, U.S.D.A., pp. 151-156

QUESTIONS or ACTIVITIES

1 What are two basic kinds of mulches?
2 What is the disadvantage of asphalt paper mulch?
3 What fertilizer should be added to corncob mulch?
4 When should mulches be applied to established garden plants?
5. What is the most common mulch?
6 What can be used as a mulch in areas where organic material is scarce?
7 List the effects of mulches in the soil mix.
8. What is a mulch?
9 What is the disadvantage of straw mulch?

Information Sheet
on
MULCHES AND THEIR USE

The landscape or greenhouse worker needs to know how to use mulching materials. What kinds of materials are used as mulches? Which kinds of materials make the best mulches? What are mulches used for? How deep should mulches be applied? When should mulches be applied? A mulch is any material applied to the surface of a soil primarily to conserve moisture, maintain a uniform temperature, and to help control weeds

Effects of mulches in soil mix

Dilutes the soil and usually increases root growth
Promotes soil granulation
Improves and stabilizes structure (surface mulch)
Affects soil pH slightly
Adds some fertilizer materials
Leads to nitrogen deficiency in cases where carbonaceous materials are added
Serves as food to micro-organisms
Introduces weed seeds in the soil in some cases

Two basic kinds of mulches.

Inorganic or processed
Organic

Inorganic or processed mulch material

1 Aluminum Foil - Used to some extent in vegetable planting Research work shows that growth of plants is increased markedly
2. Asphalt - A light spray is used commonly by landscape contractors to hold soil in place on steep banks.
3 Asphalt Paper - May be used but hard to keep in place Can become unsightly.
4 Crushed Stone - Gravel Chips - Pebbles - This is a common mulch in areas where organic mulch is scarce Good in plantings for effect. May be colored to blend in with the features or the home, patio or landscape.

Black Polyethylene - Becoming a popular mulch especially in areas which are not part of the foundation planting This mulch is used in commercial vegetable plantings

Organic Mulch Material

1 Crushed Corncobs - Excellent mulch material May be colored for use in landscape plantings Usually quite inexpensive Additional nitrogen should be applied.
2 Corncobs (whole) - Used to limited extent in farm gardens where the material is available Can be used in utility gardens where appearance is not the main objective
3 Lawn Clippings - This material is used to a limited extent. It should be applied loosely because it mats Heat must be produced during decomposition
4 Leafmold - Obtained from compositing fallen leaves in the fall of the year This partially decomposes by the spring. Good mulch but hard to apply evenly and is not particularly neat looking

Mulches and Their Use
(Information Sheet continued)

5 Leaves - Used rather extensively in areas with many trees The most inexpensive material available.
6 Peanut Hulls - Can be obtained in some garden centers or in areas where peanuts are processed This is an excellent mulch and usually quite attractive.
7 Peat Moss - This is probably the most common mulch. It is quite rich looking when used correctly. The cost of this material is usually prohibited when large areas are mulched.
8. Sawdust - Very commonly used in areas where readily available. Nitrogen deficiency is almost certain if fertilizer is not applied regularly. Reports of toxic materials have not been substantiated by experiment stations.
9. Shredded Bark - In recent years, this material has become a popular item in garden stores. The material makes an excellent mulch and is very attractive in landscape plantings. Shredded bark lasts as long or somewhat longer than peat moss and adds valuable organic matter to the soil
10 Straw - Used for winter protection and as a summer mulch. This material is highly inflammable so should not be used where a cigarette could be carelessly flipped into the material
11. Wood Chips or Wood Shavings - In recent years this material has become available in large quantities. Wood chips decompose slowly and may be the cause of nitrogen deficiency if additional fertilizer is not applied

When to Apply Mulch

The time to apply mulch to the garden on established plants is in mid-spring when the soil has warmed up sufficiently for active root growth If it is applied before this time, the mulch will keep the ground too cool and root growth may be slow. If you are applying mulch to newly planted material, do so after the plants are put into place and watered in well. If you are planting material in the late summer or early fall, apply the mulch immediately after watering so that the soil temperature will be kept warmer in the cool nights of autumn. It is important that there is sufficient root growth in fall planted stock so that the material does not heave due to freezing and thawing during the winter months

How Deep to Apply Mulch

For best results, the mulch should be at least 2-3" deep over the whole area during spring, summer, and early fall. Tender plants which need winter protection may require an additional 1-2" during the winter months around the crown or base of the plant. In the spring this additional material should be fanned out away from the stems or crowns of the plants before additional material is added for summer mulching.

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Material for this information sheet was taken from Ornamental Horticulture for Vocational Agriculture in Alabama, pp 84-86

Assignment Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT. Plant Growing Media

TOPIC: Fertilizer Nutrients

OBJECTIVE. To learn about the fertilizer requirements of plants, the function of different minerals, and how to apply these minerals

INTRODUCTION Many of the materials used for mulching require an addition of fertilizer to reduce the chance of nitrogen deficiency or starvation of the growing plant material. Whodchips, sawdust, crushed corncobs and shredded bark need additions of nitrogenous fertilizers. A report from the U S D A suggests that 1/2-1lb. of ammonium nitrate or ammonium sulfate be added to each bushel of mulch material added to the plants. Remember, without the proper amounts of fertilizer, a lot of hard work can go to waste Plants can not thrive with an improper balance of nutrients

REFERENCES Required.

1 Information Sheet, "Fertilizer Nutrients"

Supplemental:

1 *Crop Production in the South,* pp 65-77
2 *Soils and How to Improve Them.* Texas Agricultural Extension Service Bulletin B-189

QUESTIONS or ACTIVITIES.

1 What are the three primary elements?
2 What primary element gives the dark green color to plants?
3 What primary element is missing when leaves become mottled, spotted, streaked, and curled?
4. What are three sure ways of mis-using fertilizer?
5 When is the best time to fertilize a lawn?
6 What are the three nutrients obtained mostly from air and water?
7 What are the two lime elements?

Information Sheet
on
FERTILIZER NUTRIENTS

NUTRIENTS USED BY PLANTS

Large Amounts Needed		Rather Small Amounts Needed	
Nutrients Obtained Mostly From Air & Water	Nutrients Obtained From Soil	Nutrients Obtained From Soil	
Carbon Hydrogen Oxygen	Nitrogen Phosphorus Potassium Calcium Magnesium Sulfur Hydrogen Oxygen	Iron Manganese Boron Copper	Zinc Chlorine Molybdenum

SOME CONVENIENT NUTRIENT GROUPINGS

Grouping	Nutrients
Primary Elements	Nitrogen Phosphorus Potassium (Potash)
Secondary Elements	Calcium Magnesium Sulfur
Fertilizer Elements	Nitrogen Phosphorus Potassium (Potash)
Lime Elements	Calcium Magnesium
Trace Elements or Micro-nutrients	Iron Copper Zinc Boron Chlorine

Fertilizer Nutrients
(Information Sheet continued)

HOW PLANT NUTRIENTS AFFECT PLANTS

Nutrient & Chemical Symbol	Form in Which Available to Plants	Role in Plant Growth	Deficiency Symptoms
Nitrogen (N)	NH_4^+	Gives dark green color to plants	A sickly yellowish green color
	NO_2^-	Induces rapid growth Improves quality of leaf crops	A distinctly slow and dwarfed growth
	NO_3^-	Increases protein content of food and feed crops A constituent of all proteins (Note an over abundance of nitrogen leads to rank vegetative growth and tends to retard the date of plant maturity)	Drying up or firing of leaves which starts at the bottom of the plants and proceed upward. The firing starts at top of the bottom leaves and proceed down the center along the mid-rib
Phosphorus (P)	PO_4^- HPO_4^- $H_2PO_4^-$	Stimulates easy root formation and growth Gives a rapid and vigorous start to plants Hastens maturity Stimulates blooming and aids in seed formation Essential to the transformation of insoluble carbohydrates to soluble carbohydrates a constituent of all proteins	Purplish leaves, stems, and branches. Slow growth and maturity
Potassium (K)	K^+	Imparts increased vigor and disease resistance to plants. Increases plumpness of grain and seed Essential to the formation and transfer of starches, sugars, and oils Imparts winter hardiness	Mottling, spotting, streaking or curling of leaves. Leaves are scorched or burned on the margins and tips. Firing starts at tip of leaf and proceeds down

Fertilizer Nutrients
(Information Sheet continued)

Nutrient & Chemical Symbol	Form in Which Available to Plants	Role in Plant Growth	Deficiency Symptoms
Calcium(Ca)	Ca++	Promotes early root formation and growth Improves general plant vigor Influences the intake of other plant nutrients.	Young leaves in terminal bud become hooked in appearance and then die at the tips and along the margins Leaves have a wrinkled appearance In cases the young leaves remain folded There is a light green band along the margin of the leaves. Roots are short and much branched
Magnesium(Mg)	Mg++	A component of the chlorophyll molecule Essential to the formation of fats, aids in the transport of phosphorous from older or younger parts of the plant Essential to fruit production Influences uptake of other plant nutrients Plays a role in the translocation of starch	A general loss of green color which starts in the bottom leaves and later moves up the stalk The veins of the leaf remain green The plant stem is slender and weak with long branched roots Leaves are mottled or chlorotic with dead spots The leaf tips are turned or cupped upwards
Sulfur(S)	$SO_4^=$ $SO_3^=$	Essential to the formation of proteins Essential to all divisions and fruit development Promotes root growth Stimulates seed production Encourages more vigorous plant growth	The young plant leaves are light green in color and have even lighter veins The stalks are short and slender Plant growth is slow and stunted. Fruit is immature and light green in color

Propagation From Cuttings
(Information Sheet continued)

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Material for this information sheet was partially taken from.

1 State Department of Education. Agricultural Education Service, Montgomery. Alabama. Ornamental Horticulture for Vocational Agriculture in Alabama.

2. The Center for Research and Leadership Development in Vocational And Technical Education The Ohio State University "Propagating Horticultural Plants"

Fertilizer Nutrients
(Information Sheet continued)

Nutrient & Chemical Symbol	Form in Which Available to Plants	Role in Plant Growth	Deficiency Symptoms
Manganese (Mn)	Mn^{++}	This element functions in enzyme systems which are necessary for important reactions in plant metabolism The element is also essential for certain nitrogen transformations in plants	Spots of dead tissue are scattered over the leaf. The smallest veins tend to remain green producing a checkered effect
Molybdenum (Mo)	Mo_4	Acts as an electron carrier in enzyme systems which bring about oxidation reduction reactions in plants Oxidation reduction reactions are essential to plant development and reproduction and do not take place in the absence of micro-nutrients The element is also essential to certain nitrogen transformations in plants	

If plant nutrient elements are to be available to plants, three basic conditions must be met.

1 The nutrient must be in a chemical form that the plant root can absorb.
2 The nutrient must be in a position where it can be absorbed by the plant root
3 The nutruent must occur in the soil in proper proportions

Soil fertility then, does not depend only upon the supply of nutrients in the soil, but upon the form in which the nutrients are found

Some fertilizers harm seeds and foliage if the material is placed in direct contact with them Inorganic fertilizers harm plant foliage more than organic fertilizers. Often organic fertilizers are called non-burning fertilizers

Fertilizer Nutrients
(Information Sheet continued)

If you are to avoid harming seeds and foliage with fertilizers:

DO NOT

1. Apply dry fertilizers (particularly inorganic fertilizers when the foliage is wet).
2. Plant seeds directly on a band or layer of fertilizer.
3. Spill the container of fertilizer contents and fail to remove the material from the foliage by scattering or leaching. (Many times lawn spreaders are filled on the lawn and spillage is not properly cared for. It is best to fill the spreader on the sidewalk.)

DO

1. Fertilize just before a rain. (Lawns for example)
2. Place the fertilizer below and to the side of the seed.
3. Mix fertilizer materials thoroughly in the soil before planting.

Fertilizers can be applied to the soils of the greenhouse or the landscape as:

1. Liquid fertilizers
   a. Hozon proportioners or fertilizer injectors (foliar or base application)
   b. Applied in water solution with a sprinkling can (foliar application)
   c. Applied as a water solution around the base of the plant
2. Dry fertilizers
   a. Broadcast over the soil surface by means of a spreader.
   b. Broadcast over the soil surface by hand (for small quantities). This is not the most accurate method for applying fertilizers. however.
   c. Deep drilling
   d. Side dressing
   e. Banding along the row

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Material for this information sheet was taken from Ornamental Horticulture for Vocational Agriculture in Alabama, pp. 86-92.

Assignment Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT Plant Growing Media

TOPIC. Soil Organisms

OBJECTIVE To learn some of the major soil organisms, their importance, and their effect on soils

INTRODUCTION Soils are composed of broken and weathered rocks, organic matter, water, and air This material serves as a home for many kinds of plant and animal life These plants and animals are both large and small in size. Some of these plants and animals are even so small that a microscope must be used to see them. Even though these organisms are small, they play a vital role in the health of our plants.

REFERENCES Required

1. Information Sheet, "Soil Organisms"

Supplemental

2. Soil, 1957 Yearbook of Agriculture, U S D A

QUESTIONS or ACTIVITIES

1 Name three small forms of plant life that are found in the soil.
2 How much of the soil consists of organisms?
3 What damage to plants can a nematode cause?
4 What harm to a plant may fungus cause?
5 In what way do bacteria help supply the plant with fertilizer nutrients?

Information Sheet
on
SOIL ORGANISMS

Small plant life in the soil may be bacteria, fungi, or algae. The small animals in the soil include one-celled animals, and tiny, round worms called nematodes. The larger animals in the soil include worms, ants, snails, spiders, and insects. Some of these animals, especially the earthworms, help to make the soil better by burrowing through the soil, mixing it and making it possible for water and air to move easily through the soil. Also, some of the organisms in the soil are able to take nitrogen from the air and change it into a form that plant roots can absorb. Other organisms in the soil are not so helpful and actually do harm to plants by eating parts of the plant and causing various plant diseases.

Soil organisms make up about 1/1000 of the weight of an acre foot of soil. The living things in the soil use soil minerals for living activities. The minerals available to the plant then, are those that remain after the soil organisms have consumed a certain quantity for their life processes.

THE SIGNIFICANCE OF SOIL ORGANISMS

Organism	Major Activity	Beneficial to Plant Growth	Harmful to Plant Growth
Earthworm	Mixes soil. Increases the availability of plant nutrients. Especially nitrogen; Increases aeration. Promotes drainage	X	
Nematode	Penetrates plant tissue, especially roots and causes extensive damage		X Only about 50 of the thousands of nematodes known are harmful to plants.
Algae	Aid bacteria and fungi in the decomposition of plant tissue, in making nutrients available to plants, and in the synthesis of humus	X	

Soil Organisms
(Information Sheet continued)

Organism	Major Activity	Beneficial to Plant Growth	Harmful to Plant Growth
Fungi	Decompose organic residues. Promotes the formation of humus. Causes many plant diseases	X	X
Actinomycetes	Decompose organic matter releasing plant nutrients, especially nitrogen. Causes plant disease	X	X
Bacteria	Decomposes organic matter releasing plant nutrients; convert nitrogen from the air into a form available to plants (only certain bacteria are able to do this). Cause many plant diseases	X	X

The soil organisms which are beneficial to plant growth can be encouraged by adding organic matter, lime, and moisture to the soil

The soil organisms harmful to plants need to be controlled. It has been estimated that the yearly loss in farm crops in the United States is five billion dollars. The cost of pesticides and required application of these expenditures is used to control harmful soil organisms.

Basically, there are three ways to control soil organisms which are harmful to seeds and plants:

1. Soil sterilization with steam
2. Soil fumigation or drenching with chemicals
3. Seed treatment

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Material for this information sheet was taken from Ornamental Horticulture for Vocational Agriculture in Alabama, pp. 92-94

Assignment Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT Plant Growing Media

TOPIC: Soil Sterilization

OBJECTIVE To learn the advantages and disadvantages of steam sterilization (pasteurizing) and chemical treatment

INTRODUCTION. The soil organisms harmful to plants need to be controlled. It has been estimated that the yearly loss in farm crops in the United States is five billion dollars The cost of pesticides and required application equipment amounts to almost $350 million a year A considerable amount of these expenditures are used to control harmful soil organisms

REFERENCES. Required.

1 Information Sheet, "Soil Sterilization"

Supplemental:

2 Soil, 1957 Yearbook of Agriculture, U S D. A. . pp. 157-164

QUESTIONS or ACTIVITIES.

1 Why are soils treated?
2 What are four sources of steam
3 Why will soil that is too dry heat up slowly?
4 What is used to measure the soil temperature?
5 How can ammonia build-up in the soil affect plants?
6 What are the seven factors to consider when fumigating soil?
7 What are the three precautions to observe in using soil fumigants?
8 What is the cheapest method of sterilizing soil?

Information Sheet
on
SOIL STERILIZATION

This control measure is highly effective and is widely used in the greenhouse for controlling the various soil-borne pests. Steam sterilization is also used to some extent in outdoor areas and for steaming bulk soils prior to use in growing plants.

Why are soils steamed?

1. To kill soil-borne insects
2. To kill all of the bacteria, fungi, and virus organisms that are harmful to commercial crops
3. To destroy weeds
4. To promote soil granulation

Sources of steam.

1. Existing steam boilers
2. Portable oil-fired steam boilers
3. Package steamers
4. Bricked in permanent-type boilers

Preparing the soil for steaming.

1. Add humus or organic matter.
2. Water the soil lightly Soil that is too dry will heat up slowly because of poor heat conduction and distribution Soil that is too wet will also heat up slowly because it requires considerable heat to heat a large quantity of water.
3. Keep the soil moist a week prior to steaming so as to encourage weed-seed germination This will make the weeds easier to kill
4. Rototill or otherwise loosen the soil Be sure all soil is loosened and that all lumps are broken up
5. If soil in raised benches is being sterilized, unroll the canvas steaming hose down the length of the bench (Ground beds may have buried tile for steaming purposes.)
6. Cover the bench with a suitable cover. The cover may be draped over the bench, weighted down with pipe or held in place with "C" clamps.

The soil should be steamed at 180°F for thirty minutes.

Soil Sterilization
(Information Sheet continued)

KILLING TIME FOR VARIOUS SOIL ORGANISMS WHEN USING STEAM STERILIZATION

Organism	Time to Kill	Temperature
Nematodes	Instantly	140°F
Soil Insects	Instantly	140°F
Soil Fungi	10 minutes	140° - 160°F
Soil Bacteria	10 minutes	140° - 160°F.
Weed Seeds	10 minutes	140° - 160°F
Soil Virus	30 minutes	180°F

The soil temperature during steaming is registered on a soil thermometer.

After steaming. it is often found that there are other problems which could develop.

1 Nitrifying and other beneficial soil organisms are killed
2 Ammonia build-up in the soil which may cause root burn

Solving after-steaming problems

1 Use high quality, long lasting kinds of peat such as German or Canadian sphagnum, peats or other forms of organic matter that break down slowly
2 Avoid sterilizing in hot water
3 Don't feed the previous crop after it shows color, and leach it during the last waterings.
4 Keep soils cultivated during critical periods to encourage air to enter the lower soil.
5 Keep soils medium dry when steaming· sterilizing wet soils encourages the build-up of ammonia
6. Adding 4 lbs of gypsum or 40% superphosphate per 100 sq. ft. of soil immediately after steaming seems to help tie up free ammonia
7 Leach heavily after steaming

Soil Fumigation

Conditions under which chemicals are most extensively used for soil pasteurization.

1. Situations in which overhead costs are so low that the time required for aeration is not expensive
2. Situations where weeds and soil-borne insects are the main reasons for sterilizing.
3. Situations in which steam boilers are not available for sterilizing.

Chemical fumigants effective against fungi, bacteria, and nematodes are:

1. Chloropicrin (Tear Gas)
2. Methyl bromide
3. Mylone
4. Vapam or VPM
5. Vorlex
6. Trizone
7. Formaldehyde

Chemical fumigants effective against nematodes are:

1. Dichloropropene-dichloropropane mixtures
2. Ethylene di-bromide

Other fumigants include

1. Bedrench
2. Zinophos
3. Trapex
4. Nemes
5. Brozone

Factors to consider in fumigating soil.

1. Soil temperature
2. Soil moisture
3. Organic matter content
4. Soil Texture
5. Seals needed
6. Soil type
7. Depth of application

Forms in which chemical fumigants are applied.

1. Tractor-mounted equipment which lays a plastic film and injects the fumigant under the plastic cover.
2. Liquid water-miscible materials which are metered into sprinkler irrigation systems.
3. Granules, liquids, and powders which can be worked into the soil from equipment mounted in front of a rototiller
4. Tractor-mounted chisel-tooth injection shands can be used.
5. Materials in pressure cylinders can be released under plastic covers.
6. Hand-operated needle point injection guns can be used.

No plants should be planted into a fumigant-treated soil for a period of two to three weeks.

Precautions to be observed in using soil fumigants

1. Avoid inhaling the material
2. Avoid contact of the fumigant with the skin.
3. Allow sufficient time for aeration after the material is applied.

Soil Sterilization
(Information Sheet continued)

ADVANTAGES AND DISADVANTAGES OF STEAM AND CHEMICAL SOIL STERILIZATION

Treatment	Advantages	Disadvantages
Steaming	A very effective job Cost of treatment is less per acre than for chemicals ($350 - 500 per acre)	High initial cost Edges of benches and growing areas may not receive steam. After steaming, problems frequently occur
Fumigation	Useful when a source of steam is not available Gives good control of insects, weeds, and nematodes	Cost of treatment per acre is high. Not very effective against hard-to-kill organisms. A great deal of time is required for aeration after treatment.

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Material for this information sheet was taken from Ornamental Horticulture for Vocational Agriculture in Alabama, pp. 94-98

Assignment Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT. Plant Growing Media

TOPIC: Plant Growing Media Other Than Soil

OBJECTIVE To become familiar with growing media other than soil, to study their merits, and to learn how to use these media in growing horticultural plants.

INTRODUCTION. Every plant grower has his own opinion on which plant growing media is best. There are several very good additives and experience is the best method of selection.

REFERENCES Required

1 Information Sheet, "Plant Growing Media Other Than Soil"
2 "Horticulture Perlite for Texas Gardens", Bulletin TAP 256, Texas A&M Extension Service

QUESTIONS or ACTIVITIES:

1 What is the most widely used media for reproduction of plants?
2 What type of peat is most widely used in the United States?
3 How much water will sphagnum moss absorb?
4 What happens to vermiculite when heated?
5 What leaves, when in a molded state, make the best growing media?
6 What three media are probably the most readily available for use by the horticulturist in the South?
7 Why have many people witnessed failures in plant growth in a medium of sawdust?
8. What are the advantages of perlite?

Information Sheet
on
PLANT GROWING MEDIA OTHER THAN SOIL

Many different growing media may be used for rooting cuttings taken from desired plants. These may be used alone or in mixtures with soil

SAND

Sand is probably one of the most widely used growing media in the reproduction of plants. It consists of small grain or rocks ground into a fine texture by weathering. This sand must be of a good quality and must not contain silt. The recommended sand for use in rooting cuttings is of the quartz type and should be washed It can be the same quality sand used in masonry.

PEAT

Peat, commonly referred to as peat moss, is a material that has resulted from the decaying of the remains of thick vegetation in wet, marsh, swamp areas. It has been preserved over the years by being under water in a partially decomposed state. Peat varies widely in its state of decomposition, acidity. mineral content and origin. Light brown peat has been normally produced by a type of vegetation that results in a quite acid state. Brown to black peat is of the type that is alkaline. This is the type that is desirable and most used in the United States it has a very high water-holding capacity and contains approximately 1% nitrogen. This nitrogen assists in the decomposition process which results after peat has been placed in use When peat is used, it should be broken apart and moistened well before adding to the growing media or mixture

SPHAGNUM MOSS

Commercial sphagnum moss is a material that has been produced by dehydrating certain acid-bog plants. The dehydrating results in a relatively sterile material. It is very light in weight and has a very high water-holding capacity. It has been said that it will absorb 10 to 20 times its weight in water After dehydrating the plant materials have been shredded in order to make it more usable This material contains such small amounts of minerals that plant growth in it for any length of time will need additional fertilizer.

VERMICULITE

This is a material that is micaceous in nature and is therefore a mineral. It is composed of thin layers that expand or explode when heated. It is heated in order to dehydrate it for use in horticultural mixtures. It is light in weight and has a very high-water-holding capacity. Expanded vermiculite should not be pressed or compacted in any way when wet. If this is done the desired porous structure of the material will be destroyed.

Plant Growing Media Other Than Soil
(Information Sheet continued)

LEAF MOLD

Certain leaves can be decayed and placed into a growing media or mixture and will serve a very good purpose Maple, oak sycamore, and elm are among the most suitable leaves for this purpose. In preparing such a compost the layers of leaves should be alternated with thin layers of soil Small amounts of nitrogenous fertilizer should be used between the layers of leaves and soil This nitrogen assists in the decomposition of the leaves The mixture should be protected from the weather so that leaching of the mineral elements will not result during heavy rain storms To prepare suitable leaf mold, 12 to 18 months should be allowed for proper decaying of the leaves A disadvantage of leaf mold is that it may contain nematodes, weed seed or noxious insects and diseases. It should be sterilized before being used as a growing media for horticultural plants.

SHREDDED BARK SAWDUST AND WOOD SHAVINGS

In the South these materials are probably the most readily available for use by the horticulturist They are by-products of the lumber industry and can be obtained readily at very low cost They are usually of the hardwood or pine variety Decomposition of these materials is slow and one should be sure that they are decomposed before using them for plant propagation Usually it is advisable to add nitrogenous fertilizer to these materials during the decaying process

USING SAWDUST

Sawdust may be used to improve the physical conditions of soils and as a mulch. As a mulch it insulates the soil against wide fluctuations in temperature, discourages weed growth and reduces evaporation of soil moisture However, there is a difference of opinion as to its merit Some operators have long used this easy-to-get forest by-product in large quantity with complete success Others have had unfortunate experiences with sawdust and have discarded it as unsuitable to their needs

Possibly a lack of understanding as to how to handle sawdust has caused some of these failures. When sawdust is incorporated with the soil--used in place of peat--it requires large quantities of nitrogenous fertilizer if the plants growing in the soil are not to suffer from nitrogen starvation The organisms in the soil which break down cellulose require appreciable amounts of nitrogen and will use up all available supplies of this element

It has been estimated that 24 lbs of nitrogen are required per ton of sawdust from some species of pine to bring the nitrogen content up to 1 2 to 1 5%, the values needed for decomposition witl out inducing nitrogen deficiency in plants This would equal 115 lbs of ammonium sulphate or 72 lbs of ammonium nitrate per ton of sawdust during the period of its decomposition, which may be 2 or 3 years A 4inch layer of loose dry sawdust over a space 20X30' weighs a little over a ton A bushel of sawdust (10 to 15 lbs) requires 0 8 lbs. of ammonium sulphate or 0.5

lb of ammonium nitrate When the sawdust is used as a mulch, nitrage fertilization is not required to the extent that it is when the material is incorporated with the soil.

Sawdust is widely employed as a plunging material in heel beds in retail sales yards, for which it has unanimous approval, despite the fact that research showed that it is very poor for this use vastly inferior to peat The need for frequent watering is the chief disadvantage of sawdust as a filler for nursery heel beds Because of the rapidity with which it dries, it is necessary to soak thoroughly and often

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Material for this information sheet was taken from Ornamental Horticulture for Vocational Agriculture in Alabama pp 98-100

Assignment Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Plant Propagation

TOPIC: Introduction to Propagation

OBJECTIVE: To develop an understanding of the basic types of reproduction in plants and to learn the facilities, media, soil mixtures, and containers used in plant propagation

INTRODUCTION: Plant propagation is the controlled reproduction of plants in order that man can have selected plants which are of specific value to him. Today with the many new advances in science the propagation of plants has become one of the most fascinating aspects ornamental horticulture

REFERENCES:

Required:

1. Information Sheet, "Introduction to Propagation"

Supplemental:

1. Handbook on Propagation, #24, Brooklyn Botanic Garden
2. "Plant Production". B-178, Florida
3. Plant Propagation Principles and Practices, Hartmann and Kester
4. "Controlling Environment with Plastic Structures for Plant Propagation", TAP-387, Texas Agriculture Extension Service

QUESTIONS OR ACTIVITIES:

1. What is meant by plant propagation?
2. Give two methods by which plants may be propagated.
3. Give three structures used for the reproducation of plants.
4. List three requirements of the ideal plant propagation structure.
5. Give three requirements of a good media or mixture used in propagation.
6. List five of the most common types of media
7. What is used for chemical sterilization of soil?
8. Give three types of containers used in the propagation of plants.
9. What is the purpose of plant hormones?
10. What is a flat?

Information Sheet
on
INTRODUCTION TO PROPAGATION

Plant propagation is the controlled reproduction of plants in order that man can have selected plants which are of specific value to him.

Plants may be propagated by two methods -- sexual or asexual.

Seed reproduction in plants is basically a sexual process because it involves the union of sperm and egg cell before the seeds are formed. The seed has a supply of food sufficient for establishing a plant in a new location

The vegetative methods of propagation such as layering, division, cutting, grafting, and budding are the asexual types of plant propagation.

There are a number of types of facilities and propagating structures for the reproduction of plants

Many stypes of greenhouses are used. they are usually made of glass, plastic, or similar material.

The hotbed is used for propagating, but it is generally smaller and less expensive Heat is provided by fermenting manure or electric heating cables

Many growers use a propagating case made of plastic to start young plants. This case may have mist spray in it to control the environment.

The ideal structure for plant propagation should have the proper amount of ventilation, temperature, and shade or light

There are several media and mixtures used in propagation. All media should be loose and of a light mixture so that the excess water will drain It should be free from seeds, nematodes, and disease organisms

Some common types of media are sand, peat, sphagnum moss, vermiculite, and perlite.

If soil is used, sterilization is a must It may be treated by steam or chemicals. If chemicals are used methyl bromide is an excellent chemical to use.

Flats are small rectangular containers used for germinating seeds or rooting cuttings. Many types of containers such as clay pots, peat pots, and plant bands are used.

Many plant propagators use a synthetic plant hormone to promote rooting of cuttings. Various methods are used in applying these root-inducing substances, but the most common is to dip the cutting in the hormone powder, which is a chemical mixed with powdered talc at suitable concentrations. Many of the rooting hormones contain a fungicide to give protection against diseases

Assignment Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT Plant Propagation

TOPIC Propagation from Cuttings

OBJECTIVE. To develop an understanding of the methods of reproducing plants from cuttings

INTRODUCTION Cutting is one of the most important methods of propagating ornamental plants Many plants can be started from cuttings in a limited amount of space. This is an inexpensive rapid. and simple method of starting plants.

Cutting may be defined as the process of propagating plants by the use of vegetative parts which when placed under suitable conditions, will develop into complete plants

REFERENCES

Required.

1 Information Sheet, "Propagation from Cuttings"
2 Basic Gardening Illustrated Sunset pp 17-19

Supplemental

1 Flower and Plant Production in the Greenhouse, Nelson. pp 113-123

QUESTIONS OR ACTIVITIES.

1 List three reasons for producing plants from cuttings.
2 When are hardwood cuttings usually made?
3 List three plants which would be considered as herbaceous.
4 When are softwood cuttings made?
5. What temperature is necessary to root cuttings?
6 List three characteristics of a good cutting.
7 What is the function of the callus growth on cuttings?
8 What are the requirements of a good rooting medium?
9 Give four types of rooting media
10 When are cuttings ready to transplant?

Information Sheet
on
PROPAGATION FROM CUTTINGS

T ducing plants from cuttings is often cheaper and faster than producing them from seed by budding or by grafting The use of cuttings also helps maintain the characteristics of the original plant Many types and varieties of plants will not produce the same quality or type of plant from seed and must be reproduced by cuttings budding. or grafting

Commercial plant producers use cuttings to secure large numbers of plants faster than securing the same plants from seeds Cuttings are also used because they are easier and simpler to make than various budding or grafting operations

Cuttings are classified and named according to the part of the plant from which they come: stem cuttings leaf cuttings or root cuttings

Stem cuttings are most important and more commonly used They are made by cutting a segment or piece of a growing limb or shoot from the parent plant These cuttings are further classified or named by the type of wood or growth period from which the cuttings are made

1 Hardwood cuttings are usually made in the winter months (or dormant stage) from plants or trees which shed their leaves. Plants propagated by hardwood cuttings include Junipers and Yews
2 Semi-hardwood cuttings are usually made from evergreen plants and are cut from newer growth on the plant after it has finished the rapid summer growth. Plants propagated by semi-hardwood cuttings include euonymus, evergreen azaleas and holly
3 Softwood cuttings are made from new growth in spring or early summer while that part of the plant is growing rapidly Plants propagated by softwood cuttings include pyracantha, magnolia and spirea
4 Herbaceous cuttings are made from plant materials which are soft, rapidly growing and relatively high in water content Plants propagated by herbaceous cuttings include coleus, chrysanthemum geranium. and carnation.

The following environmental conditions are necessary for rooting cuttings; high humidity, air temperature of 60° to 70° at night and 75° to 85° during the day. The temperature of the rooting medium should be as close to 70 to 75° as possible Others are adequate light and a good rooting medium

After cuttings have been made and placed under environmental conditions favorable for rooting a callus layer may develop at the basal end of the cutting The callus serves as a protective layer which retards the development of decay on cuttings that are fairly slow to root The formation of callus and the formation of roots are independent of each other, although they often occur at the same time

Propagation From Cuttings
(Information Sheet continued)

The plant from which cuttings are taken should be healthy and moderately vigorous The cuttings should come from average growth from portions of the plant in full sun The cuttings are usually three to five inches long with two or more nodes The cuttings should be made with a sharp knife, making the basal cut at about a 45° angle just below a node It is best to take cuttings in the early morning and keep them moist, cold and turgid (swollen) by wrapping in damp burlap or plastic bags until they are stuck in the propagating bed

The lower 1/3 to 1/2 of the leaves should be removed from the cuttings. Dip the base of the cutting in a rooting hormone and insert in the rooting medium. spacing so that the leaves barely overlap The depth of sticking the cuttings is generally 1/3 of their length. After the cuttings are stuck. the medium should be thoroughly watered to wash the particles closely around the base of the cuttings

During rooting the medium must be kept uniformly moist, but never soggy Until the cuttings begin to root, they should be kept under partial shade After rooting, the shade should be removed for increasing periods of time until it is left off completely

A good rooting medium is one which can be kept uniformly moist. but which also provides good drainage and aeration. Some satisfactory ones are clean sharp sand (builders grade), vermiculite (horticultural grade). sand and peat moss mixture, equal parts of each, peat moss and perlite. equal parts of each

The propagation box should be at least three to four inches deep. Usually they are wooden boxes or flats with slatted bottoms Standard size nursery flats are usually about 15" wide by 22" long by 3-1/2" deep This size is convenient to handle when filled with the rooting medium and cuttings

To maintain the high humidity needed for rooting softwood cuttings, the top of the flat may be covered with plastic This may be done by placing a wire or wooden frame over the flat to support the plastic 8 to 12" above the rooting medium. After the cuttings have been stuck and thoroughly watered. the flat is covered with a sheet of plastic, which should be tucked under the bottom of the flat or tacked to the sides and ends to hold it in place

Cuttings should be properly managed after they have rooted When the cuttings have roots 1/2 to 1" long, they are ready to transplant either into pots or directly to outdoor beds. If transplanted into pots, 2-1/4 to 3" pots are used The potting mixure should contain about 1/3 organic matter such as peat or leaf mold, and 2/3 sandy loam soil The cuttings should be partially shaded for 7 to 14 days after the cuttings are established By fall the cuttings will be ready to plant in the field to grow to a size suitable for landscape use If they were rooted late in the season, they should be carried over the first winter in a covered cold frame

Propagation From Cuttings
(Information Sheet continued)

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Material for this information sheet was partially taken from.

1 State Department of Education. Agricultural Education Service, Montgomery, Alabama. Ornamental Horticulture for Vocational Agriculture in Alabama.

2. The Center for Research and Leadership Development in Vocational And Technical Education The Ohio State University "Propagating Horticultural Plants"

Assignment Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Plant Propagation

TOPIC: Propagation by Layering

OBJECTIVE: To develop an understanding of the different types of layering.

INTRODUCTION Many plants can be reproduced by layering. This is the development of roots on a stem while it is still attached to the parent plant. The rooted plant is then detached or cut after it has developed roots and becomes a new plant.

REFERENCES:

Required.

1 Information Sheet, "Propagation by Layering"

Supplemental.

1 "Propagation of Ornamental Plants", B-816-(1), Agricultural Extension Service
2 Plant Propagation Principles and Practices, Hartmann and Kester
3. "Plant Propagation", B-178. Florida

QUESTIONS OR ACTIVITIES.

1 Why do we wound plants that are to be layered?
2. What type of plants can be layered in a simple way?
3. What type of plants are air layered?
4. Why do we air layer plants?
5 What materials are used in air layering plants?
6 When is the best time to air layer plants?

Information Sheet
on
PROPAGATION BY LAYERING

The production of a new plant by layering is one of the surest methods It is commonly used to propagate plants which are difficult to root

A simple way of layering is performed by bending a branch of a plant to the ground and covering it with soil or a rooting medium, but leaving the terminal end exposed.

It is usually best to wound branches that are to be covered with soil This helps to induce root formation Many plants such as ivy, philodendrons, blackberries, and strawberries will root by this method.

Air layering is a method used to increase many plants such as croton, hibiscus dracaena, and rubber plants Many tropical plants get "leggy" and shed their lower leaves; they cannot be sold as choice plants This is a method of securing good plants at a minimum cost

Air layering is an excellent way to produce plants which do not come true from seed In some cases, a layered plant can be produced in a shorter time than by other methods of propagation

One method of air layering is to select a spot just below the joint or node of the plant to be propagated It may be necessary to remove a few leaves in order to do this. Make a slanting cut upward Be careful not to cut all the way through Take a toothpick or other small piece of wood and place it in the upper end of the slit to keep it from sealing Then sprinkle the area which is to be propagated with a hormone This will stimulate the root growth. Wrap a small handful of moist spahgnum moss around this area to keep the roots moist while in formation Cover the moss with a small piece of plastic film, polyethylene, or kitchen-grade aluminum foil to seal in the moisture Tie the plastic with two pieces of garden wire or plastic tie In a few weeks, under ideal conditions, the roots should be in formation and the stem may be cut from the parent plant and placed in a pot

Air layering is best practiced during the spring and summer months when high temperatures and high humidity contribute toward quicker rooting

Assignment Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT Plant Propagation

TOPIC. Propagation by Division

OBJECTIVE To develop an understanding of how to increase plants by division.

INTRODUCTION The propagation of plants by division is an easy and sure way of increasing plants such as chrysanthemums, daylilies, and some shrubs.

REFERENCES.

Required.

1 Information Sheet, "Propagation By Division"
2 Sunset Basic Gardening Illustrated, pp 14-16

Supplemental.

3 Propagation of Ornamental Plants. Texas Agriculture Extension Service, pp. 816
4 Plant Propagation Principles and Practices, Hartmann and Kester, pp. 419

QUESTIONS OR ACTIVITIES

1 List four plants that can be propagated by division.
2 When is the best time to divide shrubs?
3. Why do you divide perennials?
4. When should you divide perennials?
5 How should you divide a daylily or other bulbous plants?

Information Sheet
on
PROPAGATION BY DIVISION

Division is a simple form of plant propagation. Some plants which can be propagated by division are daylilies, iris, chrysanthemums, geraniums, sanservieria, and shrubs such as primrose, jasmine and fig trees

Most of these plants can be dug and shaken free of soil Then the clumps can be divided into units or small plants. each having roots stems, buds, and leaves They can be planted in containers or as individual plants where they are to grow permanently.

Plants are best divided after their season of blossoming, but with care they may be so increased at any season of the year Larger shrubs may be divided in the same method as smaller plants, but in most cases they will have to be separated with a shovel or hatchet. They should be divided when the shrubs are dormant for best results.

Assignment Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT. Plant Propagation

TOPIC Propagation by Grafting and Budding

OBJECTIVE To develop an understanding of the methods and types of grafting and budding

INTRODUCTION. Budding and grafting is usually performed when certain plants cannot conveniently be reproduced by cutting, layering, or division Also, it is used when seeds do not reproduce the characteristics of the parent variety.

Experience is necessary to be successful at grafting and budding. One of the best ways is to study all you can about grafting and budding and then practice until you become skilled

REFERENCES

Required

1 Sunset Basic Gardening Illustrated, Lane Book Co., Menlo Par, Calif , pp 20-25

Supplemental.

1 "Propagation of Trees and Shrubs", Bulletin No. 1567 U S D A.
2 "Topworking Pecan Trees by Inlay Grafting", Brison, T A P. - 93 - Texas Agriculture Experiment Station
3 Plant Propagation Principles and Practices, Hartmann, Hudson, and Kester, pp. 266-398

QUESTIONS OR ACTIVITIES

1 Explain the meaning of stock and scion
2. What is the cambium layer?
3. When do you graft deciduous trees and shrubs?
4. Why should you have a sharp knife in grafting?
5 List two kinds of budding

Assignment Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT Plant Propagation

TOPIC Propagation from Seed

OBJECTIVE To develop an understanding of producing plants from seeds.

INTRODUCTION The production of plants from seed is commonly used by horticulturists Many ornamental plants are produced by planting seeds in flats or other containers using the proper cultural methods.

Producing good plants from seed requires great skill and knowledge The grower must be able to determine the requirements for many different plants He must know when seeds should be planted. how much space should be allowed for each type of seed how deep to plant them and the proper cultural methods

REFERENCES

Required

1 Information Sheet "Propagation From Seeds"

Supplemental

1 "Propagation of Ornamental Plants", B-816, Texas Agriculture Extension Service, pp 2-3
2 The Ball Red Book, pp 3-12
3 "Plant Propagation for Florida Homes", B-178, pp 34-37

QUESTIONS OR ACTIVITIES

1 Where does the average grower secure good seed?
2 What characteristics does a good growing media possess?
3 What is the proper temperature to germinate seeds?
4 What will happen when a grower attempts to germinate seeds at a cool temperature?
5 What is the best temperature to grow plants?
6 Why do you use a sterile moisture-holding material in planting seeds?
7. What information should the label on a seeded flat contain?

Information Sheet
on
PROPAGATION FROM SEEDS

There are several basic principles that the grower must observe if he is to get good germination of his seeds and thereby be successful in producing new plants These are

1 Use good seeds For the average grower good seeds can be obtained from the commercial producer of seeds These are growers who are not growing plants for the purpose of getting a flower but for the purpose of collecting and processing the seeds for sale to plant propagators
2 The grower must always use the best of growing media for germinating the seeds A wide variety of materials can be obtained for this purpose The media, whatever his choice must possess certain characteristics it must be finely screened porous loose and have a good water-holding capacity It should be sterilized and in most cases low in nutrients necessary for plant growth These nutrients can be added after germination and after the plant begins its growth
3. The germinator or grower must maintain the proper temperature if the seeds are to germinate properly Different plant seeds require different temperatures. however there are general principles that will be helpful to the grower that will apply to most plants Most of the common plants that the retail grower will deal with require a minimum of 65° for proper seed germination In most cases the temperature should be about 70°F This is very important because the grower who attempts to germinate seeds at a cool temperature will find that the seed will rot before having a chance to germinate
4 The proper moisture level must be maintained and must be kept uniform. If this is not done after the seed germinates or sprouts the plant will die
5 After germination occurs most species of plants grow better in a slightly lower temperature and in a cooler house The best temperature is usually between 50 to 60°

To sum up these general principles you could say that if you start with good seeds sow them in a good growing medium keep them warm and moist until after germination success is most likely to occur

Reasons For Failures In Germination

If the seed is good and there are proper amounts of heat moisture and air, nearly all the seed will germinate However some factors are responsible for seeds not germinating The more important factors are

1 Damaged Seed - Seeds with broken seed coats insect or rodent damage or heat damage will not germinate properly or else will fail to germinate at all
2 Old Seed - Seeds which are more than one year old will not germinate as well as fresh seed especially if the old seed was not stored properly.
3 Soil or Media Too Wet Too much water keeps air (oxygen) from moving around the seed causing it to rot before the plant can emerge

Propagation From Seeds
(Information Sheet continued)

4 Temperatures Too Cold - When soil and/or air temperatures are low, the emerging plant develops slowly and uses up the stored food before it can manufacture its own food Cold temperatures also slow down the absorption of water needed to start the germination process
5. Hard Seed - Some plants produce seed with a tough coat which will not allow moisture to enter the seed In such cases, it is necessary to use a special process to weaken the outer seed coat This special process is called scarification , and is used to weaken the outer seed coat so that water may be absorbed to begin the process of germination
6 Disease - Many diseases which affect plants are caused by bacteria or fungi carried to the young plant by air, water, or insects These pests are present on the seed itself or are present in the soil Damping off is one of the more common diseases affecting new plants Many of these diseases can be controlled by using various seed treatments and through sterilization of the soil or media in which the seeds are planted
7 Drying Out Of Soil Or Media - It is necessary to keep the soil or media well watered after seeds are planted Care must be taken to keep the soil or media moist enough so that the seed have a continuous supply of moisture, but not so much as to encourage damping off or reduced aeration of the media
8 Planting Too Deep - Seeds which are placed too deep in the soil or media may fail to produce a plant. These seeds will use all of their stored food and energy before reaching the surface and die before they can begin to make their own food A good rule to follow is to plant seed no deeper than 3 times the smallest thickness or size of the seed Most small seeds should be planted from 1/8" to 1/4" deep with a covering of a loose moisture-holding medium

Seeding In Flats

Starting plants by seeding thickly in flats is a common practice The seed may be broadcast or planted along marked rows The seed should be placed at a depth which allows for easy emergence of the seedling If the seeds are broadcast, little covering is needed Some propagators may use a layer of a sterile moisture-holding material such as sphagnum moss as a seed bed to reduce the chances of damping off developing However, care must be taken that the sphagnum moss is not soggy wet

A flat 2" x 4" board made to fit inside the flat or a brick can be used for firming the top of the soil In general, the smaller the seed, the less covering is needed For example, celery seed would require less covering than either bean or corn

Small seeds are often hard to handle and plant To help distribute the smallest seed, you can mix them with a small amount of sand or other inert material

Propagation From Seeds
Information Sheet continued

After the seed are planted in the bed and covered. water the seedbed gently To prevent washout of fine and small seeds use fine misting nozzles, sub--surface irrigation or place burlap bagging over the seedbed and soak the bed thoroughly When misting nozzles or sub-surface irrigation is used to moisten the seed and media. the usual practice is to cover the flat with a piece of glass or place the entire flat in a plastic bag to converse moisture until germination occurs After the initial watering no additional watering is usually required prior to germination

All seeded flats should be labeled The label should include the following information.

1 Name of plant or variety
2 Date seeded
3 Student's name
4 Special treatment if any

Using pot labels

1. Always start entries at the blunt end of the label
2 Allow the lower 1/3 of the label to remain free of entries for insertion into the soil of the flat or pot This will permit reading of the information on the label without lifting and wiping off the label
3 The students should be taught that the seeding job is not complete until the label containing the required information pertaining to the seeding is in place in the container

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Material for this information sheet was taken from <u>Ornamental Horticulture for Vocational Agriculture in Alabama</u> page 54. and also from "Propagating Horticultural Plants, Module No 3 Ohio State University

Assignment Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT   Plant Propagation

TOPIC   Developing A Plant Breeding Vocabulary

OBJECTIVE   To become familiar with the words used when discussing plant breeding

INTRODUCTION   It is next to impossible to understand any subject if one does not have a working knowledge of the terms involved   Reading will be meaningless if you have to skip every third or fourth word because you are not familiar with it

REFERENCE

Required

1 "Plant Breeding as a Hobby", Circular 817, University of Illinois, College of Agriculture page 32

QUESTIONS OR ACTIVITIES

1 What is the process called by which stamens or anthers are removed to prevent self-pollination?
2 What is a perfect flower?
3 What are the three parts of the female portion of a plant?
4. Where do seeds develop?
5 How are generations numbered?
6 What part of the plant bears pollen?
7. Is it possible for one plant to pollinate itself?
8 What part connects the stigma and ovary?
9. Ask your science or biology teacher to explain D N A. (Desoxyribonucleic acid) to you   The discovery of D. N A has revolutionized the field of plant breeding.

Assignment Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Plant Propagation

TOPIC: Plant Selection and Fundamentals of Plant Breeding

OBJECTIVE To become familiar with selection processes and to develop an understanding of pollination and fertilization.

INTRODUCTION In order to breed plants successfully it is important to understand the principles of plant reproduction. A person does not have to be a scientist to understand and do plant breeding. Many people make a hobby of this field. Plant breeding, of course, is much more than a hobby. It is the foundation for developing new and better plants.

REFERENCES: Required

1. "Plant Breeding as a Hobby" Circular 817 University of Illinois. pp. 3-8

Supplemental

2. Practical Plant Breeding. W. J. C. Lawrence, London 1951

QUESTIONS or ACTIVITIES:

1. What is meant by natural selection?
2. What are the two ways in which plants reproduce?
3. In what general section of a plant are reproduction processes carried out?
4. What is the name of the total male reproduction system?
5. What are flowers called that only contain the male reproductive organs?
6. What is the major difference between pollination and fertilization?
7. Learn the parts of the perfect flower (figure 17 on page 5).

Assignment Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Plant Propagation

TOPIC Heredity

OBJECTIVE To understand how traits are passed on from generation to generation

INTRODUCTION The study of heredity is not only one of the most rewarding studies of man, it is one of the most interesting. Heredity, like a lot of subjects, seems complicated and dull at first, but with knowledge comes interest. Once you understand basic concepts, you will want to look further into the subject. You will find it interesting to actually try some of the plant breeding experiments suggested in your reference material

REFERENCES Required

1. "Plant Breeding as a Hobby" Circular 817, University of Illinois pp. 8-13

Supplemental

2. Handbook on Breeding Ornamental Plants, Brooklyn Botanic Garden Brooklyn N Y 1959

QUESTIONS or ACTIVITIES

1. If a dominant gene and a recessive gene come together, which gene will show up in the outside appearance?
2. What is usually necessary to develop new varieties?
3. How many genes does a germ cell contain?
4. Can genes be determined by looking at a plant's color?
5. What is meant by segregation as it applies to plant breeding?

Assignment Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT Plant Propagation

TOPIC General Breeding Techniques

OBJECTIVE To become familiar with the equipment and techniques necessary for successful plant breeding

INTRODUCTION Successful plant breeding is almost impossible unless the proper techniques are used It takes only a little while longer to do the job right.

REFERENCES Required

1 "Plant Breeding as a Hobby" Circular 817 University of Illinois. pp 14-20

Supplemental

2 Simple Practical Hybridizing for Beginners. D. Gourlay Thomas. John Gifford Ltd . London. 1957

QUESTIONS or ACTIVITIES

1. Make a list of the equipment which is useful in plant breeding.
2. When should prepollination steps generally begin?
3. At what time of day does pollinating work best? Why?
4. If you want to cross pollinate a perfect flower what must be done to guard against self-pollination?
5. List the proper steps for labeling the seed parent after pollination

Assignment Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT Nursery Plant Production

TOPIC Transplanting Ornamental Trees and Shrubs

OBJECTIVE To develop an understanding of the major factors involved in the proper planting of ornamental trees and shrubs.

INTRODUCTION. Since trees and shrubs are an important part of landscaping, it is essential to know how and when to plant them

Proper cultural practices will provide the desired effects after your careful selection of plants These practices include the care of the plants, preparing the soil setting the plants, and providing proper care immediately after planting

REFERENCES

Required

1 Information Sheet on "Planting Ornamental Trees and Shrubs"
2. <u>Sunset Basic Gardening Illustrated</u>, pp. 31-32, 34-35

Supplemental

3 <u>Approved Practices in Beautifying the Home Grounds</u>, Hoover, pp 143-171

QUESTIONS or ACTIVITIES.

1 When should bareroot shrubs and trees be planted?
2 What size hole should be dug for the correct planting of shrubs and trees?
3. When planting a bareroot shrub or tree, how much of the top should be pruned?
4. What does the nursery term B&B mean?
5 What size tree usually needs guy wires?

Information Sheet
on
TRANSPLANTING ORNAMENTAL TREES AND SHRUBS

Proper planting will benefit both the plants and you. If they are worth planting, they are certainly worth the time and trouble to do it correctly. Care and attention from the very beginning will be of value.

Container grown plants and those balled and burlapped (BB) can be planted anytime. Early fall is a good time to plant as they should be well established before summer.

Bareroot plants such as pecan and fruit trees, some shrubs, and roses need to be planted as soon as they begin to arrive at the nurseries. This is usually in late fall or early winter.

The size of the hole into which the plant is to be placed is very important. It should be at least one to two feet wider and at least six inches or a foot deeper than the roots of the plant.

The soil in the bottom of the hole should be worked well and mixed with organic matter. Unless barnyard manure is well rotted, avoid using it. Do not fertilize newly set out plants, especially bareroot (BR) ones.

After the hole has been dug, you can fill it with water and allow it to soak into the surrounding soil. Place some of the soil mixed with organic matter into the bottom of the hole; set the plant on this. Fill in around the roots with more topsoil and pack well. You could water again and complete filling the hole with soil. The plant should be placed at the same level at which it was originally growing.

If the shrub was bareroot, you can prune about one-third of the top to compensate for the roots lost in digging. Generally, balled and bagged will need some pruning also, but container grown do not.

If the plant was in metal, paper, or plastic container, this should be removed before planting. If it was wrapped in burlap, this does not need to be removed. It can be loosened around the top near the base of the plant. Plants in containers may need to be watered before removing to prevent the soil from crumbling.

Newly planted trees or very tall shrubs will usually need to be staked especially if they are in a windy area. A stake can be placed on the side of the prevailing wind. This stake can be put in before planting if the plant is bareroot.

Transplanting Ornamental Trees and Shrubs
(Information Sheet continued)

If the tree is over five inches in diameter, it may need guy wires The wooden stakes would be placed some distance from the base of the tree and driven about 18" into the ground. Wires can be used from the tree to the stakes. The wire should not be tied directly to the plant Rubber hose protectors may be used around the wires If the plant is not too large, plastic ties may be used

Assignment Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT Nursery Plant Production

TOPIC Care and Maintenance of Plants

OBJECTIVE To develop an understanding of the modern methods of pruning ornamental shrubs and trees

INTRODUCTION. Pruning of plants is the cutting off or cutting back of parts of a plant for better shape or more fruitful growth

Trees and shrubs may need to be pruned in order to remove dead, diseased, or injured wood Pruning may be needed to remove a branch that overlaps another or to remove foliage right after plants are transplanted in order to make up for the loss of roots

Pruning also helps to improve the shape of the plant and makes it fit into the general pattern of the landscape

REFERENCES Required

1 Information Sheet on "Care and Maintenance of Plants"
2 "Modern Pruning Methods", B-997, Texas Agricultural Extension Service

QUESTIONS or ACTIVITIES

1 What is the cardinal rule to follow in pruning ornamental plants?
2 Give three characteristics of pruning tools
3. When can trees be pruned?
4 What two factors are important in pruning ornamental shrubs and small trees?
5 How much top growth should be removed from bareroot dug plants?
6. Why do rose plants need to be pruned?
7 When should deciduous plants be pruned?
8. When is the proper time to prune shrubs which bloom in the spring?
9 When should climbing roses be pruned?
10 Why is a rounded or pointed top hedge preferred over a flat top hedge?

Information Sheet
on
CARE AND MAINTENANCE OF PLANTS

Take stock of your yard and check on an important chore - pruning Are your sidewalks and driveways covered by overgrown. sprawling shrubs? Are your doorways crowded and your windows hidden? Then you should do some pruning

Pruning the removal of surplus or undesirable parts of the plant to improve the remaining parts reduces the leaf surface or buds that grow into leafy shoots This diverts the plant food from root production to shoot production and increases the leaf growth

Deciduous plants, those which lose their leaves during cold weather, should be pruned between leaf drop and first spring growth The skeleton is exposed and the plant is easier to work with After pruning, the plant should have a framework of well-shaped uncrowded branches

Many evergreen shrubs need annual pruning These might include wax-leaf ligustrum pittosporum, eleagnus, yaupon, and viburnum They may be pruned into midsummer as they have no dormant period

Sometimes coniferous evergreens such as arborvitaes need to be pruned to keep them within a certain size This can be done by shearing the main branches and end branches with sharp hedge shears Gradually clip from the outside to almost where the brown foliage begins This foliage will turn green when the light reaches it

The average pruning is from about one-fifth to one-third of the entire shrub Many shrubs should be pruned by thinning out rather than be severe pruning If a shrub is badly out of proportion to its surroundings. you can cut it back to within a foot of the ground Fertilized, watered, and allowed to grow naturally, you will have an attractive shrub again

Shrubs grown for formal hedges need frequent cutting to keep them closely sheared within definite dimensions If a hedge is informal, it can be allowed to grow more or less at will: it can be controlled to some extent

Shrubs which bloom in the spring should not be pruned until after their flowering Severe pruning can be done then as the flowers are produced on wood grown the year before the blooms

Pyracantha or other berry-bearing shrubs should be pruned before the blooms appear in the spring The berries for next fall and winter will be lessened by late or severe pruning

Care and Maintenance of Plants
(Information Sheet continued)

Rose bushes produce flowers on wood formed the same season. Therefore, the more of last year's wood you prune, the better for your rose bushes. Cut back old, non-productive canes. Remove any dead or diseased wood.

Climbing roses should be pruned after flowering. Flowers this spring will be produced on canes grown last season; they will be much greener looking and not as old appearing as the canes produced the season before. Branches which are too long may be cut back about one-third of their total length.

Use the proper tools when pruning. Be certain they are clean and sharp. Make a clean, smooth cut and leave no jagged edges, bruised bark, or stubs.

Always remove any dead, diseased, or broken branches from plants. If branches are rubbing, crowded, weak, or growing downward, they should be removed.

Assignment Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT Floral Crop Production

TOPIC Introduction to Floral Crop Production

OBJECTIVE To develop an understanding of the field of floriculture and to learn about sources of information on the subject

INTRODUCTION Floral crop production in the United States is a comparatively young business which probably started during the early part of the nineteenth century in Pennsylvania At that time, Philadelphia was considered the social center of the country The need for floral arrangements for special occasions brought about the beginning of the production of floral crops Today the production of flowers is one of America's largest industries.

REFERENCES Required
<u>Flower and Plant Production</u>, Nelson, pp. 3-15

QUESTIONS or ACTIVITIES

1 Why is it necessary for flowers to be produced throughout the year?
2 What are the three most widely grown cut flowers?
3 Where do most retailers of pot plants acquire their plants?
4 What is the motto of the Society of American Florists?
5 What magazine on the floriculture industry is available to the southern producer and can be obtained from Ft. Worth, Texas?

Assignment Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT Floral Crop Production

TOPIC Perennials

OBJECTIVE To develop an understanding of how to successfully produce perennial flowering plants

INTRODUCTION Perennials are long-time favorites of gardeners everywhere. Unlike annuals, they continue to flower year after year. During the winter the plant goes into a period of rest called dormancy. The following season it begins growth and starts to bloom

REFERENCES Required
Basic Gardening Illustrated, Sunset pp. 100-101

QUESTIONS or ACTIVITIES

1 What is probably the best plant for a new gardener to grow?
2 What is one of the most common uses of the large mum?
3 How often should primrose clumps be divided?
4 How can one cause polyantha primroses to repeat bloom in the fall?
5. If peonies are properly planted, how often will they need dividing?

Assignment Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT Floral Crop Production

TOPIC Bulbs

OBJECTIVE To develop an understanding of how to properly use bulbs in the floriculture industry

INTRODUCTION A bulb is an underground bud that sends down roots and has a very short stem covered with leafy scales such as lilies and onions.

It is both interesting and rewarding to plant a bulb and obtain a beautiful flowering plant

REFERENCES Required:
Basic Gardening Illustrated, Sunset, pp. 104-107

QUESTIONS or ACTIVITIES

1. When do tuberous begonias bloom?
2. Why should first foliage not be cut until it turns yellow?
3. What can be used to protect bulbs from soil insects and rot?
4. What is a true bulb?
5. What is a rhizome?
6. Study the terms on page 107.

Assignment Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT Floral Crop Production

TOPIC Characteristics Identification, and Use of Important Pot Plants

OBJECTIVE To learn the characteristics identification. and use of twenty important pot plants

INTRODUCTION. This assignment contains an information sheet with some of the characteristics, uses, and cultural requirements of twenty plants that are grown in many greenhouses and garden centers in Texas A student studying for a horticultural occupation should be able to identify the important pot plants and give their characteristics and uses

REFERENCES Required

1 Information Sheet on "Important Pot Plants"
2 Seed catalogues

QUESTIONS or ACTIVITIES

1 Locate pictures in catalogues and other references and study the picture as you study about each plant listed on the information sheet
2 As you study each plant. list it on the attached form and determine its most important identifying characteristics and use

CHARACTERISTICS AND USE OF POT PLANTS

No	Plant	Characteristics	Use
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			
17			
18			
19			
20			

Information Sheet
on
IMPORTANT POT PLANTS

1. AZALES --------Bright flowering plant from mid-December through May Requires acid soil or peat moss as growing medium, ample moisture but good drainage 60-65° temperature.

2 BEGONIA --------Grown for foliage and flowers. Grown in soil that is porous and slightly acid. Top soil should become dry before watering Water thoroughly. In winter requires full sunlight, in spring and summer place in filtered sunlight.

Thrive in humid air and do well in a temperature of 60-70° Keep foliage dry

3 BROMELIAD------Exotic looking plant with showy spikes of blooms which may be attractive for several months. Most store an emergency supply of water within a natural vase-shaped center formed by their durable foliage in leaf base cups. They are easy to grow and do well in shade or sunny locations. The color patterns in the foliage and unusual growth habits make the Bromeliad an excellent and interesting plant for the home or office.

4 CALADIUM-------Colorful decorative foliage plant grown from tubers which are sold in grades expressed in inches of diameter

Plant in loose, well-drained soil. Need high humidity and ample water 80-85° best temperature to start Caladiums.

Require light but not full sun. Fertilize with complete plant food about once a month

The fancy-leaved Caladiums offer a variety of form color, and leaf patterns that few plants can match. Grow to 2 - 2-1/2'. Can be used as house plants or for outdoor planting

5 CHENILLE -------Bright green. broad foliage. Flowers in hanging cattails up to a foot long of a deep red color. Needs semi-light and ample moisture

6 DIEFENBACHIA --Large decorative foliage plant. Needs well-drained soil high in organic matter. Filtered light. Commonly propagated by cutting stems into sections containing one or more eyes.

Important Pot Plants
(Information Sheet continued)

7. **CHRYSANTHEMUM** - (Mum) - Grows best in porous, well-drained sterilized soil. Rooted cuttings should be planted as shallow as possible. They are heavy feeders and need a regular supply of fertilizer. Disease and insect control is very important. They have special requirements such as timing, pinching, lighting, and shading. Disbudding produces larger flowers.

8. **COLEUS** -------- Outstanding foliage plant which is tender; requires frequent pinching during growing season to produce attractive, compact plant.

   Needs loose, well-drained woil with ample moisture Requires partial shade in hot, dry areas of Texas. Occasionally threatened with aphids and mealy bugs. Easily rooted from cuttings

9. **CROTON** ------ - Bright glossy leaves of many different colors on a single plant. Leaves are various shapes. Require strong sunlight to retain their color Needs high humidity. Propagated usually by air-layering.

10. **DEVIL'S IVY** ---- Variegated yellow-splashed green leaves Filtered light for best coloring Requires high humidity, but do not keep constantly wet. If on totem, moisten for humidity Needs rich loam soil. Feed with complete fertilizer about once a month

11. **DRACAENA** ----- A versatile plant of various types. Most varieties are large and showy; most have leaves that are long and striped Shade or filtered light Moderately moist, but good drainage, and high temperatures

12. **FERNS** --------- Various assortments usually called table ferns. All like cool, moist shady conditions. Rich compost soil and moisture, but well drained Will provide cool greenery background for other plants

    Many varieties excellent for basket growing.

13. **FICUS** ---------- (RUBBER PLANT) - Commonly used as large specimen plants, so they do need space. Have glossy green foliage Will tolerate dry air, and do well at 70 to 80°. Do not overwater.

    Filtered light ideal, but will take a great deal of sun

    Propagated mostly by air-layering.

Important Pot Plants
(Information Sheet continued)

14. GERANIUM-----Dusty, green foliage, succulent stems Large clustered flowers in many colors Require plenty of sun to bloom properly Allow to become quite dry between waterings Sandy loam high in organic matter is best Temperature from 60-70° is ideal

15 GLOXINIA------Showy, velvety foliage and large bell-shaped blooms in assorted colors Light high humidity, moisture, rich, well-drained soil Water spots foliage and flowers, so avoid getting water on them They need filtered light, and proper spacing

16. HYDRANGEA----Showy broad dark green foliage Long lasting flowering plant commonly grown for Easter and Mother's Day Flowers in pink blue, or white Plant requires regular water during flowering and likes high humidity

17 PHILODENDRON-Most important tropical decorative plant family Tropical conditions best, but will tolerate dry air and low lighting in homes Needs loose, porous soil, sufficient water to keep soil moist Many varieties and types Some used on totems and are strong climbers

18. POINSETTIA----Seasonal plant most popular at Christmas Small yellow flowers surrounded by striking colorful bracts in red, pink or white Keep warm, chills easily Requires moisture and strong light

19. SANSEVIERIA---(Snake Plant or Mother-in-law's tongue) - Among the sturdies of the foliage plants Will do well in shade areas or in sunlight Do need porous soil, adequate drainage Do not overwater

20 SCHEFFLERA---Attractive, fast growing umbrella-shaped foliage plant Glossy green foliage Filtered light Needs good drainage, and don't overwater Large plant, needs space Usually propagated from seed.

Assignment Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT. Floral Crop Production

TOPIC. Poinsettias

OBJECTIVE. To develop an understanding of the cultural procedures in Poinsettia production

INTRODUCTION. The Poinsettia is an important blooming plant which is very popular at the Christmas season They are a native of Mexico and the tropical American countries

The beauty of Poinsettias lies in the brilliant bracts below the cluster of flowers They are now being produced as reds. whites, and pinks.

Cultural practices are more important in growing Poinsettias than most crops because they have to be timed for the Christmas season only. The day after Christmas the prices decline rapidly

REFERENCES.

Required.

1 Flower and Plant Production in the Greenhouse, Nelson, pp. 272-279

Supplemental.

1. The Ball Red Book, pp 299-310

QUESTIONS OR ACTIVITIES

1 What nutrient should be supplied if cuttings are made under a mist
2 List three poinsettia colors
3 What is the most common pest on Poinsettias?
4 What are the most common causes of leaf drop on Poinsettias?
5 What is the reason for poor root development in Poinsettias?

Assignment Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT Floral Crop Production

TOPIC Chrysanthemums

OBJECTIVE To develop an understanding of some important cultural practices in chrysanthemum production

INTRODUCTION. The Chinese began hybridizing or crossing varieties of Chrysanthemums, or mums as they are more commonly called, over 2,500 years ago. In the years since, plant breeders from many lands have done much to improve existing varieties. The Oriental growers tried to win the approval of royalty; European growers concentrated on magnificent showblooms; the American hybridizers have improved mums for florist trade.

In recent years, much has been done to cause mums to flower on a year round basis. This is accomplished in greenhouses by controlling temperatures, shading, lighting, diseases and insects.

REFERENCES

Required:

1 Flower and Plant Production in the Greenhouse, Nelson, pp. 237-244

QUESTIONS OR ACTIVITIES

1 What is the natural blooming season for mums?
2 What is the most persistent pest of pot mums?
3. What is the correct night temperature for raising mums?
4. What is the most popular color in mums?
5 Why is black cloth placed over mum plants?
6. How and when do you pinch mums?
7 What may happen when mums are planted 2 to 3" deep?
8. What is the proper schedule for misting of mums?
9 How long does the mum season last?
10 What should be done to the soil before planting mums?

Assignment Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT Floral Crop Production

TOPIC Geraniums

OBJECTIVE To develop an understanding of the cultural procedures in geranium production

INTRODUCTION Few plants can equal the geranium for color, long period of bloom, and simple care They make a fine showing as a pot plant or as a bedding plant

Geraniums were once considered an old-fashioned plant; today they are one of the most popular plants for gardeners, indoors or outdoors

REFERENCES Required

1 Flowers and Plant Production in the Greenhouse, Nelson pp 256-264

Supplemental

2 The Ball Red Book, pp 247-251

QUESTIONS or ACTIVITIES

1 Why must geraniums be shipped so rapidly?
2 What is done to the plant several weeks before the cutting harvest is to start?
3 What color of geraniums is most in demand?
4 What system of watering has proved to be excellent for geraniums?
5 Give two good management activities in the sanitation program to prevent diseases from developing and spreading
6 What is the second most popular color in geraniums?
7 What is the night and day temperature preferred by geraniums?
8 How are most geraniums shipped from California?
9 In what size pot are most geraniums produced?
10 Why have geraniums not been widely grown from seed?

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Assignment Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Floral Crop Production

TOPIC: Hydrangeas

OBJECTIVE: To develop an understanding of the cultural methods in raising hydrangeas

INTRODUCTION: The hydrangea is usually raised as an Easter and Mother's Day plant. It is an excellent long lasting flowering plant for late winter and spring season.

REFERENCES

Required

1. Flower and Plant Production in the Greenhouse, Nelson, pp. 264-267

Supplemental

2. The Ball Red Book, pp. 259-269

QUESTIONS or ACTIVITIES

1. What insect must be controlled on hydrangeas?
2. What will happen to hydrangeas if they are not frequently watered?
3. When are stem tip or leaf bud cuttings made?
4. For which two occasions are hydrangeas commonly shown?
5. What disease causes severe loss to hydrangea buds in storage?

Agricultural Education
Teaching Materials Center

Assignment Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT Establishing and Caring for Lawns

TOPIC Turf Grasses for Texas

OBJECTIVE To develop an understanding of planning the lawn and the proper selection of turf grasses for Texas

INTRODUCTION A beautiful lawn is the foundation for a pleasant home landscape No matter how expensive the home, how beautiful the trees shrubs, and flowers, they will not show up to the best advantage with an unattractive lawn

A lawn is a living thing consisting of thousands of tiny living plants or grasses Each plant needs food, water, sunshine and soil It is largely dependent upon you for many of these

The lawn is a valuable part of the landscape design and should provide the proper setting for the house, trees shrubs and other buildings It should be established properly in order to provide a beautiful area which will be easy to keep attractive

REFERENCES Required
"Home Lawns", B-203, Texas Agricultural Extension Service, pp 1-3

QUESTIONS or ACTIVITIES
1 Give five factors to consider in the selection of a turf grass
2 List two ways turf grasses are classified
3 Give three points about Bermuda as a turf grass
4 Give six points about St Augustine grass as a turf grass
5 Why does Zoysia grass make an excellent turf?

Agricultural Education
Teaching Materials Center

Assignment Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT Establishing and Caring for Lawns

TOPIC Establishing a New Turf

OBJECTIVE To develop an understanding of the principles in the establishment of a new turf

INTRODUCTION The lawn is a valuable part of the landscape design and should provide the proper setting for the house trees, shrubs, and other buildings It should be established properly in order to provide a beautiful area which will be easy to keep attractive

REFERENCES Required
"Home Lawns" B-203 Texas Agricultural Extension Service pp 5-7

QUESTIONS or ACTIVITIES

1 List three distinct steps necessary in the establishment of turf
2 List five types of organic matter which can be added to a new turf
3 How should fertilizer applications be determined?
4 What are the factors to consider in determining whether a yard will be seeded sprigged or sodded?
5 Why is the frequency of watering reduced as the lawn begins to take root and grow?

Assignment Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT Establishing and Caring for Lawns

TOPIC Managing an Established Turf

OBJECTIVE To develop an understanding of the principles and practices involved in managing an established turf

INTRODUCTION After the lawn has been properly established it is important to know the time and rate of fertilization when to water and to have a working knowledge of keeping a lawn beautiful

REFERENCES Required
"Home Lawns" B-203 Texas Agricultural Extension Service pp 8-12

QUESTIONS or ACTIVITIES

1 List four major factors involved in maintaining turf
2 Why is Nitrogen the key element in turf production?
3 Why is Phosphorous important to the lawn?
4 Explain what a lawn looks like when it has a nitrogen deficiency
5 What does a plant look like when it has a phosphorous deficiency?
6 Describe an iron deficiency in the turf
7 When should the turfed areas receive an application of complete fertilizer?
8 How may chlorosis be corrected?
9 Why are light frequent sprinklings harmful?
10 Why is the aeration of the soil in a turf important?

Assignment Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Establishing and Caring for Lawns

TOPIC: Turf Problems

OBJECTIVE To develop an understanding of the problems which occasionally arise in the management of a lawn.

INTRODUCTION. Many problems may arise in the successful management of beautiful. well-kept lawns. The horticulturist should be able to identify the important lawn diseases and insects and have a working knowledge of the control of these problems.

REFERENCES: Required

1. "Home Lawns". B-203. Texas Agricultural Extension Service. pp 12-14.
2. "Texas Guide for Controlling Insects on Ornamental Plants" Texas Agricultural Extension Service. L-199.

Supplemental

3. "Lawn Insects. How to Control Them". B-53. U S. D A

QUESTIONS or ACTIVITIES.

1. List four problems which occasionally arise in the production of a turf.
2. What is the best way to control weeds?
3. What chemical is commonly used to control broad-leaved annual weeds in the lawn?
4. Describe the appearance of a lawn which has Brownpatch.
5. What is a good fungicide for controlling Brownpatch?
6. List eight dusts or sprays which are effective for controlling most lawn insects
7. Why is renovation of old lawns necessary?
8. List four dusts that are recommended for the control of chiggers.
9. Give three good sprays for the chinch bug.
10. Give the mixture for controlling the Bermuda grass mite.

Assignment Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Controlling Plant Insects, Plant Diseases, and Other Pests

TOPIC: Causes of Plant Diseases

OBJECTIVE: To learn what causes plant disease and to learn to recognize these diseases

INTRODUCTION: There are probably about as many diseases as there are plants. Man must constantly strive to ward off these diseases. If all research stopped, it is possible that man would be living in a world of famine and hardship

REFERENCES: Required.

1. "What You Should Know About Plant Diseases", B-995, Texas Agricultural Extension Service

Supplemental:

2. "Texas Guide for Controlling Insects and Diseases", L-245, Texas Agricultural Extension Service

QUESTIONS or ACTIVITIES:

1. What are the four most important causes of plant disease?
2. What is photosynthesis?
3. What is a vector?
4. What is the best approach to controlling canker disease?
5. What are fungi?

Assignment Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT. Controlling Plant Insects Plant Diseases, and Other Pests

TOPIC: Identifying Plant Diseases

OBJECTIVE: To learn to identify plant diseases and to become familiar with the terminology used in connection with plant diseases.

INTRODUCTION: Better quality and higher yields at lower cost are possible with better disease control Diseases cost producers millions of dollars each year A large part of this expense can be prevented by learning more about diagnosing and checking plant disorders

REFERENCES: Required

1 "Identifying Plant Diseases" MP-512, Texas Agricultural Extension Service.

Supplemental

2 "What You Should Know About Plant Diseases", B-995, Texas Agricultural Extension Service

QUESTIONS or ACTIVITIES.

1 What is the key to effective control of plant disease?
2. What is meant by blasting?
3. What is exudate?
4. What is the best way to check nematode damage?

Activity:

1 Study the terms that describe plant diseases on page 7 of reference no 1
2 Collect all the publications on plant diseases from your county agent.

Assignment Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Controlling Plant Insects, Plant Diseases, and Other Pests

TOPIC: Application and Safety Precautions of Horticultural Chemicals

OBJECTIVE: To learn the safe use of the important horticultural chemicals and procedures for effective application

INTRODUCTION: There are numerous methods of applying pesticides, fungicides and other horticultural chemicals The purpose is to completely cover the plant or pest with the proper amount of control material The first factor to consider is the welfare of the people using the material, second is the welfare of the plants and then the effectiveness of the material in controlling the pest or diseases

REFERENCES: Required

1 <u>Flower and Plant Production</u>, Nelson pp 302-311
2 <u>Basic Gardening Illustrated</u> page 81

QUESTIONS or ACTIVITIES:

1 What is the first factor to consider when using chemicals?
2 What is the second factor to consider?
3. What is the third factor?
4 What is one of the most common means of applying pest or disease control materials in the greenhouse?
5. How should you store a water hose to prevent spreading of diseases?
6. What are the safety rules that should be followed when a person is working with pest control chemicals?
7. Why should a plant be completely covered with contact poisons?

Assignment Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT Controlling Plant Insects. Plant Diseases, and Other Pests

TOPIC Controlling Leaf Diseases

OBJECTIVE To learn how to identify and control the major leaf diseases.

INTRODUCTION A customer who wishes to buy a plant is usually looking for one which has a lot of healthy leaves A plant will not sell if its leaves have wilted and turned brown This will result in decreased profits on the part of the producer.

REFERENCES Required

1 "Texas Guide for Controlling Diseases on Ornamental Plants" MP-574 Texas Agricultural Extension Service. pp. 10-13

Supplemental

2 "What You Should Know About Plant Diseases", B-995 Texas Agricultural Extension Service

QUESTIONS or ACTIVITIES

1 How does one treat leaf scorch or scald?
2 What causes sooty mold?
3 What causes oedema?
4 What two chemicals are good for treating mosaic or leaf curl?
5 When do you spray azaleas and camellias for galls?
6 How often would one spray to control bacterial leaf spots?
7 What usually causes chlorosis?
8 What type of disease is anthracnose?

Assignment Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Controlling Plant Insects, Plant Diseases, and Other Pests

TOPIC: Controlling Stem, Branch, and Trunk Diseases

OBJECTIVE: To learn the major diseases that affect stems, branches, and trunks of horticultural plants and how to control these disorders.

INTRODUCTION: The stems, branches, and trunks of plants are necessary for plant growth. They are the transportation system for the plant since water and food move through them. A disease affecting these systems can cause a definite decrease in plant vigor.

REFERENCES: Required

1. "Diseases on Ornamental Plants", MP-574, Texas Agricultural Extension Service. pp. 14-16

Supplemental

2. "What You Should Know About Plant Diseases", B-995, Texas Agricultural Extension Service

QUESTIONS or ACTIVITIES:

1. How does a person treat a plant that has gall?
2. What is the control for a dodder infestation?
3. How does moss damage a plant?
4. What part of a plant does green scurf attack?
5. What causes wood rot?
6. What is the treatment for slime flux?
7. How is mistletoe spread?
8. What causes lichens?

Assignment Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Controlling Plant Insects, Plant Diseases, and Other Pests

TOPIC: Controlling Root Diseases

OBJECTIVE: To learn to detect root diseases and how to control them

INTRODUCTION: Roots are the storage organs of plants. If a disease is present in the roots of a plant, growth and vigor will be greatly affected.

REFERENCES: Required.
"Diseases on Ornamental Plants", MP-574, Texas Agricultural Extension Service. pp 17-21

QUESTIONS or ACTIVITIES:

1. What is a good treatment for mushroom root rot?
2. What is a good treatment for crown gall and hairy rot?
3. What is the first step when planning to fumigate for mushroom root rot?
4. What is the minimum distance from live plants that it is permissible to use carbon bisulfide as a soil fumigant on mushroom root rot?
5. In what sections of Texas is southern blight most common?
6. What temperature is required for southern blight development?

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Assignment Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT Controlling Plant Insects Plant Diseases, and Other Pests

TOPIC: Controlling Diseases Affecting the Entire Plant

OBJECTIVE To learn the causes symptoms and control of diseases affecting the entire plant

INTRODUCTION Many diseases are not localized in the stems, roots, or leaves, they damage the plant in all parts There are various controls for these diseases but one must first be able to make a proper diagnosis. Never assume that because a plant shows a symptom of a known disease that you have diagnosed the disease properly Many diseases have some common symptoms Don't make the mistake of diagnosing a plant disease without studying all symptoms of all diseases common to the particular plant

REFERENCES

Required

1 "Texas Guide for Controlling Diseases on Ornamental Plants" MP-574 Texas Agricultural Extension Service, pp 22-23

Supplemental

2 <u>Basic Gardening Illustrated</u> page 80

QUESTIONS or ACTIVITIES:

1 What symptoms would a chrysanthemum exhibit that had aster yellows that would not be present if it was affected by verticillium wilt?
2 What is an effective control for aster yellows?
3. What is an effective control for verticillium wilt?
4 In what section of Texas is verticillium wilt most common?
5 Who are the only people that should handle chloropicrin?
6 What is a chemical called that controls mites?
7 What are two effective treatments for botrytis blight?

Assignment Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Controlling Plant Insects, Plant Diseases, and Other Pests

TOPIC: Controlling Lawn and Turf Diseases

OBJECTIVE: To learn the major lawn and turf diseases and how to control them

INTRODUCTION: It has been said that a landscape can be no better than the appearance of its lawn. A house can be made into a beautiful home by maintaining a nice green lawn. There are several diseases which can severely damage the appearance of the turf if they are not controlled

REFERENCES Required.
"Texas Guide for Controlling Diseases on Ornamental Plants".
MP-574 Texas Agricultural Extension Service, pp. 24-26

QUESTIONS or ACTIVITIES:

1. What is the control for fairy rings or mushrooms?
2. What is the treatment for chlorosis?
3. What are the symptoms of fading out?
4. What is the treatment for slime mold?
5. What is the treatment for Piricularia leaf spot?
6. When should treatment for brownpatch be applied?
7. When should treatment for rust on bluegrass be applied?

Assignment Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Controlling Plant Insects, Plant Diseases, and Other Pests

TOPIC: Identifying Plant and Soil Insects and Methods of Control

OBJECTIVE: To learn how to recognize the major insects of horticultural plants To understand the various controls for these insects

INTRODUCTION: On any given day, a producer may walk through his plants and see numerous insects. Some of these insects and pests are taking money from his pockets by damaging his crop. A person who is depending on the proper growth and development of plants needs to know which insects are of economic importance and how to control them.

REFERENCES: Required.

1. <u>Basic Gardening Illustrated</u>, section to study: "Insect Pests", pp. 78-79
2. Information Sheet, "Identification of Plant Insects and Methods of Control"
3. "Texas Guide for Controlling Insects on Ornamental Plants", L-199, Texas Agricultural Extension Service (Study list of insects, descriptions, and types of damage.)

Supplemental:

4. "Texas Guide for Controlling Insects and Diseases", L-245, Texas Agricultural Extension Service

QUESTIONS or ACTIVITIES:

1. What is the difference between a snail and a slug?
2. At what time of year do grasshoppers hatch?
3. What are the best methods of controlling borers?
4. What part of the plant do grubs damage?
5. In what type of soil are nematodes most active?

Information Sheet
on
IDENTIFYING PLANTS AN SOIL INSECTS AND METHODS OF CONTROL

Eternal vigilance and timely applications of effective controls will reduce losses to a minimum Weeds in aisles or under benches are breeding places for a number of pests and cleanliness is imperative A generally overlooked area is that outside the greenhouse Weeds harbor many pests which can enter through side or top vents and open doors at the ends of the greenhouses Cleanliness and proper attention to the outside areas as well as under glass will reduce the sources of infestation

Great changes have occured in the field of insecticides and there is a wide array of materials which are useful in combating pests New materials are constantly being added and the horticulturist must keep informed as better insecticides are introduced

Aerosol bombs have radically changed certain pest-control practices Specific directions for their use cannot be given in general terms because they vary and directions on the bombs should be followed closely Alternation in the use of materials is suggested to avoid the rapid build-up of resistant strains of pests

Resistance of mites to insecticides is believed to occur by mutation which establishes populations that survive normal effective doses This resistance is inherited and does not retrogress Purchasing plants or cuttings infested with resistant mites can lead to considerable trouble

Sprays and dusts are still used because in many instances they are just as effective as aerosols and may be cheaper for local applications Many insecticides are deadly poisons. and precautions regarding their use will be found on the container and should be followed

Assignment Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT Controlling Plant Insects, Plant Diseases, and Other Pests

TOPIC Nematodes

OBJECTIVE To develop an understanding of nematodes as a serious pest

INTRODUCTION. When leaves of plants are wilting, drying, and falling off for no apparent reason, nematodes may be the cause. Nematodes are small, slender, worm-like parasites which cannot be readily seen by the naked eye. These pests are small, but they can completely destroy a plant.

REFERENCES. Required.

1 "What You Should Know About Plant Diseases", B-995, Texas Agricultural Extension Service, page 3, pp. 13-14
2 "Identifying Plant Diseases", MP-512, Texas Agricultural Extension Service

QUESTIONS or ACTIVITIES.

1 List the steps involved in preparing a small plant specimen as illustrated in bulletin MP-512.
2 What is the most common type of nematode?
3. What should be determined before a large amount of money is spent on nematodes?
4. Knots and galls found on plant roots do not always indicate root knot nematodes. Give at least two exceptions.
5. Name two plants that are very good hosts for root knot nematodes.

Assignment Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Controlling Plant Insects, Plant Diseases, and Other Pests

TOPIC: Control of Moles Gophers. Birds. Deer, and Ants

OBJECTIVE: To become familiar with animals and birds that are a nuisance to the producer of horticultural plants

INTRODUCTION: Plant damage by animals and birds can become quite costly. The rural nurserymen usually have a big problem with animals, and the small town producers are plagued by flocks of birds

REFERENCES: Required
Basic Gardening Illustrated, page 82

QUESTIONS or ACTIVITIES:

1 How can a person detect the presence of moles?
2 What are the two most effective means of destroying moles?
3 Why should traps be used with caution?
4 How do gophers and moles differ in their digging habits?
5 How do many gardeners who live in the country protect plant roots from gopher damage without using poisons or traps?
6. What birds have no friends and should be eliminated?
7 What is the best way to protect young seedlings from birds?
8. What is the best long term control for deer?

Assignment Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT. Controlling Plant Insects. Plant Diseases, and Other Pests

TOPIC Controlling Weeds

OBJECTIVE: To learn how to get rid of weeds and to prevent their recurrence.

INTRODUCTION: Weeds grow well without proper water and fertilizer. If you add these two ingredients. they will flourish and this produces a great deal of trouble. If not controlled, they can crowd out annuals and perennials and even small shrubs. Chemical. hand. and mechanical methods of control are all effective if you start early and are persistent

REFERENCES Required
<u>Basic Gardening Illustrated</u>, pp 84-86

QUESTIONS or ACTIVITIES:

1 If you are planning to pull up weeds in a bed, what should you do to the soil several days before starting?
2 What has been the gardener's most useful tool for over 4,000 years?
3 What is a good device for weeding between paving blocks?
4 How does encouraging shrub growth reduce weed population?
5 After weeds have been cleared, what can be done to prevent recurrence?
6 What precaution should be taken when mixing and applying chemical solution where handling is required?

Assignment Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Operating and Maintaining Horticultural Equipment

TOPIC: Principles Used to Prevent Personal Injury

OBJECTIVE: To learn the techniques and principles involved in horticultural work that will prevent personal injury.

INTRODUCTION: Gardening and growing horticultural plants can be hard work. In many instances a little time spent constructing a labor saving device can save several hours of back-breaking work.

REFERENCES: Required:
Basic Gardening Illustrated, pp. 90-93

QUESTIONS or ACTIVITIES:

1. What part of the body should do the lifting when you are picking up an object from the ground?
2. What effect does one pulley have on the force when you are attempting to straighten up a tree?
3. What can be used to remove a stump if no heavy equipment is available?
4. What preparation should be made to clay soils before attempting to do a lot of digging?
5. Tell how to make a handy device for blasting post holes and planting holes.

Assignment Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Operating and Maintaining Horticultural Equipment

TOPIC: Selecting and Maintaining Horticultural Hand Tools

OBJECTIVE: To learn to select the right tools for a job and to keep these tools in good repair.

INTRODUCTION. No situation is quite as distressing as trying to complete a job when the proper tools are not at hand

REFERENCES: Required:
<u>Basic Gardening Illustrated</u>, pp. 88-89, 94

QUESTIONS or ACTIVITIES:

1 Why will asking different gardeners for a suggested tool list be of little value?
2. What type of shovel is effective for moving sawdust, manure, and other light materials?
3 What is the most common size of hoe?
4. How often should one sharpen a hoe if the cutting is not too hard?
5 What type of hoe is used by a pushing motion rather than a chopping motion?
6. What are the two most common shapes of lawn rakes?

Assignment Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Operating and Maintaining Horticultural Equipment

TOPIC: Maintaining Small Power Equipment

OBJECTIVE: To develop the ability to maintain small power equipment.

INTRODUCTION: Value of small power equipment quickly decreases if proper maintenance practices are not diligently followed. Preventing a breakdown is usually much easier than repairing one

REFERENCES: Required
Information Sheet, "Maintaining Small Power Equipment"

QUESTIONS or ACTIVITIES:

1. What are the two factions of preventive maintenance?
2. What should an operator of equipment do at the end of each work day?
3. Why should the fuel tank be filled at the end of the day?
4. What may be used to clean the air filter?
5. What two factors should be considered when checking a belt?

Information Sheet
on
MAINTAINING SMALL POWER EQUIPMENT

Small. engine-powered equipment quickly loses its value if it is not carefully maintained Profitable use of the equipment depends on trouble-free operation on the job. While no equipment, no matter how well maintained. can be guaranteed not to break down on the job. "down time" can be extremely short if a careful maintenance program is followed. Human and livestock health care is of a preventative nature Equipment maintenance should be similar

Preventive maintenance can be described as consisting primarily of two things

1 Periodic equipment inspection to discover situations which may lead to equipment breakdown
2 Upkeep to minimize wear or to remedy potential trouble

Regularly used equipment should always be checked by the operator Should he notice any slight malfunction. he should correct it before further trouble develops. The operator should see that field maintenance is carried out regularly.

Usually not enough horticultural equipment is operated by a horticultural business to warrant hiring a full-time field mechanic or serviceman The operator has the responsibility to check oil. apply grease. and perform other maintenance when needed In some instances. this may be required every few hours At the end of the day, the operator should make an overall check and properly service his equipment. This will make the equipment ready to use the next day or on any future date it may be needed.

A regular program of shop maintenance should be carried out on each piece of small, engine-powered equipment Small engines have prescribed periods of operating time after which oil should be drained and replaced At that time a general check of the equipment is in order

Before beginning operation of a small, engine-powered piece of equipment, the following should be checked

1 Fuel
2 Engine oil level
3 Oil level and air filter
4 Belt tension
5 Chains, oil if necessary
6 Moving parts requiring frequent applications of grease or oil
7 Gearboxes
8 Implement adjustments

Maintaining Small Power Equipment
(Information Sheet continued)

During operation, the operator should constantly watch for any slight malfunction Often a change in the sound of the machine when in operation will indicate the beginning of trouble A skilled operator can tell by the sound of the machine if everything is in good working order If equipment is used for long periods during the day regular shutdowns for preventive maintenance practices are advisable

When equipment has been shut down for the day, it should be carefully checked and readied for the following day's operation

1 Fuel - Fill the fuel tank Moisture condenses more rapidly in a partially empty tank as the air cools
2 Oil - Check the oil level and add oil as required The oil should be changed periodically
3 Transmission case - Check the lubricant level, adding or changing the lubricant as necessary
4 Oil filter - Clean and check the oil level
5 Chains - Apply oil to chains at regular intervals Check the condition of the links
6 Belt condition - Check belts for excessive wear and for proper tension.
7 Moving parts - Grease all moving parts
8 Cutting surfaces - Clean and check cutting surfaces of plows, cultivator tines, mowers for sharpness Cover cutting surfaces with used oil or grease if the machine is to sit out in the weather or not be used over a period of time
9 Adjustment - Check machine to be sure that all operating parts are in correct adjustment
10 Bolts - Inspect the machine for missing and/or loose bolts
11 Damaged or broken parts - Determine if any parts have been damaged to the extent that machine operation will be impaired Replace these and all broken parts to insure proper operation
12 Machine cleanliness - Clean off accumulated dust and dirt regularly

When small, engine-powered equipment is put away for the off-season, give special care to provide the maintenance necessary to insure rapid starts the following season.

Small, engine-powered equipment is most valuable when operating properly. Proper preventative maintenance helps insure proper operation

The following general procedure should be used However, check the operator's manual for specific maintenance procedures which may be needed for a particular piece of equipment

Maintaining Small Power Equipment
(Information Sheet continued)

1. Before beginning the check, disconnect spark plug wire to eliminate a possible accident.
2. Using wire brushes, scrapers, rags, and chemical de-greasers clean the entire machine. Use chemicals only outdoors.
3. Clean air filter. Rinse with gasoline or other solvent, wipe dry, and refill with oil. If the air filter has a dry element, replace with new element according to manufacturer's recommendations.
4. Check carburetor for sediment. Remove and check if necessary.
5. Re-connect spark plug wire and run engine for five minutes. Stop the engine remove the spark plug wire, and drain the crankcase oil. Fill with new oil as recommended by the manufacturer.
6. Drain gas tank. Reconnect spark plug wire, start the engine, and run until the tank and carburetor are free of gasoline.
7. Remove spark plug and pour a teaspoonful of oil into the cylinder. Turn the flywheel to distribute oil. Replace the spark plug with a new one.
8. Adjust and/or sharpen any blades or implements.
9. Grease or oil any moving parts.
10. Wipe a light coating of oil over bare metal parts.
11. Store in a protected, dry place

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Material for this Information Sheet was taken from Module 10, "Operating, Repairing, and Maintaining Small Power Equipment." Center for Vocational and Technical Education, The Ohio State University, Columbus, Ohio.

Assignment Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Operating and Maintaining Horticultural Equipment

TOPIC: Operating and Maintaining Lawn Mowers Safely and Effectively

OBJECTIVE: To learn how to properly operate and to care for a lawn mower.

INTRODUCTION: A well mowed lawn can greatly increase the beauty of a home. There is more to operating a lawn mower than filling it with gasoline and mowing the grass.

REFERENCES Required

1. *Basic Gardening Illustrated*, page 94, "Lawn Mowing"
2. Information Sheet, "Operating and Maintaining Lawn Mowers Safely and Effectively."

QUESTIONS or ACTIVITIES:

1. What are the three general categories of power mowers?
2. What is meant by scalping a lawn?
3. What is the first step in adjusting the cutting height of a power mower?
4. A sickle bar mower consists primarily of what two parts?
5. Why should extremely long grass clippings be removed from the lawn?
6. Explain why grass leaves should never be clipped too short.

Information Sheet
on
OPERATING AND MAINTAINING LAWN MOWERS SAFELY AND EFFECTIVELY

Power mowers can be divided into three general categories (1) reel (2) rotary, or (3) sickle bar

Reel Mowers A reel mower is basically a common hand push mower powered by a small gasoline engine As the mower moves forward the revolving blades slide past the bed knife and cut the grass blades

Reel mowers used on bluegrass and similar grasses have five revolving reel blades Reel mowers used on the bent type grasses have seven or nine blades to provide a smooth even cut on these fine-bladed grasses

Reel mowers minimize the tendency of scalping or extremely close cutting on the high spots of an uneven lawn Repeated scalping will result in a weak turf at those spots

The procedure for adjusting height of cut varies for each make of reel mowers In general, the following procedures apply

1 Disconnect the spark plug wire from the spark plug and place it in a position where it is impossible for a spark to jump an air gap to the plug possibly causing accidental starting
2 Place mower on a perfectly flat hard surface such as a concrete walk or solid workbench
3 Adjust the bed knife to the proper height by manipulating the height adjusting set screws or by adjusting the wheel height
4 Check to see that the adjustment procedure has not distorted the bed knife Rotate the reel and check the clearance between reel blades and bed knife for the entire length of each of the reel blades This clearance should be uniform along the length of each blade If this cannot be achieved through adjustment, it will be necessary to utilize special equipment to grind the blades to obtain the desired clearance

Rotary Mowers Rotary mowers have a vertical shaft engine mounted on a housing which encloses a horizontally revolving blade The blade may be mounted on the engine shaft or one or more blades may be mounted on vertical jackshafts As the mower moves forward, the blade revolves at very high speeds lifting and cutting off the grass blades Rotary mowers are generally simpler in construction than reel mowers

Scalping, or extremely close cutting of high spots on uneven turf, can easily occur through careless operation Because the rotary mower is relatively square in design, the wheels may pass over a high spot and drop into a lower area during mowing and cause the blade to crop near to or hit the soil surface Excessive scalping may severely damage the turf

Rotary mower adjustment varies in detail according to the make, but the following general procedures usually apply

1 Place mower on a perfectly flat hard surface. such as the concrete walk or a solid workbench Remove spark plug wire so as to prevent the possibility of accidental starting which might result in serious injuries
2 Adjust mower blade to proper height by adjusting wheel height in relation to the housing Be sure to check the blade height and not the housing height since the blade is not level with the lower edge of the housing
3 Adjust mower handle height to suit operator

Rotary mower blades should be sharpened regularly since a dull blade rips instead of cutting the grass Before removing the blade for sharpening, disconnect the spark plug wire The blade may be sharpened by grinding or by filing Prior to remounting, the blade must be balanced The blade is mounted on a rod which is the same diameter as the hole in the blade Place the ends of the rod on a hard perfectly flat surface with room for the blade to revolve freely Two short pieces of 2" x 4" hardwood would work After resting the ends of the rod on the 2 x 4's the blade should remain level If the blade is not balanced grind or file the heavier end until perfect balance is achieved

Individual knives mounted on a base plate should be weighed after grinding to check their balance If necessary, metal may either be ground off the back of the knife or holes may be drilled in the back of the knife to remove excess weight so that perfect balance can be achieved

Sickle Bar Mowers Sickle bar mowers are used to cut overgrown turf or heavy weeds They generally do not cut neatly enough for use on home industrial. or recreational lawns

Sickle bar mowers consist primarily of a cutter bar and knife The knife is a narrow steel bar to which several triangular-shaped, sharp knife sections are riveted The knife is driven by a pitman rod through a series of guards and over numerous wear plates As the cutter bar moves forward grass blades are cut by a scissor-like action as the knife moves rapidly back and forth over the wear plates The sickle cutter bar is usually mounted on and powered by a garden tractor or is permanently mounted and powered by a specially designed power unit

Operating and Maintaining Lawn Mowers Safely and Effectively
(Information Sheet continued)

Height-of-cut adjustment is not present on some sickle bar mowers. On other makes, height adjustment is made by raising or lowering a steel "foot" which rides on the ground and keeps the mower at a set level.

Correct mowing techniques greatly influence the health, vigor, and appearance of a lawn. Leaves of the grass plant are essential to producing food for plant growth. When cut off too low, the food producing section of the leaf is lost and turf vigor quickly declines. Grasses similar in height to the bluegrasses should be cut to a height of 1 1/2 to 2 inches. Low growing grasses of the creeping bent types should be mowed to a height of about 1/2 to 3/4 inches.

If the lawn is mowed frequently enough clippings need not be removed. They filter down to the surface of the soil and act as a beneficial mulch for the turf. If the clippings are excessively long, they must be removed since they may smother the grass. Under certain conditions, some lawns develop excessive "thatch", dense mats of dead grass and clippings, at the soil surface. Under such circumstances all clippings should be removed.

The mowing pattern should be varied each time the lawn is mowed to eliminate low spots, corrugations, and some matting. The changed lawn pattern created by changing mowing directions also enhances the overall landscape appearance.

Overlapping each opposing cut improves the lawn appearance. Mowing in the opposite direction of the previous cut and overlapping past the wheel mark of the previous cut can raise grass that may have been matted down by the wheels and permit it to be cut.

Safety should be foremost in the mind of any equipment operator. He should know his mower and its capabilities and should attempt only jobs for which the equipment is designed. Except for adjusting the carburetor, he should never place his hands in or near moving parts nor allow anyone else, especially children, to be nearby when the engine is running. When the engine is stopped for cleaning or repairs, the spark plug wire should be removed to eliminate the hazard of accidentally starting the engine. The operator of a rotary mower should be constantly on guard against running over articles such as glass or stones which could be thrown by the blades of the mower, since such debris can cause severe injury to people or pets.

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Material for this Information Sheet was partially taken from Module No. 10, "Operating, Repairing, and Maintaining Small Power Equipment," Center for Vocational and Technical Education, The Ohio State University, Columbus, Ohio.

Assignment Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Operating and Maintaining Horticultural Equipment

TOPIC: Operating Rotary Tillers Safely and Effectively

OBJECTIVE: To learn the different types of tillers and how to properly operate them.

INTRODUCTION: A rotary tiller can be a handy piece of equipment. It can also be dangerous. One should exercise extreme caution in the operation of these machines. If cautions are heeded, a tiller can be used by even the inexperienced gardener to loosen soils and in preparing soil mixtures.

REFERENCES: Required:
Information Sheet, "Operating Rotary Tillers Safely and Effectively"

QUESTIONS or ACTIVITIES:

1. What are the two categories of rotary tillers?
2. Which type is used only for light work?
3. On front tine tillers, what moves the tiller forward?
4. If the front tine tiller digs too far into the ground and does not move forward, what should you do?
5. What should be done before starting any tiller?

Information Sheet
on
OPERATING ROTARY TILLERS SAFELY AND EFFECTIVELY

Rotary tillers are classified into two categories according to the arrangement of the tilling tines. Front tine tillers are those which have the tines located in front of the wheels. Rear tine tillers have the tines located behind the wheels.

Front tine tillers are generally designed for light-duty work and are often used for cultivating. In a loose soil they may do a satisfactory job of tilling to a depth of several inches. The machines usually are not heavy enough to till deeper on loose soils or to till heavy clay-packed soils with heavy vegetative cover.

Front tine tillers do not have power wheels The rotation of the tines causes the tiller to move forward. Some control can be exerted over rate of forward motion by adjusting the depth bar. If the tiller must be held back to do a proper job of tilling, the depth bar should be lowered to cause the tines to dig deeper and slow the rate of forward speed. If the tiller digs deeply and does not move forward, determine the adjustment of the depth bar.

Rear tine rotary tillers are designed for medium to heavy work. Excellent tilling can be done to depths of about eight inches in a variety of soils having various amounts of vegetation or organic matter. This type of tiller can thoroughly mix organic matter into the soil.

Rear tine tillers have powered wheels and usually a reverse gear. Power can be transferred to either the wheels or the tines Rate of forward speed is controlled by selection of proper gear and throttle setting.

Tilling depth on rear tine tillers is also adjusted by a depth bar which is usually located behind the tines. The bar is raised for increased tilling depth and lowered for decreased depth.

Since rear tine tillers are often used on heavy or packed soils, several points of operation should be noted. The following operational procedures should be observed:

1. Rotary till when soil moisture is correct Use standard method of squeezing a handful of soil to determine moisture content. When the soil ball flakes and cracks, soil has the correct moisture content for tilling.
2. First run tilling depth should be no more than one to two inches. Increase depth for each additional pass.
3. Final tilling passes should be at right angles to previous ones to break down lumps further.

Operating Rotary Tillers Safely and Effectively
(Information Sheet continued)

The handling procedures for front and rear tine tillers are considerably different. Each type can pose safety hazards to careless operators Before starting any tiller. check to see that all clutches or belt tension pulleys are disengaged. The load on the engine may be great enough to prevent the engine from starting if these clutches were engaged If the engine should start while the clutch is engaged, the machine may get away from the operator and cause personal injury or property damage Even if the engine does not start while the clutch is engaged, a sharp pull on the starting rope may upset the machine or injure the operator

Rear tine tillers present added hazards to the operator Power to the tiller tines should be disengaged whenever the tiller is not being used for tilling. This includes turning the machine around when moving it from one site to another.

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Material for this Information Sheet was taken from Module 10, "Operating and Maintaining Small Power Equipment," Center for Vocational and Technical Education The Ohio State University, Columbus, Ohio

Assignment Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Operating and Maintaining Horticultural Equipment

TOPIC: Operating Garden Tractors Safely and Effectively

OBJECTIVE: To learn how to operate a garden tractor safely and effectively.

INTRODUCTION: The sale of garden tractors has increased steadily in the past few years. These tractors are used in a number of horticultural enterprises as well as by homeowners and hobby gardeners

REFERENCES: Required·

1. Information Sheet, "Operating Garden Tractors Safely and Effectively"

Supplemental:

2. Literature from manufacturers of garden tractors

QUESTIONS or ACTIVITIES:

1. If one is planning to buy a garden tractor and a sickle bar, what should he keep in mind in regard to tractor size?
2. What is the usual horsepower range of small riding tractors?
3. Where should one attach pulled equipment to avoid tipping a tractor backwards?
4. What is the major difference between small riding type garden tractors and riding lawn mowers?
5. What are the two most widely used types of transmissions on garden tractors?

Information Sheet
on
OPERATING GARDEN TRACTORS SAFELY AND EFFECTIVELY

The small walking or riding type garden tractor is used in a number of horticultural enterprises as well as by homeowners and hobby gardeners

Walking type tractors have had the same basic design for a number of years, but moderate improvements such as rubber tires have been introduced

The basic design consists of a small gasoline engine mounted on a set of wheels attached to a pair of handles Power is usually transmitted from the engine through a reduction gear arrangement to a jackshaft An idler or belt tension pulley, is mounted for the belt between the gear box and jackshaft This provides the clutch for the tractor The power is transmitted from the jackshaft to the wheels by a chain or belt arrangement.

Extra pulleys may be mounted on either the gearbox shaft or the jackshaft to permit the use of implements requiring power A number of implements are available for walking tractors Those requiring power such as sickle bars or snow blowers, demand engines of high horsepower and tractors of heavier design Many implements are simply pulled or pushed by the tractor and often can be used with tractors of lower horsepower and lighter weight

Implements are attached to the walking tractor in two basic ways with minor modifications according to the various manufacturers Implements which are pulled are attached by a vertical rod or "pin" which secures the tool to the tractor frame behind the engine. Implements which are pushed by the tractor are rigidly secured to the frame in front of and under the engine with several bolts or pins

The following implements are available for most walking tractors

Cultivator
Plow
Disc
Reel mower
Sickle bar mower
Cart
Seeder
Fertilizer spreader
Lawn roller
Rotary roller
Sulky
Grader blade

The tractor engine can also be used to power a number of other stationary pieces of equipment, such as a small rotary cement mixer, saw, compressor, compost or soil shredder, and others.

The walking tractor is a versatile piece of equipment which, in many horticultural enterprises can supplement heavy equipment Operators of small walking tractors should, however, be familiar with the equipment since too often the tractor is damaged and the operator injured where it is used for too heavy work Quite often the walking tractor is not properly maintained since it is relatively inexpensive and possibly not used as often as larger equipment Because regular maintenance schedules are often neglected, premature equipment failure may result

Operating Garden Tractors Safely and Effectively
(Information Sheet continued)

Within the past decade, a small type of riding tractor has been developed Most are scaled-down versions of the larger types Horsepower ranges from 3 1/2 to 10. Due to the heavier weight of the machine and the added rider weight, the unit can handle somewhat heavier jobs than most walking tractors

While all small riding tractors can handle mower attachments they are not riding mowers Riding mowers are quite different from small garden tractors in that riding mowers are built to be used for mowing grass only The high interest in small riding tractors by homeowners with large lots has resulted in scores of different models produced by various manufacturers

The construction varies considerably in type as well as quality For example, some models have automotive type clutches. some centrifugal clutches. and others a belt-pulley type clutch Transmissions also vary considerably; some have an automotive type while others have a belt type

The teacher should obtain a variety of manufacturers' literature giving detailed specification of the various types of tractors

The list of equipment available for small riding tractors is the same as that listed for small walking tractors

Since the small riding tractors are basically a small-scale, standard tractor, several similar rules of operation should be kept in mind All pulled equipment should be attached properly below the rear axle level to avoid tipping the tractor backwards if the load is too great Care should be taken when operating the tractor on uneven or sloping ground to avoid turning over The operator of a walking tractor can usually move out of the way quickly in the event of an upset. but the operator of the riding tractor is in a more precarious position

Both walking tractors and small riding tractors can be valuable tools for a horticultural business or for the homeowner with a large lot For maximum value. however, they should be used only to the rated capacity of the unit, on jobs for which implements are available, and in situations where their use can be justified economically

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Material for this Information Sheet was taken from "Operating, Repairing, and Maintaining Small Power Equipment." Center for Vocational and Technical Education, The Ohio State University, Columbus. Ohio

Assignment Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Developing and Maintaining the Landscape

TOPIC: Introduction to Home Landscaping

OBJECTIVE To develop an understanding of why landscaping has become important and to learn sources of information available to the beginner

INTRODUCTION By properly landscaping a home its value can be greatly increased. The landscaping industry has grown in leaps and bounds during recent years. This growth is probably caused by the great number of people moving to the urban and suburban areas. It seems that everyone tries to have a better landscaped lawn than his neighbor. Another factor which has contributed much to the landscaping business is the greater amount of leisure time now enjoyed by American people. Many have found that working in a flower garden or watering the lawn is quite enjoyable and provides a form of relaxation which is very refreshing in this hurry-up world in which we live

REFERENCES: Required.

1. "Home Landscaping", B-980, Texas Agricultural Extension Service. pp 3-4

Supplemental:

2. Approved Practices in Beautifying the Home Grounds, Hoover

QUESTIONS or ACTIVITIES:

1. What are the three basic fields of endeavor involved in landscaping?
2. List the four main types of homeowners.
3. Why can gardens no longer be entirely naturalistic?
4. Why do landscaping plants vary so greatly from one side of Texas to the other?
5. How do some large nurseries which provide "free" landscape plans get their money back for the time and expense which they provide?

Assignment Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Developing and Maintaining the Landscape

TOPIC: Selecting a Site

OBJECTIVE: To develop an understanding of the considerations to make when purchasing a home

INTRODUCTION: Many people forget about landscape design when they are shopping for a new home. After the house is purchased, the owner then looks at his landscape potential. Many times, to his dismay, the landscaping will present special problems which require considerable expense

REFERENCES: Required.
"Home Landscaping", B-980. Texas Agricultural Extension Service, pp. 4-5

QUESTIONS or ACTIVITIES:

1. What should be the first consideration as to homesite?
2. What is meant by zoning?
3. Can most families afford to spend one-half of their annual income on a lot?
4. List some disadvantages of a corner lot.
5. List two disadvantages of sites that are too far above the street.
6. What direction should outdoor living areas face? Why?

Assignment Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT Developing and Maintaining the Landscape

TOPIC Scheduling Landscape Development and Beginning Plans

OBJECTIVE To develop an understanding of how to schedule your landscape development and to learn how to begin the landscape plan.

INTRODUCTION Successful landscapes are a result of proper scheduling and planning Few beginners can see all of the problems which will arise in landscaping a lawn It is wise to spend considerable time in reading materials written by specialists before drawing the plans.

REFERENCES Required
"Home Landscaping". B-980. Texas Agricultural Extension Service, pp 5-9

QUESTIONS or ACTIVITIES

1 Describe a well-planned garden.
2 What are the most essential elements of the plan that should be constructed first?
3 Why are trees so important in Texas landscapes?
4 What are the purposes of hedges, screens, walls, and fences?
5 What are the two important steps involved in solving a landscape problem?
6 What is meant by "site"?

Agricultural Education
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Assignment Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Developing and Maintaining the Landscape

TOPIC: Analyzing Problems and Determining Needs

OBJECTIVE: To develop an understanding of the specific problems which will be encountered on certain sites and to become aware of the four basic considerations which should be included in successful landscape development.

INTRODUCTION: Four basic considerations should be included in successful landscape development. These are suitability, function, economy and beauty.

REFERENCES: Required:
"Home Landscaping", B-980 Texas Agricultural Extension Service, pp. 9-12

QUESTIONS or ACTIVITIES:

1. List the four basic considerations which should be included in successful landscape development.
2. What is the basic step in the preparation of a program?
3. What three questions should you ask yourself in regard to outdoor surroundings?
4. What are the three economies to keep in mind in the development of a homesite?
5. What two factors determine beauty?
6. Can a beginner usually obtain simplicity in a landscape design?

Assignment Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Developing and Maintaining the Landscape

TOPIC: Developing the Landscape Plan

OBJECTIVE: To develop an understanding of the steps involved in developing the landscape plan

INTRODUCTION: Planning is the means of accomplishing an objective through an arrangement of steps. A properly designed and executed plan will result in a landscape of a desirable nature.

REFERENCES: Required:
"Home Landscaping". B-980 Texas Agricultural Extension Service pp 12-15

QUESTIONS or ACTIVITIES:

1. When should planning begin?
2. What scale is used on the sketch survey on page 13?
3. What are the four main functions that all homesites and farmsites must provide?
4. What area should occupy the largest portion of the property?
5. Around which area of the house should private areas be developed?
6. What were the two approaches to landscaping which were followed in years past?

Activity:
Study the areas in Texas where plants vary.

Assignment Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Developing and Maintaining the Landscape

TOPIC: Selecting Plants

OBJECTIVE: To develop an understanding of how to select the proper plants to be used in a landscape

INTRODUCTION: One must be very careful in selecting plants for a landscape. Otherwise, he may plant a monument to his ignorance. An example would be planting a tree that would grow high enough to damage the roof of the house.

The completed plantings are the final mark of distinction in any landscape. These are the elements that provide beauty and enrichment to the solution of the landscape problem

REFERENCES: Required
"Home Landscaping", B-980, Texas Agricultural Extension Service, pp. 20-26

QUESTIONS or ACTIVITIES:

1. How tall are large shrubs or small trees when they are full grown?
2. How tall do medium shrubs get?
3. How are shrubs classified that do not grow higher than three feet?
4. What is the danger involved in planting trees with deep, wide-spreading roots?
5. What type of tree is desirable for the warmer regions of Texas where year-round shade is needed?
6. What duties are required for proper lawn maintenance?
7. Give two examples of fast growing hedges that require frequent clipping

Assignment Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Developing and Maintaining the Landscape

TOPIC: Grading, Drainage, and Landscape Structures

OBJECTIVE To develop an understanding of the grading and drainage factors and to learn how landscape structures should be constructed.

INTRODUCTION Every homesite will require some grading to permit proper drainage. There are many factors to be considered before grading. It must be kept in mind that water directed to certain areas could cause damage to plants

The construction of sidewalks and drives is expensive. Be sure of your planning before the concrete is poured

REFERENCES. Required
"Home Landscaping". B-980 Texas Agricultural Extension Service pp 27-30

QUESTIONS or ACTIVITIES:

1 Although not the most desirable, what is the most inexpensive way of preventing water from downspouts from washing away soil?
2. Does lowering the grade around existing trees damage trees as much as filling in around them?
3 When you need to save a valuable tree, what method will least disturb the tree?
4. What is the most common mistake when constructing sidewalks?
5. What should be the minimum width of a front entrance sidewalk?

Assignment Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Merchandising Horticultural Plants and Supplies

TOPIC: Developing Personal Traits

OBJECTIVE: To understand how to increase sales. To develop the proper personal habits and techniques required to make a sale.

INTRODUCTION: No salesman is better than his personality. Act enthusiastic and you will be enthusiastic. Think happy thoughts and you will be cheerful. Smile, even though you don't feel like it Before long these will become habits and your percentage of sales will increase.

REFERENCES: Required.

1. Information Sheet on "Developing Personal Traits"

Supplemental:

2. Sales Horizons, Haas and Perry

QUESTIONS or ACTIVITIES:

1. What are the three basic ingredients of a salesman?
2. What are the two best ways to learn how to sell?
3. What are two ways in which good habits pay off?
4. How does a person become a "scientific salesman"?
5. What is required for a would-be salesman to become a tough, aggressive, and effective salesman?

Information Sheet
on
DEVELOPING PERSONAL TRAITS

The three basic ingredients of salesmanship are knowledge of self knowledge of people and knowledge of the product to be sold A person who wants to become a salesman must learn to use each of these basic divisions to its fullest potential Before anyone can understand others fully, he must have a good understanding of himself and how he relates to others Then it is necessary to understand the product or service fully

There are two basic ways of learning to sell after you have studied the basic knowledge of the product First, and probably the best, is to apply some FFA training and learn by doing This means learning from experience To do this, it is necessary to gain employment in a retail store such as a feed seed, and horticultural supply store and make direct sales to the customers

The second way to learn to sell is to learn from others This makes it necessary to observe very closely the methods used on you while you are having a product sold to you Observe what the salesman says during the sale He will get your interest by saying or doing certain things Observe how well he knows his product Observe his mistakes These can be very valuable to you

A salesman must develop a good sales attitude This is very important It involves knowing oneself It means knowing if you have the "mind" for selling.

A good attitude means that the salesman recognizes his responsibility to the company It means becoming a part of the company and growing progressively more loyal to it as time goes on

A good attitude means proving that you are growing and coming up with new ideas for the company. This involves keeping up to date on new developments Agricultural supplies are changing each day and a good salesman keeps up with these things

A good attitude means good sales habits Old habits must be changed. When the salesman learns good habits, they are his alone No one can share them Good habits pay off in promotions and dollars

A good attitude means selecting the right learning methods. These methods are study experience, and a combination of the two Study means lessons at school or constant review of materials in the business Experience means practice With each successful sale, the salesman grows When study and experience are combined, the result is a good salesman with a good attitude

Constant analysis of the sale makes a "scientific salesman" This analysis is done by getting the facts, analyzing the facts, drawing conclusions from the facts and applying the conclusions This means planning and executing the sale inch by inch It means reviewing the sale after it is made It means applying what you have learned to the next sale.

A good salesman realizes that salesmanship provides a mutual benefit to himself and his customer This makes it necessary to get the customer's viewpoint and help him get the most for his money A good salesman speaks the customer's language If possible, he determines the customer's needs, problems, business, and what the product will do for him This is easily done by a salesman of agricultural products.

Developing the Right Sales Personality

In salesmanship as in any field of work the personality of the salesman is of utmost importance. His ability to sell himself will be directly related to his ability to sell a product. Even before selling himself to others he must sell himself to himself This means being sure of what he can do Strong sales personality enables the salesman to apply scientific training to the sale of the product.

Diligence and perseverance are necessary for a would-be salesman to become a tough, aggressive, and effective salesman

There are several qualities that make up the sales personality Each will be discussed briefly

1. Sincerity - Sincerity is a quality that creates an atmosphere of confidence on the part of the customer in the salesman Insincerity does just the opposite Sincerity is, in the final analysis, the total of the salesman's attitude toward his work The correct attitude causes the salesman to apply himself to his training and do his job

2. Tact - When a salesman meets a customer the opportunity for conflict or differences of opinion is great Tact is the quality of personality that can smooth out these conflicts and bring about the proper atmosphere for making a sale. It means that the salesman will not contradict. The injured pride of a customer will prevent him from making a purchase. If the salesman wins an argument, he will still lose.

3 Enthusiasm - This is the quality of the personality that means putting everything you have into it. It involves the whole body - the face, the voice, and the actions To have enthusiasm, a salesman must be thoroughly familiar with the merchandise to be sold and he must appreciate

it. The more the salesman knows about the product. the more enthusiastic he will become

4. Courtesy - One could never say too much about the importance of courtesy to the salesman Courtesy is simply good behavior and good manners It is the quality that gives good first impressions Many times that good first impression makes the sale.

5. Cheerfulness - It has been said that we are what we think we are If we think cheerful thoughts, we are cheerful The cheerful salesman will meet his customers with a smile, whether he feels like smiling or not Cheerfulness can be measured in important sales.

6 Initiative - This characteristic is most vital to the sales personality of the successful salesman The alert mind of the salesman who possesses this quality will cause him to get new sales on his own and will cause him to operate without any prodding from his employer.

7, Friendliness - Many a sale has been won by the friendly salesman His friendly personality puts the customer at ease. The feeling of the customer can be described as a certain good friendly feeling. The unfriendly salesman can be sure that his customers will never buy his products.

8. Persistence - This quality can suggest that in some cases a salesman can become obnoxious This is not what is meant by being a persistent salesman This quality causes a salesman to try again after failing to sell a potential customer. He does not admit defeat quickly. It simply means trying again to make a sale, using a different method

9. Memory - A quick memory of the information involving the product is very important to the good salesman. A quick memory involving the name and other facts about the potential customer is also very important It has been said that forgetting a person's name may mean the loss of a sale To gain memory, the salesman will practice concentration, association. and repetition. Concentration on the facts association of these facts to something familiar, and the repetition of these facts will cause the mind to grasp them.

Developing Personal Traits
(Information Sheet continued)

10. Application - Nothing is ever truly learned until it is put into practice. The applying of any idea to making a sale is putting that idea into practice. The only sales idea that is important is the one that works. The wise salesman will try hard to improve himself by applying what he has learned. Other attributes that help a salesman make a sale are a good vocabulary, a pleasant voice, shaking hands with the customer, and being vigorous and poised. All good salesmen are recognized as having these qualities.

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Material for this Information Sheet was taken from Ornamental Horticulture for Vocational Agriculture in Alabama, pp. 229-231.

Assignment Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Merchandising Horticultural Plants and Supplies

TOPIC: Displaying

OBJECTIVE: To learn how to increase sales of horticultural plants and supplies.

INTRODUCTION: A grower may have an outstanding selection of plants and supplies; but if the public does not see these items, profits will be greatly reduced. No business will succeed without a market In most cases, the grower must create or improve his market. One of the more effective ways of increasing sales is to properly display items and create a desire on the part of the buyer.

REFERENCES: Required:
Information Sheet, "Displaying"

QUESTIONS or ACTIVITIES:

1. Where should point-of-purchase displays be placed?
2. What is the basic reason for displays?
3. What types of items are handled best in bin displays?
4. What items should be placed at eye level?
5. What are three characteristics of a good floor display?
6. What is the purpose of a sales floor window display?
7. Why should a single item not be displayed?
8. What should one consider when arranging different displays around the store?
9. What is the most practical way to display nursery stock?
10. What should be the maximum width of a display bed?

Information Sheet
on
DISPLAYING HORTICULTURAL PLANTS AND SUPPLIES

Point-of-purchase displays normally consist of tri-plane and peg board tables. special display racks, bins. display floor windows and floor displays These must be located where they will be seen by the greatest number of customers The basic reason for displays is to put merchandise where customers can see it and serve themselves

Special racks, tri-plane and peg board tables are excellent for displaying impulse items and other small competitive items Much of the fast turnover merchandise is adaptable to display selling Customers like to handle the merchandise they buy; they find it interesting These displays are easy to set up and maintain They enable the salesman to handle a larger volume of sales

Bin displays are more successful when used for familiar products, bulk seeds, and other seasonal items It is a good idea to put reminder items where they command the customer's attention The items that are to be pushed should be placed on shelves at eye level

Most businesses find floor displays are best for large items such as barrels of special fertilizer packages or for large quantities of small items in a special promotion. A floor display should be well stocked, safe. and at a convenient height.

Sales floor window displays have one definite purpose This is to stop customers and bring them into the place of business They must be appealing and attract attention by action. This necessitates the use of special signs, background, lighting, and display cards Window displays are most effective for whole goods or for tie-ins with advertised promotions

Some Proven Principles of Effective Displays

In point-of-purchase display merchandising

1. Display in quantity - A single item does not attract customers. Bulk attracts attention and gives the impression of demand

2 Use proper arrangement - Consider the traffic pattern Locate displays where the greatest number of people will pass them Each table and shelf should have a relation to the others Establish a "theme" for the entire area Keep all displays well stocked; remove a few items from the cartons and do not make the display so orderly that it will discourage the customer from picking up items

Displaying Horticultural Plants and Supplies
(Information Sheet continued)

3 Change display frequently - As customers need change, so do displays. Many dealers establish a rule to change displays after a given number of weeks. This practice permits more items to be displayed and helps keep them current with the season. Even displays of non-seasonal items should be changed because customers do not like to see the same thing on each visit. The change takes very little time, but it improves the appearance of the department and pays off in additional sales.

4 Keep displays clean and neat - This is a problem in many businesses, but all agree that good housekeeping is necessary

Point-of-sale display advertising takes advantage of the customer's presence in the store. Plant displays so that they will act as silent salesmen

Displaying Plants To Be Sold

The most practical way to display nursery stock or other plants to be sold is to arrange them in beds. This should be done whether the plants are under a lathhouse for shade or whether they are in the open. The beds should be rectangular in shape and not more than eight feet wide. A walkway adjoining the bed should be at least three feet wide. The plants in the beds should all be the same type. They are arranged according to size and the balls are covered to prevent drying out.

When arranging merchandise other than plants in the sales room, use the same principles involved in displaying plants. Small displays of similar items should be arranged. The customer should have access to these displays at all times. He should be encouraged to browse. Above all, these displays should be kept neat and stocked with merchandise

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Material for this Information Sheet was taken from Ornamental Horticulture for Vocational Agriculture in Alabama. State Department of Education.

Assignment Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Merchandising Horticultural Plants and Supplies

TOPIC: Advertising

OBJECTIVE: To learn the different methods of advertising horticultural plants and supplies. Also, to learn the effective use of each method and to become aware of the importance of advertising.

INTRODUCTION: If a business is making money, it can afford to advertise. If it is losing money. it cannot afford to under advertise. This statement is often made to show the importance of advertising. It has been said that advertising is the key to sales. If customers are not motivated to buy, sales will drop and profits will decrease.

REFERENCES: Required.

1. Information Sheet, "Advertising"

Supplemental.

2. <u>Fundamentals of Advertising</u>, Rowse and Nolan

QUESTIONS or ACTIVITIES:

1. What is the most rewarding type of advertising?
2. In most cases, what type of advertising will take up most of the advertising budget?
3. In what section of the newspaper will advertising do the most effective job?
4. What is the most important factor in direct mail advertising?
5. What three factors should be considered in selecting a method of advertising?

Information Sheet
on
ADVERTISING

Experience has shown that most salesmen get the most out of their advertising budget through point-of-purchase advertising, outside advertising. and special promotions

Point-of-Purchase Advertising consists of displays within the place of business Items well displayed are half sold Impulse buying results in millions of dollars' worth of sales annually as the growth of supermarkets shows Good displays remind the customer of things he wants If properly grouped they will often result in sales of related items There should always be a tie-in with the various specialties and service sales programs and seasonal items should be displayed several weeks ahead of season

The trend in modern retailing is increasingly toward self-service merchandising on a supermarket scale People are naturally interested in products if it is easy for them to satisfy their curiosity, it will also be easy for them to buy Farm businesses have always used bins tri-plane tables windows counters and peg boards to display items Now however it is realized that these devices deserve to be the central theme in merchandising planning Businesses who have tried self-service merchandising have been highly successful Originality and ingenuity in displaying merchandise will be reflected in increased sales and profits

Outside Advertising, in most cases. will take up the bulk of the advertising budget It includes newspaper radio. T V handbills direct mail. and road signs The basic problem is selecting the most effective media to use The medium that is selected must produce noticeable results in the cash register Don't be satisfied with anything less

In selecting the media, consider effectiveness. cost and coverage The salesman must have knowledge of all media, including their advantages and limitations

Newspaper Advertising includes both the display and classified When you prepare display ads, make sure that the layout is attractive and that the headline will arouse interest Usually. the most successful advertising is done in the classified section. A skillfully prepared personalized classified ad in the newspaper will get results because classified readers are a voluntary audience Be sure to identify the business so there is no doubt who is doing the advertising Many equipment dealers include in all their newspaper advertising a "Special for the Week" This is a promotion in which one item is featured at a special price This takes very little space in an ad. and the results are gratifying

Advertising
(Information Sheet continued)

Direct Main Advertising can be directed toward a given group of prospects. The key is the mailing list It must be up to date and broken down by specific groups interested in specific items New names must be steadily added and old names dropped when mail pieces are returned undelivered Salesmen should feed the list with names and addresses of new prospects and customers

In a letter. postcard. leaflet, or sales flyer, personalize the message to the customer. Make the story as detailed as you wish because space is not a factor.

Radio and T V. have some definite advantages They convey fast, hard-hitting messages T. V. is high in cost but has the advantage that a machine or plant can be demonstrated to the viewers For both radio and T. V. the time of presentation is vitally important It should be when a large percentage of the prospects may be listening or viewing; it should be tied into weather and news forecasts, or other home audience programs Many businesses use spot announcements and obtain good results.

Road Signs on main roads leading to the store help in picking up transient business Signs should be erected in a solo location and kept clean and well painted.

Many dealers have found handbills to be an effective, low-cost way to advertise promotions. and parts and service specials A handbill must have an eye-catching layout and a timely interesting message

Special Promotions is an area of merchandising that is almost unlimited. Use the imagination and you will promote sales In planning these slow-season specials. consider advertising through the newspaper, by direct mail, or with handbills. The purpose is not only to announce the special but also to use reduced pricing to get the customer to purchase immediately.

Again, these specials must be tied into promotional advertising and put on display to get attention. Even though a special event is held primarily to advertise whole goods, there is no reason why you can't advertise parts and accessories at the same time.

Plan your merchandising program so it will attract buyers. Make them come to your store Include displays that will act as "sales clinchers". Finally. broaden your market with special promotions

Advertising
(Information Sheet continued)

Selling Plants

We have discussed what is needed by the salesman in the way of personal knowledge of the product and his own personal ability to sell. These are just as important in selling plants as in any other field. In selling, first of all, the customers must be induced to call upon you. This is commonly called "getting traffic".

Many methods have been used to "get traffic". Advertising is one of the best ways. Of course, advertising also takes many forms. One of the best ways of advertising to sell plants is by the use of attractive well-placed signs. They should be placed along the approaches to the sales yard. These signs should be kept in good repair and the paint job should be fresh. In some cases these signs may be landscaped themselves. Remember the principle involved in the use of signs is that too much information will not be helpful.

Another practice used by salesmen in nurseries or retail rooms where plants are sold is for the salesmen to be dressed in attractive uniforms.

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Material for this Information Sheet was taken from Ornamental Horticulture for Vocational Agriculture in Alabama, pp. 236-239.

Assignment Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Merchandising Horticultural Plants and Supplies

TOPIC Labeling and Pricing

OBJECTIVE To learn how to effectively label and price horticultural plants and supplies

INTRODUCTION: The very best of plant growing techniques and practices will not pay off unless items are properly labeled and priced A short time studying this phase of merchandising could pay off in larger profits to the plant and supply businessman.

REFERENCES Required:
Information Sheet, "Labeling and Pricing"

QUESTIONS or ACTIVITIES:

1. What is the common fault of most beginners when pricing plants?
2. What costs are involved in producing plants?
3. What percent mark-up do most nurserymen use?
4. What items will not sell at a high percentage mark-up?
5. Upon what is the percentage mark-up based?

Information Sheet
on
LABELING AND PRICING

All plants should be well-labeled so that the customer can tell what it is without asking questions Tags of various shapes and sizes have been used for this These are attached to the plants or plant containers by the use of small wires When plants can be grouped together the variety and size may be identified by the use of a single sign placed in a conspicuous spot By all means if possible use color photographs on the labels The price of the merchandise may also be placed on these descriptive labels

When pricing plants and other merchandise for the first time, the beginner normally prices his plants too low Much of the cost of production is hidden in the production of plants, transplanting, salesman's salary unsold stock shrinkage in volume, and overhead These costs must be absorbed in the selling price

There is no rule to follow in pricing nursery stock but to understand the proper method of determining the mark-up on the plant will be helpful The percentage mark-up is based on the selling price not on the cost For example if an item costs the operator 75¢ and is sold for $1 50, the mark-up would be 50% rather than 100% This common misconception has caused many retailers to sell their plants too low Normally a mark-up of 50% on plants is too low An average mark-up used by many retailers is 66 2/3% However high-priced merchandise will not sell at this high percentage An example of this is that a $1 00 item that costs only 30 or 40¢ will sell and a $15 00 item will not sell if it is priced at $30 or $40

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Material for this Information Sheet was taken from Ornamental Horticulture for Vocational Agriculture in Alabama page 242

Assignment Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT Merchandising Horticultural Plants and Supplies

TOPIC Understanding the Customer and Making Sales

OBJECTIVE To understand customers and to increase sales of horticultural plants and supplies

INTRODUCTION Without a market for the final product, no business will succeed Beautiful plants or excellent supplies are useless if they are not sold Production and storing cost will become so great that the business will operate at a loss if the products are not bought and paid for by the customer

Usually the amount of sales depends upon the salesman Everyone working in a business should understand customers and know how to make sales

REFERENCES Required

1 Information Sheet. "Understanding the Customer and Making Sales"

Supplemental

2 <u>Popular Sales Techniques</u>, Series, International Harvester Co . Chicago, Illinois

QUESTIONS or ACTIVITIES

1 What is the first thing for a salesman to think about after losing a sale?
2 Which party should bring up the subject of financing?
3 Why do customers buy products?
4 Why should high pressure not be used in making sales?
5. What is the first problem of a salesman when dealing with a customer?

Information Sheet
on
UNDERSTANDING THE CUSTOMER AND MAKING SALES

We generally come in contact with two distinct types of customers. The first type is the customer who first has to be sold on the item or need for the product you are selling. He may be a potential buyer of a piece of equipment or a new and different type of fertilizer or a new and different service which your organization can perform for him.

The second type of a prospective customer differs from the first type in only one aspect, he has already decided he needs your type product. He may be undecided about buying your brand or buying a similar product from another salesman. In a case of this kind the customer must be sold on the superior features of your product. This can be done by pointing out a person in the area who is successfully using the product which you are selling. Seeing is believing

The buying interests that cause customers to buy products are.

1. Owner's comfort and convenience
2. Performance
3. Safety - This implies safety of the operator and protection of the equipment or product.
4. Appearance
5. Length of life
6. Economy - This implies saving time, money, and labor.
7. Service
8. Prestige - This interest implies that a new owner is proud of his purchase.

Making the Approach to the Sale

Before a sale can be made, a plan has to be developed for getting the attention of the potential customer in point-of-purchase selling. This approach is not as difficult as it is in making a sale outside of the store. Farmers who come into your store are normally in search of a particular product; and if given the chance by a salesman with a pleasing personality, he will ask about the product he has in mind. If he comes in with no particular product in mind but just to browse, the salesman will need to make a sales approach if he hopes to make a sale.

A salesman should put first things first. His first problem is to get the attention of the customer. This is done in many ways and it is usually done at the same time the salesman is selling himself. It is not enough to say that the salesman must get a customer's attention, he must get his "favorable attention". A salesman who is friendly, alert, courteous, and has a confident approach to the customer will usually get his favorable attention immediately. However, his personality must be bolstered with a reasonably conservative and well-groomed appearance. This appearance should never be underestimated in getting the attention of the customer especially in the agricultural business. It is true appearance does not make the man but it does make that part of the man that the customer sees first. Many times this forms the total impression that the customer has of the salesman

Enthusiasm plays a definite part in making a successful approach and sale. It has been said that enthusiasm is contagious. If the salesman displays the idea that he is "sold" on the product, this enthusiasm is likely to carry over to the customer.

The first few seconds of the sale are very important. In getting the attention of the customer, the salesman has only obtained his temporary interest. During these first few seconds the salesman in some way should reach the customer by indicating what the product can do for him. If this is done, the customer's attention or interest is aroused. You are then in a good position to hold his interest long enough to present your product.

Holding the customer's attention or interest can be done in several ways. Usually the best way is by doing something. This means showing the product or demonstrating the product to him. The customer's normal reaction is to look, to listen, and, if pleased with the product and presentation, to buy

Making and Closing a Sale

Although most salesmen would like to close every sale, it isn't possible to get that high a batting average. After losing a sale though, a salesman should become concerned about the reason he failed. Some of the reasons for his failure to close may be found in this section on the do's and don'ts of closing sales.

Be Sincere

Make certain that statements and actions are sincere when dealing with prospects. If you make factual statements during your sales presentation, your customers will have confidence in your recommendations and will be more inclined to buy.

If you believe a customer is purchasing equipment or supplies that will not perform his job satisfactorily, you are obligated to tell him so. Part of your job as a salesman is to recommend to the customer the equipment that is matched to the job. Customer satisfaction will result from sincere opinions and efforts on your part in leading him to a wise and correct buying decision. He will gain confidence in what you say only if you are sincere.

Don't High Pressure

People object to being pressured into buying They like to believe that they make up their own minds Closing a sale without using high pressure tactics is one of the greatest challenges of salesmanship

It is easy to fall into the habit of speaking quickly, concentrating on key points, and then attempting to force the prospect to make up his mind There is such a note of urgency in presentations of this type that the prospect feels he is being high-pressured into something he is not sure about His natural reaction is to feel that something is wrong or that he should be cautious

Most people will buy when the salesman has convinced them sufficiently that the product will fill their needs The prospect must be led to believe that the decision is entirely his own The skilled salesman implants his ideas carefully He presents his proposition in such a way as to give the impression that he is helping the prospect solve his problems

Sell When the Customer is Ready to Buy

In any favorable sales presentation, there are certain times when it is logical to obtain the order Experience indicates that there are certain times when an opportunity to close seems to present itself naturally One of these times is the point when the salesman and the prospect have reached substantial agreement and the prospect appears to be reasonably satisfied with the product At this time a "psychological moment" exists and the salesman should ask for the order

Don't Oversell

Many salesmen have talked themselves out of an order because they continued to sell after the prospect has decided to buy Many times silence is the best tool

Certain questions or reactions will indicate that the prospect is seriously considering the proposal These indications are signals for the salesman to try to close regardless of when they occur in the sales presentation Here are some typical indications that the prospect is ready to buy

Understanding the Customer and Making Sales
(Information Sheet continued)

1. Favorable response to the reasons given for buying now.
2. Favorable attitude toward the benefits described on a special trade allowance that is about to expire
3. When he asks, "Is this the best price you can give me?" or "Do you have a machine already set up and ready to go?" or "Can you supply this product in a large enough quantity?"

Recognizing these and similar indications and answering to the prospect's satisfaction may induce him to buy. Don't be so absorbed in the sales presentation that you miss buying signals Remember, many a salesman has lost an order because he didn't know when to stop presenting features and ask for the order.

Be Honest About All of Your Commitments

The surest and quickest way to lose a sale is to misrepresent the facts. You can make this mistake without being conscious of doing so. For this reason, you need to have a thorough knowledge of both your product and your competitor's product so that the possibility of error or misrepresentation will be reduced to a minimum.

If you come to points in your feature-by-feature selling and the customer asks you a direct question to which you do not know the answer, don't bluff your way through. Bluffing will kill any confidence he may have in you regardless of how superior your product may be The proper thing to do is to be perfectly frank with your prospect. Tell him that you are not too sure about the information he is requesting, but that you will obtain it for him immediately. Make sure you answer the prospect's questions as soon as possible The answer can skillfully be used as a reason for calling back on a customer who is offering stiff sales resistance

Don't let a question keep you from continuing your feature-by-feature selling.

Be Persistent

Many sales have been lost because the salesman was not persistent Sales Management magazine, March 2, 1962, in an article entitled, "Giving Up Too Quickly", states

1. Almost half of all salesmen - 48 percent - quit cold after a single call on a prospect.
2. Another 20 percent make two calls before quitting.
3. Seven percent make three, and five percent make four calls.
4. The remaining 20 percent make five calls or more, and these are the men who get from 75 percent to 80 percent of the business

Understanding the Customer and Making Sales
(Information Sheet continued)

This same article points out that. "Discouragement is a luxury no salesman can afford "

It is necessary to qualify each prospect and "sense" in your own mind how near you are to closing the sale If you feel an individual is going to buy stay with him until you sell him Many sales are lost because the salesman quits too soon Customers admire a salesman who has developed a degree of persistence Persistence quite often wears down resistance Persistent salesmen make it easier for customers to buy

Don't Sell Price Sell Benefits and Advantages

A dangerous practice that many salesmen fall into is trying to arouse interest by overstressing price The weak salesman will quote price argue price and cut price at the drop of a hat What he fails to realize is that many customers are interested only in a fair price and that more times than not they are more concerned with quality and service than price

Your job is to convince your prospects of the true value of your product People will buy the most expensive items if they are convinced that they will receive their money's worth If you sell a high quality product that is priced higher than that of competition. take every opportunity to describe the features in a way that justifies the higher price Sell the benefits that make your product worth its price

Make It Easy for Prospects to Buy

There are many things you can do during the selling process that will make it easy for the prospect to buy You should practice all of them while making a sales presentation. A few methods of making it easy for the prospect to buy are

1 Know your product so that you are not required to secure additional information The lack of product information may cause you to make an extra trip to see the prospect By that time he may be out of the mood to buy

2 Know your prospect so that you can fill his needs and anticipate the sales resistance you think he might bring up during your sales story

3 Offer available financing Do not make him ask for financing arrangements In addition. offer him a payment schedule that is possible for him to complete

Understanding the Customer and Making Sales
Information Sheet continued)

4. Summarize all agreements of the sale with him so that there will be no misunderstanding on the part of either you or the buyer.

5. Lead the prospect to a decision or an agreement at every opportunity. Many prospects need assistance in making a decision. you can guide them into making a decision in your favor.

6. Stay with your equipment and the prospect while demonstrating to make certain the equipment is working properly. You can answer any questions he might have while using it. It is important when making a demonstration to have the prospect operate the equipment as soon as possible. Let him operate it and he will soon feel that the equipment is his or that he would have a difficult time getting along without it.

7. Make sure that you always have order forms. finance charts, literature, and other pertinent facts that you will need to close the sale.

8. Be ready to close at any time during your sales presentation.

There are many more techniques that make it easy for the prospect to buy. Avoid statements questions, or procedures that make it difficult for him to buy.

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Material for this Information Sheet was taken from <u>Ornamental Horticulture for Vocational Agriculture in Alabama</u>. pp. 231-236.

Answer Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Introduction to Horticulture

TOPIC: Horticulture as an Industry

1 Vegetables

2. Fruits

3. a. Fruits
   b. Vegetables
   c. Flowers
   d Ornamental plants

4. Small fruits

5 The out-of-season production in the South and West.

Answer Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Introduction to Horticulture

TOPIC: Exploring Occupational Opportunities

1. a Laborer
   b. Foreman or Supervisor
   c. Assistant Manager
   d. Manager or Owner

2. To work on the job

3. Garden center employee
   Probably others which are diversified in operation

4. This answer depends on the local situations.

5. No written answer required. Coordinator should stress the importance of the student becoming thoroughly familiar with the 18 factors to consider in selecting a job.

Answer Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Plant Growth and Classification

TOPIC: Introduction

1. Study of plants

2. Over 350,000

3 Sugars and starches

4. Plants have the ability to produce food from carbon dioxide and water.

5 Van Helmont concluded that plants produced wood almost completely from water.

Answer Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT Plant Growth and Classification

TOPIC. Photosynthesis

1 Light

2 To combine or to put together

3 The combining of carbon dioxide and water by the chlorophyll of living plants in the presence of light

4. Amount of heat required to raise the temperature of a gram of water one degree centigrade

5. A combination of atoms

6 Diffusion

Answer Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT Plant Growth and Classification

TOPIC: Respiration

1. The release of chemical energy
2. Carbon dioxide and water
3. They are just the opposite
4. Carbon dioxide
5. Food and oxygen

Answer Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Plant Growth and Classification

TOPIC: Water Absorption and Loss--Nutrient Absorption--Movement of Nutrients and Water in the Plant

1 The plant will wilt.

2. Turgid

3. If you add too much fertilizer around the roots, water absorption is slowed down because most fertilizers, chemically speaking, are salts. This can cause the plant to wilt

4. Loss of water from the plant as a vapor

5. Elements, or groups of elements, needed for plant growth

6. Xylem, Phloem

7. If you girdle a tree properly, you remove the phloem and leave the xylem intact In this way water and soil nutrients continue to move up to the top of the tree. but you prevent the movement of plant foods from the leaves to the roots. After six months to two years, the tree will usually have used up its stored food supply in the roots and it will die.

Answer Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Plant Growth and Classification

TOPIC: Plant Food

1 Any substance which can be used as a source of energy for carrying on the life process

2 a. Carbohydrates
  b Fats
  c. Proteins

3 a Carbon
  b. Hydrogen
  c. Oxygen

4 Energy

5 Seeds

6. Hydrogenation

7 a Carbon
  b Hydrogen
  c. Oxygen
  d. Nitrogen
  e. Sulfur
  f. Sometimes Phosphorous

8 a. Carbon
  b Hydrogen
  c. Oxygen
  d. Nitrogen

Answer Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT Plant Growth and Classification

TOPIC: The Plant Kingdom

1 Study of the classification and naming of plants

2 a. Thallus plants
  b Mosses and liverworts
  c. Ferns and club mosses
  d. Seed plants

4 Thallus plants

5. The helpful soil organisms and the nitrogen-fixing organisms found in legume nodules

6 Fungus

Answer Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Constructing, Maintaining, and Using Structures that Aid Plant Growth

TOPIC: Types of Greenhouses

1 Glass
Plastic

2 Fall

3. a. The clarity of glass
b. Easily installed
c. Inexpensive
d. Last for several years

4. Advantages: a Inexpensive
b. Easily installed

Disadvantages: a. Not too durable
b. Moisture collects on underside and a vibration or gust of wind makes the drops fall into the greenhouse

5 Exhaust fans

Answer Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT Constructing Maintaining and Using Structures that Aid Plant Growth

TOPIC Size and Arrangement of Greenhouses

1 Bench arrangement

2. So that the minimum lengths of mains and returns are needed between the greenhouses and the boilers

3 Provide nearly level but freely draining units that can be sterilized efficiently not be recontaminated, and be the right height and width for working with the crop

4. 2-1/2 feet

5. At least 6"

Answer Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT Constructing, Maintaining, and Using Structures that Aid Plant Growth

TOPIC. Cooling the Greenhouse

1. Breaking down of the foods manufactured by the plant

2. 19.600 CFM needed for this greenhouse.
'70' x 40' = 2800 sq ft. in greenhouse, 2800 x 7CFM needed per sq. ft =19.600 CFM

3. 130.6 sq ft. of pad area
'19.600 - 150. 1 sq ft of pad area needed for each 150CFM

4. Screens can be used

Answer Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Constructing, Maintaining, and Using Structures that Aid Plant Growth

TOPIC: Heating The Greenhouse

1. Pipe coil system

2. Hot water and steam

3. Gable ends and exterior side walls

4. a. Direct-fired
   b. Indirect-fired

5. a. Vertical blow heaters
   b. Horizontal blow heaters

Answer Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT Constructing, Maintaining. and Using Structures that Aid Plant Growth

TOPIC Winter Protection Structures

1 You should notice where the frost will do the most damage by checking the pattern of nipping

2. Damp soil holds and releases more heat than dry soil

3 Allows sun to penetrate soil in daytime and traps this heat

4 Every side of a tree should "see" a heater

5 a Trees are still (no wind)
  b Stars out
  c Temperature around 45°
  d Dry windshields or windows

Answer Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT. Constructing, Maintaining, and Using Structures that Aid Plant Growth

TOPIC. Structures for Summer Heat Protection

1 a Protect foliage
  b Keep roots cool
  c Consume moisture

2 East

3 Cheesecloth, Saran

4 North and South

5. Nail each lath to a diagonal brace beneath.

Answer Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT Constructing Maintaining. and Using Structures That Aid Plant Growth

TOPIC Humidity and Watering

1. Mechanical (Chapin)

2. Hand watered

3. a All plants get watered
   b Personnel will get wet
   c May ruin colored displays

4. This equipment mechanically rotates itself around a continuously 360° circle. so that each nozzle with fair pressure, will adequately cover an area with a diameter of roughly 20 feet

5. Skinner's system is a long line of pipes with nozzles drilled at regular intervals. The pipe rotates from right to left and back to right again thus covering an area the length of the pipe and a width of 15 to 25 square feet, depending on pressure

Answer Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT Constructing. Maintaining, and Using Structures That Aid Plant Growth

TOPIC Ventilation

1 Because of danger of damaging plants with the direct cold outside air.

2 Should produce a uniformly distributed. non-turbulent, air flow pattern without cold drafts on the plants in winter

3 Prevents condensation and dripping of moisture

4 May be used in winter in connection with convection tubes

5 a Cuts down on the problem of excessive humidity
  b Decreases the disease problem

Answer Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT Constructing, Maintaining, and Using Structures That Aid Plant Growth

TOPIC Lighting

1 Roots grow away from the light Stems grow toward light

2 16 to 18 Hours

3 Chlorophyll is destroyed

4 a Red bands
  b Blue bands

5 Length of day or period in which light is present

Answer Sheet
for
HORTICULTURAL OCCUPATIONS

1. U L means "Underwriters' Laboratories, Inc "

2 Eight

3 II, III, IV

4. One

5. a Safe
   b Adequate
   c Expandable
   d. Efficient

Answer Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT Plant Growing Media

TOPIC. Origin, Composition, and Importance of the Soil

1 Topsoil
Subsoil
Parent layer

2 Climate

3 Topsoil

4 When its first plant grows, dies. and decays

5 a Different amounts of air present when soil is formed
b Amount of organic matter present
c Types of rock from which soil is formed

6 a Fertilizer elements
b Air
c Adequate water

7 a Sand
b Silt
c Clay

8 Sand

9 Climate. especially rainfall and temperature

10 Decayed plant or animal material

Answer Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT Plant Growing Media

TOPIC Soil Moisture

1 Roots

2 Transpiration

3 Organic matter

4 During droughts

5 Size of soil particles and condition of the soil

6 Structure of soil particles is damaged

7 Organic matter

8 Air cannot get to the roots

9 Soaks in, runs off, evaporates

Answer Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT Plant Growing Media

TOPIC. Soil Mixtures

1. a Better aeration
   b. Greater ease of working
   c Better drainage
   d Better moisture-holding capacity

2 a Uniformity
  b Disease free
  c Low soluble salts
  d Good drainage
  e Good moisture retention
  f No shrinkage
  g Ease of preparation and storage
  h Complete availability

3 To make it uniform and to eliminate large particles

4 Power driven cement mixer or shredder

5 1 part sand
  2 parts loam soil
  1 part peat moss or leaf mold
  1/2 part dried or well-rotted manure

Answer Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT Plant Growing Media

TOPOC Mulches and Their Use

1 a Inorganic or processed
  b Organic

2 Hard to hold in place and can become unsightly

3 Nitrogen

4 Mid-spring

5 Peat moss

6 Crushed stone, gravel chips, pebbles

7 a Dilutes the soil and usually increases root growth
  b Promotes soil granulation
  c Improves and stabilizes soil structure
  d Affects pH slightly
  e Adds some fertilizer materials
  f Leads to nitrogen deficiency in cases where carbonaceous materials are added
  g Serves as food for micro-organisms
  h Introduces weed seeds in the soil in some cases

8 Any material applied to the surface of a soil primarily to conserve moisture, maintain a uniform temperature, and to help control weeds

9 Highly inflamable

Answer Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT Plant Growing Media

TOPIC Fertilizer Nutrients

1 Nitrogen
  Phosphorus
  Potassium (Potash)

2 Nitrogen

3 Potassium

4 a Applying dry fertilizers when leaves are wet
  b Planting seeds directly on a layer of fertilizer
  c Spilling fertilizer in heaps on the lawn

5 Before a rain or watering

6 a Carbon
  b Hydrogen
  c Oxygen

7. a Calcium
  b Magnesium

Answer Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT Plant Growing Media

TOPIC Soil Organisms

1 a Bacteria
  b Fungi
  c Algae

2 1/1000 of the weight of an acre foot of soil

3. Penetrate plant tissue and cause root damage

4 Causes a great number of diseases

5 Convert nitrogen in the air to available nitrogen for plants (only certain bacteria)

6 a Add organic matter
  b Add lime
  c Add moisture

7. a Soil sterilization with steam
  b Soil fumigation or drenching with chemicals
  c. Seed treatment

Answer Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Plant Growing Media

TOPIC. Soil Sterilization

1 a. To kill soil-borne insects
  b. To kill harmful bacteria, fungi, and virus organisms
  c. Destroy weeds
  d. Promote soil granulation

2. a. Existing steam boilers
  b. Portable oil-fired steam boilers
  c. Package steamers
  d Bricked in permanent type boilers

3. Because of poor heat conduction and distribution

4. Soil thermometer

5. Burns roots

6. a. Soil temperature
  b. Soil moisture
  c. Soil texture
  d. Organic matter content
  e. Seals needed
  f. Soil type
  g. Depth of application

7. a. Avoid inhaling the material.
  b. Avoid contact to the skin.
  c Allow sufficient time for aeration after the material is applied.

8. Steam

Answer Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Plant Growing Media

TOPIC: Plant Growing Media Other Than Soil

1. Sand

2. Brown to Black

3. 10 to 20 Times its own weight

4. Expands or Explodes

5. a Maple
   b. Oak
   c. Sycamore
   d Elm

6 Shredded bark, sawdust, and wood shavings

7. They failed to add nitrogen

8 a Safe and easy to use
   b Chemically inert
   c. Completely sterile
   d Excellent water retention
   e. Long lasting
   f. Specially graded

Answer Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT. Plant Propagation

TOPIC. Introduction To Propagation

1 Plant propagation is the controlled reproduction of plants in order that man can have selected plants which are of specific value to him

2. Sexual or asexual

3. Greenhouses, hotbeds. and propagating case

4. Ventilation, temperature, shade and light

5 Loose, light, free from seeds. nematodes and disease organisms

6 Sand, peat, sphagnum moss, vermiculite and perlite

7 Methyl bromide

8. Clay pots, peat pots. and plant bands

9 To promote rooting of cuttings

10 Small rectangular containers used for seed germination

Answer Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT. Plant Propagation

TOPIC Propagation From Cuttings

1. Cheaper, faster, maintains the characteristics of the original plant

2. Winter months or dormant seaso..

3. Coleus, chrysanthemum, geranium, and carnation

4. From new growth in spring or early summer

5 60-70° at night, 75-85° during the day
Rooting medium 70-75°

6. a Should come from a healthy and moderately vigorous plant
   b Should come from average growth from portions of a plant in full sun
   c. Should be 3 to 5" long with 2 or more nodes

7. Serves as a protective layer which retards the development of decay on cuttings that are fairly slow to root

8. One which can be kept uniformly moist. provide good drainage and aeration

9 a Clean-sharp sand
   b. Vermiculite
   c. Sand and peat moss mixture, equal parts of each
   d Peat moss and perlite, equal parts of each

10. When they are 1/2 to 1" long

Answer Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT Plant Propagation

TOPIC: Propagation by Layering

1 To induce root formation

2 Ivy, philodendrons, blackberries, and strawberries

3. Plants such as crotons, hibiscus, dracaenas, and rubber plants

4 To produce plants which do not produce true from seed, also they may be produced quicker

5 Knife, toothpick or small piece of wood, growth hormone, spahgnum moss, and plastic film or aluminum foil

6. Spring and summer months when high temperatures and high humidity contribute toward quicker rooting

Answer Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT Plant Propagation

TOPIC. Propagation by Division

1. Primrose Jasmine Chrysanthemums
Fig Trees Sansevieria
Iris Geraniums

2. Dormant season

3. They get too big for their space or they become weakened due to competition.

4. Divide in autumn or early spring when plants are dormant

5. Divide with a hand fork, knife, or hatchet, if clumps are large. Some can be soaked in water to loosen dirt from around roots Pull apart and cut old leaves back about 1/2 and be careful with young growth

Answer Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT Plant Propagation

TOPIC Propagation by Grafting and Budding

1 Stock is the name for the plant on which you graft The scion the piece of stem which is grafted to the stock and becomes the new plant

2 It is the soft layer of tissue on a stem or root that lies between the bark and the wood

3 Any time during the growing season
Usually it is more satisfactory if done before buds begin to swell in late winter or early spring

4 A sharp knife makes a clean slice thereby insuring maximum contact of cambium layers

5 "T" budding and Patch-budding

Answer Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Plant Propagation

TOPIC: Propagation From Seed

1. From commercial producers of seeds

2. It must be finely screened, porous, loose, and have a good water-holding capacity. Also, it should be sterilized and in most cases low in nutrients.

3. In most cases 70°F.

4. The seed will rot.

5. 50-60°

6. To reduce damping off

7. a. Name of plant or variety
   b. Date seeded
   c. Student's name
   d. Special treatment, if any

Answer Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT Plant Propagation

TOPIC. Developing A Plant Breeding Vocabulary

1. Emasculation

2. A flower having both stamen and pistil

3. Stigma
   Style
   Ovary

4. Ovary

5. F_1, F_2, etc

6. Anther

7. Yes

8. Style

9. Ask the student what he has learned about D. N. A. (desoxyribonucleic acid)

Answer Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT Plant Propagation

TOPIC. Plant Selection and Fundamentals of Plant Breeding

1. The process that occurs in nature whereby strong and well-adapted plants survive while weak and poorly adapted plants eventually die out.
2. Asexually and sexually
3. Flower
4. Stamen
5. Staminate flowers
6. Pollination is the transfer of pollen. Fertilization is the union of the germ cells. In other words, pollination is the trip over and fertilization is the actual joining of the male and female germ cells

Answer Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Plant Propagation

TOPIC: Heredity

1. Dominant

2. Cross-pollination

3. One

4. No

5. When a self-pollinated plant produces plants unlike itself

Answer Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT. Plant Propagation

TOPIC General Breeding Techniques

1 List of equipment
Magnifying glass (10 or 15 power)
Tweezers
Small sharp-pointed scissors
Camel-hair brush
Small containers or vials
Tags
Alcohol
Rubber bands
Soft wire
Paper or cellophane bags
Paper clips
Notebook

2. Just before the flower opens

3 Morning, as it is cooler

4. Stamens must be removed

5. Steps in labeling
Write a. The number that you have assigned or the variety name of the seed parent.
b The letter X.
c The number or variety name of the pollen parent.
d. The date the cross was made.
Example on page 19 of reference

Answer Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT Nursery Plant Production

TOPIC· Transplanting Ornamental Trees and Shrubs

1 As soon as they begin to arrive at the nurseries or in late fall or early winter

2 It should be at least one to two feet wider and at least six inches to a foot deeper than the roots of the plant

3 One-third

4. Balled and burlapped

5. One which is over five inches in diameter

Answer Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Nursery Plant Production

TOPIC Care and Maintenance of Plants

1 If you have no good reason for pruning a plant, put the tools away without using them

2. High quality, sharp, and well adapted to the job on hand

3 At any time

4. Growth habit and blooming characteristics of the plant

5. About one-third

6. To tidy up their appearance, to control size and to improve their health, growth habits, and blooms

7. They should be pruned between leaf drop and first spring growth.

8. After they flower

9 After they flower

10 A flat top hedge is more difficult to maintain and clip and is more easily broken down by weather and other causes

Answer Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT. Floral Crop Production

TOPIC: Introduction to Floral Crop Production

1. Flowers cannot be stored for long periods of time.

2. a. Chrysanthemum
   b. Rose
   c. Carnation

3. Directly from the producer

4. "Say it with flowers."

5. <u>Southern Florist and Nurseryman</u>

Answer Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT Floral Crop Production

TOPIC. Growing Annuals

1. Summer

2. Alyssum

3. a. Marigold
   b. Nasturtium
   c Zinnia

4. Water annuals enough to keep the roots from drying out, but do not "drown" them.

5. Pulled up and thrown away

6. Summer

7. No

8. Fiery red

9. Rock gardens, banks

10. Often subject to wilt

Answer Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Floral Crop Production

TOPIC: Perennials

1. Chrysanthemum

2. Corsages

3. Every two years

4. Cut them back after spring bloom and give them a feeding.

5. About every twenty years

Answer Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Floral Crop Production

TOPIC: Bulbs

1. Summer

2. The foliage is needed to restore energy to the bulb.

3. Fungicides and insecticides

4. Short underground stem on solid basal plate, surrounded by fleshy leaves that store food for future growth

5. A creeping underground stem often thick with stored food

Answer Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT Floral Crop Production

TOPIC Poinsettias

1 Nitrogen

2 Red, white, and pink

3 White Fly

4 Lack of nitrogen or lack of water

5 Poorly aerated soil

Answer Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT Floral Crop Production

TOPIC Chrysanthemums

1 Fall

2 Aphids

3 60° (Some varieties need 65°)

4. Yellow

5. To make a short day which helps regulate blooming

6 All pinches must be made into the soft growth, usually 7 days after planting.

7 A slow start. often trouble with rotting of cutting

8 They should be sprayed overhead lightly the first 3 or 4 days.

9 Entire year with proper day length control

10 Sterilized

Answer Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT Floral Crop Production

TOPIC Geraniums

1 They are poor shippers and will lose foliage

2 Pinched

3 Red

4 Plastic tube system

5 a Use a fungicide on cutting
  b Sterilize propagating materials
  c Use disease-free cuttings
  d Sterilize soil

6 Light pink

7 60 degrees night. 65-70 degrees day

8 Air freight

9 Four inch

10 The seed for most desirable varieties has not been available.

Answer Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT Floral Crop Production

TOPIC Hydrangeas

1 Two spotted mite (red spiders)

2 Wilt severely

3 March to May

4 Easter. Mother's Day

5. Bud rot

Answer Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT Establishing and Caring for Lawns

TOPIC Turf Grasses for Texas

1 Geographic location the amount of water available for irrigation. the degree of shade present the time and money the home owner is willing to spend for establishment and the expected usage

2. Warm-season and cool-season

3. a Does not grow in shade
   b Turns brown after frost in the fall
   c Is more of a nuisance than other turf grasses

4 a Is susceptible to certain diseases
   b Is more susceptible to iron chlorosis
   c Is attacked by insects
   d Needs more water for survival
   e Will not survive at as low temperatures as will Bermuda
   f Is a broad-leaved coarse-textured plant

5 a Is attractive and wear-resistant
   b Is not invaded by weeds
   c Is subject to little damage from insects and diseases

Answer Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Establishing and Caring for Lawns

TOPIC: Establishing a New Turf

1. Preparation of the soil, establishment of the grass, care and maintenance.

2. Peat, compost, gin trash, sawdust, and leaf mold.

3. Fertilizer applications should be made at rates and in combinations suggested by soil tests.

4. The type of grass used and the rapidity of cover desired.

5. In order to develop a deep root system.

Answer Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Establishing and Caring for Lawns

TOPIC: Managing an Established Turf

1. Feeding, watering, aerating, and moving
2. It produces vegetative growth and gives the plant a deep green color.
3. It stimulates development of a good root system.
4. Stunted growth of the entire plant. The leaves are relatively small, thin, and yellowish-green to yellow. They show yellow to brown color at the tip of the leaf and down to the midrib.
5. Slow growth of the entire plant. leaves are an unhealthy dark green, roots are stunted.
6. Pale, bleached leaves
7. Spring and early fall
8. Applying iron sulfate or iron chelate
9. Produce shallow, weak root systems, which does not allow efficient utilization of plant food or moisture in the soil.
10. It allows air or oxygen to get into the soil, water to move into and through the soil, and the soil to hold more water.

Answer Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Establishing and Caring for Lawns

TOPIC: Turf Problems

1. a. Weed
   b. Disease and insect control
   c. Clover in the turf
   d. Renovation of old lawns

2. By proper turf grass management

3. 2-4-D

4. Brownpatch occurs as irregularly shaped brown areas, usually circular, 4 to 48 inches in diameter. The fungus gives the grass a blue, water-soaked appearance. As the disease spreads, the dark areas turn light brown.

5. A fungicide containing PCNB

6. a. Chlordane
   b. Dieldrin
   c. D. D. T.
   d. Toxaphene
   e. Malathion
   f. Aldrin
   g. Heptachlor
   h. Lindane

7. When the old turf is run down, weedy, and in a generally undesirable condition, or when a new species is to be introduced.

8. a. Chlordane
   b. Lindane
   c. Sulfur
   d. Toxaphene

9. a. Diazinon
   b. Ethion
   c. Trithion

10. Five gallons of spray mixture per 100 square feet of lawn area.

Answer Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Controlling Plant Insects Plant Diseases. and Other Pests

TOPIC. Causes of Plant Diseases

1. a. Fungi
   b. Bacteria
   c. Viruses
   d Nematodes

2. The manufacture of sugars from carbon dioxide and water with the aid of sunlight and chlorophyll

3 An agent that transmits disease-producing organisms.

4 Prevention by careful pruning

5. Tiny, thread-like plants, commonly called molds

Answer Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Controlling Plant Insects. Plant Diseases, and Other Pests

TOPIC: Identifying Plant Diseases

1. Proper identification.

2. Failure to produce seed or fruit.

3. Liquid discharge from diseased tissues.

4. Microscopic examination of roots.

Answer Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT. Controlling Plant Insects. Plant Diseases, and Other Pests

TOPIC Application and Safety Precautions of Horticultural Chemicals

1 Welfare of the people

2 Welfare of the plant

3 Effectiveness of the material in controlling the pest or disease

4 Hydraulic sprayers

5 Hang the hose on a rack with nozzle pointing upwards

6 a Read label precautions
  b Keep chemicals locked up when not in use
  c Keep children away while using
  d Don't smoke while spraying
  e. Don't spill material on skin or clothing
  f Wash exposed areas of skin immediately after job is completed
  g Never spray when windy
  h. Spray edible plants with great caution

7 The chemical must touch the insect before death occurs.

Answer Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT. Controlling Plant Insects, Plant Diseases, and Other Pests

TOPIC. Controlling Leaf Diseases

1. Water and fertilize properly and remove dead limbs

2. Caused by fungi which live on secretions from aphids and immature stages of white fly

3 Caused by excess rain or over watering

4 a Malathion
  b Lindane

5. Just before buds open and after flowering

6 Two to four weeks or as needed

7 Most often caused by lack of iron

8 Fungus disease

Answer Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Controlling Plant Insects Plant Diseases, and Other Pests

TOPIC: Controlling Stem, Branch, and Trunk Diseases

1. Prune infected portions sterilizing shears between each cut.
2. If little dodder is present remove by hand Destroy badly infected plants
3. Reduces the amount of sunlight for trees
4. Twigs and limbs
5. Fungi
6. Install in the infected parts of tree to drain the excess fluid and relieve pressure.
7. By birds
8. Fungi and algae

Answer Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Controlling Plant Insects, Plant Diseases, and Other Pests

TOPIC: Controlling Root Diseases

1. Carbon bisulfide soil fumigation
2. Methyl bromide soil fumigation
3. Removing and destroying diseased roots
4. Ten (10) feet
5. East and southeast Texas
6. 75-95 degrees

Answer Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Controlling Plant Insects. Plant Diseases, and Other Pests

TOPIC: Controlling Diseases Affecting the Entire Plant

1. Symptoms exhibited by aster yellows that are not exhibited by verticillium wilt:
   a. Bushy with numerous secondary shoots
   b. Leaves may develop a slightly reddish, brownish, or purplish tinge in later stages.
   c. Flower parts may develop into leafy structures.

2. DDT

3. Chloropicrin

4. West

5. Commercial growers or trained personnel

6. Miticide

7. Zineb, CM-19

Answer Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Controlling Plant Insects, Plant Diseases, and Other Pests

TOPIC: Controlling Lawn and Turf Diseases

1. Handpick and destroy mushrooms or toadstools.
2. Iron sulfate or iron chelate
3. Irregular-shaped dead areas from a few inches to more than several feet in diameter
4. Wash off with water applied as a spray with 20 to 30# pressure.
5. Zineb, Captan
6. One to two weeks before disease usually appears and a second application after disease appears. Then apply as needed.
7. Apply chemicals as needed in early stages of disease.

Answer Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Controlling Plant Insects, Plant Diseases, and Other Pests

TOPIC: Identifying Plant and Soil Insects and Methods of Control

1. Slugs have no shells

2. Spring

3. Spray before eggs hatch and prune

4. Roots

5. Sandy soils

Answer Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Controlling Plant Insects, Plant Diseases, and Other Pests

TOPIC: Nematodes

1. a. Select a plant that is partly alive
   b. Dig the plant instead of pulling it.
   c. Wash the soil from the roots and allow a few minutes for drying.
   d. Place the specimen in a polyethylene container and tie it securely.
   e. Fill out form D-418, available from your county extension agent.
   f. Place bag and D-418 in a box and send it to the research center.

2. Root knot nematode

3. Before spending a large amount of money for chemicals, determine if nematodes are causing a significant amount of damage to justify the expense and labor.

4. a. Crown gall
   b. Nodules from nitrogen fixation

5. Tomato, okra

Answer Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Controlling Plant Insects, Plant Diseases, and Other Pests

TOPIC: Control of Moles, Gophers, Birds, Deer, and Ants

1. By conical mounds of dirt pushed up from their main run
2. Baiting and trapping
3. Serious injury might occur to small children or dogs.
4. Gophers open their tunnels; moles do not.
5. Place chicken wire at the bottom and sides of planting holes.
6. Starlings
7. Portable bird protectors made of scrap lumber, chicken wire, or cheesecloth.
8. Fencing

Answer Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Controlling Plant Insects Plant Diseases. and Other Pests

TOPIC. Causes of Plant Diseases

1. a. Fungi
   b. Bacteria
   c. Viruses
   d Nematodes

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3 An agent that transmits disease-producing organisms

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Answer Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Controlling Plant Insects. Plant Diseases, and Other Pests

TOPIC: Identifying Plant Diseases

1. Proper identification.

2. Failure to produce seed or fruit.

3. Liquid discharge from diseased tissues.

4. Microscopic examination of roots.

Answer Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT. Controlling Plant Insects. Plant Diseases, and Other Pests

TOPIC Application and Safety Precautions of Horticultural Chemicals

1 Welfare of the people

2 Welfare of the plant

3 Effectiveness of the material in controlling the pest or disease

4 Hydraulic sprayers

5 Hang the hose on a rack with nozzle pointing upwards

6 a Read label precautions
  b Keep chemicals locked up when not in use
  c Keep children away while using
  d Don't smoke while spraying
  e. Don't spill material on skin or clothing
  f Wash exposed areas of skin immediately after job is completed
  g Never spray when windy
  h Spray edible plants with great caution

7 The chemical must touch the insect before death occurs.

Answer Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Controlling Plant Insects, Plant Diseases, and Other Pests

TOPIC: Controlling Leaf Diseases

1. Water and fertilize properly and remove dead limbs

2. Caused by fungi which live on secretions from aphids and immature stages of white fly

3 Caused by excess rain or over watering

4 a Malathion
  b Lindane

5 Just before buds open and after flowering

6 Two to four weeks or as needed

7 Most often caused by lack of iron

8 Fungus disease

Answer Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Controlling Plant Insects, Plant Diseases, and Other Pests

TOPIC: Controlling Stem, Branch, and Trunk Diseases

1. Prune infected portions sterilizing shears between each cut.

2. If little dodder is present, remove by hand. Destroy badly infected plants.

3. Reduces the amount of sunlight for trees

4 Twigs and limbs

5 Fungi

6. Install in the infected parts of tree to drain the excess fluid and relieve pressure.

7. By birds

8. Fungi and algae

Answer Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Controlling Plant Insects, Plant Diseases, and Other Pests

TOPIC: Controlling Root Diseases

1. Carbon bisulfide soil fumigation
2. Methyl bromide soil fumigation
3. Removing and destroying diseased roots
4. Ten (10) feet
5. East and southeast Texas
6. 75-95 degrees

Answer Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Controlling Plant Insects. Plant Diseases, and Other Pests

TOPIC: Controlling Diseases Affecting the Entire Plant

1. Symptoms exhibited by aster yellows that are not exhibited by verticillium wilt:
   a. Bushy with numerous secondary shoots
   b. Leaves may develop a slightly reddish, brownish, or purplish tinge in later stages.
   c. Flower parts may develop into leafy structures.

2. DDT

3. Chloropicrin

4. West

5. Commercial growers or trained personnel

6. Miticide

7. Zineb, CM-19

Answer Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Controlling Plant Insects, Plant Diseases, and Other Pests

TOPIC: Controlling Lawn and Turf Diseases

1. Handpick and destroy mushrooms or toadstools.

2. Iron sulfate or iron chelate

3. Irregular-shaped dead areas from a few inches to more than several feet in diameter

4. Wash off with water applied as a spray with 20 to 30# pressure.

5. Zineb. Captan

6. One to two weeks before disease usually appears and a second application after disease appears. Then apply as needed.

7. Apply chemicals as needed in early stages of disease.

Answer Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Controlling Plant Insects, Plant Diseases, and Other Pests

TOPIC: Identifying Plant and Soil Insects and Methods of Control

1. Slugs have no shells

2. Spring

3. Spray before eggs hatch and prune

4. Roots

5. Sandy soils

Answer Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT · Controlling Plant Insects Plant Diseases, and Other Pests

TOPIC Nematodes

1. a Select a plant that is partly alive.
   b. Dig the plant instead of pulling it
   c. Wash the soil from the roots and allow a few minutes for drying.
   d. Place the specimen in a polyethylene container and tie it securely.
   e Fill out form D-418, available from your county extension agent
   f. Place bag and D-418 in a box and send it to the research center.

2. Root knot nematode

3 Before spending a large amount of money for chemicals, determine if nematodes are causing a significant amount of damage to justify the expense and labor

4. a. Crown gall
   b. Nodules from nitrogen fixation

5. Tomato, okra

Answer Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Controlling Plant Insects, Plant Diseases, and Other Pests

TOPIC: Control of Moles, Gophers, Birds, Deer, and Ants

1. By conical mounds of dirt pushed up from their main run
2. Baiting and trapping
3. Serious injury might occur to small children or dogs.
4. Gophers open their tunnels; moles do not.
5. Place chicken wire at the bottom and sides of planting holes.
6. Starlings
7. Portable bird protectors made of scrap lumber, chicken wire, or cheesecloth.
8. Fencing

Answer Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Controlling Plant Insects, Plant Diseases, and Other Pests

TOPIC: Controlling Weeds

1. Water should be applied.

2. Hoe

3. Ice pick or screwdriver

4. Shrubs form a shade in which weeds do not thrive.

5. Apply organic mulch two to three inches deep.

6. Wear gloves.

Answer Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Operating and Maintaining Horticultural Equipment

TOPIC Principles Used to Prevent Personal Injury

1. Legs

2. One pulley only changes direction of force

3. Jack

4 Wet the soil 4 to 5 days before digging

5 Hook a 1/2" pipe onto a hose and beat the bottom end into a flattened or pointed opening. This will enable you to stick the pipe down into the hole where the force of the water through the small opening will loosen the soil

Answer Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT. Operating and Maintaining Horticultural Equipment

TOPIC: Selection and Maintenance of Horticultural Hand Tools

1 Tools are very personal pieces of equipment and all experienced gardeners have their favorites

2. Scoop

3. 6"

4. Sharpen the hoe each time you take it into the garden.

5. Scuffle hoe

6. a Fan-shaped
   b Rectangular

Answer Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Operating and Maintaining Horticultural Equipment

TOPIC: Maintaining Small Power Equipment

1. a. Periodic equipment inspection to discover situations which may lead to equipment breakdown
   b. Upkeep to minimize wear or to remedy potential trouble

2. Make an overall check and properly service equipment.

3. Water condenses more rapidly in a partially filled tank.

4. Gasoline or other solvents

5. Tension and wear

Answer Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Operating and Maintaining Horticultural Equipment

TOPIC Operating and Maintaining Lawn Mowers Safely and Effectively

1. a. Reel
   b. Rotary
   c. Sickle bar

2. Mowing too close

3. Disconnect the spark plug wire so that a spark cannot jump

4 Cutter bar and knife

5 The clippings will smother the grass

6. Leaves produce food for the plant If leaves are cut too short, the health and vigor of the lawn will be greatly reduced

Answer Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT Operating and Maintaining Horticultural Equipment

TOPIC: Operating Rotary Tillers Safely and Effectively

1 a Front tine
  b Rear tine

2 Front tine

3 Rotation of the tine

4 Raise the depth bar

5 Check to make sure that all clutches and belt tension pulleys are disengaged

Answer Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT Operating and Maintaining Horticultural Equipment

TOPIC Operating Garden Tractors Safely and Effectively

1 The tractor must have enough horsepower to operate the power sickle bar

2 3 1/2 – 10 horsepower

3 Below the rear axle level

4 Riding lawn mowers are designed only for mowing. Small tractors are designed for several types of attachments

5 a Automotive
  b Belt type

Answer Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT Developing and Maintaining the Landscape

TOPIC Introduction to Home Landscaping

1 a Art
  b Engineering
  c Horticulture

2 a Homeowners who purchase subdivision or housing development homes
  b Families who buy new homes already designed and constructed with no specific client in mind
  c Families who purchase a lot. have their home especially planned and constructed for them on the lot
  d Families who now live in older homes and desire to remodel or redesign their gardens

3 They do not fit into our mechanized way of living

4 Climate varies

5 The cost is included in the price of plants

Answer Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Developing and Maintaining the Landscape

TOPIC: Selecting the Site

1. General location

2 Zoning prevents businesses from moving into a residential section.

3. No

4. a. Privacy is difficult
   b Require installation of additional utilities, walks, and drives.
   c. Outdoor space is limited.
   d. More noise from traffic

5. a Drives and sidewalks are too steep.
   b Lawn is more difficult to keep.

6. South. Sunlight can be better controlled

Answer Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT Developing and Maintaining the Landscape

TOPIC Scheduling Landscape Development and Beginning Plans

1. A well-planned garden is one that is livable, interesting, beautiful, easy to maintain, and where relationships between outdoor and indoor areas are coordinated properly

2. Drives and walks

3. Trees are essential for shade in Texas.

4. Provide privacy and assist in temperature control

5. a There must be a program for site and landscape development.
   b There must be a plan

6. A piece of real estate which may be merely a lot or one with a home on it.

Answer Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Developing and Maintaining the Landscape

TOPIC: Analyzing Problems and Determining Needs

1. a. Suitability
   b. Function
   c Economy
   d. Beauty

2. Deciding and analyzing specific problems of a chosen site

3. a. Do you prefer them to be beautiful and pleasant?
   b. Do you want them to make you feel comfortable?
   c. Do you care whether they fit together well and serve their purpose?

4. a Space
   b. Garden development
   c. Maintenance

5. a. Individual taste
   b. Past environment

6. No. It is even hard for professionals.

Answer Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT Developing and Maintaining the Landscape

TOPIC. Developing the Landscape Plan

1 Before the property is purchased

2 1 inch equals 10 feet

3 a Entrance
  b General living area
  c Work space
  d Place for private living

4 General living area

5 Bedroom area

6 a Formal
  b Informal

Answer Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Developing and Maintaining the Landscape

TOPIC: Selecting Plants

1. 12-25 feet

2. 6-8 feet

3. Dwarf shrubs

4. The roots may clog drain pipes.

5. Broadleaf evergreen

6. a. Watering
   b. Mowing
   c Edging
   d. Clipping
   e. Weeding
   f. Fertilizing
   g. Controlling insects

7. a. Privets
   b. Arborvitae

Answer Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT. Developing and Maintaining the Landscape

TOPIC: Grading, Drainage, and Landscape Structures

1. Using splash blocks
2. No
3. Building a wall around it and leaving the grade unchanged in the immediate area
4. Making them too narrow
5. 4 feet

Answer Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT. Merchandising Horticultural Plants and Supplies

TOPIC: Developing Personal Traits

1. a. Knowledge of self
   b. Knowledge of people
   c. Knowledge of product

2. a. Experience
   b. Observing others

3. a. Promotions
   b. Dollars (profits)

4. Analysis of sales

5. Diligence and perseverance

Answer Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT Merchandising Horticultural Plants and Supplies

TOPIC: Displaying

1. Where they can be seen by the greatest number of people

2. To put merchandise where customers can see it and serve themselves

3. Familiar products, bulk seeds, or other seasonal items

4. Items that are to be "pushed"

5. a Well stocked
   b Safe
   c At a convenient height

6. To stop the customer and bring him into the place of business

7. It does not attract customers

8. The traffic pattern of the customers

9. In beds

10. Eight feet

Answer Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT Merchandising Horticultural Plants and Supplies

TOPIC Advertising

1 Point-of-purchase

2 Outside

3 Classified

4 Keeping the mailing list up to date

5 a Effectiveness
  b Cost
  c Coverage

Answer Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Merchandising Horticultural Plants and Supplies

TOPIC: Labeling and Pricing

1. Price plants too low

2. a. Transplanting
   b. Salesman's salary
   c. Unsold stock
   d. Shrinkage in volume

3. 66 2/3 percent

4. High cost items

5. Selling price of the item

Answer Sheet
for
HORTICULTURAL OCCUPATIONS

UNIT: Merchandising Horticultural Plants and Supplies

TOPIC: Understanding the Customer and Making Sales

1. Why he failed

2. The salesman

3. a. Owner's comfort and convenience
   b. Performance
   c. Safety
   d. Appearance
   e. Length of life
   f. Economy
   g. Service
   h. Prestige

4. People like to think they have made up their own minds. Also, the customer may think something is wrong with the product.

5. Getting the customer's attention

Topic Test
on
HORTICULTURE AS AN INDUSTRY

Student. ______________________ School __________ ______________

Date ______________________ Score. ______________________________

Place a check under T for True or under F for False.

T F

_____ _____ 1 Pomology is the science of producing cut flowers

_____ _____ 2 Olericulturists are concerned with vegetables

_____ _____ 3 The annual production of vegetables exceeds one billion dollars.

_____ _____ 4. Apples are classed as small fruits

_____ _____ 5 Cotton is a horticultural crop

_____ _____ 6 Grapes are classed as citrus fruits

_____ _____ 7 Floriculture has developed in the past ten years

_____ _____ 8 Out-of-season production of vegetables is an important industry in the West and South

_____ _____ 9 Ornamental plants are considered as horticultural plants

_____ _____ 10. Olericulturists are not concerned with marketing vegetables They deal only with production

Topic Test
on
EXPLORING OCCUPATIONAL OPPORTUNITIES

Student ______________________ School ______________________

Date ______________________ Score ______________________

1 List at least 10 factors in your own words which one should consider in selecting an occupation

a ____

b ____

c ____

d ____

e ____

f ____

g ____

h ____

i ____

j ____

2 List the five job titles for which descriptions were provided in the assignment

a ______________________

b ______________________

c ______________________

d ______________________

e ______________________

Topic Test
on
INTRODUCTION

Student: ______________________ School: __________________________

Date: ________________________ Score: ___________________________

Fill in the blanks.

1. ____________ is the study of plants.

2. There are over _______________ kinds of plants found in the world.

3. ______________ and ___________ are carbohydrates.

4. Van Helmont did an experiment to determine what made plants grow. His conclusion was that _______________ alone produced growth.

5. Plants differ from animals in that they produce food from _______________ and _______________.

Topic Test
on
PHOTOSYNTHESIS

Student: ______________________________ School: ________________________________

Date: ________________________________ Score: _________________________________

Fill in the blanks:

1. ______________________ is the process by which liquids and gases move from an area of high concentration to an area of low concentration.

2. ______________________ means light.

3. All substances are made up of_________.

4. Photosynthesis requires four components. They are ____________________________,
_______________________, ______________________, and ____________________.

5. When atoms are combined, we call them a ____________________.

Topic Test
on
RESPIRATION

Student: ______________________ School: ______________________

Date: ______________________ Score: ______________________

Fill in the blanks:

1. Raw materials for respiration are ______________ and ______________.

2 Energy is ______________ during photosynthesis.

3. Respiration ______________ dry weight. (increases or decreases)

4 Plants release ______________ at night. (what gas?)

5 ______________ is the release of chemical energy.

Topic Test
on
WATER ABSORPTION AND LOSS--
NUTRIENT ABSORPTION--
MOVEMENT OF WATER AND NUTRIENTS IN THE PLANT

Student: ______________________ School: ________________________

Date: ________________________ Score: _________________________

Fill in the blanks:

1. __________ are elements, or groups of these elements, needed for plant growth.

2. Eash vascular bundle has two types of conductive tissues called the ____________ and ____________

3 ________________ occurs from plant injuries.

4. __________________ is the loss of water from the plant as a vapor.

5 The principal water-absorbing structure is the _____________ _____________.

Topic Test
on
PLANT FOOD

Student: ____________________ School: ____________________

Date: ____________________ Score: ____________________

Fill in the blanks:

1. Examples of the carbohydrates include the sugars, starches, and ____________.

2 A pound of __________ has about 2-1/4 times as much stored energy as a pound of sugar

3. ____________ is the principal part of lean meat.

4. ____________, ____________. ____________, and ____________ make up about 97% of the dry weight of most plants.

5 The "____________ elements" are those which the plant must have in order to survive.

Topic Test
on
THE PLANT KINGDOM

Student: ____________________ School: ____________________

Date: ____________________ Score: ____________________

Fill in the blanks:

1. ____________ plants cause many diseases of higher plants by attacking, multiplying, and living in or on the higher plants.

2. The botanist classifies the seed-producing plants according to their ____________ ____________.

3. Helpful soil organisms and the nitrogen-fixing organisms found in legume nodules are examples of ____________ bacteria.

4. ____________ forms a green scum on ponds and lives in both fresh water and sea water.

5. The plant world has been divided into ____________ divisions.

Topic Test
on
TYPES OF GREENHOUSES

Student: ______________________ School: ______________________

Date: ______________________ Score: ______________________

PART I: Fill in the blanks:

1. ______________ ____________ handles the ventilation problem in greenhouses with no ventilators.

2. The ________ is the season for repairing greenhouse coverings.

3. It is necessary to provide a good means of exchanging the greenhouse air with outdoor air in order to regulate the greenhouse temperature. Adjust the __________, provide air movement around the plants, and introduce new supplies of __________ and carbon dioxide.

PART II. True or False

________ 1 Vinyl film is more durable than polyethylene.

________ 2 The exterior of a greenhouse does not need to be painted more often than seven years.

________ 3 Film plastic eliminates the problem of dripping water in the greenhouse.

Topic Test
on
SIZE AND ARRANGEMENT OF GREENHOUSES

Student. ______________________ School. ________________________

Date. ________________________ Score ________________________

True or False.

__________ 1 The depth of a bench for cut flowers needs to be at least twelve inches

__________ 2 The best height for pot plant benches is 2-1/2 feet

__________ 3 Before the type of greenhouse is chosen and built, a careful study should be made of the best bench arrangement for the crops to be grown

__________ 4. Wood contracts when it is wet; so boards must be fitted close together when making wooden benches

__________ 5 One of the best bench making materials for drainage and air circulation is one inch by one inch welded wire fabric.

Topic Test
on
COOLING THE GREENHOUSE

Student: ______________________________ School: ______________________________

Date: ______________________ . ____ Score: ______________________________

Problems:

1. If a greenhouse was 100 feet long and 40 feet wide, how many square feet would it contain? ____________________ (answer)

2 How many CFM would need to be exhausted for a greenhouse containing 1000 square feet? __________________ (answer)

3. How many square feet of padded area will be needed in a greenhouse that requires 7500 CFM to be exhausted? ____________________(answer)

Work here

Topic Test
on
HEATING THE GREENHOUSE

Student: ______________________ School: ______________________

Date: ______________________ Score: ______________________

<u>True</u> or <u>False</u>:

________ 1. In vertical blow heaters the shaft is vertical and the fan blade is horizontal.

________ 2 Direct-fired units are those which contain a combustion unit right in the unit itself

________ 3 In recent years the use of unit heaters for heating greenhouses has decreased considerably.

________ 4. The oldest and most conventional heating system is the pipe coil.

________ 5. The coldest spots in the greenhouse are the exterior side walls and gable ends.

Topic Test
on
WINTER PROTECTION STRUCTURES

Student. ______________________ School: ______________________

Date. ______________________ Score ______________________

Fill in the blanks:

1 ____________ gardens often have definite thermal belts and artic regions.

2 The most dangerous spots for frost damage are stretches of open ground exposed on all sides, particularly to the ____________ sky

3 Regardless of what kind of shelter you use. keep soil ____________ around plants

4 ________ soil holds and releases more heat than ________ soil.

5 ____________, made of double strength glass and available in several sizes, are set side-by-side to protect large areas.

Topic Test
on
STRUCTURES FOR SUMMER HEAT PROTECTION

Student ______________________ School ______________ ___________

Date ________________________ Score ________________________

Fill in the blanks.

1 A lath sunscreen should be placed so the laths run in a _____________ and _______________ direction

2 If you like to grow ________________ loving flowers such as tuberous begonias and cyclamens, you may want a permanent display structure

3 From sunrise to __________ o'clock in the morning there is very little heat accumulation

4 The subject of ___________ in the garden is frequently ignored or misunderstood - particularly by the beginner.

5 A structure facing an _____________ direction is ideal, especially if you live in a hot summer area

Topic Test
on
HUMIDITY AND WATERING

Student ______________________ School ______________________

Date ______________________ Score ______________________

True or False

________ 1 The majority of bedding plants are hand watered

________ 2 There is no equipment available for the purpose of watering pot plants

________ 3 Watering of greenhouse cut flower crops by mechanical means is a well-established, proven practice

________ 4 Rainbird-type nozzle systems consist of long lines of pipe with holes drilled in each end

________ 5 Most growers use pipe systems for watering bedding plants

Topic Test
on
VENTILATION

Student. ____________________ School. ____________________

Date. ____________________ Score ____________________

True or False

_________ 1 The disadvantage of using humidistats to control fans is that the problem of excessive humidity becomes greater

_________ 2 Thermostatically-controlled systems respond quickly to changing outdoor temperatures

_________ 3 The thermostat controlling the first stage fans should be set several degrees above the setting of the heating thermostat

_________ 4 Motorized roof ventilators can be controlled automatically

_________ 5. Exhaust fans in cooling systems may be used during the winter months if a convection tube is attached

Topic Test
on
LIGHTING

Student: ____ ____________________ School: ________________________

Date: ____________________________ Score: ________________________

True or False:

_________ 1 Certain kinds of seed require light in order to germinate.

_________ 2 Plants are classified into two groups in regard to light intensity, low-energy and high energy.

_________ 3. Long day plants require from 8 to 12 hours of light per day.

_________ 4. Research studies show that plants utilize chiefly three different wave length regions of radiant energy, the green, orange, and yellow.

_________ 5. White light is a mixture of all colors but white light of incadescent lamp is rich in red.

Topic Test
on
WIRING AND ELECTRICAL CONTROLS

Student: ______________________ School: ______________________

Date: ______________________ Score: ______________________

Fill in the blanks:

1. The basic requirements of any well-planned wiring system are that it shall be ____________, ____________, ____________, and efficient.

2. Only the first requirement, ____________, will be achieved by compliance with the National Electric Code. The others depend on careful planning.

3. General lighting circuits should have a maximum of ________ outlets per circuit

4. Provide individual circuits for motors ____________ horsepower and larger

5. Minimum wire size for general purpose circuits should be ________ with 15 ampere protection.

Topic Test
on
ORIGIN, COMPOSITION, AND IMPORTANCE OF SOILS

Student: ______________________ School: ______________________

Date: ______________________ Score: ______________________

PART I: Fill in the blanks:

1. The largest of the soil particles is __________.

2. Decayed plants and animal material is called ______________.

3. ______________ and ______________ determine the rate of soil formation.

4. Clay feels like ____________ rubbed between the fingers.

5. The difference in texture of soils is caused by the different sizes of soil __________.

PART II: List:

1. Three (3) layers of soil from top to bottom:

   a. ______________________

   b. ______________________

   c. ______________________

2. Three (3) factors that are responsible for differences in soil color:

   a. ____

   b. ____

   c. ____

Topic Test
on
SOIL MOISTURE

Student: ______________________________ School: __________________________________

Date ________________________________ Score: __________________________________

PART I: Fill in the blanks:

1. Moisture moves through the soil in all directions, even against gravity by _______________ movement.

2. In _________ textured soils, the particles are closer together and the attraction between soil and water is greater.

3. Much soil moisture can be lost when capillary water moves to the surface and _____________________.

4. All living cells carry on __________________________.

5. Movement of air through the soil is called _________________________.

PART II: Check T for true or F for false:

T	F	
____	____	1. Soils should be worked while in a wet condition.
____	____	2. It is possible to change water-holding capacity of soil.
____	____	3. Underwatering causes decreased aeration.
____	____	4 Sandy soils require more frequent watering than heavy clay soils.
____	____	5. Oxygen must be present for respiration to occur.

Topic Test
on
SOIL MIXTURES

Student: ____________________ School: ____________________

Date: ____________________ Score: ____________________

Fill in the blanks:

1. ______________ soils are a mixture of sand, silt, and clay.
2. ______________________ increases aeration of soil.
3. Loam soils become ________________ after watering.
4. For large scale mixing operations, use a power driven cement mixer or ____________________.
5. Loam soils often ______________ after drying.

List:

6. The characteristics of a good mixture:

a. ______________________________

b. ______________________________

c. ______________________________

d. ______________________________

e. ______________________________

f. ______________________________

g. ______________________________

h. ______________________________

Topic Test
on
MULCHES AND THEIR USE

Student: ______________________ School: ______________________

Date: ______________________ Score: ______________________

PART I: Fill in the blanks:

1. The most common mulch is ______________.

2. The time to apply mulch to the garden on established plants is in ____________.

3. Additional ______________ should be applied to a crushed corncob mulch.

4. ________ may be produced during decomposition of lawn clippings.

5. A light spray of ____________ may be used by contractors to hold soil in place on steep slopes.

PART II: Multiple choice:

____ 1. The cost of this material is usually prohibited when large areas are mulched.
a. crushed corncob b. peat moss c. wood chips

____ 2. This material should not be used in areas where a cigarette may be dropped.
a. corncobs b. asphalt c. straw

____ Any mulch should be at least this deep:
a. 1/4" - 1/2" b. 1" - 2" c. 2"-3"

Topic Test
on
SELECTING PLANTS

Student: ______________________ School: ______________________

Date: ______________________ Score: ______________________

Fill in the blanks:

1. ____________ and ______________ flowering shrubs are not as permanent as woody plant materials and usually do not provide as good covering for garden areas.

2. Most native plants require little ____________ or other care when they have become established after transplanting.

3. Plants from the Mediterranean regions and ______________ often have similar cultural and moisture requirements to our native plants.

4. Large shrubs or small trees are ____ to ____ feet tall when full grown.

5. ______________ shrubs attain a height of 6 to 8 feet at maturity.

Topic Test
on
GRADING, DRAINAGE, AND LANDSCAPE STRUCTURES

Student: ______________________________ School: ______________________________

Date. ______________________________ Score. ______________________________

Place a check under T for true or under F for false for each of the following statements:

T F

_____ _____ 1. The minimum width for an entrance sidewalk is eight feet.

_____ _____ 2. Walks should always be as direct as possible.

_____ _____ 3. Landscape planners with a minimum of design experience should avoid curved walks

_____ _____ 4. The use of splash blocks is the most desirable method of preventing downspouts from eroding soil

_____ _____ 5. Lowering the grade around existing trees does not disturb their normal functioning nearly so much as does filling.

Topic Test
on
DEVELOPING PERSONAL TRAITS

Student. ______________________ School. ______________________

Date ______________________ Score: ______________________

1. What are the three basic ingredients of a salesman?

   a. ______________________

   b ______________________

   c ______________________

2 What are two ways in which good habits pay off?

   a ______________

   b ______________

3 What are the best two ways to learn selling?

   a ______________________

   b ______________________

4 How can a person become a "scientific salesman"?

5. What is required for a would-be salesman to become a tough, aggressive, and effective salesman?

   a. ______________

   b ______________

Topic Test
on
DISPLAYING

Student: ____________________ School: ____________________

Date: ____________________ Score: ____________________

Fill in the blanks:

1. ______________ displays are designed to stop the customer and bring him into the store.

2. _____ attracts attention and gives the impression of demand.

3. Each table and shelf should have a ____________ to the others.

4. Special racks, tri-plane and peg board tables are excellent for displaying ________ items and other small competitive items.

5. ____ displays are more successful when used for familiar products.

Topic Test
on
ADVERTISING

Student: ______________________ School: ______________________

Date: ______________________ Score: ______________________

PART I: Fill in the blanks:

1. ________________ advertising consists of displays within the place of business.

2. ____________ buying results in millions of dollars' worth of sales annually, as the growth of supermarkets shows.

3. ______ advertising is high in cost but is effective because the product can be demonstrated.

PART II: List:

1. Three factors to consider when selecting an advertising medium are:

   a. ______________

   b. ______________

   c. ______________

2. Three methods of "outside of the store" advertising are:

   a. ______________

   b. ______________

   c. ______________

Topic Test
on
LABELING AND PRICING

Student: ______________________ School: ______________________

Date: ______________________ Score: ______________________

Problem:

What would be the percent mark-up of a plant if the production cost was $1.00 and selling price was $2.00?

Work:

Answer: ________

Topic Test
on
UNDERSTANDING THE CUSTOMER AND MAKING SALES

Student: ______________________________ School: ____________________________

Date: ________________________________ Score: ____________________________

Fill in the blanks:

1. The first problem of a salesman is getting the _________________ of the customer.
2. A dangerous practice that many salesmen fall into is trying to arouse interest by overstressing __________.
3. _____ percent of all salesmen quit cold after a single call on a prospect.
4. "___________________ is a luxury no salesman can afford."
5 The surest and quickest way to lose a sale is to ____________________________ ___________.

Answer Sheet for Test
on
HORTICULTURE AS AN INDUSTRY

True or False:

1 False
2 True
3 True
4 False
5 False
6 False
7 False
8 True
9 True
10 False

Answer Sheet for Test
on
EXPLORING OCCUPATIONAL OPPORTUNITIES

1 Refer to the 18 factors listed in the information sheet The student should have listed at least 10 factors in his own words, which should be considered when evaluating the desirability of an occupation

2 a Greenhouse Worker
  b Nursery Worker
  c Garden Center Employee
  d Assistant Groundskeeper
  e Parks and Landscape Employee

Answer Sheet for Test on INTRODUCTION

1. Botany
2. 350,000
3. Sugars, starches
4. Water
5. Carbon dioxide and water

Answer Sheet for Test on PHOTOSYNTHESIS

1. Diffusion
2. Phot
3. Atoms
4. (In any order)
    a. Carbon Dioxide
    b. Water
    c. Chlorophyll
    d. Light
5 Molecule

Answer Sheet for Test
on
RESPIRATION

1. Food, oxygen
2. Stored
3. Decreases
4. Carbon dioxide
5. Respiration

Answer Sheet for Test
on
WATER ABSORPTION AND LOSS--NUTRIENT ABSORPTION--MOVEMENT OF WATER AND NUTRIENTS IN THE PLANT

1. Nutrients
2. Xylem, phloem
3. Bleeding
4. Transpiration
5. Root hair

Answer Sheet for Test
on
PLANT FOOD

1. Cellulose
2. Fat
3. Protein
4. a Carbon
   b Hydrogen
   c. Oxygen
   d. Nitrogen
5. Essential

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Answer Sheet for Test
on
THE PLANT KINGDOM

1 Thallus
2 Flowering parts
3. Beneficial
4. Algae
5 Four

Answer Sheet for Test
on
TYPES OF GREENHOUSES

Fill in the blanks:	True or False:
1. Exhaust fans	1. True
2. Fall	2. False - It needs to be painted about every two years.
3. Humidity, oxygen	3. False - It is difficult to prevent dripping in houses constructed from film plastic.

Answer Sheet for Test
on
SIZE AND ARRANGEMENT OF GREENHOUSES

1. False - 6 inches
2. True
3. True
4. False - Wood expands when wet.
5. True

Answer Sheet for Test
on
COOLING THE GREENHOUSE

1. 4000 sq. ft. (100' x 40')
2. 7000 sq. ft. (1000 sq. ft. x 7 CFM)
3. 50 sq. ft. (one square foot of padded area needed for each 150 CFM)
   $\left(\frac{7500\text{ CFM required}}{150\text{ CFM}}\right)$

Answer Sheet for Test
on
HEATING THE GREENHOUSE

1. True
2. True
3. False
4. True
5. True

Answer Sheet for Test
on
WINTER PROTECTION STRUCTURES

1. Hillside

2. North

3. Damp

4. Damp, dry

5. Cloches

Answer Sheet for Test
on
STRUCTURES FOR SUMMER HEAT PROTECTION

1. North, south

2. Shade

3. 10

4 Shade

5. East

Answer Sheet to Test
on
HUMIDITY AND WATERING

1 True
2. False
3 True
4. False
5 False

Answer Sheet to Test
on
VENTILATION

1. False
2. True
3. True
4. True
5. True

Answer Sheet to Test
on
LIGHTING

1. True
2. True
3. False
4. False
5. True

Answer Sheet for Test
on
WIRING AND ELECTRICAL CONTROLS

1. a. Safe
   b. Adequate
   c. Expandable

2. Safety

3. Eight

4. One-half

5. No. 14

Answer Sheet for Test
on
ORIGIN COMPOSITION AND IMPORTANCE OF SOILS

PART I

1 Sand
2 Organic matter
3 Temperature and rainfall
4. Flour
5. Particles

PART II

1 a Topsoil
  b Subsoil
  c. Parent layer

2 a Different amounts of air present when soil is formed
  b. Different amounts of organic matter
  c Different rocks from which soil is formed

Answer Sheet for Test
on
SOIL MOISTURE

PART I:

1 Capillary
2 Fine
3 Evaporates
4. Respiration
5. Aeration

PART II.

1. False - This would tear down structure
2 True - By adding organic matter
3. False - Overwatering does this.
4. True
5. True

Answer Sheet for Test
on
SOIL MIXTURES

1. Loam
2. Organic matter
3. Sticky
4. Shredder
5. Shrink

List:

a. Uniformity
b. Disease free
c. Low soluble salts
d. Good drainage
e. Good moisture retention
f. No shrinkage
g. Ease of preparation and storage
h. Complete availability

Answer Sheet for Test
on
MULCHES AND THEIR USE

PART I:

1. Peat moss
2. Mid-spring
3. Nitrogen
4. Heat
5. Asphalt

PART II:

1. b
2. c
3. c

Answer Sheet for Test
on
FERTILIZER NUTRIENTS

1. Nitrogen
2. Calcium
3. Wet
4. Below
5. Broadcast

List:

1. a. Nitrogen
   b. Phosphorus
   c. Potassium
2. a. Calcium
   b. Magnesium
   c. Sulfur

Answer Sheet for Test
on
SOIL ORGANISMS

1. Bacteria
2. Organic matter
3. Protozoa
4. Fungi
5. Earthworm

List:
6. a. Soil sterilization with steam
   b. Soil fumigation or drenching with chemicals
   c. Seed treatment

Answer Sheet for Test
on
SOIL STERILIZATION

PART I:

1. Steam
2. Nematodes
3. Two to three weeks
4. Root burn
5. Instantly

PART II:

1. a. To kill soil-borne insects
   b. To kill harmful bacteria, fungus
   c. To destroy weeds
   d. Promote soil granulation

2. a. Avoid inhaling the material.
   b. Avoid contact of fumigant with skin.
   c. Allow enough time for aeration after material is applied.

Answer Sheet for Test
on
PLANT GROWING MEDIA OTHER THAN SOIL

1. Sand
2. 10 to 20
3. Vermiculite
4. Southern
5. Nitrogen
6. Acid
7. Peat

Answer Sheet for Test
on
INTRODUCTION TO PROPAGATION

PART I

1 Sexual or asexual
2. Ventilation, temperature. shade. and light
3. Methyl bromide
4 Seeds, nematodes, and disease organisms
5. Clay pots, peat pots, and plant bands

PART II:

1. True
2. False
3. True

Answer Sheet for Test
on
PROPAGATION FROM CUTTINGS

PART I:

1. True
2. False
3. True
4 False
5 False

PART II:

1. 70-75 degrees
2. a One which can be kept uniformly moist
    b. Provide good drainage
    c. Aeration
3. When roots are 1/2 to 1 inch long
4. From new growth in spring or early summer
5. Soggy

Answer Sheet for Test
on
PROPAGATION BY LAYERING

PART I

1 False

2 True

3. True

4. True

5. False

PART II

1. a Croton
   b. Hibiscus
   c Dracaenas
   d. Rubber plants

Answer Sheet for Test
on
PROPAGATION BY DIVISION

1 True
2. True
3. True
4. False
5. True

Answer Sheet for Test
on
PROPAGATION BY GRAFTING AND BUDDING

PART I:

1. Stock is the name for the plant onto which you graft.

2. The cambium layer is the soft layer of tissue on a stem or root that lies between the bark and the wood.

3. "T" budding and patch-budding

PART II:

1 True

2. True

Answer Sheet for Test
on
PROPAGATION FROM SEEDS

PART I:

1. True

2. False

3. False

PART II:

1. Sphagnum moss
2. Flat 2" x 4" board or brick
3. Sand or other inert material
4. a. Name of plant or variety
   b. Date seeded
   c. Student's name
   d. Special treatment, if any

Answer Sheet for Test
on
DEVELOPING A PLANT BREEDING VOCABULARY

1. Anther

2. Disc floret

3. Gene

4. Ovary

5. Ray floret

Answer Sheet for Test
on
PLANT SELECTION AND FUNDAMENTALS OF PLANT BREEDING

PART I:

1. Pollination

2. Fertilization

3. Stamen, pistil or male and female parts

4. Sepals

PART II:

1. Anther
2. Filament
3. Petal
4. Sepal
5. Stigma
6. Style
7. Ovary
8. Ovule

Answer Sheet for Test
on
HEREDITY

1. True

2. Segregation

3. Mauve

4. Pure lines

5. Ovule, trait

Answer Sheet for Test
on
GENERAL BREEDING TECHNIQUES

1. True

2. False

3. True

4. True

5. False

Answer Sheet for Test
on
TRANSPLANTING ORNAMENTAL TREES AND SHRUBS

1. One to two feet wider, six inches to one foot deeper

2. Same level

3. One-third

4. Five inches or over in diameter

5. Balled and burlapped

Answer Sheet for Test
on
CARE AND MAINTENANCE OF PLANTS

PART I:

1. True
2. False
3. True
4. False
5. True

PART II:

1. Growth habit, blooming characteristics
2. Bareroot
3. Leaf drop, first spring growth
4. Thinning out
5. Better shape, fruitful growth

Answer Sheet for Test
on
INTRODUCTION TO FLORAL CROP PRODUCTION

1. Carnations
2. Floriculture
3. Light
4. Commission
5. Beltsville

Answer Sheet for Test
on
GROWING ANNUALS

1. True
2. False
3. False
4. True
5. True
6. True
7. True
8. True
9. True
10. False

Answer Sheet for Test
on
PERENNIALS

1. Two

2. Loam

3. Chrysanthemum

4. a. Cut
   b. Feeding

5. Fall

Answer Sheet for Test
on
BULBS

1. Bulb
2. Rhizome
3. Divide
4. Sun
5. Rot

Answer Sheet for Test
on
CHARACTERISTICS, IDENTIFICATION, AND USE OF IMPORTANT POT PLANTS

PART I:	PART II:
1. Acid soil or peat moss	1. (b)
2. Shallow	2. (a)
3. Cuttings	3. (c)
4. Christmas	4. (d)
5. 80-85 degrees	5. (a)

Answer Sheet for Test
on
POINSETTIAS

1. True

2. True

3. True

4. True

5. True

Answer Sheet for Test
on
CHRYSANTHEMUMS

PART I:

1. True
2. False
3. True
4. False

PART II:

1. Rooted cuttings or cuttings
2. Aphids
3. Fall
4. Chinese

Answer Sheet for Test
on
GERANIUMS

PART I:

1. True
2. True
3. False
4. False

PART II:

1. Pinched
2. Red
3. Light pink
4. Cuttings

Answer Sheet for Test
on
HYDRANGEAS

1. Two spotted mite or red spider
2. March, May
3. Easter, Mother's Day
4. Bud rot
5. Summer

Answer Sheet for Test
on
TURF GRASSES FOR TEXAS

1. False
2. True
3. True
4. True
5. True

Answer Sheet for Test
on
ESTABLISHING A NEW TURF

1. False

2. True

3. True

4. True

5. True

Answer Sheet for Test
on
MANAGING AN ESTABLISHED TURF

PART I:

1. True
2. False
3. True
4. True
5. True

PART II:

1. Feeding, watering, aerating, and mowing
2. Stunted
3. Iron sulfate or iron chelate
4. Soil solids, water, and air
5. Loosening

Answer Sheet for Test
on
TURF PROBLEMS

PART I:

1. True
2. False
3. False
4. True
5. False

PART II:

1. Diazinon, Ethion, Trithion
2. 10-14 days
3. a. Weeds
   b. Diseases
   c. Insects
   d. Clover
4. St. Augustine and bermuda grass
5. PCNB

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Page 4

Answer Sheet for Test
on
CAUSES OF PLANT DISEASES

1. Fungi, bacteria, viruses, nematodes
2. Vector
3. Prevention by careful pruning
4. Host
5. Virus

Answer Sheet for Test
on
IDENTIFYING PLANT DISEASES

1. Identification
2. Scab
3. Canker
4. Gall
5. Nematodes
6. Mummy

Answer Sheet for Test
on
APPLICATION AND SAFETY PRECAUTIONS OF HORTICULTURAL CHEMICALS

1. Hydraulic
2. Contact
3. Read
4. Toxic or poisonous
5. Bomb

Answer Sheet for Test
on
CONTROLLING LEAF DISEASES

1. Fungi
2. Iron
3. Rain or overwatering
4. Malathion and Lindane
5. Watering and fertilization

Answer Sheet for Test
on
CONTROLLING STEM, BRANCH, AND TRUNK DISEASES

1. Fungi and algae
2. Pruning
3. Destroyed
4. Slime flux
5. 50% fixed copper and Bordeaux mixture

Answer Sheet for Test
on
CONTROLLING ROOT DISEASES

1. 75 - 95 degrees
2. Methyl bromide
3. Carbon bisulfide
4. Nematodes
5. Sterilize

Answer Sheet for Test
on
CONTROLLING DISEASES AFFECTING THE ENTIRE PLANT

1. DDT
2. Chloropicrin
3. Western
4. Zineb
5. Miticide

Answer Sheet for Test
on
CONTROLLING LAWN AND TURF DISEASES

1. Iron

2. Zineb, Captan

3. Needed

4. Handpick

5. Irregular-shaped

Answer Sheet for Test
on
IDENTIFYING PLANT AND SOIL INSECTS AND METHODS OF CONTROL

1. Roots

2. Pillbug

3. Nematodes

4. Caterpillars

5. Plant lice

6. Scales

Answer Sheet for Test
on
NEMATODES

1. Knot root

2. Okra

3. a. Expense
   b. Labor

4. Crown galls

5. Fertilizer

Answer Sheet for Test
on
CONTROL OF MOLES, GOPHERS, BIRDS, DEER, AND ANTS

1. Mole

2. Baiting
   Trapping

3. Starling

4. Fencing

5. Closed

Answer Sheet for Test
on
CONTROLLING WEEDS

1 Gloves

2. Hoe

3. Sunlight

4. Chemical

5. Water

Answer Sheet for Test
on
PRINCIPLES USED TO PREVENT PERSONAL INJURY

1. Legs

2. Changes

3. Blasting

4. Moisture, insects

5. Pulley

Answer Sheet for Test
on
SELECTION AND MAINTENANCE OF HORTICULTURAL HAND TOOLS

1. Scoop
2. Level
3. Fan-shaped and rectangular
4. 6"
5. Metal bow

Answer Sheet for Test
on
MAINTAINING SMALL POWER EQUIPMENT

1. Tension, wear
2. Operator
3 Grease, oil
4. Gasoline
5. Preventive

Answer Sheet for Test
on
OPERATING AND MAINTAINING LAWN MOWERS SAFELY AND EFFECTIVELY

1. a Reel
   b. Rotary
   c. Sickle bar

2. Scalping

3. Cutter bar and knife

4. Leaves

5. Smothers the grass

Answer Sheet for Test
on
OPERATING ROTARY TILLERS SAFELY AND EFFECTIVELY

1. Tine

2. Power

3. Depth bar

4. Rear tine

5. Disengaged

Answer Sheet for Test
on
OPERATING GARDEN TRACTORS SAFELY AND EFFECTIVELY

1. 3 1/2 - 10
2. Belt, automotive
3. Jackshaft
4. Rubber tires

Answer Sheet for Test
on
INTRODUCTION TO HOME LANDSCAPING

1. Mechanized
2. Balanced
3. Plants
4. Garden
5. Space

Answer Sheet for Test
on
SELECTING A SITE

1. General location
2. Zoning
3. Homeowner
4. Corner
5. Drainage

Answer Sheet for Test
on
SCHEDULING LANDSCAPE DEVELOPMENT AND BEGINNING PLANS

1. Walks, drives
2. Trees
3. Privacy, temperature
4. Expense
5. Site

Answer Sheet for Test
on
ANALYZING PROBLEMS AND DETERMINING NEEDS

1. Beauty

2. Site

3. a. Suitability
    b. Function
    c. Economy
    d. Beauty

4. Mass, color, texture

5. Property

Answer Sheet for Test
on
DEVELOPING THE LANDSCAPE PLAN

1. a. Access to property
    b. General living area
    c. Work space
    d. Place for private living

2. a. East Texas
    b. Coastal Plains
    c. Central Texas
    d. Texas Plains
    e. Southwest Texas
    f. Western Texas

Answer Sheet for Test
on
SELECTING PLANTS

1. Annual, perennial
2. Watering
3. Australia
4. 12, 25
5. Medium

Answer Sheet for Test
on
GRADING, DRAINAGE, AND LANDSCAPE STRUCTURES

1. False
2. False
3. True
4. False
5. True

Agricultural Education
Teaching Materials Center

Answer Sheet for Test
on
DEVELOPING PERSONAL TRAITS

1. a. Knowledge of self
   b. Knowledge of people
   c. Knowledge or product

2. a. Promotions
   b. Dollars (profits)

3. a. Experience (learn by doing)
   b. Observing others

4. Analyze each sale or failure

5. a. Diligence
   b. Perseverance

Answer Sheet for Test
on
DISPLAYING

1. Floor window

2. Bulk

3. Relationship

4. Impulse

5. Bin

Answer Sheet for Test
on
ADVERTISING

PART I:

1. Point of sale
2. Impulse
3. T. V.

PART II:

1. a. Effectiveness
   b. Cost
   c. Coverage
2. Any three of these:
   a. Newspaper
   b. Television
   c. Radio
   d. Handbills
   e. Direct mail
   f. Road signs

Answer Sheet for Test
on
LABELING AND PRICING

Work:

To the teacher: Mark-up is based on selling price. In other words, $1.00 is 50% of $2.00. Therefore, the percent mark-up is 50%.

Answer: 50%

Answer Sheet for Test
on
UNDERSTANDING THE CUSTOMER AND MAKING SALES

1. Attention

2. Price

3. 48

4. Discouragement

5. Misrepresent the facts

VT001 143

VT 001 143
National Standard Check List for Teaching Home Safety.

Joint Saf Comm of the Amer Vocat Assn and Nat Saf Counc.
Pub Date - Jun65
MF AVAILABLE IN VT-ERIC SET 6p.

*SAFETY, *ACCIDENT PREVENTION, *HOMEMAKING EDUCATION, *CHECK LISTS, UNITS OF STUDY (SUBJECT FIELDS), TEACHING AIDS,

This checklist is designed to be used by students in evaluating safety practices in the homemaking laboratory under the sections (1) When I Sew, (2) When I Iron, (3) When I Wash Clothes, (4) When I Cook, (5) When I Use Electric Appliances, (6) For Safe Wiring, (7) For Safety Underfoot, (8) For Safe Storage Areas, (9) To Avoid Fire Hazards, (10) In Case of Fire, (11) Miscellaneous Safety Tips, and (12) For Safe Use of Products. Each sentence in each section is stated as a correct procedure to which the student responds, I do always, sometimes, never, or no opportunity by circling the letter A, S, N or O. Spaces are provided at the end of each section for adding other practices or conditions which will improve safety. (FP)

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1143

NATIONAL STANDARD CHECK LIST FOR TEACHING HOME SAFETY

Prepared by the Sub Committee of the Joint Safety Committee of the AMERICAN VOCATIONAL ASSOCIATION and NATIONAL SAFETY COUNCIL

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
OFFICE OF EDUCATION

(Name)

(Date)

HOW DO YOU FEEL TODAY?

Are you relaxed? Rested after a night of adequate sleep? Are you free from anger, resentment or worry? Do you think through jobs before beginning them, and organize working materials efficiently? If so, you are well on the way toward being an effective worker wherever you are — and more likely to finish your job without having an accident.

There are approved methods of working and safe procedures for using space and equipment in the rooms of homemaking departments. These practices have application in the home. This check list has been designed to help you evaluate your safety practices as you work together in acquiring homemaking skills in your homemaking courses.

CHECKING PROCEDURE

Draw a circle around the appropriate letter, using the following letter scheme:

In the spaces provided at the end of each section, add other practices or conditions which will make your department and home a safer place.

A — Always
S — Sometimes
N — Never
O — No opportunity

WHEN I SEW

I DO

A S N O 1. Put pins and needles in pin cushions — never in my mouth, clothes or in furniture.

A S N O 2. Keep sharp objects out of my lap.

A S N O 3. Pass sharp objects to others with the handle first — never toss them.

A S N O 4. Store scissors and other sharp objects in holders or in a secure place.

A S N O 5. Keep fingers away from the path of the sewing machine needle.

A S N O 6. Use slow speed on electric sewing machine while learning to operate it.

A S N O 7. Know how to operate emergency release on electric sewing machine.

A S N O 8. Make sure cord is placed so it does not rub against motor belt when sewing machine is in use (unless machine has concealed belt).

A S N O 9. Use care not to touch hot light bulb (if it is not shielded).

A S N O 10. Arrange electric cord of machine on the floor so it will not cause anyone to stumble.

A S N O 11. Turn off motor when sewing machine is not in use.

A S N O 12. Close sewing machine carefully to avoid damaging electric cord.

A S N O 13. Keep drawers and door of sewing machine closed to avoid bumping.

A S N O 14. Avoid putting excessive weight or pressure on sewing machine leaf.

A S N O 15.

A S N O 16.

WHEN I IRON

I DO

A S N O 1. Use a well-balanced, rigid ironing board.

A S N O 2. Keep my hands away from the hot area of the iron.

A S N O 3. Place hot steam iron on its heel when not in use.

A S N O 4. Use non-combustible or treated ironing board.

A S N O 5. Know how to operate safety release on ironer.

A S N O 6. Check safety release on ironer before starting to iron.

A S N O 7. Have safety release repaired immediately if it is not operating.

A S N O 8. Disconnect iron or ironer at the outlet when called away from ironing.

A S N O 9. Release ironer roll when equipment is not in use.

A S N O 10. Position iron firmly, when rearranging clothes, to avoid dropping on the floor.

A S N O 11.

A S N O 12.

WHEN I WASH CLOTHES

I DO

A S N O 1. Wear rubbers or rubber-soled shoes if floors are damp when using electric laundry equipment.

A S N O 2. Know how to operate emergency releases on laundry equipment.

A S N O 3. Check safety release on wringer before starting to wash, and have it repaired immediately if not operating.

A S N O 4. Make sure hands are dry before connecting or disconnecting electrical laundry equipment or touching light switches.

A S N O 5. Check to see if safety lid shuts off washer when lid is raised (if automatic washer has this feature).

A S N O 6. Check to see if safety door shuts off dryer when door is opened (if dryer has this feature).

A S N O 7. Test temperature of hot water from faucets cautiously before putting hands in it.

A S N O 8. Avoid carrying loads of clothes so hig I cannot see where I am walking.

A S N O 9. Make sure appliance cords do not get damp under normal use.

A S N O 10. Follow manufacturer's directions for proper removal of lint from dryer.

A S N O 11. Have motors of laundry equipment cleaned if they have collected lint and oil.

A S N O 12. Make sure permanently connected electrical laundry equipment was properly grounded at the time of installation (before using it the first time).

A S N O 13. If circuit breaker on automatic washer operates to stop automatic washing, wait for motor to cool before starting.

A S N O 14. Check to see if load of clothes is evenly balanced in washer.

A S N O 15. Make sure washer is not subjected to below freezing temperature as water in valves and pump can freeze and cause damage.

A S N O 16. Turn off water on inlet hose when automatic washer is not in use. This avoids pressure which, in time can freeze and cause hose to burst.

A S N O 17. Have a light over washer so I don't work in a shadow.

A S N O 18.

A S N O 19.

WHEN I COOK

I DO

A S N O 1. Use flat-bottomed and well-balanced cooking utensils.

A S N O 2. Handle enamelware carefully — if cracked or chipped, flakes of the vitreous enamel can get into food.

A S N O 3. Never set hot glassware on cold or wet surfaces.

A S N O 4. Avoid using ceramicware if the glaze is cracked — dirt, fat and moisture may be absorbed and create an unsanitary condition.

A S N O 5. Avoid using inexpensive sheet tin-plated utensils which have sharp corners and raw edges exposed.

A S N O 6. Turn handles of cooking utensils inward on top of range (but not projecting over other lighted burners or pilot light) and on work areas so they will not be knocked off and contents spilled.

A S N O 7. Handle hot pans with dry pot holders or mitts — never a dish towel.

A S N O 8. Check handles of utensils to be sure they are securely attached.

A S N O 9. Drain cooked foods by holding kettle with one dry pot holder and the cover with another holder.

A S N O 10. Remove lid from hot cooking utensil by lifting the far side first so steam is directed away from me.

A S N O 11. Avoid carrying pans filled with hot food or liquid across the kitchen.

A S N O 12. Have working area on each side of surface units for easy serving — also to avoid tipping and spilling contents of utensils while cooking.

A S N O 13. Reduce heat under utensils as soon as cooking temperature has been reached.

A S N O 14. Fill pan only one-third full of fat when deep-frying.

A S N O 15. Dry food thoroughly before deep-fat frying so water will not cause fat to spatter.

A S N O 16. Use kitchen tongs to turn frying food or to remove food from hot water.

A S N O 17. Watch fat carefully, or set thermostat when frying to prevent over heating.

A S N O 18. Keep knives sharp so strong pressure is unnecessary.

A S N O 19. Use knife with sharp edge away from body.

A S N O 20. Wash and dry knives separately, never leaving them in the dishpan or under water.

A S N O 21. Store knives carefully, preferably in slotted racks.

A S N O 22. Use proper opener for cans, jars and other containers — never a knife.

A S N O 23. Use a can opener that leaves a smooth edge.

A S N O 24. Work slowly when opening a vacuum can with a key to prevent snapping of the sharp metal band.

A S N O 25. Dispose of sharp metal and broken dishes or glasses in well-wrapped package.

A S N O 26. Follow manufacturers' directions carefully when using pressure cooker, bakeware, electrical appliances, etc.

A S N O 27. Use a rubber scraper in the electric mixer bowl when the mixer is operating, never a metal or wooden spoon, fork or spatula.

A S N O 28. Use a stomper, not my fingers, for pressing food into chopper.

A S N O 29. Keep a vent tube of a pressure cooker open — if clogged, use a cleaning wire to open it.

A S N O 30. Stand to one side when lighting a gas oven — first opening the oven door for a few minutes, then lighting match before turning on the gas.

A S N O 31. Have the oven thermostat checked if cakes do not bake in the time specified by the range manufacturer.

A S N O 32. Have kitchen arranged so large appliances and equipment do not protrude and cause bruises or falls.

A S N O 33. Keep work surfaces orderly during preparation of food.

A S N O 34. Close cupboard doors and drawers carefully, and keep them closed when not in use.

A S N O 35. Read directions before using pressure canner.

A S N O 36. See that gauge, safety valve and petcock of pressure canner are operating properly.

A S N O 37. Use standard glass containers especially made for home canning.

A S N O 38. Pack jars loosely in pressure canner or water bath canner.

A S N O 39. Always lift far side of cover of pressure cooker or canner to allow steam to escape safely.

A S N O 40. Use tongs when removing jars from canner. (Check tongs first to be sure they are in good condition.)

A S N O 41. Never can by oven method because of danger of explosion.

A S N O 42. Melt paraffin in a double boiler to prevent overheating.

A S N O 43. Wear well-fitted tailored garments when cooking — never loose-fitting clothes with flowing sleeves or ties, or projecting pockets and bows which might catch on equipment.

A S N O 44.

A S N O 44. Wear canvas work gloves when rearranging the freezer or handling dry ice.

A S N O 45. Have adequate lighting over all work centers.

A S N O 46.

A S N O 47.

A S N O 48.

WHEN I USE ELECTRIC APPLIANCES

I DO

A S N O 1. Choose equipment which complies with the safety standards of Underwriters' Laboratories.

A S N O 2. Check type of current recommended for operating equipment before connecting it the first time to avoid overheating and damaging appliance.

A S N O 3. Dry hands thoroughly before connecting or disconnecting electrical equipment.

A S N O 4. Never plug in more than one appliance with a heating element on the same circuit unless an electrician has certified that the wires are large enough to accommodate the current of both appliances.

A S N O 5. Never connect electric appliances when standing on a wet surface or if perspiring excessively.

A S N O 6. Plug cord in appliance first, then in wall outlet — to prevent sparks and arcing of terminal pins, and to lengthen the life of the appliance.

A S N O 7. Arrange cord so there is no danger of stumbling over it while appliance is connected.

A S N O 8. Always disconnect cord from wall outlet before removing from appliance — otherwise a "hot" plug will be exposed.

A S N O 9. Grasp plug rather than cord when removing from outlet or appliance, holding plug firmly and pulling gently.

A S N O 10. Avoid using small appliances in area where they could accidentally fall into a sink while connected.

A S N O 11. Disconnect small appliances when not in use to avoid danger of shock or of accidentally touching "on" switch.

A S N O 12. Never let cord dangle — appliance might be pulled off working area.

A S N O 13. Replace electric cords when noticeably worn.

A S N O 14. Never plug appliances into light sockets — lighting wiring is not made to carry current necessary to operate appliances.

A S N O 15. Consult appliance instruction book for special safety precautions and directions for use.

A S N O 16. Always disconnect any appliance with exposed coils before cleaning.

A S N O 17. Never put heating unit, motor or cord of electric appliance in water as this may cause a short. (Electric skillets indicate up to what point they may be immersed in water).

A S N O 18. Always unplug an electric pressure pan before putting it in water.

A S N O 19. Disconnect at outlet appliances with exposed coils and allow to cool before cleaning.

A S N O 20. Allow hot appliances to cool before storing.

A S N O 21. Never knot appliance cord or bend sharply.

A S N O 22. Cool waffle and sandwich grills open.

A S N O 23. Never use an electric cord if the plug is loose or a screw or bolt has fallen out.

A S N O 24. Avoid getting batter or liquid into mixer mechanism.

A S N O 25. Make sure refrigerator operating mechanism is kept clean. (Check directions provided by manufacturer).

A S N O 26. Keep forks out of electric toaster.

A S N O 27. Avoid shaking toaster upside down — remove crumbs from bottom by emptying crumb tray.

A S N O 28. Have defective appliances repaired before next use.

A S N O 29. Inspect all cords regularly for frayed or cracked insulation and replace promptly.

A S N O 30. Have adequate storage space for small appliances when not in use.

A S N O 31.

A S N O 32.

FOR SAFE WIRING

I DO

A S N O 1. Avoid overloading of circuits.

A S N O 2. Protect all electric circuits with proper sized fuses (usually 15 ampere) or circuit breaker.

A S N O 3. Never use a penny to replace a fuse temporarily — the fuse is a safety valve and blows out to warn of dangerous overloading in the wiring system.

A S N O 4. Keep spare fuses of proper size on hand.

A S N O 5. Keep a candle or flashlight near the fuse box to supply handy working light.

A S N O 6. Know how to change a fuse. (Cut off electricity with main switch; stand on a dry board; be sure hands are dry.)

A S N O 7. Connect at one time lights and appliances totaling no more watts than fuse is rated (15 ampere fuse for 1800 watts — 20 ampere for 2300 watts).

A S N O 8. Know how to reset a circuit breaker, if used instead of a fuse.

A S N O 9. Keep door closed on fuse or circuit breaker box to avoid bumping and to keep dust from collecting inside box.

A S N O 10. Have wiring repaired when lamps flicker, plugs loosen in wall sockets, or switches fail.

A S N O 11. Have wiring checked before installing new appliances which draw heavy current.

A S N O 12. Make sure any wiring addition, repair or alteration is done by a reliable electrician who will arrange for inspection and produce a certificate of approval.

A S N O 13. Connect each major plug-in appliance to its own branch circuit for best operating results.

A S N O 14. Locate electrical outlets so cords cannot drop into sink or bathtub.

A S N O 15. Avoid using extension cords whenever possible; if this is necessary, check to be sure extension is the correct gauge wire for appliance used. (Asbestos-insulated cord for heating appliances, heavy-duty cords for tools, moisture-resistant cords for equipment in damp locations).

A S N O 16. Use cords listed by Underwriters' Laboratories.

A S N O 17. Never string cords across work areas or traffic lanes, across radiator, over pipes or hooks, through doors or under rugs, or in any exposed place where they are subject to wear or damage.

A S N O 18. Never run cord over a steam pipe or wrap around a warm appliance because the insulation may become scorched and eventually crack.

A S N O 19. Avoid using frayed cords or making temporary tape repairs on cords.

A S N O 20. Never twist or knot a cord as there is danger of breaking the wire or the insulation.

A S N O 21. If electric cords are stored in a drawer remove sharp-edged tools or knives which might damage the insulation.

A S N O 22. Never tack cords to the wall — use insulated staples.

A S N O 23. Have defective light switches repaired promptly.

A S N O 24. Keep cover plates on outlets and switches.

A S N O 25. Keep water away from electrical outlets.

A S N O 26. Never stick anything (such as a hairpin) into a wall socket.

A S N O 27. Never turn on lights or a motor switch while touching a metal stand, pipe or other grounded metal.

A S N O 28. Use weatherproofed wire, sockets and outlets for all outdoor electrical equipment — never household extension cords.

A S N O 29.

A S N O 30.

FOR SAFETY UNDERFOOT

I DO

A S N O 1. Keep bare floors in good repair and free from uneven or rough areas, loosened tiles, wide cracks, etc.

A S N O 2. Repair or replace floor coverings which have tears or holes, or loose frayed or curled edges.

A S N O 3. Wipe up spilled liquids, foods, grease, etc. from floors promptly.

A S N O 4. Keep floor cloths or paper towels near all work centers where liquid may be spilled.

A S N O 5. Pick up hairpins, rubber bands, paper clips and other articles dropped on floors.

A S N O 6. Keep out of traffic lanes any objects which are likely to tip or be stumbled over.

A S N O 7. Keep toys, sewing boxes and other small articles off the floor so they will not cause anyone to stumble or trip.

A S N O 8. Always rinse floors before applying self-shining water-base wax so wax will not become soft and smeary from traces of soap, detergent or other cleaners.

A S N O 9. Follow directions when using wax — for example, apply polishing wax in a very thin coat and buff thoroughly. A bright shine is a safety sign!

A S N O 10. Apply a good quality wax made by a dependable company.

A S N O 11. Use a dry dust mop, never an oiled or chemically treated one because oil softens wax and makes it smeary.

A S N O 12. Use a non-slip device under small rugs — rubber pads, a rubberized coating, etc.

A S N O 13. Provide adequate and permanent lighting in dark storage areas.

A S N O 14.

A S N O 15.

FOR SAFE STORAGE AREAS

I DO

A S N O 1. Store heavy objects on lower shelves.

A S N O 2. Store equipment and supplies as close as possible to work area in which they will be used to avoid unnecessary carrying of heavy articles.

A S N O 3. Have sturdy stepladder or safe stepstool handy for reaching high places.

A S N O 4. Close cupboard doors and drawers immediately after use.

A S N O 5. Keep food in tightly covered containers and in racks or bins off the floor away from insects and rodents.

A S N O 6. Clearly label any poisonous materials or dangerous compounds such as lyes, bleaches, insecticides, etc. and store in locked cupboard or on shelf away from other supplies and out of reach of children.

A S N O 7. Have shelves sufficiently strong to hold stored material without sagging or collapsing.

A S N O 8. Fasten shelves securely to walls.

A S N O 9. Keep all questionable materials out of reach of small children. Many common household products are dangerous when inhaled, absorbed through the skin, and some even poisonous when swallowed.

A S N O 10. Never store aerosol containers near a heat source or in an unusually warm area as container can burst.

A S N O 11. Store household cleaning and maintenance products away from food items.

A S N O 12. Medicines should be kept in a cabinet, locked and out of reach of children.

A S N O 13. Separate medications used externally from internal medicines in the cabinet, or place in separate cabinets.

A S N O 14.

A S N O 15.

TO AVOID FIRE HAZARDS

I DO

A S N O 1. Keep storage areas free of flammable fluids, paper, rags, etc.

A S N O 2. Store flammable fluids, such as kerosene and gasoline, outside in clearly labeled and approved fire-safe metal containers (never in glass).

A S N O 3. Discard oily rags or oily furniture polish cloths in covered metal containers.

A S N O 4. Remember never to leave rubbish, kindling, paints, turpentine, etc. near furnace or stove.

A S N O 5. Provide covered metal cans for ashes from furnace or stove — never wood or paper boxes.

A S N O 6. Wrap up dust from vacuum cleaner or dustpan, flour, or uncooked cereals and dispose of in garbage — never throw into open fire because dust is explosive.

A S N O 7. Never use flammable cleaning fluids indoors.

A S N O 8. Never allow even a small amount of gasoline to be exposed in a room or other confined space.

A S N O 9. Start wood and coal fires without the use of kerosene.

A S N O 10. Never quicken fires with kerosene.

A S N O 11. Keep wicks and burners clean and in good condition on kerosene lanterns, heaters, stoves, etc. (An explosion may result from a defective wick that does not fill the wick-tube section).

A S N O 12. Use quick drying paints containing volatile solvent only in well-ventilated rooms.

A S N O 13. Burn paint rags or place in a covered metal can immediately.

A S N O 14. Never place a can of paint on a stove to heat — put it in a pan of hot water.

A S N O 15. Use a paint remover only in well-ventilated areas.

A S N O 16. Keep lighter-fluid in a closed container of not more than four ounces.

A S N O 17. Store and use lighter-fluid away from sources of ignition.

A S N O 18. Never pour gasoline in an enclosed space. Use a funnel when pouring from one container to another to prevent spillage.

A S N O 19. Never filter gasoline through a chamois.

A S N O 20. Keep grease containers away from the range.

A S N O 21. Store matches in a tightly-closed metal container.

A S N O 22. Put out lighted matches and place in ash tray or non-flammable receptacle — never in a waste basket or rubbish container.

A S N O 23. Locate towel racks away from range so towels cannot fall on heating units or burners.

A S N O 24. Have gas range located away from window to avoid danger of curtain blowing over burners and catching fire.

A S N O 25. Clean oven and broiler pan regularly to prevent accumulation of grease.

A S N O 26. Have repairs made promptly on defective equipment, chimneys, stovepipes, etc.

A S N O 27. Use hot water to thaw frozen pipes, never a blow torch or open flame.

A S N O 28. Make sure small stoves and electric heaters are not placed where they can tip over.

A S N O 29. Keep electric lamp bulbs (when lighted) away from walls, stored clothing, curtains, or flammable material of any kind.

A S N O 30. Never cook or work around a fire when wearing a fluffy sweater or other flammable garments.

A S N O 31. Keep fire extinguishers in homemaking departments and choose those recommended for all types of fires (wood, oil, live electrical equipment, etc.) and tested by Underwriters' Laboratories.

A S N O 32. Have fire extinguishers inspected at least once a year and follow manufacturers' instructions for refilling.

A S N O 33.

A S N O 34.

IN CASE OF A FIRE

I DO

A S N O 1. Know the location of the nearest fire alarm box.

A S N O 2. Know how to phone for the Fire Department.

A S N O 3. Remember the location of the quickest exits.

A S N O 4. Close any door which will tend to confine the fire.

A S N O 5. See that everyone is out of danger.

A S N O 6. Know where fire extinguisher is located and how to operate it.

A S N O 7. Never try to fight a fire in a room filled with smoke — the fumes and lack of air are dangerous.

A S N O 8. Never try to enter a room where much fire is in evidence.

A S N O 9. Remember that a woolen blanket or other heavy covering will help to smother a small fire.

A S N O 10. Keep pound boxes of inexpensive baking soda ready for use in the kitchen.

A S N O 11. Use soda instead of water for grease, oil, paint, varnish, and similar fires because water spreads such a fire. (Instead, dust on soda, which smothers the flames physically and chemically with carbon dioxide gas).

A S N O 12. Smother grease fires in cooking utensils with a pan cover handled by a long fork, or by throwing soda on the blaze.

A S N O 13. Fight broiling pan fire by first turning off oven and then throwing handfuls of soda on the blaze.

A S N O 14. Throw soda on fire in ash tray, waste basket, upholstered furniture,, etc.

A S N O 15.

A S N O 16.

MISCELLANEOUS SAFETY TIPS

I DO

A S N O 1. Know the location of water, gas and electric supply shut-offs.

A S N O 2. Have a first aid kit available with supplies constantly replenished.

A S N O 3. Know elementary first aid.

A S N O 4. Avoid indoor use of toxic cleaning fluids such as carbon tetrachloride.

A S N O 5. Remember never to use a lighted match to find a gas leak — instead call the gas company, extinguish all flames, open windows — and get out of the building if the odor of gas is very strong.

A S N O 6. Use lead-free paint on indoor surfaces.

A S N O 7. Wear low heels when working in and around the home.

A S N O 8. Do household reaching and climbing on a steady, sturdy stepstool or ladder with treaded steps.

A S N O 9. Remember never to put hand inside a radio or television set.

A S N O 10. Avoid allowing water from the shower to splash on a bare light bulb.

A S N O 11. Use a pronged prier for removing nails or tacks.

A S N O 12.

A S N O 13.

FOR SAFE USE OF PRODUCTS

A S N O 1. Always read label before using household cleaning products, insecticides and medicines. Follow directions on the label.

A S N O 2. Always return products to safe storage area after use.

A S N O 3. Keep poisonous products in their original containers with labels intact.

A S N O 4. Do not combine cleaning agents unless label directions indicate that it is safe to do so.

A S N O 5. Before discarding an aerosol container, hold the valve open until all contents and gas have escaped. Place empty container in the trash, never in a fire or incinerator.

A S N O 6. Dispose of empty containers and unused portions. Flush unused portions down the drain, rinse out containers and put them in the trash.

A S N O 7. When using insecticides remove or cover food and water containers. Avoid inhaling sprays or dusts, wash immediately if spilled on the skin, and thoroughly wash hands when finished.

A S N O 8. Never spray aerosols near an open flame.

A S N O 9.

A S N O 10.

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VT001 187

VT 001 187

Learning Experiences in Agricultural Occupations for Students of Vocational Agriculture, Milk Processing Plant.

Clemson Coll., S.C. Dept. of Agricultural Education
South Carolina State Dept. of Education, Columbia
Pub Date - Apr64
MF AVAILABLE IN VT-ERIC SET 4p.

*VOCATIONAL AGRICULTURE, *COOPERATIVE EDUCATION, *MILK, *LEARNING EXPERIENCE, *LIVESTOCK PROCESSING OCCUPATIONS, JOB SKILLS,

The purpose of this guide is to assist vocational agriculture teachers and students in planning and evaluating work experiences in milk processing businesses. It was developed by a teacher educator in consultation with a dairy science professor for use in a 50-hour placement activity. Forty-two learning experiences are listed under ice cream, cheese, milk, and butter processing. A space is provided for the employer to check satisfactory completion of each experience. Single copies of this document are available without charge from Agricultural Education Department, Clemson University, Clemson, South Carolina 29631. (JM)

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LEARNING EXPERIENCES IN AGRICULTURAL OCCUPATIONS
FOR
STUDENTS OF VOCATIONAL AGRICULTURE

MILK PROCESSING PLANT

Prepared by

Agricultural Education Department, Clemson College, Clemson, South Carolina

and

State Department of Education, Columbia, South Carolina

April 1964

MEMORANDUM

TO: The ERIC Clearinghouse on Vocational and Technical Education
The Ohio State University
980 Kinnear Road
Columbus, Ohio 43212

FROM: (Person) F. E. Kirkley (Agency) Agricultural Education Department

(Address) Clemson University, Clemson, South Carolina

DATE: December 14, 1967

RE: (Author, Title, Publisher, Date) F. E. Kirkley, Learning Experiences in Agricultural Occupations for Students of Vocational Agriculture--Milk Processing Plant, Clemson Agricultural Education Department, 1964

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Provide information below which is not included in the publication. Mark N/A in each blank for which information is not available or not applicable. Mark P when information is included in the publication. See reverse side for further instructions.

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Address Clemson, South Carolina 29631
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(2) Means Used to Develop Material:
Development Group Teacher educator & professor of dairying
Level of Group State
Method of Design, Testing, and Trial N/A

(3) Utilization of Material:
Appropriate School Setting High school agriculture
Type of Program Placement for experience in Mild Processing Plants
Occupational Focus Prepare for job entry
Geographic Adaptability South Carolina
Uses of Material List of jobs and skills
Users of Material Teachers

(4) Requirements for Using Material:
Teacher Competency Agriculture teachers
Student Selection Criteria High school

Time Allotment 50 hours

Supplemental Media --
Necessary ☐
Desirable ☒ (Check Which)

Describe Local related material

Source (agency)
(address)

FOREWORD

This outline consists of some of the experiences the student may get in milk processing plants which make ice cream, cottage cheese, creamery butter and market fluid milk. Some plants may also manufacture other products such as whipping cream and coffee cream.

Just how much the student learns through these experiences will depend on his interest in the technical aspects of the various processes. If it's a matter of putting in so many hours in an ice cream plant he will likely learn little. On the other hand, if he observes, asks questions, gathers information and studies, his experience will likely be profitable.

The student should have his employer or plant superintendent to check (✓) the experiences and activities as they are satisfactorily completed.

MAKING ICE CREAM

Kind of Experiences

Check Performance

1. Preparing ingredients (mix) for making ice cream
2. Pasteurizing the mix
3. Freezing the mix
4. Packaging
5. Storing or hardening
6. Marketing ice cream
7. Sanitation and maintaining equipment

MAKING COTTAGE CHEESE

1. Pasteurizing skim milk
2. Cooling to desired temperature
3. Adding culture to form curd
4. Cutting curd
5. Heating curd to desired firmness
6. Determining firmness
7. Draining whey
8. Washing and draining
9. Packaging
10. Sanitation and maintaining equipment

MARKETING MILK

1. Hauling milk
2. Examining for flavor and odor
3. Testing for butterfat, etc.
4. Filtration and clarification
5. Cooling
6. Standardization

Check Performance

7. Homogenization
8. Pasteurization
9. Cooling
10. Bottling (paper container)
11. Storing
12. Retailing
13. Cleaning equipment

MAKING CREAMERY BUTTER

1. Separating milk to cream with approximately 40 % butterfat
2. Checking cream for acidity and adding neutralizer if needed
3. Pasteurizing cream
4. Adding color to cream if needed
5. Cooling cream
6. Churning
7. Draining buttermilk and washing fat with water
8. Adding salt
9. Testing for moisture, butterfat and curd
10. Washing, chilling, and crystallizing butter
11. Wrapping and packaging
12. Cleaning equipment

VT001 203

VT 001 203
Spice up Your Teaching with Variety.

Kelsay, Evangeline
Kentucky Univ., Lexington

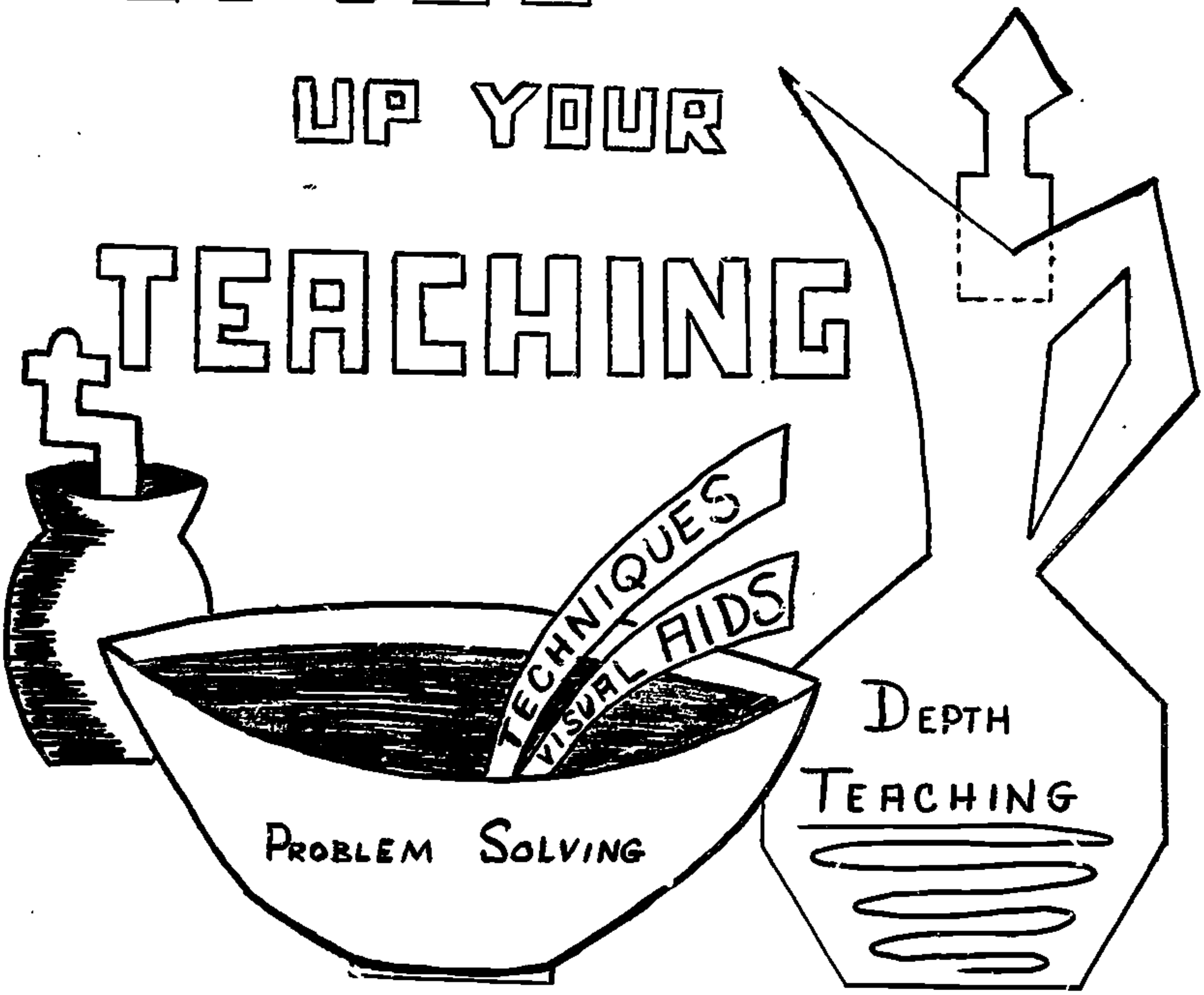
Pub Date - Aug64
MF AVAILABLE IN VT-ERIC SET 72p.

*TEACHING TECHNIQUES, *TEACHING METHODS, *PROBLEM SOLVING,
*AUDIOVISUAL AIDS, *HOMEMAKING EDUCATION,

Teaching techniques and suggestions for their use are presented to improve home economics teaching. They were compiled by graduate supervision class members and resource persons. Content areas are (1) Understanding and Using Problem Solving, (2) Understanding and Using Teaching Techniques, (3) Understanding and Using Audio-Visual Aids, (4) Teaching Techniques, (5) Audio-Visual Aids, and (6) Factors to Check in Evaluating Depth Teaching. Specific techniques such as group dynamics, case studies, interview, anecdotal record, demonstration, field trip, dramatics, games, and supervised study are presented with description, organization, appropriate use areas, examples, advantages, and disadvantages for each arranged in parallel columns. A bibliography is included. (MS)

1203

SPICE UP YOUR TEACHING



WITH VARIETY

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IV. Understanding and Using Audio-Visual Aids

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L. Dramatization

b. Role Playing Follow-up

VI. <u>Audio-Visual Aids</u>

A. Three-Dimensional Materials

B. Flat Material

Introduction

"Spice Up Your Teaching With Variety" is a publication which has been developed by classes in supervision under the leadership of Mrs. Evangeline Kelsay during the summer session at the University of Kentucky in 1958, 1959, and 1964. It is directed to those who guide student teachers, to those who teach homemaking and to college students who plan to be teachers. The publication includes some suggested guides to techniques and visual aids which can be used to improve the teaching of home economics. Improving the quality of teaching can have a great influence in preserving our democratic way of life.

It has been the desire of all these groups to share the valuable experiences gained in this class to all who are engaged in the challenging and satisfying task of training young people as home economists.

Class Members

Education 261, Summer 1958

Betty Aldridge	Clark County High School
Cleota Bolling	Franklin County High school
Agnes Foster	Hartford High School
Ester Kalb	Bracken County High School
Lucy T. Lisanby	Georgetown High School
Mary T. Poe	Lees Junior College
Margie S. Roberts	Morehead High School
Sarah Tabb	Scott County High School
Inez Toohey	Erlanger-Lloyd High School
Elizabeth Watson	Winchester High School

Education 261, Summer 1959

Gertrude Hauselman	Campbell County High School
Wilma Holland	Bristow High School
Pauline Jones	Ventura, California
Edith H. Merritt	Tollesboro High School
Mary D. Pierce	Clinton County High School
Risse Sharpton	Bellefontaine, Ohio
Marie Young	Christian County High School

Education 687, Summer 1961

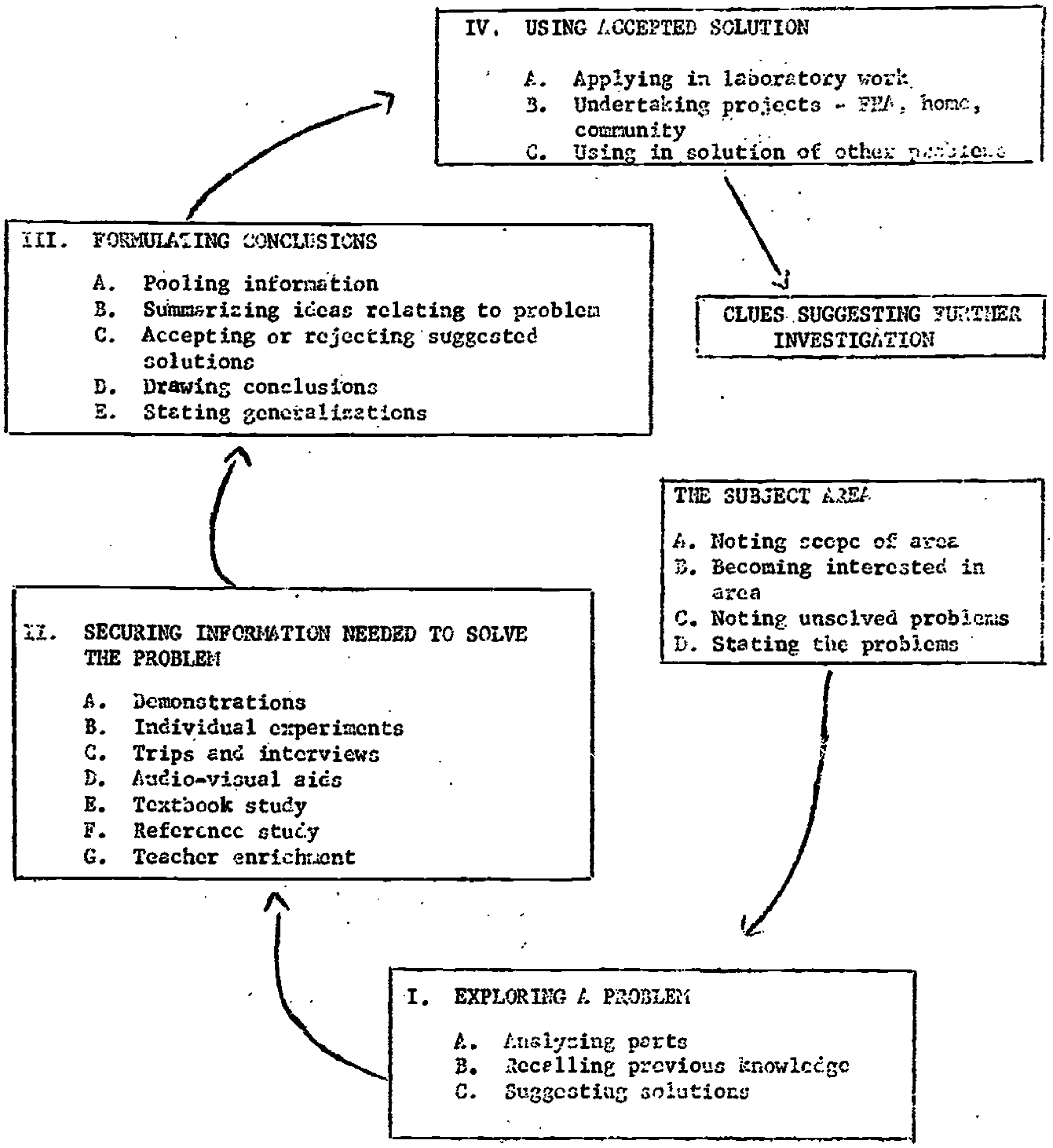
Barbara A. Carlisle	Leestown Jr. High School

Education 687, Summer 1964

Louise Alton Bennett	North Hardin County High School
Mary Alice Lay	Union College

Home Economics State Conference
Kentucky - August 1964

CYCLES OF ACTIVITIES IN PROBLEM SOLVING



THE SUBJECT AREA

- A. Noting scope of area
- B. Becoming interested in area
- C. Noting unsolved problems
- D. Stating the problems

I. EXPLORING A PROBLEM

- A. Analyzing parts
- B. Recalling previous knowledge
- C. Suggesting solutions

II. SECURING INFORMATION NEEDED TO SOLVE THE PROBLEM

- A. Demonstrations
- B. Individual experiments
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- A. Pooling information
- B. Summarizing ideas relating to problem
- C. Accepting or rejecting suggested solutions
- D. Drawing conclusions
- E. Stating generalizations

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- A. Applying in laboratory work
- B. Undertaking projects - FHA, home, community
- C. Using in solution of other problems

CLUES SUGGESTING FURTHER INVESTIGATION

NOTE: These "Cycles" are an adaptation of ones presented at the State Conference for Home Economics Teachers, August, 1963.

State Conference - Home Economics
Kentucky - August 1963

SOME GUIDES FOR USING "CYCLES OF ACTIVITIES IN PROBLEM SOLVING"

GENERAL

Pupils should be involved in carrying out all of the cycles. Guiding pupils through the cycles of problem solving will vary in length of time needed - sometimes it may take less than a period and often it may require more than one class period. More than one cycle may be carried out at the same time.

SUBJECT AREA

Problems selected should be limited in scope in accordance with the level of the class, the needs and interests of the pupils, and the time available. When setting up the unit the major problems to be considered should be identified cooperatively by teachers and pupils.

EXPLORING A PROBLEM

1. A problem may be explored by guiding pupils to think of smaller problems or questions on which they need to work in solving the greater problem.
2. A problem may be explored by thinking of goals to accomplish in solving the problem, or by setting up objectives for the unit.
3. Recalling previous knowledge may be accomplished by the use of a pretest, or by pooling ideas gained from other units, other classes, and prior experience.
4. Formulating hypotheses means suggesting possible solutions to the problems. (An hypotheses is a hunch, a tentative explanation assumed to be correct but not proven.)
5. Additional information needed, how and where to obtain information should be jointly planned by the class and the teacher. (Some of the techniques included in this bulletin will aid one in selecting ways to go about gathering this additional information.)

GATHERING EVIDENCE TO SOLVE THE PROBLEM

1. Gathering evidence to solve the problem may be accomplished by the pupils using a variety of ways to secure the needed information. The teacher guides and enriches this activity.
2. The methods used for gathering evidence should be appropriate and purposeful and recognized as such by the pupils.

FORMULATING CONCLUSIONS

1. Recall of evidence may be accomplished by guiding class to pool and organize information found, and determine its relevancy and use it in determining a solution to the problem.
2. Accepting or rejecting hypotheses includes comparing evidence obtained with their original hypotheses (or tentative solution) and formulating accepted hypotheses.
3. State some generalizations by guiding the pupils to state the findings they may use in other situations when information justified it. (Do not generalize on too little evidence)

USING ACCEPTED HYPOTHESES (laboratory work, home experiences)

GENERALIZATIONS

DEFINED

A "generalization" is a complete thought which expresses an underlying truth, has an element of universality, and usually indicates relationships.

LEVELS OF DIFFICULTY IN GENERALIZATIONS

The first level is likely to be either a description, definition, analogy, identification, or classification. Statements are simple and may relate to personal experiences.

The second level shows relationships among ideas. They may make comparisons and include more ideas than on the first level.

The third level usually explains, justifies, interprets, or predicts. Generalizations at this level may be more remote in time or space. They often suggest a direction for behavior.

SEQUENCE OF GENERALIZATIONS

The three levels of generalizations might be developed during the year or they might be one basis for sequence from year to year. The maturity of the students determines whether they are likely to be ready for the various levels of generalizations in any given topic.

WHY TEACH GENERALIZATIONS

We can only transfer what we learn from one situation to another when we generalize. Generalizations can help us to integrate learnings and give pupils a feeling of continuity from one unit to another as generalizations are applied. In home economics we teach a few general concepts and apply them in many places.

If the pupils are taught to verbalize generalizations in the summary of the classroom experience, they are more likely to remember what they have learned and to apply their learning to other situations.

STEPS IN TEACHING PUPILS TO GENERALIZE

1. After you have planned the generalizations that need to be developed for a specific class you can guide the thinking of pupils through questions.
2. Lead pupils to point out the differences the similarities among the factors in a situation - begin to draw conclusions.
3. Ask pupils to state conclusions orally or in writing to determine areas needed to be corrected or re-taught. These conclusions may be tentative as generalizations must be based on my experiences.
4. If students have misconceptions, plan and present additional experiences to clarify concept.
5. Ask for the conclusions of students and accept the kind of statements that students are ready to make. The generalizations they state may not be stated as you did when you planned. They may not be as broad.
6. Provide experiences in applying the generalizations. This will increase the understanding of them and develop ability to use them.

GENERALIZATIONS IN TEACHING HOME ECONOMICS
State Department of Education, November, 1960

UNDERSTANDING AND USING TEACHING TECHNIQUES

What is a Teaching Technique

A technique is a teaching method or procedure used to promote pupil learning. In homemaking education we know that several types of learning(s) take place in every classroom and laboratory. Learning of facts, skills, attitudes toward people and self, are among some of the important learnings to be achieved by students of homemaking. The presentation of each type of learning deserves special consideration if it is to be effective, meaningful, applicable and result in changed behavior--the ultimate objective of learning.

The Importance of a Technique

It is therefore the responsibility of teachers of homemaking to incorporate into their teaching, certain techniques or procedures which will help them uphold high standards of learning experiences. These should, in turn, become applied abilities in an improvement in home and family living for the pupils.

Criteria for Selection and Use of Techniques

A wise and resourceful homemaking teacher will select a technique which is appropriate to her instructional area and to her own personality and philosophy. A technique must help a student acquire basic concepts and understandings, skill in thinking, and a knowledge of facts and principles, as well as to motivate learning and develop and maintain interest.

Before selecting a technique these questions should be asked:
- Will the technique meet the purposes, goals, and interests of the group?
- Does the group have the ability to preform the technique?
- Do I have the ability to direct this technique?
- Will this technique develop initiative and self-direction?
- Will it create individual and group thinking?
- Will it contribute to the achievement of a goal?
- Will it help an individual to work with others?

All techniques will not meet all of the questions, but each one should meet some of the questions if it is going to be useful to a particular group.

No technique can be used with success one hundred percent of the time, however, it should be evaluated each time that it is used. The evaluation will be valuable when selecting a technique according to the purposes, goals, interests and abilities of the group.

Evaluation Check List
for Use of Techniques

	Good	Fair	Poor	Does not apply
1. Were the goals and purposes of the technique clear?				
2. Did the technique help the students reach the goal?				
3. Was preparation made in advance and all materials ready for the class?				
4. Was the technique well presented?				
5. Did the technique stimulate interest and imagination?				
6. Did the entire group participate?				
7. Was it used at a strategic point in a unit or at a time when interest was high?				
8. Did it lead to further discussion and study?				
9. Were ways shown of applying principles to other situations?				
10. Was time well managed?				
11. Was it suitable for the group?				
12. Did the summary following the technique bring out all important points.				

UNDERSTANDING AND USING AUDIO VISUAL AIDS

A. Definition of audio-visual aids

Audio-visual aids are the materials and devices used in learning situations to supplement the written or spoken word in the transmission of knowledge, attitudes and ideas.

B. Values of audio-visual aids

1. Can be used with almost any type of teaching method to increase the learning that results from its use. (Enrich teaching)
2. Contribute to longer retention of learning
3. Help to give correct first concepts or impressions. (Clarify information)
4. Can give new concepts of things outside of the range of ordinary experience
5. Stimulate interest
6. Motivate students, the slow learner
7. Stimulate discussion
8. Challenge independent thinking
9. Influence attitudes
10. Summarize what has been learned
11. Add variety to teaching techniques
12. They tend to reduce verbalizm or the repetition of words without knowing their meanings

C. Summary Statement

Audio-visual materials can never substitute for good teaching but they can be very effective tools in the hands of a well-prepared teacher. The teacher must learn to select materials carefully, preview materials, plan and use them effectively, and aid the students in developing generalizations from the use of these audio-visual aids.

Barton Morgan, Glen E. Holmes, and Clarence Bundy, Methods in Adult Education (Danville: The Interstate Printers and Publishers, Inc., 1960, p. 134.)

D. Suggested check-list for selecting audio-visual aids

<u>Directions</u>: Place a check (✓) in the column at the right under yes if you can answer yes to the questions. If your answer is no, place a check (✓) under the no column.

	Yes	No
1. Is it the best means available to realize the goal		
2. Will this material make the learning situation more realistic and concrete		
3. Is it appropriate for the age, intelligence, interests, and experience of the students		
4. Will it make learning easier and quicker		
5. Does it present information in an interesting manner?		
6. Does it stimulate the students to think critically?		
7. Does it encourage the integration of subject matter		
8. Does it help the students to develop and improve skills		
9. Will it stimulate the development of responsibility and cooperation among the students		
10. Does it present an up-to-date picture of ideas and information		
11. Is it worth the time, expense, and effort involved in its use		
12. Are its physical qualities satisfactory		
13. Does it stimulate emotional as well as intellectual experience		
14. Does it challenge students to engage in self-expressive, constructive activities		
15. Will it be available at the proper time to fulfill the class objectives		

Olive A. Hall and Beatrice Paolucci, *Teaching Home Economics* (New York: John Wiley and Sons, Inc., 1961) p. 221.

TEACHING TECHNIQUES

GROUP DYNAMICS: "Warm-up Techniques"

Description and Organization	Appropriate Use Areas - Groups	Examples	Advantages	Disadvantages
The following techniques are used to stimulate interest in spontaneous discussions.	Adaptable to a variety of learning situations			
Radioscopics A flexible teaching technique Paper cut-outs or symbols of a child's toy, a change purse, or household tool, that symbolizes the subject and problems to be discussed. A question related to the discussion topic is written on the face of each symbol. The answer is written on the back or concealed under a fold of the device. Devices are given out, questions or problems are read, possible answers given and then compared with the concealed answer.	Used to dramatize problems Used to clarify pertinent facts Adaptable to almost any learning situations at any one level Can be used in all areas of homemaking Any age group from primary to adults, civic organizations and clubs	Child Care: Folded diaper, principles of baby sitting Laundry symbols for review Clothing: Symbols of equipment, why and when they are used, care of, etc. Foods: Symbols of a cover Health: Band-aids to discuss the treatment of wounds	Contributes to the stimulation of group interest Adds variety to assignments Triggers group discussion Develops a permissive learning atmosphere Draws out reticent group members Stimulates individual contributions Facts are retained longer	Takes time to find models and make the radioscopics Hard for the teacher that has little originality Discussion must be carefully guided to bring out points relating to subject
Matching Partners Picture or card (holding problem, quotation or picture) is cut into two pieces. Student finds partner and the two discuss implications of a particular problem.	Very good for child care, family life, consumer education and safety;	"Spare the Rod/ Spoil the Child" (Partners begin discussion of necessity of spanking as punishment)	Divides group into twos and breaks up cliques.	Takes time May require much thought to get ideas for specific discussion to use in matching partners

GROUP DYNAMICS: "Warm-up Techniques"

Description and Organization	Appropriate Use Areas - Groups	Examples	Advantages	Disadvantages
Reaction to Specific Words Using words that will bring a picture to the mind, have the students give the word that first comes to them.	Foods, grooming, relationships, management	Nibble - Students may think of calories, T.V., lonesome or tired	Get variety of reactions Stimulates majority of group to contribute Opens discussion with very short answers	May result in silliness May be hard to work in to a real learning situation
Projective Techniques Used to encourage spontaneity, and prevent inhibition in discussions of personal, social, and real-life situations. Select stimuli, determine points to be made in discussion following, plan for summary.	Use to help change attitudes and beliefs, and help solve personal and social problems	Pictorial technique- Students make story about picture, giving background, what is happening, how the characters feel, and outcome. Word Association- Series of disconnected words presented, respond with first word to come to mind. Sentence completion- Opening words given on selected topic and pupils complete ending. Story completion- A brief description of dramatic incidents, unfinished plot, or conflicting situation about which student is to write. Pupil may be asked to answer "What did she do",	Reveals characteristic ideas and feelings not obtained easily in any other manner Diverts attention from student's own problems Pupils express freely Imagination is encouraged	If specific goals are not used becomes "play" Someone might inadvertently ridicule a revealing statement Stimulus must be high caliber to be effective

GROUP DYNAMICS: "Warm-up Techniques"

Description and Organization	Appropriate Use Areas - Groups	Examples	Advantages	Disadvantages
Projective Techniques Continued		"How did they feel?" (Good for religious, and moral beliefs, relationships with the opposite sex and friendships) Argument completion Pupils given cards on which is printed brief description of beginning of an argument between two or more persons. Pupils continue argument to termination using realistic dialogue. (Good for controversial subject)		
Challenging Questions Four ways to carry out technique 1. Class sets up questions to be answered by class 2. Class sets up questions to be answered by resource person 3. Leader introduces questions prepared in advance to be answered by class 4. Leader introduces questions and answers personally or calls on resource person to answer	All discussion areas With any group Less stimulating with lower ability students May use to discover pupil interest, may be used to review	Questions set up previous to discussion of child observations Questions about banking, loands, use of credit - class wishes to ask banker Questions on prenatal care to ask nurse when she speaks to class	Stimulates thinking Useful when clarification is necessary Answers concise and easily assimilated Resource person will know the needs of the class Helps pupils interpret material Emphasizes important relationships	May be difficult to capture and hold interest of a all group members Group members of limited ability may not understand or retain information Requires advance preparation of some detail

GROUP DYNAMICS: "Warm-up Techniques"

Description and Organization	Appropriate Use Areas - Groups	Examples	Advantages	Disadvantages
Question Cards During class, pass out cards to each member on which questions can be written down as they occur to him during the presentation. Each question should be written on a separate card so the cards can be sorted after the meeting. This gives the audience a chance to get questions down before they have forgotten. Breaks can be scheduled at times so questions may be written.	Good for a discussion period or for an outside speaker in most all areas	An outside speaker may be talking on a controversial subject which brings out many questions	Clarifies facts Add variety to assignments Trigger group discussion Draws out reticent group members Stimulates individual contributions	Repetition of questions Chance of getting off subject May last too long May be unable to answer all questions

GROUP DYNAMICS: Discussion (Entire group)

Description and Organization	Appropriate Use Areas - Groups	Examples	Advantages	Disadvantages
An informal group exchanging ideas, facts, feelings and questions under the guidance of a leader Taking things over to solve common problems Socialized recitation Discussion group members need: A sense of belonging A share in planning group goals A feeling of contribution to the group A clear picture of what is expected Definite signs of progress Confidence in leaders based on fair treatment, due recognition and security Functions of a leader: 1. Stimulate discussion 2. Guide along the channel of thought 3. Keep a happy balance between freedom and control 4. Draw into discussion all members of the group 5. Use authoritative sources for basic material 6. Suggest resources 7. Have a recorder 8. Summarize	Discussion occurs: Whenever a group of people gathers to discuss a problem Whenever a decision or a plan is to be made by a group Where the purpose is to stimulate the thinking of the members Small informal groups Particularly in groups discussing family relations, personal development, child guidance Classroom Workshops and conferences Leadership training committees	The discussion topics and suggesttions offered in textbooks are a general guide Problems brought up by students themselves offer specific clues for developing the discussion in light of their own needs interests, and concerns Discussion as method of setting up hypothesis to problem and/or determining the way to gather evidence on solution of the problem	To illustrate an important concept, or to help "break the ice" on occasions when the group seems reticent Opens the way for active group participation Contributes to meeting the needs and interests of each member Stimulate group thinking Leaves each one free to make his own decision Develops skill in use of democratic problems solving techniques Easiest and most familiar technique	With unskilled leadership can become a one sided conservation, debate or argument Unless purposeful may be meaingless and leave group feeling dissatisfied and frustrated May be boring to some members unless the leader keeps things moving May be dominated by the leader or by an aggressive

GROUP DYNAMICS: Discussion (cont'd)

Description and Organization	Appropriate Use Areas - Groups	Examples	Advantages	Disadvantages
9. States questions and problems clearly and in a language all will understand				
10. Avoid questions that can be answered with yes or no without reasons; ask questions that invite opinions				
11. Avoid talking too much				
12. Arrange seating of group so everyone can see and hear				
Steps in group discussion:				
Beginning the discussion Keeping the discussion going Closing the discussion				

GROUP DYNAMICS: Panel discussion

Description and Organization	Appropriate Use Areas - Groups	Examples	Advantages	Disadvantages
A group of not more than eight persons, with a leader discuss a problem. They are usually seated at the front of the room around a table or in a semicircle. The leader, who remains neutral, functions much the same as a discussion leader. When the panel members have sufficiently established their view, the chairman briefly summarizes and invites audience participation. Audience contributions may be directed to the panel as a whole or to any member on the panel.	Suitable for Jr. high Sr. high, and adults. Also suitable for groups too large for general participation Radio programs Television Conventions Conferences	Topic: "What should teen-agers and their parents expect of each other?" Panel Members: 1. 4 teen-agers 2. 2 parents 3. a moderator Moderator states the topic to be discussed. He introduces each panel member and gives the viewpoint of each. Moderator guides the panel and summarizes after all members h have participated. Group develops generalizations	Panels are particularly appropriate at Jr. and Sr. high level because they are techniques that capitalize on teen-agers' eagerness to do things in a "grown-up" way. Develops leadership Valuable practice in self expression Several aspects of a problem can be presented Allows for some participation from the audience Resource people bring fresh ideas to the group	Only a few can participate One or two may take the spot-light No one may want to talk Time required for preplanning can outweigh the value of the panel if topic and panel members do not keep interest of the audience Panel scheduling may be difficult May present opinions rather than facts

GROUP DYNAMICS: Opposing Panel

Description and Organization	Appropriate Use Areas - Groups	Examples	Advantages	Disadvantages
Use of two panels, one to ask questions and one to answer. Divide group, designate one half as question raisers and the remainder as question answerers. Announce topic, allow time for preparation (question raisers get down questions, question answerers anticipate kinds of questions and get answers) teacher should participate as question answerers. Supervise preparation. Pool questions Have group raise best questions first, if answer is not satisfactory, allow question raisers to contribute also. Repeat process for time allotted. Summarize. (Groups may be reversed in class period)	As review or evaluation technique May be more useful with better students as their questions will call for more use of relationships and transfer of learning.	Review for Foods I class on food preparation techniques. Evaluation technique on demonstration, lecture, field trip or discussion. May be review of completed unit or before six-week or semester test.	Avoids overworked materials Introduces a friendly competitive element Both groups must think of questions and possible answers May cover a wide range	May encourage students to trap each other on obscure information Better students tend to do the thinking for both sides of the panel

GROUP DYNAMICS: Forum

Description and Organization	Appropriate Use Areas - Groups	Examples	Advantages	Disadvantages
Two or more speakers present talks on the same subject. Some audience participation, questions, challenges, contributions. Organization: Chairman acts as median between audience and speakers 1. introduces speakers 2. explains question period 3. follows leaders' remarks 4. watches reactions of leader and group 5. following lecture, acts as a discussion leader, takes command 6. makes a brief summary 7. concludes meeting 8. chairman may rule out questions that have no bearing on subject	Presents opposing sides Good for dealing with controversial issues Politics Social problems Educational problems Religious issues Good in all areas	Good in relationship on such problems as what time to get in from a date, should a high school student go steady, marriage while in school	Speakers given opportunity to present material without interruption Audience enabled to clear up obscure points by questions and to obtain further information Slight audience participation Willingness for free speech on all sides of questions; fair play; look at problem objectively Usually interesting to the audience since material is controversial Change of speakers on same subject adds variety and covers diverse ideas	More forceful personality may unduly influence the thinking of the reticient person Apt to degenerate into a debate Few take part Little opportunity to answer own questions or look at own beliefs Success largely dependent upon ability of speaker (May not have opposite views presented equally as effective)

GROUP DYNAMICS: Symposium

Description and Organization	Appropriate Use Areas - Groups	Examples	Advantages	Disadvantages
Series of short talks on different aspects of a given topic Chairman requests 3 or 4 persons to prepare brief talk of 10 or 15 minutes on an assigned topic Each speaker talks in turn Chairman summarizes the main contributions of each speaker at the close of the series (May be composed of selected members following group discussion to give views expressed in groups)	Disseminating information to a large group Approaching a central theme from several different angles May be used in all areas of homemaking	Selection of meat Selection of fabric Good eating habits Getting along with brothers and sisters What it takes to like and be well-liked The effect of good equipment on time management Housing conditions	Presents several view points of a question Comprehensive analysis of a given subject Applicable to wide range of subject matter May introduce a wider variety of experience and knowledge Helps hold attention and interest by changing speakers and breaking up time span	No opportunity for group questions, contributions, challenges during the talks May lack unity because talks are prepared separately May consist of opinions rather than facts unless members are well informed May not provide thorough coverage of the topic

GROUP DYNAMICS: Debate and Colloquium

Description and Organization	Appropriate Use Areas - Groups	Examples	Advantages	Disadvantages
<u>Debate</u> Used to present topics which lend themselves to "pro" and "con" positions The "pro" side begins by pointing out reasons for favoring the issue in question, a member of the opposing team gives reasons for being against the issue. Other members of each team have opportunity to present new evidence or to answer arguments presented by their opponents.	Gifted students can delve more deeply into literature and be challenged by this technique Appropriate when there are two definitely opposite views More usable in groups who understand thoroughly the technique	Debates on going steady, getting allowances, working mothers, spanking as a form of discipline, or to build or buy a home	Teaches pupils to think critically, to admit when evidence is only a probability, and to expose fallacies in the thinking of opposite team Promotes competition	May result in "successful persuasion" rather than "sound evidence" May become argumentative
<u>Colloquium</u> Two panel groups, one consisting of resource persons; the other, class members Class representatives ask questions of experts. Moderator encourages general audience participation when it is desirable	Use when class is interested in a broad or controversal topic and could benefit from knowledge and opinions of various resouce persons	Gaining information on health services available in the community, in marriage preparation unit on divorce problems from a legal standpoint, on moral standards including social drinking, smoking and on the unit on selecting a vocation	Permits audience participation on equal footing with the experts Motivates experts to consider more closely the needs of the audience Gives more than one side of a controversal question	Resource persons may have different opinions When several resource persons are needed it is difficult to schedule

GROUP DYNAMICS: Buss Sessions (Variety - Split group plan: 66 plan, 88 plan, etc.)

Description & Organization	Appropriate Use Areas - Groups	Examples	Advantages	Disadvantages
A method to have active participation of every member of a large group by breaking down small groups and reporting back to large groups for purpose of collecting and pooling of individual ideas Break your audience into small groups--6 or 8 members either by asking members sitting near each other to move chairs into a circle or by asking 3 or 4 members in one row to turn and talk to 3 or 4 members behind them. One person from each group will be recorder or chairman and report the conclusions of group back to large group	When group is large enough to divide When decisions are to be made When next steps are to be planned When summary and conclusion are needed When there are major group problems to be discovered Used with all types of discussion groups at all age levels May be used as the basis of entire class May be used following film or filmstrip	1. Large group breaks up into groups of6 members each 2. Chairman is informally assigned 3. Small group of "6" is given a limited number of minutes for discussion 4. The discussion centers around a specific question or situation agreed upon by large group 5. After discussing reassemble as a large group 6. Chairman or secretary of small groups report group recommendations, ideas and questions to large group 7. Leader records comments 8. Meeting progresses in line with suggestions	Each member of the audience gets a chance to participate It contributes to an informal interchange of ideas even in large groups Gives time for each group member to react to certain situations Helps leader to gear meeting to problems of large group Allows maximum participation in minimum time Quick means of pooling ideas, questions, or problems of group members	Meeting time is short Loss of time in breaking down and bringing group together again Difficult to bring groups back into large group again unless skillfully handled Poor leadership may result in biased opinion Might not stay on the subject

GROUP DYNAMICS: Brainstorming

Description and Organization	Appropriate Use Areas - Groups	Examples	Advantages	Disadvantages
A technique of creative thinking for getting useful ideas through imagination rather than through reasoning. Four Basic Rules 1. Weighing idea before it is presented is ruled out 2. Free Wheeling is welcomed 3. Quantity is wanted 4. Combination and improvement are sought but criticism is ruled out Preparation for Chairman 1. Select a suitable problem 2. State the problem 3. Think through ideas to stimulate discussion	Use brief brainstorming sessions in introductory meeting as an attention getter Problem should be simple, familiar, particular and must have a number of possible solutions Use at conclusion of meeting or a series of meetings to stimulate thinking on ways of applying information learned Ideal for committee work such as F.H.A. Best suited to use for small groups Best suited to use with high school students and adults To select a project	Order of Procedure: 1. Chairman states problem 2. Group members offer suggestions 3. Idea collector records and number suggestions 4. Chairman stimulates production of ideas and ring a bell when any member offers criticism 5. Chairman closes the discussion when the ideas run out Ways to set the table, prepare food, or ways to make money	Use to get new ideas Used to release individual potentialities of thinking up ideas To change attitudes towards ideas of others Promotes creative thinking Group does not sit in judgment on ideas Avoids the predictable dullness of many small meetings Originality is encouraged Accumulates a quantity of alternative ideas	Possible to continue too long The minds of members of group may wander Can degenerate into "horseplay" Technique must be thoroughly mastered to be effective Often successful with only the more able students

GROUP DYNAMICS: Circular Response - Chain Reaction

Description and Organization	Appropriate Use Areas - Groups	Examples	Advantages	Disadvantages
A technique in which a group learns to think discuss a common problem, and individually give personal views Group members are seated in a circle The leader proposes the question The discussion begins with the individual at the leader's right. This person has a chance to speak concerning the problem for one minute (keep time).. Discussion continues around circle until every member has a turn. Record contributions. Summarize. No member of a group can speak a second time until his time comes again	Suitable for small groups desiring to become skillful in using discussion suitable for mixed age groups Where aim is reflection not fireworks Where the purpose is to get all member participation In classroom At conferences To open topic or unit for evaluation	Question: "How much homework should be required of a high school pupil?" This group includes people of various ages two parents, two teachers, ten pupils and a leader The leader proposes the question The person sitting at the right of the leader speaks first He may talk until his view is established Turns are then taken until each person in group has spoken A member can speak a second time when his turn comes again	Mechanics alone does much to remedy the bad manners and monopoplistic practices that mar many small group discussion Timid person speaks more freely Individuals speak freely as members of the group, not as individuals segregated because of their age Can arrive at a concensus understanding Persons participate	Can be pooling of ignorance Limited number can participate May be substituted for reading and thinking May stifle spontaneous contributions by some group members May exhaust problem before end of circle if group is large or problem is too narrow

GROUP DYNAMICS: Swing Around and Popcorn

Description and Organization	Appropriate Use Areas - Groups	Examples	Advantages	Disadvantages
Swing Around A technique in which the teacher gives a point and asks a question, stating the student that is to answer the question. That student answers the question and asks one of her own to another student in the room. The process is continued until all students are challenged, questions run out, or time limit is reached.	Good summary technique All areas calling for factual answers	Summarizing factors influencing selection of clothing Characteristics of good sewing equipment Factors to determine in meal planning Nutrition terms	Challenges students to think through questions they expect to be asked Good form of repetition for slower students	Some students may be called on too much to the exclusion of other students Time consuming
Pop-corn Members "pop-up" and rapidly give suggestions and ideas 1. Chairman presents question 2. Members "pop-up" quickly giving ideas 3. Secretary lists ideas and summarizes them for use by committee or the group to do further thinking on the topic May be used as summary	With any size group to get as many ideas from the group in as short a time as is possible Best used with younger groups Good summary technique	Summary points Factors to be considered in toy selection Terms related to food preparation Factors to consider in selecting fabric for beginning sewing project	Possible to pool large number of ideas in small time Promotes friendly competition Prevents lengthy discussion on any one point until all ideas are given	May go so fast students can not understand points given Few students may monopolize Students may delay asking for explanation

Case Studies, Case Situations, Case Problems

Description and Organization	Appropriate Use Areas - Groups	Examples	Advantages	Disadvantages
Presentation of a problem based on a specific situation Steps in use: 1. Explain problem - present case situation containing several problems being considered in the class 2. Outline points to consider 3. Allow time for presentation of problem 4. Discuss possible solutions 5. Weigh and evaluate facts presented 6. Draw conclusions carefully 7. Summarize	Use to stimulate the discussion of an intimate social relationship in an impersonal way As introduction For evaluation Useful tool for teacher-pupil planning May be used throughout a unit	Case studies: 1. Young career girl in management 2. College girl in clothing selection 3. Child's day in child development 4. Family for housing foods, or management 5. Embarrassing situation for relationship, manners, or clothing selection	Makes it possible to discuss intimate situation in impersonal manner Can guide students in seeing complexity of decision making and to more realistic solutions	Loss of interest if case isn't closely related to problems of the group Some students may not be able to understand procedure and may have difficulty in gaining real knowledge through the use of the technique

INTERVIEWING

Description and Organization	Appropriate Use Areas - Groups	Examples	Advantages	Disadvantages
A technique students may use to obtain information outside the classroom that is related to current classwork How to use the technique 1. Make advance arrangements 2. Prepare questions to ask in advance 3. Conduct interview singly, in pairs, or in groups of not more than three 4. Plan greetings, introductions appropriate dress, correct manner to obtain information, and courtesy to follow termination of interview 5. Set moderate time limit 6. Plan with student for immediate summary to prevent loss of impressions and facts 7. Arrange for report of the essential points to class	Desirable to use when pupils need to find out how people feel or think regarding a particular situation or how and why they follow certain procedures Day school-all areas Adult work F.H.A. Best used with more able students	May interview: 1. Young mother on what she expects of a babysitter 2. Older students on dating etiquette 3. Homemakers on cleaning schedules and procedures 4. Grand-parents on past experiences (marriage-dating customs) 5. Mothers and fathers on the responsibilities of a teenager 6. High school boy on qualities he most admires in girls 7. Teachers in school on characteristics of a good school citizen	May be valuable contribution when used with people of different ages and from different walks of life Students gain helpful information Students develop poise and self-assurance in meeting people	Often requires quick thinking and ability to ask clear and concise questions Scheduling the interview may prove difficult Reporting time consuming

RECORDING ANCEDOTES, ANCEDOTAL RECORD, OBSERVATION CASE STUDY

Description and Organization	Appropriate Uses Areas - Groups	Examples	Advantages	Disadvantages
A written description, report, or diary of incidents that have occurred in connection with a specific aspect of classwork Characteristics: 1. Recording should be done individually 2. There should be a clear, brief description of a single situation over a specified period of time 3. Should be recorded while incidents are still vivid 4. Must relate to what happened and what students did 5. Should not include at time of recording any personal appraisal or interpretation	Used in all areas To best used general guides should be set up to facilitate recording and analyzing	Child care observation Clothing - Buying wearing apparel Relationships: 1. Loss of control of temper 2. Feelings of insecurity and shyness 3. Making friends Food-Preparation of Meals Housing-Caring for my room General: 1. Developing a skill 2. Learning a hobby 3. Planning better use of time	Gives teacher and pupils insight into cause and effect of behavior Pupils learn to express themselves objectively and accurately Gives teacher and pupil basis for effective conferences	Sampling does not represent complete record of person's behavior Students must be assisted in viewing sample as indicative only of typical behavior Slower students tend to record trivial information and miss more important observations Analyzing records is difficult until pupils have had experience using technique

DEMOMSTRATION

Description and Organization	Appropriate Use Areas - Groups	Examples	Advantages	Disadvantages
Demonstration is used to provide information, create interest, or develop standards of work by showing how the process is done. Presentation of procedures or processes to be learned The three stages of a demonstration are: 1. the preparatory 2. the demonstration itself 3. the follow-up or evaluation Characteristics: 1. Steps will be developed in a consecutive order 2. Explanation will accompany the demonstration 3. Materials will be like the ones the pupils will use 4. All pupils will be able to see and hear	Demonstration: Provide information Create interest Illustrate procedures in a process Develop standards of work A demonstration may be used with any age group May be given by teacher, students, or by a resource person or by a combination of the three Only one process should be shown at a time Learning is strengthened if practice is soon and under supervision	Foods - All phases Clothing - Construction processes Housing - All phases Care of sick First Aid Care and use of equipment	Economical teaching device to stretch limited budget Encourages the desire to repeat same thing in laboratory or at home Lessens chances of making errors in trying new skills Presents high standards of workmanship, careful planning and procedure and good management of time Opportunity to ask questions as process is seen Builds confidence in self(Demonstrator and Pupils) Stimulates interest and curiosity Simpler to show how to do something than to tell how Students can see how to apply certain principles	May be too long for short class period May not hold attention of class if demonstrator does not have confidence or is inexperienced Limits students' participation Difficult to turn out a perfect product every time Need to know reason for many techniques In a large class it may be hard for all pupils to see and hold attention Takes much time for preparation and cleaning up afterwards

DEMONSTRATION

Description and Organization	Appropriate Use Areas - Groups	Examples	Advantages	Disadvantages
Demonstration continued			Gives opportunity to set up criteria or standards Showing how something is done is most effective	Difficult to obtain equipment Too many techniques shown at once May confuse student

SILENT DEMONSTRATION, OBSERVING TEAMS, LISTENING TEAM

Description and Organization	Appropriate Use Areas - Groups	Examples	Advantages	Disadvantages
Silent Demonstration Complete demonstration done silently. All directions are printed and given to each student. Each student given a sheet with specific questions to watch for and write answers Following demonstration discuss, answer questions. Summarize	Especially good for foods	Making muffins Giving a manicure Using a buttonhole attachment	Group is looking for answers to specific questions Everyone is taking part and must be very alert Demonstration not interrupted by questions and discussion	Pupil must wait until demonstration is complete before asking questions Pupil may miss step which necessarily precedes following steps. Can not understand remainder of demonstration May be answering specific questions so carefully the full meaning and importance of demonstration is lost
Observing Teams, Listening Team If you are presenting a situation, dramatizing a conflict, demonstrating a skill, or anything in which the audience may be divided into a number of sections, and each group given a particular thing to watch for or listen for Reporting may be done individually, or by groups, then one person reports	Good to use if the presentation has several points to bring out Good in class demonstrations, especially for management Good in some FHA activities For adult groups	Teacher might have a motion study demonstration and divide class into teams and watch for certain things - as one group watch for certain steps, one group watch for right hand motion, another for left hand and another for location of supplies	Keep group attention better if they must watch or listen for particular point Everyone can take part Bring out certain points better, as different groups concentrate on certain items	Reporting could be time consuming Difference in attention given could cause inaccuracy in reporting

LABORATORY

Description and Organization	Appropriate Use Areas - Groups	Examples	Advantages	Disadvantages
Practical application of principles and methods A workroom situation in which individuals or small groups do (1) productive (2) experimental or (3) observational work toward a goal or goals set up by the group, under the supervision of the teacher who moves from group to group The experimental work should solve a problem, and/or lead to generalizations. The goal in observational work is to develop abilities or draw conclusions There are 4 parts 1. understanding the purpose 2. making out a plan for achieving the purpose 3. carrying out the plan 4. evaluating the work done, and summarizing It is important that students help with each of the above steps, doing as much as possible for themselves Regular care of the laboratory should be routinized early in the year, so laboratory work will be facilitated	All areas of the day school program Adult work FHA Very good to reinforce learning from demonstration Good for all levels and with the slow learner as there is supervision	Productive: Preparing a meal Making a dress Making simple Puppets for child care class Experimental: Finding a good way to remove stains Finding the best way to remove finish from a desk Determining the best window cleaner to use in the kitchen Deciding on the easiest way to keep the department clean Observational: Examining fabrics or comparing canned goods in order to recognize quality or develop judgment	Provides for steps in manipulative and managerial skills Can help to develop resourcefulness, independence, and creative thinking Allows for variety in use of equipment and materials Gives each student responsibility May provide for individual differences Students learn by "doing" and enjoy class more Develops manipulative and managerial skills under guidance Students can correct mistakes when they make them Gives opportunity for personal help and guidance for each pupil	Can be a waste of time if purpose is not understood and/or if poor plans made Can be noisy Students can socialize too much May be expensive to provide supplies and equipment Clearing-up requires time Time management very difficult if experience requires lengthy time to complete If group large, some pupils may not get actual experience

LABORATORY

Description and Organization	Appropriate Use Areas - Groups	Examples	Advantages	Disadvantages
Laboratory continued "Rules of the game" should be set up under teacher guidance, tried out, revised, and tried again, so that students take responsibility for their conduct in the freer atmosphere			Allows teacher to determine ability to pupils to effectively and efficiently apply generalizations or principles Holds interests	

LECTURE

Description and Organization	Appropriate Use Areas - Groups	Examples	Advantages	Disadvantages
Teacher or another person presents information to the group. He should know the class's background, the subject, and questions the class has asked that he answer. A guest speaker, a class member or teacher introduces the person. If a series of lectures have been given, a summary may be given before the lecture of the day it is given. Variations: Lecture alone Lecture followed by discussion Lecture with question-and-answer period Talk interspers with discussion Illustrated lecture Speaker with panel Speaker may divide audience into 4 groups and ask each group to observe certain aspects of the talk Actual lecture time should not be too long so that group gets restless or bored.	Used to expose large group to new knowledge to report new discoveries, events, and experiences; to arouse interest; to introduce present new subject or area; to explain policies; answer questions raised in class Can give special information and study (if references are scarce) For all areas Adult work F.H.A. Ten to twenty minute lectures are more acceptable to secondary school groups Lectures should be planned to include illustrations or more discussion with slow learners	A lawyer is asked to discuss laws affecting the family One of the class tells of a visit he made to a summer camp for retarded children The County Health Nurse may furnish data on unsanitary conditions in many homes or services rendered by health department The teacher might lecture occasionally (part of a period) to give certain information, as in Child Development for senior girls, or Looking Toward Marriage	Saves time Gives people a chance to see and hear a noted individual or specialist in a certain field People who are shy or mentally tired may prefer a speaker Can be entertaining Can be relaxing Good for facts Good way to present certain materials difficult for pupils to understand or discuss, and for new information	No participation--just listening Audience has no opportunity for expression of agreement or disagreement Speaker sometimes "talks over the head" of group May not be used to best advantage unless students feel a need, and have prepared properly May be difficult to schedule resource person when desired

REPORTS

Description and Organization	Appropriate Use Areas - Groups	Examples	Advantages	Disadvantages
A subject is chosen or assigned to one or more individuals to be studied and a verbal or written account given Information may be obtained through various readings and/or resource persons who can give needed information Characteristics: Well-organized, shows clear thought, has meaning to the speaker, and also to the audience Committee work may sometimes come under this classification if the results of committee work are presented in report form, either by the chairman or other members or by various members who give certain parts (This is especially applicable in F.H.A. as well as class work)	When further information is needed to solve a problem Questions are raised and information should be sought All areas Adults (occasionally) F.H.A. groups if problem is one which needs such study	Information needed for all, such as tests for certain man-made fabrics or how to alter a skirt Information to broaden horizons, e.g., a report on various flours the differences in sources, characteristics, and uses in cooking A report on different persons' views about the need for supervised recreation for teenagers.	May be used for the same purposes as an outside speaker, and may be easier to obtain Students learn to work independently or cooperatively to solve their own problems Students are taught to use the library and other materials and resources; to compare different ideas and opinions; to organize a logical presentation May be an opportunity for co-operation between the department and the English department	Report may be poorly presented for example: 1. Reading instead of telling 2. Poorly written 3. Difficult to understand 4. Presented in a voice too low to be heard May be repetitious if several are working on the same topic (class will lose interest) Reports lose value when assigned as "busy work" Broad field may be covered superficially

COMMITTEE WORK

Description and Organization	Appropriate Use Areas - Groups	Examples	Advantages	Disadvantages
Committee work is a technique whereby groups work together for the solving of problems, reporting on topics of interest, completing project, etc. Group work with a committee is frequently desirable. A committee techniques serves two purposes. Sometimes and entire class is divided into committees to carry through a large activity. Sometimes a committee is set up to do a special piece of work for tthe entire class. Committees should be used only when they are an outgrowth of the work going on. Duties of a committee are: 1. Organize the work 2. Set up a plan 3. Decide upon a division of labor 4. Set a time for meeting 5. Complete the job 6. Reports should be the result of group thinking Those on the committee should know definitely what their duties are.	P. T. A. groups, club groups, assembly programs, entertainment, extra-curricula events, home room guidance All seven areas of homemaking	Committees for a tea, banquet, buffet, etc in foods work Committee to delve more into a problem brought up in discussion	Very desirable when big project is to be done Can give whole class a chance to take part if whole class is divided into groups Gives opportunity for additional knowledge on subjects if committees are doing research on many phases of a subject Gives an opportunity for people to get acquainted and work co-operatively Give experience and confidence to the less aggressive person Encourages student to express themselves freely	Often question is not settled on merit but by personal preference Domineering member can sway a group Often times committee will not carry thru to completion Too often members are chosen by popular vote Can be teacher controlled Takes a lot of work for the teacher to delegate tasks to a committee May be just "busy work"

FIELD TRIP

Description & Organization	Appropriate Use Areas - Groups	Examples	Advantages	Disadvantages
"Observing someone else's doing" It is a planned visit to a point outside the regular classroom It is a serious educational study with important planned purposes An opportunity for first-hand experience The teacher should plan: 1. With students A. use appropriate motivation and develop background B. help them understand purposes clearly C. raise questions to be answered; suggest things to observe; make plan for follow-up D. Guide class in setting up rules of courtesy and thoughtfulness E. Discuss appropriate attire to be worn F. Plan to write note of appreciation	All areas for the day school program Adult work FHA program	A visit to the grocery store for information needed for successful marketing, or to see cuts of meat, prices of foods, etc. A trip to a furniture store or stores in a study of furnishings for the girl's room A trip to the local nursery school during a study of child care Field trip to utility company to demonstrate kitchen planning Visit to museum for textile, period costume or furniture exhibit	Opportunity for first-hand experience May be used to: 1. stimulate new interest 2. motivate study 3. examine familiar scenes 4. develop good public relations Side benefits are the opportunities the field trip provides for the teaching of etiquette, shopping ethics, courtesy, and the personal traits of cooperation and dependability Students are challenged by new ideas and impressions they receive Critical thinking may be developed Classwork related to real-lfe situation.	Can be an "outing" unless carefully planned Can develop poor relations if good manners and conduct are not used Legal aspects: Teachers are responsible for any negligence on their part when working with students

Discription and Organization	Appropriate Use Areas - Groups	Examples	Advantages	Disadvantages
Field trip continued 2. With others A. arrange with administrators B. contact place to visit (May make preliminary survey) C. secure written permission for students to attend D. arrange for financing if necessary E. select transportation that carries liability insurance The plan to use this technique should grow out of class experience, and be a procedure which the group selected				

RESOURCE PERSON

Description and Organization	Appropriate Use Areas - Groups	Examples	Advantages	Disadvantages
Someone other than the teacher or class members who presents or contributes to the class.	Resource person may: 1. Lecture or talk 2. Participate in symposium or panel 3. Give demonstration 4. Be consultant to class 5. Participate in informal class discussions	Cake decorating, making cookies demonstrated by baker	Contacts with different people stimulate pupils and foster appreciation	Resource person not effective unless experience is carefully planned
May be experts, persons from the community with practical knowledge, other faculty or school personnel, or student from other area		Home demonstration agent give illustrated lecture on lighting	Resource persons may contribute ideas not in print	Guest may not cover points expected
Steps: 1. Obtain information to know what to expect in the presentation 2. Teacher or pupils extend invitation 3. Let guest know size of class, age level, when, where met, and how long class meets 4. Outline points you want covered 5. Prepare class 6. Have class do preliminary work on the subject 7. Have class prepare a list of questions to ask 8. Have class assistant to introduce speaker, aid in presentation, and lead discussion that follows		Doctor lectures on affect of diet on body shape and skin appearance	Students have some information clarified	May be difficult to find experienced persons for some areas
		Physical education person on panel discussing how hobbies benefit a teenager	Technique futhers understanding and helps develop good relationships between school and community	Pupils may not be responsive to guest
		Guidance counselor as consultant when class discusses choosing a vocation		May be overused

DRAMATIZATION: Role Playing, Sociodrama

Description and Organization	Appropriate Use Areas - Groups	Examples	Advantages	Disadvantages
A technique in which people spontaneously act out problems of human relations, and analyze the enactment with the help of other role players and observers No script, no memorization of lines, no rehersals Psychodrama should be avoided by the untrained, since it deals with unique problems of an individual. Socio-drama deals with interactions of individuals having problems similar to those of the majority of the group. Consists of specific parts: 1. The warm-up (short setting, or a "problem story," which presents a tense situation lacking a conclusion 2. Selecting participants (leader may let anti-social group present its ideas first) 3. Preparing audience to observe alertly, and participate through observation 4. Enactment, about 5 minutes 5. Discussion and evaluation Shared experiences and generalizing	Used to gain insight and skill in human relations problems Permissive atmosphere very important both in the enactment and the shared experience and generalizations Adult class Day school F.H.A. Health Child Care Relationships Clothing Dress and Grooming	Understanding Teens Child care - Guidance Understanding Others Improving Personality Parliamentary Procedure Growing Up- Posture Discipline Behavior Social Know-How First Date Budgeting Time Family Budgeting	Helps group to gain insight and skill in human relations Helps explore feelings about life situations which shape their attitudes values Promotes empathy Helps pupils see their own problems are not unique May break down prejudices Present emotional subject material in impersonal way Provides a realistic and interesting way to handle a problem situation Permits growth of concepts from simple incidents Develops communication skills	Requires some skill, especially with certain problems Requires much tact to prevent pupil's self-exposure or the arousal of guilt feelings If discussions cut into painful areas, group will shrink away defensively, and the session comes to to a halt Leader should not indicate what actors are to do or say, nor what he thinks is a good solution Pupil may feel he will be condemned for acting a "disapproved" role Can be overused, but must be familiar to to be most effective

DRAMATIZATION: Roleplaying Follow-up

Description and Organization	Appropriate Use Areas - Groups	Examples	Advantages	Disadvantages
<u>Roleplaying Follow-up</u>				
<u>Re-enactment</u> Role playing acted out with same players or with a different sets of actors using suggestions of the class to solve problem or improve handling of the problem	Relationships	Manners to use when eating out	Application of new learnings (Immediate)	Students may be bored with repetition if acting is not good
<u>Role Reversals</u> Begin role-playing scene by player taking role of persons different from himself to help him understand how that person may feel. Later the roles reverse so each will play own role	dating Teen Problems	Boy take role of girl, girl play part of boy Parent play role of teen and teen take the part of the parent	Gain insight of others	May find part hard to play effectively or realistically
<u>Soliloquy</u> Actors have opportunity to step out of roles to tell audience about real feelings	Relationships	Family council	Usually a dynamic experience as audience shares experience and feelings	Time consuming

DRAMATIZATION: Minute Drama, Skit-Script

Description and Organization	Appropriate Use Areas - Groups	Examples	Advantages	Disadvantages
An acting situation in which 1 to 3 class members are given very short scripts to read and to give appropriate action. (may be memorized or rehearsed) Dialogue(s) may contrast two or more methods or procedures Used to teach or emphasize a principle May follow, or be followed by, discussion Should conclude with a statement or review of principle or principles	All seven areas Day school and adults F.H.A. 1. Meetings 2. Degree work	To show different ways of meeting problems and working out solutions as follows: Behavior of children: Eating problems Agressiveness Independence Sensitivity Competition Family disagreements on use of car, hours for dating, freedom Selection of: Balanced diet Clothing Furnishings Pictures Doctor Methods of working and organizing time	It is objective; hurts no one's feelings May give shy students self-confidence Saves time (short) Interesting method of approach or review Easy Stimulates discussion by students May be prepared by students' groups or by teacher	Takes thoughtful preparation and skill to bring out principles Persons may not portray character most effectively Can be over-used Some skits may have ready-made answers or be merely sugar-coated subject matter

DRAMATIZATIONS: Pantomine

Description and Organization	Appropriate Use Area - Groups	Examples	Advantages	Disadvantages
A variation of role-playing, differing in that characters do not talk and gestures, facial expressions, and vivid action takes place of words in the portrayal of situations and character roles	All areas - to some extent		Can express one's feelings and actions without words Adds variety to role playing Requires little pre-preparation after the narration is written	Situations may not be clearly understood and might become boring If narration is required it does require some skill to write interestingly
Two types:				
1. Brief pantomine requiring 2 or 3 characters in a carefully selected situation	Relationships	Demonstration of "Do's" and "Don't's"		
2. Longer pantomine requiring unobserved announcer who briefly describes action		Pantomine of some dating types as: Clinging Cleo Beauteous Betts Glamorous Gus Made-up Matty Needlesome Ned Jealous Jed Amorous Art Boisterous Bob		

GAME PLAYING AND JINGLE WRITING

Description and Organization	Appropriate Use Areas - Groups	Examples	Advantages	Disadvantages
Game Playing Competition among individuals or groups of individual to facilitate learning Determine whether individuals or teams will compete Set up rules of game Plan subject matter to cover Explain game, divide into teams (if needed), play game Summarize material	Use to add interest to certain aspects of classwork, such as learning new terminology, or modifying undesirable work habits To summarize or review information previously covered All areas	Card Games 1. What would you do? cards describing situation, student tells what she would do 2. Matching questions and answers or terms and definitions Team or Group Games 1. Football or Baseball 2. Relays 3. Spelling Bees	Provides student with opportunity to see familiar material in a new light Sometimes motivates and sustains interest and increases retention Everyone likes to play games	Bright students may surpass others in class One wrong answer eliminating games defeat purpose Time involved may overbalance learning that takes place Values of competition as motivation for learning questioned
Jingle Writing Creative writing of rhymes Steps in using: 1. Assign topics that jingles might cover 2. Encourage practice 3. Explain that no special organization, structure, or talent is needed	Used to emphasize important points in a lesson and to develop creativity in students	When grandma washed she used a board That's where automation scored Where she did rub, and scrub, and squeeze Now we push buttons with great east. (Laundry Unit) If the old woman who lived in the shoe Had taken home economics she would have known what to do (Time Management)	Helps students remember important points Helps students develop a sense of rhythm and the ability to manipulate words Provides personal satisfaction	May be difficult to motivate students to write May take more time than is warranted by the value received

SUPERVISED STUDY

Description and Organization	Appropriate Use Areas - Groups	Examples	Advantages	Disadvantages
Students work under supervision on teacher-made assignments, student-initiated activities, or individaul projects Types in Use: Common Assignment - where level of achievement is relatively equal, silent reading guided by questions, study guides, or points to look for. When pupil encounter difficulties teacher gives aid (diagnostic and evaluative help) Achievement-level Assignment Organizing assignments at three or four levels of difficulty. Requires thorough familiarity with students and materials. Flexible individual assignments Students responsible for choosing among various activities. To be effective assignment must incorporate a broad range of activities and must provide for student initiative to operate in selecting them. Minimum core may be required from all.	Used when class does not do homework effectively, when references are scarce and when the search for information needs guidance Any area where references are used and where written information must be used to gather facts	Studying the characteristics of children from one to six Using references to determine the chemical nature of man-made fabrics Studying the influence of history on costume Determining factors necessary in selecting flatware, glassware, dinnerware and table linens Studying how individuals differ	Meets varying needs and interests of students Helps pupils acquire individual skills and work methods Give students help when they need it	Loses its value unless well planned Some teachers do not really supervise or direct study

THREE - DIMENSIONAL MATERIALS: Exhibits

Description and Organization	Appropriate Use Areas - Groups	Examples	Advantages	Disadvantages
An exhibit is a planned display which either teaches subject matter to students or which communicates something of interest to others outside the classroom	Effective when used with day-school program for all ages and groups	Display in store window interpreting total homemaking program or one phase such as FHA	Tells others about work being done in homemaking education	May be time and space consuming to construct
There are several types of exhibits: school-made displays and exhibits that are already available such as one previously made by students, teachers or ones borrowed.	Placed in a prominent place in the school, in store windows, museums, county fair	Exhibit of items depicting the home economics program for adult groups such as P.T.A.	Gives publicity when promotion is needed, such as for an adult class	Tendency is to leave exhibit up too long, thus becoming stale
Audience participation in exhibits is important. This might be anything from answering a question, pushing a button which changes lights or taking literature made available at the exhibit	May be used to introduce a unit, to cause interest, for summarizing and fixing in students' mind things that have been done	Display of items essential for home medicine chest	May help break down misunderstanding of things school is doing	Some commercial materials may be below the educational standard
The 3-dimensional effect of exhibits is important and interest is increased if participants can pick up or examine things	May be used by speakers to illustrate a talk and to emphasize points	Exhibit of toys suitable for various ages of children	Helps students in organizing their thinking into concrete illustrations	Tendency toward more emphasis on attractiveness than value of information exhibited.
	May be set up by committees growing out of any unit of instruction	Display of essential sewing equipment	Effective means of teaching especially when objects are left up for close observation	However, both are important
	Used to set up standards of work	Exhibit showing examples of work done by students	When used by a speaker, helps him to communicate because his audience can see as well as hear his message	
	Used to show finished products	Exhibit of safe storage of kitchen utensils		

THREE - DIMENSIONAL MATERIALS: Exhibits

Description and Organization	Appropriate Use Areas - Groups	Examples	Advantages	isadvantages
Exhibits continued			Exhibits or movable displays give a 3-D perspective May help increase interest of girls in homemaking classes May be a means through which girls develop initiative, creativeness, responsibility, poise, ability to meet people	

THREE - DIMENSIONAL MATERIALS: Mobile, Dioramas

Description and Organization	Appropriate Use Areas - Groups	Examples	Advantages	Disadvantages
A mobile is a group of objects or pictures suspended from an elevated point that illustrate a particular objective or objectives	All areas Any grade level	For which vocation am I suited Vitamin display Wardrobe selection Safety Hints Daily time schedule Suggestions for family recreation	Provides for pupil participation Adds interest and variety	May take too much time to prepare May not be placed to show to best advantage Requires a certain amount of artistic ability
In a diorama, models and objects are arranged against a background painting, to create a three-dimensional effect, giving the illusion of a natural setting.		Dioramas will adapt to areas of food home furnishings home care of sick clothing	Excellent for exhibits, fairs, clinics or classrooms Gives illusion of reality Conveys information	

THREE - DIMENSIONAL MATERIALS: Puppets, Boxed Lessons

Description and Organization	Appropriate Use Areas - Groups	Examples	Advantages	Disadvantages
A puppet is a doll representing a human being, animal, or fictional character. These figures are manipulated or moved by wires or strings or by hand	Especially in Child Care and Relationship units Adult Education Best suited to brief crisp playlets, full of action	Characteristics of children Social and Family Relationship experiences.	Flexible enough to suit the experience and abilities of students Teacher can tailor the puppet show to fit the requirements of the learning situation Give students an opportunity to project inner emotions Stimulates interest and is very enjoyable	Takes time to make Requires a certain artistic ability
Boxed lessons consist of all the materials required for the complete teaching of a lesson or unit	Boxed lessons best used for all areas requiring extensive materials	Selecting books for for a child Fabric selection Selection floor coverings	An effective way to store three-dimensional materials related to specific lessons or units Saves time collecting dittoed tests, study guides, printed references, and visual aids related to lesson or unit Increased efficiency in teaching procedures due to organized thinking and development of scope and sequences.	Difficulty in storing many boxed lessons Requires time to set up the plan Unless detailed labeling is done, a specific item may be difficult to locate.

FLAT MATERIALS: Graphics

Description and Organization	Appropriate Use Areas - Groups	Examples	Advantages of Graphics	Disadvantages of Graphics
Graphics refers to the arts by which we express ideas in lines, pictures, sketches, diagrams.	Graphics are used in all areas and with all groups, but simple graphics are especially effective with the slow learner.		Promotes correlation of information Promotes organization of past experiences	May be poorly done and reused May require more time than teacher feels desirable
Diagram is a drawing which makes use of lines and conventionalized and geometrical symbols, has no pictorial elements, and portrays the structure of its subject.		Commercial clothing construction pattern guides are examples of diagrams	Accurate and brief presentation of data May substitute for real articles Create interest and attracts attention	May not be used effectively May be hard to store and keep attractive
Graphs use dots, lines, or pictures to present interrelated statistical information	Graphs are effective means of presenting: factual information in condensed summary form		Clarifies ideas Illustrates facts which might otherwise be unnoticed	May lose effectiveness if displayed for long period of time
Types of graphs				
Line graphs are used in recording continuous data. Lines may be drawn to connect each point where measurements are indicated.	Quantitative information Clarification of words or symbols	Line graph of food consumption trends		May require too much explanation Commercial ones may contain too much advertising and may not be suited to the problem
Bar graph consists of a simple series of vertical or horizontal bars of unequal length but constant width	Steps in a process Relationships Classifications Organization of information	Bar graph showing percent of students who include major food groups in their diet over 7-day period		

FLAT MATERIALS: Graphics

Description and Organization	Appropriate Use Areas - Groups	Examples	Advantages of Graphics	Disadvantages of Graphics
Graphs continued- Circle or pie graph - the entire area of the circle is divided into segments representing a percentage of total area.		Circle Graph representing family's food expenditures		
A poster is a relatively large illustrated card or sheet of paper	Used when desirable to			
	Show relation of parts to the whole	Poster showing cuts from side of beef or pork		
	To show inside of objects and how they operate	Poster showing working parts of refrigerator		
	Show enlargement of small parts that cannot be easily seen	Poster showing layers in a grain of wheat		
	Show finished products	Poster showing house plans		
	Stimulate action	Poster showing safety rules		
	Attract attention or advertise	Poster showing 7 areas of vocational homemaking program		

FLAT MATERIALS: Graphics

Description and Organization	Appropriate Areas - Groups	Examples	Advantages of Graphics	Disadvantages of Graphics
Charts combine drawings, words and pictures in an orderly and logical manner.			Continued from advantages of graphics	Continued from disadvantages of graphics
Types of Charts				
Progress chart show consecutive steps of progress and indicates how many steps an individual has completed.		Progress chart for clothing construction classes		
Flow chart shows sequence of time or a process.		Flow chart showing correct procedure for making a bed.		
Tabular chart illustrates sequence in development of a process or arguments for and against something.		Tabular chart on home ownership		
Tree Chart using roots or branches representing parts of the tree trunk.		Branches of tree represents various home economics professions		

FLAT MATERIALS: Flip Charts or Cards, Cartoons

Description and Organization	Appropriate Use Areas - Groups	Examples	Advantages	Disadvantages
<u>Flip charts</u> or cards are opaque material of uniform size which are hinged, placed on easel, and flipped in succession.	All areas, especially in the home furnishing units for mounting samples of draping and upholstering fabrics.	Selection of clothing Proper arrangement of storage space	It adds interest and variety by telling a story in pictures when presenting information.	May be difficult to find appropriate pictures Require room to store
May use discarded wallpaper sample book, or a large note book set up like an easel or a map head on a stand inserting large sheets of paper.			A good way to store charts Presentation of a sequence	
<u>Cartoons</u> use pictorial representation, often in exaggerated form, to get a message across quickly and in good humor.	Can be adapted to all levels of learning Slow-learners enjoy easy-to-understand cartoons	Using Dennis the Menace in Child Care Many cartoons would be good in relationship areas	Are compact and have attention-getting qualities Presenting human relations situations in an impersonal manner Can illustrate good and poor techniques	Cartoon may require interpretation May oversimplify May appear to represent the attitudes of all members of a group

FLAT MATERIALS: Photographs and Pictures, Duplicated Materials

Description and Organization	Appropriate Use Areas - Groups	Examples	Advantages	Disadvantages
Photographs and pictures are exact copies of object, people, and events. Black and white pictures and photographs are good but colored pictures and photographs bring out more detail and depth	All seven areas of homemaking Adult classes Especially good for bulletin boards, food and clothing illustrations Pictures explain better than readings for slow reader	Child care: Show size of Children Food: Good foods in color China, linens, silver Housing: Furniture arrangement Styles of housing	Inexpensive, plentiful Close-up view for study Large group can see same picture at same time Concentrate group attention	Does not allow for individual study May not present one clear idea
Duplicated materials are made on a machine used to create an exact copy of a drawing, a printed page, etc.	Duplicated materials are especially good for the slower student	Assignments Summary sheets Tests Information sheets Forms Reports of group work	Saves time Each pupil may have his own copy for study and future reference May be used in place of reference books if none available May be used to summarize learnings	Could be expensive Might be used in place of a technique that could result in more real learning Additional copies might be inconvenient to store

FLAT MATERIALS: Bulletin Board or Tackboard, Flannel Board, Magnetic Board, Chalkboard

Description and Organization	Appropriate Use Areas - Groups	Examples	Advantages	Disadvantages
Bulletin boards or tackboards are usually made of cork, soft wood, cellotex or similar material. Is used to display visual material.	A good board display is used to arouse student interest, to develop efficiency, and follow up other teaching aids	How to set the table properly Importance of color in the home	Arouses student interest Develops subject matter	Lack of pertinent illustration Material may not be changed frequently enough
A flannel board may be made from a lightweight board or other rigid material that is covered with flannel or another fuzzy-surfaced fabric. Materials such as felt, flannel, sandpaper, and suede adhere to the surface. Illustrative objects may be cut directly from such material or a small sensitizing strip may be attached to the back of other materials.	May be used in all areas of home economics FHA, adult work, and home project.	Appropriate wardrobe for high school girl Room arrangement Wise use of time for a high school girl Selecting a vocation	Used for follow-up Students may make contributions Presents opportunity to help pupils to show initiative; cooperativeness, creativeness, and responsibility Develops good art principles	Poor if unattractive and unorganized May be poorly located or lighted
Magnetic boards have a metallic base. Pictures and objects pasted or mounted on small magnets will adhere to the board and can easily be moved about.				
A chalkboard is a board, the surface of which may be made of slate or plastic or treated wood, upon which one may write or draw with chalk		The chalkboard may be used for: explanations drawings summary		

PROJECTION MATERIALS: Filmstrips, Slides, Opaque Projection

Description and Organization	Appropriate Use Areas - Groups	Examples	Advantages	Disadvantages
A filmstrip is a series of transparencies mounted to be shown in sequence.	Used for all grade levels and all areas	Baby sitting Toy selection	A large group can see the same picture at the same time	The fixed sequence in the filmstrip makes it less useful than slides or opaque picture for certain teaching aids
A slide is a singly mounted transparency.	Used to: Stimulate discussion	Food Dishes Kitchen arrangements	A picture can be retained on the screen as long as it is wanted	
Filmstrips and slides may be accompanied by script or record	Introduce or review a lesson or unit Give detailed instructions Promote retention of knowledge Reinforce, supplement, or introduce a demonstration or a field trip Heighten interest Gain insight into the problem under study		The details of the enlarged picture can be readily studied Since the room is darkened, attention is focused on the projected pictures. Relatively inexpensive	Adequate darkening of the room may be difficult to achieve Pupils may not be able to take notes There is not always time for individual study Filmstrips and slides are subject to damage by use
An opaque projection is a projection of any flat nontransparent visual material.	Opaque projector can transfer outline material to the chalkboard or a large sheet of paper.	A diagram showing parts of sewing machine Management of family income		The opaque projector is not universally available

PROJECTION MATERIALS: Overhead Projections

Description and Organization	Appropriate Use Areas - Groups	Examples	Advantages	Disadvantages
An overhead projector, which consists of an open glass plate with a mirror above it, permits a teacher to face her class while illustrating a point.	Could be used in all homemaking classes Used to: Present information Analyze and review Prepare quick exercises in evaluation Learn identification of symbols Listing summary points	Furniture arrangement Arrangement of wall accessories Window styles and parts of window Nutritional value of foods	Teacher can face the class while using the overhead Normal classroom lighting can be used Identification of important items easily done with a pencil as a pointer Complex ideas can be shown in various parts or stages by use of overlays Can write directly on transparency during presentation Colors can be used Teacher can select, design and arrange his own material for a given lesson before class Transparencies can be saved and used again Marks can be removed and transparencies can be re-used	Expensive May be difficult to prepare transparencies Projector may be inaccessible Need a screen for best results Teacher may feel insecure if lacking in ability to write and draw artistically

PROJECTION MATERIALS: Motion Pictures

Description & Organization	Appropriate Use Areas - Groups	Examples	Advantages	Disadvantages
Motion picture is a continuous length of film containing sound and motion.	Used in all areas and at all levels. Used to: Awaken or strength interest Develop broader understanding Awaken desirable attitudes Supply information needed for problem solving Develop first stages of manipulative or judgment ability Provide common experiences as a basis for discussion	Care of the Hair Safety in the Home Quick meals from a freezer Learning to understand Children	Provides more learning in less time and better retention of what is learned Stimulates other learning activities Facilitates thinking and problem-solving Communicates facts or demonstrates procedures Compels attention Can bring distant past and present into the classroom Arouses interest Can present a process that cannot be seen by the human eye Provides an easily reproduced record of any event or operation	Incorrect and undesirable concepts may be obtained May be expensive unless borrowed or rented Not always possible to preview a film Problems may arise in operating the projector

OTHER AUDIO - VISUAL AIDS: Tape Recording

Description & Organization	Appropriate Use Areas - Groups	Examples	Advantages	Disadvantages
Tape recording is a recorded sound on a magnetic tape.	Used to: Suggest standards Collect data (can use for absent students) Develop listening ability Provide vocational and professional guidance by recording advice of leader of a profession Improve speeching ability Used for giving directions Used for group discussions	Areas especially relationships child care management Could be very challenging for gifted student	Can be played over and over Can be pre-edited and evaluated Adaptable to large and small audiences Conserves resources of qualified instructors Motivates student through a new approach or a different voice Tape recorders are simple to operate Can record programs for use in class	Limited to the audience's understanding of words Equipment cost relatively high

OTHER AUDIO-VISUAL AIDS: Television

Description & Organization	Appropriate Use Areas - Groups	Examples	Advantages	Disadvantages
Television is a device which projects pictures on a television screen for educational purposes.	Any age and all grade levels can use it	Foods demonstrations can be given	Partial solution for the teacher shortage	Television sets are not available to all
Television programing has for its goal the meeting of community needs in and out of school.	Excellent for demonstrations, appropriate styles of clothing or child care	Arrangement of equipment and step by step procedure may be observed	An effective educational medium	Expensive to put on programs
Television stations are locally owned and operated by educational institutions and organizations.	Can be used in all areas of homemaking	Summary charts may be given with recipes or other information to be copied by the viewer	Time and talents of classroom teachers is redistributed over a wide area	Classes are limited
			Adds variety	Difficult to plan for classes
			Can teach a larger number with fewer teachers	

OTHER AUDIO - VISUAL AIDS: Programed Learning

Description & Organization	Appropriate Use Areas - Groups	Examples	Advantages	Disadvantages
Programed learning is a fusion of learning and testing through a series of questions and answers presented by teaching machines or programed textbooks	Used when groups are large and individual ability is varied Very effective for slow learner since program can be prepared to give clues to answers	Learning of equivalents in measuring food	Presents material in small, simple steps and logical order Requires student participation Informs student if answer is right or wrong By immediate confirmation of student's work gives him pride in his work and helps him retain the right answers Encourages student to give right answer at first try Allows each student to progress at his own pace Teacher can devote more attention to individuals since he is freed from tiresome routines Helps prevent cheating since answer can not be changed	Limited areas of learning can be used Better suited to certain fields of subject matter than to others Preparation of programed materials is time consuming Can not handle human element of teaching

READING MATERIAL

Description &Organization	Appropriate Use Areas - Groups	Examples	Advantages	Disadvantages
Reading is one of the main channels for obtaining information Text and reference books provide a carefully organized, common core of experience for a class. Magazines contain current information on a variety of subjects. A local newspaper contains information about community affairs Many supplementary reading materials have accurate and diversified information. Library materials in school and public facilities are good sources of information.	Can be used for all areas The gifted student will often enjoy reading, understand what he reads and read faster A slower student is more dependent on a textbook for ideas and expression Select references for different levels of ability	Determining food preparation terms Reading implication of new textile labeling law Overnight assignment	Aid to teacher Aid to student Different reading materials can be supplementary Written by an authority Can be used to gather information to solve problems Pupils are in the habit of using references for studying A text is an organizing and unifying influence Saves time for the teacher	Can become a crutch and narrow curriculum if followed rigorously from day to day Reading material may not be on level of student Home Economics library may not have up-to-date reading materials Not sufficient reading materials in department Expensive (especially textbooks) Often used ineffectively Single point of view expressed

Mrs. Kelsay
Louise Bennett, Reva Bishop,
Nancy Bohannon, Bessie Covington
Evelyn Ensor, Noretta Hampton,
Mary Alice Lay, Esta Tackett

FACTORS TO CHECK IN EVALUATING DEPTH TEACHING

Agreed on by University of Kentucky, Education 687, Summer 1964.

Factors	Yes	No	Evidences
1. Are pupils working toward a recognized goal which is based on individual experiences and needs?			
2. Are pupils of all levels challenged?			
3. Are pupils developing good work habits and using time and energy wisely?			
4. Are pupils applying previous learnings?			
5. Are all pupils participating in activities			
6. Do pupils develop and apply generalizations			
7. Are pupils using up-to-date resource materials in line with their abilities?			
8. Are pupils continually evaluating progress?			

We achieve greater depth when we teach for an understanding of not only the "how" and the "what" but also the "why."

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Efficiency Factors and Production Goals for Vocational Agriculture Enterprises in West Virginia.

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*VOCATIONAL AGRICULTURE, *FARM MANAGEMENT, *AGRICULTURAL PRODUCTION, *FARM ACCOUNTS,

The efficiency factors and production goals presented are for use by vocational agriculture teachers and other agricultural personnel. They may be used at high school, young farmer, and adult farmer levels because all three groups are concerned with farm management and agricultural production. The author consulted with agricultural college staff members in developing the material. Suggestions for using the information, setting production goals, and analyzing the records, and a definition of terms are provided. Efficiency factor tables and other information are given for the following enterprises--baby chick and laying hen, broiler, beef cattle, sheep, dairy cattle, crop, and potato. A list of factors affecting different enterprises, a comparative analysis of enterprises, an analysis of the 1959 county agriculture census, and instructions for a farm comparison analysis are included. (JM)

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DEPARTMENT OF AGRICULTURAL EDUCATION
COLLEGE OF AGRICULTURE
WEST VIRGINIA UNIVERSITY
MORGANTOWN, W. VA. MAY 31 1963

EFFICIENCY FACTORS AND PRODUCTION GOALS
FOR
VOCATIONAL AGRICULTURE ENTERPRISES
IN
WEST VIRGINIA

January 1963

Revised by:

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WEST VIRGINIA UNIVERSITY
COLLEGE OF AGRICULTURE
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MORGANTOWN, WEST VIRGINIA

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Purpose

Efficiency may be defined as "effectiveness in production." Many factors must be considered when determining effeciency in the production of farm commodities.

This material has been developed for the use of vocational agriculture teachers and other agricultural personnel in West Virginia. We normally associate efficiency factors with both farm management and production, which to many people, are combined into the term "operation of a successful farm business". Since day, young, and adult farmer groups are vitally concerned with both phases, the material presented herein may be used with the three instructional programs.

Many times people must be properly motivated before a sound program can be launched. These efficiency factors, when properly used, can often serve as a motivating stimuli for improved farming programs among the students.

SUGGESTIONS FOR USING EFFICIENCY FACTORS

1. Be thoroughly familiar with the terms and measurements used in the various enterprises.
2. Do not attempt to completely analyze an enterprise for efficiency factors with first and second year students. Work into it gradually.
3. Stress the importance of setting a high goal. Vocational agriculture students should be able to double or triple many existing production averages.
4. Show class members how specific efficiency factors will affect profit or loss on a given enterprise.
5. Use production records of former outstanding vocational agriculture students as a means of encouraging increased scope and increased production of present students and other class members.
6. Approach efficiency factors from a positive standpoint. Don't feel that it's a necessary evil. Students appreciate knowing what will be expected of them in order to reach certain prescribed goals. If students are shown practices that will lead to success, they are more apt to direct their efforts in paths that will bring them close their anticipated goals. If one uses efficiency factor analysis properly, his teaching will be easier and more effective.
7. Encourage class members to discuss their production goals and accomplishments with their parents, fellow students, and neighbors. Much good can come from comparative analysis with fellow students and other farmers in the community. If a student has done a good job, he is proud of it and works for even greater achievements. Then, too, it has a desirable effect on other students who have fallen short of their expectations. On pages 29, 30, 31, and 32 you will find farms that may be used for comparative analysis of certain vo-ag enterprises.

It has been the feeling of many that the young and adult farmer groups would be hesitant about a comparative analysis. However, some states (Maryland)have found that the adults are just as eager to locate their place on the profit "totem pole" as the day students. Maryland has not particulary encouraged this comparison but has found that they automatically find themselves comparing dollar results for various farm enterprises.

For complete suggestions concerning the use of other vocational agriculture forms, see "Suggestions For Using Vo-Ag Record Book" by W. H. Wayman, 1954 State Department of Education, Charleston, West Virginia. Mimeo 10 pp.

INTRODUCTION

Today we think of farming as a business as well as a way of life. A good farmer will also be a good business man. The farm has experienced many changes during the past two decades. Thes changes have brought enrichment to those farmers that accepted them as a trend toward better living by demonstrating their ability to make sound managerial and productive decisions that would improve their farm income.

Too often the students success is measured solely in terms of yield per acre or the production per animal without regard to certain other factors that contribute to the labor income. There may be practices that could very easily be applied to an enterprise which would increase the profit a student would receive. Then, too, there may be practices that could be eliminated thus improving production and labor income.

We must first get the student interested in his business. We should never assume that all farmers should produce 100 bushels of corn per acre. This depends on the farmer himself - what he is doing, his management ability, etc. These practices can make the difference. For teaching purposes, we need to know exactly what he is doing. Through comparative analysis, the student can discover his weaknesses and through action on the part of the student and teacher, specific corrective measures can be employed to improve the productive income of the farm business.

The problem of making decisions faces the farmer constantly. Some problems are easy to solve based upon past experience. Other problems, due to existing circumstances and the lack of past experience, are more difficult. Sometimes the farmer is forced to make a decision and take action.

The above reasons furnish sufficient evidence that certain goals and efficiency factors are needed to serve as a guide in analyzing farm enterprises. It is the opinion of the writer that the standards set for the various efficiency factors enable the student to make a critical comparison of the results obtained from his enterprise with those of "superior" and "good" farmers in his community.

All businesses should have a goal, and the business of farming is no exception. Also, all business people should establish an index, above which we find profits and personal satisfaction. The different rates of production are herein set up to give you an index for your production. You will find three columns in which is listed the superior, good, and state average production. The "superior" figure is representative of the production received by the leading farmers of the state and the "good" column is designed to show the production of the above average farmer. State averages are all taken from census data or from other sources that may not be available in your school. The state average in many cases, is below what you would expect in your community or county. For that reason, a column has been provided for county averages, which should serve as a more reliable figure for local conditions. The next two columns are left blank for the student to calculate his anticipated production goal and his final achievement. This information is recorded on Form 8 of the West Virginia Vocational Agriculture Record Book.

SETTING PRODUCTION GOALS

The teacher must be sure that all students understand the importance of setting high production goals and by the use of superior practices be able to approach or surpass them. The teacher must, also, have a sound philosophy of superiesory farm visits and practice this philosophy at critical times for a given enterprise, which will help the student to realize the value of setting goals and working toward their accomplishment through recommended practices.

In order to make the production goals realistic as well as challenging, some class time should be devoted to a discussion of the production records of former students and of successful farmers in the area. These figures may be obtained by consulting the records of former students and by talking with leading farmers in the community. A chart might be prepared dividing production records into three groups; high third, middle third, and lower third. From these groupings, students should be able to determine their own production goals, taking into consideration their home conditions.[1]

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1. Bail, Joe P. - Efficiency Factors and Production Goals for Vocational Agriculture Enterprises in West Virginia - 1956

ANALYZING THE RECORDS

In vocational agriculture, we realize the importance of accurate record keeping. Record keeping, however, will not have served its full value unless some work is done in the area of record analysis. Then, as a follow-up for the analysis, the teacher and student must agree on suggestions for improvement. These suggestions will help the student to realize the importance of using superior practices to obtain high production goals. When properly used, efficiency factors will assist you to discover the strong and weak points involved in the "doing" stage of production. This process should also help the vocational agriculture teacher to discover some of his own strong and weak points. Just as the student is alert to discover areas of strength and weakness, so must the teacher be alert and observative for those areas where he can bolster his instruction whether on the farm or in the classroom to enrich the student's learning through every day's satisfying experiences.

It would be well for the teacher and students to provide charts and tables that will show production standards for certain enterprises carried in the past five years. This would provide the student with a basis for formulating his own goals. It seems to be advisable to start the freshman class out with only a few goals and progress into the more technical phases as the students advance in the vocational agriculture work. However, some first year students may have progressed sufficiently to work on more advanced efficiency factors. If you find this to be the case, then these pupils should be encouraged to do so.

DEFINITIONS OF TERMS[1]

Efficiency Factors - A designated measurement of specific factors which affects the rate, amount or the economy of production of a particular enterprise. These should be tangible and specific measurements, such as per cent of chicks raised to 10 weeks; weight of pigs at 56 days; pounds of feed per pound of gain; etc.

Efficiency Standard - A set rate of production, determined on the basis of experience or reasearch, which sets a maximum or minimum production rate for a given efficiency factor. Again a tangible statement of quality, quanitiy, proportion, or time. An example would be 200 lb. hog at 170 days (time), 350 lb. feed per 100 lb. pork (proportion), 200 eggs per hen per year (quantity), etc.

Production Goals - Goals set for each efficiency factor for a given enterprise. These should be based on the home farm situation and should be goals that are within reach yet challenging to the student.

Pupil Goal - The goals set by the pupil for his enterprise based on his home farm conditions.

Pupil Achievement - The goal which the student achieved for a given efficiency factor.

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[1] Joe P. Bail - Efficiency Factors and Production Goals For Vocational Agriculture Enterprises in West Virginia.

Table 1

Efficiency Factors For Swine Enterprise

Efficiency Factor	Efficiency Standard		W. Va. Average	County Average	Pupil's Goal	Pupil's Achievement
	Superior	Good				
No. of pigs farrowed						
Sows	12	10	9			
Gilts	10	8	8			
% of pigs raised to weaning age	95	85	74			
Wt. of pigs at 2 wks.	10	8.5	7			
Wt. of pigs at 8 wks.	50	40	30			
No. days required to reach market wt. of 200 lbs.	140	170	220			
Lbs. feed per 1 lb. gain	3.0	3.50	5.00			
Average gain per pig per day after weaning (56 days)	1.6	1.3	1.0			

Swine Enterprise

The efficient swine herdsman has breeding sows that farrow 9 or more pigs per litter. At two weeks of age, pigs should weigh 9 lbs. each if the sow is producing well. He also raises 90% of these pigs to weigh an average of 45 lbs. per pig at 56 days (8 wks.). These same pigs may be made to gain at the rate of more than 1.5 lbs. per day to reach a desired market weight of 200 lbs. at 140 days of age. This will require efficient feeding as it will take approximately 3.50 lbs. of feed to produce 1 lb. of pork. In order to meet these standards, approved practices of feeding and management must be followed, plus starting out with well-bred animals. Records must be kept if these factors are to be figured accurately.

Table II

Sample Records of a Swine Enterprise

Efficiency Factor	Efficiency Standard		W. Va. Average	Community Average*	Pupil Goal*	Pupil Achievement**
	Superior	Good				
No. of pigs farrowed						
Sows	12.0	10.0	9			
Gilts	10	8	8	9.5	9	9
% of pigs raised to weaning age	95	85	74	80	90	100
Wt. of pigs at 2 wks.	10	8.5	7.0	7.5	--	--
Wt. of pigs at 8 wks.	50	40	30	35.0	40	42
No. days required to reach market wt. of 200 lbs.	140	170	220	200	180	174
Lbs. feed per pound grain	3.0	3.5	5.0	4.0	3.0	3.75
Average gain per pig per day after weaning (56 days)	1.6	1.3	1.0	1.1	1.2	1.40

* Filled out by pupil at the beginning of the enterprise.
** Filled out by pupil when the enterprise was summarized.

The figures in the table above, taken from a vocational agricultural record book, show the results obtained for a swine enterprise. The columns which are starred were completed by the pupil.

When Tom chose swine as one of his enterprises, he decided to talk to his neighbors about it. He found that the average litter size was between 9-10 pigs and that most farmers raised 7 pigs to weaning age. Although the farmers didn't weigh their pigs at weaning age, they judged them to weigh about 35 pounds at this time. They also indicated that it required about 200 days to reach 200 pounds. This figured out to be a gain of 1.1 pounds per day. The pounds of feed per pound of gain was estimated at 4.0. Tom recorded these figures under the column entitled "Community Averages."

This figure may also be taken from the census figures on a county basis rather than to use the community average. Usually, there will be little variation between different sections of a county. You will discover that most of the material presented in this paper will use "County Average".

Tom's next step was to set goals for his enterprise. He decided that his gilt should probably farrow 9 pigs and that he should raise 8 to weaning age, and all if possible. He set a goal of 40 pounds per pig at 56 days, and a goal of 200 pounds at 170 days. This would be at the rate of gain of 1.2 pounds per day. He further decided that he would try to make a pound of gain on 3.0 pounds of feed. He did not use weight at two weeks as a measure of efficiency.

When Tom analyized his final records, he found that his gilt farrowed and raised all 9 pigs in the litter. The average weight was 42 pounds by actually weighing the pigs at 56 days. At 130 days his shoats weighed 210 pounds, or 10 pounds over his goal. The rate of gain was 1.4 pounds per day or .1 pound more than his goal. From his actual records of feed, he was able to determine that it required 3.5 pounds of feed per pound of gain.

In the final summary of his records, Tom decided that next year he would have to push his pigs a little harder to make the 200 pounds at 150 days. He further decided that he could lower his cost of production by improving his feeding practices, especially with regard to pasture and minerals. He would also have to continue all the approved practices used during the past year.

Efficiency Factors For Baby Chick and Laying Hen Enterprise

Efficience Factor	Efficiency Standard		W.Va. Average	Community Average	Pupil Goal	Pupil Achievement
	Superior	Good				
No. of chicks raised to 10 wks.	100	97	95			
Wt. of birds at 10 wks. (lbs.)						
Light breeds	2.5	2.25	2.0			
Heavy Breeds	3.0	2.75	2.5			
Lbs. feed per lb. gain to 10 wks.	2.8	3.0	3.6			
% desirable pullets kept for layers (Pullets housed)	97	95	90			
No. eggs per hen housed	250	200	196*			
Total % of mortality (laying house)	6	12	16			
Rate of Lay (%) (hen day)	85	70	60			
Lbs. of feed per doz. eggs						
Light breeds	4.0	4.5	5.0			
Heave breeds	4.2	6.0	7.5			
% Grade A eggs produced	95	90	80			

* Eggs produced per layer per year. Not hen-housed basis.

Baby Chick and Laying Hen Enterprise

For efficiently conducting the baby chick enterprise, good breeding stock, free from disease should be secured. With proper brooding, 97% of the chicks can be raised to 10 wks. of age. For light breeds, they should weight 2.5 lbs. and heavy breed 3.0 lbs. at 10 wks. of age. Efficient production is secured when 3 lbs. of feed are used per lb. of gain; approximately 25-30 lbs. of feed to 6 months of age. Ninety-five per cent of the pullets should be suitable for housing at 20 wks. of age. They should lay well in the fall and winter months and a yearly total of 200-250 eggs per hen. Mortality should not exceed 8% with good management, and culling will take out approximately 30% of the birds during the first laying year.

(Price of feed, eggs, etc. will determine this.) Approximately 4.5 lbs. of feed will be required to produce a dozen eggs. Eggs should be gathered twice daily and stored in a suitable place to maintain high quality until used.

Table IV

Efficiency Factors For Broiler Enterprise

Efficiency Factor	Efficiency Standard		W. Va. Average	Community Average	Pupil Goal	Pupil Achievement
	Superior	Good				
% chicks raised to 9 wks	100	98	98			
Wt. per bird at 9 wks	4.22	3.7	3.4			
Lbs. feed per lb. of gain	2.2	2.4	2.4			
% birds marketed in highest grade (quality)	99.5	97	96			

Broiler Enterprise

The efficient broilerman will raise 99% of his chicks to 10 wks. of age These birds should weigh 3.5 lbs. and should be of high enough quality to insure reasonable profits. The broiler industry is highly competitive and the individual producer must have sufficient scope to weather unusual market conditions. He must be efficient in his feeding practices, and should produce a pound of meat to every 2.4 lbs. of feed consumed. Fast growing birds of a desirable breed or crossbred strain should be selected, keeping in mind the market preferences. For each 0.1 lb. improvement in feed conversion, the income over all cash costs goes up $17.50 per 1000 broilers. Also, for each 0.1 lb. improvement in feed conversion the value per ton of feed goes up $5.00 or $.25 per 100 lbs. of feed.

Table V

Efficiency Factors For Beef Cattle Enterprise

Efficiency Factor	Efficiency Standard		W. Va. Average	Community Average	Pupil Goal	Pupil Achievement
	Superior	Good				
No. of live calves per year	1.0	.8	.85			
Wt. of calf at 205 days	475	425	420. *			
Lbs. protein supplement fed per yr. (cows)	100	240	——			
Lbs. gain per day (feeder calf)	2.25	2.0	1.7			
Grade of calf	Fancy	Choice	Good			

* Average of 6416 steer calves and 4447 heifer calves sold through demonstrational sales (W.Va.) 1961. State average would probably be lower.

Beef Cattle Enterprise

For the development of an efficient beef cattle enterprise; short, thick, heavy-set, blocky animals of the beef breeds should be selected. The use of good purebred sires will help to ensure calves that will develop into the highest grade. A cow should produce one calf per 365 days, dropped between February 15 and April 15 to receive best market prices. The feeder calf must be dehorned, castrated, weaned, and broken to lead in order to qualify for the state shows and sales.

The demonstrational sales throughout the state have provided a much needed outlet for many feeder calves. This system of marketing has greatly enhanced the beef industry in the state by providing a sound marketing system where the cattle are sold according to grades with the better grades commanding the better prices.

Proper feeding will ensure efficient gains of 2 lbs. per day, and a total weight of 425 lbs. at 6 months. A calf being creep fed, will eat about 4 lbs. per day. Feeder calves should grade choice or above. Dams must give sufficient milk to get calves off to a good start. Good pasture and creep feeding of grain will ensure a high quality animal. The kind of hay available will determine the amount of protein supplement needed for wintering breeding stock.

Table VI

Efficiency Factors For Sheep Enterprise

Efficiency Factor	Efficiency Standard		W. Va. Average	Community Average	Pupil Goal	Pupil Achievement
	Superior	Good				
Wt. of lamb at 5 mos.	90	80	75			
Lambs raised per ewe	1.5	1.3	1.0			
% of lambs raised	95	88	83			
Wt. of fleece:						
Corriedale cross	10	8				
Western type ewe	10	8				
Southdown	7	6				
Dorset	8	6	5.4*			
Hampshire	8	6				
Suffolk	7	6				
Average gain per lamb per day	.6	.5	.4			
% lambs grading choice (blue)	90	75	60			

*Average of all breeds in the state

Sheep Enterprise

The superior shepherd will keep ewes that average 1.5 lambs raised to weaning time, and which average 90 lbs. at marketing age of 5 months. This can be done if good pasture is provided and adequate concentrates fed to ensure a gain of .5 lb. or more per day. The weight of fleece in an efficient flock should be 7 lbs. per ewe.

The use of large ewes and good purebred rams along with good management practices including adequate parasite control are essential to meet these standards. Shelter should be provided in order to assure success with early lambing. Dock and castrate at an early age to maintain a quality product. These factors should assure the production of choice lambs with at least 80% of them grading blues.

Table VII

Efficiency Factors For Dairy Enterprise

Efficiency Factors	Efficiency Standards Superior	Efficiency Standards Good	W. Va. Average	Community Average	Pupil Goal	Pupil Achievement
Lbs. butterfat per cow	425	350	185			
Lbs. milk per cow:						
Jersey	8,000	6,500	5,100*			
Guernsey	8,500	7,000				
Ayrshire	10,000	8,500				
Holstein	12,000	10,000	9,100**			
Calving Interval (days)	365	400				

* Average of all breeds ** Average of all cows on a testing program

Table VIII Height at Shoulders and Body Weight For A Dairy Heifer Enterprise*

	HOLSTEIN		AYSHIRE		GUERNSEY		JERSEY	
Age of Heifer (months)	Normal Height (inches)	Normal Weight (pounds)	Normal Height (inches)	Normal Weight (pounds)	Normal Height (inches)	Normal Weight (pounds)	Normal Height (inches)	Normal Weight (pounds)
1	30.6	112	27.2	84	28.2	77	27.0	67
2	32.3	148	28.8	111	28.8	102	28.9	90
4	36.3	243	32.6	184	33.5	173	32.6	158
6	39.7	355	36.0	272	36.9	260	36.2	243
8	42.3	462	38.5	361	39.9	350	39.0	324
10	44.4	552	40.6	440	41.7	427	40.9	393
12	46.0	632	42.2	506	43.3	490	42.2	450
14	47.3	705	43.3	556	44.6	556	43.3	507
16	48.5	782	44.4	616	45.3	605	44.4	558
18	49.3	845	45.3	674	46.4	663	45.2	601
20	50.2	912	46.1	721	47.0	712	45.9	642
22	51.0	986	47.1	768	47.7	763	46.2	684
24	51.7	1069	47.5	819	48.0	818	46.9	733

* Watch Your Dairy Cattle Grow - West Virginia University, Agricultural Experiement Stateion, November 1943, Circular 79.

Table IX

Heart-Girth Measurements For Determining Body Weights of Dairy Cows

Heart-girth (inches)	Body Weight (pounds)	Heart-girth (inches)	Body Weight (pounds)
26	80	55	501
27	84	56	526
28	89	57	552
29	95	58	579
30	101	59	607
31	108	60	637
32	118	61	668
33	128	62	700
34	138	63	732
35	148	64	766
36	158	65	800
37	168	66	835
38	180	67	871
39	192	68	908
40	208	69	947
41	224	70	987
42	240	71	1027
43	257	72	1069
44	275	73	1111
45	294	74	1153
46	314	75	1197
47	334	76	1241
48	354	77	1285
49	374	78	1331
50	394	79	1377
51	414	80	1423
52	434	81	1469
53	456	82	1515
54	478	83	1561
		84	1607

U.S.D.A. Bureau of Dairy Industry

Dairy Cattle Enterprise

The height at the shoulders and the weight of the animal are the factors generally used in the determination of growth in the dairy heifer. An accurate guide for the growth of the individual animal may be obtained by comparison to the standards for each breed, given in table VIII. The measurement of the heart girth is often used in determining the weight of an animal. A tape may be used very satisfactorily for this purpose using figures in table IX.

The efficient herdsman maintains an average of 375 lbs. of butterfat per cow in his herd. A total milk yield of 7,000 lbs. for Jerseys, 7,500 lbs. for Guernseys, 9,000 lbs. for Ayrshires, and 11,000 lbs. for Holstein will give this total butterfat production. Good breeding stock, the use of proven dairy sires, good feeding and management practices are essential if this high rate of production is to be reached and maintained.

The proper feeding of silage, high quality legume, and concentrates (according to production) should maintain this flow of milk, Replacements for the herd should generally be raised rather than purchased, because of the possibility of bringing in diseases and also to help assure a long-range breeding program.

For all practical purposes, greater improvement in herd production will be achieved through artifical breeding. The dairyman can secure the service of proven sires or those from a high producing line at a moderate cost, thus eliminating the necessity of locating and purchasing a new herd sire every two years.

The expenses connected with the breeding program will probably be reduced, and at the same time, the dairyman will be elevating the quality of his breeding program.

Animals should be bred to calve at intervals of 365 days, with emphasis placed on production during the late fall and winter months. This will generally mean more profits since milk is at its highest price during these months.

CROP ENTERPRISES

The use of efficiency factors for crop enterprises is perhaps somewhat more limited than in the case of livestock enterprises. The differences in the soil fertility, climatic conditions, and topography of the land, to name only a few, cause great differences in production per acre. The costs per acre of production are also variable as the scope and mechanization of the enterprise increases or decreases.

In the main, however, the selection of high quality seed of the proper variety, correct rate of seeding and fertilization, and proper management of the growing crop determine whether the enterprise will be financially successful. The marketing of a high quality, properly graded product is an important factor if the greatest income per acre is to be secured. Attention should be given to maintaining the quality by proper handling and marketing. The public is demanding more and more a standardized product rather than simply a dozen of eggs or a bag of potatoes. In other words, superior practices in carrying out the enterprise will determine whether you make a profit or loss.

Since climatic conditions have a decided affect on yields and quality of crops, no definite figures could be given that would be applicable in every situation. However, average yields over a long period of time should be a reliable index to judge yearly production standards. Prices, too, are very changeable and would be of limited value in judging present day costs.

The efficiency standards for crops are for average conditions of soil fertility, average rates of seeding, etc., and may or may not be applicable to your situation.

You are urged to keep up to date on new practices and recomendations for the various enterprises in your community. For a digest on this information, you may refer to "Revised List of Superior Practices for Selected Crop Enterprises", 1960. Other pertinent material should also be evaluated for use in setting production goals and determining efficiency standards. Included here is the table of production standards for several crops. Only one efficiency factor, the yield per acre, is given. Because of the variable factors listed on the preceding page, it was felt that any others listed would be of limited value in most instances. However, additional factors that might be of value would include; cost of production per acre or unit, percentage of crop grading in highest grade, per cent of moisture at harvest time, and per cent of stand.

Table X Crop Production Standards

Crop	Production	Efficiency Standard Superior	Efficiency Standard Good	W.Va. Average*	Co. Ave.	Pupil Goal	Pupil Achievement
Cultivated							
Corn	bu./acre	120	80	45.0			
Corn silage	tons/acre	24	16	9.8			
Potatoes	bu./acre	500	425	70.0			
Tobacco	lbs./acre	2800	2200	1488			
Small Grains							
Barley	bu./acre	60	50	34.6			
Oats	bu./acre	80	60	35.4			
Wheat	bu./acre	50	30	23.0			
Buckwheat	bu./acre	36	28	20.8			
		Elevation High Low	Elevation High Low				
Forage (hay)							
Alfalfa	tons/acre	5.0 6.5	3.5 5.0	1.92			
Alfalfa-Grass	tons/acre	5.5 7.0	4.0 5.5	2.05			
Red Clover (1 yr.)	tons/acre	3.5 4.5	3.0 3.5	1.00			
Red Clover-Timothy (2 yrs.)	tons/acre	4.0 5.0	3.0 3.5	1.28			
Orchard grass***	tons/acre	5.0 6.5	4.0 5.0				
Bromegrass***	tons/acre	4.0 5.0	3.0 4.0				
Pasture							
Bluegrass-Cl.		1.5	2.5	4.5 (a)			
Orchard grass Cl.***		.7	1.5				
Orchard grass ***		.5	1.0				
Sudan grass ***		0.3	1.0				
Truck							
Cabbage	ton/acre	20	15	9**			
Greenbeans	bu./acre	200	150	72**			
Sweet Corn	doz./acre	700	600	400**			
Tomatoes	bu./acre	600	400	200**			
Small Fruits							
Blackberries	qt./acre	3000	2200	325			
Raspberries	qt./acre	2500	1800	488			
Strawberries	qt./acre	6000	4500	800			

* Based on 10 yr. average 1944-53, West Virginia State Department of Agriculture, Charleston, West Virginia

** Estimated figures-based on conferences with College of Agriculture, Staff

*** Since crop yields vary from year to year, an adjusted yield may be more accurate for judging pupil achievement. This may be figured by comparing the current yield with the community average. For example, if the pupil goal has been set at 60 bu. as compared to a community average of 45 bu., and he only achieves 48 bu. as compared to a community average of 36 bu. for the year, he has still reached his goal based on an adjusted yield.

**** Rotating pastures so that pasture is grazed intensively once every 3 to 4 weeks.

***** Using nitrogen fertilizer (100-175 lb. N/A)

(a) Estimated

Table XI

Sample Records Of A Potato Enterprise

Efficiency Factors	Efficiency Standards		W. Va. Average	County Average*	Pupil Goal*	Pupil Achievement **
	Superior	Good				
Yield per acre, bu.	500	425	70	200	425	350
Cost of production, per bu.	***	***	**	1.00	.75	.81
% of crop grading No. 1	95	85	65	75	90	88

* Filled out by pupil at the beginning of enterprise.
** Filled out by pupil during the course of the enterprise or when it was summarized.
*** Figures are too variable to be of value.

The figures in the above table were taken from a vo-ag student's record book. His enterprise consisted of ½ acre of potatoes. By checking records of former students he found that the average production was about 200 bushel per acre, although some farmers in the community were getting over 425 bushels per acre. He set his goal at 425 bushels.

During the growing season, which was reasonably favorable to potatoes, he carried out the practices indicated on Form 8 for the 1st year in vo-ag. When the crop was harvested, it measured 175.0 bushels, or on an acre equivalent, 350 bushels. Of the 175 bushels, 154 bushels were estimated to be U.S. No. 1 or better. This was about 82.2 per cent.

On checking the cost sheet, Form 9, it was noted that the Irish Cobbler variety was used. Several of the students who were getting higher yields, were using newer varieties. It was decided to try a different variety next year. He also decided to put in a cover crop and to use it as green manure the following year.

It was not possible to grade the potatoes mechanically, but there was some class discussion of the merits of doing this possibly as an activity of the F. F. A. Chapter.

Some geographical areas of the state stress the importance of packaging potatoes in attractive bags that will meet the demands of the consumer. Some departments have found this system to be quite successful and would recommend it for use in areas where loose potatoes are difficult to sell. The writer has had considerable experience with this activity and would be glad to discuss the practices involved.

The cost of producing a bushel of potatoes was .81¢. This was higher than anticipated. The only place where high cost was noted was for spray material. This was bought in relatively small lots, and not in bulk quantities. Rainy weather also required more spraying than usual.

Success can be measured, to a degree, by certain factors that affect these different enterprises.[1]

A. Dairy Cows
  1. Milk and butterfat sold per cow.
  2. Total dairy income per cow.
  3. Returns per dollar of feed fed.
  4. Price received per 100 pounds of milk.
  5. Pounds of milk per pound of concentrates fed.
  6. Number of cows in the herd.
  7. Per cent fall freshening.
  8. Per cent digestible protein in feed fed.
  9. Pasture days per cow.

B. Beef Breeding Herd
  1. Number of cows in herd.
  2. Average weight of calves sold.
  3. Pounds of beef sold per cow.
  4. Total returns from herd.
  5. Total returns from cow.
  6. Feed costs per cow.
  7. Price received per 100 pounds of calves sold.
  8. Pounds of feed per cow or calf.
    a. Grain
    b. Protein and minerals
    c. Hay
    d. Silage
  9. Pasture days per animal unit.
  10. Percent calf crop.
  11. Percent fall dropped calves.

C. Feeder Cattle
  1. Total pounds sold.
  2. Feed cost per 100 pounds of beef sold.
  3. Average price received per 100 pounds.
  4. Average price paid per 100 pounds.
  5. Returns per dollar of feed fed.
  6. Pounds of feed per 100 pounds of beef produced.
    a. Grain
    b. Protein and minerals
    c. Silage
    d. Hay
  7. Average daily gain.

D. Hogs
  1. Pigs farrowed per litter.
  2. Pigs weaned per litter.
  3. Pigs sold per sow or litter.
  4. Number of sows.
  5. Number of spring and fall litters and total per year.

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[1] Chastain, E.D., Joseph H. Yeager, E.L. McGraw. Farm Business Management Auburn Printing Company: Auburn, Alabama-1962.

6. Price received per 100 pounds sold.
7. Feed cost per 100 pounds sold.
8. Return per dollar of feed fed.
9. Average weight per head sold.
10. Death losses (weight and number).
11. Hogs marketed by months.
12. Amount of feed fed per 100 pounds sold.
    - a. Grain
    - b. Protein supplement and minerals.

E. Sheep
1. Number of ewes in flock.
2. Lambs raised per 100 ewes.
3. Lambs sold per 100 ewes.
4. Gross income per ewe.
5. Weight of wool per animal shorn.
6. Death losses (weight and number)
7. Feed cost per ewe.
8. Feed cost per 100 pounds of sheep sold.
9. Price received per 100 pounds of wool.
10. Price received per pound of wool.
11. Return per dollar of feed fed.
12. Pounds of feed per 100 pounds of sheep sold.
    - a. Concentrates
    - b. Hay
    - c. Silage
13. Per cent lamb crop.
14. Lambs marketed by months.

F. Poultry (laying flock)
1. Number of hens.
2. Number of hens per man equivalent.
3. Eggs sold per hen per year.
4. Receipts per hen per year.
5. Per cent of eggs sold in October, November, December.
6. Price received per dozen eggs.
7. Feed cost per dozed eggs.
8. Return per dollar of feed fed.
9. Per cent death loss of hens.
10. Pounds of feed per dozen eggs.
11. Cost of raising a replacement pullet.

G. Broilers
1. Number sold per year.
2. Number sold per man equivalent.
3. Feed conversion ration.
4. Average weight per bird sold.
5. Average number of weeks to market weight.
6. Price received per pound.
7. Per cent mortality.
8. Feed cost per pound of gain.
9. Return per dollar of feed fed.
10. Price paid per chick.

Comparative Analysis of Sow and Litter Enterprises of Vo-Ag Students*

	Student No. 1	Student No. 2	Student No. 3
Breed of Pigs			
No. of Litters			
Month Farrowed			
No. Pigs Farrowed Per Sow			
Average Weight of Pigs Farrowed			
No. Pigs Weaned Per Sow			
Weight Per Pig at 56 Days			
Month Marketed			
No. of Pigs Marketed Per Sow			
Selling Price Per 100 lbs.			
Average Weight of Pigs Marketed			
Average Daily Gain			
Pounds of Feed Per 100 lbs. Pork			
Cost of Grain Per 100 lbs. Gain			
Cost of Protein Per 100 lbs. Gain			
Total Feed Cost Per 100 lbs. Gain			
Veterinary Costs Per 100 lbs. Gain			
Total Cost Per 100 lbs. Gain			
Gross Income Per Litter			
Net Returns Per Litter			
Labor Income Per Litter			

* Adapted from Agricultural Education Magazine, "Developing Farming Programs for Changing Conditions," by George P. Deyoe.

Comparative Analysis of Sheep Enterprises of Vo-Ag Students

	Student No. 1	Student No. 2	Student No. 3
Breed			
No. Ewes in Flock			
Lambing Interval (Dates)			
Lambing Percentage			
No. Lamb Marketed Per Ewe			
Month Marketed			
Average Weight of Lambs Marketed			
Per Cent "Blue Lambs"			
Per Cert "Red Lambs"			
Per Cent Culls			
Selling Price Per Pound			
Cost of Roughage			
Cost of Grain			
Total Feed Costs			
Total All Costs			
Average Weight of Fleece Per Ewe			
Selling Price Per Pound of Wool			
Value of Ewes Kept for Replacements			
Gross Income Per Ewe			
Labor Income Per Ewe			

Comparative Analysis of Corn Enterprises of Vo-Ag Students

	Student No. 1	Student No. 2	Student No. 3
Acres Grown			
Variety Used			
Date of Planting			
Cost of Seed			
Cost of Land Preparation			
Cost of Commercial Fertilizer: For Side Dressing, Other			
Cost of Weed Spray Material			
All Other Costs			
Total Costs			
Yield, Bushels Per Acre			
Value of Corn Harvested			
Value of Stover			
Gross Returns Per Acre			
Labor Income Per Acre			
Cost Per Bushel of Corn Raised			

Comparative Analysis of Hay Enterprises of Vo-Ag Students

	Student No. 1	Student No. 2	Student No. 3
Kind of Hay Produced			
Acres of Hay Produced			
Cost of Seed - Seeding or Reseeding			
Cost of Fertilizer			
Cost of Lime			
Cost of Controlling Insects			
Harvesting Costs (Other Than Self - Labor)			
All Other Costs			
Yield Per Acre - Tons			
Value Per Ton			
Gross Returns Per Acre			
Net Returns Per Acre			
Labor Income Per Acre			
Cost Per Ton of Hay Produced			

The above forms may be changed by including additional factors or making delections to fit individual situations. The primary objectives should be to get information to use in planning farming programs, teaching for adoption of approved practices, and keeping worthwhile accurate records.

AN ANALYSIS OF THE 1959 U. S. CENSUS OF AGRICULTURE AS IT RELATES TO WEST VIRGINIA'S FARMS[1]

County	% Land In Farms	Average Size of Farms	Average Value Land & Bldgs.	No. Farms 10,000/	No. Farms 5,000/	Total Commercial Farms	No. Part-Time Farms	No. Residential Farms
Berkeley	65	152	18,500	161	281	461	441	286
Jefferson	78	208	38,000	171	276	376	105	40
Morgan	36	172	7,000	17	32	142	122	55
Grant	62	269	13,500	100	198	364	202	122
Hampshire	53	261	14,000	121	203	477	212	142
Hardy	60	242	11,000	198	319	571	196	197
Mineral	52	253	11,000	38	48	155	220	55
Pendleton	66	264	16,000	153	296	597	305	216
Barbour	62	119	8,000	23	85	276	590	270
Lewis	65	173	11,000	35	99	291	365	325
Randolph	33	215	12,000	19	56	262	482	260
Tucker	23	162	7,500	6	24	116	185	75
Upshur	57	109	8,500	21	42	253	640	265
Doddridge	59	175	7,000	6	33	148	275	231
Harrison	64	133	10,500	69	146	367	641	265
Marion	42	86	8,000	20	40	165	575	215
Taylor	58	118	7,500	1	16	116	300	125
Monongalia	33	102	12,500	33	63	220	420	215
Preston	50	134	7,000	39	130	406	765	315
Brooke	40	134	22,000	6	26	31	65	50
Hancock	35	101	9,500	2	12	22	135	20
Marshall	65	135	9,500	16	111	346	440	160
Ohio	55	121	18,500	51	91	171	110	15
Pleasants	41	119	10,000	10	15	50	186	60
Ritchie	48	172	7,500	15	52	171	385	275
Tyler	54	151	6,500	21	51	182	310	115
Wetzel	29	135	5,000	5	26	141	216	131

1. H.E. Edwards, State Supervisor - Vocational Agriculture 1962 - West Virginia

County	% Land In Farms	Average Size of Farms	Average Value Land & Bldgs.	No. Farms 10,000/	No. Farms 5,000/	Total Commercial Farms	No. Part-Time Farms	No. Residential Farms
Jackson	60	145	9,500	32	76	383	601	255
Mason	56	140	16,000	110	181	448	476	235
Roane	60	145	7,500	27	68	323	650	351
Wirt	48	145	7,500	17	37	162	220	105
Wood	48	102	11,000	43	78	213	610	255
Braxton	49	133	6,500	22	38	268	625	365
Calhoun	58	132	7,000	15	21	176	440	155
Clay	21	85	5,000	5	5	105	260	135
Gilmer	57	168	6,500	2	28	116	396	220
Greenbrier	38	161	15,500	111	224	626	650	276
Monroe	61	153	16,000	105	187	495	531	185
Pocahontas	30	229	12,500	43	84	256	320	176
Boone	4	43	6,000	0	0	70	130	75
Cabell	44	81	10,000	30	45	155	600	190
Kanawha	10	82	11,500	21	26	142	450	140
Lincoln	34	88	5,500	0	10	210	595	305
Logan	7	71	8,000	0	0	25	176	70
Mingo	9	80	4,500	0	0	6	144	130
Putnam	40	103	11,000	30	36	243	430	180
Wayne	33	92	8,000	31	57	252	646	265
Fayette	11	56	7,500	10	25	150	465	190
Mercer	38	86	8,500	10	25	690	202	235
McDowell	7	101	4,000	5	5	15	207	51
Nicholas	21	84	7,000	20	45	136	660	195
Raleigh	18	64	9,000	35	50	195	625	276
Summers	46	119	7,500	2	23	244	455	210
Webster	13	81	4,500	0	0	50	300	171
Wyoming	16	91	5,000	1	1	66	378	105
TOTALS	39	138	10,000	2,084	4,152	12,609	21,463	9,890

	County		West Virginia	
	1959	1954	1959	1954
Number Farms	—	—	44,011	68,583
% Land in Farms	—	—	39	
Average Size of Farm	—	—	138	107
Value Land & Buildings - Average	—	—	10,048	7,074
% Farms Operated by Owner	—	—	94	91
Average Age of Farm Operator	—	—	54.4	53.0
Number Farm Operators Working 100+ Days Off Farm	—	—	19,118	29,507
Number Commercial Farms	—	—	12,609	
Number Grossing $10,000 +	—	—	2,084	
Number Grossing $ 5,000 +	—	—	4,152	
Number Grossing $ 2,500 +	—	—	7,683	
Number Grossing $50 to $2,499 FT	—	—	4,926	
Number Grossing $50 to $2,499 PT	—	—	21,463	
Number Cattle and Calves	—	—	515,000	597,000
Number Hogs and Pigs	—	—	148,000	183,000
Number Sheep and Lambs	—	—	290,000	303,000
Number Chickens (4 mo. and over)	—	—	2,015,000	2,663,000
Acres Corn Harvested	—	—	119,000	189,000
Acres Small Grain Harvested	—	—	59,000	97,000
Acres Hay Harvested	—	—	601,000	711,000
Acres Potatoes Harvested	—	—	6,200	9,500
Acres Vegetables for Sale	—	—	3,140	3,800
Acres Strawberries	—	—	381	250
Acres Tree Fruit	—	—	39,000	50,500

Prepared by - H.E. Edwards, State Supervisor, Vocational Agriculture (W.Va.)

A LOOK AT YOUR FARM BUSINESS 1/

This mimeograph is designed to compare your farm business with similar situations on other farms in West Virginia. It is also designed to compare the relative ranking of one part of your business with another part of the business. The total mimeograph or any part of it may be used.

Farms are changing. Are you ahead of the change? Farms are getting larger, organizations are improving, rates of production are rising and efficiencies increasing. How do you compare?

Successful farms rank above most farms in a community; low income farms rank down. Your relative positions can be compared with other farmers in West Virginia. Make the comparison; then determine the direction for your business.

The first 11 tables in this mimeograph are arranged for summarizing certain activities on your farm and for making selected calculations. The summary of these can be used in Tables 12 thru 16 to make comparisons among different parts of your business and to rank your business with other farms.

The first task in working Table 1 is to record the amount of income producing enterprises on your farm. Livestock information is recorded in numbers; when the unit is described as "average", record the average number kept during the year; when the unit is "raised", record the number sold plus number used in the home. An extra line is provided to record other productive stock kept for sale, such as ponies, goats, mink and sometimes horses. Horses and mules kept for work stock are not included in figuring work units. Unweaned stock are not recorded because the factor for the dam includes the labor. Crop information generally is recorded in acreages harvested. Work off the farm for income is expressed in days. Part-time work is reported in terms of ten hour days.

The second task in working Table 1 is to calculate the size of business in productive man work units. This is done by multiplying the number of head or acreage by the work unit factor. A productive man work unit is the amount of work usually done by a man in a ten-hour day on crops, productive livestock and work off farm for pay. The work unit factors represent the average labor used on commercial farms in West Virginia. For example, farmers with dairy cows average 120 hours or 12 days of work on each dairy cow. The work unit factors serve as a conversion for different enterprises so that they can be compared in terms of labor needs or so that they can be added to get one measure of size of business.

The third task is to determine the animal units of livestock that use forage and pasture. This is done by completing Table 2. The same numbers of livestock reported in the first form may also be used in the second one providing all animals in the group are fed forage or pasture. The second table includes young stock to weaning age and work animals which are not recorded in Table 1.

Animal units of stock is figured to determine forage and pasture feeding per unit of livestock.

1/ Prepared by G. E. Toben, Department of Agricultural Economics and Rural Sociology.

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TABLE 1. YOUR SIZE OF BUSINESS

Kinds of Livestock and Crops	Unit of Measure	Number of Head or Acres	Productive Man Work Units	
			Per Unit	Total on Your Farm
Dairy Cows	Average		12.	
Beef Cows	"		3.	
Herd Bulls	"		5.	
Other cattle, beyond weaning	"		2.2	
Ewes and rams	"		0.4	
Lambs beyond weaning	"		0.2	
Sows and Boars	"		3.0	
Hogs beyond weaning	Raised		0.7	
Hens	Average		0.16	
Pullets for replacement	"		0.04	
Broilers	Raised		0.005	
Turkey hens and toms	Average		0.3	
Turkey poults	Raised		0.06	
Corn for grain or silage	Acres		2.7	
Small grains for grain	"		1.4	
" " " forage	"		1.5	
Soybeans for any use	"		2.0	
Other hay & silage - first cutting	"		0.6	
" " & " - later "	"		0.4	
Potatoes and cabbage	"		6.	
Tomatoes for canning	"		6.	
Other truck	"		15.	
Tobacco	"		37.	
Apples harvested	"		8.	
Peaches "	"		9.	
Fruit not of bearing age	"		3.	
Managed woodlot	"		3.	
	"			
Work off farm for income	Days		1.	
Total productive man work units (add last column)				

TABLE 2. LIVESTOCK USING HAY AND PASTURE

Kind of Livestock	Unit of Measure	Number	Animal Units Per Head	Animal Units Total
Dairy Cows	Average	____	1.0	____
Beef Cows and Bulls	"	____	0.9	____
Feeder Calves to Weaning	Total	____	0.15	____
All other Cattle	Average	____	0.7	____
Ewes & Rams	"	____	0.17	____
Lambs to Weaning Age	Total	____	0.02	____
Other Sheep	Average	____	0.08	____
Horses and Mules	"	____	1.	____
Ponies and Colts	"	____	0.7	____
____				____
Total animal units using hay and silage (add last column)				____
Sows and boars, if pastured	Average	____	.23	____
Other hogs, if pastured	Raised	____	.01	____
Turkey poults, if pastured	"	____	.002	____

Total animal units using pasture (include animal unit total above) ____

Acres hay & silage per animal unit (____ acres ÷ ____ animal units using hay & silage) ____

Acres pasture per animal unit (____ acre permanent and rotation pasture ÷ ____ animal units using pasture) = ____

TABLE 3. YIELDS OF CROPS

In order to compare yields of crops on your farm with those on other farms, yields per acre need to be determined. These yields may be recorded directly in the form below or may be figured by dividing total production by the acreage. If a hay field is harvested as hay and silage, divide silage production by three and add to production of hay.

Kind of Crop	Unit of Measure	Total Production		Number of Acres		Yield Per Acre
Corn grain	Bu. shelled	____	÷	____	=	____
Oats grain	Bu.	____	÷	____	=	____
Wheat grain	Bu.	____	÷	____	=	____
Barley grain	Bu.	____	÷	____	=	____
Alfalfa & mixtures	tons hay	____	÷	____	=	____
Other hays	tons	____	÷	____	=	____
Corn silage	tons	____	÷	____	=	____
Tobacco	lbs.	____	÷	____	=	____
Potatoes	hundred lbs.	____	÷	____	=	____

TABLE 4. MONTHS OF WORK

Determine the work available on the farm in the table to the right. If you, as the operator, are a full-time farmer, record 12 months of work; time away from your farm for income is shown in Table 1. Amounts of regular hired labor may be recorded in months. Labor hired for short periods is reported in months after dividing the total days by 25 working days per month. Include the time for other members of the family that is used for farm work outside the house and home garden. Adjust this work to man equivalents in terms of the percent of a man the person replaces. A convenient conversion is an hour a day during the year is equal to a month.

Worker	Months of Work
Operator	____
Regular hired	____
Irregular hired	____
son	____
daughter	____
wife	____
____	____
Total months of work	____
Man equivalent in years (divide total month by 12)	____

Work units per man (total work units in Table 1 ____ ÷ man equivalents ____ = ____

Dairy cows per man (Dairy cows in Table 1 ____ ÷ man equivalents ____ = ____

Beef cows per man (Beef cows in Table 1 ____ ÷ ____ man equivalents = ____

TABLE 5. MILK PER COW

If Dairy Herd Improvement Association Records, Way-A-Day-A-Month Records or other similar records are kept, copy the average production per cow from that record to this. If regular records are not kept, use the following form for figuring milk per cow.

Milk sold ____ lbs

Milk used in house ____ "

Milk for hired help ____ "

Milk fed livestock ____ "

Total milk from herd ____

Milk per cow (total ÷ average number of cows in Table 1) ____

TABLE 6. FEEDER CALF WEIGHT

If Beef Cattle Performance Testing Records are kept, copy from that record the average weight of calves at 205 days of age to this form. If regular records are not kept, approximate the average weight at about 7 months of age. Frequently sales occur near 7 months of age. Summarize with the following form.

Steers sold ____ head ____ total lbs.

Heifers sold ____ head ____ " "

Heifers kept ____ head ____ " "

Other calves kept ____ head ____ " "

Total calves ____ head ____ " "

Weight per calf (total pounds ÷ total head) ____ lbs.

TABLE 7. WOOL PER SHEEP CLIPPED

If records are kept in the Master Shepherd's Project, copy the average pound of wool per ewe bred from that record. Otherwise, check your records for total pounds and number sheared.

Pounds clipped ____ ÷ Head sheared ____ = ____ lbs. per head.

TABLE 8. PER CENT LAMB CROP

If Master Shepherd's Records are kept, copy the lamb crop from those records. Otherwise, figure with the form.

Lambs sold ________
Lambs kept ________
Total lambs raised ________
Ewes bred last yr. ________
Percent lamb crop
(Lambs raised ÷
ewes bred x 100) ________

TABLE 9. EGGS PER HEN HOUSED

If W. Va. On-the-Farm Performance Test records are kept, copy the hen-housed production from that record. If records are not kept, summarize production on this form.

Eggs sold ________doz.
Eggs used in home ________"
Eggs furnished labor ________"
Total eggs produced ________"

Hens housed ________
Eggs per hen
(Doz. produced
x 12 ÷ hens
housed) ________

TABLE 10. PER CENT OF HENS DIED

If On-the-Farm Performance records are kept, copy percent laying house losses from that record. Otherwise, figure losses in the following form. The year may be the period from the date of housing rather than calendar year.

Hens sold during year ________
Hens butchered during year ________
Hens kept for following year ________
Total accounted for ________

Hens at first of year ________
Hens accounted for (on left) ________
Hens died (subtract) ________
Percent of hens died
(hens died ÷ hens at first
of year x 100) ________

TABLE 11. PER CENT CHICK LOSS FOR PULLETS INTENDED FOR LAYING

Calculate losses with the following table.

Pullets placed in laying house ________
Pullets sold ________
Pullets used in home ________
Pullets furnished labor ________
Total accounted for ________

Chicks bought ________
Total accounted for (on left) ________
Chicks died (subtract) ________
Percent death loss
(chicks died ÷ chicks bo
x 100) ________

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HOW YOUR FARM RANKS WITH OTHERS

You can rank your farm performance with other farms in West Virginia in the appropriate columns below. Each column contains 10 amounts. The figure at the top of each column represents the average for the 10 percent of the best commercial farmers concerned with the specific activity. The next figure down the column is the average for the second best ten percent. The last figure is the average for the 10 percent of the poorest commercial farmers.

The preceeding pages provided tables for calculating the amounts to be used in the table below. As in the previous section, complete only those columns that are for activities important on your farm.

Draw a heavy line in each appropriate column that most nearly represents your farm situation. For example, if yoursize of business figured in Table 1 was 600 work units, draw a line in the column headed "Total Work Units" and between 700 and 550. Such a location would indicate that your size of business is above average and similar to the bottom of the top third.

At the top of each column is a number which indicates the table in which you made the calculation for the item.

Data for the various columns came from many sources. This includes production records referred to in earlier tables, U. S. Census of Agriculture, and research data.

TABLE 12. SIZE OF BUSINESS

1	4	1	1	1	8	9
Total Work Units	Man Equivalent	Number Dairy Cows	Number Beef Cows	Broilers Sold in 1000's	Number Ewes Bred	Number Hens Housed
1400	3.9	72	240	90	155	2600
1000	3.0	48	93	42	74	1400
750	2.6	39	69	30	64	1100
550	2.2	33	54	24	55	800
460	2.0	29	47	19	40	600
400	1.8	25	39	15	35	400
320	1.6	23	33	12	31	330
250	1.4	20	27	10	28	280
180	1.1	17	21	7	23	220
120	.8	12	16	4	18	150

TABLE 13. YIELD OF CROPS

3 Corn Grain	3 Oat Grain	3 Wheat Grain	3 Barley Grain	3 Alfalfa Mixture	3 Other Hay	3 Corn Silage	3 Tobacco	3 Potatoes
99	75	45	70	4.2	3.4	19	2600	240
89	58	39	59	3.2	2.6	15	2100	200
82	52	36	55	2.9	2.4	13	1900	170
75	50	34	50	2.7	2.2	12	1700	140
70	47	30	46	2.5	2.0	11	1500	120
65	40	26	44	2.2	1.9	11	1400	100
60	37	23	40	1.9	1.6	10	1200	80
58	34	22	38	1.7	1.4	9	1100	60
52	28	21	31	1.5	1.0	8	900	50
47	22	20	23	1.1	.6	6	500	40

TABLE 14. LIVESTOCK PRODUCTION FACTORS

5 Hundred lbs. Milk per cow	6 Feeder Calf Weight at 205 days	7 Wool per Sheep Clipped	8 Percent Lamb Crop	9 Eggs per Hen Housed	10 Percent of Hens Died	11 Percent Chick Loss
123	513	8.5	166	258	2	0.6
108	474	7.3	147	245	3	1.0
101	462	7.0	138	234	4	1.6
95	454	6.6	132	229	5	2.1
91	449	6.3	126	224	6	2.7
86	437	6.1	120	215	7	3.3
81	428	6.0	115	206	9	4.2
75	416	5.7	106	192	10	5.3
67	394	5.1	98	175	11	7.4
55	340	4.6	78	153	15	15.2

TABLE 15. FORAGE PER ANIMAL UNIT

2 Acres Hay & Silage per Animal Unit	2 Acres of Pasture per Animal Unit
0.7	1.0
0.9	1.4
1.1	1.8
1.2	2.2
1.4	2.3
1.5	2.4
1.7	2.7
2.1	3.0
3.0	4.3
5.0	5.0

TABLE 16. LABOR EFFICIENCY

Work Units per Man	Dairy Cows per Man	Beef Cows per Man
410	18	55
350	16	47
310	13	39
280	12	35
250	10	31
240	9	27
220	8	23
200	6	19
180	5	16
150	4	12

CROP YIELDS PER ACRE
A COMPARISON AMONG CROPS ON YOUR OWN FARM WITH A COMMON BASIS

The chart on the next page is designed to compare the yields among different crops. The basis used for the comparison is digestible energy.

Different kinds of crops are listed at the top of the columns. Two conversions are listed below each kind of crop. The first is digestible energy in therms per pound of food. The second is total digestible nutrients in percentages. The data on digestible nutrients were taken from Morrison, Feeds and Feeding, 22nd edition, Appendix Table 1. The digestible energy conversion was obtained by multiplying the constant 2.0185 times the digestible nutrient percentage. Calculations were made with digestible energy carried to two places beyond the decimal point, even though only one figure is shown for some feeds.

Along the left side of the table is an array of production in thousands of therms of digestible energy per acre. The scale changes twice. Above the 10,000 level the ranges are one thousand. Between the 5,000 and 10,000 levels the ranges are 500. Below the 5,000 level the ranges are 200 pounds.

The method of preparing yield levels is illustrated with good quality hay. Divide 12,000 therms of digestible energy by 1.11 therms per pound to get 10,811 pounds of T.D.N. Divide 10,811 by 2,000 pounds per ton to get 5.4 tons per acre.

In most all instances, yields are reported in two figures. Because of the reporting of only two figures, a few yields are rounded to the same number at different levels of digestible energy; for example, 12 is repeated under corn silage.

Yields for each crop are listed within the most common ranges of production.

In the appropriate column, draw a heavy line that most nearly corresponds with the yield on your farm. After this is done for each crop, the yields can be observed on a comparative basis.

In the case of hay, six columns are provided with two for each of three kinds of hay. Select the column that most nearly reflects the quality. Write the kind of hay above the appropriate column. Good quality hay is cut early and leaves are kept at harvest. In the case of corn grain, decide whether the crop will be fed as grain without the cob or ground and fed as corn and cob.

If a particular crop is not shown on the next page, another can be used. For example, a silage of sorghum, sudan, soybeans, or combinations of them have about a 15 percent TDN and 0.30 D.E. Use the column for hay-silage without wilt and increase the field yield of the sorghum, sudan or soybeans to 107 percent of its yield. For example: Sudan and soybeans in a field yielded 20 tons. Then 20 tons x 107 = 21.4 tons equivalent in the hay-silage with no wilt column.

CROP YIELDS PER ACRE

A comparison among crops on a common basis

KINDS OF CROPS	Corn & Cob	Shelled Corn	Barley Grain	Oats Grain	Wheat Grain	Soybean Grain	Corn Silage Young	Corn Silage Well Eared	Hay Silage No Wilt	Hay Silage Wilted	Good Hay	Medium Hay	Mature Hay
Dig. Energy	1.5	1.6	1.6	1.4	1.6	1.8	.35	.40	.28	.40	1.11	1.01	.91
Dig. Nutrients	73	80	78	70	80	88	18	20	14	20	55	50	45
Unit of Measure	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.	Ton	Ton	Ton	Ton	Ton	Ton	Ton
Thousands Therms of Digestible Energy per Acre													
20								25					
19								24					
18.								23					
17								21					
16							22	20	29	20.			
15							21	19	27	19			
14	140						19	18	25	18	6.3		
13	130						18	16	23	16	5.9		
12	120						17	15	21	15	5.4	5.9	
11	110	123					15	14	20	14	4.9	5.4	
10	100	112					14	12	18	12	4.5	4.9	5.5
9.5	95	106					13	12	17	12	4.3	4.7	5.2
9.0	90	100					12	11	16	11	4.0	4.5	4.9
8.5	85	95					12	11	15	11	3.8	4.2	4.7
8.0	80	89					11	10	14	10	3.6	4.0	4.4
7.5	75	83					10	9.3	13	9.3	3.4	3.7	4.1
7.0	70	78	93				9.7	8.7	12	8.7	3.1	3.5	3.8
6.5	65	72	86				9.0	8.1	12	8.1	2.9	3.2	3.6
6.0	60	67	79				8.3	7.5	11	7.5	2.7	3.0	3.3
5.5	55	61	73				7.6	6.9	9.8	6.9	2.5	2.7	3.0
5.0	50	56	66		52	47	6.9	6.2	8.9	6.2			
4.8	48	54	64		50	45	6.7	6.0	8.6	6.0	2.3	2.5	2.7
4.6	46	51	61		48	43	6.4	5.7	8.2	5.7	2.2	2.4	2.6
4.4	44	49	58		46	41	6.1	5.5	7.9	5.5	2.1	2.3	2.5
4.2	42	47	56		44	39	5.8	5.2	7.5	5.2	2.0	2.2	2.4
4.0	40	45	53	89	42	37	5.6	5.0	7.1	5.0	1.9	2.1	2.3
3.8	38	42	50	85	40	36	5.3	4.7	6.8	4.7	1.8	2.0	2.2
3.6	36	40	48	80	37	34	5.0		6.4		1.7	1.9	2.1
3.4	34	38	45	76	35	32	4.7		6.1		1.6	1.8	2.0
3.2	32	36	42	71	33	30	4.4		5.7		1.5	1.7	1.9
3.0	30	33	40	67	31	28	4.1		5.4		1.4	1.6	1.8
2.8	28	31	37	62	29	26			5.0		1.3	1.5	1.6
2.6	26	29	34	58	27	24			4.6		1.3	1.4	1.5
2.4			32	54	25	22			4.3		1.2	1.3	1.4
2.2			29	49	23	21			3.9		1.1	1.2	1.3
2.0			26	45	21	19			3.6		1.0	1.1	1.2
1.8			24	40	19	17			3.2		.9	1.0	1.1
1.6			21	36	17	15					.8	.9	1.0
1.4			19	31	15	13					.7	.8	.9
1.2			16	27	12	11					.6	.7	.8
1.0			13	22	10	9					.5	.6	.7
.8			11	18							.4	.5	.5
												.4	.4

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Selected Instructional Materials for Distributive Education

J. C. Levendowski
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FOREWORD

The Council for Distributive Teacher Education was organized in 1961. Membership in the organization consists of teacher educators and other distributive education personnel with an interest in advancing distributive teacher education. The primary interests of the Council are research and publication.

These selected instructional materials were compiled with the hope that they will be valuable to distributive teacher educators, adult instructors, and teacher coordinators. The publications listed are mainly free or inexpensive brochures, bulletins, pamphlets, and paperback books. The purpose of the list is to supplement Bulletin No. 5, Distributive Education Library List, a compilation of text materials for distributive teacher education which was published by CDTE in 1964.

This report was compiled by J. C. Levendowski, Researcher and Teacher Educator, Department of Education, State of California. It was edited by the charter president of CDTE and published through the courtesy of the Bureau of Business Education, California State Department of Education. Requests for copies should be addressed to the author.

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Charter President, CDTE
State Teacher Educator for Distributive Education
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INTRODUCTION

Distributive education teachers have recognized the increasing value of using free and inexpensive instructional materials to supplement basic textbook materials in their teaching.

The purpose of this bibliography is to list the instructional materials that distributive education teachers may secure and evaluate for possible use in the instructional program. A number of the materials listed should prove particularly valuable to distributive education teachers in curriculum development.

The assistance of staff members of the Bureau of Business Education and Carol Stafford, secretary, for her work in preparing the final copy, is deeply appreciated. The author is also very grateful for the cooperation of the publishers, business firms, and governmental agencies who made their materials available for review.

INSTRUCTIONAL MATERIALS

Major Subject Classification

ADVERTISING AND DISPLAY

Type of Pub.*	Publisher	Author	Title
P	2		Questions and Answers About Advertising. 5 pp. Free.
P	2	Simon, Morton J.	The Advertising Truth Book, 1960. 26 pp. $1.00.
P	7		Display for Profit. 12 pp. Free.
P	13	Andersen, John R.	Low-Cost Store Front Modernization, 1958. 40 pp. $1.00.
P	13	Zimmerly, Isabelle M.	Newspaper Advertising for the Small Retailer, 1960. 55 pp. $.50.
P	24		The ADman's Vocabulary. 6 pp. Free.
PB	35	Collins, Kenneth	Successful Store Advertising, 1959. 46 pp. $1.75.
B	41		"Guides for Advertising Allowances and Other Merchandising Payments and Services; Compliance With Sections 2(d) and 2(e) of the Clayton Act, as Amended by the Robinson-Patman Act," adopted May 19, 1960. 10 pp. Free.
B	41		"Guides Against Bait Advertising," adopted November 24, 1959. 3 pp. Free.
B	41		News Summary (weekly). Free.
P	63		Advertise . . . To Promote Your Business to Sell Your Goods, 1958. 28 pp. Free.
P	63		Display Selling, 1959. 24 pp. Free.
P	63		Making Your Windows Work For You, 1959. 20 pp. Free.

* B	Bulletin
P	Pamphlet
PB	Paperback
PM	Programmed Materials
TG	Teaching Guides

Major Subject Classification

ADVERTISING AND DISPLAY

Type of Pub.*	Publisher	Author	Title
B	80		"Advertising For Profit and Prestige," *Small Marketers Aids*, No. 56. Prepared by D. Peter Bowles, June, 1960. 4 pp. Free.
B	80		"Checklist for Successful Retail Advertising," *Small Marketers Aids*, No. 96. Prepared by Charles T. Lipscomb, Jr., October, 1963. 4 pp. Free.
B	80		"Color Can Stimulate Sales," *Small Marketers Aids*, No. 85. Prepared by Ernest Dichter, November, 1962. 4 pp. Free.
B	80		"Interior Display: A Way to Increase Sales," *Small Marketers Aids*, No. 111. Prepared by Gabriel M. Valenti, February, 1965. 4 pp. Free.
B	80		"Making the Most of Your Show Windows," *Small Marketers Aids*, No. 63. Prepared by Josef A. Head, N. M. Cartmell and Associates, March, 1961. 4 pp. Free.
B	80		"Sales Promotion Pointers for Small Retailers," *Small Marketers Aids*, No. 60. Prepared by Bernard W. Smith, December, 1960. 4 pp. Free.
TG	87		"Effective Advertising," *Administrative Management Course Program*, 1965. Pp. iii and 65. $1.25.
P	94	Belding, Don	*5 Talks on Advertising*, 1960. 63 pp. $2.00.
PB	97	Oxenfeldt, Alfred R., and Carroll Swan	*Management of the Advertising Function*, 1964. Pp. viii and 88. $1.95.

INSTRUCTIONAL MATERIALS

Type of Pub.*	Publisher	Major Subject Classification DISTRIBUTIVE OCCUPATIONS SKILLS Author	 Title
P	22		Check Protection Course. $1.00.
P	48	Vogt, David J., M. E. Newton, and Duke Newton	Profitable Check Cashing and Collection Procedures. [illegible] pp. $1.00.
P	56		PHONE POWER. (Series of 7) Free. How to Answer Letters. 4 pp. How to Promote Your Call Collect Program. 4 pp. How to Keep Your Customers Buying From You. 4 pp. How to Revive Inactive Accounts. 4 pp. How to Screen Mail Inquiries. 4 pp. How to Make Appointments. 4 pp. How to Collect Overdue Accounts. 4 pp.
B	56		Relax . . . . When You Write a Letter. 14 pp. Free.
P	56		6 Tips for Friendly and Effective Telephoning. Free.
P	56		Win More Friends by Telephone, 1961. 19 pp. Free.
P	56		You and Your Telephone. Free.
P	63		The Modern Outlook. 35 pp. Free.
P	63		Tips on Making Change. 14 pp. Free.
P	74		How to Spell It, 1963. 19 pp. Free.
TG	85		Basic Instruction for Personal Employability, Pp. iii and 47. Free.
P	87		Know Your Money, 1960. 29 pp. $.20.

* B	Bulletin
P	Pamphlet
PB	Paperback
PM	Programmed Materials
TG	Teaching Guides

INSTRUCTIONAL MATERIALS

Major Subject Classification

DISTRIBUTIVE OCCUPATIONS SKILLS

Type of Pub. *	Publisher	Author	Title
TG	93		Instructor's Manual for Show Card Writing. $.25.
TG	93		Show Card Work Book. $.35.

INSTRUCTIONAL MATERIALS

Major Subject Classification

ECONOMICS

Type of Pub.*	Publisher	Author	Title
P	1	Ketchum, Alton	The Miracle of America, Sixth Edition. 19 pp. Free.
P	3		The Case for the Union Shop. 31 pp. Free.
P	3		Labor Looks at Automation, 1959. 27 pp. Free.
P	3		Why Unions?, 1962. 14 pp. Free.
P	5		Labor Arbitration Procedures and Techniques. 23 pp. Free.
P	5		You Be the Arbitrator!, 1963. 10 pp. Free.
P	6		Banking From the Stone Age - To the Atomic Age, 1962. 20 pp. Free.
P	6	Cooley, John L.	How Banks Help, 1962. 49 pp. Free.
P	6		The Story of American Banking, 1963. 71 pp. $.30.
P	6		Using Bank Services, 1961. 40 pp. Free.
P	7	Fleming, Harold	The American Achievement, 1961. 35 pp. Free.
P	8		How We Organize To Do Business in America. Prepared by Frank C. Cyr. 34 pp. $.25.
P	23		"The Ethics of Capitalism," 1961, The American Competitive Enterprise Economy, No. XVII. 26 pp. $.50.
P	23		Free Markets and Free Men, 1953. Pp. iii and 26. $.50.
P	23		The Goals of Economic Policy, 1961. 35 pp. $.50.

* B Bulletin
P Pamphlet
PB Paperback
PM Programmed Materials
TG Teaching Guides

INSTRUCTIONAL MATERIALS

Major Subject Classification

ECONOMICS

Type of Pub. *	Publisher	Author	Title
P	23		Inflation, Unions and Wage Policy, 1960. 44 pp. $1.00.
P	23		"The National Income and its Distribution," 1963, The American Competitive Enterprise Economy, No. IV. 26 pp. $.50.
P	23		"Prices, Profits and Wages," 1961, The American Competitive Enterprise, No. VIII. 31 pp. $.50.
P	23		Productivity and Wage Settlements, 1961. 14 pp. $.50.
P	23		Profits - Something for Everyone, 1957. 35 pp. $.50.
P	23		Promise of Economic Growth - Prospects, Costs, Conditions. 1960. 55 pp. $1.00.
P	23		"Understanding the Economic System and Its Functions," 1960, The American Competitive Enterprise Economy. No. XI. 27 pp. $.50.
P	34		Automation and Employment, 1964. 32 pp. Free.
P	34		The Profit Motive. 32 pp. Free.
P	34		The Story of Competition in the American Market. 1959. 32 pp. Free.
P	34		The Story of Creative Capital. 32 pp. Free.
P	34		The Story of Man and His Work, 1959. 32 pp. Free.
P	34		The Story of Prices, 1960. 32 pp. Free.
P	34		The Story of Taxes, 1957. 32 pp. Free.
P	34		The Story of World Trade, 1960. 32 pp. Free.

INSTRUCTIONAL MATERIALS

Major Subject Classification

ECONOMICS

Type of Pub. *	Publisher	Author	Title
PB	36		The Federal Reserve System: Purposes and Functions, 4th Edition, 1961. Pp. xvi and 238. Free.
P	36		Money: Master or Servant?, 2nd Edition, 1960. 47 pp. Free.
PB	36		Readings on Money, 2nd Edition, 1957. 58 pp. Free.
P	36		The Search for Certainty in an Uncertain World, 1962. 72 pp. Free.
P	36		Your Money and the Federal Reserve System. 20 pp. Free.
P	37		Modern Money Mechanics, 1961. 34 pp. Free.
P	38		Coins and Currency. 15 pp. Free.
P	38		Keeping Your Money Healthy, 1960. 16 pp. Free.
P	38		Money and Economic Balance, 1962. 28 pp. Free.
P	38		The Story of Checks, 2nd Edition, 1962. 20 pp. Free.
B	39		SERIES FOR ECONOMIC EDUCATION. Free. Automation. 9 pp. 1964. The Balance of Payments. 13 pp. Gold! 9 pp. 1963. The Mystery of Economic Growth. 9 pp. 1962. The New Poverty. 10 pp. 1964. The Price System. 9 pp. 1962. Tax Cut: Price of Prosperity? 9 pp. 1963. Unemployment in Prosperity Why? 8 pp.
P	40		An Introduction to the History of Coinage and Currency in the United States, 1960. 32 pp. Free.

INSTRUCTIONAL MATERIALS

Major Subject Classification

ECONOMICS

Type of Pub.*	Publisher	Author	Title
P	40		Your Money Supply. 23 pp. Free.
P	42		The Evolution of Mass Production, 1956. 52 pp. Free.
B	42		1963 Business Trends and Progress. Free.
P	43		Unions and Union Leaders of Their Own Choosing, 1957. 24 pp. Free.
P	44	Kettering, Charles F., and Allen Orth	American Battle for Abundance, 1955. 103 pp. Free.
P	50	Mors, Wallace P.	"Consumer Credit Facts For You," 1959, Bureau of Business Research Educational Pamphlet No. 1. 32 pp. Free.
PB	54	Hacker, Louis M.	American Capitalism Its Promise and Accomplishment. 1957. 192 pp. $1.25.
PB	54	Rogers, Jack	Automation, 1958. Pp. viii and 94. $.50.
PB	54	Cochran, Thomas C.	Basic History of American Business, 1959. 192 pp. $1.25.
PB	54	Allen, Frederick Lewis	The Big Change - America Transforms Itself 1900-1950. 1952. Pp. ix and 271. $.50.
P	54	Korey, Edward L.	Business and the American Way, 1952. 33 pp. $.65.
P	54		Capital Key to Progress, 1952. 34 pp. $.50.
P	54		Competitive Prices in Action, 1958. 30 pp. $.50.
P	54		Economic Security for Americans, 1961. 51 pp. $.65.
PB	54	Oxenfeldt, Alfred R.	Economic Systems in Action, 1960. Pp. xiv and 207. $2.75.

INSTRUCTIONAL MATERIALS

Type of Pub. *	Publisher	Major Subject Classification ECONOMICS	
		Author	Title
P	54	Bloom, Clark C.	How the American Economy Is Organized, 1961. Pp. i and 34. $1.00.
P	54		How a Corporation Works, 1960. 15 pp. $.25.
P	54		How Everybody Makes a Living, 1959. 11 pp. $.25.
P	54		How to Raise Real Wages, 1961. 31 pp. $.50.
P	54	Wagner, Lewis E.	Income, Employment and Prices, 1960. 38 pp. $1.00.
P	54	Daugherty, Carroll R.	Inflation: Its Causes and Effects. 7 pp. Free.
PB	54	Calderwood, James D.	International Economic Problems, 1961. 71 pp. $1.00.
PB	54	Starr, Mark	Labor and the American Way, 1961. 92 pp. $.65.
P	54	Wagner, Lewis E.	Measuring the Performance of the Economy, 1961. Pp. i and 39. $1.00.
P	54	Wagner, Lewis E.	Methods of Organizing Economic Activity in the United States and the Soviet Union, 1961. 8 pp. Free.
P	54	Weiler, E. T.	Personal Distribution, 1961. 14 pp. Free.
PB	54	Steiner, Peter O., and William Goldner	Productivity, 1952. Pp. vii and 60. $.50.
P	54	Backman, Jules	What Productivity Means to Each of Us, 1961. 15 pp. Free.
P	54		Profits at Work, 1961. 26 pp. $.50.
PB	54	Campbell, Robert W.	Soviet Economic Power, 1960. Pp. x and 209. $1.95.
P	54	Wagner, Lewis E.	What Are Economic Problems?, 1961. Pp. i and 19. $.50.

INSTRUCTIONAL MATERIALS

Type of Pub.*	Publisher	Major Subject Classification ECONOMICS	
PB	54	Heilbroner, Robert L.	The Worldly Philosophers, 1961. 309 pp. $1.50.
P	55		A Primer on Profits, 29 pp. Free.
PB	58	Leamer, Laurence E., and Dorothy L. Thomson	American Capitalism, An Introduction, Revised Edition, 1961. Pp. xi and 116. $1.00.
PB	58	de Rycke, Laurence	Beginning Readings in Economics, 1961. 367 pp. $2.80.
PB	58	de Rycke, Laurence, and Alvin H. Thompson	Business Enterprise in the American Economy, 1961. 110 pp. $1.00.
PM	58	Attiyeh, Richard E.	"Capitalism, Communism, and Socialism," 1963. The American Economics Series, Book 7. 292 pp, 280 frames. $2.40.
PB	58	Lee, Baldwin	Capitalism and Other Economic Systems, 1959. Pp. v and 122. $1.00.
PM	58	Weiner, Samuel	"The Federal Reserve System and Its Effect on Money and Banking," 1963. The American Economics Series, Book 4. Pp. vii and 264, 264 frames. $2.40.
PM	58	Lumsden, Keith G.	"The Free Enterprise System," 1963. The American Economics Series, Book 1. Pp. ix and 274, 823 frames. $2.40.
PM	58	Lumsden, Keith G.	"The Gross National Product," 1964. The American Economics Series, Book 2. Pp. viii and 344, 689 frames. $2.40.
PB	58	Welfling, Weldon	Money & Banking in the American Economy, 1960. 104 pp. $1.00.
PM	58	Attiyeh, Richard E.	"Problems of Economic Stability and Growth," 1964. The American Economics Series, Book 3. 314 pp, 564 frames. $2.40.
P	60		What Everybody Ought to Know About This Stock and Bond Business, 1960. 20 pp. Free.

INSTRUCTIONAL MATERIALS

Major Subject Classification

ECONOMICS

Type of Pub. *	Publisher	Author	Title
P	62		INDUSTRY AND THE AMERICAN ECONOMY SERIES. National Association of Manufacturers. Price not available. Capital and Economic Growth, 1962. 14 pp. A Comparison of Three Economic Systems, 1962. 22 pp The Growth of American Industry, 1959. 38 pp. Industrial Research and Development, 1962. 14 pp. Industry - Organization and Employees, 1961. 14 pp. Industry's Profits, 1959. 10 pp. Our Native Land, 1961. 30 pp. Productivity and Production in Industry, 1961. 14 pp. The Role of Competition, 1961. 14 pp. The Role of Marketing, 1961. 14 pp. Wages and Prices in an Industrial Economy, 1961. 10 pp.
P	62		Monopoly Power as Exercises by Labor Unions. 31 pp. Free.
P	62		Wages ...Prices...Profits...and Inflation!, 1957. $.25.
P	63		Bank Terminology, 1962. 45 pp. Free.
P	63		4000 Years of Banking. 21 pp. Free.
P	68	Taft, Philip	Corruption and Racketeering in the Labor Movement, 1958. 58 pp. $.30.
P	68	Doherty, Robert E.	Industrial and Labor Relations Terms, 1962. 32 pp. $.15.
P	68	Cullen, Donald E.	Minimum Wage Laws, 1961. Pp. v and 58. $.50.
	69		"Portfolio of Teaching Aids," Prepared by the New York Stock Exchange. (To accompany the eleven-unit series "You and the Investment World"). Free.

INSTRUCTIONAL MATERIALS

Major Subject Classification

ECONOMICS

Type of Pub.	Publisher	Author	Title
P	73	Heilbroner, Robert L.	This Growing World, 1961. 20 pp. $.25.
P	73	Barbash, Jack	The Labor Movement in the United States, 1958. 28 pp. $.25.
P	73	Stewart, Maxwell S.	The Taxes We Pay, 1959. 27 pp. $.25.
PB	78	Senesh, Lawrence, and Barbara W. Newell	Our Labor Force, 1961. 84 pp. $1.00.
PB	78	Daugherty, Marion	Understanding Economic Growth, 1961. 119 pp. $1.00.
PB	78	Calderwood, James D., and Hazel J. Jones	World Trade, 1961. 68 pp. $.90.
B	80		"Arbitration and the Small Businessman," Management Aids for Small Manufacturers, No. 106. Prepared by S. Whitney Landon, August, 1959. 4 pp. Free.
B	80		"Small Business and Pattern Bargaining," Management Research Summary. Prepared by Walter H. Carpenter, Jr. and Edward Handler, June, 1961. 4 pp. Free.
PB	82	Hailstones, Thomas J.	Readings in Economics, 1963. Pp. viii and 512. $5.00.
P	86		Important Events in American Labor History... A Chronology 1778-1959. 50 pp. Free.
P	87		Brief History of the American Labor Movement, 1957. Pp. vi and 85. $.35.
PB	87		Antitrust Laws With Amendments 1890-1964, 1964. Compiled by Gilman G. Udell. Pp. vi and 129. $.40.
P	87		How American Buying Habits Change, 1959. 235 pp. $1.00.
P	87		Money Facts, 1964. Pp. v and 35. $.15.

INSTRUCTIONAL MATERIALS

Type of Pub. *	Publisher	Major Subject Classification ECONOMICS Author	Title
P	87		A Primer on Money, 1964. Pp. vii and 144. $.40.
P	87		Do You Know Your Economic ABC's? 40 pp. $.20.
P	87		U. S. Balance of Payments, 1964. 44 pp. $.25.
P	88		Collective Bargaining or Monopoly. 90 pp. Free.
PB	96	Traywick, Leland E.	Business Ups and Downs, 1961. 83 pp. $.96.
PB	96	Lovenstein, Meno	Capitalism, Communism, Socialism, 1962. 150 pp. $.96.

INSTRUCTIONAL MATERIALS

Type of Pub.*	Publisher	Major Subject Classification GUIDANCE Author	Title
P	29		Opportunities in Selling, 1963. 23 pp. $.25.
P	44		Can I Get the Job. Single copies Free.
P	44		Key to Careers in the Retail Automotive Business. 36 pp. Free.
P	44		Professional Profile of an Automobile Salesman, 1961. 30 pp. Free.
P	45		Getting The Right Job, 1962. Free.
P	46		...and That's No Bull! 12 pp. Free.
P	46		High School Recruiting, 1960. 20 pp. Free.
P	59		Wholesaling as a Career? Free.
P	62		Your Opportunities in Distribution, 1955. 30 pp. Free.
P	65		A Career for You in Sales and Marketing Management. 22 pp. Free.
P	66	Anderson, Kenneth L.	What's Selling? 32 pp. Free.
P	67	Whitney, Robert A.	Should You Be A Salesman?, 1959. 11 pp. Free.
P	67	Lazarus, Fred Jr.	Should You Go Into Retailing?, 1960. 11 pp. Free.
P	71		You and Your First Job, 1963. $.15.
P	75	Kirkpatrick, C. A.	Selling as a Career. Free.
P	76	Mullin, Stanley H.	What You Should Know About Sales Careers, 1964. 20 pp. $.25.
P	76		Your Opportunities in Sales and Marketing. Free.

* B Bulletin
P Pamphlet
PB Paperback
PM Programmed Materials
TG Teaching Guides

INSTRUCTIONAL MATERIALS

Type of Pub. *	Publisher	Author	Major Subject Classification GUIDANCE Title
P	77	Gilles, Lambert L.	Charting Your Job Future, 1957. 72 pp. $1.90.
P	77		Jobs in Selling, 1965. 46 pp. $1.25.
P	87		Careers in Business Management, 1960. 20 pp. $.20.
P	87		Choosing Your Occupation, 1962. 16 pp. $.15.
P	87		How to Get and Hold the Right Job..., 1962. 18 pp. $.10.

INSTRUCTIONAL MATERIALS

Type of Pub. *	Publisher	Major Subject Classification MANAGEMENT	
		Author	Title
P	13	Hill, Richard M.	Setting Sales Objectives for Small Business, 60 pp. $1.25.
P	14	Morgan, Howard E.	The Motel Industry in the United States: Small Business in Transition, 1964. Pp. xxii and 218. $1.50.
P	15	Fritzemeyer, Joe R., and William L. Haeberle	"Control for Profit in Retail Automobile Dealership," Small Business Management Research Report, March, 1961. 70 pp. $1.50.
P	15	Klasson, Charles R., and Edgar G. Williams	"Management and Financial Controls for Appliance Dealers," Small Business Management Research Report, 1961. 95 pp. $2.50.
P	15	Hay, Leon E., and Alfred Schmidt	"Management and Financial Controls for Men's Clothing Stores," Small Business Management Research Report, March, 1961. 70 pp. $1.50.
P	15	Yoder, Wallace O., and C. E. Vincent	"Management and Financial Controls for Retail Hardware Stores," Small Business Management Research Report, 1961. 65 pp. $2.00.
P	16	Lipson, Harry A.	"Selected Cases of Alabama Small Retail Stores," Small Business Management Research Report, 1963. Pp. iii and 52. $1.00.
P	16	Lipson, Harry A.	"Ten Alabama Small Retail Cases," Small Business Management Research Report, 1961. Pp. iii and 63. $1.00.
P	17	Kline, John B.	"Case Problems of Small Business in the Rocky Mountain West," Small Business Management Research Report, 1961. Pp. v and 202. $2.50.

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P	Pamphlet
PB	Paperback
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INSTRUCTIONAL MATERIALS

Major Subject Classification

MANAGEMENT

Type of Pub. *	Publisher	Author	Title
P	19	Young, Elmer R.	"Introduction to Merchandise Management Accounting for Small Retail Outlets," Small Business Management Research Report, 1964. 64 pp. $1.50.
P	21	Rotch, William	"Management of Small Enterprises, Cases and Readings," Small Business Management Research Report, 1964. 321 pp. $3.00.
P	23		Small Business: Its Role and Its Problems, 1962. 42 pp. $.50.
P	25	Erwin, Robert D.	"Merchandise Management Accounting - A Guide to Item Profitability for Small and Medium Retail Stores," Small Business Management Research Report, 1964. 128 pp. $2.50.
P	28		Consumers Look at Fair Trade, 1955. 38 pp. $.50.
P	28	Joskow, Jules, and Irwin M. Stelzer	The Consumer and Antitrust, 1957. 31 pp. $.50.
P	32	Childress, Russell L.	"Trends and Prospects for Affiliated Food Retailers," Small Business Management Research Report, 1962. Pp. viii and 164. $2.00.
P	33		The Failure Record Through 1963. 14 pp. $1.00.
P	33		Getting Ahead in Small Business, 1954. 32 pp. Free.
P	33		How to Build Profits by Controlling Costs, 1959. 47 pp. $1.00.
P	33		How to Control Accounts Receivable for Greater Profits, 1959. 35 pp. $1.00.
P	33		How Does Your Business Compare With Others in Your Line? 23 pp. Free.

INSTRUCTIONAL MATERIALS

Major Subject Classification

MANAGEMENT

Type of Pub. *	Publisher	Author	Title
P	33		How to Use Your Dun & Bradstreet Service Most Effectively. 44 pp. Free.
P	33		The Mercantile Agency, 1959. 65 pp. Free.
P	33		Opportunities for Growth in Small Business, 1958. 31 pp. Free.
P	33		The Pitfalls in Managing a Small Business, 1956. 22 pp. Free.
P	33		Profitable Management for Main Street, 1959. 48 pp. $1.00.
P	34		The Story of Management, 1961. 32 pp. Free.
P	48	Vogt, David J., M. E. Newton, Duke Newton	Profitable Check Cashing and Collection Procedures. 15 pp. $1.00.
P	51	Preston, Lee E.	"Profits, Competition and Rules of Thumb in Retail Food Pricing," Small Business Management Research Report, 1963. 71 pp. $2.50.
B	52		The Good Things of Life. Free
P	52	Womack, S. H.	Human Relations Fundamentals for Retail Credit Employees. Pp. v and 63. $2.50.
P	52	Phelps, Clyde Williams	Important Steps in Retail Credit Operation. 72 pp. $1.00.
P	52	Bandy, William R.	Legal Aspects of Consumer Credits and Collections. 62 pp. $2.50.
P	52		Making Credit Profitable. 43 pp. $.75.
P	52		Retail Collection Procedure and Effective Collection Letters. 71 pp. $2.00.
P	52		Retail Credit Sales Procedures and Letters. 72 pp. $2.00.

INSTRUCTIONAL MATERIALS

Type of Pub.*	Publisher	Major Subject Classification MANAGEMENT Author	Title
PB	55	Hailes, Wm. D. Jr., and Raymond T. Hubbard	Small Business Management. Pp. iv and 329. $3.96. 1965.
PB	58	Koontz, Harold, and Cyril O'Donnell	Management: A Book of Readings, 1964. 563 pp. $7.50.
PB	58	Dale, Ernest	Readings in Management: Landmarks and New Frontiers, 1965. Pp. xv and 516. $5.50.
P	60		How to Read a Financial Report, 1959. 28 pp. Free.
P	63		Credits and Collections, 1960. 35 pp. Free.
P	63		Electronic Data Processing, A Management Report by NCR. Free.
P	63		Expenses in Retail Businesses. 46 pp. Free.
P	63		Profiting by Adequate Business Records, 1961. 36 pp. Free.
P	69		How to Understand Financial Statements. 33 pp. Free.
B	80		"The ABC's of Borrowing," Management Aids for Small Manufacturers, No. 170. Prepared by Eugene P. Foley, February, 1965. 8 pp. Free.
B	80		"Break-Even Point Studies for Small Marketers," Small Marketers Aids, No. 50. Prepared by Samuel Berke, November, 1959. 4 pp. Free.
B	80		"Building Strong Relations With Your Bank," Small Marketers Aids, No. 107. Prepared by James A. Cashin, December, 1964. 4 pp. Free.
B	80		"Business Ethics and Small Marketers," Small Marketers Aids, No. 44. Prepared by Wayne A. R. Leys, May, 1959. 4 pp. Free.

INSTRUCTIONAL MATERIALS

Major Subject Classification

MANAGEMENT

Type of Pub. *	Publisher	Author	Title
B	80		"Checklist for Going Into Business," Small Marketers Aids, No. 71. September, 1961. 4 pp. Free.
B	80		"Choosing the Legal Structure for Your Firm," Management Aids for Small Manufacturers, No. 80. Prepared by Edward L. Anthony and A. Barr Comstock, February, 1957. 4 pp. Free.
B	80		"Collecting Past Due Accounts Without Losing Customers," Management Aids for Small Manufacturers, No. 168. Prepared by J. W. Eller, November, 1964. 4 pp. Free.
B	80		"Controlling Your Business Future," Small Marketers Aids, No. 48. Prepared by F. L. Fletcher, September, 1959. 4 pp. Free.
B	80		"Controlling Cash in Small Retail and Service Firms," Small Marketers Aids, No. 110. Prepared by D. S. Campbell, February, 1965. 4 pp. Free.
B	80		"Correcting the Causes of Marketing Waste," Small Marketers Aids, No. 90. Prepared by R. M. Hill, April, 1963. 4 pp. Free.
B	80		"Electronic Recordkeeping for Small Marketers," Small Marketers Aids, No. 84. Prepared by James M. Adams, Jr., October, 1962. 4 pp. Free.
B	80		"Finding and Hiring the Right Employee," Small Marketers Aids, No. 106. Prepared by Rudolph Raphelson, September, 1964. 4 pp. Free.
B	80		"Growth: Implications for Small Marketers," Small Marketers Aids, No. 86. Prepared by Albert Christopher, December, 1962. 4 pp. Free.

Major Subject Classification

MANAGEMENT

Type of Pub.*	Publisher	Author	Title
B	80		"Is Your Cash Supply Adequate?," Management Aids for Small Manufacturers, No. 174. Prepared by Jack H. Feller, Jr., April, 1965. 4 pp. Free.
B	80		"Keeping Score With Effective Records," Small Marketers Aids, No. 94. Prepared by William L. Raby, August, 1963. 4 pp. Free.
B	80		"Management Planning for Sound Growth," Management Aids for Small Manufacturers, No. 122. Prepared by Bruce E. DeSpelder, February, 1961. 4 pp. Free.
B	80		"Pointers for Developing Your Top Assistant," Small Marketers Aids, No. 101. Prepared by Med Serif, April, 1964. 4 pp. Free.
B	80		"Preventing Accidents in Small Stores, " Small Marketers Aids, No. 104. Prepared by S. J. (Bob) Curtis, July, 1964. 4 pp. Free.
B	80		"A Pricing Checklist for Managers," Small Marketers Aids, No. 105. Prepared by Joseph D. O'Brien, August, 1964. 4 pp. Free.
B	80		"Trade Regulation and Small Business," Small Marketers Aids, No. 67. June, 1961. 4 pp. Free.
TG	87		"Financing . . . Short and Long Term Needs," Administrative Management Course Program, Topic 5, 1965. Pp. iii and 74. $1.25.
PB	87	Mayer, Kurt B., and Sidney Goldstein	The First Two Years: Problems of Small Firm Growth and Survival, 1961. Pp. x and 233. $1.00.
TG	87		"Personnel Management - Developing Good Employees," Administrative Management Course Program, Topic 6, 1965. Pp. iii and 87. $1.25.

INSTRUCTIONAL MATERIALS

Type of Pub. *	Publisher	Major Subject Classification MANAGEMENT	
		Author	Title
TG	87		"Records and Credit in Profitable Management," Administrative Management Course Program, Topic 2, 1964. Pp. iii and 66. $1.25.
B	87		Small Business Problems in Urban Areas, 1965. 167 pp. $.50.
B	87		Small Marketers Aids, Annual No. 1. Edited by Harry David, 1959. 87 pp. $.45.
B	87		Small Marketers Aids, Annual No. 2. Edited by Robert A. Litzberg, 1960. 79 pp. $.40.
B	87		Small Marketers Aids, Annual No. 3. Edited by Robert A. Litzberg, 1961. 63 pp. $.40.
P	87	Metcalf, Wendell O.	Starting and Managing a Small . . . Business of Your Own, 1958. Pp. v and 49. $.40.
TG	87		"Success and Failure Factors in Small Business," Administrative Management Course Program, Topic 1, 1964. Pp. iii and 77. $1.25.
TG	87	Sangston, H. Earl	Suggested Management Guides, 1962. 308 pp. $1.75.
P	89	Bell, Robert W.	"Business Budgeting for Small Department Stores," Small Business Management Research Report, 1963. $2.00.
P	91	Nybroten, Norman	Credit Practices of Retailers and Financers of Furniture and Home Appliances in Two Northwest Cities, 1963. 101 pp. $3.00.
P	92	Haynes, W. Warren	"Pricing Decisions in Small Business," Small Business Management Research Report, 1962. 152 pp. $3.00.
PB	98	Coppola, Andrew J., and Harry Katz	The Law of Business Contracts, 1963. Pp. viii and 179. $3.50.

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Type of Pub.	Publisher	Major Subject Classification MARKETING Author	 Title
PB	4	Lockley, Lawrence C., and Charles J. Dirksen	Cases in Marketing, 1964. Pp. xiii and 318. $4.95.
PB	10	Andersen, R. Clifton, and Philip R. Cateora	Marketing Insights, 1963. Pp. xii and 395. $3.95.
PB	26		The European Common Market & Its Meaning to the United States. 152 pp. $2.00.
P	27		ABC's of Foreign Trade, 1961. 33 pp. Free.
P	27		Foreign Trade, So What? Free.
PB	49	Edited by: Barksdale, H. C.	Marketing: Change and Exchange, 1964. Pp. vii and 322. $3.50.
PB	49	Edited by: Barksdale, H. C.	Marketing in Progress - Patterns and Potentials, 1964. Pp. xi and 740. $6.25.
P	54		America and the World Economy, 1954. 34 pp. $.50.
PB	57	Shaw, Steven J., and C. McFerron Gittinger	Marketing in Business Management, 1963. Pp. viii and 472. $4.95.
PB	57	Westing, J. Howard, and Gerald Albaum	Modern Marketing Thought, 1964. 430 pp. $3.95.
PB	58	Howard, Marshall C.	Legal Aspects of Marketing, 1964. Pp. xi and 173. $2.75.
P	61		Marketing in Our Economy. Developed and produced by Paul S. Amidon & Associates, Inc. 23 pp. $.25.
P	62		The Role of Marketing, 1961. 14 pp. Free.

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P	70		20 Steps to Successful Test Marketing. 23 pp. Free.
B	72		Problems in Marketing, Series 1-19, 1956-1964. Free.
P	79	Kircher, Donald P.	American Foreign Trade Policy, 1962. Free.
B	80		"Checking Your Marketing Channels," Management Aids for Small Manufacturers, No. 120. Prepared by Dr. Richard M. Clewett, January, 1961. 4 pp. Free.
B	80		"Key Marketing Words -- What They Mean," Management Aids for Small Manufacturers, No. 127. Prepared by Ralph S. Alexander, August, 1961. 4 pp. Free.
B	80		"Selecting Marketing Research Services," Management Aids for Small Manufacturers, No. 117. Prepared by William C. Gordon, Jr., July, 1960. 4 pp. Free.
TG	84		Marketing Research. Training Manual No. 117. Pp. vii and 77. Free.
PB	90	Griffin, Harold E.,Jr.	Economic Considerations for Small Operators, 1963. 137 pp. $2.50.
PB	93	Lewis, Edwin H., and Robert S. Hancock	The Franchise System of Distribution, 1963. 95 pp. $2.50.
P	93	Holloway, Robert J.	Marketing Research and Market Planning for the Small Manufacturer, 1961. 51 pp. $1.50.
PB	97	Edited by: Shultz, William J., and Edward M. Mazze	Marketing in Action: Readings, 1963. Pp. xiii and 486. $4.25.
PB	98	Holloway, Robert J., and Robert S. Hancock	The Environment of Marketing Behavior, 1964. Pp. ix and 352. $4.95.

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Major Subject Classification

MERCHANDISING

Type of Pub. *	Publisher	Author	Title
	11		Business Simulations 1 & 2, 1965. $7.50.
P	12	Schreiber, G. R.	A Concise History of Vending in the U.S.A., 1961. 46 pp. $.75.
P	18	Mertes, John E.,	Creative Site Evaluation for the Small Retailer, 1962. Pp. iii and 236. $3.00.
P	28	Lee, Stewart M.	Consumers Look at Discount Houses, 1958. Pp. iv and 32. $.50.
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P	47		Nonsense and Horse Sense About Discount Retailing, Volume 32, Number 9, September, 1961. 8 pp. Free.
P	52		How to Use Consumer Credit Wisely, 1962. 30 pp. $.30.
PB	53	Rath, Patricia Mink, Gerald R. Tapp, and Ralph Mason	Case Studies in Marketing and Distribution, 1965. Pp. xii and 179. $2.00.
P	63		Cash Registers -- Their Place in Modern Retail Security, 1962. 9 pp. Free.
P	63		Controlling Merchandise, 1958. 11 pp. Free.

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Major Subject Classification

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Type of Pub.*	Publisher	Author	Title
P	63		Pointing the Way Toward Merchandising Today, 1961. 24 pp. Free.
P	63		The Race for the Customer's Dollar . . . is a 'Free-For-All'. 17 pp. Free.
P	63	Wilson, John M.	The 10 Commandments of Mass Retailing, 1956. 71 pp. Free.
B	80		"Are Your Textile Labels Legal?," Small Marketers Aids, No. 58. Prepared by Harvey H. Hannah, July, 1960. Free.
B	80		"Building Repeat Retail Business," Small Marketers Aids, No. 108. Prepared by Stuart G. Levy, Jr., December, 1964. 4 pp. Free.
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B	80		"FTC and Guides Against Deceptive Pricing," Small Marketers Aids, No. 42. Prepared by Charles E. Grandey, April, 1959. 4 pp. Free.
B	80		"Methods for Improving Off-Season Sales," Small Marketers Aids, No. 32. Prepared by Robert D. Entenberg, April, 1958. 4 pp. Free.
B	80		"Offsetting the Higher Cost of Doing Business," Small Marketers Aids, No. 91. May, 1963. 4 pp. Free.
B	80		"Pleasing Your Boss, the Customer," Small Marketers Aids, No. 114. Prepared by Dwayne Laws, June, 1965. 4 pp. Free.
B	80		"Pricing Your Services for Profit," Small Marketers Aids, No. 89. Prepared by Alfred A. Cox, March, 1963. 4 pp. Free.

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B	80		"Stimulating Impulse Buying for Increased Sales," Small Marketers Aids, No. 109. Prepared by John S. Wright, January, 1965. 4 pp. Free.
P	83		Some Frequently Asked Questions About S&H and the Trading Stamp Business, 1958. 24 pp. Free.
P	83		Trading Stamps and the Competitive Economy, 1957. 13 pp. Free.
TG	84		Wholesale Merchandising, 1960. Training Manual No. 105. Pp. iv and 159. Free.
P	90		Some Effects of the Growth of Planned and Controlled Shopping Centers on Small Retailers, 1960. 178 pp. $3.50.

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Type of Pub. *	Publisher	Major Subject Classification PROGRAM DEVELOPMENT	
		Author	Title
B	20		A Model Instructional Materials File for Coordinators of Cooperative Occupational Education, 1965. 14 pp. Price not available.
B	80		"How Distributive Education Helps Small Business," Small Marketers Aids, No. 14. Prepared by John A. Beaumont, December, 1961. 4 pp. Free.
	82	Haines, Peter G. and Herbert H. Tedder	Distributive Education Training Guides, 1963. Pp. iii and 202. $2.80.
P	83		Publicity Handbook; A Guide for Publicity Chairmen, 1962. 24 pp. Free.
P	93		Now That I Am A Training Sponsor. 13 pp. $.25.

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INSTRUCTIONAL MATERIALS

Type of Pub. *	Publisher	Author	Major Subject Classification SALESMANSHIP Title
P	13	Seymour, Robert G.	The How of Successful Selling, 1960. 26 pp. $.50.
P	31		If You Could Only Be At Every Point of Sale. 12 pp. Free.
P	33	Gentile, Joseph	Some Do's and Don'ts of Selling As One Buyer Sees Them, 1955. 29 pp. Free.
P	56		A Blue Print for Telephone Selling - Planning Your Telephone Selling Approach. Free.
P	56		A Formula for Profit. 22 pp. Free.
P	56		Selling by Telephone. Free.
P	63		Better Retail Selling. 23 pp. Free.
P	63		How to Keep Customers Buying in a Self-Service Store. 24 pp. Free.
B	80		"Common Sale and Payment Terms," Small Marketers Aids, No. 59. 1960. 4 pp. Free.
B	80		"Easy-To-Make Flip Charts Provide Selling Tools," Management Aids for Small Manufacturers, No. 167. Prepared by Ralph E. Steere, September, 1964. 4 pp. Free.
B	80		"Make Selling Attractive to Salespeople," Small Marketers Aids, No. 100. Prepared by Gerald D. Grosner, March, 1964. 4 pp. Free.
TG	80		"Managing to Sell," Administrative Management Course Program, 1964. Pp. viii and 74. $1.50.

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INSTRUCTIONAL MATERIALS

Major Subject Classification

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B	80		"Quality and Taste As Sales Appeals," Small Marketers Aids, No. 113. Prepared by Robert H. Myers, June, 1965. 4 pp. Free.
B	80		"Revitalize Personal Selling in Your Store," Small Marketers Aids, No. 103. Prepared by Karen R. Gillespie, May, 1964. 4 pp. Free.
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B	80		"Understanding Why They Buy," Small Marketers Aids, No. 73. Prepared by Dr. Bertrand Klass, November, 1961. 4 pp. Free.
P	81		Hints on Selling by Telephone, (Form SCHL-12), 1960. 11 pp. Free.
B	81		"Human Relations in Selling," Sales Reminders, Nos. 31-40. 1955. 20 pp. $1.00.
B	81		"Lost Sales -- Their Causes and Remedies," Sales Reminders, Nos. 11-20. 1953. 20 pp. $1.00.
PM	81	Schiff, J. S.	Salesmanship Fundamentals, 1964. 310 pp., frames 609. $27.50.
B	81		Sales Reminders, Nos. 1-10. 20 pp. $1.00.
B	81		"So Your Customer Didn't Buy!," Sales Reminders, Nos. 21-30. 1954. 20 pp. $1.00.

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Major Subject Classification

SUPERVISION AND HUMAN RELATIONS

Type of Pub.*	Publisher	Author	Title
P	9	Patterson, J. M.	<u>What's Your Public Relations Quotient</u>? 35 pp. Free.
B	13		"ABC of Supervision," <u>University of Illinois Bulletin</u>. 47 pp. $.50.
P	30		<u>What a Supervisor Should Know About... Constructive Discipline</u>, 1962. 23 pp. $.25.
P	30		<u>What a Supervisor Should Know About...Customer Relations</u>, 1962. 23 pp. $.25.
PB	77	Chapman, Elwood N.	<u>Your Attitude is Showing</u>, 1964. Pp. iii and 149. $2.50.
B	80		"Creative Thinking: A Commonsense Approach," <u>Small Marketers Aids</u>, No. 92. Prepared by Bruce Goodpasture, June, 1963. 4 pp. Free.
B	80		"Essential Personal Qualities for Small Store Managers," <u>Small Marketers Aids</u>, No. 46. Prepared by Dr. Jerome C. Beam, July, 1959. 4 pp. Free.
B	80		"Managing for Better Morale," <u>Small Marketers Aids</u>, No. 37. Prepared by Martin M. Bruce, December, 1958. 4 pp. Free.
TG	87		"Human Factors in Small Business," <u>Administrative Management Course Program</u>, Topic 10. Pp. iii and 82. $1.50.
TG	87		"Personnel Management," <u>Administrative Management Course Program</u>, Topic 6. Pp. iii and 87. $1.25.
PB	95		<u>The Human Side of Store Supervision</u>, 1958. 40 pp. $3.00.

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85. U. S. Department of Health, Education
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Bureau of Adult and Vocational
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Related Instruction in Agricultural Occupations and Employment Experience, Report of the Workshop in Agricultural Education (Ames, June 7-24, 1966).

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*CURRICULUM GUIDES, *OFF FARM AGRICULTURAL OCCUPATIONS, UNITS OF STUDY (SUBJECT FIELDS), *VOCATIONAL AGRICULTURE, EMPLOYMENT OPPORTUNITIES, *COOPERATIVE EDUCATION, AGRICULTURAL SAFETY, HUMAN RELATIONS, SALESMANSHIP, BUSINESS SKILLS,

Twenty-six vocational agricultural teachers, following state guidelines for agricultural occupations and employment experience programs in vocational agriculture, developed the nine modules included in this report. The modules are (1) an overview of agricultural industry, (2) career opportunities, (3) occupational experience program orientation, (4) safety, (5) human relations, (6) agricultural salesmanship, (7) business organization and functions, (8) business procedures, and (9) new agricultural technology developments. Each module consists of an introduction, objectives, recommended time allotment, competencies to be taught, followup and evaluation techniques, references, instructional materials, subject matter content, and special teaching-learning activities. (JM)

RELATED INSTRUCTION IN AGRICULTURAL OCCUPATIONS AND EMPLOYMENT EXPERIENCE

Report of the
1966 WORKSHOP IN AGRICULTURAL EDUCATION
June 7-24, 1966
Department of Education
Iowa State University of Science and Technology
Ames, Iowa

PREFACE

The guidelines for agricultural occupations and employment experience programs in vocational agriculture were presented to Iowa instructors in November and December 1965. They specify that a minimum of 275 minutes per week of related classroom or individual instruction be provided parallel to employment experience. A minimum of 180 hours of employment experience during the senior year was recommended.

It was further recommended that from 8 to 12 percent of the total instructional time during the four years of high school be allotted to a study of agricultural occupations. It was suggested that approximately three-fourths of this instruction be provided in the senior year course preceding or parallel to employment experience.

This report consists of nine separate modules developed by separate workshop committees. Each module consists of an introduction, statement of objectives, recommended time allotment, list of competencies to be taught, follow-up and evaluation techniques and a list of references and instructional materials for one specific phase of the related instruction program. Subject matter content, special teaching-learning activities and a list of suggested instructional materials are also provided.

The success of the employment experience program in agricultural occupations is to a large degree dependent upon the effectiveness of the instructor in providing needed related instruction. Much of the subject matter content in the modules is new to most instructors. It was new to most workshop participants.

It is hoped that these modules will serve as instructional guides. Instructors should feel free to delete or add sections as necessary in adapting the materials for local use.

Duane L. Blake and
Clarence E. Bundy,
Agricultural Education

TABLE OF CONTENTS

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6.	Richard P. Halstead	Voc. Ag. Instructor	Bondurant, Iowa
7.	Marvin Hoskey	Voc. Ag. Instructor	Dexfield Comm., Redfield, Iowa
8.	Donald D. Kent	Voc. Ag. Instructor	Eddyville, Iowa
9.	Charles McLaughlin	Voc. Ag. Instructor	Nashua, Iowa
10.	Grover C. Miehe	Voc. Ag. Instructor	Monticello, Iowa
11.	Charles K. Morrow	Voc. Ag. Instructor	Knoxville, Iowa
12.	Alan L. O'Neal	Voc. Ag. Instructor	Charter Oak, Iowa
13.	Charles E. Perdue	Voc. Ag. Instructor	Oskaloosa, Iowa
14.	Larry Reding	Voc. Ag. Instructor	Sac City, Iowa
15.	Roger Rinderknecht	Voc. Ag. Instructor	Webster City, Iowa
16.	Jasper Risdal	Co. Ag. Ex.. Dir.	Newton, Iowa
17.	Keith P. Schmidt	Voc. Ag. Instructor	Grinnell, Iowa
18.	Edwin F. Schroeder	Voc. Ag. Instructor	Sheffield, Iowa
19.	Larry L. Statler	Voc. Ag. Instructor	Waverly, Iowa
20.	Gerald E. Sutton	Voc. Ag. Instructor	Indianola, Iowa
21.	Paul B. Swank	Voc. Ag. Instructor	Wellman, Iowa
22.	J. D. Tillman	Voc. Ag. Instructor	Meadville, Mississippi
23.	Lloyd Tindall	Voc. Ag. Instructor	Gladbrook, Iowa
24.	Paul C. Vincent	Voc. Ag. Instructor	Paullina, Iowa
25.	Duane E. Wahlstrom	Voc. Ag. Instructor	Odebolt, Iowa
26.	Lewis L. Webster	Voc. Ag. Instructor	Leon, Iowa

AN OVERVIEW OF THE AGRICULTURAL INDUSTRY IN THE LOCAL COMMUNITY, STATE, NATION AND WORLD.

Prepared by: J. H. Cairns
D. D. Kent
C. E. Perdue

I. Introduction

In our form of American industry, agriculture is dynamic and constantly changing. It is dynamic because the role of agriculture contributes to our nation's financial economy and democratic stability. On the other hand, the constant changing picture of agriculture provides a challenge to the activities of the competent and dedicated rural work force of our nation. This challenge enables those who do not intend to become engaged in production agriculture--called farming--to pursue non-farming agricultural occupational employment experiences. These experiences in turn help to provide the supplies, services, transportation and marketing sources which farmers need.

AUDIO-VISUAL PRESENTATION -- "A Step Ahead"....film--13 minutes

II. Major Objectives

A. To develop an understanding of the importance of agricultural industry in the local community, state, nation and world.

B. To develop an understanding of the opportunity to become employed in agricultural industry in the local community, state, nation and world.

C. To provide new training and retraining opportunities in equipping persons with skills and abilities to become established in agricultural industry in the local community, state, nation and world.

III. Time Allotment 8% _____ days.

IV. Competencies to be Taught

A. To develop an understanding of the need for agricultural industry and training in an agricultural occupations employment experience program locally.

B. To develop an understanding of the need for agricultural industry and training in an agricultural occupations employment experience program on a state level.

C. To develop an understanding of the need for agricultural industry on a national scope.

D. To develop an understanding of the need for agricultural industry on an international scope.

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A. To develop an understanding of the need for agricultural industry and training in an agricultural occupations employment experience program locally.

1. Subject matter content:

(available only on local level[1]; Mahaska County illustrated[2])

a. Available skills and abilities of the people in TENCO--(a geographic area of ten contiguous counties in southeast

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[1] United States Department of Commerce, U.S. Census Report, preliminary report, 1964.

[2] Ronald Powers, The Economic Base of TENCO, RAD--31. (Iowa State University Cooperative Extension Service, April 1964.)

Iowa)--are not matched to job opportunities, locally or nationally.

b. Net out-migration from TENCO, 1950-1960, 17.4%.

c. Farm population decreased 21% in TENCO, 1950-1960. (In Mahaska County the farm population decreased 17% during this same period)

d. Farm population projected decline of 7.8% in TENCO by 1970.

e. Farm numbers decreased by 11% in TENCO, 1955-1960, while farm size increased 10% to an average size of 196 acres.

f. Retail sales in feed, seed and fertilizer increased in 2/3 of TENCO county area, 1954-1962. This is projected to increase continually.

g. New basic jobs in industry and/or recreation will slow migration.

h. Agriculture produces 2/3 of the total TENCO income.

i. Total farmers working 100 or more days off the farm[3] in TENCO increased from 9.6% in 1940 to 21.3% in 1959.

j. Evidence shows that educational programs need to offer more vocational and technical courses in high schools.

2. Special teaching-learning activities:

   a. Follow-up past graduates. Migration and present employment.

   b. List vacant houses within rural school district or by townships.

   c. List neighbors who have part-time off-farm employment.

   d. Review "The Population Change of Eight Southern Counties" pamphlet.

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[3] TENCO Agriculture Sub-Committee, Agriculture in TENCO of Iowa. (Iowa State University Cooperative Extension Service, 1964.)

3. Suggested instructional materials and references:
    a. Audio-visual transparency made from footnote 1, 2 and 3.
    b. Develop slide set for local area.

B. To develop an understanding of the need for agricultural industry and training in an agricultural occupations employment experience program on a state level.

1. Subject matter content:
    a. Two-hundred thousand Iowans (1966) work in farming, producing 3 billion dollars annually in raw food materials.
    b. Four-hundred thousand Iowans (1966) work in business, services, transportation and marketing branches which serve the farmer. These agricultural industries add in excess of 560 million dollars to the states industrial output.
    c. Iowa's industry (1966) includes 132 packing plants, 11 flour mills, 19 manufacturing and oilseed crushers, 48 poultry processing plants and 542 plants producing butter, cheese and ice cream and in excess of 500 fluid milk processors.
    d. Coupled with Iowa's agricultural industry, in 1966, are 26 wholesale food warehouses and 3,800 retail food stores. This combination employs 27,000 Iowans. Nine-thousand, six-hundred business firms in farm equipment, producing seed and gasoline deliveries, are keyed directly to farm purchasing.
    e. Farmers spend nearly 300 million dollars each year with 12,800 transportation firms.
    f. Iowa's farmers (1966) own 35,000 tractors; 106,000 trucks; 92,000 combines; 65,000 hay balers; 113,000 corn pickers

and picker-shellers and 45,000 milking machines.

g. Iowa's agriculture attracts industry to process our raw material, supply our machinery, fertilizer and general production needs. Agriculture interrelates to nearly every segment of our economy.

2. Special teaching-learning activities:

   a. Review pamphlet on "Iowa, Where Industry and Agriculture Meet".

   b. Review the following thought providing questions:

      (1) How does the income potential of agribusiness compare with farming on the state averages?

      (2) What are the conditions which exist in our state that challenge the opportunity of becoming a farmer?

      (3) What opportunity exists in our state for a boy to become established in an agricultural related occupation?

      (4) What similarities exist in our state regarding the problems encountered in agriculture related occupations and farming?

3. Suggested instructional materials and references:

   a. Flannel or bulletin board presentation on farming, (numbers and amount of dollars invested), as nucleus of agricultural atom and agricultural related occupations, (numbers and dollars of gross income), as surrounding electrons within the structure. Refer to reference 1, bulletins and pamphlets.

   b. Develop slide set for state area on related agricultural occupations.

c. Data in this competency is referred to reference number 5 under bulletins and pamphlets, use entire booklet.

4. Evaluation:

a. Research paper written by each student on his interest in one phase of agricultural related occupational opportunities within Iowa.

C. To develop an understanding of the need for agricultural industry on a national scope.

1. Subject matter content: United States

a. Between 1966 and 1975, the projected job opportunities nationally[4] are as follows: (employment increase)

65%....professional people and technicians
50%....service workers
45%....clerks and other office workers
34%....sales people
31%....managers and proprietors
29%....craftsmen, foremen and other skilled workers
17%....operators of machines and other semi-skilled workers
No change....laborers and other unskilled workers: miners
Some decline....farmers and farm workers

b. The 41% decline[5] in farm operators and workers from 1950-

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[4] Ibid., TENCO study.

[5] C. A. Peterson and Norbert K. Norpel, Iowa Employment Trends, 1947-1960, Research series 24 (University of Iowa, Iowa City, Iowa: Bureau of Labor and Management), page 11.

1960 is projected to continue.

c. Early 1900's 1 out of 3 in the U.S. labor force was engaged in farming. (By 1960, ratio changed to 1 in 18 engaged in farming)

d. Agriculture is the nations largest industry with 3/4 of the assets of all corporations combined.

e. Three out of every ten jobs in private employment are related to agriculture. Some requirements are: (1966 data)

(1) 120,000 employees are needed for supplying tractors and machinery to the agricultural market.

(2) 300,000 employees are needed for processing meat.

(3) 258,000 employees are needed for processing dairy products.

(4) 282,000 employees are needed to convert wheat to bread and related products.

(5) 208,000 employees are needed to convert raw cotton into fabrics.

2. Special teaching-learning activities:

a. Distribution of "Agriculture Is More Than Farming" pamphlets.

3. Suggested instructional materials and references:

a. Two bulletin board displays; one on amounts of national agricultural purchases by farmers and the other on the amounts of U.S. food consumption annually, pages 7 and 11, reference number 5, bulletins and pamphlets.

D. To develop an understanding of the need for agricultural industry on an international scope.

1. Subject matter content:
    a. From 1900 to 1965 the annual rate of world population increase has been about 2% which represents doubling of the world population.
    b. World population:
        (1) 1965................. 3.2 billion people
        (2) 1975................. 3.9 billion people
        (3) 2000................. 6 billion people
    c. By the year 2000, Asia will have 2/3 of the world population.
    d. Throughout the world, soils with climates favorable for production of the principal grain crops are located in the more sparsely populated areas.
    e. With the growing world population each year more food will be consumed and the food producing areas of our world will be pressured for greater yields and efficiency. These food producing areas may become over-worked and coupled with the imbalance in the distribution of world population and productive soils; this may cause serious problems by the year 2000.
2. Special teaching-learning activities:
    a. Use of overlays in pointing out food producing and population regions of the world to the students.
3. Suggested instructional materials and references:
    a. Reference bulletin number 2, pages 6 and 7.

AUDIO-VISUAL PRESENTATION -- "Dynamic Careers Through Agriculture"....film, 28 minutes

V. Follow-up and Evaluation

Summarize briefly through essay and/or bar-graph or curve, the opportunities which exist in agricultural industry in our community.

VI. Titles and Sources of References and Instructional Materials

A. Books:

1. Hoover, N. K., Handbook of Agricultural Occupations, Interstate Printers and Publishers, Danville, Illinois, 1963. Price $4.27 (single copy)
2. Weyant, J. T. etal, Introduction to Agricultural Business and Industry, Interstate Printers and Publishers, Danville, Illinois, 1965. (Teachers guide available) Price $2.25 (single copy)
3. Stone, A. A., Careers in Agribusiness and Industry, Interstate Printers and Publishers, Danville, Illinois, 1965. Price $4.27 (single copy)
4. Agricultural Education Staff, Agricultural Occupational Employment Experience, material memo grouped by Agriculture Education Staff, Iowa State University, Ames, Iowa, 1966.
5. U. S. Department of Agriculture, Fact Book of U. S. Agriculture, Supt. of Documents, U. S. Govt. Printing Office, Washington, D. C., 1965. Price $1.00 each.

B. Bulletins and Pamphlets:

1. Joint Committee U. S. Office of Education and American Vocational Association, Objectives for Vocational and Technical Education in Agriculture, Supt. of Documents, U. S. Government Printing Office, Washington, D. C., 1965. Price 15¢ each.
2. Thompson, Louis M., Iowa Agriculture, World Food Needs and Education, Center for Agricultural and Economic Development, Iowa State University, Ames, Iowa, 1965. Free
3. American Association of Teacher Educators in Agriculture etal, Agriculture is More Than Farming, Future Farmer's Supply Service, Alexandria, Virginia, 1963. Price 15¢ each.
4. Tenney, A. W., Farm Youths Urged to Train for Rewarding Careers in Agriculture, Grassland Farming Digest, New Holland, 1963. Free in quantities of no more than 5 per department.
5. Des Moines Register and Tribune etal, Iowa Where Industry and Agriculture Meet, Des Moines Register and Tribune, Des Moines Iowa, 1965 Farm-City Youth Tour. Free

6. Powers, R. C., The Economic Base of TENCO, Cooperative Extension Service, RAD-31, Iowa State University, Ames, Iowa, 1964. Free (single copy only)

7. TENCO Agriculture Sub-committee, Agriculture in TENCO of Iowa, Cooperative Extension Service, Iowa State University, Ames, Iowa. (Contact Tom Robb, S.E. District Extension Director) Free

8. Eldridge, E. etal, Paths to Progress...A Look at TENCO, Cooperative Extension Service, Iowa State University, Ames, Iowa, 1966. Free

9. Powers, R. C., The Population Change of Eight Southern Iowa Counties, Cooperative Extension Service, RAD-54, Iowa State University, Ames, Iowa, 1965. Free (single copy only)

10. U. S. Department of Commerce, United State Census of Agriculture by Iowa Counties, Bureau of Census, Washington, D.C., 1964. Price 10¢ each.

C. Films:

1. New Holland Company, A Step Ahead, NS 4244, Audio-Visual Aids Instruction Service, Iowa State University, Ames, Iowa. Rental $1.20.

2. Pfizer Company, Dynamic Careers Through Agriculture, NS 5795, Audio-Visual Aids Instruction Service, Iowa State University, Ames, Iowa. No fee.

CAREER OPPORTUNITIES IN AGRICULTURAL OCCUPATIONS

Prepared by: R. V. Fransen
R. P. Halsted
J. D. Tillman

I. Introduction

Students should be led to recognize immediately that agriculture is not a declining industry. The number of persons engaged in producing raw agricultural products is decreasing, but the number of persons engaged in processing and marketing food and fiber, providing agricultural supplies and services, agricultural research, education, etc. is increasing.

The image of agriculture has been tarnished in the eyes of many of our youth by erroneous information. Students need to be told that agriculture has many fascinating and challenging careers. Salaries in agriculture compare favorably with positions elsewhere which require the equivalent qualifications. Job opportunities in agriculture exist everywhere.

There is a bright future in agriculuure. The future belongs to those who prepare for it.

II. Major Objectives

To develop an understanding of the broad field of agriculture and the many vocations open to young men with interest in agriculture.

III. Time Allotment 13% _____ days

IV. Competencies to be Taught

A. To understand the basic changes in farming and the opportunities in farming today.

B. To understand the opportunities and challenges for young men in agricultural businesses and industry.

C. To understand the opportunities for agricultural college graduates and to help the student to decide whether to go to college.

D. To understand the criteria on which a sound choice of an agricultural occupation is attained.

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A. To understand the basic changes in farming and the opportunities in farming today.

1. Subject matter content
    a. Farming as a whole is one of the most efficient operations in our economy.
        (1) The U.S. Census reported in 1961 that some 5 million workers were employed in producing food and fiber among the total work force of 65 million persons, which means that about 8% were feeding 100% of the population.
        (2) Due largely to modern power equipment, the amount of labor used on our farms declined 41% between 1949 and 1961. Today, one hour of farm labor produces four times as much as it did in 1919-21.
        (3) In the past 15 years the increase in output (total and per man-work hour) from farming has exceeded that of industry.
        (4) Comparison of farming in America, in terms of yields

and of how many persons one agricultural worker feeds, with that in other agricultural countries.

b. Farming is our most important industry.

   (1) It is the nation's largest single industry.

   (2) Total investment in farming and farm business is nearly $220 billion -- an amount equal to 2/3 of the assets of all the corporations in the United States.

   (3) Farmers buy some $27 billion of goods and services each year to produce their crops and livestock. They are large users of petroleum products, fertilizers, motor vehicles, machinery, equipment, etc.

   (4) Farming provides products for aiding undeveloped countries, and helps in the struggle to keep independent nations of the world free of Communism.

   (5) Abundant food is a deterrent of war. Most great conflicts of man arise from the need for necessities of life which come from the soil.

c. Farming creates many jobs in related businesses and industry.

   (1) Perhaps 40% of all workers in the U.S. owe their employment, at least in part, to farming.

   (2) Processing, transporting and marketing food for about 200,000,000 people is an enormous operation.

   (3) Businesses, farming occupations, and industries are dependent upon each other.

d. Farming is a changing, but not a declining industry.

   (1) By 1980, the U.S. must increase its agricultural production by 70% if we are to maintain our present stan-

dard of living due to increase in population.

(2) Farm sizes are increasing. Compare U.S. and Iowa farm sizes.

(3) Investment in farming increases. Present capital investment per farm in the U.S. averages $36,000 to $43,000. The investment in agriculture represents an average of $21,300 for each farm employee.

(4) Fewer people live on farms.

(5) Farming demands a higher qualified worker. When workers are improving and are becoming more efficient in an occupation, we say that occupation is on the move.

2. Special teaching-learning activities
   - a. Field trip to an outstanding and successful livestock farmer in the community. Farmer needs to explain his farm management pointers.
   - b. Show film, "Agriculture, USA" or "A New Word for Farming".
   - c. Show charts, slides or transparencies on agricultural labor, farm output, farm sizes, farm investment, etc.
3. Suggested instructional materials and references
   - a. An Introduction to Agricultural Business and Industry
   - b. Careers in Agribusiness and Industry
   - c. Course of Study in Nonfarm Agricultural Occupations
   - d. Fact Book of U.S. Agriculture
   - e. Farming As An Occupation
   - f. Films - "Agriculture, USA" and "A New Word for Farming"
   - g. Handbook of Agricultural Occupations
   - h. Iowa Agriculture, World Food Needs and Educational Response

i. Iowa Annual Farm Census

j. Iowa Employment Trends

k. Iowa Farm Outlook Charts

l. Occupational Characteristics of the Iowa Labor Force

m. United States Census of Agriculture

B. To understand the opportunities and challenges for young men in agricultural businesses and industry.

1. Subject matter content

a. Careers in agriculture, other than farming, are becoming more important.

(1) In many states there are two or three nonfarm jobs to one in farming. Many of these jobs require post-high school specialized training.

(2) Agriculture is served by about 500,000 scientists and research workers.

(3) About 18 million people produce products or provide services to the farmer and process and distribute products from farms.

b. Occupations in farm machinery sales and services.

(1) Identification of job titles with level of employment.

(2) Descriptions of titles, duties, salaries and opportunities in farm machinery occupations.

(3) Methods of entering and advancing from each level of employment.

(4) Kinds of farm machinery dealers in the community and the levels of employment.

c. Occupations in farm supplies and equipment

  (1) Identification of job titles with level of employment.

  (2) Description of titles, duties, salaries and opportunities in farm supplies and equipment occupations.

  (3) Methods of entering and advancing from each level of employment.

  (4) Kinds of farm supply and equipment centers in your local community.

d. Occupations in the livestock industry

  (1) Identification of job titles with level of employment.

  (2) Descriptions of titles, duties, salaries and opportunities in the livestock industry.

  (3) Methods of entering and advancing from each level of employment.

  (4) Kinds of livestock related businesses in the community.

e. Occupations in crops, forestry, and soil conservation.

  (1) Identification of job titles with level of employment.

  (2) Descriptions of titles, duties, salaries and opportunities in occupations related to crops, forestry, and soil conservation.

  (3) Methods of entering and advancing from each level of employment.

  (4) Kinds of businesses related to crops, forestry, and soil conservation in the community.

f. Occupations in ornamental horticulture, wildlife, and recreation.

  (1) Identification of job titles with level of employment.

(2) Descriptions of titles, duties, salaries and opportunities in occupations related to ornamental horticulture, wildlife, and recreation.

(3) Methods of entering and advancing from each level of employment.

(4) Kinds of businesses related to ornamental horticulture, wildlife, and recreation.

2. Special teaching-learning activities
   - a. Take a field trip to an agricultrual business and have students interview the manager to get answers to questions and get better acquainted with this type of employment.
   - b. Show the film, "Meat on the Move" or "A New Career--The Science of Feed Technology".
   - c. Have a dealer or personnel director speak to the class.
3. Suggested instructional materials and references
   - a. Careers in Agribusiness and Industry
   - b. An Introduction to Agricultural Business and Industry
   - c. Course of Study in Nonfarm Agricultural Occupations
   - d. Films - "Meat on the Move" and "A New Career-The Science of Feed Technology".
   - e. Handbook of Agricultural Occupations
   - f. Iowa Employment Trends
   - g. Job Opportunities for Iowa's Youth
   - h. Occupational Characteristics of the Iowa Labor Force

C. To understand the opportunities of agricultural graduates and to help the student to decide whether to go to college.

1. Subject matter content

a. Surveys show that 15,000 positions open annually in agricultural industry to young men being graduated from agricultural college curriculums. Graduates totaling only 1/2 of this number are available for placement.

b. Workers with more education are employed in better positions.

c. Professions and other white collar occupations are growing the fastest.

d. Expected lifetime earnings from various levels of education.

Finished	Lifetime Earnings
Grade School	$184,000
High School	247,000
1-3 years of college	293,000
4 years of college	417,000

e. Types of professional work available upon graduation.

(1) Business
(2) Communications
(3) Education
(4) Farming
(5) Industry
(6) Research
(7) Specialized Services

f. A beginning student in college does not choose a career, but a curriculum or course of study. Curriculums available at Iowa State University in agriculture are:

(1) Agricultural Business
(2) Agricultural Education
(3) Agricultural Engineering

(4) Agricultural Journalism

(5) Agronomy

(6) Animal Science

(7) Dairy Science

(8) Dairy Industry and Food Technology

(9) Entomology

(10) Farm Operations

(11) Fish and Wildlife Management

(12) Forestry

(13) Horticulture

(14) Landscape Architecture

(15) Plant Pathology

(16) Poultry Science

(17) Rural Sociology

(18) Veterinary Medicine

2. Special teaching-learning activities

   a. Students need to check entrance requirements for the different curriculums.

   b. Have each student who can meet college requirements interview a professional person and report to the class.

   c. Show film, "Agricultural Engineering-The Profession with a Future".

   d. Agricultural college career day.

3. Suggested instructional materials and references

   a. An Introduction to Agricultural Business and Industry.

   b. Charts - "Manpower Needs of the Future"

   c. Film - "Agricultural Engineering - The Profession with a

Future

d. Handbook of Agricultural Occupations

e. Occupational Outlook Quarterly

D. To understand the criteria on which a sound choice of an agricultural occupation is attained.

1. Subject matter content
   - a. Interest area in specialized field.
   - b. Value of experiences in agriculture as a background for vocations.
   - c. Factors to consider in choice of an agriculuural occupation.
2. Special teaching-learning activities
   - a. Film - "Planning Your Career"
3. Suggested instructional materials and references
   - a. An Introduction to Agricultural Business and Industry
   - b. Film - "Planning Your Career"

V. Follow-up and Evaluation

A. Have each student use the information gathered in his notebook to line himself up with one occupation. Have a private conference with each student to check out the work he has done and counsel him concerning his choice of occupation.

VI. Titles and Sources of References and Instructional Materials

A. Books:

1. Bindley, Harold, Course of Study in Nonfarm Agricultural Occupations, Department of Agricultural Education, University of Kentucky, Lexington, Kentucky, August, 1965.

2. Hoover, N. K., Handbook of Agricultural Occupations, Interstate Printers and Publishers, Danville, Illinois, 1963. Price $4.27 (single copy)

3. Stone, A. A., Careers in Agribusiness and Industry, Interstate Printers and Publishers, Danville, Illinois, 1965. Price $4.27 (single copy)

4. U.S. Department of Agriculture, Fact Book of U.S. Agriculture, Superintendent of Documents, U.S. Government Printing Office, Washington 25, D.C. Price $1.00 (single copy)

5. Weyant, J. T., Introduction to Agricultural Business and Industry, Interstate Printers and Publishers, Danville, Illinois, 1965. (Teachers guide available) Price $2.25 (single copy)

B. Bulletins and Pamphlets

1. Bureau of Labor Statistics, Occupational Outlook Quarterly, December, 1963.

2. Cooper, D. E., Occupational Characteristics of the Iowa Labor Force, Bureau of Labor and Management, State University of Iowa, Iowa City, Iowa, June, 1963.

3. Cooperative Extension Service, Iowa Farm Outlook Charts, Iowa State University, Ames, Iowa, October, 1964.

4. Farming As An Occupation, Book Number 4, National Vo-Ag Book Company, Sheldon, Wisconsin.

5. Jakubauskas, E. B., Job Opportunities for Iowa's Youth, Cooperative Extension Service, Iowa State University, Ames, Iowa, February, 1966.

6. Thompson, Louis M., Iowa Agriculture, World Food Needs and Educational Response, Center for Agricultural and Economic Development, Iowa State University, Ames, Iowa, 1965. Free

L 7. U.S. Department of Commerce, United States Census of Agriculture, 1959, Superintendent of Documents, U.S. Government Printing Office, Washington 25, D.C. Price $1.00.

8. U.S. Department of Labor, Manpower Needs of the Future, Manpower Administration, Washington, D.C.

9. Peterson, C. A., Iowa Employment Trends, Bureau of Labor and Management, State University of Iowa, Iowa City, Iowa, April, 1962.

10. State of Iowa, Annual Farm Census, 1963, Des Moines, Iowa.

C. Films

1. Encyclopedia Britannica Films, Planning Your Career, 1150 Wilmette Avenue, Wilmette, Illinois.

2. Visual Instruction Service, Agriculture, USA, NS-6029, U.S.D.A., Iowa State University, Ames, Iowa. Rental $.75.

3. Visual Instruction Service, Agriculture Engineering-Profession with a Future, NS-1090, U.S.D.A., Iowa State University, Ames, Iowa. No Fee.

4. Visual Instruction Service, A New Word For Farming, NS-2965, Iowa State University, Ames, Iowa. Price $.75.

5. Visual Instruction Service, A New Career - The Science of Feed Technology, NS-601, Iowa State University, Ames, Iowa. Rental $.75.

6. Swift and Company, Meat on the Move, Chicago, Illinois.

ORIENTATION TO OCCUPATIONAL EXPERIENCE PROGRAM

Prepared by: Keith P. Schmidt
Gerald E. Sutton
Lewis L. Webster

I. Introduction

The proper orientation of the students is very important as a part of the pre-job preparation of those who will participate in the occupational experience program. The student should understand the purpose of the program and what is expected of him. The boy should be encouraged to analyze himself to determine if he has the right attitude, qualifications, interest and ability for the job. He should also be instructed in the legal implications of occupational experience programs.

Since many schools will be initiating this program for the first time, it is most important to select, carefully, individuals who are likely to succeed. Proper orientation can aid in this screening process and help to insure the success of the program.

II. Major Objective

To develop in the student an understanding of, and a wholesome attitude toward, the supervised occupational experience program which will prepare him for employment in one or more agricultural occupations.

III. Time Allotment 13% _____ days

IV. Competencies to be Taught

A. Understanding of specific job requirements

B. Understanding of personal qualifications needed

C. Ability to obtain a job

D. Understanding of importance of job ethics

E. Understanding of legal implications

F. Understanding of importance of good housekeeping and maintenance

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A. Understanding of specific job requirements

1. Subject matter content
    a. Importance of an agricultural background
    b. Occupations requiring a college degree
    c. Occupations requiring less than a college degree
    d. Health and physical requirements
    e. Importance of related experience
    f. Variations in aptitudes required
    g. Jobs requiring motor vehicle driving
    h. Differences in need for ability to meet public
    i. Willingness to put out a good day's work
2. Special teaching-learning activities
    a. Use an overlay showing the triangle of the supervised occupational experience program. (Reference B8)
    b. Have the student develop a check list of values to be expected in a supervised occupational program (References A3, A4 and A8)
    c. Divide class into groups according to agricultural supply, sales and service occupations, etc. Have each team observe and evaluate a particular experience program in progress. (References A3, A4 and A8)

d. Use an agricultural businessman in the community, who is a cooperating employer, to explain the program.

3. Suggested instructional materials and references

a. Refer to references No. A3, Chapter 1; No. A8, Chapter 4; No. A7, Pages 16-24; No. B9, Pages 44-46; No. A4, Chapter 1, and entire reference No. B8.

B. Understanding of personal qualifications needed

1. Subject matter content

a. Good scholastic and attendance records

b. A genuine interest in the occupation

c. Extra-curricular activities

d. Curiosity

e. Analytical ability

f. Loyalty to superiors, associates and to the business

g. Proper grooming

h. Adequate education

i. Importance of punctuality and dependability

j. Courage, not easily discouraged

k. Desirable personality

l. Be a good listener

m. Sense of humor and pleasant disposition

n. Ability to adjust to change

o. Be systematic, orderly and a good housekeeper

p. Have clean habits and maintain good health

q. Be impartial and fair in all dealings

r. Be thrifty with time and funds.

s. The ability to make decisions quickly and correctly

        - t. The ability to accept honors and advancements gracefully
    - 2. Special teaching-learning activities
        - a. Organize a panel presentation, "What Student Qualities Are Necessary in a Supervised Occupational Experience Program." Ask an employer, principal, parent and a senior student to serve on this panel. (References B8, A3, A4 and A8)
        - b. Divide the class into groups to develop a list of desirable qualities, questions for self-analysis, and to make presentations to the class. Each group should be encouraged to develop a bulletin board display. (Reference A7)
    - 3. Suggested instructional materials and references
        - a. Refer to references No. A6, Chapter 1; No. A9, Unit I, Pages 3-20; and entire reference No. B8.

- C. Ability to obtain a job
    - 1. Subject matter content
        - a. Letters of application
        - b. Applications for employment
        - c. The job interview
        - d. Personal data sheet
    - 2. Special teaching-learning activities
        - a. Have a local agricultural businessman participate in a short role-playing situation. Select a good pupil to act as the interviewee. Have the agricultural businessman ask the pupil some questions which typically are asked during the job interview.
        - b. Discuss with students the possible questions a personnel manager of an agricultural business will ask.

c. Obtain application blanks from several agricultural firms and determine information desired.

d. Discuss possible ways of determining how one finds a job opening.

e. Discuss with students and have them write letters of application to various agricultural businesses to develop letter writing skill and to decide where each student would like to work.

f. Determine by discussion the desirable actions and attitudes during an interview.

g. Determine proper and desirable dress and personal appearance for the interview.

h. Discuss what may be done after the interview to improve chances of employment.

i. Lead discussion on what and how to obtain letters of recommendation.

j. Develop with students a personal data sheet.

3. Suggested instructional materials or references

a. Sample application blanks

b. Sample letters of application

c. Sample follow-up of interview letters

d. Desirable employee traits list

e. Newspaper job lists

f. Sample personal data sheets

g. References Nos. A7, A9, B9, A5, A1 and A2)

D. Understanding of importance of job ethics

1. Subject matter content

- a. Ethics defined
- b. Ethics in applying for a job
- c. Ethics on the job
- d. Ethics when changing jobs

2. Special teaching-learning activities
    - a. Have each student give his own definition of ethics and find definition in dictionary.
    - b. Determine through discussion the different types of ethics
    - c. Determine through discussion, possible unethical practices in getting a job and while on the job.
    - d. Interview an employment agency manager to further explore unethical practices in job procurement.
3. Suggested instructional materials and references
    - a. Dictionary and school guidance materials on ethics
    - b. Bibliography references Nos. A1 and A5.

E. Understanding of legal implications

1. Subject matter content
    - a. Minimum age laws
    - b. Hazardous occupations
    - c. Certificates to employ student learners
    - d. Penalties for violation of laws
    - e. State labor laws
    - f. Safety laws
    - g. Assumption of risks
    - h. Tax and social security laws
    - i. Wage laws
    - j. Physical examination

k. Hours of employment

l. Civil liability

m. Civil rights law

2. Special teaching-learning activities

   a. Attorney speak to group on case histories related to employment of students

   b. Study recent labor laws of Iowa and United States

3. Suggested instructional materials and references

   a. Articles about legal cases

   b. Bibliography references Nos. B1, B2, B3, B4, B5, B6, B7 and B9.

F. Understanding of importance of good housekeeping and maintenance

1. Subject matter content

   a. Student keep tools in good repair and clean

   b. Keep machinery in good repair, clean, and orderly

   c. Keep floor reasonably clean

   d. Well painted attractive surroundings

   e. Properly store or dispose of oily rags and other waste material.

   f. Proper care of supplies to keep out contaminants

   g. Proper cleaning and use of bedding around livestock

   h. Proper use of disinfectants and disease prevention

   i. Proper use of rodent and pest control

   j. Keep advertising materials fresh and attractive.

   k. Keep stock supply neat, clean and orderly.

   l. Keep orderly desk and records.

   m. Attractive lighting

2. Special teaching-learning activities
    a. Have students give experiences in entering businesses where good and poor housekeeping is practiced.
    b. Businessman speak to class on why good housekeeping is needed.
3. Suggested instructional materials
    a. Flannel board and cut outs to demonstrate good and poor arrangements

V. <u>Follow-up and Evaluation</u>

A. Tests over material studied

B. Check both employer and employee on regular supervisory visits

C. Administer personality tests

D. Have each student analyze and evaluate his own personal qualifications.

E. Have employer fill out a check list evaluating the employee's personal qualifications early in the experience program.

F. Teacher use check list in evaluating students.

G. Discuss with students their progress toward employment, e. g. discuss with students how an interview went or what questions were asked and procedures were used by those successful in securing employment.

H. Grade application letters, personal information blanks, and after-interview letters, on basis of structure, neatness and grammar.

I. Draw upon experience of students and from actual examples in the business world concerning good and poor ethical practices.

J. Develop essay questions which illustrate opportunities for unethical job procurement and have students outline their course of action.

K. Check to see that student meets legal requirements for occupation.

L. Check for proper insurance coverage.

M. Be sure proper certificates for age and student learner permit are completed.

N. Have employer fill out check list on housekeeping habits of employee.

O. Have student report on general housekeeping habits in business.

VI. Titles and Sources of References and Instructional Materials

A. Books:

1. Carnegie, Dale, How To Win Friends and Influence People, Pocket Books, Inc., 1 West 39th Street, New York, New York - 10018.
2. Course of Study in Nonfarm Agricultural Occupations, Dept. of Agricultural Education, College of Education, University of Kentucky, Lexington, Kentucky.
3. Duncan, Clyde H., Find A Career In Agriculture, G. P. Putnam's Sons, New York, New York, 1961.
4. Hoover, Norman K., D. Ed., Handbook of Agricultural Occupations, 1964, The Interstate Printers and Publishers, Inc., Danville, Illinois, $4.27.
5. How to Get That Part-Time Job, (Handbook) Fiens, Cold and Arnold List, Arce Publishing Co., Inc., 180 Lexington Ave., New York, New York.
6. Hutchinson, Chester S., A Definitive Study of Your Future in Agriculture, Richard Rosen Press, Inc., New York, New York, 10010, 1965.
7. Krebs, A. H., and Hemp, Paul E., A Study Guide For Placement-Employment Programs in Agricultural Business and Industry, 1964
8. Stone, Archie A., Careers in Agribusiness and Industry, 1965, The Interstate Printers and Publishers, Inc., Danville, Illinois, $4.27.
9. Weyant, Hoover, McClay, An Introduction to Agricultural Business and Industry, The Interstate Printers and Publishers, Danville, Illinois, 1965.

B. Bulletins and Pamphlets:

1. Application for a Certificate to Employ a Student Learner, Form WH-205 (10/63), Bureau of Labor, Des Moines, Iowa.

2. A Guide to Child-Labor Provisions of the Fair Labor Standards Act, WHPC Publication 1096, Child Labor Bulletin No. 101, Bureau of Labor, Des Moines, Iowa, 1964.

3. Employment of Student-Learners, WHPC Publication 1007, Bureau of Labor, Des Moines, Iowa, 1965.

4. Handy Reference Guide to the Fair Labor Standards Act, WHPC Publication 1122, Bureau of Labor, Des Moines, Iowa, 1965.

5. Fair Labor Standards Act of 1938, As Amended, WHPC Publication 1000, 1965.

6. Labor Laws of the State of Iowa,1962 Code Bulletin No. 21, Bureau of Labor, Des Moines, Iowa.

7. Retail and Service Enterprises and Establishments Under the Fair Labor Standards Act, WHPC Publication 1135, Bureau of Labor, Des Moines, Iowa, 1965.

8. Orientation to the Supervised Occupational Experience Program, Module No. 2, Center for Vocational and Technical Education, The Ohio State University, Columbus, Ohio, 1965.

9. Planning and Conducting Cooperative Occupational Experience in Off-Farm Agriculture, Center for Vocational and Technical Education, Ohio State University, 980 Kinnear Road, Columbia, Ohio, 1965.

SAFETY IN AGRICULTURAL RELATED OCCUPATIONS

Prepared by: Ed Faselt
J. M. Risdal

I. Introduction

In almost any line of activity there are hazards. Industry and business are concerned about time and production losses due to accidents as well as costs involved in accident prevention. Coupled with this is human suffering and loss of income. In spite of this, safety awareness comes slowly, meeting a passive attutude among many people.

II. Major Objectives

A. Develop in the students a philosophy of safety awareness.

B. Develop a mental attitude conducive to the integration of safety procedures in all activities related to the job situations.

III. Time Allotment 6% _____ days

IV. Competencies to be Taught

A. Understanding the need for safety

B. Understanding hazards

C. Understanding of types of accidents

D. Understanding methods of prevention of accidents

E. Understanding of first aid

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A. Understanding the need for safety

1. Subject matter content
    a. Present accident records of the community and the state.
    b. Time loss from accidents
    c. Personal financial loss
    d. Physical suffering, handicaps, and injuries
    e. Other
2. Special teaching-learning activities
    a. Use news articles on accidents
    b. Use film-strip or movie on working safety
    c. Statistical data overlay sheet
3. Suggested instructional materials and references
    a. "Safety is No Accident" Ref. 9
    b. Office of Health, Education and Welfare statistical data, Ref. 12.
    c. Safety in the Shop Ref. 7.

B. Understanding of hazards
1. Subject matter content
    a. Housekeeping
    b. Health
    c. Clothing
    d. Identification
    e. Fatigue
    f. Methods and techniques
    g. Other
2. Special teaching-learning activities
    a. Make demonstration of hazards related to reflexes and fatigue.
    b. Call in outsider (Insurance or similar) to point out hazards and their importance.
    c. Have students check training station for hazards and prepare

a list.

3. Suggested instructional materials and references.
    - a. "Find the Hazards" Ref. 17
    - b. Industrial materials used locally.

C. Understanding of types of accidents.

1. Subject matter content
    - a. Electrical
    - b. Chemical
    - c. Falls
    - d. Mechanical
    - e. Strains
    - f. Fire
2. Special teaching-learning activities.
    - a. Develop a list of accidents by type.
    - b. Discuss characteristics of types
3. Suggested instructional materials and references
    - a. "How to Avoid Muscle Strains" Ref. 3
    - b. "Safety in the Shop" Ref. 7 (film)

D. Understanding methods of prevention of accidents.

1. Subject matter content
    - a. Discuss importance of physical condition.
    - b. Develop appreciation of importance of clothing and protective devices.
        - (1) Snug fitting clothing
        - (2) Safety shoes
        - (3) Safety glasses
        - (4) Safety helmet
        - (5) Respiratory masks
        - (6) Shields and guards
        - (7) Fire extinguishers
        - (8) Non-skid floors
        - (9) Fuses and switches
        - (10) Warning devices
    - c. Identifying dangers

(1) Visible signs
(2) Color coding
(3) Danger area markings
(4) Identify traffic areas
(5) Warning devices

d. Understanding the use of proper work habits and handling techniques.

2. Special teaching-learning activities.

   a. Have school nurse or doctor discuss importance of health in avoiding accidents.

   b. Tour of industry to point out identification of dangers.

   c. Have students develop list of identifying aids.

   d. Discuss importance of good work habits and handling techniques.

   e. Bring in fire chief to discuss fire prevention.

3. Suggested instructional materials and references.

   a. Display of safety clothing and protective devices.

   b. Films - "Its Up To You", about safety glasses, Ref. 4
   "The Warning Bell", Ref. 8
   "Safety in the Shop", Ref. 7
   "How to Avoid Muscle Strains", Ref. 3

   c. Bulletins - "Safety is No Accident", Ref. 9
   "Ten Steps to Safety", Ref. 4
   "Safe Grounding Electric Equipment", Ref. 14
   "Fire Extinguishers and First Aid Kits", Ref. 18
   "Why Safety Glasses", Ref. 19
   "First Aid", Ref. 24

E. Understanding of first aid.

1. Subject matter content

- a. What is first aid?
    - (1) Extent
    - (2) Limitations
- b. Methods and procedures
    - (1) By kind of injury
        - (a) cuts and burns
        - (b) fractures
        - (c) strains
        - (d) unconsciousness
        - (e) poisoning
        - (f) electric shock
    - (2) Techniques
        - (a) artificial resuscitation
        - (b) bandages, splints and tourniquets
        - (c) antidotes
        - (d) moving the patient
- c. Equipment and supplies
    - (1) Contents of the first aid cabinet
    - (2) Location of first aid station
- d. Agencies
    - (1) Emergency phone numbers
        - (a) doctor
        - (b) ambulance
        - (c) hospital
        - (d) family
        - (e) fire department
        - (f) police
        - (g) civil defense

2. Special teaching-learning activities
    - a. Discussion of principles of first aid
    - b. Demonstrations
    - c. Films
3. Suggested instructional materials and references
    - a. Displays

(1) Well stocked cabinet

b. Films - "First Aid Now", Ref. 1

c. Bulletins - "First Aid Guide for USDA Employees", Ref. 2

"Confusion Can be Fatal", Ref. 1

"Fire Extinguishers and First Aid Kits", Ref. 13

"First Aid Booklet", Ref. 24

V. Follow-up and Evaluation

A. Use testing devices

B. Have student develop a safety program for the job situation

C. Conference with employer

VI. Titles and Sources of References and Instructional Materials

A. Publications

1. Confusion Can be Fatal, Safety Department, Iowa Farm Bureau Inst. Dept., 10th and Grand, Des Moines, Iowa. (Free)
2. First Aid Guide for First Aid Employees, Agriculture Handbook, No. 227, U.S.D.A. (Free)
3. An Epidemiological Study of PTO Accidents, Bul. No. 10, S.U.I. Iowa City, Iowa. (Free)
4. Ten Steps to Safety, Phillips Petroleum Company.
5. 4 Keys to Pesticide Safety, National Safety Council, 425 N. Mich. Ave., Chicago, Illinois. (Free)
6. Suggestions for Safe Spraying of Herbicides, W.C. 72, I.S.U. Extension Service Bul. Office, Morrill Hall, Ames, Iowa. (Free)
7. Chemicals In Agriculture, (guide for youth programs), Supt. of Documents, Washington 25, D.C. (Free)
8. List of Free Materials - order blank, National Safety Council, Chicago, Illinois. (Free)
9. Safety is No Accident, 192.11, National Safety Council, 425 N. Michigan Avenue, Chicago, Illinois. (Free)

10. Use Farm and Home Chemicals Safely, Pm. 309, I.S.U. Bulletin Office, Ames, Iowa. (Free)

11. Fatal Accidents of Iowa Farm People, A.E. , I.S.U. Bulletin Office, Morrill Hall, Ames, Iowa. (Free)

12. Statistical Data on Accidents, Office of Health, Education, and Welfare, State Office Building, Des Moines, Iowa

13. Safe Use and Storage of Flammable Liquids, Superintendent of Documents, Washington, D.C. (Free)

14. Safe Grounding of Electrical Equipment, National Safety Council, 425 N. Michigan Avenue, Chicago, Illinois. (Free)

15. Are You Careless with Pesticides?, National Safety Council, 425 N. Michigan Avenue, Chicago, Illinois.

16. Petroleum Products and the Law, F.D.A., No. 17, U.S. Department of Health, Education, and Welfare, Food and Drug Administration, Washington 25, D.C.

17. Safe Living, A.E. 674, (check list) I.S.U. Bulletin Offiee, Ames, Iowa. (Free)

18. Fire Extinguishers and First Aid Kits, National Safety Council, Chicago, Illinois. (Free)

19. Why Safety Glasses?, Iowa Society For Prevention of Blindness, 1101 Walnut, Des Moines, Iowa. (Free)

20. Watch your Step, Farmer's Bul. 2101, Superintendent of Documents, Washington 25, D.C. (Free)

21. Needed - Trained, Mature, Alert Tractor Operators, National Safety Council, Chicago, Illinois.

22. Facts for Consumers - Pesticide Residues, F.D.A., Washington 25, D.C.

23. Use Farm Fuels Safely, National Safety Council, 425 N. Michigan Avenue, Chicago, Illinois. (Free)

24. First Aid Booklet, Johnson and Johnson Company.

B. Films - All from Visual Instruction Service at Iowa State University, Ames, Iowa

1. First Aid Now, NS 6156, 24 min., $2.20

2. Prescription for Safety, NS4346, (chemicals) 19 min., 75¢

3. How to Avoid Muscle Strains, NS325, 14 min., $2.20

4. It's Up to You, (safety glasses) 10 min., NS2212, $2.40
5. My Pop's a Lineman, (elec) 16 min., $3.60, NS417
6. The Safe Use of Pesticides, NS1600, 21 min., 75¢
7. Safety in the Shop, NS2006, 21 min., $1.40
8. The Warning Bell, NS6085, 3 min. $3.25
9. You Can Take it with You, NS1198, 11 min., $1.50
10. Safe Use of Pesticides, LS770 (slides), 31 slides, 75¢

HUMAN RELATIONS

Prepared by: F. C. Baldus
C. K. Morrow
A. L. O'Neal

I. Introduction

Human relations is how one gets along with other people. How important is it that one be able to get along well with others in order to operate a successful agricultural business? Could one be so intelligent and so well trained in his business that he would be successful no matter how well he got along with others?

The Carnegie Foundation made a startling statement in saying "On the basis of our studies we find that technical training counts for only 15 percent in the success of an individual, while personal qualities count for 85 percent."

The Harvard Bureau of Vocational Guidance found in a study of 4,400 persons who were discharged from jobs that personality factors were the cause of failure in 66 percent of the cases. Lack of technical knowledge was the basis for only 34 percent of the cases.

II. Major Objectives

A. To develop an understanding of the personal traits necessary for successful employment and advancement in agricultural occupations.

B. To encourage improvement in the ability to get along with others.

C. To develop an understanding of the importance of human relations in successful employment in an agricultural occupation.

III. Time Allotment

8% _____ days

IV. Competencies to be Taught

A. To develop an understanding of the personal qualities desired in employees.

B. To develop an understanding of desirable employer-employee relations.

C. To develop an understanding of desirable supervisor-employee relations.

D. To develop an understanding of desirable relations among co-workers.

E. To develop an understanding of desirable relations between the customer and employee.

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A. To develop an understanding of the personal qualities desired in employees.

1. Subject matter content

a. Desirable personal traits

(1) Accurate
(2) Agreeable
(3) Appreciative
(4) Alert
(5) Careful
(6) Confident
(7) Cooperative
(8) Conscientious
(9) Dependable
(10) Energetic
(11) Enthusiastic
(12) Efficient
(13) Humble
(14) Honest
(15) Kind
(16) Loyal
(17) Mature
(18) Patient
(19) Realistic
(20) Responsible
(21) Tactful
(22) Tolerant

b. Objectionable personal traits

(1) Argumentative
(2) Artificial
(3) Antagonistic
(4) Boastful
(5) Critical
(6) Defensive
(7) Domineering
(8) Greedy
(9) Inattentive
(10) Militant
(11) Moody
(12) Rebellious

(13) Sarcastic
(14) Selfish
(15) Sensative
(16) Sulky
(17) Timid
(18) Untrustworthy
(19) Vague
(20) Vulgar
(21) Vicious

2. Special teaching-learning activities
    a. Use personality evaluation check list.
    b. Use film strip "Your Attitude is Showing". C-3
    c. Have students write a personality sketch of themselves.
    d. Have students debate the factors which have the most bearing on successful employment.

3. Suggested instructional materials and references
    a. Personal evaluation check list.
    b. Film strip "Your Attitude is Showing". C-3
    c. Human Relations in Agricultural Occupations, Ohio State University, pp. 7 and 8. B-3
    d. Course of Study in Nonfarm Agricultural Occupations, pp. 55-60, B-2
    e. "How to Win Friends and Influence People", Dale Carnegie A-1
    f. Refer students to guidance counselor for special personality tests.

B. To develop an understanding of desirable employer-employee relations.

1. Subject matter content
    a. Be regular in attendance
    b. Be punctual
    c. Obey rules and policies
    d. Respect authority
    e. Possess good personal characteristics

f. Be dependable

g. Show initiative

h. Accept criticism

i. Don't pass the buck

j. Be loyal

k. Seek raises and promotions on merit.

2. Special teaching-learning activities

a. Invite a successful businessman to speak to class on personal traits desired by employers and of objectionable traits which often result in dismissal.

b. Have students compile a list of personal traits of an employee which would be desirable for a good employer-employee relationship.

c. Have students consider someone they know without mentioning names who finds difficulty in securing and/or holding a job, and consider his personal traits which make this so.

3. Suggested instructional materials and reference

a. Personal grooming check list

b. "Salesmanship Fundamentals" Ernest and Devall, p. 335, A-3

c. "Human Relations in Agricultural Occupations", B-3, Ohio State University, pp. 7 and 8.

d. "Course of Study in Nonfarm Agricultural Occupations", pp. 55-60, B-2

C. To develop an understanding of desirable supervisor-employee relations.

1. Subject matter content

a. Be sold on aims of business

b. Accept and use constructive criticism

c. Be loyal

d. Be responsible

e. Respect authority

f. Contribute new ideas

g. Recognize supervisor as an individual

2. Special teaching-learning activities

a. Have students list factors which would effect an employee's ability to get along with his supervisor.

b. Have students consider the effect of age, tenure, and education on human relations in an agricultural business.

c. Have students consider a comparison of the supervisor-employee relation and the co-worker relationship from the standpoint that the supervisor-employee relationship is a direct command relationship and the co-worker relationship is one of informal communication.

d. Have students describe how the following concepts fit into the relationship between a supervisor and an employer.

(1) Loyalty
(2) Respect for authority
(3) Willingness to learn
(4) Cooperation
(5) Honesty
(6) Responsibility
(7) Leadership
(8) Morale

3. Suggested instructional materials and references

a. "Salesmanship Fundamentals" Ernest and DaVall

b. "Human Relations in Agricultural Occupations", Ohio State University, pp. 18-33.

c. "Course of Study in Non-farm Agricultural Occupations", pp.55-60

D. To develop an understanding of desirable relations among co-workers.

1. Subject matter content

a. To maintain good human relations

(1) Treat people as individuals

(2) Don't pass the buck

(3) Be loyal to fellow workers

(4) Be cheerful

(5) Help others

(6) Seek promotion on basis of own merits

(7) Be honest, patient and sincere

(8) Learn the line of authority

(9) Develop a "stick-to-it" attitude

(10) Be resourceful

(11) Do more than is expected

(12) Approach job with enthusiasm

(13) Be friendly

(14) Be responsible

(15) Be complimentary

(16) Learn names of fellow workers

(17) Do not join cliques

(18) Study your fellow worker

(19) Develop good personality traits

b. Avoid undesirable traits

(1) Using (exploiting) other people

(2) "Politicing" - curring favors

(3) Running down others

(4) Taking credit for others' ideas

(5) Gossip, tale bearing

(6) Being jealous

(7) Being indifferent

(8) Ignoring rights of others

(9) Apple polishing

(10) Griping

(11) "Stealing" sales or easy jobs from others

(12) "Acting" as a supervisor

2. Special teaching-learning activities

   a. Show film, "Getting along with Others"

   b. Ask students to define or explain each personality trait and tell what effect it would have on getting along with a co-worker.

   c. Have students rate one another on personality traits.

3. Suggested instructional materials

   a. Film - "Getting Along With Others", C-1

   b. List of personality traits

   c. References: What Employers Want, B-5

      Human Relations in Agricultural Occupations, B-3

      Course of Study in Nonfarm Occupations, B-2

      An Introduction to Agricultural Business and Industry, B-4

E. To develop an understanding of desirable relations between employee and customers.

1. Subject matter content

   a. Treat people as individuals

   b. Recognize that human behavior is unpredictable

c. Develop a winning personality

(1) Enthusiasm
(2) Friendly
(3) Sharp
(4) Complimentary
(5) Sincere
(6) Tactful
(7) Confident
(8) Patient
(9) Considerate
(10) Sympathetic
(11) Understanding
(12) Alert
(13) Optomistic
(14) Modest

d. Avoid undesirable traits

(1) Tactless
(2) Argumentative
(3) Diffident
(4) Sullen
(5) Obstinate
(6) Conceited
(7) Sarcastic

2. Special teaching-learning activities

a. Role playing

b. Film, "Improve Your Personality".

c. Ask home economics teacher to talk on proper grooming.

d. Ask students to think of a businessman that their parents patronize because of his personality. Have them list the qualities they especially like about him.

e. Ask them to make a list of undesirable traits their parents have observed in certain businessmen they no longer patronize.

3. Suggested instructional materials and references

a. Film, "Improve Your Personality, C-2

b. Grooming charts

c. Plans for role playing

d. References: Your Personality and Your Job, B-1
Human Relations in Agricultural Occupations, B-3

Course of Study in Nonfarm Occupations,

pp. 56-58, B-2

An Introduction to Agricultural Business and

Industry, B-4

V. Follow-up and Evaluation

A. Quiz on desirable and undesirable character traits.

B. Visit training center to check on human relations of students.

C. Compare personality rating of students at the end of the course with their rating at the beginning of the course.

VI. Titles and Sources of References

A. Books

1. Carnegie, Dale, How to Win Friends and Influence People, Pocket Books, Inc., New York, New York, 1965 Edition, $.50.

2. Davis, Human Relations in Business, McGraw-Hill Publishing Company, Chicago, Illinois.

3. Ernest and DaVall, Salesmanship Fundamentals, Gregg Publishing Company Division, McGraw-Hill Publishing Company, Chicago, Illinois, 1959 Edition.

B. Pamphlets

1. Chapman, Paul W., Your Personality and Your Job, Science Research Associates, Inc., 2285 Wabash Avenue, Chicago, Illinois.

2. Course of Study in Nonfarm Agricultural Occupations, Department of Agricultural Education, University of Kentucky, Lexington, Kentucky.

3. Human Relations in Agricultural Occupations, Ohio State University, Columbus, Ohio

4. Weyant, Hoover, McClay, An Introduction to Agricultural Business and Industry, The Interstate Printers and Publishers, Danville, Illinois.

5. Worthy, James, What Employers Want, Science Research Associates, Inc., 2285 Wabash Avenue, Chicago, Illinois.

C. Films

1. Getting Along With Others, 16mm film, 29 minutes. Business Education Film, 5113 16th Avenue, Brooklyn, New York.

2. Improve Your Personality, 10 minutes. Coronet Industrial Films, Coronet Building, Chicago, Illinois.

3. Your Attitude is Showing, 35mm sound filmstrip, 13 minutes, Charles Steadman, Teacher-trainer in Distributive Education, University of Pittsburg, Pittsburg, Pennsylvania.

AGRICULTURAL SALESMANSHIP

Prepared by: Larry Statler
Lloyd Tindall
Paul Vincent

I. Introduction

Salesmanship is a broad term. A simplified definition states that salesmanship includes "The acts of personal persuasion employed by the seller to induce others to buy what he wishes to sell." One might say that nothing happens in the American economy until something is sold. Even though this is a strong statement, agricultural sales must be a very important part of any business in which you will eventually become involved. With this in mind, we certainly can justify time in our related instruction program of agricultural occupations experience program. Production of efficient salesmen that understand rural America is one of the main purposes of this module. Efficient salesmen certainly understand that customers are lost mainly because of:

Poor services rendered

Discourteous treatment received

Indifferent attitudes exhibited on the part of the salesman.

II. Major Objectives

A. Understanding the importance of personality in agricultural sales.

B. Develop the ability to enter selling occupations in agricultural supply.

III. Time Allotment 15% _____ days.

IV. Competencies to be Taught

- A. Sales personality
- B. Meeting customers
- C. Presenting supplies and services
- D. Overcoming sales resistance
- E. Closing and recording sales
- F. Displays and advertising
- G. Business communications - terminology
- H. Time budgeting - sales planning

- - - - -

- A. Sales personality
  - 1. Subject matter content
    - a. Personality planning
      - (1) First-have good reason for wanting to improve
      - (2) Second-determine which habit, attitude, trait to work on
      - (3) Third-develop specific plan for improvement
      - (4) Fourth-evaluate periodically to see if improvement is made
      - (5) Fifth-select next personality flaw and proceed.
    - b. Sales assets
      - (1) Alertness: being wide awake, keeping your "eye on the ball"
      - (2) Cheerfulness: being in good spirits, happy disposition
      - (3) Cooperation: working with others willingly, for the group
      - (4) Courtesy: politeness, consideration for others

(5) Dependability: reliable, trustworthy, able to be counted upon

(6) Enthusiasm: showing a keen interest, being sold yourself

(7) Honesty: open and above board, upright, honorable

(8) Industry: finding work without being told, keeping busy

(9) Initiative: self-starting, working on own, self-reliance

(10) Interest in customer: sincere desire to help others

(11) Intelligence: ability to meet a new situation, comprehensive

(12) Loyalty: faithfulness, constancy, stand up for business

(13) Memory: quick recall, remembrance

(14) Orderliness: systematic, keeping things "ship shape"

(15) Patience: self-possession, keeping cool, wait calmly

(16) Personal appearance: well-groomed, dressed appropriately

(17) Poise: mental balance, self-possession, handle self correctly

(18) Sense of humor: can see funny side of problem too

(19) Sincerity: being genuine, uprightness

(20) Tact and diplomacy: working smoothly in difficult situations

c. Sales liabilities

(1) Annoying mannerisms: personal habits attracting attention

(2) Familiarity: over-stepping social conventions, boldness

(3) Giving excuses: passing the buck, not facing facts

(4) Indifference: lack of concern and interest

(5) Jealousy: suspicion, not giving credit where due

(6) Procrastination: putting things off till tomorrow

(7) Rudeness: hunting other fellow's feelings, discourtesy

(8) Tendency to argue: taking opposite point-of-view

(9) Tendency to complain: fault finding, taking dark side

2. Special teaching-learning activities

a. Discuss each of the assets and liabilities as a case-conference, introducing it with a pertinent lead question.

b. Ask class to analyze the best and the poorest salesman they have encountered. Draw out the personality factors.

3. Suggested follow-up and evaluation

a. Each student prepare a personality plan, involving at least one personality fault. Discuss plan with student individually, during a particular class period.

B. Understanding how to meet a customer

1. Subject matter content

The impression of the agricultural business that the customer carries away often results from his first contact with the employee. Appearance and actions play an important part in forming this impression.

A well groomed employee attracts customers and inspires their confidence. Undivided attention on the job is essential to good salesmanship. Salesmanship is demonstrated through promptness, alertness, and interest in the customers problems.

a. Preapproach preparation

(1) Information needed about the customer

Name-address, personal characteristics, mental make-up and hobbies

(2) Sources of this information

Participate in community activities and events

Chamber of Commerce information

Comments made by other members of civic clubs

A personal notebook on customers

Past sales records, credit department records

Interview with people in the community

Local newspaper

(3) Check of the facilities and surroundings

General appearance, lighting, equipment, merchandise arrangement, and personal

(4) Knowledge of the benefits the customer will receive from merchandise sold

Design or appearance, quality of the source-trade-name, composition and construction, and special features

(5) Preparation by the employee

Neatness of appearance, knowledge of contents of merchandise, preparation of an appealing display, and knowledge of contents of newspaper advertisments, knowledge of names, backgrounds, and interest of customers, preparation of a few selling sentences, knowledge of the competitors products, and preparation of a record of common customer objections and development of methods of meeting them

b. Timing the approach

(1) Importance of the impression created by the salesman's appearance and actions

Promptness, alertness, and interest in customers' problems

c. The proper approach

(1) Types of salutations

Conventional, question, and stating a fact about the merchandise

(2) Elements of a good salutation

Courteous, short, requires no mental decision, affirmative and emphasize the desire to serve

(3) Tone of voice - pleasant, enthusiastic, distinct, articulate, and ordinary

(4) Facial expressions

A pleasant smile and cheerful expression

2. Special teacher-learning activities

a. Develop with the students a list of attitudes and actions of a good agricultural salesman.

b. Invite the manager of a successful agricultural business to discuss with the class do's and don'ts of good salesmanship he has observed.

3. Suggested instructional materials and references

a. "The Approach," 10 minute film

b. <u>Fundamentals of Selling</u>, Wingate, Nolen S.W. Publishing Company, Cincinnati, Ohio

c. Center for Voc. Tech. Education, Ohio State University, Columbus, Ohio

4. Follow-up and evaluation

   a. Have the students analyze themselves regularly

   b. Discuss the training center experiences in the classroom with the students

C. Understanding how to present supplies and services

1. Subject matter content

Successful selling requires a careful presentation by the seller. An employee must recognize the importance of each of the psychological steps in a sale. He must gain the attention, develop the interest, kindle desire, and induce action on the part of the customer.

   a. Draw attention of customers to a supply or service

   Examples

   (1) oReading an advertisement about a beef concentrate

   (2) Seeing a new herbicide on a TV commercial

   (3) Talking to a neighbor about his new five plow tractor

   (4) Mailing a circular on early fertilizer purchase discount

   (5) Meeting a new petroleum delivery truck on the road

   (6) Viewing an attractive display of seed at a supply center

   b. Develop interest in a product

   Examples

   (1) Talking to the customer about the new features of this new planter

   (2) Showing him the results of this product in test trials

   (3) Inviting him to a field day where the effectiveness of

newly developed herbicide will be shown

(4) Demonstrating how simple it is to mount this new corn picker

c. Desire for a product may be attained by relating it to a need of the customer

Examples

(1) Explain how this feed will increase net income by improving the animal's rate of gain

(2) Show him, with proof from variety trials, how the new oat variety will stand

(3) Show him that the chemical weed spray will reduce cultivation

(4) Sell the merits of the tractor seat, not its cost

(5) Provide opportunity for the customer to try the product on a trial basis.

d. Know your product

(1) Know the features of the item

(2) Be able to answer all questions about the item

(3) Demonstrate its use, operation, value, advantages and disadvantages

2. Special teaching-learning activities

a. Have students demonstrate methods of getting and holding interest

3. Sugeested instructional materials and references

a. <u>Store Salesmanship</u> textbook

b. <u>Retail Merchandising</u> textbook

c. <u>Fundamentals of Selling</u> textbook

4. Follow-up and evaluation

D. Overcoming sales resistance

1. Subject matter content

a. True motives for buying

(1) The desire to feel superior

(2) The desire for health and comfort

(3) The desire for the parent to protect the offspring

(4) The desire for amusement

(5) The desire for food and drink

(6) The desire to earn money

(7) The desire to save time and improve efficiency

(8) The desire to save energy

b. Dealing with sincere objections

(1) Turn objections into selling points

(2) Agreeing with customer and presenting another angle

(3) Requesting the customer to explain the objections thus analyzing his position

(4) Admitting the objections and giving a superior point

(5) Asking a question that when answered, overcomes the objection

c. Handling common objections and excuses

(1) Need - objections to need are overcome by stressing the usefulness and benefits of the product

(2) Quality - objections to quality are overcome by showing a better quality, and pointing out a specific feature.

(3) Source - objections to source are met by providing

names and experiences of satisfied customers, providing information about the company or by reference to national advertising.

(4) Price - objections to price are overcome by revealing hidden values, building up values, emphasizing the quality, providing an article that is not as expensive

(5) Time - objections to time are overcome by making future appointments, inviting the customer to look at additional materials, continuing to show a positive interest in him whether he is busy or not, not trying to close a sale before all objections have been satisfied

(6) Thing - objections to thing are overcome by showing more suitable goods, admitting the validity of objections but showing another feature to offset the objection, changing the objection into a selling point

2. Special teaching-learning activities
   a. Divide class in half, one group arriving at sincere objections and the other group arriving at excuses. Contrast methods of handling these two types.
   b. Ask students to list objections they would have to purchasing a product within their occupational center. Work out methods of correcting these deficiencies. Role play, as the class prescribes methods.

3. Suggested instructional materials and references
   a. Self experiences
   b. Center for Vocational and Technical Education, The Ohio State University, "Agricultural Supply-Sales and Service

Occupations", Agricultural Salesmanship module.

c. Retailing Principles and Practices textbook, p. 232-234

4. Suggested follow-up and evaluation

E. Closing and recording sales

1. Subject matter content

a. Establish prestige with the customer

(1) Be friendly

(2) Talk customers language

(3) Show you are not motivated by selfish reasons

(4) Respect his opinions and beliefs

(5) Know your business, your product

(6) Present your thoughts clearly

(7) Be a good listener

(8) Compliment him sincerely

(9) Show by doing that you mean what you are saying

(10) Remember appearance, be well groomed

b. Understand the buying cycle

(1) Recognize the problem

(2) Strong desire for solution

(3) Decides on best solution

(4) Purchases (help customer buy NOW)

c. Planning for the close

(1) Fixing or finding the problems of the customer

(2) Maintaining positive attitudes

(3) Assume customer will buy during the close and all through the talk

d. Know when client is ready to buy
  (1) Customer shows interest and desire in product
  (2) Relationship between need and merchandise is established
  (3) All objections are overcome
  (4) Product meets customer approval
  (5) Customer has power to make the purchase

e. Methods of closing
  (1) Trial close - ask leading questions calling for decision
  (2) Assumptive close - assume purchase, write up order
  (3) Action close - ask yes or no question
  (4) Inconvenience close - let prospect feel he is putting you to some trouble
  (5) Summary close - review sales talk
  (6) Pro and con close - show advantages of your product
  (7) SRO or standing room only close - last one left, first one in town
  (8) Suggesting or decision close - most people prefer this
  (9) Time payment close - can be bought on time, tell advantages of this
  (10) Premium close - offer a premium if he buys now

f. Dealing with stalls and excuses
  (1) Don't let objections distress you
  (2) Avoid argument and contradictions
  (3) Answer briefly and clearly
  (4) Turn objections into selling points
  (5) Don't pause in answering, go on selling

g. Recording results of sales
    (1) How much volume, gross, dollars, etc. did you sell in day, week, etc.
    (2) How many units did you sell per call made or customer seen
    (3) How many contacts or customers did you see to make a sale

2. Special teaching-learning activities
    a. Have students prepare a weekly plan schedule
    b. Have students explain how they would use a center of influence
    c. Have students prepare a budget to determine sales goals.
    d. Discuss ways to raise income without working more hours

3. Titles and sources of references
    a. Salesmanship Fundamentals textbook
    b. How to Apply Modern Selling Methods textbook
    c. Personal experiences

F. Understanding how to do advertising and make displays

1. Subject matter content

Advertising

a. Attract attention
    (1) Illustrations, vivid colors, decorations, preferred positions, unusual lettering, clever spacing, strong headlines, and short forceable sentences at beginning

b. Develop interest
    (1) Tie up the merchandise with the customers needs

c. Create desire

(1) Appeal to the emotions

(2) Appeal to reason

Displays

a. Attract attention

(1) Props, background, and lights

b. Develop interest

(1) Timeliness, and human interest

c. Create desire

(1) Appeal to the emotions

(2) Appeal to reason

d. Points in making a good display

(1) Decorate from customers viewpoint

(2) Select merchandise setting that is timely

(3) Have one central theme or idea only

(4) Keep the window merchandise clean

(5) Use background lights to attract attention and accent

(6) Make clever use of emphasis and balance

(7) Make original pleasing use of color and harmony

(8) Have window reflect the character of the store

(9) Display the merchandise as it can be used

(10) Change the display often

2. Special teacher-learning activities

a. Have students collect materials and make displays in the classroom. One student create display each week

b. Have students bring to class advertisements that they consider good and discuss the good and bad points of these advertisements.

3. Suggested instructional material and references

a. <u>Store Salesmanship</u> textbook

b. <u>Retail Merchandising</u> textbook

c. <u>Retailing Principles and Practices</u> textbook

d. Business Education Department in school

4. Follow-up and evaluation

a. Entire class to evaluate the self-created displays in class, as to predetermine scorecard.

G. Business communications - terminology

1. Subject matter content

a. Terminology of individual businesses (directly sales-related)

(1) Bulk rates
(2) Car load lot
(3) Commission buyer
(4) December wheat
(5) Dockage
(6) Dressing percentage
(7) F.O.B.
(8) Franchise
(9) Futures market
(10) Hedging
(11) Shrinkage
(12) Terminal market
(13) Warehouse receipt
(14) Capital investment
(15) Capital turnover
(16) Carrying charges
(17) Discount
(18) Hardware goods
(19) List price
(20) Margin
(21) Inventory
(22) Reserve fund
(23) Depreciation charges
(24) Registered check
(25) Mark-up
(26) Perishables
(27) Price leader
(28) Retail price
(29) Sale price
(30) Seasonal demand

(31) Wholesale price

(32) Bill of lading

(33) Demurrage

(34) Fishyback

(35) Piggyback

(36) Net profit

(37) Fixed costs

(38) Variable costs

(39) Gross sales

(40) Net worth statement

(41) Assets

(42) Liabilities

(43) Accounts payable

(44) Accounts receivable

(45) Check

(46) Money order

(47) Traveler's check

(48) Telegraphic money order

2. Special teaching-learning activities

   a. Ask students to define the above sales terminology by giving an example of how it would be used in their business. This would be done individually, using the experience center resources.

3. Suggested instructional materials and references

   a. Self experiences

   b. Individual experience stations

   c. Occupations experience program personnel

4. Suggested follow-up and evaluation

   a. Ask students to accumulate answers to this material as they witness their occupational experience programs. Instructor will need to check periodically if progress is being made, and an understanding of application is being developed.

H. Sales planning - time budgeting

1. Subject matter content

   a. How to organize your weekly work

      (1) Decide how much production you need per week. Decide

production by figuring a personal and business budget for the year. Find how much production your company wants per week if on a salary.

(2) Decide how many clients or customers you will need to see to meet your goal.

(3) Decide how many prospects to see each day and which ones

(4) Organize prospects into geographic areas for each day and decide on the best time for each.

(5) Have a goal in mind for each prospect.

(6) Set aside time to service clients, keep records, office work, study and plan to put in a full day everyday.

b. Planning for future sales

(1) Determine your longtime sales goals (how much needed money)

(2) Keep a good prospecting system at all times

(3) Develop centers of influence from your present customers

(4) Service your old prospects

(5) Eliminate all the deadwood from your prospect file

(6) Study new materials and goods for future sales, know your business.

(7) Improve your efficiency ratio (number of calls to make a sale or dollars)

(8) Continue to improve your work habits

(9) Keep records to show where improvement in procedure

is needed.

2. Special teaching-learning activities
    a. Have students learn and explain the buying cycle
    b. Have students practice different closes on each other and have class rate each closing attempt.
    c. Have students construct sales chart for class use.
3. Titles and sources of references
    a. Salesmanship Fundamentals textbook
    b. How to Apply Modern Selling Methods textbook
    c. Personal experiences and Business Education Department

V. Follow up and Final Evaluation

A. Since this module is made up of a complex of different competencies, we have included the suggested follow-up activities at the end of each competency.

B. Suggested oral examination for grading, plus employer evaluation.

VI. Titles and Sources of References and Instructional Materials

A. Textbooks

1. Wingate, Fundamentals of Selling, Southwest Publishing Company, Cincinnati, Ohio
2. Robison, Blackler, Logan, Store Salesmanship, Prentice Hall, Inc.
3. Wingate, Retail Merchandising, Southwest Publishing Company, Cincinnati, Ohio
4. Richard, Meyer, Hayes, Retail Principles and Practices, McGraw Hill Company.
5. Maguire, How to Apply Modern Selling Methods, Area Vocational and Technical School, Somerset, Kentucky.
6. Ernest and DaVall, Salesmanship Fundamentals, Gregg Publishing Company, Division of McGraw-Hill Company.

B. Bulletins and Pamphlets

1. Center for Vocational and Technical Education, The Ohio State University, Agricultural Salesmanship, module, Agricultural Supply-Sales and Services Occupations.

2. Human Relations Module, found as part of this series of modules.

3. Business Education Department, Division of Distributive Education, curriculum in local high school-numerous publications.

C. Films

1. The Approach, I.S.U., Visual Education Services, 10 minute film.

2. Distributive Education Department, Has access to records, visuals, etc., all contributing to successful teaching of this module.

ORGANIZATION AND FUNCTIONS
OF AGRICULTURAL BUSINESSES

Prepared by: L. L. Reding
G. C. Miehe
D. E. Wahlstrom

I. Introduction

We are concerned with the organization and functions of agricultural businesses because as a member of a business you will want to know what pattern your business uses in its organization. There are several types of businesses involved in the service and processing of agricultural products. These are all brought under a number of governmental regulations to prevent unethical operations. Thus, we must be concerned with these business functions and their organizations.

The teacher should also encourage open-mindedness to avoid reinforcing individual prejudices during the study of controversial business organizations and practices such as cooperatives, patronage dividends, and liability.

II. Major Objectives

To understand the functions and organizational patterns of agricultural businesses.

III. Time Allotment 12% _____ days

IV. Competencies to be Taught

A. To understand the functions of agricultural businesses.

B. To understand the various types of agricultural businesses.

C. To understand how agricultural businesses are established.

D. To understand governmental regulations affecting agricultural businesses.

- - - - -

A. To understand the functions of agricultural business

1. Subject matter content

a. Capitalism and/or free enterprise

(1) Capitalism offers profit incentive

(2) Define terms: business, utility, production.

b. Nature of American business

(1) Geographical area covered

(2) Types of people served

(3) Services rendered

(4) Functions: time, form, place, and price problem

(5) Define terms: eminent domain, private property, labor, capital, management.

c. Competition, profits, and risks

(1) A merchant should receive a fair rate of interest on his total investment in same way as a farmer.

(2) Competition brings about new inventions, changes in products, and other changes in technology.

(3) In business, as returns increase risks also may increase.

(4) Price is determined by quality and competition.

(5) Define terms: economic activity, monopoly, "fad item," false advertising, fair trade, credit regulations.

d. Who owns American business?

(1) American business is owned by people.

(2) Fathers of class members own stock in businesses and are members of cooperatives.

(3) Stockholders actually own the business.

2. Special teaching-learning activities

   a. Show a chart listing several forms of government and associated practices in comparison with capitalism and its practices

   b. Take class to brokerage firm and a board of trade subsidiary

   c. Have banker and investment representative speak to class

   d. Make certain class members understand following terms: government ownership, stock markets, futures, board of trade, mutual funds, speculator, hedger, "bull and bear" system

3. Suggested instructional materials and references

   a. Self-experience

   b. How do We Organize to do Business in America, Ref. B-1

   c. General Business for Everyday Living, Ref. A-2

   d. Youth Wants to Know About Business Organization, Ref. B-5

   e. Film - It's the Farmer's Business, Ref. D-2

   f. An Introduction to Agricultural Business and Industry, Ref. A-1

B. To understand the various types of agricultural business

1. Subject matter content

   a. Individually owned business

      (1) Point out why this type of organization has flexibility, why it is likely to be in a convenient location, and

why the operator is apt to associate with other merchants in obtaining buying power and promotional aids with which to compete with large scale operations.

- b. Partnership
  - (1) Illustrate businesses that started as individually owned and later combined into partnership. Reasons.
  - (2) Define terms: silent partner, secret partner, limit partnership.
- c. Ordinary corporation
  - (1) Individual business may be combined into corporations.
  - (2) Legal characteristics of corporation.
    - (a) Charter
    - (b) Seal
    - (c) Address
- d. Cooperative corporation
  - (1) Importance of cooperatives
  - (2) Role of cooperative corporations to farmers
  - (3) Types of cooperatives other than agricultural cooperatives

2. Suggested instructional material and references
   - a. How do we Organize to do Business in America?, Ref. B-1
   - b. 4 Ways of Doing Business, Instructor's guide, Ref. B-1
   - c. Do you Know Your Cooperative? Ref. B-1
   - d. Film - You and Your Cooperative, Ref. D-1

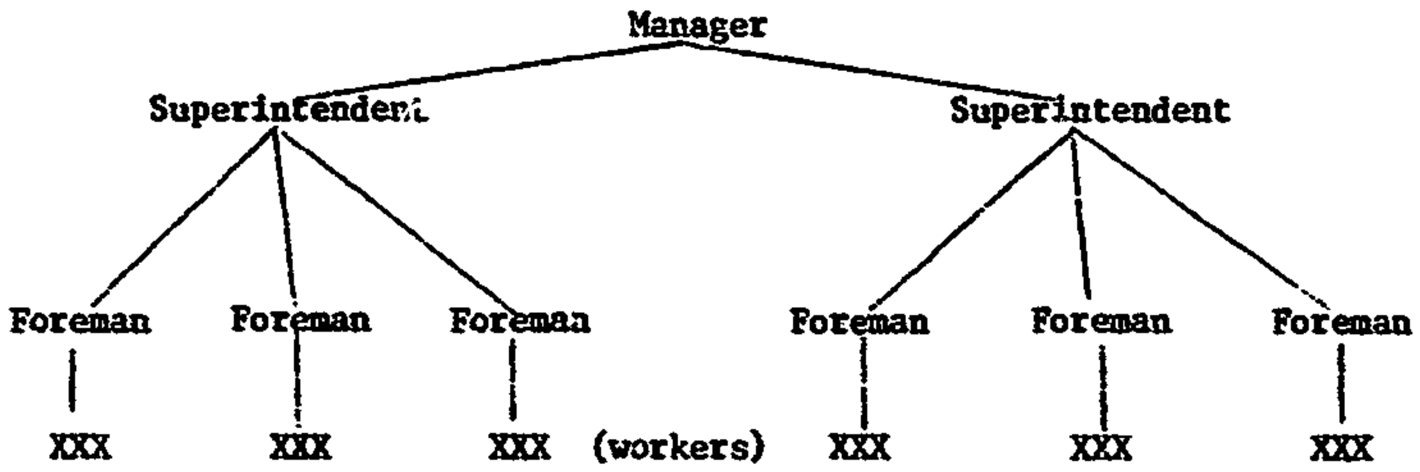
C. To understand how agricultural businesses are established.

1. Subject matter content
   - a. Location

COMPARISON OF FOUR METHODS OF DOING BUSINESS UNDER PRIVATE ENTERPRISE

	Types of Business			
FEATURES COMPARED	INDIVIDUALLY OWNED BUSINESS	PARTNERSHIPS	BUSINESS CORPORATION	COOPERATIVE CORPORATION
1. Who uses the services?	Non-owner customers	Generally non-owner customers	Generally non-owner customers	Chiefly the owner-patrons
2. Who decides policy?	Owner	Partners agree	Board of directors	Member-patrons & board of directors
3. Who manages?	Owner	One or both partners	Officers and assistants	General manager and staff
4. How is voting done?	NONE necessary	Partners agree	Each shareholder 1 vote per share	Usually one member one vote
5. Who owns business?	Individual	The partners	The stockholders	The member-patrons
6. How is business financed	Personal capital & loans	Partners' capital & loans	Stocks, bonds, & loans	Members capital, borrowing from banks and individuals
7. Returns on invested money?	Unlimited	Unlimited	Unlimited	4% to 6% (normal interest rate)
8. How may net margins be used?	As owner desired	As agreed by partners	Dividends, reserves and surplus	Interest on stock, patronage dividends, reserves, and surplus
9. What is owner's liability?	All property of owner	All property of partners	Limited to assets of corporation	Limited to his investment in cooperative

    (1) In choosing a location, explain why the number of people who pass a proposed site is less important than the nature of this traffic.
    (2) Planned shopping centers challenge downtown shopping districts for share of consumer's money.
b. Building requirements
    (1) What are the desirable types of materials for construction?
    (2) How many entrances should be provided and where should they be?
    (3) How much can a business afford to pay for housing?
    (4) What are the principle legal points in connection with the leasing and/or the purchase of property?
c. Equipment and layout
    (1) Difficulty of accurate visualization and good arrangement of store equipment.
    (2) Consider the customer when planning the business layout.
    (3) Desire of convenience - provide parking area
d. Chain of command of personnel
    (1) Line or military pattern

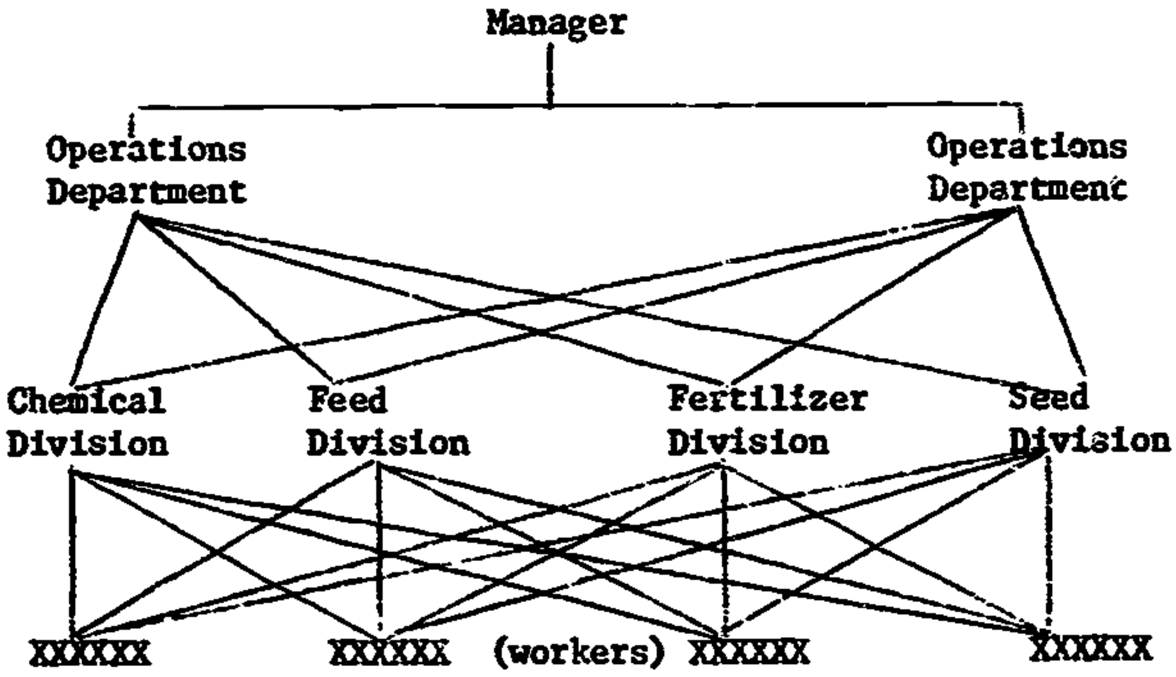


(2) Every person in the organization, except the lowest employees, has one or more subordinates to supervise. No person has more than one supervisor; top official has none - common in small business.

(3) Functional pattern

(a) Used by some agricultural supply businesses

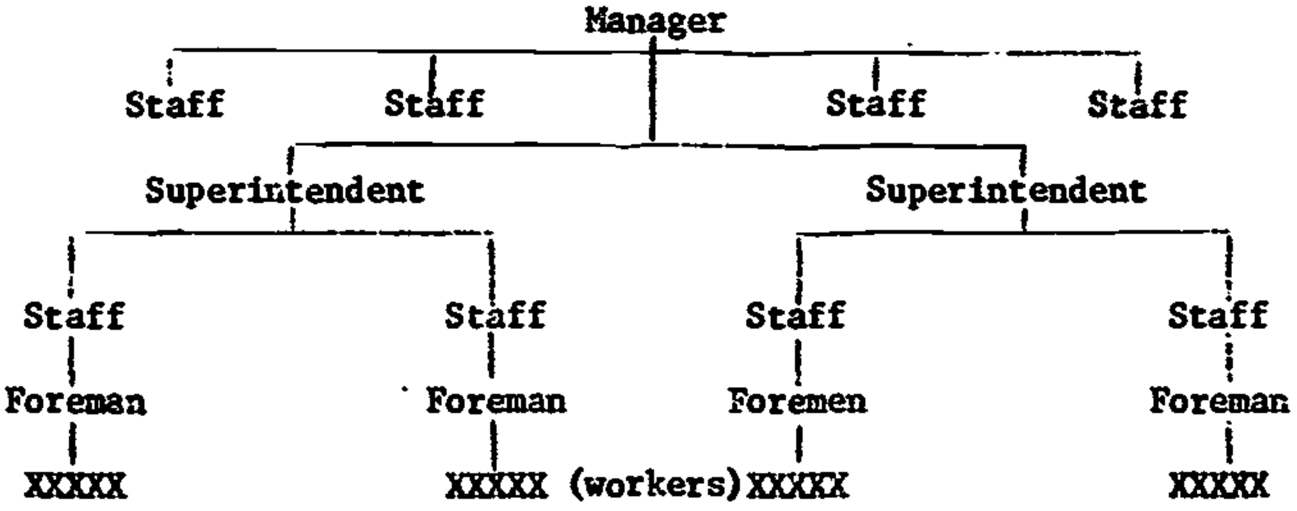
(b) Increased efficiency resulting from changing all-around supervisors into specialist supervisors



e. Line or staff

(1) Most widely used in today's business

(2) Any number of superintendents, foreman. staff officers, and workers in this pattern.



2. Special teaching-learning activities
    a. Have a construction representative or lumber yard man talk to class about materials used in construction.
    b. Visit various businesses in community and survey materials, location in regards to traffic, display of products, interior and exterior appeal, etc. (physical characteristics)
    c. Obtain a lease form used in business for students to study
    d. Have students diagram the organizational pattern of a local business
    e. Have students diagram organizational pattern of local school district, church, FFA organization.
3. Suggested instructional material and references
    a. Module 5 - Organization and Functions of Agricultural Businesses, Ref. B-4
    b. Use of local personnel in community

D. To understand governmental regulations affecting agricultural businesses

1. Subject matter content
    a. Intra & interstate commerce
        (1) Intrastate commerce - state regulation of business within its boundary.
        (2) Interstate commerce - regulations of commerce between states by the Federal government.
        (3) No state can impose duties on imports and exports.
    b. Agricultural businesses would be regulated by each.
    c. Labor regulations
        (1) State regulations are formulated as to number of hours

employees may work

(2) Most states have maximum weekly hours a person can work under set wage.

(3) Restrictions as to types of jobs - minors

(4) Minimum wage law.

(5) State laws setting standards - state regulations on employee occupational compensation

(6) Social Security Act and old age benefits

d. Price regulations

(1) Functions of a discount house

(2) Prevent monopolies

e. Fair trade laws

(1) State regulations as to manufacture - dealer price setting

(2) Fair trade item and non-signer's clauses

f. Unfair practice laws

(1) State law prohibiting dealers from selling below cost

(2) Give-away sales

g. Price discrimination laws

(1) Prevent manufacturers from giving buyers unfair price advantages

(2) Common law - contract entered under bribery illegal

h. Credit regulations

(1) Prevent inflation - declared illegal by Congress

i. Merchandising regulations

(1) Products only sold by licensed holders (drugs)

j. Choice of customers and employees
    (1) Discrimination laws
k. Advertising and selling regulations
    (1) False advertising, unfair methods of competition, and deceptive acts are unlawful
l. Mergers and combinations
    (1) Federal Trade Commission regulations
    (2) Monopolistic activities
m. Tax regulations
    (1) Purpose - to raise reserves needed by federal, city, or state governments and services
    (2) Business use of tax expert

2. Special teaching-learning activities
    a. Visit a discount house to compare price and quality of product to name brand store
    b. Have local fertilizer dealer discuss price cutting
    c. Organize a Junior PCA in FFA Chapter
    d. Have nearby manufacturer discuss product pricing with reference to price regulations
    e. Have small business administration representative discuss business laws and regulations with class
3. Suggested instructional materials and references
    a. Instructor must realize that these are ever changing laws and regulations.
    b. Retail and Service Enterprises and Establishments, Pub. 1135 Ref. B2
    6. Child Labor Provisions, Pub. 1096, Ref. B2

d. Labor Laws of State of Iowa, Bulletin 21, Ref. B-3

V. Follow-up and Evaluation

A. Field trips.

B. Testing over materials.

C. Utilize committee reports and surveys.

D. Check membership of students and parents in organizations, stockholders.

E. Have students check and analyze actual government regulations and business organizations in his work experience training center.

VI. Titles and Sources of References and Instructional Materials

A. Books

1. Weyent, J. T. etal., Introduction to Agricultural Business and Industry, Interstate Printers and Publishers, Danville, Illinois, 1965.
2. Price, Musselman, Weeks, General Business for Everyday Living, McGraw Hill Book Co. Inc., Chicago, Illinois.

B. Pamphlets

1. Do You Know Your Cooperative, Farmer Cooperative Businesses in Iowa, How Do We Organize to do Business in America, all in the Vo-Ag Instructor's Notebook on Farm Cooperatives, Iowa Institute of Cooperation, N. 9th Street, Ames, Iowa
2. Publications 1135, 1096, 1122, 1007 from the Federal Regulations Information on Labor Laws, U.S. Department of Labor, 2000 Federal Office Building, 911 Walnut Street, Kansas City, Missouri.
3. The State Labor Laws and Regulations, Bulletin 21, The labor Commissioner, Bureau of Labor, State House, Des Moines, Iowa.
4. Teaching Module for Organization and Functions of Agricultural Businesses, Center of Vocational and Technical Education, The Ohio State University.
5. Youth Wants to Know About Business Organizations, Minneapolis Grain Exchange, 4th St. and 4th Ave., Minneapolis, Minnesota.

C. References

1. Examples of leases obtained from an attorney, bank, or court house.
2. Business Education Department - local school.
3. Chamber of Commerce - local community

D. Films

1. You and Your Cooperatives, NS164, $.75, Audio-visual Instruction Service, I.S.U., Ames, Iowa
2. It's the Farmer's Business, Farm Credit Bank, Omaha, Nebraska.

BUSINESS PROCEDURES

Prepared by: M. R. Hoskey
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I. Introduction

An important part of a successful business is the ability to keep complete and accurate records and carry out correct business procedures. Some businesses hire a full-time employee to do this while at other businesses this is done by all or certain employees. In your occupational experience you may or may not have much responsibility as far as business procedures but this module will help you better understand the business part of the organization in which you may be employed.

II. Major Objectives

To develop in students the effective ability to use the ordinary business procedures common to agricultural businesses.

III. Time Allotment 15% _____ days

IV. Competencies to be Taught

A. To develop the understanding of the importance of complete and accurate records in the conduct of business.

B. To develop the understanding and ability of using business mathematics.

C. To develop the ability to use correct bookkeeping procedures.

D. To develop the understanding of credit and credit policies.

E. To develop the understanding and ability of using budgets.

F. To develop the ability to understand and take different kinds of inventories.

G. To develop the understanding and ability of using efficiency factors.

H. To develop the understanding of taxes.

I. To develop the ability to receive and store merchandise.

J. To develop the understanding and ability of properly stocking merchandise.

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A. The understanding of the importance of complete and accurate records in the conduct of business.

1. Subject matter content

a. Records are important to:

(1) Know the financial picture of the business at a given time.

(2) Give proper information to board of directors, stockholders, and others involved.

(3) Satisfy legal requirements.

(4) Plan desirable changes in management and procedures.

b. An important record is the operating statement--sometimes called profit and loss statement.

(1) May be done annually, biennially, quarterly, or monthly.

(2) Shows profit or loss for that period of time.

(3) May be broken down by departments.

c. Another important record is the balance sheet

(1) Shows assets, liabilities, and net worth at any time.

(2) Liabilities plus net worth must balance with assets.

d. Balance sheet and operating statement make up financial report for business.

e. Daily, weekly and monthly records help make up financial reports.

f. A record of cash sales should be kept and compared with cash in register.

g. Charge sales should be correctly made and entered in appropriate place.

h. All costs must be kept correctly, this includes:

(1) Purchases	(6) Taxes
(2) Payroll	(7) Supplies
(3) Property expense	(8) Services
(4) Advertising	(9) Interest
(5) Depreciation	(10) Others

i. Reducing expenses is as much of a value as increasing sales.

2. Special teaching-learning activities

a. Have students fill out operation statements and balance sheets.

3. Suggested instructional materials and references

a. Copies of operating statements, balance sheets etc. (can usually be obtained from Co-ops easier than other businesses).

B.. The understanding and the ability of using business mathematics.

1. Subject matter content

a. Figuring what the customer pays

(1) Writing up sales checks

    - (2) Ringing up sales
    - (3) Adding several items
    - (4) Figuring number of similar units at the same price. (8 items x 40 cents/item)
    - (5) Combinations of add, subtract, and multiply.
- b. Discounts
    - (1) Figuring trade discounts to allow retailer to make profit.
    - (2) Figuring quantity and cash discounts.
    - (3) Figuring the complement of the discount. (100 - % discount=complement discount)
    - (4) Figuring by equivalents.
- c. Comparison of percentage
    - (1) Changing percent to decimal in figuring cost.
    - (2) Aliquot parts of 100. (8 1/3 is 1/12 of 100; 1/12 of $18 = $1.50)
    - (3) Percents that should be changed to fractional form rather than using decimals are:

Change 8 1/3 to 1/12
12 1/2 to 1/8
16 2/3 to 1/6
33 1/3 to 1/3
66 2/3 to 2/3

- d. Costs as percentages of profit
    - (1) Comparing expenses and costs to sales
    - (2) $\frac{\text{Sales}}{\text{Costs}} = $ Profit or margin

e. Costs as percentages of sales

(1) $$\frac{\text{Expenses}}{\text{Sales}} = \text{\% expense rate}$$

(2) $$\frac{\text{Selling cost}}{\text{Sales}} = \text{\% selling cost}$$

(3) $$\frac{\text{Profit}}{\text{Sales}} = \text{\% profit}$$

(4) $$\frac{\text{Dollar reduction in price}}{\text{Sales}} = \text{\% markdown}$$

(5) Comparisons of % are more significant than comparing dollars.

f. Stockturn

(1) $$\frac{\text{Sales}}{\text{Ave. stock}} = \text{Stockturn}$$

Example:

$$\frac{\text{100,000 gal. gas sold/year}}{\text{1,000 gal. on hand}} = 100$$

(2) Importance of stockturn

g. Average Sale

(1) $$\frac{\text{Dollar Sales}}{\text{No. of transactions}} = \text{Average Sales}$$

(2) Importance of high average sale

h. Pricing goods

(1) Difference between cost and selling price.

(2) Overhead expenses such as rent, insurance, and taxes take from the above difference.

i. Markups

(1) The difference between cost and selling price is markup.

(2) Percent of markup needed to make a reasonable profit.

(3) What customers will readily pay for a product.

(4) $\frac{\text{Retail price - cost}}{\text{Retail price}} = \%\text{ markup}$

(5) Figuring retail price from known % markup.

(6) Figuring wholesale price from known % markup.

j. Profits

(1) Importance of figuring profits.

(2) Gross income - total expenses = profit.

2. Special teaching-learning activities

a. To speed up the ability of students to work problems, add and subtract items, and work efficiently, students could be divided up into teams in the class room, and compete for points.

b. Use a cash register in the classroom to give students familiarity of using it.

3. Suggested instructional materials and references

a. Agricultural Occupations Institute

b. Arithmetic in Agriculture

c. Fundamentals of Selling

d. Preparing Students for Employment in Agriculture

C. The ability to use correct bookkeeping procedures

1. Subject matter content

a. Balance sheet

(1) Purpose - to summarize the records of the business at a given point in time to evaluate net worth.

(2) Items found on balance sheet

(a) Current assets

(b) Fixed assets

(c) Current liabilities

(d) Deferred liabilities

(e) Common stock

(f) Preferred stock

(g) Reserves

(h) Surplus

(i) Net worth

b. Income statement

(1) Purpose - to summarize the records at the end of a period to determine profit or loss for that period.

(2) Items found on income statement

(a) Sales receipts

(b) Other income

(c) Sales expenses

(d) General expenses

(e) Cost of goods

(f) Beginning and ending inventory

(g) Depreciation

(h) Fixed expenses

(i) Income tax

(j) Net income

c. Sales tickets procedures

(1) Enter correct date

(2) Be sure to get correct name and address for individual or firm.

(3) Give complete description of each article sold.

(4) Enter both price and amount as retail price and discount by giving discount under description and subtracting.

(5) Make sub-total of amount column.

(6) Calculate sales or other taxes.

(7) Give other instructions (mixing, delivery date, etc.)

(8) Make grand total

(9) Indicate method of payment

(10) If method of payment is a check in an amount other than the amount of sale indicate so on ticket.

(11) Have customer sign ticket.

(12) If employee ruins a ticket, void the ticket by writing void and keep tickets. Tickets are numbered consecutively and should be accounted for.

(13) Initial the ticket.

(14) Write legibly.

2. Special teaching-learning activities

   a. Have boys acquire a few different types of sales tickets and fill them out.

3. Suggested instructional materials and references

   a. Any accounting book.

   b. Ohio State's <u>Business Procedures Module</u>.

D. The understanding of credit and credit policies

1. Subject matter content

   a. Cost of modern agriculture is so high that farmers must borrow money or use a business' credit plan for purchases.

   b. Credit from businesses usually lasts less than a year, like a growing season or fattening season.

   c. Most businesses must charge 1 to 1 1/2% per month to cover additional bookkeeping costs, etc.

   d. Interest costs may be figured 3 ways, (explain)

   (1) Flat rate basis

   (2) Discounted

(3) Interest on the unpaid balance

e. Give formula for finding actual cost of interest.

2. Special teaching-learning activities

a. Have students fill out notes and other forms used in obtaining credit.

3. Suggested instructional materials and references

a. Credit policies of local firms.

E. The understanding and ability of using budgets

1. Subject matter content

a. Definition

(1) Budgeting provides a means of systematically assembling and organizing the expected costs and returns of alternatives so that they can be carefully weighed by management.

b. Purposes

(1) To predict future events-a budget of the costs and revenues of next year's operation for a business.

(2) To guide future events-a budget to guide how disposable income will be spent over a specified future period.

(3) To establish or clarify goals-a budget to establish the estimated operating volume in the case of a particular product or business to cover anticipated operating costs and provide a desired net income.

(4) To consider the advisability of a possible future course of action-a budget to evaluate the possibility of business expansion, reduction, diversification, or integration.

      (5) To evaluate alternatives-a budget to evaluate different wage policies, mark-ups and prices, products and services, inventory policies, credit policies, uses of labor and capital, etc.

  2. Special teaching-learning activities

    a. Divide class into five groups and have the students prepare a budget for the FFA using a different budget purpose for each group.

  3. Suggested instructional material and references

    a. Managing for Greater Returns

F. The ability to understand and take different kinds of inventories.

  1. Subject matter content

    a. An inventory is a correct count, including the value of goods on hand in a business.

    b. They are important for several reasons

      (1) An accurate value is necessary for year-end or periodic analysis of the business.

      (2) Periodic counts enable the business to determine the freshness of its stocks, and to decide whether some items are going out of date.

      (3) Inventory counts will show the extent to which items are moving. They will show whether items are overstocked or understocked.

      (4) Physical count inventories are necessary to determine possible losses (difference from book inventories).

    c. Types of inventories

      (1) Perpetual inventories

   - (a) An inventory giving the number of items on hand all the time
   - (b) Done by adding purchases to and subtracting sales from inventories
   - (c) This is a "book" inventory and must be checked against an actual inventory regularly.
- (2) Physical inventory
   - (a) An actual count of all items on hand.
   - (b) Must be done at end of year and can be done at other times also.
   - (c) Procedure may include the following steps
      - 1' Arrange stock in an orderly fashion
      - 2' Check stock for condition, inventoring only that of salable quality.
      - 3' Count and record every item, listing the cost price unless local business prefer that the selling price be used.
      - 4' Keep inventories separate for different departments and type of goods.
      - 5' Compute totals.

d. Businesses may have special forms to use in taking the inventory.

e. These forms may include
   - (1) Location of merchandise
   - (2) Department to which merchandise is charged
   - (3) Names of persons taking the inventory
   - (4) Information concerning age and/or quality of merchandise

2. Special teaching-learning activities
    a. Have students inventory shop tools or reference books.
    b. Have them inventory their room at home, stress neatness, accuracy, and completeness.

G. The understanding and ability of using efficiency factors

1. Subject matter content
    a. Return on capital investment--total net earnings divided by total assets (investment)
        (1) Figured for the business as a whole and compared with other like businesses.
        (2) Figured for departments within a business and compared with other departments either within the business or the same department in another business.
    b. Inventory turnover--total sales divided by average inventory
        (1) This factor indicates the number of times the inventory was turned over in a month or other period.
        (2) This factor is used in figuring a suggested gross margin for a business--turnover times (X gross margin) = 100
    c. Labor recovery
        (1) Maximum based on 40 hour week

40 hrs. per week for 52 weeks = 2080 hrs.	per year
Two weeks vacation with pay (2x40)	80 hours
Five paid holidays at 8 hrs. per day	40 hours
Personal reasons 5 days at 8 hrs.	40 hours
Total	160 hours

$\frac{2080 - 160}{2080} = 92.3\%$ maximum that could be recovered

        (2) Percent work recovery and shop break even point.

Direct labor cost + shop's share of general operating expenses = Total shop expenses

$$\frac{\text{Total shop expenses}}{\text{Customer's rate per hour}} = \text{hours to break even}$$

$$\frac{\text{Hours to break even at customer rate}}{\text{Hours paid to employee}} = \text{\% work recovery needed to break even}$$

(3) A recommended level is 2.2 x mechanics hourly wage = customer rate. This assumes 65% work recovery.

(4) Items affecting recovery rate

(a) Coffee breaks

(b) Loafing between jobs

(c) Time to clean up

(d) Time to get to work

2. Special teaching-learning activities

a. Have students calculate returns to capital on a few businesses using their balance sheet and operating statement.

b. Have students calculate inventory turnover for a few products in some business by having them ask the businessman for his average inventory and total sales for the product.

c. Have students keep track of the exact time they are working on either a shop project or class problem discounting time to get materials and return materials plus time required to re-do some portion and then divide by total class time to get percent work recovery assuming they are paid for class time and someone is paying for their actual work time. Then let them assume a wage for themselves and have them calculate what someone else must pay for actual time at work to break even.

3. Suggested instructional material and references

   a. <u>Managing for Greater Returns</u>

   b. <u>Business Procedures Module</u>

H. The understanding of taxes

1. Subject matter content

   a. Basic reasons for taxes

      (1) To raise needed revenue

      (2) To restrict certain types of distribution (oleomargerine and butter)

      (3) To restrict sales of chain stores that compete with independent stores.

   b. Kinds of taxes

      (1) Real estate and property taxes

      (2) Occupational license tax - to handle a certain type of goods

      (3) Merchandise tax - % of cost value of merchandise carried

      (4) Excise tax - tax on each unit of certain articles handled (example - jewelry)

      (5) Sales tax - tax on all sales, paid by customer

      (6) Social Security taxes - unemployment insurance and Old Age benefits

      (7) Chain store taxes - increases with number of store units in chain

      (8) Income tax

2. Special teaching-learning activities

   a. Interview an agricultural businessman as a class to determine kinds of taxes paid by him each year, and the percentage paid for each tax.

   b. Have a lawyer or accountant visit class and explain different kinds of taxes.

3. Suggested instructional materials and references
   - a. <u>Retail Merchandising</u>
   - b. <u>Teaching Taxes</u>
   - c. <u>An Introduction to Agricultural Business and Industry</u>

I. The ability to receive and store merchandise

1. Subject matter content
   - a. Developing a plan for receiving merchandise
     - (1) Consider who is to do the work
     - (2) How merchandise is to be handled (hand, fork lift, etc.)
     - (3) How and where it is to be stored
   - b. Checking for damage or breakage as unloading proceeds.
     - (1) Note damaged or broken merchandise on receiving form
     - (2) Damaged merchandise should be destroyed, returned, or kept and sold at a reduced price.
   - c. Checking for shortage at time of receiving merchandise.
     - (1) Take an exact count
     - (2) Weigh the merchandise
     - (3) Quantity of goods received must agree with goods signed for on shipping record.
   - d. Checking invoice and goods against substitutions
     - (1) Check merchandise received with purchase order <u>before</u> signing <u>delivery slip</u>.

      - (2) Use duplicate copy of purchase order to check against merchandise received.
    - e. Checking quality of merchandise
      - (1) By visual examination
    - f. Signing for merchandise
      - (1) By employee receiving merchandise
      - (2) On receiving report form, accurate count, condition, and description of merchandise are listed.
  - 2. Special teaching-learning activities
    - a. Give the class several assumed situations concerning the receipt of merchandise by a business. Assume certain flaws in the merchandise.
    - b. Have the students complete receipt forms.
  - 3. Suggested instructional materials and references
    - a. Business Procedures Module
    - b. Retail Merchandising

J. The understanding and ability of properly stocking merchandise.

  - 1. Subject matter content
    - a. Two problems in stocking merchandise are:
      - (1) How much to stock
      - (2) When to stock it
    - b. Questions which must be answered which will help solve the above two problems are:
      - (1) Will this merchandise have a slow or fast turnover?
      - (2) Will it keep if some remains unsold?
      - (3) What will be the probable demand for this product this year or this season?

      - (4) When will the demand come?
      - (5) How long will it take to get replacement merchandise after it is ordered?
      - (6) How much money may we have tied up in inventory stocks?
      - (7) Where can we secure quality merchandise at the lowest cost?
    - c. If each employee isn't responsible for ordering merchandise he should tell the one who is responsible when he sees low stocks.
  - 2. Special teaching-learning activities
    - a. Let students check about restocking some shop supplies like welding electrodes.
  - 3. Suggested instructional material and references
    - a. Ohio's Business Procedure Module

V. Follow-up and Evaluation

- A. Business math test
- B. Have students work problems
- C. Have students fill out forms, such as sales tickets, inventories, budgets, tax forms, etc.
- D. Check with employer in his business procedures.

VI. Titles and Sources of Reference and Instructional Materials

- A. Books
  - 1. Agricultural Occupation Institute, Preparing Students for Employment in Agriculture, Oklahoma State University.
  - 2. Fenske, Drake, Edson, Arithmetic In Agriculture, Interstate Printers and Publishers, Danville, Illinois, Price $2.92 (single copy)

3. Hoover, N. K., *Handbook of Agricultural Occupations*, Interstate Printers and Publishers, Danville, Illinois, 1963, Price $4.27 (single copy)

4. Internal Revenue Service, *Teaching Taxes*

5. Ohio State's Center for Vocational and Technical Education, *Agricultural Supply-Sale and Service Occupations Business Procedures Module*.

6. Phillips, Richard, *Managing for Greater Returns*, Agri-Research Inc., Manhatten, Kansas.

7. Wingate and Weiner, *Retail Merchandising*

8. Weyent, J. T. etal, *Introduction to Agricultural Business and Industry*, Interstate Printers and Publishers, Danville, Illinois, 1965. (Teacher's guide available) Price $2.25 (single copy)

NEW DEVELOPMENTS IN AGRICULTURAL TECHNOLOGY

Prepared by: C. E. McLaughlin
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G. L. Barth

I. Introduction

Technological advances made in the field of agriculture have far surpassed all expectations of the experts in recent years. This, coupled with the present rate of acceleration in knowledge since the birth of computers, forces agricultural leaders to become constantly aware of changes as they develop, to be able to analyze and interpret these changes, and to adapt the feasible and practical ones with actual situations or they will ultimately fall by the wayside.

Importance of a constant awareness to these advances in agriculture is unquestionable; but, to remain current to new developments will require a trained mind--one that can sift the opinions from the facts using a realistic approach--and then use the information to achieve the desired goals.

II. Major Objectives

A. To appreciate the new developments in agricultural technology.

B. To develop the ability to recognize, interpret and utilize new developments in agriculture.

III. Time Allotment 10% _____ days

IV. Competencies to be Taught

A. An understanding of the vast amounts of agricultural information available on new developments.

B. The ability to identify and recognize the need for application in agri-business

C. To understand the value of increased knowledge.

D. The ability to obtain new information.

E. The ability to separate reliable information from sensational information.

F. The ability to analyze, evaluate, interpret, and utilize new knowledge.

- - - - -

A. An understanding of the vast amounts of agricultural information available on new developments.

1. Subject matter content

   a. Main sources of agricultural information.

      (1) Radio and television

      (2) Newspapers. (Daily, weekly, and monthly)

      (3) Farm magazines

      (4) Agricultural business employees

      (5) Agricultural colleges and universities

      (6) Governmental agencies

      (7) Agri-business educational programs

      (8) Farm organizations

      (9) Public libraries

      (10) Agri-business leaders

2. Special teaching-learning activities

   a. Have students write a letter to one of the sources to obtain a list of available materials.

3. Suggested instructional materials and references.

    a. Stockman's Handbook, section XV, XVI, XVII.

B. The ability to identify and recognize the need for application in agri-business.

1. Subject matter content.

    a. Factors which create a need for new developments in agriculture.

        (1) Cost-price squeeze.

        (2) Population explosions.

        (3) Increase in agricultural efficiency.

        (4) New agricultural products.

        (5) New agricultural equipment and machinery.

        (6) Consumer demands.

    b. Better communications techniques to offer accurate and credible data to citizens.

    c. Improvement of approved practices to coincide with production efficiencies.

2. Special teaching-learning activities

    a. Divide the class into committees to report on one of the factors listed above.

3. Suggested instructional materials and references.

    a. Self-experience.

C. To understand the value of increased knowledge.

1. Subject matter content.

    a. The benefits to you, the employer; the community, etc.

        (1) Advancement

        - (2) Increased reliability as a source of information.
        - (3) Self-improvement
        - (4) Increased production for a business
        - (5) Improves company-customer relations
        - (6) Improves the morale of the business
        - (7) Improves economic conditions
        - (8) Better placement of the individual
  - 2. Special teaching-learning activities
    - a. Use case studies citing examples of up-to-date employee vs employee lacking sufficient product knowledge.
    - b. Develop a questionnaire in class that a farmer or employer could use to emphasize the value of new agricultural technology in the business.
  - 3. Suggested instructional materials and references.
    - a. Instructor's experiences
    - b. Book, <u>Media for the Millions</u>

- D. The ability to obtain new information
  - 1. Subject matter content
    - a. Methods of obtaining new information
      - (1) Reading (Newspapers, magazines, bulletins, etc.)
      - (2) Listening (Radio, television, agri-business leaders, etc.)
      - (3) Attending (Clinics, workshops, commercial meetings, adult schools)
      - (4) Corresponding (Specific questions to agricultural experts)
      - (5) From advertisements

            (6) From instruction manuals

            (7) Consulting commercial businesses

        b. The steps in the flow of the idea from the source to the user.

            (1) The awareness stage

            (2) The interest stage

            (3) The evaluation stage

            (4) The adoption stage

    2. Special teaching-learning activities

        a. Have students prepare a radio and television farm news time-table.

        b. Have students prepare a list of addresses of reliable sources of agricultural information.

        c. Have students list agencies holding special or seasonal meetings in the area.

    3. Suggested instructional materials and references

        a. <u>The Diffusion Process</u>, booklet

        b. Instructor's experiences

E. The ability to separate reliable information from sensational news information

    1. Subject matter content

        a. Definition of <u>reliable</u> - Trustworthy. Tested, proven and approved.

        b. Definition of sensational - Intended for great interest or emotion. Insufficient facts or evidence for approved adoption.

        c. Reasons for separating reliable information from sensational information.

(1) To determine economic efficiency if the new idea is applied.

(2) People are interested in sensational happenings and ideas, even at the expense of sound judgment.

(3) An agricultural leader will want to establish and maintain a desirable agricultural reputation.

d. The process of separating the reliable information from the sensational ideas.

(1) Accept ideas and new technology with an open mind.

(2) Gather as much information as possible.

(3) Compare the information and facts from the new idea with approved practices and basic principles.

2. Special teaching-learning activities.

a. Have students rate an agricultural news article.

b. Have students list approved practices and principles from a news article.

3. Suggested instructional materials and references.

a. Dictionary

b. Instructor's experience

F. The ability to analyze, evaluate, interpret and utilize new knowledge.

1. Subject matter content

a. Human problems encountered in the analysis of an idea.

(1) Ease of conforming to accepted ideas.

(2) Restrictions created in our minds by past acts through habit.

(3) Inability to define or isolate

(4) Failure to secure all the facts available

(5) Failure to use many sources of information

(6) Insufficient knowledge of basic principles, approved practices, research techniques.

(7) Inability to distinguish between cause and effect

(8) The fear of making a mistake

(9) Difficulty of narrowing the idea or problem too much

(10) Overemphasis on competition or cooperation

b. Factors which affect the utilization of new technological information.

(1) The idea should pay

(2) It should improve efficiency

(3) It should be relatively simple to understand and use

(4) It should be easily grasped mentally or demonstrated

(5) It should be able to fit into existing operations

(6) The idea along with its necessary supplies, tools, or equipment should be available

(7) It should be feasible and practical

(8) Be able to file the information for future reference

(9) Time, labor, and/or capital should be available to follow-up the idea

2. Special teaching-learning activities

a. Visit or write a report on an agricultural business that originated and grew as the result of some new technological information.

b. Prepare a budget of expenses and income data as related to the adoption of a new idea in agriculture.

c. Have each student set-up a file for future reference to new ideas in agricultural technology.

3. Suggested instructional materials and references

a. The Diffusion Process, booklet

b. Instructor's experiences

V. Follow-up and Evaluation

A. Keep students aware of new developments in agricultural technology by bringing the ideas before the class regularly and discussing them.

B. Discuss new technology with the student while making supervisory visits.

C. Encourage students to budget about 15 minutes each day to read and study new developments.

D. The instructor should develop a file regarding "New Developments in Agricultural Technology".

E. Devise a simple rating sheet to study the value of a new idea.

VI. Titles and Sources of References and Instructional Materials

A. Books

1. Ensminger, S., Stockman's Handbook, The Interstate Publishers and Printers, Danville, Illinois, 1955.

2. O'Hara, R. C., Media for the Millions, Random House, 457 Madison Avenue, New York, New York, 1962.

B. Bulletins and pamphlets

1. Cooperative Extension Service, The Diffusion Process, Special Report #18 (Reprint), Iowa State University, Ames, Iowa, 1962.

VT001 510

VT 001 510

Extending Instruction in Vocational and Technical Education in Agriculture to Off-Farm Agricultural Occupations, Report of a Workshop in Agricultural Education.

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Mississippi State Univ., State College. Dept of Agr Educ.
Mississippi State Board for Voc Ed, Jackson. Voc Agr Div.

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*COOPERATIVE EDUCATION, *VOCATIONAL AGRICULTURE, *PROGRAM DEVELOPMENT, AGRICULTURAL MACHINERY OCCUPATIONS, ORNAMENTAL HORTICULTURE OCCUPATIONS, AGRICULTURAL SUPPLY OCCUPATIONS, *OFF FARM AGRICULTURAL OCCUPATIONS, STUDENT PLACEMENT, *CURRICULUM GUIDES,

Utilizing the approach which assumes that education in the science and technology of modern farming is basic to preparation for related occupations, the teachers and consultants in a 3-week workshop type course developed the materials in this report. The purposes and justification for instruction in off-farm agriculture occupations are explored. The advantages to students, schools, employers, and communities of extending vocational agriculture to off-farm agricultural occupations are listed. Outlines of steps and detailed procedures are provided for initiating, organizing, and establishing programs. Areas of instruction and training activities are outlined for (1) garden center, nursery, greenhouse roadside development, and landscaping in the ornamental horticulture curriculum, (2) managerial, mechanical, sales and service jobs in the agricultural mechanics curriculum, and (3) feed mill, farm store, chemical, and service jobs in the agricultural supply curriculum. Sections are included on providing occupational experiences, teaching related instruction, selecting training stations, and selecting students for training station placement. A summary of the Mississippi Child Labor Law, standards and provisions for student-learner certificates, a list of agricultural occupations other than farming and ranching, and various forms to be used in training programs are included. (JM)

AREAS OF EMPLOYMENT IN OFF-FARM AGRICULTURAL OCCUPATIONS

EXTENDING INSTRUCTION IN VOCATIONAL AND TECHNICAL EDUCATION IN AGRICULTURE TO OFF-FARM AGRICULTURAL OCCUPATIONS

Published by

Mississippi State University
Agricultural Education Department
State College, Mississippi

In Cooperation With

MISSISSIPPI STATE BOARD
FOR VOCATIONAL EDUCATION
Vocational Agriculture Division
Jackson, Mississippi

EXTENDING INSTRUCTION IN VOCATIONAL AND TECHNICAL EDUCATION IN AGRICULTURE TO OFF-FARM AGRICULTURAL OCCUPATIONS

Report of
A Workshop in
Agricultural Education

Sponsored by

MISSISSIPPI STATE UNIVERSITY
Agricultural Education Department
State College, Mississippi

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A. P. Fatherree, Director of Vocational and Technical Education
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Heber J. Ladner, Secretary of State, Member of Board
Joe T. Patterson, Attorney General, Member of Board

February 1966

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PREFACE

Technological change in the agricultural sector of our economy has major implications for those engaged in the field of vocational education in agriculture. The major concern is with the kind of vocational training needed to fit personnel to work in all phases of our modern agricultural economy. After much consulting together, the State Supervisor of Vocational Agriculture and his staff and the teacher training staff in agricultural education at Mississippi State University agreed that an intensive study should be made of the problem. Therefore, a three-week workshop type of course resulted. This publication presents the materials developed in this workshop.

It is believed that the materials presented in this publication will serve as a reminder to those who participated and as a stimulus to the many who could not attend the workshop. Also, it is believed that some new policies and many expanded programs of vocational agriculture will result from the materials presented in this publication which will more nearly train personnel to meet the needs of the agricultural economy of Mississippi.

All members of the agricultural education staff at Mississippi State University and the supervisory staff in vocational agriculture showed an interest in and participated in the workshop. Special recognition is given to Mr. W. T. Taylor, Assistant Supervisor of Vocational Agriculture, and Dr. J. Roland Hamilton, Professor of Agricultural Education, Mississippi State University, for their contributions in helping get the material in shape for publication.

The various committees borrowed heavily from materials prepared by The Center for Research and Leadership Development in Vocational and Technical Education at The Ohio State University.

E. E. Gross, State Supervisor
Vocational Agriculture
Jackson, Mississippi

Obed L. Snowden, Professor and Head
Agricultural Education Department
Mississippi State University

INTRODUCTION

The mention of off-farm agricultural occupations training as a function of secondary school vocational agriculture does not imply that the emphasis will be lessened in teaching individuals who are preparing to farm or to pursue an on-farm occupation. Moreover, to attempt to structure vocational education programs in agriculture without focusing attention on occupational training in farming would be worse than folly. We have evidence that skills and subject matter learned in courses designed for farmer training are basic to entering many of the off-farm agricultural occupations. Some observers have pointed out that up-grading farming (production agriculture) by the establishment of adequately trained intelligent individuals on economically sound farm business units is basic to the need for offering training in off-farm agricultural occupations. Indeed, we can be sure that without profitable agricultural production, there will be no farm-based, related, or agribusiness occupations. Dr. Milo J. Peterson, Head, Department of Agricultural Education, University of Minnesota, and one of the Nation's foremost advocates of farm management teaching in vocational agriculture courses, has champoined this concept for years.

The extension of vocational agriculture instruction to off-farm agricultural occupations will necessitate an extension of our thinking concerning the supervised experience phase of the vocational agriculture program. The following is taken from an article written by Dr. Milo Peterson.* "...In considering a transition from "supervised farming" to "supervised agricultural practice" four essentials may be postulated. They are: (1) mastery of principles and practices

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*Peterson, Milo J., An Approach to Training for Agricultural Occupations, The Visitor, Volume XLIX, July 1962, Ag-Ed. Dept., University of Minnesota.

in mechanized agriculture and farm mechanics, in agronomy and soil science, in animal science, in management and marketing, and in other agricultural disciplines; (2) making the farm or other agricultural business and the home more convenient and pleasant places in which to live and work; (3) financial self-reliance including the ability to manage money and credit wisely through earning, saving, investing, record keeping, and maintaining sound credit; (4) production and marketing of crops, livestock and livestock products or services and commodities utilized in agriculture.

Preparation for entrance into the related occupations must evolve from a degree of education in the science and technology of modern farming. Only after training and experience in the basic occupation of farming will a student have the insight and understanding to "relate" the related occupation to farming in proper perspective. This suggests that specialized study and work experience in the chosen related occupation may be introduced during the junior and/or senior years.

This approach appears to have certain advantages over vocational agriculture programs as presently structured. It provides an opportunity for the public schools to more effectively serve students interested in all aspects of modern agriculture. It does no discriminate by either place of residence or sex; supervised agricultural practice programs may be appropriately planned for boys and girls whether they reside on farms or elsewhere. It recognizes the interdependence between modern farming and related occupations resulting from the dramatic proliferation in number and kind of purchased inputs utilized in farming today. It provides for occupational mobility in the preparatory stage of vocational education. Finally, it creates, by deliberate planning, a link between high school and post-high school education whether it be at the vocational-technical or collegiate level."

The responsibility for meeting the training needs for individuals who may work in the diversity of off-farm agricultural occupations is now placed upon vocational agriculture. It is the responsibility of vocational agriculture to serve all segments of the agricultural economy.

The material in this publication is to be used as a guide in extending vocational agriculture instruction to meet the needs of those preparing to work in off-farm agricultural occupations. It is hoped that it will help answer questions which usually come up when a vo-ag teacher starts planning for expanding his program of instruction. School administrators, school counselors, personnel of business establishments, members of the advisory committee as well as the vocational agricultural teachers should find this material helpful in bringing about a correct understanding of the expanded program of vocational agriculture instruction.

PARTICIPATING PERSONNEL

Vocational Agriculture Teachers

Name	School	Address	
J. A. Ashley	New Hope	Rt. 4, Columbus	39704
J. R. Bounds	Newton	Newton	39345
H. O. Brinson	Purvis	Purvis	39475
E. A. Cain	Hollandale	Hollandale	38748
B. J. Conlee	Myrtle	Myrtle	38650
Ide B. Dickens, Jr.	Carthage	Carthage	39051
G. L. Dowell	Cleveland	Cleveland	38732
J. V. Gammage	Lucedale	Lucedale	39452
G. B. Harmon	McAdams	McAdams	39198
J. L. Hodges	Madison-Ridgeland	Madison	39110
L. B. Johnson	Nettleton	Nettleton	38858
W. R. Knight	Canton	Canton	39046
W. H. Owens	Sumrall	Sumrall	39482
J. M. Rutledge	Wiggins	Wiggins	39577
G. E. Sones	Lumberton	Lumberton	39455
J. W. Webb	Louisville	Louisville	39339

CONSULTANTS

Department of Horticulture:
Dr. Clyde Singletary, Head of Department; Professor W. C. Gordon; Professor Coy Box; Professor Ed C. Martin, Jr; Mississippi State University; State College, Mississippi; 39762

Mr. Robert Callaway; Callaway's Yard and Garden Center; Jackson, Mississippi; 39205

Consultants Continued:

Mr. Thad Caraway, Executive Director; Mid-South Farm Equipment Association, Inc.; Memphis, Tennessee; 38100

Mr. Mike Dickerson; Mississippi State Highway Department; Roadside Development Section; Jackson, Mississippi; 39205

Mr. James Fisher; Fisher's Nursery and Garden Center; Hattiesburg, Mississippi; 39401

Mr. Archie Pearson; Pearson's Nursery; Indianola, Mississippi; 38751

Mr. Claude Sampson; Secretary-Manager; Deep South Farm and Power Equipment Association; Alexandria, Louisiana; 71302

Mr. Jack Westbrook; C. W. Stuart Company; Columbus, Mississippi; 39701

Mr. John Taylor, Lowndes County Federated Cooperative, Columbus, Mississippi; 39700.

Mr. J. K. Morgan (retired), Oktibbeha County Federated Cooperative, Starkville, Mississippi; 39759

Mr. Kermit Buckley, Associate Extension Horticulturist, Mississippi Cooperative Extension Service, State College, Mississippi; 39762

SECTION I

THE PURPOSES AND JUSTIFICATION OF VOCATIONAL AGRICULTURE INSTRUCTION IN OFF-FARM AGRICULTURAL OCCUPATIONS

The primary aim of the off-farm agricultural occupations training program is to provide classroom instruction and supervised experiences for individuals enrolled in vocational agriculture courses preparing to enter off-farm agricultural employment.

In the past, vocational agriculture has not openly structured training programs designed to prepare individuals to work in off-farm agricultural occupations. This was due primarily to stated policies interpreting the intent and purposes of the Smith-Hughes Law as passed in 1917. The 1963 Vocational Education Act removes any doubt concerning the legal restrictions on the scope of training which may be given in training for any agricultural occupation.

The following quotation is taken from the Occupational Outlook Handbook, 1961 Edition, United States Department of Labor. ". . . The number of farm workers has declined, but there has been a sharp increase in the number who work off the farm in jobs closely related to agriculture. These include the workers in feed mills, fertilizer plants, the farm machinery industries, farm supply stores, food processing plants, and many other businesses that process, distribute, or transport farm products and farm supplies. This whole complex of activities on and off the farm is often called "Agri-Business". It has remained a relatively constant proportion of the total economy. The total number of trained persons needed in fields related to agriculture is constantly rising . . . "

A partial list of some of the agricultural occupations not considered farming or ranching is given in Appendix K. It is realized that this list represents a diversity of knowledge and skills. Moreover, it is inconceivable that training for all of these occupations would become a part of any single vocational agriculture program. Each teacher contemplating off-farm agricultural occupations training programs should evaluate the need for such programs before attempting to initiate such training.

SECTION II

ADVANTAGES OF EXTENDING VOCATIONAL AGRICULTURE INSTRUCTION TO OFF-FARM AGRICULTURAL OCCUPATIONS*

To The Student

1. Provides an opportunity to become trained for a payroll occupation while completing the requirements for a high school diploma.
2. Helps in the choice of occupations in agriculture other than farming.
3. Arouses the student's interest in the field of agriculture as a whole.
4. Provides supervised training on the job under actual working conditions.
5. Helps provide an opportunity for students to make an intelligent choice of their life's work.
6. Lends encouragement to stay in school until graduation.
7. Provides opportunity to receive individual instruction in the chosen field of interest at a relatively low cost.
8. Develops definite work habits, attitudes, and responsibilities.
9. Offers opportunity to realize the necessity of cooperation with others.
10. Offers opportunity to learn the technical information of a trade as well as the manipulative skills.
11. Provides a foundation for post-high school studies.
12. Provides opportunity to establish a reputation on the job through experience.

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*Most of these were taken from Handbook for Developing and Operating Agricultural Occupations Programs, Colorado State Board for Vocational Education.

13. Motivates interest in other school subjects.

14. It will help students to get a higher beginning wage.

To The School

1. Helps meet the training needs of the community without over-training for any one trade or occupation.
2. Provides a terminal course for students who do not continue their education beyond high school.
3. Increases community interest in school activities and causes the school administration to see vocational agriculture in a broader sense.
4. Promotes good public relations between the school and community. It will bring new clientele into the vo-ag program; namely, agricultural businessmen.
5. Offers a program for a school to place its graduates in payroll occupations.
6. Provides opportunity for the school to cooperate in other fields of agriculture.
7. Lessens the disciplinary problems at the school and the drop-out problem.
8. Provides opportunity for school to share in decreasing the number of unemployed.
9. Provides a qualified staff member to assist in vocational guidance work.
10. Helps in the establishment of young and adult farmer classes.

To The Employer

1. Provides opportunity to increase the interest of young people in the field of agriculture in which the employer is established.
2. Employers have an opportunity to have direct contact with the school program.

3. Provides a selection of future employees who are interested and qualified for the field in which the employer is engaged.
4. Trainees may be able to take over when key men are sick, on vacation, etc.
5. A better trained employee is available.
6. Trainee efficiency and alertness is maintained and increases through the counsel and cooperation of the agricultural occupations teacher-coordinator.
7. Helps reduce training problems and expense.
8. Increases efficiency of regular employees and makes them more alert.
9. Offers opportunity to participate in an educational enterprise which has not been available before.
10. Enables employer to receive more direct returns from school tax dollars.

To The Community

1. Encourages young people to remain in the community after graduation.
2. Improves economy by providing additional income to the citizens of the community.
3. Helps improve citizenship in the community.
4. Lessens the unemployment problem.
5. Promotes closer cooperation between the school and community.
6. Helps to eliminate the idea that everyone must get a college degree in order to get a good and satisfying job.

Summary

The advantages that have been suggested probably do not include all that might possibly come as a result of an extended program of vocational agriculture. This is not to imply that each advantage listed would be applicable in each school and community. Since each student, training center, school, and community may differ due to the nature of the agriculture occupations program offered, it is natural to assume that the particular advantages to those concerned will also differ.

SECTION III

OUTLINE OF STEPS TO TAKE IN INITIATING AND ORGANIZING OFF-FARM AGRICULTURAL OCCUPATIONS TRAINING PROGRAMS.

1. Teachers of vocational agriculture should become thoroughly familiar with all sections of this publication; then acquaint school administrators and other school officials with possibilities and potentials of such a program.
2. Contact State Supervisor of Vocational Agriculture for assistance in initiating any off-farm agricultural training program. A member of the state staff will meet with the local school officials to explain the State's reimbursement policies and standards and provide any other available service which the local school may desire.
3. Make a detailed survey of the school service area for potential employment opportunities in off-farm agricultural occupations.
4. If there is a significant need, and potentials exist for off-farm agricultural occupations training programs, set up an advisory committee. (See Section IV B for suggestions in setting up advisory committee).
5. With the assistance of the advisory committee get the school board to adopt the proposed program as an intergal part of the public school vocational agriculture program. Formulate and adopt necessary regulations, policies, and standards as an operational guide for the program.
6. The public should be informed (through adequate public relations coverage) about the program and its potentials. (See Section IV C for suggestions in informing the public about the program).
7. Develop training programs for the occupations in which training is to be offered and select training sites.

8. Select prospective trainees and acquaint trainee and parents with the off-farm agricultural occupations program.

9. After trainees have been selected, establish a detailed understanding among the trainees, parents, training site, and the school as to what regulations ect., will affect the cooperative-work experience phase of the off-farm agricultural program (this will require that written agreements be executed).

10. Evaluate on a continuous basis the progress made by off-farm agricultural occupations trainees.

SECTION IV

DETAILED PROCEDURE IN GETTING THE OFF-FARM AGRICULTURAL OCCUPATIONS TRAINING PROGRAM STARTED

A. Study The Community

One of the first and most essential things to do in inaugurating off-farm agricultural occupations training programs is to survey the area to determine opportunities for employment in off-farm jobs in which agricultural skills and knowledge of agricultural subjects are essential or helpful in successfully performing the duties of the job.

If a vocational agriculture teacher has been in the community for any length of time, he should be familiar with most of the agricultural firms, business establishments, and agricultural organizations. Where there is doubt about the completeness or accuracy of his knowledge, the vocational agriculture teacher should get assistance. There are several sources of occupational information available to the vocational agriculture teacher. In the large metropolitan areas, perhaps the most readily available source of ag-related businesses is the yellow pages of the local telephone directory. However, it must be recognized that not all ag-related businesses are listed in the yellow pages of the telephone directory. Other sources such as local civic clubs, local chambers of commerce, local employment security office, and professional organizations will be available in making a complete list.

After the list of agriculturally related businesses, organizations, agencies, etc. has been completed a survey from should be developed for obtaining occupational job titles and training possibilities from the establishments listed. The form shown on pp.11-13 is an acceptable form to use in making the survey.

SURVEY FORM

School______________________ Interviewer____________________

Date of Interview______________

EMPLOYMENT OPPORTUNITIES AND POSSIBLE TRAINING CENTERS IN AGRICULTURAL OCCUPATIONS OTHER THAN FARMING

I. Company, firm, organization, or agency

A. Name of company, agency, etc.______________________________

B. Address____________________County____________________

C. Name of person interviewed______________________________

Telephone: Area code__________Number____________________

D. Position of person being interviewed

____1. Owner	____5. Sales manager
____2. Owner-manager	____6. Office manager
____3. Manager (hired)	____7. Supervisor
____4. Personnel director	____8. Other

E. Main functions of company, firm, organization, or agency

____1. Sales (retailing)	____ 6. Processing
____2. Services	____ 7. Wholesaling
____3. Purchasing	____ 8. Transportation
____4. Manufacturing	____ 9. Finance, insurance, etc.
____5. Government (Federal, state, or local)	____10. Other

F. Major products, services, etc. (specify)

____

____

____

G. Percentage of business agriculturally oriented______________________

H. Year this business or service was established in this locality________

I. Is there a labor union in the firm?__________________

II. Employees

A. Total number of employees (including owners)__________________

B. Present job titles of employees

	Employees in each job title					
	Full-time			Part-time		
	No.		Employment Level*	No.		Employment Level*
	M	F		M	F	
1.						
2.						
3.						
4.						
5.						
6.						
7.						
8.						

C. What new job titles are foreseen in this firm in the next five years?

Job titles	Number of Employees	Employment Level*
1.		
2.		
3.		
4.		

D. In reference to company policy, can this firm hire high school age personnel?__________ Do you have a minimum wage?_____. If so, how much?________

*Level of employment code
1. Professional
2. Technical
3. Proprietors and managers
4. Supervisors and foremen
5. Sales
6. Clerical
7. Skilled
8. Semi-skilled
9. Service(unskilled)

E. Who makes the decision as to training needs?____________________

III. Procedure for hiring employees

A. ( ) Use State Employment Service

B. ( ) Use College Placement Service

C. ( ) Use high school principals or superintendents

D. ( ) Advertise vacancies

E. ( )

IV. Pre-employment educational program believed to be most beneficial to those who might work with company, firm, or agency (Check one)

A. ( ) General high school education with courses in basic principles of agriculture, supplemented with directed work experience in production agriculture and agricultural mechanics

B. ( ) Special courses in vocational education to develop needed manual skills to work in a variety of agricultural occupations

C. ( ) Special technical training beyond the high school level to be provided by technical institutes or junior colleges

D. ( ) A college degree with suitable major for working with company, firm, or organization

E. ( )

V. Company's, firm's, or agency's willingness to cooperate in providing supervised work experiences for prospective employees who are enrolled in vocational agriculture training (Check one)

A. ( ) Not willing

B. ( ) Employ students for specific jobs during periods when school is not in session

C. ( ) Employ students for specific jobs on a part-time basis during the school year

D. ( ) Allow students to work a few hours each day in specific jobs on a non-pay basis during the school day

E. ( )

VI. Company's, firm's, or agency's willingness to assist in preparing suitable training programs for individuals to enter specific job titles (Check all that apply)

A. ( ) Not interested

B. ( ) Will work with school personnel in preparing training programs for specific job titles

C. ( ) Will release key employees to give specialized instruction to trainees when requested by the regular teacher

D. ( ) Will allow students to come to company, firm, or agency for special instruction by your personnel

After the surveys are made, summarized, and evaluated, and it is decided that there is ample evidence that there is need for off-farm agricultural occupations training programs, an advisory committee should be appointed to help in further activities of getting the program started.

B. The Vocational Agriculture Advisory Committee

A local vocational agriculture advisory committee can help in giving effective direction to off-farm agricultural occupations training. Such a committee can provide a useful link between the activities of the school and the agricultural business interest of the community. It must be kept in mind that the function of the advisory committee is to advise and council with school personnel in educational programs. The administration of any school program must remain with the school board. In some situations the local school board may act as an advisory council. This, of course, will depend on the composition of the board.

Purposes of the Advisory Committee.

1. To secure ideas and advice of representative key people in agricultural businesses in the school district.

2. To help study community situations and determine community ideas.
3. To clarify the relationship of the vocational agriculture department with the community.
4. To explain the vocational agricultural program to the public and help improve public relations.
5. To cooperate with the teacher and give him encouragement and support.
6. To help evaluate the work of the agriculture department.
7. To serve as a sounding board for advice on program operating procedure.

Advantages of an Advisory Committee.

1. Provides a link between the school and community.
2. Gives prestige to the school, community, and vocational program.
3. Gives the school an opportunity to explain the objectives of the total educational program.
4. Brings about a closer relationship between management and labor.
5. Provides an opportunity to study the real training needs in a community.
6. Provides a sounding board for new ideas from many sources.

Functions to Be Performed By Advisory Committee.

1. Assist in the selection of training centers.
2. Render services in developing employment opportunities.
3. Assist in setting standards for trainee selection.
4. Give advice on development of instructional material.
5. Provide guidance in wage and hour problems.
6. Help publicize the program.
7. Recommend local training standards on a cooperative basis between training stations and school.
8. Render services in conducting community surveys.

9. Assist in the selection of subjects, course content, and the determination of emphasis that should be included in the training plans, as well as resource personnel for related classroom instruction

Qualifications Of Committee Members.

1. Members should be well-known leaders in their occupational field.
2. They should express an interest in the problems of the school system.
3. They should be representatives of the general opinion of: management, labor, agriculture, and public.
4. They should have the necessary time to devote to committee work.
5. They should not be persons who will exploit the work of the committee for their own personal benefit.

Size Of Committee.

1. A good working committee should consist of seven to twelve members, depending upon what is considered as an effective size for the job to be done. It is suggested that the members be representative of the following:

EDUCATION:
    Superintendent
    Principal
    Guidance personnel
    Teacher-Coordinator (If one is employed in the school)
    Vocational agriculture teacher (ex officio member)

BUSINESS: BUSINESS-ED. PERSONNEL
    Chamber of Commerce
    Civic or professional clubs
    Ag. business-owners, managers, etc.
    Ag. association personnel

LABOR:
    Organized labor (If present in the community)

NEWS MEDIA:
    Local editor, local radio manager, etc.

How To Appoint (Suggestions).

1. Involve the superintendent of schools and the school board. Go over the list of prospects and ask them to assist you in making the selections.
2. The superintendent can then send out a letter explaining the purpose of the committee to those selected to serve. He can also give the time and place of the first meeting.

Term Of Appointment.

About one-third of the committee should be appointed for a one-year term, one-third for a two-year term, and one-third for a three-year term. All subsequence appointments should be for a three-year term.

C. Informing The Public

Correct public understanding of the program is essential if we expect complete public support. The first phase of informing the public about the off-farm agricultural occupations training program is to publicize the objectives, benefits, and operating procedures of the program. All public relations media available in the area should be used. In many situations this will involve the newspapers, radio, and television. In addition, the teacher of vocational agriculture and others interested in the program should seek parts on the programs of civic clubs, chamber of commerce meetings, P.T.A. meetings, etc. After the program is in operation, the vocational agricultural teacher-coordinator should keep the public informed so that their interest and support is kept at its maximum.

There should be a follow-up story about the program. For example, if the press is used to announce that the school has inaugurated an off-farm agricultural occupations training program, a news article should follow within a reasonable length of time, giving enrollment, training cneters, and other information of interest to the general public.

CAUTION: Do not "ballyhoo" the off-farm agricultural occupations training program. Do not mislead the public into expecting that this program is a guarantee for good jobs, or that it is replacing the farmer-training program. All of your public relations activities should adhere to school policy concerning the release of information.

The following example of a skeleton news story may be helpful in constructing news articles. All news stories should be adapted to meet local conditions.

FOR IMMEDIATE RELEASE

Off-Farm Agricultural Occupations Training Program
Mr. John Doe
Vocational Agriculture Instructor
Union High School

Introductory Article

A new on-the-job training program for high school students will be launched this fall at ______________________ High School, according to __________, Superintendent of Schools.

An off-farm agricultural occupations curriculum has been developed by ______________________, vocational agriculture teacher. This program will give some students an opportunity to spend some time in on-the-job training with local agricultural business and industrial firms during periods when they are not in school. In some cases they may spend part of their school time under supervision with an employer in the training center.

Trainees who qualify for cooperative occupational training will be enrolled in regular high school courses, including one period of related instruction, during which time they will study information related to their particular on-the-job training. They may spend some time each weekday on the job, learning the skills and management practices involved, under the guidance of a skilled instructor selected from the firm in which the trainee is working.

The off-farm agricultural occupations training program is designed to offer training to all high school students who have an interest in an agricultural occupation other than farming or ranching. Without such a program we are not realizing the full potential of the vocational agriculture department. Such training can lead to in-school employment and immediate employment after completion of their high school program.

A survey recently conducted indicated there are______________ ag-related
(Number)
businesses in the________________________ area. ________________ of these
(town) (Number)
have indicated an interest in taking student trainees. The off-farm agricultural occupations program was provided for by the Vocational Education Act of 1963.

SECTION V

ORGANIZATION OF COURSES

The present plans for the inclusion of the off-farm agricultural occupations training phase of vocational agriculture in Mississippi are primarily for high school junior and senior students, (third-and fourth-year vocational agriculture) and post-high school students. We have no intention of de-emphasizing vocational agriculture for ninth and tenth grade students. Indeed, it is here that the basic scientific principles of modern farming are taught and experienced. Moreover, it is in these two grades (9th and 10th) that the student is given vocational guidance, broad-fields instruction and supervised experience in fundamentals of production agriculture which is essential or helpful in pursuing many of the off-farm agricultural occupations and absolutely essential for effectively studying agricultural technology as it is applied to modern farming and ranching.

Perhaps we will find that in many of our secondary school districts there will not be a sufficient number of off-farm agricultural occupations job opportunities to justify organizing the program into separate classes with a separate teacher, curriculum. etc. Therefore, it will be necessary to teach these students in the same class with students studying production agriculture, using individual and small group instruction to meet the needs of students involved. However, where the need justifies, separate classes and curriculums with a special teacher may be organized. Procedure for doing this will need much study.

The diagram of courses in vocational and technical education in agriculture in secondary schools on page 21 shows how the course organization for most of our schools can develop.

DIAGRAM OF COURSES IN VOCATIONAL AND TECHNICAL EDUCATION IN AGRICULTURE IN SECONDARY SCHOOLS -- MISSISSIPPI

FIRST YEAR

EXPLORING AGRICULTURAL OPPORTUNITIES
BASIC PRINCIPLES OF PRODUCTION AGRICULTURE
BASIC PRINCIPLES OF AGRICULTURAL MECHANICS
DIRECTED SUPERVISED EXPERIENCE

SECOND YEAR

CONTINUED BASIC PRINCIPLES OF PRODUCTION AGRICULTURE
BASIC PRINCIPLES OF AGRICULTURAL MECHANICS
DIRECTED SUPERVISED EXPERIENCE

THIRD YEAR

OCCUPATIONAL CHOICE
PRODUCTION AGRICULTURE (FARMING AND RANCHING

AGRICULTURAL PRODUCTION (FARMING AND RANCHING
AGRICULTURAL MECHANICS
DIRECTED SUPERVISED EXPERIENCE

OCCUPATIONAL CHOICE
AGRICULTURAL BUSINESSES, ETC.
(OFF-FARM AGRICULTURAL OCCUPATIONS)

AGRICULTURAL SERVICES
AGRICULTURAL PROCESSING AND DISTRIBUTION
AGRICULTURAL MECHANICS
DIRECTED SUPERVISED EXPERIENCE TRAINING IN SPECIALIZED OCCUPATIONS

FOURTH YEAR

FARM BUSINESS MANAGEMENT
AGRICULTURAL PRODUCTION (FARMING AND RANCHING)
AGRICULTURAL MECHANICS
DIRECTED SUPERVISED EXPERIENCE

AGRICULTURAL SERVICES
AGRICULTURAL PROCESSING AND DISTRIBUTION
AGRICULTURAL MECHANICS
DIRECTED SUPERVISED EXPERIENCE IN SPECIALIZED OCCUPATIONS

POST-SECONDARY SCHOOL

ADVANCED AGRICULTURAL PRODUCTION TECHNOLOGY
ADVANCED AGRICULTURAL MECHANICS
FARM BUSINESS MANAGEMENT
DIRECTED SUPERVISED EXPERIENCE

ADVANCED AGRICULTURAL SERVICES PROCESSING AND DISTRIBUTION, TECHNICIAN LEVEL
DIRECTED SUPERVISED EXPERIENCE IN SPECIALIZED OCCUPATIONS

First Year-basic principles of production agriculture, with primary emphasis on basic principles of plant science, animal science, agricultural mechanics, exploring agricultural opportunities, etc. In addition there must be directed work experience on a farm, or in an agricultural occupation legally permissable. (see Appendix for legal restrictions)

Second Year-continued study of basic production agriculture, expanding to basic principles not taught in the first year. Our state program of the scope of basic principles to be taught in vocational agriculture is outlined in "The Teacher's Handbook for Vocational Agriculture." It is mandatory that there be directed or supervised work experience provided for each student enrolled.

Third Year-at the beginning of the third year, those who remain in vocational agriculture would begin a more intensified type of training. For the most part, third-year students will be Juniors. It is at this time that teachers begin guiding the student into more specific occupational training, whether this be for production agriculture, or for an off-farm agricultural occupation.

It is anticipated that two types of training courses will be offered:

A. The vocational agriculture course for those preparing to farm or work in production agriculture. This program will give more emphasis to agricultural practices, advanced technology, farm management and agricultural mechanics. The emphasis will be on the development of abilities necessary for successful operation of a modern farm, or ranch. The enrollees for this course will be those who are definitely on their way to an establishment in farming or ranching, or who are preparing to continue their training in farming beyond the high school. Supervised experience on a farm is essential for successfully completing the course.

B. Specialized agricultural training programs for employment in off-farm agricultural occupations which require knowledge and skills in agricultural subjects. In most situations, it will not be feasible to have a separate class for each occupation. Every effort will be made to cluster the occupations around units of subject matter. In some occupations the units in production agriculture and units in off-farm occupations can be taught in the same class. This would be especially true in agricultural mechanics.

The biggest difference in the training programs will be brought about by the differences in the supervised experience programs. In the third year class, all the students would have developed a supervised work experience program. The kind and extent would be governed by the occupational objective. One group may have supervised farm experienced programs, or farm placement for experience much as we have had in the past. Another group would have supervised work experienced programs in off-farm agricultural occupations of their choice. It is conceivable that the group of students who are looking to schooling beyond the high school could have a supervised work experience program in agriculture with professional agriculture workers. For example, if a student definitely planned to be a veternarian or a veterinary technician, he would have a work experience program with the locel veterinarian.

Making arrangements for supervised work experiences in off-farm agricultural establishments is discussed in detail in Section VIII.

Fourth Year-the fourth year is to be a continuation of the third year with increased emphasis on business managements and advanced technology.

Post-Secondary School-a post-secondary school program in vocational and technical agriculture is being developed in our Mississippi Junior College system. Post-secondary training may also be given at secondary schools. This is in keeping with the State plan.

In all of the foregoing courses, supervised work experience will apply, whether it is on the home farm, placement for farm experience ; school laboratories, cooperative work experience, job placements in agricultural establishments, or other work experience programs which can be helpful to the student in reaching his occupational goal.

DEVELOPING COURSES OF STUDY FOR TRAINING IN ORNAMENTAL HORTICULTURE OCCUPATIONS

There are various types of ornamental horticulture training programs which can be developed and carried on as a phase of the vocational agriculture program of the secondary school. These programs may vary in length from two to four or more years, depending upon the needs and interests of the students to be served.

In Mississippi it is not contemplated that we will have courses designated as horticulture I for first year, horticulture II for second year, etc. It will be recalled that the diagram of courses in vocational agriculture shows first year and second year agriculture. These two years are to be introductory, exploratory, and preparatory in the broad fields of basic production agriculture. However, those who show an interest in preparing to enter training for horticultural occupations should be encouraged to carry out supervised experience programs relating to ornamental horticulture even during the first and second years of vocational agriculture.

<u>THIRD AND FOURTH YEARS, OR ELEVENTH AND TWELTH GRADE COURSES</u>

The suggested areas of instruction and training activities for eleventh and twelth grade, or third-and fourth-year vocational agriculture outlined is rather comprehensive. It is suggested that the vocational agriculture teacher, in consultation with an advisory committee and the school administration, use these suggestions as a guide in determining those areas of instruction and training activities that fit the local conditions. It is not expected that every local program would include all areas of instruction listed unless the local program or circumstances warranted giving some attention to each of them. The opportunities for field experience will, in most cases, be the determining factor in what areas to include in the course of study. In any event, practical judgement will have to be exercised by the teacher in determining what to teach.

SUPERVISED WORK EXPERIENCE

In addition to instruction given in the classroom and laboratory, each trainee is required each year to carry on an approved supervised work experience program. The Mississippi State plan for vocational education, which is an agreement between the Mississippi State Board for Vocational Education and the U.S. Office of Education, requires that the number of hours devoted to work experience shall not be less than that devoted to the in-school vocational instruction. The supervised work experience may be carried on during time school is in session or when school is not in session. In some cases it might be advantageous to permit the trainee to obtain some of his supervised work experience at a school land laboratory, a nursery farm, a greenhouse on the school campus, outside regular class hours. This is presupposing that these facilities can be provided on or near the school campus.

ORNAMENTAL HORTICULTURE IS A PART OF THE TOTAL CURRICULUM IN THE SECONDARY SCHOOL

Ornamental horticulture as used herein refers to the production, care, management, and marketing shrubs, trees, bulbs, turf grasses, flowers, etc. The instruction given is vocational agriculture and will be an integral part of the students' curriculum leading toward a secondary school diploma.

For students who can not, for one reason or another, keep pace with those in the regular vocational agriculture course, a special course for the appropriate level of training may be offered. Where such a situation exists, the vocational agricultural teacher should contact the State Supervisor of Vocational Agriculture for directions.

ORNAMENTAL HORTICULTURE OCCUPATIONS

The course of training in ornamental horticulture outlined in this section will prepare individuals for entry jobs with landscape service companies, greenhouses, nursery stock growers, roadside and park maintenance, etc. The level of achievement attained will be governed by the ability of the individual.

Competencies Required to Succeed in Ornamental Horticultural Occupations

A. As a beginning trainee

1. Pleasing personality, able to work with others
2. Good morals, honest, dependable
3. Good attitude, willing to learn
4. Industrious, willing to work
5. Dexterous
6. Reasonable amount of versatility, ability to adapt to changing situations
7. Safety conscious

8. Knowledge of basic plant science

9. Knowledge of basic soil science

B. As a trained employee

1. (Numbers 1, 2, 3, 4, 5, 6, 7, above)

2. Some mechanical skills in using hand and power tools

3. Reasonable functional knowledge of horticultural plants

4. Ability to grade plants

5. Ability to read planting plans

6. Ability to care for plants and plant material

7. Ability to plant, or set out, trees, shrubs, and other plants correctly

8. Know proper use of fertilizer, mulching, preparation of soil

9. Know how to prune plants correctly

10. Ability to design a planting plan

11. Ability to recognize and control weeds (including chemicals)

12. Ability to merchandize ornamental horticultural plants and supplies.

COURSE OF STUDY FOR ORNAMENTAL HORTICULTURE OCCUPATIONS
(11th, 12th grades, and post-secondary)

AREA OF INSTRUCTION	TRAINING ACTIVITIES	APPLICABLE TO TRAINEES WORKING IN					
		Garden Center	Nursery	Green house	Rd.-Side Devel.	Landscaping Devel.	Landscaping Main.
1. Exploring occupations in horticulture	1. Through investigation of the present situation, determine employment opportunities in horticulture, including salaries, working conditions, etc.	x	x	x	x	x	x
	2. Through visitation to businesses, etc., determine qualifications for entry in horticultural occupations.	x	x	x	x	x	x
	3. Through study and analysis, determine opportunities for growth in horticultural occupations. (Correlate with Section II, Area One; V in the Teachers Handbook.)	x	x	x	x	x	x
II. Identifying horticultural plants and determining their characteristics	1. Use specimens to familiarize students with the common and scientific names of commonly used horticultural plants.	x	x	x	x	x	x
	2. Student make and bring to class a collection of species of horticultural plants; identify and note general characteristics.	x	x	x	x	x	x
	3. Through field trips or on-the-job training, familiarize student with important characteristics of horticultural plants. (Size,	x	x	x	x	x	x

AREA OF INSTRUCTION	TRAINING ACTIVITIES	APPLICABLE TO TRAINEES WORKING IN					
		Garden Center	Nursery	Greenhouse	Rd.-Side Devel.	Landscaping	
						Devel.	Main.
	color, shape, growth, habits, berries, flowers, special adaptation.) A. Trees. B. Shrubs. C. Herbacious, annuals and Perenials.						
III. Developing a landscape plan. (This area to be for advanced students only.)	1. Through classroom procedure and field trips, familiarize student with the basic principles of landscaping for: a residence, including public, private, and service areas, same activities for parks and other public areas.	x	x	x	x	x	x
	2. Student read and interpret blueprints of buildings.					x	
	3. Student make list of errors in a home landscape.	x	x	x		x	x
	4. Student develop landscape plan for a residence. A. Make a sketch of existing features, then draw to scale outlines of buildings, border lines, walks, drives, etc. B. Designate plants to be left or relocated.					x	x
	5. Make plantings according to the landscape plan for a residence.	x				x	x
	6. Student develop other landscape plan for: A. A neighbor.	x				x	x

AREA OF INSTRUCTION	TRAINING ACTIVITIES	APPLICABLE TO TRAINEES WORKING IN					
		Garden center	Nursery	Green house	Rd. Side Devel.	Landscaping	
						Devel.	Main.
	B. School. C. Church. D. Other.						
IV. Developing and maintaining lawn and turf-grass areas.	1. Student, through classroom and laboratory procedure, prepare soil for lawn and turf-grass areas. A. Selecting sutiable grass. B. Establishing sod. C. Maintenance of lawn and turf-grass areas. (Fertilizing, controlling pest and diseases, and mowings.) D. Watering.	x	x		x	x	x
	GREENHOUSE						
V. Constructing and maintaining horticultural structures and facilities.	1. Through classroom, laboratory, and field procedures, student engage in the following.						
	A. Select site for greenhouse.		x	x			
	B. Study greenhouse designs.		x	x			
	C. Select materials (plastic or glass).		x	x		x	x
	D. Select and install heating and ventilation system.		x	x		x	x
	E. Select and install irrigation system.		x	x		x	x
	F. Select and install electrical system.		x	x		x	x
	3. Construction of greenhouse and installation of above systems.		x	x		x	x
	4. Maintenance of structures and above systems,		x	x		x	x

AREA OF INSTRUCTION	TRAINING ACTIVITIES	APPLICABLE TO TRAINEES WORKING IN					
		Garden Center	Nur-sery	Green house	Rd. Side Devel.	Landscaping Devel.	Landscaping Main.
	LATH HOUSE						
	1. Through classroom, laboratory, and field procedures, student engage in the following:	x	x	x		x	x
	A. Select site for lath house.						
	B. Study lath house designs.						
	(1) Select materials for lath house.						
	(2) Select and install irrigation system.						
	C. Construction of lath house and above systems.						
	D. Maintenance of lath house and above systems.						
VI. Selecting, preparing, and using growing media.	1. Through classroom, laboratory, and field procedures, student engages in the following:	x	x	x		x	x
	A. Determine characteristics and suitability of various growing media (ratio of materials. Ex. 1/2 peat; 1/2 sand, etc.)						
	B. Selection, perparation, and use of growing media.						
	C. Study of soil origin and composition and its importance as applied to production of horticultural plants.						
	D. Determine suitability of various soils for growing horticultural plants.						
	E. Evaluate and use effectively soil conditioners						
	F. Determine how soil structure effects watering practices.						
	G. Evaluate and use effectively soil mulches.						

AREA OF INSTRUCTION	TRAINING ACTIVITIES	APPLICABLE TO TRAINEES WORKING IN					
		Garden Center	Nursery	Green house	Rd. side Devel.	Landscaping Devel.	Landscaping Main.
	H. Recognize and maintain proper fertility level (fertilization) of plant growing media as required for good plant growth.						
VII. Propagating horticultural plants.	1. Through classroom study, laboratory and field procedure, develop in student the ability to:	x	x	x			
	A. Produce various plants from seed.						
	B. Produce plants from cuttings.						
	C. Produce plants from layerage.						
	D. Propagate by budding and grafting.						
	E. Select or build suitable propagating containers and equipment.						
VIII. Planting a landscape plan.	1. Through classroom study and directed work experience, each student develop the ability to select site and prepare soil for setting plants (including fertilization soil tests.)	x	x		x	x	
	2. Through on-job-training each student develop skills as follows:						
	A. Select suitable plants.	x	x	x	x	x	x
	B. Dig hole to proper depth and width.	x			x	x	x
	C. Place plant in hole and position it correctly.	x			x	x	x
	D. Fill hole with soil.	x			x	x	x
	E. Pack soil and other media.	x			x	x	x
	F. Water plant after hole has been filled.	x			x	x	x
	G. Mulch plant.	x			x	x	x
	H. Other						

AREA OF INSTRUCTION	TRAINING ACTIVITIES	APPLICABLE TO TRAINEES WORKING IN					
		Garden Center	Nursery	Greenhouse	Roadside Devel.	Landscaping	
						Devel.	Main.
	3. Through classroom study and directed work experience maintain landscape: A. Pruning, fertilization, mulching, and irrigation. B. Cultivating different plants.	x	x	x	x	x	x
	4. Through classroom study and directed work experience student will: A. Make a collection of bulbs, rhizomes, and corms suitable for putting in a landscape plan. B. Become familiar with principles and procedures involved in planting by planting a collection of bulbs, rhizomes, and corms.	x	x		x	x	x
IX. Controlling insects and diseases in horticultural plants.	1. Through classroom study, laboratory procedure, and on-the-job training student will:						
	A. Make collection and identify insects harmful to shrubbery and flowers. Also identify diseases that attack horticulture plants.	x	x	x	x		x
	B. Learn the effect of various chemicals on different shrubs and flowers.	x	x	x	x		x
	C. Formulate various spray solutions for insect and disease control.	x	x	x	x		x
	D. Make list of hazards involved in use of chemicals.	x	x	x	x		x

AREA OF INSTRUCTION	TRAINING ACTIVITIES	APPLICABLE TO TRAINEES WORKING IN					
		Garden Center	Nursery	Greenhouse	Roadside Devel.	Landscaping	
						Devel.	Main.
	E. Make a list of safety precautions to observe in use of chemicals.	x	x	x	x	x	x
	F. Make contact with State Plant Board to secure policies, and laws regulating the control of diseases in ornamental horticultural plants.	x	x	x	x	x	
	G. Practive insect and disease control on plants at home and on the job.	x	x	x	x	x	x
X. Selection, use , and care of horticultural equipment.	1. Through classroom procedures, familiarize student with basic principles, characteristics, and cost of various horticultural equipment.						
	2. By cooperative arrangements and on-the-job experience, have student learn to operate and maintain the following:						
	A. Cultivating equipment.	x	x		x	x	x
	B. Digging equipment.		x		x	x	x
	C. Dusting and spraying equipment.	x	x	x	x	x	x
	D. Irrigating equipment.	x	x	x	x	x	x
	E. Mowing and mulching equipment.	x	x	x	x	x	x
XI. Harvesting and preparing ornamental horticultural plants for market.	1. Through on-the-job training familiarize students with the following:						
	A. Balling and burlapping field-grown plants.		x				
	B. Grading plants.	x	x	x			
	C. Labeling plants by their correct name.	x	x	x			
	D. Caring for plants after balling and burlapping.	x			x	x	x

AREA OF INSTRUCTION	TRAINING ACTIVITIES	APPLICABLE TO TRAINEES WORKING IN					
		Garden center	Nursery	Green house	Rd. side Devel.	Landscaping Devel.	Landscaping Main.
	E. Caring for plants in the marketing center.						
	1. Canned plants	x	x	x			
	2. Balled and burlapped plants.	x	x				
	3. Preparing plants for carry-over to next marketing season.	x	x	x			
XII. Managing ornamental horticultural businesses.	1. Through classroom study and directed work experience familiarize students with:	x	x	x			
	A. The basic factors that effect a horticultural business.						
	B. The kind of basic records kept in a horticultural businesses.						
	C. Purchasing procedures used in the horticultural businesses.						
	D. Merchandizing procedures for products and services.						
	E. Types of business organizations in ornamental horticulture; for example, individual proprietorships, partnerships, etc.						
	2. Through classroom study and consultation with horticultural business managers, familiarize student with:						
	A. Insurance problems.	x	x	x			
	B. Source and use of credit sources.	x	x	x			
	C. Procedures used in hiring and managing employees.	x	x	x	x	x	x

AREA OF INSTRUCTION	TRAINING ACTIVITIES	APPLICABLE TO TRAINEES WORKING IN					
		Garden Center	Nursery	Green house	Road side devel	Landscaping	
						Devel.	Main.
	D. Business laws applicable to horticultural businesses.	x	x	x	x	x	x
	E. Reporting and paying federal, state, and local taxes.	x	x	x	x	x	x
	F. Kinds of markets and marketing methods. Example, wholesale marketing, retail marketing, mail order sales, etc.	x	x	x			
	G. Trade organizations and government agencies.	x	x	x	x	x	x

DEVELOPING COURSES OF STUDY FOR TRAINING IN AGRICULTURAL MACHINERY---SERVICE OCCUPATIONS

There are many different types of work in the broad area of agricultural machinery for which vocational agriculture instruction can make a worthwhile contribution. Agricultural mechanics instruction has been, over the years, an integral part of the basic instructional program for vocational agriculture.

In Mississippi the secondary school vocational agriculture program will, as it has in past years, give broad field-training in basic agricultural mechanics which relates to the diversity of mechanical activities with which the modern farmer has to cope. The diagram of courses shown on Page__21_shows that we plan to continue as we are now doing, to teach basic principles of ag-gricultural mechanics to first-and second-year students. It is realized that not all of the basic principles of agricultural mechanics can be taught during these two years. However, it is the consensus of those who have given thought to the problem, that knowledge and skills in agricultural mechanics are essential preparation for those who are preparing to farm, and for those who will enter many off-farm agricultural occupations.

Since supervised experience is mandatory in any vocational agriculture training program, it is usged that the teacher of vocational agriculture plan for and make extensive use of agricultural mechanics experience during these first two years. Opportunities can be provided for supervised experience in agricultural mechanics on students' home farms, placement on farms as workers, in school shop, and agricultural machinery and equipment dealer establishments. (See Appendix__A__for legal limitations). In any case, a student who is anticipating employment in agricultural mechanics-service occupations will find this basic knowledge and experience useful.

THIRD AND FOURTH YEARS, OR ELEVENTH AND TWELFTH GRADE COURSES

Knowledge and skills needed by workers in agricultural machinery service occupations are varied. The degree of competency needed by individuals will also vary. The suggested areas of instruction and training activities outlined for third-and fourth-year vocational agriculture is rather comprehensive and is more than can be adequately taught in two years. Perhaps it will be advisable for the vocational agriculture teacher, in consultation with personnel from the farm machinery industry, to determine what can best be dealt with on each grade level, including post-high school.

SUPERVISED WORK EXPERIENCE

By and large the supervised work experiences for those in training to enter agricultural machinery service occupations will be cooperative training programs worked out with farm machinery dealers. More details concerning cooperative training programs are given in Section VI.

AGRICULTURAL MACHINERY-SERVICE OCCUPATIONS TRAINING IS A PART OF THE TOTAL CURRICULUM IN THE SECONDARY SCHOOL

Agricultural machinery as used herein refers to tractors and power units, land preparation equipment, planting equipment, cultivating or tillage equipment, harvesting equipment, and spraying and dusting equipment.

The instruction given is vocational agriculture and will be an integral part of the students' curriculum leading toward a secondary school diploma.

As in the case of many other fields of study, there will be some individuals who can not keep pace with others and may be potential dropouts. For these individuals a special course for the appropriate level of training in agricultural machinery occupations may be offered. Before taking action on such a course, check with the State Supervisor of Vocational Agriculture,

AGRICULTURAl MACHINERY---SERVICE OCCUPATIONS JOB TITLES

The course of training outlined here will prepare individuals for entry in the following job classifications:

1. Agricultural machinery set-up and deliveryman.
2. Agricultural machinery mechanics.
3. Agricultural machinery mechanics helper.
4. Agricultural machinery parts man.
5. Agricultural machinery service supervisor, or shop foreman.
6. Agricultural machinery assistant shop foreman.
7. Agricultural machinery firm manager.

The level of achievement attained will be governed by the persistence and ability of the individual. For many of those who finish high school, the technical courses being set up at Jr. Colleges in agriculture machinery offers an opportunity to further training in this field to attain a higher level of competency.

COMPETENCIES REQUIRED TO SUCCEED IN AGRICULTURAL MACHINERY--SERVICE OCCUPATIONS

1. Have an appreciation of the job.
2. Recognize and understand the need for profit in business.
3. Ability to accept responsibility and make decisions.
4. A functional knowledge of local production agriculture.
5. Ability to think creatively and positively and communicate effectively.?
6. Have a high ethical standard and have wholesome attitudes toward the agricultural machinery industry.

7. Ability to merchandize agricultural machinery and services.

8. Recognize and follow safety practices at all times.

9. Ability to cope with competitive practices.

10. Functional knowledge of agricultural machinery.

11. Competencies in the respective job title involved in as an individual--in other words be good in what you do.

12. Have a wholesome attitude toward the free enterprise system.

13. Have efficient work habits.

14. Ability to appraise, to a reasonable degree, the economic outlook as it effects the agricultural machinery business.

It is not expected that every worker would possess a high degree of training level in each of these responsibilities. For example, individuals holding job titles calling for managerial, or sales responsibilities would need a high level of training in all competencies with the exception of high mechanical skills, while those in the service, or mechanical jobs would need a high level of training in mechanical skills. It is suggested that the vocational agriculture teacher work closely with competent agricultural machinery personnel in developing individual training programs.

COURSE OF STUDY FOR AGRICULTURAL MACHINERY--SERVICE OCCUPATIONS
(11th, 12th, grades, and post-high school)

AREA OF INSTRUCTION	TRAINING ACTIVITIES	APPLICABLE TO TRAINEES WORKING IN			
		Managerial Job Titles	Mechanics	Sales	Service
I. Exploring opportunities in agricultural machinery occupations.	1. Through classroom study and visitation to agricultural machinery establishments, student will determine job opportunities in this field. A. Qualifications for entry. B. Opportunities for advancement, etc. (Correlate with Section II, Areas one and five in teachers handbook.)	X	X	X	X
II. Understanding tractors and tractor systems.	1. Through classroom study and on-the-job work experience in agricultural machinery dealerships, student will: A. Develop an understanding of the basic principles of the operation of an internal combustion engine, including a study of the function of each major component of the engine.	X	X	X	X
	B. Develop an understanding and working knowledge of: (1) The power train (2) The fuel system (3) The cooling system (4) The electrical system (5) The hydraulic system (6) Lubrication system (7) Traction system (ex. wheels, steering, tire case, etc.) (8) Clutch (9) Brakes	X	X	X	X

AREA OF INSTRUCTION	TRAINING ACTIVITIES	APPLICABLE TO TRAINEES WORKING IN			
		Managerial Job Titles	Mechanics	Sales	Service
III. Tractor tune-up and maintenance.	1. Through classroom study, school shop practice, and supervised work experience in agricultural machinery dealer establishments, student will develop competency in:		X		X
	A. How to check and correctly adjust valve clearance.		X		X
	B. How to check, adjust and tune tractor ignition system.		X		X.
	(1) Timing distributor				
	(2) Timing magneto				
	(3) Battery service				
	(4) Checking, cleaning, and adjusting spark plugs.				
	(5) Checking, installing and adjusting breaker points.				
	(6) Checking and repairing lighting system				
	C. How to check, adjust, and maintain air, fuel, and exhaust systems.		X		X
	(1) Checking and servicing air filter.				
	(2) Checking, cleaning and adjusting carburetor.				
	(3) Checking and cleaning sediment bowl.				
	(4) Checking, cleaning, and repairing fuel lines.				
	(5) Checking manifold and exhaust system.				
	D. How to check and service cooling system.		X		X
	(1) Flushing radiator.				
	(2) Replacing and adjusting fan belt.				

AREA OF INSTRUCTION	TRAINING ACTIVITIES	APPLICABLE TO TRAINEES WORKING IN			
		Managerial Job Titles	Mechanics	Sales	Service
	(3) Selecting and adding coolant.				
	(4) Checking for and stoping leaks.				
	(5) Checking grill and exterior parts of radiator.				
	(6) Checking, replacing, and adjusting thermostat.				
	E. How to maintain and adjust tractor power train.		X		X
	(1) Checking and adjusting clutch (hand and foot operated)				
	(2) Checking and servicing the drive train-transmission, differential, and final drive.				
	F. How to check, replace parts, and adjust braking system.		X		X
	G. How to maintain steering mechanism and wheels.		X		X
	(1) Checking wheel alignment.				
	(2) Checking tires.				
	(3) Checking and servicing front-wheel bearings.				
	H. How to maintain the lubricating system.		X		X
	(1) Checking oil level, draining and flushing engine crankcase.				
	(2) Checking and replacing oil filter.				

AREA OF INSTRUCTION	TRAINING ACTIVITIES	APPLICABLE TO TRAINEES WORKING IN			
		Managerial Job Titles	Mechanics	Sales	Service
	(3) Selecting proper lubricants. (4) Servicing pressure-type grease fittings and other points of lubrication.not specifically covered under other systems. NOTE: IF THE STUDENT HAS NOT BEEN TAUGHT BASIC PRINCIPLES OF LUBRICATION AS OUTLINED IN TEACHERS' HANDBOOK (Area ten, V.B,2, P. 87, Greases and Oils Used in Agricultural Machinery), HE SHOULD BE TAUGHT THAT COMPETENCY AT THIS TIME. SUGGESTION TO THE TEACHER-It is suggested that each student be required to demonstrate that he can correctly perform a complete engine tune-up and perform the maintenance functions of all sys-				

AREA OF INSTRUCTION	TRAINING ACTIVITIES	APPLICABLE TO TRAINEES WORKING IN			
		Managerial Job Titles	Mechanics	Sales	Service
	tems outlined above. Where dynamometer is available, the student should be taught how to use it in performing the tune-up operation.				
IV. Assembly, adjustment, maintenance, and repair of land preparation equipment.	1. Through classroom study, school shop practice, and work experience in agricultural machinery dealers' establishments, student will become familiar with: A. Types of land preparation equipment and their component parts. B. Purposes for which equipment is used and factors governing use. C. Procedure for adjusting and operating land preparation equipment safely and efficiently.		X	X	X
	2. Through school shop practice and directed work experience in dealer establishments student will: A. Assemble, adjust and operate: (1) Trailor-hitch moldboard plows. (2) Mounted tractor-operated moldboard and disk plows. (3) Two-way mold board plows.		X	X	X

AREA OF INSTRUCTION	TRAINING ACTIVITIES	APPLICABLE TO TRAINEES WORKING IN			
		Managerial Job Titles	Mechanics	Sales	Service
	(4) Multiple-bottom plows. (5) Multiple-disk plows. (6) And other land preparation equipment used in the area.				
	B. Learn servicing and maintenance procedure on all land preparation equipment used in the area.	X	X	X	X
	C. Assist in the repair of all land preparation equipment brought into the shop for repair.		X		X
V. Assembly, adjustment, maintenance, and repair of crop planting equipment.	(The same general training activities as suggested under IV above will apply to areas V, VI, VII, VIII, and IX.		X	X	X
VI. Assembly adjustment, maintenance, and repair of cultivating equipment.			X	X	X
VII. Assembly, adjustment, maintenence and repair of harvesting machinery.			X	X	X
IX. Assembly , adjustment, and repair of spraying and dusting equipment.			X	X	X

AREA OF INSTRUCTION	TRAINING ACTIVITIES	APPLICABLE TO TRAINEES WORKING IN			
		Managerial Job Titles	Mechanics	Sales	Service
X. Tractor engine overhaul	1. Through classroom study student will become famaliar with construction of tractor engine (gasoline) parts and component parts. A. Crankcase B. Cylinders C. Cylinder head D. Crankshaft E. Flywheel F. Pistons G. Connecting rods H. Camshafts I. Valves and valve operating mechanisms.		X		
	2. Through school shop practice and supervised work experience, student will develop competencies in tractor engine overhaul by assisting in overhauling tractor engines which are brought into the school and dealer service shops. For the more advanced students a complete overhaul job may be assigned the student with head mechanic supervising. NOTE: When the opportunity is available, and the local conditions warrant, the same study and practice procedure will be followed for desel engines.		X		

AREA OF INSTRUCTION	TRAINING ACTIVITIES	APPLICABLE TO TRAINEES WORKING IN			
		Managerial Job Titles	Mechanics	Sales	Service
XI. Organization and management of agricultural machinery dealerships.	1. Through classroom study and work in agricultural dealership firms, student will develop an understanding of:	X		X	
	A. How a dealership is organized.				
	B. The importance of the retail agricultural machinery dealerships.	X		X	
	C. How the agricultural machinery and parts are ordered and how they are moved from manufacturer to customers.				
	D. Job titles and job functions in the organization of a retail agricultural machinery dealership. (1) Areas of operations (examples, management, parts, sales, service, etc.) (2) Duties of persons working in each job title.	X		X	
	E. How agricultural machinery dealerships are financed. (1) Credit sources. (2) Financing time sales.	X		X	
	(3) Discounts, etc.			X	
	F. Policy regarding selecting, training, and compensating employees. (1) How selected. (2) Training policy (3) Compensating employer. Fringe benefits. (4) Employer-employee relationships.	X			

AREA OF INSTRUCTION	TRAINING ACTIVITIES	APPLICABLE TO TRAINEES WORKING IN			
		Managerial Job Titles	Mechanics	Sales	Service
XII. Service department operating procedure.	1. Through classroom study and work experience in agricultural machinery dealerships, student will develop and understanding of: A. Service shop organization, personnel organization, etc. B. How charges for services are determined. C. Efficient shop layout. D. Shop safety practices. E. Service shop cost factors. F. Policies governing the providing of field service for customers.	X	X	X	X
XIII. Parts department operating procedure.	1. Through classroom study and work experience in agricultural machinery dealerships, student will develop competencies in: A. Classifying parts. B. Inventorying parts. C. How to lay out a parts department. D. How to control parts inventory. 2. Through work experience in parts department of a dealership, become familiar with: A. How parts are ordered. B. Principle policies on parts. C. Kinds of records kept. D. Procedure concerning obsolescence. E. Discount procedures. F. Working relationships with service department.	X	X	X	X

AREA OF INSTRUCTION	TRAINING ACTIVITIES	APPLICABLE TO TRAINEES WORKING IN			
		Managerial Job Titles	Mechanics	Sales	Service
XIV. Merchandizing agricultural machinery.	1. Through classroom study and work experience in an agricultural machinery dealership, student will become familiar with:	X	X	X	
	A. The selling program of the establishment.	X	X	X	
	B. Competencies needed by salesmen.	X		X	
	C. Personal characteristics of effective salesmen.	X		X	
	D. Sales approaches made by salesmen.	X		X	
	2. Through classroom study and work experience with a salesman, student will learn:				
	A. How attitude influences sales.	X		X	
	B. How to determine the kind of machinery used in the area.				
	C. How to appraise machinery traded in.				
	D. How prospects are located.	X		X	
	E. How salesmen overcome price resestance.				
	F. When to cut prices.				
	G. How to hold old customers and add new ones.	X		X	
	H. Things, or characteristics that customers don't like about salesmen.	X		X	
	I. How to put on an effective sales demonstration.	X		X	
	J. How to prepare a sales report.				
	K. The pricing policy of the establishment.	X		X	X
	L. How salesmen are compensated.	X		X	
	M. Company policy on machinery rentals, rental contracts, etc.	X		X	X

DEVELOPING COURSES OF STUDY FOR AGRICULTURAL SUPPLY--SALES AND SERVICE OCCUPATIONS

The purposes of the agricultural supply--sales and aervice occupations training programs are:

1. To prepare individuals for employment in businesses which distribute agricultural supplies and equipment.
2. To prepare individuals for employment in providing services connected with agricultural supplies and equipment.

There is a diversity of occupations in the agricultural supply and service sector of the agricultural economy for which a basic knowledge of production agriculture is at least useful, if not essential. In Mississippi's secondary school vocational agriculture program, the instruction in basic principles of animal science, soil science, plant science, agricultural mechanics, etc., will be taught during the first and second years, or 9th and 10th grade vocational agriculture. (See diagram, page 21).

AGRICULTURAL SUPPLIES--SALES AND SERVICE OCCUPATIONS TRAINING PROGRAM IS A PART OF THE TOTAL CURRICULUM IN THE SECONDARY SCHOOL

The term agricultural supplies--sales and services as used herein refers to the industries and businesses which are oriented to supplying and servicing those engaged in production agriculture. There is a diversity of businesses and industries classified as being oriented to supplying and servicing farmers. Some of these are firms engaged in the manufacturing and distributing of feed; firms engaged in manufacturing and distributing fertilizers and agricultural chemicals; businesses engaged in supplying farmers with seed, small equipment, miscellaneous, supplies, etc.; and businesses which cater to providing custom service tocfarmers.

The instruction given will be vocational agriculture and will be an integral part of the students' curriculum leading to a secondary school diploma. As in the case of all vocational courses, there will be those who can not keep pace with regular high school standards and may be candidates for school drop-outs. For these individuals a special course may be organized on a lower level of training in agricultural supply--sales and service. Before taking action on such a course, check with the State Supervisor of Vocational Agriculture.

AGRICULTURAL SUPPLY--SALES AND SERVICE OCCUPATIONS JOB TITLES

The kinds of businesses and industries oriented to agriculture differ, and in many cases overlap with other firms. For example, one type of industry may be designated as feed manufacturing and that is exactly what the firm does. In the same area or elsewhere a firm may be advertised as a feed mill, and sell not only feed, but fertilizers, chemicals, etc.

Some of the more common occupational titles associated with agricultural supplies--sales and service are:

1. Product salesmen outside (in field).
2. Store sales clerk.
3. Serviceman for store, feedmill, fertilizer plant, etc.
4. Foreman in mill or plant.
5. Feedmill operator.
6. Plant worker in fertilizer and feed mill manufacturing firms.
7. Mechanics, welders, electricians, etc.
8. Store managers.
9. Quality control technician.

As in all occupational training, the level of achievement will be governed by persistence and ability of the individual. In this occupational area, many of these who finish high school, will find that they are prepared to and need to pursue more technical training in order to attain a higher level of competency.

COMPETENCIES REQUIRED TO SUCCEED IN AGRICULTURAL SUPPLY--SALES AND SERVICE OCCUPATIONS

1. Have an appreciation for and like this type of work.
2. Absolutely honest. (Some of these job titles require the handling of large sums of money).
3. Have a wholesome attitude toward service. Pleasing personality, etc.
4. Willing to work at many different activities.
5. Basic understanding of production agriculture.
6. Basic knowledge of and some skills in agricultural mechanics.
7. Understanding of and skills in business operation. (Recognition of profit philosophy).
8. Ability to appraise economic factors and their effect on businesses.

It is not reasonable to expect that all of those of secondary school age would be able to attain a high degree of competency in all responsibilities and areas of knowledge needed in this area of agriculture. In all probability individual differences in those enrolled in the vocational agriculture classes will take care of this.

SUPERVISED WORK EXPERIENCE

Those individuals enrolled in vocational agriculture and have some phase of agricultural supply--sales and service as their occupational objective will need work experience in the occupation for which they are preparing. In some schools this may be difficult due to lack of training centers. Unless on-the-job training centers can be provided for the students, this course should not be undertaken. However, the enterprising teacher of vocational agriculture will not let any opportunity to train his students pass.

Some suggestions of places where supervised work experience in this occupational area may be provided:

1. Feed mills.
2. Farm supply stores.
3. Federated cooperative stores.
4. Seed, feed and fertilizer dealers.
5. Fertilizer and agricultural chemical firms.
6. Farm services including:
    a. Artificial inseminator
    b. Auctioneer
    c. Country butcher
    d. Crop duster
    e. Custom farm machine worker
    f. Farm building repairman
    g. Mobile repair shop operator

Whenever any of the above occupations are available in the community, the vocational agriculture teacher should acquaint the owners or proprietors of the businesses with the vocational agriculture program and enlist their cooperation in providing work experience for those students who are interested. Perhaps some of the businesses can be used as cooperative training centers. (See section X for details).

COURSE OF STUDY FOR AGRICULTURAL SUPPLY--SALES AND SERVICE OCCUPATIONS

AREA OF INSTRUCTION	TRAINING ACTIVITIES	APPLICABLE TO TRAINEES WORKING IN			
		Feed Mill	Co-op or Farm Store	Ag.-Chem. Industry	Service Jobs
I. Exploring occupational opportunities in agricultural supply--sales and service.	1. Through investivation of existing conditions, student will determine kinds of employment available in agricultural supply--sales and service, including salaries, working conditions, etc.	X	X	X	X
	2. Through visitation with owners and proprietors, student will determine qualifications to enter employment on various levels of employment.	X	X	X	X
	3. Through classroom study and analysis, student will determine opportunities for growth in agrecultural supply--sales and service occupations. (Correlate with Section II, Area One, V. In Teachers Handbook.)	X	X	X	X
II. Understanding human relations in the area of agricultural supply--sales and service.	1. Through classroom study student will become familiar with different personality traits of people.	X	X	X	X
	2. Through work experience in some business firm or agricultural industry, determine to what extent the employees have to deal with the public.	X	X	X	X
	3. Through classroom study and work experience in Ag. business, Ag. industries, etc., student will develop ability to communicate effectively with prospective employers.	X	X	X	X

AREA OF INSTRUCTION	TRAINING ACTIVITIES	APPLICABLE TO TRAINEES WORKING IN			
		Feed Mill	Co-op or Farm Store	Ag.-Chem Industry	Service Jobs
	4. Through interviews with owners, personnel directors, etc. or Ag. businesses and Ag. industries, student will determine what personal traits are desired in employees. Student will rate himself and a few volunteer members of the class on these traits.	X	X	X	X
	5. Through activities in student organizations, the student will develop personality traits which will be helpful in meeting and dealing with the public.	X	X	X	X
III. Understanding business procedures.	1. Through study and work experience in a business establishment, a student will develop an understanding of: A. Kinds of records kept in the business establishments. B. The importance of complete and accurate records in the efficient operation of a business. C. Kinds of sales tickets in use. D. The importance and use of credit in a business operation. E. Discount policies. F. Mark-ups for retail sale. G. Kinds of business forms used in ordering and receiving merchandise. H. Kinds of reports that have to be made to government and other agencies.	X	X	X	X

AREA OF INSTRUCTION	TRAINING ACTIVITIES	APPLICABLE TO TRAINEES WORKING IN			
		Feed Mill	Co-op or Farm Store	Ag.-Chem. Industry	Service Jobs
	2. Through work experience in a business establishment, student will develop ability to: A. Make a business inventory. B. Receive and store merchandise properly. C. Properly mark items for sale. D. To keep business stocked properly. E. Ability to make sales ticket effectively.	X	X	X	X
IV. Agricultural salesmanship.	1. Through classroom study and observation of salesmen, student will learn: A. What attributes are possessed by good salesmen. B. The correct sales approach. C. How to handle customer complaints. D. What employers expect from their salesmen.	X	X	X	X
	2. Through work experience in a sales establishment, student will become proficient in selling.	X	X	X	X
V. The organization and functions of agricultural businesses.	1. Through classroom study and interviews with agricultural business managers, student will determine: A. How the various agricultural businesses are organized. B. Differences between private ownership, cooperative, and corporations. C. Functions performed by different types of agricultural businesses.	X	X	X	X

AREA OF INSTRUCTION	TRAINING ACTIVITIES	APPLICABLE TO TRAINEES WORKING IN			
		Feed Mill	Co-op or Farm Store	Ag.-Chem. Industry	Service Jobs
VI. Feed businesses sales and services.	1. The student, through classroom study and work experience in a feed business developes: A. An understanding of the basic economics of a feed business and live-stock feeding programs. B. An understanding of live-stock feeds and their value. C. An understanding of basic animal nutrition. (If not adequately covered in years 1 and 2). D. The ability to formulate a grain ration for different kinds of livestock. E. An understanding of the different methods used to prepare feeds. F. An understanding of the methods used and trends in mechandizing feeds. G. An understanding of the regulations governing the formulating, labeling and using of feeds.	X	X		
VII. Fertilizers sales and service.	1. Through classroom study, interviews with agricultural leaders, students will determine: A. The economic importance of fertilizer in the area. B. The kinds of soils in the area and the common soil deficiencies. C. The fertilizer practices of farmers in the area.		X	X	X

		APPLICABLE TO TRAINEES WORKING IN			
AREA OF INSTRUCTION	TRAINING ACTIVITIES	Feed Mill	Co-op or Farm Store	Ag.-Chem. Industry	Service Jobs
	D. The recommended fertilizer practice for the area. NOTE: Some of this should have been taught during first and second year vo-ag. If not, a study of basic principles of soil and fertilizers should be provided for here.				
	2. Through classroom study and work experience in a business establishment, student will become familiar with: A. How fertilizer is sold. B. Kinds of fertilizers commonly used, meaning of analysis, etc. C. How price is determined. D. How fertilizer is inventoried. E. Pricing procedure, margin of profit, discounts,etc. F. Kinds of records kept. G. With regulations governing the labeling of fertilizers. H. With methods and trends in merchandizing fertilizers.		X	X	X
VIII. Agricultural chemicals--sales and service	1. Through classroom study and work experience in an establishment where agricultural chemicals are sold, student will: A. Determine the economic importance of agricultural chemicals in modern agriculture.		X	X	X

AREA OF INSTRUCTION	TRAINING ACTIVITIES	APPLICABLE TO TRAINEES WORKING IN			
		Feed Mill	Co-op or Farm Store	Ag.-Chem. Industry	Service Jobs
	B. Develop ability to properly identify pests that are prevalent in the area and the damage done by each. (See teacher's handbook-Vocational Agriculture, Area Six, VI and VII.) NOTE: This subject matter is absolutely essential for this unit. If this subject matter has not been taught, it should be included here.)				
	C. Identify areas of responsibilities of the sales personnel in determining the correct pesticide used for different pests.				
	D. Determine the hazards in incorrect use of pesticides, and legal restrictions.				
	E. Determine the importance of correct application of pesticides.				
	F. Develop and understanding of the safe handling, storage, and use of all agricultural chemicals sold through the firm.				
	G. Develop ability to understand literature and labels pertaining to pesticides.				
	H. Develop ability to effectively merchandise agricultural chemicals.				

AREA OF INSTRUCTION	TRAINING ACTIVITIES	APPLICABLE TO TRAINEES WORKING IN			
		Feed Mill	Co-op or Farm Store	Ag.-Chem. Industry	Service Jobs
IX. Miscellaneous agricultural supplies-sales and service.	Around metropolitan areas there are opportunities for working in agricultural supply firms dealing with seed distribution for lawn, garden, small packaged fertilizers, small items of equipment, etc. Developing effective training activities for these should be approached in much the same manner as has been suggested under other occupations.				

SECTION VI

PROVIDING OCCUPATIONAL EXPERIENCES IN OFF-FARM AGRICULTURAL OCCUPATIONS IN VOCATIONAL AGRICULTURE

Schools, through programs of vocational education in agriculture, are charged with the responsibility for preparing students for gainful employment in all occupations involving knowledge and skills in agriculture. Traditionally, programs of vocational agriculture in the secondary schools have emphasized the importance of integrating classroom and laboratory instruction with supervised occupational experience. Over the years, it has been emphasized that classroom and laboratory instruction provide students with basic knowledge and skills needed to perform well on the job. But the competency in performing on the job is developed by work experience in a real-life situation. This has been true over the years and it must always remain so.

It is the consensus of all that some form of occupational experience appears to be vital in all programs preparing individuals for employment in off-farm agricultural occupations. The nature, amount, and complexity of such training will vary with the occupation involved. Programs at the junior or senior high school level will serve more as exploratory courses than post-high school programs. Following are some of the most important objectives of occupational experience programs.

1. To arouse in the student interest in one or more specific expanding and rewarding fields in agriculture.
2. To acquaint students with specific job titles or classifications in agricultural occupations.

3. To help students learn the various responsibilities associated with specific job titles in off-farm agricultural occupations.

4. To give students an opportunity to learn to get along with and work efficiently with employers.

5. To provide background training for students planning to enroll in an agricultural technical school or agricultural college for more technical training.

6. To provide students with some specific job skills and experiences needed in off-farm agricultural occupations.

7. To provide employers with employees who have had some training and experience for specific job responsibilities.

The extent to which these objectives will be met in a local situation will depend primarily upon the effectiveness of the administrator and instructor in planning and carrying out the program. A number of questions must be answered before satisfactory programs may be undertaken. The decision must be made in regard to who will provide the occupational experience and where it will be provided. Consideration must be given to the school, employer, labor, and other inter-relationships. The amount of time allotted to occupational experience must be determined. There are many legal questions that must be answered. Administrative policies must be worked out. Evaluative criteria and devices must be worked out. Lastly, since most teachers of vocational agriculture have had little or no experience in this type of endeavor, some in-service training needs must be met by workshop-type courses.

Who Shall Provide the Occupational Experience?

The occupational experience provided at the high school level in the main must be provided outside the high school in the place of business or industry. It is assumed that many understandings and abilities will be developed in advance of the experience training period in the high school or developed in the high school at the time that the student is obtaining employment experience.

It is the consensus of most vocational educators that carefully selected personnel of agricultural businesses and industries will have the major responsibility of providing occupational experience. These individuals must be selected very carefully. Not all applicants for this type of training will profit from the training. The applications of some should be rejected. Not all employers, managers, or supervisors of these businesses and industries have potential as teachers. The success of the program will depend upon the ability of the administrators and teachers to bring together business and industrial personnel who have the ability to teach and students with the interest, desire, and need for training. Perhaps a few sessions with personnel of industries and businesses who are to work with trainees in their firms would need a few sessions in effective teaching techniques.

Businesses and industries selected to provide occupational experience should have a physical plant, personnel, safety regulations, labor relationships, and employment possibilities necessary to reach the objectives outlined for the program. Pilot studies indicate that facilities and personnel are available in most communities for many learning situations. The instructors of vocational agriculture in extremely small schools and communities may find it necessary to transport students to neighboring cities for the experiences. To do this means special scheduling of classes, and may be the most difficult phase of providing experience.

Interrelationships Between School, Employers, Labor, and Student.

While the public school will assume major responsibility in initiating and conducting the training program, it is very important that prospective employers, labor leaders, and others involved in the program have a part in the planning and developing of the program. Policies concerning the conditions under which the trainee will be working must be agreed upon by all persons concerned. In most cases it appears logical to use an advisory committee or council in developing desirable interrelationships.

In certain occupations the experiences are both agricultural and trade related. It is important that trade and industry personnel be involved in the planning and coordinating of these programs. In other occupations, the experiences, while agricultural, are also related to business, or with distributive occupations. Representatives of these educational services should be participants on an advisory council or other means provided for participation of trade and industry, distributive education, and business personnel in the planning and conducting of the experienced program.

Amount of Time for Occupational Experience.

Occupational experience programs at the high-school level largely for exploratory purposes will require much less experienced time than programs at the post-high school level which lead directly to the establishment of students in specific and perhaps complex occupations. The allocation of time should be determined after careful consideration of the objectives outlined for the program. It is possible that one semester of time may be sufficient for certain students' work experience while in training, but others will need the equivalent of one-half time devoted to work experience for the two-year period. The allotment of time cannot be done until the complete program has been planned and the specific objectives have been determined and subdivided by interests, attitudes, understandings, skills, and abilities to be attained. Sufficient time should be allotted for occupational work experience, but care should be taken to avoid unnecessary repetition or dull routine activities which have no training value. The Mississippi State Plan requires that cooperative work experience programs be developed for non-farm occupations related to agriculture, and the time devoted to occupational work experience shall not be less than that devoted to the in-school vocational instruction.

The question arises as to whether the training should be provided in one business or industry or in two or more locations. Where wide differences exist in responsibilities, it may not be advisable for trainees to receive experience in more than one location. Continuity of the training program, however, is facilitated by having the program in one location, and under one instructor. It may be necessary to increase the allotment of time in case the experience is to be had in more than one location.

Wide variations in the amounts of time allotted to occupational experience are found among post-high school programs. In some cases arrangements are made to have the students in the classrooms for a half-day period and approved agricultural businesses and industries during the remaining half-day period. In some cases the formal classroom work is completed during one semester and the students are placed with businesses and industries for full-time employment during the second semester. The plan is repeated in case of two-year programs. Since the complexity of the occupation determines the amount of time to be allotted for employment training, it is important that each individual occupation be considered and evaluated separately. The lack of uniformity among training programs from the standpoint of allotment of time for occupational experiences may be an asset rather than a liability.

Legal Aspects.

There are federal and state laws concerning labor that must be considered in planning occupational experience programs in certain kinds of businesses and industries. Most states have child labor laws. (See Appendix A.)

Those agricultural occupations that are closely related to trade organizations or trade unions must be coordinated so that occupational experiences would be provided in such a manner to meet the standards of organizations involved.

In some cases, it will be necessary to have the licensing of wage earners. It is not likely that trainees will need to be licensed. They, however, should become familiar with the process.

Each wage earner will need to obtain a social security number and report this number to his employer. In most cases the employer must also withhold social security and income tax payments.

Workmen's compensation laws provide for some income protection for workers during periods of unemployment and for workers who are injured. It is important that employers as well as trainees are familiar with the provisions of these laws.

Since the trainees will be employed outside the school facilities and in many cases will be transported from the school to the places of employment, certain legal questions may arise concerning responsibility in case of accident of individuals going to or coming from employment. There may be questions also concerning the status of insurance purchased by the school or by the student, as applied to students who are engaged in occupational experience programs.

Administration of Occupational Experience Programs.

The administrative setup will vary greatly with the size of the school district and the number of occupational experience programs sponsored. In large high schools, a director of vocational education may be directly responsible to the superintendent and school board for the administration of the occupational experience program in off-farm agricultural occupations. He, in turn, may delegate certain responsibilities to a coordinator of occupational experience programs, or to the teacher of vocational agriculture or both. In some cases the distributive education, trade and industry, and vocational agriculture coordinators may administer the program jointly. As mentioned previously, it would be very desirable to have an advisory committee or council to serve in providing advice related to policies and program development. In most schools in Mississippi for the present, the regular vocational agriculture teacher will have this responsibility.

The number of trainees should be limited to the demand for persons in the occupations available and to persons who are most likely to qualify for placement in the available occupations. In some cases, a selection committee may be advisable. In other cases, a teacher of vocational agriculture may assume this responsibility. While in other cases, the trade and industry, distributive education, and/or business education personnel may jointly make the selection.

Carefully designed job-operation sheets, carefully selected texts, and training outlines should be made available during the occupational experience period of the training. Some competencies may be developed in the school at the same time the individual is developing other competencies in the place of agricultural business and agricultural industry. The program should be conducted in such a manner that a student at all times will be cognizant of the progress that he is making and the opportunities that lie ahead.

A very important function of administration will be the providing of on-job supervision. Periodic visits to the training station to coordinate the related class instruction; to evaluate training progress; to improve relationships between the school and the coordinator; and to develop better on-job training must be provided for. In some occupations, this supervision may logically be done by the vocational agriculture instructor. In other occupations, all or part of the supervisory visits may be made by the coordinator for occupational experience programs or by instructors in trade and industry, or distributive education. In most cases the teacher of vocational agriculture is best qualified to do this job. In other cases, however, it will be advantageous to use the services of personnel in other areas of vocational education.

One visit per week may be a desirable goal. In some cases, visits may be necessary more often, particularly if problems between the trainee and the employer arise. In most cases, visits made at two-week intervals are sufficient for most training programs. The more efficient the instructor in the place of business is, the less often supervisory visits may be needed by the school personnel. The amount of time allotted for each visit will vary greatly with the type of training station, the competence of the instructor, and the competence of the trainee.

Sufficient time should be available for the vocational agriculture instructor or other supervisory personnel to evaluate the job that the individual is doing and to help the trainee in the solution of problems that exist. Some time should be available for use in developing relationship between the school and the employer. The supervisor should inspire both the cooperating teacher in the employing establishment and the trainee. The supervisory visits should provide inspiration to the vocational agriculture instructor also.

Careful records should be kept by both the student and the employer of the progress of the trainee. These records should involve not only a record of time arrival, time of leaving the business, total hours of employment, specific jobs completed, but also some measure of the quality of work done by the trainee. The French-Bray Printing Company publication, "Records of Supervised [illegible] [illegible]

Occupational Experience and Training in Vocational Agriculture", has much potential for student use or may serve as a guide in developing a record book for use in our State. A recent publication by Interstate Printers and Publishers of Danville, Illinois entitled "A Study Guide for Placement Employment Programs in Agricultural Businesses and Industry" also has much potential. These publications or other publications developed to meet our specific needs will aid materially in administering and implementing the occupational experience program.

Evaluation.

Evaluation is very important in all educational programs. It is especially important in agricultural occupational experience programs since in most cases, the programs being established are in a sense pilot programs. We have had very little experience in evaluating this type of training in vocational agriculture. As a result, we will need to evaluate carefully these programs as they are being conducted so that changes can be made to make them more effective. Evaluative instruments will need to be developed in order to have evaluations of the program made by the cooperating employers, the students, the administrators, and perhaps by members of the advisory committee. Evaluative criteria established should be in line with the objectives of the program. Instruments can be developed to determine the extent to which each of the interests, attitudes, understandings, skills, and abilities are developed by the trainee. In part, the evaluation of the program can best be made in terms of the percentage of the trainees who complete the course and the occupational training of the effectiveness of the program would involve the success and progress of these trainees in their new position.

Evaluation must be done continuously. The vocational agriculture [illegible] instructor will need to maintain a close follow-up of the individuals who finish over a period of years.

In addition to evaluation of the effectiveness of the program in the training of prospective employees, evaluation needs to be made of the specific methods and procedures used in conducting the agricultural occupational training program. The amount, length, and type of experiences included in the program should be evaluated as well as the use of team teaching. The question of course content in vocational agriculture one, two, and three should be answered. Information concerning the possibilities of having farm and non-farm trainees in the same classes should be determined. The FFA program of work, as related to the occupational experience program must be carefully evaluated. In communities where the major objective of vocational agriculture will be to prepare individuals as workers in production agriculture, the effect of the occupational experience program on the preparation of students for this phase of agriculture should be carefully evaluated. Factors causing enrollment to increase or decrease should be determined as well as factors related to drop-outs of students who enroll. Careful evaluation will need to be made concerning the effectiveness of advisory committies and councils.

SECTION VII

TEACHING RELATED INSTRUCTION

Related instruction will be of two types: A core of common general related instruction which will be presented to all students regardless of the occupation in which they are working, and instruction related to each specific job on which the different students will be working.

In the teaching of general related instruction all the various methods and techniques common to the teaching of regular vocational agriculture may be used. Following is a list of possible topics that could be taught in the core of common general related instruction. In most instances additional topics will be covered.

1. Becoming familiar with the agricultural occupations training program.
2. Determining the importance of agriculture in the community.
3. Choosing a career.
4. Applying for a job.
5. Developing desirable personal traits.
6. Parliamentary procedure.
7. Budgeting your income.
8. Saving and investing.
9. Taxes.
10. Labor Unions.
11. Employer-employee relationships.
12. Your personality.

13. Business forms and documents.

14. Social and business etiquette.

15. Business ethics.

16. Social security, income tax, witholding, fringe benefits, etc.

The <u>specific related instruction</u> has to do with the information and knowledge needed for competency in skilled occupations. Since each student will be covering different material involving different occupations, group teaching techniques may be more difficult to employ. Individualized instruction must be used more frequently so that the needs of each student can be met. Most of this will done through individualized supervised study. Since vocational agriculture instructors are familiar with the use of this technique, no further explanation is needed.

The material which a trainee studies during the specific related instructional period will be determined from the training plan and should be correlated with the on-the-job work in which the student is engaged.

A student study guide should be developed for each occupation in which training is offered. In some cases these have been developed by other states and are available for a nominal fee. Perhaps the best source for training program guides is "The Center for Research and Leadership Development in Vocational and Technical Education," The Ohio State University, 980 Kinnear Road, Columbus, Ohio 43212.

The trainee study guide should contain key questions, problems and other assignments to enable the trainee to become familiar with the information which the training plan lists as being pertinent to the on-the-job training. The study guide should also list the references and, in some cases, present basic information so that the trainee may comprehend the material by working on an individual study basis.

DEVELOPING TRAINING PLANS FOR COOPERATIVE OCCUPATIONAL EDUCATION PROGRAMS

The employment of a student in a job does not necessarily insure that the student will receive training and that the experience will be educational in nature. A desirable cooperative occupational experience program consists of deliberate efforts to prepare a student for specific job competence. It includes a direct progression of job experiences, operations, or processes. The vocational agriculture teacher-coordinator has the responsibility of seeing that the work accomplished by students placed in cooperative-occupational experience programs is educational in nature and not mere work experience. To insure that the student's on-the-job experience will be truly educational, a training plan must be developed.

The training plan consists of a listing of the activities in which the student should be engaged while working at the training station. Opposite this there should be a listing of the subject matter that should be dealt with in the related instruction at school. Space is provided so that a record of progress can be kept of the on-the-job experiences and a grade or completion mark can be recorded for the related instruction. All activities considered essential to the occupational training should be included in the training plan.

Purpose and value of training plans

The primary purpose in developing a training plan is to determine in advance of the training program what activities the student is to participate in while on the job. This then serves as a guide to those involved in the training to see that these experiences are provided. The vocational agriculture teacher coordinator and employer should refer to the training plan frequently, making certain that the student-learner is receiving the experiences previously agreed upon.

The training plan is especially valuable to the teacher-coordinator. It enables him to understand job requirements and specifications; to determine the value of a training station; to help select students for specific occupations; and to compare the proposed on-the-job experiences with those actually being practiced.

Through the training plan the trainee knows what will be expected of him. He can then better understand the objectives and scope of his chosen occupation.

Training plans remind employers of the breadth and depth of training that is to be provided the trainee. It is also most valuable to an employer to know what related instruction is being provided for the trainee at the school.

Developing individual training plans

A training plan should be developed for each student placed in cooperative occupational experience. This plan should be based upon the ability of the student, the type of occupation, the conditions at the training station, and the length of the occupational experience period.

Training plans should be developed cooperatively between the teacher-coordinator and the employer. In some cases, experience may be gained by students in occupations which are not completely familiar to the teacher-coordinator. The necessary information should be obtained through personal interviews with the employer or the person responsible for the on-the-job instruction. When developing training plans, the following procedures should be kept in mind:

1. Thoroughly explain the need and value of training plans before involving the employer in their development.
2. Let the employer look at samples of training plans which have been completed.
3. Do not expect the employer to prepare the actual plan. The teacher-coordinator should assume the responsibility for the preparation of the final plan after suggestions and recommendations have been made by the employer.

Some examples of training plans for farm tractors and farm machinery job titles are shown on pages 76-81.

FARM TRACTORS AND MACHINERY AREAS OF OFF-FARM AGRICULTURAL OCCUPATIONS

PLANNING AN ACTIVITY PROGRAM FOR DIFFERENT JOB TITLES

JOB TITLE: Mechanics Helper

A. Outline of instruction to be given in school.

1. Basic principles of internal combustion engines.
2. Fuel system, basic components and function.
3. Lubrication and its essentials.
4. Functions and parts of cooling systems.
5. Basic principles of the electrical system.
6. Basic principles of welding.
    a. Gas
    B. Electric
7. Shop safety.
8. Identification and use of hand tools.
9. Disaasemble and clean parts to be overhauled.

B. Outline of instruction to be given in the business establishment.

1. Identify, recognize, and observe component parts of the engine and their functions.
2. Observe construction and operation of the engine.
3. Servicing air cleaner.
4. Clean and adjust carburetor.
5. Check and service fuel lines.
6. Flush crank case.
7. Service oil filter.
8. Selection of lubricants and use.
9. Flushing and cleaning radiator.
10. Adjust and replace fan belt.
11. Selection of coolant and use.
12. Check for leaks and repair.
13. Check thermostat.
14. Adjustment, maintenance, and repair of small gasoline engines.
15. Welding
    a. Gas
    b. Electric
16. Practice shop safety.
17. Clean, store, and proper use of handtools.

JOB TITLE: Utility Man

A. Outline of instruction to be given in school.

1. Importance of clean working conditions.
2. Importance of good personal appearance.
3. Hand-tool identification and correct use.
4. Preparation and cleaning of equipment for major overhaul.
5. Importance of the appearance of the building and grounds.

6. Shop safety.
7. Basic fundamentals of welding.
   a. Gas
   b. Electric

B. Outline of instruction to be given in the business establishment.

1. Clean building and working area.
2. Dress appropriately for work.
3. Clean and store handtools in proper place.
4. Steam clean tractors and equipment.
5. Care for grounds and outside equipment.
6. Clean and arrange equipment on display.
7. Practice safety.
8. Welding simple jobs.
   a. Gas
   b. Electric

JOB TITLE: Set-up and Delivery Man

A. Outline of instruction to be given in school.

1. Interpretation of set-up diagrams and set-up manuals.
2. Importance of proper delivery.
   a. Contact with customer and importance.
   b. Effective communication.
3. Hand-tool identification and use.
4. Selection and use of proper lubricants.
5. Importance of proper tire inflation.
   a. Air.
   b. Liquid.
6. Shop safety.
7. Basic fundamentals of welding.
   a. Gas
   b. Electric

B. Outline of instruction to be given in business establishments.

1. Use set-up manual in setting up equipment.
2. Proper assembly.
   a. Double check all bolts, cotter pins, etc. for secureness.
3. Make delivery with proper instructions.
4. Use hand-tools properly
   a. Clean and store hand-tools properly
5. Refer to operator's manual for checking the following:
   a. Crankcase oil
   b. Front-wheel grease
   c. Transmission and differential grease
   d. Hydraulic system oil
   3. Check and service air cleaner
6. Check tires for proper inflation.
7. Practice safety.

8. Welding
    a. Gas
    b. Electric

JOB TITLE: Mechanic

A. Outline of instruction to be given in school.

1. Basic principles of internal combustion engines.
2. Fuel system and basic components and function.
3. Lubrication and its essentials.
4. Functions and parts of cooling system.
5. Functions and parts of electrical system.
6. Functions and breaddown of geartrain.
7. Proper adjustment of brakes.
8. Proper adjustment of clutch.
9. Welding.
    a. Gas
    b. Electric
10. Shop safety.

B. Outline of instruction to be given in business establishment.

1. Completely overhaul one engine.
2. Check clutch assembly and overhaul.
3. Check and repair or install cooling system.
4. Check electrical system, repair and install.
    a. Generator
    b. Starter
    c. Battery
    d. Distributor
    e. Voltage regulator
    f. Wiring layout.
5. Check and install spark plugs and wires.
6. Check and replace coil.
7. Clean, check, and install fuel system.
8. Clean, service, and install air cleaner.
9. Check transmission and differential, replace parts, etc.
    a. Bearing wear
    b. Gear wear
    c. Check and repair brakes
10. Replace oil and grease according to operator's manual.
    a. Front wheels
    b. Crank case
    c. Transmission
    d. Hydnaulic system
    e. Rear axle bearing and seals
11. Check and reapir hydraulic system.
12. Welding.
    a. Gas
    b. Electric
13. Practice safety.

JOB TITLE: Shop Foreman and Assistant Shop Foreman

A. Outline of instruction to be given in school.

1. Acquaint student with working knowledge of the following:
    a. Utility engineer
    b. Set-up man and delivery
    c. Mechanic trainee
    d. Mechanic
2. Importance of service to the customer.
3. Importance of making work order.
4. Importance of supervision to all shop personnel.
5. Importance of planning and organizing jobs.
6. Importance of acquiring knowledge of the operating policies of the business.

B. Outline of instruction to be given in business establishment.

1. Meet customer and make job order.
2. Scheduling of work for all personnel.
3. Practice and promote safety.
4. See that jobs are completed on schedule.
5. Check all completed jobs before delivery is made to customer.
6. Be a good service salesman.

JOB TITLE: Parts Trainee

A. Outline of instruction to be given in school.

1. Importance of clean and orderly working conditions.
2. Importance of good personal appearance.
3. Importance of quick and efficient service to customer.
4. Importance of parts inventory.
5. Importance of knowledge of parts and correlated parts.
6. Importance and use of parts book and price book.
7. Importance of writing legibly.
8. Be honest.

B. Outline of instruction to be given in business establishment.

1. Keep parts and area clean and orderly.
2. Dress appropriately.
3. Give quick and efficient service.
4. Keep inventory of parts and order as needed.
5. Learn to use parts and price book.
6. Make display of fast-moving parts.
7. Check incoming parts and properly store.
8. Check and order parts ahead of seasonal work.
9. Make all tickets legibly.
10. Practice honesty.

JOB TITLE: Parts Man

A. Outline of instruction to be given in school.

1. Acquaint student with same knowledge as parts trainee.
2. Importance of a correct inventory.
3. Importance of work experience.
4. Importance of training trainee.
5. Importance of reporting customer complaints.
6. Importance of assuming all responsibilities.
7. Honesty.

B. Outline of instructions to be given in the business establishment.

1. Responsible for keeping parts and area clean and orderly.
2. Responsible for quick and efficient service.
3. Responsible for adequate inventory.
4. Responsible for correct use of parts and price book.
5. Responsible for advertising and displaying parts to increase sales.
6. Responsible for all parts orders.
7. Responsible for parts sales and receipts.
8. Maintain good public relations.
9. Practice safety.
10. Practice honesty.

JOB TITLE: Sales Trainee and Salesman

A. Outline of instruction to be given in school

1. Importance of personal appearance.
2. Importance of knowledge of product.
3. Importance of knowledge of adaptability of equipment to a farm.
4. Importance of evaluating farmer's present machinery inventory.
5. Importance of keeping prospect list up-to-date.
6. Importance of staying in touch with the farmers.
7. Importance of quality prospects.
8. Importance of mechanical background.
9. Importance of salesman and other employees relationship.
10. Importance of price quotation to prospective buyer.
11. Importance of salesmen and owner relationship.
12. Importance of personal qualifications.
    a. Honesty and dependability
    b. Leadership
    c. Self-control
    d. Business-like attitude
    e. Service minded

B. Outline of instruction to be given in business establishment.

1. Dress appropriate.
2. Know the products to be sold.
3. Work with experienced personnel to observe equipment for proper adaptation.
4. Make inventory of equipment on several farms.

5. Make prospect list and keep up-to-date.
6. Make visits to farmers periodically.
7. Observe all prospects and their financial responsibility.
8. Improve mechanical knowledge.
9. Maintain good relationship with owner.
10. Study and keep up-to-date on price books.
11. Observe and practice these quality traits:
    a. Honesty and dependability
    b. Leadership
    c. Self-control
    d. Business-like attitude.
    e. Service minded.

SECTION VIII

SELECTING TRAINING STATIONS FOR COOPERATIVE WORK EXPERIENCE

One of the most important factors in determining the success of the cooperative work experience program is the adequacy of the training station at which a student is placed for on-the-job instruction and experience. It is imperative, therefore, that definite consideration be given to the selection of training stations before students are placed for occupational experience. The survey of the agricultural businesses and firms in the community, explained earlier, should provide a good list of possible training stations. Information gained from the personal interviews or knowledge already possessed by the vocational agriculture teacher-coordinator and consulting committee members should provide sufficient basis for determining whether possbile training stations meet the desired criteria.

Criteria for Selecting Training Stations

The following items should be used as criteria in selecting training stations:

1. Type of occupation. The training station should provide experience in an occupation that requires some knowledge, understanding, and skill in agricultural subjects.
2. Opportunities for rotation. The training station should provide a wide variety of experiences associated with the occupation for which the student is training. It should not ne just a routine work experience of a repetitive nature.

3. On-the-job supervision. The training station should provide someone capable of serving as an on-the-job instructor. This should be someone who is thoroughly competent in the skills and technical aspects of the occupation. He should be someone who is interested in the program and who will enjoy cooperating in the training program.

4. Working conditions. The working conditions of training stations should be safe and clean, with a good record of accident prevention. It should also present few, if any, conditions that might impair the health of the workers.

5. Reputation. The training station personnel should have a good reputation and be respected by the community as reliable business people. It should be a business that the community is glad to have within its boundaries.

6. Business climate. The personnel in the training station should use ethical business practices and leave a favorable impression with the student. The firm should have a record of participation in civic affairs, and a favorable attitude toward the welfare of its employees.

7. Stability of employment. The training station should have a reputation of continuous operation. It should have a record of few or no lay-offs, lock-outs, close-downs, or extensive periods of curtailment.

8. Hours of employment. The training station should be able to provide for a sufficient number of training hours at a time which is conducive to the employment of student workers.

9. Facilities and equipment. In order to provide adequate training, the training stations should possess adequate facilities and equipment and use up-to-date methods.

10. Employer-employee relationship. The training station should maintain a good employer-employee relationship. Firms that make it a policy to train

and promote their own personnel score high on this point.

11. Accessibility. Training stations should be within a reasonable distance from the school or accessible to the trainee. In some cases, the training station may be outside the normal limits of the school area if the student has adequate transportation to and from work, and the training station rates high on other factors. In some cases where students are attending area schools, they can be placed in their local community for occupational experience.

12. Wages. The training station should be able to pay a minimum wage for student workers based on that paid other employees of similar experiences and training. Wages of regular employees should be at least comparable to those paid in similar occupations in the community.

Training Station Check Sheet

The final selection of training stations can be facilitated by the use of a check sheet. The purpose of this sheet is to obtain a comparative rating of possible training stations. This sheet should list criteria to be considered when making the selection. The consulting committee can be very helpful in completing the check sheets on the different firms.

Careful consideration should be given to each item on the check sheet. Any unusual situations should be listed at the bottom of the sheet under "Remarks." If a prospective training station is not selected, the reasons may be listed in this space and relayed to the employer. This may help correct deficiencies in the prospective training station so that it may be used in the future if needed.

(An example of a training station check sheet is shown in Appendix D.)
(An example of a cooperating employer appraisal is shown in Appendix E.)

SECTION IX

SELECTION OF STUDENTS FOR PLACEMENT IN TRAINING STATIONS

It must be realized that the student is the most important element in a cooperative occupational experience program. Much of the success of the program will depend upon the calibre of the students enrolled. Students termed "of high calibre" do not necessarily mean those with outstanding grades, but refers to those students who possess the aptitude and qualifications required for success in a given occupation. The objectives of this program can be attained only when the student is capable and desires to receive training. There may be a tendency among some educators to gear the program toward students with low academic and occupational abilities, while the training for many occupations to be entered requires students to have desirable personal traits and above-average aptitudes.

With the above considerations in mind, the need for a sound system for screening and selecting students besomes evident. The vocational agriculture teacher-coordinator should plan a system that utilizes numerous activities and procedures in selecting students.

Procedures for Selecting Students

The following steps are suggested as a guide to follow in the selection of students:

1. Make a general announcement concerning the program to all eligible students at least two months before pre-registration for courses.
2. Have all interested students complete an "application for enrollment form." A sample form is shown in Appendix F.

3. Make arrangements with the school counselor to obtain various test scores and other confidential information that is not reported on the application form.
4. If sufficient tests have not been administered, the teacher-coordinator may wish to administer commercial tests or in some cases special interest surveys. These can determine the student's interest and abilities in specialized areas such as sales and mechanics. Contact your school guidance counselor for obtaining this type of information.
5. In most cases the teacher-coordinator will be familiar with the personal characteristics of possbile stydents, since he would most likely have them in previous vocational agriculture classes. In some cases, however, the teacher-coordinator may have very little contact with interested students. If this be the case, it may be advantageous to have other teachers more familiar with the student, evaluate the personal characteristics of the student. A sample teacher's rating form is shown in Appendix G.
6. Record the information obtained from the previoux steps on a "Student Information Sheet." (See Appendix H.)
7. Interview each candidate personally. This will help obtain information that has not been obtained in any of the precious steps.

Criteria for Selecting Students

After the above steps have been completed, sufficient information should be available to make a final selection. The following criteria are suggested as possible points to be kept in mind when selecting students.

Occupational objectives. Students selected should have an interest in agricultural occupations for which the training program is designed, and in which adequate training stations will be available.

Parents' approval. Students selected should have their parents' approval to participate in the program.

Ability and willingness to work. Students selected should have demonstrated that they are able and willing to work.

Age. Most states have minimum age laws (usually 16) and, therefore, this must be considered when students are selected. Students selected should be able to meet the age requirements specified by local, state, and federal labor laws. (See Appendix A.)

Scholarship. Students selected should have done well in school subjects related to the occupation in which they will be trained.

Attendance records. Students selected should have a minimum number of absences and tardinesses on their school records.

Hours available for work. Students selected should be able to work the minimum required hours per week for the total training period.

Transportation. Students selected should be able to have transportation to and from their training station.

Handicaps. Students selected should not possess any handicaps which would prevent them from being hired by any employers in the available training stations.

Personal characteristics. Students selected should have desirable personal characteristics. This would include such items as character, loyalty, initiative, attitude, and personality.

Placement of Trainees in Training Stations

Perhaps the placement of qualified trainees in selected training stations is a rewarding climax to the vocational agriculture teacher's effort up to this time.

After a list of qualified trainees and suitable training stations have been made, the next important step is matching trainees to jobs for the most effective training. It is believed that the final selection of the trainee for a particular training station should be made by the employer. However, there are certain things that the teacher-coordinator can do to assist in getting trainees properly placed in desirable training station, these are:

1. Give the qualified trainees instruction on job classifications, employer-employee relations and procedure in applying for job.
2. Rate the eligible trainees for suitability for each particular job.
3. Give the list to the proper employer and let him select the students he wants to interview.
4. If some jobs require an application form, guide the student in completing this form, but let the student gain the experience of actually completing such a form.
5. In some cases, the teacher-coordinator may wish to go with the student and introduce him to the employer. However, this depends upon the individual student. The teacher-coordinator may wish to go with the student and introduce him to the employer. However, this depends upon the individual student. The teacher-coordinator from his knowledge of the student should know whether to use this procedure or not.
6. After the employer has had an opportunity to interview the students, the teacher-coordinator should assist him in his selection by furnishing him all the information available about each student being considered. This can best be done by letting him review the Student Information Sheet. The teacher-coordinator should refrain from giving his personal recommendations or arbitrarily assigning a trainee to a training center. Remember, the final selection of the trainee should be made by the employer, unless circumstances are such that a cooperative arrangement be worked out for selecting trainees for certain establishments.

PLACEMENT OF STUDENTS IN TRAINING STATIONS

A concerted effort should be exerted by the vocational agriculture teacher-coordinator to insure that the interest of both the student and the employer is considered when placing a student in a training station. Also parents should show their interest.

One mistake the teacher-coordinator should avoid is arbitrarily assigning a student to a training station without involving the employer. Past experiences of some have shown that this may lead to an undesirable situation. First of all, students do not receive the actual experience of applying for a job under realistic circumstances, and secondly, if for some reason the student does not do well at the training station, the teacher-coordinator must assume full responsibility.

When Should Students be Placed?

Due to the variety of programs which offer training in off-farm agricultural occupations, it is difficult to say when students should be placed in cooperative occupational experience programs. Some students will need to be placed in the summer before entering a class where related instruction is to be offered, while others will need to be in the class for a considerable period of time before they are placed in on-the-job training.

Although it is sometimes difficult to accompolish, students should receive formal instruction in as many areas as possible before they are placed for cooperative occupational experience. The type of employment will determine to some extent the previous instruction needed. For most occupations it is desirable for students to be acquainted with the procedures of applying for a job, employer-employee relations, and a general knowledge of the nature and scope of the occupation for which they are preparing before they begin their on-the-job experience.

How Should Students Be Placed?

Although there are no definite procedures in placing students in training stations, there are certain practices that should be followed. The following practices are recommended as desirable procedures for the teacher-coordinator use:

1. Have more than one student apply for a job at a training station. This will enable the employer to have a choice and it will enable students to encounter a more realistic situation in that he knows that he is competing for a position. Fair competition is the "spice of life."
2. Have the student write a letter of application. This gives practical experience to the student and at the same time enables the employer to determine if he wants to give the student's application further consideration by having him complete an application form or attend a personal interview. An example of a student's letter of application is shown on page 92..
3. Help the student complete the application forms that the employer requires. If the employer does not require application forms, the teacher-coordinator may construct a sample form which students may complete for practical experience. These forms plus a personal data sheet may be given to an employer if he requires information in addition to that obtained during an interview. An example of an application form is shown in Appendix I. An example of a personal data form is shown in Appendix J.
4. Ask the employer to conduct a personal interview with those students that meet his minimum requirements. This is excellent experience for the student and it enables the employer to determine which student he feels is best suited for the position available. Some specific helps concerning student-employer interviews are found on pages 93 and 94.
5. As pointed out before, the final selection of the student to be placed in the training station should be made by the employer. This will enable the employer to have the same freedom and responsibility in the hiring of student-learners as for a regular employee. In many cases

the employer works directly with the teacher-coordinator in that the teacher-coordinator will supply information concerning the students if the employer so desires.

6. If a student is not selected for a job in one training station, he should then apply at another approved station which can provide training in an occupation that is available. This being realistic to live situations.

_______________ High School
Vocational Agriculture Department

(Sample Letter of Application)

Box 100
Farmville, U. S. A.
September 20, 1965

Mr. John McAhee, Manager
Brown Farm Implement Co.
340 Main Street
Farmville, U. S. A.

Dear Mr. McAhee:

Mr. Andrews, vocational agriculture teacher-coordinator at Farmville High School, has informed me of a vacancy in the teacher and machinery parts department of your firm. I would like to submit my name for consideration for this position.

At present, I am a student enrolled in the vocational agriculture occupations training program at Farmville High School and, therefore, will be availabl for employment after 2:00 p. m. on school days, and the entire day on Saturdays and during the summer. I do not plan to go to college, and I plan to seek full-time employment in an agricultural firm when I graduate.

I have lived and worked on a farm all my life. Last summer I worked in the parts division of the Farmville Tractor and Equipment Co. I have served as secretary of the local FFA Chapter and scholastically, I rank in the upper fourth of my high school class.

I am interested in a career in agricultural machinery sales and recognize the value of being associated with a firm of your reputation. I would appreciate a personal interview with you at your earliest convenience so you may become better acquainted with my qualifications. I will be available for an interview after 2:00 p. m. on school days and any time on Saturdays.

I may be contacted at the above address or through Mr. Andrews at the high school. I am looking forward to your reply.

Sincerely,

John Jones

Some Helps Regarding Interviews*

The following is a sample of the type of information the teacher can give to help prepare students for interviews.

Planning the interview

Planning for a successful interview usually begins long before the interview. After the trainee knows the firm where he is to get his work experience, he is in a position to do a little research. He should find out where the company is located, who the manager is, what the company sells (including "brand name" products), its policies and organization. The trainee should ask himself how he can fit into the firm best.

The teacher should emphasize the following in talking with the trainee about interviews. Before you leave for the interview, check your personal appearance. Dress smartly and neatly. Above all, be clean. Carry with you a portfolio or references and your personal data sheet.

When you enter the interview office, smile, and act naturally. The interviewer is interested in the real you. He will usually be an experienced person and will take the initiative throughout the interview. If he gives you a chance, offer special information about your interests and desires and your interest in the firm. Ask questions. Show interest and aggressiveness.

Before the interview

The following questions should be answered by the trainee before the interview:

1. What kind of training do you really want?
2. Where can you go to find such training?
3. What qualifications are necessary to obtain such training?
4. Does the firm hire persons without experiences for the kind of job

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*Adapted from the material for conducting pilot programs in off-farm agricultural occupations in Kentucky.

5. How can you best get the kind of experience you need?

6. What do you know about the firm?

7. Who is the one who does the employing?

8. Are you positive on the training you want?

9. What kind of clothes should you wear for the interview?

10. What references should you carry with you to the interview?

11. Why is it important to arrive on time for your interview?

12. Where is the exact location the interview will take place?

During the interview

The trainee should keep the following questions in mind and know what to do when the interview takes place:

1. Should you shake hands with the interviewer?
2. Should you smile?
3. If you are introduced to the interviewer, what should you say?
4. Should you sit down immediately?
5. How should you sit?
6. Where should you put your materials that you have carried with you?
7. If the interviewer sits waiting for you to speak, what should you say?
8. If the interviewer asks questions, how should you reply?
9. If the interviewer makes no offer of a training position, what should you do?
10. If the interviewer makes an offer of a training position, what questions should you ask?

After the interview

Every interview should be followed with a letter of appreciation, thanking the interviewer for his consideration and reaffirming your desire to have the training position. The follow-up letter may express your interest in the company, its products, or the kind of work involved. Remember that a prospective employer has more to decide than whether or not the applicant will fit in with his firm; he must decide who will fit the job best.

YOU MUST STAND OUT FROM THE REST. This fact alone should be enough to convince you that you must be "on your toes" and sell yourself every minute of the time you spend with a prospective employer. Remember that you are not only competing with other applicants, but you are also competing with the standards of quality that every firm establishes.

SECTION X

SUMMARY COOPERATIVE OCCUPATIONAL EDUCATION IN AGRICULTURE

1. Age of Trainees

The trainees must be 16 years of age or older to meet the requirements of labor laws for many occupations. Trainees who will be 16 during the first 6 weeks after the beginning of school may be enrolled. They can not, however, be employed under a student-learner certificate until they are 16 years of age. (See Appendix A and B.)

2. Hours of Training

Trainees employed in occupations governed by the U. S. Fair Labor Standards Act may spend as many hours at the trianing center as approved, provided these hours, plus the hours spent in regular classes in school do not exceed 40 hours per week. Sufficient time in training on the job is needed for instruction, observation, and practice to learn the various phases of the job. Normally, the trainees will spend five hours per day in school and three hours per day at the training center. When school is not in session on any school day, the trainee may work more hours than the student-learner's certificate authorizes, provided, however, the total hours shall not exceed eight hours per day. During the school term when school is not in session the entire week, the trainee may work additional hours, not to exceed 40 hours. The trainee must spend as many hours on the job as he does in the vocational agriculture class.

3. Selection of Trainees

Trainees should be selected who are interested in preparing for occupations which require knowledge and skills in agriculture. Trainees must be employable; therefore, it is essential that selection be based on a carefully designed procedure which takes into consideration such things as aptitude, interest, personality, work habits, etc.

4. Wages Paid Trainee

Trainees must be paid for the time spent on the job at the training center at the same rate as other employees of the same age or experience. The local Advisory Council may recommend minimums if not covered by minimum wage laws. Employers may obtain a Student-Learner Certificate allowing them to pay 75 percent of the minimum wage for a portion of the training period.

5. Length of Employment of Trainees

Trainees must be employed in an occupation at the training center for enough time to justify the program. This may vary according to occupation, and the amount of training available at the centers.

6. Travel of Trainees

Trainee must be responsible for his own travel to and from the training center. Any training center approved should be within a reasonable travel distance from the school and the home of the trainee in order to reduce the amount of travel required.

7. Individual Training Plan

An individual training plan must be developed for each trainee. Both a course-of-study for his classroom related instruction and a training outline for his occuaptional on-the-job training at the training center is necessary.

8. F.F.A.

Boys enrolled in the agricultural occupations program are leigible for membership in the Future Farmers of America.

RELATED CLASSROOM INSTRUCTION IN AGRICULTURAL OCCUPATIONS

1. Length of Time

A minimum of one hour per day for related classroom instruction is required.

2. Course Content

a. Instruction applicable to all agricultural occupations regardless of occupation pursued, will be provided. Such instruction will include such areas as:

(1) Applying for a job
(2) Employer relations
(3) Ethics
(4) Labor laws
(5) Workman's Compensation laws
(6) Social Security
(7) Other

b. Instruction will also be provided which is applicable to the individual trainees occupation which he is engaged. This instruction will be primarily individual study under the supervision of the vocational agriculture teacher.

3. Size of Classes

Since the related occupations program is new and will probably require more time by the teacher than the regular program, it is suggested that fewer students be enrolled per class where related occupations students are enrolled. A good many teachers are overloaded at present. In some schools consideration should be given to the employment of an additional teacher or teachers to assist with the expanded program.

4. Class Schedule

Cooperative occupations trainees may meet with the vo-ag classes as scheduled.

5. Facilities and Instructional Material

a. The school must provide satisfactory classroom facilities for this program. In most cases, the vocational agriculture department will be adaptable to provide the necessary facilities.

b. The school must also be responsible for providing sufficient instructional materials for the students.

ON-THE-JOB TRAINING AT THE TRAINING STATION

1. The length of training period will vary, according to the type of occupation and offerings of the Training Station.
2. The amount of time spent at the station can not exceed the difference between the total hours in school and 40 hours per week.
3. On-the-job training must not be less than that spent in the vocational in-school classes.

TRAINING PLAN

1. The Training Plan should be developed cooperatively by the person directly responsible for training the student and the agricultural teacher.
2. The Training Plan should contain the basic knowledge, manipulative skills, and abilities that the trainee shoald learn on-the-job and in the classroom.

SUPERVISION OF TRAINEES AT THE TRAINING CENTER

1. By the employer

The employer, or a person designated by the employer, will be responsible for training the student at the place of business. He should assist in the developing of the training plan in order that no step, job, operation, or procedure is omitted. He is to provide instruction at the center in such a manner or method that will be understandable to the trainee.

2. By the teacher of vocational agriculture

The primary role of the teacher will be to work closely with the employer and/or the person directly responsible for training the student. He will make periodic visits to the training center to check with the business personnel and observe the student in training. The local school district should provide ample time for the coordination of the program.

3. Start of training

The occupations program cannot be started the day school opens like the usual vocational agriculture courses. Unless the students are placed at the training centers during the summer, there will be a considerable amount of confusion in starting both the regular Vo-Ag classes and the occupations program at the beginning of the school term. On this basis, it is recommended that students commence their training on-the-job during the summer months. This will allow the students to be observed for a period of time to determine if the training at the center makes a suitable beginning and indicates progress. It will permit changes where it is evident that changes should be made before the regular school term begins.

APPENDIX A SUMMARY OF MISSISSIPPI CHILD LABOR LAW--1960

MINIMUM AGE

The minimum age is 14 to work in any mill, cannery (except fruit or vegetable cannery), workshop (interpreted by Attorney General to include stores, factory, or manufacturing establishments.

CERTIFICATES

No employment-certificate system. (For work in establishments listed above, employer must be secure from a child between 14 and 16 parents' affidavit and certificate of school superintendent or principal stating place and date of birth, school grade attended, name of last school sttended, and teacher in charge.)

AGE CERTIFICATES

No provision. (For the purposes of the child-labor provisions of the Fair Labor Standards Act, Federal certificates of age are issued upon request by the Federal Issuing Officer, Wage and Hour and Public Contracts Divisions, U. S. Department of Labor, 145 Amite Street, Jackson.)

HOURS

8-hour day, 44-hour week, for children between 14 and 16 in any mill, cannery (except fruit or vegetable cannery), workshop, factory, or manufacturing establishment, or (by interpretation) in any store. Railroads and public service corporations are exempted.

10-hour day for all employees 16 and over in any mill, cannery (except fruit or vegetable cannery), workshop, factory, or manufacturing establishment, with the following exemptions: (1) Cases of emergency; (2) Where public necessity requires; (3) Railroads or other public service corporations; (4) Establishments handling or converting perishable agricultural products in season, and which use adult male labor only; (5) Overtime permitted to make one shorter workday per week (30 minutes daily for the first 5 days of the week, such additional time to be deducted from the last day of the week. Persons employed at night only may work 11 1/4 hours the first 5 nights of the week and 3 3/4 hours on Saturday night but 60 hours shall constitute a full week's work for such employees). 10-hour day, 60-hour week, for females in any laundry, millinery or dressmaking store, office, merchantile, establishment, telegraph or telephone office, or in any other occupation not herein enumerated except (1) cases of emergency, (2) where public necessity requires, and (3) domestic service.

NIGHTWORK

Prohibited from 7 p.m. to 6 a.m. for children under 16 in any mill, cannery (except fruit or vegetable cannery), workshop, factory, or manufacturing establishment, or (by interpretation) in any store. Railroads and public service corporations are exempted.

STREET TRADES

No provision.

MEAL PERIOD

No provision.

AGENCY AUTHORIZED TO ENFORCE CHILD-LABOR LAW

Division of Occupational Health and Factory Inspection, State Board of Health, Jackson, Mississippi.

STATUS OF ILLEGALLY EMPLOYED MINORS UNDER THE WORKMEN'S COMPENSATION ACT

Illegally employed minors are covered by the State compensation act, and the double compensation is provided in case of injury to minors under 18 employed in violation of the State child-labor law. The employer alone and not the insurance carrier shall be liable for such increased compensation.

LEGAL REFERENCES. Miss. Code 1942 Ann., Recompiled 1952, Supp. 1958. Child Labor: secs. 6985-6993. Workmen's Compensation: secs. 6968.02, 6998.54. School Attendance: secs. 6221 through 6228 repealed by ch. 26, Laws 1953; sec. 6225-03.

APPENDIX B

STANDARDS AND PROVISIONS FOR STUDENT-LEARNER CERTIFICATES*

The following section is taken from the information guide and instructions for completing applications for student-learner certificates and from title 29, part 520-Employment of Student-Learners.

Under regulations established pursuant to both the Fair Labor Standards Act and the Walsh-Healey Public Contracts Act, student-learners may be employed at wages below the minimum wages established under those acts in accordance with certificates issued by the Wage and Hour and Public Contracts Divisions of the U. S. Department of Labor. The employment of student-learners at special minimum wages is subject to Regulations, part 520, issued under authority of section 14 of the Fair Labor Standards Act. Section 50-201.1102 of the general regulations under the Walsh-Healey Public Contracts Act recognizes the standards and procedures of Regulations, part 520, as applicable to the ussuance of certificates permitting employment of student-learners at special minimum wages in the performance of government contracts.

1. Coverage

The Fair Labor Standards Act applies to all employees (including student-

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*Adapted from the Arkansas Manual on Supervised Training for Agricultural Employment.

learners) engaged in interstate commerce or in the production of goods for interstate commerce, including any closely related processes or occupation directly essential to such production, unless specifically exempt by some provisions of the act. The act also applies to employees (including student-learners) who are not themselves engaged in or producing goods for commerce but who are employed in certain large enterprises engaged in commerce or in the production of goods for commerce. Popularly known as the Federal Wage and Hour Law, this act establishes minimum wage, child labor, and maximum hours and overtime standards for employment subject to its provisions.

The Walsh-Healey Public Contracts Act applies in general to all contracts entered into by the government for the manufacture or furnishing of materials, supplies, articles or equipment in any amount in excess of $10,000. This act requires the payment to employees engaged in the performance of such contracts of not less than the minimum wage determined by the Secretary of Labor to be prevailing for the industry. In addition, the Public Contracts Act contains special provisions for safety and health standards, restrictions against the use of child labor and convict labor, and special provisions for the payment of overtime for work subject to the act.

Special situations which may arise under these two acts are explained in section 2 cf "On Completing Student-Learner Certificates." The Wage and Hour and Public Contracts Division have available upon request bulletins on the coverage of these acts. If in doubt as to whether either or both of these acts apply to a particular type of employment, a letter explaining your situation should be sent to the regional office of the division serving your area.

2. Who Is A Student-Learner?

As defined in the regulation, a student-learner is a student who is receiving instruction in an accredited school, college or university, and who is employed on a part-time basis pursuant to a bonafide vocational training program administered by his school. A bonafide vocational program is one authorized and approved by a State Board of Vocational Education or another recognized educational body. These programs <u>must</u> provide for part-time employment training supplemented by and integrated with a definitely organized plan of instruction designed to teach technical knowledge and related industrial information which is given as a regular part of the student-learner's course of study in the educational institution he attends. Such programs may be either retail and service occupations or in trade and industrial skills.

3. <u>Who May File?</u>

Whenever it is believed necessary in order to prevent curtailment of employment opportunities, application may be made for a certificate authorizing an employer to pay student-learners special minimum wages below the applicable statutory (or wage order) minimum wage under the Fair Labor Standards Act or below a minimum wage determination under the Walsh-Healey Public Contracts Act. A separate application on official forms furnished for the purpose must be filed by the employer for each such student-learner. Parts of this application are best completed by a school official, other parts by the employer. The appropriate school official, the employer, and the student-learner must sign the application. Before a certificate can be issued, the conditions specified in section 520.5 of the regulation must be met. (See section 4 on "Completing Student-Learner Certificates" for these conditions.)

4. <u>Where To File</u>

Applications must be made on official forms supplied by the Divisions. The original of the completed application must be filed with the regional offices of these Divisions serving your area. The regional office serving Mississippi is:

U.S. Department of Labor
W. H. P. C. Division
Birmingham, Alabama

A copy must be retained in the employer's files. Additional copies may be made available to school officials and to the student-learner.

The field office for Mississippi is located at Jackson, Mississippi.

5. When To File

Applications should be filed 15 to 30 days in advance of the date the student-learner begins his employment so that the Divisions can take action on the application before employment begins. Certificates Cannot Be Issued Retroactively.

When the student's employment opportunity might be lost by delay in obtaining a certificate, section 520.6 (c) (2) if the regulation establishes a procedure for a temporary authorization. A description of this procedure appears at the top of the face of the application.

6. Age and Proof of Age

Minors under 16 years of age are not eligible for student-learner certificates. Furthermore, in occupations declared to be hazardous by the Secretary of Labor, the student-learner must be at least 18 years of age. (Hazardous Occupations Nos. 5, 8, 10, 12, 14, 16, and 17, permit student-learner employment at 16 and 17 years of age under certain specified conditions.) For information concerning child-labor provisions of the Fair Labor Standards Act, see Child-Labor Bulletin No. 101.

For employment subject to the Walsh-Healey Public Contracts Act, male employees must be at least 16 years old and female employees must be at least 18 years old.

In addition to entering the student-learner's birthdate in item 3 of the application, the employer should obtain and keep on file an employment or age certificate showing the student-learner to be at least the minimum age for the occupation in which he is employed. In 45 states, the District of Columbia, and Puerto Rico, State employment and age certificates are accepted as proof of age under the child-labor Provisions of the Fair Labor Standards Act. (Such certificates also provide assurance that the employment is in compliance with the requirements of the state child-labor law.) In four states, Mississippi, Idaho, South Caroline, and Texas, where state age and employment certificates are not available, federal certificates of age may be obtained within the state from the Wage and Hour and Public Contracts Divisions. Special arrangements have been made in Guam and Alaska. For information concerning proof of age in these areas consult the nearest office of the Wage and Hour and Public Contracts Division.

7. Period of Employment Training At Special Minimum Wages.

A certificate may be issued only for that portion of employment training period for which special minimum wages below the minimum wages under the Fair Labor Standards Act or the Walsh-Healey Public Contracts Act are necessary. This period may not exceed the length of one school year unless a longer period is found to be justified by extraordinary circumstances which must be explained in detail at the time of the application. No certificate shall authorize employment training beyond the date of graduation of the student-learner.

Employment training at special minimum wage rates during the summer vacation period will not generally be authorized. However, in exceptional cases summer employment training may be authorized when it is an integral part of the vocational training program. Requests for summer vacation employment must be accompanied by a statement explaining the extraordinary circumstances justifying this employment, including the number of hours per week for which special minimum wages are requested.

In item 16 of the application, show only the number of weeks of employment during which special minimum wages will be paid. The beginning and ending dates of employment shown in items 8 and 9 should coincide with this period.

8. Hours of Work and School Instruction

The term "hours of school instruction" applies to all hours spent by the student-learner in actual classes of school instruction and does not include school hours spent in study hall, homeroom, and activity periods for which no academic credit is given.

The combined hours of school instruction and employment training authorised under a certificate may not exceed 40 hours a week unless justified by extraordinary circumstances. Such extraordinary circumstances must be explained in detail in a statement submitted with the application. Hours at special minimum wages in addition to those authorized on a certificate may be worked provided that the total hours worked do not exceed:

(a) 8 hours on any school day when school is not in session;

(b) 40 hours in any week during the school term when school is not in session for the entire week.

The employer shall note in his records the number of such additional hours and that they were worked because school was not in session. A Student-Learner May Not Be Employed In Any Week At Special Minimum Wage Rates For Hours In Addition To Those Authorized In The Paragraph Above.

In item 17 of the application, show only those hours of employment during a week for which you intend to pay wages below the wage determination minimum applicable under the Public Contracts Act.

9. Wage Rates

The hourly wage rate shall not be less than 75 percent of the applicable statutory minimum wage under the Fair Labor Standards Act. It is suggested that consideration be given to the payment of a progressive wage schedule, particularly if a full year of employment training at special minimum wages is requested. If a progressive wage schedule is proposed, the special minimum starting rate must not be less than 75 percent of the applicable statutory minimum. In item 18, show only those wages which are below the applicable minimum wage under the Fair Labor Standards Act. (This paragraph also applies to work subject to Public Contracts Act Wage Determinations.) See section 2 below.

APPENDIX C

STUDENT-LEARNER CERTIFICATES

1. Certificates

The original copy of the student-learner certificate will be mailed directly to the employer. Two copies will be mailed to the appropriate school official, one to be retained for his records and the other to be presented to the student-learner. Applications Which Do Not Contain All Requested Information May Be Returned For Completion Before Action Is Taken. Student-learner certificates can be issued with a minimum of delay where the application provides the details requested. For additional information or application forms, communicate with the regional office of these Divisions which serves your area.

2. Special Situations Under the Walsh-Healey Public Contracts Act

The general provisions of this act are explained in Appendix B, Standards and Provisions for Student-Learner Certificates. The general regulations under the Public Contracts Act permit the employment of Student-Learners at wages below prevailing minimum wage determinations made under this act in accordance with the same standards and procedures as are prescribed for their employment at wages below the minimum wage applicable under the Fair Labor Standards Act. The provisions of Regulations, part 520 and the instructions in this guide apply to student-learners employed in the performance of Government contracts subject to the Public Contracts Act.

An employer who holds or who obtains a student-learner certificate issued in order to prevent curtailment of opportunities for employment under the Fair Labor Standards Act may employ the named student-learner in the performance of a Government contract subject to the Public Contracts Act at the authorized special minimum wage and in accordance with the terms specified in that certificate.

An employer may not need a student-learner certificate in order to prevent the curtailment of employment opportunities under the Fair Labor Standards Act or his employees may not be subject to that act. In either case, an employer performing a Government contract subject to a minimum wage determination under the Public Contracts Act may, upon proper application be issued a certificate authorizing a special minimum wage rate not less than 75 percent of the minimum wage determination applicable to the contract being performed. Employment under such certificates is subject to the standards and procedures of Regulations, part 520.

3. Compliance

Certificates may not be issued if there are serious outstanding violations of a student-learner certificate previously issued to the employer or if there are serious violations of other provisions of the Fair Labor Standards Act by the employer which provide reasonable grounds to conclude that the terms of the certificate would not be complied with, if issued. Moreover, no certificate permitting a wage lower than the statutory minimum under the Fair Labor Standards Act or a Public Contracts Act minimum wage determination will excuse non-compliance with the child-labor, overtime, or other provisions of these acts or the regulations issued thereunder.

A certificate may be withdrawn if it is no longer necessary to prevent curtailment of opportunities for employment or if the employer fails to comply with the limitations in the certificate or otherwise violates the act.

4. Conditions Governing Issuance of Special Student-Learner Certificates

The following conditions must be satisfied before a special certificate may be issued authorizing the employment of a student-learner at subminimum wages:

(a) Any training program under which the student-learner will be employed must be a bonafide vocational training program;

(b) The employment of the student-learner at subminimum wages authorized by the special certificate must be necessary to prevent curtailment of opportunities for employment;

(c) The student-learner must be at least 16 years of age (or older as may be required pursuant to paragraph (d) of this subsection);

(d) The student-learner must be at least 18 years of age if he is to be employed in any activity prohibited by virtue of a hazardous occupation order of the Secretary of Labor, (See Hazardous Occupations.);

(e) The occupation for which the student-learner is receiving preparatory training must require a sufficient degree of skill to necessitate a substantial learning period;

(f) The training must not be for the purpose of acquiring manual dexterity and high production speed in repetitive operations;

(g) The employment of a student-learner must not have the effect of displacing a worker employed in the establishment;

(h) The employment of the student-learners at subminimum wages must not tend to impair of depress the wage rates of working standards established for experienced workers for work of a like or comparable character;

(i) The occupational needs of the community or industry warrant the training of student-learners;

(j) There are no serious outstanding violations of the provisions of a student-learner certificate previously issued to the employer, or serious violations of any other provisions of the Fair Labor Standards Act of 1938, as amended, by the employer which provide reasonable grounds to conclude that the terms of the certificate would not be complied with, if issued;

(k) The issuance of such a certificate would not tend to prevent the development of apprenticeship in accordance with the regulations applicable thereto or would not impair established apprenticeship standards in the occupation or industry involved;

(l) The number of student-learners to be employed in one establishment must not be more than a small proportion of its working force;

(m) The special minimum wage rate shall be not less than 75 per cent of the applicable minimum under section 6 of the Act;

(n) No special student-learner certificate may be issued retroactively.

5. Employment Records To Be Kept

In addition to any other records required under the record-keeping regulations, the employer shall keep the following records specifically relating to student-learners employed at subminimum wage rates:

(a) Any worker employed as a student-learner shall be identified as such on the pay roll records, with each student-learner's occupation and rate of pay being shown;

(b) The employer's copy of the application, which is serving as a temporary authorization must be available at all times for inspection for a period of 3 years from the last date of the employment of the student-learner;

(c) Notations should be made in the employer's records when additional hours are worked by reason of school not being in session.

6. Duration of Certificates

A special student-learner certificate may be issued for a period not to exceed the length of one school year unless a longer period is found to be justified by extraordinary circumstances. No certificate shall authorize employment training beyond the date of graduation.

Questions Pertaining To The Application For and Certification Of Student-Learners

Note: The reference in parenthesis refers to the section of Title 29 part 520 of the code of Federal Regulation--"Employment of Student-learners"

1. In the average situation, for what period of time is a student-learner certificate issued?

   Ans. - for one school year only. (Section 520.8.) This is an appropriate 36 week period, consisting of 15 to 25-hour work-weeks.

2. What rate of pay is applicable to the student learner's employment?

   Ans. - 75 percent of the applicable minimum wage, i.e., $1.25 per hour = - $.94 (Section 520.6 (b)).

3. Does the application for the certificate constitute a temporary certificate?

   Ans. - Yes, if the application is correctly filed. The temporary authorization becomes effective the date the application is postmarked. Section 520.6 (c) (2)

4. Can a student learner under 18 years of age work in some of the occupations declared as particularly hazardous for minors?

   Ans. - Yes. (Section 520.5 (d)). If a written agreement is on file as described in the Child Labor Bulletin No. 101, Page 9.

5. May student learners work in any of the Hazardous Occupations without the exemption being granted?

   Ans. - No. There is no provision for this.

6. Who does the Wage and Hour Division hold responsible for compliance with the Hazardous Occupations Orders and the terms of the certificate?

   Ans. - the employer.

7. When school is not in session, how many hours may a student work, under the provisions of a certificate?

   Ans. - When school is not in session, the student may work a number of hours in addition to the weekly hours granted by the certificate: provided, the total hours do not exceed 8 hours in any one day or 40 hours in any week. (Section 520.6 (d) and (3)).

8. How many copies of the application are necessary and who gets them?

   Ans. - Four copies are made. One is given to the student, one is given to the employer, one is given to the school, and the original is sent to the regional labor office.

9. How many hours may a student-learner work at his occupation?

Ans. - The number of hours at work plus the number of hours spent in class at school must not exceed 40 hours per week.

10. May a student-learner work under the provisions of a certificate during the summer months?

Ans. - Yes. For example: if a student learner begins his employment at the beginning of the spring semester (approximately January 1), his training may continue through the summer months, provided he has not graduated and provided the summer work is under the auspices of the teacher-coordinator.

11. May a student-learner ride as a passenger in a vehicle getting from job site to job site?

Ans. - Yes. If the student is not primarily engaged in loading or unloading the vehicle or as a driver or driver's helper, he may ride the vehicle.

12. Is a student-learner under 18 subject to the Hazardous Occupations Orders, whether or not the employer is paying the minimum wage?

Ans. - Yes--and if a student-learner is to be employed in a hazardous occupation that carries an exemption (i.e. Hazardous Occupations Orders No. 5, 8, 10, 12, 14, 16, and 17,) there must be a written agreement on file as described in "II" under the heading "Student-Learner" of the Child Labor Bulletin No. 101 pp. 7-8.

APPLICATION FOR A CERTIFICATE TO EMPLOY A STUDENT-LEARNER

The certification of the appropriate school official on the reverse side of this application shall constitute a temporary authorization for the employment of the named student-learner at less than the statutory minimum wage applicable under Hazardous Occupations Orders of the Fair Labor Standards Act of 1938, as amended, or at wages below the applicable Walsh-Healey Public Contracts Act minimum wage determination, effective from the date this application is forwarded to the Divisions until a student-learner certificate is issued or denied by the Administrator or his authorized representative, provided the conditions specified in Section 520.6 (c) (2) of the Student-Learner Regulation (29 CFR 520) are satisfied.

PLEASE READ CAREFULLY THE INSTRUCTIONS FOR COMPLETING THIS FORM

PRINT OR TYPE ALL ANSWERS

1. Name and address of establishment making application:
3. Name and address of Student-Learner:

Date of Birth:

2. Type of business and products manufactured, sold, or services rendered:
4. Name and address of school in which student-learner is enrolled:

INFORMATION ON SCHOOL INSTRUCTION

5. Number of weeks in school year
6. Total hrs. of school instruction per week
7. Number of hours directly related to employment training
8. Proposed beginning date of employment
9. Proposed ending date of employment
10. Proposed graduation date of student-learner
11. Are Smith-Hughes Act or George-Barden Act funds used for this program? (yes or no)
12. Was this program authorized by the State Board of Voc. Ed.?
13. If the answer to item 12 is "No" give the name of the recognized local educational body which has approved this vocational training program:
14. Outline the school instruction directly related to the employment training. (List courses, etc.)

FORM WH-205 (10/63) ATTACH SEPARATE PAGES IF NECESSARY

Information on employment training at special minimum wages:

15. How is employment training scheduled (weekly, alternate weeks, etc.)?

16. Number of weeks of employment training at special minimum wage

17. Number of hours of employment training a week

18. Special minimum wage(s) to be paid student-learner (if a progressive wage scale is proposed, enter each rate and specify the periods during which it will be paid):

19. Title of Student-learner occupation:

20. Number of employees in this establishment

21. Number of experienced employees in student-learner's occupation shown in question 19

22. Minimum hourly wage rate of experienced workers in 21

23. Is an age or employment certificate on file in this establishment for this student-learner? (If not, see instructions)

24. Is it anticipated that the student-learner will be employed in the performance of a Government contract subject to the Walsh-Healey Public Contracts Act?

25. Outline training on-the-job (describe briefly the work process in which the student-learner will be trained and list the types of any machine used).

26. Signature of student-learner:
I have read the statements made above and ask that the requested certificate authorizing my employment training at special minimum wages and under the conditions stated, be granted by the Administrator or his authorized represe tative

(Signature of Student) (Date)

27. Certification by school official:
I certify that the student named herein will be receiving instruction at an accredited school and will be employed pursuant to a bona fide vocational training program, as defined in section 520.2 of Student-Learner Regulations.

(Signature of School Official)Date
Title

28. Certification by employer or authorized representative:
I certify, in applying for this special certificate, that all the foregoing statements are, to the best of my knowledge and belief, true and correct.

(Signature of Employer or Rep.)Date
Title

APPENDIX D

________________________High School
Vocational Agriculture Department

CHECK SHEET FOR SELECTING TRAINING STATIONS

Establishment____________________________ Address______________________________

Date____________________________________ Phone No._____________________________

FACTORS	Poor	Fair	Good	Very Good	Outstanding
Type of occupation					
Opportunities for rotation					
On-the-job supervision					
Working conditions					
Reputation					
Business climate					
Hours of employment					
Facilities and equipment					
Employer-employee relationships					
Accessibility					
Wages					

Remarks: ____

Overall Rating: Outstanding____________ Very Good____________ Good____________

Fair____________ Poor____________

(Note: Copies of this sheet may be obtained from the Ag. Ed. Dept., Box 1419, State College, Mississippi on request. Also all other forms shown in the Appendix may be ordered from the same source.)

APPENDIX E

_______________High School
Vocational Agriculture Department

COOPERATING EMPLOYER APPRAISAL

Name________________________________ Date__________________

Criteria	Rating			
1. Interested in helping students	4	3	2	1
2. Successful in agri-business	4	3	2	1
3. Able to get along with students	4	3	2	1
4. Willing to cooperate with school	4	3	2	1
5. Uses proper English	4	3	2	1
6. Of good character	4	3	2	1
7. Emotionally stable	4	3	2	1
8. Able to explain ideas and concepts to students	4	3	2	1
9. Familiar with vocational agriculture	4	3	2	1
10. Familiar with the off-farm agricultural occupational experience program	4	3	2	1
11. A member of agricultural, civic, or community organizations	4	3	2	1
12. Motivated by high ideals	4	3	2	1
13. Eager and hard-working	4	3	2	1
14. Patient	4	3	2	1
15. Tactful	4	3	2	1
16. Open-minded	4	3	2	1
17. Willing to take time to work with students	4	3	2	1
OVER-ALL RATING	4	3	2	1

4 - Outstanding	2 - Fair
3 - Good	1 - Poor

APPENDIX F

APPLICATION FOR ENROLLMENT IN VOCATIONAL AGRICULTURE OCCUPATIONS TRAINING

Name______________________ Parents or Guardian's Name______________________

Address______________________ Phone No.______________

Age______ Sex______ Height______ Social Security Number______________

Location from School______________________

Grade in School______ Do you plan to go to college? Yes______ No______

List the high school credits you have earned in Math______ English______ Social Science______ Science______ Agriculture______ Commercial______ Other______

Parents' Occupation - Father ______________ Mother______________

What hobbies do you enjoy______________________

List the Clubs and Organizations to which you belong______________________

____

Do you wear glasses? Yes______ No______. Will you have transportation to work? Yes______ No______. Do you have any physical handicaps? Yes______ No ______. If the answer is "Yes," please explain______________________

List the name of employer and previous jobs you have held and the length of time spent on the job.

Name of Employer	Job	Number of Months

In what occupations do you prefer to receive training? First Preference______ ______________ Second Preference______________

What types of work do you dislike? ______________________

Will you be available for work: after school?______ on Saturdays?______ During summer months? ______

What subjects do you need to graduate from high school?______________________

____

(Have your parents complete the following)

______________________ Has my permission to participate in the agricultural occupations program. Signed by Parent or Guardian______________

APPENDIX G

____________________High School
Vocational Agriculture Department

TEACHER'S RATING OF STUDENTS INTERESTED IN AGRICULTURAL OCCUPATIONS

Date______________

Student's Name__________________________ Course__________________________

Please rate the student on the following traits:

	Excellent	Good	Fair	Poor
Character				
Loyalty				
Initiative				
Attitude				
Resourcefulness				
Dependability				
Personality				
Achievement in your course				

Do you feel this student is qualified to represent our school on a job?
Yes_____ No_____

List any outstanding abilities or talents this student possesses.______________

For what vocation do you feel this student is best suited? ______________

Does this student take orders and criticism well? Yes_____ No_____

Which does this student prefer: Mental activities_____ Physical activities___

Other remarks:______________________________________

____
Teacher

APPENDIX H

STUDENT INFORMATION FOR AGRICULTURAL OCCUPATIONS TRAINING
(To be completed by teacher of Vo-Ag and kept in permanent record file)

Date__________

Name__________ Parent's Name__________

Age_____ Sex_____ Height_____ Weight_____ Social Security No.__________

Grade in school__________ Parent's occupation - Father_____ Mother_____

Location from school_____ Plan to go to college? Yes_____ No_____

Credits earned - Math_____ English_____ Social Science_____ Science_____
Ag_____ Commercial_____ Other__________

Hobbies__________ Grade Average__________

Days absent last year__________ Transportation to work - Yes_____ No_____

Clubs and Organizations__________

Physical handicaps__________ Glasses?__________

Previous work experience and Name of Employer	Job	Months

Student Interests__________

Student Dislikes__________

Occupations Objective__________

I. Q. Tests (List each)__________

Other tests	Test	Results

Parents approve of participation in Agricultural Occupations program? Yes__ No__

Availability for work after school_____ Saturdays_____ Summer_____

Subjects needed to graduate__________

Miscellaneous information__________

APPENDIX I

________________ High School
Vocational Agriculture Department

APPLICATION FOR EMPLOYMENT*

Trainee Practice Form
Vocational Agriculture Occupations Training Program

PERSONAL INFORMATION

Name____
(Last) (First) (Middle)

Address________________________________ Telephone__________
(Street) (City) (State)

Social Security Number______________ Date of Birth______________

Height__________ Weight__________ List physical handicaps if any:______

Have you ever been seriously injured on a job?________ Explain__________

Did you receive compensation for the injury?____________________

Have you ever been convicted in a court of law for any violation other than traffic?______ If so, explain?____________________

EDUCATIONAL BACKGROUND

Public School Attended: Name of School________ City________ State________

1 - 2 - 3 - 4 - 5 - 6 - 7 - 8 - 9 - 10 - 11 - 12
(Circle number indicating highest grade completed.)

Leadership Activities:____________________

SPECIAL SKILLS YOU POSSESS

List your fields of training____________________

Machines you can operate____________________

---

*Adapted from the 1965 Workshop Report of the Agricultural Occupation Institute held at Oklahoma State University.

Continued from preceding page

OCCUPATIONAL EXPERIENCE

(Start with your last position and work to the first)

1. ______________________________

Exact title of position Name and address of employer

____

Reason for leaving

____

Dates of Employment From: To:

2. ______________________________

Exact title of position Name and address of employer

____

Reason for leaving

____

Dates of Employment From: To:

3. ______________________________

Exact title of position Name and address of employer

____

Reason for leaving

____

Dates of Employment From: To:

REFERENCES

(Name)	(Title)	(Business)	(Address)

Employer's comment ______________________________

____

____

APPENDIX J

_________________ High School
Vocational Agriculture Department

(Sample Personal Data Sheet)

John Jones
Box 100
Farmville, U.S.A.

Personal Information

Age: 17
Height: 5'9"
Weight: 160
Health: Excellent
Telephone: 262-9038

Job Objective

I wish to secure a position in retail selling of agricultural products. My first preference is farm machinery and equipment sales. My second preference is in the area of agricultural chemical sales.

> Note: State the kind of position you desire or the specific interests you have. Clearness of objective and clarity of expression are both important. State your interest fully but be as brief as possible.

Education

High School: Senior at Farmville High School
Major: Vocational Agriculture
Technical Skill: Three years vocational agriculture, with specific instruction in repair and adjustment of farm equipment and machinery, farm welding, public speaking, parliamentary procedure, animal science, and crop science.
Leadership Activities: Secretary of FFA, Treasurer of Sophomore Class, member of Student Council.

Work Experience

Farmville Tractor & Equipment, Main Street, Farmville
Worked in the parts department during summer of 1965.
Jones Farm, Box 100, Farmville.
Worked as a general farm worker on my father's farm after school and during the summers from 1960 to 1964.

> Note: Briefly list all the jobs or positions you have held giving the employer's name, address, title of job, and length of service. Begin with your most recent job first.

Continued from preceding page

References

Mr. Neal Groves, Manager, Farmville Tractor & Equipment Co., Main Street, Farmville.
Mr. Gilbert Andrews, vocational agriculture instructor, Farmville High School, Farmville.
Mr. Claude Rolloff, Box 101, Farmville.

Note: Obtain permission to use names. The following is acceptable if references are not listed: "Appropriate business and personal references will be furnished upon request."

APPENDIX K

AGRICULTURAL OCCUPATIONS OTHER THAN FARMING AND RANCHING

To give an idea of how broad the field of related agricultural occupations is, we give a partial list of agricultural occupations other than farming and ranching, classified by agricultural occupation families.

I. FARM MACHINERY SALES AND SERVICE OCCUPATIONS.

100 Blacksmith, welder, and general repairman
101 Custom farm machine operator
102 Farm machinery mechanic's helper
103 Farm machinery mechanics
104 Farm machinery service center foreman
105 Farm machinery parts helper or clerk
106 Farm machinery parts manager
107 Farm machinery salesman
108 Farm machinery fieldman
109 Farm tire service operator
110 Manager
111 Assistant manager
112 Office worker
150 Other

II. FARM SUPPLIES AND EQUIPMENT OCCUPATIONS

200 Country store clerk
201 Farm hardware and equipment store employee
202 Farm hardware and equipment store manager
203 Farm hardware and equipment store assistant manager
204 Farm hardware and equipment store office worker (bookkeeper, clerk)
205 Farm equipment fieldman
206 Farm equipment servicemen
207 Feed salesman
208 Feed mill employee
209 Farm cooperative service store employee
210 Farm equipment and supplies salesman
211 Truck driver for a feed mill or farmer cooperative
212 Truck driver for a rural gasoline and oil distributor
213 Truck driver for spreading bulk fertilizer
250 Other

III. LIVESTOCK AND POULTRY INDUSTRIES OCCUPATIONS

a. Dairying, dairy manufacturing and processing

300 Dairy herd supervisor
301 Dairy plant employee
302 Dairy plant manager
303 DHIA tester
304 Milk sanitarian
305 Milk truck driver
306 Other

b. Livestock Marketing and Processing

320 Butcher
321 Meat department manager
322 Livestock auction employee
323 Livestock auctioners
324 Livestock auction manager
325 Livestock buyer
326 Livestock dealer
327 Livestock truck driver
328 Slaughter house or locker plant manager
329 Slaughter house or locker plant employee
330 Stockyard employee
331 Other

c. Poultry Industry Occupations

340 Egg grader
341 Egg inspector
342 Hatchery employee
343 Hatchery manager
384 Poultry and egg buyer
345 Poultry debeaker
346 Poultry processing plant manager
347 Poultry processing plant assistant manager
348 Poultry sexer
349 Other

d. Livestock Industry Occupations
(Not elsewhere classified)

360 Animal industry laboratory technician
361 Animal industry laboratory assistant
362 Animal industry laboratory veterinarian
363 Apiary inspector
364 Livestock disease control worker
365 Veterinarian
366 Veterinarian's assistant
367 Other

IV. CROPS, FORESTRY, AND SOIL CONSERVATION OCCUPATIONS

400	Cannery or processing plant employee
401	Cannery or processing plant fieldman
402	Field crop, fruit and vegetable inspection employee
403	Forester
404	Fruit and vegetable produce buyer
405	Fruit and vegetable employee
406	Fruit and vegetable manager
407	Grain elevator employee
408	Grain elevator manager
409	Irrigation ditch rider
410	Lumberman or sawmill employee
411	Sawmill employee
412	Sawmill foreman
413	Manager
414	Soil conservationist
415	Soil conservationist aid
416	Soil conservation technician
417	State or national forest employee
418	Woodsman
419	Other

V. ORNAMENTAL HORTICULTURE OCCUPATIONS

501	City, state or national park employee
502	Florist or flower grower
503	Garden center employee
504	Garden center manager
505	Greenhouse employee
506	Greenhouse manager
507	Golf course superintendent
508	Golf course employee
509	Ground maintenance employee
510	Landscape architect
511	Landscape gardner
512	Nursery employee
513	Nursery manager
514	Tree pruner
515	Tree surgeon
516	Other

VI. WILDLIFE AND RECREATION OCCUPATIONS

601	Fish warden
602	Game bird propagator
603	Game management employee
604	Other

VII. FARM SERVICE OCCUPATIONS

701	Artificial inseminator
702	Country butchers
703	Crop duster
704	Crop pollinator
705	Crop sprayer
706	Custom farm machine worker
707	Farm appraiser
708	Farm building painter
709	Farm building renovator
710	Feed and hammer mill
711	Field supervisor (A.S.C.)
712	Fruit caretaker
713	Fruit sprayer
714	Lime spreader
715	Mobile blacksmith shop operator
716	Mobile repair shop operator
717	Rural insurance representative
718	Rural real estate representative
719	Sheep dipper
720	Sheep shearer
721	Other

VIII. AGRICULTURAL SERVICE OCCUPATIONS

801	Farm auctioneer
802	A.S.C. field superintendent
803	A.S.C. office manager
804	A.S.C. checker
805	Farm placement representative
806	Farm advisory work, consultant
807	Field representative for agricultural marketing business
808	Ag advertising
809	Ag newspaper and magazine work
810	Farm appraiser
811	Farm organization staff person
812	Agricultural economist
813	Agricultural engineer
814	Agricultural journalist
815	Agronomist
816	Agricultural college instructor
817	Entomologist
818	Extension work-county agent
819	Pathologist (plant)
820	Rural sociologist
821	Soil conservationist
822	Vocational agriculture instructor
850	Other

VT001 543

VT 001 543

Study of Selected Curricula in Technical Education in Public Junior Colleges.

Guemple, John R.

Texas Education Agency, Austin. Vocational Education Div.

Pub Date - Sep64

MF AVAILABLE IN VT-ERIC SET 22p.

*CURRICULUM, *TECHNICAL EDUCATION, *JUNIOR COLLEGES,

Junior college courses, with hours per week and credit hours are listed for the following technologies--(1) air conditioning, refrigeration, and heating, (2) automotive, (3) chemical, (4) civil, (5) construction, (6) data processing, (7) drafting, (8) electrical, (9) electronic, (10) highway construction, (11) industrial, (12) industrial instrument, (13) law enforcement, (14) mechanical, (15) medical laboratory assistant, (16) medical x-ray, (17) metallurgical, (18) registered nurse, and (19) television production. The core curriculum common to most technical programs is included. The curriculums are representative of what junior colleges are doing in this field in various parts of the United States. (PS)

VOCATIONAL EDUCATION DIVISION
TEXAS EDUCATION AGENCY
Austin, Texas

Study of Selected Curricula
in
Technical Education
in
Public Junior Colleges

This study is intended as a suggestive guide in formulating plans for Junior College curriculum development. It is representative of what other Junior Colleges are doing in this field in various parts of the United States.

Core Curriculum

These courses represent training needs common to most technical programs.

Non-Technical	credit hours	
English Grammer	3	
English Composition	3	
Communication Skills	3	
Technical Report Writing	3	
Industrial Psychology, Sociology or Introduction To Business Management	3	15
Basic Science		
Technical Mathematics	6	
General Physics (mechanics, electricity, heat, light and sound)	6	12
Other Requirements		
Orientation	1	
Physical Education	4	5
Additional Texas Associate Degree Requirements		
History	6	
Government	6	12
TOTAL		44

Air Conditioning, Refrigeration & Heating

Technology

	Hours Per Week Lect.	Hours Per Week Lab.	Credit Hrs.
Refrigeration Theory & Lab	2	3	3
Industrial Refrigeration	3	3	4
Air Conditioning	3	3	4
Air Conditioning Systems	3	0	3
Heating & Comfort Air Conditioning	2	3	3
Air Conditioning Controls	2	3	3
Air Conditioning Problems & Design	3	3	4
Fundamentals of Drafting	0	6	2
Pipe Drafting	0	6	2
Architectural Drafting	0	6	2
D. C. Electricity	2	3	3
A. C. Electricity	2	3	3
TOTALS	22	42	36

Automotive Technology

	Hours Per Week Lect.	 Lab.	Credit Hrs.
Fundamentals of Drafting	0	6	3
Internal Combustion Engines	2	3	3
Automotive Electricity	2	3	3
Carburetion & Fuel Systems	2	3	3
Automotive Ignition Systems	2	3	3
Automotive Transmissions	2	3	3
Engine Testing	0	6	3
Automobile & Truck Chassis	2	3	3
Welding	1	4	3
Machine Shop Operations	0	6	3
Automotive Servicing	0	12	6
TOTALS	13	52	36

Chemical Technology

	Hours Per Week Lect.	Lab.	Credit Hrs.
Fundamentals of Drafting	0	6	2
General Chemistry I	3	3	4
General Chemistry II	3	3	4
Quantitative Analysis	3	3	4
Qualitative Analysis	3	3	4
Physical Chemistry	3	3	4
Instrumental Analysis	3	3	4
Differential Calculus (or Math Elective)	3	0	3
Integral Calculus (or Elective)	3	0	3
Unit Operations	0	9	3
TOTALS	24	33	35

Civil Technology

	Hours Per Week Lect.	 Lab.	Credit Hrs.
Fundamentals of Drafting	0	6	2
Architectural Drafting	0	6	2
Surveying	2	3	3
Strength of Materials	3	0	3
Materials Testing	0	6	2
Hydraulics	1	4	3
Water & Sewer Systems	1	4	3
Concrete Construction	3	0	3
Steel Construction	3	0	3
Heavy Construction	2	3	3
Photogrammetry	2	3	3
Differential Calculus (or Math Elective)	3	0	3
Integral Calculus (or Elective)	3	0	3
TOTALS	23	35	36

Construction Technology

	Hours Per Week Lect.	Hours Per Week Lab.	Credit Hrs.
Fundamentals of Drafting	0	6	2
Architectural Drafting	0	6	2
Structural Drafting	0	6	2
Surveying	2	3	3
Strength of Materials	3	0	3
Construction Methods	3	0	3
Concrete Design	1	4	3
Building Materials Laboratory	0	6	2
Contracts & Specifications	1	4	2
Codes & Practices	3	0	3
Job Management	3	0	3
Building Design	1	4	3
Industrial & Labor Relations	3	0	3
TOTALS	20	39	34

Data Processing Technology

	Hours Per Week Lect.	Lab.	Credit Hrs.
Economics	3	0	3
Statistics	2	3	3
Introduction to Business Organization	3	0	3
Principles of Accounting	3	0	3
Introduction to Data Processing	3	0	3
Unit Record Equipment Operation	3	3	4
Unit Record Equipment Programming	3	3	4
Introduction to Computer Programming	3	3	4
Computer Programming Systems	3	3	4
Accounting Systems & Data Processing	3	3	4
Field Project (or Seminar)	2	3	3
TOTALS	31	18	36

Drafting Technology

	Hours Per Week Lect.	Lab.	Credit Hrs.
Descriptive Geometry	2	3	3
Fundamentals of Drafting	0	6	2
Architectural Drafting	0	6	2
Machine Drafting	0	6	2
Topographic Drafting	0	6	2
Surveying	2	3	3
Machine Shop Operations	2	3	3
Construction Drafting	0	6	2
Pipe (or Steel) Drafting	0	6	2
Machine Tool Drafting	0	6	2
Photogrammetry	2	3	3
Building Codes	3	0	3
TOTALS	11	54	29

Electrical Technology

	Hours Per Week Lect.	 Lab.	Credit Hrs.
Fundamentals of Drafting	0	6	2
Electrical Drafting	0	6	2
Architectural Drafting	0	6	2
Electrical Circuits	2	3	3
Network Analysis	2	3	3
Machine Shop Operations	2	3	3
D. C. Electricity	3	3	4
A. C. Electricity	3	3	4
Vacuum Tubes & Transistors	3	3	4
A. C. Machinery	3	3	4
D. C. Machinery	3	3	4
Electrical Control Systems	3	0	3
TOTALS	24	42	38

Electronics Technology

	Hours Per Week Lect.	Lab.	Credit Hrs.
Fundamentals of Drafting	0	6	2
Fundamentals of Electronics	3	0	3
D. C. Electricity	3	3	4
A. C. Electricity	3	3	4
Vacuum Tubes & Transistors	3	3	4
Pulse Techniques	3	3	4
Electronic Circuits (or Industrial Electronics)	3	3	4
Transmitters & Antennas	2	3	3
Electronic Measurements	2	3	3
Amplifier	2	3	3
Microwave Techniques	2	3	3
TOTALS	26	33	37

Highway Construction Technology

	Hours Per Week Lect.	Lab.	Credit Hrs.
Surveying Law	3	0	3
Fundamentals of Drafting	0	6	2
Topographic Drafting	0	6	2
Surveying (Plane)	2	3	3
Surveying (Route)	2	3	3
Surveying (Highway)	2	3	3
Concrete Construction	2	3	3
Asphalt Paving	1	3	2
Highway Organization & Planning	3	0	3
Contracts & Specifications	3	0	3
Materials Testing	0	6	2
Physical Geology	3	3	4
Photogrammetry	2	3	3
Soil Mechanics	3	0	3
TOTALS	26	39	39

Industrial Technology

	Hours Per Week		
	Lect.	Lab.	Credit Hrs.
Industrial & Labor Relations	3	0	3
Fundamentals of Drafting	0	6	2
Machine Drafting	0	6	2
Industrial Processes	3	0	3
Production Control	3	3	4
Quality Control	3	3	4
Strength of Materials	3	0	3
Plant Organization	3	0	3
Cost Control & Accounting	4	0	4
Machine Shop Operations	2	3	3
Business Law	3	0	3
TOTALS	27	21	34

Industrial Instrument Technology

	Hours Per Week Lect.	Hours Per Week Lab.	Credit Hrs.
Fundamentals of Drafting	0	6	2
Electrical (or Pipe) Drafting	0	6	2
Principles of Instrumentation	2	3	3
D. C. Electricity	3	3	4
A. C. Electricity	3	3	4
Vacuum Tubes & Transistors	3	3	4
Industrial Instruments	2	3	3
Process Control Instruments	2	3	3
Quality Control Instruments	2	3	3
Advanced Process Control Instruments	2	3	3
Quality Control Instrumentation	2	3	3
TOTALS	21	39	34

Law Enforcement Technology

	Hours Per Week Lect.	Lab.	Credit Hrs.
General Chemistry	4	6	6
Introduction to Criminology	3	0	3
Photography	2	3	3
Traffic Control & Investigation	2	3	3
Crime Causation, Prevention, and Correction (Field Trip)	3	3	4
Criminal Law, Procedure and Evidence	3	0	3
Investigation, Personal & Criminal	3	0	3
Arrest, Search and Seizure	3	0	3
Physical Evidence	3	0	3
Police Procedure	2	3	3
Police Administration & Planning	3	0	3
TOTALS	31	18	37

Mechanical Technology

	Hours Per Week Lect.	Lab.	Credit Hrs.
Fundamentals of Drafting	0	6	2
Machine Drafting	0	6	2
Machine Shop Operations	2	3	3
Machine Design	2	3	3
Machine Tools	2	3	3
Manufacturing Processes	3	0	3
Industrial Processes	3	0	3
Fluid Mechanics	3	0	3
Industrial Electricity	3	3	4
Fundamentals of Instrumentation	2	3	3
Mechanical Equipment	2	3	3
Precision Measurement	2	3	3
TOTALS	24	33	35

Medical Laboratory Assistant Technology*

	Hours Per Week Lect.	 Lab.	Credit Hrs.
Biology I	3	3	4
Biology II	3	3	4
Anatomy & Physiology	3	3	4
Chemistry I	3	3	4
Chemistry II	3	3	4
Quantitative Analysis	3	3	4
Qualitative Analysis	3	3	4
Instrumental Analysis	3	3	4
Biochemistry	2	3	3
Pharmacology	2	3	3
Hematology	2	3	3
Clinical Pathology	1	6	3
Blood Banking & Grouping	2	3	3
Bacteriology & Immunology	2	3	3
Bacteriology & Serology	2	3	3
TOTALS	37	48	53

* This program requires two calender years.

Medical X-Ray Technology

	Hours Per Week Lect.	 Lab.	Credit Hrs.
General Chemistry	4	6	6
Modern Physics (radioisotopes and radiation detection devices)	3	3	4
Anatomy and Physiology	3	0	3
Radiography Practice	2	3	3
Radiographic Chemistry	3	3	4
Appendicular Skeleton Radiography	2	3	3
Radiographic Physics	3	0	3
Procedures	0	6	3
Radiation Physics	3	0	3
Film Critique	2	3	3
Axial Skeleton Radiography	3	0	3
Practice	0	9	3
Skull & Sinus Radiography	2	3	3
Externship (4 terms hospital experience to qualify for examination by national registering board)			0
TOTALS	30	39	44

Metallurgical Technology

	Hours Per Week Lect.	Lab.	Credit Hrs.
Fundamentals of Drafting	0	6	2
Materials	3	0	3
Materials Processing	1	6	3
Physical Metallurgy	2	3	3
Welding Metallurgy	1	6	3
Heat Treating of Ferrous Steel	2	3	3
Foundry Metallurgy	2	3	3
Non-Ferrous Metallurgy	2	3	3
Extraactive Metallurgy	2	3	3
Spectroscopy	2	3	3
Industrial Organization	3	0	3
TOTALS	20	36	32

Registered Nurse Technology

	Hours Per Week		
	Lect.	Lab.	Credit Hrs.
Biology	3	3	4
Anatomy & Physiology	3	3	4
General Chemistry I	3	3	4
General Chemistry II	3	3	4
Fundamentals of Nursing	4	3	5
Introduction to Medical-Surgical Nursing	3	3	4
Medical Surgical Nursing	(Experience)		22
Maternal & Child Care	(Experience)		9
Psychiatric Nursing	(Experience)		5
Nursing Seminar	2	0	2
TOTALS (plus experience)	21	18	63

Television Production Technology

	Hours Per Week		
	Lect.	Lab.	Credit Hrs.
D. C. Electricity	3	3	4
A. C. Electricity	3	3	4
Vacuum Tubes & Transistors	3	3	4
Introduction to Mass Communications	3	0	3
Audio Operations	3	3	4
Studio Operations	3	3	4
Vidio Operations I	1	6	3
Vidio Operations II	1	6	3
Directing & Production I	1	6	3
Directing & Production II	1	6	3
Continuity Writing For Television	3	0	3
TOTALS	25	39	38

VT001 627

VT 001 627
Auto Mechanics Group Instruction, Instructor's Guide for Use with a Course of Study for Students in Auto Mechanics.

Baugrud, Kim
Missouri Univ., Columbia. Dept. of Industrial Education
Missouri State Dep of Educ, Jefferson City. Ind Educ Sect
Pub Date - Oct66
MF AVAILABLE IN VT-ERIC SET 34p.

*TEACHING GUIDES, *TRADE AND INDUSTRIAL EDUCATION, *AUTO MECHANICS (OCCUPATION), *MOTOR VEHICLES, HIGH SCHOOLS, GROUP INSTRUCTION, *COOPERATIVE EDUCATION,

This instructor's guide provides an organized group instructional procedure for teacher use in high school or post-high school cooperative education programs in auto mechanics. It was developed by a statewide development committee and research assistants, designed by subject matter specialists and teacher educators, and field tested. It provides resource material to supplement class discussion topics in the student manual (VT 001 628). The assignment sheet keys provide answers to student assignment sheets, suggested supplementary assignments, and visual aids, and other resources. The material is to be used by the instructor in a 1-year program, and, since it is intended as a basic guide, should be adapted to the individual instructor's needs. The instructor should be a competent vocational teacher, and the students should be juniors in high school with proper prerequisites. The document is mimeographed. Lists of automotive instructional aids and specification manuals are included. This document is available for $1.50 from Industrial Education, 103 Industrial Education Building, University of Missouri, Columbia, Missouri 65201. (HC)

AUTO MECHANICS GROUP INSTRUCTION

Instructor's Guide

For Use with
A Course of Study for Students in
Auto Mechanics

Issued by
Department of Industrial Education
College of Education
University of Missouri
Columbia, Missouri

In Cooperation With
Industrial Education Section
State Department of Education
Jefferson City, Missouri

STUDY GUIDES FROM MISSOURI CURRICULUM MATERIALS LABORATORY

GENERAL

General Related Study Guide -- Student's Manual

General Related Study Guide -- Coordinator's Manual

STUDY GUIDES AND KEYS FOR SPECIFIC OCCUPATIONS

Auto Body Repair
Auto Mechanics
Cabinetmaking
Carpentry
Chef

Cleaning and Pressing
Dental Assistant
Dental Laboratory Technology
Electrical Appliance Servicing
Electrical Construction (Interior Wiring)

Floristry
Food Service
Food Service Supervisor (Institutional)
Frozen Food Locker Plant Operation
Furniture Retailing

General Mechanics
Grocery Store, Retail
Hardware Retailing
Hatchery Management
Hotel Management

Jewelry Making and Repair
Machine Shop
Management Group Instruction
Management Individual Study
Marketing Group Instruction

Marketing Individual Study
Meat Cutting
Medical Assistant
Medical Record Technology
Merchandising Group Instruction

Merchandising Individual Study
Offset Lithography
Painting and Decorating
Pre-Nursing
Printing

Projectionist, Motion Picture
Radio and TV Servicing
Salesmanship Group Instruction
Salesmanship Individual Study
Sheet Metal

Shoe Retailing
Tile Setting
Upholstery
Variety Store Merchandising
Building Trades

Drafting & Design Technology
(Course Outline)
Design Drafting
Materials Testing (Course
Outline for Instructor's Use)

Write for a price list of these and new courses of study prepared since this publication.

AVAILABLE THROUGH

Department of Industrial Education
University of Missouri
Columbia, Missouri

MEMORANDUM

TO: The ERIC Clearinghouse on Vocational and Technical Education
The Ohio State University
980 Kinnear Road
Columbus, Ohio 43212

FROM: (Person) James B. Karnes (Agency) Univ. of Mo. at Columbia

(Address) 103 Industrial Education Building, Columbia, Mo.

DATE: October 19, 1967

RE: (Author, Title, Publisher, Date) Indus. Ed. Dept., Univ. of Mo. at Columbi

AUTO MECHANICS GROUP INSTRUCTION, cooperatively with Indus. Educ.

Dept. (U. of Mo. at Columbia) and Mo. State Dept. of Ed. (1966)

Supplementary Information on Instructional Material

Provide information below which is not included in the publication. Mark N/A in each blank for which information is not available or not applicable. Mark P when information is included in the publication. See reverse side for further instructions.

(1) Source of Available Copies:
Agency Industrial Education Dept., Univ. of Mo. At Columbia
Address 103 Industrial Education Building
Limitation on Available Copies quantity Price/Unit $1.50
(quantity prices) same
instructor's guide $1.50

(2) Means Used to Develop Material:
Development Group Development Committee and Research Assistants
Level of Group State
Method of Design, Testing, and Trial Subject matter specialist and teacher educators. Field tested.

(3) Utilization of Material:
Appropriate School Setting High School, post high school, area vocationa
Type of Program preparatory vocational industrial education progran
Occupational Focus job cluster covering various phases of auto mechanic
Geographic Adaptability United States
Uses of Material Study guide for related instruction on a group basis
Users of Material student guiding class discussio

(4) Requirements for Using Material:
Teacher Competency competent vocational instructor
Student Selection Criteria junior in high school with proper prerequisites
Time Allotment 180 days

Supplemental Media --
Necessary x
Desirable x (Check Which)

Describe P

Source (agency) (see attached list)
(address)

REFERENCES FOR AUTO MECHANICS

A. Crouse, William H., Automotive Mechanics, Fifth Edition, Webster Division, McGraw-Hill Book Company, Inc., 1154 Reco Avenue, St. Louis, Missouri, 63126, 1965, $6.84* (21)**

B. Stockel, Martin W., Auto Mechanics Fundamentals, The Goodheart-Willcox Company, Inc., 18250 Harwood Avenue, Homewood, Illinois, 60430, 1963, $6.96* (18)**

C. General Motors Corporation, ABC's of Hand Tools, General Motors Corporation, Detroit, Michigan, 1945, Free. (1)**

D. Occupational Outlook Handbook, U. S. Department of Labor, Sold by Superintendent of Documents, U. S. Government Printing office, Washington 25, D. C. (1)**

E. (Obtain from School Guidance Department)
   1. SRA -- Occupational Brief, #610e Automotive Mechanic
   2. Chronicle - Occupational Brief, #5-81.01 Automobile Mechanic (1)**

SUPPLEMENTARY REFERENCE

Toboldt, William K., and Purvis, Jud, Motor Service's Automotive Encyclopedia, The Goodheart-Willcox, Company, Inc., 18250 Harwood Avenue, Homewood, Illinois, 60430, 1964, $6.71*

* Subject to educational discount.
**Frequency of use in assignments.

FOREWORD

This instructor's guide has been prepared for the convenience of the auto mechanics instructor to provide source material in guiding class discussion as designated in the student's manual. For each discussion question provided in the student's manual the reference is given indicating the source of information which provides the answer by the letter indicating the particular text or reference in the assignment.

An attempt was made to keep the number of references at a minimum and still provide adequate coverage. The references were the most recent available at the time of preparation. Additional sources of references may be found under "supplementary assignments" which the instructor may find valuable in supplementing the basic material as well as in making assignments for advanced students.

Special credit is due to Mr. Kim Baugrud, Research Assistant in Industrial Education at the University of Missouri, who prepared the assignment sheets and compiled this material.

HUBERT WHEELER

Commissioner of Education

October, 1966
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INTRODUCTION

The instructor's guide and student manual for Auto Mechanics were designed to provide an organized instructional procedure for the teacher. In preparing this material, it has been assumed that job skills and procedures will be learned through actual experience under the direction of a qualified mechanic. The technical and related information is to be given through the use of these manuals and the direction of the instructor, in the school.

Each of the student assignment sheets contain an introduction, a reading assignment, selected references, and a series of questions based on the readings. The question and the assignment sheets serve two purposes:

1. To guide the student to the important aspects of the reading.

2. To form a basis or guide for classroom discussion.

These questions may also be used as written assignments to emphasize some of the more important ideas.

The instructors guide should be used as a supplement to make his teaching more effective. It is intended to be used only as a basic guide and should be adapted to individual teacher's needs. Individual modification to fit your needs is encouraged.

Each student should be encouraged to start a notebook, and to keep it neat and as well organized as possible. A notebook can be useful in instruction, provided it is kept within bounds, i. e., diagrams drawn from an actual part, or questions from a job sheet, not available except in the shop, are proper materials for notebook work.

Your attention should be directed to the fact that there are two types of study guides available in auto mechanics:

1. An <u>individual</u> study guide having objective questions designed for self study.

2. A <u>group</u> study guide with discussion type questions covering the same material.

If the instructor chooses, he may use questions from either of the study guides as test material.

4

INFORMATION CONCERNING INSTRUCTIONAL MATERIALS

The intelligent use of instructional materials reinforces teaching and teaching methods employed by the teacher. It is therefore the responsibility of the teacher to select, with care, the proper aid to be presented for the lesson being given. A film, chart, or other aids should never be a substitute for good teaching nor just a means to occupy student time.

Annually, many excellent instructional materials are provided for the teachers across the nation on free loan or with a minor charge. Placing these sources in the hands of the teacher presents a problem. Catalogs represented by every major phase of industry supplying materials are to be had for just a nominal postage fee. The problem, therefore, seems threefold, they are to:

1. Have available a listing of the materials.
2. Place them into the hands of the users.
3. Schedule the material providing maximum utilization.

Wise planning of these materials may in some cases require a schedule of considerable flexibility and pre-planning, often as much as a year in advance.

The following instructional materials source listing is not complete, but is suggested as representive.

AUTOMOTIVE INSTRUCTIONAL AIDS

Automotive Service Industry Association
Chicago, Illinois

American Motors Corporation
Customer Relations Department
14250 Plymouth Road
Detroit, Michigan

Chrysler Corporation - Information regarding availability of service manuals.

Chrysler-Plymouth Division
Service Department
P.O. Box 1658
Detroit, Michigan 48231

Dodge Division
Service Department
P.O. Box 1259
Detroit, Michigan 48231

Ford Motor Company

Ford Division
All service publications may be obtained at nominal charges
through the local Ford dealer;
or
Educational Affairs Department
The American Road
Dearborn, Michigan

Lincoln-Mercury Division
Service Department
3000 Schaefer Road
Dearborn, Michigan

General Motors Corporation
Educational Relation Section
Public Relations Section
General Motors Corporation
General Motors Technical Center
Warren, Michigan 48090

Kaiser Jeep Corporation
The Manager
Technical Publications
Kaiser Jeep Corporation
Toledo, Ohio 43601

Kaiser Aluminum and Chemical Corporation
Public Affairs Department
300 Lakeside Drive
Oakland 12, California

Modern Picture Service
102 E. Vermont Street
Kansas City, Missouri

U. S. Department of Interior
Bureau of Mines
Graphic Services
4800 Forbes Avenue
Pittsburgh 13, Pennsylvania

SPECIFICATION MANUALS

Ammco Tools, Inc.
North Chicago, Illinois

Automotive Electrical Association
Detroit, Michigan

Bear Manufacturing Company
Rock Island, Illinois

Hunter Engineering Company
Saint Louis, Missouri

John Bean Division
FMC Corporation
1305 S. Cedar St.
Lansing, Michigan 48909

Carter Carburetor Division
ACF Industries, Inc.
Saint Louis, Missouri

Chek-Chart Corporation
Chicago, Illinois

Holley Carburetor Company
Warren, Michigan

ESB Brands Inc.
Educational Aids
P.O. 6949
Cleveland, Ohio 44101

Federal-Mogul
600 W. Chicago St.
Coldwater, Michigan 49036

Perfect Circle Corp.
School Assistant Dept.
Hagerstown, Indiana

Rochester Products
United Motors Service
General Motors Corporation
Detroit, Michigan

Sun Electric Corporation
Harlem & Avondale
Chicago, Illinois 60631

Allen Testing Equipment
(No address given)

Dana Parts Co.
P.O. 500
Hagerstown, Indiana 47346

P. A. Sturtevant Co.
Addison, Illinois

Thompson Ramo Wooldridge, Inc.
8001 E. Pleasant Valley Road
Cleveland, Ohio

KEY--ASSIGNMENT SHEET NO. 1
INTRODUCTION TO THE AUTOMOBILE REPAIR BUSINESS

I. Key To Study Questions:

1.	B, C	4.	B, C
2.	B, C	5.	B, C
3.	B, C	6.	B, C

II. Suggested Supplementary Assignments:

1. Interview a successful local auto repair owner. Find out how he would suggest a young man of high school age work toward becoming a mechanic.
2. Report the advantages and disadvantages of owning your own business as obtained from a local garage dealer.
3. Write to Small Business Administration for information on starting your own business or starting an Automotive Service Station. (Free)

III. Suggested Visual Aids:

Booklet:

"GM Educational Opportunities"

A booklet explaining the procedure to be followed in applying for college undergraduate scholarships. (General Motors)

"In Planning Your Future"

This booklet outlines the opportunities available to young men and women in the retail automobile business. This booklet was written to tell students something about how the business operates, how they can get started, what they would do in various jobs and what the future is likely to be. (General Motors)

Film:

"Aim For the Top"

This film describes the opportunities available to young men and women in retail automative business. It depicts the present level of occupation and outlines the future opportunities that lie ahead for those who desire. (16 mm - sound - color - 15 min - General Motors)

IV. Suggested Speakers:

1. Local auto repair dealer to discuss his views on hiring youngsters, and his recommendations for job entry.

KEY--ASSIGNMENT SHEET NO. 2
BASIC COMPONENTS OF THE AUTOMOBILE

I. Key To Study Questions:

1. A-1
2. A-2
3. A-6
4. A-3
5. A-4
6. A-4
7. A-7
8. A-9
9. A-39
10. A-43
11. A-43
12. A-47
13. A-48

II. Suggested Supplementary Assignments:

1. Obtain several back issues of Life, Post, etc., magazines (the older issues). Compare the automobile advertisements of then to the present, noting particularly the body style.
2. Write to Ford Motor Co. for the booklet, "The Evolution of Mass Production." Study what effects of mass production of automobiles are noticeable today.

III. Suggested Visual Aids:

Booklet:

"A Car is Born"

A 32-page booklet describing all steps necessary to the design, development, manufacture, assembly and distribution of automobiles. Junior and senior high school classes. Available in quantities up to 30. (SS 105 - Ford Motor Co.)

Film:

"Member of the Family"

The revealing of the complex and unique process involved in styling, engineering and manufacturing the modern automobile. (16mm - sound - color - 19 min - Buick Motor Division)

"Mechanics of the Car"

Discusses the necessity of understanding simple car mechanics. Explains the power source, the cooling and electrical systems, lubrication, brakes, exhaust and power accessories. (30 min-Black & White - Indiana University)

"What It Takes to Make Your Car"

(Automobile Manufacturers Association)

"The World Makes an Automobile"

(Automobile Manufacturers Association)

2. Vocational School director to discuss post high school opportunities in auto mechanics.

3. Labor Union Official - Apprentice Director - to discuss entrance into work, apprenticeships.

KEY--ASSIGNMENT SHEET NO. 3
SHOP PROCEDURES AND SAFE PRACTICES

I. Key To Study Questions:

1. A-11
2. A-11
3. A-35
4. A-35
5. A-36
6. B-21-2
7. B-21-7
8. Ref. C

II. Suggested Supplementary Assignment:

1. Provide the student with a picture of a wrench or a nut. (Ref. C, p. 15) Have student show:

   A. How he could increase the leverage applied to the nut and not break the wrench.

   B. How would he apply two different methods to remove the nut if it was rusted on a manifold.

   C. How he would increase the torque on the nut in a confined space.

2. Interview a local garage mechanic on the procedure he uses to care for his tools.

3. Write to a tool supplier and ask to have a field representative discuss special tools for automotive use.

III. Suggested Visual Aids:

Film:

"ABC's of Hand Tools", I & II

A simple and informal film to accompany the booklet of reference C, telling the right and wrong ways of handling and using the more common hand tools. (General Motors Film Library)

"How to Install a School Eye Program"

Fendall Co., 2222 Diversey Parkway, Chicago, Ill. C0647

"Safety Packet"

National Safety Counsel, 425 N. Michigan Ave., Chicago, Ill.

KEY--ASSIGNMENT SHEET NO. 4
AUTOMOTIVE ENGINE DESIGN

I. Key To Study Questions:

1. B-1-7
2. B-1-7
3. B-1-7
4. B-1-9
5. B-7-4
6. B-7-6
7. B-7-6
8. B-7-9
9. B-7-1
10. A-61
11. A-64
12. A-74

II. Suggested Supplementary Assignments:

1. Obtain from several automobile dealers, pictures of V8 engines with various horsepower ratings. Compare the placement of the distributor, coil, fuel pump, oil filter, etc. of each to one another.

2. Discuss what effect the use of aluminum parts has on engine design.

III. Suggested Visual Aids:

Booklet:

"The Automobile Engine"

An illustrated text showing principles governing operation of internal combustion engines, and the way in which these principles are incorporated into a modern V8 gasoline engine. (32 pages, junior and senior high school classes, single copies, SS 103 - Ford Motor Co.)

Film:

"ABC's of the Automobile Engine"

Explains the parts and workings of the automobile engine. (13 min. - color - General Motors)

"ABC's of Internal Combustion"

Clearly describes the theory of the internal combustion engine and the four-stroke cycle. (13 min-color-General Motors)

KEY--ASSIGNMENT SHEET NO. 5
AUTOMOBILE ENGINE COMPONENTS

I. Key To Study Questions:

1. A-83
2. A-84
3. A-85
4. A-86
5. A-86
6. A-86
7. A-90
8. A-90
9. A-91
10. A-93
11. A-95
12. A-97
13. A-97
14. A-98
15. A-100
16. A-102
17. A-103
18. A-104-5
19. A-109
20. A-110
21. A-115
22. B-2-5
23. B-2-7
24. B-2-9
25. B-2-10
26. B-2-11
27. B-2-12
28. B-2-16
29. B-2-19
30. B-2-20
31. A-126
32. A-124

II. Suggested Supplementary Assignments:

1. Illustrate in sectional view sequence, the operation of a generator, a distributor.

2. Compare the valve angles of a V8 engine with the same manufacturer's 6 cylinder engine.

3. From an exploded view of an engine, identify the parts.

III. Suggested Vivual Aids:

Film:

"ABC of the Automobile Engine"

Explains the parts and workings of the automobile engine. (18 min.-color-General Motors)

"ABC of Internal Combustion"

Clearly describes the theory of the internal combustion engine and the four stroke cycle. (13 min.-color-General Motors)

"Know Your Car"

An excellent technical film on the parts and functions of the modern automobile. (15 min.-Black & White-Chicago Motor Club)

KEY--ASSIGNMENT SHEET NO. 6
ENGINE SERVICE

I. Key To Study Questions:

1. A-272
2. A-272
3. A-273
4. A-274
5. A-274
6. A-274
7. A-277
8. A-280
9. A-281
10. A-285
11. A-287
12. A-288
13. A-288
14. A-290
15. A-297
16. A-300
17. A-301
18. A-303
19. A-304
20. A-305
21. A-308
22. A-311
23. A-316
24. A-317
25. A-319
26. A-321
27. A-322
28. A-324
29. A-327
30. A-330
31. A-331

II. Suggested Supplementary Assignments:

1. Obtain six discarded valves from several engine types. Diagnose the probable cause of failure and suggest what steps might have been taken to prevent each trouble.

2. Write a brief page on the use and operation of a valve-seat run out gauge. Estimate the cost of a valve and ring "job".

3. Write for a free copy of "Just what is a piston fit?" Sunnen Products Co., 7910 Manchester Ave., St. Louis 17, Mo.

4. Describe an economical method that can be used to remove and replace a cylinder sleeve.

III. Suggested Visual Aids:

Film:

"It's Magic"

A detailed film showing how an engine is assembled in a modern automotive engine plant. (16 min.-Black & White-Modern Picture Service)

"Where Mileage Begins"

In a stop-motion sequence the engine is assembled without being touched by human hands. (22 min.-Black & White-General Motors)

Booklet:

"Principles of Valve and Valve Seat Reconditioning"

$.50 (Black & Decker, Jappa Road, Towson, Maryland, 21204)

Poster:

Ring installation Poster (Dana Co.)

KEY--ASSIGNMENT SHEET NO. 7
ENGINE TESTS, MEASUREMENTS, AND TROUBLE SHOOTING

I. Key To Study Questions:

1. A-49
2. A-51
3. A-51
4. A-52
5. A-53
6. A-53
7. A-57
8. A-57
9. A-58
10. A-59
11. A-248
12. A-248
13. A-250
14. A-251
15. A-253
16. A-253
17. A-257
18. A-258
19. A-269

II. Suggested Supplementary Assignments:

1. Prepare a chart on the distribution of energy as obtained from five gallons of gasoline. Ref. page A-59.

2. Estimate how much power is absorbed by the use of engine accessories, power equipment, etc.

III. Suggested Visual Aids:

Booklet:

"Tune-Up, Troubleshooting And Maintenance Information"

(TALL3) This booklet consists of a complete set of tune-up procedures covering all series engines and governors which are normally found in the Maintenance Manuals. Included are the maintenance recommendations and a set of trouble-shooting charts. (General Motors)

Film:

"Details Make the Difference"

35 MM sound slide film, color, with 33 1/3 RPM record on how to check out the overhaul of an automobile engine. Accompanying instructor's manual contains suggestions for classroom use of film and record. (Free. Sealed Power Corp. Muskegon, Michigan)

"Engine Tune-Up Procedure Filmstrips"

The following group of filmstrips is accompanied by a Meeting Leader's Guide. Each covers the complete tune-up procedure which includes valve adjustment, injector timing and governor adjustments. The procedures are described in a step by step method pointing out the simplicity of the correct tune-up procedure. 53 In-Line Engines with Limiting Speed Governor (25SE20). 6V-53 Engine with Limiting Speed Governor (25SE19--General Motors)

"Trouble Shooting"

(Federal-Mogual Co.)

"Diagnose It First"

(Perfect Circle Co.)

KEY--ASSIGNMENT SHEET NO. 8
FUEL SYSTEMS AND SERVICE

I. Key To Study Questions:

1. B-6-15
2. B-6-31
3. B-6-32
4. B-6-22
5. A-160
6. A-171
7. A-169
8. A-334
9. A-334
10. A-131
11. A-132
12. A-146
13. A-154
14. A-149
15. A-133, 156
16. A-167

II. Suggested Supplementary Assignments:

1. Compare the thermostatic fuel gauge system with a balancing coil regarding the dash units.

2. Explain why an idle compensator is needed on engine carburetors when equipped with air conditioning and why it is not needed when air conditioning is not part of the equipment.

III. Suggested Visual Aids:

Chart:

"Automotive Fuel System"

The fuel system starts with the gasoline tank and this chart explains the fuel pumping and carburetion principles of today's automobiles. A textual discussion is on reverse side. (General Motors)

Manual:

"AC Fuel Pump Shop Manual"

This manual explains how the AC Fuel Pump works and outlines the complete service procedure for maintenance and overhaul. Single copies available free to automotive mechanics teachers; quantity prices upon request. (General Motors)

Film:

"Rochester Carburetor Film Strips"

Several 35mm. training films are available on Rochester GM Carburetors. These together with the availability of school carburetors, parts and service manuals, bulletins and basic schematics are listed in a training aids folder which includes an order blank. Address:

United Motors Service
Attn: Supply Purchasing Dept.
3044 West Grand Boulevard
Detroit, Michigan 48202

"Gasoline's Amazing Molecules"

This film illustrated the formation of petroleum molecules and shows the complete story of the manufacturing of gasoline. (Modern Picture Service)

Booklets:

"Facts About Gasoline"

$.07, (Ethyl Corp.,100 Park Avenue, New York, N. Y., 10017)

"The Story of Gasoline"

$.42, (Ethyl Corp., 100 Park Avenue, New York, N. Y., 10017)

KEY--ASSIGNMENT SHEET NO. 9
ENGINE LUBRICATION AND SERVICE

I. Key To Study Questions:

1. B-5-3
2. B-5-4
3. B-5-6
4. B-5-14
5. B-5-16
6. B-5-18
7. A-172
8. A-174
9. A-174
10. A-174
11. A-174
12. A-176
13. A-178
14. A-183
15. A-186
16. A-342

II. Suggested Supplementary Assignments:

1. Explain the difference between the fuel flow lubrication system and the by-pass system.

2. List the purposes of engine oil.

3. Obtain samples of various engine oils in each rating and list the visual differences between each. Test each with a blotter for impurities.

III. Suggested Visual Aids:

Film:

"Why of Auto Lubrication"

Shows chief units of car which needs lubrications. Shows use of engine oil in cylinder and on bearings. Also takes up need for lubrication in transmission. Brings about an application of the facts learned about lubrication. (21 min.-color- #209 Modern Picture Service)

"Basic Principles of Lubricating"

Shows underlying necessity of proper lubrication. (25 min-Black & White-General Motors)

"Kit of Educational Material"

Why change crankcase oil? The story of oil, and others. (Quaker State Oil Co., Box 989, Oil City, Pa., 16302)

"Handbook for Teachers"

Facts about oil. (American Petroleum Institute, 1271 Avenue of Americas, New York, N. Y., 10020)

KEY--ASSIGNMENT SHEET NO. 10
ENGINE COOLING SYSTEMS AND SERVICE

I. Key To Study Questions:

1. B-4-2
2. B-4-8
3. B-4-11
4. B-4-13
5. B-4-14
6. A-197
7. A-190
8. A-193
9. A-194
10. A-195
11. A-349
12. A-350
13. A-351
14. A-352
15. A-196

II. Suggested Supplementary Assignments:

1. Place each of the following in a separate laboratory beaker: plain water, 50% alcohol base antifreeze, 50% Ethylene Glycol base anti-freeze. Heat to a boiling condition, observe the temperature at which each boils by placing a thermometer in the beaker. Discuss which one would make the best lasting antifreeze.

2. Test the opening temperature of a thermostat by placing it in water and heat to a boiling temperature. Discuss the resulting effect on the coolant if the thermostat did not open at the proper temperature.

3. Place in a freezer container of solutions of various strength of antifreeze solutions. At what minimum strength will a solution not freeze over a period of 24 hours at the freezer temperature? Report your findings.

III. Suggested Visual Aids:

Manual:

"Automotive Cooling and Heating System Manual"

Basic service procedures for liquid and air cooled engines, car heaters and windshield defroster, and car air-conditioning systems. (Single copies-General Motors)

"Cooling System Service Manual"

($1.00-Warner Patterson Co.-600 S. Michigan Avenue, Chicago, Illinois, 60605)

KEY--ASSIGNMENT SHEET NO. 11
PRINCIPLES AND COMPONENT PARTS OF THE ELECTRICAL SYSTEM

I. Key To Study Questions:

1. B-19-25
2. B-19-22
3. B-19-24
4. A-203
5. A-204
6. A-205
7. A-208
8. A-209
9. A-211
10. A-219
11. A-222
12. A-225
13. A-229
14. A-220

II. Suggested Supplementary Assignments:

1. Explain the relationship of the electrical system to the economical operation of the automobile.

2. Produce a check list of common electrical trouble symtoms.

3. Prepare a chart on alternators vs. generators as a source of electrical power listing advantages of each.

III. Suggested Visual Aids:

Manual:

Training Manual Volume I
Electrical Systems, $.75, automotive
Electrical Association, 16223 Meyers Road
Detroit, Michigan 48235

Film:

"The Story of the Modern Storage Battery"

The film traces the history of the storage battery, introducing the scientists who contributed to its development and illustrating some of the problems they overcome. The narration portrays the principles of the battery and its evolution. (27 min.-color-Bureau of Mines)

KEY--ASSIGNMENT SHEET NO. 12
THE ELECTRICAL SYSTEM IGNITION & LIGHTING

I. Key To Study Questions:

1. B-3-5
2. B-3-7
3. B-3-12
4. B-3-14
5. B-3-18
6. B-3-21
7. A-236
8. A-239
9. A-241
10. A-240
11. A-243
12. A-245
13. A-246
14. A-384
15. A-387

II. Suggested Supplementary Assignments:

1. Prepare a comparison between spark plugs and their heat ranges.

2. Discuss the importance of headlight adjustment and the apparatus used to adjust the headlights.

3. Report on the legal restrictions placed on automobile lighting.

4. Discuss the effects of transistorizing the ignition system on engine efficiency.

III. Suggested Visual Aids:

Manual:

"Headlight Tester"
(#560, $.30, Bear Co.)

Handbook:

"Facts About Spark Plugs and Engines"
(Champion Spark Plug, Box 910, Toledo, Ohio, Free)

"Ignition Circuit Maintenance"
(324-3, $.80, Delco Remy) The Ignition System (5133D Delco Remy)

Film:

"A Spark in Time on the Firing Line"
(#2211, 20 min., color, Modern Picture Service) This is an excellent fully-animated educational film on the operation of an automobile ignition system.

"The Spark of Power"
(#2492, 13 min., color, Modern Picture Service) Here is a fully animated outstanding film on the function of spark plugs in the internal combustion engine.

KEY--ASSIGNMENT SHEET NO. 13
ELECTRICAL SYSTEM SERVICE

I. Key To Study Questions:

1. A-225
2. A-226
3. A-226
4. A-228
5. A-229
6. A-229
7. A-371
8. A-372
9. A-372
10. A-373
11. A-375
12. A-378
13. A-383

II. Suggested Supplementary Assignments:

1. Prepare a maintenance table on the electrical system.

2. Bring to class an article depicting recent advances in service procedures given to auto electrical systems.

III. Suggested Visual Aids:

Film:

"Commutation of DC Machines"

(Same principle as in automobile, 24 min., Black & White, Westinghouse, 411 N. 7th Street, St. Louis 1, Mo.) Clearly presents the theory and maintenance of communication of direct-current motors and generators. Animated drawings explain the theory of commutation and the troubles that arise from stray oil and grease, moisture, looseness of mounting, worn brusholder boxes, grooving, poor seating of new brushes and irregular inspection. How to prevent and mend these troubles is graphically demonstrated in detail.

Manuals:

"Alternator & Transister"

(Set of 3, $1.00 each, Detroit) (A. E. A.)

KEY--ASSIGNMENT SHEET NO. 14
CLUTCHES AND CLUTCH SERVICE

I. Key To Study Questions:

1. A-391
2. A-393
3. A-395
4. A-398
5. A-401
6. A-402
7. A-403
8. A-404
9. B-9-3
10. B-9-3
11. B-9-5
12. B-9-7
13. B-9-8
14. B-9-9
15. B-9-2
16. B-9-1
17. B-9-9
18. B-9-10

II. Suggested Supplementary Assignments:

1. Write a brief summary on why driving safety is economy.
2. Describe the advantages of purchasing an automobile with a clutch.

III. Suggested Visual Aids:

"Exploded View of Clutch Assembly"

Prepare a handout for class use from text book.

KEY--ASSIGNMENT SHEET NO. 15
TRANSMISSIONS AND THEIR SERVICE

I. Key To Study Questions:

1. A-409
2. A-406
3. A-407
4. A-411
5. A-409
6. A-416
7. A-421
8. A-428
9. A-430
10. A-434
11. B-10-2
12. B-10-12

II. Suggested Supplementary Assignments:

1. Investigate the duties, pay, location, opportunities, schools, training, etc. of a transmission specialist, report your findings to the class.

III. Suggested Visual Aids:

Chart:

"Three-Speed Gear Transmission"

Printed instruction on the back of this chart explains clearly the mechanics of shifting gears in the conventional automotive transmission. (General Motors)

"Typical Gear Combinations"

The many gears and gear combinations used by modern industry are outlined and explained in this interesting wall chart. (General Motors)

KEY--ASSIGNMENT SHEET NO. 16
AUTOMATIC TRANSMISSIONS AND SERVICE

I. Key To Study Questions:

1. B-12-7
2. B-12-8
3. B-12-8
4. B-12-10
5. B-12-13
6. A-448
7. A-448
8. A-450
9. A-451
10. A-455
11. A-454
12. A-456
13. A-459
14. A-469
15. A-500

II. Suggested Supplementary Assignments:

1. Read chapters 43,44 in supplementary reference.

III. Suggested Visual Aids:

Chart:

"Chrysler Corporation Automatic Transmission"

(Illustrations, 8 1/2 X 11, single to teachers)

Manual:

"Service Manuals for Various Heavy Duty Automatic Transmissions"

A series of seven service manuals describing the product; telling how and why it works. Words and pictures are used to show teardown and rebuild procedures. (Available singly, General Motors)

Book:

"Cruise-O-Matic"

These are 8 1/2 X 11 individually bound books containing schematics or gear train build ups designed to be colored (in) by the learner. It is felt by coloring these . . . the operation will be more firmly fixed in the mind of the student. ($1.10, Ford Motor Co.)

Film:

"Automatic Transmissions"

Stresses economy and comfort in the uses of automatic transmissions (13 min., Black & White, Ford Motor Co.)

KEY--ASSIGNMENT SHEET NO. 17
DRIVE MECHANISMS

I. Key To Study Questions:

1. A-502
2. A-505
3. A-506
4. A-506
5. A-509
6. A-510
7. A-511
8. A-512
9. A-513
10. A-515
11. A-515
12. A-515
13. A-515
14. B-14-8
15. B-14-7
16. B-14-8
17. B-14-8
18. B-14-12

II. Suggested Supplementary Assignments:

1. Discuss the importance of a heavy lubricant in the differential. Compare this lubricant with the type used in a universal joint.

2. Sketch the various universal joint types.

3. Report on the functions of the differential, slip-joint.

4. Relate the importance of the ring gear to the drive pinion while making a turn.

III. Suggested Visual Aids:

Chart:

"Rear Axle Assembly"

(General Motors) This chart shows views of the automobile rear axle assembly and presents a clear and simple explanation of this complicated mechanism.

Film:

"Indianapolis 500"

A recap of the 1963 auto racing classic in which Roger Ward, driving the Kaiser Aluminum Special, finished fourth. The film features the battle between the standard offenhauser driven, front engine cars and a new, lightweight, rear engine car using an 8 cylinder Ford engine. Race highlights the increasing importance of weight saving and the contributions being made by aluminum. (30 min., color, Kaiser Aluminum & Chemical Corporation)

KEY--ASSIGNMENT SHEET NO. 18
SPRINGS AND SUSPENSION SYSTEMS

I. Key To Study Questions:

1. A-517
2. A-519
3. A-519
4. A-520
5. A-523
6. A-524
7. A-525
8. A-526
9. A-531
10. B-15-5
11. B-15-6
12. B-15-6
13. B-15-10
14. B-15-10
15. B-15-14
16. B-15-14
17. B-15-18
18. B-15-18

II. Suggested Supplementary Assignments:

1. Discuss the relationship of the springs to the drive mechanism.

2. Explain the effect of placing a shock absorber inside a front end coil spring. Why are both items used on the front suspension?

III. Suggested Visual Aids:

Chart:

"Automobile Chassis"

The typical automobile chassis pictured in the chart makes it easy to show how the various mechanical parts fit together and operate as a single unit. (General Motors).

Booklet:

"Delco Automotive Suspension Products"

(Delco, Dayton, Ohio)

KEY--ASSIGNMENT SHEET NO. 19
SERVICING STEERING AND SUSPENSION SYSTEMS

I. Key To Study Questions:

1. B-17-2
2. B-17-5
3. B-17-23
4. B-17-6
5. B-17-8
6. B-17-10
7. B-17-12
8. B-17-14
9. B-17-15
10. A-543
11. A-544
12. A-546
13. A-561
14. A-562
15. A-569
16. A-570

II. Suggested Supplementary Assignments:

1. Compare the front end suspension system to a gyroscope.

2. Why should the tie rods be increased in diameter when power steering is a part of the system? Estimate the power consumption used by a power steering booster.

3. Report on the type fluid used in a power steering system and characteristics it must possess.

III. Suggested Visual Aids:

Manual:

"Wheel Alignment of Your Car--What it is--How it works"

$.30 (Bear Co.)

"Wheel and Steering Alignment"

Routine manual ($.30, Bear Co.)

"Fundamentals of Wheel Alignment"

Notebook ($.40, Bear Co.)

Chart:

"Steering System"

This schematic diagram pictures the automobile steering gear assembly and also shows how power steering is applied. (General Motors)

KEY--ASSIGNMENT SHEET NO. 20
BRAKES AND BRAKE SERVICE

I. Key To Study Questions:

1. B-18-1
2. B-18-2
3. B-18-4
4. B-18-6
5. B-18-8
6. B-18-10
7. B-18-13
8. B-18-16
9. B-18-20
10. A-571
11. A-573
12. A-576
13. A-577
14. A-577
15. A-580
16. A-573
17. A-576
18. A-587
19. A-590
20. A-592

II. Suggested Supplementary Assignments:

1. List the qualities a good brake fluid should possess.

2. What adjustments are possible on a master cylinder in a dual system?

3. List characteristics of brake shoe linings, and "clues" of brake trouble.

4. Report on the effects of oil, gasoline, water, and dust particles have on brake shoe lining.

III. Suggested Visual Aids:

Schematic:

Prepare a schematic of a single and dual brake system.

Manuals:

Fundamentals of Brake Service Notebooks $.40, (Bear Co.)

Chart:

"Brake System"

This schematic drawing clearly illustrates the operation of the hydraulic and mechanical principles involved in the brake system of the modern automobile. (General Motors)

Films:

"When the Chips Go Down"

(#2169, 22 min., color, Modern Picture Service) The importance of good brake linings is stressed in this film. We see how they are manufactured and the astonishing number of rigid tests they must pass. A brief and tragic episode shows what happened to a family when their brakes failed to work.

"It's All in the Brakes"

(#EG504) American Insurance Association, 85 St. John's Street, New York, N. Y., 10038

KEY--ASSIGNMENT SHEET NO. 21
WHEELS, TIRES, AND TIRE REPAIR SERVICE

I. Key To Study Questions:

1. A-564
2. A-595
3. A-595
4. A-596
5. A-599
6. A-600
7. B-16-2
8. B-16-2
9. B-16-3
10. B-16-4
11. B-16-5
12. B-16-5
13. B-16-7
14. B-16-7
15. B-16-8
16. B-16-9

II. Suggested Supplementary Assignments:

1. Discuss the advantages of each of the following:

   a. tire recapping
   b. tire rethreading
   c. wheel balancing
   d. tire chain usage
   e. tubeless tires

2. List the factors that cause variations in tire pressure.

3. What differences are required in wheel rim shapes when comparing tube type to tubeless tires.

III. Suggested Visual Aids:

Film:

"Tommy Looks at Tires"

(Free, 16mm, 20 min., color) Film giving information about research, development and testing in the manufacturing of tires. Stearling Movies, U. S. A., Inc., Central Booking Exchange, 43 West 61st St., New York 23, New York.

KEY--ASSIGNMENT SHEET NO. 22
AIR CONDITIONING

I. Key To Study Questions:

1. B-20-2
2. B-20-2
3. B-20-2
4. B-20-4
5. B-20-4
6. B-20-5
7. B-20-5
8. B-20-8
9. B-20-11
10. B-20-11
11. B-20-4
12. B-20-4

II. Suggested Supplementary Assignments:

1. Prepare a color coded sketch of the components of an air conditioning system.

2. Study the trouble shooting chart prepared on page 48-8 of the supplementary reference.

III. Suggested Visual Aids:

Manual:

"Frigidaire Service Home Study Course #1"

Covers basic food preparation and fundamentals of refrigeration. (General Motors)

"Frigidaire Service Home Study Course #2"

Covers the components which make up a refrigeration system. (General Motors)

Film:

"Chemical Stability in a Refrigerating System"

(Sound strip, 23 min., General Motors) This slide film illustrates how chemical stability and freedom from contamination is vitally necessary for the efficient operation of refrigerating products. The proper procedures to be followed by servicemen in maintaining chemical stability are thoroughly covered and the results of improper servicing techniques are graphically illustrated. Based on the booklet on the same subject.

"Fundamentals of Air Conditioning and Heating"

(Sound Strip, 30 min.,) Covers a study of air circulation, ventilation, filtration, sound and comfort of air conditioning. Also includes the testing of combustion as it applies to heating equipment.

KEY--ASSIGNMENT SHEET NO. 23
JOB MANAGEMENT AND PRICING

I. Key To Study Questions:

1. D
2. D
3. D
4. D
5. D
6. D
7. D
8. D
9. D
10. D
11. D
12. D
13. D
14. D
15. D
16. D
17. D
18. D
19. D
20. D
21. D

VT001 628

VT 001 628
Auto Mechanics Group Instruction, A Course of Study Designed for Students Preparing for or Presently Employed in Auto Mechanics.

Karnes, James B.
Missouri Univ., Columbia. Dept of Industrial Education
Missouri State Dept. of Education, Jefferson City
Pub Date - Oct66
MF AVAILABLE IN VT-ERIC SET 75p.

*STUDY GUIDES, *TRADE AND INDUSTRIAL EDUCATION, *AUTO MECHANICS (OCCUPATION), HIGH SCHOOLS, JOB ANALYSIS, GROUP INSTRUCTION, *COOPERATIVE EDUCATION, *MOTOR VEHICLES,

Students may use this guide in studying technical and related information in high, post-high, or area vocational school auto mechanics programs. It was developed at the state level by a committee and research assistants and has been field tested. The 23 assignment sheets contain introductory statements, assignments, references, and discussion questions. The questions guide the student to the important aspects of the reading assignments and form a basis or guide for classroom discussions. Representative assignment sheet titles are (1) Basic Components of the Automobile, (2) Automotive Engine Components, (3) Engine Service, (4) Clutches and Clutch Service, and (5) Air Conditioning. An information sheet is included on job management. The material is to be used on a group or class basis in conjunction with experience in actual repair situations of an automobile or component parts under teacher supervision for 1 year or 180 days. Teachers should be vocationally competent, and students should be in grade 11 or 12 and have proper prerequisites. Supplementary materials include a list of references and a trade analysis. A second study guide (VT 002 080) has been developed for individual study. It is based on the same references and has the same assignments with objective-type questions which may be used for test purposes with this study guide. An answer key (VT 002 081) which locates the question reference sources is available for both study guides. This document is available for $1.50 from Industrial Education, 103 Industrial Education Building, University of Missouri, Columbia, Missouri 65201. (HC)

AUTO MECHANICS GROUP INSTRUCTION

A Course of Study

Designed for
Students Preparing for
Or Presently Employed in Auto Mechanics

Issued by
Department of Industrial Education
College of Education
University of Missouri
Columbia, Missouri

In Cooperation With
Industrial Education Section
State Department of Education
Jefferson City, Missouri

1628

MEMORANDUM

TO: The ERIC Clearinghouse on Vocational and Technical Education
The Ohio State University
980 Kinnear Road
Columbus, Ohio 43212

FROM: (Person) James B. Karnes (Agency) Univ. of Mo. at Columbia

(Address) 103 Industrial Education Building, Columbia, Mo.

DATE: October 19, 1967

RE: (Author, Title, Publisher, Date) Indus. Ed. Dept., Univ. of Mo. at Columbia

AUTO MECHANICS GROUP INSTRUCTION, cooperatively with Indus. Educ.

Dept. (U. of Mo. at Columbia) and Mo. State Dept. of Ed. (1966)

Supplementary Information on Instructional Material

Provide information below which is not included in the publication. Mark N/A in each blank for which information is not available or not applicable. Mark P when information is included in the publication. See reverse side for further instructions.

(1) Source of Available Copies:
Agency Industrial Education Dept., Univ. of Mo. At Columbia
Address 103 Industrial Education Building
Limitation on Available Copies quantity Price/Unit $1.50
(quantity prices) same
instructor's guide $1.50

(2) Means Used to Develop Material:
Development Group Development Committee and Research Assistants
Level of Group State
Method of Design, Testing, and Trial Subject matter specialist and teacher educators. Field tested.

(3) Utilization of Material:
Appropriate School Setting High School, post high school, area vocational
Type of Program preparatory vocational industrial education programs
Occupational Focus job cluster covering various phases of auto mechanics
Geographic Adaptability United States
Uses of Material Study guide for related instruction on a group basis
Users of Material student guiding class discussion

(4) Requirements for Using Material:
Teacher Competency competent vocational instructor
Student Selection Criteria junior in high school with proper prerequisites
Time Allotment 180 days

Supplemental Media --
Necessary x
Desirable x
(Check Which)

Describe P

Source (agency) (see attached list)
(address)

REFERENCES FOR AUTO MECHANICS

A. Crouse, William H., Automotive Mechanics, Fifth Edition, Webster Division, McGraw-Hill Book Company, Inc., 1154 Reco Avenue, St. Louis, Missouri, 63126, 1965, $6.84* (21)**

B. Stockel, Martin W., Auto Mechanics Fundamentals, The Goodheart-Willcox Company, Inc., 18250 Harwood Avenue, Homewood, Illinois, 60430, 1963, $6.96* (18)**

C. General Motors Corporation, ABC's of Hand Tools, General Motors Corporation, Detroit, Michigan, 1945, Free. (1)**

D. Occupational Outlook Handbook, U. S. Department of Labor, Sold by Superintendent of Documents, U. S. Government Printing office, Washington 25, D. C. (1)**

E. (Obtain from School Guidance Department)
  1. SRA -- Occupational Brief, #610e Automotive Mechanic
  2. Chronicle - Occupational Brief, #5-81.01 Automobile Mechanic (1)**

SUPPLEMENTARY REFERENCE

Toboldt, William K., and Purvis, Jud, Motor Service's Automotive Encyclopedia, The Goodheart-Willcox, Company, Inc., 18250 Harwood Avenue, Homewood, Illinois, 60430, 1964, $6.71*

* Subject to educational discount.
**Frequency of use in assignments.

FORWARD

This course of study, consisting of an analysis of AUTO MECHANICS GROUP INSTRUCTION, together with assignment sheets covering the related (occupational) information, has been prepared for teaching auto mechanics on a group or class basis in a trade preparatory program.

The original analysis for this course of study was developed in 1940 by Mr. R. W. Baker, Director of Vocational Education, Joplin, Missouri, and by Mr. Lloyd E. Estes, formerly coordinator, and Mr. Kenneth Epperson, Auto Mechanics Instructor, Hannibal, Missouri. The assignment sheets for this course of study are especially designed for group instruction and were prepared by Mr. Kim Baugrud, Research Assistant in Industrial Education at the University of Missouri.

We wish to acknowledge our indebtedness to Dr. H. H. London, Professor of Industrial Education at the University of Missouri, for the direction and administration of the Curriculum Materials Laboratory in which this material was prepared, and to Dr. James B. Karnes, Assistant Professor of Industrial Education at the University of Missour who supervised the preparation of the material and edited the manuscript Credit is due to Mr. B. W. Robinson, Assistant Commissioner of Educatio Mr. Merton Wheeler, Director of Industrial Education, and to other staff members of the State Department of Education for their efforts in the development of the Industrial Education Curriculum Series of which this course of study is a part.

HUMBERT WHEELER

Commissioner of Education

October, 1966
800

March, 1967 (Reprint)
1000

TABLE OF CONTENTS

Assignment Sheets:

Information Sheet:

INTRODUCTION

In preparing this course of study, it has been assumed that job skills and procedures will be learned through experience in actual repair situations of an automobile or component parts under the direction of a competent teacher. The technical and related information is to be given in conjunction with each associated assignment at the appropriate time. The teaching sequence set up in the manual is intended to be flexible.

Each assignment in the manual contains an introduction, reading assignment, and a series of discussion questions based on the reference pages assigned. The purposes of the introduction are to create interest, convey the importance of the assignment to the student, and tell him specifically what he is expected to learn. The reading assignments are keyed to the basic texts listed on page (6) six of this manual.

The questions on the assignment sheets serve two purposes: (1) to guide the student to the important aspects of the reading assignment, and (2) to form a basis or guide for classroom discussions. The questions may also be utilized as written assignments to emphasize a particular procedure as topic, as well as selected essay test items.

Your attention should be called to a second study guide on Auto Mechanics, one designed specifically for a single student doing individual study. It is based on the same reference material, has the same assignments, but the questions for each unit are of the objective type. These questions lend themselves very well to test purposes. A key is available for both study guides locating the reference source from which the questions were written.

As the student proceeds through the course, it is advisable for him to keep a well organized notebook. In this notebook, he would bring to the shop any information needed to perform the day's assignment. This will give added life to the text. Related information not found in the text would also be kept here.

TO THE STUDENT-WORKER

The auto mechanic's trade is a service type of trade which is concerned primarily with the adjustment, repair, and installation of parts, and general maintenance of the automobile. Auto mechanics are classified either as general mechanics or as specialists. The general auto mechanic is capable of performing the great majority of operations necessary to return a vehicle to its normal operating condition. A specialist is one who has all-around knowledge of the trade, but who has, in addition, become especially skilled in one or more particular phases of automotive repair, such as carburetion, brakes, or ignition.

Outlook and Opportunity for the Automotive Mechanic

An increasing number of competent automotive mechanics will be in demand throughout the forseeable future. This upward trend is certain to continue due to the rapidly rising number of cars, trucks and buses on the nation's highways. The increase in farm mechanization will also add to this demand. Today there are approximately one million automotive mechanics. For an occupation this size the Labor Department estimates that retirements and deaths alone create about 12,000 to 15,000 openings each year.

In addition to the increase in numbers needed, there will be a demand for mechanics with more skills and technical knowledge than has been required. The relatively new features such as automatic transmissions, power brakes, power steering, air conditioning and other mechanical innovations requires an understanding of numerous scientific principles and their application in the servicing and repair of motor vehicles.

Earnings for the auto-mechanic vary depending on the location and size of the community, the mechanic's specialty, the type of establishment and other factors. However, regardless of these factors the competent mechanic can look forward to earning good wages. A survey by the Department of Labor in 1958 showed that wages for mechanics ranged from $2.05 to $3.16 an hour, with the average being $2.50 an hour. More important than wages, perhaps, is the fact that the prospective mechanic will not be tied to a dead-end job. Instead, he can look forward to a life of challenging experiences as he repairs and services the complex motor vehicles of the future.

Personal-Social Traits Essential for the Auto Mechanic

Personality traits are of extreme importance, not only in securing and holding a desirable position but in life in general. Personal and social traits can be improved through training when the individual learns what to improve, how to improve and why improvement is advisable. Among the personal-social traits of chief importance to the auto mechanic are the following:

Patience. Much of the work of the auto mechanic is in "hard-to-get" places, and it requires patience as well as skill to make the necessary adjustments and repairs.

Personal Appearance. Clothing should be worn that makes for safety, efficiency, and a pleasing impression upon the people you serve.

Good Physical Condition. Physical requirements are not excessive, but the conditions of work are not always ideal. Often it is necessary to work in cold, drafty, and poorly ventilated places. One must be in good physical condition to keep at top efficiency. One must have good muscular coordination, mechanical dexterity, good eyesight, and steady nerves.

Cooperation. Auto mechanics requires a willingness to work cooperatively with fellow workers. This means an attitude of readiness to assist others when they need help, and to join in group undertakings.

Consideration of Others. A thoughtful attitude toward making things easy and pleasant for others, such as keeping things in order, putting tools away, and doing your full share of work is an important marketable trait of a good auto mechanic.

Industry. This character trait means a habit of careful, thoughtful, energetic attack upon the job without loitering or wasting time.

Initiative. The ability to see what needs to be done and to go ahead without constant supervision is an essential trait of an auto mechanic.

Reliability and Trustworthiness. Intrusted in your care are people's lives and valuable property. Negligence on your part as a mechanic can easily cause death and destruction.

REFERENCES FOR AUTO MECHANICS

A. Crouse, William H., Automotive Mechanics, Fifth Edition, Webster Division, McGraw-Hill Book Company, Inc., 1154 Reco Avenue, St. Louis, Missouri, 63126, 1965, $6.84*

B. Stockel, Martin W., Auto Mechanics Fundamentals, The Goodheart-Willcox Company, Inc., 18250 Harwood Avenue, Homewood, Illinois, 60430, 1963, $6.96*

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* Subject to educational discount.

ANALYSIS

Introduction to Auto Mechanics

JOB TRAINING: What the Worker Should Be Able to Do	Assign. No.	RELATED INFORMATION: What the Worker Should Know
	1	1. Importance of automobiles in today's world
	1	2. Nature and opportunities in the auto-repair business
	1	3. Occupational and vocational guidance information
	1	4. Sources of auto repair information
	1	5. Things to consider before opening your own business
	2	6. Historical Review of the Automobile
	2	7. The Automotive Industry
	2	8. Automobile, Design and Major Components
	3	9. Auto-Repair Hand Tools
	3	10. Tool Safety and Usage

The Engine

JOB TRAINING: What the Worker Should Be Able to Do	Assign. No.	RELATED INFORMATION: What the Worker Should Know
	4	11. Physical principles involved in engine construction
	4	12. Types of engines used in automobiles
	4	13. Engine classifications
	4	14. Gas turbine and experimental engines
	4	15. Engine component identification
	4	16. Engine mounting
	4	17. Two cycle engine operation
	5	18. Engine block design
	5	19. Principles of cylinder construction
	5	20. Piston and connecting rod design
	5	21. Piston ring design and cylinder installation
	5	22. Variations in cylinder head placement
	5	23. Types and purposes of gaskets
	5	24. Function of intake and exhaust manifold
	5	25. Construction and design of engine bearings

JOB TRAINING: What the Worker Should Be Able to Do	Assign. No.	RELATED INFORMATION: What the Worker Should Know
	5	26. Cam, crankshaft design and function
	5	27. Kinds of engine valves
	5	28. Principles of the valve train
	5	29. Function of engine fly wheel
	5	30. Importance of proper valve timing
	5	31. Engine timing devices
	5	32. Crankcase design and function
	5	33. Types and operation of valve lifters
	6	34. Operating characteristics of valve trains and valves
	6	35. Diagnosing valve troubles
36. Free stickey valves	6	36. Methods of servicing valves
37. Adjust valve-tappet clearance		
38. Remove and replace valves		
39. Recondition valves and valve seat		
40. Replace a valve seat insert		
41. Test valve guide wear		
42. Check and repair hydraulic valve lifters		
	6	43. Cylinder head maintenance
44. Remove, clean, replace cylinder head		
45. Install gaskets		
46. Inspect piston for damage	6	46. Service to pistons and cylinders
47. Check cylinder walls for variation		
48. Remove ridge ring		
49. Refinish cylinder walls		
50. Remove, fit, install pistons		
51. Clean piston ring grooves		
52. Remove, fit and install piston rings	6	52. Types of piston rings
53. Remove, fit, and replace piston pin bushings	6	53. Ways of servicing connecting rods
54. Remove, align, install connecting rod		
55. Align connecting rod to piston		
56. Remove and replace connecting rod bearings		

JOB TRAINING: What the Worker Should Be Able to Do	Assign. No.	RELATED INFORMATION: What the Worker Should Know
57. Remove and replace crankshaft	6	57. Methods used to check crankshafts
58. Test and align crankshaft		
59. Clean oil passages		
60. Check and adjust crankshaft end play		
61. Remove and install main bearings		
62. Remove and replace oil seals		
63. Remove and replace cam shaft		
64. Test and align cam shaft.		
65. Remove and replace camshaft bearings		
66. Measure engine efficiency	7	66. Engine measurements
67. Test engine compression	7	67. Testing instruments used in engine service
68. Measure engine vacuum		
69. Diagnose engine troubles	7	69. Principles of trouble shooting the engine

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	8	70. Chemistry of engine fuels
	8	71. Effects of condensation on fuels
72. Check fuel lines	8	72. Fuel tank design
73. Remove and replace fuel pump, bowl	8	73. Operating theory of fuel pumps
74. Test fuel pump pulsation for output		
75. Remove, clean, replace fuel filter	8	75. Types of fuel filters in use
76. Test venturi tube	8	76. Principles of carburetion
77. Adjust air bleed		
78. Test carburetion with analyzer		
79. Check and adjust discharge jet		
80. Adjust choke lever	8	80. Principles of the choke
81. Adjust automatic choke		
82. Adjust choke control cables		
83. Position the throttle valve	8	83. Throttle valve principles

JOB TRAINING: What the Worker Should Be Able to Do		Assign. No.	RELATED INFORMATION: What the Worker Should Know	
84.	Test engine RPM			
85.	Test engine combustion	8	85.	Principles of fuel combustion
		8	86.	Malfunctions occuring in carburetion
		8	87.	Carburetor types and their functions
		8	88.	Manifold design for carburetion
89.	Remove, clean, replace air filter	8	89.	Air filteration principles
90.	Inspect and interpret fuel injector chart	8	90.	Fuel injection systems
		8	91.	Diesel fuels and their operating principles
		8	92.	Carburetion using liquified petroleum
93.	Test fuel consumption	3	93.	Test instruments used in fuel system service
94.	Analyze exhaust gas			
95.	Measure manifold vacuum			
96.	Diagnose fuel system troubles	8	96.	Trouble shooting the fuel system

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97.	Check, drain, fill crankcase	9	97.	Characteristics of engine lubricating oils
		9	98.	Principles of crank case ventilation
		9	99.	Function of engine lubricating system
		9	100.	Types of lubricating systems
101.	Check oil cooler	9	101.	Types and functions of oil coolers
102.	Check, repair oil line damage			
103.	Replace oil filter	9	103.	Types and function of oil filters
104.	Replace oil gauge	9	104.	Principles of oil gauge operation
105.	Correct low oil pressure	9	105.	Testing instruments used in lubrication system
106.	Correct excessive oil pressure			
107.	Replace diluted oil			
108.	Diagnose lubrication troubles	9	108.	Introduction to engine lubrication trouble diagnosis

JOB TRAINING: What the Worker Should Be Able to Do	Assign. No.	RELATED INFORMATION: What the Worker Should Know
	Cooling System	
109. Check antifreeze solution concentration	10	109. Types and characteristics of antifreeze solutions
110. Drain cooling system	10	110. Care of cooling systems
111. Examine radiator for restrictions, leaks		
112. Flush radiator rust and scale		
113. Test and install thermostat	10	113. Function of thermostats
114. Examine, replace cooling system hoses		
115. Remove, replace water pump	10	115. Water pump operation
116. Test radiator cap pressure	10	116. Pressurized cooling systems
117. Check over flow line		
118. Check fan blade	10	118. Engine fan operation
119. Adjust fan belt tension		
120. Test hot water heater	10	120. Hot water heater operation
	Electrical Systems	
	11	121. Electrical terminology
	11	122. Function of electrical system
	11	123. Ohms law and its application
	11	124. Battery construction and operation
125. Determine battery ratings	11	125. Battery ratings and efficiency
	11	126. Wet and dry-charge battery stock maintenance
127. Remove and replace a battery	11	127. Installation procedures of batteries
128. Recharge a battery	11	128. Principles of recharging a battery
	11	129. Factors affecting battery life
130. Test battery specific gravity		
131. Test battery output		
132. Check, fill battery liquid level		
133. Readjust specific gravity of battery		

JOB TRAINING: What the Worker Should Be Able to Do	Assign. No.	RELATED INFORMATION: What the Worker Should Know
134. Determine battery rating		
	11	135. Safety precautions used with batteries
136. Remove, replace a generator	11	136. Servicing a generator
137. Test generator for short		
138. Turn commutator segments on a lathe		
139. Remove mica between commutator segments		
140. Remove, replace generator brushes		
	11	141. Operating principles of three brush generator
142. Test alternator output	11	142. Principles of an alternator
	11	143. DC-AC conversion practices
144. Test starting current voltage	11	144. Starter Motor principles and operation
145. Remove, replace starter motor		
146. Check, repair bendix drive		
147. Bench test starter motor		
148. Test starter solinoid		
	12	149. Coil construction and operating principles
150. Test coil polarity	12	150. Functions of coil polarity
151. Test coil primary voltage		
152. Test coil secondary voltage		
153. Remove, replace coil		
	12	154. High voltage theories
	12	155. Principles of rotor action
156. Record engine firing sequence	12	156. Firing sequence theory of engines
157. Remove, replace distributor		
158. Time distributor to engine		
159. Adjust vacuum advance	12	159. Operating principles of vacuum advance
160. Adjust centrifugal advance		
	12	161. Condenser construction and operation
162. Remove, replace condenser		

JOB TRAINING: What the Worker Should Be Able to Do		Assign. No.	RELATED INFORMATION: What the Worker Should Know	
163.	Remove, replace spark plug	12	163.	Construction of spark plugs and relationship of parts
164.	Clean and adjust electrode gap	12	164.	Spark plug electrode classification
165.	Analyze spark plug condition	12	165.	Principles of testing and techniques of cleaning spark plug
166.	Select spark plug for a specific engine	12	166.	Spark plug chart interpretation
		12	167.	Pre-ignition factors of a spark plug
		13	168.	Regulation of generator output
		13	169.	Functions of circuit breakers and relays
170.	Remove, adjust, replace regulator	13	170.	Voltage and current regulation through separate devices
171.	Test regulator input, output			
172.	Remove, replace charging circuit wires			
173.	Trace regulator circuits			
		13	174.	Functions of a three unit regulator
		13	175.	Principles of double contact regulation
176.	Test indicator light	13	176.	Devices to indicate generator output
177.	Test ammeter			

Clutch

178.	Adjust clutch linkage	14	178.	Types of clutches and their operation
179.	Remove, replace clutch friction disk	14	179.	Clutch components
180.	Diagnose clutch troubles	14	180.	Clutch trouble-shooting

Transmissions

181.	Adjust fluid level	15	181.	Function, types, and operation of transmissions
182.	Adjust control linkage	15	182.	Gearshift mechanism operation

JOB TRAINING: What the Worker Should Be Able to Do		Assign. No.	RELATED INFORMATION: What the Worker Should Know	
		15	183.	Synchromesh transmission operation
184.	Diagnose transmission troubles	15	184.	Operating procedures of transmissions
185.	Test an overdrive	15	185.	Function and operation of an overdrive
186.	Adjust liquid level of transmission	16	186.	Operation of fluid overdrive
187.	Adjust hydramatic drive	16	187.	Operation of hydramatic drives
188.	Remove, repair, replace transmission	16	188.	Planatory gearing in transmissions
		16	189.	Principles of torque conversion and multipliers

Drive Mechanisms

		17	190.	Function, types of propeller shafts
191.	Remove, replace universal joint	17	191.	Selection and operation of universal joint
		17	192.	Function of slip joints
193.	Remove, replace axel shafts and bearings	17	193.	Types of rear-axel drive mechanisms
194.	Adjust axel-shaft end play			
195.	Remove, replace axel assembly			
196.	Remove, replace differential assembly	17	196.	Principles of the differential
197.	Disassemble, assemble differential	17	197.	Service to differentials
198.	Remove, replace drive pinion			
199.	Remove, replace oil sela and bearings			
200.	Adjust pinion bearing			
201.	Replace ring gear			
202.	Diagnose rear axel trouble	17	202.	Trouble shooting the drive mechanism

Springs and Suspension Systems

203.	Replace leaf spring	13	203.	Types and functions of springs
204.	Replace coil spring			
205.	Replace stabilizer bar	18	205.	Front end stabilization
206.	Adjust shock absorber	18	206.	Types and function of shock absorbers

JOB TRAINING: What the Worker Should Be Able to Do	Assign. No.	RELATED INFORMATION: What the Worker Should Know
207. Replace shock absorber		
	18	208. Independent wheel suspensions

Servicing Steering and Suspension Systems

JOB TRAINING: What the Worker Should Be Able to Do	Assign. No.	RELATED INFORMATION: What the Worker Should Know
	19	209. Operating principles of steering systems
210. Test, adjust camber	19	210. Front end geometry
211. Test, adjust caster		
212. Test, adjust toe-in		
213. Test, adjust king-pin inclination		
214. Remove, replace front-suspension system		
215. Repack wheel bearings		
216. Balance wheels	19	216. Procedures of wheel balancing
217. Adjust steering gear	19	217. Steering system operation and function
218. Adjust fluid level in steering reservoir		
219. Check, adjust fluid level	19	219. Principles of power steering
220. Adjust steering unit belt tension		
221. Inspect system for leakage		
222. Diagnose steering-system troubles		

Brakes and Brake Service

JOB TRAINING: What the Worker Should Be Able to Do	Assign. No.	RELATED INFORMATION: What the Worker Should Know
	20.	223. Role of friction in brake operation
224. Adjust brake linkage	20	224. Types of brake systems
225. Check cylinder fluid level		
226. Make wheel brake adjustments		
227. Recondition brake drums		
228. Replace brake lining		
229. Check, repair master cylinders		
230. Bleed brake system		
231. Adjust parking brake	20	231. Principles of brake operation
232. Test, adjust vacuum booster	20	232. Types and operation of heavy-duty brakes

JOB TRAINING: What the Worker Should Be Able to Do	Assign. No.	RELATED INFORMATION: What the Worker Should Know
233. Adjust air brakes		
234. Test electric brakes		
235. Diagnose brake trouble	20	235. Trouble-shooting the brake system

Wheels, Tires, Tire Repair Service

JOB TRAINING: What the Worker Should Be Able to Do	Assign. No.	RELATED INFORMATION: What the Worker Should Know
	21	236. Function and types of tire construction
	21	237. Sources of tire failure
238. Analyze tire condition	21	238. Physical features of abnormal tire wear
239. Sketch tire rotation pattern	21	239. Methods of tire rotation
240. Repair tube damage	21	240. Repair service given to tires, tubes
241. Repair tubeless tire		
242. Install minor tire boot		

Air Conditioning

JOB TRAINING: What the Worker Should Be Able to Do	Assign. No.	RELATED INFORMATION: What the Worker Should Know
243. Trace freon flow in air-conditioning unit	22	243. Principles of air-conditioning
244. Test, adjust component parts	22	244. Functions of air conditioning component parts
245. Adjust freon level	22	245. Uses of freon gas as a coolant

Job Management and Pricing

JOB TRAINING: What the Worker Should Be Able to Do	Assign. No.	RELATED INFORMATION: What the Worker Should Know
	23	246. Essentials of advertising
247. Establish customer rapport	23	247. Methods of attracting business
248. Prepare central location for receiving customers	23	248. Techniques of selling service
249. Prepare service order		
		250. Sources of off-season income
251. Clean and repair service area	23	251. Off-setting free service time
252. Estimate and establish prices	23	252. Factors determining price quotations
253. Determine profit loss ratio-scale	23	253. Importance of shop overhead
254. Prepare records and make reports	23	254. Methods used to keep good records

Assignment
Sheet No. 1

Covering
Units 1-5

INTRODUCTION TO THE AUTOMOBILE REPAIR BUSINESS

Job opportunities in the automotive industry are expected to continue in a sharp rise over the next two decades. This is due primarily to the increase in the two-car families, general prosperity, and the population explosion. In addition, the increased complexity in the modern engine will open many doors to future jobs for the trained mechanic.

It is important to understand that your job is an investment for the future. As a prospective mechanic, it would be beneficial to know all the pitfalls and advantages of the trade. Such significant items as tools may be overlooked. Foolish is the person who spends hundreds of dollars, years of time and effort, in preparing for a trade that is of no interest to him.

In this assignment you will have an opportunity to learn about the significance of the automobile repairman in our society, and obtain an overall view of the future.

Assignment:

1. Read the references listed below.
2. From the classified section of a metropolitan newspaper, obtain six(6)different job opportunities in the automotive trade. What common requirements, if any, are stated?
3. Write a letter of application for the position you would like to have as obtained from the newspaper.
4. Answer the questions below and turn in the assignment by ____________________.

References:

A. Stockel, Auto Mechanics Fundamentals, Chapter 22
B. Occupational Outlook Handbook, (Obtain from Guidance Department) (D.O.T. 5-81.000 through .999)
C. either
    1. SRA -- Occupational Brief, # 610e, Automotive Mechanic.
    2. Chronicle -- Occupational Brief, # 5-81.01, Automobile Mechanic.

Questions:

1. Why should an auto mechanic know the advantages and disadvantages of the trade before entering it? What are some of the pitfalls you would expect to encounter when entering the trade?

2. What reasons can be attributed to the increased need of trained auto mechanics?

3. What type of training is necessary for success as an auto mechanic? Will an apprenticeship speed this process up? Who is an apprentice? Where can you obtain information about apprenticeships?

4. What are the primary duties of a general automobile mechanic? How do the tune-up specialist's duties differ from his?

5. Is it possible for a person to be a specialist and not have a general all-round mechanics background?

6. How much money can be earned per week on the average? As an apprentice? Journeyman?

Assignment
Sheet No. 2

Covering
Units 6-8

BASIC COMPONENTS OF THE AUTOMOBILE

The automotive industry, since it is keenly competitive, is highly specialized. It requires of its people a thorough up-to-date working knowledge of techniques and specializations. However, before specialization can take place, a broad background from which the mechanic can select his specialty must be acquired.

It is important for anyone going into a trade that he learn as much as possible about his trade. Unless the student draws ideas from many sources, his background will be limited.

The purpose of this assignment is to provide a brief overview of the component parts of an automobile.

Assignment:

1. Read the reference listed below.
2. Obtain from several new car dealers literature showing the new features on their new models, place them in a notebook.
3. Answer the questions below and turn in this assignment by ________________.

Reference:

A. Crouse, Automotive Mechanics, pp. 1-10, 38-48.

Questions:

1. What is meant by the term interchangable parts? How has this concept helped mass production?

2. How do the operating principles of the steam engine compare with those of the gasoline engine?

3. Compare an automobile frame with a chassis? Are the terms synonymous?

4. Is a complete fuel system absolutely necessary? Could an automobile operate without one of the parts? How does each part contribute to the whole system?

5. What purpose does oil serve in an engine? Why must oil be present within the engine at all times?

6. Explain what is likely to happen if the cooling system became inoperable. Trace the flow of coolant through an engine.

7. What components make up a brake system? By what principle does a hydraulic brake operate.

8. How does a slip joint differ from a universal joint? Where and for what purpose are each used?

9. Define reciprocating motion, rotary motion. How does an engine utilize these motions? How is rotary motion converted into reciprocating motion?

10. What was the purpose of placing two valves at the closed end of a cylinder? What is a valve seat? a stem? a valve guide?

11. If stroke refers to piston movement, what is meant by a four stroke engine? two stroke engine?

12. What is the relationship between the number of cylinders and engine power?

13. What basic physics principles are associated with the fly wheel? Why are teeth placed on the fly wheel?

Assignment
Sheet No. 3

Covering
Units 9-10

SHOP PROCEDURES AND SAFE PRACTICES

During the early days of the accident prevention movement the emphasis was placed on the task of providing proper safeguards for structures and machinery. Today, over 73 per cent of the accidents studied were found to be caused directly by unsafe acts of individuals.

Think twice before committing a foolish act. It may be you that ends up in the hospital or cemetary, not the machine. Safety is a way of life. Unless you practice safety with everyday awareness you may find it difficult to turn it on and off. Remember, you may last a life time if you take care of yourself.

In this assignment you will have an opportunity to learn some of the ways of avoiding accidents through the proper use of tools and equipment. Suggestions will also be given on how to cope with certain hazards that may arise in the shop.

Assignment:

1. Read the references listed below.
2. In a brief report discuss the procedure you would suggest to organize an effective program of safety for an auto repair shop.
3. A fellow worker is consistantly using a tool in the wrong manner, i.e. a wrench as a hammer. Discuss the method and tact you would suggest to help correct the bad work habits he has developed.
4. Answer the questions and hand in the report (2 or 3) prepared by ______________.

References:

A. Crouse, Automotive Mechanics, pp. 11-37.
B. Stockel, Auto Mechanics Fundamentals, Chapter 21.
C. General Motors Corporation, ABC's of Hand Tools, pp. 3-47.

Questions:

1. Discuss the six basic service classifications which all automotive jobs fall under.

2. What type of specifications are used in the modern automobile? Who is responsible for determining these specifications?

3. What significance is placed on working with clean, dry tools?

4. Explain the procedure to follow when using power driven equipment in the automotive shop.

5. Discuss the procedure used to handle and store highly flammable mixtures.
6. What characteristics should be looked for in quality automotive tools?
7. Discuss the safety practices applicable for student use in the shop.
8. Discuss the correct procedures associated with each of the hand tools, as depicted in Reference C.

Assignment
Sheet No. 4

Covering
Units 11-17

AUTOMOBILE ENGINE DESIGN

Basically, the engine may be thought of as the power source component of the automobile. It derives its power from the conversion of a fuel into mechanical energy within its walls, and the term internal combustion engine is used to denote such action.

The engine not only furnishes power for propulsion, but also, among other things, furnishes power to gererate electrical energy. The auto mechanic needs to know about the various parts that make up an engine, their function, and how to repair or replace a malfunctioning part. A large portion of the wages earned by the auto mechanic, as well as company profit, will be derived from work on the engine.

This assignment will provide the opportunity to learn some of the theories involved in engine operation. The function of the various parts and their relation to engine design will be introduced.

Assignment:

1. Read the references listed below.
2. Examine the literature obtained in Assignment Sheet No. 1. If possible, identify the various types of cylinder arrangements. Record your findings in a notebook.
3. Answer the questions below and turn in this assignment by ______________________.

References:

A. Crouse, Automotive Mechanics, pp. 61-82.
B. Stockel, Auto Mechanics, Chapter 1, 7.

Questions:

1. How does an engine convert fuel into usable mechanical power?

2. What determines whether an engine is internal combustion or not?

3. What determines the fuel for engine operation?

4. What is the purpose of breaking up gasoline into smaller particles?

5. What causes an engine fuel to ignite?

6. What causes preignition?

7. Is the shape of the combustion chamber the same for all engines? Why?

8. What determines the classification of engine cylinder arrangements?

9. What advantages do the two-stroke engines have over the four-stroke engines?

10. Discuss in a brief paper the various methods of classifying internal combustion engines.

11. What is meant by the term pancake engine when referred to a chevrolet corvair?

12. How do the intake and compression strokes of a diesel engine compare with those of a gasoline engine?

Assignment
Sheet No. 5

Covering
Units 18-33

AUTOMOBILE ENGINE COMPONENTS

This assignment is a continuation of the last and we are going to continue our study by going into greater detail concerning some of the various parts that make up the internal combustion engine.

Auto repair deals with more than just taking a car apart and putting it back together again. The successful auto mechanic must learn to make wise use of his time without going up too many "blind alleys." This involves being able to determine what is wrong without taking the engine apart. The services of one who is a good "trouble shooter" will be much sought after. However, before one can do this, he has to know what the parts are that make up the engine and how they operate.

In this assignment you will have an opportunity to study the function, design, and terminology of certain parts that go together to make up the automobile engine.

Assignment:

1. Read the references below.
2. Select an automobile engine, and list the component parts, the kind of material each part is made from, and why that particular material was chosen. (A three column chart)
3. Answer the questions below and turn in this assignment by __________________________.

References:

A. Crouse, Automotive Mechanics, pp. 83-126.
B. Stockel, Auto Mechanics Fundamentals, Chapter 2.

Questions:

1. How is a cylinder block constructed? What materials go into the casting of a cylinder block?

2. What characteristic improvement is made to a cylinder block when it is plated with chrome? Which section is plated?

3. What advantage does an aluminum cylinder head have over iron?

4. Compare the L. and I head engines noting the physical differences

5. Why is a gasket put between a cylinder head and an engine block? What material is a head gasket made from?

6. What material is used for an oil pan? What purpose is the oil pan used for?

7. Differentiate between the exhaust manifold and the intake manifold?

8. What is the function of a vibration damper? Which type of vibration does it control?

9. What are sleeve bearings? How did they obtain their name?

10. Define oil clearance in an engine bearing. How may a bearing be lubricated?

11. How much clearance is permitted in a bearing? What happens as the clearance is increased?

12. What is a semifitted bearing?

13. Discuss the requirements placed on bearings for operation.

14. What materials are bearings made from? Are all bearings made of the same material?

15. What function does the crankpin end of a connecting rod perform? What three methods are used to attach a connecting rod with a piston pin?

16. What is meant by the term "blow-by?" How can this situation be corrected?

17. What is the purpose of a compression ring? What is the purpose of having the piston ring split?

18. What is an oil spit hole? Describe the relationship between oil control rings and cylinder lubrication. What effect does speed have on oil control?

19. Why is piston clearance necessary? How much clearance is needed for proper operation? What is the result of too much piston clearance?

20. Describe a cam ground piston.

21. Why is it important to keep a sodium-cooled valve away from your skin and water? What recommendation should you give for disposing of a sodium filled valve?

22. What is a slipper skirt in piston design? A partial skirt?

23. What is a piston pin boss?

24. How does a heat dam affect a piston? What effect does it have on the top ring?

25. Why is it necessary to use expander devices with some types of piston rings?

26. What is wear in? How long does it take? How can it be speeded up?

27. What effect does a special coating have on a piston ring?

28. What device is used to control crankshaft end play? How does this device allow for taking up the end play?

29. What is an oil gallery? Where is it used?

30. What is the purpose of a starter ring gear? Where is it located?

31. What dangers are present when valve movement and timing are way out of line? Especially in new car engines?

32. How do cams differ when using hydraulic lifters rather than mechanical lifters? Why is a cam "tear drop" in shape?

Assignment
Sheet No. 6

Covering
Units 34-66

ENGINE SERVICE

The work of an automechanic might be compared to that of a doctor. For example, a doctor proceeds to diagnose the probable cause of his patient's illness before he prescribes a cure. The same procedure should be followed by the automechanic. First, he should determine the possible cause and then by process of elimination, locate the source of trouble.

It is important for the trouble shooter to plan a logical procedure before he starts work on the automobile. Such a plan will save considerable time and effort.

In this assignment you will have an opportunity to learn some of the procedures that are used in the repair of basic parts of engines.

Assignment:

1. Read the reference listed below.
2. On an 8 1/2 x 11 sheet of paper sketch the following and label the parts:
    a. a valve train
    b. a piston and rod assembly
    c. a crankshaft
3. Answer the questions below and turn in this assignment by ____________________.

Reference:

A. Crouse, Automotive Mechanics, pp. 272-332.

Questions:

1. What would result if dirt were allowed to remain within an engine after engine service?

2. What is the importance of having every portion of the engine functioning properly?

3. Discuss the conditions which cause valve burning?

4. What causes valve face wear?

5. Describe the services that could be included in a five hour valve service job.

6. What is the importance of tappet clearance on valves?

7. Is is permissable to interchange valve parts? Why?

8. What two main tests are performed on valve springs? Describe each test.

9. Describe the precautions to observe when installing valves.

10. Discuss the procedure for securing an engine head.

11. Describe the tests made on pushrods.

12. What precautions are necessary when removing carbon deposits from an engine.

13. What steps are used to service valves?

14. What service must be done to the valve seat? A valve guide?

15. What two types of valve listers are used? What is the main difference between them?

16. For what purpose is the bearing oil leak tester used? How does this device operate?

17. What is ridge ring? Why is it harmful to the removal of pistons?

18. Why is the alignment of a connecting rod important? What is likely to result from a rod being out of alignment?

19. Discuss the replacement of piston pin bushings.

20. Discuss the probable causes of bearing failure.

21. Explain the use or uses of plastigage.

22. What service is given to pistons? To piston rings?

23. Why are piston rings fitted for each cylinder?

24. What use is put to a piston ring compressor?

25. Discuss the effects of bearing wear and the condition of the crankshaft.

26. What are the main classifications of bearings? How are bearings fitted?

27. What correction is necessary to overcome crankshaft sag? What type of measurement will result from this condition?

28. When should main bearings and seals be replaced?

29. Discuss the service given to engine cylinders.

30. Why are the engine cylinders honed? Describe this process.

31. Under what conditions are the cylinder sleeves replaced?

Assignment
Sheet No. 7

Covering
Units 67-70

ENGINE TESTS, MEASUREMENTS, AND TROUBLE SHOOTING

Before an automotive tune-up specialist can diagnose an engine malfunction and tune the engine, he must know the basic ways in which engines are tested. An engine analysis cannot be done properly without the use of special instruments designed for each test.

Through these engine tests it is possible to diagnose the difficulty occuring within the engine and recommend a process to change the existing condition.

In this assignment you will have an opportunity to study various ways in which engines are measured, tested and prescribed for treatment.

Assignment:

1. Read the references listed below.
2. In a short paper discuss horsepower as related to engine torque.
3. Compare the engine tests performed on a combustion analyzer with the compression ratio of an engine cylinder. Discuss the changes as the compression ratio is increased.
4. Answer the questions below and turn in this assignment by ____________________.

References:

A. Crouse, Automotive Mechanics, pp. 49-61, 248-271.
B. Stockel, Auto Mechanics Fundamentals, Chapter 8.

Questions:

1. Compare dry friction with greasy friction.

2. Discuss the relationship between the bore of an engine and the engine stroke.

3. Explain how the compression ratio of an engine is determined. How does this compare with piston displacement?

4. What effects are noticed in engine output as the compression ratio is increased?

5. What does volumetric efficiency mean? How can one improve volumetric efficiency in an engine?

6. Compare the characteristics of brake, indicated, and friction horsepower in relation to each other.

7. Discuss the formula used to compare engines suggested by the Society of Automotive Engineers.

8. Do brake horsepower and torque have the same meaning? Why?

9. What types of engine efficiency are used to compare engines?

10. What percentage of the gasoline energy is generally used to propel the automobile? What happens to the rest of the fuel?

11. How does a tachometer operate? What measurement does it provide?

12. Compare the engine cylinder tester with the cylinder leakage tester. Which one gives the most accurate readings?

13. Of what significance is the intake manifold vacuum?

14. What information can be obtained by using an exhaust-gas analyzer?

15. What device is used to "see" around corners when working on an engine? How is this possible?

16. Discuss the importance of proper engine timing.

17. How can the test report sheet be used to benefit the mechanic?

18. What are the advantages of a systematic trouble-shooting chart?

19. What information can be obtained from an engine listening rod?

Assignment
Sheet No. 8

Covering
Units 71-97

FUEL SYSTEMS AND SERVICE

The fuel system is designed to furnish the engine with fuel. It is transferred from the fuel tank to the engine cylinders where it is ignited to furnish power to run the automobile.

There are certain adjustments and checks that the auto mechanic should be able to make on the various parts of fuel systems. It is important to have a knowledge of fuel systems so that one will be able to diagnose and correct troubles that may arise.

In this assignment you will have opportunity to study about the principles, functions, and the servicing of various parts of fuel systems.

Assignment:

1. Read the references listed below.
2. Make a pencil drawing or sketch of a simplified fues system on a sheet of 8 1/2x 11 paper. Label the main parts. On another sheet of 8 1/2 x 11 paper, explain in 200 words or less how a carburetor works.
3. Answer the questions below and turn in this assignment by ____________________.

References:

A. Crouse, Automotive Mechanics, pp. 127-172, 333-342.
B. Stockel, Auto Mechanics, Fundamentals, Chapter 6.

Questions:

1. What are the differences between a circuit and a system in a carburetor? Explain the operation of each.

2. What type of manifold system uses a ram induction? How does this unique system operate?

3. What function does muffler design serve in relationship to a fuel system?

4. What is a choke stove? Where is it used? Why?

5. Compare a liquified petroleum gas (LPG) system with a gasoline fuel system. How are they similar? Differ?

6. What limitations do (LPG) systems have as a fuel?

7. What do the letters ONR refer to in a gasoline fuel? Is this desirable?

8. How do replacable air filter elements differ from the oil bath filter?

9. What is the procedure for reconditioning polyurethane air cleaner element?

10. What main advantage does an electrical fuel pump have over a mechanical pump?

11. What does a silencing chamber of an air cleaner do? What does an air cleaner remove from the air?

12. What troubles are eliminated in using an automatic choke and not a past conventional type?

13. How does an increase in the number of carburetor barrels or carburetors as a unit increase engine performance?

14. Describe a method which can be applied in a practical sense to promote increased evaporation as the fuel enters the engine.

15. Does a fuel injection system employ a carburetor? How is atomization obtained with fuel injection?

16. What means are used to control knocking in a cylinder?

Assignment
Sheet No. 9

Covering
Units 98-109

ENGINE LUBRICATION AND SERVICE

In the fieldof mechanics, there is no single item as important as the proper lubrication of moving parts. Automotive engines of today are lubricated by means of a lubrication system that is engineered to supply the right amount of oil to all bearing surfaces within the engine.

Adequate maintenance of the lubrication system is absoutely essential to the efficient operation of an engine. Irreparable damage may be done within a very few minutes to a bearing service that is operated at high speed without oil. Proper lubrication is the best form of precaution for one to take against undue wear of engine parts.

This assignment will provide you with an opportunity to become acquainted with the types of internal combustion engine lubrication systems, their parts and their functions. Information is also presented that deals with some of the more general aspects involved in servicing engine lubrication systems.

Assignment:

1. Read the references listed below.
2. Obtain two samples (approximately 1/4 cup) of engine lubrication oil. Sample No. 1 should be new oil. sample No. 2 should be oil that has just been drained out of an automobile engine. Put each sample in a small bottle. Filter each and show the filter and the material filtered out of each oil sample to your coordinator. (Filter paper from the chemistry department or a fine woven piece of cloth may be used for this purpose). Write a brief paper describing the differences in the material that has been filtered out of each oil sample excluding color.
3. When you have completed items 1 and 2, answer the questions below and hand in with item 2 on ____________________.

References:

A. Crouse, Automotive Mechanics, pp. 172-189, 342-348.
B. Stockel, Auto Mechanics Fundamentals, Chapter 5

Questions:

1. What are the chief differences between friction and anti-friction bearings?

2. What is the purpose of classifying motor oils? Explain the three types of classifications used by the American Petroleum Institute.

3. How does the splash system of oiling an engine differ from the full pressure system?

4. What is the purpose of the by-pass valve in an oil filter? How does this function?

5. What is meant by forced ventilation of the crankcase? Will this reduce smog?

6. What does the dip stick indicate?

7. How can an oil effectively reduce engine power loss?

8. Given an oil rating of S. A. E. 10 W, what does "S. A. E." represent? What does the "W" represent?

9. Why are oil companies so careful of the viscosity index they assign an oil? What changes the index of a given oil?

10. How does viscosity index differ from viscosity rating?

11. How can a viscosity index be improved? Will an oil additive accomplish this?

12. How can we reduce sludge formations in oil?

13. How often do automobile manufactures recommend changing oil filters?

14. What is the function of a spring loaded by-pass valve in an oil system? Does this type oil system need filter changing?

15. Why is a crankcase ventilator valve necessary? Where is it located?

16. What service should be done to the lubricating system when an engine is overhauled?

Assignment
Sheet No. 10

Covering
Units 110-121

ENGINE COOLING SYSTEMS AND SERVICE

Did you know that enough heat can be produced by an ordinary six-cylinder internal combustion engine to heat a six room house? Yes, some experts claim this to be true, for temperatures over 4,000° F. are reached each time the fuel mixture is exploded within an engine's combustion chamber. Under such high temperatures the engine would not be able to continue operation without some means of dissipating a greater part of this heat into the air.

A cooling system is essential to keep an engine from "burning up." Temperatures that deviate too much from the normal should be investigated to find the cause.

In this assignment you will have an opportunity to become acquainted with types of cooling systems used on internal combusiion engines, their various parts and the functions of these parts.

Assignment:

1. Read the references listed below.
2. Obtain a cooling system thermostat and test it to see at what temperature the valve opens. (See A-349 for the procedure commonly used.) Write a brief paper summarizing the procedure and findings of your experiment.
3. Answer the questions below and turn in this assignment by ____________________.

References:

A. Crouse, Automotive Mechanics, pp. 189-199, 348-355.
B. Stockel, Auto Mechanics, Fundamentals, Chapter 4.

Questions:

1. Discuss the three major purposes of a cooling system.

2. What are three types of radiator hoses in use? Why are the variations necessary?

3. What role does pressure play in a cooling system? What does a change in atmospheric pressure do to the boiling point of liquids?

4. Where is the bulb of a bourbon tube temperature gauge located? Explain the principles of operation of this instrument.

5. How does the operation of an electric temperature gauge differ from the operation of a bourbon tube gauge?

6. Where is a vapor-pressure indicator used? What is the purpose of it?

7. Are water jackets designed to cool an engine? What relationship do they have with a water pump?

8. Differentiate between a ribbon-cellular and a tube-fin radiator.

9. List 3 types of thermostats. How does each work? Are different principles involved with each type?

10. What difficulties may arise from a faulty radiator cap?

11. Why is it necessary to test a thermostat? Is the boiling water test a good one?

12. What is the purpose of a cooling system air suction test?

13. What are some leading complaints that lead a mechanic to check the cooling system?

14. Is afterboil harmful to an engine?

15. What advantage does ethylene glycol have over alcohol as a coolant?

Assignment
Sheet No. 11

Covering
Units 122-149

PRINCIPLES AND COMPONENT PARTS OF THE ELECTRICAL SYSTEM

The modern automobile has an extensive electrical system. Rapid advancement is being made in the number of electrically operated accessories and controls that are accepted as standard equipment.

The auto mechanic should be familiar with the main components and the principles upon which they operate. A major cause of faulty performance is defects in the electrical system.

In this assignment you will have an opportunity to become acquainted with the main components of the electrical system, some of the principles involved, and their relation to one another.

Assignment:

1. Read the references below
2. In a two page paper discuss the principles of operation of an alternator as you understand them.
3. Answer the questions below and turn in this assignment by ____________________.

References:

A. Crouse, Automotive Mechanics, pp. 200-232, 356-370.
B. Stockel, Automotive Fundamentals, Chapter 19.

Questions:

1. Briefly describe several basic differences between an AC generator and DC generator.

2. What happens in a regulator as the generator speed is increased?

3. What is generator polarizing? When does a generator need polarizing? How is this accomplished?

4. What is an electrolyte? What is it made of?

5. How are batteries rated? What is the difference between a 20 and a 25 ampere hour rating in a battery?

6. How is the direction of rotation in a starting motor determined?

7. Distinguish between a bendix drive and a flo-thru drive in a starting motor.

8. What is the function of the overrunning clutch? How does it operate?

9. How is it possible to control a cranking motor?

10. What purpose is attached to a diode? Where is this part located?

11. Is a DC generator regulated the same as an AC generator? Why?

12. Why is temperature a factor to control in current regulation?

13. How does a fully transistorized regulator work? How does it differ from a conventional regulator?

14. In what ways can the three stator circuits of an AC generator be connected? Explain the necessity of more than one circuit connection.

Assignment
Sheet No. 12

Covering
Units 150-168

THE ELECTRICAL SYSTEM -- IGNITION AND LIGHTING

A knowledge of the structure, composition, arrangement and correct action of the component parts of an ignition system makes it easy to arrive at the cause of malfunctions and to prescribe a remedy.

The ability to read wiring diagrams and trace out electrical defects is important to the success of the auto mechanic.

In this assignment you will have an opportunity to become acquainted with the ignition and lighting as a part of the automobile electrical system.

Assignment:

1. Read the references listed below.
2. Sketch a typical ignition circuit, with the aid of colored pencils identify the high voltage and low voltage systems.
3. Draw a wiring diagram of an ignition coil and color code the primary and secondary windings.
4. Answer the questions below and turn in this assignment by ____________________.

References:

A. Crouse, Automotive Mechanics, pp. 233-247, 384-390.
B. Stockel, Auto Mechanics Fundamentals, Chapter 3 and Chapter 19, pp. 38, 39.

Questions:

1. What happens to the ignition system when negative polarity is used? How important is polarity?

2. Describe why points burn in a distributor. Will a condenser prevent the burning of points?

3. What is the difference between a standard spark plug and a resistor spark plug?

4. How does a mechanic set engine timing?

5. Where is a magneto ignition used? What is a flywheel magneto?

6. What type of coupling does a magneto utilize? How does this coupling operate?

7. How does a transistorized distributor system operate? What breaks the primary circuit contact?

8. How does the coil increase 12 volts to a very high voltage?

9. What is the name given to the device used to re-establish current flow in a distributor? Upon what principle does this device operate?

10. Compare the spark angle obtained from a centrifugal-advance distributor running at 1000 RPM to the same distributor running at 2000 RPM.

11. Why is an ignition coil resistor necessary? Where is it located?

12. What four indicating devices are located on most instrument panels? What functions do they perform?

13. What is the chief characteristic of a sealed beam headlight? What adjustments are necessary for its operation?

14. An oscilloscope may be compared to what device? What does an oscilloscope test?

15. Discuss the causes of ignition failure using the outline provided on page 387 of reference A.

Assignment
Sheet No. 13

Covering
Units 169-178

ELECTRICAL SYSTEM SERVICE

Since the generator does not include a means of self-regulation or distribution for its output, a device called a regulator is provided for this purpose. Usually a regulator has more than a single unit involved as components, for example, a typical regulator may have means to regulate current, voltage, or simply a cutout device.

To better understand the functions of this part of the system and to provide adequate service, a working knowledge of electricity is needed.

In this assignment, you will learn some of the methods and equipment used in regulating, testing, and servicing an automobile electrical system.

Assignment:

1. Read the reference listed below.
2. Examine a regulator for the control of current obtained from both AC and DC generators. With the aid of a sketch and colored pencils, distinguish the components by color coding.
3. Write a short paper discussing what you would test a regulator for and how malfunctions could be corrected occurring in each unit.
4. Answer the questions below and turn in this assignment by ______________________.

Reference:

A. Crouse, Automotive Mechanics, pp. 221-232, 371-383.

Questions:

1. What effect does temperature have on current regulation? What temperatures are taken into consideration?

2. Why are AC generators used without the traditional cutout relay? What accomplishes the task formerly done by the cutout relay?

3. Explain magnetic by-pass in a regulator.

4. How is the current limiter used in a three-unit AC regulator?

5. What is the function of the transistor when it is placed in a regulator circuit?

6. Describe the effects of combining a regulator and a transistor in the same circuit.

7. What steps should be taken when abnormal operations begin to show up in an electrical system?

8. Describe what happens when you ground a double contact regulator.

9. Explain the effects of a DC test on an AC regulator.

10. Why should you not polarize an AC generator? Why must a DC generator be polarized after any regulator work?

11. Why must a "load" be applied to a current regulator? How is this accomplished?

12. How is a generator tested for ground?

13. Discuss the operation of a belt tension tester.

Assignment
Sheet No. 14

Covering
Units 179-181

CLUTCHES AND CLUTCH SERVICE

In its simplest analogy the operation of a clutch may best be illustrated by placing your two hands firmly together and rotating the right hand. Notice how the left hand follows the movement. Now, separate your hands by at least one inch (as happens when the clutch pedal is depressed) and rotate your right hand again. Observe that there is no follow movement by the left hand. This is the action of a clutch.

If you were to place a grease layer on your hands and pressed them together, some slipping would occur as in the actual operation of the parts.

This assignment will give you an opportunity to become acquainted with various types of clutches used in the automobile, as well as their operating functions.

Assignment:

1. Read the references listed below.
2. Prepare a progress check list to be used when adjusting a clutch.
3. Answer the questions below and turn in this assignment by ____________________.

References:

A. Crouse, Automotive Mechanics, pp. 391-405.
B. Stockel, Auto-Mechanics Fundamentals, Chapter 9.

Questions:

1. Briefly describe the actions taking place as the driver depresses the clutch petal.
2. How does a coil spring clutch differ from the remaining clutch types?
3. What two devices are associated with the friction disk to give a smoother performance? Explain how each operates.
4. What function do the weights on the clutch release levers have on a semicentrifugal clutch? What increases the pressure on the pressure plate in this unit?
5. Discuss the characteristics of the categories to which clutch troubles may be classified under.
6. Why are most clutch noises most noticable under idling conditions?

7. Describe the process of a clutch linkage adjustment.

8. Where are the general instructions for installing clutches given?

9. Of what material is a pressure plate made? Where is a pressure plate used?

10. Describe the action of the clutch release lever mechanism? What is the role of a throw-out fork?

11. Explain how a diaphragm clutch operates?

12. What procedure is followed to adjust clutch pedal linkage? Clutch pedal free travel?

13. What are the effects of clutch riding? What two types of springs are used in a typical pressure plate?

14. What is the function of a flywheel in a clutch assembly?

15. What is a slave cylinder in reference to hydraulic clutch control?

16. Why should you disconnect the battery when working on the clutch?

Assignment
Sheet No. 15

Covering
Units 182-186

TRANSMISSIONS AND THEIR SERVICE

Transmissions are a box of gears that are placed in the automobile power train to provide separate pre-selected power ratios between the engine and the rear wheels, as well as a device to reverse the direction of the gears to permit the backing of the auto.

Most transmissions are heavy and internally complex. Although they are not a frequent source of automobile failure, they do require minor repairs. Occasionally, the auto mechanic is called on to make a major transmission overhaul.

In this assignment you will have opportunity to learn about the various types of transmissions, how they operate, and the principles involved in their maintenance and repair.

Assignment:

1. Read the references listed below.
2. Sketch a planetary gear system indicating the direction each gear rotates in first gear and reverse.
3. Answer the questions below and turn in this assignment by ____________________.

References:

A. Crouse, Automotive Mechanics, pp. 406-447
B. Stockel, Auto Mechanics Fundamentals, Chapter 10,11.

Questions:

1. How does a transmission accomplish various gear ratios between the engine and rear wheels? By what means can an automobile reverse its direction?

2. Give an example of a torque multiplier. What actually multiplies the torque?

3. Explain the difference between torque ratio and gear ratio. Give an example to prove this.

4. Explain how a 3 to 1 gear ratio might be obtained in a simple transmission. In what gear would the transmission be positioned?

5. What gears are engaged with the main transmission shaft when it is in neutral?

6. Could a transmission operate without a synchronizing device? What job does this device perform?

7. Compare the cone clutch and the pin type synchronizing device.

8. For what reasons are overdrives placed on automobiles? How much is gained by having one on your car?

9. Describe the action of a planetary gear system. Where does it get its name?

10. Explain what takes place as the driver momentarily releases the pressure on the accelerator to cut in an overdrive. With the overdrive locked out, what happens?

11. How is the engine helped by the transmission?

12. Summarize the action of a transmission.

Assignment
Sheet No. 16

Covering
Units 187-190

AUTOMATIC TRANSMISSIONS AND SERVICE

The automatic transmission is operated by fluid coupling. These principles in themselves, are not complicated. However, an understanding of their application requires considerable study. Transmission design is undergoing constant change which requires the mechanic to keep up-to-date. An understanding of the basic principles is absolutely essential before extensive work can be undertaken on automatic transmissions. This is usually done by a specialist.

In this assignment you will learn the basic principles and some of the methods of application which characterize many types of transmissions.

Assignment:

1. Read the references listed below.
2. Answer the questions below and turn in this assignment by ____________________.

References:

A. Crouse, Automotive Mechanics, pp. 448-501.
B. Stockel, Auto Mechanics, Fundamentals, Chapter 12.

Questions:

1. Explain the necessity of curving the pump vanes in a converter of a transmission. Are the turbine blades curved for the same reason?

2. How does a variable stator operate in a transmission? What is the difference between it and any other stator?

3. Why is vortex flow of oil increased in a torque converter as compared to fluid coupling?

4. What happens in a transmission as you press the accelerator to increase the speed of the auto?

5. What band is operated by a servo? What is a servo? What purpose does a servo band serve?

6. Explain how the engine power is transferred to the wheels using an automatic transmission.

7. What is a driving force? A driven force?

8. What is the function of a guide ring? What does it resemble?

9. Discuss how a speed reduction and a speed increase can be obtained with a planetary set.

10. How does the governor pressure control a transmission? Does the amount of governor pressure depend on engine speed?

11. Describe the action with a schematic diagram of a hydraulic control system for a brake band servo and clutch.

12. How is upshift and downshift accomplished in a hydra-matic?

13. List the variations between a two-coupling and a torque multiplier hydra-matic.

14. Discuss fluid coupling and torque converters noting any variations.

15. What are the implications of the stall test?

Assignment
Sheet No. 17

Covering
Units 191-203

DRIVE MECHANISMS

Essentially, there are two major problems that must be solved in the remaining drive train. They are: flexibility for rear end movement and variability to each wheel on turning curves.

The universal joint and the slip joint combined take care of the flexibility part of the problem. A differential handles the wheel rotation difficulty.

It is the purpose of this assignment to acquaint the student with the operating principles of the drive mechanisms.

Assignment:

1. Read the references listed below.
2. Write a brief report on multi speed axles including the shifting procedures used to change the axle ratios (this information may be obtained from a service manual at any automobile repair shop).
3. Answer the questions below and turn in this assignment by ____________________.

References:

A. Crouse, Automotive Mechanics, pp. 502-516.
B. Stockel, Auto Mechanics Fundamentals, Chapter 13 and 14.

Questions:

1. Discuss two main considerations used in propeller shaft design.

2. Compare the three types of universal joints used on automobiles.

3. What is a spline? Where is it used?

4. Explain the operation of a Hotchkiss drive. List the main differences between the Hotchkiss and torque-tube drives.

5. What would happen to each rear wheel on a corner if the automobile had no differential?

6. What happens to a pinion gear as an automobile turns a curve?

7. Is a differential necessary on a straight road?

8. How does a non-slip differential differ with a standard differential?

9. What determines the ratio of the differential gearing?

10. How is double reduction in an axle obtained?

11. What is the difference between a dead axle and a live axle? Give an example of how each are used.

12. Explain how a hum, growl, or a knock will indicate trouble in the drive mechanism.

13. How is blacklash in a power train detected?

14. How is it possible for a universal joint to fluxuate the shaft speed?

15. Compare the differentials on a Chrysler sure-grip rear axle with the non-slip differential of the Dodge division of the Chrysler.

16. When is it desirable to have one rear wheel rotating at a greater R. P. M. than the other?

17. Why are hypoid geared axles used? What is a swing axle? Where is it used?

Assignment
Sheet No. 18

Covering
Units 204-209

SPRINGS AND SUSPENSION SYSTEMS

Riding comfort is one of the chief characteristics that owners desire in their pleasure automobiles. Faulty springs and shock absorbers may make the control of an automobile difficult to maintain and make travel uncomfortable to the driver and passengers.

There are many different devices in use today for the purpose of absorbing shock created by irregularities in the roadbed. Some of these devices wear rapidly and requirerepair and replacement.

In this assignment you will have an opportunity to become familiar with the various types of springs and shock absorbers and how they are serviced and repaired.

Assignment:

1. Read the references listed below.
2. Answer the questions below and turn in this assignment by ____________________.

References:

A. Crouse, Automotive Mechanics, pp. 517-532.
B. Stockel, Auto Mechanics Fundamentals, Chapter 15.

Questions:

1. Discuss the differences between the four main types of springs used on automobiles.

2. What is the difference between a spring hanger and a spring shackel? How do each type hold the spring?

3. What happens to each spring leaf as pressure is applied?

4. Explain why an increase in the unsprung weight increases the roughness of the ride in the late model automobiles?

5. Why is a spring pad necessary?

6. Explain why rubber bushings are used in spring shackles?

7. Compare rear end torque in the Hotchkiss and torque tube drives.

8. What additional movements are needed in the front suspension that are not necessary in the rear end?

9. Describe the compression and rebound action in a shock-absorber.

10. What is threaded shackle? A bronze bushed shackle? A rubber bushed shackle?

11. Describe the action of a torsion bar spring.

12. Explain briefly the semi-elliptical leaf spring.

13. Explain the reasoning behind the adjustable shock absorber.

14. What is independent suspension? How does it differ from solid suspension? List an advantage of each type.

15. What care must be taken when dismantling a front suspension system?

16. How is an air compressor used in a suspension system?

17. Compare a stabilizer bar with a torsion bar.

18. What considerations must be considered when a design for a rear end is adopted?

Assignment
Sheet No. 19

Covering
Units 210-223

SERVICING STEERING AND SUSPENSION SYSTEMS

With the development of automobiles that operate at high rates of speed, the steering system has become increasingly important. Purchasers of automobiles are usually very critical of the quality referred to as "ease in handling", which is dependent to a large extent upon proper operation of the steering mechanism and suspension system.

The auto mechanic must be familiar with the principles involved in the various types of steering mechanisms and be prepared to diagnose mechanical difficulty and make repairs and adjustments.

In this assignment you will have an opportunity to learn about the various types of steering and suspension systems and how they are repaired and adjusted.

Assignment:

1. Read the references listed below.
2. Write a brief report describing either:
   a. The effects of power steering on the modern automobile, or
   b. The adjustments necessary to have proper alignment in the front end assembly.
3. Answer the questions below and turn in this assignment by ____________________.

References:

A. Crouse, Automotive Mechanics, pp. 533-571.
B. Stockel, Auto Mechanics Fundamentals, Chapter 17.

Questions:

1. Discuss the importance of front end alignment .

2. What is the relationship between the center lines of the wheel axis and steering axis? How will toe-in be affected by this relationship?

3. Discuss the angles involved to obtain proper front end alignment. Explain each type of angle.

4. Explain the effects of slip angle when turning a corner.

5. What method of adjustment is used for toe-in?

6. Compare the steering linkage between a solid axle and independent suspension.

7. Discuss the action within a manual gear box.

8. How is the amount of steering gear reduction determined for each vehicle?

9. Compare the operating principles of the two general types of power steering units.

10. Discuss the advantages of having an adjustable angle for the steering wheel.

11. What types of pumps are used to obtain pressure for the steering gear?

12. Explain the principles in the operation of power steering.

13. Compare the various suspension troubles and the effects each has on the front tires.

14. What procedure or steps would you recommend to correct car wander and car pull to one side? Are these two conditions the same?

15. What are the preliminary checks that are necessary before any alignment should be adjusted?

16. What type of service is given to the steering gear?

Assignment
Sheet No. 20

Covering
Units 224-236

BRAKES AND BRAKE SERVICE

It is important that an automobile moves, but even more important that it can be stopped. This means good brakes. One's safety is often dependent upon the effectiveness of the automobile's brakes. Because of the number of variables influencing braking action, a driver cannot afford to let his brakes get out of top working order. The auto mechanic failing in this responsibility to his customers may be directly responsible for a serious accident.

The assignment will deal with various types of brakes and some of the basic principles underlying their operation. Causes of brake failure are discussed, along with procedures for adjustment and repair.

Assignment:

1. Read the references listed below.
2. Construct two schematic sketches of a hydraulic master cylinder in a brake system.
   - A. Using a conventional master cylinder.
   - B. Using a tandem master cylinder. (Color code each of the split system separately.)
3. Answer the questions below and turn in the assignment by ____________________.

References:

A. Crouse, Automotive Mechanics, pp. 571-594.
B. Stockel, Auto Mechanics Fundamentals, Chapter 18.

Questions:

1. Explain why a liquid is able to transmit both motion and force.

2. Describe the principles of operation in the hydraulic brake system. (Pascal's Law)

3. Why is the reservoir of a master cylinder vented?

4. Describe the cycle of events within a master cylinder as pressure is exerted on the brake.

5. What type of flexible hose is recommended for brake lines?

6. Explain how to remove air from a hydraulic system.

7. What is brake fade? How is it overcome?

8. What is an anti-roll device? How does it compare with an antiskid device?

9. What types of boosters are used in power systems? Explain each type.

10. What determines the amount of friction between the brake lining and drum?

11. Explain the operations of the two main components of a hydraulic brake system.

12. Compare a conventional master cylinder with a tandem master cylinder.

13. What feature determines whether a brake is self-adjustable?

14. Compare the action of a disk brake with that of an antiskid device. Are they the same?

15. Why must brake fluid be inert? What does inert mean?

16. How does a split hydraulic system work? What type of master cylinder does it use?

17. What are some of the troubles associated with brakes? What types of adjustments are given to brakes?

18. What precautions should be followed in replacing brake lines?

Assignment
Sheet No. 21

Covering
Units 237-243

WHEELS, TIRES, AND TIRE REPAIR SERVICE

In the early stages of the development of inflated tires, the motorist expected frequent tire repair jobs on the road. He carried several spare tires and a tire repair kit. Much progress has been made in improving the pneumatic tire. Today, tire repair on the road is almost unheard of and the necessity of changing tires en route is rare.

Tires, though greatly improved, still require careful servicing. Tire failure at speeds reached by modern automobiles is extremely hazardous and, in most cases, can be prevented by proper maintenance and care.

In this assignment you will have opportunity to learn about the various types of tires and how they are constructed, serviced and repaired.

Assignment:

1. Read the references listed below.
2. Illustrate the two types of tire balance, describe the procedure used to overcome these malfunctions.
3. Complete the assignment below and turn in by ________________________.

References:

A. Crouse, Automotive Mechanics, pp. 563-566; 595-601.
B. Stockel, Auto Mechanics Fundamentals, Chapter 16.

Questions:

1. Discuss the abnormal effects occurring in tires, giving the probable cause of each. How would you correct the malfunction?

2. What is a four ply tire? How does it differ from a six ply tire?

3. Describe the two basic types of tires and give an illustration where each may be used.

4. What are the special features of a puncture-sealing tube? Compare this tube with a safety tube.

5. Why is safety such an important part of tire removal?

6. The text illustrates a method of rotating tires. Why? Is tire rotation important?

7. What types of rims are used to mount tires on most automobiles? What advantages does this rim offer? Explain the purpose of a safety ridge.

8. What two methods are common to secure a wheel to the hub? What method is used in race cars? Why?

9. What is a castle-nut? Where is it used? Why does a cotter pin secure this nut?

10. How does a front hub differ from a rear hub?

11. What materials go into the construction of a tire?

12. In what ways does a tubeless tire differ from a conventional tire?

13. What is the difference between static balance and dynamic balance in a tire?

14. Discuss the importance of proper tire inflation.

15. Interpret the chart on tire temperature and road speed as indicated on page B-16-8.

16. Describe a recommended tire rotation plan. Explain your choice of rotation.

Assignment
Sheet No. 22

Covering
Units 244-246

AIR CONDITIONING

The automobile contains numerous examples of items which were past luxuries that are now rapidly becoming a necessity. The modern a r conditioner is an example of this new changing concept in driving comfort. Essentially this device performs two operations to the air within the automobile, which are filtering the air and removing excess moisture from the air. This process is similar to a household refrigerator.

In this unit you will have an opportunity to review the principles of refrigeration and their application to the air consitioner as used in today's automobile.

Assignment:

1. Read the references listed below.
   - A. Study the color coded schematic of the freon cycle on page B-20-12 A of your text.
   - B. In a short paper discuss the operation of each component of an air conditioning system.
2. Locate a book on refrigeration in the library, investigate why freon is used as the gas.
3. Answer the questions below and turn in this assignment by ____________________.

References:

A. Crouse, Automotive Mechanics, pp. 602-604.
B. Stockel, Auto Mechanics Fundamentals, Chapter 20.

Questions:

1. Define air conditioning as used in an automobile.

2. Is air conditioning the same as cooling? What similarity between the two terms can be observed?

3. Discuss the three principles of heat transfer.

4. What does latent heat have in relationship to the B.T.U.

5. How does pressure affect liquid boiling and vaporization points?

6. What is the purpose of the sight glass in the refrigeration system? What observations may be made with the use of a sight glass?

7. Discuss the two functions of an expansion valve. What forces control this valve?

8. How does a magnetic clutch operate? What function does it perform?

9. Briefly describe the precautions necessary when handling freon.

10. What purpose does a muffler serve in an air conditioning system?

11. What process takes place in the receiver? How is this accomplished?

12. Discuss the functions of each component of an air conditioning system.

Assignment
Sheet No. 23

Covering
Units 247-255

JOB MANAGEMENT AND PRICING

The principal reason automobile repair shops are in operation is to provide services for automobile owners. However, these services are continued only if the shop owners realize a reasonable profit on their investment.

Each shop owner strives to offer the greatest amount of services for the least cost to customers and, at the same time, realize a fair return from his investment. In order to accomplish this, management is required to employ sound principles of job management and of pricing services.

In this assignment you will have an opportunity to learn about methods of receiving and routing jobs through the shop and the various methods of pricing services.

Assignment:

1. Read the reference listed below.
2. Ask your employer for copies of business forms which are used in the service department. Complete the forms using an imaginary repair order.
3. When you have completed Items 1 and 2 answer the questions below and hand in with Item 2 on ____________________.

Reference:

Information Sheet No. 1, this manual, p. 64.

Questions:

1. What is the function of a service manager? Is the owner sometimes the service manager? Why?

2. What use is made of a job ticket? Who makes it out? Where is it recorded? What happens to the carbon copies?

3. How does a job ticket compare with a contract?

4. Where can job tickets be obtained?

5. What is the purpose of recording the mileage on the job ticket?

6. What other information is needed besides the work order?

7. What confusion can be brought out between an estimate and a contract?
8. Who is responsible for a loss due to a shop fire?

9. Who is responsible for additional work found while making repairs? How should this be handled?

10. Why is it important to have all copies of the job ticket the same?

11. What types of charge rates are usually in effect while working on a repair job?

12. Who generally assigns work to the mechanic in a large shop?

13. Discuss the responsibility of making work assignments.

14. Discuss the advantages of a good record system.

15. What determines profit? What conditions or factors should be included to insure some profit?

16. Why is the actual job time important? How does this time compare with unproductive time?

17. Who should pay for unproductive shop time? How should this time be absorbed within the profit, loss system?

18. Discuss the factors to be included in the cost estimate of a job.

19. How are flat rates for job repairs established? Do they vary much from each job?

20. Who makes flat rate time studies? For what purpose are they made?

21. Discuss the ways used to determine the hourly rate for repair shops. Compare the flat rate system of price fixing with that of time and material charges.

Information
Sheet No. 1

JOB MANAGEMENT

Owners and operators of small businesses often are not aware of the extent of the responsibilities that they incur. They feel that, if they do the work specified by the customer and pay their bills, they are meeting all their obligations. However, there are other things to be considered as many businessmen have realized after it was too lat

If a businessman fails to provide adequate protection for himself and his customers he can be sued for damages obtained by any person who is injured on his premises. Of course, it is first necessary for the injured party to prove in court that there has been negligence on the part of the owner.

Obviously, every repair shop owner will want to take every possible precaution for the safety of his customers and employees. Not only should he attempt to make his shop completely safe but, in addition, he should take out insurance so that he will be protected financially regardless of what may occur.

Selecting from over 55 types of insurance policies applicable to automative sales and service, the owner should only take out those policies which he can afford and those necessary to protect him adequately.

PROPERTY HAZARDS

Many of the safeguards that can be taken by the careful shop operator are easily arranged. Others are more complicated and difficult, and will require constant attention on the part of the owner to insure that the safety rules he has made are being observed.

One of the most difficult provisions that can be made for the safety of customers and employees is a clean, oil free floor on which people can walk without danger of slipping or stumbling. Law books are full of cases where damages have been granted to persons who have been injured from falls caused by negligence in the care of floors.

The cement floor of a repair shop requires constant attention, for only a slight spot of grease can easily result in a severe fall if walked on with rubber soles or heels. It is particularly important to make sure there is no grease or litter on the floor surrounding a pit, for a fall at such a point can be extremely serious.

Tools scattered on the floor, a jack handle left protruding from underneath a car, or similar careless and thoughtless handling of equipment can cause serious injury.

Safety precautions should be taken if the shop operates certain kinds of machinery. Many dangers must be guarded against. The gearing and belting on machines must be protected by a suitable guard so that it is impossible for anything to become entangled in the moving parts. Grinding wheels should never be operated without a guard.

It is essential that all tools be inspected frequently to make sure they are safe to use. Always be sure that jacks, horses, and lifts are in perfect working order and that there is no possibility of their failure, with consequent injury to anyone underneath. Never use makeshift blocking instead of a horse or a jack to support a car.

All types of fire-fighting equipment should be inspected frequently to insure that they are in good working order and of the proper type for use against garage type fires.

TYPES OF INSURANCE

To achieve full protection against accidents and other hazards in the operation of your business, be sure that you have all necessary types of insurance. Discuss your insurance needs with a reliable insurance agent, who will advise you regarding the kinds and amounts of insurance that you require.

In general, the types of insurance found adequate to cover hazards in automobile repair shop operation are public liability, workmen's compensation casualty, fire, and theft.

Public liability will insure against any accidents that happen to customers when they are on your premises. For instance, if a customer should slip and injure himself while in your shop, the damages awarded him by the court would be taken care of by your public liability insurance. This insurance is an important safeguard, since your action in opening a shop may be construed as an invitation to the public to ente with the assurance of safety. Public liability also covers damage or injury that might be caused by your truck or other equipment used away from the premises.

Workmen's compensation insurance is designed to compensate workmen for any injuries received while on a job. It is required by law in most states when a minimum number of workmen, usually four, are employed. However, it is a protection for you against claims, regardless of the number of your employees and would be advisable to purchase if you have less than the required number of workers.

Casualty insurance covers the risk of damage to such property as buildings, machinery, fixtures, boilers, and plate glass. The value of fire and theft insurance is obvious.

INJURIES

Probably few, even of the largest shops, could maintain a thoroughly equipped emergency room. However, every shop should be prepared to furnish emergency first aid to the injured.

The first-aid kit should be fitted out as recommended by the American Red Cross. It should be replenished immediately after being used, and its contents checked once a month. These supplies must, of course, be kept clean. Cases for first-aid supplies preferably should be made of metal, and be so constructed as to exclude dust.

The effects of an accident may be intensified through lack of immediate and proper care. On the other hand, unskillful handling of a severe injury may do further harm besides causing unnecessary pain. Therefore, the first thing to do in case of a major accident is to get a doctor. Pending his arrival, no first-aid treatment should be given beyond the necessities of the emergency.

Every injury that occurs, no matter how trivial, should be noted in a record book. All cuts, scratches, and bruises should be recorded as soon as they have received attention. Any injury involving lost time requires a more formal report. Such a report usually gives the name of the employer for whom the injured worked and the industry, the name, age, sex and occupation of the worker, cause of injury and designation of the part of the body injured, steps taken to prevent similar injuries and other pertinent data.

As a rule, workman's compensation laws require the reporting of industrial injuries to the appropriate workmen's compensation board. Some of these boards require the reporting all injuries, including those involving only first aid; others, all disabling injuries; still others, only those injuries which exceed the waiting period. Therefore, you should ascertain the requirements of the compensation act applicable to your employees and comply fully with those regulations.

If you carry your compensation insurance with an insurance company, you should, of course, learn the company's requirements for reporting injuries and abide by them.

RECORDING INCOMING JOBS

The success or failure of an automotive repair shop is dependent on many factors. Among the most important and ones that directly affect customer good will are prompt attention to the incoming customer and the careful recording of all work ordered.

To insure that none of the items of repair ordered by the car owner are overlooked and that all work is paid for, it is necessary that a detailed record be kept of the repairs authorized. Most shops use the job ticket or shop order for this purpose and it is the duty of the owner or service manager to make sure that the ticket is filled out in detail.

The repair order or job ticket constitutes an actual contract between you and the car owner and binds you to do a certain amount of work. Care in filling out the job ticket will prevent any misunderstanding later as to the amount of work for which you are contracted.

If you fail to do all of the work agreed upon, the car owner can hold you responsible. On the other hand, if you do more work than was originally contracted for, you cannot force the owner to pay for the additional labor.

There are many different types of printed job tickets available, some designated especially for the large shops and others for smaller ones. They can be obtained from companies manufacturing business machines, from specialty printers, or from the companies from whom you may be purchasing fuel and lubricants. It is advisable that you study the various forms and select the type best suited to your particular business.

The job ticket used in large shops is usually made out in triplicate. The first copy serves as the customer's invoice, the second goes to the repair shop's accounting department, and the third is given to the mechanic assigned to the job so that he will know what repairs are to be made.

Usually, the job tickets provide places for the name, address, and telephone number of the car owner, the date when the work was received, the time the completed job is promised, and important facts about the car, such as make, motor and license number, and the mileage indicated on the speedometer.

Such information is required in some states as a means of enabling the police to locate stolen vehicles, but it can also be of particular use to you. For instance, the owner's name can be put in your file of persons to whom direct-mail advertising is sent. The mileage reading helps the mechanics to determine what other repairs might be necessary. Furthermore, having a record of the mileage at the time of repair will help you to disprove any claims which the owner may later make to the effect that the car failed after a few miles of driving. Other information contained on the job ticket is of extreme importance for tax, social security, and other purposes.

The major portion of the job order is devoted to listing the various repairs that are to be performed. If the repair shop is operating on a flat-rate price basis, the repair operation number should be noted and the job should be described briefly. There is space provided for writing in the labor charges for each operation and the words "estimates for labor only, material additional" are usually included near this space. This explanation is important as it is impossible in most instances to estimate all the parts that will be required for a particular repair job.

Space is provided for the car owner's signature and a statement similar to the following is usually included: "It is understood and agreed that this company assumes no responsibility for loss or damage occasioned by fire, theft, demonstration, or while road testing, delivering, and/or calling for any vehicle placed with this company for storage, sale, repair, or otherwise."

Unless such conditions are included the car owner can be awarded compensation for damage to his car resulting from fire or other accidents while it is in possession of the shop.

On two copies of the job ticket space is provided for listing all parts used in repairing the car, and their prices. The list of parts can be obtained from the requisition forms made out by the mechanic who did the job. The total cost of the parts is added to the labor charge on the face of the order to indicate what the customer shall pay.

Whether stamped in by a regular time clock or written down by the shop owner or foreman, work-time information is particularly important where the mechanic is paid on a flat-rate or some other basis involving the actual time required for the repair operation. It may also be of value in determining the relative efficiency of the various mechanics as it constitutes a record of the time they require to do the different jobs.

Upon completion of the work, the third copy of the job order is sent to the accounting department so the mechanic's pay may be calculated.

The form described above, since it is to carry all the information required by large shops, is unduly complicated for use of the shop owner employing only a few men, particularly if they are paid a straight weekly salary. The smaller shops use a simpler form, a single copy of, at most, two copies, to serve the same purposes.

When this simpler type of job order is used, one copy is given to the customer and the other is retained by the shop to supply the information needed by the mechanic assigned the job and by the accounting or bookkeeping department.

ASSIGNING AND CHECKING WORK

The shop foreman or owner, as the case may be, must assign work to the mechanics. Naturally, if there are a large number of employees, some will be found to be more skillful than others on certain types of repairing. Therefore, when possible, jobs should be assigned to the mechanics best fitted to do them. In a small shop, assignment of work should not be much of a problem because presumably any mechanic hired would be capable of turning out a good job on all parts of the automobile.

The responsibility of making work assignments involves seeing that repair jobs are completed on schedule.

It is essential that the car be ready for the owner at the time recorded on the job ticket. If the shop fails to live up to its agreement, it will probably lose trade. It is up to the service manager of a large shop or the owner of a small establishment to make careful note of the delivery promise with respect to each car, and to see that all such promises are kept.

It isn't enough to have the delivery time written on the job sheet. A record of the time promised should be kept in plain view, on a blackboard for all the cars under repair. In general, the only information required for such a record is the name of each car owner and the date and time promised.

The owner or service manager must check frequently with the mechanics to make sure that the work on each car is progressing satisfactorily and that it will be completed at the time promised. If for any reason a car cannot be ready on time, the shop operator or service manager should phone the owner and explain the delay.

Keeping a record of this sort has another distinct advantage in that it will help to discourage the person who takes the order from making promises that cannot be kept. In other words, if a shop has only one motor mechanic, the operator should not promise any more work than can be performed by that one mechanic. For example, it requires approximately 6 1/2 hours to do a valve job on an 8-cylinder car. By working fast the mechanic can finish one such job in a day and with luck might start a second. Assuming that no other jobs take precedence, the shop operator should feel safe in promising the owner of the second car that it would be ready for him the following day.

CONTROLLING FOR PROFIT

Too frequently, the shop operator neglects to include all charges when he makes up the customer's bill. It should be remembered that failure to include the price of parts, lubricants, or other materials used on a repair job can change a profitable transaction into a loss. Mechanics should be impressed with the importance of noting either on requisition blanks or in the spaces provided on the job ticket, all parts and materials required for each piece of work.

An accurate record of the time the individual mechanic takes to do various jobs assigned him is important not only because the data needed in fixing charges to the customer, but also because of the growing use of incentive pay methods based on actual work time. Therefore, time clocks, formerly found only in the larger shops, are coming more and more into use.

If a shop operator does not feel justified in going to the expense of purchasing a time clock, he must then write in on each job ticket the time the mechanic starts and finishes the job. Unless the time is checked in each case with the mechanic, this method may result in disagreement between the mechanic and the operator.

FREE SERVICE AND UNPRODUCTIVE TIME

The owner of a repair shop soon finds that he is expected to give many small services on which there is no definite charge. For example, a car with a severe engine miss may be driven up to the shop. A quick diagnosis will disclose that the miss is caused by a shorted spark plug. Obviously, it will only take a minute to clean the spark plug. since actual time spent in doing the whole job would not exceed five minutes, the shop owner will be inclined to make no charge, particularly if the car owner is a regular customer.

Free service time mounts up and a practice of not charging could result in business failure. On the other hand, the good will gained by free service should not be overlooked. The shop owner will have to weigh the value of this good will against the time lost on such jobs.

There are many ways to avoid excessive free servicing. In the case of an engine miss, the shop operator could point out to the car owner that, while only one plug was shorted at the moment, the condition which caused that one cylinder to misfire would undoubtedly be found in the other cylinders, as well. He would be justified in saying that a complete tune-up should be done, and possibly new spark plugs to insure satisfactory operation. Be sure, in each instance, to suggest all the work that is required to overcome the trouble.

Unproductive time in a shop can cause considerable loss of profit. Among the factors that can cut deeply into a shop's earning capacity are lost tools, defective or inadequate equipment, lack of intelligent management, and failure to order necessary parts and to have them ready when needed. Another factor is the time spent in selling a small job that could otherwise have been devoted to selling a complete one. Such haphazard selling forces the car owner to make repeated trips to the shop for a lot of small jobs when all the work should have been sold and completed on one trip.

COSTS AND QUOTATIONS

In order to operate a successful shop you must be sure that your charge to the customer is sufficient to allow you a profit. Many repair shops have failed because they didn't take into consideration all the expenses that had to be met. Too frequently the dollars left over at the end of a week are looked on as profit even though the rent is unpaid and there are outstanding bills.

It is only when your books have been balanced at the end of your fiscal year that you can determine definitely the extent of your earnings above your salary, but if you fix prices that allow for all cost items, you will lessen the possibility of experiencing a loss.

National averages indicate that profits for successful automotive repair shops approximate 8 percent of net sales. Naturally, there are some automotive repair shops that have profits in excess of the average, many that have profits smaller than average, and still others that are operating at a loss.

Charges for many kinds of auto repair jobs are fairly well standardized, so you will probably have no particular difficulty in establishing your prices. Originally, the procedure was to charge the customer on a time-and-material basis. Owing, however, to pressure on the part of car owners who wanted to know the cost of repairs before they were actually made, repair shops gradually adopted what are known as flat-rate prices for most operations.

Such prices were tried out rather reluctantly by many operators, as they felt it was impossible to foretell accurately how long it would take to do the jobs. However, experience soon indicated that charges could be established which were fair both to the repair shop and the car owner.

FLAT-RATE PRICES

It is true that the time required to do repair jobs of the same kind may vary. But the variation is small and the advantages of being able to quote a price before the work is performed are so great that flat-rate prices are now charged by virtually all shops.

Repair shops owned and operated by car dealers use, for the most part, the prices established by the respective car factories. Independent repair shops, working as they do on all makes of cars, use flat-rate prices established by companies specializing in fixing such rates.

Experience has shown that flat-rate prices can be established for 85 to 90 percent of all the repair operations done on an automobile. For the remaining jobs, such as straightening fenders and repairing wrecks, which cannot be given a flat-rate price, the charge is based on actual time and material.

FIXING THE FLAT-RATE PRICE

A publishing company compiling a manual of flat-rate prices first makes time studies on the repair operation to get an average time for doing that particular work. The average hourly rate that could appropriately be charged by the majority of repair shops is then selected. The prices given in the manuals are based on this average hourly rate and the average time required to do that particular job. Conversion tables are provided so that, if the individual repair shop operates on an hourly rate other than the average rate selected by the publisher, he can revise the published rate.

While the published flat-rate prices figured on averages are convenient guides, it will still be necessary for you to determine the hourly rate you should charge to repair cars in order to obtain the desired profit. Furthermore, you will need to know your hourly rate to figure any time-and-material charges you may quote.

Obviously, a repair shop on the main street of a metropolitan area has a higher overhead and, consequently, has to charge a higher hourly rate than is feasible for a smaller repair shop in some rural section. Repair shop owners starting in business frequently make the mistake of selecting an hourly rate that is too small.

There are two ways to determine the hourly rate for an automotive repair shop.

The first method, used by virtually all car dealers on the recommendation of their respective car factories, is based on the hourly wages paid to the mechanic. To determine the hourly rate by this method the mechanics' hourly wage is multiplied by a factor which ranges from 2 to 2.5. Some car factories advocate the lower factor while others are in favor of the higher one.

As an example, suppose that you are paying your mechanic $1.00 an hour. To obtain the hourly rate on which to base your flat-rate charge to the customer, you have only to multiply $1.00 by 2 or 2.5. The results from this simple method check very closely with those obtained by the second and more complicated accountant's method based on the cost of doing business.

To obtain the hourly rate by the second method, you divide the total of all costs of doing business in a month's time by the number of productive hours during that same period. By "productive hours" is meant the total time actually spent by mechanics working on cars, and would not include the time of a stenographer, bookkeeper, attendants at the gasoline pumps, or the manager.

Suppose that for a shop employing a mechanic and requiring a small amount of nonproductive bookkeeping help, the itemized cost of doing business is as follows:

Rent	$ 100
Depreciation	30
Salary, mechanic	350
Salary, nonproductive	190
Electricity	10
Telephone	5
Mail and advertising	25
Bad debts	10
Unemployment and social security taxes	25
Miscellaneous	55
	$ 800

Most of the items of business cost included above require no explanation. However, it should be pointed out that salaries for everyone in the shop must be included. Remember that you should place yourself on the payroll at a definite salary. Taxes include unemployment taxes, social security taxes, and any municipal or other taxes incurred.

If you are renting your establishment, depreciation would include only the depreciation of equipment. The amount would depend on the length of time before the equipment would normally become obsolete. If you have $1,800 worth of equipment and wish to calculate depreciation on the basis of five years, you divide the amount of worth by 60, which gives $30 as the monthly depreciation. If you own the building, instead of a rent item you would have real estate taxes, interest on mortgage and on invested capital, and certain expenses for maintaining your building.

In large shops it is frequently necessary to make different hourly charges for the work done in different departments. For example, if a shop has wheel-aligning, tune-up, car-washing, brake, and engine-overhaul departments, it would probably charge on the basis of approximately $3.50 per hour for wheel aligning and $2.50 per hour for work in the other departments.

The charge can be calculated accurately for each department by using the same procedure as suggested above for the entire shop. The only difference is that each department is assigned a certain portion of the rent and other general expenses. Naturally, only the salaries of those mechanics who work in the department are used when calculating the hourly costs.

There are other reasons for variations in the hourly rate. For example, some specialty shops, because of a high investment in equipment, charge more per hour than do other specialty shops rendering other services.

TIME-AND-MATERIAL CHARGES

The foregoing discussion deals with the problem of fixing charges on an hourly time basis. For such jobs as repairing a wrecked car or straightening a fender, the charge will have to be made on a time-and-material basis. Do not attempt to fix the charges in advance unless you have had years of experience in such estimating and quote prices that are fair to the customer and yet will insure an adequate profit for yourself.

As the term implies, time-and-material charges are based on an hourly rate and the cost of the various parts installed in the car. Determining this charge when the job is completed presents little difficulty if a time record is kept on the repair order or job ticket, or the necessary requisitions are made out by the mechanic who does the work.

Some repairmen make the mistake of using a low hourly rate when calculating the price for such jobs, in the belief that there is sufficient profit in the discount they obtained on the purchase of the repair parts installed. This is a serious error because a great many repairs on modern cars require few parts. For instance, the installation of a detent spring in a transmission may require 5 hours of work but the spring itself will cost only 20 to 25 cents.

Obviously, very little profit can be realized from the parts in such an operation but if the shop is to be successful it must obtain a profit on labor.

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A Basic Plan for the Organization and Management of Instruction in Vocational Offset Printing.

Mississippi State Dep of Voc and Tech Educ, State College
Mississippi State Univ., State College. Curriculum Lab.

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*CURRICULUM GUIDES, *TRADE AND INDUSTRIAL EDUCATION, *PRINTERS, *OFFSET LITHOGRAPHY, HIGH SCHOOLS, OCCUPATIONAL INFORMATION,

This guide is for teacher use in planning a course and developing instructional materials for trade preparatory offset printing in the secondary schools. It was developed by two trade instructors and the instructional laboratory staff by identifying the major areas of the trade and grouping the basic manipulative activities and information necessary for intelligent job performance into instructional blocks. This is a preliminary draft to be revised after review by instructors and an industrial committee. The course objective is to develop knowledges and skills that qualify the trainee for employment as an advanced learner in the trade. The analysis of operations and related instruction are outlined in instructional blocks--(1) Composition, (2) Camera, (3) Mashing and Stripping, (4) Platemaking, (5) Presswork, (6) Binding, and (7) Comprehensive Problem. The suggested number of hours assigned to each block indicates the relative amount of emphasis on each area in its relation to the total 1,080-hour training period. The teacher should be trade competent with teaching skills, and the students should be those who want, need, and are able to profit from the training. Student selection should be based on tests, school records, and personal interview. Supplementary materials include lists of recommended texts, suggested references, equipment, and supplies. This document is available for $1.00 from Curriculum Laboratory, Box NU, State College, Mississippi 39762. (HC)

BASIC PLAN
for the
Organization and Management of Instruction
in
VOCATIONAL
OFFSET PRINTING

PRELIMINARY DRAFT — — FOR DISCUSSION ONLY

Prepared and Issued by the
CURRICULUM LABORATORY
TRADE AND TECHNICAL EDUCATION
STATE DEPARTMENT OF VOCATIONAL AND TECHNICAL EDUCATION
Jackson, Mississippi

Located in the
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MEMORANDUM

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(Address) P. O. Box NU, State College, Mississippi 39762

DATE: October 6, 1967

RE: (Author, Title, Publisher, Date) Mississippi Curriculum Laboratory

A BASIC PLAN FOR VOCATIONAL OFFSET PRINTING

State College, Miss: Curriculum Laboratory of the State Department of Vocational and Technical Education, Mississippi State University, 1967

Supplementary Information on Instructional Material

Provide information below which is not included in the publication. Mark N/A in each blank for which information is not available or not applicable. Mark P when information is included in the publication. See reverse side for further instructions.

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(2) Means Used to Develop Material:
Development Group P
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Method of Design, Testing, and Trial This is a preliminary draft which is being reviewed by offset printing instructors; at a later date it will be evaluated by an industrial committee; the published form will contain the revisions recommended by these two groups.

(3) Utilization of Material:
Appropriate School Setting Vocational (trade) training
Type of Program Preparatory
Occupational Focus P
Geographic Adaptability Normally found in the secondary schools, but believed to
Users of Material be applicable at post secondary level; for use by instruc-
Users of Material tor in planning daily teaching activities.

(4) Requirements for Using Material:
Teacher Competency Trade competent, with teaching skills
Student Selection Criteria Those who want, need, and are able to profit from the training; recommend screening by testing, by examination of school records, and by
Time Allotment personal interview

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Necessary X) (Check Which)
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Describe This is a guide for use in planning instruction; it is in outline form; thus it requires supplementary references which are listed and carry bibliographical citation
Source (agency)
(address)

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On August 21 and 22, 1967, the initial draft of this publication was developed by Mr. Raford Foster, Tupelo Attendance Center, Itawamba Junior College, and Mr. Robert Lowry, Perkinston College, in a meeting on the campus of Mississippi State University. After a review of job descriptions, these instructors of offset printing were assisted by members of the Laboratory staff as they identified major areas of the trade, called blocks, and then listed the operations, basic manipulative activities, within the blocks. Next, information necessary for intelligent job performance was listed. Then, training activities which incorporated these basic skills and knowledges were listed as "Suggested Jobs". Finally, items of equipment, tools, and supplies were listed which were necessary for effective instruction.

Mr. Foster and Mr. Lowry are to be commended for their efforts in developing this material and for promoting an interest in the offset printing trade. The Laboratory staff gratefully acknowledges the assistance of the public institutions which made these men available.

This publication is the starting point for the development of instructional materials to be used by the trade instructor. A definite part of the developmental process is an evaluation and authenticating by a representative industrial committee.

HOW TO USE THIS PUBLICATION

As a tool for teaching, this publication is primarily designed for use in planning, preparing, presenting, and evaluating instruction. As a tool, it lists operations, jobs, and informational topics--with the job as the focal point. Each job should be assigned to students, either as a group, a subgroup, or individually. The following procedure is recommended as an effective teaching sequence.

Step I. -- Tell how the job is done.
Give a full explanation of the steps necessary to perform the job. Emphasize the proper sequence; stress techniques requiring special care; point out the hazards to persons and the equipment.

Step II. -- Show how the job is done.
Demonstrate the proper procedure for performing the job. Re-emphasize the sequence, techniques, and hazards. Make sure each student can see what is being done and understand the steps.

Step III. -- Have the student do the job.
Assign each student the task of applying what he has just learned. Supervise his work; correct any variation from proper procedure or any hazardous techniques. Re-explain when necessary.

Step IV. -- Check the student for proficiency.
Assign a similar job to the student to be performed independently. Observe his work and examine the completed product or service. He is proficient when he can perform the job without supervision in a prescribed length of time.

Students who have demonstrated proficiency in one job move to the next job. The teaching steps *tell, show, do, check* are used again. Students who are not proficient perform additional jobs of a similar nature and are retaught in weak areas.

Additionally, this publication can be used (1) by the director and the instructor in a local program in communicating with their craft committee, (2) by the local director in supervising instruction and program operation, and (3) by the state supervisory staff in communicating with local school administrators and in supervising the operation of local programs.

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JOB DESCRIPTION

The offset printing trade offers many opportunities for young men and women. The offset processes, as one of the major printing methods, is a rapidly-growing, ever-expanding industry. Employment potential is wide since shop size varies from that of the one-man operation to the large plant employing over a hundred persons. Equipment used ranges from less than a $1000 for a table-model duplicator to a web press costing over $100,000. Yet all major and auxiliary equipment centers around the basic offset process.

The offset printing trade is essentially one of analyzing the job, selecting and cutting stock, preparing master copy or plates with direct-impression equipment or the process camera, printing copy, and collating and binding the finished job. In the small shop all of these steps are performed by one or two persons. In the large plant, there is much specialization, even to the point of having several duplicate machines, each of which requires one or more operators.

The following are typical descriptions of job opportunities. They have been abstracted from the Dictionary of Occupational Titles, third edition.

LAY-OUT MAN (print. and pub.) 141.081.

The layout man plans page layouts, for use in preparing newspaper advertisements, books, and technical manuals.

The layout man apportions space and roughly arranges positions of copy parts which includes sketches, photographs, diagrams, body and display type, and others. He determines sizes of type and illustration to be used to obtain maximum clarity and the most desirable effect. He indicates positions of various parts by sketching lines and marks worksheets for printing. The layout man may select illustrations and direct the activities of art personnel in preparing drawings, cartoons, and similar materials to accompany printed copy.

PHOTOLETTERING-MACHINE OPERATOR (print. and pub.) 652.885. typesetter.

The photolettering-machine operator tends the photolettering machine that photographically prints display type and headings onto film or photographic paper.

He loads the film magazine, selects and positions the film font, makes the exposure, develops the film, and removes the finished product from the machine.

PHOTOTYPESET OPERATOR (print. and pub.) 650.582. photosetter.

The operator "types" on the keyboard of an automatic phototypesetting machine to photographically print type matter onto strips of photosensitive paper to prepare paper flats for making printing plates. He loads rolls of photosensitive paper or film into the camera magazine and positions the magazine. He selects fonts for enlargements, reductions, etc. and depresses keys to "type" copy. The operator removes the copy from the machine for development.

PHOTOGRAPHER, LITHOGRAPHIC (print. and pub.) 972.382. cameraman; copy cameraman; lithographic-cameraman; photographer, stone; photographer, wet plate; photolithographer; photographic process man; process man.

The lithographic photographer, or cameraman, sets up and operates a process camera to photograph illustrations and printed materials to produce film or glass negatives or reversed negatives used in the preparation of photographic printing plates.

The cameraman mounts materials to be photographed on the copy board and focuses the camera for a shot the same size, or larger, or smaller. He may select and place screens and color filters over the negative for halftone and color separations. The cameraman exposes the film to copy for specified periods of time; he develops and dries film. He prepares film or glass plate positives by the contact method.

CONTACT-FRAME OPERATOR (print. and pub.) 976.884. darkroom man; process man; lithographic contact-frame operator.

The operator controls the contact printing process and developing to produce photographic film positives or negatives for transferring illustrations or designs to printing plates or rollers.

The operator evaluates the original copy to determine the proper exposure procedure, mounts the negative and film in a contact frame, and exposes it to transfer the image. He removes it from the frame and processes it through a series of chemical baths including developer, short stop, and fixer, then he dries it. The operator repeats the above process in making a positive.

NEGATIVE-CUTTER-AND-SPOTTER (any ind.) 976.884. stripper; type artist.

The stripper retouches film negatives to prepare them for printing.

The stripper examines negatives on a glass-topped table, over light, to detect flaws. He brushes opaque over negatives to blacken bare spots and scratches. He scrapes emulsion from film, using stylus, to sharpen outlines of designs, lettering, and illustrations. He mounts whole and parts of negatives on specially blocked, opaque paper. He replaces portions by cutting out unwanted segments and replacing them with prefered copy.

OFFSET PRESSMAN (print. and pub.) 651.782. lithographic pressman; offset-press operator.

The offset pressman washes the plate to remove protective gum coating; builds up the back of the plate, when necessary; installs the plate on the plate cylinder; places folio on the blanket cylinder to bring it up to the diameter of the plate cylinder; adjusts space between the blanket and impression cylinder according to the thickness of the stock. The pressman fills the moisture fountain and regulates the moisture delivery. He operates the press to secure proof copy; examines the proof and adjusts press controls to correct maladjustments. He starts the press and completes the production run. The pressman removes the plate and cleans the cylinders. He periodically lubricates the press.

OFFSET-DUPLICATING-MACHINE OPERATOR (print. and pub.) 651.782.

The operator runs an offset-duplicating machine to reproduce single or multicolor copies of charts, schedules, bulletins, and related matter, according to oral instructions or layout and stock specifications on the job order. He installs the master copy or printing plate, regulates flow of ink and moisture from the fountains he previously filled, and selects stock feed and speed. The operator starts the machine and runs proof copy, adjusts necessary controls, and makes a production run. He cleans and files master copy or plate. He periodically cleans and oils the machine. The operator may work with auxiliary machines such as the collators, the folding machine, copy camera, and others.

COLLATING-MACHINE OPERATOR (print. and pub.) 653.885. set-making machine operator.

COLLATOR (print. and pub.) 653.687.

The collator assembles and checks copy which has been printed. The assembly may be by hand or by semiautomatic or automatic machines and may include glueing and binding on some equipment. The collator may jog assembled copy and stack; also, may drill holes in completed sets, using a drilling machine.

FOLDING-MACHINE SET-UP MAN (print. and pub.) 753.780. folding-machine adjuster.

He sets up,according to blueprint specifications, a machine that automatically folds and cuts printed sheets into signatures (pages) for binding.

FOLDING-MACHINE FEEDER (print. and pub.) 653.886.

He feeds printed sheets into the fold guide of a machine that automatically folds and cuts into pages for binding.

FOLDING-MACHINE OPERATOR (print. and pub.) 653.782. folder, machine.

He operates a machine that automatically folds and slits printed sheets into signatures for binding. He makes all adjustments such as conveyor blades, feed rollers, creasing blades, and fold rollers. He may operate two or more machines simultaneously.

BOOKBINDER (print. and pub.) 977.884. binder; finisher and bookbinder.

BOOKBINDER, HAND (print. and pub.) 977.781. binder and finisher, hand; finisher and binder, hand.

The bookbinder attaches covers to books or pamphlets, and performs book finishing operations, determining production procedures from the job order. He compresses pages, applies glue to the back edges to stiffen, trims to size and shape. He applies color to the remaining edges, fabricates a cover, and he may emboss or impress a design or lettering on the cover.

COURSE DESCRIPTION

GENERAL OBJECTIVE

To develop knowledges and skills that qualify the trainee for employment as an advanced learner in the offset printing trade.

ASSUMPTIONS

1. That trainees have had no previous experience in the offset printing trade
2. That trainees have a vocational commitment to the offset printing trade
3. That trainees have a aptitude for the trade

DESIRABLE PREREQUISITES

1. That trainees have a background in elementary mathematics, in general science, and in communications skills
2. That trainees have a course in touch-typing and have a proficiency of at least 40 words per minute

NOTE: Those desiring to enroll who lack the above prerequisites should be counseled concerning their deficiencies and then assigned to remedial couses when these are available. It is not recommended that a person lacking the above prerequisites be denied training.

NATURE OF THE TRAINING

1. The duration of the training is normally three hours per day, five days per week, thirty-six weeks per year for two years; or, six hours per day, five days per week, thirty-six weeks per year for one year--a total of 1080 clock hours of training.

2. Related instruction by lecture, demonstration, the use of audiovisuals, and others immediately precedes application by the trainee in shop practice; instruction and its application are correlated as closely as possible at all times; and the major allotment of time is given to the development of manipulative skills.

3. No instruction directly related to the trade is offered outside the shop.

CONTENT OF RELATED INSTRUCTION

Systematic and purposeful presentation of the following:

1. A review of the typewriter keyboard and a comparison with the keyboard of strike-on or direct image composers; an identification of the basic type fonts including gothic, serif, italics
2. An introduction to the methods of composing display type, such as the type stick, pressure lettering, and photographic line composing
3. A working knowledge of the principles of photography as they relate to the use of the process camera, including screens, filters, and film, to make same-size shots, enlargements, and reductions
4. A general knowledge of the theory of film development, including the composition of chemical solutions, the nature of acids and bases, the correct mixing proportions, and the measuring systems used
5. An examination of techniques of layout and stripping, especially the planning of multipage signature
6. Detailed coverage of the offset process, including the types of inks, printing stock, and control of moisture
7. An introduction to methods of collating, folding, and binding

LEVELS OF SKILL

1. Immediately employable level of skill in keyboard composing for those trainees with the prerequisite typing
2. Moderate level of skill in manual photocomposing, with increased speed to be developed after employment
3. Moderate levels of skill in mounting and shooting line copy
4. Elementary levels of skill in shooting halftone copy from good photos
5. High level of skill in masking and stripping for small presses, which will allow adaptation to larger and more complex work
6. High degree of skill in platemaking
7. A high level of skill in running simple jobs of one and two colors on small duplicators
8. A moderate level of skill in binding techniques, except hard cover binding

INSTRUCTIONAL BLOCKS

The blocks listed show the major areas of instruction. The number of hours assigned to each block indicate the relative amount of emphasis on each area in its relation to the total training period. It should not be inferred that hour allotments be rigidly adhered to or that students be rotated on a clockwork basis. On the contrary, the emphasis is on individual proficiency. It is likely that students of lesser ability will require longer periods to attain skill in certain areas. These students may gain only the minimum proficiencies while more able students progress rapidly and engage in many enriching experiences. Consequently, the planning, sequencing, and alloting of time are not designed to standardize programs, but to assist local teachers to plan carefully: to select sequence, and assign learning experiences so that instruction may be conducted efficiently and the maximum use of available time may be obtained.

MAJOR INSTRUCTIONAL BLOCKS

		Contact hours
I.	Composition	135
II.	Camera	240
III.	Masking and Stripping	120
IV.	Platemaking	60
V.	Presswork	300
VI.	Bindry	105
VII.	Comprehensive Problem	120
	Total hours	1080

ANALYSIS OF OPERATIONS

1. COMPOSITION

    A. Keyboard composer

        1. Insert and/or change the type font
        2. Change the ribbon
        3. Set margins
        4. Set tab stops
        5. Set the justification code
        6. Set the vertical spacing (lead)
        7. Set the impression control

    B. Disc-type film printer for heads

        1. Set or adjust letter spacing
        2. Set or adjust word spacing
        3. Set light exposure
        4. Mount a disc

    C. Strip-type film printer for heads

        1. Insert film font
        2. Set letter spacing
        3. Set word spacing
        4. Set light exposure
        5. Adjust for enlarging or reducing of type font
        6. Adjust for slanting of type font
        7. Adjust for expansion or condensing of type font

    D. Stick type: mount letters, numbers, etc.

    E. Pressure type: impress letters, numbers, etc.

    F. Layout equipment and tools

        1. Position work on and fasten work to a layout table
        2. Attach copy with tape
        3. Lay out parallel lines with a T square
        4. Lay out standard angles with a T square and triangles

    5. Lay out odd angles with a straight edge
    6. Draw free-hand and straight lines with a ruling pen
    7. Draw regular arcs with a compass
    8. Attach copy to a layout sheet with rubber cement
    9. Attach copy to a layout sheet with a wax coater
    10. Trim paper, film, and copy with a make-ready knife
    11. Layout copy with a proportional spacing scale

II. CAMERA WORK

  A. Shooting layouts

    1. Mount a layout and hold with a cover glass and a vacuum holder
    2. Position a glass screen and adjust distance from the film
    3. Adjust the set up for shooting percent
    4. Set the f-stop
    5. Set the timer
    6. Mount the ground glass and determine the size of film
    7. Position film on vacuum back and turn on the vacuum
    8. Expose film

  B. Darkroom techniques

    1. Mix solutions with a plastic beaker
    2. Cut film on a cutting board
    3. Handle film with plastic tongs
    4. Hang film with clips or pins

III. MASKING AND STRIPPING

    1. Scribe lines by cutting the film emulsion with a scribe
    2. Apply opaque with a brush

IV. PLATEMAKING

  A. Exposing

    1. Position the negative and plate
    2. Turn on the vacuum
    3. Flip the exposure frame (optional)
    4. Set the timer and expose

B. Developing

1. Clamp the plate to the developing table
2. Apply desensatizer with a sponge
3. Apply developer with a sponge in a holder
4. Polish plate with a cheese cloth

V. PRESS WORK

A. Stock feed

1. Set the sheet separators
2. Manually raise and lower the paper feed table; set the table for automatic raise
3. Adjust the verticle magazine guides
4. Set and/or adjust the side stack guides for the stock
5. Set and/or adjust the end guide for the stock
6. Set and/or adjust the stock height control
7. Turn on and adjust the air blower; adjust the position of the blower tubes
8. Turn on and adjust the vacuum; adjust the suction feet
9. Adjust the pull-out rolls
10. Adjust the pressure of the friction feed rollers
11. Adjust the doubles eliminator

B. Set up

1. Apply fountain solution to the moisture rollers
2. Ink the fountain and the ink rollers
3. Engage all ink and moisture rollers
4. Set and/or adjust the moisture control
5. Set and/or adjust the ink control
6. Install a sleeve on a dampening roller
7. Install a blanket on the blanket cylinder
8. Install a mat or plate on the plate cylinder

C. Feed table

1. Adjust the spacing of the conveyor tapes
2. Adjust the conveyor paper retainer
3. Set the rider wheels
4. Adjust the stationary paper guide

5. Adjust the jogger guide with the thumb screw
6. Adjust the jogger guides with the micrometer
7. Adjust the paper stops

D. Stock delivery

1. Adjust the position of the ejector rollers
2. Adjust the position of the ejector rings
3. Change the static eliminator
4. Set the sides and/or the end of the paper receiving tray
5. Engage and disengage the receding stacker
6. Adjust the lowering rate of the receding stacker
7. Adjust the side jogger on a receding stacker (course)
8. Adjust the side jogger on a receding stacker (fine)
9. Adjust the rear jogger on a receding stacker
10. Manually raise and lower the dolly in a receding stacker

E. Pressure checks

1. Adjust the pressure of the dampener roller
2. Adjust the pressure of the ink form rollers
3. Adjust the pressure between the plate cylinder and the blanket cylinder
4. Adjust the pressure between the blanket cylinder and the impression cylinder

F. Press Operation

1. Turn on the printing head
2. Engage the moisture rollers, ink rollers, and the plate cylinder
3. Feed stock

G. Lubrication and cleanup

1. Remove ink fountain and wash it up
2. Wash up the ink rollers by hand
3. Engage automatic washup attachment
4. Drain the fountain solution
5. Change the oil and wash the filter in the vacuum and blower pump jars

VI. BINDRY

- A. Collating: gather copy
- B. Plastic binding
    1. Engage or disengage punching dies
    2. Punch holes
    3. Bind with plastic binding
- C. Cutting
    1. Change the cutting stick
    2. Set the split-back
    3. Change the cutting blade
    4. Engage the hold-down clamp
- D. Numbering
    1. Change numbers and letters
    2. Number with a hand stamp
- E. Folding
    1. Set the front stop
    2. Set the top guide
    3. Set the back stops
    4. Center the feed rollers
    5. Open the folding gates
    6. Set the fold stops
    7. Set the delivery
    8. Set the scorer and the perforator
- F. Padding
    1. Clamp in a padding press
    2. Apply glue with a brush
- G. Stitching
    1. Set the stitcher for thickness
    2. Change the sizes of wire
    3. Adjust the stop to position copy
    4. Mount the plate for saddle stitching
    5. Mount the safety stop for stitching

H. Taping back edges: apply water-soluable glue tape

I. Drilling copy

1. Set the back stop
2. Set the side stop
3. Change the drill bit
4. Sharpen the drill bit
5. Mount a slotter on a round-corner attachment

J. Counting stock: count stock by hand fanning

SUGGESTED JOBS

I. COMPOSITION

A. Keyboard composing

1. Set unjustified copy
2. Set justified copy
3. Set tabular work
4. Center heads
5. Fit copy to a specified area
6. Rule forms

B. Headlining

1. Set heads
2. Set ads

C. Using stick type and pressure lettering

1. Set heads
2. Set ads

D. Laying out (line copy, halftones, and combinations)

1. Lay out business forms
2. Lay out single-page copy
3. Lay out multiple-page copy
4. Lay out multiple-color copy
5. Lay out for gang printing

E. Marking copy: proof and mark copy

II. CAMERA AND DARKROOM WORK

A. Shooting copy: enlarge, reduce, one hundred percent

1. Shoot line work
2. Shoot line work through a filter
3. Shoot halftones
4. Shoot reverses
5. Shoot for gang printing

B. Working in the darkroom

1. Set up the developing sink and check solution temperatures
2. Mix solutions for developing film: developers, short-stop baths, fixers or hypos
3. Develop and dry negatives
4. Clean up developing sinks, trays, work tables, and floors

III. MASKING AND STRIPPING

1. Mask line work
2. Mask halftones
3. Mask combination halftones and line work
4. Mask for double burns
5. Mask for multiple-color runs
6. Strip for gang printing
7. Rule forms on a negative, using a film scribing tool

IV. PLATEMAKING

1. Burn a plate (single exposure)
2. Burn a plate (double exposure)
3. Burn a plate, using the step-and-repeat technique
4. Burn each plate in a multiple-color job
5. Process a plate

V. PRESSWORK

1. Make a single-color run of line work
2. Make a single-color run of a large halftone
3. Make a multiple-color run
4. Make a run of unbalanced copy

VI. BINDRY

A. Cutting stock

1. Cut stock to specified size
2. Trim books and pads

B. Folding copy

    1. Fold letters and brochures
    2. Fold signatures
    3. Fold signatures, using scorer attachment

C. Drilling, rounding corners, and slotting

    1. Drill a two-hole job
    2. Drill a three-hole job
    3. Trim a round-corner job
    4. Cut a slotted job

D. Assembling copy by hand (collate)

    1. Assemble a job by hand
    2. Assemble a multicolor flat job
    3. Assemble signatures for saddle stitching
    4. Assemble signatures for flat stitching

E. Binding copy

    1. Punch for and bind with plastic binding
    2. Bind a job by saddle stitching
    3. Bind a job by flat stitching
    4. Bind a job by padding

F. Wrapping: wrap and label a finished job

VII. COMPREHENSIVE JOB:

Print a 16-page signature, including preparing a dummy, composing, shooting line work and halftones, masking and stripping, burning plates, printing, binding, packaging, and labeling

RELATED INSTRUCTION

I. COMPOSITION

A. Layout

1. Job titles
    - a. Layoutman
    - b. Compositor
2. Equipment and materials
    - a. Drawing board
    - b. T square
    - c. Triangles: 30-60°, 45°
    - d. Drafting instruments: compass, dividers, others
    - e. French curves
    - f. Scales (rules)
    - g. Airbrush
    - h. Proportional rule
    - i. Copyfitting tables
    - j. Type specimens
    - k. Paper catalogs
    - l. Ink charts
    - m. Pencils and crayons of various colors
    - n. Erasers
3. Sources of composition work
    - a. Printing agencies
    - b. Composition shops
    - c. In-house
4. Layout considerations
    - a. Style of lettering
    - b. Letter and word spacing
    - c. Balance
        - (1) Formal
        - (2) Informal

d. Copy arrangement

(1) U
(2) T
(3) Y
(4) S
(5) Reverse S

e. Margins and borders
f. Border decorations
g. Illustrations

(1) Artwork
(2) Line drawing
(3) Halftones

h. Copy enlargement and reduction

(1) Diagonal line method
(2) Formula method

i. Ink color
j. Paper

5. Parts of a typical layout

a. Head
b. Text
c. Illustration
d. Signature
e. Borders and margins

6. Layout procedure

a. Thumbnail sketch
b. Rough layout
c. Comprehensive layout
d. Dummy (books)

B. Cold-type composition

1. Methods

a. Typewriters
b. Keyboard composers

- c. Photographic composers
  - (1) Disc-type
  - (2) Film-type
- d. Others
- e. Stick type
- f. Pressure lettering
- g. Freehand

2. Parts of type (hot)
   - a. Body or shank
   - b. Face
     - (1) Stem
     - (2) Serifs
     - (3) Kern
     - (4) Hairline
   - c. Counter
   - d. Beard
   - e. Shoulder
   - f. Pin mark
   - g. Groove
   - h. Feet
3. The point system
   - a. The inch
   - b. The pica
   - c. The nonpariel
   - d. The point
4. Standard type sizes
   - a. Body type: 6-, 8-, 12-point
   - b. Display type: 14-, 18-, 24-, 30-, 36-, 42-, 48-, 54-, 60-point
   - c. Cast type: 72-, 84-, 120-, 144-point and larger
   - d. Agate type: 5-1/2-point for newspapers
   - e. Others

5. Type fonts
    a. Gothic
    b. Serif
6. Typewriter composition
    a. Fabric or carbon ribbon
    b. Fixed or changeable type fonts
    c. Fixed type size
    d. Fixed or proportional letter spacing
    e. Fixed line spacing
7. Strike-on composition
    a. Fabric or carbon ribbon
    b. Changeable type fonts
    c. Variety of type sizes
    d. Proportional letter spacing
    e. Variable line spacing
    f. Semi-automatic justification
8. Photographic composition
    a. Virtually unlimited point range
    b. Virtually unlimited font range
    c. Single or multiple line copy
    d. Positive or negative copy
    e. Strip, page, or roll printout
    f. Single print key
    g. Magnetic- and punched-tape operation
    h. Memory bank available
9. Pressure lettering
    a. Wide range of fonts
    b. Wide range of point sizes
    c. Numerals, letters, pictures, decorations, etc. available
10. Methods of preparing ruled forms
    a. Set hot type
    b. Hand set type

- c. Draw lines on proof copy
- d. Scribe through emulsion

11. Proofreading and copy marking
    - a. Kinds of proofs
        - (1) Metal and wood type
        - (2) Photographic negatives and positives
        - (3) Direct image
        - (4) Pasteups or mechanicals
    - b. Proofreaders marks
        - (1) Size and style of type
        - (2) Position
        - (3) Spacing
        - (4) Insertion and deletion
        - (5) Diacritical marks, signs, symbols
12. Use of the line gage

II. CAMERA AND DARKROOM WORK

- A. Theory of photography
    1. Source and nature of light rays
    2. Reflection of light rays
    3. Effect or role of a camera lens
    4. Nature of the image in a camera
    5. Nature of an image on ground glass
    6. Nature of light sensitive film
- B. The process camera
    1. Basic camera parts
        - a. The copyboard and its features
            - (1) Method of attaching copy
            - (2) Method of tilting
            - (3) Methods of care and cleaning
        - b. The lensboard and its features

- (1) The lens
  - (a) Precision glass elements
  - (b) Focal length
  - (c) Cost factors
  - (d) Distortion
  - (e) Care and cleaning
- (2) The diaphragm or aperture opening
  - (a) Construction
  - (b) The nature of f-stops
  - (c) Manual and automatic controls
- (3) The shutter mechanism
  - (a) Lens cover
  - (b) Manual and automatic control
- (4) Waterhouse stop slot
- (5) Flash lamp

c. Bellows

- (1) Composition
- (2) Care and cleaning

d. Camera back

- (1) Ground glass
- (2) Film holder
  - (a) Adhesive
  - (b) Vacuum
- (3) Glass halftone screen

e. Light source

- (1) Incandescent bulbs
- (2) Quartz-iodine bulbs
- (3) Carbon arc
- (4) Pulsed xenon

f. Controls

- (1) Automatic timers

        - (2) Foot switch
        - (3) Vacuum pump controls
        - (4) Master electrical switch
        - (5) F-stops or diaphragm control
        - (6) Reduction-magnification scale

2. Types of cameras

    a. Position

        (1) Horizontal
        (2) Vertical

    b. Placement

        (1) Darkroom or built-in
        (2) Galley

    c. Other: roll film, overhead

3. Camera copy

    a. Types

        (1) Line copy
        (2) Halftones
        (3) Color

    b. Proper care

        (1) Protective cover
        (2) Handling and marking
        (3) Storing

4. Setting up the camera

    a. Same size copy

        (1) Determining basic exposure
        (2) Determining f-stop
        (3) Setting angle and distance of lights
        (4) Determining bellows extension
        (5) Determining copyboard extension

    b. Copy to be enlarged or reduced

        (1) Determining magnification: M

        - (2) Determining copyboard extension: CE
        - (3) Determining bellows extension: BE
        - (4) Determining exposure-time factor: F
    - c. Corrections
        - (1) For paper colors other than white
        - (2) For ink colors other than black
        - (3) For different films
        - (4) For different filters

C. The film

- 1. Composition
    - a. Base: acetate, polyester, glass; .003-.008" thick
    - b. Emulsion side: gelatin and silver salts
    - c. Base side: anti-halation coating
- 2. Types
    - a. Orthochromatic
    - b. Panchromatic
    - c. Monochromatic

D. Line copy

- 1. Definitions
    - a. Line copy
    - b. Line negative
    - c. Film positive
- 2. Examples
    - a. Printed type
    - b. Pen and ink drawings
    - c. Hand lettering
    - d. Previously screened photographs
    - e. Ruled forms
- 3. Setting up
    - a. Specifying size
        - (1) Giving either width or height, not both

(2) Using acceptable measuring units

(a) Picas
(b) Inches
(c) Percent
(d) Decimal
(e) Fraction

(3) Marking printed area, rather than margin

5. Other considerations

a. Using dull white paper
b. Using dense black ink
c. Judging imperfections to be enlarged or reduced
d. Judging line widths to be enlarged or reduced
e. Specifying for reverse printing

6. Commonly used abbreviations

a. SR: scale or reproduction
b. FL: focal length of lens
c. CE: copyboard extension
d. BE: bellows extension
e. OET: old exposure time
f. NET: new exposure time
g. f#: basic aperture setting or f-number
h. Nf#: new aperture setting or f-number
i. OD: original distance of lights
j. ND: new distance of lights

E. Halftone photography

1. Problem: graduation of tone

a. Impossible on offset
b. Illusion of graduation

2. Creating the halftone dot

a. The makeup of the screen
b Effects of screening
c. Percentage of black

3. Screen grading: lines per inch
   - a. 65 line: letterpress printing of newspaper
   - b. 100 or 120 line: offset printing on rough paper
   - c. 120, 133, 150 line: typical offset printing
   - d. 150 line and over: offset printing on coated papers

4. The glass screen
   - a. Makeup
   - b. Position of the screen in relation to the film
   - c. No limitation on reduction and enlargement
   - d. Camera requirements
   - e. Cost

5. Special considerations when using glass screens
   - a. Locating screen in the camera
   - b. Setting the aperture
   - c. Determining exposure

6. Contact screens
   - a. Makeup
   - b. Types
     - (1) Magenta for negatives
     - (2) Magenta for positives
     - (3) Gray
   - c. Use, handling, and care
   - d. Cost

7. Screen-pattern films
   - 1. Makeup
   - 2. Camera requirements
   - 3. Limitations on reduction and enlargement
   - 4. Exposure length
   - 5. Compensation for improper exposure
   - 6. Cost

F. Densitometry

1. Basic terms
    - a. Densitometry
    - b. Opacity
    - c. Density
    - d. Transmittance
    - e. Reflectance
    - f. Transmission density
    - g. Reflection density
    - h. Density range and scale

2. Classes of copy
    - a. Ideal photographic copy
    - b. Low-key photos
    - c. High-key photos
    - d. Drop-out halftones

3. Types of densitometers
    - a. Calibrated gray scale
    - b. Visual-type
    - c. Photoelectric-type

4. Film sensitivity factors
    - a. Contrast
    - b. Color
    - c. Speed

5. Contrast characteristics

6. Techniques of contrast control
    - a. Shadow flash exposure
    - b. Highlighting or bump exposure
    - c. till development
    - d. Filter employment

7. Evaluating negatives

8. Making a negative from a halfton print
    - a. Shooting as line copy
    - b. Rescreening

9. Combination prints

  a. Regular: black lettering on halftone
  b. Open: white lettering on halftone
  c. Rectangles: black or white rectangle with reverse lettering
  d. Lines and arrowheads

G. Color separation and color process

1. Preparation of negatives

  a. Use of the circular-dot halftone screen

    (1) 90° for yellow
    (2) 75° for red
    (3) 15° for blue
    (4) 45° for black

  b. Exposure times and methods
  c. Use of filters
  d. Types of film

2. Methods of development
3. Duotones, duographs, duotypes

H. Darkroom work

1. Essential feature of a darkroom

  a. Absolute darkness
  b. Light-tight storage

2. Highly recommended features

  a. Hot and cold running water, with a drain
  b. Developing sink

    (1) Corrosive resistant
    (2) Temperature control

  c. Electricity: 110v, single-phase, 60-cycle, alternating current
  d. Safe lights
  e. Ventilation
  f. Camera-back built in to one wall

3. Desirable characteristics
    a. Air control: temperature, humidity
    b. Shelving
4. Use and care of film
    a. Storage
    b. Age or shelf life
    c. Handling
    d. Loading camera and exposure cabinets
5. Units of measure
    a. Ounce
    b. Liter
    c. Gram
    d. Grain
6. Developing solution
    a. Function
    b. Content
        (1) Reducing agent
        (2) Accelerator
        (3) Governor
        (4) Preservative
        (5) Other
7. Short-stop bath
    a. Function
    b. Content
        (1) Acid
        (2) Other
8. Fixer
    a. Function
    b. Content
        (1) Acid
        (2) Hypo
        (3) Alum

9. Procedure for developing and fixing
    a. Formulas and mixing
    b. Temperature control
    c. Technique
        (1) Agitation
        (2) Still
        (3) Combination
10. Checking chemicals for strength and age
11. Methods of drying
    a. Line or natural
    b. Chemical or solution
    c. Forced
12. Photographic papers
    a. Uses
        (1) Pasteups
        (2) Paper negatives
    b. Types
        (1) Contact-printing
        (2) Enlarging
        (3) High-contrast

III. MASKING AND STRIPPING

A. Equipment

1. Layout table
2. Steel rules with beveled edges
3. Steel triangles: 30-60°, 45°
4. Scribing tools
5. Scissors
6. Assorted sizes of artists brushes
7. Magnifying glass
8. Steel square
9. Dividers

10. Compass
11. India ink
12. Opaque solution
13. Transparent tape with dispenser
14. Red photographic tape with dispenser
15. Stripping knife with replacement blades

B. Terms

1. Flat
2. Goldenrod
3. Stripping
4. Reference lines
5. Register marks
6. Gripper edge

C. Laying-out procedure

1. Cleaning up the layout surface
2. Laying-out the flat
    a. Cutting goldenrod to plate size
    b. Positioning and lining
    c. Locating, drawing, and labeling the center line
    d. Identifying the trim size
3. Stripping-in the negative
    a. Positioning the negative
    b. Inspection and opaquing
    c. Trimming
    d. Scribing reference marks
    e. Taping
    f. Cutting windows
    g. Scribing lines
4. Cutting reference marks
    a. Cylinder or register
    b. Trim, fold, and cut marks
    c. Other marks
5. Step-and-repeat layout

6. Combinations
    a. Positive lettering
    b. Reverse lettering
7. Stripping for two-color jobs

IV. PLATEMAKING

A. Plate characteristics

1. General types
    a. Masters, usually for duplicator sizes
    b. Plates, usually metal
2. Composition
    a. Paper
    b. Plastic-coated paper
    c. Acetate
    d. Zinc
    e. Aluminum
    f. Copper
    g. Steel
    h. Combinations: laminates
3. Methods of attaching to the cylinder
    a. Looped for posts
    b. Straight for clamping
    c. Oval holes for posts
    d. Punched for pin bars
4. Thickness
    a. Small size: .005-.012"
    b. Large plates: .020 and thicker
5. Other features
    a. Clear area
    b. Image area
    c. Surface grain

6. Main types by process: surface plates
    a. Direct image
    b. Presensitized
        (1) Contact printed
        (2) Photo-direct
7. Additional types
    a. Other surface plates
    b. Deep-etch plates
    c. Relief plates
8. Care of plates
    a. Unexposed plates
        (1) Avoid light
        (2) Handle by edges
        (3) Avoid any abrasive action
    b. Developed plates
        (1) Gumming: gum arabic
        (2) Putting under: asphaltum
    c. Storage
        (1) Drawers
        (2) Hangers

B. Plate and master making
1. Direct-image masters
    a. Construction
    b. Typing or composing
    c. Drawing and lettering
2. Plate-exposure in vacuum frames
    a. Construction of the equipment
    b. Light source
        (1) Mercury-vapor
        (2) Carbon-arc

c. Determining exposure

3. Presensitized masters

   a. Coatings

      (1) Diazo

      (2) Others

         (a) Silver halide
         (b) Biochromated
         (c) Ferric
         (d) Photo polymers
         (e) Photo-electrostatic
         (f) Thermographic

   b. Processing of negative-working plates

      (1) Exposing
      (2) Desensitizing
      (3) Gumming

   c. Processing of positive-working plates

      (1) Exposing
      (2) Staging-out
      (3) Developing
      (4) Intensifying
      (5) Gumming

4. Transfer plates

   a. Gelatin-silver-emulsion
   b. Silver-diffusion
   c. Electrostatic dry transfer

5. Repairing plates

V. PRESSWORK

A. Basic principles

1. Grease and water do not readily mix

        - a. Imaged plate area
            - (1) Attracts ink
            - (2) Repels water
        - b. Clear plate area
            - (1) Receptive to water
            - (2) Repels ink
        - c. A balance of ink and water
    - 2. The image transfer
        - a. The transfer (offset) of a positive image from the plate to a reversed image on the intermediate cylinder
        - b. The transfer (offset) of a reversed image on the blanket cylinder to a positive image on the paper

- B. Historical sketch
    - 1. Alois Senefelder
    - 2. Stone lithography
    - 3. Early presses
    - 4. Currier and Ives
    - 5. Daguerreotype pictures
    - 6. Early negatives
    - 7. The halftone screen
    - 8. Photo-offset lithography

- C. Offset press fundamentals
    - 1. The major systems
        - a. Dampening system
            - (1) Fountain solution
            - (2) Moisture control
            - (3) Moisture rollers
            - (4) Roller composition and covers
        - b. Inking system
            - (1) Ink fountain
            - (2) Ink control

- (3) Ink rollers
- (4) Roller composition

c. Combination ink - water delivery system

d. Main printing unit

- (1) Three cylinder design
    - (a) Plate cylinder
    - (b) Blanket cylinder
    - (c) Impression cylinder
- (2) Two cylinder design
    - (a) Plate-impression cylinder
    - (b) Blanket cylinder

e. Feeder unit

- (1) Friction feed
    - (a) Rubber feed rollers
    - (b) Stock-height guide
    - (c) Stop fingers
- (2) Vacuum feed
    - (a) Blower motor and blast tubes
    - (b) Vacuum motor and sucker feet
    - (c) Stock-height guide
    - (d) Pull-out rolls
    - (e) Doubles-eliminator

f. Register board

- (1) Conveyor tapes
- (2) Skid wheels
- (3) Jogger
- (4) Stop fingers
- (5) Forward feed rollers

g. Delivery system

- (1) Ejector rollers and stripper strap
- (2) Chain delivery and receding stacker

D Moisture control

1. Content of the moisture fountain solution

   a. Distilled water
   b. Acid
   c. Other

2. Checking and maintaining the pH

   a. pH scale
   b. Litmus paper check

E. Offset inks

1. Requirements

   a. Non-emulsifying
   b. High resistance to breakdown

2. Composition

   a. Vehicle: linseed oil
   b. Pigment: usually from coal tar
   c. Modifiers: control compounds

3. Manufacture

   a. Preparing
   b. Mixing
   c. Grinding
   d. Testing
   e. Packaging

4. Color mixing: basic colors required

   a. Yellow
   b. Red
   c. Blue
   d. Orange
   e. Green
   f. Purple
   g. White
   h. Black

        - i. Job black
        - j. Halftone black
        - k. Metallic ink
        - l. Water colors
    - 5. Terminology
        - a. Viscosity
        - b. Tack
        - c. Opacity
        - d. Permanence
        - e. Transparency
        - f. Fugitive
        - g. Resistance
        - h. Lakes
    - 6. Storing ink
- F. Maintenance
    - 1. Cleanup
        - a. Inking system
        - b. Moisture system
    - 2. Roller care and storage
        - a. Rubber rollers
        - b. Covered rollers
    - 3. Lubrication
        - a. Vacuum and air filters
        - b. Bearings
        - c. Others
- G. Troubleshooting
    - 1. Poor copy
        - a. Washed out
        - b. Scumming
        - c. Too dark
        - d. Blurred copy

- e. Streaks
- f. Uneven printing

2. Pressure checks

    - a. Form roller pressure
    - b. Plate-to-blanket pressure
    - c. Blanket-to-impression-cylinder pressure
    - d. Pullout roll pressure
    - e. Forward feed roller pressure
    - f. Skid wheel pressure

3. Additional checks

    - a. Ink
    - b. Moisture
    - c. Glazed rollers
    - d. Stripping of rollers
    - e. Other

VI. BINDRY

A. Paper

1. Requirements

    - a. Affinity for ink
    - b. Resistance to breakdown
    - c. Flat surface
    - d. Line- and fuzz-free

2. Pulp: raw material for paper

    - a. Kinds of pulp
        - (1) Mechanically-ground wood
        - (2) Old paper
        - (3) Chemical wood
        - (4) Rag
        - (5) Cotton
    - b. Process of making paper
        - (1) Reducing to fiber

        (2) Beating
        (3) Refining
        (4) Sizing
        (5) Loading
        (6) Forming
        (7) Calendering
        (8) Packaging

    3. Terms

        a. Ream
        b. Package
        c. Piece
        d. Sheet
        e. Felt side
        f. Wire side
        g. Grain
        h. Basis (substance)
        i. Weight
        j. Coated

    4. Testing the direction of grain
    5. Paper cutting

        a. Equipment

            (1) Manual
            (2) Power

        b. Figuring pieces from a sheet

    6. Controlling stretching and shrinking of paper

B. Jogging

    1. Hand methods
    2. Mechanical methods

C. Gathering and collating

    1. Distinguishing gather from collate
    2. Hand methods

        3. Mechanical methods
            a. Semiautomatic
            b. Automatic
    D. Stapling, stitching, and sewing
        1. Stapling
        2. Stitching (metal wire)
        3. Saddle stitching
        4. Sewing (cord or string)
    E. Punching and drilling holes
    F. Folding, scoring, slitting, and serrating
    G. Padding

VII. COMPREHENSIVE PROBLEM

    A. Receiving the job order
    B. Estimating supplies
    C. Planning layout
    D. Composing
    E. Shooting line work and halftones
    F. Making the plate
    G. Production running
    H. Binding

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EQUIPMENT LIST

Quantity	Item
1	Offset press, 17 x 22; pinbar clamp, chrome-plated cylinders; pump and drive motor(s) minimum of 3/4 hp (total), 60 cycle, 120v, 1-phase; 3500-5500 iph running capacity; vacuum feed; chain delivery; spray gun attachment; double sheet eliminator; 2 work lights, one over cylinders, one in chain delivery
2	Offset duplicators, 11 x 17; pinbar clamp; chrome-plated cylinders; pump and drive motor(s) minimum of 3/4 hp (total), 60 cycle, 120V, 1-phase; 3400-8400 iph running capacity; vacuum feed; chain delivery; spray gun attachment; double sheet eliminator; 2 work lights, one over cylinders, one in chain delivery
1	Offset duplicator, 10 x 15; pinbar clamp; chrome-plated cylinders; pump and drive motor(s) minimum of 1/2 hp (total), 60 cycle, 120v, 1-phase; 3400-8400 iph running capacity; vacuum feed; friction-roller delivery; 8600 iph
	NOTE: Recommend one machine of each major manufacture
1	Camera, process; vacuum film holder, 16" x 20"; ground glass graduated in inches, 16" x 20"; one piece bellows, supported; multi-element, color corrected lens with 200% enlargement and 20% reduction; 21 x 25, glass covered copyboard with rotating and tilting features; manual iris diaphragm control; shutter control to include foot switch, lamp contactor, and electric timer; with 4 quartz-iodine lamps, 1500w; 115v, 60 cycles, single-phase, a-c current
15	Quartz-iodine lamps, replacement; for above camera
2	Composing machines, keyboard; differential letter spacing; variable line spacing; carbon ribbon; replaceable type fonts (elements) with 7-12 point range; electric, 115v, 60 cycle, single-phase, a-c current; with coders for keyboard
1 each (7-,9-,10-, 12-point)	Type fonts (elements); serif, san serif, gothic; italic, regular, bold
2	Ruling fonts
	NOTE: Recommend one composing machine of each major manufacture
2	Typewriter stands and chains for the above composers
1	Line composer, photographic; 6- to 84-point type size; single line composer acceptable, multiple line composer preferred; equipment preferred which will enlarge, reduce, and/or slant type font

3	Light tables; for layout and stripping; minimum glass area 24 x 36"; 60 watts of fluorescent lighting; graduated scales, both horizontal and vertical; steel T square for each table, 36"; 110-v, 1-phase, 60-cycle, a-c current; each table with a stool which has a back
2	Light tables for layout and stripping; tilt-top; minimum glass area 20 x 30"; 60 watts of fluorescent lighting; graduated scales, both horizontal and vertical; steel T square for each table, 36"; 110-v, 1-phase, 60-cycle, a-c current; each table with a stool which has a back
5	Tables or stands for the above light tables
1	Light table, precision; for layout and stripping; minimum glass area, 30" x 42"; horizontal and vertical straight edges, steel, geardriven, vernier spacing mechanism; minimum 60 watts of fluorescent lighting; 110-v, 1-phase, 60-cycle, a-c current; mounted on stand with drawers; with a stool which has a back
3	Triangles, plastic; 30-60°, 10"
3	Triangles, steel; 30-60°, 10"
3	Triangles, plastic; 45°, 10"
3	Triangles, steel; 45°, 10"
6	Scales, steel; level edges; 18"
2 sets (8 pieces ea.)	French curves; plastic; assorted sizes
3 kits (7 pens ea.)	Ruling pens; one each of the following sizes: 00, 0, 1, 2, 2-1/2, 3, 4; with handle, ink bottle, cleaner bottle, in a box
2 sets	Needle points
6 kits	Knives; for layout and stripping; one with fixed head, one with swivel head; both with replaceable blades
3 dozen assorted	Artists brushes, camels hair
3	Magnifying glasses, clamp-on type; 4-1/2 diameter; 24" flexible arm
3	Magnifying glasses; floor-model; 4-1/2" diameter; 24" flexible arm
1	Galley cabinet; for pressure lettering storage; single tier; 25 galleys, 8-3/4 x 13"
1	Cutting board; for paper; 24"; maple board, 1/2" scoring; with safety guard
1	Wax coater, electric; 110-v, 1-phase, 60-cycle, a-c current

1	Developing sink; temperature control; non-corrosive work areas; sink area must be large enough to hold three 18 x 24" trays
1	Viewing unit; minimum glass area 18 x 24"; unit may be combined with developing sink
3	Safelights; for darkroom; one amber, one red, one green; 15 watt, 110-v
1	Platemaker or exposure cabinet: carbon-arc light or equal; minimum 20 x 26", vacuum frame; flip-top design preferred; 220-v, 1-phase, 60-cycle, a-c current
1	Plate sink; 20" x 26" working area; with flushing line
1	Paper cutter; power; 30-1/2 cutting width; 2 hand safety control; 220-v, 1-phase, 60-cycle, a-c current
1	Paper folding machine; 17" x 22"; 2 front and 3 side folds; vacuum feed; perforating and scoring heads; stripping fingers; 110-v, 1-phase, 60-cycle, a-c current
1	Stitcher, wire (stapler) power; for both side and saddle stitching; range up to 3/4"; 110-v, 1-phase. 60-cycle, a-c current
1	Paper drill, power: foot-pedal-operated, automatic trip gage; capacity 2", 1/8-1/2" drill; to include electric switch, 24 assorted drills, 36 drill blocks, 2 sharpeners, slitting-slotting-and-round-corner attachments, straight knives (1/8, 1/4, 7/16"); 110-v, 1-phase, 60-cycle, a-c current
1	Cabinet; for unexposed plate and film storage; light-tight; 17 x 22"; may be built-in to darkroom
1	Hand numbering stamp; 1/4"; adjustable for repeat, duplicate, and consecutive numbering
1	Paper punch, 3 hole; for up to 8-1/2" x 11" stock; adjustable
1	Padding press; hand-operated screw; 18" wide
As req.	Storage cabinets, exposed offset plate· for standard size plates: 10 x 15", 11 x 17", 17" x 22"; with hangers
1	Punch, plastic ring binding; manually operated
1	Binder, plastic ring; manually operated
	NOTE: punch and binder may be ordered as a single unit
3	Tables, utility work; 30w x 901 x 30"h; laminated maple top; with steel legs and storage shelves
2	Gathering racks
	Tape dispensers

SUPPLIES LIST

The quantity and nature of printing jobs selected for training by the instructor are the factors which determine the supplies needed. The list which follows suggests typical items.

Quantity	Item
	Brushes: artists camel hair; assorted sizes
	Blanket, offset: rubber, in sizes for each type duplicator or press
	Cement: rubber (with thinner); padding
	Chemicals, darkroom: developer, stop-bath, fixer, dryer
	Erasers: art gum; ruby; offset-master
	Film, darkroom: in sizes to fit camera and work planned
	Hand cleaner: oil-emulsifying-type; abrasive soap; mild soap
	Ink, offset: job black, halftone black, opaque white, transparent white, red, green, blue, yellow, varnish; india ink for drafting and layout
	Lubricants: gear grease, light oil, and others as recommended by equipment manufacturer
	Masking and stripping paper
	Plates, offset: paper masters, acetate masters, and aluminum plates to fit duplicators and presses ordered
	Pencils: 4H, 2H, F, B; reproducing; non-reproducing
	Pens: reproducing, with refills
	Pressure lettering: a range of fonts, and point sizes
	Paper, wrapping: for packaging completed jobs
	Stock: card stock, paper, onionskin, etc; a range of sizes, colors, textures and other characteristics
	Sponges: for developing and cleaning plates

Solutions for plate making and preserving: etch; gum preservative; laquer; desensitizer

Solutions for the offset process: blanket cleaner; deglazer; fountain concentrate; pH (litmus) paper; spray fix

Tape: drafting; dummed wrapping; transparent; lithographic opaque

VT001 829

VT 001 829

Mechanic, Electronic (Industrial), Suggested Guide for a Training Program.

Chambers, W. W.
Office of Education, Washington, D.C.
Pub Date - 65
MF AVAILABLE IN VT-ERIC SET 42p.

*CURRICULUM GUIDES, *TRADE AND INDUSTRIAL EDUCATION, *ELECTRONIC MECHANICS, *ELECTRONICS, POST SECONDARY EDUCATION, PROGRAM PLANNING,
MDTA Programs,

This curriculum guide is for administrator and teacher use in organizing courses and developing course content for post-high school programs to prepare persons for employment as electronic mechanics. It was developed by the Ohio State University under contractual arrangements with the U.S. Office of Education Division of Vocational and Technical Education. The objectives of the course are to prepare trainees to (1) solve mathematics problems involved in electronic work, (2) read, interpret, and use electronic drawings, and (3) understand and make practical applications of the fundamentals of electricity, electronics, and electronic and magnetic controls. Some of the 7 units are (1) Basic Mathematics for Electronics, (2) Fundamentals of Electricity, and (3) Fundamentals of Electronic Controls. Each unit gives the suggested training time, objectives, and subject matter outlines. The time allocations for each unit within the 2,000 hour course may be changed to meet trainee and community needs. The teacher should understand the philosophy, objectives, and requirements of the program and meet state teacher certification requirements. Students should have a high school education or maturity as needed to profit from training and have satisfactory scores on the General Aptitude Test Battery B-359. Suggestions for teaching the course, a list of references, and suggested equipment, tools, supplies, and training facilities are included. (HC)

MECHANIC, ELECTRONIC (INDUSTRIAL)

A Suggested Guide
for a Training Course

U.S. DEPARTMENT OF HEALTH, EDUCATION AND WELFARE

Office of Education

MECHANIC, ELECTRONIC (INDUSTRIAL)
D.O.T. Occupational Code 5-83.444
Suggested Guide for a Training Program

U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE

John W. Gardner, Secretary

Office of Education

Harold Howe II, Commissioner

Manpower Development and Training Program

FOREWORD

There has been a tremendous growth and development in the practical applications of electronics in recent years. Industry is making increasing use of electronics in the development of modern technological improvements in methods of production. This has created a demand for mechanics who are qualified to install and service electronic apparatus and equipment.

This suggested guide has been developed for use by administrators and teachers in organizing courses and developing course content for programs designed to prepare individuals for employment as electronic mechanics. It was prepared under contract for the Division of Vocational and Technical Education by the Instructional Materials Laboratory, Trade and Industrial Education, The Ohio State University, under the direction of Dr. Robert M. Reese, Department Head, Trade and Industrial Education Services, and W.F. Stover, Consultant, Instructional Materials Development.

Appreciation is expressed to W.W. Chambers, Lima, Ohio, a former vocational teacher, teacher educator, and local supervisor of trade and industrial education, for the preparation of the content of this guide; and to the following persons who served as consultants in developing and reviewing the content: C.H. Ayers, Electronics Instructor, Lima Senior High School, Lima, Ohio; and H.K. Omer, Electronics Engineer, Westinghouse Electric Corporation, Lima, Ohio.

The sequence of units may be changed to meet local needs and requirements. This flexibility of content makes possible its use for initial development of untrained persons and also for upgrading and retraining workers already employed.

A suggested list of texts and references, training aids, equipment, tools, supplies, sources for purchase of same, and a floor plan of a suggested facility has been included to assist administrators and teachers in organizing new courses. The assistance of local advisory groups should be sought for guidance in selecting equipment which will best serve the local conditions. Modification of the suggested shop layout should follow advisory committee recommendations.

The increased applications of electronic principles to industry will probably continue at a high rate. This will assure a continuing demand for well-trained mechanics. Trade extension classes for workers in this field should expand to keep pace with the demand.

Walter M. Arnold
Assistant Commissioner
for Vocational and
Technical Education

CONTENTS

TRAINING PROGRAM FOR MECHANIC, ELECTRONIC (Industrial)

General Plan for the Course

The following suggestions are for training persons who are to become industrial electronic mechanics.

Teachers must adjust and adapt the suggestions in this guide to the needs of the particular group they are teaching because the duties of the electronic mechanic may differ from industry to industry, and the trainees will vary in education, experience and ability. In addition to having firsthand information concerning job requirements, the teacher must secure as much information as possible about the trainees. The specific objectives, teaching methods, and time allotted to each aspect of the training can then be adjusted to the local situation and to the trainees.

Job Functions

The industrial electronic mechanic repairs electronic equipment such as computers, industrial controls, transmitters, antennas, and servomechanisms following blueprints and manufacturers' specifications and using hand tools and test instruments; tests faulty equipment and applies knowledge of fundamental operation of electronic units and systems to diagnose cause of malfunction; tests electronic components and circuits to locate defects using instruments, such as oscilloscopes, signal generators, ammeters, and voltmeters. He replaces defective components and wiring and adjusts mechanical parts using hand tools and soldering iron; aligns, adjusts, and calibrates equipment according to specifications; calibrates testing instruments; maintains records of repairs, calibrations, and tests.

Program Objectives

To prepare trainees:

1. To solve the mathematical problems involved in electronic work.
2. To read, interpret, and use electronic drawings, symbols, and diagrams and to do simple sketching and drawing.
3. To understand and make practical application of the fundamentals of electricity.
4. To understand and make practical application of the fundamentals of electronics.
5. To understand and make practical application of the fundamentals of electronic and magnetic controls.

It is suggested that the teacher review carefully the "Criteria for Evaluating Trainee Readiness for Employment" (see page 23) prior to developing plans for teaching this course. The criteria will be useful throughout the course in setting up specific objectives, providing learning experiences, and making periodic evaluations.

Teacher Qualifications

A qualified teacher for this course is one who satisfactorily meets all the requirements for a State vocational trade and industrial education teaching certificate. He must understand the educational philosophy, the objectives and specific requirements that characterize this program. He must be flexible enough to adjust the course to the needs of the individuals enrolled and the occupation they are preparing to enter.

Trainee Qualifications

A trainee should have a high school education or such maturity as needed to profit from the training. Graduation from a vocational course in electricity would be most desirable. He should be required to make a satisfactory score on the U.S. Employment Service General Aptitude Test Battery B-359. He must have the patience to do very tedious work and the ability to perform the math problems involved.

Length of Course and Course Units

A basic course of approximately 2000 hours is suggested for the training. It is further suggested the course be taught 8 hours a day, 5 days a week, for 50 weeks. In all probability, much outside study will need to be done in order to complete the course in the time suggested. The following suggested time in hours for each of the units can be used as a guide for planning a course to meet trainee and employer needs.

Course Unit	Title	Hours
I.	Orientation to the Occupation of Mechanic, Electronic (Industrial)	10
II.	Basic Mathematics for Electronics	180
III.	Electrical and Electronic Drawing, Symbols, and Diagrams	50
IV.	Fundamentals of Electricity	780
V.	Fundamentals of Electronics	600
VI.	Fundamentals of Electronic Controls	260
VII.	Fundamentals of Magnetic Controls	120
	Total	2000

Course Unit I

ORIENTATION TO THE OCCUPATION OF MECHANIC, ELECTRONIC (Industrial)

Suggested Training Time 10 Hours

Objectives

To orient trainees to the development, nature and scope of the present-day electronic industry.

To provide trainees with an understanding of the importance of the occupation of electronic mechanic.

To assist trainees in a realization of the technical knowledge and manipulative skill required for successful employment as an electronic mechanic.

Unit Outline

A. Orientation

1. The history and background of the development of the electronic industry
2. The importance of the occupation of an industrial electronic mechanic to present-day industry.
3. The necessity of knowing the safety precautions peculiar to the electrical trade and the importance of observing them at all times. (See page 27 for suggested teaching aids.
4. The importance of acquiring the technical knowledge and the development of manipulative skill in the use of the tools and equipment in the analyzing and servicing of electronic equipment. It is suggested that the use of tools should be taught and required during the shop periods.
5. The job opportunities and promotion possibilities in the electronic industry.

B. Trainees Requirements

1. Have the patience and ability to correctly analyze electronic faults and to plan and execute an efficient approach to their successful solution.
2. Have the ability to make the necessary mathematical calculations.
3. Have the ability to read, interpret and make wiring diagrams, etc.
4. Are able to keep records.
5. Are able to work well with their fellow employees.
6. Know local, state, and national codes regarding electrical work.

C. Unit Achievement Test

Course Unit II

BASIC MATHEMATICS FOR ELECTRONICS

Suggested Training Time 180 Hours

It is suggested this unit be taught two hours each day until completed.

Objectives

To provide trainees with a general review of arithmetic.

To teach trainees to understand and use the basic fundamentals of mathematics in its application to the solution of electronic problems.

Unit Outline

A. Arithmetic

1. Addition
2. Subtraction
3. Multiplication
4. Division
5. Common fractions
6. Decimal fractions
7. Square root

B. Algebra

1. General numbers
2. Addition
3. Subtraction
4. Multiplication
5. Division
6. Factoring
7. Fractions
8. Equations
9. Fractional equations
10. Simultaneous equations
11. Exponents and radicals
12. Quadratic equations

C. The slide rule - powers of ten

D. Trigonometry

   1. Functions
   2. Solution of right triangles
   3. Periodic functions

E. Elementary plane vectors

F. Vector algebra

G. Logarithms - applications

H. Unit achievement test

Course Unit III

ELECTRICAL AND ELECTRONIC DRAWING, SYMBOLS, AND DIAGRAMS

Suggested Training Time 50 Hours

It is suggested this unit be taught one hour each day until completed.

Objectives

To teach trainees:

1. The techniques involved in orthographic projections and pictorial drawings.
2. To make simple free-hand sketches.
3. The importance of and ability to do lettering.
4. To have a working knowledge of electrical and electronic symbols.
5. To correctly interpret wiring and schematic diagrams.
6. To do the electrical drawing for building plans.

Unit Outline

A. Orthographic projections

  1. Two-view drawings
  2. Three-view drawings
  3. Auxiliary views
  4. Sectional views

B. Pictorial drawings

  1. Isometric
  2. Oblique
  3. Dimetric
  4. Perspective
  5. Sectional views

C. Free-hand sketching

  1. Making horizontal lines
  2. Making vertical lines
  3. Making curved lines
  4. Making circles

D. Lettering

1. Types
    a. Making vertical capital letters
    b. Making vertical lower case letters
    c. Making inclined capital letters
    d. Making inclined lower case letters
2. Numbers
    a. Making vertical numbers
    b. Making inclined numbers
    c. Making fractional numbers

E. Symbols

1. Battery
    a. Single cell
    b. Multi-cell
2. Capacitor
    a. General
    b. Variable
    c. Shielded
3. Contact
    a. Open
    b. Closed
    c. Electrically operated single-pole with series blowout coil
4. Chassis and ground
5. Relay coil
6. Resistor
    a. General
    b. Variable
    c. Tapped
7. Switch
    a. Single-throw, open and closed
    b. Double-pole, double-throw
    c. Push-button
8. Transformer
    a. General
    b. General with magnetic core
    c. General with one winding having an adjustable inductance
    d. Current transformer with polarity marking
9. Mechanical linkage
10. New device symbols
11. Electron-tube
12. Transistor

F. Wiring and schematic diagrams

1. Types
   a. Point to point
   b. Highway
   c. Airlane or base line
2. External - interconnection
3. Cabling
4. Panel or chassis
5. Block
6. Electronic schematic
7. Industrial electronic
8. Electric power drawing

G. Electrical drawing

1. Simple wiring diagram - one-story
2. Wiring symbols on a simple floor plan
3. Electrical plan for a small building
4. Fixture schedule and legend
5. Electrical rise diagram for a three-story building

H. Unit achievement test

Course Unit IV

FUNDAMENTALS OF ELECTRICITY

Suggested Training Time 780 Hours

It is suggested that the training in this unit be divided into 620 hours of classroom lecture, demonstration and discussion, and 160 hours of practical shop experience.

Objective

To teach trainees to have a working knowledge of the fundamentals of electricity as a prerequisite to the fundamentals of electronics.

Unit Outline

A. Introduction

1. History of electricity
2. Electron theory of electricity
3. Conductors and insulators
4. Terms and definitions
5. Sources of electricity
6. The closed circuit
    a. Potential
    b. Current
    c. Resistance

B. DC circuits

1. Ohm's law
    a. Simple circuits
    b. Practical units
    c. Power
2. Series circuits
3. Kirchhoff's law
4. Parallel circuits
5. Series - parallel circuits
6. Coefficient of resistance
7. Superposition theorem
8. Thevenin's theorem

C. AC circuits

1. Faraday's law
2. Sine wave power generation
    a. Sine wave voltages
    b. Sine wave currents
3. Linear circuit elements
    a. Resistor
    b. Inductor
    c. Capacitor
4. Inductive reactance
5. Capacitive reactance
6. Impedance
7. Simple resistive circuits
8. Simple inductive circuits
9. Simple capacitive circuits
10. Resistive - inductive circuits
11. Resistive - capacitive circuits
12. R-L-C circuits
13. Series resonance
14. Parallel resonance
15. Real and apparent power
16. Polyphase circuits

D. DC machines

1. Physical description
2. Electromechanical energy conversion principles
3. Characteristics of DC motors
    a. Shunt
    b. Series
    c. Compound
4. Characteristics of DC generators
    a. Shunt
    b. Series
    c. Compound
5. Performance of DC machines
6. Applications of DC machines

E. AC machines

1. Single-phase transformers
    a. Construction features
    b. Principle of operation
    c. Effect of core saturation

    - d. Equivalent circuit
    - e. Fundamental transformer constants
    - f. The open circuit test
    - g. The short circuit test
    - h. Voltage regulation

2. Polyphase transformers
    - a. Two-phase transformers
    - b. Three-phase transformers
    - c. Wye-wye transformation
    - d. Delta-delta transformation
    - e. Wye-delta transformation
    - f. Open delta transformation
3. Special purpose transformers
    - a. Instrument transformers
    - b. Potential transformers
    - c. Current transformers
    - d. Auto transformers
4. Polyphase induction machines
    - a. Introduction and physical description
    - b. Rotating field principle
    - c. Production of torque
    - d. Equivalent circuit
    - e. Circuit constants
    - f. Performance characteristics
        - (1) Starting
        - (2) Operating
    - g. Measurement of induction motor constants
    - h. Speed control
5. Synchronous machines
    - a. Introduction and physical description
    - b. The elementary AC generator
    - c. Revolving field
    - d. Single-phase windings
    - e. Three-phase windings
    - f. Generation of harmonics
    - g. Distribution factor
    - h. Pitch factor
    - i. Performance characteristics
        - (1) No-load saturation curve
        - (2) Short circuit saturation curve
        - (3) Construction of load saturation curves
        - (4) Torque angle characteristics
        - (5) Parallel operation of generators
        - (6) Starting of synchronous motors

        - (7) Synchronous motor characteristics
    6. Single-phase motors
        a. Introduction
        b. Single-phase induction motor
            (1) Cross-field theory
            (2) Revolving field theory
        c. Capacitor motors
        d. Universal motors
        e. Applications of single-phase motors

F. Instrumentation

1. Introduction
2. D'Arsonval galvanometer
3. DC ammeters
4. DC voltmeters
5. Ohm meters
6. Wheatstone bridge
7. Iron-vane instruments
8. Dynamometer instruments
9. Thermocouple instruments
10. AC bridges
11. Watt meters
12. Recording instruments
13. Shunts

G. Magnetic circuits

1. Magnetism
2. Magnetic circuit relations
3. Ohm's law of magnetic circuits
4. Magnetic potential gradient
5. Flux density
6. Air gaps
7. Magnetization curves
8. Saturation
9. Series magnetic circuits
10. Branched magnetic circuits
11. Hysteresis
12. Permanent magnetics
13. Flux leakage

H. Unit achievement test

Course Unit V

FUNDAMENTALS OF ELECTRONICS

Suggested Training Time 600 Hours

It is suggested that the training in this unit be divided into 300 hours of classroom lecture, demonstration, and discussion and 300 hours of practical shop experience.

Objective

To teach trainees to have a working knowledge of the fundamentals of electronics.

Unit Outline

A. Introduction

1. History of electronics
2. Methods of electron emission
3. Electron ballistics

B. Vacuum tubes

1. Diode
    a. Physical description
    b. Theory of operation
    c. Operation characteristics
    d. Ratings
    e. Applications
2. Triode
    a. Physical description
    b. Theory of operation
    c. Operation characteristics
    d. Ratings
    e. Applications
3. Other multi-element tubes
    a. The tetrode
    b. The pentode
    c. Beam power tubes

C. Gas filled tubes

1. Thyratron
   a. Physical description
   b. Theory of operation
   c. Operation characteristics
   d. Ratings
   e. Applications
2. Ignition
   a. Physical description
   b. Theory of operation
   c. Operation characteristics
   d. Ratings
   e. Applications

D. Semi-conductors

1. Selenium rectifiers
   a. Physical description
   b. Theory of operation
   c. Operation characteristics
   d. Ratings
   e. Applications
2. Silicon diodes and rectifiers
   a. Physical description
   b. Theory of operation
   c. Operation characteristics
   d. Ratings
   e. Applications
3. Transistors
   a. Physical description
   b. Theory of operation
   c. Operation characteristics
   d. Ratings
   e. Applications
4. Silicon controlled rectifiers
   a. Physical description
   b. Theory of operation
   c. Operation characteristics
   d. Ratings
   e. Applications
5. Zenier diodes
   a. Physical description
   b. Theory of operation
   c. Operation characteristics

        - d. Ratings
        - e. Applications

E. Filter circuits

1. Simple R-C filters
2. Simple R-1 filters
3. Low-pass filters
4. Band-pass filters

F. Power supplies

1. Typical power supply circuits
    - a. Single-phase
    - b. Three-phase
    - c. Six-phase
2. Power supply rating
    - a. Input voltage
    - b. Output voltage
    - c. Output current
    - d. Ripple frequency and voltage

G. Amplifiers

1. Voltage amplifiers
    - a. Classification of amplifiers
    - b. Simple single-stage amplifiers
    - c. Equivalent circuits at low frequency
    - d. Equivalent circuits at high frequency
2. Audio-frequency power amplifiers
    - a. Introduction
    - b. Class "A" amplifiers
    - c. Parallel operation of tubes
    - d. Push-pull operation
    - e. Class "B" amplifiers

H. Magnetic amplifiers

1. General description
2. Theory of operation
3. Operation characteristics
4. Applications

I. Feed-back controls

1. Introduction
2. Examples of closed-loop servo systems
3. The reference signal
4. Effects of gain in circuit
5. Effects of feed-back on stability

J. Unit achievement test

Course Unit VI

FUNDAMENTALS OF ELECTRONIC CONTROLS

Suggested Training Time 260 Hours

It is suggested that the training in this unit be divided into 170 hours of classroom lecture, demonstration, and discussion and 90 hours of practical shop experience.

Objective

To teach trainees to have a working knowledge of electronic controls and their practical application and use.

Unit Outline

A. Introduction

B. Timing circuits

1. R-C discharge circuits
2. R-C charge circuits
3. Time-delay and time-constant calculations
4. Synchronous timers
5. Thermal timers

C. Photoelectric devices

1. Applications
2. Photoconductivity cells
3. Photoemissive cells
4. Photovoltaic cells

D. Electronic control of resistance welders

1. Basic principles of resistance welding
2. Electronic control of heat
3. Electronic timing control
4. Energy storage welding

E. High frequency heating

  1. Induction heating
  2. Dielectric heating
  3. Methods of generating high frequency current
  4. Vacuum tube oscillators

F. Electronic control of motors and generators

  1. Control of armature and field voltages
  2. Saturable reactors
  3. Automatic speed regulators
  4. Automatic voltage regulators

G. Light dimming control

  1. Reactor control of AC power
  2. Thyratron control of reactors
  3. Theater light dimming controls

H. Unit achievement test

Course Unit VII

FUNDAMENTALS OF MAGNETIC CONTROLS

Suggested Training Time — 120 Hours

It is suggested that the training in this unit be divided into 90 hours of classroom lecture, demonstration, and discussion and 30 hours of practical shop experience.

Objective

To teach trainees to have a working knowledge of magnetic controls and their practical application and use in electronics.

Unit Outline

A. Introduction

  1. Symbols
  2. Diagrams

B. DC contactors and relays

  1. Physical description
  2. Operating characteristics
  3. Specifications
  4. Time delay relays

C. AC contactors and relays

  1. Physical description
  2. Operating characteristics
  3. Specifications

D. DC control circuits

  1. Motor starters
  2. Jogging
  3. Reversing
  4. Shunt field control
  5. Armature control

   6. Protective devices
   7. Plugging

E. AC control circuits

   1. Motor starters
   2. Jogging
   3. Reversing
   4. Plugging
   5. Protective devices

F. Construction of control panels

   1. Types of construction
   2. Panel wiring
   3. Nema standards
   4. Draw-out controls

G. Unit achievement test

TEACHING THE COURSE

Planning the Lesson

The best guide or lesson plan is, of course, one that has been prepared by the individual teacher, based on personal experience and manner of teaching. Although teachers differ in their ways of organizing and coordinating important parts of their presentations they agree that the purpose of a lesson is to provide effective and meaningful classroom and shop instruction.

Written plans may be brief, but before the class starts the good teacher will know the following:

1. The goals or objectives of the lesson -- the kind of learning desired.
2. The outline and suggested time schedule for the lesson, including:
    a. An interest approach - method of introducing the lesson to obtain the interest of the trainees and direct their attention to the lesson's goals or objectives and to connect the lesson to knowledge already known by the trainee.
    b. Activities which involve the trainees in discovering new facts and principles, solving realistic problems, or practicing skills.
    c. A way to summarize the lesson -- to help trainees arrive at some valid conclusions and/or to evaluate the extent to which lesson goals have been achieved.
3. The subject matter content -- the facts and principles or main ideas to be brought out in the lesson.
4. The teaching materials and references to be used.

Suggested Teaching Aids

In addition to the training facility, suggested textbooks and reference materials being used to teach the class, the course should be supplemented by:

1. Providing a satisfactory demonstration table and equipment for the use of the teacher in the classroom.
2. Having a representative from the American Red Cross visit the class to discuss and demonstrate first aid techniques and artificial respiration.
3. Contacting the State industrial commission and division of safety and hygiene, for the use of safety films, charts, brochures, etc., as well as for a visit by one of their field men.
4. Field trips to local and/or area industrial electronic establishments.
5. Inviting local and/or area electronic personnel to discuss with the trainees the problems they are likely to encounter as electronic mechanics.
6. Contacting the local library, board of education, and State department of education for visual aids they have in their respective libraries for educational purposes at little if any cost.
7. Having a representative from the local fire department discuss and demonstrate for the trainees the correct method of fighting electrical fires.

Criteria for Evaluating Trainee Readiness for Employment

The criteria for determining whether the trainee is ready for employment as an industrial electronic mechanic will be quite largely the trainees' ability to quickly and correctly analyze electronic faults and to efficiently repair them. Understanding of human frailties and needs and insight into how to provide the various services required by employers are of such importance that every attempt should be made to evaluate trainee progress.

The use of various evaluative devices is necessary for the teacher and the trainee to accumulate objective information about the growth of the trainee. The following attributes and competencies need to be developed or strengthened during the training program:

A. Personal qualities:

  1. Courtesy, friendliness, and tact in dealing with fellow workers
  2. Acceptable appearance -- good grooming for the job to be done
  3. Good personal habits in speech, mannerisms, cleanliness, and methods of work
  4. Mature judgment in a variety of situations
  5. Acceptable attitudes -- calmness and patience in disorganized situations, positive attitude toward work, and cooperativeness
  6. Understanding and assuming the role of the industrial electronic mechanic.

B. Activities showing knowledge, understanding, and skills:

  1. Works effectively under supervision
  2. Demonstrates knowledge of electronic equipment maintenance and repair

3. Understands and carries out instructions or directions of employer
4. Understands problems of supply and cost and proper methods of keeping records and accounts
5. Understands need for safety in work -- recognizes danger areas and follows necessary safety precautions
6. Knows action to take in an emergency
7. Uses tools and equipment properly and safely
8. Demonstrates ability to develop and follow a work plan or schedule
9. Demonstrates proper techniques and methods of cleaning up work areas

TEXTBOOKS AND REFERENCE BOOKS
(Class of 20 trainees - 1 instructor)

Textbooks

21 - Baer, Charles J. Electrical and Electronic Drawing. New York: McGraw-Hill Book Co., 1960

X 21 - Chute, George M. Electronics in Industry. New York: McGraw-Hill Book Co., 1965

21 - Cooke, Nelson M. Basic Mathematics for Electronics. New York: McGraw-Hill Book Co., 2nd edition

21 - National Electric Code. Fire Underwriters, National Board of. 1962

21 - Grob, Bernard. Basic Electronics. New York: McGraw-Hill Book Co., 1962

21 - Heumann, Gerhart W. Magnetic Control of Industrial Motors. New York, John Wiley & Sons, Inc. 1961

20 sets - Electronic and Electrical Fundamentals. Volumes 1, 2, 3, 4, 5, and 6. Philco Corporation.

20 sets - Student's Laboratory Manuals for Electronic and Electrical Fundamentals. Volumes 1, 2, 3, 4, 5, and 6. Philco Corporation.

1 set - Instructor's Manuals for Electronic and Electrical Fundamentals. Volumes 1, 2, 3, 4, 5, and 6. Philco Corporation.

21 - Siskind, Charles S. Electrical Machines, Direct and Alternating Current. New York: McGraw-Hill Book Co., 1959

TEXTBOOKS AND REFERENCE BOOKS (Cont.)

21 - Wellman, William R. Elementary Industrial Electronics. Princeton, New Jersey: D. Van Nostrand Company, Inc., 1957

Reference Books

4 - Fitzgerald, A.E. and Charles Kingsley, Jr. Electric Machinery. New York: McGraw-Hill Book Co., 1961

4 - Reference Data for Radio Engineers. International Telephone and Telegraph Corporation.

4 - Kiver, Milton S. Transistors in Radio, Television and Electronics. McGraw-Hill Book Co., 1962

4 - Oldfield. R.L. The Practical Dictionary of Electricity and Electronics. American Technical Society, 1959

4 - Tang, K.M. Alternating Current Circuits. Scranton, Pennsylvania: International Textbook Co., 3rd edition

SUGGESTED TRAINING AIDS

1 - Philco. Audio Visual Package. AN-1000. Fundamentals of Transistor Electronics

1 - Philco. Color Code Wall Chart. LC-1

Appendix A

SUGGESTED LIST OF EQUIPMENT

Classroom Area

1 - Teacher's desk
1 - Teacher's desk chair
1 - Teacher's combination wardrobe and storage cabinet
1 - Filing cabinet
1 - Waste basket
1 - Chalkboard
1 - Chalkboard pointer
1 - Coat and hat rack for 20 trainees
20 - Tablet arm chairs
1 - Pencil sharpener
21 - Slide rules
20 - Notebook binders, 3 ring, 8 1/2" x 11"
1 - Electronics Fundamentals Units Complete - Item 1, Part number 463-4645, Philco
1 - Panel vacuum tube multimeter - Item 27, Part number 463-4527, Philco
1 - Transistor lecture demonstration unit complete - Item 20, Part number 463-4523, Philco
1 - Lecture demonstration unit complete - Item 2, Part number 453-5132-1, Philco
1 - Laboratory circuit analysis trouble shooting kit - Item 4, Part number 40-8744, Philco
1 - Voltage regulator lecture demonstration unit - Item 5, Part number 463-2528, Philco
1 - Industrial electronics demonstrator complete - Item 26, Part number 463-4720, Philco
1 - Slide rule demonstrator

Wash and Restroom Area

1 - Water closet
1 - Urinal
1 - Lavatory
1 - Hot water tank
1 - Bradley wash fountain
1 - Drinking fountain
2 - Mirrors
2 - Waste baskets

SUGGESTED LIST OF EQUIPMENT (Cont.)

2 - Paper towel dispensers
1 - Soap dispenser
1 - First aid kit, complete

Shop Equipment

10 - Laboratory circuit analysis units complete - Item 29, Part number 463-4760, Philco
10 - Transistor laboratory circuit analysis units complete - Item 21, Part number 463-4571, Philco
10 - Laboratory circuit analysis units complete - Item 3, Part number 453-5105-1, Philco
10 - Voltage regulator laboratory circuit analysis units complete - Item 6, Part number 463-2530, Philco
1 - Distribution panel equipped to supply:
    Single phase 120 Volt - AC - 200 Amp.
    Three phase 220 Volt - AC - 150 Amp.
    120 Volt - DC - 150 Amp.
    Motor generator set rating 200 Amp.
10 - Work benches, 60" x 30" x 32" high with 1 3/4" laminated maple top.
    Each bench equipped to supply:
    0 - 120 Volt - DC - 10 Amp.
    0 - 120 Volt - AC - 60 cyc. - 10 Amp.
    Single phase - 120 Volt - AC - 60 cyc. - 10 Amp.
    Three phase - 220 Volt - AC - 60 cyc. - 10 Amp
20 - All steel stools with wood seat - 24"
2 - Radio and television service benches complete, including accessory test equipment, 72" x 30" x 32" high with 1 3/4" laminated maple top.
    Model ET8B, Brodhead-Garrett Company
1 - Tool storage cabinet, 62" x 22" x 84" high, Model TS13, Brodhead-Garrett Company
1 - Drill press, 17" floor model, complete with 1/2 H.P., 115 Volt, 1725 RPM motor, pulleys, belt, belt guard, switch, 1/2" chuck and chuck key, cord and plug
1 - Grinder, 7" floor model, complete with 1/2 H.P., 115 Volt, 1725 RPM motor, wheel guards, water pot, safety shields, lamp bulbs, tool rests, wheels, switch, cord and plug
2 - Storage cabinets, 36" x 24" x 78" high with doors and drawers for small parts
30 - Multimeters, Simpson 631

SUGGESTED LIST OF EQUIPMENT (Cont.)

10 - Oscilloscopes, Textronix 504
20 - Ammeters, AC, Simpson 370
20 - Ammeters, DC, Simpson 375
6 - Watt meters, 0 - 500 - 1000 Watts, Weston 432 Series
5 - VTVM, Simpson 303
1 - Work bench, 64" x 54" x 32" high with 2 1/4" laminated maple top
1 - Woodworking vise - 4" x 7" jaw x 9" opening
1 - Bench vise, 4" jaw, swivel base
5 - Power supply units, Electro DC, Model EFB
1 - Motor-generator set, 200 amp. rating
10 - Bench dusters, 8"
4 - Floor sweeps, 18"
2 - Dust pans
2 - Trash cans, 50 gallon
- Several items of equipment electronically controlled
3 - Fire extinguishers, CO$_2$
1 - 2 1/2 H.P. AC induction motor, 3 phase, 220 Volt, L-L, 1800 RPM, 60 cps.
1 - IKVA transformer, 3 phase, 220 Volt L-L, primary Y connected, 120 Volt L-L secondary Y connected, 60 cps.
1 - 0.5 KVA transformer, single phase, 220 Volt L-L primary, 120 Volt L-L secondary, 60 cps.
1 - 1 H.P. DC motor, shunt field, 120 Volt DC

Appendix B

SUGGESTED LIST OF TOOLS

10 - Electric soldering irons, 1/2" tip
10 - Electric soldering guns, heavy duty
2 - Electric drills, 1/4" capacity
1 - Cable cutter
10 - Wire cutter and stripper
1 each - Cold chisels, 1/2, 5/8, 3/4
2 sets - Needle files
2 - Offset screwdrivers, 5"
2 - Offset screwdrivers, Phillips, 5"
6 - Screwdrivers, Xcelite, 1/8" x 4" blade
6 - Screwdrivers, Xcelite, 3/16" x 6" blade
6 - Screwdrivers, Xcelite, 5/16" x 8" blade
6 - Screwdrivers, Xcelite, 1/4" x 1 1/4" blade
4 - Screwdrivers, Xcelite Phillips, #1 point
4 - Screwdrivers, Xcelite Phillips, #2 point
4 - Screwdrivers, Xcelite Phillips, #3 point
8 - Alignment screwdrivers, 7/32" x 6"
8 - Screwholding screwdrivers, 6 1/4"
11 - Screw extractor set, Ezy-out
1 set - Allen wrenches
2 - Hex and spline wrench kits with case
4 - Adjustable wrenches, 4"
4 - Adjustable wrenches, 6"
2 - Adjustable wrenches, 8"
2 - Combination box and open end wrenches, 7/16"
2 - Combination box and open end wrenches, 1/2"
2 - Combination box and open end wrenches, 9/16"
2 - Combination box and open end wrenches, 5/8"
1 - Combination box and open end wrench, 3/4"
1 - Combination box and open end wrench, 7/8"
1 - Rivet set, Pexto, #00 to #8
4 - Sanding blocks 2 3/4" x 9" sanding sheets
1 - Tap and die set, complete with die stock, tap wrench, screw pitch gauge, screwdriver and 1 each tap and solid die as follows:
    4 x 36 - 6 x 32 - 8 x 32 - 10 x 24 - 10 x 32 - 12 x 24 M.S.S.
    1/4 x 20 - 5/16 x 18 - 3/8 x 16 - 7/16 x 14 - 1/2 x 13 U.S.S.
    1/4 x 28 - 5/16 x 24 - 3/8 x 24 - 7/16 x 20 - 1/2 x 20 S.A.E.
    1/8" pipe

SUGGESTED LIST OF TOOLS (Cont.)

1 set - Fractional size drills, straight shank, high speed, 1/16" to 1/2" by 32nds
3 - Tweezer kits with pocket case
1 - Nut driver set, hex sizes, 3/16", 7/32", 1/4", 9/32", 5/16", 11/32", 3/8"
1 set - Spade-type wood bits, sizes 3/8", 1/2", 5/8", 3/4", 7/8", 1"
1 set - Auger bits, 1/4" to 1" by 16ths
2 - Ratchet braces, 10"
1 - Expansion bit, #1 - 5/8" to 1 1/2"
2 - Countersinks, wood, 3/4"
10 - Diagonal cutting pliers, 6"
10 - Needle nose pliers, 6"
10 - Electrician's side cutting pliers, 7"
6 - Combination pliers, 6"
10 - Sloyd knives, 2 5/8" blade
10 - Assorted metal and woodworking files with handles
2 - File cards and brushes
1 each - Round chassis punches, 3/4", 1", 1 1/16", 1 1/8"
1 - Square chassis punch, 3/4"
1 - Combination square with center head
1 - Steel square, 8" x 12"
2 - Try squares, 6"
1 - "T" bevel square, 8"
10 - Steel rules, 12"
20 - Steel scales, 6"
1 - Block plane, 6"
1 - Smooth plane, 9"
1 - Combination India oil stone, 8 x 2 x 1
1 set - Letter stamps, 1/8"
1 set - Numeral stamps, 1/8"
1 each - Nail sets, 1/32", 1/16", 3/32", 1/8"
4 - Scratch awls, 3 1/2" blade
3 - Prick punches, 3/8" stock
3 - Center punches, 3/8" stock
3 - Pin punches, 1/8" point
1 - Compass saw, 12"
1 - Keyhole saw, 10"
1 - Bench drill vise, 2 3/8" jaws, open 2 5/8"
3 - Continuity testers with batteries
3 - Electric testers, 90-550 Volts, AC-DC
2 - Tin snips, straight cut, 3"
2 - Tin snips, curved cut, 3"

SUGGESTED LIST OF TOOLS (Cont.)

1 - Compound lever snips, 8", 1 5/8" cut
1 - Hawk bill snips, 3"
1 - Aviation snip, right cut, 10"
1 - Bolt clipper, 12", 3/16" capacity
1 - Scissors, 6"
1 - Scissors, 8"
2 - Nail hammers, 12 oz.
1 - Ball-pein hammer, 8 oz.
1 - Ball-pein hammer, 12 oz.
2 - Soft-face hammers, 8 oz.
2 - Magnetic hammers, 7 oz.
1 - Rubber mallet, head 1 1/2" D x 3 1/4"
1 - Wood mallet, head 2 1/2" D x 6"
2 - Hand drills, capacity 1/4"
1 - Handsaw, 10 point
1 - Handsaw, 5 1/2 point
2 - Coping saws, 6 1/2" pin end blade
1 - Wing divider, 8"
10 - "C" clamps, 3"
2 - "C" clamps, 4"
2 - Hacksaw frames, adjustable 12"
1 each - Wood chisels, 1/4", 3/8", 1/2", 3/4", 1"

Appendix C

SUGGESTED LIST OF SUPPLIES

3 ream - Notebook paper, 3 hole, 8 1/2" x 11"
1 box - White chalk
1 box - Colored chalk
6 - Chalkboard erasers
\- Paper towels
\- Cleaning cloths
1/2 gross Hacksaw blades, 12"
\- Rosin core solder
\- Sandpaper, assorted grades
\- Magnet wire, various sizes
\- Friction tape
\- Electrical tape
\- Insulated staples
1 gross - Coping saw blades, 6 1/2" pin end
\- Solderless terminals
\- 1.5 Volt dry batteries
\- Assortment of brads and nails
\- Assortment of wood screws

Appendix D

SUGGESTED SOURCES FOR THE PURCHASE OF BOOKS, TOOLS, EQUIPMENT AND SUPPLIES

Allied Electronics, 100 N. Western Avenue, Chicago, Illinois 60680

American Technical Society, 848 East 58th Street, Chicago, Illinois 60637

Brodhead-Garrett Company, 4560 East 71st Street, Cleveland, Ohio 44105

D. Van Nostrand Company, Incorporated, 120 Alexander Street, Princeton, New Jersey 08540

Electronic Engineers Master Catalogue, Tech Publishers, Incorporated, 645 Stewart Avenue, Garden City, New York 11533

Electronics Kits Supply Company, 1727 Glendale Boulevard, Los Angeles, California 90026

Electronics Teaching Laboratories, 5034 Wisconsin Avenue, N.W., Washington, D.C. 20016

Hampden Engineering Corporation, Shaker Road, East Longmeadow, Massachusetts

International Telephone and Telegraph Corporation, 67 Broad Street, New York, New York 10004

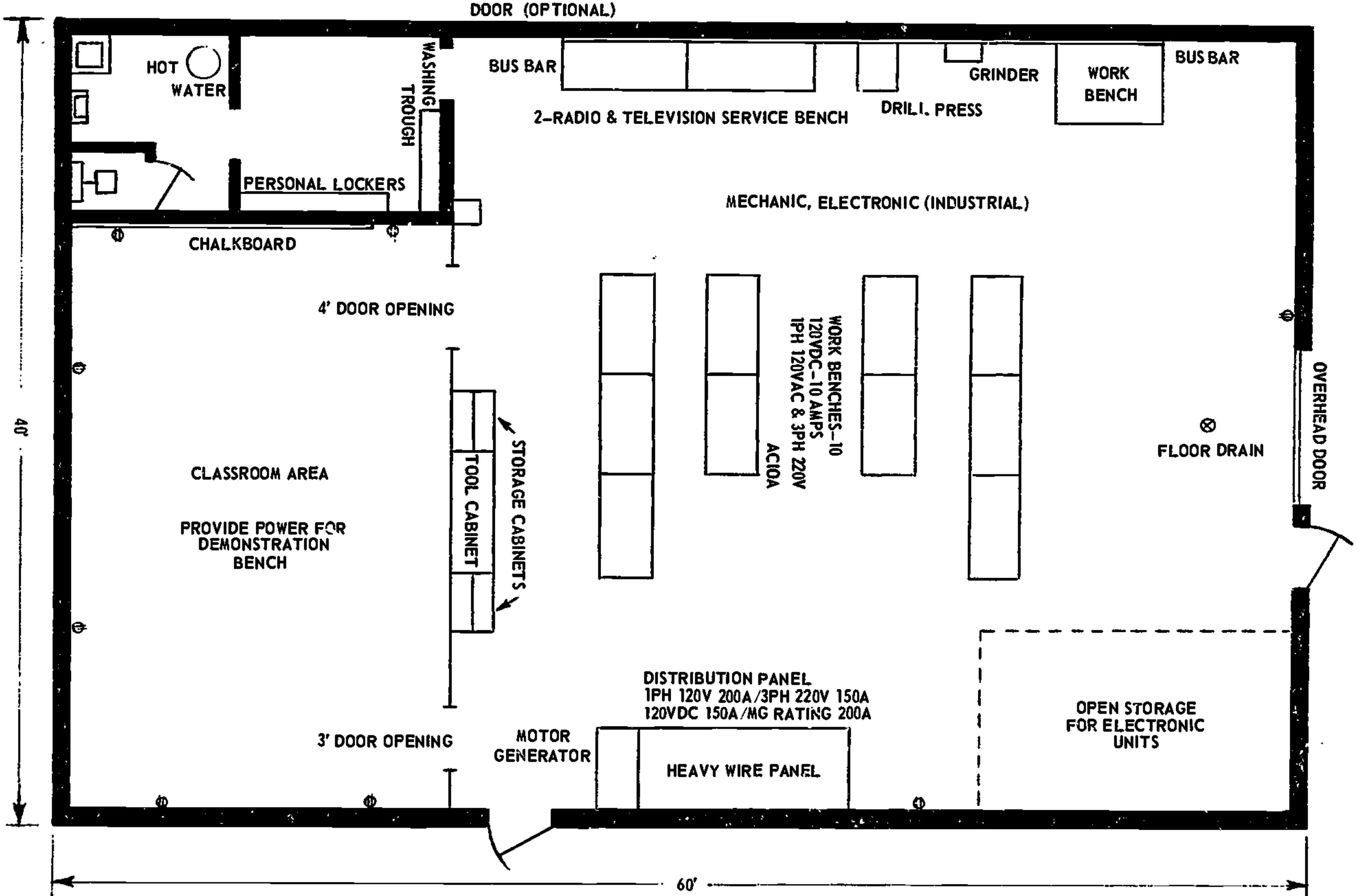
International Textbook Company, Scranton, Pennsylvania 18515

John Wiley & Sons, Incorporated, 605 Third Avenue, New York, New York 10016

McGraw-Hill Book Company, Incorporated, 330 West 42nd Street, New York, New York 10036

National Board of Fire Underwriters, 465 California Street, San Francisco, California 94104

Philco Corporation, P.O. Box 4730, Philadelphia, Pennsylvania 19134



Appendix E

Suggested Training Facility

DISCRIMINATION PROHIBITED - Title VI of the Civil Rights Act of 1964 states: "No person in the United States shall, on the ground of race, color or national origin, be excluded from participation in, be denied the benefits of, or be subject to discrimination under any program or activity receiving Federal financial assistance." Therefore, the Vocational Education program, like every program or activity receiving financial assistance from the Department of Health, Education, and Welfare, must be operated in compliance with this law.

VT001 858

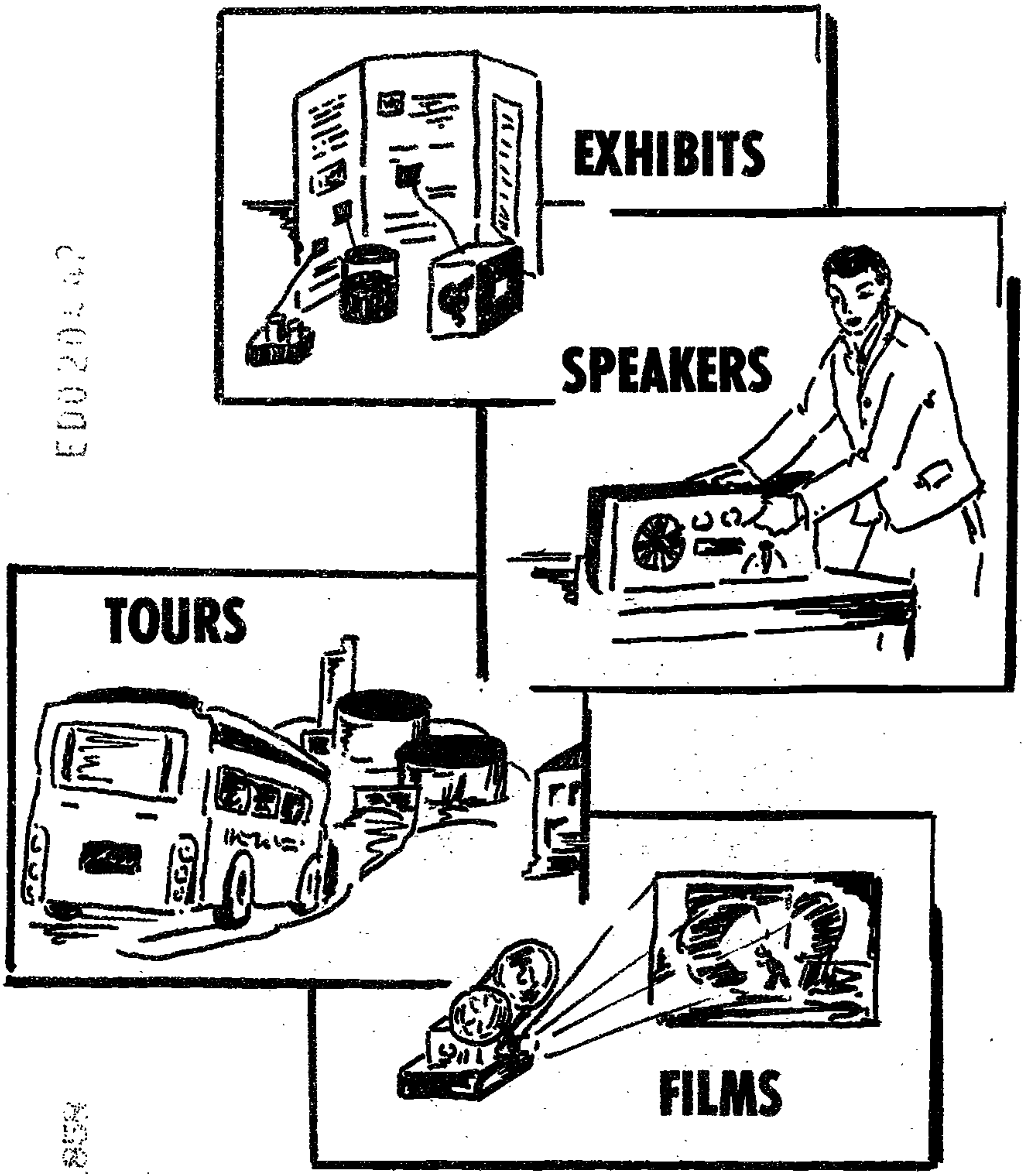
VT 001 858
Career Education Resource Guide.

Taylor, Arlin
Napa County Superintendent of Schools, Calif.
Pub Date - Nov66
MF AVAILABLE IN VT-ERIC SET 68p.

*BIBLIOGRAPHIES, *FILMS, *FILMSTRIPS, *EDUCATIONAL RESOURCES, *INDUSTRIAL ARTS, OCCUPATIONAL INFORMATION,

This guide contains a list of business and other establishments which provide guidance or educational resources, and an annotated bibliography of educational films. For each establishment information is given for (1) availability of tours, speakers, and reference materials, (2) contact persons, (3) products, and (4) employment requirements. The bibliography lists 219 films and filmstrips categorized under the subjects--(1) auto, (2) crafts, (3) electricity, (4) mechanical drawing, (5) metals, and (6) wood. The film annotations were written by industrial arts instructors. Film sources are given. (EM)

CAREER EDUCATION RESOURCE GUIDE



OFFICE OF
NAPA COUNTY SUPERINTENDENT OF SCHOOLS
PIERCY C. HOLLIDAY
NAPA, CALIFORNIA

Office of

NAPA COUNTY SUPERINTENDENT OF SCHOOLS

Piercy C. Holliday

CAREER EDUCATION RESOURCE GUIDE

Compiled by Arlin Taylor

Director of Vocational Education

November 1966

Name of Firm	American Flotation
Product Information	Foam (plastic) products
Tours Available	yes
Who to Contact	Barbara Leach
Advance Notice needed	2 weeks
Size of Group	10 maximum
Age Limitations	none
Length of tours	1/2 hour
Reference Materials available	yes
Speakers available	yes
In what fields	Sales, molding
Who to contact	Barbara Leach
Advance notice needed	1 month
Audience level	no limit
Access to other speakers	no
In what fields	---
Are repeat lectures possible	no
Equipment available (to be lent to school for demonstrations)	no
Vocational training desirable for job entry	High School. Non Union. High School Juniors - part-time.
Type of training needed	High School. Mechanical abilities

Name of Firm	American Pedodontic
Product Information	Specialized Dental Equipment
Tours Available	yes
Who to Contact	Mr. Atkinson
Advance Notice needed	none
Size of Group	10 maximum
Age Limitations	none
Length of tours	1/2 hour to 1 hour
Reference Materials available	no
Speakers available	no
In what fields	---
Who to contact	---
Advance notice needed	---
Audience level	---
Access to other speakers	---
In what fields	---
Are repeat lectures possible?	---
Equipment available (to be lent to school for demonstrations)	no
Vocational training desirable for job entry	non-union
Type of training needed	Mechanical ability

Name of Firm	Barwick-Duttons
Product Information	Office supplies and equipment
Tours Available	Service facilities
Who to Contact	R. E. Barwick
Advance Notice needed	1 week
Size of Group	4 - 5 person
Age Limitations	none
Length of tours	30 minutes
Reference Materials available	yes
Speakers available	yes
In what fields	Commercial Stationery & office machines
Who to contact	R. E. Barwick
Advance notice needed	3 - 5 days
Audience level	Jr. High and up
Access to other speakers	yes
In what fields	Same as above
Are repeat lectures possible?	yes
Equipment available (to be lent to school for demonstrations)	Probable
Vocational training desirable for job entry	Delivery boys - sophomore Other - no experience necessary
Type of training needed	none

Name of Firm	Basalt Rock Company
Product Information	Rock products
Tours Available	possibly
Who to contact	George Stein
Advance notice needed	1 week
Size of group	5 - 10
Age limitations	Jr. High and up
Length of tours	Determined by interest in industry
Reference materials available	no
Speakers available	yes
In what fields	Sales, welding, machine shop
Who to contact	George Stein
Advance notice needed	1 week or more
Audience level	Jr. High and up
Access to other speakers	---
In what fields	---
Are repeat lectures possible?	---
Equipment available (to be lent to school for demonstrations)	no
Vocational training desirable for job entry	Union [illegible]
Type of training needed	Machinist - no experience needed. Electrician apprenticeship program available.

Name of Firm	George Blaufuss & Son
Product information	Cider-making
Tours Available	yes
Who to Contact	Mr. Blaufuss
Advance Notice needed	1 week - work is seasonal
Size of Group	no limit - smaller children supervised
Age Limitation	no limit
Length of tours	1/2 hour
Reference Materials available	no
Speakers available	yes
In what fields	processing
Who to contact	Mr. Blaufuss
Advance notice needed	3 weeks
Audience level	no limit
Access to other speakers	---
In what fields	---
Are repeat lectures possible?	---
Equipment available(to be lent to school for demonstrations)	---
Vocational training desirable for job entry	Must be 18
Type of training needed	None - hard work

Name of Firm	C & H Sugar, Crockett
Product Information	Refined sugar
Tours available	yes
Who to contact	Mr. McKeown (ext. 283)
Advance notice needed	1 day
Size of group	10 people
Age Limitations	12 years to 60 years old
Length of tours	2 hours (10:00, 1:00, 3:00 on operating days)
Reference materials available	yes
Speakers available	yes - under certain circumstances
In what fields	Sugar refining or crafts
Who to contact	Mr. McKeown
Advance notice needed	1 week
Audience level	High School or older
Access to other speakers	no
In what fields	---
Are repeat lectures possible	yes
Equipment available (to be lent to school for demonstrations)	no
Vocational training desirable for job entry	2 years of High School
Type of training needed	2 years of High School

Name of Firm	Cal-Napa Tanning Co.
Product Information	Leather tanning
Tours Available	Occasional
Who to Contact	Peter Manassi
Advance Notice needed	1 day or more
Size of Group	15 - 20
Age Limitations	Jr. High and Up
Length of tours	1/2hour
Reference Materials available	no
Speakers available	possible
In what fields	Leather tanning
Who to contact	Mr. Manasse
Advance notice needed	1 week
Audience level	Jr. High and up
Access to other speakers	---
In what fields	---
Equipment available (to be lent to school for demonstrations)	---
Vocational training desirable for job entry	none
Type of training needed	None - train on the job

Name of Firm	Casell Co., Inc. Electro Flasher Div.
Product Information	Manufacturing flashing lights, barricades
Tours Available	Yes
Who to Contact	Jack Monroe
Advance Notice needed	1 week
Size of Group	15 - 25
Age Limitations	Jr. High and up
Length of tours	1/2 hour
Reference Materials available	no
Speakers available	yes
In what fields	Development of small business
Who to contact	Jack Monroe
Advance notice needed	2 weeks
Audience level	Jr. High and up
Access to other speakers	no
In what fields	---
Are repeat lectures possible	---
Equipment available (to be lent to school for demonstrations)	---
Vocational training desirable for job entry	1 type of job requiring no H.S. Carpentry, handy skills
Type of training needed	none needed

Name of Firm	Christian Brothers
Product Information	Wine making
Tours Available	yes
Who to Contact	Mr. Wehr
Advance Notice needed	Less than 10 no notice necessary. 1 week for larger groups.
Size of group	10 and above
Age Limitations	none
Length of tours	45 minutes to 1 hour
Reference Materials available	yes
Speakers available	no
In what fields	---
Who to contact	---
Advance notice needed	---
Audience level	---
Access to other speakers	---
In what fields	---
Are repeat lectures possible	---
Equipment available (to be lent to school for demonstrations)	---
Vocational training desirable for job entry	Packaging - only summer work Cellar work - no previous experience.
Type of training needed	Retired men for executive positions, ex-business men, small business owners.

Name of Firm	Ferro Glove Company
Product Information	gloves
Tours Available	yes
Who to Contact	Mr. Ferro
Advance Notice needed	1 week
Size of Group	small
Age Limitations	none
Length of tours	1/2 hour
Reference Materials available	no
Speakers available	no
In what fields	---
Who to contact	---
Advance notice needed	---
Audience level	---
Access to other speakers	---
In what fields	---
Are repeat lectures possible	---
Equipment available (to be lent to school for demonstrations)	no
Vocational training desirable for job entry	Non union
Type of training needed	Seamstress, not essential.

Name of Firm	General Mills, Vallejo
Product Information	Flour - all types
Tours available	no
Who to Contact	---
Advanc notice needed	---
Size of group	---
Age Limitations	---
Length of tours	---
Reference materials available	no
Speakers available	no
In what fields	---
Who to contact	---
Advance notice needed	---
Audience level	---
Access to other speakers	---
In what fields	---
Are repeat lectures possible	---
Equipment available (to be lent to school for demonstrations)	---
Vocational training desirable for job entry	High School education
Type of training needed	High School education. Union.

Name of Firm	J. W. Rice
Product Information	Formica
Tours available	yes
Who to contact	Mr. Marsh or Mr. Rice
Advance notice needed	1 week
Size of group	15 - 20
Age Limitations	none
Length of tours	1/2 hour
Reference materials available	no
Speakers available	maybe
In what fields	---
Who to contact	Mr. Rice
Advance notice needed	1 week
Audience level	---
Access to other speakers	---
In what fields	---
Are repeat lectures possible	---
Equipment available (to be lent to school for demonstrations)	---
Vocational training desirable for job entry	Apprenticeship through Union.
Type of training needed	Experience. Union member

Name of Firm	Kaiser Steel
Product Information	Heavy fabricated steel
Tours available	no
Who to contact	---
Advance notice needed	---
Size of Group	---
Age Limitations	---
Length of tours	---
Reference materials available	no
Speakers available	no
In what fields	---
Who to contact	---
Advance notice needed	---
Audience level	---
Access to other speakers	---
In what fields	---
Are repeat lectures possible	---
Equipment available (to be lent to school for demonstrations)	---
Vocational training desirable for job entry	High School. Union after 30 days employment
Type of training needed	Pre-apprentice and jorneymen

Name of Firm	Kitchen Fixtures
Product Information	cabinet manufacturers
Tours available	possible
Who to contact	George Grimm, Bob Hamilton
Advance notice needed	2 weeks
Size of group	20 - 25
Age Limitations	Jr. High and up
Length of tours	1 hour
Reference Materials available	no
Speakers available	no
In what fields	---
Who to contact	---
Advance notice needed	---
Audience level	---
Access to other speakers	---
In what fields	---
Are repeat lectures possible	---
Equipment available (to be lent to school for demonstrations)	none
Vocational training desirable for job entry	Apprenticeship through union High School
Type of training needed	Wood shop good idea

Name of Firm	Mare Island Naval Shipyard
Product information	Warships - repairs
Tours available	Tours are available for a U.S.N.R. sub only
Who to Contact	Lt. Gaylord 646-2247
Advance Notice needed	10 days
Size of group	30 maximum - 8 years old minimum
Age Limitations	8 years old. Must be physically fit.
Length of tours	1½ hours
Reference materials available	no
Speakers available	yes-16mm sound films, slides
In what fields	All fields (deep submergence, construction, polaris subs)
Who to contact	Lt. Gaylord
Advance notice needed	10 days
Audience level	Tailored for any group
Access to other speakers	no
In what fields	no
Are repeat lectures possible	yes - under certain circumstances
Equipment available (to be lent to school for demonstrations)	no - but there are presentations for training division
Vocational training desirable for job entry	Yes - desirable
Type of training needed	Shop courses, pre-engineering

Name of Firm	Mervyn's
Product Information	Retailing
Tours available	yes - stock room
Who to Contact	Mr. Thompson or Mr. Lane
Advance notice needed	1 week
Size of Group	6 - 10
Age Limiations	17 or older
Length of tours	1/2 hour
Reference materials available	yes
Speakers available	no
In what field	---
Who to contact	---
Advance notice needed	---
Audience level	---
Access to other speakers	---
In what fields	---
Equipment available (to be lent to school for demonstrations)	no
Vocational training desirable for job entry	No one under 17 hired. High School graduate. Union.
Type of training needed	On the job training.

Name of Firm	Montgomery Ward
Product Information	Retail Merchandising
Tours available	yes
Who to Contact	Bart Beeber
Advance notice needed	2 days
Size of Group	10 - 15
Age Limitations	17 minimum
Length of tours	1 hour
Reference materials available	yes (insurance, fringe benefits)
Speakers available	yes
In what fields	Merchandising, buying
Who to contact	Mr. Beebee, Mr. Williams
Advance notice needed	1 week
Audience level	17 or over
Access to other speakers	no
In what fields	---
Are repeat lectures possible	no
Equipment available (to be lent to school for demonstrations)	no
Vocational training desirable for job entry	High School graduate. Non-union.
Type of training needed	Sales only - training program available Planning Career Trainee Program for employees.

Name of Firm	Napa Glove Co.
Product Information	Glove making
Tours Available	Occasionally
Who to Contact	Joe Greco
Size of Group	10-15
Age Limitations	none
Length of tours	1/2 hour
Reference materials available	no
Speakers available	no
In what fields	---
Who to contact	---
Advance notice needed	---
Audience level	---
Access to other speakers	---
In what fields	---
Are repeat lectures possible	---
Equipment available (to be lent to school for demonstrations)	---
Vocational training desirable for job entry	No high school necessary - non-union
Type of training needed	Factory experience for men Power sewing machine for women

Name of Firm	Napa Paper Box Co.
Product Information	Gift Boxes
Tours Available	yes
Who to Contact	Mrs. Emma Hayes
Advance Notice needed	7 - 10 days
Size of Group	no limit
Age Limitations	none
Length of tours	1/2 to 1 hour
Reference material available	no
Speakers available	no
In what fields	---
Who to contact	---
Advance notice needed	---
Audience level	---
Access to other speakers	---
In what fields	---
Are repeat lectures possible	---
Equipment available (to be lent to school for demonstrations)	---
Vocational training desirable for job entry	No training necessary - do hire machinists. All work
Type of training needed	none

Name of Firm	Napa State Hospital
Product Information	---
Tours Available	yes
Who to Contact	Dr. Rood
Advance notice needed	2 weeks
Size of Group	minimum 5 - 25 maximum 45 - 50
Age Limitations	High School minimum
Length of tours	High School 9:30 - 12:00 College 9:30 - 3:30
Reference Material available	no
Speakers available	yes
In what fields	Psychiatry
Who to contact	Dr. Rood 226-2011 ext. 466
Advance notice needed	2 weeks
Audience level	High School, Junior College
Access to other speakers	Staff members
In what fields	Rehabilitation - Children - Geriatrics
Are repeat lectures possible	no
Equipment available (to be lent to school for demonstrations)	no
Vocational training desirable for job entry	High School. Pass test.
Type of training needed	On the job training. Trainee program.

Name of Firm	Robin Aids
Product Information	Artificial limbs - wheel chairs
Tours Available	Could make available
Who to Contact	Mr. George Robinson
Advance Notice needed	For evening tour 2 days - for day 1 mo.
Size of Group	No more than 25
Age Limitations	11th grade
Length of tours	Day 1 hour - evening 2 hours
Reference Msterials available	no
Speakers available	yes
In what fields	Prosthetics & Orthodontics
Who to contact	Mr. Robinson
Advance notice needed	As much as possible
Audience level	11th grade and up
Access to other speakers	no
In what fields	no
Are repeat lectures possible	no
Equipment available (to be lent to school for demonstrations)	no
Vocational training desirable for job entry	High school - apprentice - non union
Type of training needed	All skills: welder, seamstress, design mechanics, machine shop, etc.

Name of Firm	Sawyer Tanning Co.
Product Information	Leather tanning - manufacturer of leather coats
Tours available	no
Who to contact	---
Advance Notice needed	---
Size of Group	---
Age Limitations	---
Length of tours	---
Reference materials available	---
Speakers available	no
In what fields	---
Who to contact	---
Advance notice needed	---
Audience level	---
Access to other speakers	---
In what fields	---
Are repeat lectures possible	---
Equipment available (to be lent to school for demonstrations)	---
Vocational training desirable for job entry	none
Type of training needed	None - move along faster if some experience in machine operation, seamstress.

Name of Firm	Standard Tire
Product Information	tire rebuilding
Tours available	no
Who to contact	---
Advance Notice needed	---
Size of group	---
Age Limitations	---
Length of tours	---
Reference material available	---
Speakers available	no
In what fields	---
Who to contact	---
Advance notice needed	---
Audience level	---
Access to other speakers	---
Access to other speakers	---
In what fields	---
Are repeat lectures possible	---
Equipment available (to be lent to school for demonstrations)	---
Vocational training desirable for job entry	High School
Type of training needed	Experienced Vulcanizer.

Name of Firm	Stoshner
Product Information	Steel Fabrication
Tours available	no
Who to contact	---
Advance notice needed	---
Size of Group	---
Age Limitations	---
Length of tours	---
Reference material available	---
Speakers available	no
In what fields	---
Who to contact	---
Advance notice needed	---
Audience level	---
Access to other speakers	---
In what fields	---
Are repeat lectures possible?	---
Equipment available (to be lent to school for demonstrations)	---
Vocational training desirable	Welding - Shop course in High School
Type of training needed	Welding, Equipment operation - fork lift, truck. Union after 30 days.

Name of Firm	Sunsweet Growers
Product Information	Fruit Packers
Tours available	yes
Who to contact	Mr. O'Connor
Advance notice needed	1 week
Size of group	20
Age Limitations	High School or Jr. High
Length of tours	1/2 hour
Reference materials available	no
Speakers available	no
In what fields	---
Who to contact	---
Advance notice needed	---
Audience level	---
Access to other speakers	---
In what fields	---
Are repeat lectures possible	---
Equipment available (to be lent to school for demonstrations)	no
Vocational training desirable for job entry	none
Type of training needed	No special training. Machine operators trained on job.

Name of Firm	Trade Fair
Product Information	Retailing
Tours Available	Can make available
Who to Contact	Harry Hamber - 255-0272
Advance Notice needed	1 week
Size of Group	any size
Age Limitations	High School only
Length of Tours	depending on objective
Reference materials available	no
Speakers available	yes
In what fields	Retailing
Who to contact	Harry Hamber
Advance notice needed	1 week
Audience level	any level
Access to other speakers	Mr. Sparlin
In what fields	Retail Clerk Union
Are repeat lectures possible	---
Equipment available (to be lent to school for demonstations)	---
Vocational training desirable for job entry	Clerical work - High School graduate. Union.
Type of training needed	none

Name of Firm	Wells Fargo Bank
Product Information	banking
Tours available	yes
Who to Contact	Mr. C. C. Cady
Advance Notice needed	1 week
Size of Group	15 - 20
Age Limitations	17
Length of tours	1/2 hour to 1 hour
Reference Materials available	---
Speakers available	yes
In what fields	banking
Who to contact	Mr. Cady
Advance notice needed	2 weeks
Audience level	Jr. High & High School
Access to other speakers	---
In what fields	---
Are repeat lectures possible?	---
Equipment available (to be lent to school for demonstrations)	---
Vocational training desirable for job entry	Must pass simple employment test
Type of training needed	Teller - clerical; Typist - 50 w.p.m.; Steno 100 wpm 50-60 typist. High School Graduate

Name of Firm	Wilkins Instr. & Research
Product Information	Tools and Dies
Tours available	occasional
Who to contact	---
Advance notice needed	---
Size of group	---
Age Limitations	---
Length of tours	---
Reference materials available	no
Speakers available	no
In what fields	---
Who to contact	---
Advance notice needed	---
Audience level	---
Access to other speakers	----
In what fields	---
Are repeat lectures possible	---
Equipment available (to be lent to school for demonstrations)	---
Vocational training desirable for job entry	High School. Machinist.
Type of training needed	Experience preferred.

Name of Firm	Wilkins Inst. & Research
Product Information	Gas Chromographs
Tours available	yes
Who to contact	Sam Johnston
Advance notice needed	1 week
Size of group	15
Age Limitations	High School and up
Length of tours	1/2 hour to 1 hour
Reference materials available	no
Speakers available	no
In what fields	---
Who to contact	---
Advance notice needed	---
Audience level	---
Access to other speakers	---
In what fields	---
Are repeat lectures possible	---
Equipment available (to be lent to school for demonstrations)	none
Vocational training desirable for job entry	High School. Some electronic background.
Type of training needed	Electronics. Occasional trainees.

Name of Firm	Yuba Manufacturing, Benecia
Product Information	Heavy steel fabricating
Tours Available	Yes
Who to contact	Mr. Christo 745-2830
Advance notice needed	1 week
Size of Group	8 people at maximum
Age Limitations	High School or over 18
Length of tours	45 minutes
Reference materials available	no
Speakers available	no
In what fields	---
Who to contact	---
Advance notice needed	1 week
Audience level	---
Access to other speakers	no
In what fields	---
Are repeat lectures possible	---
Equipment available (to be lent to school for demonstrations)	none
Vocational training desirable for job entry	Welding training
Type of training needed	Welding

HOW TO OBTAIN FILMS FROM SOURCE

Care in selecting and requesting films is important to a good program. It is recommended that you utilize the following procedures:

1. Use school letter-head stationery.
2. If possible, indicate your official position.
3. Be sure to include:
    a. Title of film
    b. Complete shipping address
    c. First choice of showing date, and alternate showing dates when possible
    d. Allow 2 months to 10 weeks when possible.

It is suggested that you allow ample time between date of request and the showing date. Return the film promptly so as not to disappoint other users.

Note: The evaluation comments following the content synopsis were made by Industrial Arts Instructors.

AUTOMOTIVE

TITLE	TIME	COLOR OR BLACK & WHITE	SPONSOR NUMBER
ABC'S OF THE AUTOMOBILE ENGINE This film, in full color, combines cartoon and technical animation to illustrate the component parts of an automobile engine and how they operate.	18	C	31
ABC'S OF THE DIESEL ENGINE In simple primer book language, this film shows how the diesel engine works. Animated drawings in full color enable the audience to see right inside the engine, and three cartoon characters - Air - Fuel - Ignition entertainingly go through their paces to show how they work together to produce power.	20	C	31
ABC'S OF INTERNAL COMBUSTION An animated motion picture explaining the basic principles of the internal combustion engine.	13	C	31
AN INTRODUCTION TO THE AUTOMOTIVE ELECTRICAL SYSTEM This is a film strip rather than a 16mm film.			21
ATOMIZATION Schematic models and a high-speed camera (3,000 pictures a second) are used in explaining the principles involved in producing sprays and the need for precisely even distribution, especially in sprays from atomizers	17	B&W	56
AUTOMOTIVE ELECTRICITY Fundamentals and function of the magneto; advantage over battery ignition.	14	B&W	66
AUTOMOTIVE ELECTRICITY II Design, construction and operation of generator; how it converts mechanical energy to electrical energy; relationship between electricity and magnetism.	13	B&W	66
AUTOMOTIVE ELECTRICITY III Electrical and magnetic principles involved in operation; construction; how electrical energy is converted to mechanical energy.	12	B&W	66

AUTO (Cont'd)

AUTOMOTIVE ELECTRICITY IV

11 B&W 66

Function, components and operation; course of current traced through system; relationship of primary and secondary circuits, and magnetic field, to voltage intensity.

AUTO TROUBLE SHOOTING

33 B&W 66

Checks and tests of: manifold vacuum and compression, battery and ignition cable, spark plugs, distributor and ignition timing, battery clearance, manifold and heat control, fuel system, carburetor, idling speed and mixture adjustments.

BETTER IGNITION

19 21

This is a film strip rather than a 16mm film.

BIRTH OF AN OIL FIELD

30 C 56

Live action shots show oil men building a derrick and drilling crews moving with split-second timing as they operate heavy equipment. Models show the technique of fishing when the drill pipe breaks and the use of the shipstock in by-passing the break. Animated sequences show how natural underground forces make oil flow and how pumps or special drives are used when natural forces slacken.

CARBURETOR

25 B&W 66

Major components and functioning; utilization of air pressure differential; application of Venturi principles; operation of circuits.

COOLING SYSTEM

9 C 63

This film depects the construction and function of the cooling system and its various parts, such as the water pump, radiator, thermostat, hoses, and pressure cap. The effects of maintenance neglect, rust and scale are shown, and the value of anti-rust and anti-freeze is explained.

FIREBIRD III

13 C 56

In this film we see the car take form in the styling studios and research laboratories - then see the actual car being built. Best of all we see it actually performing out on the GM proving ground in Arizona.

HEAVY DUTY GENERATOR I

21

This is a film strip rather than a 16mm film.

HYDRAULIC CONTROLS	26	B&W	66

Basic shifting patterns; principles and applications in up-shifting and downshifting.

HYDRAULIC STEERING	14	B&W	66

Function of major components: reservoir pump, relief valve, control valve, power cylinder; how components assist steering.

INTRODUCTION TO THE HEAT ENGINE	23	B&W	56

The heat engine, which makes the conversion, began with 17th century experiments in steam. Progress toward greater efficiency came with the development of the gasoline engine, the steam turbine and the diesel. (Good for junior high)

JET AGE DRIVING	17	C	44

This film is a super highway safety film instructing drivers on proper methods of entering and leaving today's modern freeways.

PLANETARY GEARS I	18	B&W	66

Components, use and operation.

PLANETARY GEARS II	15	B&W	66

Principles governing operation of multiple sets; advantage of greater mobility and speed over single sets.

PROSPECTING FOR PETROLEUM	23	C	56

Three-dimensional animation helps tell the history of the oil industry and describe the techniques used in the search for oil.

REFINING OIL FOR ENERGY	20	C	56

The mystery of how a modern refinery converts crude oil into useful products is cleared up by means of animation to show how pipes, furnaces and fractionation towers separate the raw material into component parts - or fractions.

STORY OF OIL MARKETING	27	C	56

Eye-catching animation and live action are combined in an excellent introduction to the role of marketing in a modern economy.

AUTO (Cont'd)

STORY OF THE MODERN STORAGE BATTERY

32 C 73 or 45

Shows the processes used in the manufactur of a modern storage battery, including, the making of the grids, insulators, testing, sealing, filling and packing the batteries.

STYLING AND THE EXPERIMENTAL CAR

C Ford

Good for drafting and automotive design. Good student interest.

STRETCH OF IMAGINATION

27 C 32

Depicts how Goodyear's two new stereo synthetic rubbers are made, one a duplicate of natural rubber, the other a completely new versatile synthetic. From the tiny molecule to an eighty-pound rubber bale, the film is presented in an interesting and understandable manner.

SUPERCHARGING

20 B&W 66

Purpose, components, operation and effects of supercharging and fuel injection systems used to increase engine horsepower.

THE DIESEL STORY

19 B&W 56

The versatile, efficient diesel is an early result of the designer's effort to burn fuel inside the cylinder instead of under a boiler nearby. Development of the diesel is traced from Otto "silent" gas engine of 1877 to the machines that now drive ships, trains, tractors, trucks and even cars.

UP FROM CLAY

25 C 31

Dramatizes the scope of modern automobile body-building operations. Beginning with a new concept in the mind of the automobile stylist, the story touches on the refinement of the design on paper through sculpturing it in clay. Body engineers enter at this point meeting the challenge of capturing the form and beauty of the newly created design in a strong, sound structure of steel. (Good student interest)

WHERE MILEAGE BEGINS

26 C 31

Brilliant color photography, easy-to-understand animation, and fascinating stop motion technique combine to make this a most entertaining and explanatory picture on what makes a car go and how its engine is put together.

WILDCAT

28 B&W 69

This film follows two wildcatting brothers from Oklahoma, from the time they decide to drill right through to the suspenseful moments when they learn whether they have oil or just another duster.

CRAFTS

ALCHEMY OF FIRE

14 52

Different artists demonstrating the art of enamelling.

BLOCK CUTTING & PRINTING

60

(Good student interest for all ages above junior high school.)

BOOKBINDING

24 C 60

The objective of the film is to demonstrate a step by step procedure of two practical, durable and artistic methods for the case binding of the pamphlet by hand; to demonstrate how a simple pamphlet can be rebound to make a durable book with aesthetic appeal. (Good student interest.)

CRAFTS OF MY PROVINCE

12 C 19

The master craftsmen of New Brunswick, shown at work in this film, have made their province famous for its pottery, handloomed fabrics, silverware and jewelry of native stones.

CRAFTSMEN OF CANADA

27 C 19

This surveys the work of Canadian craftsmen in many fields, showing how the changing Canadian scene has been their constant inspiration and how business enterprises today is increasingly using skills of the artisan to enhance the decor of building interiors.

CRAFTSMEN YOUNG AND OLD

10 B&W 19

A film visit to the home workshop of Andre Bourgault, famous French-Canadian woodcarver whose sculptures have brought renown to the village of St. Jean Port Joli, Quebec.

DECORATION

10 C C.O.

Full emphasis on decoration.

HOW FILM IS MADE

19 C 26

This color film is a step-by-step portrayal of film production - from the raw cotton growing in the fields to the finished package on the photo counter. (Good student interest.)

HOW KODAKITH FILM IS MADE

20 C 26

This film is a step-by-step portrayal of film production, concentrating on Kodak films for the graphic arts (printing industry).

CRAFTS (Cont'd)

INSIDE STORY

33 C 26

Depicts the care, clearliness, and control methods used in producing sensitized materials for radiography and relates this care to their ultimate use by the darkroom technician and the radiologist.

NEW DESIGNS FOR AN OLD CRAFT

14 B&W 52

A perspective of work of some of the graduates of the Institute of the Applied Arts (formerly known as the School Furniture) of the Province of Quebec directed by Jean-Marie Gauvreau. Interior arrangements make the most of the work of these artisans.

PHOTOENGRAVING MEANS BUSINESS

16 C 26

Photoengravers use chemical, optical and mechanical means to convert color photographic images into four metal plates for printing millions of full-color reproductions. (Good student interest.)

PLASTICS FROM PETROLEUM

13 C 12

Laboratory demonstrations explain the derivation of certain synthetic resins from petroleum hydrocarbons, showing the different types of plastics obtainable from these resins and several methods used in manufacturing them into an amazingly varied number of articles used today in home and industry.

PLASTICS: INDUSTRIAL PROCESSES & PRODUCTS

24 C 60

Provides viewers with an understanding of the principles of the basic manufacturing processes of the plastics industry and their applications to the production of consumer goods. (Excellent - good student interest)

PUTTING A JOB ON A PLATTEN PRESS

11 B&W 14

Shows basic operations involved in press make ready. Included are inking, packing, inserting guides and sealing them. (Good student interest, but too much nonsense.)

QUALITY IN PHOTO LENSES

25 C 26

Film follows a typical lens through production at the Hawk-Eye Works of Eastman Kodak Company. Film stresses quality control in producing the very finest photographic lens, (Good for adults and upper grades.)

THE MAGIC BOX THAT REMEMBERS

16 C 26

Compares old-time, tedious, picture-taking techniques and equipment with today's push-button-easy procedures and trim, modern cameras. (Good student interest)

THE STORY OF OHIO LEATHER	30	B&W	48

Tanning of raw calfskin into finished leather products. (Very good student interest.)

ELECTRICITY

A CENTURY OF LIGHT

35 C 50-43

The development of the use of gas and electricity is traced over the century to present day conveniences.

A IS FOR ATOM

15 C 64

Explains the atomic structure of the ninety-two basic elements. It goes on to illustrate the process by which the energy within the atom is released through nuclear fission and the means of controlling this energy to supply power to a peace time world.

AMERICA'S RISING NEW GIANT

22 C 22

Demonstrates how and why Electronics has become one of America's most promising fields of opportunity. Sequences show how Electronics is now being used in industry; in fact, in many phases of everyday life.

AT YOUR COMMAND

32 C 50-43

Story of what happens when you snap a switch. Filmed in scenic mountain and valley areas, it focuses on power transmission.

BASIC ELECTRICITY - CAPACITANCE

5 B&W 35

Defines capacitance and demonstrates how a capacitor works, discusses the physical factors that effect capacitance and the effect of capacitance in an AC circuit. (Good student interest.)

BASIC ELECTRONICS

18 C 35

Meaning of atoms & electrons, vacuum tube, cathode, rectifier tube, amplifier tube, grid and bridge circuits.

BASIC TELEPHONY

23 B&W 65

Explains the electromagnetic theory as applied to basic telephony and describes the components, operation, and transmission range of the three fundamental telephone systems commonly used in tactical operations.

BIG BOUNCE

15 C 49

This film documents the original space communications experiment known as "Project Echo" and describes possible future TV and telephone satellite systems.

CAPACITANCE PT. I

16 B&W 35

Ohm's law as related to the effect of current flow of condensers, connecting condensers in parallel and series, dialectric constant(Good student interest)

ELECTRICITY (Cont'd)

CAPACITANCE. PT. II

15 B&W 35

Variations of a charge on a condenser in relation to time, and the behavior of capacitance with alternating current.(Good student interest)

CERAMICS AND ELECTRONICS

22 C 62

Shows the importance of ceramic materials in the electronics industry. It stresses the application of ceramic strips and other ceramic parts in the oscilloscope. It also presents the complete manufacturing process from the mixing of clays, firing and glazing to silvering the strips.

CIRCUIT TESTING - SIGNAL GENERATORS

26 B&W 66

Explains thetheory and operation of the signal generator, including oscillating circuits, audio-oscillators, radio frequency oscillators, and frequency oscillators, and frequency meters.

CURRENT & ELECTROMOTIVE FORCE

11 B&W 35

Explains electro theory, arrangement of molecules, building up current, conductors, electromotive forces, resistance, chemical & mechanical sources of electromotive forces.

CURRENT FLOW, WHAT IS IT?

4 B&W 35

Shows electrons move in chain reaction due to repulsion between electrons and positive atoms.

DAWN OF BETTER LIVING

15 C 50-43

A Walt Disney production showing the history of lighting and the growth of the electrical servants at home and work.

DIODE: PRINCIPLES AND APPLICATION

17 B&W 35

Principles of electron flow across a gap, basic features of diode tube, control of electron flow in tube, photoelectric cells, x-ray tubes, and the diode as a rectifier.

ELECTRIC FIELDS

24 B&W 27

Discusses electric field as a mathematical aid and as a physical entity.

ELECTRIC LINES OF FORCE

7 B&W 27

Shows how to produce electric field patterns using a neon sign transformer as a high voltage source.

ELECTRICITY (Cont'd)

ELECTRICAL SAFETY IN THE HOME

14 C 60

Demonstrates proper means of preventing or correcting electrical hazzards in the home.

ELECTRICITY AND HOW IT IS MADE

16 C 28

Demonstrates principle ways in which electricity can be produced. (Good for primary grades.)

ELECTRICITY AND MAGNETISM PT. I

14 B&W 66

Explains breakdown of molecule into atoms, and relation of protons and electrons to electricity.

ELECTRICITY AND MAGNETISM PT. III

18 B&W 66

Explains the principles involved in the voltaio cell, dry cell and storage battery.

ELECTRICITY AND MAGNETISM PT. IV

16 B&W 66

Charging, care and preparation of storage batteries; constant voltage and methods and modifications.

ELECTRICITY FOR BEGINNERS

11 C 20

Dramatized incidents are used to explain that electricity flows in only one continus pathway. Emphasizes importance of safety.

ELECTROCHEMICAL REACTIONS

14 C 20

Reviews ionization.

ELECTROMAGNETS

3 B&W 35

Shows current can be induced by use of magnetic field; current in turn induces magnetic field all along wire; shows components of electromagnet & how strength can be varied. (Good for junior high or below.)

ELECTRONICS IN SPACE TRAVEL

22 C 22

This film utilizes filmed sequences, animation and easily understood narration to cover the role which electronics is playing in man's conquest of space. Scenes filmed in beautiful color of Cape Canaveral, Florida, animation describing future manned flights to other planets, and a landing on the moon, make up some of the unique sequences in the film.

ELECTRICITY (Cont'd)

ELECTROSTATIC CHARGES & FORCES

25 B&W 20

Experimental check to show that electrons do acquire the predicted energy when they move in a vacuum tube for a known distance in a known electric force field.

HOW TO MAKE A MOTOR GO

20 C 4

Maintenance and installation using cartoon characters and illustrations. Motors discussed.

HOW TO TAKE STEP SEVEN

20 C 4

Maintenance and installation using cartoon characters and illustrations. Motors are serviced.

HUGHES ELECTRON NEWS I

15 C 33

A newsreel report including electron tube production, the GAR-3 Super Falcon, transister manufacturing, and the first fully automated production line and new diode production facilities and techniques.

HUGHES ELECTRON NEWS II

15 C 33

A newsreel report including the Ruby Laser, RAMAC, the missle monitor, ion engine, and freeways and electronics.

KILOWATT BUILDERS

30 C 50-43

Postwar construction program of new hydroelectric and steam generating plants. Fascinating shots of road building, tunneling, dredging, etc. in the high Sierra and elsewhere.

LICENSE NUMBER ONE

35 C 50-43

Dramatically portrays the pioneering accomplishments of scientists and engineers over the past century which led to the production of electricity from the atom at the P.G. & E. at G.E. Vallecitos Atomic Power Plant.

MAGNETISM

16 B&W 28

What magnetism is; difference between magnetism and electricity.

MAKING CONVERSATION

12 C 49

You'll see how telephones are made with the skill needed for this complex instrument as you tour the Western Electric factory, manufacturing arm of the Bell System.

ELECTRICITY (Cont'd)

MOTORS & GENERATORS PTS. I & II

60 B&W 66

Part I describes the construction, uses, and principles governing the operation of DC motors and generators. Part II describes the design, characteristics, and operation of AC generators and motors.

NIKE - HERCULES

28 C 49

The missile designed to seek out an enemy plane and destroy it. Narration and on-the-spot filming traces the Nike-Hercules from the engineer's drawing board to its elaborate testing by the Army Missile Command. This film emphasizes the cooperation necessary between the nation's industry and armed forces.

OHM'S LAW

21 B&W 66

Brief review of basic electronics, emphasizing theory and application of Ohm's Law. Describes current and current flow in electronic circuits. Explains principles and use of Ohm's Law in electronic circuits.

OHM'S LAW

19 B&W 35

Explains elements of electricity & electrical energy; composition of matter; use of force & energy; resistance: purpose & use of meters. (Basic, but good student interest)

OSCILLATORS

13 B&W 35

Explains the basic principles of electronic oscillation.

PRINCIPLES OF GAS-FILLED TUBES

15 B&W 35

Application of theory of ionization, control of current in circuits employing gas-filled tubes, gas diode as a rectifier, action of grid in a gas triode, gas triode as a gridcontrolled rectifier.

PRINCIPLES OF THE TRANSISTOR

21 B&W 35

Brief review of crystal set, invention of valve; detailed explanation of how germanium diode & transistor function. (Good student interest)

RADIO ANTENNAS: CREATION & BEHAVIOR OF RADIO WAVE

12 B&W 35

Explains electric and magnetic fields, behavior of radio waves in space, ground wave, electro-magnetic waves, reflection & refraction, ionosphere, and causes of fading.

RADIO RECEIVERS: PRINCIPLES OF THE RECEIVER

17 B&W 35

Shows principles & working of crystal and tube detectors, radio and audio frequency amplification, superheterodyne circuit.

ELECTRICITY (Cont'd)

RADIO SHOP TECHNIQUES
38 B&W 35

Shows radio technician's tools, orthographic projection, layouts, sawing and filing, drilling, bending metal, wiring, soldering in making regenerative receiver. (Introduction to construction project)

RCL
34 B&W 35

Relationship of current and voltage to time, curves, measurement at source, the addition of phase components, effect of impedance on resonance.

SAFETY WITH ELECTRICITY
C 28

(Very good for junior high school, but not high school, too elementary.)

SERIES & PARALLEL CIRCUITS
8 B&W 35

Illustrates series & parallel circuits, explaining current flow and voltage drop across each lamp. (Basic material, good student interest. Film might be well used for review work.)

SEVEN MILLION MILES OF WHITE POWER
14 C 37

Shows advantages in installation of aluminum building wire.

SIGNAL GENERATOR OPERATIONS
9 B&W 35

Shows how to use signal generator to align radio receiver.

SIMILARITIES IN WAVE BEHAVIOR
27 B&W 49

Using specially built torsion wave machines, Dr. J. N. Shive of Bell Telephone Laboratories demonstrates and discusses the following aspects of wave behavior: reflection of waves; superposition, standing waves and resonance; energy loss by impedance mismatching; and reduction of energy loss by quarter-wave and tapered-section matching transformers.

STORY OF THE MODERN STORAGE BATTERY
33 C 73 or C.O.

Shows the processes used in the manufacture of a modern storage battery, including the making of the grids, insulators, testing, sealing, filling, and packing the batteries. (Very good student interest)

TELEGRAM FOR AMERICA
20 B&W 72

This film shows modern telegraphy at work--exploring new frontiers with facsimile transmission, micorwave beam, and other modern development. It also includes some historical background of the industry.

ELECTRICITY (Cont'd)

TELEVISION - LAND OF NEW FRONTIERS

22 C 22

Takes the viewer behind the scenes in television. Interesting sequences show actual televising of both studio and remote programs. Scenes show trained technicians in action, and explain many studio operations which TV viewers seldom see. Primary purpose is to show the wide variety of opportunities in television. Perfect for high school vocational guidance programs and adult groups.

TELEVISION RECEIVERS

7 B&W 35

Explains specific functions of each section in a typical intercarrier sound receiver circuit, from antenna and transmission line to picture tube.

TELSTAR

27 C 49

The story of the Telstar I Communications Satellite, including the extensive research that went into it. (A good enrichment film for an electronics program. The film moves slow, but has good student interest.)

TESTING WITH METERS

33 B&W 66

Use of Voltohmeters, Wheatstone bridge, decibel meter, tube tester, etc; in testing transformers, capacitors, resitors, telephone loop circuits. (Good student interest, but slow moving.)

THE ELECTRON THEORY

5 B&W 35

Shows orbit of electrons around a representative atom, symbols used for neutral atom, electron, and atom with one positive charge and current flow. (Very elementary, but good for basic information.)

THE KINGS

27 C 50-43

Breathtaking photography takes you through the rich farm lands of the San Joaquin Valley on location with construction crews at work in the granite gorge of California's Kings River Canyon. Shows the building of dams, tunnels, penstocks and powerhouses on this project.(Good for general viewing)

THE MAGIC IN TELEVISION TUBES

10 B&W 22

Using easily understandable animation, this Hollywood produced film traces the development and shows the operation of the heart of a modern television set - the cathode ray "picture" tube.

THE MAGIC LINK

20 C 50-43

Adequate wiring in today's homes.

ELECTRICITY (Cont'd)

THE MIGHTY ATOM

17 C 50-43

Cartoon motion picture of the origin of electricity with "Reddy Kilowatt" as star and narrator. Particularly interesting to school children.

THE NEW GIANT

15 C 33

Present a look at the unbelievably complex world of military electronics. It examines the tremendous growth of a new industry. (Good general student interest.)

THEORY OF OPERATION OF THE FOUR-POLE MAGNETO

30 B&W 15

This film describes the use of the components of the four-pole, high tension magneto, and combines them into a working magneto. It gives the theory of the magnetic principle, the condenser, contact points, and coil and describes how each operates.

TRANSISTORS V

30 B&W 66

Basic Class A transistor amplifier circuit; fundamentals and variations of amplifier circuit operation. Conventional and complementary symmetry amplifiers; how transistor amplifiers are modified to become oscillators. (Technical, but good student interest.)

TRANSISTORS PART VI

39 B&W 66

Diverse uses of transistors in pulse application. Characteristics and application of basic types of waveforms, or pulses: square, saw tooth, and spiked. Shows how a transistor functions as a switch to make square waves first electromechanically and then electronically. (Technical and advanced, but good student interest.)

TRANSISTORS PART VII

31 B&W 66

Standard troubleshooting approach, as developed for vacuum tube circuits; visual inspection, checking for shorts, operation check, power supply check, sectionalizing and localizing and isolating. Procedure is then applied to transistorized equipment. (Technical repair, good student interest)

TRANSISTORS: HIGH FREQUENCY OPERATION

14 B&W 35

Describes how transistors operate in high frequency amplifiers and in oscillator circuits, shows influence of transit effect in the base.

TRANSISTORS: P-N JUNCTION FUNDAMENTALS

11 B&W 35

Explains theory and mechanisms of semi-conductor diode and transistor action, discusses fundamental principles that apply to all transistors and junction rectifiers. (Technical, but good student interest.)

TRANSISTORS: LOW FREQUENCY AMPLIFIERS

15 B&W 35

Shows how transistors are used to amplify low frequencies in common base, common emitter and common collector circuits. Explains transistor functions.

TRANSISTORS: SERVICING TECHNIQUES

17 B&W 35

Discusses common types of transistor failures. Demonstrates with over-shoulder camera views, the special techniques that must be used with transistorized equipment.

TRANSISTORS: SWITCHING

14 B&W 35

Examples of switching circuits in transistorized computers, explaining concept of digital computation and how transistors are used, how a simple transitor switch works.

TRIODE: AMPLIFICATION

14 B&W 35

Principles of diode and triode, electric fields, triode amplifier circuits, amplification of DC voltage changes, alternating voltages, distortion, amplification of audio frequency signals.

TROUBLEMEN

15 B&W 50-43

An absorbing story of electric serve maintenance during a severe electric storm, featuring George Kritsky, a P.G & E troubleman. Traces the restoration of power in the midst of a driving storm.

TUNED CIRCUITS

28 B&W 66

Theories of electronics of tuned circuits, application of theories to a practical radio receiver layout and a radio transmitter.

VACUUM TUBES: ELECTRON THEORY & DIODE TUBE

14 B&W 35

Explains electron behavior, electron sources in vacuum tubes, diode & duodiode as reflectors.

VACUUM TUBES: TRIODE AND MULTIPURPOSE TUBES

14 B&W 35

Triode tube, its structure, capacities, circuits in which tube functions. Functions of grid, grid bias, screen, suppressor grids, and multi-purpose tubes indicated.

VOLTAIC CELL, DRY CELL & STORAGE

18 B&W 35

Explains principles of voltaic cell, dry cell, storage battery.

ELECTRICITY (Cont'd)

WHAT IS ELECTRICITY?

12 C 50-43

Fundamentals of electricity are explained clearly and simply. Methods of generating electricity are described with emphasis on generation by magnetism.

YOUR FUTURE IN ELECTRONICS

21 C 53

Shows actual training of electronics technicians and depicts something of the opportunities in industry for person with this training. It will be of special interest to high school students who have an interest in electronics.

MECHANICAL DRAWING

A IS FOR ARCHITECTURE

30 C 19

Presents the romance of architecture, the story of man's buildings through the ages, perpetuating in stone the pride and spirit of his days.

ALUMINUM ON THE SKYWAY

28 B&W 2

Filmed over a three year period, the film shows step-by-step construction of the recently completed thirty-story Alcoa Building in Pittsburgh, Pennsylvania. (Good student interest.)

AMERICAN LOOK

29 C 36

Shows the progression of a specific design from the initial concept of the idea to the finished product, with artists at work on the project.

AUXILIARY VIEWS I

13 B&W 41

Reviews orthographic projection on three principal planes and on auxiliary planes; describes the theory of double auxiliary or oblique view, using animation techniques; demonstrates the steps in drawing an object with an oblique face. (Good student interest.)

AUXILIARY VIEWS II

23 B&W 41

Reviews orthographic projection and describes the true shape of an object with one or more slanting, faces. The film explains auxiliary projecting through three-dimensional technique. Discusses auxiliary elevations right and left auxiliary views and front and back auxiliary views. (Good student interest.)

BEHIND THE SHOP DRAWING

B&W 36 or CO

Discusses many aspects from elementary to complicated objects.

BLUE PRINT FOR ACTION

28 C 43

Shows the importance and need of the copy and reproduction industry and its role in today's business world. (Good student interest.)

DESIGN AGAINST THE SKY

38

DRAFTING TIPS

28 B&W Penn.State

Tips to look for in drawing. (Good student interest.)

MECHANICAL DRAWING (Cont'd)

HOUSES HAVE FOUR SIDES

30 C 2

Assists builders and home improvement contractors in selling and installing new Alcoa siding, a fast growing trend in the designs for contemporary home construction. Job estimates, accessory utilization and installation completion are shown in detail.

LANGUAGE OF DRAWING

10 B&W 41

Attempts to provide a sensible and acceptable answer to the question, "Why study Mechanical Drawing?" and to stimulate the beginning student's interest in the subject. (Good student interest.)

LEVER AGE

21 B&W 56

Primitive man discovered that it was easier to move heavy objects with the aid of a tree branch and rock than by hand alone. The development of this principle and its application in modern technology are the subjects of this motion picture.

MAKING A HOUSE MODEL

10 14

(Too elementary - good for fourth grade level.)

MEN, STEEL AND EARTHQUAKES

25 C 43

(Good student interest.)

PICTORIAL SKETCHING

13 B&W 41

Using a combination of animated drawings and live photography, it describes the three methods of pictorial sketching-axometric, oblique, perspective -- and explains where and how to use each method.

SECTIONS

10 B&W 41

Explains various symbols used in sectioning and demonstrates the construction of a full sectional view. (Good student interest.)

SHAPE DESCRIPTION I & II

19 B&W 41

Describes orthographic projection, utilizing a combination of animated diagrams and animated photography of specially prepared models to provide unusual three-dimensional effects. In Part II, the step-by-step procedure of constructing a drawing is demonstrated and reasons for each step are explained. (Good student interest.)

SHOP PROCEDURES

17 B&W 41

Shows how finished drawings are used as detailed instruction in every step of manufacturing. (Good student interest.)

MECHANICAL DRAWING (Cont'd)

SIMPLE DEVELOPMENT
11 B&W 41

Animated drawings are used in this film to explain what simple developments are and how they are made. Step-by-step development of a hexagonal prism, truncated cylinder, right rectangular pyramid, oblique pyramid, right circular cone and truncated right circular cone is shown. (Good student interest.)

SIZE DESCRIPTION
13 B&W 41

The method for describing complex drawings by breaking them down into simple geometric parts for dimensioning is shown. (Good student interest)

STEEL RULE
14 41

(Good student interest)

WHY STUDY I.A.
10 B&W 41

A discussion of why the study of industrial arts is important to the student now and in later life. (Good student interest.)

YOUR CAREER IN ARCHITECTURE
27 42

METALS

ABRASIVE CUTTING

33 C 5

This film describes and demonstrates abrasive cutting and its applications in industry. It shows four basic types of abrasive cut-off machines - copstroke, oscillating, horizontal, and rotary; and explains the type of operations to which each is especially adapted.

ALIGNMENT FOR BETTER INTERNAL GRINDING

30 C 16

Discussion of close tolerance work that can be produced on an internal grinder. The elements which contribute to its alignment are clearly defined and the correct relationship of the elements to each other is illustrated by models. The types of mis-alignment are also presented.

ALUMINUM ON THE MARCH

28 B&W 55

Aluminum production and application, from raw bauxite to finished aluminum products. (Good student interest.)

AGE OF PRECISION

30 C 17

Shows the impact of cyclindrical grinding improvements on all of our lives.

ARC WELDING STAINLESS STEEL

20 C 3

The principles and factors that govern arc welding of stainless steel are portrayed in this film. How and why the arc welder works are covered in detail. (Good for advanced welding.)

BURNING BLADES

29 C 1

Explains gas cutting, it graphically reveals the versatility of Airco's machine oxyacetylene cutting equipment. Actual producting scenes are used.

BRIGHT STEEL

30 C 43

Many uses of tin plate, exemplifing the making of tin cans. (Good student interest.)

CARE AND USE OF HAND TOOLS -- BARS, PUNCHES AND DRIFTS

14 B&W 66

Purposes, correct uses, and commom misuses.

CARE AND USE OF HAND TOOLS -- CHISELS

12 B&W 66

Various types of cold chisels; correct use and safety precautions.

METALS (Cont'd)

CARE AND USE OF HAND TOOLS -- HACKSAWS
18 B&W 66

Various types of hacksaw frames; proper and improper uses.

CARE AND USE OF HAND TOOLS - HAMMERS
11 B&W 66

Correct use of ball, straight, cross-peen, sledge and clawhammers.

CONTINENTAL PRODUCTION SAW
15 C 24

Describes how the need for higher cutting rates was met by using a two-inch wide saw blade on an advanced design, large capacity, cut-off machine. Animation is used to illustrate the unique design of the machine and split gram photography indicates the relatively fast cutting rates compared to other more common machines.

CUTTING EDGE
29 C 47

Demonstrates in detail the procedure in sharpening the four basic types of milling cutters.

DESIGN FOR ARC WELDED STRUCTURES
15 C 40

Animation is used to describe the development of structures through the ages and explains how the arc welding process allows designers and engineers to overcome previous limitations in building structures today. It describes the reasons for arc welding in buildings and bridges. (Good student interest)

DESIGNING MACHINERY FOR ARC WELDING
15 C 40

Describes the functional approach to machine design in a simple manner, suitable for school use. It explains how welded design permits greater strength and rigidity from less material. (Good outline and order, advanced, but good student interest)

DRAMA OF METAL FORMING
28 C 56

The excitement, noise and color of forming mills are presented in vivid sequences showing gigantic machines, operated with high precision, shaping metal into products ranging from a 100 ton rotor to fine copper wire. The metal-forming operations portrayed include hot and cold rolling, tube forming, wire drawing, forging, extrusion, deep drawing and pressing.

EASY DOES IT
24 C 54

Show the manufacture and application of Electrunite EMT conduit.

EUTALLOY
20 C 29

METALS (Cont'd)

EXTENDING THE RANGE OF MODERN SURFACE GRINDING

20 C 24

Reveals the capability of the modern surface grinder for the performance of tasks other than flat grinding. It shows form grinding and automatic grinding as well as attachments for obtaining automatic grinder operation.

FILES, HOW TO USE THEM

Tells what happens when a file cuts stock. How to file teeth work. Helps to clear up the use and function of the file as a basic cutting tool.

GOLDEN HORIZONS

32 C 10

Historical - early uses of copper, iron and aluminum. (Moves too slow, but good student interest.)

GRINDING CUTTER BITS

20 C 77

Shows how to grind cutter bits of various lathe operations including rough and finish turning, facing and thread cutting. Many clear close-ups make it easy for the beginner to understand how to grind the correct clearance and rake angles. (Good student interest.)

HACKSAWS: HOW TO USE THEM

30 C 57

Film teaches best methods of hacksaw cutting, hand and power. Shows how to choose and correctly use hacksaw blades.

HEAT TREATMENT OF STEEL

30 B&W 8

Shows the importance of heat treatment of steels in today's exacting requirements for tools, springs and machine components. The film describes the iron carbon and time-temperature transformation diagrams as these pertain to heat treating. (Technical and good student interest.)

HIGHWAY TO PRODUCTION

30 C 17

Tells the story of the construction of a milling machine. It shows machine tool patterns, founding and precision machining. Scientific know-how and planning of production are stressed. (Good student interest.)

HOW TO FORM ALUMINUM

15 B&W 65

Blanking and Piercing; This is one of the excellent "How to do it" series put out by ALCOA. It shows sheet metal layout, and the use of shears, saws and routers. Rubber pad forming is also displayed.

HOW TO FORM ALUMINUM

13 B&W 65

Tube & Shape Bending; Proper methods of bending aluminum tubes and shapes are demonstrated.

METALS (Cont'd)

LATHE-SOUTH BEND

20 C 77

Introduces the student to the standard back-geared screwcutting lathe by familiarizing him with the name of each individual part of the lathe, its purpose and operation. It is ideally suited for beginners before actual operation of the lathe. (Good student interest.)

MACHINE KNIVES IN INDUSTRY

30 C 57

Shows the manufacture of various kinds of machine knives and their employment in mills, factories, plants, etc.

MANUFACTURE OF DIES

11 C 3

Steps in manufacturing of lamination dies from oil-hardening, high-carbon, high-chrome tool steel. (Advanced, good student interest.)

MILES OF STAINLESS

27 C 3

Shows complete sequence of manufacturing bars and wire from melting to finished product.

MODERN STEEL MAKING

22 C 68

This is the story of basic steel making today in the blast furnace, open hearth and electric furnaces. Operations are illustrated by animation and live shots with on the scene sound effects. (Very good student interest.)

OLD AS THE HILLS

28 C 47

The story of man's learning from nature the techniques of abrasion, and how to develop abrasive material to care for his own needs.

ONE HOE FOR KALABO

25 C 43

Contrasts the making of one hoe in the heart of Africa with our modern industrial techniques. It also offers some historical development of machine tools. (Very good student interest.)

PLAIN TURNING

20 C 77

Illustrates all of the operation involved in machining a shaft held between the lathe centers. It teaches many of the basic procedures encountered in all lathe work. (Good student interest.)

RIBBONS OF STAINLESS

20 C 3

Manufacturing of strip including melting, blooming, hot rolling, etc.

METALS (Cont'd)

SAND AND STEEL

10 B&W 3

Covers the complete operation of the manufacture of stainless steel. It includes sand preparations, pattern making, molding, and the melting and pouring of heat resistant castings. (Good foundry film.)

STORY OF STAINLESS

21 C 54-43

Here is a fascinating record of the birth and growth of a great industry - stainless steel. Excellent scenes of the plants of stainless steel manufacturers and users are in this film.

THE LITTLE SHOW-OFF

20 C 39

Informative film describing the Tri-D Rotary Milling Head and its application.

THE MAGIC WAND OF INDUSTRY - ARC WELDING

25 C 40

How arc welding is used in all types of industry. (Good student interest.)

THE MAKING, SHAPING, TREATING OF STEEL (Series of 6 films)

50 C 68

This film series is more detailed than "Modern Steel Making" and is intended for audiences who either through interest or specific needs desire to know more about some of the technical aspects of steel. (Excellent series, good student interest, good order.)

THE PREVENTION AND CONTROL OF DISTORTION IN ARC WELDING

20 C 40

Showing how molten weld metal cools and contents. (Excellent, informative, good student interest.)

THE ROUGE

20 C 76

Show the men and machines of the Rouge performing the major steps in the building of cars, from the smelting of iron ore to the final assembly line. (Good student interest.)

THE SPIKED CANDLESTICK

13 C 71

Describes and illustrates in detail the complete operation involved in the casting and finishing of an authentic reproduction of the candlesticks.

TOOL FOR MANY USES

18 C 1

Shows the use of inert gas arc welding in a variety of industrial applications. Coil-fed rod and welding of many materials are displayed.

USES AND ABUSES OF TWIST DRILLS

30 B&W 18

Proper uses and common misuses of these tools. (Good student interest.)

WOOD

A SAFE SHOP

11 B&W 41

Discusses the safety problems and procedures for the school shop. (The film has a very broad scope; however, it has good student interest for use in safety instructions.)

AMERICAN WALNUT

22 B&W 9

History of the walnut tree and its many uses.

CHISELS & GOUGES

13 B&W 41

Demonstrates the nature, function, use and care of chisels and gouges used in woodworking. (Moves slow, but has good student interest.)

COMPARATIVE FIRE TEST ON TIMBER AND STEEL BEAMS

15 C 45

Illustrates an actual test on the fire resistance of glued-laiminated timber and steel "I" beams.(Quite technical, moves too slow and little student interest.)

COMPARATIVE FIRE TEST ON WOOD AND STEEL JOISTS

10 C 45

Provides building designers and owners with reliable information on the comparative behavior of unprotected wood and steel joists. Shows results of a fire test in which wood joists and steel joists were exposed simultaneously to identical fire conditions. (Quite technical, moves too slowly, little student interest.)

CONVENTIONAL & HOT SPRAY METHODS

25 C 23

(A technical film perhaps usable for T & I instruction: however, not appropriate for this area. It moves quite slow and has little student interest.)

FINE ART OF FURNITURE FINISHING

25 C 25

This film was made on the production line in a furniture factory. It describes how furniture is finished from bare wood to the end product. It shows various operations and the care that is taken to insure a durable and beautiful finish. (Moves slow and is technical, but has good student interest.)

FOREVER LIVING FORESTS

27 C 34

Where and how redwood grow, produce, etc. (A technical, slow moving film with good student interest.)

FROM TREES TO LUMBER

14 B&W 6

This film shows by dramatic photography and simple diagram how paper is made from trees. It also tells how scientific forest management assures growth of repeated tree crops. (Good for general school use or for adult audiences, good student interest.)

WOOD (Cont'd)

FROM TREES TO PAPER

12 B&W 6

This film shows by dramatic photography and simple diagram how paper is made from trees. It also tells how scientific forest management assures growth of repeated tree crops. (Good for general school use or for adult audiences, good student interest.)

HAND SAWS

10 B&W 41

Identifies common types of hand saws and explains the correct uses of each type. (Moves too slow, good student interest.)

HERE'S HOW

25 B&W 46

Features Norman Brokenshire demonstrating how to paint interiors, exteriors, masonry, as well as covering floor finishing.(Fair student interest, moves slowly.)

IT'S A TREE COUNTRY

14 B&W 6

America's forests are now adding more wood in new growth than is being removed each year. Shows the tree farming, forest fire prevention, research and utilization activities of wood-using industries and other timberland owners which have helped make this favorable balance possible. (Moves slowly, fair student interest.)

KNOWING WOODS & THEIR USES

20 B&W 41

Explains the classifications and characteristics of woods so that the craftsman can better select and order the woods he needs. (Moves too slowly, little student interest.)

JOINING AND GLUING

20 B&W 41

Demonstrates the techniques for joining and gluing wood surfaces. (Fair student interest.)

LIFE OF LEISURE

20 C 7

Plans are made by a young couple to build a "second home" in the mountains. (Too much nonsense, fair student interest in spots.)

MAKING THE MOST OF SPRAY PAINTING METHODS

30 B&W 23

This film shows how spray equipment works; the types of equipment and their adjustment, the elements of the spraying machines and their function. It Also shows how to use spray equipment, how to care for the equipment, and the cleaning of the gun, both hose and containers. It includes the locating and correcting of commom defects. (Moves too slowly with little student interest, might be good for advance classes.)

WOOD (Cont'd)

MEASURING AND SQUARING

12 B&W 41

Demonstrates the function and use of common types of shop measuring and squaring tools. (Moves slowly with fair student interest.)

MODERN WOOD SANDING

20 C Behr-Manning
Div. of Norton Co.
Troy, N.Y.

Filmed in leading furniture plants, this film takes you step-by-step through the machine rooms, to the sanding room and cabinet room on to final finishing. (Very good student interest.)

OLYMPIC VILLAGE U.S.A.

15 C 7

Winter sports action is woven in this story of changing a mountain meadow into an Olympic site. Emphasis is on unusual construction rather than sports. (Good student interest, but not a strong teaching aid for this area.)

PLANES.

13 B&W 41

Identifies the common types of hand planes, and shows the correct use and care of each. (Fair student interest.)

PLYWOOD FLEET

27 C 7

The use of plywood in commercial boats such as tunaclippers is illustrated as well as private pleasure boats. (Fair student interest, not good for this area of study.)

THREE APPRENTICES

33 19

TOMORROW'S TREES

25 C 43

A well illustrated story of forestry. (Good student interest, but may not be of extreme benefit in this area.)

UNICOM - METHODS OF HOUSE CONSTRUCTION

30 C 45

Shows how Unicom method of house construction provides a uniform basis for manufacturing house components. Features construction of two complete house shells, from installing floor joists to applying the siding. (Good technical carpentry film, little student interest in a general wood course.)

USING SCREWS AND NAILS

12 B&W 41

Identifies the common types of nails and screws used in woodworking, as well as function and uses of hammers, nailsets and screwdrivers. (Fair student interest.)

WEALTH OF THE WEST			
	30	C	75

Features the manufacture of box shock and the packing and shipping of fresh produce in standard nailed containers. (Fair student interest.)

WOOD FINISHING			
	16	B&W	41

Explains the common types of finishing materials used on wood, and demonstrates the procedures for each. (Good student interest.)

SPONSORS - NAMES AND ADDRESSES

1. Air Reduction Sales Co.
1485 Park Avenue
Emeryville 8, California

2. Alcoa
Motion Picture Sec.
818 Alcoa Building
Pittsburgh, Pennsylvania

3. Allegheny Ludlum Steel
Pittsburgh, Pennsylvania

4. Allis - Chalmers Mfg. Co.
Tractor Group
Milwaukee 1, Wisconsin

5. Allison - Campbell Div.
P.O. Box 430
Bridgeport, Conn.

6. American Forest Products
1816 N. Street N.W.
Washington 6, D.C.

7. American Plywood
1119 A Street
Tacoma, Washington 98401

8. American Society of Metals
Mr. T.C. DuMond
Metals Park, Ohio

9. American Walnut Mfg Assoc.
666 N. Lake Shore Drive
Chicago 11, Illinois

10. Ampco Metals, Inc.
P.O. Box 2004
Milwaukee 1, Wisconsin

11. Archer - Daniels Midland Co.
2191 W. 110th Street
Cleveland, Ohio

12. Arizona State University
Film Cooperative
Tempe, Arizona

13. Armco Steel Corp.
Film Library
703 Curtis Street
Middletwon, Ohio 45042

14. Bailey Films
6509 DeLongpre Ave.
Hollywood, California

15. Bendix
Service Dept.
Sidney, New York

16. Bryant Chucking Grinder Co.
Springfield, Vermont 05159

17. Cincinnati Milling Machine Co.
Advertising Dept.
4701 Marburg Ave.
Cincinnati 9, Ohio

18. Cleveland Twist Drill Co.
Mr. W. E. Wenger Adv. Mgr.
P.O. Box 6656
Cleveland, Ohio 44110

19. Consulate General of Canada
Film Library
310 South Michigan Ave.

20. Coronet Films
65 E. So. Water Street
Chicago 1, Illinois

21. Delco - Remy Div.
General Motors Corp.
Anderson, Indiana

22. De Vry Technical Institute
4141 Belmont Avenue
Chicago, Illinois 60641

23. Di Vilbiss Co.
Dept. 133 Phillips Ave.
Toledo 1, Ohio

24. Do All Company
Film Libraries
254 N. Laurel Avenue
Des Plaines, Illinois

25. DuPont Motion Picture Dist.
Wilmington 98, Delaware

26. Eastman Kodak Co.
343 State Street
Rochester, New York 14650

27. Education Services, Inc.
Watertown, Mass

28. Encyclopedia Britannica
Public Relations Dept.
Wilmette, Illinois

29. Eutectic Welding Alloys Co.
40 - 40 172nd Street
Flushing 58, New York

30. Federal Products Corp.
1144 Eddy Street
Providence, Rhode Island

31. General Motors
Film Library
405 Montgomery Street
San Francisco, Calif.

32. Goodyear Tire & Rubber Co.
Audio-Visual Dept.
Akron, Ohio 44316

33. Hughes Aircraft Co.
Mr. K. G. Brown
Bldg. 114, Mail Station 13
P.O. Box 90515
Los Angeles 9, California

34. Ideal Pictures
Audio-Visual Dept.
1840 Alcatraz Avenue
Berkeley, California

35. Intercounty Loan
Audio-Visual Dept.
San Joaquin County
Stockton, California

36. Jam Handy Organization
2821 E. Grand Blvd.
Detroit, Michigan 48211

37. Kaiser Aluminum & Chem. Corp.
Mr. Robert L. Del Re
1924 Broadway
Oakland 12, California

38. Kaiser Steel
Kaiser Center
300 Lakesie Drive
Oakland 12, California

39. Kearney & Trecker Corp.
Advertising Dept.
1100 Theodore Trecker Way
Milwaukee, Wisconsin

40. Lincoln Electric Co.
25358 Cypress Ave.
Hayward, Calif.

41. McGraw - Hill Co.
330 W. 42nd Street
New York 36, New York

42. Modern Learning Aids
3 E. 54th Street
New York 22, New York

43. Modern Talking Pictures
444 Mission Street
San Francisco 5, Calif.

44. Monroe Auto Equipment
East First Street
Monroe, Michigan

45. National Lumber Mfg. Assoc.
1135 W. Huntington Drive
Arcadia, California

46. National Paint Varnish &
Lacquer Assoc.
1500 Rhode Island Ave N.W.
Washington 5, D.C.

47. Norton Abrasive Company
Advertising Dept.
Worcester 6, Mass.

48. Ohio Leather Co.
1052 N. State Street
Gerard, Ohio

49. Pacific Bell Telephone
apply at local office

50. Pacific Gas and Electric
apply at local office

51. Pratt & Whitney
Advertising Dept.
Charter Oak Blvd.
West Hartford 1, Conn.

52. Quebec Government House
Rockefeller Center
17 W. 50th Street
New York, New York 10020

53. R.C.A. Institutes, Inc.
Mr. C. E. Tomson, Reg.
350 W. 4th Street
New York 14, New York

54. Republic Steel
224 East 131st Street
Cleveland, Ohio 44108

55. Reynolds Metal Co.
5004 W. Clay Street
Richmond 18, Virginia

56. Shell Oil Co.
Film Library
430 Peninsular Avenue
San Mateo 8, California

57. Simonds Saw and Steel Co.
218 Littlefield Avenue
South San Francisco, Calif.

58. Southern Pine Assoc.
P.O. Box 1170
New Orleans, Louisiana

59. Sterling Movies U.S.A.
43 West 61st Street
New York, New York

60. Stout State College
School of Ind. Education
Menomonie, Wisconsin

61. Tandy Leather Co.
Box 791 E.P.S.
Fort Worth, Texas

62. Tektronix, Inc.
Film Library
Delivery Station 74/298
P.O. Box 500
Beaverton, Oregon 97005

63. Union Carbide Corp.
Sales Technical Service
270 Park Avenue
New York, New York 10017

64. U.S. Atomic Energy Comm.
Office of Public Info.
2111 Bancroft Way
Berkeley, California

65. U.S. Bureau of Mines
4800 Forbes Avenue
Pittsburg 13, Penn.

66. U.S. Dept. of the Army
6th Army
Presido of San Francisco.
San Francisco, Calif.

67. U.S. Dept. of the Navy
Twelfth Naval Dist.
Federal Naval Office Bldg.
San Francisco 2, Calif.

68. U. S. Steel Corp.
120 Montgomery Street
San Francisco 6, Calif.

69. United World Films
211 Park Avenue South
New York, New York 10003

70. Universal - Cyclops Steel Corp.
6252 E. Telegraph Road
Los Angeles, Calif.

71. Virginia Metalcrafters, Inc.
Waynesboro, Virginia

72. Western Union
Mr. R. D. Saylor V,P.
742 Market Street
San Francisco, Calif.

73. Willard Storage Battery Div.
246 - 286 E. 131st Street
Cleveland, Ohio

74. Youngstown Sheet & Tube
Stamburgh Blvd.
Youngstown, Ohio

75. Western Wood Box Institute
55 New Montgomery
San Francisco, Calif.

VOCATIONAL AND INDUSTRIAL ARTS FILMS
AND FILMSTRIPS -- NAPA COUNTY

NEW MATERIALS -- 1966-67

MP 1037	ABC'S	OF	HAND TOOLS	PT. I
MP 1038	"	"	" "	PT. II
MP 1039	"	"	JET PROPULSION	
MP 1040	"	"	THE AUTOMOBILE ENGINE	
MP 1041	"	"	INTERNAL COMBUSTION	
MP 1042	"	"	DIESEL ENGINE	

ELECTRICITY

MEASUREMENT) These are pending NDEA
PRODUCTION) acquisitions. Decisions
STATIC) will be made soon regarding
DISTRIBUTION) final purchase.

TRANSPARENCIES (masters)

TRANSP. 1 TECHNICAL GRAPHICS

FILMSTRIPS

FS	228	WHAT IS YOUR FUTURE IN THE CHANGING WORLD OF WORK?
FS	229	YOUR FUTURE IN THE SHEET METAL TRADE

OTHER MATERIALS ON HAND

MP	60	FLOW OF ELECTRICITY	
MP	113	FRICTION	
MP	243	SIMPLE MACHINES: LEVERS	)
MP	244	" " PULLEYS	) Very elementary
MP	245	" " INCLINED PLANES	)
MP	346	SERIES OF PARALLEL CIRCUITS	
MP	424	LEARNING ABOUT LIGHT	
MP	425	" " HEAT	
MP	426	" " SOUND	
MP	439	ELECTRICITY ALL ABOUT US	
MP	440	NATURE OF ENERGY	
MP	441	NATURE OF LIGHT	
MP	582	MAGNETS	
MP	828	WHAT IS ELECTRIC CURRENT?	
MP	829	HOW TO PRODUCE ELECTRIC CURRENT WITH MAGNETS	
MP	830	MAGNETIC, ELECTRIC AND GRAVITATIONAL FIELDS	
MP	832	ELECTRONS AT WORK	
FS	122	FRICTIONAL ELECTRICITY	
FS	695	ELECTRICITY	
FS	696	PERMANENT MAGNETS	
FS	700	ELECTRIC MAGNETS	
FS	701	SIMPLE MACHINES	
FS	959	WONDER OF ELECTRICITY	
FS	960	WONDER OF ELECTRIC LIGHT	
FS	1173	ELECTRICITY IN EVERYDAY LIFE	

VT001 877

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Choosing an Occupation, A Guide for High School Students.

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OCCUPATIONAL INFORMATION, INDIVIDUAL CHARACTERISTICS, *HIGH SCHOOL STUDENTS, *OCCUPATIONAL GUIDANCE, *OCCUPATIONAL CHOICE,

The purpose of this bulletin is to assist high school students in choosing an occupation. In planning a career, the student should (1) analyze his individual interests, abilities, values, personality, and physical characteristics, (2) investigate different occupational and professional requirements, and (3) weigh individual characteristics against the demands of the occupation or profession. A self-inventory and an occupational study worksheet are included. (WB)

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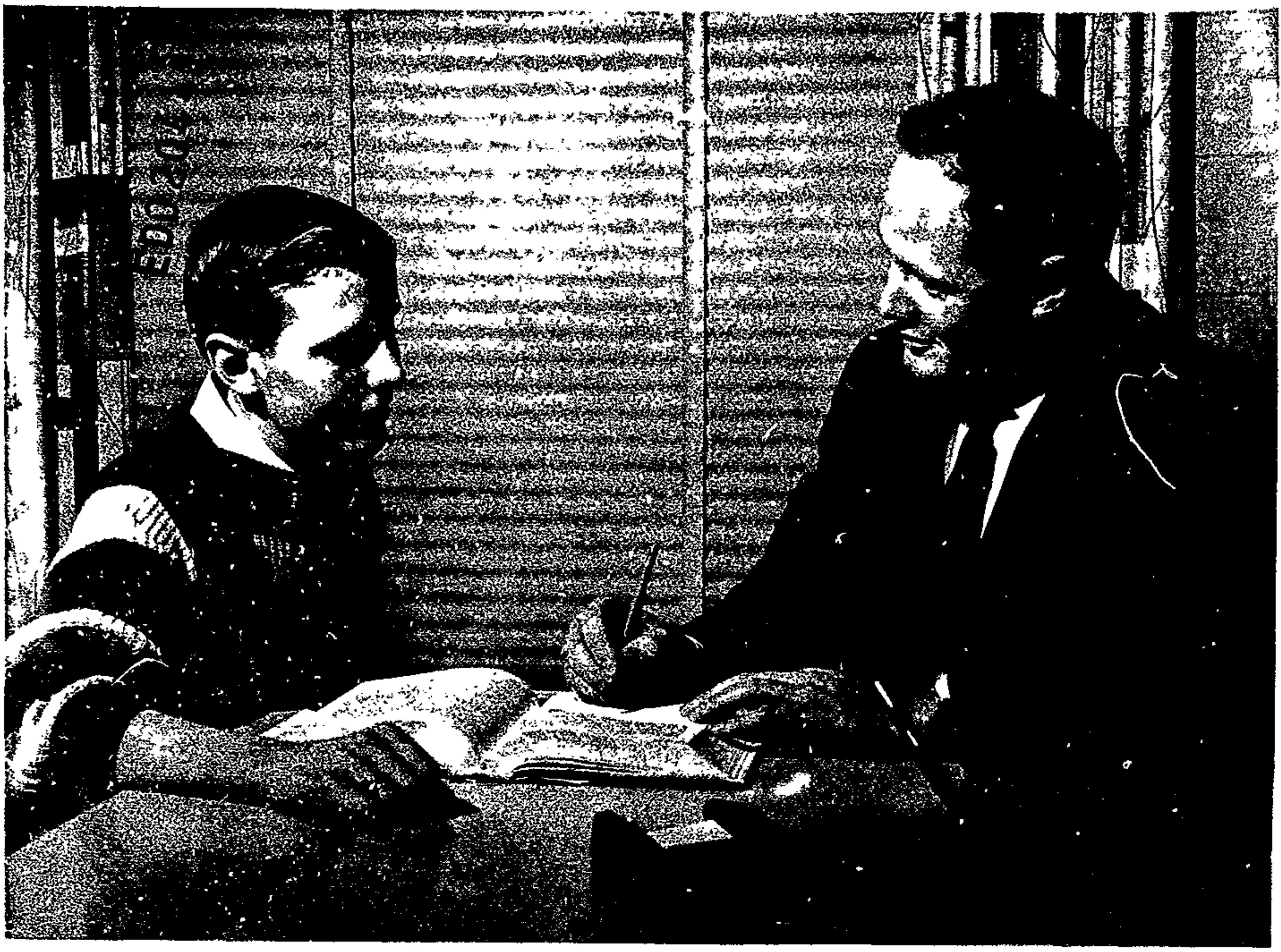

CHOOSING AN OCCUPATION
a guide for high school students

Joe P. Bail and A. Gordon Nelson

CONTENTS

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CHOOSING AN OCCUPATION

a guide for high school students

Joe P. Bail and A. Gordon Nelson

If you are in junior or senior high school, from time to time you probably ask yourself: How will I, someday, earn a living? How can I get information about various occupations? This bulletin has been written to help students in their search for answers to these questions.

A person's vocation is a very important part of his life. During at least five days of each week, over a period of 40 to 50 years, the average adult's job occupies more of his time than does any other activity. The surroundings in which he earns his livelihood, the kinds of people with whom he works, and the degree of satisfaction he gets from the work itself affect not only his enjoyment of life, but the quality of his service to other people. To drift into an occupation is to run the risk of becoming a vocational misfit. When junior and senior high school students become interested in exploring the ways in which people earn a living, and begin to think about the problem of choosing a suitable vocational goal, they are showing good judgment.

PLANNING FOR THE FUTURE

The fact that John's brother, Robert, decided when he was in the seventh grade that he wanted to become an architect (and eventually did become one), does not mean that there was something wrong with John because he did not decide on a vocation until he had almost completed his freshman year in college. It would be foolish to suggest that every student should choose an occupation before he enters senior high school. Some students know at a young age how they will earn a living, but many do not decide until they have investigated and thought about different types of work over a considerable period of time. It is because sound career planning does take time that we believe a student should begin to think about himself in relation to occupations while he is still in junior high school.

You may have observed that one kind of work seems right for some people but wrong for others. This does not mean, of course, that everyone is cut out for just one vocation, for all of us are capable of succeeding in a number of different jobs. It is true that an individual cannot learn to do equally well or with equal satisfaction every kind of work. Each one of us has weaknesses as well as strengths, and certain types of employment fit our characteristics and needs better than others. When we say that an occupation is suitable for a particular person, we mean three things: that *it requires abilities he possesses; that he enjoys the work itself; and that he is convinced, in his case, that its advantages outweigh its disadvantages.*

When you think about the preceding sentence, you see that it suggests a good approach to career planning:

1. Analyze yourself.
2. Investigate different types of work.
3. Balance your characteristics against the demands of the occupation to determine whether the occupation requires abilities you now have or can develop; involves activities that you would probably like; has advantages for you that outweigh its disadvantages.

We shall discuss this approach in detail in other sections of this bulletin.

WHAT PEOPLE DO FOR A LIVING

If you were to visit a typical town you would find that people's occupations can be classified into several major groups. The italicized words in the next two paragraphs are used by employment and governmental agencies to distinguish various groups of workers.

The drugstore has a manager, a pharmacist, a retail clerk, and a soda dispenser. All of these people are needed to perform the functions of this establishment. The *manager* is also the *proprietor* or a businessman; the pharmacist is a *professional* person; the retail clerk is a *salesman*; and the soda dispenser is a *service* worker. In another building are the offices of a doctor, a lawyer, and a real estate agent. The doctor and lawyer are, of course, *professional* men; the employees of the real estate firm are *salespeople*, with the exception of the receptionist, who is a *clerical* worker. In the doctor's or lawyer's office is a secretary, another kind of *clerical* worker. The doctor has a nurse who is a *professional* worker and an x-ray technician who is *semi-professional*.

Further along, in the supermarket, the *manager* is supervising the unloading of a trailer truck loaded with foodstuff, while several men are unpacking and preparing the products for display. The truck driver is a *semi-skilled* worker; the men unloading the truck, *unskilled* workers. The cashier has a *clerical* position. Where a new home is being constructed, *skilled* workers are painting, plumbing, laying bricks, and installing an electrical system. At the intersection, the policeman is directing traffic; he is performing a *service* job. Beyond the town are *farmers*.

In these and other occupations, regardless of the type of work they do, people are earning a living. All the jobs listed and many more, some glamorous and others not so glamorous, are necessary to furnish needed services and products. As long as it serves a useful purpose, all work is honorable.

If this hypothetical town were large enough to have thousands of workers, there would be the following breakdown into major occupational groups:

Number of Workers per 1000 in Major Occupational Groups, 1960*

Occupation	Number per 1000
Semi-skilled	173
Clerical	141
Skilled	124
Service	120
Professional and Technical	108
Proprietors and Managers	102
Farmers and Farm Laborers	80
Sales	63
Unskilled Workers	53
Armed Forces	36
	1000

*Based on reports of U. S. Department of Labor.

The trends in different types of work are as important as the number of workers. Professional, clerical, service, skilled, and managerial occupations are growing most rapidly; the proportion of unskilled jobs, both on and off the farm, is decreasing. The demand is for better people in all fields, indicating that more education and training are needed for today's specialized jobs.

You will want to think and study about where you may fit into this picture after graduation from high school or after further technical or college training. The final decision depends on you.

UNDERSTANDING YOURSELF

Understanding yourself as a step in vocational exploration means getting a clear idea of your interests, abilities, values, personality, and physical characteristics. The better you know yourself, the better you will be able to judge whether an occupation you investigate is likely to be satisfying to you.

Interests are your preferences, the activities that appeal to you, and the ones you enjoy. During your high school years you have many opportunities to analyze your interests—in school courses, extracurricular activities, part-time jobs, and spare-time hobbies.

When you discover that you enjoy a particular activity, it may suggest a field to explore. For example, if you like shop courses, you may want to investigate mechanical occupations as career possibilities. If agricultural courses interest you, you may decide to get information about the different vocational opportunities in this broad field. If you enjoy mathematics, you may become interested in studying occupations that demand a liking for this subject. Do you know anyone who had a part-time job or a hobby that later became his or her career? Do you have any school or outside interests that suggest occupations you might explore?

You may, of course, become interested in jobs that are not directly related to any of your present or past activities. Someone may tell you that a particular occupation would appeal to you, and so you find out more about it. A motion picture, a television program, or a book may suggest a career. You may see a person engaged in work that looks

These students are participating in a demonstration-lecture at a college during a special science program. Such programs to acquaint high school students with college life can be very rewarding.

interesting to you. In brief, interests may develop as a result of many experiences.

When you are studying an occupation to find out whether it might be satisfying, you also should keep in mind the kinds of activities you dislike. If you have never enjoyed mathematics or science, for example, you probably would not find much satisfaction in trying to become an engineer, a chemist, or a physicist, for these professions are based on mathematics and science. If a junior high school girl does not like to draw. what are some of the careers that probably would not appeal to her? What activities do you dislike?

Abilities. When you are trying to analyze yourself in relation to different types of work, you must consider not only what you like, but what you can do or can learn to do. Sometimes interests and abilities go together, but not always. Mary likes to sing and can sing very well; George, too, likes to sing, but he has a poor voice. It will be obvious to you which of these two might become a professional singer.

From participating in an activity, you can discover something about your abilities. When a boy studies French, he finds out how much ability he has for learning a foreign language. When a girl is making an evening dress to wear to the Junior prom, she is discovering her sewing ability. Your answers to the following questions will give you a better understanding of your abilities:

In what school subjects have you done your best work?

In what extracurricular and leisure-time activities have you excelled?

Have your parents or others praised you for doing particular jobs especially well?

Has a teacher or a school counselor told you that you performed well on certain achievement or aptitude tests?

In some vocations the ability to understand and use words is very important. In others, the ability to comprehend advanced mathematics is essential. In still others, the skillful use of tools is basic. When you investigate an occupation, you should ask yourself: Could I probably learn to do well what the workers in this occupation do? This is not the same as asking: Would I like to do what they do?

Values. People have different ideas about what makes a job attractive. You should ask yourself whether a vocation seems to offer the advantages you consider important.

Several years ago a large group of ninth-grade students were asked what they considered most important in a job. Below are some of the answers. After each reply, a phrase indicates the value that the student considered important:

> "I'd like to have a job where I could better myself and get ahead." (Chance for advancement)
>
> "I would like to find an occupation where I'd be doing different things all the time." (Variety in work)
>
> "I want to have a good income." (Financial reward)
>
> "I would like to be a missionary, because in that career you are working for the good of others, and not just for yourself." (Service to others)
>
> "I'd want an occupation that has long vacations, so I could enjoy myself quite a bit, and not just work all the time." (Leisure time)
>
> "I'd like a job where I could retire at 60 and have a nice little pension coming in." (Financial security)
>
> "I wouldn't mind doing routine clerical work if I had a clean place to work and good people to work with." (Working conditions)
>
> "I want to be a forest ranger or a farmer, because I want to work outdoors." (Location of work)
>
> " I want a career in which the duties are interesting." (Interesting work activity)

What other values might make a particular type of work attractive? What do you consider the most important advantages an occupation can offer?

Personality means personal qualities such as persistence, sociability, patience, cooperativeness, and aggressiveness. In the following remarks, students are thinking about the relation between their personalities and occupations:

> "I don't believe I would like that kind of work. I couldn't stand having a boss tell me what to do every time I turned around. I like to work on my own."
>
> "That job would suit me fine, because it would give me a chance to become friendly with many different kinds of people."
>
> "I wouldn't want to teach young children—they get on my nerves."
>
> "I would have a chance to become a leader in that kind of work; I have always enjoyed being the head of any organization I have ever joined."

What personality characteristics should you keep in mind when you explore various types of jobs?

Physical characteristics include personal appearance, general health, strength, endurance, height, and special physical abilities and disabilities. If you are in good health and have no handicapping disabilities, you are physically qualified for many occupations. Some students have physical limitations that they must consider; others have physical characteristics that will be assets if they decide to enter certain occupations. In the following statements students were thinking about physical factors that might affect their vocational planning:

> "I do not believe I could become an accountant—I have poor vision."
>
> "I'd like to be a bulldozer operator, but I don't have the strength and endurance for a job like that."
>
> "Our family doctor gave me a thorough examination, and he is certain that I can get into the Air Force."
>
> "I have always done well in all kinds of athletics, so I believe I can become a physical education teacher and coach, if I make satisfactory grades in college-preparatory subjects in high school."

What physical assets or limitations should you consider when exploring occupations?

A *Self-Inventory Worksheet* is given on page 7 to help you analyze your interests, abilities, values, personality, and physical characteristics. You may fill out this worksheet now, or you may wait until you have read the suggestions for studying occupations.

SELF-INVENTORY WORKSHEET

(Think carefully before you answer each question.)

Interests

Of all the school subjects you have taken since first grade, which have you enjoyed most?

....

....

Which subjects, if any, have you disliked?

....

....

Which extracurricular school activities have you especially liked?

....

....

....

What jobs or chores have you found very interesting?

....

....

What hobbies or other leisure-time activities do you especially enjoy?

....

....

What occupations have you observed, read about, heard about, or thought about that you would like to investigate?

....

....

Abilities

In which school subjects have you done your best work?

....

....

With which subjects, if any, have you had difficulty?

....

....

In which extracurricular activities, jobs and chores, hobbies and other leisure-time activities have you performed especially well?

....

....

....

What abilities, aptitudes, or talents have other people (your parents, teachers, school counselor, friends) mentioned?

....

....

Have you taken any special achievement or aptitude tests on which you have performed well? If so, what did the results of these tests suggest to you about your strong points?

....

What do you believe are your best abilities?

....

Values

Below is a list of advantages or values people consider important in careers. You may add others in the blank spaces provided. Check (√) three or four that you consider especially important:

( ) Interesting work activities
( ) Healthful working conditions
( ) Opportunity for service
( ) Opportunity for advancement
( ) Chance to be creative
( ) ....
( ) ....
( ) Security of employment
( ) Congenial co-workers
( ) High income
( ) Good job location
( ) Freedom from supervision
( ) ....
( ) ....

Personality and Physical Characteristics

Are there certain personality characteristics you should keep in mind when you are making career plans?

....

....

Have you any physical limitations which are important to your planning?

....

Have you any physical assets that might enable you to do certain kinds of work especially well?

....

EXPLORING AN OCCUPATION

Questions to Ask About Any Occupation

What then shall I be? In seeking an answer to this question, you will be looking for the facts about particular vocations. Call it exploring a career—finding out all you can about any occupation in which you have an interest.

Your primary concern is to do this in a systematic way that will uncover all the facts, that will reveal not only the favorable, but the unfavorable aspects of the job. We begin by asking a few pertinent questions:

What are the duties of the worker? Would you operate a machine, sell goods or products, manage a business, teach children, produce crops? There are thousands of jobs in the world of work, each with its own combination of duties. Many of these jobs are described in *The Occupational Outlook Handbook.* Ask your counselor about this excellent reference volume prepared by the United States Department of Labor.

What are the personal requirements for the occupation? Must I be of a certain age or sex? Are there special physical requirements of vision, hearing, and strength? What interests do I have that will contribute to my satisfaction and success in the occupation? Do I need special abilities or skills? What personality traits are important?

What are the educational requirements? Are certain courses in high school recommended for people planning

After you have made a tentative selection of a post-high school institution, a visit to the admissions office can be helpful and informative. This high school student is talking over his plans with an admissions counselor.

to enter this occupation? What post-high school education is required: trade school, college, technical institute, apprenticeship, or on-the-job training? How long will it take me to receive the necessary training? What will be the cost of getting the required education? Am I familiar with academic standards and admission requirements for entering college or a special school?

What are the advantages and disadvantages of the occupation? What are the hours and conditions of work? Will my earnings balance the training or educational expenses? Do earnings vary in different parts of the country? Is there a reasonable amount of security in the job? What are the opportunities for advancement? What satisfactions and joys does the occupation offer?

What is the present demand and the future outlook in the occupation? How many workers are employed locally, in the state, and in the nation? Is the present demand great, moderate, slight, or non-existent? What is the probable future demand? Are the jobs confined to certain areas of the country?

What are the minimum requirements for entrance into the occupation? Must I have graduated from high school, trade school or technical institute, college? Is an entrance examination required? Is experience necessary? Do I need my own capital to get started? Is licensing or union membership required?

Where can I get additional information about the occupation? Do I know anyone I can talk to who is employed in this occupation? What reference books or occupational literature are available?

Fill in the worksheet on page 11 with the answers to the questions raised in this discussion. Be sure to get factual information; do not fill out the blank simply because it is there. Wait until you have complete information before recording it.

Finding the Answers to Questions About Occupations

Within your school

The school guidance office. You should become familiar with the facilities and staff of the guidance department. In addition to attending the regular conferences and meetings with counselors, make it a habit to visit the guidance office to check the bulletin boards for announcements, brochures on job opportunities, and educational material. Most bulletins or brochures describing jobs, educational opportunities, and scholarships will be kept on file. Find out from the person in charge how students may use the materials on hand and how to request additional material. If an open file is maintained, learn to use it properly. The guidance office is ready to serve you; make the best possible use of it.

The school library. Most materials relating directly to jobs will probably be kept in the school guidance office. However, much that is useful will be found in the library. Biographies and autobiographies detail experiences in many careers. The stories of real people's lives are often vivid and revealing. The school librarian will help you select such books. Books of fiction, adventure, and travel broaden your outlook and may suggest career opportunities you have never thought about. The library is truly a collection of the experiences of people in the world about us.

The school staff. Counselors, working closely with all teachers, probably will refer you frequently to specific teachers. If you are interested in home economics, you will want to talk with the homemaking teacher; if in agriculture, with the teacher of agriculture. Whatever your field of interest, you will usually find a faculty member who can help you. Cultivate the friendship of your teachers and get information and suggestions from them.

Within your community

Resource people. Most adults are happy to discuss their work with young people. You should be prepared to ask specific questions instead of saying vaguely, "Tell me all about your job." Make an appointment so the person you want to see can be free to spend some time with you. The school counselor and teachers can suggest people for you to talk with.

Business and industrial concerns. Since many of you will stay in your present community, you should know about the local business and industrial concerns. In addition to discussing jobs with specific individuals, you will often find that a field trip, planned as a class activity, provides an overview of the total operation and answers questions about the variety of jobs, opportunity for advancement, and working conditions. These field trips may be part of the class program or they may be sponsored by civic and community organizations.

Within your home

Your parents, with the greatest interest in your choice of career, want you to be successful in all that you do—in school, in activities, and in the work you choose. Talk over your goals and aspirations with them. You may want to talk too with your school counselor, teachers, and minister. If necessary, explore opportunities for financial assistance. Your future and the future of the other young people of our nation will be determined by the amount and the kind of training and education you secure.

Your parents are interested in your future educational and vocational plans. Talk over your aspirations and desires with them whenever the occasion arises.

Career publications

Publications describing job opportunities must be looked at critically. There is much material. Many of these publications are attractive and give unbiased information. Some, however, paint a misleading picture of opportunity, high salary, and good working conditions. A few tips are presented below to help you select publications that meet desired standards. You will probably wish to ask your school counselor, teacher, or some other adult to help you in evaluating these publications. Some of the questions that should be asked are:

Has the publication been issued by a responsible agency or organization?

Does the information apply to the majority of workers in this occupation?

Is the publication free of flowery words and phrases?

Is the publication accurate and up-to-date?

Does the publication tell where you may get additional information about the occupation?

Does the publication present both advantages and disadvantages of the job?

WORKSHEET FOR STUDYING AN OCCUPATION

Name of Occupation

....

Duties of the Worker

....

....

....

....

....

....

....

....

Personal Requirements

Age range: .... *Sex:* ....

Interests and abilities needed: ....

....

....

....

....

....

Personality and physical requirements: ....

....

....

....

....

Educational Requirements

Recommended high school program: ....

....

....

....

....

....

Post-high school education required or recommended (Trade school, college, technical institute, apprenticeship, on-the-job training): ....

Estimated length of time for education: ....

Estimated cost of education: ....

Other information about education (schools, admission standards): ....

....

....

Advantages and Disadvantages

(Earnings, hours, and conditions of work; security of employment; opportunity for advancement)

Advantages: ....

....

....

....

....

....

....

Disadvantages: ....

....

....

....

....

....

....

Present Demand and Future Outlook

Number of workers: National .... State ....

Local ....

Present need for workers: Great .... Moderate ....

Slight . . . . .

Probable future trend: Increasing need ....

Decreasing need ....

Little change ....

Are jobs confined to certain areas? Yes .... No ....

(If yes, where? ....)

Entering the Occupation

(Any special entrance requirements: minimum education, entrance examinations, experience, capital, licensing, union membership?)

....

....

....

Sources of Additional Information

(People, reference books, occupational pamphlets)

....

....

....

VT001 996

VT 001 996
Financing Farming Activities.

Farm Credit Banks of Louisville, Ky.
Pub Date - May63
MF AVAILABLE IN VT-ERIC SET 66p.

*VOCATIONAL AGRICULTURE, *CREDIT, *TEXTBOOKS, FARM MANAGEMENT,
FARMER COOPERATIVES, AGRICULTURAL PRODUCTION,

An outgrowth of a textbook entitled "Agricultural Credit" published in 1947, this publication was developed in consultation with teacher educators by farm bank personnel for use in vocational agriculture classes. It includes an introduction and chapters titled How the Farmer Uses Credit, Financing Farm Production, Financing

Farm Ownership, and Financing Farm Cooperatives. The textual material is supplemented by photographs, drawings, graphs, and specimens of credit instruments. A list of relevant movies is given. This document is available for 50 cents from Farm Credit Banks of Louisville, P.O. Box 239, Louisville, Kentucky 40201. (JM)

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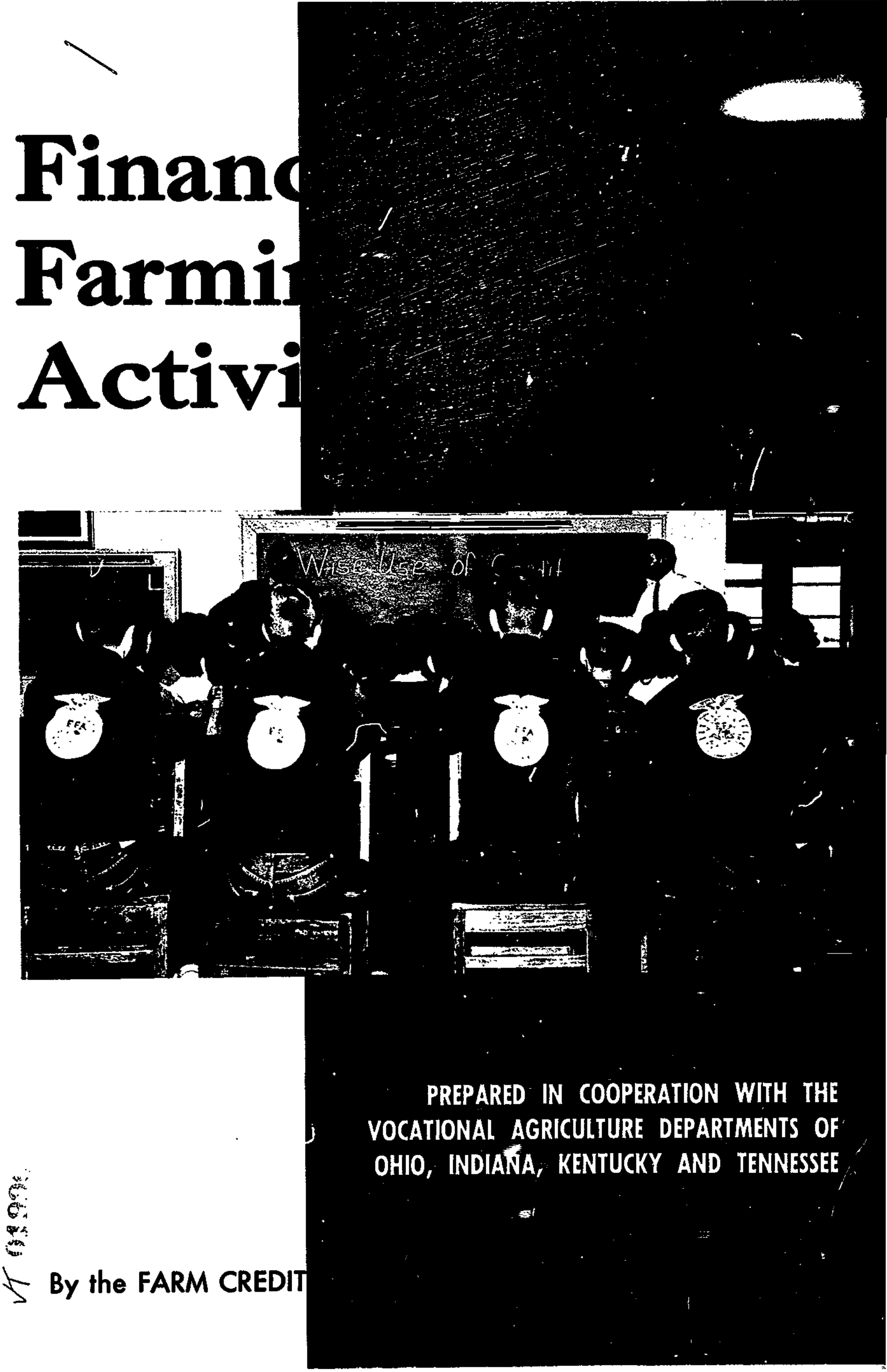

PREPARED IN COOPERATION WITH THE
VOCATIONAL AGRICULTURE DEPARTMENTS OF
OHIO, INDIANA, KENTUCKY AND TENNESSEE

By the FARM CREDIT

FINANCING FARMING ACTIVITIES

HOW THE FARMER USES CREDIT
FINANCING FARM PRODUCTION
FINANCING FARM OWNERSHIP
FINANCING FARM COOPERATIVES

First Edition — June, 1947
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Chapter II — FINANCING FARM PRODUCTION

Chapter III — FINANCING FARM OWNERSHIP

Chapter IV — FINANCING FARM COOPERATIVES

Acknowledgment

In 1947 the Farm Credit Banks of the Louisville District published a textbook for high school classes in vocational agriculture and for veterans-on-the-farm-training classes under the title AGRICULTURAL CREDIT. This was so well received that a second printing was required in 1948 and a third printing with slight revisions in 1949.

This textbook, titled FINANCING FARMING ACTIVITIES, is published in response to demand for a new and up-to-date book on the same subject. This new textbook is an outgrowth of the earlier one. Through the years many leaders in the field of vocational agriculture have contributed to the development of this book. In particular, we wish to acknowledge and express our appreciation for the contributions made over the years by E. O. Bolender of Ohio; Harry W. Leonard of Indiana; the late W. R. Tabb and Dr. George L. Luster of Kentucky; Dr. J. W. Brimm and Dr. V. R. Cardozier (the latter now at the University of Maryland) of Tennessee; and to Dr. Paul Irvine of Alabama Polytechnic Institute for his special editing help.

We will be glad to receive from teachers using this textbook comments about its usefulness and suggestions for its improvement.

Farm Credit Banks of Louisville

J Kenneth Ward

J. Kenneth Ward
General Agent

May 1963

Introduction

Farming is business! Big Business! For any young man who expects to farm or do business with farmers the financing of the farming business is important. It will be more important in the future.

Looking ahead to 1975—not so far away—it is predicted that:

1. The nation's farms will have to produce 30 percent more food to meet the demands of our increasing population.

2. To meet this demand for greater production farmers will use more machines and equipment and better business methods.

3. Farms generally will tend to become "commercial" in these ways: they will use more money, invest more in equipment, borrow more, keep better accounts. In fact, farming will be a business, and the farmer will use many of the financial and accounting methods of the businessman.

4. Added capital the farmer will need for modern farming he will obtain by borrowing. The modern farmer needs to know how to borrow money. He must learn to manage his farm finances so that he makes more money by using borrowed money.

5. There will be fewer farmers to produce the increased amount of food; therefore, individual incomes and living standards of farm people will be higher in relation to other occupational groups than they are now.

6. Professional and commercial positions that call for understanding of farming and finance are increasing rapidly. These are open to young men who know farm life and understand financing. Among these positions are: bank adviser on farm financing, agricultural economist, manager of a cooperative, representative of implement, seed, fertilizer and food processing companies.

7. Along with more money and better financial methods the farmer of the future will enjoy more of the things money will buy—a better home, more conveniences, more contact with business enterprises, a larger place in the life of his community.

These are some of the reasons why it is important for young people who are growing up on farms to understand the why and the how of farm financing.

The Use of Money is Bought and Sold

CHAPTER I

HOW THE FARMER USES CREDIT

When we buy goods or services, we use either cash or credit. When we use cash we give the seller money—or a check as evidence of that money—at the time of the sale. When we use credit, we agree to pay for the goods or services at a later date.

Credit, then, is a means of obtaining goods, services or money in exchange for a promise to pay at some future date. Credit is based on trust; the word "credit" comes from the Latin word "credere" meaning to trust.

A wise man has said, "Credit has done a thousand times more to enrich mankind than all the gold mines in the world."

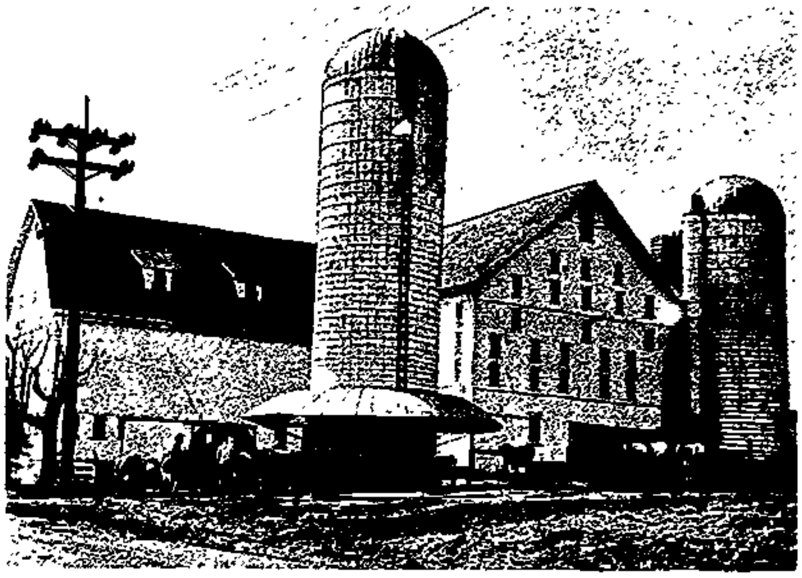
Farmers' Need for Capital and Credit

Farmers use large amounts of capital (including both cash and credit) to own their land, buildings, equipment, livestock and other things.

In its "Balance Sheet of Agriculture", The United States Department of Agriculture reports that American farmers owned real estate valued at $144.5 billion as of January 1, 1963. To own this real estate they were using credit in the form of $15.4 billion of real estate mortgages. These farmers also owned property other than real estate valued at $69.6 billion (including $17.8 billion of cash, bank deposits, savings bonds and investments in their cooperatives). They were using $12.3 billion of credit in the form of non-real estate loans. Thus, on January 1, 1963, American farmers were using at least $27.7 billion of credit. In addition, farmer-owned cooperatives were using vast amounts of credit in off-the-farm business jobs they do for farmers.

So we see that credit plays a large part in farmers' owning and operating their farms. Today, farmers *owe* more dollars than ever before in history; but the dollar value of what they *own* is also the highest in history.

Farmers having real estate loans from the Federal Land Bank of Louisville owed on these loans an average of $8,400 on December 31, 1962. Those having farm operating loans from their production credit associations owed an average of $4,500 on these loans.



Livestock, equipment, buildings, improvements, electrical power and land call for extensive use of credit.

How Farmers Use Credit

Farmers use credit (they borrow money) for many purposes. A farmer usually borrows money for one or more of the following purposes:

To buy a farm

To add new acreage to the farm he already owns

To build a house, barn, grain storage, or other farm building that will add to the efficient operation of the farm

To buy equipment with which to cultivate his land and operate his farm

To buy fertilizer, lime, or hire labor to make his land produce more and better crops

To add better sires or other breeding stock to improve and increase production

To buy feed for livestock he is raising, or to buy livestock to consume feed he is growing

Every farm boy who earnestly wants to farm faces the question — How can I reach my goal of owning enough land to provide a good living for me and my family? The wise use of credit will help him reach this goal earlier in life than would be possible if he waits to buy until he accumulates the full purchase price.

To buy other goods or services

> *Example: A farmer plans to send his son to college in September. He will not have the money to pay these expenses until he sells his tobacco crop in December, and some hogs the following March. He borrows the money from a lending institution and pays his son's expenses. Then, in December he pays off part of his loan from tobacco income and the remainder in March from hog income. He has thus bought services for his son's education in anticipation of income he expects to receive later.*

Successful farming today requires big capital investments. A young man owning or renting a small farm handicaps himself if he has not learned how to use credit. He can seldom save enough cash to buy all that he needs to own and operate his farm.

A farm boy should learn early in life how to use credit wisely. Without using credit, he cannot expect to make much progress. When he has saved enough cash to buy one gilt, or heifer, or lamb, he might borrow to buy the second. He will stand to make twice the profit from his labor. If one animal dies he still will have the second one to pay off his loan and return a profit. As the years pass he will be ready to start farming for himself much sooner than if he waited until he had saved all the cash he needed.

Most of the FFA members who have been named State Farmers have already learned to use credit as a means of getting ahead.

Cost of Credit

The cost of credit varies widely. Take, for example, a man whose ability to pay is not known and who has little to offer as security. He will have to pay a high rate of interest; he may not be able to get credit at all. On the other hand, the man with a strong financial position and plenty of collateral can get credit at low cost. Such men are often able to borrow money for operating expenses without giving even a chattel mortgage (that is, a mortgage on a chattel—movable property like livestock or equipment).

It often pays a farmer to shop around for his credit; in that way he will find his best source of credit. Usually he will find that the lender who specializes in the type of credit he needs will charge the lowest rate and allow him the most favorable terms. Suppose a farmer needs a loan to finance his farming operations. He will look up a lender—like the production credit association—which specializes in short-term and intermediate-term loans. If he needs a long-term loan to buy farm land, he will go to a lender, like the Federal land bank, which specializes in long-term loans.

If you should buy on credit from a feed and implement dealer or a hardware merchant you would probably find that you paid a high cost for your credit. The reason is that such merchants specialize in feed, implements and other farm supplies—not in credit. When they sell "on time" or "on credit," they are tying up capital they need in their farm supply business. Their costs of collecting on such sales are usually high, so they have to charge more to cover these costs and have a fair return on their capital.

The method of financing and the plan of repayment also figure in the cost. For example, a man needs $1,000 for this year's operations:

January 15	$ 400	for purchase of equipment
May 15	200	for labor, fertilizer and seed
June 15	200	for taxes
October 15	200	for insurance and fall expenses
	$1,000	

January 15	6% on $400 for 1 year	$24.00
May 15	6% on $200 for 8 months	8.00
June 15	6% on $200 for 7 months	7.00
October 15	6% on $200 for 3 months	3.00
	Total Interest	$42.00

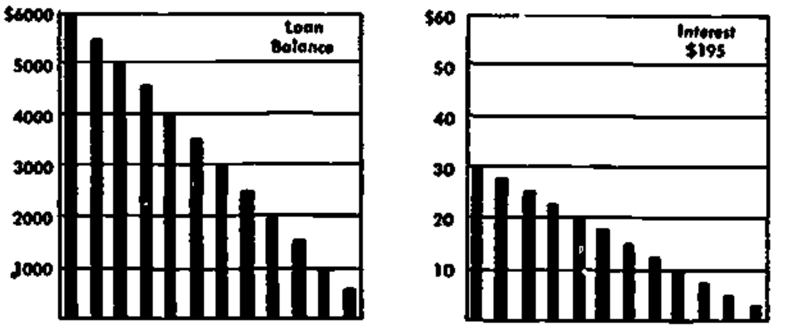
If he borrowed the full amount of $1,000 on January 15 at an interest rate of 6 percent for a full year, he would pay $60 in interest.

But, he can borrow on a budget plan; he will receive his loan in parts as needed and pay back all of the money at the maturity of the note, next January 15. This is the way the interest would be figured:

If, however, he had a wheat crop to sell August 15 for $400 and some hogs to sell September 15 for $200, the above-listed cost of $42.00 could be further reduced by making each payment at the time of the sale. He would save five months' interest on the wheat payment, or $10.00, and four months' interest on the hog payment, or $4.00. This would reduce the cost of the loan an additional $14.00 to $28.00.

SIMPLE INTEREST
Borrowed $6,000 at 6% For One Year To Be Paid In 12 Monthly Installments

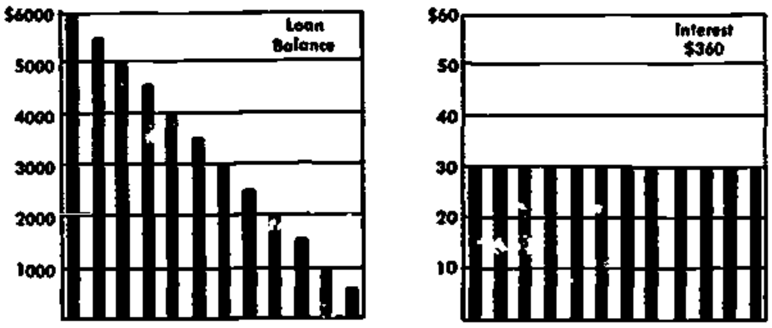
Interest at 6% figured on the unpaid balance for each month. Payments are $500 per month plus interest.



True Interest Rate—6%

INTEREST ON FULL PRINCIPAL
Borrowed $6,000 At 6% For One Year To Be Paid In 12 Monthly Installments

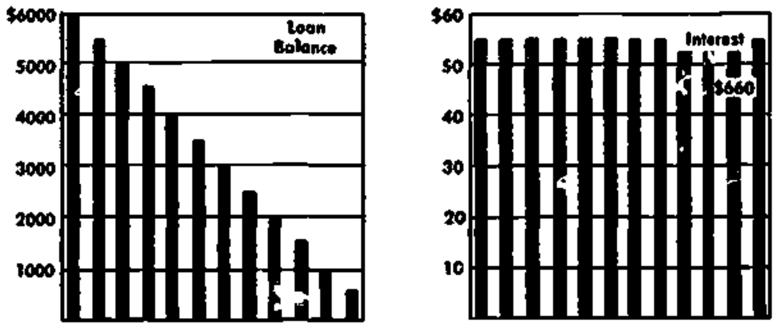
Interest is calculated at 6% for the entire year on the original balance with payments divided into 12 equal installments. Payments are $530 per month for one year.



True Interest Rate—11.1%

"EASY PAYMENT" PLAN
Borrowed $6,000 At 6% For One Year Payments Of $555 A Month For One Year

6% interest on the beginning amount borrowed plus 5% carrying charge is added to purchase price then divided over 12 equal payments.



True Interest Rate—20.3%.

Extending this type of credit is common practice for production credit associations.

Long-term credit, such as that used for the purchase of land, usually calls for rates of interest ranging from 5 percent to 6 percent. Commercial banks' long-term loans are usually made for periods of one to five years; Federal land banks and life insurance companies lend on an amortization basis up to 40 years. Amortization refers to the practice of regularly paying some on the principal each time an interest payment is made. Thus, long-term amortized loans allow the farmer to pay for his farm year by year out of the earnings of the farm.

We may say, then, that cost of credit depends partly, but not entirely, on the rate of interest. It depends, too, on the type of loan made and the methods used in advancing the funds, accepting payments, and figuring interest.

How Interest is Figured

Sometimes a lender quotes an interest "rate" that confuses or deceives the borrower. It is, therefore, important for the borrower to know the difference between the "cost" of the loan and the "rate" of interest charged. This isn't easy, because some lenders use unusual terms, charges and methods deliberately to confuse the borrower. You may find that, in addition to interest, there are added charges, such as: carrying charges, "time differential" charges, inspection fees, finance charges, sales commissions and difference in discount granted. When you are analyzing the cost of a loan, you should include all costs, including these "extras."

If interest alone is charged, you should determine whether it is charged on the unpaid balance, on the original or face amount of the loan, or whether interest is paid in advance.

1. Let's assume that you borrow $6,000 at 6 percent simple interest to be repaid in 12 equal monthly installments. If you were paying interest on only the unpaid balance each month, the charge would decrease from $30.00 the first month to $2.50 the twelfth month; altogether you would pay a total of $195 interest for the year. The average size of your loan outstanding during the year would be $3,250. Dividing $195 by $3,250 gives a true annual interest rate of 6 percent, the same as stated in the note.

2. If your interest charge is figured on the face amount of the loan each month, rather than the outstanding balance, you would pay 6 percent of $6,000 or $360 interest. Now divide the $360 paid as interest by the average amount outstanding during the year ($360 ÷ $3,250) and you find that you have been charged a true interest rate of 11.1 percent. This is nearly double the 6 percent rate shown in the note.

3. Or, the lender may "discount" the loan—that is, require you to *pay* the year's *interest*, $360 in *advance*. In this case you never have the use of the whole $6,000; you have the use of only $5,640 ($6,000 — $360) and you will be paying a true interest rate of 11.78 percent. The true interest rate on a discounted loan is always higher than on a non-discounted loan with the same "rate."

4. Where charges other than interest are made, sometimes called an "easy payment plan", you should give special attention to the full cost of the loan. Be just as careful about installment purchases where apparently there are no special charges. An example will illustrate what might be involved. Assume that you trade your old tractor for a new one and finance the balance due of $1,440. You have some current income from your dairy enterprise, so you sign a note calling for 24 monthly payments of $72.50 each. What rate of interest are you paying?

Total amount paid	$72.50 × 24 = $1,740
Principal amount financed	1,440
Loan or interest charge	300
Loan or interest charge per year	150
Average amount outstanding	750
True interest charge	$150 + $750 = 20 percent

There is a formula you can use to figure the true annual interest rate charged, when your note calls for evenly spaced payments:

Formula for Figuring the True Rate of Interest

$$\frac{\text{Total of finance charges}}{\frac{1}{2}\text{ original loan}} \times \frac{\text{No. of payments}}{\text{No. of years}} \times \frac{1}{\text{No. of payments} + 1} = \text{True annual interest rate}$$

Example: Substitute figures from the last example above:

$$\frac{300}{720} \times \frac{24}{2} \times \frac{1}{25} = 20 \text{ percent.}$$

The USDA Agriculture Handbook No. 230, "Farmers' Handbook of Financial Calculations and Physical Measurements," gives valuable information on figuring interest rates.

Farmers Use Different Kinds of Credit for Different Purposes

Farmers use the following kinds of credit:

- Short-Term Credit for year-to-year farm production
- Intermediate-Term Credit for larger production or capital outlays
- Long-Term Credit for farm ownership
- Credit for farmer-owned off-the-farm business
- Consumer Credit

Short-Term Credit

The very nature of the farming business, with its slow turnover, creates a need for credit. It takes from five to six months to bring a new litter of pigs to market, from six months to a year to make a crop, and from one to two years to grow out a steer. During these processes, the farmer is paying out money with the expectation of getting all of it back, plus a profit, at market time. During these periods of preparation, he may need credit. His income is seasonal while his operating and maintenance expenses go on throughout the year. With such a slow turnover in the things he produces to sell, he frequently needs and profits by the use of credit in his current operations. This kind of credit will be discussed in detail in Chapter II.

Intermediate-Term Credit

Farmers have some outlays for large production or improvement items that call for more than one season's income; they may require the income from 2, 3, 4 or 5 crop seasons to repay. Some examples are: a combine, baler, field chopper, crib, bulk milk cooler, milking parlor, breeding or milking herd, laying flock, fencing, irrigation equipment, extensive soil conservation measure, or some building improvement. This kind of credit also is discussed in Chapter II.

Long-Term Credit

Farm ownership and operation require large capital investments. An Ohio Agricultural Experiment Station official said in September, 1957:

"Some recent records from our Department of Agricultural Economics show that a general livestock farm averaging 218 acres in western Ohio represents an investment of $75,471, while a corn-hog farm (254 acres) is worth $103,969.

"As we break down these figures for the corn-hog farm we find investments represented as follows on an acre basis:

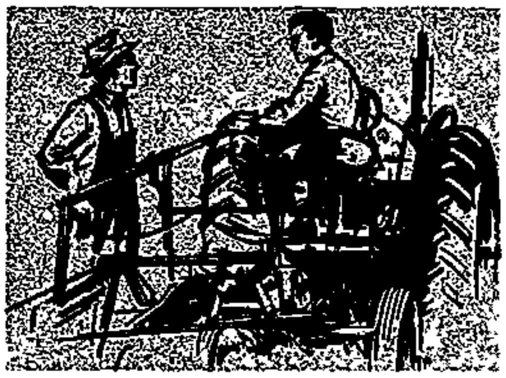
Land	*$202.39*
Buildings	*110.42*
Machinery	*34.52*
Livestock	*35.27*
Feed and Supplies	*21.79*
	$404.39 per acre."

The greatest part of this investment is in land and buildings. It takes many years to accumulate such a capital investment. Long-term credit used for this purpose is discussed in Chapter III.

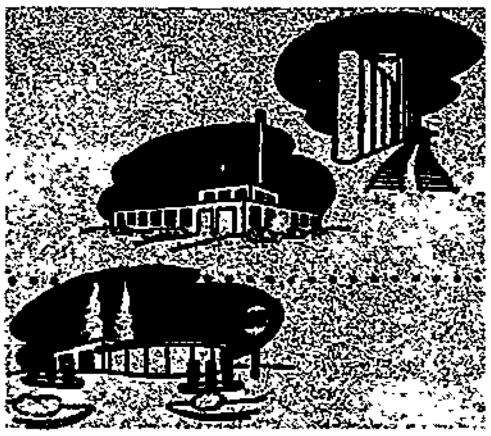
Credit for Farmer-Owned Off-the-Farm Business

Farmers join together in their cooperatives in order to do things they cannot do by themselves as individuals. These cooperatives usually perform jobs beyond the farmer's line fences. Through them the farmer conducts his off-the-farm business. Cooperatives also have to use money, part of it borrowed. We shall discuss this kind of credit in Chapter IV.

Long-term real estate mortgage loans provide low cost financing for the ownership of the farm.



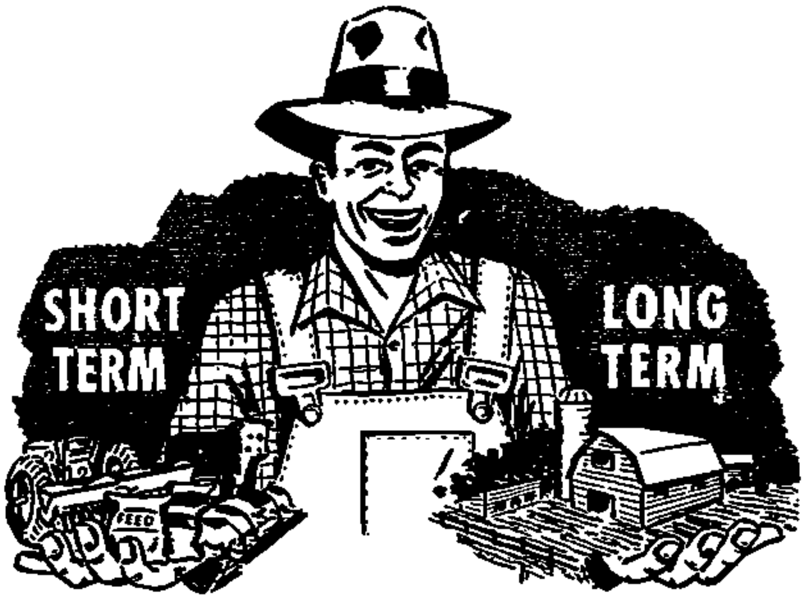
Short- and intermediate-term production loans provide financing for farm operation and improvement.



Farmer cooperatives need credit for plants, facilities and equipment — for operating purposes — and for orderly marketing of commodities.

Consumer Credit

Every farm family buys some things that provide enjoyment but are not necessary to the successful operation of the farm business. These are usually called consumer items, or consumer goods. A tractor is an essential production tool, while a television set is not essential. A pick-up may be useful in the farm business, whereas a new car might be a luxury. The distinction between necessities, needs and wants is brought out on page . Often luxury or consumer items are made so attractive that we allow ourselves to be "sold" something we do not need. When the "easy payments" begin coming due, we find that we cannot pay them without using income we need for necessary things. Monthly payments, usually called for in installment buying of consumer goods, do not suit farmers well, except possibly dairymen, poultrymen and a few others whose income is well distributed throughout the year. As you will see on page , such consumer or installment credit comes exceedingly high in cost. The wise farmer will avoid using any consumer credit that he cannot get from the same lender who supplies his sound, short- and intermediate-term credit needs.



A good lender will help you keep the proper balance between short-term and long-term credit.

The Proper Use of Credit

In using credit even for a right purpose it is important that it be used at the right time, in the right amounts, and over the right periods of time.

When to Use Borrowed Funds

Using credit for a sound, constructive purpose is a good business practice. A good test is to ask yourself: will I be better off after repaying the loan than I would have been without borrowing the money?

Example: A farmer has a good supply of corn. He knows that he can market this corn most profitably through a bunch of hogs. But he has no hogs nor the money with which to buy them. Then it's time for him to use credit. If he has sufficient grass to grow a bunch of calves or keep a flock of sheep but lacks funds to buy them, it is time to borrow the money for that purpose. Similarly, he may need more power to plant, cultivate, and harvest larger crops; or he may need more labor to operate the farm more efficiently. If he lacks cash to pay for all of these things, it is time to plan and arrange for credit to boost his current income.

On the average farm there are many needs which, if supplied through credit, will increase the producing power and income of the farmer. When such conditions exist, it is time for the farmer to use the right amount and right type of credit.

How Much to Borrow

Every person who borrows money realizes, of course, that he must pay it back with interest. He should know, when he makes the loan, from what income he will repay it. Certainly he should never borrow more than he actually needs for a specific purpose.

If a farmer needs only $925 to pay for cows, it would be unwise for him to borrow $1,000. The larger amount costs him more in interest and he has more to pay back at the maturity of the loan.

Never borrow more money than you feel reasonably sure you can repay within the period agreed upon. To be reasonably sure you should have a good margin of safety between your expected income and the amount you plan to pay. Few of our plans work out one hundred percent. You cannot tell exactly how many bushels of wheat or corn you will raise or what it will bring when sold; you have to depend on the seasons and the market. Neither can you tell how many lambs or pigs you can save and market from your ewes and sows. So, in borrowing money to be paid back from such sources, the amount you borrow should always be well within the amount of your anticipated income. Borrow only the amount of money you can put to work to increase your earnings; then you are operating on a sound basis. Plan your needs accurately and carefully; then borrow only enough to meet them.

A general purpose loan that includes a number of purposes distributed over the year should be made for a period of one year; it should be paid as and when income is available from the various projects.

In a long-term loan for the purchase of a farm, the repayment plan usually should be on a semi-annual or annual basis. In this way, the farm can be made to pay for itself.

What the Lender Looks for in a Borrower

When a lender is deciding whether to make a loan, he has to consider these five factors: the man; his financial position; his ability to repay; purpose of the loan; and security for the loan.

Planning Term of Repayment

A farmer should plan definitely how he is going to pay his loan when he first seeks it. His plan of repayment should provide for reducing the loan as soon and as often as his farm program will permit. If, for example, he asks for a current operating loan of $1,000 and is expecting a major part of his income monthly from a dairy herd, he should include in the payment plan a definite amount to be paid each month from this source. If he has lambs to sell in the spring and hogs in the fall and tobacco in the winter, he should use at least a part of income from these sales to pay on the loan. This is the easiest and cheapest way to use credit.

If a farmer borrows money to buy livestock to feed for market, the loan should be for the time needed to finish the feeding program. He will make payment on the loan whenever he sells any of the livestock. If he sells earlier than planned, he will save interest by paying his note before it matures. In all short-term operating loans, the period of the loan should correspond with the length of time estimated to complete the program being financed.

The Man

Of primary importance in any loan is the man who borrows the money. A lender wants, first of all, a borrower who has established a reputation for moral responsibility and who has demonstrated his ability as a farmer. If he does not already know the applicant, he will investigate these elements of character thoroughly. The loan should not be made unless there is mutual confidence between the lender and the borrower.

a. *His Moral Responsibility*

One of the best recommendations an applicant can have is his past record of honesty and fair dealing with all people. Such a reputation is built over a period of years, with the foundation being laid in one's youth. Would you favor approving a loan to a boy who has the reputation of being a "cheater"?

Or consider the young couple who, in order to set up housekeeping and live as they were accustomed to, have purchased a car and household goods on time. They have had a hard time meeting the payments. Recently they have been charging more and more farm production expenses. Would you lend money to this young couple?

Here are some of the factors that may indicate whether the applicant has a sense of responsibility about debts:

Unpaid bills of long standing, many small bills, or court judgments may show that he does not try very hard to pay his debts or that he obligates himself for more debt than he can ever expect to pay.

Items left out of the financial statement show that he is careless, does not understand the importance of the statement, or, in some cases, that he is dishonest. False statements are a definite warning signal to the lender.

Inaccurate or false statements about past production or sales are also danger signals.

Bankruptcy, compromise debts, and other legal means used to escape payment of debts have to be looked into. The circumstances under which such action was taken should be given proper weight.

So you see that a man's honesty and sense of responsibility are basically important in financial dealings.

b. *His Managerial Ability*

The man's ability to run a farm successfully is another important factor.

The lender wants to know whether the applicant is a good farm operator. For evidence on this point, he will consider how fast the applicant is getting ahead. If there is lack of progress, he will want to find out whether it is due to poor management or to misfortunes over which the farmer has no control.

The lender will try to determine whether the applicant is up to date in his methods, whether he keeps in close touch with market conditions, and whether he shows ability to manage the property he owns.

The applicant's family also is important. A capable, energetic, and intelligent wife is necessary to a man's success. Children eager to cooperate in farm work and fun add to the success of farm operations.

Financial Position

Unless the lender already knows from close acquaintance, every applicant for a loan is asked to furnish information regarding his financial position. He should prepare a statement which shows:

(a) an itemized list of all he owns—land, livestock, equipment, and other assets; (b) an itemized statement of all his debts; and (c) a statement showing his net worth, which is the difference between total assets owned and debts owed.

The lender uses this statement to answer a number of questions about the borrower: How much capital does the applicant control? How much ownership does he have in his assets? Are there debts that may interfere with the prompt payment of the loan being applied for? Does the applicant have property which could be quickly sold for cash to pay current expenses and debts (known as quick assets)? Has the applicant been going forward or backward financially in recent years?

Imagine now that you are a lender looking at these financial statements of two farmers:

ASSETS	FARMER A	FARMER B
Cash	$ 500	$ 2,000
Grain, feed on hand	2,000	3,500
Livestock	5,000	7,500
Equipment	3,500	5,000
Land	30,000	....
Total	$41,000	$18,000
LIABILITIES		
Store bills	$ 400	$ 100
Unpaid taxes	300	....
Chattel mortgage loan	3,500	....
Farm mortgage loan	22,000	....
Total	$26,200	$ 100
NET WORTH	$14,800	$17,900

Ordinarily, financial statements are submitted in greater detail than those above.

In the above illustration, notice that Farmer A has assets worth more than twice as much as Farmer B. But Farmer A is heavily in debt: he has a mortgage loan on his farm; he has a chattel mortgage loan on his livestock and other personal property; and he owes taxes and store bills of a considerable amount. Actually, his net worth is smaller than that of Farmer B. Farmer A has another problem; he has few quick assets (on which he could raise money quickly) as compared with the amount of his short-term debts; there is some doubt that he will be able to raise enough cash to meet both his short-term debts and his operating expenses.

Farmer B has few debts and a larger net worth. In addition to $2,000 in cash, he has grain and livestock to market in the near future; he should have ample funds to meet his operating expenses.

In view of the less favorable debt position, the small amount of quick assets, and the smaller net worth, you would consider Farmer A a less desirable credit risk than Farmer B.

Progress of the applicant as shown by financial statements over several years is important. If a man has inherited considerable property, for example, and has had a declining net worth since that time, it raises a danger signal since it suggests that he is a poor manager. Certainly the lender will want to look into the reasons for his losing ground. On the other hand, if the statements show steadily increasing net worth with no outside help, the applicant is judged to be successful in his farming.

The lender will examine how the value of assets has been figured. If prices above reasonable values have been used, the net worth will be too high. Such over-valuation means either poor judgment or an effort to deceive. Failure to list all debts also is a danger signal.

Ability to Repay

When making the loan, the lender will look into the borrower's capacity to repay it. An insurance company, for example, receives an application for a long-term loan of $10,000 to be secured by a mortgage on 240 acres. The annual payment on this loan covering principal and interest would be $770. The insurance company estimates that the farmer could sell products from the farm totaling about $8,000 per year, and that feed, labor, repairs, taxes, and other farm operating expenses will run about $5,000. This leaves a net income of $3,000. Can he support his family and pay $770 out of this amount? Does he have sufficient repayment capacity to carry such a loan?

Repayment capacity will depend upon the size of the farm and whether or not the farm business is organized and managed on a sound basis.

The farm shows the ability of the manager to a very large extent. The intelligence, energy, and resourcefulness of the applicant tell how well he will manage the business. Past success in the present or similar enterprise is an excellent guide. Remember, however, that the best manager cannot make a success of a hopeless business.

a. *Reasons for Poor Repayment Ability*

(1) Business is so small that it can yield only a small gross income.

(2) Production per unit is low: poor crop yields per acre, low percentage of cows calving, small pig crop, small returns from poultry.

(3) Price per unit for products sold is low, due to poor market, poor marketing, poor quality, unfavorable general price situation.

(4) Cash production costs are high, due to high feed costs, high labor costs, high replacement costs.

(5) Cash overhead costs are high, due to heavy debt load or high interest rate, heavy taxes, and high maintenance costs for buildings and machinery.

(6) Cash living costs are high due to extravagance, sickness, education of children.

(7) Applicant's record shows he borrows above ability to repay.

(8) He overestimates amount of the loan that can be repaid each year.

b. *Reasons for Good Repayment Ability*

(1) Business is large enough to yield an adequate gross income.

(2) Production or yield per unit is high.

(3) Price per unit for products sold is good.

(4) Cash production costs are low.

(5) Cash overhead costs are low.

(6) Applicant manages his home well.

Any one of these reasons may make or break your farm business if it is sufficiently good or bad. For instance, very low production per unit will wreck almost any agricultural enterprise, even though the size of the business, prices received, and costs are excellent. One or more factors may be sufficiently good to offset weakness in the other factors. For example, you may sometimes offset high costs by having high production per unit and selling at high prices. From the standpoint of repayment you would be the best credit risk if you excelled in all six factors. Such cases are rare. In deciding repayment ability a lender usually balances favorable factors against less favorable ones and weighs the net effect on the farm business.

Purpose of Loan

This subject is discussed in detail on page 5.

Security for Loan

Any financing program should be arranged so that the borrower can repay the debt from his farm income. As security for the loan, you may pledge to the lender such specific assets as land, livestock, machinery, stored products, or growing crops. The evidence of this pledge may be a mortgage, warehouse receipt, or bill of lading. When you pledge property as security or collateral for a loan, you give the lender certain rights to that property. When the debt is paid, he returns the evidence and his rights are canceled.

This pledging of assets by the borrower to the lender as security for the loan protects the lender in two ways. (1) It will prevent some other creditor from seizing the working capital of the borrower. (2) If the borrower does not repay the money he has borrowed, the lender may sell the collateral to recover his loan.

Collateral is not always required for short-term loans. High grade credit risks—honest, well-established farmers with a good record of debt payment—frequently can borrow without giving collateral of any kind.

What a Borrower Looks for in a Lender

As a borrower, you should study carefully the sources from which you may obtain credit. Find out about the services offered by each; on the basis of the facts you learn, decide which one can give you the credit best fitted to your needs. After you have selected your lender, you should establish a credit rating with him; then build up a working relationship over a period of years that will be mutually profitable.

A complete understanding is the basis for confidence between borrower and lender and is the only way a sound loan can be made.

There are five general aspects of the lender that you will wish to investigate: character; lending policies; permanence and dependability; experience and knowledge of farming; and cost of the loan.

Character

You will want a lender who has established a reputation for fairness and honesty in dealing with his borrowers. It is important that the lender have a good understanding of farming. If he is to work out financing programs that take account of the full needs of a farmer, he must recognize the possibility of unfavorable weather and price conditions and other factors over which the farmer has no control.

Lending Policies

Look into the past policies of the lender. Has he adapted his credit terms to the needs of farmers? For example, have the lender's loans called for repayment schedules that are fitted to the earnings of the farm and capacity of the farmer to pay? Is the period of time for which loans are made adjusted to the length of time required to complete the operation being financed? Do the capital loans call for large amounts coming due at any one time, or are the payments spread over a reasonable income period?

The policy toward borrowers during hard times also is important. Has the lender been interested enough in the welfare of the deserving borrower to carry loans during temporary periods of low income? Did he extend further credit when unusual conditions made it difficult for the farmer to repay on schedule?

Permanence and Dependability

Once you have established a credit rating and built up a satisfactory working relationship with the lender, you will usually wish to continue on a permanent basis. You want to be sure that the lender will be able to finance you year after year as your business requires loans.

Will your lender be able to serve you in times of trouble? This is particularly important. In the past, some sources of credit have dried up during periods of drought or financial depressions, just when farmers needed credit most. Where the lender obtains his funds may determine how dependable his credit service is.

Experience and Knowledge of Farming

There is an advantage in having a lender who has a broad, up-to-date knowledge of agriculture and who has had long experience in making loans to farmers. As a result of such knowledge and experience, the lender is in an excellent position to counsel with farmers regarding not only their financial affairs, but also their farming operations. A trained, experienced lender, who has had an opportunity to observe success and failure among his borrowers, can be a valuable adviser. He can be especially helpful to a young man who is just starting out to build up a farming business.

Cost of Loan

Re-read "Cost of Credit" beginning on page 6.

Compare Sources of Credit on These Points

Points of Comparison	SOURCE			
	A	B	C	D
Character				
Reputation with farmers				
Knowledge of farming				
Policies				
Security required				
Length of loan				
Repayment plan				
Time to get loan				
Eligibility of borrower				
Dependability				
Permanent				
Bad times, as well as good times				
Experience				
Length of experience				
Value of counsel to young farmers				
Cost of Loan				
Interest charge				
Other charges				
Cooperative stock purchase				
Dividends paid				
Patronage refund				

Separate comparisons should be made of sources of (1) production credit, (2) longtime land credit, and (3) credit for cooperatives.

Credit Instruments: The Tools of Borrowing and Lending

Virtually all loans are supported by a written record or document. Such a record is tangible evidence that a contract has been made—something one can put a finger on and say, "This is proof that an agreement has been made." These records "in black and white," used in making loans, are called credit instruments. What are the various credit instruments?

Applications for Loans

A written application for a loan shows the lender how much money is wanted, for what purpose it is to be used, and how and when the borrower plans to pay it back. From this application the lender can set up the loan to fit the needs and the convenience of the borrower. He can arrange the loan so the borrower can get the amounts he needs when he needs them. It enables both lender and borrower to understand the program and work together to carry it out efficiently.

Checks

A check is a signed written order to a bank to pay a certain sum of money on demand to the person named on the check.

What are some of the advantages in using checks instead of cash in doing business?

a. There is less danger of loss or theft than when money is carried or sent through the mails.

b. Checks are much more convenient than money, except for small amounts.

c. The canceled check, though not a receipt, is good evidence of payment.

d. It is much easier to keep records when checks are used.

In writing checks the following instructions should be observed:

a. Write all checks in ink. They are much harder to change or "raise."

b. Write plainly. Neither the holder nor the bank should have any trouble reading it.

c. Leave no space between the dollar sign and the amount of the check. Also, fill in completely the line giving the amount in writing. This, too, prevents "raising."

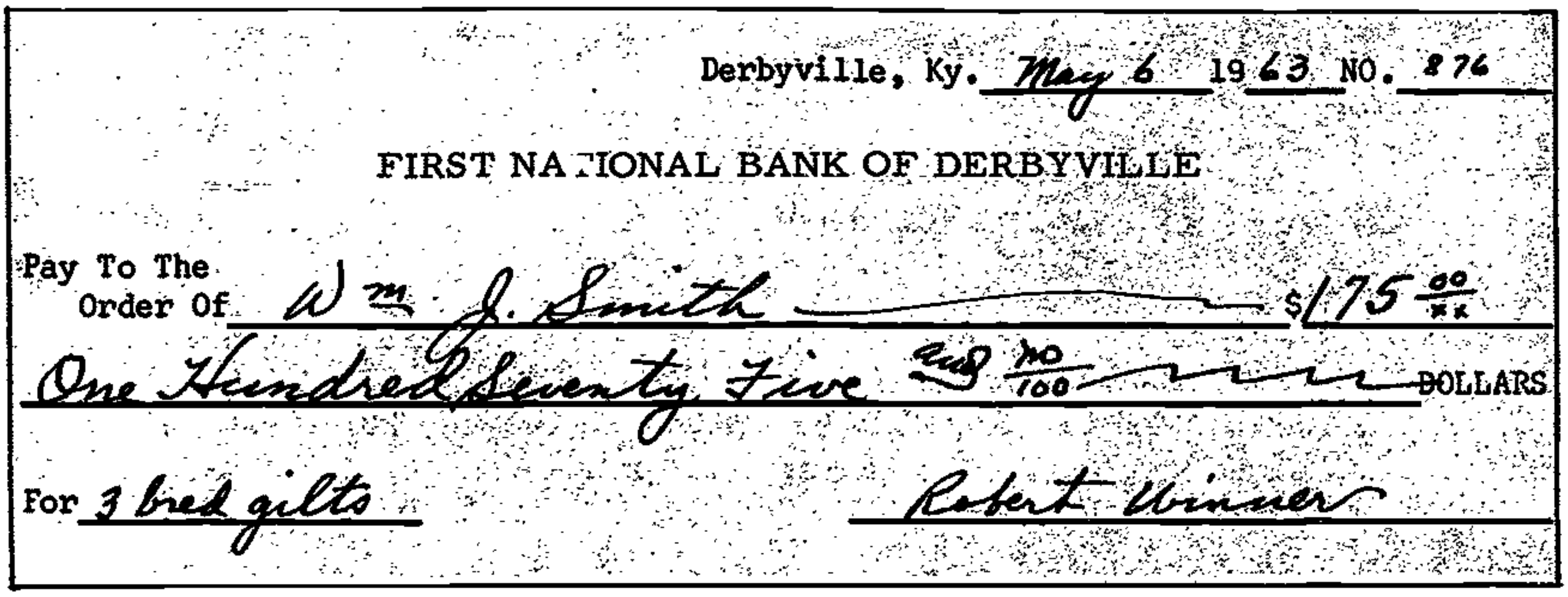
d. Do not make checks payable to cash. Anyone getting the check can cash it.

e. Never sign a check in blank. You place your whole bank account in the hands of the holder.

f. If you make a mistake in filling out a check destroy it and write a new one.

g. Show for what the check is written. This makes a more complete record and may serve as a receipt.

Sample Check



Derbyville, Ky. May 6 19 63 NO. 876

FIRST NATIONAL BANK OF DERBYVILLE

Pay To The Order Of Wm. J. Smith $175 00/xx

One Hundred Seventy Five and no/100 DOLLARS

For 3 bred gilts Robert Winner

Endorsing Checks

William J. Smith
Wm J. Smith
W. J. Smith
Will Smith
William Jason Smith

What's your name? — Get in the habit of signing your name the same way every time you sign a check, note, mortgage, or any other legal paper. In a real estate mortgage or deed it is especially important that you sign your name exactly the same as it was spelled in the deed to you.

William J. Smith

Blank endorsement — When you endorse a check in the blank, simply by signing your name, you make it possible for anyone into whose hands the check may fall to cash it. Don't endorse checks this way if you send them in the mail. Endorse checks this way only when you hand the check personally to the individual or organization you want to receive the cash.

Payable only to
My Production
Credit Association
William J. Smith

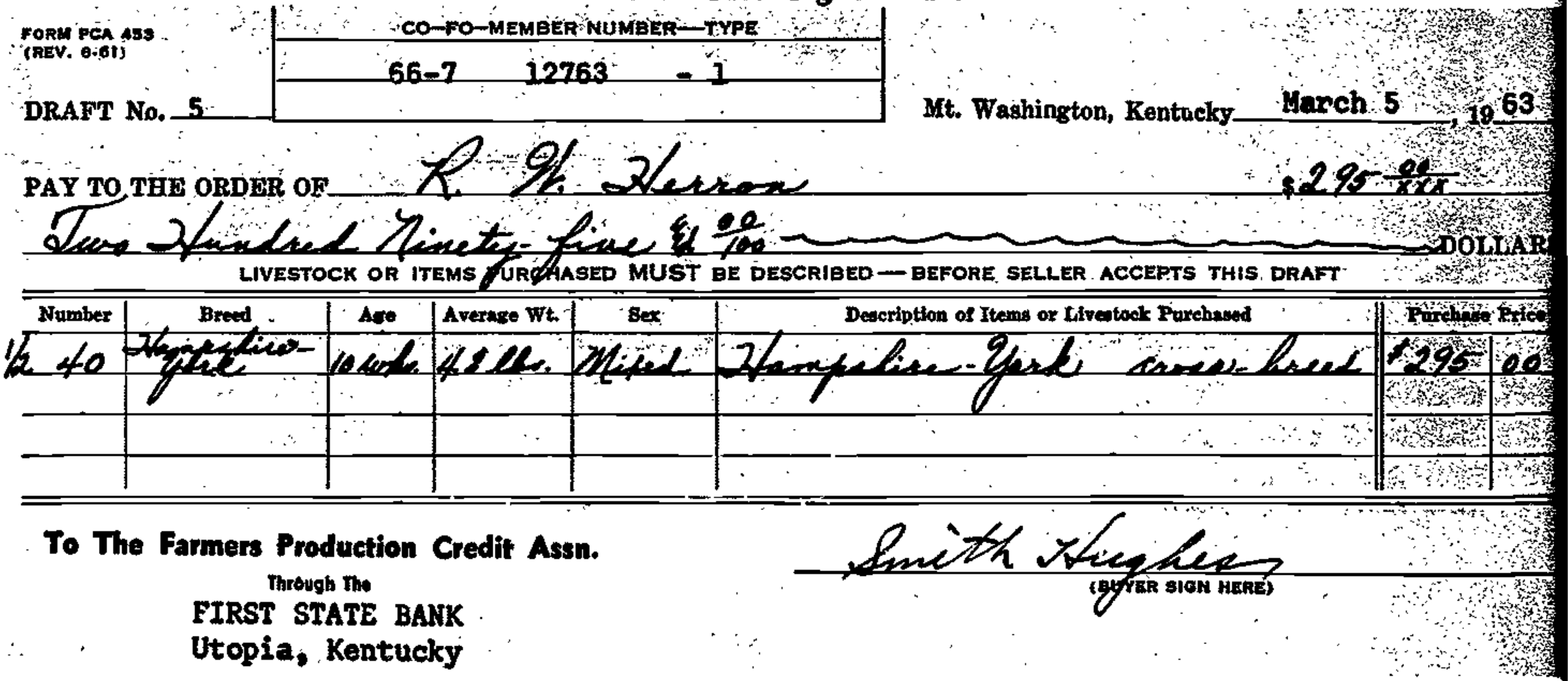
Restrictive endorsement — Use this endorsement when you send checks through the mail. Only the person or organization to whom you endorse the check can cash it.

Drafts

A draft is like a check except that the order when paid by the bank is not charged to the signer but to a third person named on the face of the draft. Of course, before the bank will honor this kind of order it must know that the person against whom the draft is written will accept the charge of the amount named. Usually in the course of business this has all been arranged before the draft was written. Financial institutions such as banks and production credit associations sometimes give "letters of credit" to their customers agreeing to honor drafts drawn on them under conditions set forth in the letter.

A production credit association member who obtains a loan to finance the purchase of livestock or other property may be authorized to use a draft—sometimes called a bill-of-sale sight draft. The member completes and gives a draft to the seller of the property for the amount of the purchase price. The draft transfers title to the property purchased to the member and gives the seller the right to collect the stated amount from the production credit association through the bank which is named on the draft. The

Bill of Sale Sight Draft



FORM PCA 453
(REV. 6-61)

CO—FO—MEMBER NUMBER—TYPE
66-7 12763 - 1

DRAFT No. 5

Mt. Washington, Kentucky March 5, 1963

PAY TO THE ORDER OF R. W. Herron $295 00/xx

Two Hundred Ninety-five & 00/100 DOLLAR

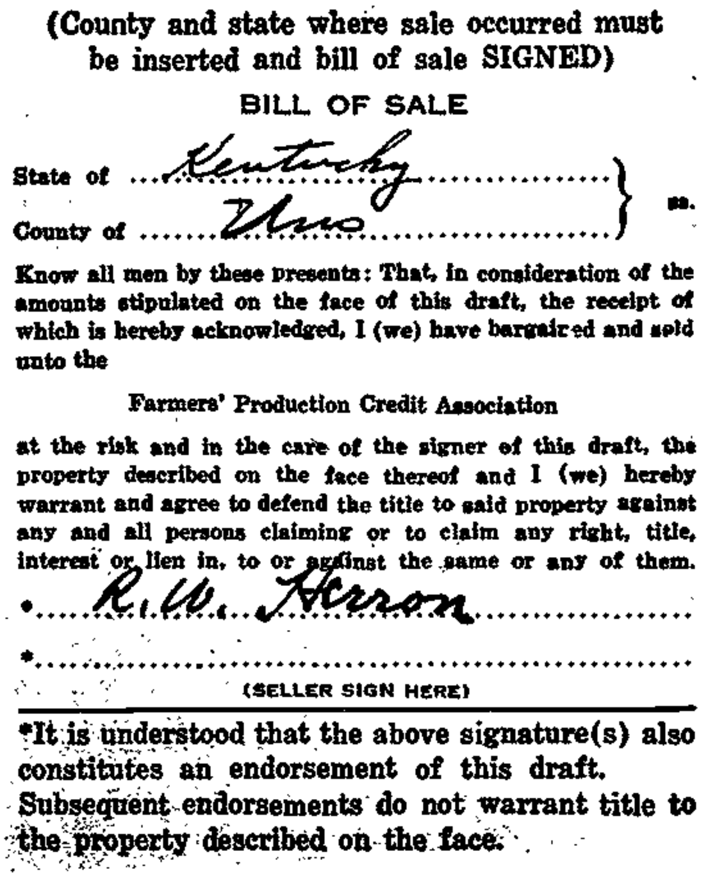
LIVESTOCK OR ITEMS PURCHASED MUST BE DESCRIBED — BEFORE SELLER ACCEPTS THIS DRAFT

Number	Breed	Age	Average Wt.	Sex	Description of Items or Livestock Purchased	Purchase Price	
½ 40	Hampshire-York	10 wks.	48 lbs.	Mixed	Hampshire-York cross-breed	$295	00

To The Farmers Production Credit Assn.
Through The
FIRST STATE BANK
Utopia, Kentucky

Smith Hughes
(BUYER SIGN HERE)

Bill of Sale Sight Draft
(Back)



(County and state where sale occurred must be inserted and bill of sale SIGNED)

BILL OF SALE

State of ......Kentucky......}
County of ......Uno......} ss.

Know all men by these presents: That, in consideration of the amounts stipulated on the face of this draft, the receipt of which is hereby acknowledged, I (we) have bargained and sold unto the

Farmers' Production Credit Association

at the risk and in the care of the signer of this draft, the property described on the face thereof and I (we) hereby warrant and agree to defend the title to said property against any and all persons claiming or to claim any right, title, interest or lien in, to or against the same or any of them.

*......R. W. Herron......
*..................................
(SELLER SIGN HERE)

***It is understood that the above signature(s) also constitutes an endorsement of this draft. Subsequent endorsements do not warrant title to the property described on the face.**

draft pictured here shows how Mr. Hughes, whose loan is discussed in Chapter II, used a draft to pay for some shoats he bought.

Promissory Notes

A note is an unconditional written promise, signed by the maker—the person borrowing the money. He promises to pay, upon demand or at a definite future time, a certain sum in money to the holder or to a person he designates as payee.

This form of written contract is usually signed by a person borrowing money; also, it is often given in return for goods or services. A note may be signed by one or more makers. It tells how much is to be paid and should state the interest rate. It states where and when repayment is to be made, and normally it names the party to receive the money. The note assumes but rarely states a consideration (money, goods, services, rights, etc.) for which it is given. Sometimes the phrase "for value received" is used.

In connection with notes it is well to remember that:

a. A person who signs a note as maker establishes his liability, or responsibility, for payment. His failure to understand the provisions in the note does not prevent collection.

b. The maker of a note is still liable for payment of any balance not covered by the proceeds from the collateral he gave.

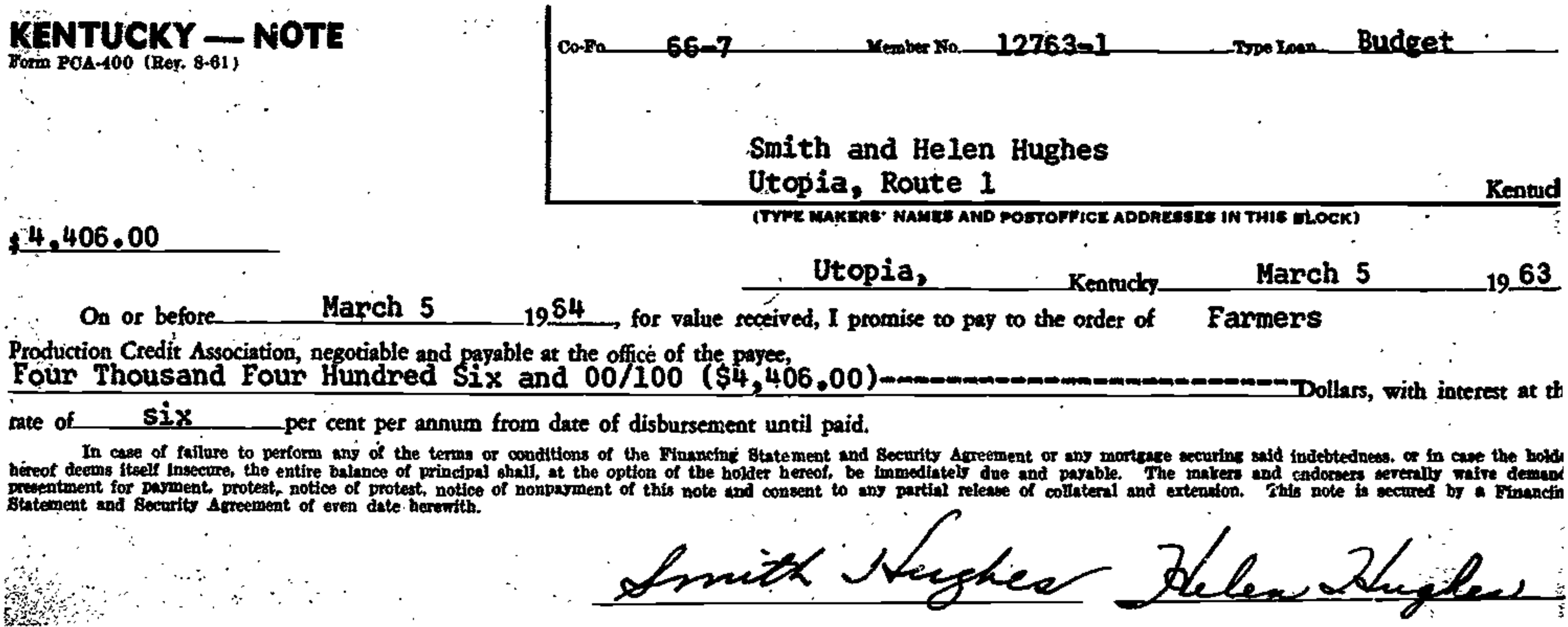
c. A person should never sign a note unless he stands ready to pay the obligation. This includes co-signing to accommodate someone else.

Mortgages

A mortgage is an instrument creating a lien, or legal claim, on property. Thus, when you mortgage your property you give the lender a legal claim against it for the amount of your debt, unless the debt is paid as set forth in the mortgage contract. You still have ownership and control of your property; the lender has the security of knowing that it may be sold if necessary to satisfy his claim.

One of the simplest forms of security is the pledge or pawn, such as a watch or other article of value, left with the lender when a loan is obtained. In case the borrower

Promissory Note



KENTUCKY — NOTE
Form PCA-400 (Rev. 8-61)

Co-Fo. 66-7 Member No. 12763-1 Type Loan Budget

Smith and Helen Hughes
Utopia, Route 1 Kentud
(TYPE MAKERS' NAMES AND POSTOFFICE ADDRESSES IN THIS BLOCK)

$4,406.00

Utopia, Kentucky March 5 19 63

On or before March 5 19 64, for value received, I promise to pay to the order of Farmers Production Credit Association, negotiable and payable at the office of the payee, Four Thousand Four Hundred Six and 00/100 ($4,406.00)------------------------------Dollars, with interest at th rate of six per cent per annum from date of disbursement until paid.

In case of failure to perform any of the terms or conditions of the Financing Statement and Security Agreement or any mortgage securing said indebtedness, or in case the holde hereof deems itself insecure, the entire balance of principal shall, at the option of the holder hereof, be immediately due and payable. The makers and endorsers severally waive demand presentment for payment, protest, notice of protest, notice of nonpayment of this note and consent to any partial release of collateral and extension. This note is secured by a Financin Statement and Security Agreement of even date herewith.

Smith Hughes Helen Hughes

fails to repay his loan within the specified time he forfeits ownership of the article pledged. Another form of security is collateral. Collateral is a term used to include government or other bonds and readily salable stock. Banks often want this type of security for their loans.

A farmer, when borrowing money, usually does not have stocks, bonds or other quickly salable collateral to offer as security. In the place of this type of security he gives a mortgage (deed of trust in some states). On long-term loans he will offer a mortgage on his land; on a short-term loan he will offer a chattel mortgage on his personal property (equipment and livestock). This latter may provide for a lien on his crops, which in some states cannot be given before the crop is planted. These two kinds of mortgages gives the mortgagee (the lender) the right to take certain legal steps if the note or other contract is not met according to its terms. Such steps usually result in the public sale of the property, with the net proceeds (money received) of the sale being applied to pay off the debt. The debtor retains any property in excess of the sales necessary to repay the loan, or receives the money above that amount. The creditor usually has the right to sue the debtor for any unpaid balance on the debt after the proceeds of the sale of the collateral or mortgaged property have been paid on it.

Mortgages are filed on record in the county courthouse as a means of public notice that the lien has been established. Any lender who may be considering making a loan to be secured by mortgage or collateral may go to the courthouse records and determine whether the property in question is already mortgaged. Often he has an abstracter do this for him. Sometimes two or more mortgages are filed covering the same property. Filing dates determine the order of settling claims to such property. For example, it may become necessary to sell the property in order to pay loans secured by the mortgages. Proceeds of the sale usually are used first to satisfy loans secured by the mortgage filed first. Any proceeds left then may be used to satisfy other mortgages in the order in which they are filed.

Warehouse Receipts

A warehouse receipt is a receipt given by a warehouseman for goods received by him for storage in his warehouse. It is documentary evidence that the person named in the receipt has deposited with the warehouseman products of a specified quantity and quality.

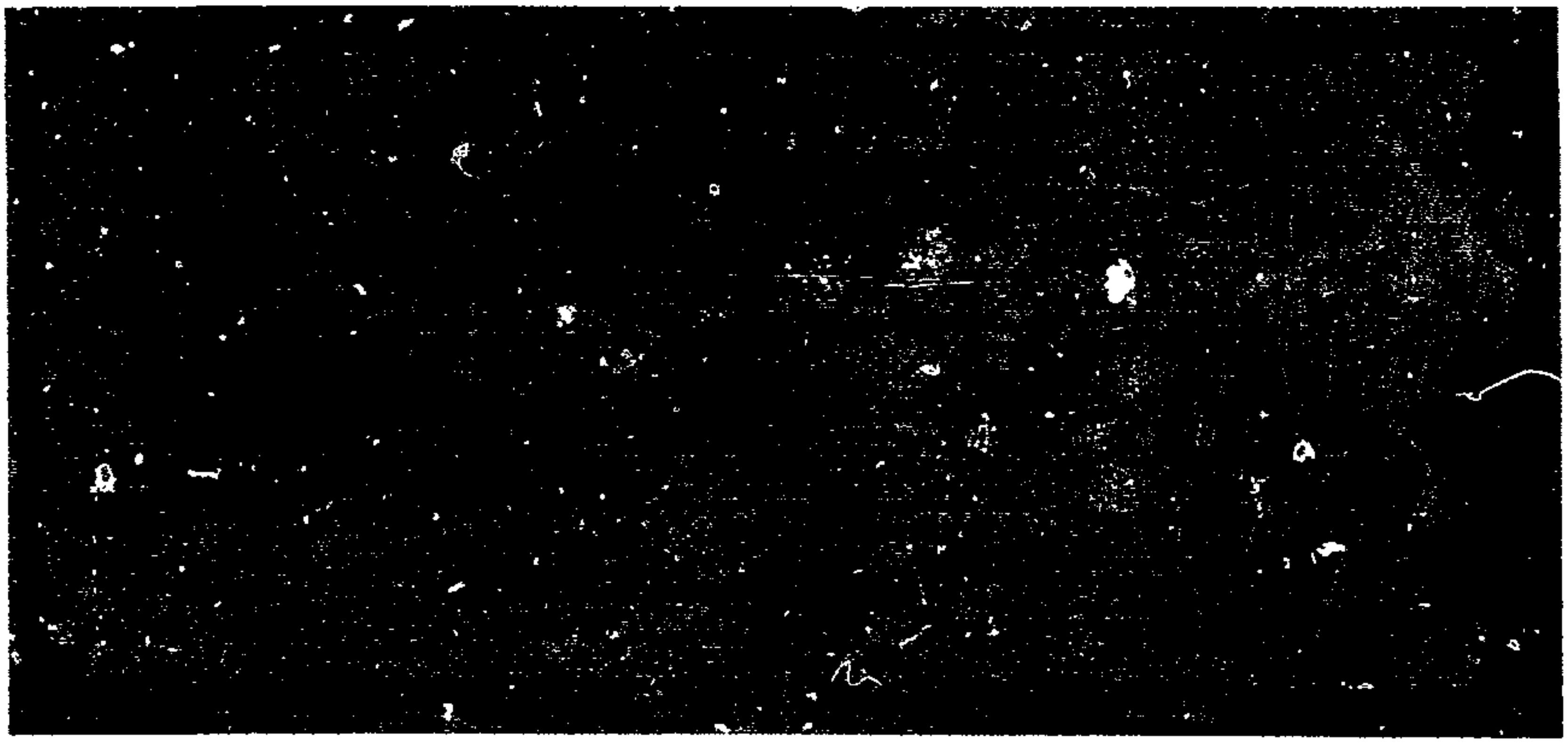
The practice of storing grain, wool, butter, honey, tobacco, cotton, soybeans and other storable farm products has become increasingly widespread in recent years. Farmers and their cooperative associations often borrow on the security of such stored products.

Two types of warehouses issue warehouse receipts: (a) those operated under the U. S. Warehouse Act, commonly called Federal Warehouses; and (b) those operated under a State Warehouse Act, commonly called State Warehouses.

This example illustrates the use of warehouse receipts.

A farmer may have more grain than he can store on his farm. By holding the grain he thinks he may get a better price. He puts his grain in a licensed elevator and receives a warehouse receipt specifying the quantity and grade. Usually he is protected against damage and can put the grain on the market when he chooses. In the meantime he may need to use part of the money he could obtain by selling the grain. In this case he can usually obtain a loan from a bank or production credit association by signing a note and attaching to it, as security, his warehouse receipt. The farmer may sell or dispose of his grain at any time he wishes, provided he surrenders the warehouse receipt to the elevator.

Warehouse Receipt



Bills of Lading

A bill of lading is a contract or receipt signed by a common carrier (such as a railroad or truck line) agreeing to deliver the described freight to a given person at a stated place.

Credit is often advanced on farm products at the time they are shipped; a bill of lading becomes the collateral for such credit.

The bill of lading states that the railroad, truck line, or other carrier: (a) has received the property which is described; (b) is shipping the property to a certain party located at a certain place; and (c) will surrender the property to that party when he presents the bill of lading under conditions stated in it, and pays the freight charges.

Releases and Satisfactions

A release is the transfer of a person's interest or right to a piece of property to another person. Usually this other person already has an interest in the property and may already possess it.

Suppose you have just paid off a mortgage on your farm. The mortgagee (lender) no longer has any claim to the property. As evidence of this, it is customary for him to return your canceled mortgage and note. It is also his duty to give you a receipt called a "release"; this shows that the debt has been paid in full. You should have this receipt recorded at once by the person in charge of mortgage records. In some states the law requires the lender to have the release recorded; but, since, it is your property that is affected, you should see that the release is recorded.

Sometimes a partial release is signed during the life of the mortgage. This release permits the mortgagor (the borrower) to sell some mortgaged livestock or other chattels, or timber, gravel, or mineral on the land, or even a certain portion of the land itself. Usually if considerable money is received from the sale, part or all of it must be applied on the debt. No matter what the amount, the borrower is legally bound to account for everything and to apply on the debt whatever the lender requires.

Often the mortgagee (lender) is willing to take a deed to the mortgaged property in satisfaction of the mortgaged indebtedness; in this event the mortgage is ordinarily released of record and the note returned to the borrower. Sometimes the mortgagee (lender) has to resort to court action, commonly known as foreclosure proceedings. In these proceedings the mortgaged land is sold by the sheriff and the proceeds of the sale applied on the debt. If the proceeds of the sheriff's sale do not fully pay the mortgaged debt, the borrower is usually still liable for payment of the balance.

In some states the law permits, when the mortgage so states, for land to be sold by the sheriff without the necessity of court proceedings. He needs only to advertise or give notice of sale. This procedure is known as foreclosure by advertisement.

Sales Contracts

A sales contract is an agreement by one party to sell property or a service to a second party for a stated consideration and under stated terms and conditions.

In farm financing, contracts of sale are often used in selling land and are commonly referred to as land contracts. In contracts of this type the person agreeing to purchase the land is commonly called the vendee or purchaser. The person agreeing to sell the land is commonly known as the vendor or seller. The contract, because it is related to the sale of real estate, must be in written form. The writing is then evidence of the obligations of the purchaser to the seller and the seller to the purchaser. Land contracts usually contain statements relative to the receipt of a down payment, the total purchase price, the dates and amounts of the other payments, the rate of interest to be paid on the unpaid portions, the conditions creating a default by either the purchaser or seller, the legal position of the parties to the contract if default occurs, and when legal title to the land is to be given the purchaser by deed or other instrument. It should be noted, however, that land contracts are not necessarily uniform and each one should be studied as to its particular contents.

CHAPTER II

FINANCING FARM PRODUCTION

Farmers' Need for Short-Term Credit

Success in operating a farm depends, to a large extent, upon the farmer's ability to have operating funds on hand when he needs them. Some farmers always have enough cash on hand or in their checking account at the bank to keep their operations going. Others have the money to provide only part of their operating funds; they have to borrow money to tide them over during certain seasons of the year. The kind and amount of credit they need will depend largely upon the type of farming operations they carry on.

A crop farmer does not cash in on his crop until late in the year; he may need to finance his business during the entire crop season. The combination crop and livestock farmer may need partial financing during the year; the income he receives from time to time from wool, lambs, milk, hogs and cattle may not meet all operating expenses; or it may not bring in money at the time he will need it most. By using his credit properly he will be able to carry on his operations successfully even though he has nothing to sell at the time certain expenses have to be met.

A young man who has chosen farming as his life's work may begin to accumulate property while he is still in high school. By using his credit wisely he can hasten the time when he can operate on his own. This will aid him in getting started in the farming business; it will help him learn how to use credit wisely and how to establish himself as a good credit risk.

As his program progresses, he may want to make investments that cannot be paid for rapidly; or he may decide to buy large pieces of equipment or breeder livestock. Now he is ready to look for an intermediate-term source of credit.

You can be sure that this FFA Star Farmer has learned how to use wisely one of today's most important farm tools — credit.

Farmers' Need for Intermediate-Term Credit

Farmers often need credit for capital purposes that could be repaid over a period of two to seven years. Only recently have lenders realized that neither short- nor long-term credit fully filled this need. Short-term lenders have adapted their policies to meet these needs; qualified farmers can now obtain the types of credit best adapted to their needs and repayment ability.

Purposes: Necessities, Needs and Wants

The purposes for which farmers borrow money have much to do with the profit they make by using credit. Lenders, likewise, consider some purposes more sound than others: quite often their decision to make a loan hinges on whether it is for a productive or non-productive purpose. Generally farmers are able to qualify for a greater amount of credit for livestock or crop production than they can for such purposes as refinancing old debts or buying things that will not produce income. The reason is obvious. In one instance, the loan enables the farmer to produce income; in the other it does not, within itself, increase income or contribute to increased profits.

For ease of analysis, we may well divide the purposes of loans into three classes—"necessities," "needs," and "wants."

Under "necessities" we would list things which are required for financing the year's operations. Sound loan policy requires that these "necessities" be provided first, before credit is used for any other purpose.

"Needs" are those purposes which, though not direct costs of producing any specific crop or livestock, are farm operation items which eventually must be met.

Under "wants" we would list those things which the farmer can easily get along without and which do not contribute directly to profitable operation of the farm business.

Here are some items for which farmers borrow money on a short-term basis:

Seed
Feed
Fertilizer
Labor
Fences
Repairs
Refinancing debts already owed
Farm equipment
Tiling and draining
Terracing
Digging Ponds
Feeder or grazing cattle
Breeding stock
Dairy animals
Repairing house or farm buildings
Home appliances
An automobile
Taking a vacation
Medical care
Education of children

Which of these items are "necessities"? Which are "needs"? Which are "wants"? You and your classmates may find it interesting and profitable to decide.

"Success in operating a farm depends, to a large extent, upon the farmer's ability to have operating funds on hand when he needs them."

Remember that statement made in the opening paragraph of this chapter? We repeat it because it has so much to do with the subject we are dealing with here. A good farmer is careful to see first that he has sufficient credit for the "necessities" he must have to operate his farm profitably. He does not first use up his basis for credit for "needs" or "wants"; he would run the risk of not having enough credit available for "necessities."

Look again at the list of items, above, for which farmers may borrow on a short-term basis. There are several items that involve capital investment. Whether or not borrowing for this purpose should be on a short- or intermediate-term basis would depend upon the farmer's repayment ability. If more than two years are needed to repay, then the farmer might be better financed with an intermediate-term loan.

Sources of Short- and Intermediate-Term Credit

A farmer desiring short- or intermediate-term credit has several sources from which he may borrow money. The wise farmer selects the source that he believes will give him the best service during bad times as well as good times. Hammonds and Tabb, in their book "YOUR FARMING PROGRAM," advise young farmers to consider:

"1. *Where you will likely want to continue to borrow. Start doing business where you want to build up your credit rating.*

"2. *The terms of the loan offered you:*
   (*a*) *Rate of interest and other costs.*

   (*b*) *Whether the notes are discounted (that is, whether interest is subtracted from the amount of the note).*

   (*c*) *Whether you must pay interest on the full amount for the entire time of the loan or pay interest only for the time the money is used.*

(d) *Whether payments can be made on the loan before the date of maturity.*

(e) *Whether the time of the loan is long enough to permit you to pay off the loan when it falls due.*

(f) *The security required."*

Following this advice, progressive farmers "buy" their credit just as they would buy other articles, such as a plow, a tractor or a herd of cows. They want to obtain credit that is useful and profitable to them. The following are common sources from which farmers may obtain their short- and intermediate-term credit. These sources cannot be discussed in much detail here, so you may want to broaden your knowledge of this subject by studying the sources of credit in your own community.

Merchants and Dealers

In some communities considerable credit is extended to farmers by firms selling farm supplies such as fertilizer, seed, fuel, provisions and the like. This is called "merchant" or "dealer" credit.

In obtaining this type of credit, there is usually no written agreement to support the transaction. The farmer simply buys his supplies "on time" and pays the "time" price. This means that the dealer does not charge interest on the money but rather he usually charges an increased price over that charged when a cash sale is made. Even though this type of credit ordinarily comes rather high, some farmers are willing to pay the price because:

1. It is convenient.
2. The funds are expected to be repaid in a few days.
3. They neglect to figure the cost.
4. Credir cannot be obtained elsewhere.

Merchants and dealers sometimes extend credit for longer periods of time, occasionally up to two years or more. Tractors and other items of farm equipment are often sold on this basis, the dealer taking a "title retention note" or a "conditional sales contract." These types of legal instruments usually provide for the dealer retaining actual title to the equipment until it is completely paid for. Many farmers feel that they lose their bargaining power when they are obliged to purchase from dealers who also do the financing. When farmers go to a lending agency, give a note for the amount they want to borrow, pay an agreed interest rate and then take the cash and "shop around" they are exercising good business judgment and are thus able to buy machinery for the "low dollar."

Commercial Banks

The extension of bank credit to farmers varies widely from place to place, depending on the extent of local bank resources and the attitude of the management toward financing agriculture. Many banks, particularly those located in the smaller cities and towns, take an active interest in financing the short-term needs of farmers. A few banks, some even in the larger cities, employ a man with an agricultural background to help them serve farmers.

To harvest or plant crops at just the right time, farmers use great amounts of credit for labor saving machinery.

Money loaned by banks is obtained principally from their depositors. This means that banks must fit their financing program to the possible demands of their depositors for funds.

Interest rates charged by banks vary widely by areas and depend somewhat on state laws. Generally speaking, though, the rate of interest runs from 6 to 8 percent on short-term loans. Large farm operators who periodically use sizeable amounts of credit are sometimes given lower interest rates than small borrowers.

Some banks prefer to make loans only for periods of from 90 to 120 days but many are willing to finance farm operations right on through to marketing time. The banks which follow the latter policy are the ones which are rendering the best service to agriculture. After all, farmers are interested in obtaining credit that is geared to fit their needs, and bankers interested in serving farmers recognize the importance of setting up farmers' loans on this basis.

"Small Loan" Companies

Several states have laws permitting small loan companies to charge 3 to 3½ percent a month on loans under a certain size, usually $300. The result is that such loan companies, often called "finance companies," have materially expanded their services until they now have offices in most towns. It takes very little calculation to figure that this type of credit is costing the farmer from 36 percent to 42 percent a year for the use of his credit. Farmers, who do business with these concerns, neglect to make full inquiry as to the loan terms and cost, or they are unable to obtain credit elsewhere.

Individuals

Most every community has certain individuals who extend credit from their own savings. Retired farmers or businessmen, landlords, persons with considerable wealth, or quite often members of the family are included in this group. This is not a dependable source of credit because too many things can happen to the individual—he may die; he may run out of funds; or he might suddenly decide to use his money for something else. Interest rates charged usually follow rather closely the rate prevailing in the community. Maturities range all the way from "one day after date" to several years on larger amounts or on real estate loans. The "one day after date" note, or "demand" note as it is sometimes called, means that the lender can demand payment any time he wants to. He is thus allowed to set the maturity or "call" date at will, without giving prior notice to the borrower. A young farmer may "get a start" by borrowing from members of his family. Even though the relative may not need to have the money repaid very soon, the important thing is to pay it back as soon as possible and develop the habit of handling credit in a business-like way. A promissory note should be given so both the lender and the borrower understand the terms of the loan.

Credit Unions

In many large corporations and industrial concerns, the employees band themselves together to form a credit union which may be organized either under a state or a Federal charter. The purpose of the credit union is twofold.

1. It provides a means of employees' saving by investing in shares and receiving dividends on them.
2. It enables employees who need additional funds to borrow from the credit union.

Since the interest rate is ordinarily quite reasonable, employeees often find it more profitable to borrow from their own credit union than purchase goods "on time" from dealers and merchants.

Although most credit unions are located in cities, a few serve rural members including farmers. The interest rate charged by a credit union is ordinarily somewhat higher than is paid at a production credit association, for instance. Farmers who use large amounts of credit that cannot be repaid quickly, prefer to borrow from lenders that are able to make loans at a lower interest rate than do credit unions.

Farmers Home Administration

The Farmers Home Administration is a government lending agency in the United States Department of Agriculture. It is required by law to make loans only to farmers who do not have the basis for adequate financing on reasonable terms from commercial banks, production credit associations, Federal land banks or other lenders. Loan funds are appropriated biennially by the Congress and all loans are supervised. FHA loans are not intended to provide permanent financing for those who can get credit from other sources.

The Farmers Home Administration makes both short- and long-term loans. Its short-term loans for operating purposes and for meeting emergency situations in disaster areas may be made for as long as seven years.

When you need money for your farm business or your farm home, you will be able to save by getting your loan from a lender which charges simple interest on the outstanding balance.

Production Credit Associations

A production credit association is an organization of farmers, who, through cooperative effort, obtain short- and intermediate-term credit at a reasonable cost to carry on their farming operations. A production credit association makes loans only to farmers and stockmen. It is operated by farmers and stockmen for their mutual benefit. A farmer who can qualify for membership in a production credit association is assured a permanent, dependable source of credit adapted to his needs as long as he maintains a sound basis for it.

Production credit associations obtain their loan funds from Federal intermediate credit banks. They thus have access to money markets all over the country. The 12 Federal intermediate credit banks in the United States began operation in 1923 under provisions of the Agricultural Credits Act of that year as "wholesalers" of credit to lenders making loans to individual farmers. In less than 40 years they have obtained more than $45 billion of loan funds through the sale of debentures on the money markets of the country. This experience has proved that funds obtained in this manner are available in bad times as well as good. Production credit associations are permanent sources of credit operating under Federal charter, authorized by Congress in the Farm Credit Act of 1933. They are subject to Federal examinations.

Loans are adapted to each individual farmer's needs. Farmers serve on the association's loan committee. They are able to adapt loans to the individual borrower because they themselves are farmers and understand the use of credit on a farm.

Each farmer who borrows from a production credit association becomes a voting member and stockholder. All the voting stock is held by these farmer-members, who elect a board of directors at the annual meetings of stockholders. Each farmer who borrows owns Class B or voting stock in the association equal to $5 for each $100 he borrows. This stock can be used over and over again, year after year. Collectively, the Class B stockholders own all the voting stock, but each member has only one vote regardless of the amount of stock he owns.

When production credit associations were first organized in 1933 and 1934, the Government invested in Class A or non-voting stock to provide them with beginning capital. Since that time, farmers have increased their ownership in the associations so that now nearly all PCAs in the United States are wholly farmer owned. As provided in the Farm Credit Act of 1956, the associations have been buying the Federal intermediate credit banks from the Government by retiring the Government's investment in these banks.

When an association accumulates enough reserves to take care of possible future losses, it may then pay dividends on both the voting and non-voting stock. After any declared dividends have been paid, any funds remaining may be distributed to the borrowers in patronage refunds.

How to Obtain a Production Credit Association Loan

In this detailed explanation of how a farmer goes about arranging for his short-term credit requirements, we are using a production credit association as an example. In obtaining a loan from other lenders some details may be different, but all the essential factors are included in this example.

Making Application

You make application for a production credit association loan with an association representative on the farm, or at the PCA field office. When members of such youth groups as Future Farmers of America or 4-H Clubs apply for loans, a representative of the association meets with the group and helps each member prepare his application.

Your application for a loan will contain all essential credit information. This is considered carefully by the association's loan committee. As an example, turn to page 26 and look at the application of Smith and Helen Hughes for a loan of $4,406. Notice that several important things have been said about their farm business: (1) what they own; (2) what they owe; (3) their net worth; (4) their crop program; (5) amount of credit they need and the purposes for which they will use it; (6) their plan of repayment; and (7) information about the amount of insurance they carry. All of this information appears above the signatures of the applicants, Mr. and Mrs. Hughes.

Preparing Field Report

The field report (page 27) contains credit information which has been developed by the person who has taken the application—in this case, Jack Armstrong. Here, the representative, Armstrong, records important credit information about the applicant and his family. He describes the farm which Hughes operates, and enters values of property to be used as security for the loan. The field report also has a statement of estimated income and expense which represents the combined thinking of both the applicant and the PCA representative. General credit information is shown under Item 9. Armstrong obtains this information either by talking with Hughes in the field office or by visiting the farm. A farm visit is always made on loans to farmers who are coming to the association for the first time. Thereafter, loans are usually closed without another visit to the farm. Field representatives keep themselves informed about each member's business through their annual farm visits. They can thus do a better job of financing the members.

Credit Factors Considered

Final decision on an application rests with the loan committee. This committee is made up of two directors who are farmer members and the manager. Two of these three members must be present to provide a quorum. An application can be approved only by unanimous approval of the committee members present.

In deciding whether a loan should be made, the loan committee considers five credit factors. Taking the Hughes case as an example, let us consider these five factors and examine the information which the application furnishes about them.

1. The Man. Item 3 of the field report (Form 203A) headed "The Man and Farm Family," provides facts concerning their reputation for honesty, their ability as managers, and other important information about their health, cooperation, credit record, age, number of children, how they were able to accumulate the property they now have, and an estimate of the current value of any real estate they may own.

2. Financial Position and Progress. Item 2 of the application furnishes most of the information that is needed on this credit factor. It shows that the Hughes' have a net worth of $19,739. We arrive at this figure by sub-

CREDIT FORM PCA-202 (REV. 9-61)

LOAN APPLICATION
PRODUCTION CREDIT ASSOCIATION

PCA CODE	LOAN NO.	AMOUNT IMMEDIATE DISCOUNT

1. Name(s) Smith and Helen Hughes
2. Postoffice Utopia Route 1 In Uno County, State of Kentucky Tel. No. 5198

My Int.	FINANCIAL STATEMENT ALL ASSETS	Value	FINANCIAL STATEMENT ALL LIABILITIES	Amount	
1/2	18 Cows ___ Heifers 2 Calves	1,810	Chattel Mortgages		
1/2	___ Steers ___ Steers 2 Bulls	160	P.C.A. Farmers Due 3-11-63		
	___ Ewes ___ Lambs ___ Rams		Orig. Amt. $ 2,000 Add. Advances $ 600	866	37
1/2	5 Gilts 15 Sows 1 Boars	580	Holder ___ Due ___		
1/2	60 Pigs 39 Shoats ___ Mkt. Hogs	750	Orig. Amt. $ ___ Date Contracted ___		
all	40 Hens ___ Turkeys ___ Broilers	40	Title Retention Notes		
1/2	350 bales straw	85	Holder Universal Auto Co. Due Demand		
1/2	3000 Bu. Corn ___ Bu. Oats	1,500	Item(s) Covered Truck		
1/2	___ T. Silage 2500 bales T. Hay	600	Orig. Amt. $ 1,085 Date Contracted 2-15-63	1,085	00
	___ Bu. Wheat ___ Bu. Soybeans		Personal Notes		
	___ Lbs. Tobacco ___ B. Cotton		Holder ___ Due ___		
all	Tractor No. 2 $ 3,000 Implements $ 4,880	7,880	Orig. Amt. $ ___ Date Contracted ___		
all	Truck No. 1 $ 2,000 Auto No. ___ $ 1,800	3,800	Holder ___ Due ___		
	Cash Value Life Insurance ___		Orig. Amt. $ ___ Date Contracted ___		
	Notes and Accounts Receivable ___		List Open Accounts, Past Due Taxes, Judgements, etc.		
	Stock Owned in PCA "A" Shares ___ "B" Shares 20	100			
	Stocks and Bonds (Market Value) Farm Bureau	125	Life Ins. Loan(s) ___		
	Outside Business (Except Real Estate) ___		Past Due Cash Rent $ ___ R. E. Int. $ ___		
	Cash on hand or in Bank ___		Current Liabilities of Outside Business ___		
	TOTAL QUICK ASSETS	17,430	TOTAL CURRENT LIABILITIES	1,951	37
Tract I	Title in Smith and Helen Hughes		Real Estate Mortgages		
	Survivorship (YesXX) Acres 65	7,500	Holder Fed. Land Bank Yr. Due 1978 Rate 5	1/2	
Tract II	Title in ___		Tract ___ Orig. Amt. $ 3,800 Contr'd 1958	3,240	00
	Survivorship (Yes-No) Acres ___		Holder ___ Yr. Due ___ Rate ___		
Tract III	Title in ___		Tract ___ Orig. Amt. $ ___ Contr'd ___		
	Survivorship (Yes-No) Acres ___		Holder ___ Yr. Due ___ Rate ___		
Tract IV	Title in ___		Tract ___ Orig. Amt. $ ___ Contr'd ___		
	Survivorship Clause (Yes-No)		Tract IV—Other Real Estate ___		
	(Indicate Life Estates, Real Estate Purchased under contract, kind property in Tract IV)		Total Real Estate Indebtedness	3,240	00
	Total Value Real Estate	7,500	TOTAL ALL LIABILITIES	5,191	37
	TOTAL ALL ASSETS	24,930	NET WORTH	19,739	63

3. (a) Insurance: Life $ 5,000 Beneficiary ___ Chattels $ 6,000
Buildings $ 5,000 Auto Liability $ 10-20 Farm Liability $ ___
(b) Notes endorsed or guaranteed for others $ ___ Ever in Bankruptcy? ___
4. Crops growing or to be grown on land operated, including those cultivated by others, (X) those to be mortgaged.

X	Appl. Share	Total Acres	Kind of Crop	Harv. Year	Est. Yield Per Acre	Name of Farm	X	Appl. Share	Total Acres	Kind of Crop	Harvest Year	Est. Yield Per Acre	Name of Farm
x	1/2	75	Corn	1963	60	Gibbs							
	1/2	23	Wheat	1963	20	Gibbs							
	1/2	37	Alf.&Clover	1963	2T	Gibbs							

5. Dates	Purposes of Loan and Sources of Repayment	Amount of Advance	Estimated Receipts	Outstanding Balance
	To Pay PCA Bal. Prin. $ 866.37 Int. $ 103.63	970		
	LSF $ 25 CBS $ 125 CLI $ 46 ( )	196		
Now	Pay Universal Auto Co.	1,085		
Now	Clover seed	50		
Now	Buy 40 shoats, 1/2 int.	300		2,601
4-15	Sale of 39 hogs, 1/2 int.		750	1,851
5-1	Fertilizer $500; seed corn $50	550		
5-1	Fuel $500; Supplement $500	1,000		
6-1	Buy rotary hoe	255		3,656
9-1	Sale of 60 hogs and hogs purchased, 1/2 int.		1,500	
1-1	Sale of increase 3 sows and 5 gilts, 1/2 int.		1,000	
2-1	Sale of increase 12 sows, 1/2 int.		1,500	
	TOTAL AMOUNT APPLIED FOR $	4,406	4,750	

We authorize ___ to exercise our voting rights and to perform any other transactions in connection with our investment with the association. The representations and authorizations printed on the reverse side hereof, which we have read, are included herein by reference.

Date March 5 1963 Signed Smith Hughes Signed ___

Date of last farm visit 8-12 1962. Loan to mature 3-5- 1964 Amount to be inserted in additional advance clause $ ___

Application approved ___ 196__, for $ 4,406 subject to the following requirements: ___

LC	Closing Authority

Ex-Comm. Ex-Comm. Sec'y-Treas.

CREDIT FORM PCA-203B (REV. 9-61)

FIELD REPORT

FARMERS PCA

THE MAN AND FARM FAMILY

1. Name Smith Hughes Age 38 Wife Helen Age 32 Dependents 4
yrs. farming life present farm 6 mo. this county 13 formerly resided Ashland County
State of Ky. Lives on farm (Yes ☒ No ☐) Farm Help - Family: Hired:

2. Name Age Wife Age Dependents
yrs. farming present farm this county formerly resided County
State of Lives on farm (Yes ☐ No ☐) Farm Help - Family: Hired:

3. (Management, experience, credit record, cooperation, health, etc.) Managerial ability is satisfactory. Experienced hog producer and dairyman. Property acquired through their own efforts. Family lives economically, are cooperative and work hard. Have good credit record with association and others.

4. **THE FARM** Reasonable current value 65 A. $ 7500 A. $ A. $
Farm location: On county road one mile northeast from the town of Utopia, County of Uno, bounded on the North by Webb, on the east by Johnson, on the south by Stone and on the west by Miller.
App'l Rents 173 A. From Wm. Gibbs Basis of Rental 50-50 Grain and livestock
App'l Rents A. From Basis of Rental
App'l Rents A. From Basis of Rental
Productivity and type of land; condition of buildings: Rolling land in fair state of productivity. Limed and well fertilized. Produces good grass and legumes. Ample barn room and dairy equipment. All buildings in good repair. Fences all new.

5. Have courthouse real estate records been checked? yes If records indicate information given in financial statement relative to title(s), survivorship clause(s) or debts(s) to be incorrect, explain:

6. PROPERTY TO BE GIVEN AS SECURITY TO THIS LOAN

Livestock on hand: Br. $ 580 Fr. $ 750, to be bought: Br. $ Fr. $ 300 Total $ 1,630
Equipment on hand $ 7,880, to be purchased $ Auto(s)—Trucks $ Total $ 7,880
Stored commodities to be sold and applied on loan Total $
Feed 1/2 -3,000 bu. corn other collateral
R. E. to be mortg. A. value $. prior lien $ Ins. on Bldgs. $

7. STATEMENT OF INCOME AND EXPENSE—APPLICANTS SHARE ONLY

Income From	Income Previous 12 Months	Estimated Income Next 12 Months	ESTIMATED COST OF OPERATION NEXT 12 MONTHS	
Dairy Prod.		2,500	Living Expenses: (Food, clothing, fuel for home, electricty, medical services,	xxx
Cattle		200	charity contributions, education, recreation, etc.)	2,000
Hogs		4,750	Feed $ 500 Seed $ 100 Fertilizer $ 500 Lime $	1,100
Lambs. Wool			Labor $ Tractor oil and fuel $ 500 Repairs on equipment $ 200	700
Poultry			Custom Work $ Veterinary Expense $	
Corn			Auto and truck expense	250
Wheat		400	Livestock to be purchased, fed, and sold	300
Soybeans			Repairs on buildings and fences	
Cotton			(A) TOTAL OPERATING EXPENSES $ 4,350	xxx
Tobacco			R. E. Pay'ts Due March Amt. $ 158 Due Sept. Amt. $ 158	316
			Interest and payments on other obligations	
			Taxes: Real estate $ Personal Property $ Income $	250
			Cash Rent: Due Amt Due Amt.	
			Insurance: Fire, lightning, cyclone $ Auto $	250
			Life $ Hospitalization $ Liability $	
Outside Inc.			(B) TOTAL FIXED OVERHEAD EXPENSES $ 816	xxx
Total Inc.		7,850	TOTAL EXPENSES (A plus B)	5,166

Source of outside income: Years of seniority:

8. Analysis of credit extended during term of previous loan:
Renewal $ 820 Capital $ 1,135 Feeders $ -0- Operating $ 645 Total $ 2,600
Repayments Expected $ 2,600 Repayments Made $ 1,734 Renewal Expected $ -0- Actual Renewal $ 866

9. REMARKS: Explain anything that cannot be readily understood from information already furnished in this application and field report, including reasons for renewal and past performance. **(If there has been diversion of proceeds, explain and indicate action taken with the member.)**

Satisfactory reduction was made in loan last year which included $1135 for capital investment and a renewal of $820 of funds advanced in 1961 for purchase of additional dairy cows. Member expected to pay loan balance in full but had bad luck with sows farrowing. Has a good dairy and plenty of feed for hogs and cattle. Has a good line of equipment. While May 1 is set as the approximate date for advancing operating money, member follows the practice of requesting it at the times and in the amounts needed. The 65 acre farm listed in the financial statement is seeded down and used for pasture only. Member's parents live in house on this farm on Social Security income.

Date March 5 1963.

Signature Jack Armstrong
(Field Representative)

FORM - PCA 401-KY
Rev. 10-62

FINANCING STATEMENT AND SECURITY AGREEMENT

THIS AGREEMENT, by and between Smith and Helen Hughes whose address is Utopia, Route 1, Uno County, Kentucky (hereinafter called "Debtor," whether one or more) and the FARMERS Production Credit Association whose principal office is at Farmington Kentucky, (hereinafter called "Lender");

WHEREAS, the undersigned Debtor is indebted to the Lender and bereafter expects to seek additional loans and advances from the Lender and desires to give security for all such indebtedness and future advances;

NOW, THEREFORE, WITNESSETH: As security for the payment of existing and future indebtedness of the Debtor to the Lender, the Debtor hereby gives and grants unto the Lender a security interest in the property and goods described in the Schedule below, and further covenants and agrees with the Lender as follows:

1. That the statements contained in the Debtor's loan application or applications are true and correct and that the proceeds of the loan or loans secured hereby will be used solely for the purposes set forth in such applications.
2. That the Debtor holds title to the within-described property free and clear of liens and encumbrances and prior security interests.
3. That the Debtor will pay when due all indebtedness secured hereby with interest, together with any rent, taxes, levies, assessments or other claims which are or may become liens against the said property.
4. That the Debtor will care for and maintain the crops and property herein described in a good and husbandlike manner and will not further encumber, conceal, remove, sell or otherwise dispose of the same without the written consent of the Lender and, upon demand, will provide additional collateral acceptable to the Lender.
5. That he will insure the said crops and property in such amounts and in such manner as may be required by the Lender and will pay the premiums therefor.
6. That the Lender, or its agents, shall have the right to inspect the said property at any time.
7. That, upon the death or bankruptcy or insolvency of the Debtor the entire indebtedness secured hereby shall, at the option of the Lender, become immediately due and payable.
8. That, upon breach by the Debtor of any of the covenants or terms hereof, all indebtedness secured hereby shall, at the option of the Lender, become immediately due and payable and the Debtor hereby waives all notices and all exemptions and agrees that in the event this instrument be placed in the hands of an attorney for foreclosure or other legal action, the Debtor will pay all costs and attorney's fees incurred, and in the event the Lender pays any rent, taxes, assessments, levies, charges or any liens whatsoever affecting the said property or insurance premiums, the same shall become a part of the debt hereby secured and shall be payable on demand, PROVIDED, HOWEVER, if the Debtor shall pay the indebtedness hereby secured when due, including such further advances as may be made by the Lender to the Debtor, then this indenture and the estate and interest hereby granted in the said property shall cease and determine and become void, anything herein to the contrary notwithstanding.
9. The Debtor hereby instructs the Lender not to file a Termination Statement of this Financing Statement and Security Agreement until requested to do so by the Debtor in writing.
10. It is the intention of the parties that this instrument shall serve both as a "Financing Statement" and "Security Agreement" as authorized by law.

IN WITNESS WHEREOF the parties hereto have caused this Agreement to be executed this March 5 1963, at 10:35 AM/~~PM~~

Smith Hughes
(Debtor)

FARMERS Production Credit Association
(Lender)

Helen Hughes
(Debtor)

By Jack Armstrong

(Debtor)

SCHEDULE OF GOODS COVERED BY THIS AGREEMENT AND STATEMENT:

1. CROPS—All of the debtor's interest in the following crops to be planted or growing within one year from the date hereof on the hereinafter described land:

Corn

2. EQUIPMENT on the hereinafter described land:

All farm equipment

3. LIVESTOCK, FARM PRODUCTS AND PERSONAL PROPERTY on the hereinafter described land:

Corn
All hogs

4. All property similar to that listed above, which at any time may hereafter be acquired by the Debtor including, but not limited to, all offspring of livestock, additions and replacements of livestock and poultry, and replacements of and additions to equipment and other personal property above described; and including the wool to be clipped from any sheep or goats, all milk produced by any cows, all products of any poultry, and all feed to be used in maintaining or fattening said livestock and poultry.
5. All proceeds of the sale or other disposition of any of the property described or referred to under Items 1 to 4, inclusive above, and of any offspring, wool, milk and poultry products derived from said property, together with all accounts receivable resulting from such sales.

All of the above-described crops and property are or will become located on the farms described as follows:

The Gibbs farm located on county road one mile northeast from the town of Utopia, County of Uno, bounded on the north by Webb, on the east by Johnson, on the south by Stone and on the West by Miller.

tracting their liabilities from their assets. Under assets are shown the various items of property they own. The liability side of the financial statement shows the Hughes' various debts. Note that the original amount of the debts is shown, and the date they were contracted. This information enables the loan committee to determine the progress the Hughes' are making in reducing their obligations. When passing on a loan application, the loan committee also reviews, from their files or other available sources, the applicant's progress and trends in his business over a period of years.

3. Repayment Capacity of the Farm Business. Next to the "man" factor, the loan committee gives most consideration to this factor. They are eager to see that member-borrowers repay their loans without harming their farm business. It is of prime importance that farmers use credit in ways that improve their financial position. This is so important that production credit associations endeavor at all times to make loans that are self-liquidating and help the farmer run his business efficiently.

Now look at Item 7 of the field report on the Hughes' application. You see that an operating statement of estimated income and expense has been worked out. By analyzing this statement the borrowing member and his production credit association are able to determine (a) the credit needed, and (b) how it is to be repaid. Notice that income from dairy products, cattle, and wheat will not be used to repay the loan; it will be available to pay family living and operating expenses. This income, plus operating funds provided in the loan, will cover all expenses shown in the operating statement. This is vital. The loan must be sufficient to cover expenses not met by unpledged income. This is absolutely necessary if the entire operation is to be financed on a basis that fits the needs of the farm family.

4. Purpose of Loan and Basis of Approval. On the Hughes' application the first item under "purpose of the loan" is renewal of the previous year's loan balance. This raises the question: Is this renewal justified? The explanation found under Item 9 of the field report shows that this member's record of performance is satisfactory. Remember in the preceding paragraph we saw that the operating expenses provided in the loan, together with income unpledged, was sufficient to cover the entire cost of operation. These are "necessities" and, therefore, are constructive loan purposes.

In addition to the renewal, another capital item in the loan purpose is to pay for a truck just purchased. This item of equipment is considered necessary in the operation of this particular farm business.

From this analysis, we see that the association's loan committee can determine that the purpose is sound. Now they are ready to examine the plan of repayment. The Hughes' plan calls for sale of hogs expected to bring $4,750. This is more than the amount applied for. They have the feed on hand and in prospect to finish the hogs. Adequate cash to carry the program to successful completion is provided by the loan and unpledged income from the sale of farm products. The plan of repayment, therefore, is sound.

5. Collateral Offered or Available as Security. The Hughes' have offered a mortgage on the corn crop, the hogs, the equipment and the feed. (See application form, Item 3, and field report form, Item 6.) Thus, the mortgage covers collateral that is to be sold to repay the loan, plus additional backlog-collateral to provide a margin of security and to enable the association to take care of unforeseen credit needs that may arise during the period of the loan. Of the security back of the loan, only the hogs are expected to be sold.

Closing the Loan

As an applicant for a loan you usually sign a note (page 17) and a mortgage or financing statement and security agreement (page 28) if the loan is to be secured by a lien — at the time you make your application. If you are getting your first loan from the association, this operation may be postponed until the association's loan committee has approved your application. As a "first-time" applicant you usually would not sign legal papers until you are assured the loan would be closed. The note represents the amount of money you applied for and is made to mature as specified on the application. The location and boundaries of the land on which the property is kept, and the description of the chattels being taken as security for the loan, are entered directly on the financing statement and security agreement (page 28). The other information, such as witnessing the signatures and recording of mortgages, is required by state laws.

Production credit associations do not always require you to give a chattel lien as security for a loan. If the loan committee decides the five credit factors are sufficiently strong, they will approve an unsecured loan, that is, not require a mortgage. In this event you will sign only the application and the note.

Members of the loan committee indicate their approval of a loan or a line of credit by placing their initials in the space provided on the application. The loan is now ready for closing. A chattel abstract is prepared showing that there are no prior liens against the property offered in the mortgage. The association is now ready to write a check for the first advance. In the Hughes' case this amounts to $2,601. Then the association places the financing statement and security agreement on record in the County Recorder's office. Remainder of the loan will be paid according to the loan agreement. If the Hughes' farming program should change, a different disbursement schedule may be agreed upon. If advances set up in the loan do not prove sufficient to meet the Hughes' needs they may get additional funds by filing an "additional advance" application and signing another note for the amount desired. It is not necessary to sign another financing statement and security agreement in the Hughes' case, as the original one is drawn to cover additional advances.

Budgeting Loans

Many loans made by production credit associations are set upon a fully or partially budgeted basis. By a plan agreed upon, loan funds are advanced as needed and repayments are made at the time farm income is expected. The Hughes' loan is an example. The budgeted loan has these advantages: it is well adapted to many types of operation; it results in considerable savings in interest cost; it eliminates the necessity for making arrangements for credit more than once a year.

Note: You and other members of the class may want to learn more about legal documents by talking with a county official or an attorney. Or you might invite one to visit your class for such a discussion.

Line of Credit

In the event the Hughes family has an approved line of credit with the association, the entire transaction up to this point would require no more than a half hour or so. Had they been new borrowers who had not established a line of credit, the loan usually would not have been closed before being approved by the association's loan committee.

Establishing a line of credit simply means that the loan committee has analyzed the Hughes' farm business, record of performance, and other credit factors. When these factors are favorable the loan committee sets an amount, called a line of credit, which the association manager or field representative has full authority to disburse for designated purposes should the member apply for it. The line of credit is indicated on the loan papers and may be changed or withdrawn by the committee when conditions warrant. Most PCA loan committees meet once or twice a week, but during heavy lending seasons, they may meet more frequently.

Repaying the Loan

Repayments are set up to be made on your loan at times you expect to have income from the sale of crops or livestock. This does not keep you from making additional payments when you have the money. Production credit associations charge no penalty for repayment ahead of schedule. This encourages members to repay loans as rapidly as possible. This not only helps your credit rating but is an effective means of reducing interest cost. Payments may be made either by mail or by calling at one of the association's offices. A receipt is issued for each payment so that you know exactly how your account stands at all times.

You may not always be able to make your repayment on schedule. If this should happen you should get in touch with your association representative promptly so that a substitute plan can be worked out.

Cost of the Loan

Production credit associations secure their funds for lending from private investors through the Federal intermediate credit banks at rates comparable to those paid by other large public borrowers. To the cost of this money the associations may add around 2 percent to pay their own operating expenses and build reserves. In 1962 most associations charged farmers 6 percent. Interest is charged only on the daily loan balance outstanding.

If the Hughes' had gotten all of their advances as scheduled and repaid their loan as originally set out in the plan of repayment, their total interest charges would have amounted to $144.15. If they had received all the loan at one time, and waited until maturity to repay, the interest would have amounted to $264.36. You can see at once the advantage of borrowing on a budgeted basis and repaying as farm products are sold. In the Hughes' case, it saved them $120.21 in interest charges.

In addition to the interest rate, most associations charge a nominal loan service fee. On the Hughes' loan this fee amounted to $25, which was included in the loan.

Period for Which a Loan May Be Made

Production credit association loans are usually made to mature at the end of the crop or livestock program being financed. This is usually from six to twelve months. In certain situations where the complete program financed extends over a period beyond twelve months, the loans may be made for a sufficient length of time to cover this longer period. The associations also make intermediate-term loans to finance capital investments over a two to seven year period. Loans involving both operating and capital investment credit are usually made to mature within twelve months, with renewal of certain portions expected at maturity. In such cases it is to the advantage of both the member and the association to arrange for financing the farm business on an annual basis. This will allow them to adjust the financing to changing conditions on the farm.

Educational Loans

Production credit associations make loans for financing the education of both boys and girls from farm families after graduation from high school. Such loans cover any costs in connection with an education, including tuition and other fees, books, room and board, and clothes. They are made to eligible individuals regardless of the professions they expect to follow after receiving their education.

Educational loans are made jointly to an eligible student and his sponsor. A sponsor may be a parent of the student, or other individual willing to share responsibility for the loan. The loan may be made either on a secured or unsecured basis. A loan agreemnt is signed by both the student and his sponsor and made a part of their loan file.

Repayment plans on educational loans are adapted to each individual's situation and his ability to repay. It would ordinarily be expected that such a loan would be repaid in full within seven years. The greater portion would be repaid after graduation when the young person would normally expect to be receiving some return from his investment in an education.

Factors that must be considered in making an educational loan include (1) the ability and desires of the student; (2) the arrangements for assistance and guidance by a sponsor; (3) the sponsor's financial responsibility; and (4) the student's agreement to repay the loan within a reasonable time after graduation.

CHAPTER III

FINANCING FARM OWNERSHIP

Using Long-Term Credit

Most people who buy farms need to borrow part of the purchase price. It is usually necessary that a loan made to purchase a farm be written for a long term of years. This is because it normally takes many years to produce and sell enough farm products from the average farm to repay the total purchase price of the farm.

In some cases farm owners borrow to refinance existing debts, to purchase additional land in order to expand operations and develop greater efficiency, or they may borrow to erect buildings or otherwise improve the farm. Again, the income produced by such expenditure will require a long time to repay the investment. In order to secure the repayment of a long-term loan, the farmer usually gives the lender a mortgage on the farm land and buildings as collateral for the note which he executes as evidence of the debt. Because the average farm is durable and salable, a mortgage on the farm affords the lender the greatest possible security. By reducing his lending risk it permits him to offer the borrower a longer time for repayment and a lower rate of interest.

Purposes of Long-Term Credit

Long-term mortgage credit is needed and used to finance investments in land, buildings and equipment which have a relatively long period of usefulness. Level farm land with deep topsoil may last for generations. On the other hand, steep, rolling land can lose a large part of its fertility and earning power in a few years. Farm buildings may last and remain useful 20, 50, or even more years depending upon how they are constructed and maintained. Some larger pieces of farm machinery may last for many years if properly maintained. Such purposes from which the farmer expects to reap benefits over a long period of time are well adapted to long-term credit. Most farm mortgage loans, then, are made for one or more of the following purposes:

To buy land;

To purchase equipment, fertilizer and livestock necessary for the operation of the farm;

To construct or repair buildings or other permanent improvements such as drainage or irrigation systems;

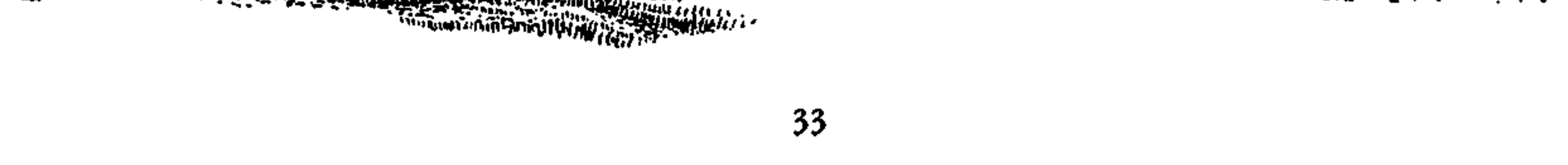
To build terraces and make other soil improvements; and

To refinance existing debts.

While these are the principal purposes for which long-term loans are made, there are others such as paying for the education of children and engaging in other forms of business.

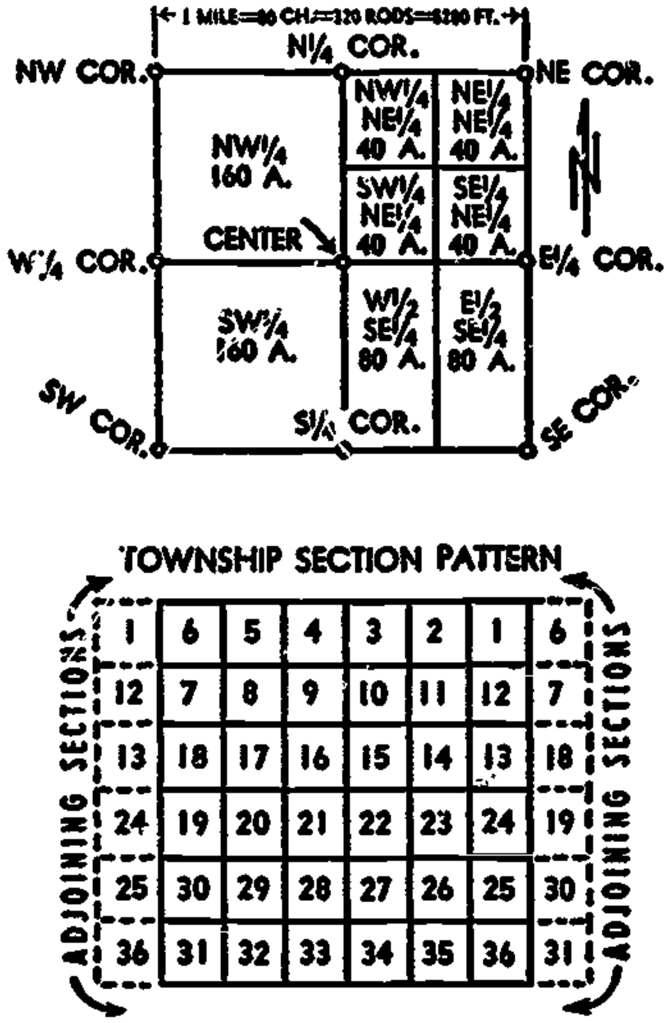
Some of the uses of mortgage credit by a farmer can be illustrated by relating the experience of one farm family. Although the name and sequence of events are fictional, this story illustrates experiences typical of many farmers.

As a young man, just married, Mr. Worth began operating a good 160-acre farm belonging to a relative. Through hard work and intelligent management Mr. Worth gradu-



LAND SURVEY CHART

Standard Section — 640 Acres



This chart is useful in describing accurately the extent and location of farm land.

ally accumulated and paid for enough farm machinery and equipment to operate the 160 acres efficiently. By frugality and with the cooperation of his wife he also managed to lay aside some savings in the form of cash, Government bonds, and shares in a local savings association. After some years the relative who owned the farm died. His will provided that the farm should be inherited equally by Mr. Worth and four other relatives. The other relatives were not farmers and each wanted his portion of the estate in cash. It thus became necessary to sell the farm to settle the estate. Mr. Worth then had to decide whether he should try to buy the farm he had been farming with good success, or take his part of the estate in cash and find another farm to buy, or operate as a tenant.

Mr. and Mrs. Worth set down on paper just what their situation was at that time. By working out a balance sheet, they established the information needed to make the best decision. The farm they had been operating was generally considered to be worth $200 an acre, a total of $32,000. The heirs and the executor of the estate agreed to sell for that amount. His inheritance of one-fifth of that amount gave Mr. Worth an equity of $6,400. This left $25,600 for him to pay in order to buy the farm. His savings, including his checking account, amounted to approximately $11,000. The present value (cost less depreciation) of his farming equipment was approximately $7,500. The fair market value of his livestock was estimated at $6,000. He consulted representatives of several companies in the long-term farm lending business and found he could get a long-term mortgage loan of $16,000. He and Mrs. Worth decided to take the $16,000 loan on the farm for a 25-year repayment period and to borrow $4,000 on their livestock and equipment for a shorter term of three years. Their total debts then were $20,000 The remainder of the purchase price ($5,600) came from their savings. They still had about half of their savings as a reserve fund for emergencies. After buying the farm they made up a new balance sheet. They now owned a farm worth $32,000, equipment worth $7,500, livestock worth $6,000 and had approximately $5,000 left in their checking account and savings, making total assets of $50,500. On the other hand, they now owed a long-term mortgage of $16,000 and a short-term chattel mortgage of $4,000, making a total indebtedness of $20,000. This left them a substantial net worth of $30,500, approximately 60 percent of their total assets.

After about five years the Worths found themselves in this situation. They had paid off the short-term debt and had reduced their long-term loan from $16,000 to approximately $14,000. Because of a rising trend in farm values and because of some improvements to the farm which they had made, they now considered their farm to be worth $36,000. Additional equipment purchased and paid for brought their inventory to $10,000 and they had about $9,000 worth of livestock on hand. Paying off the short-

The advice of an experienced farm lender can help you judge wisely the amount of debt a farm should be able to repay.

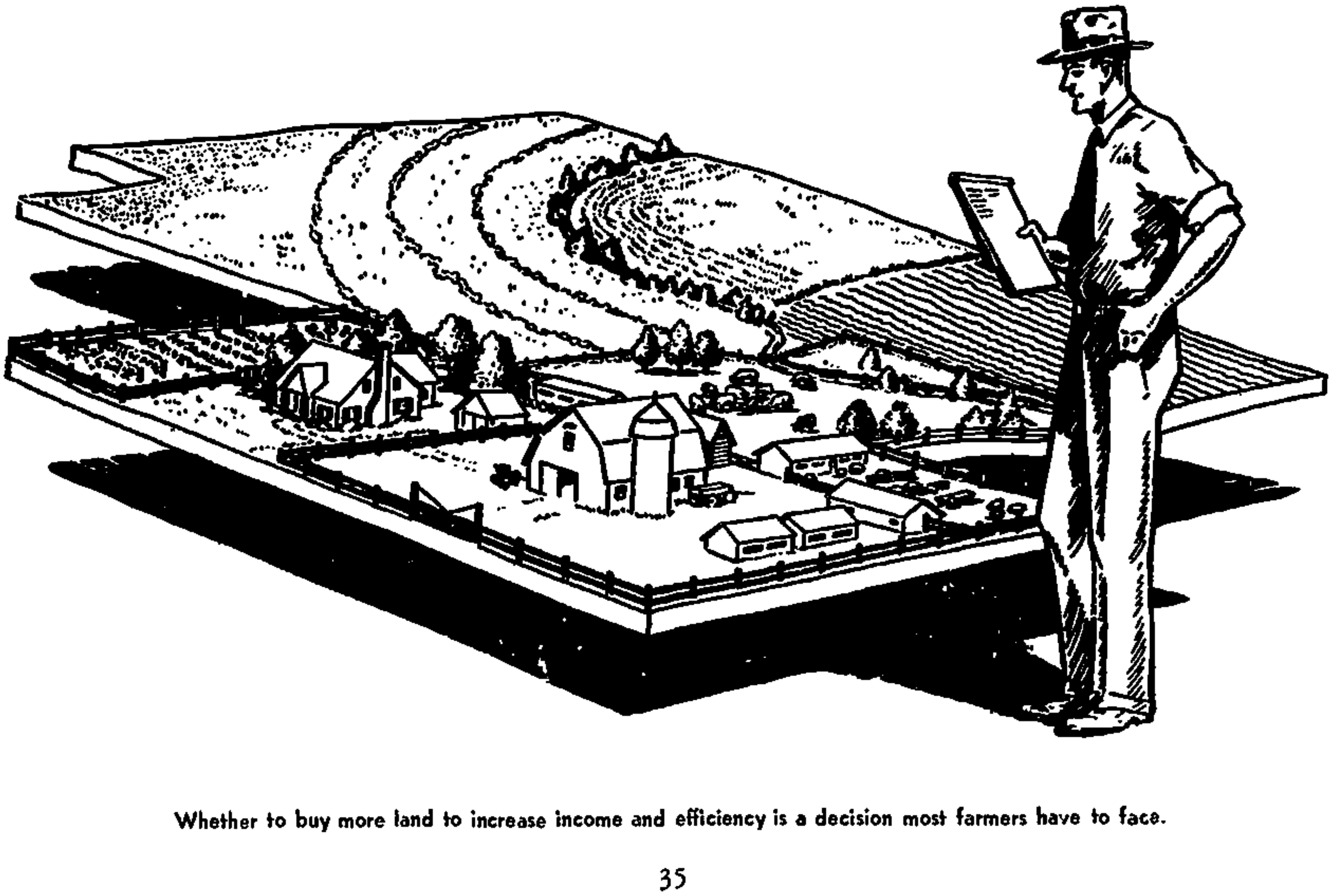
term debt, increasing their inventory and the expense of an operation for one of the children had prevented them from adding to their savings. Their balance sheet now showed assets of $59,000 and debts of $14,000. Their net worth had increased to $45,000, nearly 75 percent of their total assets.

The Worths now faced a new decision. A fairly good adjoining 80 acres could be bought for $250 an acre, a total of $20,000. This seemed a little high. But having ample equipment to operate more land, they believed their total net earnings could be increased materially by adding the 80 acres to their 160. All members of the family agreed.

The oldest boy in the family was a senior in high school. He planned to go to college to study agriculture with the hope that he could return home to go in business with his father.

This time the family worked out their balance sheet together. They tried to estimate their prospects for future earnings as well as the outlook for family expenses. They now had their home farm worth $36,000, plus the farm they intended to buy worth $20,000, plus $19,000 worth of equipment and livestock and $4,000 cash and savings—a total of $73,000. Their only indebtedness was the $14,000 still due on their long-term mortgage plus the $20,000 they proposed to invest in the 80 acres. This would make a total debt of $34,000. They found they could borrow on the combined farms of 240 acres a total of $27,000. This left them $7,000 short of the amount needed to buy the additional land. Because of expected expenses in sending the boy to college, they felt they should not dip into their savings any more but they did feel safe in borrowing the $7,000 on a five-year contract, secured by a lien on their livestock, equipment and crops. In negotiating their long-term loan they felt that repayment of the $7,000 short-term debt, plus the education of the son, would make it difficult to pay any portion of the principal on their long-term indebtedness for the first five years. They therefore arranged with the lender for a 30-year contract, with no principal payments required these first five years when they would be paying on their short-term loan and college expenses for the oldest boy. Repayment of the long-term loan would then be completed over a 25-year period. After buying the additional 80 acres the Worths had assets worth approximately $79,000 and debts of $34,000. Their net worth of $45,000 was now down to about 57 percent of their total assets. The Worths and their creditors agreed that stepping up their earning capacity at the time they were educating their children more than offset their weaker net worth position.

While this story is imaginary, it shows how farmers can expand their farming operations, increase their earning power and improve their standard of living through the wise use of credit.



Whether to buy more land to increase income and efficiency is a decision most farmers have to face.

Amount of Loan

A farmer using long-term credit should make sure the amount he intends to borrow will not be more than he will be able to repay systematically. He must consider what he can expect in the way of farm income in poor years as well as good or average years. He must take into account all expenses of operating his farm and maintaining it over the life of the loan as well as requirements for family living. He should consider what he wants to accomplish with the loan and, within his ability to repay, be sure that he borrows enough—but no more than enough—to get the job done. He should be particularly careful not to enter into a long-term contract for a part of what he needs and depend upon other credit with heavy repayments for the balance of the funds needed. Having to make heavy repayments on short-term debts while repaying long-term debts has caused many farmers serious trouble. In deciding how much he can expect to repay systematically and without undue sacrifice, the farmer should study such information as the accompanying chart. This chart shows the fluctuation over the years of the number of bushels of crops or pounds of livestock needed to pay debts. Could you not reasonably expect similar fluctuations in the future?

The amount of loan concerns both the lender and the borrower. The borrower is concerned about his ability to repay the loan. The lender is concerned about fluctuations in the value of the property. He wants his loan adequately secured by the future value of the farm during the life of the loan. A lender might consider a farm worth $250 an acre today and lend $150 an acre on the farm. A few years in the future the situation might change so the debt on the farm would amount to $140 an acre and the value have dropped to $125 an acre. The borrower then has security worth less than the amount of the debt.

Terms of Loans

Period of Years

Several factors affect the length of time a mortgage contract should run. The longer the term of years the smaller the periodical payments will be on the principal. At the same time, the longer the term of years the greater the total amount of interest the borrower will pay. This lower annual cost, over a longer term of years, would be an advantage to a young farmer: he normally would have many years of productive capacity. This would not be so with an older man. A man 45 years old may be near his peak in earning capacity. At the end of a 30-year mortgage contract he would be 75 and his earning capacity might be limited.

To the lender the characteristics of the farm offered as security are important in determining the length of time the contract should run. A farm of deep, fertile, durable soil, located in a community of similar farms and having reasonably new, well constructed and well maintained buildings, will permit the lender to contract for a longer term of years than would a farm of limited fertility, subject to natural hazards of erosion, overflow or other soil depletions, especially if the buildings are of poor construction, quite old or obsolete.

Interest Rate

The rate of interest on long-term mortgage loans varies considerably, depending upon such factors as location of the farm, the degree of risk and the extent of competition among lenders. Many lenders tend to be selective in the areas they serve. They confine themselves to communities where good, durable farms predominate and land values are

HOW THE AMOUNT OF FARM PRODUCTS REQUIRED TO PAY $1,000 OF DEBT VARIES

Years	200 lb. Hogs	1000 lb. Cattle	90 lb. Lambs	100 lbs. Milk	Cases Eggs	Bushels Wheat	Bushels Corn	Pounds Tobacco	Bales Cotton
1919	30	10	87	304	81	463	662	3,205	6
1922	60	17	112	474	133	1,035	1,366	4,386	9
1932	150	24	249	781	235	2,618	3,165	9,524	31
1939	80	14	143	592	192	1,447	1,761	6,494	22
1948	22	5	49	205	71	505	781	2,074	7
1958	26	5	53	242	87	571	893	1,669	6
1959	35	4	59	240	106	568	962	1,715	6
1960	33	5	62	238	93	571	1,004	1,642	7
1961	30	5	70	237	88	545	926	1,567	6
1962	30	5	63	243	100	495	926	1,672	6
1965	?	?	?	?	?	?	?	?	?

subject to less fluctuation. Competition for loans among lenders is likely to be keen in such areas and interest rates low. In other areas where less desirable and less durable farms predominate and where risk is greater, the lenders either will not compete for business or they will lend at higher rates of interest. Local bankers and individuals are influenced by local conditions more than by state or national conditions. The Federal land bank maintains a uniform rate throughout its lending area.

In addition to the interest rate paid on his loan, the farmer should consider any commissions, service fees or other charges imposed either at the time the loan is made or later. Such additional charges may add greatly to the cost of the loan.

Repayment Plan

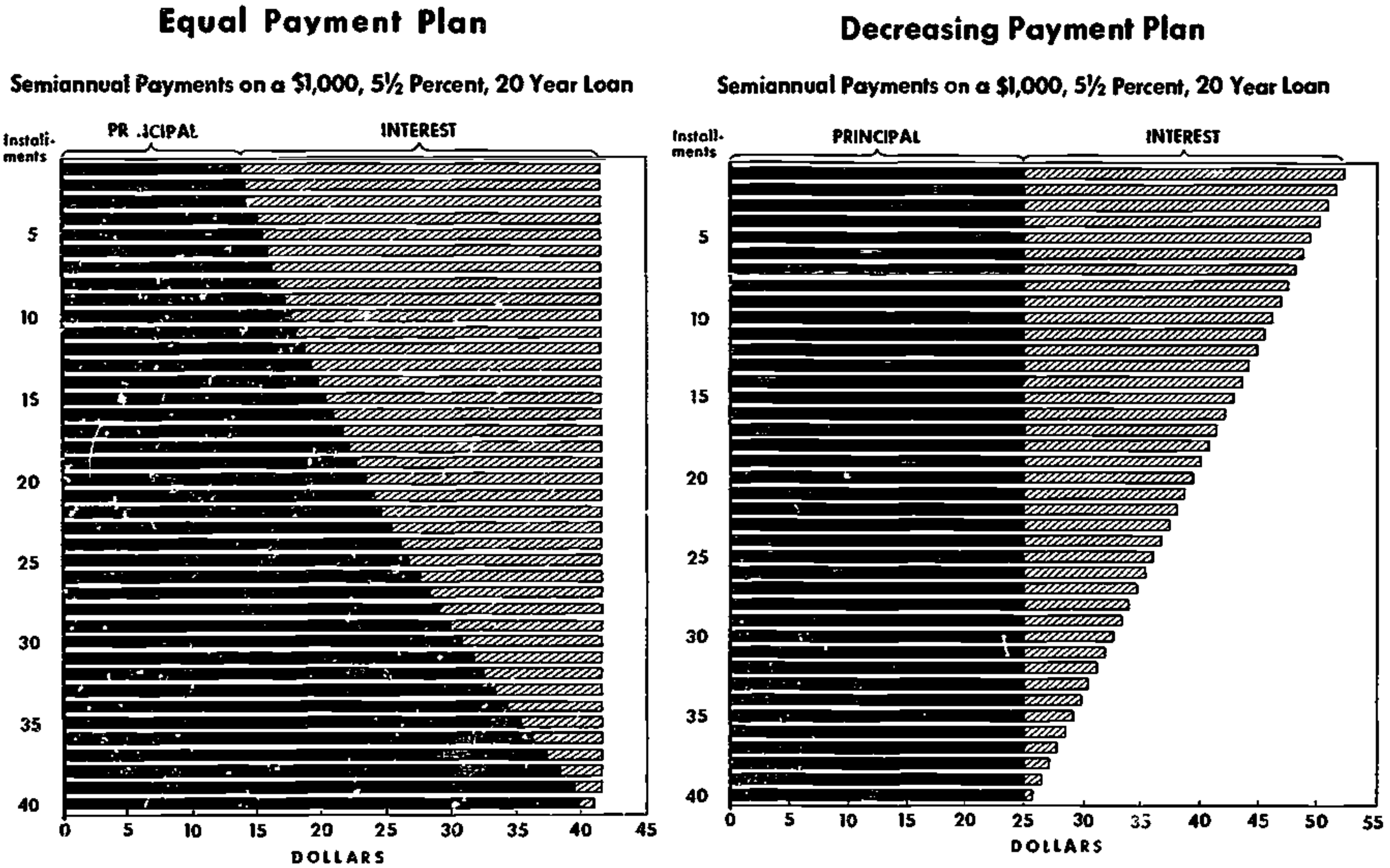
Practically all long-term mortgage loans on farms include in the contract a definite plan for repayment. Before the Federal land banks began operating in 1917, nearly all farm mortgage loans were made to mature in one, three or five years. The Federal land banks started making amortized loans, where a small portion of the principal was paid each six months with the interest payment. Now, practically all major lenders make amortized loans. Two general plans of amortization are offered. One is the equal payment plan. The borrower pays the same amount (principal and interest combined) on each installment date. Early in the life of the loan the major portion of the installment represents interest due on the unpaid balance of the loan. As payments are made the principal is reduced. The amount of interest included in each succeeding installment decreases and the amount of principal applied on the loan increases.

The other plan of amortization is the decreasing payment plan. It provides for equal amounts to be paid on the principal at each installment date. Interest on the unmatured balance is added to the principal portion. The installments are relatively heavy at first; then, as the loan is paid down, the installments become smaller. Regularly scheduled repayments help the borrower for he knows what he will be required to pay at each installment date and can plan accordingly. The lender also benefits for he knows what he can expect to collect in interest and principal at each installment date and can plan his lending operations accordingly.

The greatest advantage an amortized loan provides the borrower is systematic reduction of his debt, its final retirement and ultimate debt-free ownership of his farm.

Some lenders now offer other variations in amortization payments. These include partially-amortized, non-amortized and monthly repayment plans.

A few lenders, particularly the Federal land bank, permit advance payments on amortized loans without penalty.


Equal Payment Plan

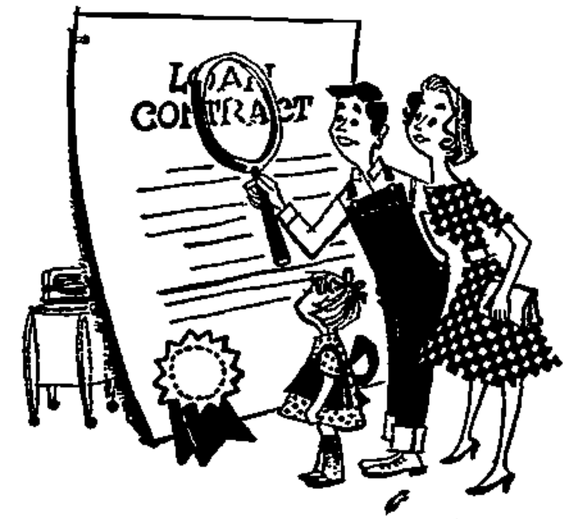
Semiannual Payments on a $1,000, 5½ Percent, 20 Year Loan

Decreasing Payment Plan

Semiannual Payments on a $1,000, 5½ Percent, 20 Year Loan

The farmer should select the loan repayment plan that fits his farm best.

This privilege enables the borrower to take advantage of good years, or outside income, or windfalls such as inheritances to make extra payments on the principal of his loan at times of his chosing. Most lenders permit such optional payments only after the loan has been in force for a certain length of time or only upon payment of a penalty or pre-payment privilege fee. This restriction is intended to protect the lender until he has recovered expenses incurred in making the loan.



Prepayment without penalty is assured only when written into the loan contract.

Another variation of an amortized loan, though rarely used, is the variable payment plan. Under such a plan payments are geared to earnings of the farm. In years of substantial income substantial payments are required on the loan; in years of meager income smaller payments are required. This plan requires close supervision by the lender and involves considerable administrative expense. At present the Farmers Home Administration is the only institutional lender known to be offering loans on the variable repayment plan.

Contract Financing

Contract financing is one form of long-term farm financing which has been used increasingly in recent years. It is frequently used where the seller finances the farm he is selling. Under contract financing the borrower does not have title to the property. The seller and buyer enter into a contract which usually provides for a relatively small down payment and retention of title to the property by the seller until the buyer shall have paid a stipulated amount. The buyer uses contract financing to get hold of a farm when he has limited funds to invest in the farm. The buyer's risk is greater because he will lose the entire amount that he has paid into the contract if he is unable to meet his payments when due. On the other hand contract financing is attractive to the seller because it gives him substantial control over the property until the buyer has paid substantial amounts. While the farm is under a contract and title remains in the name of the seller, no foreclosure or other legal action is necessary for the seller to regain possession of the farm. Under a sales contract, the borrower or buyer should assure himself of his ability to meet the contract terms and should have thorough assurance concerning the integrity and dependability of the seller.

Sources of Long-Term Credit

The five groups of long-term farm mortgage lenders are shown in the accompanying table. This table shows the amount of loans held by each group.

Individuals and Others

There are two general classes of individuals who frequently make farm mortgage loans. There is the individual who sells his farm either on a land contract or for a substantial down payment with a mortgage securing the balance. Oftentimes such a seller wishes to retire and expects the interest income on his mortgage to replace farm income as a source of livelihood. There are other individuals who have money to lend. These include successful business or professional men, widows, and others who have inherited substantial sums. They wish to invest in something they consider safe and personally can watch more closely than they could an investment in stocks or bonds . Before borrowing from an individual the farmer should thoroughly acquaint himself with the individual's reputation as a

FARM MORTGAGE DEBT OUTSTANDING JANUARY 1, 1962, BY LENDERS AND STATES

(Thousands of Dollars)

Lender	Ohio	Indiana	Kentucky	Tennessee
Life Insurance Companies	$ 86,310	$147,757	$ 54,540	$ 23,929
Federal Land Banks	97,414	90,129	40,317	41,979
Commercial Banks	114,745	79,167	82,567	64,426
Farmers Home Administration	8,567	9,069	13,937	26,308
Individuals and Others	228,281	148,327	45,376	78,190
Total	$535,317	$474,449	$236,737	$234,832

lender, consider his age, and be sure the terms fit his requirements.

A limited amount of credit is obtained from miscellaneous other sources such as county and state funds, trust funds established for colleges, various foundations, cemetery associations, orphanages and charitable institutions. The terms of credit available from these sources vary widely. Ordinarily such loans do not incorporate the service features most farmers consider desirable.

Life Insurance Companies

In many areas, life insurance companies are one of the most important sources of farm mortgage loans. A life insurance company must build up a reserve fund on each life insurance policy it writes in order to pay claims on that policy when called upon. Such reserve funds are invested in order to yield an income. Investment in farm mortgage loans is one way in which these funds are put to work. Life insurance companies which make farm loans usually have well organized loan departments staffed by capable people. In the better farming communities loans will be available from several insurance companies. Each will have a direct representative of the company working with local representatives over a rather large area. These local representatives may be local banks, insurance agents or real estate men. After an application has been filed with the local representative an employee of the insurance company appraises the farm. For many years insurance company loans were limited to relatively short terms. In recent years it has become common practice for such loans to be made for longer terms, especially on the better farms. Most insurance company loans are amortized. Interest rates are influenced by prevailing interest rates, the intensity of competition, the durability and stability of the farm, and the relation of the amount loaned to the value of the farm property

Banks

Commercial banks invest money deposited with them to produce income. Most such investments are in negotiable bonds or short-term loans so the bank can always be in a position to meet demands of its depositors. A small part of its funds, however, may be used for long-term farm mortgage loans. The interest rates and terms of such loans vary.

Bank loans generally, however, are made for relatively short periods. Should a renewal date come at a time when depositors need their money, a borrower may have to look elsewhere for a refinancing loan.

National banks may now lend not to exceed two-thirds of the appraised value of the farm for a term not longer than ten years provided 40 percent or more of the principal of the loan is amortized during that ten years, or for 20 years providing 100 percent of the loan is amortized. If no amortization payments are called for, no more than 50 percent of the appraised value of the farm may be loaned for a period up to five years. Some large city banks share in loans made by smaller country banks.

Through contacts with insurance companies some banks are able to offer long-term amortized loans. The insurance company simply purchases the loan from the bank under stated conditions.

Farmers Home Administration

Long-term credit may be obtained from the Farmers Home Administration. To be eligible to borrow, a farmer must be unable to obtain adequate credit at prevailing interest rates from other lenders. Such loans by Farmers Home Administration are made principally for the development, purchase and improvement of family type farms. The financing usually is carefully worked out and adapted to the needs and earning capacity of the farmer. The borrower receives a certain amount of counsel and supervision from the agency's representatives.

The amount of credit available from this source depends upon the appropriation made by Congress each year for this purpose.

The Farmers Home Administration also insures mortgages on loans made by private lenders. Insured farm mortgage loans are limited to 90 percent of the fair and reasonable value of the farm. Most counties in agricultural areas are served by a Farmers Home Administration supervisor or representative. Loans must be approved by a local FHA committee, prior to approval at the state level.

The Federal Land Banks

The Federal land banks and the Federal land bank associations are a nationwide system of credit institutions organized as a cooperative. They were established under authority of the Federal Farm Loan Act passed by Congress in 1916. For many years farmers and their organizations had needed better farm mortgage credit. There is a Federal land bank in each of the 12 farm credit districts in the United States. The Federal Land Bank of Louisville was chartered in March 1917 and makes loans in Ohio, Indiana, Kentucky and Tennessee.

How To Obtain a Federal Land Bank Loan

How a farmer gets a Federal land bank loan can be illustrated by the experience of Mr. and Mrs. Worth.

When Mr. Worth first decided to purchase the farm in which he had inherited an interest he talked with the manager of the Federal land bank association serving the county in which he lived. Together they made out an application on the regular form used by the Federal land bank. (See pages 40 and 41.)

A Federal land bank association is a cooperative owned entirely by those farmers who have obtained Federal land

FLB 4-201 (Rev. 9-62)

APPLICATION FOR LOAN

APPLICATION NO. 051525 F.L.B.A. of Springville, Indiana (To be filled in by FLBA) Loan No. ______

Source: Advertising __ Personal Contact __ Direct Mail __ FLBA Member X FLBA Former Member __ Other ______

Ned and Mildred E. Worth — Rt. #3, Mayberry, Indiana — Mayberry 731-6264
Name of Applicant and Spouse (If single or widowed, so state) Address Telephone

______
Name of Applicant and Spouse (If single or widowed, so state) Address Telephone

hereby apply for a loan from THE FEDERAL LAND BANK OF LOUISVILLE, through the Federal Land Bank Association above named, in the amount of $16,000. Payments to become due May 1 and November 1 (Months).

A. DESCRIPTION AND LOCATION: State Indiana County Penn Twp. or Dist. Davidson

I (we) offer as security a first mortgage on the real estate described as follows:

The SE quarter of Section 10, Township 24 South, Range 12 West, lying east of the

COPY OR ATTACH ACCURATE DESCRIPTION
(Attach plat or tracing of photo only if manager is not making the appraisal)

Mayberry and Springville Road, which road is known as State Road No. 15, containing 160 acres, more or less, but subject to all legal highways.

Containing 160 acres, located 3 miles south (Direction) from Mayberry (Nearest Town), on public road Indiana #15 Blacktop (Name or Number of Road), ____ miles to ____ (Name or Number) Highway. I (we) (have—have not) title to right-of-way to the property. Title is now in name(s) of Estate of Meredith Williams;

to be in name(s) of applicants jointly (Same—Applicants Jointly—Etc.).

B. MINERALS AND TAXES:

Mineral rights (~~have~~—have not) been sold ☐; leased ☐ — Coal ☐; Others ☐; — All ☐ Part -

Depth of vein -; thickness of vein - Is subsidence a hazard? Yes ☐ No ☐. Annual real estate taxes on this farm $ 390.00 Land (~~is~~—is not) located within an Improvement District - (Name).

Unpaid Bonded Debt $ -. Amount of annual assessments $ -. Are there flowage easements on this farm? Yes ☐ No ☒

C. PURCHASE TERMS OF FARM: (We acquired or are about to acquire this property in the following manner:)

Date Acquired	Acres	Acquired From (If Relative State Relation)	Inherited	Cash Payment	Mortgage or Contract	Trade Valued at	Total Purchase Price
1957	160	Estate of Meredith Williams (uncle)	6,400	9,600	16,000		32,000

I have made improvements on the property valued at $ -, described as follows: Just purchasing

D. PERSONAL STATEMENT:

I am a native of Indiana (State or Country) and (am—XXXXX) a citizen of the United States; am (~~single~~—married).

My age 36; age of spouse 34; number of children 4; 2 boys aged 13, 8 and 2 girls aged 12, 10 reside at home. My actual residence is now at on this farm which is - miles from this property. This land is farmed personally (Personally — Through an Agent — Tenant), and (~~is~~—is not) rented or leased for a term of - years; cash $ -; crop share -. I (~~am~~—am not) an officer, director or employee or a member of the family of an officer, director or employee of any of the Farm Credit Banks or Federal land bank associations in the Fourth Farm Credit District. If so, explain: ______. I (~~am~~—am not) liable on other Federal Land Bank loans: - (Name of bank, state, loan number, amount of loan)

E. FINANCIAL STATEMENT: ☐ Joint financial statement of husband and wife.
(Attach separate statements of other applicants—Form FLB 4-201-A)

ASSETS	
Present market value of this farm	$ 32,000
Present market value of other farms	$
Present market value of other real estate	$
FLBA and/or PCA stock	$
Farm products for sale	$
Feed and supplies	$
Livestock:	
No. ___ Kind ___	$
No. ___ Kind ___	$
No. ___ Kind ___	$
No. ___ Kind ___	$ 6,000
Farm Equipment:	
	$ 7,500
	$
	$
	$
Cash on hand and in banks	$ 2,000
Salable stocks and bonds	$ 9,000
Notes and accounts receivable (good)	$
Other assets (describe)	$
	$
	$
TOTAL ASSETS	$ 56,500

LIABILITIES	
Liens on this farm: (If FLB loan, show loan number)	
Held by Contract to purchase	$
Held by 4/5 interest this farm	$ 25,600
Held by	$
Balance due on purchase (contract)	$
Delinquent taxes on this farm	$
Judgments, mechanic's liens, etc.	$
Liens on other farms	$
	$
Liens on other real estate	$
Chattel Mortgages:	
Held by	$
Held by	$
Notes secured by other pers. prop.	$
Unsecured notes	$
CCC Storage Facility loans (bin, crib, etc.)	$
Other taxes and interest due	$
Open accounts	$
All other liabilities:	
	$
	$
TOTAL LIABILITIES	$ 25,600
NET WORTH	$ 30,900

Contingent liabilities: ___ $ None

Crop base allotments: Tobacco___ Cotton___ Wheat___ Other___

Income from other sources: ___ : ___ (No Yrs) $ None

Insurance carried on permanent improvements through Farmers' Mutual (County) (Agent) $ 18,000 (Total Amt.)

Main dwelling $ 10,000 ; Barn $ 6,500 ; Others $ 1,500 garage, tool shed - Homeowners comprehensive liability

F. PURPOSES OF LOAN: (Indebtedness to be paid from proceeds of the loan).

NAME OF CREDITOR	Mtge. Note or Acct.	Amount of Debt	Date Debt Incurred	Purpose of Debt	Amount to be paid
					$
					$
					$
					$

To purchase 160 acres of land (to be—XXXXXX) included in mortgage $ 15,200

To provide for buildings and other improvements on security (new dwelling—attach form FLB-4-267) $

(If to construct new barn, outbuildings or to remodel or repair existing buildings, describe as to kind, size, foundation, roof, etc.) Estimated Cost $___

Other purposes (describe) ___ $

To purchase stock in Association and pay loan expense $ 800

Total (must equal amount herein applied for) $ 16,000

I agree to carry at least the amount of insurance required by the bank and further agree to forward and assign the policies to the bank to be held during the life of the loan. If I fail to furnish the insurance by the time the loan is ready to be closed, the bank may place the insurance and deduct the premium therefor from the loan. It is understood that approval of this application, if granted, may be withdrawn at any time before said loan is made without any liability to me on the part of said bank.

This application is executed in duplicate and either copy may be treated as the original application; if accepted and a loan granted hereon I agree to furnish at my expense, an abstract or other evidence of title to the real and/or personal property offered as security for said loan, acceptable in form that will show the title perfect in me and the mortgage securing said loan a first lien on the property described. Said abstract or other evidence of title shall be considered a part of the security for said loan and shall be retained by the bank until I have paid said loan in full, or in the event said loan is not completed, until all expenses in connection with the application therefor shall have been paid. I agree to pay all fees for recording such instruments as are necessary to the loan. I hereby apply for membership and agree to purchase stock in the association through which the loan is closed, to the extent of $5.00 for each $100.00 loaned by the bank. I agree that the cost of the stock may be deducted from the loan. If title to the security is held jointly, said association (is—is not) hereby directed to issue said stock to said joint owners with right of survivorship; and authority is hereby given Ned Worth to act for and on behalf of the other joint owner(s).

Ned Worth

Mildred E. Worth
(Signatures of Applicants)

Date August 1, 1957

WITNESS: W. W. French

bank loans through it. The Federal land banks in turn are owned by the Federal land bank associations. Anyone obtaining a Federal land bank loan purchases stock in the local Federal land bank association in an amount equal to 5 percent of his loan. The association, in turn, purchases this same amount of stock in the Federal land bank. When Mr. Worth obtained a Federal land bank loan of $16,000 he purchased stock in the amount of $800 in the association. The association then purchased an equal amount of stock in the land bank. When Mr. Worth's loan is completely paid off the land bank will refund this stock to the association and the association will refund it to Mr. Worth When earnings of the Federal land bank and the land bank association permit, Mr. Worth will receive dividends on his stock.

Farmers serve on the association's loan committee to approve Mr. Worth's application.

The members of the association elect the directors at their annual meeting. The directors elect the association officers including the manager, who also is an employee. He has active charge of the office, meets and consults with farmers wanting loans, assists them in preparing applications for loans, brings their applications before the association's loan committee and follows through all the steps in making the loan. He also services the loan after it is closed. Should unforeseen developments prevent the farmer meeting his regular payment schedule, the association manager works with him in developing a solution to the problem.

The association pledges its assets for the payment of each loan it makes by endorsing each loan. An agreement between the land bank and the association provides that each will share half of the loss should any develop. To determine whether it will endorse a loan, the association's loan committee obtains an appraisal on the value of the security and a credit report on the applicant. The credit report is made by the manager and the appraisal of the value of the farm by a land bank appraiser or the association manager if he has been authorized to make appraisals. In the case of Mr. Worth, the credit references and his record were favorable and the value of the property permitted a loan in the amount he had requested. The association's loan committee, therefore, felt justified in recommending that the loan be made and in endorsing it. The application showing the loan committee's action, the credit report and the appraisal report were forwarded to the Federal land bank. In most instances where an association recommends a loan the Federal land bank concurs in that recommendation. That was the case with Mr. Worth's application.

The association's loan committee is composed of two directors and the manager. The directors are farmers living in the area. Their knowledge of local conditions and the people put them in a good position to give sound advice both in making loans and in servicing them after they are made.

Eligibility

A Federal land bank loan may be made to any person who is engaged in farming operations or is shortly to become engaged in farming operations or whose income is derived principally from farming operations. A person will be deemed to be engaged in farming operation if, in the capacity of owner, lessee or tenant of a farm, he actively participates personally or through an agent to a substantial degree in the management or conduct of the farming operations on any farm land. Subject to certain limitations, loans may be made to special classes of applicants such as executors and administrators, trustees, guardians, partners and farming corporations.

To be acceptable security for a loan a property must meet each of the following minimum standards:

1. It must be sufficiently desirable to be readily salable or rentable under normal agricultural conditions.

2. It must be sufficiently durable to maintain satisfactory production during the loan term specified.

3. It must have sufficient stability of value to assure that on a loan that would be proper to a typical owner of the property the bank could recover its investment should the property be foreclosed.

4. Under typical operation it must be capable of producing sufficient normal agricultural earnings to pay farm operating expenses, including taxes and other fixed charges, maintain the property and meet family living expenses and installments on a loan that would be proper to a typical operator, provided that where income from dependable sources other than farm earnings is available to a typical operator, such income may be relied upon to meet loan installments and family living expenses including that part of the taxes, insurance and maintenance costs chargeable to the dwelling.

The latter part of item 4 of the security standards permits loans to be made on part-time farms. Many Federal land bank loans are made on such properties.

Appraisal

The appraiser is a man of broad farm experience and special training in valuing farms. To do this job properly he must be open minded and impartial. He makes a careful examination of the farm. He goes over the farm looking carefully for both good and bad features and

F.L.B. 4-308
Rev. 10-62

APPRAISER'S REPORT

TO THE FEDERAL LAND BANK OF LOUISVILLE

Bureau of the Budget
Form No. 108-R019.1

Federal Land Bank Association of Springville (CITY OR TOWN) Indiana (STATE) Application No. 051525

I have made a personal examination of and identified the property described in above numbered application made by Ned and Mildred E. Worth of Rt. #3, Mayberry, Indiana for a loan of $ 16,000 and report as follows:

A. LOCATION, TYPE, AND QUALITY OF FARM

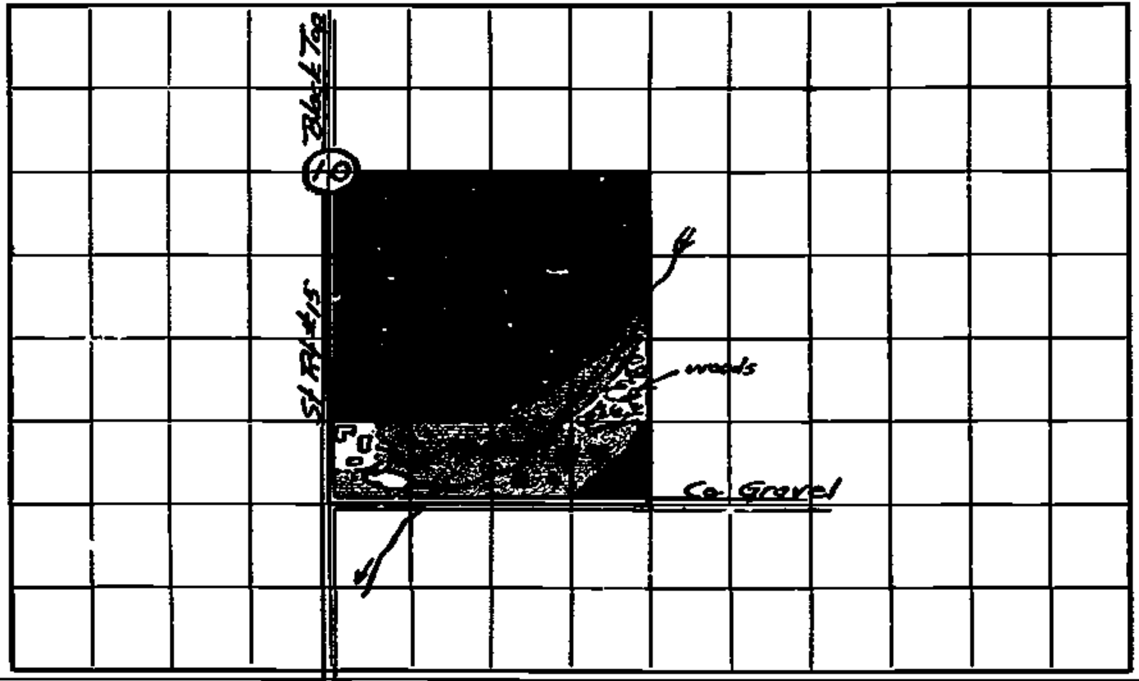
1. State Indiana County Penn Civil District or Section 10 Township Davidson Range 12W Total Acres 160
2. The farm is located 3 miles South (DIRECTION) from Mayberry (NEAREST TOWN) 12 miles North (DIRECTION) from Springville (COUNTY SEAT)
3. Farm is on State Road #15 blacktop (KIND, NUMBER, AND CONDITION OF ROAD) miles ____ (DIRECTION) from nearest highway ____ (GIVE NUMBER AND TYPE) Type of farming
4. in community is grain & livestock Conveniences available are (✓) ✓ ✓ ✓ ✓ ✓ (R.D., SCHOOL BUS, MILK ROUTE, POWER LINE, TELEPHONE, ETC.)
5. This farm is not (IS-IS NOT) in ____ (NAME) drainage or levee district.
6. Adequacy of drainage mostly natural Overflow hazards none
7. Adequacy of water supply (describe) deep well and pressure system, pond and small stream
8. A comparison of this farm with the average in the community is: Location above;
9. soils equal; Improvements equal; General desirability and salability equal
10. The general condition of farm is good (EXCELLENT, GOOD, FAIR, POOR); improved (BEING MAINTAINED, IMPROVED, NO CHANGE, DEPRECIATING—DISCUSS)
11. The farm is a class C (A-B-C-D-E) farm. It is in a class 3 (1-2-3-4-5) area. Land is not (IS-IS NOT) in a mineral area. (Discuss in Par. D)

B. PURCHASE DATA OF FARM

1. Applicant acquired this farm 1957 (YEAR) by Inheritance and purchase with this loan (PURCHASE OR INHERITANCE)
2. The purchase price was, without personal property, $ 32,000; with personal property - $ -
3. Cash payment $ 9,600 Changes since purchase (describe)
4. Contract $
5. Mortgage $ 16,000
6. Trade Inherited $ 6,400
7. TOTAL $ 32,000
8. Remarks

C. PLAT

1. The legal description given in the application is (IS-IS NOT) correct. Indicate corrections, if any, on plat and explain in remarks.
2. Extreme care should be used to ascertain location of corners if buildings are close to line. Indicate points of compass and show scale of map. Designate section number at section centers.



D. DESCRIPTION OF BUILDINGS

No. and Kind	Rooms	Size	Type of Construction	Type of Foundation	Type of Roof	Condition-Improvements and Adaptability to Probable Use for the Next Few Years. Also Any Other Features That Enhance or Reduce Salability, Including Conformity with Community Standards	*Value For Insurance Purposes
1. Dwelling	8	32 x 40 14 x 18L	frame	conc.	asb. Sh.	Bath, basement, new furnace, kitchen cabinets, modern	10,000
Garage-Tool		22 x 36	frame	conc. block	asb. Sh.	Dirt floor, good	1,500
2. Barn		34 x 54	conc. block	conc.	metal	Good, hay storage floor to roof	6,500
with att.			frame				
Silo		12 x 40	conc.				
						TOTAL	$18,000

* Present cost of replacement, less depreciation, including obsolescence

E. DESCRIPTION OF LAND

Normal Use	Acres	Type and Quality of Soil; Topography; Crop Adaptability; Ease and Economy of Operation; Any Other Important Features.
Crops	110	Gently rolling to undulating St. Clair and Nappanee silty clay. Some Brookston spots. Fair condition.
Pasture	39	Gently rolling open, with creek (sometimes dry) dividing farm. Good
Woods	5	Brushy
Lots	4 2	Building site, pond Highway
TOTAL	160	

F. EARNING POWER OF FARM (Typical Operator - - Usual Conditions)

Crop	Acres	Average Yield Per Acre	Average Total Production	Unit Value (Normal Price)	Average Gross Value	Average Normal Sales	Value Landlord's Share
corn	40	65	2,600	$ 1.30	$ 3,380	$	$1,690
wheat	15	25	375	1.70	638	600	319
soybeans	25	24	600	2.10	1,260	1,200	630
Clover & alfalfa	30	2T	60T	20.00	1,200		600
Misc.	8						
Pasture	42	35 Units for 6 mos. @ $2.00			420		420
TOTALS	160				$ 6,898	1,800	$3,659

Rentability of this farm is good - average for area

Usual rental terms are 1/2 crops, livestock

Estimated annual outside income of typical operator $ none

Sources and dependability of outside income under usual conditions (discuss) none

G. INCOME AND EXPENSE

	Typical Operator	Rental
Sale of crops	$1,800	$3,659
Sale of livestock (pltry)	$	$
Sale of livestock products	$7,084	$
Sale miscellaneous products	$	$
R: Cash $ Share $	$	$
Total Gross Income	$8,884	$3,659
Cash operating expenses	$3,200	$1,300
Feed	$ 600	$
Real estate taxes	$ 390	$ 390
Personal property taxes	$ 140	$ 100
Drainage O&M costs	$	$
B. & I. pymts. for ___ yrs.	$	$
Building upkeep	$ 200	$ 200
Repair & replmt. equipmt.	$ 800	$
Ins. on bldgs. & per. prop.	$ 140	$ 80
Int. on short term credit	$ 60	$
Total Expenses	$5,530	$2,070
Net Return	$3,354	$1,589

H. VALUATIONS AND ACCEPTABILITY

Normal agricultural value of farm $ 25,000

Normal market value of farm $ 25,000

Present market value of farm $ 32,000

1. Consideration has been given to total taxes, O&M, and B&I charges of $ - per acre and project debt liability of $ - against this land.
2. Any shortage in the acreage of this farm that may be developed upon examination of the title and verification of the plat which does not exceed 5 percent of the total acreage shown in my report and which is not caused by the exclusion of a specified part of the property will not affect my estimate of the normal agricultural value.
3. This property is (IS-IS NOT) satisfactory security for a loan not to exceed - years subject to the following requirements being fulfilled: none
4. Without the foregoing requirements being fulfilled the normal agricultural value of this property is $ - , it is a class - (A-B-C-D-E) farm, and it - (IS-IS NOT) satisfactory security for a loan not to exceed - years.

I. REMARKS (Explain any unusual features not sufficiently covered elsewhere. If security is not acceptable or if the term is limited, give reasons.)

This farm is located in an area of fair to good farms. Cropland is in good state of productivity with few low spots subject to freezing out when in winter wheat. Adequately fenced and reflects a good type of operation, with property being improved. Stream through pasture leaves some fields odd shaped. Buildings are in good condition and provide good facilities for operation of farm. Well located on good highway.

Comparison to	C Benchmark farm
Located in	Penn County
Location	above
Soils	some below
Improvements	equal
Overall	equal

The above report is true and correct to the best of my knowledge and belief.

1. Date appraised August 5 19 57
2. Date written August 5 19 57
3. Date mailed 19
4. Date received by FLBA 19

W. W. French
LAND BANK APPRAISER

28

FLB 4-201-B

REPORT AND RECOMMENDATION OF

Federal Land Bank Association of Springville, Indiana

Name of applicant Ned and Mildred E. Worth Application No. 051525

This recommendation is based on the identical property described in the accompanying signed application.

A. APPLICANT:

Farming experience and/or education farmed all life

Ability as a farm and business manager Good, hard worker, manages well

Character (moral risk) Good Disabilities None

Credit risk (reputation for paying obligations) Excellent

The financial statement in application (does-xxxxxx) reflect applicant's true condition. (If not, explain:)

State plan for financing or refinancing balance, if any, of indebtedness and/or requirements:
Has arranged for PCA loan

B. REMARKS:

Elaborate on any special circumstances and other facts and/or conditions influencing your recommendation:
This is an attractive farm with good rentability and salability. Applicant has cooperative family, oldest boy good help in fields and with livestock. He inherits 1/5 interest in this farm. Will supplement proceeds of this loan with PCA loan of $4,000 on livestock and equipment and from salable bonds he owns. He has made very good progress as a tenant on this farm. Progressive and frugal.

C. RECOMMENDATION:

Based upon an investigation of the security, its normal value, durability and stayability; and the solvency, character and qualifications of the applicant, I recommend a Federal land bank loan of $ 16,000 for 20 years.

Date August 6, 1957

W. W. French
Investigator

ACTION OF LOAN COMMITTEE

We, the undersigned, being all the members of the Loan Committee of the above named Federal Land Bank Association who participated in the consideration of the application referred to herein, having made or caused to be made such investigation of the applicant and the security offered as is deemed necessary, do hereby agree that a Federal land bank loan of $ 16,000 for 20 years, including -0- years deferment of principal, should be made on equal semi-annual payment plan, with a requirement that a minimum amount of $ 18,000 insurance be carried. Other requirements, if any:

We hereby elect said applicant to membership in this association.

Any shortage in the acreage of this farm that may be developed upon examination of the title and verification of the plat which does not exceed 10 percent of the total acreage shown in this report and which is not caused by the exclusion of a specified part of the property will not affect our conclusions.

No member of this Committee or any person who made the investigation is interested directly or indirectly in the loan sought by the applicant.

Joe Knorr Frank Going Charles Wells
(All members of the Loan Committee must sign)

Capital stock proceeds issued in connection with Loan Number(s) - , being refunded, (xxxxxx should not) be applied on final payment of this loan.

Date August 8, 1957

W. W. French
Manager

FOR BANK USE ONLY

Approved $ 16,000 for 20 years, including -0- years Deferment of Principal

Conditions:

Monthly Standard ☐
Unamortized ☐
Partially amortized ☐
Decreasing ☐ Equal ☒
Semi-annual ☒ Annual ☐

Total Insurance $ 18,000

Appraisal report by dated , satisfactory for this identical security case.

Date August 24, 1957

Bank Officer

☐ Cancellation ☐ Withdrawal ☐ Reinstatement ☐ Reconsideration

Over ☐

sampling the soil with an auger where necessary. He inspects the buildings, fences, erosion hazards and soil fertility. He checks location of schools and churches and considers general community standards. He knows how farms have sold in the area where he works and is qualified to determine accurately the agricultural and market value of the property.

He estimates:

1. Long-time average crop yields on this farm. He must allow for the good and bad years, the possibility of erosion and similar factors.

2. The average value of the crop that will be grown each year on the farm or the value of the livestock which will be produced. In figuring this he estimates yields, the probable acreage of each crop and long run, "normal" prices. These prices have been determined by the Farm Credit Administration after a study of prices over a period of more than 100 years. They represent the best thinking of leading economists in the country. They take account of wide fluctuations in prices such as we have had in the past and probably will have in the future.

3. The average net income which will be received from the farm by a typical operator, and by the landlord if it is rented. Allowance must be made for the many things that will happen to a farm during a period of 20 to 35 years during which a loan might run. The applicant might die, he might decide to sell the farm, or he might move to town and rent the farm. It is, therefore, necessary that he determine the average net income produced by a typical operator rather than the operator presently on the farm.

When the appraiser has completed his inspection and completed his estimates, he sets down what he thinks the farm is worth (its normal agricultural value). He checks this value with his estimated net income to see if the net income represents a fair return on such value. He also compares it with local farm sales over recent years. His final decisions and recommendations are set out in his appraisal report. The appraiser's report on Mr. Worth's application is reproduced on pages 43 and 44.

Amount that may be Loaned

A Federal land bank loan may be made for an amount up to 65 percent of the normal agricultural value of the farm as set by the appraiser. Cost of the membership stock in connection with the loan may be added to this 65 percent. Less than 65 percent of the normal agricultural value is loaned where the applicant's financial position or the condition or type of farm does not warrant a full loan.

In the case of our friend Mr. Worth, the appraiser set a normal agricultural value of the security at $25,000. The Federal land bank loan which was closed, therefore, represented nearly 65 percent. Federal land bank loans are made in multiples of $100.

The law does not limit the amount the Federal Land Bank of Louisville may lend a single borrower except for the limit imposed by the normal agricultural value of the farms he can offer as security. It is probable that no individual in the four states served by the Louisville bank owns enough farm land to qualify for a loan greater than what the bank could lend.

Completing the Loan

After the appraiser's report, credit report and application bearing the recommendation of the association's loan committee have been approved by the bank, the applicant furnishes satisfactory evidence that he has a clear title to the property. This evidence may be an abstract of title, a title certificate by an approved attorney, or title insurance. Attorneys for the bank examine the title evidence. If it is found acceptable the closing papers for the loan are prepared. A draft for the loan proceeds to be disbursed goes to the association manager with the closing papers. Papers the borrower must sign consist of a note as evidence of the debt and a real estate mortgage securing that note. The real estate note executed by Mr. and Mrs. Worth and the mortgage executed by Mr. and Mrs. Worth are reproduced on pages 48, 49 and 50. When the note, mortgage and other necessary papers have been signed properly, the manager of the association issues checks to the proper payees to accomplish the purpose for which the loan was made.

The only expense incurred by the borrower in securing a loan from the Federal land bank is the cost of his title evidence and recording the mortgage. He has been charged no application or appraisal fee.

Source of Funds

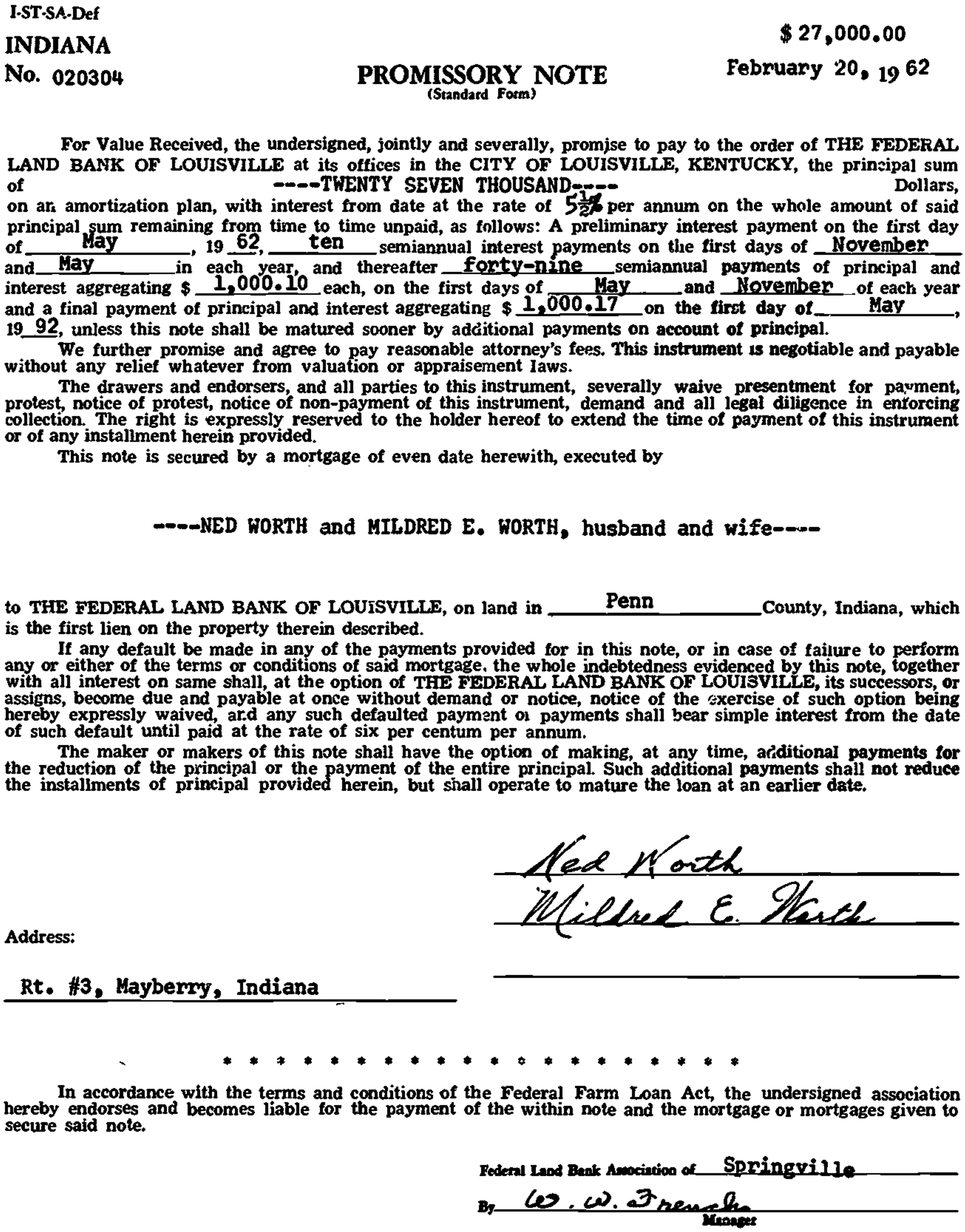
Because the word "Federal" appears in its name some people suppose the Federal land bank is a Government agency, lending Government funds. This is not true. The Federal land bank system is a cooperative owned by farmers who have obtained Federal land bank loans. No one else shares in the ownership of the Federal land banks.

Money which Federal land banks lend through Federal land bank associations is obtained from the investing public by the sale of consolidated farm loan bonds. These bonds are issued jointly by the 12 Federal land banks in the United States. They are secured by first mortgages on the farms owned by the Federal land bank association members.

These consolidated bonds are sold as are Federal Intermediate Credit Bank debentures and Bank for Cooperatives debentures, through a fiscal agent employed by the 37 Farm Credit banks.

Repayment of the Loan

When Mr. Worth made his second loan ($27,000) to purchase the additional 80 acres he chose the equal payment plan of amortization. He also selected a repayment schedule with annual installments due February 1. Since he had a



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INDIANA

No. 020304

$ 27,000.00

February 20, 19 62

PROMISSORY NOTE

(Standard Form)

For Value Received, the undersigned, jointly and severally, promise to pay to the order of THE FEDERAL LAND BANK OF LOUISVILLE at its offices in the CITY OF LOUISVILLE, KENTUCKY, the principal sum of ----TWENTY SEVEN THOUSAND---- Dollars, on an amortization plan, with interest from date at the rate of 5½% per annum on the whole amount of said principal sum remaining from time to time unpaid, as follows: A preliminary interest payment on the first day of May, 19 62, ten semiannual interest payments on the first days of November and May in each year, and thereafter forty-nine semiannual payments of principal and interest aggregating $ 1,000.10 each, on the first days of May and November of each year and a final payment of principal and interest aggregating $ 1,000.17 on the first day of May, 19 92, unless this note shall be matured sooner by additional payments on account of principal.

We further promise and agree to pay reasonable attorney's fees. This instrument is negotiable and payable without any relief whatever from valuation or appraisement laws.

The drawers and endorsers, and all parties to this instrument, severally waive presentment for payment, protest, notice of protest, notice of non-payment of this instrument, demand and all legal diligence in enforcing collection. The right is expressly reserved to the holder hereof to extend the time of payment of this instrument or of any installment herein provided.

This note is secured by a mortgage of even date herewith, executed by

----NED WORTH and MILDRED E. WORTH, husband and wife----

to THE FEDERAL LAND BANK OF LOUISVILLE, on land in Penn County, Indiana, which is the first lien on the property therein described.

If any default be made in any of the payments provided for in this note, or in case of failure to perform any or either of the terms or conditions of said mortgage, the whole indebtedness evidenced by this note, together with all interest on same shall, at the option of THE FEDERAL LAND BANK OF LOUISVILLE, its successors, or assigns, become due and payable at once without demand or notice, notice of the exercise of such option being hereby expressly waived, and any such defaulted payment or payments shall bear simple interest from the date of such default until paid at the rate of six per centum per annum.

The maker or makers of this note shall have the option of making, at any time, additional payments for the reduction of the principal or the payment of the entire principal. Such additional payments shall not reduce the installments of principal provided herein, but shall operate to mature the loan at an earlier date.

Ned Worth

Mildred E. Worth

Address:

Rt. #3, Mayberry, Indiana

* * * * * * * * * * * * * * * * * * * *

In accordance with the terms and conditions of the Federal Farm Loan Act, the undersigned association hereby endorses and becomes liable for the payment of the within note and the mortgage or mortgages given to secure said note.

Federal Land Bank Association of Springville

By W. W. French
Manager

This note covers the real estate loan obtained by the Worths to buy the additional 80 acres. Note the five-year deferment of principal. Note also the prepayment privilege clause in the last paragraph just above the Worths' signatures.

postponement of principal for five years, his annual installment for each of the first five years amounted to only $1,485.

Ordinarily his first payment would have been due the sixth year and would have amounted to $2,012.83. Of this, $527.83 would have been applied on the principal and $1,485 would have been interest. After paying two regular installments Mr. Worth found that his gross income was somewhat higher than usual because of favorable crop conditions and favorable livestock prices. His son was now home from college and helping him. This had reduced his operating expenses so that his net income was higher than he had been receiving. Because he had extra money for which he had no immediate need, he decided to pay an extra $2,000 on the principal of his loan. While this reduced his total debt it did not alter his repayment schedule except to shorten the total life of the loan. The following year Mr. Worth sustained a rather serious illness which proved expensive. At the same time adverse weather greatly reduced his crop production. He found himself short of funds to meet his installment. He talked the situation over with his association manager. It was agreed that having made advance payments on the principal he would be required at this time to pay only the interest while the principal portion of the installment would be deferred until final payment.

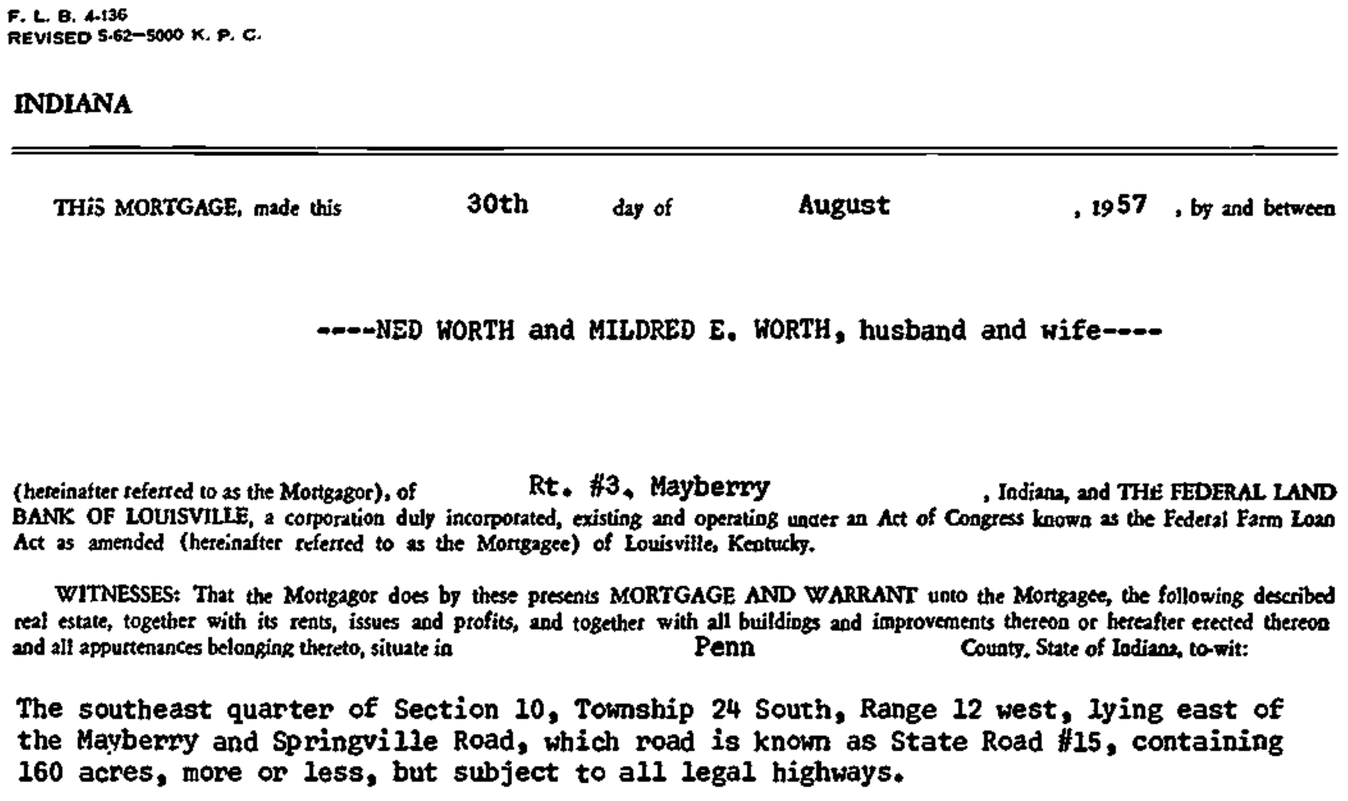
Generally speaking Mr. Worth has been a quite successful farmer. He has had no difficulty in making the payments on his loan. Not all farmers plan as well and are as frugal as Mr. Worth and his family. Nor are all so fortunate as the Worth family. A satisfactory lender must be able to help borrowers who at times may have difficulty in meeting their loan payments. Suppose a borrower is unable to meet a payment on time but is acting in good faith, doing his honest best and will soon have the money to pay. In such case his Federal land bank association will grant him an extension of time. Should his trouble be of a longer nature, such as drought, low prices or other misfortune over which the borrower has no control, a more formal method of giving more time for payment may be followed. Here are several such methods:

1. Written extension agreement.
   This merely gives the borrower more time to pay the delinquency and sets a new date for him to pay it at a time he expects to have money.

2. Deferment of principal.
   Under this form the borrower pays only interest for a certain period and then begins with the full installments as before. This results in prolonging the life of a loan but serves to carry him forward to a time when his income is expected to be better.

3. Reamortization.
   This form is necessary when the borrower cannot meet his loan installments as they mature and has little prospect of getting in a position to do so. If re-arranging his amortization schedule to call for smaller payments would enable him to keep the loan current, then the balance of his loan is reamortized

Real Estate Mortgage



F. L. B. 4-136
REVISED 5-62—5000 K. P. C.

INDIANA

THIS MORTGAGE, made this 30th day of August , 1957 , by and between

----NED WORTH and MILDRED E. WORTH, husband and wife----

(hereinafter referred to as the Mortgagor), of Rt. #3, Mayberry , Indiana, and THE FEDERAL LAND BANK OF LOUISVILLE, a corporation duly incorporated, existing and operating under an Act of Congress known as the Federal Farm Loan Act as amended (hereinafter referred to as the Mortgagee) of Louisville, Kentucky.

WITNESSES: That the Mortgagor does by these presents MORTGAGE AND WARRANT unto the Mortgagee, the following described real estate, together with its rents, issues and profits, and together with all buildings and improvements thereon or hereafter erected thereon and all appurtenances belonging thereto, situate in Penn County, State of Indiana, to-wit:

The southeast quarter of Section 10, Township 24 South, Range 12 west, lying east of the Mayberry and Springville Road, which road is known as State Road #15, containing 160 acres, more or less, but subject to all legal highways.

This Mortgage is given to secure the payment of a note of even date herewith executed and delivered by the Mortgagor to the Mortgagee in the principal sum of ----SIXTEEN THOUSAND---- Dollars with interest at the rate stated in said note, said principal being payable on an amortization plan, the last installment being due on the 1st day of November , 19 77, without any relief whatever from valuation or appraisement laws, and the Mortgagor further promises and agrees to pay reasonable attorney's fees

The Mortgagor covenants and agrees (1) to pay, when due, the several installments of interest and principal of the debt secured hereby, in accordance with the terms of this mortgage and of the promissory note hereby secured, and all taxes, liens, judgments or assessments lawfully against said property; (2) to use the proceeds of the loan secured hereby solely for the purposes specified in the Mortgagor's application for said loan; (3) to keep said property insured to the satisfaction of and under policies deposited with the Mortgagee, insurance proceeds, if not used in accordance with applicable regulations for reconstruction of buildings destroyed, to be applied on the indebtedness hereby secured as the Mortgagee may elect; (4) to maintain improvements in good repair, to refrain from the commission of waste, to cultivate said premises in a good husbandmanlike manner and not to cut, remove or permit the cutting or removal of timber therefrom except for domestic use; (5) to pay all expenses incurred by the Mortgagee in securing the original or supplemental abstracts of title and to pay all court costs, expenses and attorney's fees incurred by the Mortgagee in defending and enforcing the lien of the within mortgage; and any such costs, expenses or fees paid by the Mortgagee shall become a part of the debt secured hereby; (6) that if the Mortgagor fails to pay when due any tax, lien, judgment, assessment, court cost, expenses and attorney's fees or for any abstract of title, or to maintain insurance as hereinbefore provided, the Mortgagee may do so, and all amounts so paid and defaulted payments of principal and interest shall bear interest from date of payment or default at the highest rate authorized by law not exceeding six percent (6%) per annum and be secured hereby; (7) that there are hereby specifically assigned to the Mortgagee all rents, royalties, revenues, damages and payments of every kind at any time accruing under or becoming payable on account of any and all oil, gas, mining and mineral leases, rights or privileges of any kind now existing or that may hereafter come into existence covering the said property, or on account of any condemnation proceedings or other seizure of all or part thereof under the right of eminent domain or otherwise, and the Mortgagee, at his option, may collect and receive the same as the same become due and payable, and all moneys received by the Mortgagee by reason of this assignment may be applied, at the option of the Mortgagee, upon any unpaid amounts of principal and/or interest, whether or not the same shall be due and payable: provided that nothing herein shall be construed as a waiver of the priority of the lien of this mortgage over any such lease, rights or privileges granted subsequent to the date of this mortgage; (8) that the Mortgagee may extend and defer the maturity of and renew and reamortize said indebtedness, release from liability any party liable thereon, and release from the lien hereof portions of said property, without affecting the priority hereof or the liability of the Mortgagor or any other party for the payment of said indebtedness, all such extensions, deferments, renewals, and reamortizations to be secured hereby; (9) that if the Mortgagor shall sell the premises and the purchaser thereof does not assume and agree to pay the indebtedness secured hereby, or if the Mortgagor defaults in the payment of said indebtedness, or with respect to any warranty, covenant, or agreement herein contained, then, at the Mortgagee's option, the entire indebtedness secured hereby shall forthwith become due and payable and bear interest at the highest rate authorized by law not exceeding six percent (6%) per annum, and the Mortgagee shall have the right to enter upon and take possession of said premises and to foreclose this instrument; (10) that in any foreclosure action or other proper proceeding the court shall, at the request of the Mortgagee, appoint a receiver for said premises with the usual powers of receivers in like cases; (11) that the omission of the Mortgagee to exercise its option upon any default as aforesaid, or to exercise any other option or right hereunder, shall not preclude it from the exercise thereof at any subsequent time or for any subsequent default; (12) that the covenants, agreements and provisions herein contained shall be binding upon and inure to the benefit of the heirs, devisees, personal representatives, grantees, successors and assigns of the respective parties; (13) that wherever in this mortgage either the Mortgagor or the Mortgagee is named or referred to, such naming or reference includes all of the class and the assigns, heirs, personal representatives, grantees, or successors of either, as the case may be; and that the pronoun as used herein in the third person singular, includes the person, number and gender appropriate to the first designation of the parties.

THE CONDITION OF THIS MORTGAGE is such that if the Mortgagor shall well and truly make all payments called for in said note in accordance with its terms, and shall perform and comply with each and all the covenants, conditions and agreements, either in said note or in this mortgage contained, then this mortgage shall be null and void, otherwise the same shall remain in full force and virtue in law.

IN WITNESS WHEREOF, the Mortgagor has hereunto set his hand, the day and year first written above.

Ned Worth
Ned Worth

Mildred E. Worth
Mildred E. Worth

STATE OF INDIANA }
} SS
COUNTY OF Penn }

Before me, the undersigned, a Notary Public in and for said State and County, this day personally appeared

----NED WORTH and MILDRED E. WORTH, husband and wife----

who acknowledged the execution of the foregoing instrument, as their voluntary act and deed.

Witness my hand and seal this 30th day of August , 1957.

My commission expires April 4, 1959.

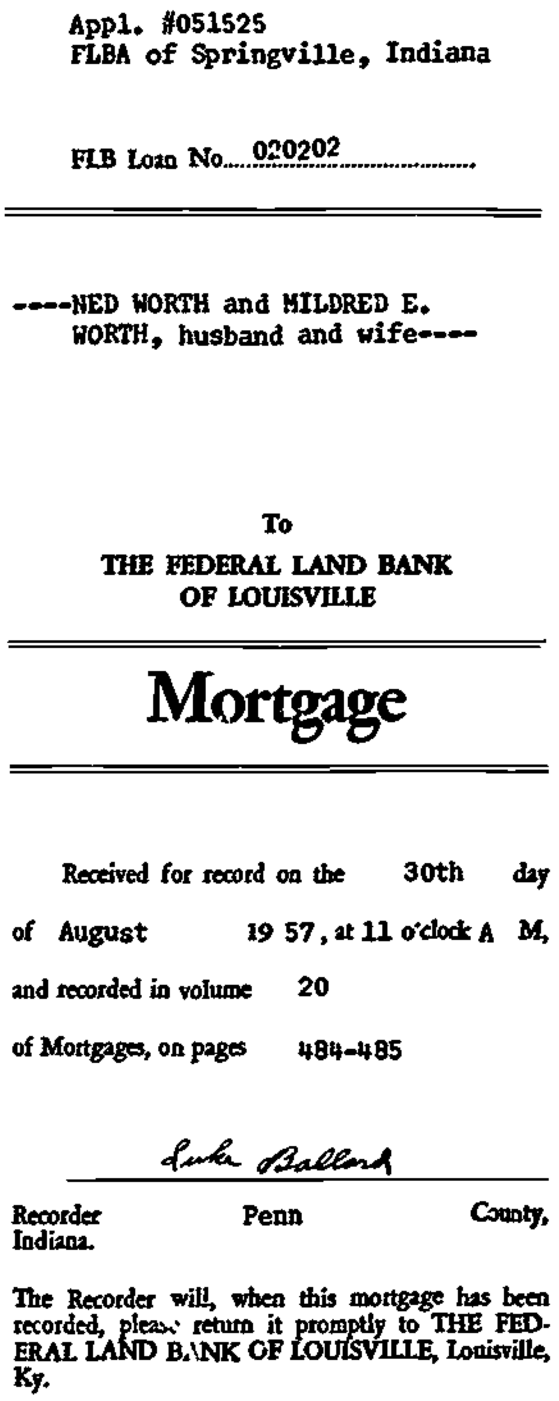
Betty Houston
Notary Public

over a longer period resulting in smaller payments. This plan frequently helps a borrower who has sold a portion of his farm thus reducing his earning capacity as well as the unmatured balance of his loan.

If the Loan Cannot be Paid

Any long term mortgage lender that does much business may have cases where the borrower cannot or will not repay the loan. In such cases foreclosure is the last resort. The rule followed by the Federal land bank is that no borrower will be foreclosed if:

1. He is doing his honest best.
2. He is applying the proceeds of production over and above necessary living expenses to his primary debts.
3. He is taking proper care of the farm.
4. He has the capacity to work his way out of a reasonable burden of debt under normal conditions.



Appl. #051525
FLBA of Springville, Indiana

FLB Loan No. 020202

----NED WORTH and MILDRED E. WORTH, husband and wife----

To

THE FEDERAL LAND BANK
OF LOUISVILLE

Mortgage

Received for record on the 30th day of August 19 57, at 11 o'clock A M, and recorded in volume 20 of Mortgages, on pages 484-485

Luke Ballard

Recorder Penn County, Indiana.

The Recorder will, when this mortgage has been recorded, please return it promptly to THE FEDERAL LAND BANK OF LOUISVILLE, Louisville, Ky.

CHAPTER IV

FINANCING FARM COOPERATIVES

People have found that there are some things which they can do better by working together than by working separately. Such working together is called cooperation. Among farmers cooperation varies from simple tasks, such as helping each other in making hay and combining grain, to much more complicated arrangements, where groups of farmers own and operate grain elevators, creameries, farm supply stores, petroleum bulk plants, and other business concerns. The preceding chapters of this book are concerned primarily with financing for the individual farmer. This present chapter will deal with principles and practices used by farmers in financing the businesses they own cooperatively.

What Is a Cooperative?

Any group of farmers working together for their mutual interest may be considered a cooperative, or a "co-op" as we often call it in our conversation. If they engage in buying and selling and wish to own property on a cooperative basis, they should incorporate under the laws of their state. There are also Federal laws that relate to cooperatives. While this is not a legal definition of a cooperative,* we may use this one:

(1) A farmer cooperative is an association of agricul-

Through county cooperatives such as this farmers market their grain as well as buy a wide variety of farm supplies.

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*From a Federal standpoint, there is no all-inclusive statutory definition of an agricultural cooperative. A generally accepted definition, however, is that given by the Agricultural Marketing Act and its revisions governing loans made by the banks for cooperatives.

tural producers that operates for the mutual benefit of its members.

(2) The value of the business done with members must be at least as great as that done with others.

(3) The association must use the one-man, one vote plan, or limit dividends on capital stock to not more than 8 percent.

Why Have a Cooperative?

The main reason for having "co-ops" goes back to the familiar principle that "in unity there is strength." Farmers have found that their position is much stronger when they act together than when each acts alone. Let us see why.

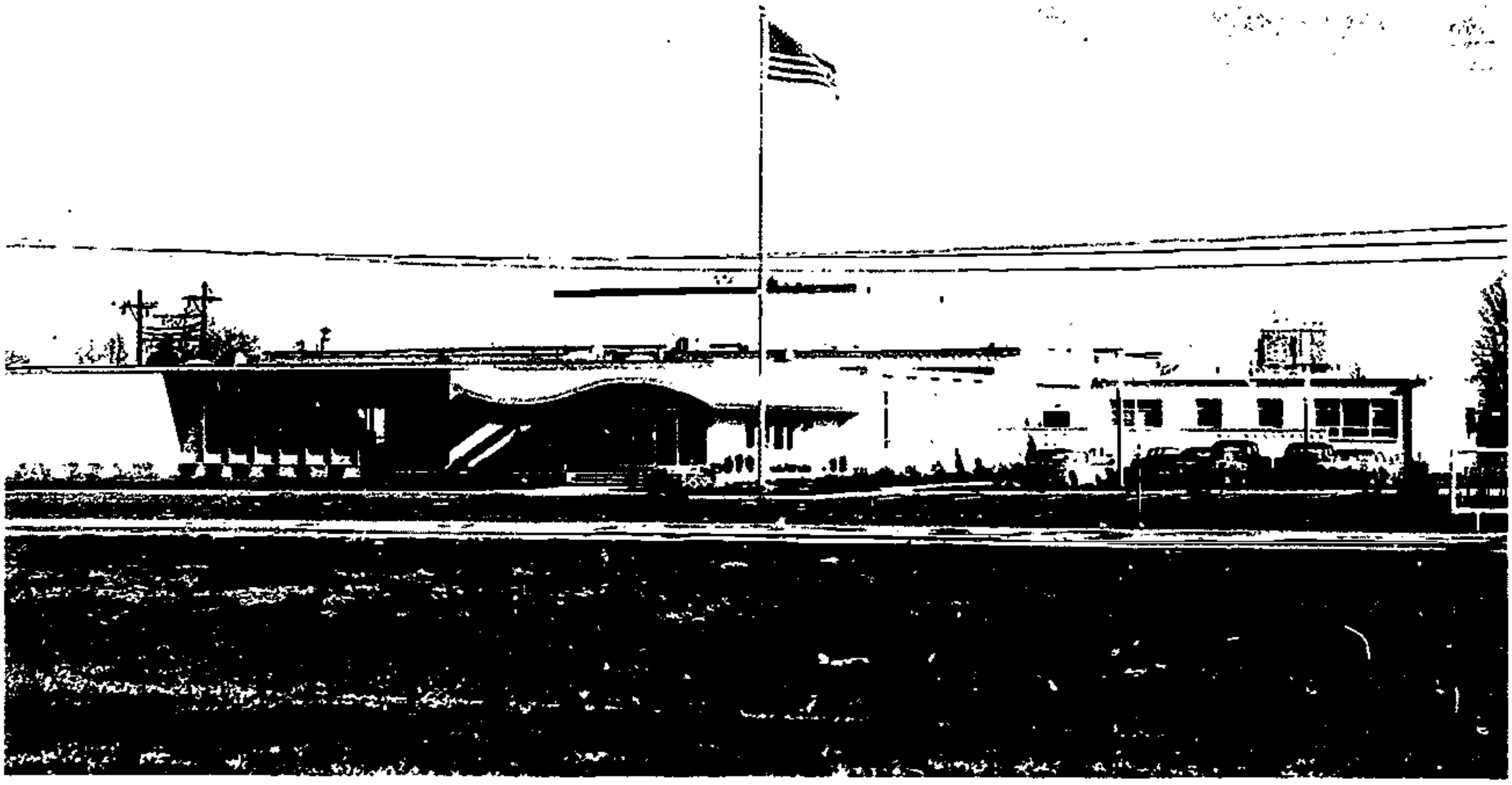
In marketing his products, purchasing supplies, or getting credit and needed services, the farmer deals with a highly organized business world. By himself, a farmer cannot bargain to advantage with a big corporation, especially when some of his neighbors may be competing with him. When he acts alone, the farmer sells his products at wholesale and buys his needed goods at retail.

Now suppose he and his neighbors join together in a "co-op." They strengthen their bargaining power when they avoid bidding against each other. Furthermore, by selling together, they learn sooner what customers want. By meeting these wishes through quality production, proper grading and packaging, they increase their own profits. They also gain similar advantages by buying together the supplies of goods they need. Through well managed cooperatives, farmers are more sure of getting top prices for their products and of paying no more than actual worth for the supplies and services they buy.

Although farmer "co-ops" are probably the best known, many other groups also use the cooperative form of business organization. The Associated Press is a cooperative news gathering agency, owned by most of the daily newspapers in the United States. The Railway Express Agency is another cooperative, owned by the nation's railroads. Mutual insurance companies operate on cooperative principles. Many groups of retail merchants, such as hardware dealers, grocers, and department stores, belong to cooperative wholesale organizations. They do this to pool their buying power and get the benefits of buying merchandise in large quantities. This gives them a better chance to compete with larger firms, such as chain stores.

Most cooperative organizations are incorporated. The basic differences between an ordinary corporation and a cooperative corporation are below. Both types of business organizations have been important in developing the American system of free enterprise.

Item	Ordinary Corporation	Cooperative Corporation
A. Purposes	To make money for stockholders as investors.	To benefit users. To make users' own businesses more profitable.
B. Control	Stockholders control in proportion to stock ownership. Usually one vote for each share of common stock.	Usually one-man, one vote or may control on basis of patronage.
C. Distribution of net earnings	Dividends on stock are returned to stockholders in proportion to stock owned.	Nominal rate of return on capital with remainder distributed on basis of patronage.



This large dairy cooperative bargains for its farmer-members and processes milk in peak seasons.

Cooperative Principles

The fundamental principles in the organization and operation of a cooperative can be traced back more than 100 years to ideas adopted by the Equitable Pioneers Society at Rochdale, England, in 1844. These fundamental principles are:

1. Open membership and ownership without regard to race, nationality, politics, or religion.
2. Democratic control, each member has one vote.
3. Limited returns on capital, and return of gains to members through patronage refunds.
4. Regular provision of funds for promotional and educational work.
5. Cash trading.
6. Trading at market prices (as opposed to price-cutting methods).
7. Regular provision for the building of substantial reserves.

Methods of Financing Farm Cooperatives

In general, farmers finance their cooperative businesses by using the standard methods of other business corporations. These include common stock, preferred stock, membership fees, bonds, various kinds of certificates, and borrowed capital. However, there is a basic difference. Customers of ordinary corporations supply little, if any, of the capital needed to run those businesses. But most of the money needed to establish and operate a farmer cooperative comes from farmer members who own and use it. Farmer members supply capital for their cooperative in one or more of the following ways:

1. They purchase capital stock or other securities
2. They authorize capital deductions from sales proceeds
3. They permit the cooperative to retain savings and margins.

The proportions of capital that come from each of these sources make up the capital structure of a cooperative. This is often supplemented by borrowed capital, but the financing methods used must be tailor-made to fit each organization. Furthermore, a sound financing program must be based upon continuous planning well in advance of requirements. Among cooperatives, sound financing also depends on an educational program. This program must inform the patron of the activities of the cooperative; it must acquaint him with his responsibility to provide the funds necessary for efficient operation.

In planning the financing for a cooperative, its officers and directors must first figure how much money will be needed for plant and equipment. Next they must decide how much will be needed for operating capital on a year-round basis and how much additional will be needed during busy seasons. When these needs have been determined, the cooperative should aim eventually to get from the members all of the capital needed to finance (a) fixed assets, (b) other assets of a long-term nature, and (c) inventories and receivables in normal or slack seasons. If members can supply these basic needs, the cooperative is in a good position to borrow the funds needed in busy seasons at reasonable interest rates and on desirable terms. Then, if expansion should become necessary or advisable, the cooperative is better able to obtain the necessary financing.

The board of directors (elected by the members) determines the co-op's policies including its use of borrowed capital.

In planning its financing a cooperative should try to establish and maintain a strong working capital position. This means that the current assets should substantially exceed current payables. Current assets consist of cash, accounts receivable, inventory, and other items which would normally be converted into cash within a relatively short time. This is especially important to a cooperative in which inventories are a major factor. Without adequate working capital, a cooperative may find that it cannot pay its bills soon enough to obtain the maximum discounts which are allowed or to purchase needed supplies and merchandise at favorable times. The credit standing of a cooperative, as of any other business, is determined to a great extent by its working capital position.

Capital Structure

There are two basic types of capital set-up used by cooperatives — permanent and revolving. It may use one or both. Many combinations of the two are found in successful use today. This pattern or method of getting its capital is called its capital structure. Each type has certain advantages and certain disadvantages. Therefore, the capital structure selected by any cooperative should be the one that best fits the conditions and circumstances under which it will operate.

1. *Permanent Capital*

The permanent capital of a cooperative consists of funds invested by members and operating margins retained by the cooperative on a permanent basis. For these invested or retained funds the co-op usually issues preferred or common stock certificates; it usually pays dividends of not more than 6 percent a year on this stock. When this method of financing is used, the net savings for each year can be paid in part as current cash patronage refunds. Then the co-op issues stock or permanent certificates for the balance, distributing this stock on a patronage basis. Most cooperatives have found that some permanent capital is desirable, at least to the extent of their investment in fixed assets. Some cooperatives use the permanent capital method for all of their capital needs. The biggest disadvantage of this method is that each member does not contribute capital in proportion to his use of the cooperative. Furthermore, cooperatives usually find it difficult to sell securities unless cooperative experience in their territory has been good. A considerable number of cooperatives that finance their organization on this basis have sold sizable amounts of capital stock to outsiders. Many cooperative leaders discourage this arrangement: they feel it tends to weaken the interest the members have in their own cooperative. It has been used to advantage where local townspeople and others desire to invest in the cooperative because they feel it is an asset to the community and desire to bring trade to their town.

2. *Revolving Capital*

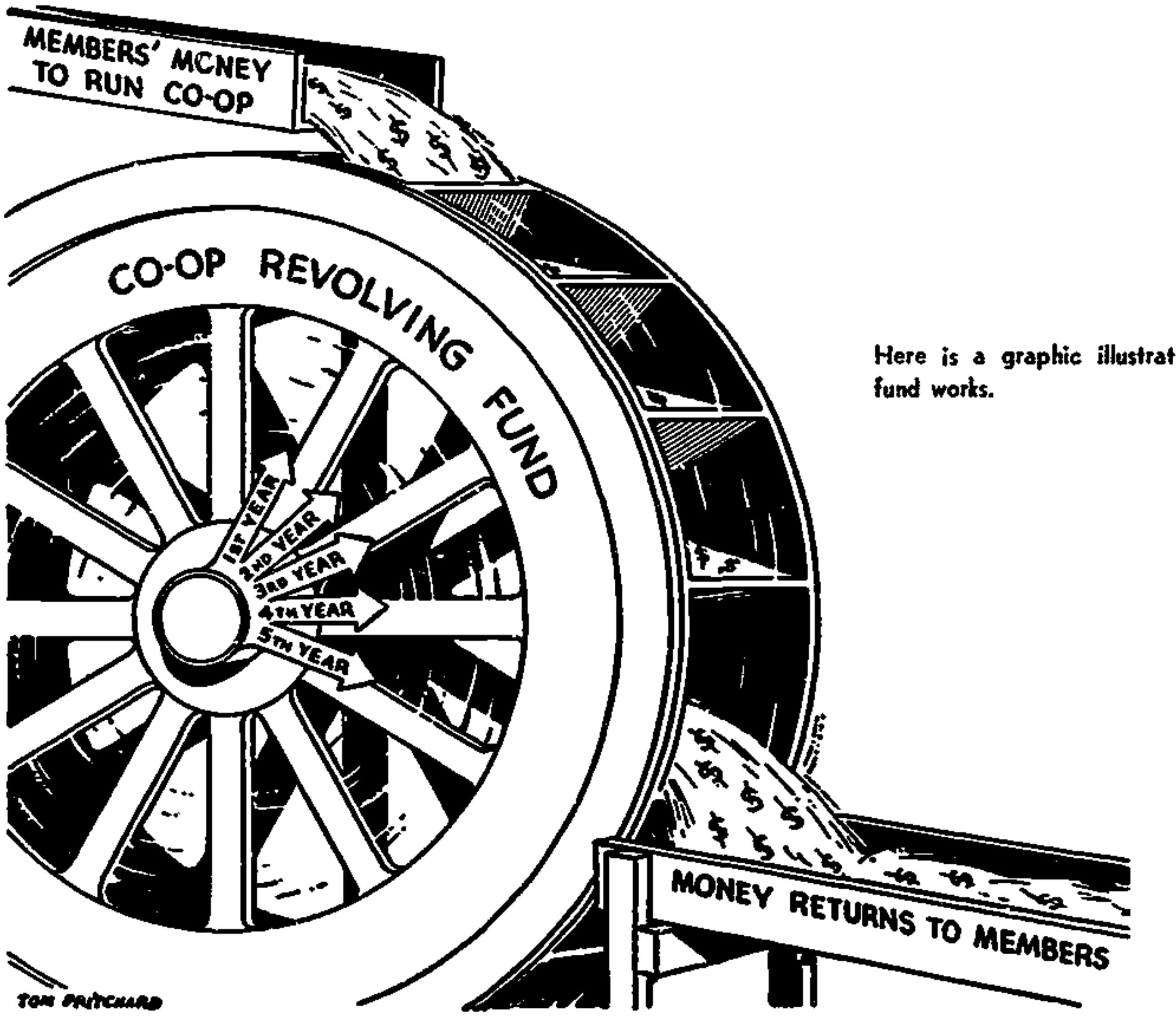
This method of building up and maintaining adequate funds for the operation of a business is a cooperative way of doing business. Many people regard it as the most effective plan for raising capital, maintaining cooperative practices, and keeping the control of an association in the hands of its current members and patrons.

With this plan of financing, funds are built up over a period of several years in two ways: (1) the co-op deducts a share of proceeds of farm products marketed for patrons; or, (2) it retains in the business net savings which are earned. Patrons are credited with their share of the deductions and net savings retained. When the manager and the board of directors believe that sufficient capital has been accumulated, they may retire the oldest deductions out of current deductions and savings. Thus, their capital keeps "revolving." In many cooperatives the patron receives shares of stock or certificates of indebtedness for the amounts retained by the cooperative. In others he receives only a notice that a certain amount of money has been credited to his revolving account. Where this revolving capital method is used:

a. Members and patrons provide financing in proportion to their patronage (i.e., the amount of business each does with the "co-op.")

b. Inactive patrons are systematically eliminated from membership.

c. Adjustments to changing financial needs of the cooperative can be made by increasing or decreasing the amounts retained or by lengthening or shortening the period of rotation.



Here is a graphic illustration of how the revolving fund works.

However, the revolving method of financing, when used alone, has certain disadvantages:

a. Patronage refunds in the form of certificates are less desirable than cash. Book credits, when used, are even less desired by farmers.

b. If the rotation period is lengthened too much to finance expansion of facilities, patrons lose confidence in their business.

In general, this method of financing is best suited to marketing associations and others having a large annual sales volume in relation to total assets and a relatively small investment in fixed assets.

Borrowed Capital

Loans from various sources have a sound place in financing a cooperative. Loans are used by cooperatives (a) to help finance the purchase or construction of facilities, (b) to provide permanent operating capital for inventories and accounts receivable, (c) to finance seasonal activities of marketing farm products, and (d) to finance seasonal increases in farm supply inventories and accounts receivable.

Many cooperatives, in the early stages of their history and during periods of rapid growth, make extensive use of long- and intermediate-term loans to finance fixed assets and provide operating capital. Many other cooperatives have enough membership capital to finance fixed assets and minimum operating capital requirements. They make excellent use of borrowed funds to finance seasonal activities.

Whatever the purpose for which funds are borrowed, it is important that the loan terms be adapted to the cooperative's repayment ability.

There is no fixed ratio between the amount of capital owned by the cooperative and the amount that may be borrowed. As a general rule, though, long-term loans should not exceed the amount of the patrons' investment in the cooperative. Long-term loans are generally repaid in regular periodic payments over a period of years. A cooperative should not borrow, under normal operating conditions, more than it can repay in five to ten years out of savings from operations, or from capital deductions.

Loans to finance seasonal activities are usually on a short-term basis. The cooperative should be able to repay them in full during its slack period.

Sources of Cooperative Credit

There are a number of sources from which cooperatives may borrow. It is a good idea for a cooperative to establish good relations with one or two lending institutions and look to them for loans when borrowed capital is needed. Usually an association is better able to meet its needs for borrowed capital by using only one or two sources than by trying to borrow from many sources.

Farmer cooperatives borrow principally from commercial banks, individuals, insurance companies, other cooperatives, and the banks for cooperatives.

Commercial Banks

Many cooperatives obtain at least part of their financing from commercial banks. In each case the rate of interest and the terms are agreed upon by negotiation between the cooperative and the bank. The rate of interest will depend upon the type of loan, the rates prevailing in the community for similar loans, and the credit standing of the cooperative.

One difficulty that may be met is the size of loan which a commercial bank can make to a single customer. A bank is permitted to lend only a limited percent of its capital and surplus to any one borrower. For this reason, the cooperative may not be able to obtain adequate financing from the local bank if the amount of credit needed is fairly large.

Individuals

Frequently a director or a member will lend funds to his cooperative. Rate of interest and terms are agreed upon and adapted to the particular situation. In the early days of cooperative history, individuals were about the only source of credit cooperatives had. In some communities they are still an important source. As cooperatives have become more firmly established and have improved their financial position, they obtain most of their credit from established lending institutions.

Through the sale of debenture bonds, or certificates of indebtedness with a prescribed rate of interest and a definite due date, numerous cooperatives obtain a considerable amount of financing from individuals.

Insurance Companies

Insurance companies furnish only a small percent of the borrowed capital used by cooperatives; however, they meet a definite need through their willingness in some cases to make long-term loans.

Other Cooperatives

Some cooperatives borrow from regional or federated cooperatives with which they are associated. Some of these loans are obtained for a period of several years to finance operations or expansion. More often, particularly with marketing associations, the loans represent merely advances on farm products awaiting processing and distribution.

Banks for Cooperatives

Because many financially sound cooperatives were unable to meet their needs from already existing lenders, the Congress of the United States in 1933 provided for the establishment of a permanent, nationwide system of 13 banks for cooperatives. This system is comprised of twelve district banks for cooperatives — one in each Farm Credit District, and one central bank for cooperatives located in Washington, D. C. These banks provide credit for agricultural cooperatives at reasonable interest rates, and on terms suited to the special needs of each borrower. Borrowing cooperatives have a part in both ownership and control of this specialized system of credit. In this way they carry the cooperative principle even into their borrowing program.

The 13 banks for cooperatives provide more than half of the credit used by farm cooperatives in the United States. The twelve district banks make both long-term and short-term loans to the individual cooperatives in their district. The Central Bank for Cooperatives participates with district banks in any loans that exceed the lending limits of the district banks.

How the Banks for Cooperatives Function

The general policies for the operation of the entire Farm Credit system, of which the banks for cooperatives are a part, are established by a thirteen-member Federal Farm Credit Board. In addition to the Federal Farm Credit Board in Washington, there is a district Farm Credit board composed of seven members for each of the twelve Farm Credit districts.

Congress passed the Farm Credit Act of 1955, which provides a means whereby the banks for cooperatives will eventually become borrower-owned and controlled. This act provides for three classes of capital stock for each bank for cooperatives:

> Class A stock is owned entirely by the United States Government. It carries no provision for dividends or voting rights. Instead of dividends the banks for cooperatives pay an annual franchise tax for the use of Government capital. The tax amounts to 25 percent of the annual earnings of each bank but not to exceed the cost of such money to the Government.
>
> Class B stock is an investment type stock which carries no voting rights. It provides for dividends of not to exceed 4 percent a year as declared by the district board of directors. Before any patronage refunds may be distributed, at least a 2 percent dividend must be paid on this stock.
>
> Class C stock is voting stock and may be owned only by farmers' cooperative associations. No dividends are paid on this stock.

The Government capital will be retired over a period of years principally from the bank's earnings and by purchase of Class C stock by the borrowers.

Banks for cooperatives operate on a cooperative basis. After paying operating expenses, providing for reserves and surplus, paying the franchise tax to the Government, and paying dividends on Class B stock, any remaining net savings of the bank are distributed to its borrowers on a patronage basis in Class C stock and allocated credits.

When all Class A (Government) stock in the bank has been retired, Class C stock may be retired in the order in which it was issued.

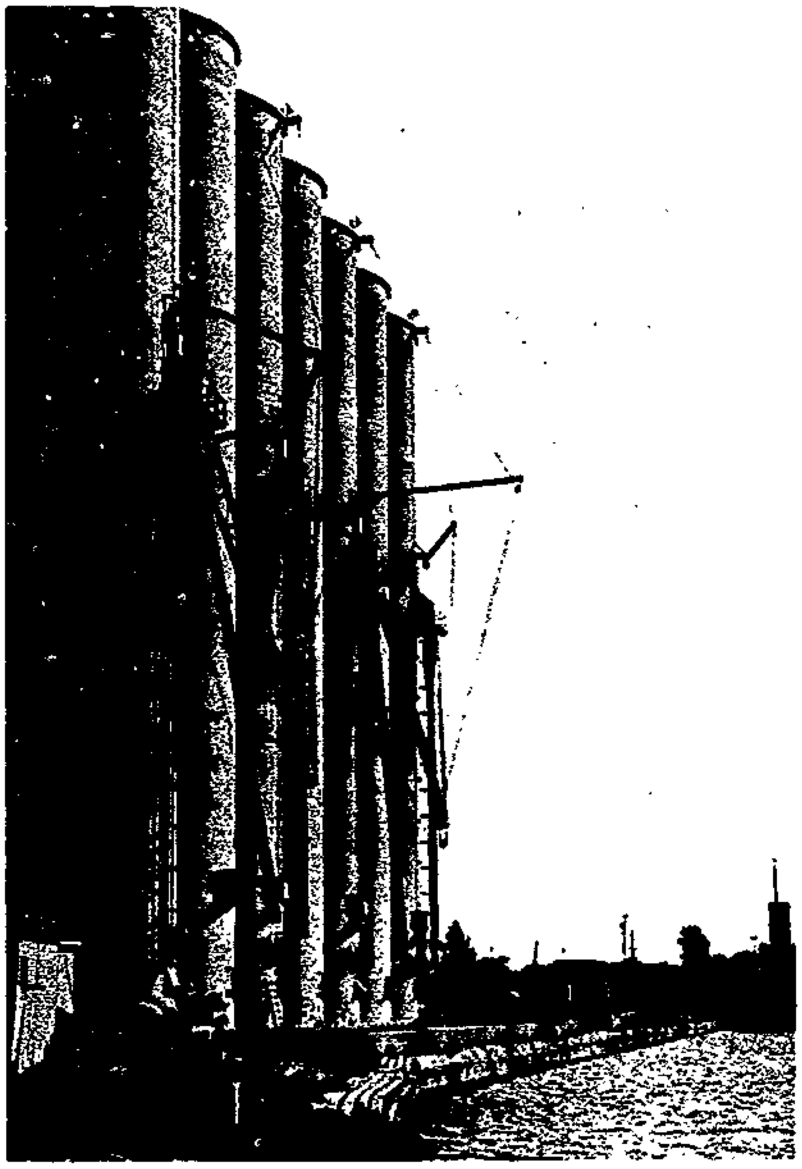
Sources of Loan Funds

The banks for cooperatives obtain their loan funds principally from the following sources:

a. The bank's' capital, consisting of stock owned by the United States Government, stock owned by the cooperative associations, allocated reserves, and surplus.

b. Consolidated debentures, which are sold to the investing public and for which all 13 banks for cooperatives are liable.

c. Loans from commercial banks, from other banks for cooperatives, or from other banks in the Farm Credit system.



Farmer cooperatives invested their own funds and also funds borrowed from the Louisville Bank for Cooperatives to build this $2½ million grain terminal. Through such cooperative facilities where ocean going boats can be loaded, farmers have access to world markets for their grain.

What Cooperatives May Borrow?

A cooperative must meet certain requirements if it is to borrow from a bank for cooperatives. It must be made up of farmers who are acting together to process, prepare for market, handle, or market farm products, or who are purchasing farm supplies or furnishing farm business services. It must not do more business with non-members than with members. No member may have more than one vote unless the dividends on capital stock or membership capital are limited to 8 percent a year. At least 90 percent of the voting rights of a cooperative must be held by farmer members or by associations owned and controlled by farmers. In the case of farmers' mutual insurance companies, members must control at least 75 percent of the voting stock.

Types of Loans

Loans made by banks for cooperatives are based on (1) economic need, (2) financial responsibility, (3) stability of organization, (4) operating policies, (5) management, and (6) repayment ability. They may be made either to provide operating capital or to help cooperatives acquire warehouses, elevators, equipment or other facilities.

Operating capital loans are of several types:

a. Long-term operating capital loans are made for such purposes as supplementing an association's own working capital funds used in carrying inventory and accounts receivable and paying operating expenses. Loans of this type may be repaid over a period of several years, depending upon the association's needs and its ability to repay.

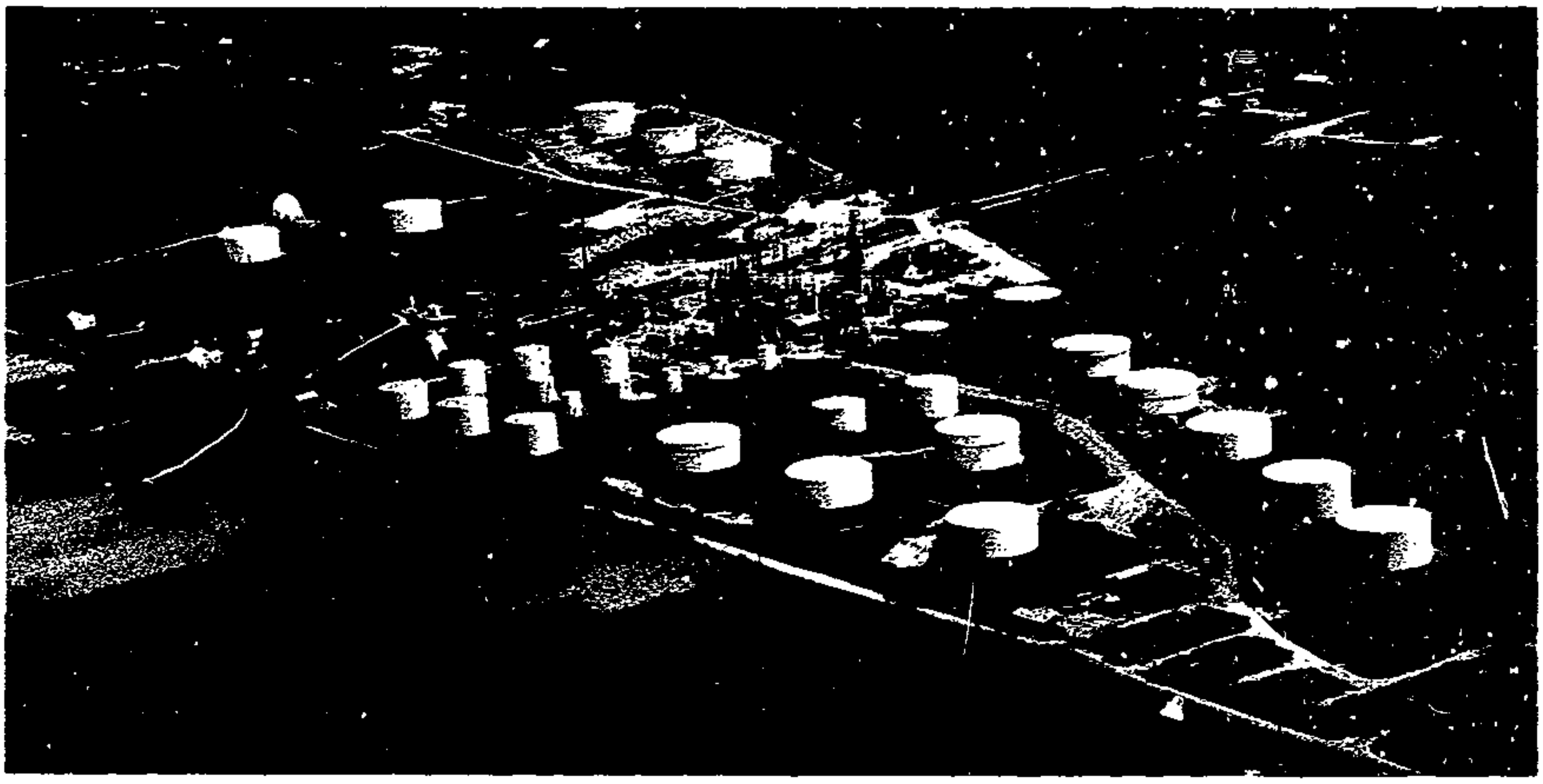
b. Short-term operating capital loans are made to assist an association in financing its seasonal requirements. They are usually granted for a period of not more than one year. These loans include a reinstatement privilege.

Facility loans may be made to purchase or build facilities or to refinance indebtedness created by acquiring facilities. Loans of this type must be secured by a first mortgage and may be repaid over a period of not more than ten years.

Commodity loans are made to finance inventories of such farm products as cotton, grain and wool from the time such products are delivered to the association until they are marketed. Loans of this type are usually secured by warehouse receipts. (See page 18.)

Application for Loans

Suppose you are an officer in a cooperative. How would your co-op apply for a loan? This depends in part on whether your cooperative is already organized and in operation or is a new cooperative, being organized and need-



This cooperative petroleum refinery cost farmers $7½ million. Through it they provide themselves low price, high quality gasoline and diesel fuels necessary to efficient farming operations.

ing credit to begin operations. In either case, your officers or leaders, before filing a written application for a loan, would meet with representatives of the bank for cooperatives to discuss your situation and needs.

In this preliminary discussion you would inform the representative of the bank of your association's plans and the purposes of the proposed loan. He would study briefly the association's financial condition and operating record. From long experience in financing cooperatives the officers of the bank can usually give sound advice in the organization, management, and financing of such associations. Their counsel is available not only at the time a loan is considered but also throughout the life of the loan.

If you are organizing a new cooperative, the bank's officers and fieldmen can help in drawing up the plans of organization and in planning the type of operation. They can also advise you about legal steps to take in organizing your cooperative so that it will be eligible for a loan from the bank.

After preliminary discussions are completed, the cooperative may then apply for a loan by using the bank's regular application form and submitting any additional information the bank may require.

A Soundly Financed Cooperative

In the four states of the Farm Credit District of Louisville, many cooperatives are engaged in the purchase of farm supplies. Some of these cooperatives have been in operation since the early part of this century. Others gut their start in recent years. The cooperative discussed here is an example of the latter group. No doubt it has profited from the experience of pioneer cooperatives in this area.

This organization was incorporated in 1945. During the first two years, it operated on a part-time basis and did not employ a full-time manager until the fall of 1947. During this period, it operated from a rented building. Its sales consisted almost entirely of fertilizer. With the employment of a full-time manager, the association's directors began a campaign to raise membership capital through the sale of capital stock. After a few thousand dollars had been subscribed, the association purchased a well-located business site at a cost of $12,000, paying for it partly with funds invested by members and partly with funds obtained through a mortgage loan from a local bank. The stock-selling campaign was continued and plans were made to build a warehouse at a cost of approximately $15,000 and a rail siding at a cost of approximately $3,700.

By the close of 1948, the association had an investment in fixed assets, including land, a truck, and some equipment, totaling about $16,000. The operation at this point was financed by approximately $21,000 in capital stock and by the mortgage loan from the local bank.

A schedule (page 59) illustrates the association's growth over a period of years, the net savings which it realized, and what it did with these savings. Another schedule (page 61) reflects the association's financial position following the completion of the principal expansion programs.

During 1949, the association built its warehouse and rail siding and, at the close of the year, had an investment of nearly $37,000 in fixed assets. The expansion in fixed assets was financed entirely through the sale of capital stock, and the association's net worth at the end of the

SUMMARY OF SALES, NET SAVINGS AND DISTRIBUTION OF NET SAVINGS

			Dividends on Stock and Patronage Refunds	
Fiscal Year	Sales	Net Savings	Cash	Allocation
1947	$ 26,100	$ 1,900	$ 1,575	$ 325
1948	202,900	9,935	8,640	1,295
1949	348,600	10,060	9,125	935
1950	430,960	17,440	12,165	5,275
1951	562,100	10,900	4,585	6,315
1952	618,000	40,250	17,465	22,785
1953	572,100	28,420	16,680	11,740
1954	675,100	45,690	18,295	27,395
1955	750,900	49,300	19,670	28,145
1956	876,100	69,340	22,900	44,710
1957	1,130,000	88,725	27,535	56,695
1958	1,354,000	101,310	32,320	66,520
1959	1,439,000	85,750	35,680	46,280
1960	1,532,800	113,120	37,530	73,125
1961	1,598,500	106,400	39,550	59,130

Note: Beginning with 1955 the association also set aside small tax-paid general reserves each year.

year amounted to about $62,800, an increase of nearly $31,000 over the net worth at the close of the preceding year.

Primarily because of its difficulty in getting enough financing through local banks, the association, in 1949, applied for and was granted a $10,000 short-term loan commitment by the Louisville Bank for Cooperatives. Loans under this commitment were secured by the pledge of stock which the association owned in the state wholesale organization of which it was a member.

During 1950, the association, in order to handle its rapidly expanding sales volume, built an $8,700 addition to its warehouse. This addition and the increased operating capital requirements were mostly financed by the sale of additional capital stock. However, at the close of the year, the association was indebted to the local bank in the amount of $4,200, to the Bank for Cooperatives in the amount of $9,000, and to an individual in the amount of $3,000. During the latter part of 1950, the association began planning for a petroleum products bulk plant to be in operation for the following spring. Before work was begun, the Louisville Bank for Cooperatives was asked about financing this venture. Representatives of the bank met with the association's manager and directors and discussed the over-all financing program. Based on the information available, it was estimated that the association would need additional permanent capital or long-term loans of approximately $42,000 and a $15,000 loan commitment to finance seasonal requirements. After it received a formal application from the association, the bank granted a $12,000 ten-year facility loan and a $15,000 five-year operating capital loan to be available as soon as the association had increased its own paid-in capital at least $15,000.

The bank also granted the association a $15,000 short-term operating capital loan commitment for seasonal requirements. During 1951, the bulk plant was completed and the proceeds of the loans from the bank were advanced.

The association's financial position at the close of the year is reflected in the balance sheet schedule presented on page 61. You will see that the association's patrons, at this point, had invested more than $96,000 (sum of preferred stock, common stock and allocated reserves) in the association to finance an investment in noncurrent assets of approximately $85,000 (sum of net fixed assets and total other assets). The remaining $11,000 was available for operating capital. The association's sales volume during 1951 passed the $500,000 mark, compared with $203,000 for its first full year of operation.

Following its first two full years of operation, the association had distributed in cash almost all its net savings for those years. Following its 1950 year, the association, in addition to dividends on stock, paid a substantial cash patronage refund and retained in an allocated form approximately $5,300. The major part of the association's net savings for 1951 were allocated.

Soon after the close of that year, the association employed a new manager. During the next three years, it devoted its efforts primarily to building its sales volume and strengthening its financial position. During this period, the association reduced its long-term note indebtedness from $24 900 to $13,350, realized more than $114,000 in net savings, of which nearly $62,000 was retained in the business on an allocated basis, and undertook no major fixed asset expansion.

It had become increasingly apparent that an efficient, up-to-date custom feed mill was needed in the territory. From preliminary plans, it was estimated that the type of facilities needed would cost about $40,000.

At this point, the association's board of directors was faced with perhaps its most important decision since the cooperative was organized. There was every indication that the association could proceed for a number of years with a satisfactory sales volume and annual net savings sufficient to retire its outstanding long-term indebtedness in a short time and pay substantial cash patronage refunds to its members. On the other hand, there was a great deal of evidence that, if the association did not act promptly, it might lose the initiative and eventually the influential position it had established. After considerable study, the board decided to proceed with the planned expansion and requested a conference with the Louisville Bank for Cooperatives in connection with the necessary financing.

After this conference, it was found that a complete revision in its loan program would be to the association's advantage. Soon thereafter, the association applied for and was granted a $68,650 line of credit, consisting of existing long-term loans of $13,350, a new $40,300 long-term facility loan, and a $15,000 short-term operating capital commitment to provide financing for seasonal activities. During 1955, the association completed its feed mill. Its financial position at the close of the year is shown in the balance sheet schedule on page 61. As of the close of its 1955 year, the association's patrons had invested in cash or in the form of retained savings more than $171,000 (sum of preferred stock, common stock and allocated reserves), but the association's investment in noncurrent assets at that time amounted to nearly $181,000. From the undistributed savings of that year, the association's directors subsequently decided to keep in the business on an allocated basis approximately $28,000, in order to improve the overall financial position.

Since then, the association has substantially enlarged and improved its feed mill and has constructed a modern seed cleaning facility. During 1959, when most of this expansion program was undertaken, the association applied for and was granted additional long-term loans of $100,000 by the Bank for Cooperatives to assist in financing the cost of the new facilities. By the time this expansion was completed, the association's total assets amounted to more than $708,000. Its net worth, consisting of common and preferred stock outstanding and allocated reserve, was almost

COMPARATIVE YEAR END BALANCE SHEETS

ASSETS	1948	1951	1955	1961
Current Assets:				
Cash	$ 558.52	$ 5,015.20	$ 176.54	$ 80,391.47
Cash Deposits	1,975.00	7,500.00	10,075.00	16,975.00
Accounts Receivable	9,486.99	25,775.91	45,939.56	141,535.03
Inventory	13,674.17	49,015.00	61,645.30	115,412.45
Total Current Assets	25,694.68	87,306.11	117,836.40	354,313.95
Fixed Assets:				
Facilities	16,232.32	70,527.68	148,170.14	401,142.05
Less Reserve for Depreciation	259.55	4,822.45	27,786.52	136,370.17
Net Fixed Assets	15,972.77	65,705.23	120,383.62	264,771.88
Other Assets:				
Investments	3,111.00	17,971.86	53,499.76	194,587.14
Prepaid and Misc. Items	127.59	1,041.06	6,927.87	30,614.92
Total Other Assets	3,238.59	19,012.92	60,427.63	225,202.06
Total Assets	$44,906.04	$172,024.26	$298,647.65	$844,287.89
LIABILITIES				
Current Liabilities:				
Accounts Payable	4,800.80	21,910.31	23,335.82	36,280.40
Notes Payable—Short Term	-0-	18,000.00	15,000.00	-0-
Notes Payable—Current Payments	2,100.00	4,200.00	7,800.00	14,640.00
Total Current Liabilities	6,900.80	44,110.31	46,135.82	50,920.40
Fixed Liabilities:				
Notes Payable—Long Term	6,300.00	20,700.00	37,600.00	90,140.00
Total Liabilities	13,200.80	64,810.31	83,735.82	141,060.40
NET WORTH				
Preferred Stock	20,670.00	87,680.00	101,780.00	218,360.00
Common Stock	774.00	901.00	938.00	848.00
Allocated Reserve	325.50	7,730.02	68,844.01	376,791.18
Surplus	-0-	-0-	-0-	11,518.34
Undistributed Savings	9,935.74	10,902.93	43,349.82	95,709.97
Total Net Worth	31,705.24	107,213.95	214,911.83	703,227.49
Total Liabilities and Net Worth	$44,906.04	$172,024.26	$298,647.65	$844,287.89
Working Capital	$18,793.88	$ 43,195.80	$ 71,700.58	$303,393.55

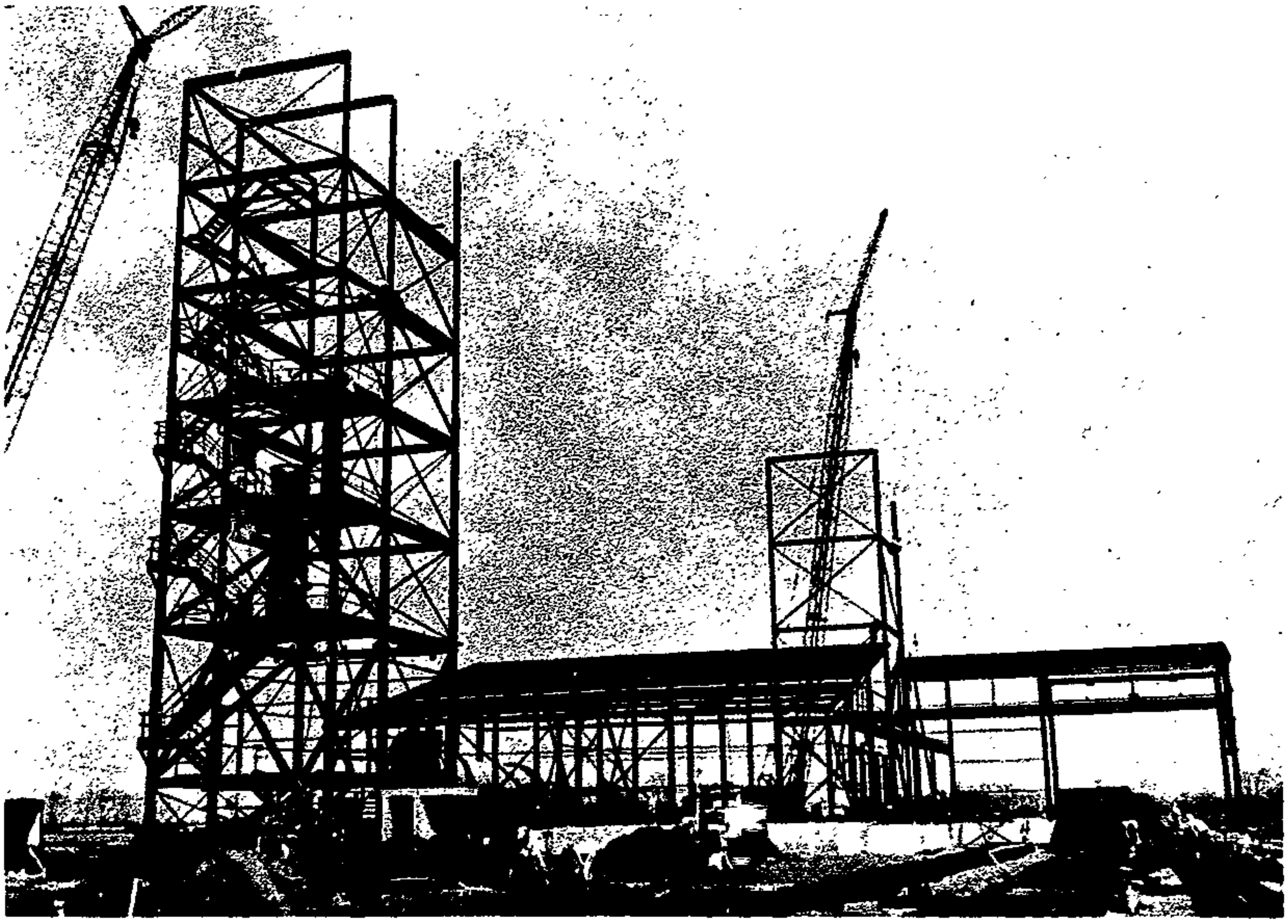
$552,000. Liabilities amounted to about $156,000, of which almost $120,000 was a long-term loan payable over approximately a ten-year period. During 1961, the association made additional investments in fixed assets, financed entirely by the sale of stock to patrons and other interested investors. Its financial position was further strengthened by retaining in the business about $60,000 of the net savings for that year. Its sales volume for that year reached nearly $1,600,000.

The association's operations are integrated to a considerable extent by membership in a regional cooperative that operates on a state-wide basis and manufactures fertilizer and feeds, operates seed cleaning and processing plants, and warehouses on a wholesale basis. Most of the other farm supply items are handled by the local retail cooperatives in the state. The association's investment in this regional cooperative is nearly $170,000.

Through an aggressive policy, the association has reached a point where it exercises a definite influence over the quality and price of merchandise offered in its territory. By attempting to realize a fair margin on the merchandise and services offered, the association has established an excellent operating record, has returned to its patrons each year a reasonable cash refund, and has strengthened its financial position through substantial allocations which are being retired on a revolving basis. The association's operation has been characterized by intelligent planning, careful financial analysis, sound pricing policies, and effective inventory control. Although it has been somewhat liberal in its credit policy, its bad debt losses have not been excessive in relation to its sales volume.

Although its growth has been rapid, the association has maintained a strong working capital position. It has done this by obtaining membership capital or long-term loans to take care of permanent and long-term investments and normal requirements for receivables and inventories.

For its borrowed capital, the association, since early in its history, has looked toward the Louisville Bank for Cooperatives. It has also maintained an excellent relationship with its local bank and has utilized that source upon several occasions to provide additional funds needed for a short period of time.



Under construction is this $20 million nitrogen plant. It will be owned and operated by cooperatives serving 550,000 farmers in four states. It is being financed by the purchase of stock and bonds by individual farmers together with funds borrowed from the Louisville Bank for Cooperatives. Such facilities are important to farmers because half of their fertilizer costs are for nitrogen.

MOVIES

The Farm Credit Banks of Louisville maintain a small library of educational movies for vocational agriculture classes and other farm groups at no cost except for return transportation. All are 16 mm. sound, color films. For any of the following movies: write to J. M. Heizer, director of information, Farm Credit Banks of Louisville, P. O. Box 239, Louisville 1, Kentucky. Requests should be made several weeks in advance of desired showing dates. List second choice film and give type and size of audience expected to see it.

	Minutes
Farmer Cooperatives Today	20
Farmers Working Together	20
Livestock Cooperatives in Action	20
What Is A Farm Worth?	22
It's the Farmer's Business	14
Credit Where Credit Is Due	28

VT002 020

VT 002 020
Preparing for Employment in Child Care Services in Pennsylvania Schools.

Pennsylvania State Dept of Public Instruction, Harrisburg
Pub Date - 66
MF AVAILABLE IN VT-ERIC SET 63p.

*CURRICULUM GUIDES, *TEACHING GUIDES, *OCCUPATIONAL HOME ECONOMICS, *CHILD CARE OCCUPATIONS, CHILD CARE, *CHILD DEVELOPMENT, HIGH SCHOOLS, PROGRAM DEVELOPMENT, EDUCATIONAL FACILITIES, EDUCATIONAL EQUIPMENT, OBSERVATION, RESOURCE MATERIALS,

This curriculum guide is designed to help prepare students for employment in occupations of less than professional level in child care services. The resource materials are organized around 12 key concepts which could be easily adjusted to local situations and changing conditions. Examples of concepts are--(1) The care and guidance of children is a fundamental concern of society, (2) Concern for safety is a prime responsibility when caring for children, (3) Heredity and environment are cofactors in the growth process, and (4) Play helps a child move toward his full potential. Specific objectives, generalizations, and experiences are listed with each unit developed around a concept. The teacher must be certified to teach in a nursery or prekindergarten school and also at the secondary level. The 11th and 12th grade students should have the necessary personal qualifications, and have 1 year in a comprehensive homemaking course. The suggested time allotment is 2 years, and half the time should be spent in observation and work with young children. Also included are (1) requirements for space and facilities, (2) a list of guidelines for planning, equipping, staffing child care and development laboratories in secondary schools, (3) layout plans for child development laboratories, (4) resource lists, (5) sample evaluation instruments, and (6) certification regulations. (MS)

Preparing For Employment In Child Care Services In Pennsylvania Schools.

COMMONWEALTH OF PENNSYLVANIA
Department of Public Instruction
Harrisburg
1966

Errata

Page 13 - Under Teacher References, first line, the author's name, "Tabs" is misspelled. It is spelled "Taba".

Page 18 - "Experiences" column, the statement "Disadvantaged" children may be found on all economic and cultural levels" should appear in the column, "Generalizations."

Acknowledgements

Dr. Winona Morgan, also serves as the Director, Nursery Schools, The Pennsylvania State University.

Miss Katherine Stooksbury, is the Assistant Director, Nursery Schools, The Pennsylvania State University.

MESSAGE FROM THE SUPERINTENDENT OF PUBLIC INSTRUCTION

The Vocational Education Act of 1963 opened avenues for the development of new home economics education programs to prepare youth and adults for employment in occupations of less then professional level. The area of Child Care and Development is one which merits special consideration since there is an increased need for public and private services to children in a period of accelerated social change. The rapid expansion of services and facilities concerned with the care of young children is creating an increasingly difficult problem of adequate staffing of trained personnel. The publication, "Preparing for Employment in Child Care Services in Pennsylvania Schools" includes resource materials for planning, initiating and conducting programs to prepare trained personnel for employment.

This bulletin is prepared for the use of teachers, administrators, vocational directors, advisory committee members and others interested in starting a Child Care and Development Center for training students to work with young children in nursery or pre-kindergarten schools, Headstart programs, day-care centers, recreation programs, summer camps, private homes and institutions.

J. R. Rackley

J.R. Rackley

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APPENDIX

INTRODUCTION

This bulletin is designed to assist school districts in the implementation of a course leading to employment in occupations of less than professional level in child care services. A course of this type is especially timely because of the impact of the Vocational Education Act of 1963 which has focused attention on wage earning skills which stem from Home Economics subject matter; and because of the Economic Opportunity Act which has highlighted the need for increased services to young children. Other federal legislation such as the Elementary and Secondary Education Act is providing funds which may be used for educational services for pre-school children.

Job opportunities in the field of Child Care Services are increasing because of:

- the initiation of programs for disadvantaged children which involve the use of teacher aides. These aides have proved to be so useful in relieving teachers of non-professional duties that their widespread use throughout the elementary school seems imminent.

- the upward trend in the employment of working mothers which has resulted in an increased demand for public and private day-care centers.

- the increased personnel needs of public and private schools and institutions providing care for normal and atypical children.

- the general affluence of our society which enables many homemakers to pay for skilled assistance with the care of children in the home.

The resource materials in this publication are organized around certain key concepts which might well form the basis for any course in child development from the junior high school level upward into college. The teacher will need to use her judgment concerning the order in which these concepts are presented to students. After the trainees are participating in the nursery school program, it will be necessary for the teacher to continue to direct attention to the many ways in which these concepts are applied when actually working with children.

Evaluation devices should be used which will indicate the completeness of concept formation and the extent of application in the laboratory experience. A few suggestions for evaluation are given in the Appendix, but for the most part, evaluation techniques should be developed through teacher-pupil planning. Aiding the trainees in the art of self-evaluation should be considered one of the most important aspects of the training course.

Pertinent references have been given with each key concept. Other references of a more general nature are included in the supplementary bibliography in the Appendix. A special effort was made to list only films which are easily available to Pennsylvania teachers at little or no cost.

PROGRAM ORGANIZATION

Program Objectives

To train employees for child care services who will:

Be familiar with employment opportunities in this field.

Recognize that caring for children is an important worthwhile job.

Have a functional understanding of the basic concepts of child development.

Cooperate with all who are concerned with the welfare of children.

Be capable of interpreting and carrying out directions and instructions.

Have the ability to plan, prepare, and serve simple nourishing meals and snacks for children.

Assume responsibility for helping children to develop good personal habits relative to food, housekeeping, cleanliness, and safety.

Assist in keeping the children's surroundings clean, safe, and attractive.

Be capable of directing individual or group activities of children such as story telling, games, play, and various creative experiences.

Assume responsibility for the safety of children.

Handle emergencies calmly and intelligently.

Understand the selection, use, and care of various games, play apparatus, toys, and supplies.

Be resourceful in improvising play materials and activities.

Assist with the keeping of records.

Teacher Qualifications

The teacher will be certificated to teach in a nursery or pre-kindergarten school, as well as at the secondary level. She will meet the standards established by the Department of Public Instruction for "Comprehensive Certification of Teachers of Nursery Schools; or Child Care and Development in Child Development Laboratories in Secondary Schools including Vocational Schools (See page 56 of Appendix).

Since there is a scarcity of teachers in this field, it may be necessary for school districts to use teachers with interim certificates until properly certificated teachers become available.

Selection of Students

To major in Child Development, a pupil should be:

mentally and physically healthy,
interested in children,
capable of average intellectual achievement,
a pleasant cooperative individual.

It would be desirable for trainees to have the following courses as prerequisites:

one credit in comprehensive vocational home economics.
one credit in biology.

If this course is offered to out-of-school youth and adults, it may be necessary to give additional consideration to the screening of trainees.

Grade Level

This course would be offered at the 11th and 12th grade level in the comprehensive high school. It might also be offered in the Area Technical School on the 11th and 12th grade level or on the post-high school level. The resource material in this bulletin could also be adapted as a course offering in a junior or community college.

Length of Course

The minimum length of this child development program would be the equivalent of two class periods (90-100 minutes) per day for two years. Approximately one-half of the time should be spent in observation in laboratory work with young children. The program might be expanded by providing additional time for supervised laboratory experience with children and/or a work experience program in community child care centers or institutions. Adequate supervision and evaluation should be provided for work experience programs outside the school. Such programs should comply with health and labor regulations.

Scheduling

The scheduling should be flexible enough to permit the blocking of time for nursery school participation and field trips.

Program of Studies for Child Development Majors

Following is a suggested program of studies for students majoring in child development. This can be adapted to meet local education situations.

10th Grade

1 Credit	English
1 Credit	World Cultures
1 Credit	Biology
1 Credit	Mathematics
1/3 Credit	Health and Physical Education
1 Credit	Home Economics including Food and Nutrition, Management, Clothing, and Family Relationships

11th Grade

1 Credit	English
1 Credit	U.S. History
1 Credit	*Elective (suited to trainee's interest and ability)
1/3 Credit	Health and Physical Education
2 Credits	Child Development

12th Grade

1 Credit	English
1 Credit	P.O.D. including Economics
1 Credit	*Elective
1/3 Credit	Health and Physical Education
2 Credits	Child Development

*Typing is considered a desirable elective, but it is not listed as a requirement because it is considered desirable to allow some flexibility to meet individual needs and interests of pupils.

Advisory Committee

An advisory committee should be established before the program is initiated. This is a requirement of the Vocational Education Act of 1963 for all wage earning programs in home economics education.

In setting up the advisory committee, an attempt should be made to have it truly representative of the total community. People can be invited to serve from various economic levels, different racial and nationality groups, and varying educational levels. The teacher will need to keep in mind that the people on the committee will undoubtedly be busy people. Therefore, their time should not be wasted. Meetings should be well planned, efficiently conducted, and scheduled at a time most convenient for those concerned.

It would be desirable to include representation from the Board of Education and the school administration. Representatives from social agencies or institutions concerned with the care of children can make a valuable contribution to curriculum planning. They can also cooperate in arranging field trips, provide opportunities for realistic work experiences, and assist in the job placement of graduates. Mothers of pre-school children can assist in the recruitment of children for the nursery school group and in making arrangements for their transportation. Professional people such as pediatricians, nurses, and social service workers will be valuable resource people on the committee.

Parent Education

Nursery schools are usually more successful when there is a close working relationship with the parents of the children. This relationship can be promoted (1) through informal contacts with the parents as they bring the children to the school, (2) through home visits, and (3) through a planned program of parent education which would involve fathers as well as mothers.

It would be a worthwhile experience for the trainees in the class to assist the teacher in planning and conducting a series of meetings for parents. A survey of the community should reveal several resource people who could be asked to participate as speakers or consultants. The possibility of financing such a program with adult vocational education funds should be explored.

Financing

Programs which meet the criteria for reimbursement from Vocational Education funds will be financed according to the Federal Acts, State Laws and Regulations established by the State Board for Vocational Education. Requests for home economics programs and equipment funds will be submitted on the appropriate VE-Form. Additional information and directions may be secured from the Department of Public Instruction, Bureau of Vocational, Technical and Continuing Education, Section of Home Economics Education and School Food Service.

CURRICULUM GUIDE AND RESOURCES

The Curriculum Guide and the suggested resource materials are centered around twelve key concepts of child care and guidance. A curriculum that is structured on basic concepts and supporting generalizations can be easily adjusted to local situations and changing conditions. It can also be adapted to meet the individual needs of pupils of varying educational and ability levels.

Key Concepts

- The care and guidance of children is a fundamental concern of society.
- Evaluation is a continuous process of appraisal concerned with determining the extent and effectiveness of learning.
- Heredity and environment are co-factors in the growth process.
- Human growth has certain basic needs which must be satisfied through interaction with the environment.
- The entire growth process is a dynamic quest for maturity. (Individual differences).
- Food plays an important role in the growth process.
- Effective guidance of children's behavior helps them to move forward toward social maturity. (Discipline).
- Effective child guidance requires harmonious teamwork on the part of all people concerned.
- Play helps a child move toward his full potential.
- Retarded children can be helped to grow toward their fullest potential by proper care and guidance.
- Children with certain physical handicaps require special care.
- Concern for safety is a prime responsibility when caring for children.

Key Concept: The care and guidance of children is a fundamental concern of society.

Objectives:

The recognition that child care and guidance is an important responsibility of society.

An awareness of the various employment opportunities in the field.

The beginning of an understanding of certain basic terms and concepts.

Generalizations	Experiences
The family is the fundamental unit of our society. In our culture, the family assumes much responsibility for the care and guidance of children. The family has biologic, economic, and cultural functions. Family life provides a setting for the transmission of cultural patterns from one generation to another.	View a film such as, "Skippy and the Three R's," for the purpose of focusing attention of the class on a normal child with a favorable family background. Use the film as the basis for a circular response discussion on the role of the family during the pre-school years. Summarize the discussion by planning and arranging a bulletin board showing the contributions of the family to the child. Encourage pupils to generalize concerning the role of the family.
The feeling of security which a young child derives from his life within the family facilitates his development. The family situation should provide a setting in which a child can acquire an attitude of self-respect, as well as an attitude of respect for others.	View a film showing a child with a less desirable background such as, "A Desk for Billie," or "A Child Waits." Contrast this family with the one shown in the Skippy film. Analize the reasons for family failure to provide a suitable environment and atmosphere for its children. Through discussion begin to develop an understanding of such terms as: The "culturally deprived" child The "under-privileged" child The "disadvantaged" child

Generalizations	Experiences
Social change is constantly taking place. The process of social change is accelerated by rapid technological advance, and by changes in political theory. Families differ in their ability to cope with social change. Families differ in their ability to assume the responsibilities involved in the rearing of children. Society provides various agencies and individuals to help families with the rearing of children.	Make a survey of the community to determine the agencies, both public and private, which are concerned with the care and welfare of children. List these with a brief description of the service which they provide and a brief job description for each of the types of personnel employed. Issue this in mimeographed form for future reference regarding job opportunities. Arrange field trips to some of these agencies - or invite personnel from the agencies to visit the class and discuss the type of service provided.
The complexity of modern life sometimes makes it necessary for the family to call on other agencies to assist with the care of children.	Make a survey of the working mothers of young children to determine how the children are cared for while the mother is working. Using library research and/or the technique of interviewing older people, analyze some of the changes which have occurred in the American family during the past fifty years. Use the information obtained as the basis for a class discussion, relating it particularly to the effect which these changes have had on the rearing of children.

Generalizations	Experiences
Society must sometimes provide a substitute for the family.	Discuss the pros and cons of foster homes vs. institutional care for children without families of their own. A field trip to the Milton Hershey School would be a worthwhile experience.
Legal adoption makes it possible for many children to acquire a family.	View the film, "A Baby Named X."
The adoption of children is carefully regulated to protect both the child and the adopting parents.	Invite a representative from a child adoption agency to discuss the subject with the class.

NOTE: The films mentioned in this section may be secured from the Bureau of Community Mental Health Services, Department of Public Welfare, Harrisburg, Pennsylvania.

The film "Skippy and the Three R's" may also be secured from the National Education Association.

Key Concept: Evaluation is a continuous process of appraisal concerned with determining the extent and effectiveness of learning (growth).

Objectives:

An appreciation of the importance of evaluation as an integral part of the educative process.

Some understanding of the many factors involved in evaluation.

The ability to assist in simple appraisals of the development of nursery school children.

A willingness to engage in self-evaluation.

The ability to use the results of evaluation as a guide to future action.

Generalizations	Experiences
Evaluation is a continuous process which begins with the formulation of objectives and continues as an integral part of the learning process.	The trainees should be given a chance to participate in establishing the objectives of the training course.
An awareness and acceptance of objectives is a necessary prerequisite for evaluation.	Various techniques can be used to keep the students aware of the basic objectives of the course.
Evaluation is more meaningful if pupils participate in setting up objectives and in devising ways in which their progress can be evaluated.	Students can suggest and develop various ways in which their progress can be evaluated.
Self-evaluation is essential to growth and improvement.	Use the check sheet in Hatcher and Andrews, "Adventuring in Home Living," Book II, pages 463-464.
Evaluation of the children's development is a responsibility of the "child guidance team."	Devise other types of evaluative devices and use them in the nursery school.

Generalizations	Experiences
Evaluation can point the way to future action.	Plan nursery school activities which will help bring about the desired learnings.

Teacher References:

Curriculum Development - Theory and Practice. Hilda Tabs. Harcourt, Brace and World, Inc., New York, 1962. Chapter 19.

The Teaching of Home Economics. Hatcher and Andrews. Houghton Mifflin Co., Boston. Second Edition, 1963. Chapter 12.

Handbook for Teachers. Evaluation in the Total Learning Process, Curriculum Bulletin No. IV, August 1962. Department of Education, Home Economics Education, Honolulu, Hawaii.

Evaluation Materials for Use in Teaching Child Development. Marjorie Brown and Jane Plihal. Burgess Publishing Company, 426 South Sixth Street, Minneapolis, Minnesota, 55415.

Key Concept: Heredity and environment are co-factors in the *growth process.

Objective:

An understanding of the role of heredity and environment in the growth process.

Generalizations	Experiences
The basic pattern or blueprint of human growth is determined by the laws of heredity.	Discuss the role of heredity and the role of environment in relation to the growth process. To provide background for the discussion, view two or three films dealing with heredity and human reproduction.
The element of chance plays a part in inheritance.	
Growth is a continuous process which begins at the moment when the egg cell is fertilized by the sperm.	Assemble a collection of books and pamphlets relating to human reproduction and arrange time for students to do free choice reading in the classroom.
The growth process occurs through the interaction of the organism with its environment.	
Adequate pre-natal care helps insure the health of the new baby.	Make a survey of community agencies which offer help during the pre-natal period. Ask a public health nurse to discuss the work of a pre-natal clinic.
	Discuss the problem of the unmarried mother and ascertain what the community is doing to deal with this problem.

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*The terms "growth" and "growth process" as used here, and on ensuing pages, refer to the total development process, not to physical growth alone. The teacher may wish to consult "The First Five Years of Life," by Arnold Gesell, Harper Brothers, pages 6 to 9, for a discussion of "growth" as the key concept in child development.

Generalizations	Experiences
The diet of the mother before and during the pre-natal period influences the development of the baby.	Discuss "Diet during pregnancy." Plan a day's food pattern which would serve as a guide for meal planning during this period. Use the pattern to plan a day's meals. Set it up in visible form using food models such as those which can be obtained from the Dairy Council.
Birth defects result when something goes wrong, either in the blueprint (heredity) or in the mother's body (environment).	Ask a librarian's assistance in locating some of the excellent articles on this subject which have appeared in recent periodicals. Secure pamphlets and leaflets from national organizations such as the Kennedy Foundation. Divide the class into committees and have each committee prepare a report dealing with one type of birth defect.
	Visit a special education class or institution where children with birth defects are enrolled. Ask the special teacher to talk to the class concerning her work with these children.
	Ask a representative of one of the national organizations to speak to the class. The National Association for Retarded Children and the Cerebral Palsy Associati have volunteer members in most communities.
Some birth defects can be prevented.	Discuss the prevention of birth defects.

The following books and films will provide useful background information concerning heredity and environment during the early stages of the growth process.

Books:

DNA-Ladder of Life. Edward Frankel, McGraw-Hill, N.Y. 1964

The Genetic Code. Isaac Asinov, New American Library, N.Y. 1963

Life's Key - DNA. Carleen M. Hutchins, Coward-McCann, N.Y. 1961

The Coil of Life. Ruth Moore, Alfred A. Knopf, N.Y. 1961

Being Born. Francis Bruce Strain. Appleton-Century-Crofts. 1936

Films:

Biography of the Unborn. Traces the creation of life from the moment of fertilization to the moment when the infant begins independent life.

Blood Groups, Skin Color, and Gene Pools. Emphasizes the part played by chance in inheritance.

Cell Reproduction. The role of DNA is emphasized.

From Generation to Generation. Illustrates basic facts of human reproduction showing childbirth as an emotional and spiritual experience as well as a physical one.

Human Reproduction. Factual film on human reproduction.

Inheritance in Man. Illustrates how the laws of heredity apply to man.

Science of Genetics. More on DNA.

Baby Meets His Parents. Shows the relation of heredity and environment to personality.

NOTE: The first seven films mentioned above may be obtained from the film library of the regional Instructional Center serving Northeastern Pennsylvania and will probably be found in similar centers throughout the Commonwealth.

The film Baby Meets His Parents may be secured from the Bureau of Community Mental Health Services, Department of Public Welfare, Harrisburg, Pennsylvania.

Key Concept: Human growth has certain basic needs which must be satisfied through interaction with the environment.

Objectives:

An understanding of the basic needs of growth.

An understanding of the type of environment which will best enable children to satisfy their basic needs.

A positive commitment to the improvement of environment as a means of facilitating growth.

The ability to assist in the establishment of a favorable environment.

Generalizations	Experiences
There are basic needs which all individuals seek to satisfy.	Through discussion, identify the basic needs of children and classify in a way which is meaningful to the trainees:
All individuals have certain needs in common, but there is a variety in their manifestation and satisfaction.	1. Physical 2. Mental 3. Social 4. Ego-integrative Plan and carry out the details of a nursery school experience which will provide a favorable environment for satisfying the basic needs of pre-school children. Ideally, the nursery school children should be representative of a variety of backgrounds - economic, cultural, racial, etc.
The needs and goals of maturing individuals are dynamic and have far-reaching consequences moving from immediate situations toward more remote situations.	Review a "case study," a movie, or biographical material which will indicate the far-reaching effects of unsatisfied needs. Plan a rotation of duties in the nursery school so that each trainee will have an opportunity to participate in: 1. Planning and preparation of meals and snacks for children.

Generalizations	Experiences
	2. Supervision of eating, rest periods, and toileting. 3. Assisting in the preparation and care of play materials. 4. Participating in the direction of play, story telling, music, art, and science experiences. 5. Laundering and caring for children's clothing. 6. Participation in parent conferences and group meetings for parents.
When the environment fails to enable a child to satisfy his basic needs, the child is termed "disadvantaged" or "underprivileged."	Discuss various ways in which a child may be "disadvantaged." "Disadvantaged" children may be found on all economic and cultural levels. Plan nursery school experiences which will be helpful to the disadvantaged children in the group. Keep a special record of their development. Develop cooperatively a code of ethics for trainees to follow when discussing the intimate problems of nursery school children and their families.

Teacher Reference:

Journal of Home Economics, Vol. 58, No. 2, February, 1966, p. 107. Implementing the Concept Approach in Teaching Child Development at the Secondary Level. Flossie M. Byrd.

__Key Concept__: The entire growth process is a dynamic quest for maturity.

Objective:

An understanding of the developing personality.

Generalizations	Experiences
Each child comes into the world with a unique individuality.	View two films dealing with individual differences. Part I - __Each Child is Different.__ Part II - __Discovering Individual Differences.__
Each child has a tempo and a style of growth which is characteristic of his individuality.	Use these films as a basis for the discussion of individual differences.
There are laws of sequence and maturation which account for general similarities and basic trends of development.	Assist the school nurse in weighing and measuring primary school children.
The child grows as an integrated whole - all aspects of growth are interrelated.	Weigh and measure the nursery school children and make plans to keep a record of their physical growth during the nursery school period.
The growth process is sparked by an innate dynamic urge to reach maturity.	Secure a table of normal heights and weights for young children. Compare with those of the children weighed and measured by the class. In the light of previous class discussions, discuss the use and misuse of norms. (See Gesell - __Infant and Child in the Culture of Today__, pp. 68-72.)
Growth is a patterning process which organizes the individual and brings him toward a state of physical, mental, emotional, and social maturity.	Discuss other aspects of the growth process which are not so easily measured. Ask the school psychologist to discuss the measurement of mental development in young (pre-school) children. View the film strip titled, "__Your Child's Intelligence.__"

NOTE: The film strip may be purchased from NEA in Washington, D.C. for $7.00. This price includes a recording of the script.

Generalizations	Experiences
Since no two children grow at the same rate or in exactly the same way, norms can be misleading.	Determine the meaning of the term, "Intelligence Quotient." Discuss the value and the danger of using it as an indication of mental growth. Compare its significance as an indication of normal mental growth with the height-weight table as an indication of normal physical growth.*
Each child's personality is a product of slow and gradual growth.	View and discuss two films which show the emerging personality patterns of pre-school children.
Personality patterns are influenced by many factors.	"The Terrible Twos - The Trusting Threes."
The most bewildering task for a young child is to discover his own self-identity and to relate his newly discovered self satisfactorily to other people.	"The Frustrating Fours - The Fascinating Fives."
Emotions are an integral part of behavior patterns.	Prepare an age chart of personality characteristics of pre-school children.
Emotions grow and mature in the same sense that perceptions, judgments, and concepts grow.	
Adults who understand and accept a child's immaturity are more capable of guiding him effectively.	

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*Teachers wishing to update their own concepts of intelligence and personality will find the following books helpful:

"Productive Thinking in Education," edited by Aschner and Bish, National Education Association, 1201 Sixteenth Street, N.W., Washington, D.C. (paperback edition, $3.00).

"Personality" by J. P. Guilford, McGraw-Hill, N.Y., $7.95.

Note: The films mentioned can be secured from the Bureau of Community Mental Health Services, Department of Public Welfare, Harrisburg, Pennsylvania.

Key Concept: Food plays an important role in the growth process.

Objectives:

An understanding of the nutritional needs of children.

The ability to prepare and serve nutritious and attractive meals for pre-school children.

The ability to assist children in the formation of desirable food habits.

The ability to make observations and keep records which will indicate the progress which the children are making.

Generalizations	Experiences
Learning to eat and enjoy a variety of nutritious foods is an important part of a child's development.	Observe the eating habits of a group of children in the school lunch program of a primary school. Use an observation sheet for each child observed. Discuss the observations in class and identify the differences found in the food habits of the children. Classify the habits observed as desirable or undesirable from the standpoint of the children's health and growth. Encourage pupils to generalize concerning the formation of food habits.
The formation of wholesome attitudes toward food begins during infancy.	View a film such as, "Babies Like to Eat," which will summarize the feeding of infants and provide a background of work with pre-school children.
Lasting food habits are formed during the pre-school years.	Discuss the factors which influence children's food habits. Decide how pre-school children can be encouraged to form desirable habits. Use these suggestions as a guide for nursery school procedure.
Food habits are influenced by many factors.	

Generalizations	Experiences
Children's meals must be carefully planned to include all the nutrients needed for health and growth. Meals for children should be simple, nutritious, attractive, and carefully planned.	Review the nutrients which are necessary for health and growth. Develop a "pattern" for a preschool child's daily meals similar to the Type-A pattern for school lunches. Using the pattern as a guide, plan meals for preschool children. Actually prepare and serve the noon meal for preschool children over a period of several weeks. (The amount of training given in actual food preparation prior to the preparation of meals for the children will depend on the background of the trainees.)
Mealtime can be a happy experience for children.	Trainees can take turns eating with the children at their small tables. "<u>Adventuring in Home Living</u>" by Hatcher and Andrews, Book II, pages 474-489, provides many suggestions for helping children with eating problems.
Making it possible for children to participate in the serving and clearing away of meals increases their interest in food and their sense of responsibility.	Plan ways in which children in the nursery school can participate in the serving and clearing away of meals.
	Develop a method of recording observations concerning the children's food habits. Use these records as a basis for determining corrective procedures and for evaluating progress.

NOTE: The film, "Babies Like to Eat" can be obtained from the National Dairy Council in Chicago or from any of its local branches.

Key Concept: Effective guidance of children's behavior helps them to move forward toward social maturity.

Objectives:

The ability to guide the behavior of children in ways which enable them to maintain their self-respect and move forward in their quest for social maturity.

The ability to discriminate between acceptable and unacceptable patterns of behavior - and to help the child learn to discriminate.

The ability to set limits for children's behavior and enforce them in those situations where they are too immature to judge the consequences of their own behavior.

Generalizations	Experiences
Adults differ in the way in which they guide children's behavior.	Discuss various ways in which members of the class have seen adults give direction to children's behavior. Role-playing of several situations might be used to stimulate discussion. The film, "*Preface to a Life*," shows a contrast between democratic and autocratic techniques. Discuss the difference.
Teachers guide behavior in many subtle ways.	View again the film, "*Skippy and* the Three R's." This time, focus attention on the teacher. Try to analyze the various ways in which she gave direction to the children's behavior.
Understanding the reason for misbehavior helps adults deal with it more effectively.	
Effective guidance helps the child establish a value structure which serves as a guide to his own self-control.	Make some generalizations concerning the effective guidance of children's behavior.
Effective guidance helps the child develop and maintain his self-respect.	

Generalizations	Experiences
Action is often more effective than words.	Discuss the use of words in guiding behavior. Describe specific situations and decide how words might be used to guide behavior in these circumstances.
Words have power in the guidance of behavior only if they are skillfully used and adapted to the tempo of the child's mind.	
Positive suggestions are more effective than negative ones.	View the film, "Helping a Child Accept the Do's and Don'ts."
Words are of little use when a child is emotionally disturbed. Words can be used to give encouragement.	Use situations which occur in the nursery school as a basis for class discussion and evaluation.
It is easier for a child to accept limits and restrictions which are consistently enforced by all adults concerned.	
Children accept guidance more readily from adults whom they respect.	Discuss punishment and decide on criteria which might be used to decide whether a certain type of punishment is desirable or undesirable. Use the criteria set up by the class to evaluate the following: physical punishment humiliation praise rewards threats natural consequences isolation removal of privileges
Children learn to accept limits and restrictions just as adults learn to accept regulations and laws.	
Once a direction has been given it should be complied with, or a follow-up suggestion should be made.	
Discipline should never be administered in a vicious or hostile manner.	
A child should never have occasion to doubt that he is loved and respected even though his behavior is not approved.	

NOTE:

The films, "Preface to a Life," "Skippy and the Three R's," and "Helping a Child Accept the Do's and Don'ts," may be secured from the Bureau of Community Mental Health Services, Department of Public Welfare, Harrisburg, Pennsylvania.

The filmstrip, "Your Child and Discipline," including narration, may be secured from National Education Association, 1201 Sixteenth Street, N.W., Washington, D.C. (Price $7.00 - Order stock number 388-11710).

A pamphlet, "Your Child and Discipline," by Dreikurs and Soltz, may also be secured from the same source in packages of 35 for $1.00. (Order stock number 382-11708).

Reference Book:

Children: The Challenge by Rudolph Dreikurs and Vicki Soltz. 1964. Meredith Press.

Key Concept: Effective child guidance requires harmonious teamwork on the part of all people concerned.

Objectives:

An appreciation of the importance of teamwork in the guidance of the growth process.

The ability to plan cooperatively with others.

A willingness to understand and accept common goals in child guidance.

The ability to work harmoniously with others in the attainment of common goals.

The ability to communicate meaningfully with other members of the child guidance team.

Generalizations	Experiences
A child's development is facilitated when all those concerned with his guidance have common goals and work together as a team.	Use the establishment of a nursery school as an experience in teacher-pupil planning. An approach of this sort is suggested in "Adventuring in Home Living," Book II, by Hatcher and Andrews. If the nursery school is already in operation, involve the nursery school teacher in the planning sessions. View the film, "Family Circles," which points up the need for home and school cooper-tion, - and plan ways in which the nursery school parents can participate in this experience. Invite some parents to participate in the planning sessions.
Cooperative planning is one way of developing a spirit of teamwork.	Summarize the cooperative planning by generalizing concerning the value of cooperative planning as a technique in human relations.
Participation in planning increases interest in a project.	
Participation in planning develops an awareness of problems and objectives.	
Participation in planning develops a sense of responsibility for the success of the project.	

Generalizations	Experience
An understanding of other people's viewpoints is conducive to harmony in human relations.	Use the training film, "Role Playing in Human Relations Training - How to Do It."
Role-playing is a technique which can be used to increase our understanding of others.	Use role-playing as a teaching technique at an appropriate time during the training course. The movie will be more effective if it is shown immediately preceding the role-playing experience.
Communication with other people is an important part of working together.	Use a training film such as, "Let's Discuss It," to focus attention on ways to improve discussion techniques. Use the information or suggestions in the film to formulate a guide for class discussions.
Group discussion is a valuable form of communication.	Select an appropriate subject for class discussion and try to make use of the suggestions in the film. Decide on various ways to communicate with the parents of the nursery school children. Carry out these ideas throughout the course.
Written records provide (1) a means of communication, and (2) form a basis for evaluation of a child's progress.	Develop a plan for nursery school record keeping which will serve as a means of communication for members of the class, - and also provide a basis for the evaluation of each child's progress.
Objectivity is an important consideration when reporting nursery school observations.	Practice writing brief objective anecdotal reports of incidents occurring in the nursery school. Use these as the basis for class discussion and evaluation.

NOTE: The films mentioned in this section may be secured from the Bureau of Community Mental Health Services, Department of Public Welfare, Harrisburg, Pennsylvania.

Key Concept: Play helps a child move toward his full potential.

Objectives:

An understanding of the role of play in the total growth process.

The ability to select play materials suited to the age, interests, and ability levels of the children concerned.

The ability to improvise play materials from inexpensive commonplace articles.

The ability to set the stage and supervise creative play experiences.

An understanding of the proper care of various play materials.

The ability to secure the cooperation of the children in caring for their play materials.

Generalizations	Experiences
Through play, a child discovers his senses and his muscles. Given proper materials and guidance, a child will work hard to improve his ability.	Discuss the various types of play such as: Block play Dramatic play Manipulative play Outdoor play Creative play.
Pre-school children need many opportunities for free play. Safety is an important consideration in the selection of toys. There should be little adult interference with play.	Develop criteria to be used in selecting toys and play materials for the nursery school. If the nursery school is not already equipped - plan the play materials needed. If it is already equipped - plan to add some new items specially planned by the group of trainees. The Pre-School Guide published by the Colorado Future Homemakers will be extremely helpful.
Pre-school children are in the large muscle stage of development and require vigorous body activity.	Prepare some improvised toys and play materials. Arrange an exhibit for a P.T.A. - or some other place where they may be seen by parents.

Generalizations	Experiences
Through play, children learn to cope with their environment.	Formulate a guide for trainees to use when guiding play activities in the nursery school.
If a child's introduction to stories and books is a happy one, he will be better prepared for future learning experiences.	Visit the children's department of a public library and ask the children's librarian to discuss the selection of books for children. Arrange for a skillful story teller to present a demonstration of story telling for the class. Have members of the group prepare simple stories and practice telling them to other members of the class. Select suitable books for the nursery school.
Creative art experiences are of great importance to the development of pre-school children.	Provide an opportunity for the trainees to become familiar with the art activities commonly used in a nursery school such as:) easel painting) finger) sponge) clay modeling) dough cutting pasting crayons sand water snow flannel board
The process is more important than the product in the development of the child.	
Adult standards and ideas should not be imposed on the child.	
	Assemble and prepare art materials for use in the nursery school.

Generalizations	Experiences
Children can be helped to become more aware of the world around them.	Plan science experiences suitable for nursery school children and carry them out.
	Plan a field trip for the older nursery school children.
Music activities provide a creative outlet for pre-school children.	Practice and carry out musical and rhythmic experiences suitable for pre-school children.

Excellent Reference:

Pre-School Guide published by the Colorado Association of Future Homemakers of America, 510 State Office Building, Denver, Colorado, 80203. Price $2.50 plus postage.

This book contains many illustrations of play equipment which can be constructed in the school shop or the home workshop.

Key Concept: Retarded children can be helped to grow toward their fullest potential by proper care and guidance.

Objectives:

An understanding of the nature of retardation.

An awareness of the special needs and problems of the retarded child.

A willingness to respect retarded children as individuals.

The recognition that helping retarded children attain happiness and further their development is a uniquely satisfying experience.

Generalizations	Experiences
The development of retarded children has been slowed down or arrested because of genetic or environmental factors.	Observe children in special education classes for (1) the educable retarded and (2) the trainable retarded. If possible, arrange a field trip to an institution caring for the totally dependent mentally retarded.
There are many levels of retardation.	
Classification of retarded children is difficult.	Discuss the observations in class and formulate the characteristics of the educable, the trainable, and the dependent.
It is important that retarded children be respected as individuals.	An outstanding member of the class (or the teacher) might give a book review of "The Child Who Never Grew" by Pearl Buck.
Most retarded children can be helped to develop independence in caring for themselves.	If possible, arrange for the trainees to have a part of their laboratory experience with children in a school or institution caring for retarded children. This is especially important if there are many job openings in this type of work for the graduates.
Each retarded child has a unique pattern of growth. Growth in all areas is not necessarily consistent.	

Generalizations	Experiences
Each child's level of development must be carefully observed for pressure to learn when applied too early leads to failure, and failure lessens the child's desire to learn the task when he is ready.	
Observation of the child's play will usually reveal those areas in which he is ready to grow.	
Retarded children have a slower rate of development, but the sequence of development is similar to that of normal children.	
Retarded children require many successful repetitions in order to acquire basic skills of self-help.	A part-time job caring for a retarded child in a home in the community would be an excellent supplemental experience for a trainee.
The retarded child requires more encouragement and recognition of his achievements than the average child.	
Success is more likely if only one skill is stressed at a time.	
Complexity of any kind overwhelms the retarded child and may result in a complete loss of interest in learning.	
Concentrating on strengths promote growth - calling attention to weaknesses retards growth.	
Individuals concerned with the care of retarded children must be unusually patient, calm, and pleasant.	

Generalizations	Experiences
Habits are more easily learned if the child feels some need for learning the habit.	The book, "You and Your Retarded Child" by Kirk, Karnes, and Kirk, will provide a wealth of material which can serve as a basis for class discussions and activities.
Retarded children generally have very short spans of interest.	
Drill periods should be short, and repeated at frequent intervals.	
Talking in simple statements to the child while he is practicing will facilitate learning.	Any of the films listed at the end of this unit may be used, especially if there is little opportunity for actual experience with retarded children.
Retarded children have difficulty in transferring learning from one situation to another.	
Controlling the behavior of retarded children requires special considerations.	

References for Teacher and Trainees:

You and Your Retarded Child. Samuel A. Kirk, Merle B. Karnes, and Winifred D. Kirk. Macmillan, New York. 1955.

The Child Who Never Grew. Pearl S. Buck. John Day, New York. 1950.

Play Activities for the Retarded Child. Bernice Carlson. Abingdon Press, New York. 1961.

Child in the Shadow. Edward L. French and J. Clifford Scott. Lippincott, Philadelphia. 1960.

Basic Lessons for Retarded Children. Lucy Hamilton. John Day, New York. 1965.

Retarded Children Can Be Helped. May A. Pines. Channel Press, Inc., Great Neck, New York. 1957.

Films:

The following films may be secured from the Bureau of Community Mental Health Services, Department of Public Welfare, Harrisburg, Pennsylvania.

Beyond the Shadow. Shows the program for diagnosing and training retarded children in Colorado.

Eternal Children. A descriptive film covering the nature and needs of retarded children from "basket" child to moron.

Forget Not These Children. A color film which shows what one state is doing to help retarded children become useful members of society.

One Small Candle. A color film showing examination, diagnosis, and education of retarded children.

Children Limited. A color film showing many children with a variety of causes of arrested mental growth. Suggests the need for special care and training.

<u>Key Concept</u>: Children with certain physical handicaps require special care.

Objectives:

An understanding of the various types of physical handicaps which require special care.

Generalizations	Experiences
Aside from their handicaps, physically handicapped children are normal children.	Discuss the common physical handicaps such as: Blindness Deafness Cerebral-palsy Muscular dystrophy
Specialized care can help the physically handicapped child become a more self-sufficient individual.	Review of the books, "<u>Karen</u>," and "<u>With Love from Karen</u>," by Marie Killilea will increase understanding of cerebral-palsy.
	Arrange field trips to special school classes or institutions caring for physically handicapped children. Ask individuals connected with these institutions - or associations such as the Cerebral Palsy Association, to talk to the class concerning the care of these children.

References:

"Karen" and "<u>With Love from Karen</u>" by Marie Killilea. Prentice Hall, New York.

Key Concept: Concern for the safety of children is a prime responsibility of the Child Care Aide.

Objectives:

The ability to recognize safety hazards.

The ability to decide on a proper course of action in an emergency.

The ability to apply simple first aid treatments.

The ability to help children acquire a concern for their own safety.

Generalizations	Experiences
Many accidents can be prevented.	List the major safety hazards and decide on preventive action.
	Use newspaper clippings to focus attention of trainees on hazards to child safety.
	Arrange bulletin boards and exhibits which emphasize important points.
Emergencies call for prompt effective action.	Formulate a course of action to be followed in common emergencies.
	Ask the school nurse to demonstrate effective first aid measures for minor injuries.
Fire is a prime killer of children.	View a film (or films) which deal with fire. The "Educators Guide to Free Films" will list many excellent films which are available from "The Underwriters" or the various insurance companies.
	Have practice fire drills in the nursery school.

Generalizations	Experiences
	Plan a course of action for dealing with a fire emergency in a private home.
	Collect newspaper clippings concerning fires in which children have perished and use them as the basis for discussion and for bulletin board arrangements.
As children grow toward maturity, they can acquire a concern for their own safety.	Discuss ways in which the nursery school experience can help a child begin to assume responsibility for his own safety.

Reference:

"<u>First Aid for Your Infant and Child</u>." Eric Northrup with foreword by Morris Fishbein, M.D. Henry Holt and Co., New York. 1958.

FACILITIES AND EQUIPMENT

The essential facilities and equipment are:

A classroom or discussion center with movable tables, chairs, chalkboard, reference books, and other teaching aids. If the discussion area can not be darkened for the showing of films and film strips, an additional room should be available for this purpose. Audio-visual equipment should be available.

A child study laboratory large enough to accommodate a minimum of 12 children. It should be equipped as follows:

a. facilities for indoor and outdoor play where the trainees may, under the supervision of a professional teacher;

    guide children during play activities.

    supervise children during mealtime, rest periods, and toileting.

    supervise creative activities such as painting, clay modeling, music, and puppetry.

    help children develop desirable habits of caring for clothing and play materials.

b. facilities for observation, preferably an observation booth with a one-way window or screen.

c. provision for trainees to assist in the keeping of records pertaining to the development of children.

d. kitchen facilities in which meals and snacks for the children can be prepared by the trainees.

Guidelines for planning, equipping, and staffing a child care laboratory will be found on the following pages.

GUIDELINES FOR PLANNING, EQUIPPING, AND STAFFING A CHILD CARE LABORATORY*

Indoor Play Area - 4 Trainees

General Suggestions

- 35 to 50 square feet per child
- A warm floor is desirable. In new buildings, radiant heating should be considered. Old buildings may need to use carpeting.
- Tables and chairs should be child-size. Trapezoidal tables make varied arrangements possible. Stacking chairs are more easily stored.
- Plenty of open shelving at low heights is desirable.

Specific Suggestions

Consideration should be given to equipment for each of the following activities:

- Art activities -
  - 2 easels
  - 1 table with 4 chairs
  - Display space
  - Storage space for paints, crayons, modeling clay, paste, etc.
- Science activities -
  - Aquarium
  - Shelving for science materials
  - Plants
- Quiet activities -
  - Carpeting is desirable
  - Shelves for books
  - Record player
  - Puzzles and hand manipulative toys
  - 2 tables with 8 chairs
- Housekeeping activities -
  - 1 table with 4 chairs
  - Play table with chairs
  - Dolls and doll clothing
  - Child-size kitchen equipment
  - Cupboard for play dishes
  - Doll bed
  - Child's rocker
  - Iron and ironing board
  - Dress-up clothes

*Adapted and expanded from "Guidelines for Planning and Equipping a Child Care Instruction Laboratory," prepared by Ata Lee of DHEW for the National Seminar on Home Economics Education, Columbus, Ohio, March 28-30, 1966.

Indoor Play Area (Continued)

	• Block activities - Preferably located near door to outside play area so that large blocks may be used in both areas. Large hollow blocks should be provided. Small boards for building. Various accessories such as animals, soldiers, tractors, trucks, traffic lights, etc. • Open space activities - Open uncluttered space should be provided for group play which requires movement.

Outdoor Play Area - The same 4 trainees who conducted the indoor play activity will move outdoors with the children. The observers will also move outdoors to continue their observation.

General Suggestions	Specific Suggestions
• Located where it gets sunlight during morning hours. • Fenced or inclosed for safety. Fencing can be concealed by shrubbery. • Hard smooth surface over part of the area is desirable. • Roof over part of area is desirable. • Large enough to permit varied activities. • Landscaped to stimulate creative play.	Jungle gym See-saws Boards and saw horses Large wooden boxes Hollow blocks Sandbox Wheel toys Balls Hoops If space permits - Play-house large enough for three or four children to get inside. Flower garden. Vegetable garden. Facilities for animals such as rabbits, chickens, etc.

Toilet Area and Related Storage - 1 Trainee

General Suggestions	Specific Suggestions
• Should be located so that it is accessible to both indoor and outdoor play area. • Should be located near entrance. • Equipment should be child-size. • Should meet state requirements for nursery or pre-kindergarten schools.	• Individual cubicles for storage of children's belongings such as soap, wash cloths, comb, etc., as well as outer clothing and boots. • First-aid equipment should be accessible.

Rest Area

General Suggestions	Specific Suggestions
• Indoor play space may be utilized for rest periods. In all-day schools it should be possible to partially darken the room.	• All-day schools should provide a folding or stack cot and blanket for each child. • Part-day schools may find washable individual floor rugs satisfactory for the short rest period before lunch.

Observation Area

General Suggestions	Specific Suggestions
• Should be located where observers can have a view of indoor play area and toilet area. • Adequate ventilation should be provided. • Can double as storage area when nursery school is not in operation.	• Four to six chairs, preferably of stacking variety. • Shelf in front of chairs for note-taking. • Shielded from pupil view by one-way mirror glass. • A sound system should be considered to pick up conversation in play area.

Workshop Area - 4 Trainees

General Suggestions

A workshop area should be provided where trainees can:

- Construct, launder, and repair the clothing of nursery school children.
- Construct and repair play equipment and materials for the nursery school.
- Prepare bulletin boards, exhibits and materials for parent education.

Specific Suggestions

- Table and chairs.
- Automatic washer and dryer.
- Sink for hand laundering.
- Ironing board and iron.
- Storage for clothing repair articles, and bulletin board supplies.
- Flannel Board.

Food Preparation Area - 3-4 Trainees

The 4 trainees who had charge of the play activities will eat with the children.

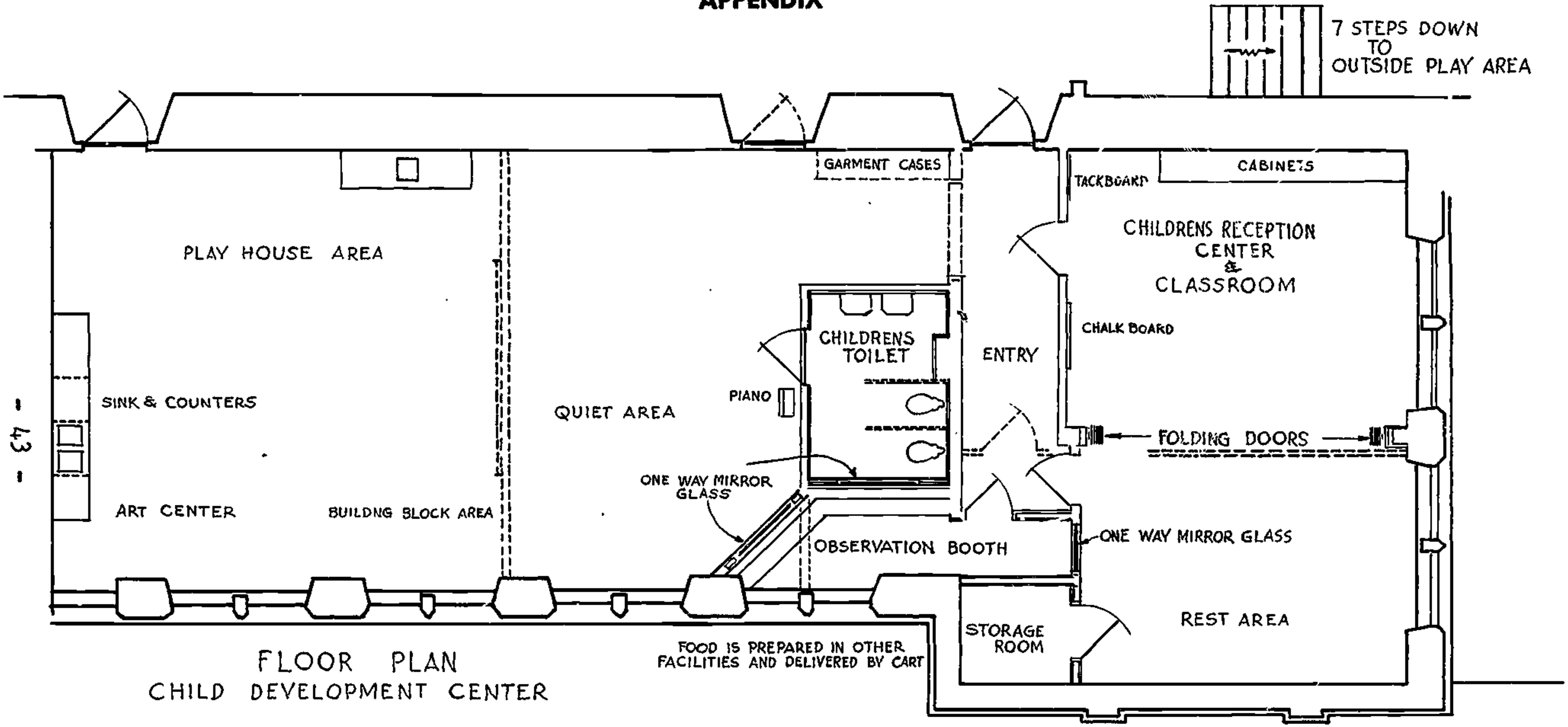
General Suggestions

- Should be located adjacent to the indoor play area which will double as dining space.
- The child-size tables and chairs used for play activities may be used for dining.
- The child-size tables and chairs used for play activities may be used for dining.
- The kitchen should be equipped for the preparation and serving of the noon-day meal for the nursery school children and the trainees who will eat with them.

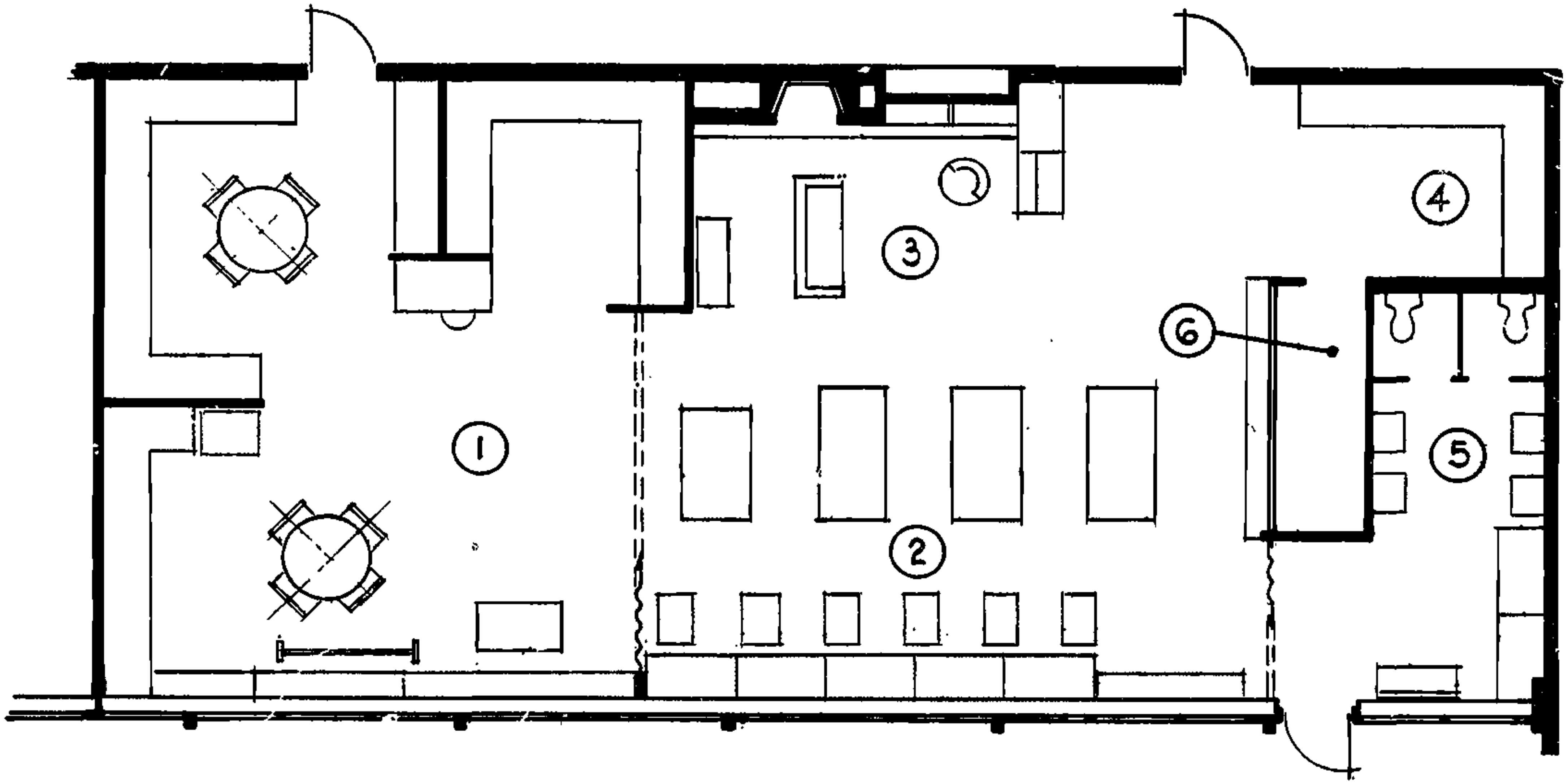
Specific Suggestions

- Surface cooking units and oven. (One home-size range with 4 surface units and double oven will suffice.)
- Refrigerator.
- Frozen food storage.
- Double bowl sink.
- Dishwasher.
  (Home type should be satisfactory for small nursery schools.)
- Storage for dishes, cutlery, glassware, cooking utensils, and supplies.
- Storage for staple foods.

APPENDIX



Drawing of Nursery School Suite in
Westinghouse High School, Pittsburgh



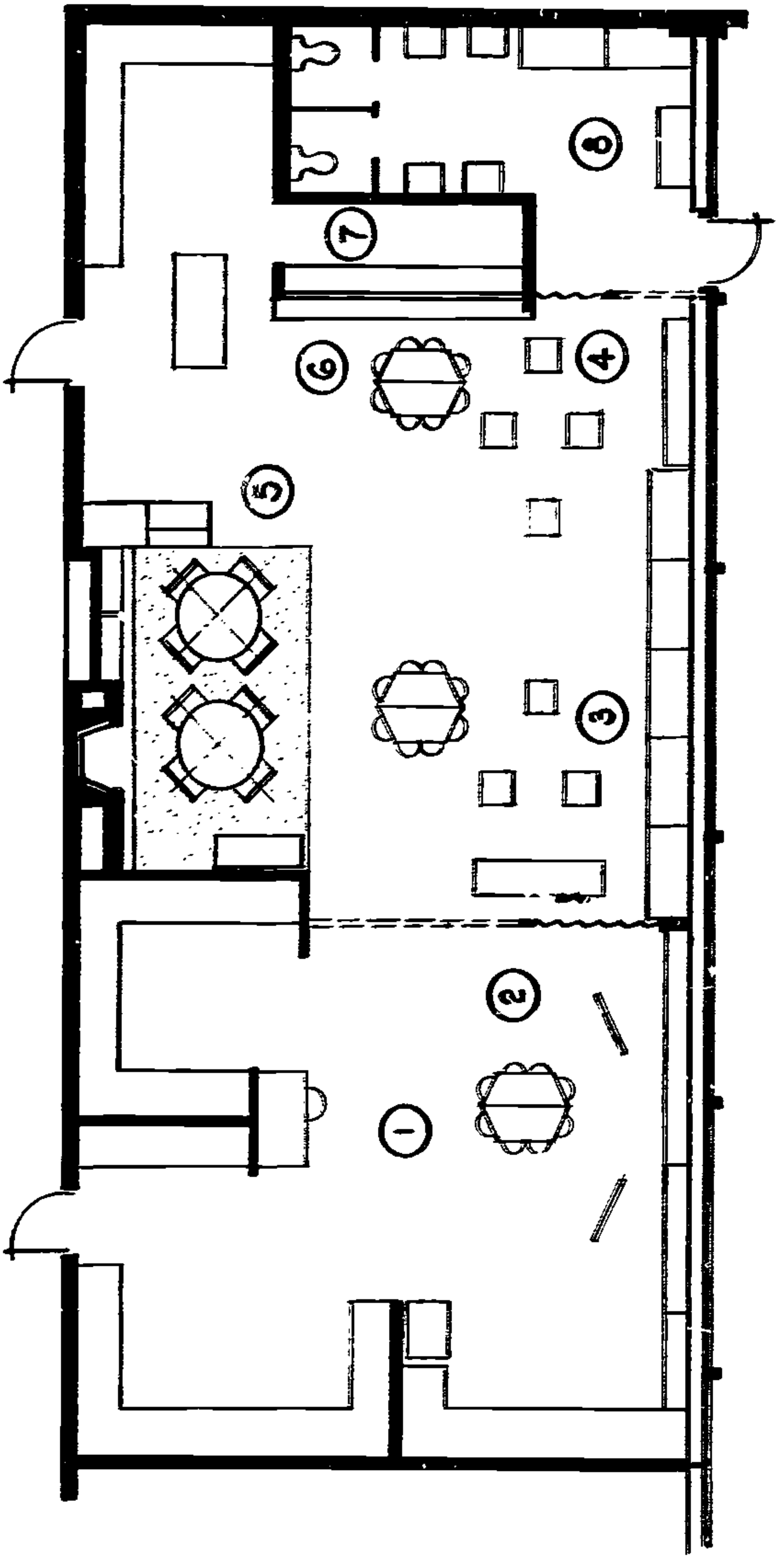
Drawing of All-purpose Senior High School Home Economics Room under construction in the Crestwood High School, Luzerne County

GENERAL HOMEMAKING LAYOUT

SCALE : 1/8" = 1'-0"

① — FOODS AREA
② — SEWING AREA
③ — LIVING AREA
④ — FITTING & GROOMING AREA
⑤ — CHILD CARE
⑥ — STORAGE

Drawing of All-purpose Senior High School
Home Economics Room in Crestwood High School
showing its adaptation for use as a Child Care Laboratory



CHILD DEVELOPMENT CENTER
SCALE : 1/8" = 1'-0"

① — FOOD PREPARING
② — ART AREA
③ — HOUSEKEEPING AREA
④ — BLOCK AREA
⑤ — QUIET AREA
⑥ — SCIENCE AREA
⑦ — OBSERVATION BOOTH
⑧ — TOILET & WRAP AREA

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CHILD DAY CARE TRAINING QUESTIONNAIRE*

PART I The way I feel about children:
Read each sentence carefully.
If the sentence tells the way you feel...
Not any time - write 1 in the blank
Part of the time - write 2 in the blank
Half of the time - write 3 in the blank
A lot of the time- write 4 in the blank
All of the time - write 5 in the blank

_____1. When I work with children, I feel that they understand me and I understand them.

_____2. I feel that children do what I expect them to.

_____3. I wish children would act more like adults.

_____4. I feel easy and comfortable when I am working with children.

_____5. I feel that I can listen to children and talk with children.

_____6. I feel it is important to listen to children.

_____7. I feel that I can take care of most children's problems.

_____8. I like to work and play with children.

_____9. When children are noisy, I wish they would be quiet or go away where I cannot hear them.

____10. I feel that there is nothing like a good spanking to get results.

PART II What I know about children:
Read each of these sentences carefully. Write the age that you think fits the sentence in the blank.

1. Children seldom play with other children or share toys with other children before they are _________ years old.

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*See page 48 for the source of this questionnaire and directions for its use.

2. The best time to start to teach a baby to use the toilet is when he is about _________ months old.

3. A child will usually ask to go to the bathroom or will go himself when he is about _________ years old.

4. Usually a baby will stop using a bottle when he is _________ year old, and should stop by the time he is _________.

5. Most children up to the age _________ need to sleep in the afternoon and also need to sleep 12 hours at night.

6. Most children between ages _________ and _________ will probably not sleep in the afternoon but should rest.

7. I would expect a baby as old as _________ months to cry often when he is unable to do what he wants to do.

8. A _________ year old child can understand punishment for wrong doing while diversion works better with younger children.

9. Most children are not ready to learn to read or write before they are _________ years old.

10. Most children can dress themselves by the time they are _________ years old.

PART III Things I know or can do in taking care of children:

Below is a list of things you know or can do in taking care of children. Rate your knowledge or ability by writing A, B, C, D, or E in the blank.

A - excellent
B - good
C - fair
D - poor
E - no knowledge

_____1. Telling stories to children.

_____2. Playing games with little children.

_____3. Singing simple songs.

_____4. Correcting children.

_____5. What to expect from children of different ages.

_____6. Arranging a schedule or routine for children.

_____7. Guiding play.

_____8. Knowing how to take care of a child who is hurt.

_____9. Looking for signs of illness in a child.

_____10. Getting ready for painting, working with clay or other art work.

This questionnaire was developed by Mrs. Mary York of Phoenix College and the Arizona State Department of Vocational Education and is reprinted with her permission. Following are her suggestions for using the device.

> This questionnaire is administered at the beginning of the training period and again at the end. The first set of questionnaires is kept by the instructor and may be used to determine areas of attitudes, knowledge, and skills where improvement is needed. At the end of the course the two sets may be compared to determine improvement. Usually the trainees mark their own papers to indicate that the answer given on the paper is the better, the same, or worse than on the first. If the answer is worse, the instructor may suggest that the trainees indicate whether or not this is the result of a more realistic self-appraisal.

EVALUATING PUPIL CONCEPTS

The following test is illustrative of the type of evaluative device which might be used:

. as a pre-test to determine the concepts which pupils already have before teaching takes place.

. as a means of introducing a concept and stimulating discussion.

. as a follow-up of teaching to evaluate changes which are taking place in pupils' concepts.

If you strongly agree with the statement, place a "2" in the Agree column.

If you somewhat agree, place a "1" in the Agree column.

If you strongly disagree, place a "2" in the Disagree column.

If you somewhat disagree, place a "1" in the Disagree column.

If you are puzzled as to whether you agree or disagree, place a question mark between the two columns.

Pre-test on Individual Differences

Agree	Disagree	
( )	( )	1. Each child has a tempo and style of growth which are as characteristic of his individuality as are the features of his face or his finger-prints.
( )	( )	2. The basic pattern of development is the same for all children.
( )	( )	3. Brothers and sisters in the same family are usually so similar that it is possible to treat them all alike.
( )	( )	4. Infants are individuals from the moment of birth.
( )	( )	5. Scientific studies show that the individual characteristics of infants do not persist into later life.

( ) ( ) 6. By the time a child reaches school (5 or 6 years of age) his ways of thinking and working are basically formed.

( ) ( ) 7. Children who are intellectually ambitious in their early years tend to remain so as adults.

( ) ( ) 8. Very little learning takes place during the pre-school years because the child is too immature.

( ) ( ) 9. It is difficult to measure human growth precisely because of its many variations.

( ) ( ) 10. Babies are very much alike at birth – the differences which become apparent as they mature are due entirely to environmental factors.

Directions for scoring:

1. Mark statements 1, 4, 6, 7, and 9 as positive (true) statements on your key copy. Mark statements 2, 3, 5, 8, and 10 as negative (untrue) statements on your key copy.
2. On positive statements give 10 points for each "2" in the Agree column and 5 points for each "1" in the Agree column.
3. On negative statements give 10 points for each "2" in the Disagree column and 5 points for each "1" in the Disagree column.
4. Give no score for question marks.

WHAT WOULD YOU SAY?
(A means of evaluating pupil concepts)

One Pennsylvania teacher devised a quick and subtle way to evaluate pupil concepts. She merely described a simple situation and asked the pupils what they would say to the child involved. Their responses were then placed on the blackboard (without names) and used as the basis for class discussion.

Following is a sampling of some responses which revealed some very inadequate concepts concerning the nature of a two year old:

The situation:

Johnny (age 2-1/2) was so busy playing he forgot to go to the toilet. Now his pants are wet and there is a puddle on the floor where he was playing. WHAT WOULD YOU SAY TO JOHNNY?

"Johnny be a good boy and try to make it next time."

"Oh, Johnny, you were working so hard that you forgot to go to the bathroom! Try and remember next time. You're getting to be a big boy now!"

"Johnny, you should have gone to the bathroom. Now go and change, and then clean it up."

"Don't be ashamed. All little ones do it."

"That's all right, Johnny, I'll clean it up."

"I would ask him to try and be careful, and I would say that he should not play unless he knows when to stop."

"I would say, Johnny, why didn't you tell me so that I could have taken you to the bathroom? The next time you tell me."

"I would say to Johnny that he is a big boy - and big boys don't do that. Tell me next time."

NOTE: A device of this sort can serve not only to evaluate the level of pupil concept formation, but also as an ideal starting point for developing a concept of what can be expected of a two-year old child.

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Jenkins, Gladys G., Helen S. Shacter, and William W. Bauer. These Are Your Children. Scott, Foresman, and Company, Fair Lawn, New Jersey. 3rd Edition. 1966.

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LIST OF FIRMS DEALING IN TOYS AND EQUIPMENT

If suitable toys and equipment can not be purchased locally, catalogues for such supplies may be secured from the following companies:

Childcraft Equipment Company, Inc.
155 East 23rd Street
New York 10, New York

Community Playthings
Rifton, New York

Creative Playthings, Inc.
Princeton Road
Cranbury, New Jersey

Holbrook Wood Products Company
Coldwater, Michigan

Kurtz Brothers School Supplies
Clearfield, Pennsylvania
or
1001 Cassatt Road
Berwyn, Pennsylvania

New Method Book Bindery, Inc.
Vandalia Road
Jacksonville, Illinois 62650

Seaver Toy Company
3050 North Lima
Burbank, California

R. H. Stone Products
18279 Livernois
Detroit, Michigan

ADDRESSES AND PUBLICATIONS OF ORGANIZATIONS

Association for Childhood Education International
3615 Wisconsin Avenue, N.W.
Washington, D. C.
(Publishes the magazine, "Childhood Education.")

Feelings and Learnings, 1965	$5.95

National Association for the Education of Young Children
3700 Massachusetts Avenue, N.W.
Washington, D. C. 20016
(Publishes the magazine, "Young Children.")

This organization has a Publications Office at 104 East 25th Street, New York, New York 10010. The following publications are available from this address:

#100	Essentials of Nursery Education by Chittenden, Murphy, and Williams	$.75
#101	Let's Play Outdoors by Katherine H. Read	$.50
#102	Nursery School Settings - Invitation to What? by Evelyn Beyer	$.50
#103	Science Experiences for Nursery School Children by Dorothy Haupt	$.75
#104	Sharing - A New Level in Teacher-Parent Relationships by Evelyn Beyer	$.50
#105	Water, Sand and Mud as Play Materials by Friedman et al	$.50
#402	Some ways of Distinguishing a Good School or Center for Young Children (Minimum Order 25 copies $1.50)	$1.50
#106	What Does the Nursery School Teacher Teach? by Elizabeth Tarnay	$1.00

#107	What is Music for Young Children? by Betty Jensen Jones	$.75
#109	Play Parks by Lady Allen of Hurtwood	$.75
#111	Space for Play: The Youngest Children by Lady Allen of Hurtwood	$2.00

National Committee for the Day Care of Children, Inc.
44 East 23rd Street
New York, New York

Commonwealth of Pennsylvania
DEPARTMENT OF PUBLIC INSTRUCTION
BUREAU OF TEACHER EDUCATION
Box 911, Harrisburg

COMPREHENSIVE CERTIFICATION OF TEACHERS OF NURSERY SCHOOLS; OR CHILD CARE AND DEVELOPMENT IN CHILD DEVELOPMENT LABORATORIES IN SECONDARY SCHOOLS INCLUDING VOCATIONAL SCHOOLS

I. BASIC REGULATIONS*

A. Graduation - See Basic Regulations
B. Citizenship, Character, etc. - See Basic Regulations
C. General Education - See Basic Regulations (60 semester **hours**)
D. Professional Education - See Basic Regulations (18 semester **hours**)

II. REGULATIONS GOVERNING THE ISSUE OF NEW CERTIFICATES

A. A certificate of standard grade valid for teaching in the elementary curriculum or home economics may be extended to include teaching in the nursery school upon the completion of 1 and 2. as given below.

B. A certificate of standard grade valid for teaching in the elementary curriculum may be extended to include child care and development in child development laboratories in secondary schools upon the completion of 1, 2, 4, and 5, as given below.

C. A college certificate valid for teaching child care and development in child development laboratories in secondary schools will be issued to college graduates not holding secondary certificates upon the completion of 1. 2, 3, 4, and 5 as given below.

D. A certificate valid for the teaching of home economics in the secondary field will be extended to include child care and development in child development laboratories in secondary schools upon the completion of 1 and 2, as given below.

1. Courses in each of the following areas:

Child Development. Growth, Health, Mental Hygiene. Such courses as Growth and Development of Young Children, Child Development, Child Hygiene, Mental Hygiene, Child Psychology. Minimum requirement—6 Semester Hours.

Family Life Education. Personal Relationships within the Family Group. The Family and the Community. Such courses as The Family, Marriage and the Family, Family Relationships. Minimum requirement—2 Semester Hours.

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*Basic Regulations - Page 9

Nursery School Education. The Purpose, Function, and Administration of the Nursery School. Meeting the needs of two-to-four-year-old children.

Such courses as Nursery School Education, Nursery School Administration, Equipment and Materials for Children in the Nursery School. Minimum requirement—4 Semester Hours.

Nutrition. Basic Principles, including the Planning and Preparation of Meals for the Nursery School.

Such courses as Child Nutrition, Food for Children, Food Preparation for Nursery School Children. Minimum requirement—2 Semester Hours.

2. Student Teaching with children between the ages of two and four. Four semester hours of credit with a minimum of 120 clock hours.

3.	Introduction to Teaching	3 Semester Hours	
	Educational Psychology	3 Semester Hours	
4.	Secondary Education	6 Semester Hours	
	Adolescent Psychology or the equivalent		2 Semester Hours
	Principles of Secondary Education and Methods of Teaching in Secondary Education or the equivalent		4 Semester Hours

5. Student Teaching in home economics in Secondary Schools. Six (6) semester hours with a minimum of 180 clock hours.

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VT 002 042

Offset Lithography, A Course of Study Designed for Cooperative Part-Time Students Employed in Lithographic Occupations.

Karnes, James B.
Missouri Univ., Columbia. Dept of Industrial Education
Pub Date - Apr64
MF AVAILABLE IN VT-ERIC SET 139p.

*STUDY GUIDES, *TRADE AND INDUSTRIAL EDUCATION, *PRINTERS, *OFFSET LITHOGRAPHY, *COOPERATIVE EDUCATION,

This study guide is for student use in preparatory or service training courses for offset lithographers. It was developed by research assistants and an advisory consultant. Assignment sheets cover (1) History of Offset Printing, (2) Offset Printing as a Vocation, (3) Accidents and Health Hazards, (4) Methods of Type Composition and Reproduction, (5) Job Planning, Artwork, and Layout, (6) Proofreading and Legal Restrictions, (7) Basic Photograph Processes in Lithography, (8) Line and Halftone Photography, (9) Film Developing, (10) Negative Corrections, Stripping, and Opaquing, (11) Platemaking, (12) Papers and Inks for Offset Printing, (13) Fundamentals of Offset Presswork, (14) Makeready on Offset Presses, (15) Operation of an Offset Press, (16) Offset Press Troubles, (17) Offset Duplicators, and (18) Bindery Operations. Assignment sheets give assignment, references, and questions. Instruction time required is 180 class hours. The instructor should be a qualified coordinator. Students should be at least high school juniors. Supplementary materials include a reference bibliography, an analysis of offset printing, and a progress record. Answers for this guide are available in VT 002 052 for 50 cents. This document is available for $1.50 from Industrial Education, 103 Industrial Education Building, University of Missouri, Columbia, Missouri 65201. (EM)

OFFSET LITHOGRAPHY

A Course of Study

Designed for
Cooperative Part-time Students
Employed in Lithographic Occupations

Issued by

Department of Industrial Education
College of Education
University of Missouri
Columbia, Missouri

In Cooperation with

Industrial Education Section
State Department of Education
Jefferson City, Missouri

MEMORANDUM

TO: The ERIC Clearinghouse on Vocational and Technical Education
The Ohio State University
980 Kinnear Road
Columbus, Ohio 43212

FROM: (Person) James B. Kranes (Agency) University of Missouri at Columbia

(Address) 103 Industrial Education Bldg., Columbia, Mo.

DATE: September 25, 1967

RE: (Author, Title, Publisher, Date) Industrial Education Dept., Univ. of Mo. at Columbia, OFFSET LITHOGRAPHY, cooperatively with Industrial Education Dept. (U. of Mo. at Columbia) and Missouri Dept. of Education

Supplementary Information on Instructional Material

Provide information below which is not included in the publication. Mark N/A in each blank for which information is not available or not applicable. Mark P when information is included in the publication. See reverse side for further instructions.

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Limitation on Available Copies quantity Price/Unit $1.50
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Method of Design, Testing, and Trial Designed subject matter specialists, tested in the field and revised periodically.

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Appropriate School Setting Secondary and post secondary schools
Type of Program High School Preparatory or In service training progr
Occupational Focus Specific skill
Geographic Adaptability United States
Uses of Material Related Instructor Study Guide
Users of Material Students (note instructor's key available)

(4) Requirements for Using Material:
Teacher Competency Qualified Coordinator or Instructor
Student Selection Criteria Junior and High School with [redacted] proper prerequisites
Time Allotment 180 hours

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REFERENCES

A. Cogoli, John E., Photo-Offset Fundamentals, First Edition, McKnight and McKnight Publishing Company, Bloomington, Illinois, 1960, $4.80.* (16)**

B. Department of the Navy, Lithographer 3 & 2, NavPers 10452-A, U. S. Government Printing Office, Washington 25, D. C., 1963 $2.75. (14)

C. Latham, Charles W., Lithographic Offset Press Operating, Revised Edition, Graphic Arts Technical Foundation, Inc., 3400 Forbes Avenue, Pittsburgh, Pennsylvania 15213, 1956, $1.80.*** (5)

D. Latham, Charles W., Advanced Pressmanship, Graphic Arts Technical Foundation, Inc., 3400 Forbes Avenue, Pittsburgh, Pennsylvania 15213, 1963, $1.80.*** (3)

E. Reed, Robert F., Offset Press Troubles, Graphic Arts Technical Foundation, Inc., 3400 Forbes Avenue, Pittsburgh, Pennsylvania 15213, 1962, $1.50.*** (1)

F. United States Department of Labor, Occupational Outlook Handbook, 1963-64 edition, Bulletin No. 1375, U. S. Government Printing Office, Washington, D. C. 20402, 1963, $4.75. (1)

*Subject to educational discount
**Frequency of use in assignments
***Member price (also available to schools at this price).

FOREWORD

This course of study, consisting of an analysis of OFFSET LITHOGRAPHY, together with assignment sheets covering the related (occupational) information to be taught by the school, has been prepared for teaching offset lithography on an individual basis in a cooperative part-time program.

The original analysis and assignment sheets were prepared by Dr. G. Pat Powers, formerly Research Assistant in Industrial Education at the University of Missouri. The present revision was made by Mr. Jack Kirby, Research Assistant in Industrial Education, University of Missouri. We acknowledge the assistance of Dr. Robert E. Goetz, Professor of Graphic Arts at Central Missouri State College, Warrensburg, Missouri, for his counsel and constructive critism of the manuscript.

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HUBERT WHEELER

Commissioner of Education

April, 1964
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March, 1965
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300

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Assignment Sheets:

Information Sheets:

Training Plan and Progress Record

INTRODUCTION

In preparing this course of study, it has been assumed that the attainment of occupational competency in any type of work involves three different, yet closely related, types of learning. They are:

1. Mastery of the practical job skills and procedures performed by the worker in the occupation.
2. Comprehension of the technical and related information basic to an intelligent understanding and practice of the occupation.
3. Development of those personal-social traits which are essential for the successful worker.

The first group of these "learning units"--the job skills and procedures--has been arranged in the analysis under the heading of "Job Training." The second group of learning units--the technical and related information--has been arranged under the heading of "Related Information." And the third group--the personal-social traits--has been listed under "Personal-Social Traits Essential for the Printer of Today" in the introductory section addressed to the student.

In a cooperative educational program it is necessary for both cooperating agencies--the school and the employer--to understand clearly just what each is to be responsible for in the training of the student-worker. Experience has shown that most of the practical job skills and procedures of an occupation can best be learned through supervised work on the job. Experience has shown also that the school can best teach most of the technical and related occupational information needed by young student-workers. This division of responsibility has been made in the arrangement of the course of study; that is, it is expected that the student-worker will master the job skills and procedures through practical work on the job under the immediate supervision of the employer, and that he will receive instruction in related occupational information in the school under the direction of the coordinator.

Skills and related information are matters for direct instruction, but personal-social traits are acquired only through practicing them during the process of acquiring skills and information and in one's daily conduct. Therefore, both the employer and the school, as well as the home, must assume responsibility for developing in the student-worker those habits, attitudes and character traits which are essential for success in his occupation and in life. Both the employer and the school should be constantly on the alert to see that the student-worker places desirable interpretations on his experiences and that he does not practice habits and exhibit character traits detrimental to his success.

Since the coordinator's class will be made up of fifteen or more students, each differing from the other significantly, studying a dozen or more occupations which differ markedly in their requirements, it follows that it will be impossible for him to teach, through the group method, the occupational information which relates to the <u>specific job</u> of each student-worker. In order to be effective, this type of instruction must be <u>individualized</u>. There is, of course, some related information, such as occupational health and safety, workmen's compensation, wage-hour laws, fair labor standards, unemployment compensation, and the like, which is of common interest and concern to all student-workers, and may be effectively taught by the group method. But if the coordinator is to make a real contribution to the in-service vocational education of his students, he must devote a major portion of his classroom instruction to content which deals specifically with the work of each boy and girl enrolled.

With this requirement in mind, and in order to facilitate individual instruction, these assignment sheets have been prepared. Each contains certain record data as to number and range of units covered, introductory paragraphs designed to develop interest, explain the importance of the assignment, and to convey to the student what he is expected to learn, specific assignments including reading, learning activities and a series of new-type questions designed to check his attainment.

Obviously, it is desirable to teach the related information in the school at the time it will be used most advantageously on the job. This means that the two phases of the student-worker's training should parallel each other in a progressive manner. The coordinator will find the assignment sheets well adapted to this end. He can select from day to day the assignment which covers the informational units related to the work being done on the job. With this arrangement, the coordinator will become, during a major portion of his classroom time, a supervising study and helping teacher.

In selecting books for the course, an effort has been made to restrict the number to an adequate coverage of the material, and to select those of recent publication so that current practices can be consistently presented. It is recommended that copies of these books be secured and kept in the coordinator's classroom for ready use by the student.

The key sheets, available in a separate pamphlet, have been prepared to enable the coordinator to score quickly the objective tests which are a part of each assignment sheet. These key sheets give the correct answers to the questions, as well as the reference and the page on which each answer can be found. The key sheets should be kept in the coordinator's possession.

TO THE STUDENT-WORKER

Printing is one of our chief means of communication. Nearly every civilized person today uses printed products in some form.

For the printing industry to be able to produce the needed quantities of printed products, with the speed and economy necessary to remain in business, a number of different printing processes have been developed. This book that YOU are now beginning to study is a product of one of these several processes.

In this course you will learn the operations necessary to do offset printing. Offset printing or as it was known earlier, "Lithography", is one of the newer printing processes and one of the most important processes in our modern printing industry.

OPPORTUNITIES AND REQUIREMENTS:

Because of the need for printed matter in nearly all of man's activities, printing has in modern times ranked consistently high among the nation's great industries. The wide variety of products of the press and the demand for a constant supply requires the efforts of many skilled persons in printing firms ranging from the small "one-man" establishments to large plants employing hundreds of workers.

Offset Printing as a vocation attracts many young men and women because it offers genuine opportunities for steady work, good pay, and advancement. The trade has several branches and numerous allied industries such as: compositors, photographers, platemakers, commercial artists, retouchers, layoutmen, proofreaders, pressmen, and draftsmen.

Young people who enter the printing trade will find that it offer abundant opportunities. While there are more men than women in the trade, women find places in all branches except where heavy lifting is done. For printing the usual requirements include a good education -- a high school education is preferred and is rapidly becoming an essential--good health, good eyesight, and a sense of design and proportion. For the most part the work of printing requires exceptional patience and a greater than average interest and aptitude for creative work.

Opportunities for advancement are especially favorable at the present time when there are few apprentices in proportion to the total number of journeymen. The work is not heavy, as a rule, and the fact that it is indoors makes it attractive to many persons as a year-around occupation.

In spite of a former widespread belief that printing occupations are injurious to health, there is little evidence on which to base this belief. There are, of course, shops in which the best conditions still do not exist, and the worker must be able to recognize them. While there are accident hazards in the use of the machinery in a printing shop, exercising reasonable care, and using the safety devices which are provided will make serious accidents unlikely.

PERSONAL-SOCIAL TRAITS ESSENTIAL FOR THE PRINTER:

Personality traits are of extreme importance, not only in securing and holding a desirable position, but in life in general. Personal-social traits can be improved through training when the individual learns what to improve, and why improvement is advisable. Among the personal-social traits of chief importance to the printer are the following:

<u>Accuracy</u>: It is of prime importance that the printer be accurate, since accuracy is basic in the printing business.

<u>Honesty</u>: This means giving full value for pay received, truthfulness, unqualified loyalty to one's employer.

<u>Dependability</u>: The ability to do good work in a businesslike manner without supervision.

<u>Intelligence</u>: The printer must be above average in general intelligence, with at least a high school education.

<u>Cooperation</u>: This implies the ability and disposition to work harmoniously with others, to be helpful, to work together.

<u>Health</u>: A printer needs good health, especially good eyesight and endurance. One who is not physically and mentally able to stand long, irregular hours should not undertake the work.

<u>Personality</u>: A printer should be able to build up good will among his customers so that they will come back. He should be a go-getter, a person of ideas, ready with helpful suggestions for potential customers. He must possess a pleasing personal appearance, a good speaking voice, and a sense of humor.

<u>Alertness</u>: For the printer who operates his own machines, manual dexterity and mental alertness are essential.

<u>Ambition</u>: The printer must have love of his work, a singleness of purpose, and an ambition to expand his business, with caution in expanding beyond his capacity to make his business pay.

Tactfulness: The ability to do and say things without offending people.

Courtesy: This involves respect for the point of view, interests, and wants of others, and although at times it will require effort, it is essential in good business and human relations.

REFERENCES

A. Cogoli, John E., Photo-Offset Fundamentals, First Edition, McKnight and McKnight Publishing Company, Bloomington, Illinois, 1960, $4.80.* (16)**

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ANALYSIS OF OFFSET PRINTING

JOB TRAINING: What the Worker Should Be Able to Do	Assign. No.	RELATED INFORMATION: What the Worker Should Know
	Introduction	
	1	1. History of offset printing
	1	2. Principles of offset lithography
	2	3. Opportunities, requirements and future outlook of offset printing
	3	4. Accident and health hazards in the printing shop
	Planning and Proofing	
5. Set type by hand	4	5. How type is set by hand
	4	6. Thoery of typesetting machines
	4	7. Theory of phototypesetting machines
8. Identify and select type characters	4	8. Type materials: Parts, size fonts, faces, families and series
9. Calculate with point system	4	9. Printing system of measurement
10. Space lines	4	10. Kinds of spacing units and their arrangements
	4	11. Factors that affect legibility
12. Prepare text material on typewriter, IBM Executive, Varityper, Justowriter, etc.	4	12. Methods of preparing text material
	4	13. Methods of producing cold type composition
	4	14. Methods of hand lettering in display composition
	4	15. Kinds of photolettering machines
	4	16. Methods of preparing direct-image plates
	5	17. Basic considerations of good layout

JOB TRAINING: What the Worker Should Be Able to Do	Assign. No.	RELATED INFORMATION: What the Worker Should Know
18. Prepare dummy and other layouts	5	18. Procedure for preparing the dummy and worksheet
19. Ascertain amount of space that work will fill	5	19. Procedure for fitting copy
20. Prepare headlines and titles with pastedown letters	5	20. Types of pastedown letters used in display lines
	5	21. Types of art copy
22. Prepare line drawing	5	22. Artistry techniques
23. Prepare tone copy	5	23. Art work equipment
24. Prepare combination copy		
25. Retouch photographs and illustrations	5	25. Retouching techniques
	6	26. Kinds of proofs
27. Proofread and proofmark	6	27. Standard proofreaders" marks and usage
	6	28. Legal restrictions on copying

Plate Making - Photolithography Process

	7	29. Kinds of camera copy
30. Figure reductions and enlargements	7	30. Methods of figuring reductions and enlargements
31. Prepare line copy	7	31. Methods of preparing line copy
	7	32. Theory of photography
	7	33. Cameras for offset work
	7	34. Basic parts of the camera
35. Set camera for "shooting" line copy	7	35. Basic camera settings
36. Prepare illumination	8	36. Types of lighting for process cameras
37. "Shoot" line copy	8	37. Procedure in "shooting" line copy
38. Superimpose line copy	8	38. Techniques of superimposing
	8	39. Theory of halftone photography
	8	40. Types of halftone screens
41. Make halftone negative	8	41. Procedure for making halftone negatives

JOB TRAINING: What the Worker Should Be Able to Do		Assign. No.	RELATED INFORMATION: What the Worker Should Know	
		I	42.	Procedure for making a negative from a printed half-tone illustration
		I	43.	Methods of preparing combination copy
		I	44.	The darkroom and equipment
		I	45.	Theory of negatives
46.	Mix chemicals and prepare tray solutions	I	46.	Types of tray solutions
47.	Develop negatives	I	47.	Procedure for developing negatives
48.	Make a film positive	I	48.	Procedure for ~~making~~ film positives
49.	Make contact print	I	49.	Procedure for making contact prints
50.	Make screen negatives	I	50.	Procedure for making screened negatives
		I	51.	Kinds of films
		II	52.	Equipment and supplies needed for stripping
53.	Prepare for stripping	II	53.	Preparatory procedures for stripping
54.	Strip-in negative	II	54.	Procedure for stripping-in halftone negative
55.	Opaque a negative	II	55.	Methods of correcting negatives
		II	56.	Procedure for step-and-repeat work
57.	Strip for color	II	57.	Procedure for color stripping
		II	58.	Types of offset plates
59.	Grain plates	II	59.	Purpose and methods of graining plates
60.	Prepare solution for making albumin plates	II	60.	Procedure for making albumin plates
61.	Make albumin plate			
62.	Prepare plates by Xerography	II	62.	Procedure for preparing plates by Xerography
63.	Prepare presensitized plates	II	63.	Procedure for preparing presensitized plates
64.	Prepare deep-etch plate	II	64.	Procedure for preparing deep etch plates

JOB TRAINING: What the Worker Should Be Able to Do	Assign. No.	RELATED INFORMATION: What the Worker Should Know
	11	65. Procedure for preparing direct-image plates
66. Make minor plate corrections	11	66. Methods of making minor plate deletions, additions, and corrections
67. Restore bad plates	11	67. Causes of plate failure
68. Preserve plates for future runs	11	68. Procedure for preserving plates

Setting Up and Running Press

JOB TRAINING: What the Worker Should Be Able to Do	Assign. No.	RELATED INFORMATION: What the Worker Should Know
	12	69. Types of offset inks
	12	70. How offset inks are prepared
	12	71. Theory of color mixing inks
	12	72. Types of paper for offset printing
	12	73. Methods of making paper
	12	74. Methods of controlling the stretching and shrinking of paper
75. Prepare fountain solutions	13	75. Methods of preparing fountain solutions
	13	76. Parts of the offset press
77. Install plate	13	77. Procedure for installing an offset plate
78. Adjust dampening mechanism	13	78. Theory and adjustment procedures of dampening mechanism
	13	79. Problems in dampening mechanisms
80. Adjust inking mechanism	13	80. Theory and adjustment procedures of inking mechanism
81. Clean and adjust rollers	13	81. Techniques of setting and caring for rollers
82. Lubricate press	13	82. Techniques of lubricating press
	13	83. Types of press feeders
	13	84. Function of press feeders
85. Load feeder	13	85. Procedure for operating feeder

JOB TRAINING: What the Worker Should Be Able to Do	Assign. No.	RELATED INFORMATION: What the Worker Should Know
86. Set feeder		
	13	87. Types of registration controls
	13	88. Function of delivery unit
89. Prepare and mount blanket	13	89. Function of blanket
90. Pack cylinder	13	90. Purpose of cylinder packing
91. Condition paper	14	91. Definitions and functions of pre-makeready
92. Set registration controls	14	92. Types of makeready
93. Set delivery controls	14	93. Makeready procedure
94. Adjust impression cylinder setting		
95. Run test sheets and adjust		
96. Make final run	15	96. Operations involved in running the press
97. Control pH	15	97. pH measurements
98. Wash-up press	15	98. Wash-up procedures
99. Remedy sheet feed and delivery troubles	16	99. Sheet feed and delivery troubles
100. Remedy printing unit troubles	16	100. Printing unit troubles
101. Remedy ink feed and distribution troubles	16	101. Ink feed and distribution troubles
102. Remedy plate dampening troubles	16	102. Plate dampening troubles
103. Remedy press plate troubles	16	103. Press plate troubles
104. Remedy offset blanket troubles	16	104. Offset blanket troubles
105. Remedy paper troubles	16	105. Paper troubles
106. Remedy ink troubles	16	106. Ink troubles

Small Duplicators

	17	107. Types of offset duplicators
	17	108. Advantages and special features of offset duplicators
109. Run offset duplicators	17	109. Procedure for operating offset duplicators

JOB TRAINING: What the Worker Should Be Able to Do	Assign. No.	RELATED INFORMATION: What the Worker Should Know
	Bindery Work	
	18	110. Procedure for figuring paper cutting
111. Jog paper		
112. Trim paper to exact size	18	112. Methods of cutting paper
	18	113. Care of paper cutters
114. Operate folding machines	18	114. Methods of folding paper
115. Fold impositions	18	115. Techniques of folding impositiong
116. Gather paper	18	116. Methods of gathering paper
117. Pad paper	18	117. Methods of padding
118. Bind material	18	118. Types and methods of binding
119. Punch and drill paper	18	119. Methods of punching and drilling paper
120. Perforate paper	18	120. Methods of perforating paper

Assignment
Sheet No. 1

Covering
Units 1-2

HISTORY OF OFFSET PRINTING

Printing is one of our chief means of communication. It is difficult to imagine a world without books, magazines and other printed material. Printing actually began with the Chinese who were printing from carved blocks as early as 840 A. D. It wasn't until 1453, when Johann Gutenberg invented a mold for casting raised letters on individual metal bodies that printing really got underway.

There are four basic methods of printing: letterpress or relief printing (printing from raised surfaces), intaglio or gravure printing (printing from depressed surfaces, stencil processes, and lithography (printing from a flat surface). Lithograph, which means "stone writing," was discovered in 1798 by Alois Senefelder and is based on the chemical principle that "grease and water do not mix." At first, all lithographic printing was done by forcing the paper against the stone or plate. In 1906, Ira W. Rubel developed a press which "offset" the image onto the paper instead of printing it on directly. The development of photography and the halftone screen gave offset lithography a fresh boost.

Today, high-quality chemicals, modern halftone glass and magenta contact screens, fine plates, precision presses, and highly-refined photographic processes make possible the productions of a large volume of beautifully printed materials in either black and white or color.

In this unit you will study the important events in the history of printing with particular emphasis on the evolution of offset-lithography.

<u>Assignment</u>:

1. Read the references listed below.
2. Answer the questions below and turn in this assignment by ________________________.

<u>References</u>:

A. Cogoli, <u>Photo-Offset Fundamentals</u>, pp. 8-19.
B. Department of the Navy, <u>Lithographer 3 & 2</u>, pp. 1-6.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. The term "lithography" means "stone writing."

T F 2. The inventor of lithography first used stone for plates in his early experiments.

T F 3. One of the early problems of lithography was the necessity of reverse writing.

T F 4. Artists were among the first to apply the lithographic process.

T F 5. When metal plates were first used, the plate printed directly onto the paper.

T F 6. The first attempts at photography were confined to silhouette pictures.

T F 7. The Daguerreotype process made it possible to make additional prints or copies of the picture.

T F 8. The first photographic negatives were made of paper.

T F 9. The substitution of glass for paper in making photographic negatives reduced the length of time needed for exposure.

T F 10. The first halftone screen was made of glass.

T F 11. Modern halftone screens for process color work are circular.

T F 12. The only recorded works, up until a few hundred years ago, were those hand-lettered by the scribes in the monasteries.

T F 13. Although zinc and aluminum have proven satisfactory for making plates, stone is still used a great deal.

T F 14. Offset printing methods were used on tin before they were used on paper.

T F 15. Offset lithography was developed due to well planned, scientific work.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. ____________ ____________ invented a mold for casting raised letters in the year ________.

2. The lithographic process of printing was invented by ________ in the year ________.

3. The stones used for lithographic printing are a natural ____________ ____________.

4. The term ________ ____________ was applied to the process where the metal plate printed onto a second cylinder which was covered with a rubber blanket which printed on the paper.

5. The wet-collodion negative required an exposure time of ____________.

6. The ________ ____________ made it possible to print photographs and type on the same sheet.

7. Modern halftone screens are made from __________ or ____________ ____________.

8. The printing process combining photography and offset lithography is called ____________ ____________.

9. Small offset machines used in business offices are called __________ __________.

10. Printing from raised surfaces is called ____________ printing.

11. Printing from depressed surfaces is called ____________ printing.

12. The first lithographic presses were called ____________ presses.

Multiple-Choice

Directions: In the space at the left of each statement, write the letter of the item which will provide the correct answer to complete the statement.

_____ 1. Lithography is based on the principle that (A) like charges repel; (B) grease and water do not mix; (C) heat increases evaporation; (D) utilizes centrifugal force.

_____ 2. The first successful cylindrical metal plates were made of (A) aluminum; (B) steel; (C) copper; (D) tin.

_____ 3. The process of photo-offset lithography was first used in the period between (A) 1875 and 1900; (B) 1900 and 1910; (C) 1910 and 1920; (D) 1850 and 1870.

_____ 4. In lithography the design is (A) raised; (B) depressed; (C) neither raised nor depressed; (D) both raised and depressed.

_____ 5. Early lithographic stones often weighed as much as (A) one ton; (B) a half ton; (C) 100 lbs.; (D) 10 lbs.

_____ 6. Rotary type presses were a result of (A) the use of zinc and aluminum for plates; (B) the development of photography in printing; (C) new type inks; (D) better types of paper.

_____ 7. The person credited with the practical discovery of offset lithography was from (A) Europe; (B) England; (C) New York; (D) New Jersey.

_____ 8. The offset press was developed in (A) 1899; (B) 1903; (C) 1906; (D) 1913.

_____ 9. One primary advantage of offset printing is (A) no press is needed; (B) less ink is used; (C) embosses paper; (D) it does not require reverse image.

Matching

Directions: In the left hand column is a list of items. The right hand column contains descriptive phrases or synonymous terms. Match the descriptions to the terms by placing the letter of the description in the blank at the left of the appropriate term.

______ 1. Johann Gutenberg

______ 2. Alois Senefelder

______ 3. Ira W. Rubel

______ 4. Professor Mitterer

______ 5. Nathaniel Currier

______ 6. Daguerre

______ 7. William Talbot

______ 8. Claude Felix Niepce

______ 9. Frederick Scott Archer

______ 10. Mathew Brady

______ 11. Charles Bennett

______ 12. George Eastman

______ 13. Henry Talbot

A. Introduced the halftone screen

B. Substituted glass for paper in making negative

C. First movable type

D. First to use photography in warfare

E. Most famous American lithographer

F. Introduced a "dry plate"

G. Discovered lithographic process

H. Introduced the first flexible film

I. Discovered offset process

J. First practical photographic process

K. Discovered the first practical process for producing photographic negative

L. Developed a cylinder-scraper press

M. Introduced the wet-collodion negative

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. List the advantages of the offset process over direct contact lithography.

(A) ______________________________

(B) ______________________________

(C) ______________________________

(D) ______________________________

(E) ______________________________

(F) ______________________________

Assignment
Sheet No. 2

Covering
Unit 3

OFFSET PRINTING AS A VOCATION

Printing is one of the world's largest industries; it is graphic communication on a mass scale. It directly affects the lives of every one of us. The printing industry was small 100 years ago; today it comprises over 32,000 establishments and employs over 850,000 workers in the United States.

If one expects to remain in, and advance in, the printing industry, it is not adequate merely to know of the existence of job openings. The extent of these opportunities, the requirements of the various jobs, wage trends, how the field of work compares with others in the nation, future expectations of the industry and vast amounts of other pertinent information relative to the printing industry must also be known.

That you will not fall into the category of uninformed workers, this unit is designed to acquaint you with various items of factual information which will enable you to become well-rounded in your knowledge of the printing industry as a whole, and also make you aware of the position of the industry in our national economy.

Assignment:

1. Read the references listed below.
2. Secure facts and figures on local employment; find the number of plants, the number of workers, wages and hours.
3. Answer the questions below and turn in this assignment by ____________________.

References:

E. Cogoli, Photo-Offset Fundamentals, pp. 1-4, 20-25.
F. Department of Labor, Occupational Outlook Handbook, pp. 301-303.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. The advent of automation has eliminated the craftsman idea from the printing trade.

T F 2. Dollarwise, as of 1954, offset printing ranks second in the printing industry.

T F 3. From 1947-1954, offset printing made a greater growth in total value of its products than did letter press printing.

T F 4. The sales staff plan and direct the company operation.

T F 5. The sales staff must know printing procedure, what the plant can do, and how much it will cost.

T F 6. The customer sometimes furnishes part, or all, of the artwork.

T F 7. Cameramen make negatives of the desired size for all the type proofs, photographs and other illustrations.

T F 8. Feeders assist the pressmen on large presses.

T F 9. Some offset shops do only presswork.

T F 10. The value of the products of the printing industry has mounted to almost $1 billion.

T F 11. The printing industry provides employment for more than 900,000 workers.

T F 12. Better than one half of all printing employees work in the printing craft occupations.

T F 13. The largest printing division in terms of numbers employed is job printing.

T F 14. Although employment in printing can be found almost anywhere, most of the employees are located in just a few states.

T F 15. Lithographic employees make up the largest group of printing craftsmen.

T F 16. Apprenticeship is the most common means of entering the printing crafts.

T F 17. In some instances, formal apprenticeship is the only method of attaining journeyman status.

T F 18. It is predicted that the demand for pressmen will decrease in the immediate future.

T F 19. It doesn't appear that technology will have much effect on the printing industry.

T F 20. The average weekly pay of production workers in the printing and publishing industry is higher than the average of production workers in all manufacturing.

T F 21. The printing industry tends to be very unstable, varying with the yearly seasons.

T F 22. Most printing craftsmen are members of unions.

T F 23. Lithography work concerns a number of specialized jobs.

T F 24. The largest expansion in offset printing has taken place in the commercial printing field.

T F 25. Most lithographic work is heavy and requires much physical effort.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. The ______________ ______________ works with customers, determining their requirements and furnishing information about the work to be done in the plant.

2. The maintaining and cleaning of equipment and facilities is the job of ______________ ______________.

3. Sales promotional literature and campaigns are planned by ______________ and ______________ ______________.

4. Detailed layouts are made by ______________ ______________.

5. When the type is completely accurate, a ______________ or ______________ ______________ is taken, which will be used for camera copy.

6. A "stripped-up" arrangement of negatives is called a "______________."

7. Multiple exposures are made on a "______________" machine.

7. Printed sheets are sent to the ______________ where they are cut, folded, punched, assembled or otherwise finished as may be required.

8. The ______________ ________________ wraps the finished work and ships or delivers it to the customer.

9. Each printing method requires some special ______________ in performing the work.

10. Lithographic shops are among the approximately _______ thousand establishments included in the commercial or job printing field.

11. Commercial shops that employ more than half of the total workers in these shops will generally have less than ______ workers.

12. Printing craftsmen in 1960 numbered about ____________.

13. The term of apprenticeship for printing craftsmen is generally from ___________ to ___________ years.

14. Due to the increased use of photography in printing, two science areas that are becoming important to workers in the trade are ______________ and _________________.

15. It is generally necessary to be a __________ ________________ graduate to enter the printing crafts.

16. The 1962 union wage for cylinder pressmen was __________.

17. The majority of unionized lithographic plants are under contract with the _____________ _____________ of _______________.

18. To become an all-round lithographic craftsman, an apprenticeship of from _______ to _______ years is usually required.

19. In 1960 about ____________ journeymen lithographic workers were employed.

20. The widest range of hourly rates in the lithographic field tends to be for ______________ __________________.

21. It is expected that each year during the next ten to fifteen years that _________ to __________ new workers will be needed.

Multiple-Choice

Directions: In the space at the left of each statement, write the letter of the item which will provide the correct answer to complete the statement.

_____ 1. Who analyzes each piece to be printed, determines the time required for each production step, computes the value of materials used, and gives the sales department the total cost of the job to "quote" to the customer? (A) executives; (B) layout men; (C) compositors; (D) estimators.

_____ 2. What group of workers maintain correspondence and records of purchases? (A) sales staff; (B) office staff; (C) executives; (D) estimators.

_____ 3. Who sets the type from the copy? (A) cameramen; (B) layout men; (C) copy preparation workers; (D) compositors.

_____ 4. Who checks the trial printing to be sure that there are no errors? (A) compositors; (B) proofreaders; (C) copy preparation workers; (D) strippers.

_____ 5. Who assembles the etch proofs and prepares them in desired page layouts for the camera? (A) copy preparation workers; (B) strippers; (C) proofreaders; (D) layout men.

_____ 6. Who arranges and tapes all the negatives on goldenrod paper? (A) copy preparation workers; (B) strippers; (C) layout men; (D) compositors.

_____ 7. Who prepares the coating solutions and coats the plates? (A) pressmen; (B) storekeepers; (C) platemakers; (D) strippers.

_____ 8. Who maintains stocks of paper, ink, and other supplies? (A) shipping department; (B) storekeepers; (C) platemakers; (D) feeders.

_____ 9. Who attaches the plate to the press? (A) pressmen; (B) platemakers; (C) copy preparation workers; (C) compositors.

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. List three common methods of learning a printing trade.

(A) ____________________

(B) ____________________

(C) ____________________

2. Some printing trades require a good knowledge of:

(A) ____________________

(B) ____________________

(C) ____________________

(D) ____________________

3. List four types of schools that offer courses in printing.

(A) ____________________ (C) ____________________

(B) ____________________ (D) ____________________

4. The main groups of lithographic workers are:

(A) ____________________ (D) ____________________

(B) ____________________ (E) ____________________

(C) ____________________

5. Offset printing is expected to continue to grow due to the greater use of:

(A) ____________________ (C) ____________________

(B) ____________________ (D) ____________________

Assignment
Sheet No. 3

Covering
Unit 4

ACCIDENT AND HEALTH HAZARDS

As a general group, printers usually enjoy good health. Government surveys have shown that long and continuous employment in the printing trades is compatible with reasonably good health.

You who have elected to work in the printing industry and who will work in the printing shops should realize that accident and health hazards are found in the printing industry as in any other major production industry. Because these conditions do exist, the hazards, their results, and means of prevention must be known in order to provide a background of knowledge about the particularly dangerous machines, and personal conduct necessary to prevent injury or illness.

A diligent study of the references assigned in this unit will provide the information necessary to aid in accident prevention, and develop an attitude which will enable you to protect your personal health.

Assignment:

1. Read the references listed below.
2. Make a list of the possible accident and health hazards as you see them in the shop you are working in.
3. Answer the questions below and turn in this assignment by ________________________.

References:

A. Cogoli, Photo-Offset Fundamentals, pp. 176-179.
C. Latham, Lithographic Offset Press Operating, pp. 241-253.
D. Latham, Advanced Pressmanship, pp. 42-44.
I. Information Sheet No. 1, "Accident and Health Hazards."

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. A standard operating plan should be worked out for the shop so that, in case of injury, each individual concerned knows exactly what should be done.

T F 2. First-aid kits should be kept locked to insure safekeeping of supplies.

T F 3. The first-aid kit should be assembled by the plant physician.

T F 4. People who work in the shop should be instructed in first-aid procedures.

T F 5. An injured person should never be left alone.

T F 6. A person should never be allowed to work alone in the darkroom.

T F 7. Unsafe practices by a worker should always be corrected.

T F 8. Paper cutters should always be operated by two people.

T F 9. You cannot expect to keep the floor clean and free from paper in a print shop.

T F 10. When making solutions, the chemical should be poured into the water.

T F 11. Chemicals and solutions should always be locked in the cabinet whenever they are not in use.

T F 12. Milk bottles and other food containers should never be used for storing chemicals.

T F 13. All work areas should receive a proper amount of illumination, but this is impossible because the glare cannot be controlled.

T F 14. Skin infections can result from the use of benzine for cleaning purposes.

T F 15. The lack of dust-control within the workroom may cause diseases of the respiratory system.

T F 16. Cleaning liquids may be stored in the workroom.

T F 17. In the composing room, a bellows should be used to clean the compartments of the type cases.

T F 18. A headache or feeling of weariness may be one of the first indications of the presence of carbon monoxide within a poorly ventilated shop.

T F 19. Proper ventilation and adequate washing facilities should be provided when benzine is used to wash presses.

T F 20. Lead poisoning, while causing discomfort, is not a serious health hazard.

T F 21. In the interest of health, sterilized wiping cloths should be used for cleaning presses.

T F 22. A thoughtless or careless workman can cause a well-guarded machine to become dangerous.

T F 23. Injuries occur when the worker has his attention diverted from his job.

T F 24. Very small cuts need not be treated to prevent infection.

T F 25. Fatigue and the weakening of body resistance are the results of improper ventilation.

T F 26. Poor housekeeping is the cause of many accidents.

T F 27. The wearing of gloves can be more dangerous than none at all if bichromates get inside them.

T F 28. All workers are likely to be affected by lithographic chemicals and inks.

T F 29. There is no real cure for occupational dermatitis.

T F 30. Some research is being done in efforts to develop remedies for dermatitis.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. Before any repairs should be made on a machine, the switch should be ______________ ______________.

2. Plug-in appliances should be ______________ after use.

3. The press should never be operated without the ______________ ______________ in place.

4. Chemicals should be stored on the ______________ shelves in their cabinets.

5. Never pour ______________ into ________________.

6. Every container into which any chemical preparation is to be placed must be ______________________.

7. When the hands must come into contact with irritants, ___________ ______________ should be worn.

8. A ______________ ______________ should be worn to keep chemicals from staining clothing and prevent them from reaching the skin.

9. Chemicals should never be mixed in the darkroom unless there is an ____________ _______________ in operation.

10. When looking at the burning arc of an arc light, ______________ _________________ should be worn.

11. To eliminate having to climb up and down on a machine to check certain operations, an operator may install a _______________.

12. A worker will be investing in his own safety by learning to do the job the _____________ ___________ which is also the ____________ ______________.

13. Besides good housekeeping, the other important aspect of safety is the _____________ ______________ of the press.

14. Of the solvents used in lithography, ______ ____ causes more skin irritations than the others.

15. The only remedy for dermatitis at the present time, is ___________________.

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. List five safety precautions concerning fire prevention.

(A) ____

(B) ____

(C) ____

(D) ____

(E) ____

2. List four safety precautions concerning clothing worn around machinery.

(A) ______________________ (C) ______________________

(B) ______________________ (D) ______________________

3. List the three steps in thinking through each job safely.

(A) ____

(B) ____

(C) ____

4. What five precautions should be taken when loading feeders of large presses?

(A) ____

(B) ____

(C) ____

(D) ____

(E) ____

<u>Matching</u>

<u>Directions</u>: In the left hand column is a list of items. The right hand column contains descriptive phrases or synonymous terms. Match the descriptions to the terms by placing the letter of the description in the blank at the left of the appropriate term.

_____ 1. Tripping and falling

_____ 2. Saws and trimmers

_____ 3. Paper cutters

_____ 4. Dust

_____ 5. Lead poisoning

_____ 6. Benzine

_____ 7. Talking with workmen

_____ 8. Fatigue

_____ 9. Platen presses

_____ 10. Handling paper

A. Colic, heart and kidney disease, death

B. Loss of fingers or hand

C. Cuts, rupture, strains

D. Bruises or broken bones

E. Getting caught in rollers and belts

F. Burns and mangled hands

G. Ill health

H. Skin infection, dizziness, headaches

I. Burns

J. Crushed fingers or hands

K. Mangled hands and eye injuries

L. Respiratory diseases

M. Getting out of time with machines

Information
Sheet No. 1

ACCIDENT AND HEALTH HAZARDS

This information sheet will present certain accident and health hazards as well as their ultimate results and means of prevention.

Accident Hazards

Saw and Saw Trimmers: Mangled hands can result from contact with the moving blade, or eye injuries can result from the eyes being struck by metal pieces thrown by the moving blade. To prevent hand injuries from saws and trimmers, use guards and work holders at all times. To prevent eye injuries, wear goggles whenever operating saws and saw trimmers, even though guards are provided.

Composing Machines: With careless and improper adjustment, composing machines can cause burns and mangled hands. To prevent such injuries, see that all automatic stops are adjusted and work correctly; do not throw pigs of metal into pot; guard molds, gears, and belts.

Paper Cutters: These machines can cause the loss of one or more fingers or a hand. To prevent these losses, work alone when cutting paper; do not catch scrap as it comes from the knife; see that nonrepeating devices work properly. Make sure that the machine is fit with proper safety guards.

Slug cutters and Mitering Machines: Although these machines are hand operated their use can result in crushed, torn or cut fingers or hands. Safety demands that great care be taken when using unguarded machines: When guards are provided, they should be used.

Unguarded Belts and Gears: To avoid being caught and injured by these means of power transmission, see that all belt and gear hazards are well guarded.

Staplers, Stitchers, Platen Presses and Cornering Machines: These machines can cause crushed fingers or hands. To avoid such injury, install guards where feasible and take care when operating.

Tripping and Falling: Painful bruises are a frequent result of this hazard, with broken bones or other serious injuries possible from falling against or into machinery. The prevention of these injuries requires all type cases to be closed when not in use. Trouser cuffs should be rolled inside.

Folding Machines: The greatest hazard with this machine is getting caught in rollers or belts. The prevention of these injuries demands that guards be placed at danger points. Make adjustments only when machine is not running.

Fire: From this hazard, burns are the usual result. To prevent fires and the subsequent injuries, use approved safety cans for benzene, gasoline and kerosene; do not keep stores of flammable liquids in the workroom; do not use a celluloid eyeshade if smoking on the job is permitted.

Paper Handling: From this activity paper cuts, ruptures, and strains are possible results. To avoid strains and ruptures, do not lift excessively heavy loads. When paper cuts occur, they should be properly treated to prevent infections.

Plate Handling: Cuts on the hands are the usual result from the careless handling of plates. To prevent these cuts, take care when removing offset plates, however, if they do occur, treat the cuts to prevent infection.

Horseplay: Childish actions are extremely undesirable in a plant employing men, and usually result in falls against workmen who are operating machines; or falling against or into the machine themselves. Horseplay can be prevented by refraining from wrestling or engaging in other play.

Talking with Machine Operators: The most serious result is usually to the machine operator who runs the risk of serious hand injuries if the conversation causes him to get out of time with the machine. To eliminate this hazard, do not talk to machine operators.

Press Adjustments: Making adjustments on the press while it is running can be very dangerous. It is a good practice to never make any adjustments on the press while it is running regardless of how minor they may be.

Unauthorized Use of Machines: The variety of injuries resulting from the unauthorized use of machinery and equipment is too enormous to make a specific list of them. In order to aviod injuries from this source, all workers should heed the danger signs posted to indicate those machines which require special instruction for their operation, and refrain from operating those machines, until given the proper instruction in their use or operation.

Health Hazards

Lead Poisoning: Depending upon the amount and length of exposure, this hazard may manifest itself in any one or more of the following ways: colic, constipation, paralysis, disease of the heart, blood vessels, and kidneys, insanity or death. To prevent lead poisoning, the following precautions should be taken: do not create lead dust by splashing pigs in the metal pot; keep pieces of type from the mouth; avoid dry sweeping; do not eat in the workroom; wash hands before eating; clean nails frequently; and do not chew or smoke while working.

Improper Ventilation: This hazard is especially dangerous during the winter months when windows and doors are kept closed against the cold. The results of improper ventilation are: fatigue, weakening of body resistance, poisoning from gas and fumes. To prevent this hazard all fumes and gases should be piped from the shop.

Carbon Monoxide: This hazard results from improper ventilation and causes headaches, dullness, lassitude, nervousness, insomnia, digestive ailments, and possible death. Proper ventilation and the piping of fume and gases from the shop will remove this hazard.

Tuberculosis: The result of this hazard is general sickness, and possible death. To offset the effects of this hazard, do not use a common drinking cup or towel; prohibit spitting on the floor; exercise in open air and in sunlight; have good ventilation in the workroom.

Benzene: This cleaning fluid is highly volatile, and therefore, can present hazards both as a liquid and a gas, causing skin infections, faintness, dizziness, headaches, and vomiting. To prevent these conditions, proper ventilation should be provided, use gloves when cleaning presses, and provide adequate washing facilities. Also, see fire discussed previously for the fire hazards of benzene.

Cleaning Mixtures: The use of cleaning solutions with anilin oil bases can cause convulsions and death. If these cleaning mixtures are used, gloves should be worn; proper ventilation provided, and the user should avoid splashing the mixture on hands or clothing.

Poor Blood Circulation: The result of this condition is general ill health. Exercise in sunshine and open air after working hours will usually correct this condition.

Bad Lighting: Improper lighting causes impaired eyesight, which can be prevented by the amount of illumination, shaded and located to prevent glare.

Unclean Wiping Cloths: The skin infections caused by the use of unclean wiping rags can be eliminated by the use of sterilized wiping cloths. Local laundries usually provide a towel and wiping cloth service for those establishments requesting this service. There are also towel services located in larger cities which also offer this service.

Fatigue: The ill health caused by fatigue can be eliminated by proper rest.

Dust: The inhalation of dust results in diseases of the respiratory system. These diseases may be prevented by eliminating dust from the workroom, by prohibiting dry sweeping, by cleaning pot plungers outside the plant, and by prohibiting the use of a bellows to clean type cases while the cases are in the workroom.

Assignment
Sheet No. [illegible]

Covering
Units 5-16

METHODS OF TYPE COMPOSITION FOR REPRODUCTION

There are many type styles from which the printer may choose. The first concern of a printer in selecting a type is, of course, clarity. Type styles, if used properly, can convey the feelings or mood of a message. There are also several methods of type composition that may be used for setting copy which is to be printed by photo-offset lithography.

There are no hard and fast rules governing the style of type that is to be used in most instances. It is primarily a matter of good taste and association. You must be familiar with the various styles of type and be able to recognize them in order to make wise selections. You must also be familiar with the various methods of type composition in order to select the best method for each job.

In this unit you will learn the styles of type available, their advantages and disadvantages, and the various methods of type composition.

Assignment:

1. Read the references listed below.
2. Make up a chart showing the most commonly used typefaces with which you will be working and explain an appropriate use for each.
3. Answer the questions below and turn in this assignment by ____________________________.

References:

1. Cogoli, Photo-Offset Fundamentals, pp. 33-55.
2. Department of the Navy, Lithographer 3 & 2, pp. 13-33, [illegible].

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. Newly cast type should be used for making reproduction proofs.

T F 2. Enlarging or reducing type may destroy the original balance and beauty of the type.

T F 3. The current practice in industry is to send reproduction proofs to the cameraman all "made up" in page form.

T F 4. The shoulder is not included when measuring the body size of the type.

T F 5. It is necessary to see the type in actual printed form to determine how large it will appear when printed.

T F 6. Type that measures 4 picas is 24 point.

T F 7. Strips 6 points or more are called "leads."

T F 8. A brayer is used to measure type.

T F 9. Monotype is cast in complete lines of individual letters and spaces according to copy.

T F 10. Linotype and Monotype machines are similar in appearance, operation and final product.

T F 11. The Intertype machine casts individual characters.

T F 12. A line of type cast by a Linotype machine is called a "slug."

T F 13. Matrices are often referred to as "mats."

T F 14. Each matrix must be returned to its original place by hand when using the Linotype machine.

T F 15. Linotype slugs cannot be melted down and used in casting other slugs.

T F 16. The Ludlow machine produces a solid line of type.

T F 17. The Ludlow machine is faster than the Monotype machine.

T F 18. The Ludlow machine is not recommended where large sizes of type are needed.

T F 19. The Ludlow machine is a hand set system.

T F 20. Four-line wood type would measure 2 picas.

T F 21. Hand lettering is especially useful for display lines.

T F 22. The Vari-Typer is a machine used to cast type.

T F 23. A wide selection of type faces is available for the Vari-Typer.

T F 24. The Vari-Typer makes no provisions for line justification.

T F 25. Display lines are often composed by assembling printed characters.

T F 26. The Headliner is a portable phototype-composition machine for composing entire pages.

T F 27. The film must be removed from the Headliner for developing.

T F 28. The Monophoto will produce photo-composed type matter from 6 points to 24 points in size.

T F 29. The maximum film size for the Monophoto is 8½" by 11".

T F 30. The Monophoto is actuated by a perforated paper ribbon that is prepared on the same Monotype keyboard used for "hot-metal" composition.

T F 31. The Intertype Fotosetter photographs one line of type at a time.

T F 32. The ATF Typesetter will set only one size of type.

T F 33. One hundred eight different faces and sizes of type are available on the Linafilm system.

T F 34. The Linafilm system uses an automatic justification system.

T F 35. Unlike the ordinary typewriter, the IBM Proportional Spacing machine does not allow the same amount of space between each letter.

T F 36. The DSJ composing machine allows the same amount of space to all letters.

T F 37. Eight- to fourteen-point type is considered to be too small for good legibility.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. Metal type may be set either by ______________ or by ______________.

2. Reproduction proofs are taken from metal type on dull-coated ______________ paper with ______________ ink.

3. Cellophane reproduction proofs are best made on a proof press equipped with a ______________ tympan sheet.

4. Many types have a space beneath the letter on its face, called the ______________.

5. ________ picas equal approximately one inch.

6. There are ___________ points in each pica.

7. All metal type used in the U. S. is ________ inches high measured from the feet to the face of the type.

8. Complete collections or assortments of foundry type are called ______________.

9. Blank units are called ______________.

10. Variations of any one type face design are known as a ______________.

11. Making lines equal in length is called ______________.

12. Wide spaces are called ______________.

13. Composed foundry type is placed on a ______________ which is placed on a bed of a proof press.

14. The Monotype system employs two machines: the ______________ machine and the ______________.

15. The Ludlow machine finds great use in ______________ composition.

16. Wood-type is employed instead of metal type for very ___________ sizes of type.

17. Wood-type is usually made of ______________ wood.

18. Sizes of wood-type are designated in ______________.

19. Typed copy that is to be photographed for reporduction is often called ____________________.

20. The Monophoto operates at the rate of ________ characters per minute.

21. The Linofilm composer performs two basic functions: ____________________ and ______________.

22. The first concern of a printer in selecting type is ____________.

23. The most commonly used type for the text of books is ___________.

24. The type face most commonly used for announcements, invitations, etc., is called ______________.

25. Text type face may be called ________________ ________________.

26. Italics are used in text matter to show ________________.

27. When an initial letter is used, the remainder of the word is generally ______________.

28. If a line is so short that the adjustment of space between words is not enough, it becomes necessary to place ______________ ______________ between the letters of each word.

29. The process of placing thin inserts between the letters in each word is known as ______________.

30. Paper or plastic plates used on smaller offset presses areknown as ____________________ plates.

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. List seven methods of type composition:

(A) __________________________ (E) __________________________

(B) __________________________ (F) __________________________

(C) __________________________ (G) __________________________

(D) __________________________

2. List four kinds of metal type:

(A) ______________________ (C) ______________________

(B) ______________________ (D) ______________________

3. List four machines used for composing entire pages of type matter on film:

(A) ______________________ (C) ______________________

(B) ______________________ (D) ______________________

4. Of what four units is the Linofilm system comprised:

(A) ______________________ (C) ______________________

(B) ______________________ (D) ______________________

5. List the six main classes of types as classified by the references:

(A) ______________________ (D) ______________________

(B) ______________________ (E) ______________________

(C) ______________________ (F) ______________________

6. List the six factors that have the greatest bearing on legibility:

(A) ______________________ (D) ______________________

(B) ______________________ (E) ______________________

(C) ______________________ (F) ______________________

7. List five types of work that would be classified as copy preparation:

(A) ______________________ (D) ______________________

(B) ______________________ (E) ______________________

(C) ______________________ ______________________

Assignment
Sheet No. 5

Covering
Units 17-25

JOB PLANNING, ARTWORK, AND LAYOUT

Good planning, which is an essential part of every job, is little more than proper organization. One aspect of planning involves determining the operations to be performed and estimating the time, men, and materials that will be required to do the job. Another aspect of planning involves a plan or "layout" of the job to be done. The layout may involve the preparation of artwork or at least touching up photographs or illustrations.

A lack of planning will result in the loss of time, money, effort and perhaps customers. It is of utmost importance that every job be analyzed and carefully planned. Each step must be planned to make the most efficient use of time and equipment. A full-sized layout will insure the customer of getting what he wants--he will be able to see what the finished product will look like. It also contains all instructions so that each worker knows exactly what is to be done.

In this unit you will learn techniques of planning and methods and procedure for making the layout. You will also learn of some of the procedures for preparing artwork.

Assignment:

1. Read the references listed below.
2. Answer the questions below and turn in this assignment by ______________________.

References:

A. Cogoli, Photo-Offset Fundamentals, pp. 26-32, 61-67.
B. Department of the Navy, Lithographer 3 & 2, pp. 34-39, 64-82.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. The layout contains instructions for the worker.

T F 2. Large firms usually employ specialists in layout.

T F 3. Some customers have their work planned and laid out by commercial advertising agencies.

T F 4. Type that is smaller than 14 point is generally referred to as display type.

T F 5. It is generally agreed that the most legible body type composition consists of 6- to 8- point type.

T F 6. Punctuation marks must be included when determining the total number of typewritten characters there are in the total copy.

T F 7. Some type manufacturers furnish information concerning the number of characters per pica for their type.

T F 8. A sketch or a proof of an illustration should always be put on the layout.

T F 9. It is not necessary to indicate type faces on a dummy.

T F 10. The dummy must be made to look as much like the finished work as possible.

T F 11. A dummy usually involves more than one page of printed work.

T F 12. Two different jobs should never be run at the same time.

T F 13. A layout should be made-up to the exact finished size of the job.

T F 14. Generally a fairly complete layout will save more time than can be eliminated by making just a very rough layout.

T F 15. You should not write on the back of camera copy.

T F 16. Halftone copy includes all work which has gradations in tone.

T F 17. Halftone screens come with just one size screen ruling.

T F 18. Usually line drawings are prepared larger than they will be printed.

T F 19. Line drawings require more care than tone copy.

T F 20. Retouching of photographs is generally done with watercolors.

T F 21. If photographs are not receptive to watercolors, they cannot be retouched.

T F 22. Airbrushing is particularly useful for retouching photographs with damaged emulsion.

T F 23. Photographs should never be rolled.

T F 24. Cropping means mounting photographs on stiff cardboard.

T F 25. Tone drawings should always be prepared to be used at full size.

T F 26. It is generally difficult to copy colored photographs and other colored illustrations for black-and-white reproductio

T F 27. Crayon drawings generally give good reproduction.

T F 28. Transparencies have their widest use for black-and-white reproduction.

T F 29. When making up combination copy, the overlay method is the most economical.

T F 30. If it is desirable to have white type show up on the final product, white letters must be put on the copy.

T F 31. Illustrations that are to be reduced or enlarged can be placed on the paste-up but a notation should be included to inform the camera man of this fact.

T F 32. Illustrations done by others should be used only as references and should never be copied.

T F 33. The separation of colors for color reproduction of tone copy normally is not done by the artist.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence.

1. A full-sized plan of the contemplated job is called a __________.

2. Before a full-sized plan is attempted, a number of ______________ ______________ are made.

3. When a rough layout seems promising, a ______________ layout is made.

4. The copy notation for a display line indicates the type size as "16/18"; this indicates a 16-point ______________ on an 18-point ______________.

5. Type faces 12 points and smaller are called ______________ or ______________ types.

6. The typewritten copy that is to go into a certain space on the layout is indicated by a ______________ or ______________ marking.

7. Determining whether or not the type will fit in the available space is known as ____________________.

8. The amount of space that display type will occupy is determined by means of a ______________ ______________ ______________.

9. When no leading is set between lines, the type is said to be set "______________."

10. A good selling point is to use ______________ on the layout in the same manner as it will be used for the finished illustrations on the job.

11. The body type in a dummy is indicated by ______________ ______________.

12. If it is desired to reduce an illustration with a width of 9 inches and a height of 12 inches so that the reduced height is 4 inches, then the reduced width will be ________ inches.

13. One advantage of reducing original drawing is that the ______________ are also reduced.

14. The proper physical form to be used for a job should be determined by the ______________ of the job.

15. Running small jobs two or more up reduces ______________ and cuts down ______________ ______________.

16. When a number of pages of a job are printed on one sheet, the sheet is referred to as a ______________.

17. Certain kinds of work, such as photographs and water color drawings are known as ______________ ______________.

18. In order to indicate instructions and specifications on artwork without marking up the copy, an _______________ should be used.

19. A group of photographs pasted together to form a new picture is called a _______________.

20. When an illustration is to bleed, it must be marked so that after reduction, it will be at least ________ points wider and higher than it is to appear after the page has been trimmed.

21. An inset is a small picture inserted into a _______________ _______________.

22. Quality work in combination copy is best achieved by using an _______________ _______________.

23. When colors are to overlap in a color reproduction, it is essential that some type of _______________ be used in preparing the copy.

24. When doing preliminary ruling for a paste up, a _______________ pencil should always be used.

25. The adhesive that should be used for pasting up is _______________ _______________.

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. Notations along side the layout of display type should indicate:

(A) ______________________________

(B) ______________________________

(C) ______________________________

(D) ______________________________

(E) ______________________________

(F) ______________________________

(G) ______________________________

2. List four examples of line copy:

(A) ______________________________

(B) ______________________________

(C) ______________________________

(D) ______________________________

____

3. List three examples of halftone copy:

(A) ______________________________

(B) ______________________________

(C) ______________________________

4. List four methods of figuring reductions and enlargements:

(A) ______________________________

(B) ______________________________

(C) ______________________________

(D) ______________________________

5. All artwork falls into one of three general classifications which are:

(A) ________________ (C) ________________

(B) ________________

6. Three types of halftone finishes are:

(A) ________________ (C) ________________

(B) ________________

7. Additional interest can be brought into page make-up by the use of:

(a) ______________________________

(b) ______________________________

(c) ______________________________

Assignment
Sheet No. 6

Covering
Units 26-28

PROOFREADING AND LEGAL RESTRICTIONS

A universal language among printers exists in the system of marks used to indicate errors in composition and the changes necessary for the correction of these errors. It is essential that the compositor master the formation and the interpretation of these marks regardless of the size of the shop in which he works. Large commercial printing firms, such as those printing newspapers and magazines, employ trained proofreaders who check proofs for errors. The compositor must be able to interpret the proofreader's marks in order to make the indicated corrections in the composed form. In smaller printing establishments, the compositors also do proofreading, usually that which someone else has composed.

Because much of lithography work involves the copying of previously printed work, it is well for workers in the field to be familiar with the legal restrictions on copying. This will help to eliminate serious problems and possibly court action.

This unit will provide you with the general procedures of proofreading and also a knowledge of the Standard Proofreader's Marks. Further, you will learn of some of the legal restrictions that govern copying material.

Assignment:

1. Read the references given below.
2. Make a chart of the common proofreader's marks
3. Answer the questions below and turn in this assignment by ______________________________.

References:

A. Cogoli, Photo-Offset Fundamentals, pp. 56-60, 180-184.
B. Department of the Navy, Lithographer 3 & 2, pp. 61-63.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. Proof is usually pulled on paper which is larger than the type form.

T F 2. Photographically composed type is proofread directly from the positive or negative.

T F 3. Only the final camera copy of typewritten and pasted-up type is usually available for proofreading.

T F 4. Copy is usually proofread only once.

T F 5. A revised proof is taken after the compositor has corrected the errors.

T F 6. Mark-up instructions are not proofread.

T F 7. Special indentions are noted by the reader.

T F 8. The reader tells whether dates and amounts are indicated by figures or words.

T F 9. All errors are marked in the left-hand margin.

T F 10. As an extra precaution, the marker often reads aloud from the proof and the reader follows the original copy after the first proofreading.

T F 11. Sometimes one person performs the functions of both reader and marker.

T F 12. The only responsibility the proofreader or marker has is to see that the proof exactly matches the copy.

T F 13. The proofreader or marker may suggest improvements in the grammar of the copy.

T F 14. Some magazines are proofread twelve or more times.

T F 15. The proofreader is not supposed to make any changes except where there are typographical errors.

T F 16. Proofs should also be checked for type sizes.

T F 17. "Stet" indicates a change is to be made.

T F 18. The proofreaders' mark $\underset{\smile}{\#}$ means "equalize space between words."

T F 19. The proofreaders' mark "∽" when used in text, means to transpose.

T F 20. The proofreaders' mark sp. means to spell out.

T F 21. It is not possible to copyright everything.

T F 22. A copyright may not be renewed.

T F 23. It is best to get written permission to copy something.

T F 24. If no copyright is indicated on printed matter it can be assumed that permission is granted to copy.

T F 25. Any photographs which show clearly recognizable faces of persons cannot be used for advertising purposed without first obtaining written consent from the persons involved.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. Proofreaders' marks are really a printer's ______________.

2. The ______________ reads aloud from the original copy to the ______________ who follows along on the proof.

3. The reader spells out ____________ — ______________ and ______________.

4. The marker indicated the necessary correction by using a system of symbols known as ______________ ______________.

5. The proofreaders' mark G? indicates a question of ___________.

6. The proofreaders' mark F? indicates a question of ___________.

7. The proofreaders' mark "flush ¶" means no paragraph ______________.

8. Proofreaders' marks should made with a ______________ pencil when marking copy.

9. To correct an error before the copy is photographed, it is merely a matter of ______________ the correction over the error.

10. The owner of the copyright has the exclusive right to ______________ his work, and to ______________ or ______________ copies of his work.

11. A copyright runs for a period of ________ years.

12. Protection on unpublished books, photographs, maps, etc. begins when the works are created and ends when they are published for ______________ or ______________.

Multiple-Choice

Directions: In the space at the left of each statement, write the letter of the item which will provide the correct answer to complete the statement.

_____ 1. The marginal mark "bf" combined with a word underlined with a wavy line in the text of the proof means: (A) broken font; (B) delete word; (C) set in small italics; (D) set in bold face.

_____ 2. The mark "stet" in the margin of a proof means: (A) set this eliminated text; (B) let it stand; (C) second revise; (D) scrap time every time.

_____ 3. The mark "l.c." in the margin of a proof means: (A) lower caps; (B) less capitals; (C) lower case; (D) leaded counter.

_____ 4. The mark "#" in the margin means: (A) insert space; (B) equalize space between words; (C) close up partly; (D) close up entirely.

_____ 5. The proofreaders' mark "⁐" means: (A) close up partly; (B) close up entirely; (C) not leaded; (D) more space between words.

_____ 6. The proofreaders' mark "#" means: (A) no paragraph indention; (B) hanging indention; (C) no paragraph; (D) begin a paragraph.

_____ 7. The proofreaders' mark "fl L" in the margin means: (A) set in light face type; (B) move to left; (C) align type vertically; (D) less space.

_____ 8. The proofreaders' mark " $\frac{1}{M}$ " indicates to the compositor that: (A) one hyphen is to be inserted; (B) one em-quad is to be inserted; (C) one em-dash is to be inserted; (D) paragraph is to be indented one em-quad.

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. List the three elements of a copyright notice.

(A) ______________________________

(B) ______________________________

(C) ______________________________

2. List five groups of items that may not be reproduced in photographic or printed form:

(A) ______________________________

(B) ______________________________

(C) ______________________________

(D) ______________________________

(E) ______________________________

T F 24. Two or more individual lenses are usually fitted together for use in cameras.

T F 25. Depth of focus is quite important in process camera work.

T F 26. Focal lengths are fixed and do not change.

T F 27. Focal length of a lens is usually stamped on the lens barrel.

T F 28. Lenses with short focal lengths can produce larger images than those with long focal lengths.

T F 29. Enlarging an image requires a longer exposure time.

T F 30. The opening formed by the iris diaphragm is called the lens aperture.

T F 31. The fastest lens is the one with the smallest relative opening.

T F 32. The largest apertures always have the smallest f-numbers.

T F 33. Large apertures and short exposures will produce sharper pictures than small apertures and long exposures.

T F 34. Both the lens opening and the exposure time need to be adjusted for practically all exposures.

T F 35. Camera lenses should be cleaned with alcohol.

T F 36. Even the best lenses have some defects.

T F 37. Filters are used to alter the color and the intensity of light.

T F 38. All process cameras are equipped with shutters.

T F 39. Longer exposures are necessary when filters are used.

T F 40. Vertical process cameras are hardly ever focused visually.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. Film is placed in the camera with the _______________ side facing the lens.

2. The transparent area on the film is called the ______________.

3. Two general classes of horizontal cameras are used for offset photography: the ______________ camera and the ______________ camera.

4. The most critical part of the camera is the ______________.

5. A lithographic worker should never take the lens ______________.

6. The abbreviation FL is used to indicate the ______________ ______________ of a lens.

7. Focal length of a camera lens is given in ______________.

8. A practical expression of focal length would be: ______________ of the distance from the camera copyboard to the ground glass. when the focused image on the ground glass is the ______________ ______________ as the object on the copyboard.

9. F-stop numbers indicate the size of the ______________.

10. A slot in the lens barrel to permit the use of filters for color work is called the ______________ ______________ slot.

11. The light source for the darkroom (or gallery) camera may be ______________ or ______________ ______________.

12. The ______________ of a camera focuses or projects the light rays onto the film.

13. The film used in cameras is a sheet of transparent acetate coated with a layer of gelatin in which are suspended millions of tiny particles of ______________ ______________.

14. The paper positive is called a ______________.

15. The camera used for copying is known to the trade as a ______________ camera.

16. There are two types of process cameras: ______________ and ______________.

17. The image formed on the film in a pinhole camera appears upside down because light travels only in ______________ ______________.

18. Tripling the distance between the film and the lens will enlarge the image ______________ times.

19. Doubling the distance between the film and the lens will require an exposure ______________ times longer than the original.

20. The focal length of a lens is 8"; if the collar is set at f4, the diaphrahm will form an opening in the lens barrel that is approximately ______________ in diameter.

21. Sharp visual focusing may not always agree with the scale positions because of flaws in the lens known as ______________.

22. The length of the exposure is controlled by the ______________.

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. The five basic parts of a darkroom camera are:

(A) ______________ (D) ______________

(B) ______________ (E) ______________

(C) ______________

2. List the three components of the camera back:

(A) ______________ (C) ______________

(B) ______________

3. List two types of film holders:

(A) ______________

(B) ______________

4. The five basic camera settings for same size are:

(A) ______________ (D) ______________

(B) ______________ (E) ______________

(C) ______________

5. List the three parallel planes of a horizontal process camera:

(A) ______________________ (C) ______________________

(B) ______________________

6. The three items by which lenses are usually classified are:

(A) ____

(B) ____

(C) ____

7. List seven types of flaws in camera lenses:

(A) ______________________ (E) ______________________

(B) ______________________ (F) ______________________

(C) ______________________ (G) ______________________

(D) ______________________

Assignment
Sheet No. 3

Covering
Units 36-43

LINE AND HALFTONE PHOTOGRAPHY

Lithographic photography is divided into two kinds: line photography and halftone photography. Line photography is the photography of copy which is composed entirely of solid areas or lines of a single tone. No shadow areas or gradations of tone may be present. Any work which contains gradations of tone must be reproduced by the halftone process. Gradations of tone are formed in such things as original photographs, oil paintings, crayon and pencil art.

Tone values are lost in line photography; the introduction of the halftone screen made possible the reproduction of original photographs and the like without loss of tone values. It wasn't until 1893 that photoengravers took up halftone work in earnest. The photographs in newspapers, magazines, and books are almost always printed by the halftone process.

In this unit you will learn about methods and procedures involved in shooting line and halftone copy.

Assignment:

1. Read the references listed below.
2. Answer the questions below and turn in this assignment by __________________________.

References:

A. Cogoli, *Photo-Offset Fundamentals*, pp. 75-90.
B. Department of the Navy, *Lithographer 3 & 2*, pp. 137-171.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. The sharpness of focus should be checked with a magnifying glass.

T F 2. The camera must be focused before the film is loaded.

T F 3. Ortho Type 2 film is sensitive to red light.

T F 4. The emulsion side of the film should be facing away from the camera lens during exposure.

T F 5. The emulsion side of the film is darker than the base side.

T F 6. Standardization is important in process camera work.

T F 7. Most cameramen use the f/32 aperture for same size line work.

T F 8. If adjustments for size are necessary, the lensboard is first moved and then the copyboard is relocated to return the image to focus.

T F 9. When focusing the camera visually, the diaphragm should always be wide open.

T F 10. Fine line work should always be focused with the opening that is to be used for the exposure.

T F 11. The emulsion side of film can be determined in total darkness by moistening your lips and pressing a corner of the film between them.

T F 12. A notch on the corner of film indicates that the film is to be used for color reproduction only.

T F 13. White backgrounds and copy with smooth surfaces require more exposure time than dark backgrounds and copy with rough surfaces.

T F 14. The best way to determine the correct exposure is by shooting a trial negative with a series of different exposures.

T F 15. If lens aperture remains constant, exposure time must be varied for enlargements or reductions.

T F 16. Greater sharpness can be obtained with an f/32 aperture than with an f/45 aperture.

T F 17. In making line shots for color reproduction, a simple black-and-white drawing is all that is required if the colors do not overlap.

T F 18. Filters must be used in photographing all colored copy.

T F 19. When the subject is to be made dark against a light background, you should select a filter which will transmit the color of the subject and absorb the color of the background.

T F 20. The halftone is a smooth gradation of tone.

T F 21. Negatives used to make printing plates must contain no semi-opaque areas.

T F 22. The usual screen angle for a blue color is 45-degrees.

T F 23. Filters are not necessary in making color negatives if the angle of the screen is changed for each color.

T F 24. Halftone negatives are usually made with one exposure.

T F 25. The "flash" exposure is made by opening the camera back and exposing the film set-up to a flashing lamp.

T F 26. An already-printed halftone picture must always be "rescreened."

T F 27. It is not necessary to make a test negative when the Kodak exposure computer is used.

T F 28. The lines on the screen are generally the same width as the space between them.

T F 29. Halftone screens are placed in the screen holder with the marked side facing the lens.

T F 30. A wedge gage is used to set the screen parallel with the film.

T F 31. You should use the same screen distance for all exposures made with a given screen.

T F 32. The size of the openings in the screen has a direct bearing on the distance the screen is placed from the film.

T F 33. Waterhouse stops are used when large apertures are needed.

T F 34. The f/22 opening is generally used as a basis for the high-light exposure.

T F 35. Colors for halftone color separation are obtained by using colored film.

T F 36. Overprinting green with yellow produces blue.

T F 37. Color separation is only about 60 per cent accurate.

T F 38. Only one negative is necessary in combination work if the line does not overlap the tone copy.

T F 39. Masks are often used in combination work.

T F 40. The contact screen is composed of opaque lines.

T F 41. Magenta screen cannot be used for direct color separation.

T F 42. Generally it is not possible to get both good highlight separation and shadow detail with a magenta contact screen.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. Copy that is composed of solids or lines is called ______________ ______________.

2. To determine the size of the film needed, measure the size of the ______________ on the ______________ ______________.

3. An image consisting of very fine lines should be examined with a ______________ to ensure a sharp focus.

4. The exposure time is figured directly as the ______________ of the distance from the light to the copy.

5. Process lenses are at their best when used with openings ranging from ______________ to ______________.

6. To ensure uniformly developed negatives, one should have a ______________ sink or a ______________ and a ______________ ______________ chart in the darkroom.

7. To make a positive print by the contact print method, the film should be exposed to ______________, ______________ light.

8. Most pictures in newspapers and magazines are printed by the ______________ process.

9. There are two general types of halftone screens: ______________ and ______________ ______________.

10. The usual screen angle for a yellow color negative is ______________.

11. ________________ screens for halftone photography are used in direct contact over the film in the camera back.

12. When making halftone negatives with the Kodak Magenta Contact Screen, the required detail exposure and the flash exposure can be determined by using the ____________ ____________ ____________ ____________ ____________ and the ____________ ____________ ____________ ____________.

13. The halftone screen was invented by ______________ ____________

14. Halftone screens are available in standard rulings of from ____________ to ____________ lines per inch.

15. When using a 133-line screen, the distance from the film to the glass surface should be about ____________.

16. The f/ ____________ lens opening is generally used as a basis for the detail exposure.

17. A ____________ scale is used for classifying contrast of copy.

18. Halftone negatives which have no dot at all in the highlights or in the white background are called ________________.

19. Halftone color separation is known as ______________ ______________.

20. If the copy is to be reproduced in full color, it is necessary to make ____________ separate negatives and ______________ separate press plates for it.

21. There are two methods of making color-separation negatives: the ______________ method and the ______________ method.

22. ________________ per cent of the paper is left as white space in a quarter tint.

23. When a halftone is rescreened and the new dot formation overlaps the old, a pattern called ______________ is formed.

24. There are two types of contact screens: the ____________ screen and the ______________ screen.

25. ____________ ______________ ______________ film does not require the use of a screen to produce a halftone negative.

Matching

Directions: In the left hand column is a list of items. The right hand column contains descriptive phrases or synonymous terms. Match the descriptions to the terms by placing the letter of the description in the blank at the left of the appropriate term.

Color to be photographed

_____ 1. Red as white

_____ 2. Violet as black

_____ 3. Blue as white

_____ 4. Green as white

_____ 5. Yellow as black

_____ 6. Red as black

_____ 7. Green as black

_____ 8. Violet as white

_____ 9. Orange as white

_____ 10. Yellow as white

Color of filter

A. Green

B. Deep yellow

C. Red

D. Light green

E. Blue

F. White

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. Exposure time is dependent on the:

(A) ____________________

(B) ____________________

(C) ____________________

(D) ____________________

2. Full color-process printing generally requires four separate printing impressions -- one for each of the following colors:

(A) ______________________ (C) ______________________

(B) ______________________ (D) ______________________

3. The formation of the dots produced by the glass halftone screen is dependent on:

(A) ____

(B) ____

(C) ____

(D) ____

(E) ____

4. List the three common exposures in a multiple exposure of halftone work.

(A) ______________________ (C) ______________________

(B) ______________________

Assignment
Sheet No. 9

Covering
Units 44-51

FILM DEVELOPING

Reflected light during exposure of the film in the camera produces a latent image on the film. After the film has been exposed, it must be developed to make the latent image visible. There are four steps to developing: (1) the developing bath; (2) the shortstop bath; (3) the fixing bath; and (4) the washing of the film.

Photography is a scientific art based on chemistry and physics. As you have seen in previous assignments, a great deal of care must be taken in setting up the camera and making the exposure. But, regardless of the care that is taken in making the exposure, a good negative can result only from following the proper developing procedure. If the negative is ruined in the developing process, all of the previous work in setting up the camera and exposing the film is lost--this is a waste of time, effort, and material.

In this unit you will learn about the materials used and the processes involved in developing film.

Assignment:

1. Read the references listed below.
2. Answer the questions below and turn in this assignment by ________________________.

References:

A. Cogoli, Photo-Offset Fundamentals, pp. 91-97.
B. Department of the Navy, Lithographer 3 & 2, pp. 113-136.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. Materials used in photography are not noticeably affected by temperature changes.

T F 2. Darkrooms should be well ventilated.

T F 3. All chemicals should be stored in the darkroom.

T F 4. A blue safelight should be used for orthochromatic film.

T F 5. Panchromatic film emulsions are sensitive to all colors of light and must be handled in total darkness.

T F 6. The sharp detail obtained in contact printing is often lost in enlarging.

T F 7. Matte prints are usually dried on ferrotype plates.

T F 8. A pH value of 2 denotes alkalinity.

T F 9. A pH of 5 is ten times as acid as a pH of 6.

T F 10. The colorimetric method of determining pH is the most accurate method.

T F 11. The pH control in lithography is used chiefly for testing the coating solution for the zinc plates and the press fountain solution.

T F 12. Fast films are more grainy than slower films.

T F 13. Glass plates are usually used for close-register work.

T F 14. Wet plates are used more often in lithographic work than dry plates.

T F 15. Photographic papers are sometimes used for making negatives

T F 16. Paper negatives are not recommended for halftone work.

T F 17. Panchromatic film is sometimes used for color-separation jobs.

T F 18. Process film is generally used for continuous tone negatives.

T F 19. Process film forms sharper, more abrupt breaks between the highlight and shadow areas than does commercial film.

T F 20. Commercial film is usually used for halftone negatives.

T F 21. Line negatives are usually made with process film.

T F 22. Most process film is slow.

T F 23. The shortstop bath removes all unexposed particles of silver from the film.

T F 24. Too much accelerator will soften the emulsion and cause fog.

T F 25. The water used to dissolve developer powder should not be over 125° F.

T F 26. Distilled water is preferred for developers.

T F 27. Developer should not be used after it has set for more than ten hours.

T F 28. A highly concentrated developer will cause the film to develop too fast and may produce excessive contrast and fog.

T F 29. Too much dilution of the developer will increase fog.

T F 30. Developer is usually sold in concentrated powder form in two separate containers: Part A and Part B.

T F 31. Development may stop entirely if the temperature of the developer drops below 70° F.

T F 32. Film may be developed by inspection instead of a set time.

T F 33. Chemicals left on the film from the fixing bath will cause brown stains if they are not removed.

T F 34. Soft photographic papers are used if the negative is thin and flat.

T F 35. Number 1 photographic paper is softer than Number 5.

T F 36. It is better to control the contrast of the print by manipulating development time than by varying the exposure.

T F 37. Negatives that are to be kept for future jobs should be washed for at least thirty minutes.

T F 38. An image may be prepared on a mechanical negative by typing or drawing with a stylus.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. Colored lights used in the darkroom are called ________________.

2. Entrance to the darkroom is by way of a ____________________ ________________.

3. Work should be kept at least ____________ feet away from the safelight.

4. Positive copies on film are called ______________ ____________.

5. Glossy prints are usually dried on thin metal plates called ______________ ________________.

6. One of the quickest ways of telling whether a solution is a base or an acid is by testing it with _____________ paper.

7. The degree of activity of the acid or alkali in a solution is known as its _______________ value.

8. There are two processes for determining pH: the ____________ method and the ______________ method.

9. The light-sensitive silver particles used in making films are suspended in _______________.

10. There are two types of glass plates: _____________ plates and ______________ plates.

11. The manufacturer of film generally places a coating of dye known as _______________ _______________ between the emulsion and the film base.

12. The _______________ bath stops the action of the developer solution.

13. A ________________, such as boric acid, is used in the developer solution.to control the activity of the paraformaldehyd

14. Developer solution should be about ___________ or ____________ degrees F. when used.

15. A negative that lacks density was most likely _______________ or _______________.

Multiple-Choice

Directions: In the space at the left of each statements, write the letter of the item which will provide the correct answer to complete the statement.

_____ 1. The thickness of film ranges from: (A) 0.001 to 0.004 of an inch; (B) 0.003 to 0.015 of an inch; (C) 0.03 to 0.15 of an inch; (D) 0.4 to .8 of an inch.

______ 2. Orthochromatic film is sensitive to all colors except: (A) red and green; (B) orange and red; (C) green and blue; (D) orange and green.

______ 3. Panchromatic film is sensitive to: (A) red colors; (B) green and blue colors; (C) red and orange colors; (D) all colors.

______ 4. A film's ability to reproduce thin lines is known as its: (A) resolving power; (B) speed; (C) sensitivity to light; (D) density.

______ 5. Most process film has a high contrast ranging between a gamma of (A) 1 to 3; (B) 3 to 10; (C) 5 to 9; (D) 7 to 11.

______ 6. Which of the following baths causes the latent image to become visible on the film? (A) shortstop; (B) fixer; (C) developer; (D) water.

______ 7. An alkali is generally added to the developer to act as a/an (A) reducing agent; (B) accelerator; (C) buffer; (D) preservative.

______ 8. A generally satisfactory shortshop bath is composed of 15 parts water and one part: (A) acetic acid; (B) silver salt; (C) hydroquinone; (D) boric acid.

______ 9. Which solution dissolves all the underdeveloped silver salts and clears the film to prevent fogging? (A) developer; (B) shortshop; (C) fixer; (D) water.

______ 10. Water used in the water bath should be (A) 56° F; (B) 68° F; (C) 79° F; (D) 84° F.

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. List, in the order of their use, the four trays that are generally used in the developing process.

(A) ______________________ (C) ______________________

(B) ______________________ (D) ______________________

2. List the three most common bases for photographic emulsions.

(A) ______________________ (C) ______________________

(B) ______________________

3. What are the five main chemical agents in developing solutions?

(A) ______________________ (D) ______________________

(B) ______________________ (E) ______________________

(C) ______________________

4. Film emulsions are classified according to their:

(A) ______________________ (D) ______________________

(B) ______________________ (E) ______________________

(C) ______________________ (F) ______________________

5. List three possible reasons, other than too short a developing time, for the image not developing on a negative.

(A) ______________________ (C) ______________________

(B) ______________________

Assignment
Sheet No. 10

Covering
Units 52-57

NEGATIVE CORRECTIONS, STRIPPING, AND OPAQUING

Few negatives are perfect. While you should do your best to produce a perfect negative -- follow the proper developing procedure and keep the darkroom clean -- you will often find that minor corrections need to be made on the negative. Pinholes, shadow lines and other undesirable marking on the negative must be corrected before the plate is made.

After the negatives for a job have all been made and corrected (if necessary), they are taped on a sheet of goldenrod paper. This paper, with its taped on negatives, is called a "flat;" arranging and mounting the negatives on the flat is referred to as "stripping." Much care must be taken in laying out the flat; after the exposed plate has been developed, the image on the plate is an exact duplicate of the image on the flat. Spacing cannot be changed after the plate is made.

In this unit you will learn the proper procedures for correcting negatives and stripping the flat.

Assignment:

1. Read the references listed below.
2. Answer the questions below and turn in this assignment by __________________________.

References:

A. Cogoli, Photo-Offset Fundamentals, pp. 98-107.
B. Department of the Navy, Lithographer 3 & 2, pp. 172-190.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. Chemicals spilled on the darkroom floor may cause undesirable markings on negatives in the darkroom.

T F 2. Shadow lines may be spotted out on negatives by opaquing.

T F 3. Opaque should never be applied to the back of a negative.

T F 4. The main disadvantage of black opaque is its tendency to chip and smudge.

T F 5. Red opaque covers larger areas better than black opaque.

T F 6. Red opaque is more likely to prevent absolute contact between the negative and the plate than black opaque.

T F 7. The primary disadvantage of turpentine opaque is its tendency to develop pinholes.

T F 8. Opaque is generally applied with a brush.

T F 9. Opaquing is an art job and requires the skills of an artist

T F 10. Halftones may be cropped by using opaque colors.

T F 11. In applying opaque, you should always start at the bottom of the negative and work up.

T F 12. All negative corrections should be made over a light table.

T F 13. Hand engraving is used extensively on negatives used in making maps.

T F 14. Goldenrod paper is used in stripping because it allows the penetration of actinic light.

T F 15. If enough space is not allowed between illustrations on the flat, this may be corrected by adjusting the plate on the press.

T F 16. A master layout is desirable when working with standard sizes.

T F 17. The same T-square should be used for all work on the same flat.

T F 18. Vertical lines should be drawn by moving the head of the T-square to the top of the table.

T F 19. Image areas of the negatives should not be placed in or below the gripper margin.

T F 20. Usually negatives are stripped, emulsion side up, on the golden-rod layout sheet.

T F 21. The page numbers on the goldenrod sheet should be just the reverse, left to right, from those on the imposition.

T F 22. If a negative is made correctly, the emulsion side is the unreadable side.

T F 23. Windows are cut in the goldenrod paper before the negatives are taped into position.

T F 24. Negatives are sometimes stripped for both the front and back-up pages on the same flat.

T F 25. In bookwork, you should not allow more than 1/16" for trim on the top of the page.

T F 26. The sides of the sheet that are to be fed to the guides should be indicated on the layout.

T F 27. The gripper edge of the layout is always marked.

T F 28. The left side of the layout is generally considered to be the guide side if the flat is not marked.

T F 29. Most jobs look best when the top margin is slightly greater than the bottom.

T F 30. Generally it is best to strip an insert into the main negative before attaching the main negative to the flat.

T F 31. Reverse lettering requires a film positive of the line negative.

T F 32. In stripping up line work to be printed in more than one color, you may use the flat for the main color as the master for the others.

T F 33. If support is used for positive film units the readable side should be up.

T F 34. A great deal of masking is required in stripping for film positive layouts.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. Pinholes on negatives are spotted out by ____________________.

2. Except where there is a possibility of needing to remove the opaque, it is generally applied to the ____________________ ____________________ of the negative.

3. Flat chisel-edge brushes are used primarily for ________________.

4. The process of recutting weak lines on a negative is known as ________________ ________________ or ________________.

5. Goldenrod paper, with its taped-on negatives, is called the ____________________.

6. The paper generally used for stripping is an ________________-pound double coated goldenrod stock.

7. A negative that is stripped on the right side of the flat will print on the ________________ side of the plate.

8. Never tape the negative any closer to the image than ____________ inch.

9. A layout that calls for running a number of unrelated jobs on the same sheet of paper is called a ________________ imposition.

10. The goldenrod mask should be kept at least ____________ inch away from the working areas of the film.

11. When it is not possible to splice an insert into a master negative, a process called ________________ is used.

12. Proofs from flats may be contact printed on ________________ or ________________ paper.

Multiple-Choice

Directions: In the space at the left of each statement, write the letter of the item which will provide the correct answer to complete the statement.

______ 1. If negatives are to be used in making albumin plates, they are generally assembled on (A) goldenrod paper; (B) glass; (C) photographic paper; (D) acetate.

_____ 2. Arranging and mounting the negatives on the flat is referred to as (A) laying out; (B) negative cutting; (C) opaquing; (D) stripping.

_____ 3. The order in which the pages are to be placed on the layout is determined by a/an (A) flat; (B) imposition chart; (C) master layout; (D) surprint.

_____ 4. A layout in which the pages for one side of a signature is prepared on one flat and the back-up pages are prepared on another is called a (A) work-and-turn imposition; (B) gang imposition; (C) sheetwise imposition; (D) work-and-tumble imposition.

_____ 5. The creeping and spreading of light rays under the edge of a negative is called (A) scribing; (B) opaquing; (C) reduction; (D) halation.

_____ 6. An unwanted line that is accidently scribed on a negative may be corrected by (A) reduction; (B) opaquing; (C) halation; (D) taping.

_____ 7. Layouts that call for stripping the negatives for both the front and back-up pages on the same flat are called (A) work-and-turn impositions; (B) gang impositions; (C) back-up layouts; (D) sheetwise impositions.

_____ 8. Negatives are generally fastened to the flat with (A) rubber cement; (B) staples; (C) red cellulose tape; (D) thumb tacks.

_____ 9. The process of stripping up a job to expose one image a number of times on the same plate without duplicating the negatives for each unit area is called (A) combination work; (B) surprinting; (C) double printing; (D) step-and-repeat work.

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. List the three most commonly used materials as supports in stripping.

(A) ____________________ (C) ____________________

(B) ____________________

2. List four types of impositions.

(A) ____________________ (C) ____________________

(B) ____________________ (D) ____________________

Assignment
Sheet No. 11

Covering
Units 58-68

PLATEMAKING

After the film has been stripped on the goldenrod layouts, it must be printed on a lithographic plate. The phenomenal growth of offset printing has brought about the development of many types of offset plates. Plates are made from zinc, aluminum, plastics, and other materials.

Before most plates can be used they must undergo a few preliminary operations, such as graining and coating. The surface of some offset plates is "grained" to make it water receptive and is coated with a light-sensitive solution. Some types of plates are coated by the manufacturer and used only once; but others are regrained and recoated so that they may be used many times. Exposure and development of the plates depend upon the type of plate being used. One of the most critical problems in offset printing is that of controlling the fountain solutions and dampening solutions.

In this unit you will learn about the type of lithographic plates and the correct procedure to follow in preparing, exposing, and developing the plates.

Assignment:

1. Read the references listed below.
2. Answer the questions below and turn in this assignment by ____________________.

References:

A. Cogoli, Photo-Offset Fundamentals, pp. 108-129.
B. Department of the Navy, Lithographer 3 & 2, pp. 191-222, 460-471.
C. Latham, Lithographic Offset Press Operating, pp. 109-122.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. Surface coated plates may be purchased with the plate coating solution already applied.

T F 2. The non-printing area of a deep-etch plate is etched to a depth slightly below that of the printing area.

T F 3. The deep-etch plate has a longer press life than the surface coated plate.

T F 4. Multi-metal plates require no fountain solution.

T F 5. The dry-offset plate requires a harder-than-usual ink-form roller.

T F 6. The direct image plate does not employ the photographic process in its preparation.

T F 7. All conventional plates can be regrained and used again.

T F 8. Stainless steel plates require deeper grains than zinc or aluminum.

T F 9. Aluminum plates may be grained chemically.

T F 10. Direct-image plates do not need to be grained.

T F 11. Pumice can be used for both removing the inked image and for graining.

T F 12. It usually takes about two hours to regrain a used plate.

T F 13. Ammonium bichromate is a deadly poison if taken internally.

T F 14. The flat should be taped to the coated metal plate so that the negatives are in readable form.

T F 15. Traces of scum cling to the plate and are removed by desensitizing.

T F 16. Ordinarily, a vacuum frame pressure of about 40 pounds is required to hold goldenrod flats.

T F 17. The relative humidity of the atmosphere tends to be the most difficult variable to control in determining exposure time.

T F 18. When developing the albumin plate, the ink should be completely dry before it is soaked in the sink.

T F 19. A piece of cotton will remove the ink from the image areas thus developing the plate.

T F 20. Gumming provides a film on the non-working areas.

T F 21. To store a plate, the ink should be removed from the image areas and the image then covered with asphaltum.

T F 22. The deep-etch process is very similar to the albumin process.

T F 23. It is not possible to make corrections on a used plate.

T F 24. Presensitized metal plates are ready for exposure when removed from their original carton.

T F 25. Presensitized plates will keep indefinitely.

T F 26. Presensitized plates should be opened only in subdued light.

T F 27. It is better to overexpose a presensitized plate than to underexpose it.

T F 28. Direct-image plates should not be handled in bright light.

T F 29. Xerography is a "dry" process.

T F 30. The "copy" to be reproduced by Xerography must be typed on a special copy machine.

T F 31. When Xerographic plates are exposed to the copy, electrical charges appear wherever light strikes it.

T F 32. The deep etch process requires a flat made of negatives.

T F 33. The areas that do not print and that are made to resist the acceptance of ink are called sensitized areas.

T F 34. With the introduction of halftones, coarse grained and albumin plates were no longer satisfactory.

T F 35. The cause of most cases of blinding is gum from the fountain solution that has accumulated on the image.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. Surface coated plates that are purchased with the surface coating solution already applied are called ________________ plates.

2. The surface of some offset plates must be ____________ to make them water receptive.

3. Strong light ______________ the albumin solution.

4. The density of albumin stock solutions is measured with a ________________.

5. Two types of hydrometers are used in lithographic work: __________________ and ________________ __________________.

6. In exposing the albumin plate, the distance from the arc light to the frame should be equal to the ____________ measurement of the printing frame.

7. After the albumin plate is exposed, ______________ ________________ is applied to the image areas.

8. The albumin plate is developed in ____________.

9. As a final measure to remove all excess developing ink, the albumin plate can be placed in a solution of water and ________________ of ________________.

10. If the plate is not to be used for a day or two, or if it is to be used for color work, one should wash the developing ink off the plate and cover it with _______________.

11. A coating of _____________ ______________ solution should be applied to a plate if there is a prolonged interruption in the press run.

12. Preparing a stored plate for re-running involves washing the plate off with _______________.

13. A ___________-_____________ plate is a plate which has no sensitized coating, nor is one applied to its surface.

14. The ____________ ____________ gum stencil, which is free from albumin, has proved an effective desensitizer.

15. Improved desensitization resulting in finer grains means that ____________ ____________ can be used and better ____________ ____________ can be printed.

16. With new developments in plate making, less water may be used on the fine grain plates which means more ____________ ____________ with less ink.

17. On plates which require strong dampening solutions to keep them clean, under the influence of the acid the ____________ may ____________ and not be receptive to ink.

18. The indication that too much ink is being used will be filled halftones, ____________ ____________ and a tendency to catch up.

19. For good plate life and high quality work, the rollers must be ____________, ____________ and set light.

20. Even though the plates start to show signs of scumming, if the image is still good they may be ____________.

21. Any one handling offset plates should practice extreme care to avoid ____________ and ____________.

Multiple-Choice

Directions: In the space at the left of each statement, write the letter of the item which will provide the correct answer to complete the statement.

_____ 1. The most popular plate in the smaller shop is the (A) Xerography plate; (B) multi-metal plate; (C) direct image plate; (D) surface-coated plate.

_____ 2. What type plate requires no fountain solution? (A) presensitized plates; (B) multi-metal plates; (C) dry-offset plates; (D) surface-coated plates.

_____ 3. The type of plate on which the image is typed, drawn, or printed directly is called (A) direct-image plate; (B) presensitized plate; (C) dry-offset plate; (D) deep-etch plate.

_____ 4. What plate is produced by a dry photographic-electrostatic process? (A) dry-offset plate; (B) surface-coated plate; (C) direct-image plate; (D) Xerography plate.

_____ 5. In multimetal plates, the metal used to repel water and accept ink is (A) copper; (B) zinc; (C) aluminum; (D) steel.

_____ 6. If a plate is not to be used for some time after it is grained, it should be covered with (A) trisodium sulphate; (B) gum arabic; (C) masking tape; (D) silica gel.

_____ 7. The etching solution is applied with a (A) rag ball; (B) piece of cotton; (C) brush; (D) sponge.

_____ 8. Gum arabic solutions should always have a Baumé reading of (A) 6 degrees; (B) 9 degrees; (C) 14 degrees; (D) 21 degrees.

_____ 9. What is used as a counter-etch solution for aluminum plates? (A) hydrochloric acid; (B) nitric acid; (C) boric acid; (D) acetic acid.

_____ 10. You may erase unwanted lines or words from the albumin plate after it has been developed and before it has been etched by rubbing it with (A) lithotine; (B) a sponge; (C) pumice powder; (D) the snake slip.

_____ 11. Solid areas or lines are usually painted on plates with a diluted ink called (A) tusche; (B) litholine; (C) dichromate; (D) asphaltum.

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. What are the six main types of offset plates?

(A) ______________________ (D) ______________________

(B) ______________________ (E) ______________________

(C) ______________________ (F) ______________________

2. What are three methods of controlling the size of the grain in graining plates?

(A) ____________________

(B) ____________________

(C) ____________________

3. List the three main ingredients in an albumin coating solution:

(A) ____________________ (C) ____________________

(B) ____________________

4. List the eight main steps in preparation of a surface-coated metal plate by the albumin process.

(A) ____________________ (E) ____________________

(B) ____________________ (F) ____________________

(C) ____________________ (G) ____________________

(D) ____________________ (H) ____________________

5. List the four main factors that influence the exposure time of the plate.

(A) ____________________

(B) ____________________

(C) ____________________

(D) ____________________

6. List the steps in preparing a presensitized metal plate.

(A) ____________________ (C) ____________________

(B) ____________________ (D) ____________________

7. List the steps in preparing an uncoated paper (cellulose base) plate.

(A) ____________________

(B) ____________________

(C) ____________________

(D) ____________________

(E) ____________________

(F) ____________________

8. List the steps of procedure in making a deep etch plate.

(A) ______________

(B) ______________

(C) ______________

(D) ______________

(E) ______________

(F) ______________

(G) ______________

(H) ______________

(I) ______________

(J) ______________

(K) ______________

(L) ______________

(M) ______________

(N) ______________

(O) ______________

(P) ______________

(Q) ______________

9. The two main reasons for plates going blind on the press are:

(A) ____

(B) ____

Assignment
Sheet No. 12

Covering
Units 69-74

PAPERS AND INKS FOR OFFSET PRINTING

There is a paper manufactured to fit almost every purpose; it is one of the lithographer's most important tools. Paper is actually a thin layer of wood or vegetable fibers which are pressed together and held by sizing and mineral filler. Another basic tool of the lithographer is ink; paper and ink go hand in hand. In letterpress work, there is an ink manufactured to suit each type of paper, but there is less variety in offset inks.

The lithographer must have a thorough knowledge of the characteristics of papers and inks if he is to use them effectively. Difficulties are often encountered with paper: it wrinkles, curls, shrinks, stretches, and waves. In order to control the paper and overcome difficulties encountered, the lithographer must study its makeup and understand its characteristics. Offset inks must be "doctored" and modified quite often to suit a particular kind of stock.

In this unit you will learn about the characteristics and uses of papers and inks used in offset printing.

Assignment:

1. Read the references listed below.
2. Answer the questions below and turn in this assignment by ________________________.

References:

A. Cogoli, Photo-Offset Fundamentals, pp. 130-145.
B. Department of the Navy, Lithographer 3 & 2, pp. 380-396.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. Fine paper stock will improve a printing job.

T F 2. Paper is apt to be more troublesome in printing than ink.

T F 3. Newsprint is a very high grade paper.

T F 4. Newsprint is usually made from cotton pulp.

T F 5. Mechanically-ground wood pulp makes very strong paper.

T F 6. Alpha-cellulose pulp forms into a strong paper with good folding qualities.

T F 7. Sulphate pulp makes a paper of high tear-test.

T F 8. All paper made from cotton pulp is high grade.

T F 9. Pulps for lithographic printing papers receive a very small amount of sizing materials.

T F 10. Newsprint is particularly suitable for fine halftones.

T F 11. Rag-content bond paper is used for business forms and letterheads.

T F 12. Twenty-pound stock is generally used for letterheads.

T F 13. Linen is a term printers apply to paper made from flax.

T F 14. Mimeograph paper is a paper with a highly polished surface.

T F 15. The most inexpensive form of book paper is called "super-calendered book."

T F 16. Coated papers have a supersmooth finish.

T F 17. Coated papers are very well suited for reproduction proofs.

T F 18. Antique paper is bulky, soft, and porous.

T F 19. Offset work requires special water-resistant book stocks.

T F 20. Plate finish covers have a uniform surface suitable for halftone reproduction.

T F 21. Cover papers cannot be run on the offset press.

T F 22. Chipboard is well suited for halftone reproductions.

T F 23. Paper should be printed on the felt side.

T F 24. The grain of paper should run vertically in a pamphlet or book.

T F 25. The usual way to determine the weight of the paper is to weigh 1000 sheets of stock cut to a certain size.

T F 26. When paper absorbs moisture, it will expand more across the grain than with the grain.

T F 27. Letterpress inks should never be used on the offset press.

T F 28. Lithographic inks depend on volume for their covering qualities.

T F 29. More prints can be obtained with opaque inks than with transparent inks.

T F 30. When running your finger across a sheet to check for drynes you should use the sheet on top of the stack since it was printed last and will indicate the dryness of the others.

T F 31. Cobalt is one of the most common driers used in ink.

T F 32. Yellow is considered a warm color.

T F 33. Blue is considered a cool color.

T F 34. When mixing inks, the color should always be added to white rather than white to the color.

T F 35. In speaking of ink, "viscosity" is a measure of "stickiness."

T F 36. Opacity is the "hiding" or "covering" quality of ink.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. ____________________ is the most widely used commodity in the world.

2. Paper is actually a thin layer of ____________________ or ____________________ fibers.

3. Most paper is designated according to its ____________________ or ____________________.

4. The process that roughens and frays the fibers so they may better cling together in the finished paper is called ____________.

5. The ultimate refinement of the pulp is done by a ________________ ________________.

6. If the sizing is added while the pulp is in the beaters, ________________ is used.

7. Calender rolls ________________ and ________________ the paper.

8. Colored newsprint is called ________________ ________________.

9. ________________ ________________ paper is used in most national magazines.

10. A ream of paper contains ______________ sheets.

11. A package of paper usually contains ______________ sheets.

12. The watermark is "readable" on the ________________ side.

13. Sixteen-pound bond paper is the equivalent of ______________ pound book paper.

14. Lithographic inks differ from letterpress inks in that they are ______________, ________________, and ______________________.

15. Inks are described as ______________ or ______________, depending on their body.

16. Inks are classified as ______________, ________________, or ________________, depending on the nature of the pigment and the extender used.

17. Ink dries in two ways: by ________________ and by ________________.

18. To regulate tack and other qualities, certain materials called ________________ are sometimes added to the ink.

19. When black is added, the color becomes a ________________.

20. If a color is added to white the result is a ________________.

21. ____________________ is the best color for attracting attention.

22. In ink terminology, ____________ ______ is the "resistance to flow."

Matching

Directions: The left hand column contains descriptive phrases. In the right hand column is a list of terms. Match the descriptions to the terms by placing the letter of the terms opposite the appropriate description.

_____ 1. Produced by grinding the entire log

_____ 2. Made by returning used paper to a pulp state by a chemical cooking process

_____ 3. Made by cooking wood chips in a digester

_____ 4. Suited only for handbills, newspapers and other items which are not permanent

_____ 5. Used to make the finest permanent paper

_____ 6. Made of wood of the beech, birch, maple, oak and poplar trees cooked with caustic soda

_____ 7. Long fiber pulp made from evergreens

A. rag pulp and cotton pulp
B. old-paper pulp
C. mechanically-ground wood pulp
D. chemical wood pulp
E. sulphite pulp
F. soda pulp

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. List the pulps in common use.

(A) ______________________ (D) ______________________

(B) ______________________ (E) ______________________

(C) ______________________

2. List seven common kinds of paper.

(A) ____________ (E) ____________

(B) ____________ (F) ____________

(C) ____________ (G) ____________

(D) ____________

3. List the usual steps in making paper.

(A) ____________ (E) ____________

(B) ____________ (F) ____________

(C) ____________ (G) ____________

(D) ____________ (H) ____________

4. List four ways of testing the direction of the grain of paper.

(A) ____________ (C) ____________

(B) ____________ (D) ____________

5. Offset inks consist of:

(A) ____________ (C) ____________

(B) ____________

6. List five vehicles generally used in lithographic inks.

(A) ____________ (D) ____________

(B) ____________ (E) ____________

(C) ____________

7. List the three primary colors used in mixing inks.

(A) ____________ (C) ____________

(B) ____________

8. List the three most likely causes of offsetting.

(A) ______________________________

(B) ______________________________

(C) ______________________________

Assignment
Sheet No. 13

Covering
Units 75-90

FUNDAMENTALS OF OFFSET PRESSWORK

An offset press is made of many parts; these parts form "units" and "systems," such as the printing unit, delivery unit, inking system, etc. Although the different makes of presses differ in construction details, there is a basic similarity in their fundamental parts and functioning.

In order to operate and service the offset press, the pressman must know how the various parts and systems function and what to do when they do not function properly. He must be able to make adjustments on the press and perform the routine maintenance duties.

In this unit you will learn the names and functions of the parts and systems of the offset press; you will also learn techniques of adjusting the press.

Assignment:

1. Read the references listed below.
2. Answer the questions below and turn in this assignment by ________________________.

References:

A. Cogoli, Photo-Offset Fundamentals, pp. 5-7, 145-157.
B. Department of the Navy, Lithographer 3 & 2, pp. 223-248.
C. Latham, Lithographic Offset Press Operating, pp. 14-36.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. The water fountain roller contacts the plate first.

T F 2. The image is in "readable" form on the blanket.

T F 3. The inked image on the plate replenishes the ink on the blanket image.

T F 4. The plate image must roll against the blanket image in exactly the same location every revolution of the press.

T F 5. The plate cylinder is usually twice the diameter of the blanket cylinder.

T F 6. The plate cylinder is always the uppermost cylinder.

T F 7. The plate cylinder should be the most accessible cylinder.

T F 8. The bearers on the ends of the plate cylinder have a slightly smaller diameter than the cylinder.

T F 9. The gear on the plate cylinder drives the gear on the blanket cylinder.

T F 10. When the width of the front margin on a sheet has to be changed, it is easier to change the cylinder in relation to the gear than to shift the plate.

T F 11. Contact is broken between the plate cylinder and the blanket cylinder by backing away the blanket cylinder.

T F 12. The impression cylinder must be parallel to the blanket cylinder.

T F 13. Packing sheets should be selected which, when added to the blanket thickness, will total .002" in thickness more than the undercut of the blanket cylinder.

T F 14. The blanket should be stretched as tightly as possible around the cylinder.

T F 15. An automatic oiling system usually takes care of the lubrication of the linkage and leaves that throw pressure on and off the cylinder.

T F 16. The printing unit is the most dangerous part of the press.

T F 17. Low spots can be found on most cylinders.

T F 18. The total thickness of the packing sheet and the plate should be .001" more than the undercut of the plate cylinder.

T F 19. The plate should be "gummed" before being removed from the cylinder.

T F 20. Most presses have automatic inking systems.

T F 21. Modern presses average about six rollers per unit.

T F 22. One of the weaknesses of most inking systems is the loss of fountain setting when the press idles.

T F 23. A roller that bumps at the gap is set too heavy.

T F 24. Ordinary ink solvents will clean rollers.

T F 25. The inking system requires no lubrication.

T F 26. The first thing to do in adjusting rollers is to determine which mounting system is used.

T F 27. Rubber and vulcanized-oil rollers must be covered with a thin film of oil before storing.

T F 28. A new dampening system is available that eliminates the use of molleton covers on dampening rollers.

T F 29. The fountain solution requires careful control.

T F 30. The feed table rises automatically as the sheets are fed into the press.

T F 31. The function of the feeder is to separate the top sheet from the rest of the pile, and then to move it forward into the forwarding device.

T F 32. The paper is placed on the stock table about 1/8" off the center line of the feeder.

T F 33. The height of the pile is of little importance to the performance of the feeder.

T F 34. The function of the delivery mechanism is to carry the sheets forward from the impression cylinder and deliver them face up on a pile and properly jogged.

T F 35. Worn chains and sprockets affect the gripper opening.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. The ________________ at the ends of the plate and blanket cylinders maintain the two cylinders parallel to each other.

2. During the operation of the press, the ____________ cylinder presses the sheet of printing paper against the blanket.

3. A set of automatic grippers is placed in the gap of the ________________ cylinder.

4. The blanket is made from a ______________ covered fabric.

5. The thickness of the blanket should be measured with a ________________ ________________.

6. Cylinders should be kept clean with ________________ and ________________.

7. The inking system is composed of an ____________ ______________ and a set of ________________.

8. Molleton-covered dampening rollers should be cleaned first with ________________ and then with ________________.

9. The fountain roller revolves in a pan of water mixed with a chemical solution known as ____________ ______________.

10. The water supply is controlled by a ____________ adjustment.

11. The conveyor tapes carry the sheet to the end of the feederboard where it is stopped by a set of pins known as the ____________ ______________.

12. The paper is loaded onto the feed table in small stacks called ________________.

13. After the sheet is "buckled" by the comber, it is lifted by the ________________.

14. If every sheet goes through the press and is printed in the same position relative to the gripper edge and the guide side, the press is said to be printing "________________ ________________."

15. The simplest register system is the ________________ ____________________________ system.

16. As the paper reaches the end of the feedboard, the ____________ ________________ moves in and pushes the sheet sidewise to its proper registering position.

17. The _____________ ________________ stop the sheet and hold it on the feedboard while the side guides move it into position sidewise.

18. Most of the trouble encountered in the delivery is poor ________________.

Multiple-Choice

Directions: In the space at the left of each statement write the letter of the item which will provide the correct answer to complete the statement.

_____ 1. The main part of the offset press is the (A) automatic inking system; (B) automatic feeder unit; (C) automatic delivery unit; (D) printing unit.

_____ 2. The plate is attached to the (A) top cylinder; (B) bottom cylinder; (C) impression cylinder; (D) blanket cylinder.

_____ 3. Most offset presses are (A) one-cylinder units; (B) two-cylinder units; (C) three-cylinder units; (D) four-cylinder units.

_____ 4. The total recommended squeeze between the blanket and plate should be (A) .001"; (B) .003"; (C) .010"; (D) .300".

_____ 5. What is a likely result of insufficient pressure between the plate and blanket? (A) slur; (B) fuzzy images; (C) no image; (D) double printing.

_____ 6. The film of ink varies in thickness with the setting of the (A) reservoir; (B) fountain roller; (C) vibrators; (D) fountain blade.

_____ 7. Small rotating wheels used to make the first sheet separation are called (A) suction feeders; (B) combers; (C) suckers; (D) spring separators.

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. The basic parts of an offset press are:

(A) ______________________ (E) ______________________

(B) ______________________ (F) ______________________

(C) ______________________ (G) ______________________

(D) ______________________

2. List the four major classifications for designating offset presses.

(A) ____

(B) ____

(C) ____

(D) ____

3. List the six steps in setting bearers:

(A) ____

(B) ____

(C) ____

(D) ____

(E) ____

(F) ____

4. List the steps in setting the rollers as stated in references:

(A) ______________________________

(B) ______________________________

(C) ______________________________

(D) ______________________________

(E) ______________________________

(F) ______________________________

(G) ______________________________

(H) ______________________________

Assignment
Sheet No. 14

Covering
Units 91-93

MAKEREADY ON OFFSET PRESSES

The term "makeready" refers to the preparatory steps taken by the pressman in preparing the press for running a job. Offset makereadies may be divided into three general classes: simple, partial and full makeready.

It is of utmost importance that the pressman properly prepares the press before starting the job. A job poorly started can be wasteful of material, time, and effort. Wasteful makereadies mean that the jobs must start with large overruns and, even then, wind up with shortages.

In this unit you will learn the proper procedure and steps to be taken in preparing the press for running a job.

Assignment:

1. Read the references listed below.
2. Read reference "A" below and outline the procedure for preparing the "Chief 20" press for operation, or obtain the manufacturer's instruction manual for the press on which you are training and outline the procedure for preparing it for operation.
3. Answer the questions below and turn in this assignment by ____________________.

References:

A. Cogoli, Photo-Offset Fundamentals, pp. 158-168.
B. Department of the Navy, Lithographer 3 & 2, pp. 249-255.
C. Latham, Lithographic Offset Press Operating, pp. 87-108, 175-189, 189-205.
D. Latham, Advanced Pressmanship, pp. 212-226.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. The real difference between a simple job and a high quality job is in the makeready.

T F 2. The amount of makeready time required is determined by the make of the press and the type of work.

T F 3. The testing of new chemicals, plate materials, inks, etc. is classified as pre-makeready.

T F 4. Establishing some method of pre-positioning plates before washing is classified as pre-makeready.

T F 5. Simple makeready usually consists of only changing a plate.

T F 6. The ink rollers must be washed in a partial makeready.

T F 7. The partial makeready is often referred to as the No. 1 makeready.

T F 8. The press washup is not a part of the makeready.

T F 9. All steps in the full makeready are performed by the pressman.

T F 10. The changing and setting of dampeners at least once should be a step in every makeready for a color job.

T F 11. The final setting of the dampeners should be made before the plate is put on.

T F 12. The best time to check a blanket is just before a new job is run.

T F 13. A periodic rest period is good for blankets.

T F 14. When tightening the blanket clamp screws, you should start with the center one.

T F 15. The blanket packing must be changed even if the blanket is not changed.

T F 16. The surface of the blanket must be kept in a like-new condition at all times.

T F 17. New blankets have a tendency to stretch after they are put on the press.

T F 18. Modern blankets should be powdered with sulphur after they are cleaned.

T F 19. The blanket must be cut perfectly square.

T F 20. A new blanket must be scrubbed before using.

T F 21. Blankets should not be punched until you are ready to put them on the press.

T F 22. If the sides of the blanket print more heavily than the center, more ink should be used.

T F 23. The running of about 300 waste sheets is needed to break in a blanket to new plates.

T F 24. Packing is used to change the diameter of the cylinder.

T F 25. An ordinary machinist's micrometer should be used to check the thickness of a blanket.

T F 26. The first color should be printed shorter than the plate.

T F 27. When mounting a plate, the leading edge should be fastened first.

T F 28. If the size and the weight of the paper are different from that used on the last job, the feeder setting will be different.

T F 29. The pile height gauge must be readjusted for each new pile of paper.

T F 30. If the gripper opening cam needs to be reset, this should be done when the press is running at printing speed.

T F 31. The pressman usually does the matching of color in color printing.

T F 32. In making adjustments in the ink, the keys should be completely opened and then closed down as needed.

T F 33. Experienced pressmen often test the dampeners for moisture by touching them with their knuckles or the back of their hand.

T F 34. The ink rollers are dropped before the plate is dampened.

T F 35. A trial run is made with waste paper before the actual job is started.

T F 36. Small halftone dots do not ordinarily print until the plate is "broken in."

T F 37. Waste paper used in the trial run should be cut true to size and not torn or wrinkled.

T F 38. The purpose of the first trial sheets is to check the quality of the work.

T F 39. As a rule, the good pressman will keep his ink on the spare side while making ready.

T F 40. If the plate has been moved during makeready, the blanket should be cleaned before starting the run.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. A properly prepared press and adequate makeready prevents waste of ____________, ______________, and ________________.

2. The biggest part of makeready is ________________.

3. Pre-makeready requires that a full set of ___________ ___________ be on hand.

4. Paper conditioning is part of _______________.

5. On large presses, each worker turns off his ________________ ________________ when he has completed his work on a cylinder.

6. Partial makeready consists of a ______________ change.

7. Blankets that are to be used for _____________ have to be scrubbed particularly clean.

8. The first color should be printed ______________ in case the paper stretches.

9. To print short you must use a ______________ blanket and a ________________ plate.

10. The back-cylinder pressure must be readjusted when a paper of different _________________ is used.

11. Joggers must be repositioned when a different ____________ of paper is used.

12. The pressman usually adjusts the ink for ______________ and ________________ only.

13. Scrubbing a blanket removes the slightly ______________ ________________ that prevents the blanket from picking up the full value of the fine halftones that are on the plate.

14. Absorption of the ____________ ________________ is responsible for embossing the blanket surface.

15. Tackiness is due to the formation of a sticky, plastic product as a result of the simultaneous _______________ of the rubber and the absorbed _______________ _______________.

16. The normal press tension of the blanket should be about ______________ pounds per inch of width.

17. The term ______________ refers to the paper sheets that are put under the blanket and plate.

18. About ________________ good sheets of paper should be put between every _______________ sheets of waste paper in the trial run.

19. If the work is cocked on a press that does not have movable guides, the ______________ must be swung.

20. When the image is off center sidewise, the pressman can generally adjust it by moving the _____________ ________________.

21. If the nonprinting areas of a plate have picked up ink, the pressman cleans the plate with a sponge dipped in the ________________ ________________.

22. Once a blanket has been properly mounted, no further adjustments will be required until it becomes ______________ or ________________.

23. During the run, the pressman should examine the work at regular intervals, by removing a sheet from the delivery pile about every ______________ to _________________ impressions.

24. At the end of the day, the pressman usually removes all ink from the fountain and cleans the ______________, ______________, and _________________.

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. List four methods of pre-positioning plates before washing them.

(A) ______________________________

(B) ______________________________

(C) ______________________________

(D) ______________________________

2. List the three types of makereadies:

(A) ______________ (C) ______________

(B) ______________

3. What four factors determine the amount and type of driers used in ink?

(A) ______________ (C) ______________

(B) ______________ (D) ______________

4. The position of the image on the sheet depends on:

(A) ______________________________

(B) ______________________________

(C) ______________________________

5. List the procedure for restoring a "smashed" blanket.

(A) ______________ (C) ______________

(B) ______________ (D) ______________

6. List the three main reasons for wanting to control the cylinder body diameters by packing.

(A) ______________________________

(B) ______________________________

(C) ______________________________

Assignment
Sheet No. 15

Covering
Units 96-98

OPERATION OF AN OFFSET PRESS

Running an offset press is greatly simplified by having carefully made the press ready for running. Systematic and continuous maintenance operations will also make running the press much easier. Although a large part of the skill and efficiency of a pressman is evidenced by the way he makes ready his press for running, he still has to run it and come out with a good uniform job that matches his O. K. sheet.

The responsibilities of the pressman vary from shop to shop. In most cases, however, he is fully responsible for the cleanliness and safety of his station. He must keep a constant check on the press to see that it functions properly, and make notes of anything that needs attention after the job is run. Some adjustments and repairs must be made immediately.

In this unit you will learn the procedures involved in running the offset press and how to perform the various operations.

Assignment:

1. Read the references listed below.
2. Answer the questions below and turn in this assignment by ______________________.

References:

A. Cogoli, *Photo-Offset Fundamentals*, pp. 168-170.
C. Latham, *Lithographic Offset Press Operating*, pp. 190-198; 206-216.

Supplementary Reference:

D. Latham, *Advanced Pressmanship*. (Review as assigned by coordinator to fit specific needs of student.)

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. The pressman is responsible for eliminating unnecessary running time.

T F 2. The efficiency of the offset press during the running is dependent to a great extent on the makeready.

T F 3. If the makeready has been slighted, the whole running of the job can be just a continuation of the makeready.

T F 4. If the pressman will use his ink knife freely in the makeready, it will eliminate many adjustments during the running of the job.

T F 5. A part of the pressman's job is to season the paper.

T F 6. The pressman is responsible for the paper behaving in such a manner as to insure good fit and register.

T F 7. In large plants the foreman is responsible for the paper.

T F 8. It is not necessary for the pressman to know about paper.

T F 9. It is possible that paper may vary within a single skid.

T F 10. During the running of a first color, there is nothing on the sheet to show whether or not the other colors will fit.

T F 11. The pressman is fully responsible for the cleanliness and safety of his station.

T F 12. The pressman is responsible for the acts and omissions of his helper.

T F 13. The pressman is not usually responsible for providing a list of what needs to be done on the press to keep it in top shape.

T F 14. Anything that would affect the quality of the job or the immediate performance of the press should be done right away.

T F 15. Small irregularities are more likely to show up on simple jobs than on an exacting job.

T F 16. It is well to check the register and ink coverage frequently.

T F 17. It is difficult to tell whether it is ink or water that is causing a tone change in the printed image.

T F 18. The front marks will tell the pressman whether or not the press registering devices are operating satisfactorily.

T F 19. Sheets that register across the front and back must continue to fit in the center of the sheet.

T F 20. Keeping the fountains filled is one of the duties of the pressman.

T F 21. Checks of the pH of the fountain solution should be made during the running of the job.

T F 22. On two-man presses, the operator has enough routine duties to keep him busy all of the time.

T F 23. Keeping the plate in good condition is part of the routine of running the press.

T F 24. It is permissible to make stops and let the plate dry up.

T F 25. Too frequent stops of the press can be harmful to the uniformity of the work.

T F 26. The plate is kept moist while the press idles.

T F 27. The vibrators of an idling inking system will level out the ink on the rollers so that it no longer coincides with the fountain setting.

T F 28. The pressman will not know much about his plate until he starts to run it.

T F 29. Kerosene is an effective ink solvent.

T F 30. A solution having a pH value of 10 is neutral.

T F 31. If a formula calls for a pH of 3.4, you may disregard the decimal points and make it an even 3.

T F 32. The pH of fountain solutions should be about 9.5.

T F 33. The pH of a fountain solution will never decrease unless acid is added.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. The moisture balance of paper may be checked with the ________________.

2. If the paper for a multicolor job on a single color press is too dry, it will ________________.

3. During the running of a first color, the pressman should check the sheets for fan and draw by using a ________________ ________________.

4. Ordinarily, the pressman need only watch his ________________, his ________________, and his ________________ to keep the press running in good order.

5. A constant watch kept on the ________________ is the only thing that will insure uniformity of color.

6. Sheets are checked for strength of color in both the ________________ and the ________________.

7. When running yellow, an inspection booth lighted with ________________ is excellent for checking.

8. As the pressman pulls each sheet, he examines it for ________________ and ________________ register.

9. The pressman can check the rear marks to see if the paper is ________________ ________________, ________________ or ________________.

10. If there is dirt or ink skin along the edge of the blade, ________________ ________________ will show up on the roller.

11. If the press is stopped entirely, the plate must be ________________ again before starting.

12. Press cloths that have been used in cleaning up a press should be placed in a covered ________________ ________________ ________________

13. Traces of kerosene used in press wash-up must be removed with ________________.

14. Kerosene left on rollers will cause them to ________________.

15. The term pH is used in measuring the ______________ or ______________ of a solution.

16. The pH scale runs from ________ to ________.

17. Solutions having pH values above seven are ______________.

18. An acid solution with a pH of 4.0 is ________ times as acid as one having a pH of 5.0.

19. An acid solution with a pH of 3.0 is 100 times as acid as one having a pH of ________.

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. List the steps for starting the run.

(A) ______________ (E) ______________

(B) ______________ (F) ______________

(C) ______________ (G) ______________

(D) ______________

2. List the steps for stopping the press.

(A) ______________ (F) ______________

(B) ______________ (G) ______________

(C) ______________ (H) ______________

(D) ______________ (I) ______________

(E) ______________

3. To condition the press and make ready in such a way as to make it possible to run off a job with a minimum variation requires:

(A) ______________ (C) ______________

(B) ______________

4. List three applications of pH control.

(A) ______________________ (C) ______________________

(B) ______________________

Assignment
Sheet No. 16

Covering
Units 99-106

OFFSET PRESS TROUBLES

It is far better to prevent trouble than to try to correct it. If the press is properly installed, maintained and adjusted, and the plates are carefully prepared, many of the troubles often encountered in operating the offset press may be avoided.

The beginner may find it very difficult to locate the cause of trouble on the offset press. Some conditions may be caused by any of a number of things. Therefore, it is necessary for the pressman to know the possible causes of the troubles that are commonly encountered. Time lost looking for the cause of some difficulty can be very expensive.

In this unit you will learn about the common troubles encountered in operating the offset press and the most likely causes of these troubles.

Assignment:

1. Read the references listed below.
2. Answer the questions below and turn in this assignment by ______________________.

References:

A. Cogoli, Photo-Offset Fundamentals, pp. 171-175.
B. Reed, Offset Press Troubles, pp. 1-102.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. If the feeder is feeding more than one sheet, one reason may be that the pile is too high.

T F 2. If the sheets have a tendency to stick when in the feeder, the remedy is to increase the air blast.

T F 3. If the side guide contacts the sheet after the grippers have closed or sheet has started forward, it is necessary to correct the timing of the side guide.

T F 4. If the sheets tend to stick to the blanket it means that either the gripper tension is too weak or the ink is too tacky.

T F 5. Running too much ink on coated stock will usually result in slurring over the entire sheet.

T F 6. "Filling up" is evidenced on the printed sheet and plate by the type matter and halftones filling in with ink.

T F 7. If the ink is too tacky, you should add thin varnish or a non-pick compound.

T F 8. "Filling up" may be caused by too much ink.

T F 9. Lack of coloring matter in ink may be corrected by adjusting the ink fountain.

T F 10. The oscillating drums of the inking system should not have the same surface speed as the printing plate.

T F 11. Horizontal streaks in the printing may be caused by one or more of the form rollers being set too hard against the plate.

T F 12. To remedy stripping caused by the metal drums, it is essential to remove the drums and coat them with ebonite or copper.

T F 13. Uneven ink feeding can be prevented to some extent by being certain that the ends of the rollers and drums are dry after machine wash-up.

T F 14. Wash marks will appear when too much dampening water is used.

T F 15. Color variation due to the feed of the dampening solution can be remedied by maintaining a constant level of solution in the water fountain.

T F 16. Presensitized aluminum plates will generally produce the largest number of prints.

T F 17. If the image goes blind because a deep-etch plate was not completely developed, the only solution is to have the plate remade.

T F 18. A new blanket should not cause any troubles unless the blanket was defective before it was used.

T F 19. When the paper tends to stick to the non-printing areas of the blanket, the best remedy is to treat the blanket with blanket lacquer or hardener.

T F 20. A loose and slipping blanket will cause horizontal streaks in printing.

T F 21. Linty paper will tend to leave fibers on the blanket only.

T F 22. When paper picks or splits due to its being of low quality, and reducing the inks tack does not solve the problem, speeding up the press may correct the situation.

T F 23. The curling of sheets on delivery usually occurs with lightweight papers.

T F 24. Thin papers that curl downward on delivery will tend to curl toward the printed side after a period of time.

T F 25. "Set-off" may be caused by excessive ink.

T F 26. Too much drier in the ink may cause the sheets to stick together in the stacker.

T F 27. A fountain solution that is too strong may cause bare sections on the rollers.

T F 28. Mottling is usually caused by too much reducer in the ink.

T F 29. The most likely cause of chalking is thin varnish in the ink.

T F 30. The ink is said to "run" if it penetrates through the paper stock.

T F 31. Boiled linseed oil will speed up the setting of ink.

T F 32. Varnish will reduce the inks tack.

T F 33. Varnish will shorten the ink.

T F 34. Some troubles may be caused by ink being too fresh and therefore it should stand for a week or so before using.

T F 35. Not much is known as to exactly why mottling occurs.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. The proper clearance for the fingers on the feeder for papers over .010" thick is ________ times the paper thickness.

2. Uneven color can result from either uneven or varying ____________ ______________ or ______________ cylinder pressures.

3. Ink picked up by the clear areas of a plate and transferring this ink to the clear areas of the sheet produces a condition called ______________.

4. A uniform, light-colored tint over the entire sheet of paper is referred to as ______________.

5. The building up of ink on the plate or blanket is called ______________.

6. The gradual disappearance of some lines and some halftone dots from the plate image is called ______________.

7. If vanishing occurs due to the composition of the ink, it can be corrected by adding a little ______________ acid to the ink.

8. When black solids are gray and color solids weak, it is a result of too much ______________ ______________.

9. Scum streaks are usually due to lack of sufficient ______________ or to excessive ______________ ______________.

10. The slurring of halftones usually results from excessive ______________ or excessive ______________.

11. If a blanket has lost its ink receptiveness due to its becoming glazed and hard it should be washed with solvent and water and then scrubbed with ______________ ______________ and solvent.

12. If the ink picks, splits or tears the paper, this can be either an ______________ or ______________ trouble.

13. For ink to dry properly, coated paper should have a pH above ________ and uncoated a pH above ________.

14. Improper drying of ink can be caused by the temperature of either or both the ______________ or the ______________ being too low.

15. If chalking occurs the vehicle's penetrating rate should be decreased with an acceptable form of ____________ __.

Matching

Directions: The probable causes of scumming are listed in the left hand column; a remedy for each of these causes is listed in the right hand column. Match the items on the right with the proper item on the left by placing the proper letter in each blank on the left.

		Probable Cause		Remedy
_____	1.	Clear areas of plate not etched properly--cannot repel the ink	A.	Re-set according to instruction book. Make new plate, if damaged
_____	2.	Too little fountain solution	B.	Maintain at recommended pH
_____	3.	Dampener form rollers not parallel, or set too far from plate cylinder	C.	Even out, recover if necessary
_____	4.	Dirty dampener rollers	D.	Re-etch the plate, or make a new plate
_____	5.	Unevenly applied molleton cover on dampener roller	E.	Replace rollers
_____	6.	Dampener roller not parallel with the plate	F.	Take up the slack
_____	7.	Dampener roller dragging or bouncing on plate	G.	Increase flow of fountain solution
_____	8.	Fountain solution too strong or too weak	H.	Make new plate
_____	9.	Plate and blanket cylinders not properly packed	I.	Cut down on ink, and re-etch the plate
_____	10.	Flatten form rollers	J.	Set according to instruction manual. Make new plate if damaged, or re-etch the plate

_____ 11. Plate not perfectly concentric with cylinder

_____ 12. Skidding form roller

_____ 13. Too much ink during make-ready

_____ 14. Loose blanket

_____ 15. Oxidation of plate

_____ 16. Over-developed plate

_____ 17. Residual coating solution on plate

K. Take up slack. Make new plate if the image is damaged

L. Clean or replace the dampener rollers. Check the pH of fountain solution Feed less ink. Replace ink if emulsified

M. Set according to instruction manual

N. Maintain proper contact between the rollers and their riders

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. List five probable causes of tinting.

(A) ______________________________

(B) ______________________________

(C) ______________________________

(D) ______________________________

(E) ______________________________

2. List three probable causes of piling.

(A) ______________________________

(B) ______________________________

(C) ______________________________

3. List three probable causes of "picking."

(A) ____________________

(B) ____________________

(C) ____________________

4. List three probable causes of gray type.

(A) ____________________

(B) ____________________

(C) ____________________

5. List seven causes of uneven cylinder pressures.

(A) ____________________

(B) ____________________

(C) ____________________

(D) ____________________

(E) ____________________

(F) ____________________

(G) ____________________

6. The stripping of ink drums or rollers can result from:

(A) ____________________

(B) ____________________

(C) ____________________

7. An image will go blind or "walk off" because:

(A) ______________________________

(B) ______________________________

(C) ______________________________

(D) ______________________________

(E) ______________________________

(F) ______________________________

8. Eight requirements of paper for satisfactory performance are:

(A) ______________________________

(B) ______________________________

(C) ______________________________

(D) ______________________________

(E) ______________________________

(F) ______________________________

(G) ______________________________

(H) ______________________________

Assignment
Sheet No. 17

Covering
Units 107-109

OFFSET DUPLICATORS

Small offset presses are often referred to as "duplicating equipment." These smaller machines are well adapted to many uses. They require little floor space and they are relatively easy to operate.

Offset duplicators are generally used for jobs that are printed on sheets ranging from 10" x 14" to 3" x 5" in size. While the offset duplicator operates on a smaller scale than the large offset presses, the principle behind it is practically the same.

In this unit you will learn about operating and maintaining some of the common types of offset duplicators.

Assignment:

1. Read the reference listed below.
2. Answer the questions below and turn in this assignment by ______________________________.

Reference:

B. Department of the Navy, Lithographer 3 & 2, pp. 256-334.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F." Items 1 through 10 refer to the Multilith Press.

T F 1. The Multilith has a printing area of 11" x 14".

T F 2. When the Multilith is in operation, the ductor roller contacts the plate, keeping it moist.

T F 3. To increase the water supply on the Multilith, the lever is pushed toward the delivery end of the press.

T F 4. At the beginning of the day it is best to distribute water over the rollers of the Multilith with a sponge.

T F 5. The blanket of the Multilith should always be underpacked with paper.

T F 6. The Multilith uses only paper plates.

T F 7. The blower tubes on the feeder of the Multilith should be in the front position for ordinary work.

T F 8. The Multilith is equipped with a device which will throw out the sheets if more than one is fed through.

T F 9. It is necessary for a sheet to be fed through the Multilith in order for the impression to print.

T F 10. The Multilith differs from the larger offset presses in that it does not have a continuous chain delivery.

T F 11. Being a small, percision-built machine, the Multilith requires continual adjusting.

T F 12. The Multilith is designed so that it is never necessary to change pressure between the impression cylinder and the blanket to accomodate different thicknesses of stock.

T F 13. When running very heavy stock on the Multilith, it is recommended that an old blanket be used.

T F 14. The Davidson Dualith differs from other offset presses in that it has only two cylinders.

T F 15. The impression-plate cylinder of the Dualith makes two revolutions to one for the blanket cylinder.

T F 16. The Dualith can be used for either offset or relief printing.

T F 17. The Dualith can be used to print on both sides of the sheet at once.

T F 18. The plate should be mounted from the feed end of the Dualith.

T F 19. The use of presensitized plates on older model Dualiths will require underpacking.

T F 20. The Davidson inking system is considerably different from that of the Multilith.

T F 21. The dampening systems of the Multilith and the Davidson press are quite similar.

T F 22. The roller cleaning unit of the Davidson should be left on while the press is in operation.

T F 23. On the A. B. Dick Offset Duplicator, the ink and water are fed to the plate from the same set of form rollers.

T F 24. The A. B. Dick machine requires special inks and fountain solutions for proper operation.

T F 25. The A. B. Dick machine will handle only paper plates.

T F 26. To raise or lower the image on the A. B. Dick machine it is necessary to reposition the plate.

T F 27. The feeder on the A. B. Dick machine is different from other presses.

T F 28. The speed of the A. B. Dick duplicator should be changed while the press is in operation.

T F 29. At the end of the day, all tension on all rollers should be relieved on the A. B. Dick duplicator.

T F 30. The "Whitin" presses have two forwarding rollers instead of one.

T F 31. The entire inking unit can be removed from the Photostat Offset Duplicator, allowing quick color change overs.

T F 32. The manual control knob of the "Whitin" presses should be turned only in a clockwise direction.

T F 33. If the image is not straight, the plate must be loosened and adjusted on the photostat machine.

T F 34. Although the Photostat Offset Duplicator has two moveable side guides, usually only one is used at a time.

T F 35. The vacuum pump on the "Whitin" presses should always be turned off when the feeder is shut down.

T F 36. It is possible to run small jobs in an off-centered position on the Photostat Offset Duplicator.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. The fountain is kept at a constant level on the Multilith by means of a ______________ filled with water.

2. The blanket for the Multilith is provided with ______________ for attaching it to the blanket cylinder.

3. If the image is not straight on the plate of the Multilith, it is necessary to shift the ______________.

4. The paper supports on the Multilith should be adjusted so that they are about ________ inches from each edge of the stock.

5. The sheets being fed through the Multilith are carried to the printing unit by means of ______________ ______________.

6. Static from the paper is removed by stretching a piece of ______________ across the delivery end of the Multilith.

7. The two form rollers of the Multilith which distribute the ink over the plate must be ______________ for even distribution of ink.

8. When replacing the rollers of the Multilith after cleaning, the ______________ rollers should be inserted first.

9. On the Davidson Dualith, the plate and impression units are combined on a single ______________ cylinder.

10. The blanket for the Dualith must be mounted from the ______________ end of the press.

11. The Dualith has a speed range of from ________ to ________ impressions per hour.

12. Adjustments to the rollers on the Davidson press should be done with the aid of strips of ______________ bond paper.

13. The rollers of the dampening unit of the A. B. Dick Offset Duplicator do not need ______________ ______________.

14. If two sheets go through the A. B. Dick machine at the same time it shuts off the ______________ unit.

15. The Photostat Offset Duplicator is equipped with two side guides on the feeder but usually just the ______________ side is used as an active guide.

15. The Photostat Offset Duplicator is equipped with two side guides on the feeder but usually just the ______________ side is used as an active guide.

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. List the rollers included on the dampening system of the Multilith.

(A) ______________________________

(B) ______________________________

(C) ______________________________

(D) ______________________________

2. List the causes for most difficulties on the Multilith.

(A) ______________________________

(B) ______________________________

(C) ______________________________

(D) ______________________________

(E) ______________________________

(F) ______________________________

3. List three specific printing operations that can be done on the Davidson Dualith that normally cannot be done on other duplicators.

(A) ______________________________

(B) ______________________________

(C) ______________________________

Assignment
Sheet No. 18

Covering
Units 110-120

BINDERY OPERATIONS

In small print shops it is common practice to require the learners, who have reached some acceptable degree of ability, responsible for the final operations which are performed on printed jobs. These operations - cutting, folding, gathering, binding, packaging, et cetera - are performed in the bindery section of the printing establishment.

To one who has never had occasion to perform any of the bindery operations, they may seem simple and of minor importance. However, having to report to the supervisor a job ruined by a careless error, will quickly amend any unfounded idea concerning the ease or simplicity of bindery operations.

In this unit you will learn about the machines and operations common to bindery rooms.

Assignment:

1. Read the reference listed below.
2. Answer the questions below and turn in this assignment by
   ____________________.

Reference:

B. Department of the Navy, Lithographer 3 & 2, pp. 397-421.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. The most common bindery operation is folding.

T F 2. Most paper cutters have a sliding metal tape that has 1/64" calibrations.

T F 3. The clamp on the paper cutter should apply more pressure to soft, springy stocks than to hard stocks.

T F 4. It is a good idea to place a piece of cardboard on top of the paper stack before clamping it in the paper cutter.

T F 5. The beginner's job usually includes sharpening the knives of paper cutters.

T F 6. When using the paper cutter, the web of the clamp should be low enough so that the sharp edge of the cutting knife is not exposed.

T F 7. When trimming paper on 4 sides, the first 2 cuts should be made slightly wider than the desired size.

T F 8. When books are to be trimmed, they are placed in the machine with the folded edge away from the back gage.

T F 9. Machine folding usually involves sheets laid out as signatures.

T F 10. The knife folder is faster and more accurate in folding large sheets than the roller-operated folder.

T F 11. The knife folder is more versatile than the roller-operated folders.

T F 12. The friction feeder is generally found on the smaller machines.

T F 13. The pile feeder must be stopped before loading.

T F 14. The continuous feeder requires that the sheets be loaded on it upside down.

T F 15. Roller pressure should always be kept the same for all rollers.

T F 16. The cross carrier can be removed and the stacker attached in its place at any point where no folds are required.

T F 17. Pasting units may be attached to folding machines.

T F 18. To ensure the use of a folding machine, the arrangement of the pages on a signature must be planned with the folding machine in mind.

T F 19. Padding is the process of putting covers on books or pamphlets.

T F 20. Two or three staples are sufficient for most booklets.

T F 21. Wire stitchers are more versatile than foot staplers.

T F 22. The wire stitcher is much faster than the stapler.

T F 23. Printers often tie books with cord.

T F 24. Spiral binding is a part of routine shop operations.

T F 25. Multiple punching machines are used for punching different sized holes simultaneously.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. The ________________ is the end of the road for the printing job.

2. The distance between the ____________ ________________ and the knife of a paper cutter regulates the width of the cut.

3. Sheets are loaded onto the cutter table in small stacks called ________________.

4. The process of getting the edges of a stack of paper even is called ________________.

5. The two types of folding machines used today are: ______________ folders and ________________ folders.

6. To enable a sheet to pass over certain fold plates, they are covered with ________________.

7. When right-angle folds are required on sheets that have 2 or 3 parallel folds, the sheet is usually scored with ________________ ________________.

8. The sheet emerges from the folding machine on a belt in a unit known as the ________________.

9. After the signatures have been folded, they must be assembled into proper order; this is known as ________________ or ________________.

10. Bookbinding has no place in the ____________ job shop.

11. The two most common methods of stapling books are: ___________ stapling and ____________ stapling.

12. Thick books are not _______________ before they are tied.

13. Friction on paper drills can be reduced by applying ___________ to the drill.

Multiple-Choice

Directions: In the space at the left of each statement, write the letter of the item which will provide the correct answer to complete the statement.

_____ 1. A long strip of maple wood or plastic which fits into a groove in the cutter table just below the knife is called the (A) clamp; (B) guillotine; (C) tape indicator; (D) cutting stick.

_____ 2. The average small paper cutter will take a stack of paper from (A) 1/2 to 1 inch high; (B) 1 to 2 inches high; (C) 2 to 3 inches high; (D) 4 to 6 inches high.

_____ 3. What will most likely be the result if the stack is too high? (A) The knife will stall in the middle of the cut. (B) The knife will break. (C) The machine will not start. (D) A fuse will be blown.

_____ 4. If an order calls for 200 3 x 5 cards, approximately how many extra should be cut to allow for spoilage? (A) 4; (B) 6; (C) 10; (D) 20.

_____ 5. The metal chute which causes the paper to buckle and pass through the fold rollers is called the (A) plate stop; (B) deflector; (C) fold plate; (D) register.

_____ 6. The process of making pads or tablets by cementing the edges of the stacks of sheets is called (A) stitching; (B) collating; (C) padding; (D) bookbinding.

_____ 7. How many holes are generally punched when a book is to be tied with cord? (A) 2; (B) 3; (C) 4; (D) 6.

_____ 8. The item that is sometimes used to reinforce a punched hole is a (A) grommet; (B) plastic binding; (C) spiral; (D) die.

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. The three main types of folds that can be done on a folding machine are:

   (A) ______________ (B) ______________ (C) ______________

2. Three types of feeders for folding machines are:

   (A) ______________________ (C) ______________________

   (B) ______________________

3. List the two types of pressure used on folder rollers.

   (A) ______________________ (B) ______________________

4. List three methods of facilitating the making of right-angle folds on hard-to-fold sheets.

   (A) ______________________ (C) ______________________

   (B) ______________________

TRAINING PLAN AND PROGRESS RECORD
for
OFFSET LITHOGRAPHY

Employer's Copy

JOB TRAINING: What the Worker Should Be Able to Do	Proficiency Shown	RELATED INFORMATION: What the Worker Should Know
	Introduction	
	☒	History of offset printing, opportunities, requirements and future outlook of offset printing. Principles of offset printing. Accident and health hazards in the printing shop.
	Planning and Proofing	
Set type by hand, identify type characters, calculate with point system, space lines, prepare text material on typewriter, IBM Executive Varityper, Justowriter, prepare headlines and titles, prepare artwork, retouch copy, proofread. Time in hours _____	☒	How type is set by hand, theory of typesetting, type materials printing system of measurement, kinds of spacing units and their arrangements, types of letters, types and technique of artwork, retouching techniques, standard proofreader's marks.
	Photolithography Process	
Prepare line copy, "shoot" line copy, superimpose line copy, mix chemicals, make contact print and screen negatives, strip in negative. Time in hours _____	☒	Methods of preparing line copy, theory of photography, procedure in "shooting" line copy, techniques of superimposing, procedure for making contact prints, and for stripping halftone negative.
	Platemaking	
Make albumin plate, prepare plates by Xerography, make minor plate corrections, prepare plates for future runs. Time in hours _____	☒	Procedure for making albumin plates, procedure for preparing plates by Xerography, causes of plate failure.

Setting Up and Running Press

Prepare fountain solutions, adjust dampening mechanism, clean and adjust rollers, prepare and mount blanket, remedy ink and plate image troubles, remedy streaking and register troubles Time in hours _____	☒	Methods of preparing fountain solutions, adjustment procedures of dampening mechanisms, makeready techniques of setting and caring for rollers, causes of scumming and ink troubles, causes of register troubles

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Small Duplicators

Set up and operate offset duplicator. Time in hours _____	☒	Types of offset duplicators, advantages of offset duplicators, procedure for operating offset duplicators

---

Bindery Work

Jog paper, trim paper to exact size, operate folding machines, gather paper, punch and drill paper, perforate paper, fold impositions Time in hours _____	☒	Procedure for figuring paper, methods of cutting and folding paper, methods of padding and binding, methods of punching and drilling paper, methods of perforating paper, techniques used in folding impositions, legal restrictions on copying

---

Code for employer's use in marking student's progress:

Performed some operations in area	☒	Performed some operations with reasonable proficiency	☒
Performed most operations in area	☒	Performed most operations satisfactorily	☒

TRAINING PLAN AND PROGRESS RECORD
for
OFFSET LITHOGRAPHY

Student's Copy

JOB TRAINING: What the Worker Should Be Able to Do	Proficiency Shown	RELATED INFORMATION: What the Worker Should Know
	Introduction	
	☒	History of offset printing, opportunities, requirements and future outlook of offset printing. Principles of offset printing. Accident and health hazards in the printing shop.
	Planning and Proofing	
Set type by hand, identify type characters, calculate with point system, space lines, prepare text material on typewriter, IBM Executive Varityper, Justowriter, prepare headlines and titles, prepare artwork, retouch copy, proofread. Time in hours _____	☒	How type is set by hand, theory of typesetting, type materials printing system of measurement, kinds of spacing units and their arrangements, types of letters, types and technique of artwork, retouching techniques, standard proofreader's marks.
	Photolithography Process	
Prepare line copy, "shoot" line copy, superimpose line copy, mix chemicals, make contact print and screen negatives, strip in negative. Time in hours _____	☒	Methods of preparing line copy, theory of photography, procedure in "shooting" line copy, techniques of superimposing, procedure for making contact prints, and for stripping halftone negative.
	Platemaking	
Make albumin plate, prepare plates by Xerography, make minor plate corrections, prepare plates for future runs. Time in hours _____	☒	Procedure for making albumin plates, procedure for preparing plates by Xerography, causes of plate failure.

Setting Up and Running Press

Prepare fountain solutions, adjust dampening mechanism, clean and adjust rollers, prepare and mount blanket, remedy ink and plate image troubles, remedy streaking and register troubles Time in hours _____	☒	Methods of preparing fountain solutions, adjustment procedures of dampening mechanisms, makeready techniques of setting and caring for rollers, causes of scumming and ink troubles, causes of register troubles

Small Duplicators

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Performed most operations in area	☒	Performed most operations satisfactorily	☒

VT002 045

VT 002 045
Electrical Appliance Servicing Group Instruction, A Course of Study, Designed for Students Preparing for or Presently Employed in Electrical Appliance Servicing Occupations.

Stevens, Marion P.
Missouri Univ., Columbia. Dept. of Industrial Education
Missouri State Dept. of Education, Jefferson City
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*STUDY GUIDES, *TRADE AND INDUSTRIAL EDUCATION, *ELECTRICAL APPLIANCE SERVICEMEN, *HOME APPLIANCES, HIGH SCHOOLS, *GROUP INSTRUCTION,

This study guide is for 11th or 12th grade student use in a 180-hour electrical appliance service course. It was developed by research assistants and an advisory consultant for use in group instruction. Assignment sheets including reading assignments, references, and questions cover (1) Basic Tools and Materials and Their Uses, (2) Fundamental Principles of Electricity, (3) Safe Practices and Repair Procedures, (4) Home Electrical Wiring, (5) Signals and Alarms, (6) Electric Heaters, Blankets, Heating Pads, and Irons, (7) Electric Water Heaters, (8) Electric Toasters, Blenders, Coffee Makers, Shavers, Knife Sharpeners, Popcorn Poppers, Can Openers, Skillets, and Waffle Irons, (9) Electric Broilers, Roasters, and Ranges, (10) Electric Motors, Motor Trouble, and Repair, (11) Electric Fans, Blowers, and Vacuum Cleaners, (12) Food Mixers and Sewing Machines, (13) Electric Ironers, (14) Electric Garbage Disposers and Dishwashers, (15) Conventional Washing Machines, (16) Automatic Washer Operation and Service, (17) Automatic Clothes Dryers, (18) Theory of Electrical Refrigerator Operation, (19) Electric Refrigerator Components, Repair, and Servicing, (20) Home Freezers, and (21) Air Conditioners. An analysis of the course in two-column form correlates what the worker should be able to do and what the worker should know. An answer key (VT 002 046) is available for 50 cents. This document is available for $1.50 from Industrial Education, 103 Industrial Education Building, University of Missouri, Columbia, Missouri 65201. (EM)

ELECTRICAL APPLIANCE SERVICING GROUP INSTRUCTION

A Course of Study

Designed for
Students Preparing for
Or Presently Employed in
Electrical Appliance Servicing Occupations

Issued by
Department of Industrial Education
College of Education
University of Missouri
Columbia, Missouri

In Cooperation With
Industrial Education Section
State Department of Education
Jefferson City, Missouri

2045

MEMORANDUM

TO: The ERIC Clearinghouse on Vocational and Technical Education
The Ohio State University
980 Kinnear Road
Columbus, Ohio 43212

FROM: (Person) James B. Karnes (Agency) University of Missouri at Columbia

(Address) 103 Industrial Education Bldg., Columbia, Mo.

DATE: September 26, 1967

RE: (Author, Title, Publisher, Date) Industrial Education Dept., Univ. of Mo. at Columbia, ELECTRICAL APPLIANCE SERVICING GROUP INSTRUCTION, cooperatively with Industrial Education Dept. (U. of Mo. at Columbia) and Missouri Dept. of Education

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REFERENCES FOR ELECTRICAL APPLIANCE SERVICING

A. Manly, H. P., Electrical Appliance Repair and Servicing, Book I, Fredrick J. Drake and Company, 9 South Clinton Street, Chicago 6, Illinois, 1958. $1.50* (6)**

B. Manly, H. P., Electrical Appliance Repair and Servicing, Book II, Fredrick, J. Drake and Company, 9 South Clinton Street, Chicago 6, Illinois, 1958. $1.50* (8)**

C. Campbell, Edward A., How to Repair Washing Machines, Clothes Dryers, Refrigerators, Vacuum Cleaners, Fans, Mixers, Toasters, and Other Home Appliances, Acro Publishing Co., Inc., New York City 17, New York, 1957. $2.00* (9)**

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* Subject to educational discount
** Frequency of use in assignments

FOREWORD

This course of study, consisting of an analysis of ELECTRICAL APPLIANCE SERVICING GROUP INSTRUCTION, together with assignment sheets covering the related (occupational) information, has been prepared for teaching electrical appliance servicing on a group or class basis in a trade preparatory program.

The analysis for this course of study was originally prepared by Mr. Marion P. Stevens, then a graduate student in Industrial Education at the University of Missouri. The assignment sheets for this course of study are especially designed for group instruction and were prepared by Mr. Philip Epperson, Research Assistant in Industrial Education at the University of Missouri.

We wish to acknowledge our indebtedness to Dr. H. H. London, Professor of Industrial Education at the University of Missouri, for the direction and administration of the Curriculum Materials Laboratory in which this material was prepared, and to Dr. James B. Karnes, Assistant Professor of Industrial Education at the University of Missouri, who supervised the preparation of the material and edited the manuscript. Credit is due to Mr. B. W. Robinson, Assistant Commissioner of Education, Mr. Merton Wheeler, Director of Industrial Education, and to other staff members of the State Department of Education for their efforts in the development of the Industrial Education Curriculum Series of which this course of study is a part.

HUBERT WHEELER

Commissioner of Education

September, 1966
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Assignment Sheets:

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INTRODUCTION

In preparing this course of study, it has been assumed that job skills and procedures will be learned through experience in actual repair of appliances under the direction of a competent teacher. The technical and related information is to be given in conjunction with each associated assignment at the appropriate time. The teaching sequence set up in the manual is intended to be flexible.

Each assignment in the manual contains an introduction, reading assignment, and a series of discussion questions based on the reference pages assigned. The purposes of the introduction are to create interest, convey the importance of the assignment to the student, and <u>tell</u> him specifically what he is expected to learn. The reading assignments are keyed to the basic texts listed on page (6) six of this manual.

The questions on the assignment sheets serve two purposes: (1) to guide the student to the important aspects of the reading assignment, and (2) to form a basis or guide for classroom discussions.

The questions may also be utilized as written assignments to emphasize a particular procedure on topic, as well as, selected essay test items.

Your attention should be called to a second study guide on Electrical Appliance Servicing-Individual, designed specifically for a single student doing independent study. It is based on the same reference material, has the same assignments, <u>but</u> the questions for each unit are of the objective type. These questions lend themselves very well to test purposes.

A key is available for both study guides locating the reference source from which the questions were written.

As the student proceeds through the course, it is advisable for him to keep a well organized notebook. In this notebook, he would bring to the work station any information needed to perform the day's assignment. This will give added life to the texts. Related information not found in the text would also be kept in the notebook.

TO THE STUDENT

Within the past few years there has been a marked increase in the production, variety, complexity, and use of electrical appliances. There has also been a new conception of repair service in recent years. Successful electrical appliance store owners are now aware that the reputation of a store depends to a large extent on the quality of its servicing. No longer is service fundamentally an "extra" with the sale of a new appliance; it is a business of its own. This fact was brought in prominence during World War II when new appliances ceased to be manufactured. It was then that appliance servicing was of greatest importance not only to manufacturers, distributors, and dealers, but to customers as well.

Nature of Work

The main duties of the electrical appliance serviceman are to install, service, and repair large appliances such as ranges, washing machines, and refrigerators, and to service and repair numerous smaller appliances such as irons and toasters. Many sell appliances and replacement parts in connection with these services. Hand tools, power tools, and electrical instruments are used by the appliance serviceman.

Opportunities in Electrical Appliance Servicing

From all indications and reliable sources, the opportunities for electrical appliance service are good. Manufacturers and power companies are urging dealers to establish service departments or arrange for reliable service work. Sales of new appliances will no doubt continue to be on the increase, and this will mean much work for servicemen, especially in view of the guarantees given on new appliances. The appliance serviceman will likewise be in demand repairing old appliances especially in the event that the manufacture of new ones is curtailed.

Electrical appliance repairmen are employed mainly in service departments of stores and other concerns selling electrical appliances and in shops specializing in the repair of such appliances. Many trained and experienced men operate their own repair shops. Some are employed by appliance manufacturers and electric companies.

Opportunities are to be found in all parts of the country and jobs may be found in small towns or large cities. In some regions of the country where the electric rates are cheap, such as the Pacific Northwest and Tennessee Valley, more use is made of appliances than in other areas.

Requirements for Entry Into Electrical Appliance Servicing

On-the-job training is one of the best ways of entering the trade. Many employers offer opportunities for this by participating in the cooperative part-time program. Training in fundamentals of electricity and in operation and construction of various types and makes of appliances may also be secured from trade, correspondence, and other schools. To be considered fully qualified, it is necessary that a worker have had practical work experience. This may require several years.

High school courses particularly helpful to one planning to enter electrical appliance servicing include mathematics, physics, industrial arts shop and drawing courses, economics, and English.

The beginner should realize that in any electrical work there are dangers involved. If improper working procedures are followed, the result may be injurious to the worker, to the appliance, or both. However, once the fundamental safety principles of electrical work are understood, the worker may pursue his work with confidence. Work will be inside and will not be affected by seasons. The repairman will make numerous calls to homes and make repairs there. The complaints he will receive will be numerous and varied. He must be tactful in his dealings with these appliance owners.

To one interested in electrical and mechanical work, electrical appliance servicing will provide a challenge and an opportunity to earn good wages while performing a useful service to a community.

Personal-Social Traits Essential for the Electrical Appliance Serviceman

More and more, men who are seeking jobs or wanting to go into business for themselves need good personal qualifications. Holding a job is also largely dependent upon one's personality. Satisfaction on the job will be determined by the willingness, respect, and cooperative attitude that one has toward his job and his fellow workers.

With a conscientious effort one can improve his personal-social traits. In order to do this one must know what to improve, how to improve and why improvement is necessary.

Among the personal-social traits of chief importance to the electrical appliance serviceman are the following:

Honesty -- Give full value for every cent received, truthfulness in dealing with customers, and loyalty to one's employer or associates.

Health -- Observe habits that promote vitality and vigor.

Courtesy -- Respect the other person's point of view, his interests, and wants. This may require effort at times but it will eventually pay off.

Initiative and Industry -- The ability to see things that need to be done and to keep busy without constant supervision.

Alertness -- The ability to pay close attention, to respond quickly, and to concentrate on one's work.

Cooperation -- Work harmoniously with other, and be helpful.

Promptness -- Avoid being tardy or absent from your responsibilities.

Self-Control -- Maintain a pleasant disposition and keep temper under control.

Voice -- Use good English and speak in a pleasant manner.

Personal Neatness -- The appliance repairman has close contact with the general public and represents his employer to them. The work often requires calls at the homes of customers where one's clothes should be neat and reasonably clean. The work may require getting your hands dirty but they should be cleaned as the situation warrants to avoid damage to the customer's property.

Neat and Orderly Work Habits -- The customer may not have any technical knowledge of what you are doing but he easily recognizes slovenly work habits.

REFERENCES FOR ELECTRICAL APPLIANCE SERVICING

A. Manly, H.P., Electrical Appliance Repair and Servicing, Book I, Frederick J. Drake and Company, 7312 N. Ridgeway Ave., Skokie, Illinois 60076, 1958. $1.50* (6)**

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** Frequency of use in assignments

ANALYSIS OF ELECTRICAL APPLIANCE SERVICING

JOB TRAINING: What the Worker Should be Able to Do	Assign. No.	RELATED INFORMATION: What the Worker Should Know
Basic Tools and Materials		
1. Lay out stock with dividers	1	1. Characteristics of dividers
2. Measure inside and outside dimensions with calipers	1	2. Types and use of calipers
3. Make measurements using micrometer	1	3. Micrometer settings and their meanings
	1	4. Proper care of precision measuring tools
5. Mark parts with prick punch	1	5. Types of punches and chisels
6. Cut holes in sheet metal using drive punch		
7. Drive out rivets and pins with punch		
8. Cut slots in metal with cape punch		
9. Cut metal with cold chisel		
10. Recondition worn or abused screwdrivers	1	10. Care and use of screwdrivers
11. Select, care for and use proper wrench for the job	1	11. Kinds, sizes and care of wrenches
12. Set rivets with tinner's hammer	1	12. Hammer specifications
13. Rivet with ball peen hammer		
14. Fasten materials in vise	1	14. Vises: their care and use
15. Select files	1	15. File and rasp specifications
	1	16. Care and use of files and rasps
17. Drill holes in metal	1	17. Drill specifications
18. Recondition drills	1	18. Cutting angles for drill bits
19. Cut inside and outside threads using taps and dies	1	19. Tap and die specifications
20. Clean and tin soldering copper	1	20. Electric soldering iron specifications

JOB TRAINING: What the Worker Should Be Able to Do	Assign. No.	RELATED INFORMATION: What the Worker Should Know
21. Solder joints	1	21. Types and uses of solders and fluxes
	1	22. Sizes, shapes and uses of rivets

Basic Electrical Principles

	2	23. Characteristics and properties of atoms
	2	24. Characteristics of electrons and protons
	2	25. The theory of electrons
	2	26. Difference between static and current electricity
	2	27. Conducting and nonconducting materials
	2	28. Cause of electron movement in a conductor
	2	29. Direction of current flow
	2	30. Effects of current flow
	2	31. Speed of electric current
32. Measure current, voltage, and resistance	2	32. The meaning of volt, ohm, ampere and watts
	2	33. Characteristics and difference of direct and alternating current
	2	34. Effect of wire size and length on resistance
	2	35. Effect of resistance in electric circuits
	2	36. Ohm's Law and its applications
	2	37. Characteristics and differences of series and parallel circuits
	2	38. The meaning of voltage drop: its causes and results

JOB TRAINING: What the Worker Should Be Able to Do	Assign. No.	RELATED INFORMATION: What the Worker Should Know
Precautions and Safe Practices		
	3	39. Test equipment and tools needed in the electrical repair shop
	3	40. Methods used to locate troubles
	3	41. Nature of electrical troubles
	3	42. Safety precautions to be observed
	3	43. Points to be observed during disassembly and reassembly
	3	44. Possible substitutions in emergencies
	3	45. Typical faults in drive mechanisms
46. Lubricate appliance bearings	3	46. General precautions when lubricating
47. Attach cord to lamp socket	3	47. Importance and use of Underwriter's knot
48. Attach wires to terminals		
49. Attach cord to appliance plug	3	49. Types of appliance plugs and their uses
50. Attach resistance wire with terminal eyelets		
51. Repair resistance wire with mending sleeve		
	3	52. Types of appliance cords and their uses
53. Remove insulation from wire	3	53. Methods of removing insulation
54. Make a Western Union splice	3	54. Amount of insulation to be removed from wire for splices
55. Make a tap splice	3	55. Common uses of the different splices
56. Make a pigtail splice		
57. Make a solderless connection		

JOB TRAINING: What the Worker Should Be Able to Do	Assign. No.	RELATED INFORMATION: What the Worker Should Know
		Safe Practices
58. Remove shocked person from electrical conductor		
59. Apply artificial respiration	3	59. Method of dealing with person receiving shock
	3	60. Safety factors in the use of electricity
	3	61. Advantage of grounding appliance
	3	62. The human body as a conductor
		Electricity in the Home
	4	63. Purpose of the National Electrical Code
	4	64. House-wiring systems
	4	65. Overload devices used in home wiring systems
66. Test and replace fuses	4	66. Function of fuses; their types and sizes
67. Trace house circuits	4	67. Types of wiring used
68. Troubleshoot electric wiring circuits		
	4	69. Method of specifying round wire sizes
	4	70. Causes of poor electrical service in homes
		Signals and Alarms
71. Install bells, buzzers and chimes	5	71. Operating principles of bells, buzzers and chimes
	5	72. AC and DC operated signals
73. Install bell transformer	5	73. Power sources for signals
74. Install multicontrol circuits	5	74. Common signal faults
	5	75. Circuits for signal operation

JOB TRAINING: What the Worker Should Be Able to Do	Assign. No.	RELATED INFORMATION: What the Worker Should Know
	Electric Irons	
	6	76. Types of electric irons
77. Disassemble and assemble iron	6	77. Essential parts of an electric iron
78. Avoid scratching iron sole plate	6	78. Methods of preventing damage to iron while repairing
79. Test iron for complete circuit		
80. Test iron for ground		
81. Clean thermostat contact points	6	81. Function and operation of the thermostat in automatic irons
	6	82. Dangers involved in cleaning contact points
	6	83. Common troubles of irons and their causes
84. Check thermostat operation		
85. Test temperature setting of iron	6	85. Types of iron testers and their construction
86. Readjust thermostat		
87. Install new heating element	6	87. Types of heating elements
88. Change temperature setting	6	88. Operating temperatures of electric irons
89. Polish damaged sole plate	6	89. Materials used in polishing iron sole plate
90. Clean steam iron	6	90. Operating principles of electric steam irons
	6	91. Care of electric steam irons
	6	92. Effect of hard water on steam irons
	6	93. Effect of using an a.c. iron on d.c. current
94. Replace iron cord and plug		
	Electric Heaters	
	6	95. Types of electric heaters and their construction

JOB TRAINING: What the Worker Should Be Able to Do	Assign. No.	RELATED INFORMATION: What the Worker Should Know
96. Repair or replace heater element in bowl type heater	6	96. Service requirements of bowl type heater
97. Determine length and size of resistance wire needed	6	97. Effect of bunching of coils on heater insulator
98. Assemble and disassemble a convection heater	6	98. The operating principle of convection
99. Replace heating element in convection heater		
100. Remove and replace heater element in electric steam radiator	6	100. The operating principles of electric steam radiators
101. Fill electric steam radiators	6	101. Maintenance requirements of electric steam radiators
	Electric Blankets	
	6	102. Types of electric blankets and their construction
103. Repair or replace heating element in electric blanket	6	103. Service requirements of electric blankets
104. Making adjustments on a thermostat	6	104. The operating principles of a thermostat
105. Testing the action of the thermostats and temperature of the heating elements	6	105. Testing procedure for determining the effectiveness of an electric blanket
106. Correct control box defects and clean dirty thermostat points	6	106. Maintenance requirements of an electric blanket
	Electric Heating Pad	
	6	107. Types of electric heating pads
108. Repair or replace heating element in heating pad	6	108. Service requirements of a heating pad.
109. Adjust or replace a thermostat	6	109. The functioning principle of a thermostat
	Electric Water Heaters	
	7	110. Types and construction of electric water heaters
	7	111. Essential parts of an electric water heater

JOB TRAINING: What the Worker Should Be Able to Do	Assign. No.	RELATED INFORMATION: What the Worker Should Know
	7	112. Sizes of electric water heaters
113. Check for complete circuit	7	113. Causes of opens in the heater circuit
114. Check for bad fuse		
115. Check time clock	7	115. Causes of insufficient hot water
116. Remove thermostat		
117. Clean thermostat contact points	7	117. Materials used in cleaning thermostat contact points
118. Adjust thermostat	7	118. Types of thermostats used in electric water heaters
119. Remove and replace thermostat well		
120. Install new thermostat	7	120. The operation of thermostats in water heaters connected for non-limited, limited or off-peak demand
121. Remove and replace heater element	7	121. Types and construction of heating elements for water heaters
122. Install magnesium rod in heater tank	7	122. Purpose of a magnesium rod in an electric water heater tank
123. Prevent heat loss	7	123. Causes of heat loss in hot water systems
	7	124. Purpose of gooseneck or heat trap
	7	125. Effect of steam on heater elements
126. Clean heater element	7	126. Methods of cleaning heater element
127. Clean heater tank	7	127. Materials used in cleaning and repairing heater tank
128. Repair a leaky tank		
129. Eliminate circulatory system	7	129. The principle of circulatory circulation in hot water systems
130. Install electric water heaters	7	130. Factors involved in the installation of electric water heaters
131. Install tempering tank	7	131. Functions and purpose of a tempering tank

Electric Toasters

	8	132. Types and characteristics of electric toasters
	8	133. Operating principles of electric toasters

JOB TRAINING: What the Worker Should Be Able to Do	Assign. No.	RELATED INFORMATION: What the Worker Should Know
134. Disassemble and assemble electric toaster		
135. Repair break in heating element	8	135. Types of heating elements used in toasters
	8	136. Arrangement of heating elements in toasters
137. Shorten elements in through-type automatic toaster		
138. Replace heating element in through-type toaster		
139. Check for faulty motor operation in through-type toaster	8	139. Factors involved in the repair or readjustment of through-type toasters
140. Locate troubles in pop-up toasters	8	140. Operating characteristics of pop-up toasters
141. Make adjustments and repairs	8	141. Timing devices used in toasters
	8	142. Causes of pop-up toaster failure or faulty operation
143. Clean thermostat contact points	8	143. Materials used in cleaning thermostat contact points
144. Replace cord and plug		
	8	145. Types of appliance cord used for toasters

Electric Waffle Irons

JOB TRAINING: What the Worker Should Be Able to Do	Assign. No.	RELATED INFORMATION: What the Worker Should Know
	8	146. Types of electric waffle irons
	8	147. Automatic waffle iron operation
148. Avoid scratching or damaging finish		
149. Disassemble and assemble waffle iron	8	149. Essential parts of an electric waffle iron
150. Test for complete circuit		
151. Test for ground	8	151. Possible troubles of a waffle iron and their causes
152. Diagnose trouble		
153. Clean thermostat contact points	8	153. Principle of heat adjustment on electric waffle irons
	8	154. Materials used for cleaning thermostat contact points
155. Adjust thermostat		
156. Remove and install new elements		

JOB TRAINING: What the Worker Should Be Able to Do	Assign. No.	RELATED INFORMATION: What the Worker Should Know
157. Test for thermostat operating temperature	8	157. Operating temperatures of waffle irons
	8	158. The result of operating an a.c. waffle iron on d.c.

Electric Coffee Makers

JOB TRAINING: What the Worker Should Be Able to Do	Assign. No.	RELATED INFORMATION: What the Worker Should Know
	8	159. Types of electric coffee makers
	8	160. Essential parts of electric percolators
	8	161. Operating principles of electric coffee makers
162. Avoid scratching or damaging percolator finish		
163. Test for complete circuit	8	163. Common percolator troubles
164. Test for grounded circuit	8	164. Causes of grounds in electric coffee makers
165. Check and install new fuse	8	165. The object of a fuse in electric percolators
166. Remove heating element	8	166. Types of heating elements used in electric coffee makers
167. Check percolator heater plate for flatness	8	167. Importance of a tight heater element cover
168. Check and remove sediment in percolator well	8	168. Effect of accumulated sediment in percolator well
169. Disassemble and assemble brewer coffee makers	8	169. Essential parts of brewer coffee makers
	8	170. Varieties of brewer coffee makers
	8	171. Common troubles in brewer coffee makers; their causes and remedies
172. Adjust thermostat temperature control		
173. Test for correct thermostat adjustment		
174. Replace damaged parts		

Electric Shaver

JOB TRAINING: What the Worker Should Be Able to Do	Assign. No.	RELATED INFORMATION: What the Worker Should Know
	8	175. Types of electric shavers
176. Disassemble to assemble electric shaver	8	176. Principle parts of an electric shaver
177. Clean and replace shaving head and blades	8	177. Causes of improper shaving
178. Lubricate motor precisely	8	178. Maintenance requirement of an electric shaver

JOB TRAINING: What the Worker Should Be Able to Do	Assign. No.	RELATED INFORMATION: What the Worker Should Know
Electric Knife Sharpener		
	8	179. Types of electric knife sharpeners
180. Disassemble and assemble electric knife sharpeners	8	180. Principle parts of an electric knife sharpener
181. Replace worn brushes, switch, plug, and cord	8	181. Causes of poor operation of electric knife sharpener
182. Lubricate knife sharpener	8	182. Maintenance requirement of an electric knife sharpener
Electric Can Opener		
183. Disassemble and assemble electric can opener	8	183. Principle parts of an electric can opener
184. Replace dulled cutting edges, worn gears	8	184. Principle cause of inadequate operation of an electric can opener
185. Clean and lubricate electric can opener	8	185. Maintenance requirement of an electric can opener
Electric Popcorn Poppers		
	8	186. Types of popcorn poppers
	8	187. Types and sizes of heating elements used in popcorn poppers
188. Repair or replace heating and control units in popcorn poppers	8	188. Service requirements of an electric popcorn poppers
Electric Skillets		
	8	189. Types of electric skillets
	8	190. Types of heating elements used in electric skillets
191. Repair or replace heating and control units in electric skillet	8	191. Service requirements of an electric skillet
Electric Blenders		
	8	192. Types of electric blenders
193. Install new knives and repair motor	8	193. Service requirements of an electric blender

JOB TRAINING: What the Worker Should Be Able to Do	Assign. No.	RELATED INFORMATION: What the Worker Should Know
Electric Broilers and Roasters		
	9	194. Types and construction of electric broilers
195. Disassemble and assemble broiler	9	195. Principal parts of electric broiler
196. Check for open circuit		
197. Check for ground		
198. Replace heating element	9	198. Method of determining length of replacement coil
199. Make temporary repairs to heating element	9	199. Number and location of heating elements
	9	200. How broilers and roasters operate
201. Disassemble and assemble roaster	9	201. Principal parts of electric roaster
202. Check thermostatic action	9	202. Causes of improper roaster operation
203. Check timing device		
204. Adjust thermostat		
205. Replace insulation	9	205. Type of insulation used in roasters
	9	206. Factors involved in reassembling a roaster
Electric Ranges		
	9	207. Types and construction of electric ranges
208. Check range for open circuit	9	208. Voltage requirements of electric range
209. Test range voltages with voltmeter	9	209. Reason for having a three-wire circuit for range
	9	210. Advantages of a separate light meter for large appliances
211. Check for loose connections		
212. Test for shorts		
213. Check and replace fuse		
214. Ground range according to electric code	9	214. Reason for grounding range
215. Check and replace surface element switch	9	215. Arrangements of electrical connections in switch to provide various heats
216. Check range surface elements	9	216. Types of surface heating units

JOB TRAINING: What the Worker Should Be Able to Do	Assign. No.	RELATED INFORMATION: What the Worker Should Know
	9	217. Possible causes of range complaints and their correction
218. Replace range surface elements		
219. Straighten heating elements		
220. Replace surface element signal light		
221. Replace deep-well cooker switch	9	221. Construction of deep-well cookers
222. Replace deep-well heating element		
223. Replace or adjust cut-out thermostat		
224. Repair or replace oven heating element	9	224. Types of oven heating units
225. Adjust or replace oven element thermostat	9	225. Electrical circuits used in oven heating units
226. Replace oven element spring contacts	9	226. Types and construction of oven control thermostats
227. Clean oven element contact blades	9	227. Materials used for cleaning contact blades
228. Check and replace oven element switch		
229. Adjust oven temperature control	9	229. Equipment necessary for checking temperature
230. Replace or adjust oven switch		
231. Replace oven-unit insulating bushing	9	231. Types of insulating bushings used with oven heating elements
232. Remove and replace sheathed coil on tabular oven heating units		
233. Replace tabular-type contact blades of oven heating units	9	233. Types of contact spring assemblies used with oven heating units
234. Check operation of oven thermostatic heat control	9	234. Methods of checking the operation of oven thermostatic heat control
235. Adjust thermostatic oven control		
236. Replace timer unit	9	236. Types and construction of oven timers
237. Convert three-heat surface unit to five-heat	9	237. Factors involved in converting a three-heat surface unit to five-heat
238. Level range		
239. Adjust oven door for proper fit		

JOB TRAINING: What the Worker Should Be Able to Do	Assign. No.	RELATED INFORMATION: What the Worker Should Know
240. Repair or replace oven door hinges, springs, or bearings		
241. Replace oven light switch		

Electric Motors

JOB TRAINING: What the Worker Should Be Able to Do	Assign. No.	RELATED INFORMATION: What the Worker Should Know
	10	242. The nature of magnetism
	10	243. Characteristics and kind of magnets
	10	244. Characteristics of magnetic lines of force
	10	245. Principles of electromagnetism
	10	246. Factors determining the strength of electromagnets
	10	247. Types and uses of electric motors
	10	248. Operating principles of electric motors
	10	249. Characteristics of fractional horsepower motors
	10	250. Types of speed controls used for appliance motor
	10	251. Meaning of phase
252. Remove and replace brushes	10	252. Advantages and disadvantages of the types of motors
253. Remove and replace worn motor bearings	10	253. Effects of worn bearings on motor operation
254. Test motor armature	10	254. Methods of testing motor armature
255. Repair motor armature		
256. Repair or replace centrifugal switch in split-phase motors	10	256. Operating principle of centrifugal switch
257. Reverse induction motor	10	257. Location of switch in motor circuit
258. Rewind and install new field coils	10	258. Materials used in rewinding motors
259. Clean motor	10	259. The importance of a clean motor
260. Oil motor	10	260. Lubricating systems of motors
261. Ascertain starting torque of motor	10	261. Equipment necessary for testing motors.
262. Measure power output of motor		
263. Measure rpm of motor		
264. Make no-load, full-load, locked-torque, and breakdown tests		

JOB TRAINING: What the Worker Should Be Able to Do	Assign. No.	RELATED INFORMATION: What the Worker Should Know
265. Test capacitor for short	10	265. Methods of testing capacitor
266. Polish dirty commutator	10	266. Materials used in cleaning commutators
267. Turn commutator in lathe	10	267. Importance of having a smooth commutator
268. Order replacement parts	10	268. Information necessary in ordering repairs

Fans and Blowers

269. Test for complete circuit and grounds	11	269. Types and construction of fans and blowers
	11	270. Types of motors used in fans
	11	271. Uses of blowers
272. Disassemble fan		
273. Clean motor		
274. Inspect and replace bearings		
275. Replace defective switch		
276. Install new cord		
277. Align fan blades		
278. Oil motor	11	278. Type of oil used in fans
	11	279. Purpose of kitchen ventilator
	11	280. Operating principles of attic ventilator
281. Repair motor windings		
282. Adjust or repair oscillating mechanism		

Vacuum Cleaners

	11	283. Types and characteristics of vacuum cleaners
284. Disassemble vacuum cleaner	11	284. Operating principles of vacuum cleaners
	11	285. Principal parts of vacuum cleaner
286. Adjust rotary brushes on upright cleaners	11	286. Methods of adjusting rotary brushes
287. Measure amount of vacuum developed in vacuum cleaner	11	287. Materials necessary to measure vacuum of cleaner
	11	288. Reasons why cleaner will not clean
289. Balance fans on tank type vacuum cleaner	11	289. Causes of cleaner noise or vibration
290. Replace belt and rotary brushes on upright cleaner		
291. Replace switch and cord		
292. Repair motor		

JOB TRAINING: What the Worker Should Be Able to Do	Assign. No.	RELATED INFORMATION: What the Worker Should Know
Food Mixers		
293. Disassemble mixer		
	12	294. Types and construction of food mixers
295. Adjust or replace governor switch	12	295. Function of the governor switch
296. Trace armature and field winding circuits		
297. Adjust speed settings	12	297. Types of speed controls used
298. Replace motor brushes	12	298. Possible causes of mixer troubles and their correction
299. Remove and replace worn bearings and gears	12	299. Methods of gearing used in electric mixers
300. Clean and repair armature		
301. Replace mixer switch		
302. Replace governor condenser		
303. Lubricate mixer		
Electric Sewing Machines		
	12	304. Power control on sewing machines
305. Clean and lubricate sewing machine	12	305. Causes for noisy operations
306. Replace needle	12	306. Points to be observed during inspection and adjustment
307. Adjust foot pressure		
308. Adjust bobbin winding mechanism		
309. Adjust belt tension		
310. Adjust thread tension	12	310. The effect of unequal thread tension upon stitc
311. Adjust foot pressure		
312. Adjust lift of feed dogs		
Electric Ironers		
	13	313. Types of electric ironers
314. Disassemble ironer	13	314. Principal parts of rotary ironer
315. Check ironer circuit for short	13	315. Operating principles of rotary ironers
316. Check for and eliminate open circuit	13	316. Wiring circuits of rotary ironers
317. Check and repair ironer heating elements	13	317. Characteristics of ironer heating elements

JOB TRAINING: What the Worker Should Be Able to Do	Assign. No.	RELATED INFORMATION: What the Worker Should Know
318. Check ironer motor circuit		
319. Readjust motor end thrust		
320. Replace main or handle switch	13	320. Types of switches and controls employed on rotary ironers
321. Check and replace rotary ironer motor switch		
322. Check and replace shoe thermostat		
323. Replace belt, chain, or coupling on rotary ironer	13	323. Ironer troubles and their corrections
324. Adjust or repair control linkage		
325. Adjust or replace roll-clutch mechanism on moving shoe type rotary ironer		
326. Remove roll and clean gears		
327. Repair or adjust roll drive chain, rachets, or roll clutch on stationary shoe type rotary ironer		
328. Readjust speed control lever on stationary shoe type ironer		
329. Replace roll padding	13	329. Materials used in replacing padding
	13	330. Factors involved in the replacement of ironer roll padding
331. Replace or adjust pressure spring		
332. Adjust roll-to-shoe clearance		
	13	333. Amount of clearance necessary between roll and shoe
334. Clean caked or rusted ironer shoe	13	334. Materials used in cleaning and waxing ironer shoe
335. Wax ironer shoe		
336. Test temperature of ironer shoe	13	336. Equipment needed for testing ironer shoe temperature

JOB TRAINING: What the Worker Should Be Able to Do		Assign. No.	RELATED INFORMATION: What the Worker Should Know	
Garbage Disposers				
		14	337.	Construction and operating principle of garbage disposer
		14	338.	Kinds of waste matter which can be disposed
339.	Check for and correct ground in disposer circuit	14	339.	Disposer troubles and their correction
340.	Adjust or replace defective switch	14	340.	Types of disposer controls
341.	Clean and free switch plunger			
342.	Disassemble and assemble garbage disposer	14	342.	Factors involved in assembling and disassembling garbage disposer
343.	Correct or replace misaligned or worn bearings			
344.	Clean and free stuck hammers	14	344.	Methods of freeing stuck hammers
345.	Replace worn hammers			
346.	Adjust water-flow interlock	14	346.	Function of the flow interlocking device
347.	Test water flow interlock for amount of water flowing			
		14	348.	Reason why cold water is used with disposer
		14	349.	Cautions in disposer usage
Electric Dishwashers				
		14	350.	Types of dishwashers
		14	351.	Construction and operation of electric dishwashers
		14	352.	Water temperature necessary for electric dishwashers
		14	353.	Soaps and detergents for dishwashing
354.	Adjust or replace water indicating signal (semi-automatic)			
355.	Adjust or replace defective water inlet valve solenoid (automatic)			
356.	Adjust, align or replace defective drain valve solenoid (automatic)			

JOB TRAINING: What the Worker Should Be Able to Do	Assign. No.	RELATED INFORMATION: What the Worker Should Know
357. Adjust water control	14	357. Amount of water used in dishwashers
	Washing Machines	
	15	358. Types of washing machines
359. Disassemble washing machine	15	359. Construction and operation of washing machines
360. Check for and correct short or ground in electric circuit		
361. Replace fuse		
362. Replace defective switch or timer	16	362. Characteristics and operation of automatic washer timers
363. Reset or replace overload switch	16	363. Function of overload switch
364. Repair, replace or adjust washer transmission	16	364. Types of transmissions used in washing machines
365. Replace or adjust clutch		
366. Trace electrical circuits (automatic washers)	16	366. Functions of the various electrical circuits of automatic washers
367. Replace defective solenoid	16	367. Functions and characteristics of solenoids in automatic washers
368. Lubricate or replace bearings	16	368. Oiling procedures for electric washer
369. Adjust or replace timer contacts		
370. Replace defective inlet valve thermostat		
371. Install pressure regulator in water line	16	371. Factors in determining the need for pressure regulator
372. Clean or adjust drain valve		
373. Clean out lint trap		
374. Clean, repair or replace water pump	16	374. Characteristics and operating principles of wash-water pump
375. Adjust belt tension		
376. Install new belt		
377. Remove suds lock	16	377. Factors which cause a suds lock in automatic washers
378. Tighten or replace supporting springs or shock absorbers (automatic)		

JOB TRAINING: What the Worker Should Be Able to Do	Assign. No.	RELATED INFORMATION: What the Worker Should Know
379. Tighten hose connections		
380. Replace or tighten cylinder seal		
381. Remove rough spots on agitator	16	381. Materials used for removing rough spots on agitator
382. Replace wringer latch		
383. Straighten wringer tie bar		
384. Replace wringer, coupling and gears	16	384. Types of wringer head assemblies
385. Repair clutch lever		
386. Clean rolls	16	386. Methods and materials used in cleaning wringer rolls
387. Remove stuck agitator	16	387. Methods and factors involved in the removal of a stuck agitator
388. Install automatic washer	16	388. Factors involved in the installation of automatic washer
	16	389. Water pressure requirements for automatic washers
390. Repair washer motor and cord		

Automatic Clothes Dryers

	17	391. Types of clothes dryers
392. Disassemble and reassemble dryer	17	392. Construction and operation of automatic clothes dryers
	17	393. Factors involved in dryer disassembly and reassembly
394. Check wiring circuits	17	394. Wiring circuits used in clothes dryers
395. Replace fuse	17	395. Voltage requirements for electric dryers
	17	396. Causes of dryer troubles and their correction
397. Replace heater assembly		
398. Check, repair, or replace timer	17	398. Operation cycle of dryer timer
399. Replace germicidal lamp	17	399. Characteristics and functions of germicidal lamp
400. Replace bearings		
401. Tighten or replace loose belt		

JOB TRAINING: What the Worker Should Be Able to Do	Assign. No.	RELATED INFORMATION: What the Worker Should Know
402. Clean exhaust screen	17	402. Purpose of dryer exhaust
403. Reset or replace thermostat	17	403. Methods of checking temperatures
404. Adjust burner and air shutter on gas dryers	17	404. Operating temperatures of automatic clothes dryers
	17	405. The meaning of British Thermal Unit
406. Replace fusible link	17	406. Purpose and operating principle of fusible link
407. Install dryer	17	407. Factors involved in dryer installation
408. Service and repair motor		
Refrigerators		
	18	409. Types of refrigerators
	18	410. Systems of refrigerating
	18	411. Principles of cooling by heat removing
	18	412. Meaning of a change of state
	19	413. Refrigerator operation and function of component parts
414. Diagnose refrigerator troubles	19	414. Possible cause of refrigerator complaints and their correction
415. Check refrigerator wiring		
416. Measure running wattage		
417. Replace starting relay		
418. Remove dirt from condensers	19	418. Types of refrigerator condensers
419. Remove gummed oil restriction in refrigerant line	19	419. Methods of removing gummed oil restriction in refrigerant line
420. Check refrigerator temperature	19	420. Temperature of refrigerator at normal setting
421. Adjust temperature control		
	19	422. Types of refrigerant controls
	19	423. Purpose and principle of capillary tube
	19	424. Function and principle of unloader device
425. Free stalled compressor	19	425. Methods of freeing stalled compressor
	19	426. Types of compressors
427. Check operation of evaporator	19	427. Methods of checking evaporator

JOB TRAINING: What the Worker Should Be Able to Do	Assign. No.	RELATED INFORMATION: What the Worker Should Know
	19	428. Functions of freezer compartments
429. Free stuck float bulb	19	429. Methods of freeing a stuck float bulb
430. Remove and replace refrigerator unit	19	430. Factors involved in the removal, crating of old, and installing of new refrigerator unit
431. Replace door liner		
432. Adjust door latch		
433. Level refrigerator		
	19	434. Insulating materials used in refrigerators
	19	435. Care and use of refrigerator

Home Freezers

	20	436. Characteristics of frozen foods
	20	437. Sensible and latent heats
	20	438. Relationship between compartment size and type of frozen food
439. Check cabinet temperature	20	439. Types of cabinets
440. Replace door gasket		
	20	441. User complaints
442. Clean and adjust motor	20	442. Refrigeration mechanisms
443. Clean starting relay contacts	20	443. Freezer control circuits
444. Clean and adjust temperature control		
445. Repair or replace power cord and other electrical wires		
446. Clean and adjust freezer alarm	20	446. Freezer alarms
447. Replace freezer alarm batteries		
448. Measure suction pressure in condenser	20	448. Suction and discharge pressure in condensers and their relationship to temperature
449. Measure discharge pressure in condenser		
450. Clean condenser		

JOB TRAINING: What the Worker Should Be Able to Do	Assign. No.	RELATED INFORMATION: What the Worker Should Know
		Air Conditioners
	21	451. Theory of air conditioner operation
	21	452. Function of air conditioners
	21	453. Kinds and types of air conditioners
	21	454. Humidity and its effect on human comfort
455. Install air conditioner		
	21	456. Operation of air conditioners
457. Adjust air circulation vents	21	457. Purpose of air flow system
458. Clean air filter, screens, fan blades and condenser		
459. Test performance of air conditioner	21	459. Factors which affect normal cooling

Assignment
Sheet No. 1

Covering
Units 1-22

BASIC TOOLS AND MATERIALS AND THEIR USES

Every occupation has what is known as the "tools of the trade." These are the basic tools that are essential to do the work required. Some tools are useful in a number of different occupations, hence the term "basic tools."

No doubt you are familiar with a number of the tools presented in this unit. Some of them may be new to you. You will find, as you progress in your work, that the electrical applicance repairman uses many different types and kinds of tools. He may need some of the tools used by the machinist, the woodworker, and the sheet metal and electrical workers.

In this assignment you will study the proper and safe use and care of the various tools used by the electrical appliance repairman.

Assignment:

1. Read the reference listed below.
2. Answer the questions below and turn in this assignment by ____________________.

Reference:

A. Manly, How to Repair Electrical Appliances, pp. 11-58.

Questions:

1. Discuss the use of basic tools in electrical appliance work.

2. Explain how measurements are made with the micrometer caliper. Describe the graduations on barrel and thimble of a micrometer in relation to their measurement of a diameter.

3. Describe some of the various kinds of screwdrivers needed for electrical work. How are screwdrivers misused?

4. Discuss the styles of open-end wrenches used for electrical work. Describe the correct use of the adjustable wrench in turning a lock nut.

5. Explain the different types of pliers used for gripping and those used only for cutting.

6. Describe the types of hammer heads usually associated with electrical work. What safety precautions should be considered when using a hammer?

7. What are some of the different classifications of screws and bolts used for electrical repair work? What are self-tapping screws and drive screws?

8. What names are given to the various cuts of file teeth? What are some different shapes of files?

9. Describe the uses of various types of cold chisels.

10. Describe the procedure for determining drill bit sizes. Describe the correct procedure in grinding drill bits.

11. What tools are used for cutting threads and taping holes in metal?

12. Explain the uses of various kinds of soldering irons. How is their size specified?

13. Discuss the appropriate uses of rosin core and acid core solder. How are these solders different? Explain correct soldering procedure around finished joints, tacking a seam and sweating of solder joints.

14. How are rivets used in electrical appliance work? Describe the different kinds of rivets available.

Assignment
Sheet No. 2

Covering
Units 23-38

FUNDAMENTAL PRINCIPLES OF ELECTRICITY

Have you ever wondered what makes a light bulb glow, an electric motor run, and an iron heat? We would all agree that it is by electricity that these things are accomplished, but what is electricity?

There is much to learn and much to be accomplished in the field of electricity. To one interested, it offers a useful, enjoyable, and challenging career. The testing, servicing, and repair of even the simplest electrical appliance requires some knowledge of the fundamental electrical principles. These principles are the foundation blocks for every phase of electrical work. The more complex the electrical device, the better informed the serviceman must be if he is to do an intelligent and satisfactory repair job.

In this assignment you will study basic introductory material concerning electricity. This will involve a study of atoms and the electron theory, current electricity, and its fundamental quantities and measurements.

Assignment:

1. Read the reference listed below.
2. Answer the questions below and turn in this assignment by ____________________.

Reference:

Information Sheet No. 1 (this manual)

Questions:

1. Discuss the meaning of an electric charge. How has electricity effected our way of life?

2. Explain the characteristic of any material that makes for good conductors of electricity.

3. Discuss the electron theory. What is an electron path?

4. What is meant by direct current? How are alternating current and direct current different? What is meant by 60-cycle alternating current?

5. Explain what voltage represents. How is amperage different from voltage? What is amperage?

6. What is electrical resistance? What effect does the increased length, diameter, and temperature of a conductor have on electrical resistance?

7. What is meant by temperature coefficient of a conductor?

8. Describe the cause of voltage drop. How does it effect the amount of electricity used in the home?

Information
Sheet No. 1

FUNDAMENTAL PRINCIPLES OF ELECTRICITY

Present theories indicate that all matter is composed of atoms, and the atoms are composed of subatomic particles called electrons, protons, and neutrons. The neutrons and protons are contained in the nucleus (the center of the atom), and the electrons spin in various orbits about the nucleus. All these electrons are tightly bound to the nucleus except those in the outer orbit of some atoms. These outer orbital electrons are free to move from their orbits if subjected to some external force. Such electrons are called "free electrons".

The simplest atom is the hydrogen atom. Normally its nucleus consists of a single proton with one electron in orbit. If this atom loses its electron, the remaining nucleus is said to have a positive electrical charge. This charge is equal to and opposite to the charge on the electron which was removed. Thus the charge on the electron is referred to as a negative charge. When the negatively-charged electron is in orbit about the positively-charged proton, the hydrogen atom is complete and has a neutral electrical charge. That is, the negative charge on the electron balances out the positive charge on the proton. An electron is impossible to see.

All other atoms have more electron-proton combinations than the hydrogen atom. The heavier the atom is, the more protons it has in its nucleus and hence more electrons in orbit about the nucleus. In addition, all these atoms except the normal hydrogen atom, have neutrons in their nuclei. For example, the copper atom has 29 protons and 39 neutrons in its nucleus plus 29 electrons in orbits about the nucleus. If an atom loses an electron from its outer orbit, it would have a single positive charge of electricity. If it lost two electrons, it would possess two positive charges. Thus, for each electron that escapes from the outer orbit, the atom gains a positive charge.

Atoms combine with other atoms to form molecules of matter. If all of the atoms in a particular piece of matter are the same kind of atom, the material is called an element. Examples of elements are copper, silver, gold, oxygen, hydrogen, and chlorine. On the other hand, if the atoms of a substance are made up from different kinds of atoms, the substance is called a compound, e.g., lead-oxide, water, copper-sulphate, and sodium-chloride (table salt).

The formation of molecules from atoms or from other molecules is called a chemical reaction. If two different kinds of elements combine chemically, the resulting product is a chemical compound.

Atoms or groups of atoms that possess an electric charge are called "ions". An ion which has a positive charge is called a cation. If it has a negative charge, it is called an anion.

If asked to define heat, a person might say that it is something that raises the temperature, keeps one warm, makes water boil, or melts ice. Heat does produce all these effects; but to understand what heat is, reference must be made again to atoms and molecules. Modern theory states that heat is caused by the increased speed of the atoms and molecules. As the speed of motion of the molecules in a piece of iron is increased, the temperature is increased. Similarly, if a piece of iron is heated, the velocity of the molecules is increased. This increased speed of the molecules (which are assumed to be in a constant circular-type motion) causes each molecule to revolve in larger orbital paths. This, in turn, causes the material to expand. Most solids, liquids, and gases will expand in this manner when heated.

STATIC ELECTRICITY

The early Greeks learned that a piece of amber, if rubbed, would attract small bits of dry wood shavings or lint. They also noted that the force around the piece of amber was different than the force around a piece of magnetized iron. That is, the amber and wood shavings were non-magnetic materials, whereas the magnetized iron will only attract magnetic materials.

Later, many other materials were found to exhibit the same characteristics as amber. In 1600 William Gilbert attempted to explain the nature of this force. He classified all known substances as electrics and non-electrics. An electric he considered to be any substance possessing the proberty of amber. A nonelectric was any substance not possessing the property of amber.

Later a Frenchman, DuFay, concluded that there were two opposite kinds of electricity. Benjamin Franklin named these forces positive (+) and negative (-). He said positive was the force (charge) associated with a piece of glass, and negative was the force associated with a piece of hard rubber.

If two light objects such as two pith balls (small flakes of aluminum foil will do) are both given a like charge, they will repel each other. If the two objects have unlike (opposite charges) they will attract each other. If there are no charges on the objects (both neutral) there will be no interaction between them. Therefore, it may be concluded that fundamental laws hold true: LIKE CHARGES REPEL EACH OTHER; UNLIKE CHARGES ATTRACT EACH OTHER.

ELECTRIC CURRENT

When free electrons are forced to move along a path, the flow of electrons is called an electric current. The force that causes these electrons to move in the path (conductor) is called voltage, potential, or electrical pressure. The potential is caused by a greater number of free electrons being massed at one point than another. If the two points are connected together by a conductor, electrons will flow from the point of higher potential (greater number of free electrons) to the point of lower potential (fewer electrons), but never reach the other point in practice.

An electric generator or battery is a device that removes large numbers of electrons from one place (positive terminal) and deposits them at another place (negative terminal). A generator does not produce electricity. It produces an electrical potential (pressure). When a conductor is placed between the two terminals, the electrical pressure will force electrons to flow through the conductor. The energy of these moving electrons can be used to run electric motors, heat toaster elements, and operate many other electrical devices.

Electrons can move through some substances more easily than through others. Some substances such as copper, iron, aluminum, and many other metals form good paths through which electrons may readily flow. Such substances, because they readily permit electrons to flow through them, are called conductors. Other substances, such as rubber and glass, do not readily permit electrons to flow through them; these substances are called nonconductors or insulators.

CONDUCTORS

The conductor of electricity has many free electrons. Hence, when an electrical potential is applied to the conductor, the free electrons move toward the point of lower potential. Electrons leave the higher point of potential and enter the conductor. Electrons at the point of lower potential are drawn away by the generating device and placed at the high potential end. Thus, there is a complete circuit (path) around which the electrons flow. The movement of any individual electron along the path is quite slow. It may only move a fraction of an inch per minute. But, the pressure when applied is exerted instantly (at almost the speed of light) from one end of the circuit to the other.

INSULATORS

Nonconductors are composed of atoms or molecules which have their electrons very tightly bound to their nuclei. Very high electrical potentials are required before electrons will force their way through such materials. Therefore, these materials are used as insulators. That is, they are placed in between two points of potential to prevent electron flow between them. Insulation over electrical wires is used for this purpose. It is also used as a safety measure so that animals and people do not come into contact with two wires of opposite potential. Wires are covered with such insulating materials as rubber, plastic, enamel paint, cotton, and silk. The type and thickness of the insulation is determined by the potential difference between the conductors. Current carrying parts in electric machines are often supported by mica, bakelite, or fiber insulators. Dry air is also a good insulator.

ELECTRICAL MEASUREMENTS

Electric current is a flow (sometimes referred to as a drift) of free electrons from one point to another. The more electrons in a motion past a given point in the circuit, the greater is the current. The practical unit of electrical current is the ampere. The ampere is the standard unit of the rate of flow of electrons in a circuit. An ammeter is used to measure electrical current.

Electrical pressure (potential) is the electrical force that causes electrons to move through a conductor. The unit of electrical pressure is the volt. A voltmeter is used to measure electrical pressure.

The opposition that a device or material offers to the flow of direct current is called resistance. The unit of resistance is the ohm A conductor has one ohm of resistance if it allows one ampere of current to flow when a voltage of one volt is applied. An ohmmeter is used to measure resistance.

ALTERNATING CURRENT

Direct current is a continuous flow of free electrons from one end of a conductor to another. When the electric current is caused to continuously vary in value and to reverse its direction of flow at regular intervals, the current increases from zero to maximum and back to zero in one direction. The number of cycles that occur in one second of time is called the frequency.

Both direct current (d.c.) and alternating current (a.c.) are used extensively. However, a.c. is most commonly used in industrial and home power applications, because it is more readily and economically transmitted over long distances. The most common frequency is 60-cycle.

SERIES CIRCUITS

In a series circuit there is only one path through which the current can flow. Therefore, the current is the same at any point in the circuit.

PARALLEL CIRCUITS

In a parallel circuit there are two or more paths through which the current can flow. Also, the current will divide up so that some current flows in each parallel path. The amount of current that flows in each path (or branch line) will be dependent upon the resistance of each path.

RESISTANCE IN SERIES AND PARALLEL

In a series circuit, the total resistance is equal to the sum of the individual resistances. In a parallel circuit the total resistance is less than the lowest value resistor in the parallel group. Parallel resistances are calibrated with somewhat more difficulty.

Resistance increases with temperature for the following reason. It can be supposed that as the atoms of a wire are set into more rapid motion (or in other words, as the wire becomes heated), the electrons do not move quite so easily between the atoms. The larger the number assigned to wire, the smaller is its diameter, and the more resistance it offers.

TEMPERATURE COEFFICIENT

It is desirable to know more exactly what temperature means in terms of increased resistance. There will be numerous occasions to use such information in appliance servicing work. Temperature coefficient gives the amount of change in resistance that a wire undergoes for each degree of temperature change. The resistance change per degree of temperature change is greater at low temperatures than at high temperatures.

Assignment
Sheet No. 3

Covering
Units 39-62

SAFE PRACTICES AND REPAIR PROCEDURES

In the modern home, most of the appliances are operated electrically. These appliances are electrically driven, electrically heated, or may be a combination of the two.

It is impractical to discard a household appliance every time it ceases to operate. The fault may be either mechanical or electrical; therefore, it is necessary for the electrical appliance repairman to be able to diagnose and repair the electrical as well as the mechanical fault.

In this assignment, you will be able to learn some of the common procedures followed in first, locating the trouble and, second, making the necessary repair with greatest amount of safety.

Assignment:

1. Read the references listed below.
2. Answer the questions below and turn in this assignment by ____________________.

References:

A. Manly, How to Repair Electrical Appliances, pp. 59-96.
C. Campbell, How to Repair Washing Machines, Clothes Dryers, Refrigerators, Vacuum Cleaners, Fans, Mixers, Toasters, and Other Home Appliances, pp. 1-19.
D. Tricomi, How to Repair Major Appliances, pp. 7-17.

Questions:

1. Describe the different types of fuses available for use in an electrical circuit. With what type of circuit is each used?

2. Explain the purpose of grounding a circuit. What is the best means of grounding?

3. What is the first rule of safety when working with an electrical appliance?

4. Discuss the four principal types of trouble in electric circuits?

5. Describe how you can locate an open, a ground, and an abnormally high resistance by using a test instrument?

6. Explain why it is important to use an underwriter's knot on an appliance cord when attaching a plug.

7. Discuss the two kinds of electric current.

8. Explain how test equipment for electrical work can be used to a great advantage for safety purposes.

Assignment
Sheet No. 4

Covering
Units 63-70

HOME ELECTRICAL WIRING

Improper functioning of an electrical appliance is often due to factors or defects other than the appliance itself. Many of these defects lie in the home wiring system. These defects will often cause serious damage to an electrical appliance.

Many times the appliance repairman will be called upon to service and repair certain appliances in the home. In some instances, he will need to check the wiring and make suggestions for improvement if needed. This will necessitate an adequate understanding of home wiring systems and the factors involved in order that he may accomplish these things.

In this assignment, you will cover material concerning home wiring which the electrical appliance serviceman should know. This will involve a study of circuits, wiring and wire sizes, protective devices, and other necessary factors.

<u>Assignment</u>:

1. Read the reference listed below.
2. Answer the questions below and turn in this assignment by ____________________.

<u>Reference</u>:

C. Campbell, <u>How to Repair Washing Machines, Clothes Dryers, Refrigerators, Vacuum Cleaners, Fans, Mixers, Toasters, and Other Home Appliances</u>, pp. 20-23.

<u>Questions</u>:

1. Explain what determines the capacity of a house wiring system. Describe the three main parts of a house wiring system.

2. Discuss the electrical distribution system in a home. What are "branch circuits"?

3. Describe what is meant by wire gauge. Why is wire gauge important in electrical work? What determines the wire gauge to be used?

4. Explain the purpose of an outlet box. What procedure should be followed to permit easy accessability to the contents of the box?

5. Describe the principle involved in using each of the following: (1) a single-pole, single-throw switch; (2) a double-pole, single-throw switch; (3) a single-pole, double-throw switch, and (4) a double-pole, double-throw switch.

6. What is the National Electrical Code? What restrictions are placed on the use of appliance cords by the NEC?

7. Discuss what the National Board of Fire Underwriters represent. Are they a law?

8. Explain the importance and meaning of the famous "UL" label placed on appliances.

9. What problems are potentially present when an antiquated fuse box is observed? How can these be solved?

Assignment
Sheet No. 5

Covering
Units 71-75

SIGNALS AND ALARMS

Door bells, buzzers, and chimes have a number of use in the home and industry. They may be used to indicate the presence of a friendly visitor or may be used for burglar alarms. Signals in offices, throughout industrial plants, and even between buildings often use small lamps, buzzers, bells, or chimes.

The signals and alarms may be operated from a relatively high voltage used in the lighting system which is "stepped down" or may be operated from batteries.

In this assignment, you will have placed before you information concerning the construction, installation, and repair of various signal and alarm systems.

Assignment:

1. Read the reference listed below.
2. Obtain a door bell. Observe its construction. Connect it to the proper voltage and observe its operation.
3. Observe the operation of door chimes.
4. Answer the questions below and turn in this assignment by __________________________.

Reference:

A. Manly, How to Repair Electrical Appliances, pp. 87-109.

Questions:

1. What are the main uses of bells and chimes? From what electrical sources may they be operated?

2. Discuss the operating principle of a bell system. Discuss the maximum voltage to be used with a bell or chime system.

3. Discuss the different size bell transformers used for bells, buzzers, and chime systems.

4. How does the chimes system differ in voltage requirement from other household systems? What are the voltage ranges for a chimes system?

5. Explain why bells and buzzers used with batteries must have circuit breakers. Does battery operation at a door chime require more or less voltage as transformer operation?

6. Describe two of the methods used in determining troubles in a bell and a buzzer system.

7. Why are chime systems so free of troubles?

Assignment
Sheet No. 6

Covering
Units 76-109

ELECTRIC HEATERS, BLANKETS, HEATING PADS, AND IRONS

The convenience and utility of many of the small electric appliances has brought about their widespread acceptance in the American home. In nearly every American home today, there can be found several electric appliances that depend for their action upon resistance wires which produce heat when current passes through them.

The increased use of these resistance appliances makes it more necessary than ever for the appliance repairman to have a good understanding concerning their operation. Much of his work may consist of the repair of these appliances. He needs to know how these appliances work and how they may be serviced and repaired.

In this and the three following assignments, you will have an opportunity to learn about resistance heating appliances commonly found in the home and which at times require servicing. You will study about the various types and essential parts of the different appliances together with their operating principles. Causes of failure or faulty operation and factors involved in the repair of each will also be covered.

Assignment:

1. Read the reference listed below.
2. Measure the wattage consumption of the following and compare the obtained values to the ratings listed with the appliance.
    a. an electric heater
    b. a heating pad
    c. an electric blanket
    d. an electric iron

References:

A. Manly, Electrical Appliance Repair and Servicing, pp. 123-129.
C. Campbell, How to Repair Washing Machines, Clothes Dryers, Refrigerators, Vacuum Cleaners, Fans, Mixers, Toasters, and Other Home Appliances, pp. 136-139.
E. Darr, How to Repair Small Appliances, pp. 24-31, 50-54.

Questions:

1. Describe the working principle of a reflector-bowl type heater. Explain the replacement procedure for a heater-wire in a bowl type heater.

2. Explain the working principle of the steam iron. What are the main components? What is the purpose of each component?

3. Describe the procedure for testing the action of a thermostat in an automatic flatiron.

4. Discuss the correct dissassembly procedure for a flatiron. How does the disassemble procedure of an automatic iron differ from the non-automatic iron?

5. What preventive maintenance should be considered in the care of the automatic iron?

6. Describe the different types of heating elements used in electric irons. What are the advantages and disadvantages of each?

7. Explain the disassembly procedure of a steam iron.

8. Describe the function of the control box on an electric blanket.

9. Discuss the major troubles in electric blankets. How may they best be avoided?

10. Explain a testing procedure to determine if the electric blanket is working properly. How does this procedure compare with testing an electric heating pad?

Assignment
Sheet No. 7

Covering
Units 110-131

ELECTRIC WATER HEATERS

Electric water heaters are very popular in homes today. They offer to the homemakers a clean, safe, and economical method of heating water. Since the water is heated by the action of electric current passing through resistance element, this appliance is among those classed as resistance heating appliances.

Electric water heaters are relatively simple in construction and have few moving parts. Therefore, there is little that can go wrong with them. More often, user complaints arise from some cause outside the water heater itself. Other than knowing how to make repairs and replacements, the serviceman must know how to make correct installation so that he can diagnose a complaint of improper heater operation in the light of existing conditions. He must understand the purpose and operation of each heater part and know the possible causes of complaints regarding heater operation.

In this assignment, you will gain an understanding of electric water heaters and their operation. Factors involved in installation, diagnosing troubles, and repairing water heaters will be stressed.

Assignment:

1. Read the reference listed below.
2. Make wiring diagrams of a two-element hot-water heater connected for nonlimited-demand operation.
3. Make wiring diagrams of a two-element hot-water heater connected for limited-demand operation. Make a comparison between the two types of wiring situations.
4. After completing items 1, 2, and 3, answer the questions below and turn in this assignment by ____________________.

Reference:

D. Tricomi, How to Repair Major Appliances, pp. 194-203.

Questions:

1. Discuss the procedure for determining the average consumption of hot water in different size families. Will geographical location have any effect on water consumption?

2. What are the most common forms of hot-water waste. How can this type of waste be avoided?

3. Explain the induction method of heating water electrically. How is it different from the immersion heating method?

4. Describe the function of an electric hot-water heater in operation. What part does the thermostat play in an electric hot-water heater?

5. Explain the function of the control devices of an electric water heater. What safety factors should be considered here?

6. What are some of the factors to be considered, from the standpoint of electrical wiring, when installing an electric hot-water heater?

7. What are some of the most important points to check if the heater fails to produce hot water? Explain how they can be corrected.

8. What might be the causes of insufficient hot water? What checks should be made?

9. Discuss the possible causes for leaks in a hot water system. How may these leaks be corrected?

Assignment
Sheet No. 8

Covering
Units 132-193

ELECTRICAL TOASTERS, BLENDERS, COFFEE MAKERS, SHAVERS, KNIFE SHARPENERS, POPCORN POPPERS, CAN OPENERS, SKILLETS, AND WAFFLE IRONS

The convenience and utility of many of the small electric appliances have brought about their widespread acceptance in most homes. In nearly every American home today, there can be found several appliances whose action depends upon heat produced by current flowing through resistance wire or current flowing to create mechanical movement.

Many of the appliances were not available in quantity years ago. It becomes necessary for the electrical appliance repairman to have an understanding of their construction and operation. Much of his work will consist of the repair of many of the small items.

In this assignment, you will have an opportunity to learn about some of the small resistance heating and mechanical appliances commonly found in the home which at times need servicing.

Assignment:

1. Read the references listed below.
2. Answer the questions below and turn in this assignment by ____________________.

References:

A. Manly, How to Repair Electrical Appliances, pp. 110-123.
C. Campbell, How to Repair Washing Machines, Clothes Dryers, Refrigerators, Vacuum Cleaners, Fans, Mixers, Toasters, and Other Home Appliances, pp. 130-135.
E. Darr, How to Repair Small Appliances, pp. 8-23, 32-33, 37-47, 57-60.

Questions:

1. Describe the construction and various arrangements of heating elements in electric toasters.

2. Explain the principle on which the automatic or clock-timed toaster operates.

3. Discuss the disassembly and repair procedure for an electric toaster. Is there a difference between the non-automatic and automatic toaster in the repairing procedure?

4. Describe the function of the electric percolator. What are some of the troubles that may develop with the electric percolator?

5. Discuss the principle on which an electric hot plate operates. What is the major cause of inoperation of an electric hot plate?

6. Describe each part and its function of a waffle iron. What precautions must be considered when reassembling a waffle iron?

7. Why is the correct preparation of the grids of a waffle iron good preventive maintenance?

8. Describe the principle of an electric shaver using a vibrator type driving mechanism. How does this differ with one which uses rotating blades?

9. Explain the causes for most shaver troubles. How can they be avoided?

10. What problems are usually encountered with an electric food blender? How can these problems be remedied?

11. Explain the wiring arrangement used on automatic coffee makers. Describe the change in the circuit when the brewing cycle occurs; warming cycle.

12. Describe the difference between the heating element of the repairable popcorn popper as to the popcorn popper with a sealed element.

13. Discuss the electrical operation of the plug-in type thermostatic control unit used with an electric skillet. What trouble might develop from this type of skillet?

14. What testing procedure may be used to determine correct functioning of an electric skillet after repair work is complete?

15. Discuss the problems that occur with a combination electric can opener and knife sharpener.

Assignment
Sheet No. 9

Covering
Units 194-242

ELECTRIC BROILERS, ROASTERS, AND RANGES

One of the larger electrical appliances that is classed as a resistance-heating appliance is the electric range. Electric broilers and roasters, while not as common to the average family as the electric range, are also used in the home. Each of these appliances require servicing and repairing at some time or another. Therefore, the serviceman needs to know the characteristics and operation of these appliances and the factors invovled in their repair. In connection with electric ranges, most service and repairs will be made in the homes. This necessitates quick diagnosis of the trouble and, in many cases, it will involve tact in giving the user instructions in correct use of the appliance.

In this assignment, you will study the various types, characteristics, and operation of the electric broiler, roaster, and range. Together with these you will study the factors involved in the servicing or repairing of each.

Assignment:

1. Read the references listed below.
2. In order to better acquaint yourself with the electrical circuits and operation of the range, do one of the following:

   Prepare a sketch for the following wiring diagrams.
   a. A surface-unit control switch
   b. A surface unit
   c. An oven thermostat

3. After completing items 1 and 2, answer the questions below and
q turn in this assignment by ____________________.

References:

A. Manly, How to Repair Electrical Appliances, p. 1.
D. Tricomi, How to Repair Major Appliances, pp. 136-138.

Questions:

1. Describe the principal parts of an electric roaster or oven. What effect does the insulating material have on the heating process?

2. Explain the method used in connecting an electric range to a house wiring system. How much voltage should be present for efficient operation?

3. Discuss the advantages of the wire-coil type surface units as compared to the tubular unit on electric ranges.

4. Explain the three-setting switch arrangement of contacts of an electric range at each setting. What coils become heated when switch is at medium high position; medium; and medium low position?

5. Describe the seven-position switch of an electric range. How does it differ from the three-position system?

6. Discuss the operation of the oven control selector switch and the oven control thermostat. Is the oven thermostat adjustable? How does the sensing bulb effect the thermostat?

7. Why are circuit breakers an important feature in an electric range circuit? What happens when the range wattage consumption exceeds the high limit set by the circuit breaker?

8. Why does the calibration of the oven in an electric range require the greatest servicing attention? How can this be avoided?

Assignment
Sheet No. 10

Covering
Units 243-269

ELECTRIC MOTORS, MOTOR TROUBLE, AND REPAIR

A large number of the electrical appliances which the serviceman will repair or service contain some type of electric motor. Quite often the trouble within these appliances will lie within the motor itself. The serviceman should be able to readily detect the various types of electric motors with which he may come into contact and know the characteristics of each.

Although motor repair work is considered a specialty within itself and done by someone other than the general electrical appliance serviceman, much of the service can be done easily by the appliance serviceman if he has an understanding of motor operation and is familiar with causes and remedies of motor troubles. He should be able to make simple repairs and diagnose major troubles even though he may not be equipped for all types of motor repair work.

In this unit, you will study the various types of motors commonly used in electrical appliances together with trouble-shooting procedures and service and repairs that can be made without special equipment.

Assignment:

1. Read the references listed below.
2. Make wiring diagrams of the various types of motor field winding connections presented in this assignment and place them in your notebook for future use.
3. Answer the questions below and turn in this assignment by ________________.

References:

B. Manly, How to Repair Electrical Appliances, pp. 145-174.
C. Campbell, How to Repair Washing Machines, Clothes Dryers, Refrigerators, Vacuum Cleaners, Fans, Mixers, Toasters, and Other Home Appliances, pp. 34-43.
E. Darr, How to Repair Small Appliances, pp. 95-111.

Questions:

1. Describe the operation of the centrifugal switch for starting an induction motor. What are some of the principles employed in centrifugal switches?

2. Explain the working principle of a series motor. How is it different from an induction motor?

3. What changes are made in a series motor to obtain speed control? What is a rheostat?

4. Why do electric motors require a much greater flow of current while starting than after running at normal speed? How would this greater current requirement for starting an electric motor effect the fusing or circuit breaker system?

5. Discuss some of the preventive maintenance procedures necessary to eliminate motor troubles. How does motor lubrication effect the life of a motor? How can brushes be cared for properly? Commutators?

6. Describe the disassembly procedure of an electric motor. What parts should be examined as they are removed from the case?

7. Discuss the symptoms of motor troubles. What tests and remedies may be applied in each case to relieve the malfunction?

8. Describe the wiring schematic of a synchronous motor. Where is this type of motor most used?

9. Explain the two methods of connecting the field coils in an electric motor.

Assignment
Sheet No. 11

Covering
Units 270-293

ELECTRIC FANS, BLOWERS, AND VACUUM CLEANERS

Electric motors are one of the most important of all electrical devices. They perform innumberable tasks in this age of mechanized living. A great expansion in this respect has been in connection with the use of the electric motor for many appliances in and about the home.

In many electrical appliances, the motor is the sole electrical componenet of the appliance, and on it depends all of the action of the appliance. Although many of the difficulties that arise in these appliances are due to motor trouble, some complaints are the result of other parts which are worn, broken, or out of adjustment. The electrical appliance repairman needs to know how to repair or service these parts as well as the repair of the motor. This necessitates an understanding of the construction and operation of each appliance.

In preceding assignments, you have covered motors and motor repair. This assignment will cover only information on motors as related to fans, blowers, and vacuum cleaners. You will also study the types, construction, and operation of these appliances together with factors involved in the service and repair of each.

Assignment:

1. Read the references listed below.
2. Prepare a trouble shooting chart of each appliance covered in this assignment showing the common troubles, causes, and solution of each. Refer to text and service manuals. Keep charts in your notebook.
3. Answer the questions below and turn in this assignment by ____________________.

References:

B. Manly, How to Repair Electrical Appliances, pp. 188-198.
C. Campbell, How to Repair Washing Machines, Clothes Dryers, Refrigerators, Vacuum Cleaners, Fans, Mixers, Toasters, and Other Home Appliances, pp. 44-55.

Questions:

1. Explain the function of each of the three basic parts of a vacuum cleaner.

2. Describe the operation of a separator vacuum cleaner. How does it differ from other vacuum cleaners?

3. Discuss the purpose of each part of an enclosed-separator mahcine which is in the motor and fan end of the outer shell.

4. Why do larger fans have a split-phase or capacitor-start motor?

5. Describe some of the complaints about the operation of electric fans. How can each complaint be corrected?

6. Explain the procedure for determining the trouble of an electric fan that will not run. What is the correct procedure in disassembling an electric fan?

7. Why are motors for household types of vacuum cleaners of the universal type? What are the RPM's that a motor will run at while cleaning is being done? Are all power ratings the same for all sizes and styles of cleaners? If not, what is the power rating range?

8. Discuss why the tank cleaner is inferior to the upright in cleaning carpets.

9. Describe some of the reasons why the cleaning action of a tank cleaner may be inadequate. Upright cleaner.

10. If the cleaner doesn't run at all, what testing procedure should be carried out? What test can be made to check the entire electrical path of a vacuum cleaner?

Assignment
Sheet No. 12

Covering
Units 294-313

FOOD MIXERS AND SEWING MACHINES

In electrical appliances, like food mixers and sewing machines, the motor is the sole electrical component and upon it depends the driving action. Although many of the difficulties that arise in these appliances are due to motor troubles, some complaints are the result of other parts which are worn, broken, or out of adjustment.

The electrical appliance repairman needs to know how to diagnose, service, and repair worn or broken parts as well as to repair the motor. This necessitates an understanding of the construction and operation of these appliances.

In a preceding assignment, you have covered motors and motor repair. In this assignment, emphasis is placed upon the construction and operation of food mixers and sewing machines having variable speed motors along with factors involved in the service and repair of each.

Assignment:

1. Read the references listed below.
2. Prepare a chart of one appliance covered in this assignment showing the common troubles, causes, and solution to each and place in your notebook.
3. Answer the questions below and turn in this assignment by ____________________.

References:

B. Manly, How to Repair Electrical Appliances, pp. 175-188.
C. Campbell, How to Repair Washing Machines, Clothes Dryers, Refrigerators, Vacuum Cleaners, Fans, Mixers, Toasters, and Other Home Appliances, pp. 46-49.
E. Darr, How to Repair Small Appliances, pp. 34-36, 48-49.

Questions:

1. Describe the principle parts and their operation of an electric mixer.

2. Explain the operation of an electric food mixer speed selector switch.

3. How are mixer speeds varied? Describe how a three-speed drive gearing system works.

4. Discuss where most troubles are encountered with an electric mixer. What is a remedy for each?

5. Describe the working principle of a sewing machine foot control switch. What is the most common difficulty with the sewing machine foot control?

6. What are some of the main troubles encountered with a sewing machine? How can these be avoided?

7. Discuss the importance of preventive maintenance. How is it applied to a sewing machine?

8. Explain the disassembly procedure of a sewing machine in the correct order.

9. What is a bobbin? What difficulties may occur from the bobbin? Describe what cleaning may be done to eliminate problems with the bobbin case.

10. What are some of the problems caused by using dull needles? When should a needle be discarded?

11. Explain the effects on stitching of equal and unequal tensions on upper and lower threads. What correction can be made to avoid unequal stitching?

12. Describe how a bobbin is rewound.

13. What type of motor is best suited for a sewing machine? What driving mechanism is usually used on a sewing machine?

Assignment
Sheet No. 13

Covering
Units 314-337

ELECTRIC IRONERS

Ironers today are most often found in commercial cleaning establishments. This device turns out a fast professional ironing job while the operator remains relaxed.

There are many different types of electric ironers, some of which contain numerous parts, both stationary and movable. These parts have distinct functions to perform during the ironing process and must be understood by the appliance serviceman. He should also be familiar with the general ironer troubles, the possible causes of these, and the corrections that will be needed. The appliance serviceman cannot and should not rely on his mechanical intuition in repairing these electrical devices.

In this assignment, you will have an opportunity to study about the types of electric ironers, their construction and operation, and factors involved in service and repair of each.

Assignment:

1. Read the reference listed below.
2. Answer the questions below and turn in this assignment by ____________________.

Reference:

B. Manly, *How to Repair Electrical Appliances*, pp. 215-224.

Questions:

1. Describe how the shoe is held against and released from the roll in an electric ironer. What is the purpose of the shoe?

2. What is the eccentric wheel on an electric ironer? Describe its function.

3. Explain how longer periods of pressing can be obtained between the shoe and the roll of an electric ironer. When is this usually desired?

4. What are some of the checks that can be made if the shoe fails to heat on an electric ironer? What are some remedies for each check?

5. Explain what can be done to determine why the roll does not turn on an electric ironer.

6. Describe the electrical system for the shoe, motor, and switches of an electric ironer.

7. Discuss the procedure for replacing a heating element in an electric ironer. What special problems would you anticipate?

8. Explain the procedure for replacing roll padding on an ironer. Describe the different materials necessary for padding on a roll of an electric ironer.

Assignment
Sheet No. 14

Covering
Units 338-358

ELECTRIC GARBAGE DISPOSALS AND DISHWASHERS

Garbage disposers are relatively new to the long list of home electrical appliances. A few minutes operation of the disposal each day disposes unwanted food scraps. This feature makes the disposer a very practical appliance and one that is increasing in popularity.

Domestic types of electric dishwashers are also new; however, they may be found in many homes today. With the modern dishwashers of today, the pressing of a single button will wash, rinse, and dry the dishes automatically.

A distinguishing feature of a good electrical appliance repairman is his widespread knowledge of the many electrical appliances used today. More use is being made of the garbage disposal and the dishwasher in homes today. Therefore, the serviceman should become familiar with these appliances in order to render the service required of him. He must have a knowledge of the construction, operation, and repair of each of these appliances.

In this assignment, you will have an opportunity to study about the various types of garbage disposers and electric dishwashers. Included in this will be a study of the construction, installation, operation, and repair of each.

<u>Assignment</u>:

1. Read the reference listed below.
2. Prepare a step-by-step procedure for adjusting a staring switch on a garbage disposer.
3. After completing items 1 and 2, answer the questions below and turn the assignment in by ____________________.

<u>Reference</u>:

D. Tricomi, <u>How to Repair Major Appliances</u>, pp. 139-165.

<u>Questions</u>:

1. Describe the principle of operation of a dishwasher. What are some of the different styles of dishwashers?

2. Explain the functioning of an impeller-type dishwasher. What are the major components of this type dishwasher? Describe the function of each.

3. What type of motor do most dishwashers employ? What unique feature must this type of motor have?

4. Discuss the function of a spray-arm circulating-pump dishwasher. How does it differ from the impeller-type? What are the advantages and disadvantages of each?

5. Describe the filtering system of a spray-arm dishwasher.

6. Explain the wiring system for the impeller-type dishwasher. Describe the changes that take place in the circuit when washers change operations.

7. Discuss the wiring system for the spray-arm dishwasher. What is the purpose of the solenoid-operated water inlet valve on this type of system?

8. Describe the functional purpose of a dishwasher drain pump.

9. Explain the principal parts and working principle of a detergent-cup tripping mechanism.

10. What are some of the most frequent washing complaints that will be encountered with a dishwasher? How can they be avoided or correcte

11. What corrections need to be made when part of the cycle is omitted or shortened during a dishwashing operation?

12. Explain the possible causes of trouble for dishes not drying as they should in an automatic dishwasher. What adjustments should be made?

13. What is the basic purpose of a garbage disposal unit? Describe its basic function.

14. Describe the electrical system of a garbage disposal unit. Is any additional preparation electrically necessary to connect disposal unit into circuit?

15. Discuss the installation procedures of a garbage disposal unit. What special consideration must be given in order to have effective operation?

16. What are some of the causes of abnormal noise and vibration in a disposal unit? How may they be remedied?

17. Discuss reasons for slow disposing of garbage. What are possible remedies?

18. Explain the causes for erratic operation and/or disposal unit not starting. What are some remedies?

Assignment
Sheet No. 15

Covering
Units 359-362

CONVENTIONAL WASHING MACHINES

Although automatic washers have increased in numbers in recent years, there are still more washers of the conventional or non-automatic type found in the homes in the United States. This is an important fact to the electrical appliance serviceman.

Except for the electric motor and switch, the service and repair of non-automatic washers consist primarily of adjustment and replacement of mechanically operated parts. It is important for the serviceman to understand the general principles by which these mechanisms work. With the aid of specific manufacturers' service manuals, he can then perform the tasks necessary to keep the washer operating efficiently.

In this assignment, you will cover materials concerning the general operation of the conventional or non-automatic washers. Causes of washer troubles and factors involved in their adjustment and repair will be covered.

Assignment:

1. Read the reference listed below.
2. Answer the questions below and turn in this assignment by ____________________.

Reference:

B. Manly, How to Repair Electrical Appliances, pp. 199-215

Questions:

1. Describe the principal parts of an electric washing machine. What is the function of each?

2. When both agitator and wringer are disengaged and the belt or shaft cannot be moved, what possible troubles could exist in the transmission of a washing machine? How may this be corrected?

3. What are some of the possible causes why a conventional washing machine wringer rolls will not turn?

4. Describe some of the possible sources where noisy operation of parts would occur in a conventional washing machine. What are the remedies for the elimination of these noises?

5. Discuss the importance of lubrication of washing machines. How long will oil in transmissions last? What precautions should be considered when changing oil? What type of oil is specified? How much is usually needed?

6. Describe the disassembly procedure for the transmission of a washing machine. When completely disassembled, what preventive maintenance can be given to shafts, bearings, etc., before reassembling the unit?

Assignment
Sheet No. 16

Covering
Units 363-391

AUTOMATIC WASHER OPERATION AND SERVICE

The automatic washer has found its way into a number of homes. It has taken much of the drudgery out of the chore of doing the family laundry and has released the housewife to perform other required tasks at the same time the laundry is being washed.

Automatic washers are much more complicated than the non-automatic type, and hence, there is the possibility that more troubles are liable to occur. While there is a certain similarity in the construction and operation of all automatic washers, there are also differences in makes and differences in models of the same company. The appliance repairman must be familiar with the general operation of many machines and consult specific manufacturers' manuals in order to make himself a competent repairman of automatic washers.

In this assignment, you will cover material that every washer serviceman should know. The reference material is brief and general in nature. More specific information may be obtained by consulting manufacturers' manuals.

Assignment:

1. Read the references listed below.
2. Prepare a short paper discussing the various methods used to regulate amount of water an automatic washer uses with short fill and regular fill levels.
3. Answer the questions below and turn in this assignment by ______________________.

References:

C. Campbell, How to Repair Washing Machines, Clothes Dryers, Refrigerators, Vacuum Cleaners, Fans, Mixers, Toasters, and Other Home Appliances, pp. 59-121.
D. Tricomi, How to Repair Major Appliances, pp. 60-66, 76-101.

Questions:

1. Why is the automatic clothes washer so complicated? What are the functions it performs?

2. Describe the functional operation of a single solenoid controlled off-on valve on an automatic washer; a double solenoid shut-off valve; and two-way valve.

3. How does the water pump on an automatic washer receive its driving power? What purpose does a water pump serve?

4. Discuss the purpose of filters in an automatic washer. Why are dispensers an important part of an automatic washer?

5. Describe the various devices controlled by the electrical system on an automatic washer.

6. Explain how the pressure switch controls the fill level of an automatic washer. What are the two basic types of fill switches?

7. What is the recommended temperature for water to produce a good wash? Why is this so important?

8. Describe some of the reasons why water will not enter an automatic washing machine. How may these be remedied?

9. Explain some causes for the motor of an automatic washing machine not to run. How can these be corrected?

10. Discuss some of the causes for the automatic washer agitator not to function. Give some solutions to each cause.

11. Give some of the reasons why the spin cycle of an automatic washer fails to function. What corrections may apply?

12. Describe how excessive vibration by the automatic washer can be avoided.

Assignment Sheet No. 17

Covering Units 392-409

AUTOMATIC CLOTHES DRYERS

To many persons, the automatic clothes dryer is as necessary to the modern home laundry as the washer itself. It completes the laundry and makes it independent of the weather, day or night. Crowded living conditions have created a clothes drying problem for many families. This and other factors have made the clothes dryer a most desirable appliance to own and one which is used in many homes today.

As with other appliances or mechanical devices, the automatic clothes dryer will at times need servicing or repairing. Most generally, these services will be performed in the owner's home. This necessitates a thorough knowledge of dryer construction, operation, and repair on the part of the serviceman.

In this assignment, you will have an opportunity to study the various types, construction, and operation of automatic clothes dryers and factors involved in servicing these appliances.

Assignment:

1. Read the reference listed below.
2. Explain in a brief paper why it is necessary to provide an auxiliary fuse circuit for most dryers. Sketch a fuse circuit for a dryer; label the proper fuse designation for adequate service.
3. Answer the questions below and turn in this assignment by ____________________.

Reference:

D. Tricomi, How to Repair Major Appliances, pp. 102-108, 116-125.

Questions:

1. Describe the drying principle of an automatic clothes dryer.
2. Discuss how the drying cycles of an automatic dryer are controlled. Can they be changed easily? If so, how?
3. How is the heat for drying produced in an electric dryer? What are the average watts used at 230 volts?
4. Explain the procedure for converting a 230-volt dryer to 115-volt operation. What is the purpose of doing this?
5. Describe some of the reasons why a clothes dryer does not start? What are some remedies that can be applied?
6. Explain why the motor of an electric dryer will run, but drum will not turn.
7. Why would there be no heat in the drum of an electric dryer but the turns? How may this be corrected?

8. Discuss reasons for dryer not turning off.
9. When the drying process is unusually slow, what may be the causes?

Assignment
Sheet No. 18

Covering
Units 410-413

THEORY OF ELECTRICAL REFRIGERATOR OPERATION

Refrigerators are electrical appliances which are designed to keep food cool and to help prevent its spoilage. There are many kinds and types of electrical refrigerators. However, their primary purpose is to remove heat from the storage compartment. Therefore, the basic theory of refrigeration is about the same for all of them.

The electrical appliance serviceman will be called upon to service refrigerators. In order to properly diagnose, to explain what is wrong to the customer, and to repair the refrigerator, it is very important that the electrical appliance service repairman has an understanding of the theory of refrigerator operation.

In this assignment, you will have an opportunity to learn about the theory of refrigerator operation and, in turn, discover how this theory applies to the repair and servicing of refrigerators.

Assignment:

1. Read the references listed below.
2. Inspect the condenser on a frigerator; note that when the refrigerator is running, the condenser appears to be giving off heat. Explain why you think this happens.
3. Answer the questions below and turn in this assignment by ____________________.

References:

B. Manly, <u>How to Repair Electrical Appliances</u>, pp. 225-231.
D. Tricomi, <u>How to Repair Major Appliances</u>, pp. 18-26.

Questions:

1. Discuss the scientific principle of how heat is changed. What is cold? Describe the states of matter.

2. What is a refrigerant? What type of refrigerant is most commonly used in refrigerators?

3. What is evaporation? What is meant by sensible heat? What is latent heat?

4. List the three stages of refrigerant in cooling tubes of a refrigerator. What causes the refrigerant to change?

5. Describe the principal parts of a typical electric refrigerator. What is the function of each?

6. Discuss what and how the bellows and bulb effect the operation of the switch in a control unit of a refrigerator.

7. Explain the difference between a plate condenser and a gravity-flow condenser in a refrigerator. What is a condenser?

8. How are foods cooled in the food compartment of a refrigerator? Where are the warmest places in the food compartment?

9. Describe some of the problems encountered with the compressor unit of a refrigerator.

10. What are some causes for the cabinet of a refrigerator to be too warm? What corrections should be made?

11. Why do foods sometimes not freeze in a freezer compartment of a refrigerator? How may this be corrected?

12. Explain why noisy operation would exist with an electric refrigerator.

13. How may an excessive load on a refrigerator unit be lessened?

14. Describe how patching of porcelain or enamel on a refrigerator can be done.

Assignment
Sheet No. 19

Covering
Units 414-436

ELECTRIC REFRIGERATOR COMPONENTS, REPAIR, AND SERVICING

In most homes, the electric refrigerator is considered an essential electrical appliance. The refrigerator allows the housewife to preserve, buy at times most convenient, and more efficiently use many perishable foods.

Today's electrical refrigerators are almost trouble free and, because of this, many people have become accustomed to depending on them all of the time. Therefore, when his refrigerator is in need of service or repair, the customer wants quick, efficient, and reliable attention to his problem.

The electrical appliance serviceman should be thoroughly informed on the theory of refrigeration, refrigerator systems, their component parts, and a fundamental knowledge of basic refrigerator repair and servicing techniques if he is to do a good job.

In this assignment, you will have an opportunity to study different refrigerator systems, the various parts of these systems, and the symptoms of different types of refrigerator troubles and the necessary procedures for diagnosing, servicing, and repairing them.

<u>Assignment</u>:

1. Read the references listed below.
2. Prepare a schematic diagram of a refrigerator unit showing and color coding all components. Indicate the refrigerant directional flow through each part.
3. Answer the questions below and turn in this assignment by ____________________.

<u>References</u>:

B. Manly, <u>How to Repair Electrical Appliances</u>, pp. 225-240.
D. Tricomi, <u>How to Repair Major Appliances</u>, pp. 26-59.

<u>Questions</u>:

1. Discuss the function of the thermostat in controlling the compressor cycling. How can the setting on the thermostat be changed?

2. Describe how the freezer unit of a refrigerator is defrosted; nonautomatic type; automatic type.

3. Explain the two-compartment cooling system of a refrigerator-freezer combination. Does this type of unit have two evaporators?

4. What is the function of a differential pressure-control valve of two-compartment cooling in a refrigerator?

5. Describe the evaporator area method of cooling two compartments in a refrigerator unit.

6. Explain the cooling system in a refrigerator when the freezer compartment is converted into an ordinary refrigerated section.

7. Describe the electrical system of a refrigerator that runs on 110-volt, 60-cycle, single-phase alternating current. What is the purpose of the voltage relay? Current relay?

8. Discuss how performance checks can be made to determine the operation of an electric refrigerator.

9. Explain the procedure for recharging a refrigeration system with refrigerant. What precautions are necessary?

10. Describe some of the causes for the refrigeration unit not to operate. What can be done to remedy these causes?

11. Explain why the defrosting cycle would not take place in a refrigerator unit. How can this be corrected?

12. What are the causes of trouble when refrigerator unit runs continuously but the cabinet remains warm? Give the possible remedies for this problem.

Assignment
Sheet No. 20

Covering
Units 437-451

HOME FREEZERS

An increasingly large number of families are using freezers in the home for storage of food. The convenience and economy of these food freezers have changed the eating habits of a large portion of our citizenry.

The actual working of the freezer is similar to that of the refrigerator although lower temperatures are maintained. In most cases, there is a greater investment in the piece of equipment itself and its contents.

In this assignment, you will learn those things that pertain to the servicing of home and farm freezers, along with information concerning the properties of the frozen food.

Assignment:

1. Read the reference listed below.
2. Answer the questions below and turn in this assignment by _____________________.

Reference:

B. Manly, How to Repair Electrical Appliances, pp. 241-263.

Questions:

1. Discuss the importance of constant storage temperature in an electric home freezer. What happens when the freezing temperature varies?
2. Describe the different types of cabinets used as home freezers.
3. What are some of the more common complaints usually made by users of home freezers?
4. Explain the methods of placing and attaching Evaporator Tubing to the liners of food compartments in home freezers.
5. Describe the path of refrigerant through a system having separate compartments for freezing and for storage in home freezers.
6. Discuss the electrical circuit as found in a home freezer. Should a freezer be connected to the same electric line that serves other electrically powered devices? If not, why not?
7. What are some of the possible electrical troubles that might be encountered with a home freezer?
8. How does a battery-operated freezer alarm system compare with an alarm system with which A-C line power is used to operate the signal? What are the advantages and disadvantages of each?

9. How might measurement of operating temperatures and pressures in a freezer provide rather definite clues to the kinds of trouble which may be present?

10. Whenever a freezer system is being examined and tested for causes of trouble, why should you make every effort to locate faults outside of the motor-compressor unit before replacing that unit?

Assignment
Sheet No. 21

Covering
Units 452-460

AIR CONDITIONERS

Air conditioners are newly developed appliances which are designed to make people more comfortable by cooling and removing moisture from the air in homes, offices, stores, schools, and other buildings.

In view of the importance of and demand for air conditioning, it is important that the electrical appliance serviceman know how to install and service air conditioners.

In this assignment, you will have an opportunity to learn about the theory, function, and operation of air conditioners. You will also study about installing and servicing air conditioners.

Assignment:

1. Read the references listed below.
2. Answer the questions below and turn in this assignment by ____________________.

References:

C. Campbell, How to Repair Washing Machines, Clothes Dryers, Refrigerators, Vacuum Cleaners, Fans, Mixers, Toasters, and Other Home Appliances, pp. 122-130.
D. Tricomi, How to Repair Major Appliances, pp. 166-193.

Questions:

1. Describe the refrigeration system in a typical room air conditioner. Explain briefly what happens to the warm air in the room. Does the cooled air have less moisture than the warm air? If so, what happens to the moisture?

2. Discuss the typical electrical system in an air conditioner. What is the function of the thermostat?

3. Describe the power supply and capacity of a typical room air conditioner. What is meant by BTU? How many BTU's would a half-ton air conditioner represent?

4. Explain the cooling phase of the heat-pump air conditioner. Why is it important that de-icer be introduced into such a system?

5. What two things are of uppermost importance when installing an air conditioner?

6. Describe the heating phase of the heat-pump air conditioner.

7. Explain the de-icing phase of the heat-pump air conditioner.

8. Discuss the installation procedure for an air conditioner in a: double-hung window construction; casement window; transom installations; and through-the-wall installation. Explain the advantages and disadvantages of each.

9. Describe the procedure for evacuating a system in an air conditioner.

10. What are some possible causes for the compressor and fan motor not to run on an air conditioner? What checks may be made to determine the possible causes?

11. Discuss some reasons for a fan to run but compressor not to function on an air conditioner.

12. What are some causes for noisy operation of an air condition system? How may each be eliminated?

13. Why would there be insufficient cooling by an air conditioner? Explain how to correct this.

14. Discuss what causes excessive sweating on the suction line of a room air conditioner.

VT002 050

VT 002 050
Chef, A Course of Study, Designed for Cooperative Part-Time Students Employed in Food Service Establishments.

Karnes, James B.
Missouri Univ., Columbia. Dept. of Industrial Education
Missouri State Dept. of Education, Jefferson City
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CURRICULUM, *FOOD, *COOKS, *STUDY GUIDES, *TRADE AND INDUSTRIAL EDUCATION, *COOPERATIVE EDUCATION, GRADE 11, GRADE 12,

This study guide is for use by junior and senior high school students in preparatory programs for the vocation of chef. It was developed by an advisory consultant and research assistants at the local and state levels and has been field tested and revised periodically. Twenty-one assignment sheets, each containing information, assignment, references, and questions, cover 97 units in the subject areas--(1) The Chef, (2) Operation and Care of Equipment and Facilities, (3) Selection and Preparation of Food, and (4) Organization, Planning, and Purchasing. A two-column analysis form correlates what the worker should be able to do and what the worker should know. This material is to be used by individual students under teacher supervision for 180 hours. A bibliography of references and self evaluation forms are included. An answer key (VT 002 051) is available for 50 cents. This document is available for $1.50 from Industrial Education, 103 Industrial Education Building, University of Missouri, Columbia, Missouri 65201. (FP)

CHEF

A Course of Study

**Designed for
Cooperative Part-Time Students
Employed in Food Service Establishments**

Issued by

**Department of Industrial Education
College of Education
University of Missouri
Columbia, Missouri**

In Cooperation with

**Industrial Education Section
State Department of Education
Jefferson City, Missouri**

MEMORANDUM

TO: The ERIC Clearinghouse on Vocational and Technical Education
The Ohio State University
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FROM: (Person) James B. Karnes (Agency) University of Missouri at Columbia

(Address) 103 Industrial Education Bldg., Columbia, Mo.

DATE: September 26, 1967

RE: (Author, Title, Publisher, Date) Industrial Education Dept., Univ. of Mo at Columbia, CHEF, cooperatively with Industrial Education Dept. (U. of Mo. at Columbia) and Missouri Dept. of Education

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REFERENCES FOR THE CHEF

A. The Culinary Institute of America, Inc. and the Editors of Institutions Magazine, The Professional Chef, Institutions Magazine, 1801 Prairie Avenue, Chicago 16, Illinois, 1963, $7.50 (also available are 100 color slides covering the main entrees at 50¢ each). (19)**

B. American Home Economics Association, Handbook of Food Preparation, 1600 Twentieth Street, N.W., Washington 9, D.C., 1962, 50¢. (8)

C. Smith, E. Evelyn, A Handbook on Quantity Food Management, Burgess Publishing Company, Minneapolis, Minnesota, 1957, $3.50.* (8)

D. Division of Health of Missouri, Bureau of Food and Drug Inspection, Sanitation Laws, E 6.12 Rev. 3/58, Jefferson City, Missouri, free. (1)

E. Sealtest Foods, Know Your Job, Sealtest Foods, Sales and Advertising Department, 260 Madison Avenue, New York 16, New York, 1948, 35¢. (1)

* Subject to educational discount.
** Frequency of use in assignments.

NOTE: Reference "D" is similar to the publication listed below. It may be desirable to substitute the one listed below for reference "D," particularly for use outside the state of Missouri.

U. S. Department of Health, Education, and Welfare, Food Service Sanitation Manual, Superintendant of Documents, U. S. Government Printing Office, Washington 25, D. C., 1962, 55¢.

FOREWORD

This course of study consisting of an analysis of CHEF together with assignment sheets covering the related (occupational) information to be taught by the school, has been prepared for teaching chefs on an individual basis in cooperative part-time programs.

The original course of study was prepared by Mr. Robert F. Shrader, formerly Research Assistant in Industrial Education, University of Missouri. This revision was prepared by Mr. Jack Kirby, Research Assistant in Industrial Education, University of Missouri.

We wish to acknowledge our indebtedness to Dr. H. H. London, Professor of Industrial Education, University of Missouri, for the direction and administration of the Curriculum Materials Laboratory in which this material was prepared, and to Mr. James B. Karnes, Instructor in Industrial Education, University of Missouri, who supervised the preparation of this manual and edited the manuscript. We wish to acknowledge the assistance of Dr. Pauline Garrett, Associate Professor of Home Economics, and Dr. John M. Welch, Professor of Agricultural Economics, both of the University of Missouri, for their consultation and advice. Credit is due Dr. H. Pat Wardlaw, Assistant Commissioner of Education, Mr. Merton C. Wheeler, Director of Industrial Education, and to other staff members for their efforts in the development of the Industrial Education Curriculum Series of which this course of study is a part.

HUBERT WHEELER

Commissioner of Education

January, 1964

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Assignment Sheets:

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INTRODUCTION

In preparing this course of study, it has been assumed that the attainment of occupational competency in any type of work involves three different, yet closely related, types of learning. They are:

1. Mastery of the practical job skills and procedures performed by the worker in the occupation.
2. Comprehension of the technical and related information basic to an intelligent understanding and practice of the occupation.
3. Development of those personal-social traits which are essential for the successful worker.

The first group of these "learning units"--the job skills and procedures--has been arranged in the analysis under the heading of "Job Training." The second group of learning units--the technical and related information--has been arranged under the heading of "Related Information." And the third group--the personal-social traits--has been listed under "Personal-Social Traits Essential for the Chef" in the introductory section addressed to the student.

In a cooperative educational program it is necessary for both cooperating agencies--the school and the employer--to understand clearly just what each is to be responsible for in the training of the student-worker. Experience has shown that most of the practical job skills and procedures of an occupation can best be learned through supervised work on the job. Experience has shown also that the school can best teach most of the technical and related occupational information needed by young student-workers. This division of responsibility has been made in the arrangement of the course of study; that is, it is expected that the student-worker will master the job skills and procedures through practical work on the job under the immediate supervision of the employer, and that he will receive instruction in related occupational information in the school under the direction of the coordinator.

Skills and related information are matters for direct instruction. but personal-social traits are acquired only through practicing them during the process of acquiring skills and information and in one's daily conduct. Therefore, both the employer and the school, as well as the home, must assume responsibility for developing in the student-worker those habits, attitudes and character traits which are essential for success in his occupation and in life. Both the employer and the school should be constantly on the alert to see that he does not practice habits and exhibit character traits detrimental to his success.

Since the coordinator's class will be made up of fifteen or more students, each differing from the other significantly, studying a dozen or more occupations which differ markedly in their requirements, it follows that it will be impossible for him to teach, through the group method, the occupational information which relates to the specific job of each student-worker. In order to be effective, this type of instruction must be individualized. There is, of course, some related information, such as occupational health and safety, workmen's compensation, wage-hour laws, fair labor standards, unemployment compensation, and the like, which is of common interest and concern to all student-workers, and may be effectively taught by the group method. But if the coordinator is to make a real contribution to the in-service vocational education of his students, he must devote a major portion of his classroom instruction to content which deals specifically with the work of each boy and girl enrolled.

With this requirement in mind, and in order to facilitate individual instruction, these assignment sheets have been prepared. Each contains certain record data as to number and range of units covered, introductory paragraphs designed to develop interest, explain the importance of the assignment, and to convey to the student what he is expected to learn, specific assignments including reading, learn activities and a series of objective-type questions designed to check his attainment.

Obviously, it is desirable to teach the related information in the school at the time it will be used most advantageously on the job. This means that the two phases of the student-worker's training should parallel each other in a progressive manner. The coordinator will find the assignment sheets well adapted to this end. He can select from day to day the assignment which covers the informational units related to the work being done on the job. With this arrangement, the coordinator will become, during a major portion of his classroom time, a supervising study and helping teacher.

In selecting books for the course, an effort has been made to restrict the number to an adequate coverage of the material, and to select those of recent publication so that current practices can be consistently presented. It is recommended that copies of these books be secured and kept in the coordinator's classroom for ready use by the student.

The answer-key which is available as a separate manual, has been prepared to enable the coordinator to score quickly the objective tests which are a part of each assignment sheet. This key gives the correct answers to the questions, as well as the reference and the page on which each answer can be found. The answer key should be kept in the coordinator's possession.

TO THE STUDENT-WORKER

Each year many young people enter the field of restaurant occupations of which the chef is one type. The chef in a restaurant is responsible for the preparation of food in large quantities. The skills required and the types of preparation vary with the size and type of establishment.

The art of gracious food preparation is one of the oldest and most respected of occupations. The standard of living in this country has made it possible for increasingly large numbers of people to eat somewhere other than at home. Whether from choice or from necessity, this situation demands good eating houses and restaurants. Many of the people who eat away from home choose an establishment by physical appearance alone, but few people return to any particular place unless the food is nourishing, attractive, tasty, and served in ample portions.

This course of study will consider, but not preclude, only the normal duties of a head cook, and not all the administrative possibilities that could develop over a period of time due to any particular ability or resourcefulness of the individual.

Personal Qualifications of the Chef

The type of work performed by the chef demands someone who is dedicated to the job and one who is highly concerned with the satisfaction, health, and welfare of all with whom contact is made.

Among the personal-social traits essential for the chef are the following:

Professional Attitude. Professionalism is revealed by the sincerity with which the chef promotes the welfare of and interest in his profession.

Intelligence. Average or above intelligence is desirable for successful performance.

Responsibility. The chef must know the responsibilities of his job and perform them to the best of his ability at all times.

Dependability. The chef should be punctual, regular in his work habits and do his work well.

Health. The job of chef requires a person who is healthy and practices and promotes good health habits.

Courtesy and Friendliness. A chef should be courteous and polite in all situations. He should have friendliness and a spirit of cooperation toward all those with whom he comes in contact.

Precision and Accuracy. The health and welfare of many depend on the precision and accuracy with which the chef performs his work.

Appearance. It is essential that the chef be suitably dressed, scrupulously clean and generally well-groomed in this field of food preparation and service.

REFERENCES FOR THE CHEF

A. The Culinary Institute of America, Inc. and the Editors of Institutions Magazine, The Professional Chef, Institutions Magazine, 1801 Prairie Avenue, Chicago 16, Illinois, 1963, $7.50 (also available are 100 color slides covering the main entrees at 50¢ each). (19)**

B. American Home Economics Association, Handbook of Food Preparation, 1600 Twentieth Street, N.W., Washington 9, D.C., 1962, 50¢. (8)

C. Smith, E. Evelyn, A Handbook on Quantity Food Management, Burgess Publishing Company, Minneapolis, Minnesota, 1957, $3.50.* (8)

D. Division of Health of Missouri, Bureau of Food and Drug Inspection, Sanitation Laws, E 6.12 Rev. 3/58, Jefferson City, Missouri, free. (1)

E. Sealtest Foods, Know Your Job, Sealtest Foods, Sales and Advertising Department, 260 Madison Avenue, New York 16, New York, 1948, 35¢. (1)

* Subject to educational discount.
** Frequency of use in assignments.

NOTE: Reference "D" is similar to the publication listed below. It may be desirable to substitute the one listed below for reference "D," particularly for use outside the state of Missouri.

U. S. Department of Health, Education, and Welfare, Food Service Sanitation Manual, Superintendant of Documents, U. S. Government Printing Office, Washington 25, D. C., 1962, 55¢.

ANALYSIS OF CHEF

JOB TRAINING: What the Worker Should Be Able To Do	Assign. No.	RELATED INFORMATION: What the Worker Should Know
		The Chef
	1	1. Factors in history that have influenced eating habits
2. Anticipate needs of clientele	1	2. Social and economic welfare effects on food consumption
	1	3. How food and eating habits change
4. Anticipate the desires of customers	1	4. Why people eat away from home
5. Maintain cleanliness	2	5. Personal health and appearance
6. Carry out duties and responsibilities	2	6. Duties and responsibilities of the chef
7. Cooperate and work with others	2	7. Importance of good relationships with others
8. Be ethical in dealing with others	2	8. Essential ethical and personal qualities
9. Maintain physical fitness and personal appearance	2	9. Personal appearance and health
	2	10. Essential training and experience
		Operation and Care of Equipment and Facilities
11. Control and improve sequence of operations	3	11. When equipment and facilities contribute best to operations
12. Identify kinds of cooking utensils	3	12. Various tools and equipment for efficient operation
13. Clean various tools	3	13. Knowledge of cleaning procedures
14. To sharpen and adjust tools and equipment	3	14. Maintenance of utensils and equipment
15. Safely handle tools	3	15. Potentially dangerous situations
16. Safely operate equipment	3	16. Dangerous aspects of machines
17. Wash utensils by hand	3	17. Detergents and soaps
	4	18. Importance of cleanliness

JOB TRAINING: What the Worker Should Be Able To Do	Assign. No.	RELATED INFORMATION: What the Worker Should Know
19. Handle food in a sanitary manner	4	19. Factors to consider in the handling of food
20. Maintain clean facilities	4	20. Sanitary facilities and cleaning procedures
	4	21. Sanitation standards
	4	22. Laws and regulations governing food establishments

Selection and Preparation of Food

23. Select beef, pork, and mutton	5	23. Selection procedures for meats
	5	24. Grades of meat
	5	25. Sources of meat
26. Follow correct timing and temperatures	6	26. Timing and temperature control methods
27. Prepare beef for cooking	6	27. Methods of preparing and cooking meats
28. Prepare pork for cooking		
29. Prepare mutton for cooking		
30. Cook beef and beef dishes		
31. Cook pork and pork dishes		
32. Cook mutton		
	7	33. Kinds and sources of seafoods
34. Prepare seafood for cooking	7	34. Methods of preparing seafoods
35. Cook seafood		
	8	36. Types of poultry and game
37. Prepare poultry and game	8	37. Methods of preparing poultry and game
38. Cook poultry and game		
39. Make special sauces	9	39. Kinds and uses of sauces, gravies, and condiments
40. Make gravy		
41. Properly season foods	9	41. Types of food seasonings
42. Select correct fats and oils	10	42. Types of cooking fats and oils
43. Cook with fats and oils	10	43. Methods of cooking with fats and oils
44. Select dairy products	11	44. Selection of dairy products
45. Prepare fresh milk for use	11	45. Methods of preparing milk and dairy products
46. Cook with milk		
47. Cook with cheese		

JOB TRAINING: What the Worker Should Be Able To Do	Assign. No.	RELATED INFORMATION: What the Worker Should Know
48. Substitute dry and condensed milk products		
49. Prepare cooked cereals	12	49. Cereals and breakfast dishes
50. Serve dry cereals		
51. Cook with eggs	12	51. Uses of eggs in food preparation
52. Cook eggs		
53. Prepare appetizers	13	53. Types of appetizers and soups
54. Prepare soups and soup stock		
55. Make sandwiches	13	55. Types of sandwiches
56. Cut sandwiches		
57. Select fresh and canned fruits	14	57. Kinds, selection, and characteristics of fruits
58. Prepare fresh fruits for table use		
59. Cook fruit for sauce, fillers, and combination dishes		
60. Select fresh and canned vegetables	15	60. Kinds, selection, and characteristics of vegetables
61. Clean vegetables	15	61. Methods of using and cooking vegetables
62. Cut and prepare vegetables		
63. Cook vegetables		
64. Combine vegetables		
	16	65. Types and varieties of salads
66. Prepare salad materials	16	66. Methods of preparing salads
67. Make up salads	16	67. Types and uses of salad dressings
68. Make salad dressings		
	17	69. Types of flour
70. Prepare flour mixes	17	70. Types of flour mixes
71. Bake flour mixes	17	71. Types of leavening agents
72. Prepare and cook paste products	17	72. Types of paste products
73. Prepare and cook rice		
74. Prepare frozen and fruit desserts	18	74. Types of frozen and fruit desserts
75. Prepare pies, pastries and cakes	18	75. Types of pies, pastries, and cakes
76. Bake pies, pastries, and cakes	18	76. Types of beverages

JOB TRAINING: What the Worker Should Be Able To Do	Assign. No.	RELATED INFORMATION: What the Worker Should Know
77. Prepare hot beverages	19	77. Methods of preparing beverages
78. Prepare cold beverages		
Organization, Planning, and Purchasing		
79. Consider nutritional needs in planning	20	79. Nutritional needs
80. Follow acceptable planning	20	80. Principles of menu planning
81. Plan acceptable menus	20	81. Convert recipes
82. Calculate food costs	20	82. Food cost methods
83. Standardize and write recipes	20	83. Construction of recipes
	20	84. Standardized recipes
85. Follow establishment purchasing policies	20	85. Policies and procedures in food purchasing
	20	86. Buying guides for food products
	20	87. Sources and supply
	20	88. Seasonal purchasing
	20	89. Quantity purchasing
90. Formulate and place orders	20	90. Quality, size, and grades
91. Organize and supervise kitchen activities	20	91. Kitchen organization
92. Prepare products for storage	21	92. Methods of storage
93. Control humidity and temperature for storage		
	21	94. Receiving, storing, and preservation of purchased foods
95. Work efficiently	21	95. Methods of work simplification
96. Handle food economically	21	96. Standard proportions and servings
97. Prepare and use leftovers	21	

Assignment
Sheet No. 1

Covering
Units 1-4

THE EXPANDING FIELD OF FOOD PREPARATION

The social and economic welfare and standard of living of the people of a country are closely tied together. This is true in America, and has great implications for the art of food preparation.

In order to be an efficient and well-informed chef, it is well to know some of the eating habits and customs of people. Also, it is well to know how these habits have changed in recent years.

In this unit you will have an opportunity to become acquainted with the background of food preparation and get a look at many of the food service occupations.

Assignment:

1. Read the references listed below.
2. Check in the school library for source material and write a very brief history of man's eating habits up to the present time.
3. Answer the questions below, and turn in this assignment by ____________________.

References:

A. The Culinary Institute of America, The Professional Chef, pp. 2-4.
I. Information Sheet No. 1, "Food."

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the "T." If it is false, draw a circle around the letter "F."

T F 1. In large establishments, it is quite possible to become a specialist in a certain area of food service.

T F 2. The chef usually has not performed any other food service duties.

T F 3. Food, or lack of food, has determined destinies of nations.

T F 4. The earliest known trade, or barter, was in food.

T F 5. Food transportation is local business or hauling.

T F 6. There are no people left who still get all of their food by depending on nature.

T F 7. The kind of food people eat depends to a large extent on what kind of food they grow.

T F 8. The religion of some people influences the choice of foods they eat.

T F 9. Moslems eat pork but never eat beef.

T F 10. Americans have not borrowed eating customs from others, but organized a unique set of their own.

T F 11. The idea of the "chafing-dish" comes from the Africans.

T F 12. Arabs use only the left hand for dipping food.

T F 13. People in warm-climate countries are the ones that tend to eat outside more.

Completion

<u>Directions</u>: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. A person with little or no training in food service may start out as a ______________ ______________.

2. One of man's oldest occupations is the hunt for ______________.

3. New ways of preparing food by primitive people were advanced after the discovery of ______________.

4. City dwellers depend solely on ______________ ______________ for almost everything they eat.

5. When man learned to make weapons, he also found he could kill larger ______________ and ______________.

6. Western civilization had a great start in ______________ about ________ years ago.

7. One of the reasons for the expanding of the Greek and Roman Empires was the search for ______________.

8. History usually credits the Romans as the first people to set out ______________ beds.

9. ______________ was discovered accidentally in the search for food by the Spaniards.

10. ______________ countries usually eat the food they have, while ______________ countries may import a more varied diet.

11. In some countries the people eat as many as ________ regular meals per day.

12. The French people usually breakfast on a ______________ and ______________ or ______________ ______________.

13. The English people like ______________ and ______________ for their breakfast.

14. Pancakes are usually considered an ______________ breakfast dish.

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. The different titles that a chef may have are:

(A) ________________________ (D) ________________________

(B) ________________________ (E) ________________________

(C) ________________________

2. Early man found that from domesticated animals he could have:

(A) ________________________ (C) ________________________

(B) ________________________

3. The landing in America brought discovery of such new foods as:

(A) ________________________ (E) ________________________

(B) ________________________ (F) ________________________

(C) ________________________ (G) ________________________

(D) ________________________

4. Although they seem repulsive to people in this country, some people eat such odd things as:

(A) ________________________ (C) ________________________

(B) ________________________ (D) ________________________

Information
Sheet No. 1

FOOD

If a person who lived in the Middle Ages could come to life again, he would find the common American grocery store one of the most wonderful things in the modern world. The grocery store is the latest stage in man's oldest occupation--the hunt for food.

Every living thing--plant, animal or human being--must have food to live. Abundance or lack of food has for centuries influenced the destinies of nations. People hungry are people dissatisfied. The United States has made its biggest bid for friendship throughout the world by sending food to foreign countries.

Our earliest known trade was in food. The first men ate only what they found and prepared for themselves. But after so long a time they found that they could exchange food with their neighbors. After the discovery of fire, new ways of preparing food were discovered and this, no doubt, started the exchange of "recipes" or various methods of preparing the same foods. Then, as people began to travel from one country to another, they found that foods would grow in one place, but not in another. And so began another type of barter. Today, millions of people earn their living by processing or distributing food in such industries as dairies, mills, packing plants and canneries. The greatest business of our transportation networks is the carrying of food. Through this great network exchange, we can drink tea from India and coffee from Brazil. We can have sugar from Puerto Rico, spices from the Orient, and all of the foods that grow in various sections of our own U. S. Millions of town and city dwellers depend solely on food stores for everything they eat. All of their food must be processed and delivered to the stores for their purchasing.

Food Through the Ages

Primitive man ate what food he could find. There are still people in the jungles of Africa and South America who live in the same manner. They depend entirely on nature to supply their needs. However, successive discoveries have given us our present system. Man first discovered how to make weapons. Thus, he could kill larger animals and fish. Then he discovered fire and how to make pots in which to cook food. Then he learned that he could partly control his food supply by scratching the ground and planting seeds, and that they would grow food for him. Then he learned that he could domesticate animals to work for him, and that animals supplied him with milk and meat. Such discoveries caused man to settle in one place and develop his own land. This is the beginning of modern civilization, of communities living together, of the developing of towns and of nations.

Western civilization was born about 6,000 years ago in Egypt. The yearly flood waters of the Nile left behind much rich soil. The warm climate meant that farmers could grow crops all year round--and this was the basic reason for Egypt's being the first great Western civilization. The Egyptians learned to roast and charcoal-broil meat. They learned the art of preserving food in brine, and of smoking and salting meat.

Other great centers of civilization developed different kinds of food. The ancient Hebrews in the Holy Land lived much more simply on grain, vegetables and rice. Bread was made from barley, lentils or beans, and baked in tiny loaves. A favorite food was a thick soup of lentils or beans, called pottage. The Bible tells us that Esau sold his birthright to his brother Jacob for a mess of pottage.

The foods of the early Greeks and Romans were sea foods and the meats of tamed animals, with porridge, flat round loaves of bread, figs and olives. They developed olive oil and later grew grapes and learned to make wine. One of the main reasons for the growth of the Greek and Roman empires was the shortage of food in the homeland. They learned to bring back delicacies from other lands and to raise these new foods at home. The Romans were the first to set out oyster beds. They grew fish in ponds and learned to use new meats and nuts.

America was discovered in the search for food. A route to India was sought so that spices could be brought back to Spain for preserving meats. Their landing in America by mistake brought them many new food adventures--such as maize, potatoes, sweet potatoes, pumpkins, squash, tomatoes and pineapples.

Today most of the foods of the world are shared by all civilized countries. Each region of the world has its own special food which it grows in abundance and sells to other parts of the world in order to have food from all over the world.

However, the kind of food a people eat depends to a large extent on what kind of food they grow. Poor countries usually eat the food they have, and richer countries can buy more food from other lands and so have a more varied diet.

People of different countries do not always agree on what is good food. Some people eat lizards, beetles, grasshoppers, the eyes of fish, and foods that seem repulsive to us. Also, people of different locales prepare the same food differently. The French make coffee by the drip method, while in Sweden a big pot of coffee is kept hot and black on the stove all day, and Turkish coffee is served black and very thick.

Religion and food have always been closely connected in the lives of people. Most religions thank their Gods for food. Many religions have food laws which do not allow their followers to eat certain foods. Buddhist will not eat meat; the cow is sacred in India, and beef is seldom eaten there. Moslems do not eat pork. Orthodox Jewish food laws forbid the eating of pork, scaleless fish such as oysters and catfish, and wild animals such as deer, and they eat only the forequarters of domesticated animals. The animals must be killed in a certain way to be regarded as clean. Other religions forbid the eating of certain foods on certain days.

Each country has its own ways and manners of eating. In Europe and America people eat at tables and use separate plates, with a knife and fork; Arabs dip their food out of a central bowl using only the left hand; Chinese and Japanese eat with chopsticks; and primitive people eat with their fingers. On some tropical islands, large leaves are used as plates. Orientals sit on the floor and eat from low tables. Many people in tropical or warm climates prefer eating outdoors. Some countries eat two or three meals a day, but others eat as many as five.

Americans are great borrowers of customs from other lands, especially since World War II, when soldiers were in countries all over the world and observed and brought home new ideas in eating. The French prepare food in chafing dishes at the table, and this is now a prevalent custom in our country. We eat outside more, as the Latin Americans do; we use bamboo place mats and Oriental-flavored dishes in the style of the Chinese and Japanese; and we borrow our breakfast habits from several countries. It is the French who have a roll and coffee or hot chocolate; the people of the Netherlands eat cereals such as oats, wheat and barley; the English like meat and eggs; and the Syrians always include fruit in their breakfast. Pancakes seem typically American, but the Mexicans start the day with sweet bread and tortillas, which are corn cakes.

Assignment
Sheet No. 2

Covering
Units 5-10

PERSONAL REQUIREMENTS

The success or failure of any project depends primarily upon the individual involved. His abilities and personality will govern the degree of success or failure that will result.

The modern chef has a variety of duties and therefore needs numerous talents and abilities. Aptitude, initiative, training, and personal health habits will have a definite influence on the work of the chef. The amount of education and past experience will also have a bearing on how well a chef will get along with his work.

In this unit you will learn of some of the desirable characteristics that are necessary for success in the food preparation field.

Assignment:

1. Read the references listed below.
2. Interview your employer and secure information on the following: (a) how he received his training, (b) personal qualities necessary, (c) technical requirements, (d) opportunities for the future, and (e) financial remuneration. Do his answers sound similar to your own plans?
3. Answer the questions below and turn in this assignment by ____________________.

References:

A. The Culinary Institute of America, The Professional Chef, pp. 1, 4-5.
C. Smith, A Handbook on Quantity Food Management, pp. 209-211.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. The chef is usually in the kitchen and therefore, his personal appearance is not important.

T F 2. A good chef must have average or above average intelligence.

T F 3. A good chef needs to be physically strong and well coordinated.

T F 4. Todays chef is expected to be a good leader and organizer.

T F 5. Dirt under the fingernails is in such small amounts that it requires no attention.

T F 6. A physical examination for a communicable disease is usually unnecessary because the chef does not come in contact with other people very often.

T F 7. Past work experience can be important in work as a chef.

T F 8. The opportunity to be creative no longer presents itself in chef's work.

T F 9. A chef's duties are concerned only with preparing the food.

T F 10. This is one area where pride of workmanship is not very important.

T F 11. Formal education is of little help in work as a chef.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. Assurance that instructions are being followed and good habits have been developed can be accomplished by ______________.

2. Usually there is a definite relation between wages and ______________ of work.

3. On-the-job training is essential to all workers, but ______________ and past experience are decided assets.

4. The manager should know the worker's qualifications so as to best fit him for the ______________.

5. Sometimes it is best to start from the beginning in a line of work than have to unlearn ______________ work habits.

6. The worker should be shown around the plant to give him some idea of his part of the ______________ enterprise.

7. Good morale is important for the worker so he can get along with ______________ other workers.

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. The orientation of a worker can be helped by:

   (A) ____

   (B) ____

   (C) ____

   (D) ____

2. Training for an operation should be accomplished by:

(A) ____________________

(B) ____________________

(C) ____________________

(D) ____________________

(E) ____________________

3. In addition to actual cooking of food the chef, or head cook, may supervise or participate in:

(A) ____________ (E) ____________

(B) ____________ (F) ____________

(C) ____________ (G) ____________

(D) ____________

Assignment
Sheet No. 3

Covering
Units 11-17

CARE AND OPERATION OF KITCHEN EQUIPMENT

Care and operation of kitchen equipment in an eating establishment is a very important part of the workers' duties. This equipment can save time and money as well as make your job easier when it functions correctly. A breakdown through neglect can be costly for the management and disrupting to the kitchen schedule.

There are hazards involved with improperly functioning equipment as well as delays. A dull or misaligned unit can contribute directly or indirectly to accidents.

In this unit you will learn some of the more desirable practices concerning equipment care and operation.

Assignment:

1. Read the references listed below.
2. List and write a brief description and function of the equipment found in the kitchen at your work station.
3. Construct a flow chart as it now applies to your establishment. Could this be made more efficient in the food handling process?
4. Answer the questions below and turn in this assignment by ____________________.

References:

A. The Culinary Institute of America, The Professional Chef, pp. 8-12.
C. Smith, A Handbook on Quantity Food Management, pp. 97-110, 190-191.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. Modern equipment is expected by customers, so therefore all of it should be out front where it can be seen.

T F 2. Logical arrangement of machines is important for sequence of operations.

T F 3. It is not desirable for food workers to help plan a work area since architects have been trained for all types of planning.

T F 4. There is no logical order for receiving, storage, service and preparation of food as long as they are convenient.

T F 5. A machine should always be a large size to allow for future expansion

T F 6. Need for a machine should be established before purchasing.

T F 7. A slicing machine can help with standardization of portions.

T F 8. A slicing machine is always a time saving device.

T F 9. Time taken to sharpen a machine will usually pay in the long run.

T F 10. Machines can contribute to work simplification.

T F 11. The use of the proper size machine will result in efficient operation.

T F 12. Volume of food is unaffected by power-driven machines.

T F 13. The quality of food is unaffected by power-driven machines.

T F 14. Nutritive values are sometimes better maintained when power-driven machines are used.

T F 15. Most power-driven machinery needs nothing but periodic cleaning.

T F 16. Instructions should be given and the worker should observe before he is allowed to operate any equipment.

T F 17. Vegetable peelers should run just long enough to remove skins.

T F 18. Vegetable peelers will do an excellent and economical job on any size or shape vegetable.

T F 19. The biggest advantage of a coffee urn is that coffee can be kept warm for hours.

T F 20. Steam cooking, even when properly done, is detrimental on nutrients and color.

T F 21. A spoon is recommended for stirring or whipping.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. To efficiently use modern food machines, good floor ______________ is needed.

2. If quantity food production is to be efficient, the arrangement should be planned for good ______________ and ______________.

3. All work should have logical sequence with no ______________ of steps.

4. Correct use of machines will eliminate ______________ of ______________ and allow more time for high quality and finesse.

5. There should be a ______________ for any machine purchase.

6. Small quantity in a large machine very often results in an ______________ product.

7. Beyond saving work, any machine that eliminates ______________ will be an asset.

8. Cost control can be anticipated by standardizing ______________, ______________, ______________, and ______________.

9. Instructions for proper use of machines can be obtained from the ______________.

10. Instructions should be ______________ for all machines, and the worker should be trained to ______________ them.

11. An experienced cook will value a good set of ______________.

12. A block should never be scrubbed with ______________.

13. After cleaning a wooden block, a covering of ______________ should be applied.

14. The tool used to keep knives sharp is called a ______________.

15. Knives should not be used for anything except that which they were ______________.

16. Tampers for grinders should be of wood or a certain metal otherwise they might ______________ the equipment.

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. Before purchasing a particular machine, two things that should be determined are:

   (A) ____________________ (B) ____________________

2. Advantages of the proper machines may be:

   (A) ____________________ (D) ____________________

   (B) ____________________ (E) ____________________

   (C) ____________________ (F) ____________________

3. A food mixer may be used for:

   (A) ____________________ (C) ____________________

   (B) ____________________

4. When using a food mixer, the worker should:

   (A) ____________________ (C) ____________________

   (B) ____________________ (D) ____________________

5. Four rules for running a vegetable peeler are:

   (A) ____________________ (C) ____________________

   (B) ____________________ (D) ____________________

6. Five important points in cleaning a slicing machine are:

   (A) ____________________ (D) ____________________

   (B) ____________________ (E) ____________________

   (C) ____________________

Assignment
Sheet No. 4

Covering
Units 18-22

SANITATION AND ACCIDENT PREVENTION

Most states have sanitation laws and regulations to help protect both reputable businesses and customers. These laws and regulations are available from the Department of Health or similar agency and copies should be on hand in public food serving establishments.

It is the responsibility of the manager and employees to ensure the serving of safe food to the public. All workers should be required to read the laws and regulations and to abide by them. A clean and well kept place or work should also be emphasized and maintained.

In this unit you will become familiar with desirable practices which should lead to better standards and be beneficial to all concerned.

Assignment:

1. Read the references listed below.
2. Note any items in your establishment that may not conform to your state regulations, and report them to your employer in a helpful way.
3. Answer the questions below, and turn in this assignment by ______________________.

References:

A. The Culinary Institute of America, The Professional Chef, pp. 4-7, 10-12.
C. Smith, A Handbook on Quantity Food Management, pp. 173-178.
D. Division of Health of Missouri, Sanitation Laws and Regulations Covering Eating and Drinking Establishments.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. When buying food, unwrapped bread or pastry not in covered containers should be avoided.

T F 2. Food should not be stored on the floor at any time.

T F 3. Service workers but not kitchen workers need to have immunization tests.

T F 4. Workers with common colds should not be allowed to work until well.

T F 5. Very hot rinse water can eliminate the necessity of toweling pots and pans.

T F 6. A regular schedule for cleaning of the kitchen is unnecessary as it is "everybody's" work.

T F 7. Sharp tools should always be washed separately.

T F 8. A worker should have on a long-sleeved shirt to reach in the oven.

T F 9. A fat fire should be immediately removed from the stove.

T F 10. Walls should be washable up to any level reached by normal splash or spray.

T F 11. Openings to outer air (doors and windows) must be screened to keep out flies or else other measures taken to prevent the entrance of flies.

T F 12. Hot and cold running water must be easily accessible wherever food is prepared or dishes washed.

T F 13. Cyanide is a good polishing material, recommended for stainless steel.

T F 14. The use of tobacco in any form is prohibited in food preparation rooms.

T F 15. The actual bacteria must accompany food when eaten to cause food poisoning.

T F 16. Left overs should not be kept over 3 days.

T F 17. A stove or oven should be cleaned immediately after using.

T F 18. After sharpening a knife, be sure to wipe it off before using.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. Dishes should be rinsed with water at a temperature of at least __________ or __________ degrees F.

2. Cups and glasses should be stored in an ________________ fashion.

3. After washing hands it is good practice to use a sanitizing agent such as __________________.

4. Minimum refrigerator temperature should be about ____________ degrees F.

5. No live animals or fowls may be kept or allowed in any room in which food or drink is __________ or __________.

6. Annual __________ __________ are no longer required for employees handling food, and the responsibility now falls on the __________ to assure himself that the health situation is good.

7. The chief means of fighting bacteria is by controlling __________.

8. A temperature of ________F. or above will kill most bacteria.

9. For safety, floors should be __________ and __________.

10. When not is use, knives should be properly ______________.

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. Accidents can be costly to:

(A) ______________ (B) ______________ (C) ______________

2. It is sound practice to have within easy reach in emergencies a:

(A) ______________________ (C) ______________________

(B) ______________________

3. Foods that in the past have created the greatest number of cases of food poisoning are:

(A) ____

(B) ____

(C) ____

(D) ____

(E) ____

4. Prevention of food poisoning can be accomplished by:

(A) ____

(B) ____

5. Three conditions that appeal to bacteria are:

(A) ______________________ (C) ______________________

(B) ______________________

6. Four carriers of germs are:

(A) ______________________ (C) ______________________

(B) ______________________ (D) ______________________

7. Three things that can be done to food to ensure its being healthful are:

(A) ______________________ (C) ______________________

(B) ______________________

8. Accidents are caused by:

(A) ____

(B) ____

Assignment
Sheet No. 5

Covering
Units 23-25

MEAT SELECTION AND GRADING

Meat constitutes an important share of food intake. Cutting, handling, and processing of meat can be a field alone, but one must know some basic elements of the trade to be a competent chef.

It is very important that the correct grade of meat be selected to ensure customer satisfaction and efficient operation. Once it is selected it needs to be properly cared for to take maximum advantage of the meat with regards to appearance, tenderness, taste, and sizes of portions.

In this unit you will learn about the common kinds of meat, how it is graded, where it comes from, and how to care for it.

Assignment:

1. Read the reference listed below.
2. List the typical beef cuts used and what servings come from them.
3. Answer the questions below and turn in this assignment by ____________________.

Reference:

A. The Culinary Institute of America, The Professional Chef, pp. 27-34, 43-51, 71-77.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. Meat not marked with a purple stamp still might be government inspected.

T F 2. Meat from all packing houses is graded the same.

T F 3. Fat content distinguishes veal from other meats.

T F 4. Cuts of veal are generally smaller than those of beef.

T F 5. A recently added grade of meat is called AVERAGE.

T F 6. The public now demands leaner pork than it used to.

T F 7. Written specifications are used by most beef buyers.

T F 8. There are just five government grades of beef.

T F 9. The hind shank of beef tends to have the most bone per cut.

T F 10. Variety meats are parts other than regular cuts that can be eaten.

T F 11. Aging has no effect upon meat other than darkening the color.

T F 12. Veal comprises about 20% of the meat consumed.

T F 13. The ink left on the meat by the inspection stamp must be removed before cooking.

T F 14. Good quality pork is a light, greyish pink color.

T F 15. Meats of all kinds have standard grades.

T F 16. The better grades of meat have considerably better nutritional value.

T F 17. Beef is one of the largest profit makers on the menu due to its low initial cost.

T F 18. Single cuts of veal may be cooked without first defrosting.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. Veal actually is young ________________.
2. The beef loin is customarily used for ________________.
3. Meat is very high in ________________.
4. Cooking tends to destroy or weaken ________________ ________________ of the meat.
5. The top grade of beef is called ______________.
6. Meat comprises about ___________ per cent of the food budget.
7. The most popular meat, and therefore that which will require the greater portion of the chefs' time is ________________.
8. Meat is actually the ________________ of animals
9. A variety meat that is extremely perishable is ________________.

10. Pork is usually preferred with a ______________ of fat.

11. The meat that has a fairly stable quality is ______________.

12. Two meats that should always be cooked well done are ______________ and ______________.

13. A chef can particularly display his skill in preparing ______________ meat.

14. It is best to defrost veal in a ______________.

15. Pork and most fresh meat should be stored at __________ degrees F.

16. The preparation of veal in America has a ______________ influence.

17. Edible lining of the stomach is called ______________.

18. Because it contains a great deal of fat and results in considerable waste, the ______________ grade of beef is not used in the average eating place.

19. A grade of beef that was introduced in 1959 but is still relatively unknown is ______________.

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. Meat is cooked to:

(A) ________________________ (C) ________________________

(B) ________________________ (D) ________________________

2. Federal laws do not apply to packing houses which do not ship their meat out of state and which are governed by:

(A) ________________________ (C) ________________________

(B) ________________________

3. The common grades of beef and lamb are:

(A) ________________________ (C) ________________________

(B) ________________________ (D) ________________________

4. Written specifications for purchasing meat indicate:

(A) ________________________ (C) ________________________

(B) ________________________ (D) ________________________

5. The nutritional value of meat lies in its abundance of:

(A) ____________________ (C) ____________________

(B) ____________________

6. Variety meats include:

(A) ____________________ (E) ____________________

(B) ____________________ (F) ____________________

(C) ____________________ (G) ____________________

(D) ____________________

Assignment
Sheet No. 6

Covering
Units 26-32

MEAT COOKERY

The cooking of meat is extremely important because it is usually the main dish around which the whole meal is organized. If this portion of the meal is not cooked correctly and according to the customers' wish, the rest of the meal can seem very poor as well, no matter how carefully these other foods may have been prepared.

In this unit you will study about the various methods of cooking meat and some of the techniques used.

Assignment:

1. Read the references listed below.
2. Find the approximate percentages of beef, veal, pork, lamb and mutton that is served where you work. How does this affect your buying and storage problems?
3. Answer the questions below and turn in this assignment by ____________________.

References:

A. The Culinary Institute of America, The Professional Chef, pp. 27-90.
B. American Home Economics Association, Handbook of Food Preparation, pp. 24-27.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. The cooking of meat generally causes it to shrink.

T F 2. The more economical cuts of meat generally require the dry method of cooking meat.

T F 3. Boiling actually means simmering.

T F 4. Steaming is one of the more popular methods of cooking.

T F 5. Poaching might be considered as a modified method of boiling.

T F 6. Cooking meat at a constant low temperature has been proven to be the best.

T F 7. Preheating of the oven is important when roasting.

T F 8. In roasting meat, the fat side is usually placed up to provide a natural basting condition.

T F 9. In testing meat for doneness with the fingers, if the meat reacts like a piece of soft rubber it is too done.

T F 10. For ease of carving, roasts should be sliced immediately after removing them from the oven.

T F 11. The only recognized method of testing roasted meat for doneness is with the fingers.

T F 12. In general, the cheaper grades and cuts of meats require more time and effort to prepare properly.

T F 13. The addition of vegetables tends to raise the nutritional value of braised meats.

T F 14. It is best to use a little too much seasoning than none at all.

T F 15. In braising and broiling, the heat causes the juices to leave the meat immediately.

T F 16. It is important in stewing to add vegetables at the proper time so that both meat and vegetables are done at the same time.

T F 17. It is recommended to leave excess fats in a stew.

T F 18. Veal chops and steaks should generally be braised.

T F 19. Tripe should always be precooked.

T F 20. Cold water aids in bringing out flavor and juice of meat whereas warm or hot water tends to keep it in.

T F 21. Extensive boiling of meat will produce a clear, undesirable stock.

T F 22. Sautéing is similar to pan frying.

T F 23. Meat should be tested for doneness frequently.

T F 24. Roast meat should be heated to the desired temperature and then left in the oven about 15 minutes longer.

T F 25. Grilled meat is not directly exposed to open heat.

T F 26. Meats should be broiled about half of the indicated time on one side after which it should be turned and broiling completed.

T F 27. A 7 1/2 pound smoked picnic shoulder should be cooked approximately 1 1/2 to 2 hours.

T F 28. The meat thermometer should be inserted in the center of a roast so that it rests on the bone for the most accurate testing of doneness.

T F 29. A pork loin requires a higher temperature (for well done) than a veal loin of same weight and same cooking time.

T F 30. If proper thawing and cooking temperatures are followed, very little difference will exist between meat that has been cooked from the frozen or thawed state.

T F 31. The safest temperature for thawing meat is the generally accepted refrigerator temperature.

T F 32. Thawed meat should never be refrozen.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. A meat thermometer is used to determine the degree of ______________ in a roast.

2. Salt has a tendency to draw the ______________ out of meat.

3. Barbecuing as we know it today was previously referred to as ______________.

4. For best quality food, it is recommended that economical cuts of meat be cooked by the ______________ heat method.

5. The inclusion of strips of salt pork to allow proper cooking and to provide additional flavor is called ______________.

6. Meats generally are roasted between ________ and ________ degrees Fahrenheit.

7. Sticking to the broiler or grill rack can be prevented by making sure that the rack is ______________ before cooking the meat.

8. Foods for broiling should have considerable ______________.

9. The only useful method of testing the doneness of broiled meat is with the ______________.

10. Two methods of cooking meat that are classified as combinations of dry and moist methods are ______________ and ______________.

11. To increase browning when braising, a covering of ______________ should be used.

12. When broiling meats, the top of the meat should be ________ inches below the flame for a one inch cut and ________ inches for thicker cuts.

13. Meats that should not be broiled are ______________ and ______________ ______________.

14. The cooking of frozen meat requires extra ______________ ______________

15. All meats should be sliced ______________ the grain.

16. A popular serving of lamb is called ______________ ______________.

Listing

<u>Directions</u>: List the items called for in each of the following. Select your answers carefully.

1. Dry heating methods of cooking are:

   (A) ______________ (C) ______________

   (B) ______________ (D) ______________

2. The recommended methods of cooking veal are:

   (A) ______________ (D) ______________

   (B) ______________ (E) ______________

   (C) ______________

3. Methods of determining the degree of doneness of meat are:

   (A) ______________ (C) ______________

   (B) ______________ (D) ______________

4. Searing and then applying moisture to meat tends to:

   (A) ______________________________

   (B) ______________________________

5. Seven advantages of cooking meat at low temperatures are:

   (A) ______________ (E) ______________

   (B) ______________ (F) ______________

   (C) ______________ (G) ______________

   (D) ______________

6. A mirepoix contains:

(A) ____________________ (C) ____________________

(B) ____________________

Assignment
Sheet No. 7

Covering
Units 33-35

SEA FOOD COOKERY

Although the United States is not mainly dependent upon sea food as are some other countries, sea food is still an important part of our diet. Fish are valuable as a source of proteins and other nutrients. However, most people do not include enough sea food in their diet.

Sea food properly prepared and served can be very appetizing and healthful. For the most part, sea food is inexpensive and the good chef will make good use of it in his menus.

In this unit you will learn the secrets of preparing the various kinds of fish so that they are appetizing and desirable.

Assignment:

1. Read the references listed below.
2. Investigate the most common kinds of sea foods served in your establishment. List the sources (suppliers) from whom these seafoods are obtained.
3. Answer the questions below and turn in this assignment by ____________________.

References:

A. The Culinary Institute of America, The Professional Chef, pp. 123-156.

B. American Home Economics Association, Handbook of Food Preparation, pp. 29-30, 40.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. Some fish are difficult to digest, therefore, they need to be cooked well.

T F 2. Fish should never be refrozen.

T F 3. Fish are generally considered a high priced luxury item.

T F 4. Fish are extremely perishable and spoil rapidly unless refrigerated.

T F 5. Long cooking times are required for most fish.

T F 6. Fish are usually prepared and served in individual portions.

T F 7. Fresh water fish comprise most of the fish that are cooked and served commercially.

T F 8. It is always necessary to add a liquid of some sort when baking fish.

T F 9. The fat content of all fish is quite constant.

T F 10. When broiling fish, it is necessary to apply an oil before cooking even if the fish have been coated with flour.

T F 11. It is desired to have lobsters of about 10 lbs. for public serving.

T F 12. Shrimp requires just a short cooking time.

T F 13. Lobsters that are not pre-cooked should be cooked live.

T F 14. Oysters are purchased by the pound.

T F 15. Broiling is preferred over grilling as a method of preparing fish.

T F 16. The stewing of fish is not a very popular method.

T F 17. Overcooking of fish needs to be watched carefully, otherwise a useless product will result.

T F 18. If water is not used, fish should be simmered directly in court bouillon.

T F 19. When simmering or poaching large fish, the cooking should start in a very hot liquid.

T F 20. The sauce to be served with fish is actually more important than the fish itself.

T F 21. The eggs of fish are sometimes used as food.

T F 22. The cooking time for most fish to be simmered in water will not be more than 20 minutes.

T F 23. The baking of dressed fish requires the longest cooking time.

T F 24. All frozen fish should be thawed before cooking.

T F 25. It is safest to thaw frozen fish in a refrigerator.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. The two categories of fish are ____________ ____________ and ____________.

2. Salt water fish are valuable nutritionally as a source of ____________.

3. To refrigerate fish it is best to use ____________ ____________.

4. The most popular fresh water fish used by food service institutions is ____________.

5. Cooking fish en papillote means cooking in ____________.

6. Fish cooked in papillote should be coated with ____________, ____________ ____________, and ____________ before it is sealed up.

7. An extremely fast method of cooking fish is called ____________.

8. It is best to keep live shellfish in ____________.

9. The color of fresh lobster meat is ____________.

10. The most expensive scallops come from the ____________.

11. King crabs are obtained from the Pacific Ocean near ____________.

12. A common method of preparing small, whole fish is ____________ ____________.

13. Fish which have just the inside removed are referred to as ____________.

14. For easier handling, fish should be ____________ before they are breaded and fried or stuffed.

15. Fillets are for the most part, without ____________.

16. Shell fish that have been removed from their shells are referred to as ____________.

17. Cooking temperatures of fish and shellfish normally do not exceed ________.

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. Characteristics of fresh fin fish are that they:

(A) ____________ (D) ____________
(B) ____________ (E) ____________
(C) ____________

2. Six forms in which fin fish may be purchased are:

(A) ____________ (D) ____________
(B) ____________ (E) ____________
(C) ____________ (F) ____________

3. The individual cutting, cooking, and serving of fish results in:

(A) ____________ (D) ____________
(B) ____________ (E) ____________
(C) ____________ (F) ____________

4. Court bouillon is made of:

(A) ____________ (E) ____________
(B) ____________ (F) ____________
(C) ____________ (G) ____________
(D) ____________

5. Shellfish include:

(A) ____________ (E) ____________
(B) ____________ (F) ____________
(C) ____________ (G) ____________
(D) ____________

Assignment
Sheet No. 8

Covering
Units 36-38

POULTRY AND GAME COOKERY

Poultry is considered meat due to the nutritive values and the methods used for cooking. Domesticated birds such as chicken, turkey, ducks, geese, guineas, squabs, and pigeons are those classified as poultry although some game birds are used to some extent.

Chicken is popular the world around and fried chicken is surpassed only by beef in popularity in food service establishments. Because of its constant availability and the many variations of preparation, chicken is always found on the menu and enables the chef to display his skill.

In this unit you will study the various kinds of poultry and game and how to properly prepare them.

Assignment:

1. Read the references listed below.
2. Investigate and report on sources, and inspection of fowls purchased for serving in your establishment.
3. Answer the questions below and turn in this assignment by ____________________.

References:

A. The Culinary Institute of America, The Professional Chef, pp. 91-122.
B. American Home Economics Association, Handbook of Food Preparation, p. 28.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. Nutritive value of poultry is lower than other meats.

T F 2. Poultry should be cooked well done.

T F 3. The tenderness of poultry all depends on the cooking.

T F 4. Before poultry can be shipped to another state, all non-edible parts need to be removed.

T F 5. Poultry is cooked much the same way as meat.

T F 6. Large turkeys are more economical than small ones.

T F 7. Turkey contains a large amount of fat.

T F 8. Poultry spoils readily and is easily recognized by the undesirable odor that is produced.

T F 9. Turkey is generally frozen and can be cooked that way.

T F 10. Since all poultry needs to be dressed before shipping, it is not necessary to clean it before cooking.

T F 11. It is possible that two fowl of the same size and weight may require different cooking time.

T F 12. Game is a very common item in most public eating places.

T F 13. Capon is a type of duck.

T F 14. Stuffing should be packed tightly into the body cavity.

T F 15. Stuffing should not be seasoned too heavily.

T F 16. It generally takes about 1 1/2 hours to roast a 4-5 pound duckling.

T F 17. Fresh bread should be used for stuffing.

T F 18. A meat thermometer is the only recommended method for testing the doneness of poultry.

T F 19. A 2 1/2 pound chicken will normally provide two servings of fried chicken.

T F 20. When testing a fowl for doneness, it should be removed from the pot by sticking a fork next to the backbone.

T F 21. When a number of fowl are cooked at the same time, it is necessary to test only one for doneness.

T F 22. Vegetables should be cooked very little if at all before insertion in the stuffing since considerable cooking takes place as the poultry is being cooked.

T F 23. A 24 pound turkey will take about 4 hours to roast.

T F 24. The cooking of fried chicken is completed in an oven.

T F 25. Poultry that has been stuffed should not be frozen.

T F 26. It is best to stuff poultry for roasting a day ahead of time.

T F 27. Roasted poultry can be tested for doneness by moving the leg joints

T F 28. Thawed uncooked poultry should never be refrozen.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. The preferred grade of poultry for food service is ____________.
2. The more expensive types of poultry are usually prepared by ______________.
3. To obtain uniform cookery to ensure customer satisfaction, poultry should be of uniform ______________ and ______________.
4. The shape of broilers and fryers is maintained by ______________.
5. Ducks should be placed on racks when roasting, due to the large amount of ______________.
6. An economical way to make chicken stock is to use ______________ ______________.
7. Characteristics of good stuffing are that it is ______________ and ______________.
8. About one hour of cooking time can be saved if turkeys are not ______________.
9. Two types of fancy stuffings are called ______________ and ______________.
10. A 24 pound turkey should produce about ________ servings.
11. In roasting, steaming, or boiling chicken, the chicken is broken down into serving portions ______________ cooking.
12. Care must be taken when broiling or grilling turkey since turkey is quite ______________.
13. Poultry will become dry, stringy, and not very tasty when ______________.
14. Duckling will taste best when the skin is ______________.
15. When using bread for stuffing, the ______________ should be removed.
16. Ducklings should be cut into eight equal portions which provides servings for __________ people.
17. Color and crispness can be added to the skin of duckling and goose by ______________ the heat near the end of roasting.
18. You should plan to finish cooking poultry about ________ to ________ minutes before serving to enable easy carving.

19. It will generally take from ________ to ________ days to thaw frozen poultry in a refrigerator.

20. If the bird and the stuffing are prepared the day before cooking, they should be refrigerated ________________.

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. Tenderness of poultry is determined by:

(A) ____________________ (C) ____________________

(B) ____________________

2. Game birds that might be cooked and eaten are:

(A) ____________________ (D) ____________________

(B) ____________________ (E) ____________________

(C) ____________________

3. Edible trimmings of poultry are:

(A) ____________________ (C) ____________________

(B) ____________________

4. Distinguishing features of broilers and fryers are that they are:

(A) ____________________ (C) ____________________

(B) ____________________

5. The basic ingredients of most stuffings are:

(A) ____________________ (C) ____________________

(B) ____________________ (D) ____________________

6. Domestic birds used for food are:

(A) ____________________ (E) ____________________

(B) ____________________ (F) ____________________

(C) ____________________ (G) ____________________

(D) ____________________

Assignment
Sheet No. 9

Covering
Units 39-41

SAUCES, GRAVIES AND CONDIMENTS

Proper seasoning is an extremely important part of good food preparation. Chinese and French cooks have always been highly rated in this art. There are no definite rules to be laid down, as tastes differ, condiments vary in strength, and different foods require varying amounts of supplemental flavoring.

Almost all foods require condiments. Others are condiments in themselves. Whichever be the case, they should be used sparingly. Some are made into sauces, and most gravies obtain their distinctiveness from proper proportions of condiments, correctly combined with the basic stock.

In this unit you will study some of the basic condiments and their uses, as additives, as sauces, and as a part of gravies.

Assignment:

1. Read the reference listed below.
2. Answer the questions below and turn in this assignment by ____________________.

Reference:

A. The Culinary Institute of America, The Professional Chef, pp. 279-291, 322-325.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. The primary purpose of a sauce is to increase nutrition.

T F 2. A sauce will not cover up poor food.

T F 3. Most sauces are entirely different from each other.

T F 4. White sauce might be called cream sauce.

T F 5. Hollandaise sauces should be used within one and one-half hours after preparation.

T F 6. Hollandaise sauces contain large amounts of butter and eggs.

T F 7. Hollandaise sauces are among the easiest to make.

T F 8. Salt is a very important ingredient in stocks since it controls the flavor.

T F 9. The cooking time of roux is governed by the ingredients that are used in making it.

T F 10. Roux can generally be prepared long before its intended use and stored until needed.

T F 11. Roux should be cooked before it is added to other ingredients to form the sauce, soup, or gravy.

T F 12. The process of making a sauce can be speeded up, if necessary, by having the liquid and the roux hot before mixing.

T F 13. Gravy should have a taste that is similar to the meat from which it is made.

T F 14. Sage is used mainly for added color.

T F 15. Shallots are used for basically the same reason as garlic.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. Sauces are used primarily to improve the ______________ and ______________ of the food.

2. Seasoning needs to be just right so that the final food product is not ______________ nor excessively ______________.

3. As tastes differ, seasoning of food is an art which takes some amount of ______________.

4. The discoloration of eggs prevents the use of ______________ cookware when making a hollandaise sauce.

5. Demi-glaze consists of a combination of espagnole and brown stock along with ______________ ______________.

6. Roux is composed of ______________ and ______________.

7. A simple but flavorless thickening agent is composed of ______________ and ______________.

8. When a somewhat clear sauce is desired, ______________ is the most economical thickening agent to use.

9. Any sauce with eggs in it must not be heated over ________ F.

10. Hollandaise sauce cannot be regrigerated because it contains ______________ nor can it be excessively heated because of the ______________ it contains.

11. Cloves can be used either ______________ or ______________.

12. A common flower of which the leaves are used in salads and sandwiches is the ______________.

13. Meat and poultry juice obtained by dry heat methods are used to produce ______________.

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. The basic warm sauces are:

(A) ______________________

(B) ______________________

(C) ______________________

(D) ______________________

(E) ______________________

2. Tomato sauce is composed of:

(A) ______________________

(B) ______________________

(C) ______________________

(D) ______________________

3. Fats that might be used in making roux are:

(A) ______________________

(B) ______________________

(C) ______________________

(D) ______________________

(E) ______________________

(F) ______________________

4. Those spices and herbs that are used both whole and ground are:

(A) ______________________

(B) ______________________

(C) ______________________

(D) ______________________

(E) ______________________

(F) ______________________

(G) ______________________

(H) ______________________

Assignment
Sheet No. 10

Covering
Units 42-43

COOKING WITH FATS AND OILS

Deep fried foods, properly prepared, can add variety to a menu and are quite adaptable in situations requiring fast service. Fats and oils are also used for other methods of cookery.

A major problem in cooking with fats and oils is that of preventing too much fat or oil to be absorbed into the food. It is therefore necessary to understand the current methods of cooking with these products and the various characteristics of them.

In this unit you will learn some of the characteristics of fats and oils and the proper use of them. Special emphasis will be given to deep fat frying and the preparation of food for this and other methods of cooking with fats.

Assignment:

1. Read the references listed below.
2. Find what type of fat or oil is used by your employer in the kitchen for: table use, deep frying, pan frying, additives for cooked dishes and pastries.
3. Answer the questions below and turn in the assignment by ____________________.

References:

A. The Culinary Institute of America, The Professional Chef, pp. 157-170.
B. American Home Economics Association, Handbook of Food Preparation, pp. 31, 39-40.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. Generally foods that are to be fried are first coated in some manner.

T F 2. Oils are solid at room temperature.

T F 3. Even though deep fried foods are properly prepared and do not absorb much fat, the fact that they are prepared in fat makes them difficult to digest.

T F 4. One reason for coating deep fried food is to keep the juices in the product.

T F 5. Products coated with bread generally result in a crisper and better crust than those dipped in batter.

T F 6. The amount of fat absorbed is in direct ratio to the exposed surface of the product.

T F 7. Products of high water content originally will tend to repel the absorption of fat.

T F 8. If the temperature of the fat is too low the food will tend to become greasy.

T F 9. Fat will eventually "wear out" from continued use and will not hold correct temperatures.

T F 10. A frequent lowering of the fat temperature will help to preserve the life of the fat.

T F 11. Unserviceable fat can be made usable again by adding new fat to it provided that the new fat at least equals the old.

T F 12. Generally vegetable shortening can be used longer than most other types.

T F 13. Fried foods should be allowed to cool slightly before serving so that they can be eaten as soon as they are received.

T F 14. A deep fat fryer should be drained and cleaned at least once a week.

T F 15. Since the food itself will have a somewhat irregular surface, uniform covering when breading is not important.

T F 16. Wash, with reference to breading, is concerned with the washing of the food before coating it.

T F 17. It is best to bread products shortly before they are to be fried.

T F 18. If fried foods are covered during the cooking process, they will tend to become soggy.

T F 19. Chicken must be deep-fried at a greater temperature than french fried potatoes.

T F 20. Oleomargarine packages must indicate the type of fats used to produce it.

T F 21. Oils that are edible and commonly used in the American home are of vegetable origin.

T F 22. Salad oils have been processed and will remain clear at refrigerator temperatures.

T F 23. Fats and oils have been bleached to remove coloring materials.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. As commonly used, the term "fats" refers to those that are ____________ at room temperature and the term "oil" refers to those that are _______________ at room temperature.

2. Although the quality of the fat has very little to do with the quality of the finished product, the selection of a fat is usually based on its ability to remain __________ at frying temperatures.

3. Deep fat frying temperatures range from _____ F to ______F.

4. Lard is fat that is processed from a ___________.

5. Foods with high _________ content will generally absorb more fat than those with low content.

6. The temperature of the fat used when making french fried potatoes will tend to be lowered considerably when the potatoes are first placed in the fryer due to the high _____________ content of raw potatoes.

7. The determining of the proper temperature for frying various products will best be accomplished with ____________.

8. The life of the fat will be lengthened if it is _____________ daily.

9. At least one hand should be _________ when breading food.

10. A process for solidifying fats and oils by the addition of hydrogen is known as _______________.

11. Margarine must contain _______ per cent fat.

12. Oils are subdivided into __________ oils and __________oils.

13. Lard is obtained from the fatty tissue of ___________.

14. The changing of an oil from a liquid to a solid is called ________________.

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. Common frying substances are:

(A) ______________________ (D) ______________________

(B) ______________________ (E) ______________________

(C) ______________________

2. Factors that affect the degree of fat absorption in deep fat frying are:

(A) ______________________ (D) ______________________

(B) ______________________ (E) ______________________

(C) ______________________

3. Length of cooking time is determined by:

(A) ____

(B) ____

(C) ____

(D) ____

(E) ____

4. Five classifications of food that may be deep fried are:

(A) ______________________ (D) ______________________

(B) ______________________ (E) ______________________

(C) ______________________

5. Wash for breading may be composed of any of the following:

(A) ______________________ (C) ______________________

(B) ______________________ (D) ______________________

Assignment
Sheet No. 11

Covering
Units 44-48

MILK AND MILK PRODUCTS

Milk is the food nature provided for mammals to feed their new-born young during the first stage of life. It contains many nutrients needed for body-building during this time. For human beings, cow"s milk is probably the most important when considering total life span. Milk from other animals is used but primarily in other countries.

No food is complete in itself and this applies to milk as well, although milk is one of the most nearly complete foods. The need for milk and milk products has been reasonably established as essential throughout the average person's lifetime.

In this unit you will learn some of the important characteristics of these products, their use and procedures in preparation for serving.

Assignment:

1. Read the references listed below.
2. Interview your employer, and secure information on the following: (a) how much fresh milk is used per week, (b) how much condensed or evaporated milk is used per week, (c) how much dried (whole skim or buttermilk) is used per week? Does this present a storage problem? Could the problem be improved by using different forms of milk? Why or why not?
3. Answer the questions below and turn in this assignment by ____________________.

References:

A. The Culinary Institute of America, The Professional Chef, pp. 22-23.
B. American Home Economics Association, Handbook of Food Preparation, pp. 36-38.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. Whole milk must contain at least 3.25 per cent butter fat.

T F 2. Pasteurization has no effect on the food value of milk.

T F 3. Homogenization is a process of breaking up the fat into uniform size globules that remain evenly distributed throughout the milk.

T F 4. Whole milk is much more nutritious than skim milk.

T F 5. Evaporated milk is an economical way to transport whole milk.

T F 6. Dry milk might be used in the dry form for some types of cooking.

T F 7. If salt is added to butter, the butter tends to keep better.

T F 8. An advantage of processed cheese is its ease of combining with other foods.

T F 9. It is recommended that when cooking with cheese, a high temperature and long cooking time be used.

T F 10. Some milk products are made by adding bacteria to milk.

T F 11. Half and half consists of a mixture of milk and cream.

T F 12. Concentrated milk is classified as evaporated milk.

T F 13. Ice milk is the same as ice cream except that the proportions of ingredients is different.

T F 14. Sour milk can only be obtained by letting fresh milk stand at room temperature until sour.

T F 15. Whole milk contains about 60 per cent water.

T F 16. Chocolate milk is made from skim milk.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. Milk is made healthful by a process called ______________.

2. When the butterfat has been removed from milk the result is ______________ ______________.

3. Condensed milk differs from evaporated milk in its ______________ content.

4. The cheapest form of milk and quite acceptable for use is ____________ ____________ ____________.

5. Quality ice cream will have more than ________ lb. per gallon butterfat weight.

6. Most milk has ______________ added.

7. Cottage cheese is popular with people who are trying to ________________ weight.

8. The mixture of two or more cheeses is called __________________ ____________________.

9. Additions to butter that are not required by law are ____________ and _________________.

10. The most popular cheese in the United States is _______________.

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. Four classifications of cheese are:

(A) ______________________________ (C) ______________________________

(B) ______________________________ (D) ______________________________

2. Three common forms in which milk may be purchased are:

(A) ______________________________ (C) ______________________________

(B) ______________________________

3. Three types of semi-soft cheese are:

(A) __________________ (B) ___________________ (C) __________________

4. Vitamins added to multivitamin milk are:

(A) ______________________________ (C) ______________________________

(B) ______________________________ (D) ______________________________

5. Fermented type milks include:

(A) ______________________________ (D) ______________________________

(B) ______________________________ (E) ______________________________

(C) ______________________________ (F) ______________________________

6. Evaporated milk is obtained by the process of:

(A) ______________________________ (C) ______________________________

(B) ______________________________ (D) ______________________________

Assignment
Sheet No. 12

Covering
Units 49-52

CEREALS, EGGS, AND BREAKFAST DISHES

The foods in this unit include variations of some of the basic foods of people the world over. Grains and seeds of grasses supply high percentages of the total diets for many countries. The egg, with its functions to develop into a fowl, therefore, contains all the materials necessary for body building, and can supply many vital elements for the well-being of humans.

These foods are usually associated with the breakfast meal, but are served very often for other meals, or as an added ingredient in many combinations of dishes. In your preparation as a chef, you should be familiar with these foods.

In this unit you will gain some knowledge of these foods, as they stand alone for foods and how they mix and combine for selected dishes.

Assignment:

1. Read the references listed below.
2. Answer the questions below and turn in this assignment by ____________________.

References:

A. The Culinary Institute of America, The Professional Chef, pp. 18-22.
B. American Home Economics Association, Handbook of Food Preparation, p. 38.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. Eggs are a good source of iron.

T F 2. Eggs are generally easy to digest.

T F 3. There are times when the shells of eggs will be beneficial as decoration and nutritional value.

T F 4. Only pure white eggs should be used for quality cooking.

T F 5. The difference in weight between size classes of eggs is three ounces.

T F 6. The shells of eggs will prevent the penetration of odors but not dirt.

T F 7. Grade B eggs should never be used for cooking.

T F 8. There are various methods that may be used to simmer eggs.

T F 9. Eggs that are not turned over during the frying process are called sunny-side up eggs.

T F 10. Some sort of liquid should always be added to eggs when scrambling.

T F 11. A green ring around the yolk after simmering is a result of the feed used and cannot be changed.

T F 12. It is important that an omelette be served as soon as it is cooked.

T F 13. Cereals have no use other than as a breakfast item.

T F 14. Granular cereals should always be mixed in cold water before cooking.

T F 15. Too much stirring in cooking whole grain cereals can result in an inferior product.

T F 16. Bacon and ham will not spoil as easily as sausage.

T F 17. It is generally desirable to purchase bacon that is already sliced.

T F 18. Bacon should be pre-cooked and then cooked quickly at a high temperature just before serving.

T F 19. Pancakes and other such products will not tend to rise as much if the batter is mixed up too far ahead of using time.

T F 20. The continental breakfast originated in Asia.

T F 21. The advantage of the continental breakfast is the absence of extensive cooking.

T F 22. Frozen egg whites generally have ingredients added to improve keeping qualities.

T F 23. Special mixtures of eggs and milk or eggs and shortening are available for use.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. Eggs are many times used as a substitute for ______________.
2. Twelve medium size eggs will weigh about _________ ounces.
3. The grade of eggs is determined by their ____________ and _______________.
4. When poaching eggs with thin whites, it is helpful to add _______________ to the water.
5. The green ring around the yolk of boiled eggs may be eliminated by placing the eggs in ___________ _____________ immediately after cooking.
6. Fried eggs will tend to be ___________ if fried in an excessive amount of fat.
7. To make a dinner omelette, ____________ eggs should be used.
8. Two distinct characteristics of cereal are the ample supply of _______________ and the lack of ____________.
9. The two basic types of cereals are the _______________________ cereals and the ___________ cereals.
10. Two common types of breakfast sausage are __________ sausage and sausage _________________.
11. Meats used for breakfast service are usually ___________________ to enable better service.
12. In blanching bacon, the slices are usually cooked until about ___________ done and then kept until serving, at which time they are completed to order.
13. Potatoes are usually served ______________ for breakfast.
14. The quality of syrup used for pancakes can be improved by _______________.
15. Putting small holes in a sausage prior to cooking will prevent _________________.
16. Frozen egg yolks usually have ______________ or ______________ added.

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. The various uses of eggs for cooking are:

(A) ____________________ (D) ____________________

(B) ____________________ (E) ____________________

(C) ____________________ (F) ____________________

2. The six sizes of eggs and their weight per dozen are:

(A) ____________________ (D) ____________________

(B) ____________________ (E) ____________________

(C) ____________________ (F) ____________________

3. The four grades of eggs by U. S. standards are:

(A) __________ (B) __________ (C) __________ (D) __________

4. The most common methods of cooking eggs are:

(A) ____________________ (D) ____________________

(B) ____________________ (E) ____________________

(C) ____________________ (F) ____________________

5. Poor quality fried eggs can result from:

(A) ____

(B) ____

(C) ____

(D) ____

6. Country style eggs are prepared by cooking eggs with:

(A) ____________________ (C) ____________________

(B) ____________________ (D) ____________________

7. The three methods of making omelettes are:

(A) ______________________________

(B) ______________________________

(C) ______________________________

8. The most common meats offered on breakfast menus are:

(A) __________ (B) __________ (C) __________

9. A continental breakfast is composed of:

(A) __________ (B) __________ (C) __________

10. The classifications fo food that are common on breakfast menus are:

(A) __________ (E) __________

(B) __________ (F) __________

(C) __________ (G) __________

(D) __________

Assignment
Sheet No. 13

Covering
Units 53-56

APPETIZERS, SOUPS AND SANDWICHES

The food in this unit may be served alone as lunches or snacks, or may be complements to a complete dinner. They, like other foods, should be prepared and served properly and attractively. Since they generally precede the main meal, they can do much to determine the customer's attitude towards the rest of the meal. When served alone they need to satisfy the customer's immediate appetite.

In this unit you will learn what different appetizers, soups, and sandwiches are commonly used in food establishments and how to prepare them.

Assignment:

1. Read the references listed below.
2. Answer the questions below and turn in this assignment by ________________.

References:

A. The Culinary Institute of America, The Professional Chef, pp. 14-15, 243-278.
C. Smith, A Handbook on Quantity Food Management, p. 68.
E. Sealtest, Know Your Job, pp. 36-39.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. A sweet appetizer should be served prior to a meal that is basically light.

T F 2. Canapes are much like hor d'oeuvres except that the ingredients are served on bread or crackers.

T F 3. In preparing appetizers, speed is not important since appearance is the main consideration.

T F 4. French Bouillabaisse is a common soup to be served along with the main meal.

T F 5. Quality soup is based on the stock that is used.

T F 6. Broth and bouillon both mean the same thing.

T F 7. All soups should be served extremely hot.

T F 8. To obtain clarification, it is important that the stock is simmered rather than boiled to extremes.

T F 9. Continuous stirring is required to obtain clear consomme'.

T F 10. The garnishes are the foods that are put into the stock to make the soup.

T F 11. The decline of actual stock making in the kitchen is due to the fact that the public prefers the manufactured bases.

T F 12. Cooking time to obtain stock should be at least eight hours.

T F 13. Stocks should never be salted since they are generally cooked with other foods which may tend to change their salt content.

T F 14. In cooking stock it should be boiled and then allowed to simmer.

T F 15. Fat that forms from cooling stocks should be left on during refrigeration since it will act as protection.

T F 16. If stock is placed in the refrigerator directly from the store, it will result in poor quality stock.

T F 17. Bones should be chopped up into small pieces before using in stock.

T F 18. Soup stock may be kept on top of the stove indefinitely.

T F 19. Meat for sandwiches should be sliced about 1/16 inch thick.

T F 20. The filling of a sandwich should not be spread to the very edge of the bread.

T F 21. A small sized work space is all that is needed for efficient sandwich service.

T F 22. All chopping, slicing, and spreading of bread should be done on a special board.

T F 23. A separate spreader should be used for each different sandwich spread mixture.

T F 24. Sandwich ingredients should be prepared well ahead of time for use.

T F 25. It is most practical to use cheaper grades of mayonnaise for making sandwiches.

T F 26. Bread or other sandwich materials should not be handled with the hands.

T F 27. More bone than meat should be used for stock soups.

T F 28. Stock soups should be simmered for a long time.

T F 29. Soup stocks should be cooled quickly.

T F 30. Cream soup should be salted just before serving.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. An appetizer is a food that is served ____________ the meal.

2. Canapes and hor d'ouervres can provide a good profit provided the __________ cost is kept down.

3. Canapes are similar to hor d'ouevres except that the mixture is served on a ______________.

4. Bouillabaisse should be served both as __________ and ___________.

5. It is important to have good ___________ in order to produce a good soup.

6. Most consomme's are obtained from ___________ stock or _________ stock.

7. In obtaining a clear liquid, the coagulation of _____________ _____________ and _____________ causes the other food particles to form a solid mass.

8. Soups are usually served accompanied by a ____________ item.

9. Modern processing of meat has eliminated ____________ which creates problems in making stock.

10. For better nutritional value, vegetables are added __________ the cooking process when making stock.

11. Meat bones should be added _____________ pieces to give more flavor.

12. The main difference between brown stock and white stock is that in white stock the bones have not been _______________.

13. When it is desirable to bring the flavor out of a food while cooking, that food should be placed in ______________ water to start cooking.

14. One very important rule in cooking is: ____________ hot foods as quickly as possible; and ___________ cold foods as quickly as possible.

15. When cooling stock, it is recommended that the stock be ______________ occasionally.

16. An item that may be useful for dipping sandwich filling is the __________ ___________ ___________.

17. Butter may be softened for spreading by adding a small amount of ___________ ______________ and then whipping.

18. The testing of seasoning of sandwich fillings should be done by the ___________ _____________.

19. Two pints of mayonnaise should be enough to spread about _________ slices of bread.

20. Food such as chicken, greens, and cheese can easily be cut up with _____________.

21. Flavor or color of soup stock can be influenced by ___________ some of the meat used.

22. When making soup stock, the juices of the meat are extracted by adding ____________ _______________.

23. Cream soup uses a _____________ sauce.

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. The five basic appetizers in the U. S. are:

(A) _________________________ (D) __________________________

(B) _________________________ (E) __________________________

(C) _________________________

2. The main classifications of soup are:

(A) _______________ (B) _______________ (C) ________________

3. Garnishes fall into the commonly used categories of:

(A) ____________________ (F) ____________________

(B) ____________________ (G) ____________________

(C) ____________________ (H) ____________________

(D) ____________________ (I) ____________________

(E) ____________________

4. Possible accompaniments of soup are:

(A) ____________________ (D) ____________________

(B) ____________________ (E) ____________________

(C) ____________________

5. Stocks are usually derived from:

(A) ____________________ (C) ____________________

(B) ____________________

6. The four main stocks are:

(A) ____________________ (C) ____________________

(B) ____________________ (D) ____________________

7. Methods of cutting bread for sandwiches are:

(A) ____________________ (C) ____________________

(B) ____________________ (D) ____________________

8. Types of bread that might be used for sandwiches are:

(A) ____________________ (D) ____________________

(B) ____________________ (E) ____________________

(C) ____________________ (F) ____________________

9. Seven ways in which sandwiches might be served are:

(A) ____________________ (E) ____________________

(B) ____________________ (F) ____________________

(C) ____________________ (G) ____________________

(D) ____________________

10. Seven main classifications of sandwiches under which most varieties fall are:

(A) ______________________

(B) ______________________

(C) ______________________

(D) ______________________

(E) ______________________

(F) ______________________

(G) ______________________

Assignment
Sheet No. 14

Covering
Units 57-59

FRUIT PREPARATION AND COOKERY

Fruits contribute important nutrients to the diet and are excellent sources of natural sugars. In addition to these features, most fruits also help with the natural elimination processes of the body.

Fruits are seldom used as the complete meal but rather as appetizers, desserts, or "snacks" in their fresh form. They play an important part in the making of certain salads which will be covered in a later unit.

In this unit just a brief study will be made, primarily concerned with preparing and cooking fruits either prior to use with other foods or as they would be served separately.

Assignment:

1. Read the reference listed below.
2. Make a list of fresh fruits available in your area. Which of these are available all year round and which are seasonal in nature?
3. Answer the questions below and turn this assignment in by ____________________.

Reference:

I. Information Sheet #2, "Preparing and Cooking Fruits."

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. Most fruit should be washed before preparing.

T F 2. The same procedure is used to obtain both grapefruit and orange sections.

T F 3. Oranges should be chilled before cutting into slices.

T F 4. In removing the core from apples for baking, a cut should be made around the core all the way through the apple and the core removed.

T F 5. Discoloration of bananas after peeling can be prevented by covering them with an acid fruit.

T F 6. Apples should be baked in a deep pan.

T F 7. It is important when baking apples that all the apples are completely covered with water.

T F 8. Applesauce should never be served hot.

T F 9. Cranberries should be cooked until their skins burst.

T F 10. Dried apricots and prunes should be washed in warm water before stewing.

T F 11. Canned fruits should be opened 30 minutes before serving and cooled.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. Seeds are removed from orange juice by ____________.

2. Before cutting orange slices, the oranges should be placed in ____________ ____________ for 5-8 minutes.

3. Orange slices should be ____________ before cutting to thickness.

4. Badly damaged and ____________ berries should be discarded in preparation.

5. Discoloration of apple sections can be prevented by covering them with ____________ ____________ ____________.

6. The skins of peaches can be removed easily by first placing them in ____________ ____________.

7. After baked apples have cooked, a form of ____________ should be placed on the top and then broiled to form a glaze.

8. In making applesauce, the sugar should be added just before the apples are ____________.

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. Four acid fruits are:

(A) ______________________ (C) ______________________

(B) ______________________ (D) ______________________

2. Three things that bananas are covered with before baking are:

(A) ______________________ (C) ______________________

(B) ______________________

3. The creamed mixture for baking peaches consists of:

(A) ______________________ (C) ______________________

(B) ______________________

Information
Sheet No. 2

PREPARING AND COOKING FRUITS*

How To Prepare Fresh Fruit

Juice Extraction from Citrus Fruits

1. Cut the fruit crosswise into halves or lenghtwise into halves and quarters.
2. Hold the glass reamer with one hand and the half section of the fruit with the other hand.
3. Invert the half section over the top of the glass reamer. Rotate the fruit back and forth while pressing firmly against the blade of the reamer.
4. Strain to remove seeds and particles of pulp.

Grapefruit Halves

1. Wash grapefruit and cut crosswise into halves. Use a sharp pantry knife.
2. Using scissors or grapefruit knife, cut the center core free from the tough membranes which separate the sections and also from the rind. Remove the core and seeds.
3. Loosen each section from the membranes and the rind, using a small knife.

Grapefruit Sections

1. Cut off the rind from the top and bottom. Stand upright on the work table or cutting board.
2. Remove the rind from the sides, starting at the top and cutting downward toward the table. Cut the layer deeply enough to remove the white membrane.
3. With the left hand, turn the fruit from right to left, as necessary, until the rind is removed.
4. With the back of the knife, lift out the whole segments of pulp. Remove the seeds.

Orange Sections

1. Cut off the rind from the top and bottom. Stand upright on the work table or cutting board.

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*Adopted with permission from Food Service by Helen Livingstone, McKnight & McKnight Publishing Company, Bloomington, Illinois, 1950.

2. Remove the rind from the sides, starting at the top and cutting downward toward the table. Cut the layer deeply enough to remove the white membrane.
3. With the left hand, turn the fruit from right to left, as necessary, until the rind is removed.
4. With the back of the knife, life out the whole segments of pulp. Remove the seeds.

Orange Slices

1. Let whole oranges stand in boiling water from 5 to 8 minutes.
2. Cut through the rind around the orange lengthwise twice. This will divide the rind into four parts.
3. Cut a thick layer of skin from the top.
4. Remove the rind in four strips lengthwise.
5. Chill.
6. Cut crosswise to the thickness desired (¼ to ½ inch).
7. Remove the seeds.

Diced Oranges

1. Remove the rind and cut into sections.
2. Cut sections crosswise into uniform pieces the size desired (about ¼ inch).
3. Remove the seeds.

Lemon Sections

1. Cut a layer of rind from top and bottom.
2. Cut lengthwise into halves.
3. Cut halves lengthwise into sections of the desired thickness.
4. Remove the seeds.

Lemon Slices

1. Cut a thick slice from the top and bottom of the lemon.
2. Cut crosswise into slices of the desired thickness (¼ to ½ inch).

3. The rind is scored with a fork before cutting the slices. This gives a fluted edge to the slice.

4. Remove the seeds.

Raspberries, Blackberries, Blueberries

1. Inspect the berries carefully. Discard overripe and badly damaged berries.

2. Cut off the damaged, discolored portions from the good berries.

3. Place the berries in a colander and lift up and down in a quantity of cold water.

4. Handle carefully to prevent bruising.

5. Drain them well.

Strawberries For General Use

1. Place the berries in a colander and wash under running water.

2. The perfect berries are sorted from those with spots or blemishes.

3. Remove the stems, soft or discolored portions, and blemishes, and drain the berries well.

Strawberries To Be Served Whole

1. Select large, perfect berries.

2. Wash as already suggested.

3. The stems are not removed.

4. Drain well and chill them until serving time.

Apples For Baking

1. Select large red apples.

2. Wash and dry them.

3. With a small, sharp-pointed knife cut through the pulp around the stem, making a circle 3/4 to 1 inch wide. Extend the cut to within 1/2 inch of the bottom. At this point cut across the core and remove it whole.

4. Pare a band of skin 1/2 to 3/4 inch wide off the top around the opening made by removing the core.

Apple Sections

1. Wash and drain the apples.
2. Cut into halves from top to bottom. Cut the halves into quarters.
3. Cut the core from each quarter. Remove the skin, bruises or blemishes.
4. If smaller sections are desired, cut the quarters into uniform pieces, lengthwise.
5. Place sections in lemon or other acid fruit juice to prevent discoloration until ready to use.
6. Drain well.

Diced Apples

Place several sections close together on work table and cut crosswise into cubes of the desired thickness (¼ to ½ inch). Use French knife.

Apple Slices

1. Prepare the sections.
2. Cut the sections crosswise into slices from 1/8 to 1/4 inch wide, according to use.

Bananas

1. Cut the banana from the bunch.
2. Cut off stem and remove the skin.
3. Remove all the inner white membrane which may adhere to the pulp.
4. Cut off soft or discolored portions.
5. Cut into halves or strips lengthwise; into wedges, or slices, as desired.
6. Cover the pieces with an acid fruit or salad dressing.
7. If acid fruits such as oranges, pineapple or grapefruit are prepared at the same time, the bananas are covered by the other fruits to prevent discoloration until ready to use.

Peaches

1. If the fruit is very ripe, the skin is easily removed. Pierce the skin with the point of the knife and lift it from the pulp. Begin peeling at the bottom of the peach. Use short, quick strokes.

2. If the skin is not easily removed, dip the peach into boiling water long enough to loosen the skin (about one minute or less), and then peel.

3. Cut into halves lengthwise and remove the pit.

4. Cut the halves into wedges or slices, as desired.

5. Peaches are prepared only a short time before using, or are covered with acid fruit juice to prevent discoloration.

Pears To Be Served Uncooked

1. Cut the pear into halves lengthwise. Cut out the core and remove the skin.

2. The halves are cut into wedges or slices, as desired.

3. Prevent discoloration. Refer to peaches, apples, etc.

Pears For Baking

1. Remove the skin and stem.

2. Small pears or those having a soft pulp are baked whole.

3. Hard pears are pared, cut into halves lengthwise, and the core removed.

Pears For Stewing

1. Small pears are stewed whole after removing the skin.

2. Large pears are prepared as for baking.

How To Cook Fruits

Baked Apples

1. Arrange the prepared apples in a shallow baking pan.

2. Poor one-half to one inch of water into the pan and cover closely.

3. Cook slowly on top of the stove, keeping the water below the boiling point. Continue cooking until the apples are tender when pierced with a toothpick.

4. Remove the cover. Spread the tops of the apples with sugar or heavy syrup.
5. Place under the broiler until the sugar melts and forms a glaze.
6. One serving -- one apple.

Applesauce

1. Place the prepared apple sections in a saucepan and add one-half their measure of cold water or place in a steamer.
2. Cover and cook slowly until the apples are tender.
3. Remove from the fire or steamer and add sugar to taste--about 1 tablespoon per apple.
4. Beat with a spoon or mixer. Strain if preferred.
5. Spplesauce is served hot or cold.
6. One serving -- 1/3 cup.

Baked Bananas

1. Cut the bananas in halves lengthwise.
2. Place in a buttered baking pan. Brush with lemon juice; brush with melted butter; cover with sugar or heavy syrup.
3. Bake in a moderate oven (350° F.) 15 to 20 minutes.
4. One serving -- 1/2 banana.

Cranberry Sauce

1. Place the prepared berries in a saucepan or kettle with one-third their measure of water.
2. Add one-half their measure of sugar and stir until the sugar is dissolved.
3. Cover and cook slowly until the skins burst.
4. Remove the foam, which forms on top of the pan, with a cooking spoon.
5. One serving -- 1/4 cup.

Cranberry Jelly

1. Place the prepared berries in a saucepan or kettle with one-third their measure of water. Cover and cook slowly until the skins burst.

2. Strain through a sieve, pressing the berries against the sides with a wooden spoon or use the strainer attachment of the mixing machine.

3. Put the strained berries into the saucepan again and add one-half their measure of sugar. Cook slowly, stirring until the sugar is dissolved. Continue cooking for five minutes.

4. Pour into molds and let stand until firm before serving.

5. One serving -- 1/4 cup.

Baked Peaches

1. Prepare a creamed mixture of sugar, butter and lemon juice, allowing the following proportions for 6 peaches: 4 tb. sugar; 2 tb. butter; 1½ t. lemon juice.

2. Place the prepared peaches in a buttered baking pan. Fill each cavity with the creamed mixture.

3. Bake in a moderate oven (350° F.) for 15 to 20 minutes.

4. Nutmeg or cinnamon is sprinkled over the peaches before baking, if desired.

5. One serving -- 2 halves.

Baked Pears

1. Place the prepared pears in a baking pan.

2. Pour one-half inch layer of water into the pan.

3. Sprinkle pears with sugar, allowing 1/2 tb. for each pear.

4. Bake in a moderate oven until tender.

5. Baste the pears several times with the liquid in the pan while baking.

6. One serving -- 2 halves.

Stewed Pears

1. Prepare a syrup in the following proportion: 1/2 c. water; 1/2 c. sugar; 6 pears.

2. Cook the syrup for 5 minutes.

3. Add the prepared pears to the syrup and cook slowly until tender.

4. Remove the pears and continue cooking the syrup until it is thick.
5. Pour syrup over the pears before serving.
6. Add vanilla, nutmeg, or lemon juice to the thick syrup if desired.
7. One serving — one pear.

Stewed Dried Apricots And Prunes

1. Allow 4 or 5 halves for serving.
2. Wash with warm water. Drain them.
3. Cover the fruit with warm water and soak for two or three hours. Cook slowly in the same water until plump and tender. Keep the water below the boiling point.
4. Add sugar if desired.
5. Cook a piece of lemon or orange rind with the fruit if desired.

Stewed Figs

1. Allow 4 medium dried figs for each serving.
2. Inspect the figs and remove stems and inedible portions.
3. Wash in warm water and drain.
4. Cover with water and cook slowly until the figs are plump and tender. Keep the water below the boiling point.
5. No sugar will be needed.
6. Add lemon juice or the rind to the figs while cooking, if desired.

Raisins

1. Inspect the raisins and remove stems or foreign substances.
2. Wash in warm water and drain.
3. For salads, soak in warm water until plump. Dry before using.
4. When added flour mixtures, raisins are washed, soaked until plump, dried, and covered with flour before using.
5. For fillings and sauces, cover with water and cook slowly until plump. Sugar is added if desired.

Canned Fruits

Canned fruits are already cooked and may be served as they come from the can. It is a good plan to open them at least 30 minutes before serving and also cool them in the refrigerator. They may be used in place of cooked fresh fruits as an accompaniment for the main course and in various desserts such as puddings and gelatins.

Canned fruits may be used also in combination with fresh fruits for fruit cups and salads.

Assignment
Sheet No. 15

Covering
Units 60-64

VEGETABLE PREPARATION AND COOKERY

Vegetables are becoming more and more important in today's menus. Their richness in food value is publicly known and, therefore, customers demand vegetables that are of good quality and properly prepared.

In comparison with other food, the cost of vegetables is relatively low. Therefore, they should be attractively presented to increase sales.

In this unit you will learn the characteristics of vegetables and study the methods of cooking.

Assignment:

1. Read the references listed below.
2. Make a list of vegetables used in your establishment in a week's time. Show which are fresh, which are canned, and which are frozen. How does this affect purchasing, storage, and cost? Are facilities adequate for keeping a reasonable supply on hand? How could they be improved?
3. Answer the questions below and turn in this assignment by ____________________.

References:

A. The Culinary Institute of America, The Professional Chef, pp. 171-198.
C. Smith, A Handbook of Quantity Food Management, pp. 72-73.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. Vegetables that taste better and look better when cooked generally do not contain the most food value.

T F 2. It is necessary to wash all vegetables before cooking.

T F 3. All frozen vegetables should be cooked without thawing.

T F 4. Generally frozen vegetables require less cooking time than fresh vegetables.

T F 5. Canned vegetables are cooked before canning and therefore need only to be reheated.

T F 6. Dried legumes are becoming more important in today's cookery.

T F 7. It is recommended that baking soda be used in cooking green vegetables in order to intensify their color.

T F 8. Vegetables may be classified by their color.

T F 9. A vegetable plate should always contain just vegetables.

T F 10. Newsprint is a good material to cover vegetables with when storing.

T F 11. In cooking vegetables, the water should be salted.

T F 12. Sugar can add to the flavor of vegetables if added just before serving.

T F 13. Newly cooked vegetables added to previously cooked vegetables will provide a satisfactory product.

T F 14. The roots of beets should be removed before cooking.

T F 15. Large steam cookers generally need preheating so that the cold metal does not absorb the heat of the steam.

T F 16. Frozen vegetables should always be thawed before steaming.

T F 17. When washing leaf vegetables, the leaves should be removed from the water so that dirt and grit will not remain on the leaves.

T F 18. Due to opposite chemical reactions, most red vegetables are cooked covered while green vegetables are cooked uncovered.

T F 19. Most vegetables require only a small amount of water for cooking; however, it is necessary to cook a few with considerable water.

T F 20. Potatoes and squash require storage by refrigeration.

T F 21. Frozen vegetables should be stored just below 32° F.

T F 22. If vegetables are not to be used immediately after cooking, they should be cooled with cold water.

T F 23. Vegetables should be cooked without being cut whenever possible.

T F 24. Dried milk should never be used in making mashed potatoes.

T F 25. Fresh potatoes should be used for making french fried potatoes.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. Precooking of fresh vegetables is referred to as ______________.

2. Worms can be removed from cauliflower and broccoli by soaking in cold salt water or ______________ ______________.

3. Frozen squash will cook unevenly unless thawed first due to the large amount of ______________ it contains.

4. Canned vegetables usually require the addition of ______________ and ______________ before serving.

5. Pod bearing vegetables are classified as ______________.

6. The main use of dried legumes is in ______________ ______________.

7. Green vegetables should generally be cooked ______________ whereas red vegetables are normally cooked ______________.

8. If white vegetables are overcooked they will tend to appear ______________.

9. Vegetable plates should be made up of at least ________ vegetagles or equivalents.

10. Acids added to red vegetables to intensify the color should be added at the ______________ of the cooking period.

11. Vegetables should be cooked until they are ______________.

12. The absence of ______________ and ______________ in pressure cooking helps to preserve the vitamins in the vegetables.

13. The addition of small amounts of ______________ when pressure cooking will help keep in the minerals.

14. Steam cooking of fresh potatoes usually takes about ________ minutes.

15. Steam cooking of fresh corn on the cob takes only about ________ minutes.

16. Cooking pressure for a pressure cooker generally is about ______ pounds.

17. The cover or door of a pressure cooker should never be removed until all of the ______________ has been removed.

18. Frozen vegetables should not be _______________ once they are thawed.

19. Fresh vegetables should be cut nearly the same size in order to insure _______________ _______________.

20. Unnecessarily large amounts of _______________ should be avouded when cooking vegetables.

21. Pressure cooking times depend upon the degree of _______________ and the type of _______________.

22. Prepared vegetables should be covered with a _______________ _______________ until ready to use.

23. When baking potatoes the temperature of the oven should be about ________ F.

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. The nutritional values of vegetables are:

(A) __________________________ (C) __________________________

(B) __________________________

2. Four "don'ts" with regard to vegetable selection for the menu are:

(A) ____

(B) ____

(C) ____

(D) ____

3. Three values of cooking vegetables are:

(A) __________________________ (C) __________________________

(B) __________________________

4. Three changes that occur as vegetables cook are:

(A) __________________________ (C) __________________________

(B) __________________________

5. Four classifications of vegetables are:

(A) ____________________ (C) ____________________

(B) ____________________ (D) ____________________

6. Overcooking of vegetables will result in:

(A) ____________________ (C) ____________________

(B) ____________________ (D) ____________________

7. Spoilage of canned vegetables can be discovered by:

(A) ____

(B) ____

(C) ____

(D) ____

8. Three grains that might be used as substitutes on a vegetable plate are:

(A) ____________________ (C) ____________________

(B) ____________________

9. Three frozen vegetables that should be thawed before cooking are:

(A) ____________________ (C) ____________________

(B) ____________________

10. Common methods of cooking vegetables are:

(A) ____________________ (C) ____________________

(B) ____________________ (D) ____________________

Assignment
Sheet No. 16

Covering
Units 65-68

SALADS AND SALAD DRESSINGS

Salads may be classified as appetizers or as the main dish for a light luncheon. Originally a salad was designated as a dish of raw greens, with oil and seasonings, and some of the better salads today are the simple, attractive, appetizers that supplement regular meals.

Salads generally do not get the attention that they deserve in preparing a meal. They provide a good opportunity to display the artistry of the chef and should add something to the meal. A salad should be attractive, crisp, and tasty and should be accompanied by an appropriate dressing.

Completion of this unit should enable you to prepare and present attractive and desirable salads and dressings.

Assignment:

1. Read the references listed below.
2. What types of salads does your establishment serve? Are they made up ahead of time? If so, how long are they held? Are they properly covered to prevent wilting and deterioration? Could your process be improved? How? Report your findings to your coordinator.
3. Answer the questions below and turn in this assignment by ____________________.

References:

A. The Culinary Institute of America, The Professional Chef, pp. 199-242.
C. Smith, Handbook on Quantity Food Management, pp. 74-75.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. Salads are always served cold.

T F 2. Salads should hang over the edge of the plate to give the customer the impression of a large amount.

T F 3. It is a good idea to place salad plates into a refrigerator before placing the salad on them.

T F 4. In attempting to get eye appeal in a salad, generally the flavor will suffer; therefore, it is extremely important to prevent this.

T F 5. Salad dressings are always served separate from the salad enabling the customer to apply it to his desires.

T F 6. If too much gelatin is used to make a gelatin salad, the salad will be come soft and sloppy.

T F 7. A better gelatin salad will generally result if natural fruit juices are added along with the water.

T F 8. Hot water should be used only to dissolve the gelatin after which cold should be used.

T F 9. Fruit acids tend to speed up and aid the action of the gel and therefore should be used whenever possible.

T F 10. As the volume of gelatin increases, its power to gel decreases.

T F 11. Ice can be used as a means of speeding up the gelling process.

T F 12. Parsley is a garnish that is used considerably with fruit salads.

T F 13. A menu generally should contain only one choice of salad.

T F 14. Romaine is a salad green that must be treated with care since it is highly perishable.

T F 15. After greens have been washed in a pan of cold water, the water should be poured out and the greens refrigerated.

T F 16. Practically all fresh fruits and vegetables except bananas should be refrigerated until used.

T F 17. Generally salads should be made up well in advance and refrigerated until time of service.

T F 18. Aluminum storage equipment should not be used since they tend to discolor food.

T F 19. Since mayonaisse is high in fat content, it is desirable and possible to make potato salad with other materials.

T F 20. French dressing is generally used with most tossed salads.

T F 21. Dressings have no food value but are used for flavor, appearance, and ease of eating.

T F 22. Boiled dressings contain little or no fat.

T F 23. Good french dressing will not have a separation of oil and acid after a period of standing.

T F 24. Mayonnaise should be made in the kitchen whenever possible.

T F 25. In making mayonnaise in the kitchen it is important to add oil slowly and in small amounts.

T F 26. French dressing, although a dressing in itself, is also a prime ingredient for other dressings.

T F 27. A general rule is: The stronger the salad, the milder the dressing should be.

T F 28. French dressing needs to be shaken well before using.

T F 29. Fruit and vegetable salads should be assembled by the assembly line method.

T F 30. If a gelatin salad is to be kept overnight, a greater proportion of gelatin should be used.

T F 31. Congealing time for gelatin can be shortened by dissolving the gelatin in a cold liquid.

T F 32. Fruits, vegetables, and other such ingredients should be added after the gelatin is partially congealed.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. Salads will tend to loose some of their flavor if they are served too ________________.

2. That part of the salad which is included primarily for appearance is called the ________________.

3. Flavorless gelatin should be soaked in ________________ ________________ before using.

4. A garnish that is commonly used with all salads is ________________.

5. The most common salad green used for a salad base is ________________.

6. Because of their water content and the fact that they will tend to wilt the greens and make them soggy, ________________ are seldom used in the main part of a salad.

7. Over-handling and cleaning of greens may result in the formation of ________________.

8. The cutting of fresh fruits to prepare them for salads should be done with ________________ ________________ knives to prevent discoloration.

9. From the standpoint of customers selection and preparation time and effort, salads should generally be kept ______________.

10. A combination of raw or cooked vegetables with greens is referred to as a ______________, ______________ or ______________ salad.

11. The oil content of salad dressings is primarily for ______________.

12. Fruit french dressing is a variation of french dressing that is accomplished by substituting a fruit juice for some of the ______________.

13. Products similar to mayonnaise but which do not meet government regulations are termed simply ______________ ______________.

14. Probably the most important job in making mayonnaise is the ______________ of the eggs and oils.

15. It is important when making mayonnaise to prevent the ______________ of the ingredients.

16. French dressing can be stabilized by adding ______________ or ______________.

17. Salad greens that are refrigerated prior to assembly in a salad should be covered with a ______________ ______________.

18. Salad dressings should be added to salads just before ______________.

19. If the emulsion of mayonnaise breaks, it should be combined with more ______________ ______________.

20. Mayonnaise should be combined with ______________ ______________ for fruit and vegetable salads to prevent leaking.

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. The first innovation of Ceasar's salad was composed of:

(A) ______________________ (C) ______________________

(B) ______________________

2. Individual salads fall into the catagories of:

(A) ______________________ (C) ______________________

(B) ______________________ (D) ______________________

3. The four main parts of a salad are:

(A) ______________________ (C) ______________________

(B) ______________________ (D) ______________________

4. The purposes of the base of a salad are:

(A) ____

(B) ____

(C) ____

5. Products that will hinder the action of the gel in preparing a gelatin salad are:

(A) ______________________ (C) ______________________

(B) ______________________

6. The three basic types of salad dressings are:

(A) ______________________ (C) ______________________

(B) ______________________

7. Four required ingredients of mayonnaise are:

(A) ______________________ (C) ______________________

(B) ______________________ (D) ______________________

8. When making mayonnaise, the oil and eggs may separate because:

(A) ____

(B) ____

(C) ____

Assignment
Sheet No. 17

Covering
Units 68-73

FLOUR AND GRAIN PRODUCTS

Flour and grain products comprise an important part of our everyday diet. They provide us with carbohydrates which are necessary for energy.

Although some of the products can be obtained ready-to-use, there are a number of popular menu items that require skillful preparation and cooking.

This unit will familiarize you with these various flour and grain products and the correct methods of preparation.

Assignment:

1. Read the references listed below.
2. Answer the questions below and turn in this assignment by ____________________.

References:

A. The Culinary Institute of America, The Professional Chef, pp. 23-25.
B. American Home Economics Association, Handbook of Food Preparation, pp. 40-44.
I. Information Sheet #3, "Preparing and Baking Flour Mixes."

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. Yeast is the most common leavening agent used in flour mixes.

T F 2. The liquid that is generally used in flour mixtures is milk.

T F 3. Wheat flour is used to provide most of the flour used in flour mixtures.

T F 4. Juices should never be used to thin down a flour mixture.

T F 5. The types of flour mixes are determined primarily by the ratio of liquid to flour that is used.

T F 6. All of the methods of preparing flour mixes require that the liquid be added to the dry ingredients.

T F 7. The readiness of cooking griddles and irons can be tested by putting water on them.

T F 8. Pastry should be chilled before using.

T F 9. An 8-inch pie should provide eight servings.

T F 10. Whole wheat flour has not been ground.

T F 11. The main difference between whole wheat flour and white flour is that white flour is sifted.

T F 12. General purpose flour has less protein content than bread flour.

T F 13. Soy flour has good gluten forming characteristics and therefore is good for breadmaking.

T F 14. All leavening agents produce a gas which causes the dough or batter to rise.

T F 15. Pastas many times take the place of potatoes and vegetables.

T F 16. Pastas are generally served along with some other food to provide more nutrition to the meal.

T F 17. Most pastas should be cooked in a liquid to aid digestion and appearance.

T F 18. Soft noodle doughs should be used as soon as they are prepared so that they don't dry out.

T F 19. As with other foods, pasta products should be simmered rather than extreme boiling to preserve the flavor and nutritional value.

T F 20. It is best to cook pastas covered so that the steam and heat will not escape, thus permitting better cooking.

T F 21. Rice is not classified as a flour product.

T F 22. Although rice may take the place of potatoes or vegetables, the loss of nutrition needs to be replaced with some other food.

T F 23. The amount of coating or layers removed from rice in the milling process determines to a great extent the nutritional content.

T F 24. Pre-cooked rice is preferred over other rice because of the fact that it does not require a great deal of further preparation.

T F 25. In preparing rice, the rice is always poured into the water or liquid no matter which method of preparation is being used.

T F 26. Rice may be cooked over open heat or in an oven.

T F 27. When paste products are cooked and need to be held for service, cold water should be run on the outside of the pot to cool and prevent sticking.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. The two most common wheat flours are ______________ ______________ and ______________.

2. Soft doughs require about ________ part liquid to ________ parts flour

3. Pastry should be baked at about ________ F.

4. The wheats used for macaroni and other pastes are called ______________ wheats.

5. Rice that has had only the hull removed is called ______________ rice.

6. A general rule in cooking paste products is to use about ________ or ________ parts of salted water to 1 part paste.

7. Spaghetti will usually require about ________ minutes of cooking time.

8. Rice that has been ______________ should be washed before cooking to remove the ______________.

9. A high priced rice that is used with poultry is called ______________ rice.

10. In preparing rice by the boiling-steaming method, the rice is ______________ into boiling water.

11. The most common method for preparing rice is the ______________ method.

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. The basic ingredients of flour mixtures are:

(A) ______________ (B) ______________ (C) ______________

2. The four types of flour mixtures are:

(A) ________________ (C) ________________

(B) ________________ (D) ________________

3. The three common methods of mixing batters and doughs are:

(A) ____________ (B) ____________ (C) ____________

4. Flours that are low in gluten-forming proteins and need to normally be used with wheat flour are:

(A) ____________ (E) ____________ (H) ____________

(B) ____________ (F) ____________ (I) ____________

(C) ____________ (G) ____________ (J) ____________

(D) ____________

5. Enriched flour has the following ingredients added:

(A) ________________ (C) ________________

(B) ________________ (D) ________________

6. The three main varieties of rice are:

(A) ____________ (B) ____________ (C) ____________

7. The germ of rice contains:

(A) ________________ (C) ________________

(B) ________________ (D) ________________

8. Rice or grain is composed of three parts, namely:

(A) ____________ (B) ____________ (C) ____________

Information
Sheet No. 3

PREPARING AND BAKING FLOUR MIXES*

Flour Mixtures

1. The chief ingredient in flour mixtures is flour. Many ingredients such as sugar, fat, eggs, flavoring, fruits and nuts, are added to flour mixtures, but their essential ingredients are flour liquid and leavening.

2. Leavening results from one or more sources, such as air beaten or folded into the mixture; steam from the liquids used; gas from baking powder, soda or yeast.

The steam created from one cup of liquid will leaven one cup of flour. Soda is used with sour milk or molasses. One-half teaspoon of soda is required for one cup of sour milk or molasses and leavens one cup of flour.

The amount of yeast required for a bread is dependent upon the time allowed for fermentation. More yeast is used to shorten the time, which varies from 2 to 10 hours. Two cakes of yeast for each cup of liquid are used for bread process requiring four hours or less.

Baking powder is the most commonly used leavening agent. Several types are available: slow acting, quick acting, and composite or double-acting. For best results, the amount specified by the manufacturer is used.

Milk is the liquid most commonly used in flour mixtures: sweet, sour or buttermilk. Evaporated, condensed, or dried milk is often substituted for fresh milk. Sour milk and buttermilk are used in recipes in which soda is the leavening agent. Water and fruit juices are used in some types of quick breads and cakes.

3. Flour is made from wheat, buckwheat, rye, corn, rice, barley, potatoes, and soya beans. Many variations in all types of batters and doughs are possible. Wheat flour, however, is the most extensively used. There are two kinds of wheat flour used extensively -- whole wheat and white flour. Whole wheat flour is prepared by grinding the whole wheat grain. White flour is the finely milled product which consists chiefly of starch and gluten. Gluten is the elastic substance which forms the framework or structure of a product. Flour made from other grains that do not contain enough gluten to form a structure is, therefore, used with flour from wheat in certain types of products.

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*Adapted with permission from Food Service by Helen Livingstone, McKnight and McKnight Publishing Company, Bloomington, Illinois, 1950.

An all-purpose flour is one that contains a moderate amount of gluten and is used for all types of mixtures. Pastry flour or cake flour contains a small amount of gluten. Raw or cooked cereals, such as rolled oats, corn meal and rice also are used with wheat flour.

Principal Types of Flour Mixtures

The proportion of liquid to flour is the chief factor in determining the four principal types of flour mixtures -- thin batters, thick batters, soft doughs and stiff doughs.

1. Thin batters, such as griddle cakes, are thin enough to pour easily from a pan or pitcher.
2. Thick batters, such as muffins and drop cookies, are thick enough to drop from a spoon.
3. Soft doughs, such as biscuits, yeast bread and rolls are thick enough to be handled on a mixing board or table.
4. Stiff doughs, such as pie crust and noodles, are stiff enough to be rolled.

Flour Mixtures Classified According to Consistency

Type	Proportion of Liquid to Flour	Examples	Variations
Thin batters	1 c. to 1 c.	Popovers, griddle cakes	Waffles, cream puffs
Thick batters	1 c. to 2 c.	Muffins, cakes	Gingerbread, cup cakes, drop cookies
Soft doughs	1 c. to 3 c.	Baking powder biscuits, breads rolls	Strawberry, shortcake, cinnamon rolls, nut bread
Stiff doughs	1 c. to 4 c.	Noodles, pastry, rolled cookies	Tarts, cheese straws, icebox cookies

COMPARISON OF INGREDIENTS IN TYPICAL BATTERS AND DOUGHS

Product	Flour	Liquid	Leaven	Salt	Fat	Sugar	Eggs	Flavoring
Popovers	2 c.	2 c.		1/2 t.			2	
Griddle cakes	2 c.	1 1/2 c.	4 t. baking powder	1 t.	4 tb.		1	
Waffles	2 c.	1 1/2 c.	4 t. baking powder	1 t.	4 tb.	1 to 2 tb.	2	
Muffins	2 c.	1 c.	4 t. baking powder	1 t.	4 tb.	2 to 4 tb.	1	
Ginger-bread	2 c.	3/4 c. water & 3/4 c. molasses	2 t. baking powder and soda	1/2 t.	4 tb.	1/2 c.	1	1 t. ginger and cinnamon
Cup cakes	2 c.	3/4 c.	4 t. baking powder	1/4 t.	4 tb.	1 c.	1	1 t. vanilla
Drop cookies	2 c.	1/2 c.	2 t. baking powder	1/2 t.	1/2 c.	1 c.	1	1 t. vanilla
Baking powder biscuit	2 c.	2/3 c.	4 t. baking powder	1 t.	4 tb.			
Yeast rolls	2 c.	2/3 c.	1 yeast cake	1/2 t.	2 tb.	2 tb.		
Pastry	2 c.	1/2 c.		1 t.	1/2 c.			

How to Prepare Typical Flour Mixtures

There are three ways commonly used for mixing batters and doughs. They are the muffin way, the batter way, and the biscuit way. Many variations of these three ways are possible, but the following procedures are simple and satisfactory.

The Muffin Way

This one may be used for either thick or thin batters.

1. Measure the dry ingredients. Sift them together in a mixing bowl.
2. Prepare the liquid ingredients as follows: measure the milk; beat the eggs until light; measure and melt the fat.
3. Mix the liquid ingredients together.
4. Pour the liquids all at once into the dry ingredients. Mix lightly until all the dry ingredients are moistened. The batter will have a lumpy appearance.
5. For large amounts -- use the mixing machine.

The Biscuit Way

This one may be used for either soft or stiff doughs.

1. Measure the dry ingredients and sift together into a mixing bowl.
2. Measure the fat and add to the dry ingredients.
3. Cut the fat into the dry ingredients, using two knives, scissor-fashion by hand, or use the mixing machine.
4. Measure the liquid and add gradually to the flour and fat mixture.
5. Mix the dough until it is the proper consistency.
6. Remove the dough to a floured board or work table and prepare for baking.

The Batter Way

This one is the one most commonly used for cakes made with fat.

1. Measure and cream the fat by hand or machine.
2. Measure the sugar and add to the fat, a little at a time. Continue creaming until the mixture is light and smooth.

3. Add the eggs, beating well after each is added.
4. Measure and mix the dry ingredients together. Sift several times.
5. Measure the liquid.
6. Beginning with dry ingredients, add the dry ingredients and the liquid alternately to the creamed mixture.
7. Mix well after each addition. The batter should be smooth and light.

How to Bake Typical Flour Mixtures

Griddle Cakes

1. Heat the griddle gradually. It is hot enough for baking when drops of water poured on it form into balls and roll across its surface.
2. Pour enough batter from a pitcher or large spoon to form a cake two or three inches in diameter. Leave space between the cakes so they will not touch when spread.
3. As the cakes bake, bubbles form at the edges and the batter rises. When the cakes are slightly set, turn them over with a spatula or pancake turner.
4. Continue cooking until the cakes are browned on the under side. Griddle cakes are turned only once to insure lightness.
5. Serve while hot.
6. One serving -- 3 cakes.

Waffles

1. Close the baker and heat the electric waffle iron gradually. If the iron is not equipped with a heat indicator, use the water test as indicated for testing a hot griddle.
2. Pour the batter from a pitcher onto the center of the baker. Fill the grids within one inch of the edge to allow for spreading of the batter.
3. Close the baker at once and keep it closed throughout the baking period. Steam escapes during the baking. When steaming ceases, the waffle is baked.
4. Open the baker and lift the waffle from the grid with a fork.
5. Serve hot.
6. One serving -- 2 sections

Muffins or Cup Cakes

1. Grease the muffin pans.
2. Use a spoon to lift the batter into the pans.
3. Fill cups 2/3 full.
4. Bake cup cakes in a moderate oven (350° F. to 375° F.).
5. Bake muffins in a hot oven (400° F. to 425° F.).
6. One serving -- 2 muffins or 1 cup cake.

Drop Cookies

1. Grease the baking sheets.
2. Use two spoons for shaping the cookies. Fill one spoon with the batter. Use the other spoon to remove it to the baking sheet and to shape the cookies.
3. Place the cookies in rows, allowing one to two inches between them for spreading.
4. Bake in a moderate oven (375° F.)
5. One serving -- 2 cookies.

Biscuits

1. Place the dough on a floured board or work table.
2. Flour the hands and press or knead the dough lightly for thirty seconds.
3. Pat or roll the dough to 1/2 inch thickness. Light handling is necessary to keep the dough light and springy. If a rolling pin is used, push the dough lightly, lifting the pin upward at the end of each roll.
4. Use a floured cutter to cut the biscuits.
5. Place biscuits on a baking sheet or in a shallow pan about 1/2 inch apart.
6. Bake in a hot oven (450° F.).
7. One serving -- 2 biscuits.

Pastry

1. Pastry is chilled before using.
2. Roll only enough dough for one crust at a time.

3. Place the dough on a floured board or work table.

4. Press the dough lightly with a floured rolling pin to flatten and shape it into a circular form.

5. Use short, light strokes to roll the dough from the center toward the edge to 1/8 inch thickness. Lift the dough carefully with a spatula if it sticks and lightly flour the board. Keep the dough circular by moving it as needed. The pastry should be about 2 inches larger than the pie pan.

6. Fold the dough double and lift it onto the ungreased pie pan with the fold in the center. Unfold the pastry and fit it loosely to the bottom and sides, leaving no air between the pastry and the pan. Avoid stretching.

7. Fold back the dough that extends beyond the edge of the pan. Form a fluted rim by pressing the dough firmly between two fingers.

8. When a top crust is used, the bottom crust is cut around the edge to fit the pan.

9. Moisten the edge of the lower crust before adding the top crust. Press the two crusts together with a fork or flute the rim with the fingers.

10. Pastry is baked in a hot oven (450° F.).

11. Servings — 6 single servings in an 8-inch pie; 8 servings in a 10-inch pie.

Assignment
Sheet No. 18

Covering
Units 74-76

DESSERTS

Desserts are becoming more and more popular and are important to the chef since the dessert generally represents the end of the meal. This, then, will have a more lasting effect on the customer. They are served at the end of a meal since their high sugar content tends to dull the appetite.

Desserts can generally be classified into two groups: frozen and fruit desserts, and pastries, although there are others such as custards and puddings. The popularity of frozen desserts has increased primarily because of transportation and storage facilities and the ingenuity of some chefs. Pastries are old favorites with pie heading the list. It is important to keep pastries quite light even when they follow a light meal. A good understanding of parts of the previous unit will help in studying this phase of desserts.

This unit will provide you with some information and experiences in the techniques of dessert making.

<u>Assignment:</u>

1. Read the reference listed below
2. Answer the questions below and turn in this assignment by ____________________.

<u>Reference:</u>

A. The Culinary Institute of America, <u>The Professional Chef</u>, pp. 293-321.

<u>Questions:</u>

True-False

<u>Directions:</u> The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. In selecting desserts for a menu, only the customers desires and satisfaction should be considered.

T F 2. Pastries and desserts provide a good chance for a chef to display his ability and to be original in his work.

T F 3. Yeast will react more favorably when a temperature of about 140° F is used.

T F 4. Placement of the pans and products in the oven for baking can have an effect on the final result.

T F 5. It is important, even for the experienced chef, to weigh out the ingredients for baking.

T F 6. A formula sheet should be used for all quantity baking.

T F 7. Experience and proper teaching are all that is necessary to obtain great skill and craftsmanship in baking.

T F 8. Unusual though it may seem, there are some ice cream desserts that require a certain degree of baking.

T F 9. Appareil a Bombe, which is a base for other desserts, can be prepared as much as a week in advance.

T F 10. Ice Cream Bombes were named because the shape of the original ones resembled a bomb.

T F 11. An Ice Cream Bombe should be removed from the mold by running cool water over the mold until the mold breaks free.

T F 12. A common mistake in making cream puff paste is the use of the wrong number of eggs.

T F 13. Paper or grease may be used to cover the pans when making cream puff paste.

T F 14. Puff paste contains no sugar but rises due to the addition of cream of tartar.

T F 15. Great care should be taken in preparing, rolling, and folding puff paste.

T F 16. Turnovers may be made by baking with or without the filling.

T F 17. Meringue is a difficult item to make but well worth the effort.

T F 18. Great care and effort should be used in folding and handling meringue.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. In order to insure customer satisfaction and increased sales, ______________ in desserts should be offered.

2. An important characteristic of a chef to enable him to obtain good results is ______________.

3. One prerequisite for good desserts is to use the ______________ ingredients

4. Yeast will not be functional at just any ______________.

5. All baking should be done with the aid of a ______________ ______________.

6. To be a skillful chef, one needs to have the right experience and a ______________ of baking.

7. A popular dessert that is easy to prepare is ______________ ______________.

8. The basic ingredients for the base for mousses are ______________ ______________, ______________, and ______________.

9. Ice Cream Bombes are usually topped with ______________ ______________.

10. Ice Cream Bombes should be sliced with a knife that has been dipped in ______________ ______________.

11. Cream puff paste should be cooked at about ________ F.

12. The folding of puff paste should not be done until all loose ______________ has been removed.

13. After puff paste dough is cut, it should ______________ for about 30 minutes before baking.

14. Puff paste should be rolled at least ________ times.

15. The main ingredients of meringues are ______________ ______________, ______________, and ______________.

16. In making meringues, the pans should be coated with ______________ when possible.

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. Four areas that a baker or pastry chef should be informed on are:

(A) ______________________ (C) ______________________

(B) ______________________ (D) ______________________

2. Three critical temperatures for yeast are:

(A) ______________________ (C) ______________________

(B) ______________________ (D) ______________________

3. The information on or parts of a formula sheet are:

(A) ______

(B) ______

(C) ______

(D) ______

(E) ______

(F) ______

(G) ______

(H) ______

(I) ______

(J) ______

(K) ______

(L) ______

4. Puff paste contains:

(A) ______ (D) ______

(B) ______ (E) ______

(C) ______ (F) ______

Assignment
Sheet No. 19

Covering
Units 77-78

BEVERAGES

A beverage of some sort is usually a part of every meal. Although some beverages have nutritional value, their chief function is as a stimulant.

Coffee is perhaps the most popular commercial beverage and the people of the United States are great coffee drinkers. Other common beverages are tea, milk, and milk drinks such as cocoa, etc. One should not overlook water as a beverage, possibly as a second beverage with many meals. You have already studied some of the values and uses of milk in another unit, and since it and water require little or no preparation, no further mention of them will be make.

This unit will enable you to study the ingredients of beverages requiring preparation.

Assignment:

1. Read the references listed below.
2. Compute the approximate percentages of coffee, tea, and milk in relationship to the total beverages served in your establishment, not including water. Are these made and kept fresh? Does this involve problems of storage or waste? How could this be improved?
3. Answer the questions below and turn in this assignment by____________________.

References:

A. The Culinary Institute of America, The Professional Chef, pp. 16-18.
I. Information Sheet #4, "Chocolate and Cocoa."

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. The roasting of coffee beans is done primarily to allow the coffee to be ground.

T F 2. For best results, no more than three kinds of coffee should be blended together.

T F 3. Most coffee is ground before it is purchased by eating establishments.

T F 4. No matter what method is used, when preparing coffee accurate measurement is important.

T F 5. Generally speaking, fresh coffee should be made every hour.

T F 6. A coffee urn should always be cleaned as soon after use as possible

T F 7. It is recommended that water be left in an urn when not in use but that this water should be replaced when making coffee again.

T F 8. Steel wool or some stiff brush should be used to scour the urn baskets during the semi-weekly cleaning.

T F 9. The equipment available will determine to a large extent what grind of coffee to use.

T F 10. Once the grounds have released their properties and they are removed, the coffee is ready to drink.

T F 11. Urn bags should be replaced at least once every two weeks.

T F 12. Coffee that is held lower than 185° F. will tend to lose its flavor.

T F 13. Only pure cream should be used with coffee.

T F 14. Iced coffee should be made double strength.

T F 15. The common tea in the United States is black tea.

T F 16. There are only three types of teas.

T F 17. Teapots should be preheated before making hot tea.

T F 18. Cocoa is used more than chocolate in preparing a beverage.

T F 19. Chocolate should not be exposed to too much heat as this will cause it to spoil.

T F 20. Either milk or water may be used in making a beverage from cocoa.

T F 21. In mixing a beverage, using cocoa and other ingredients, the dry ingredients should be added separately to the liquid.

T F 22. Chocolate drinks should always be served hot.

T F 23. The entire seed is ground up to produce chocolate.

T F 24. The main difference between cocoa and chocolate is that cocoa is chocolate with most of the fat removed.

T F 25. Cocoa and chocolate should never be refrigerated since this tends to make them bitter.

Completion

Directions: Fill in the blank(s) in each sentence with the word(s) required to complete the sentence correctly.

1. The United States receives most of its coffee from ______________.

2. A coffee of outstanding flavor in the better grades comes from ______________.

3. The quality, flavor, and taste of coffee will be degraded by ______________ heating.

4. Ground coffee will tend to become stale and useless when exposed to ______________ and ______________.

5. Good coffee should have ______________, ______________, and ______________.

6. The cleaning of coffee making equipment should always be done with ______________ water.

7. Bitter coffee is generally a result of too ______________ a grind for the equipment available.

8. Coffee should always be made with ______________ water.

9. It is important to spread coffee ______________ in the equipment when preparing.

10. Filters that have been used should be stored in ______________ ______________ when not in use.

11. Generally the ratio of water to coffee should be ________ gallons of water to 1 pound of coffee.

12. The grind of coffee that requires the longest brewing time is ______________.

13. The lowest butterfat content that any pure cream can have is ________ per cent.

14. Extra light cream is a combination of ______________ and ______________.

15. It is best to make tea in equipment that is made of ______________.

16. The steeping of tea should not be longer than ________ minutes.

17. Improper storage of cocoa will result in it becoming ______________.

18. The flavor of beverage made from cocoa and chocolate can be improved by the addition of ______________ and possibly some ______________.

19. One problem in preparing hot chocolate beverages is the accumulation of ______________ on the top.

20. A cup of hot cocoa or chocolate can be dressed up by the addition of ______________ ______________.

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. Four characteristics of coffee that may vary depending on where the coffee was grown are:

   (A) ______________ (C) ______________

   (B) ______________ (D) ______________

2. The three kinds of roasting for coffee beans are:

   (A) ______________ (B) ______________ (C) ______________

3. Three pre-requisites of good coffee are:

   (A) ______________ (C) ______________

   (B) ______________

4. The three common grinds of coffee are:

   (A) ______________ (B) ______________ (C) ______________

5. The three main types of tea are:

   (A) ______________ (B) ______________ (C) ______________

6. An accompaniment of tea might be:

   (A) ______________ (B) ______________ (C) ______________

7. The formation of skum on the milk when preparing hot chocolate beverages can be avoided by:

   (A) ______________

   (B) ______________

   (C) ______________

Information
Sheet #4

CHOCOLATE AND COCOA

Chocolate and cocoa are made from the seed of the cacao tree. The seeds are quite bitter in the raw state and must be roasted. After roasting they are split open and the germ removed. This is the form in which the product is shipped to this country. It is then ground, forming the chocolate which contains considerable fat. The removal of some of this fat and then pulverizing results in cocoa. Both chocolate and cocoa may be used in the preparation of beverages. However, cocoa is the most commonly used.

Both cocoa and chocolate should be stored in a dry, cool place, even refrigerated if necessary. Cocoa tends to lump if stored in a moist atmosphere or at high temperature. When chocolate is stored at high temperature, some of the cocoa butter softens and forms a grayish film on the outside of the chocolate; this makes the product appear stale but the flavor may not be impaired.

A smooth well blended product is the goal in preparing a beverage with cocoa and chocolate. The addition of sugar and some salt will improve the flavor some. Although milk is generally used as a liquid due to the fact that it will improve the flavor and nutrition, water may also be used. Normal procedure for mixing is to mix the dry ingredients together and then add this to the liquid. To save time in preparing either a hot or cold chocolate drink, a chocolate syrup might be prepared ahead of time and kept refrigerated until used.

One difficulty in preparing these hot beverages is the formation of skum on the milk. This can be avoided by eliminating unnecessary heating of the milk, by keeping the milk covered during heating, and by beating or whipping. Whipped cream is a common addition to a cup of hot chocolate or cocoa.

Assignment
Sheet No. 20

Covering
Units 79-91

KITCHEN ORGANIZATION AND PLANNING

The selection of food may depend upon availability, economics, and needs and desires of both management and clientele. Food should meet individual needs, both physical and emotional, for good nutrition and satisfaction of hunger. Abundant health requires not just food, but the right food properly prepared. With so many people eating away from home, part of the responsibility for adequate menus must be assumed by the food establishment.

Although all chefs may not get the opportunity nor be required to do any organizing or planning, they should nevertheless be prepared should the situation demand it. Some plan of organization is needed to efficiently operate a kitchen, particularly large ones. Planned buying and planned menus are also necessary for efficient operation.

In this unit you will study some of the factors involved in the organization and planning of the kitchen activities.

Assignment:

1. Read the references listed below.
2. Does your establishment keep up-to-date records similar to those found in Reference C, pp. 9-39, 129-133? What are the strong points of your record system? How could it be improved?
3. Determine the cost for 30 portions of a simple recipe used in your establishment by the method indicated in Reference A, p. 13. They convert this recipe to provide for 10 portions.
4. Answer the questions below and turn in this assignment by ____________________.

References:

A. The Culinary Institute of America, The Professional Chef, pp. 12-13.
B. American Home Economics Association, Handbook of Food Preparation, pp. 1-21.
C. Smith, A Handbook on Quantity Food Management, pp. 5-63, 113-137.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. The purchasing of food is the most important consideration in kitchen planning.

T F 2. A food cost percentage needs to be figured for each item in order to get the total average food cost percentage.

T F 3. A 40% food cost means that the selling price will be 40% more than the cost of the food.

T F 4. It is important to have standardized and consistant portions in order to obtain a reasonable profit.

T F 5. Not only does the standardization of recipes help to control costs and profits but it also benefits the customer by providing the same product each time it is ordered.

T F 6. Abbreviations should be used whenever possible in the construction or the re-working of recipes.

T F 7. If specific tests or temperatures are written into a recipe, general tests need not be included.

T F 8. A quarter pound bar of butter or similar fat will generally be equal to about one half cup of fat.

T F 9. An equal amount of cornstarch may be substituted for flour in a recipe.

T F 10. The nutritional value of a menu is not the responsibility of the chef, but rather that of the customer.

T F 11. When different types of groups are to be served, it is necessary to have an entirely different menu planned for each group.

T F 12. It is best not to repeat a dish on the menu for at least eight days.

T F 13. It is good practice to utilize seasonal foods primarily when they are in season rather than year round.

T F 14. A master work sheet that all can see is preferable over individual work sheets for each worker.

T F 15. The processes of food preparation that best preserve the natural qualities of the food will also ensure the best food value.

T F 16. Storage or holding of unprepared and prepared foods should be kept to a minimum.

T F 17. Reheated foods tend to become flavorless.

T F 18. The use of substitutes in a recipe will usually cheapen or make the product inferior.

T F 19. The advantage of prepared mixes is that they need not be checked ahead of time.

T F 20. Each serving should be standardized and the customers should be able to tell this by observing the servings.

T F 21. Obtaining standard portions only affects the cost.

T F 22. Tabulation studies should be made frequently.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. All items on a menu may not necessarily result in a ____________ for the establishment.

2. The cost of the raw food is multiplied by ________ to obtain a 45 per cent food cost.

3. The cost of each item on a menu must be based on the ____________ of each food.

4. Recipes are usually kept on _______________.

5. The constant or number that each ingredient of a recipe should be multiplied by to convert 15 portions to 45 portions is ________.

6. The abbreviation "tsp." means _______________.

7. A recipe contains a list of _______________ and the method of _______________ the product.

8. When constructing a recipe the yield should be included, giving both the _______________ and _______________ of servings.

9. To replace 1 tablespoon of flour in a recipe, it requires ________ teaspoons of tapioca.

10. A well worked out menu pattern to ensure well planned menus should be _______________ to the clientele and _______________ as related to the staff and equipment available.

11. As a guide to menu planning, a chef should study _______________ _______________.

12. A menu chart will help to ensure _______________ and _______________ in type of menu items.

13. A detailed check on the amount of food purchased, prepared or cooked, and the number of servings obtained is the result of a _______________ study.

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. Three important considerations for efficient management of food are:

(A) ____________ (B) ____________ (C) ____________

2. Non-profit items may be put on a menu for:

(A) ______________________________

(B) ______________________________

(C) ______________________________

3. The three most common forms for presenting recipes are:

(A) ____________ (C) ____________

(B) ____________

4. Techniques of good menu planning consider the following:

(A) ____________ (D) ____________

(B) ____________ (E) ____________

(C) ____________

5. An individual work sheet should show:

(A) ____________ (C) ____________

(B) ____________ (D) ____________

6. Standard recipes help to:

(A) ____________ (D) ____________

(B) ____________ (E) ____________

(C) ____________

7. Three imporcant aspects of organization and planning are:

(A) ____________ (C) ____________

(B) ____________

Assignment
Sheet No. 21

Covering
Units 92-97

WORK SIMPLIFICATION AND WASTE CONTROL

To cut down on the drudgery and routine of jobs, most businesses try to simplify operations. Properly done, this simplification helps to control waste, both in human resources and material products, thus minimizing hackneyed efforts and utilizing maximum efficiency.

In this unit you will study some aspects of this problem to see how they can benefit your establishment and yourself.

Assignment:

1. Read the reference listed below.
2. Has your employer tried to show you how to minimize waste motion? Have you learned to apply these principles to everything you can do? Does your establishment have a suggestion box for this purpose? Make a list of items with which you are familiar that could help the efficiency of the whole business and you personally. Check with your instructor and employer to see if they are valid, and can be incorporated into your work.
3. Answer the questions below and turn in this assignment by ____________________.

Reference:

C. Smith, A Handbook on Quantity Food Management, pp. 139-159.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. One aim of work simplification is to produce more effectively with less worker fatigue.

T F 2. A worker should never sit down while working in the kitchen.

T F 3. Good habits may be formed by continual use of correct motions.

T F 4. Finger motions are too minute to make a difference in standard motions.

T F 5. Straight line motions are the best since they will result in the shortest distance.

T F 6. Work simplification can be accomplished to some extent by preparing some items ahead of time.

T F 7. Wasted food generally costs more in the long run than used food.

T F 8. A large variety of foods does not affect waste.

T F 9. A curved work space will generally provide a better work area.

T F 10. Ventilation is unimportant for accomplishment of standard results.

T F 11. Adequate lighting is important for accomplishment of standard results.

T F 12. A work area should be organized so that the worker can use both hands at the same time.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. Work simplification toward improvement should involve ____________________ of techniques.

2. Before working, the worker should ________________ the equipment around the work space.

3. To accomplish standard results, a worker should be provided with sufficient and well-planned ________________ ________________ and proper ________________ and ________________.

4. Food waste will fall into two main classifications: that of ________________ waste and that of ________________ waste.

5. Checks for waste control should include waste from both the ________________ ________________ and the ________________.

6. Edible leftovers should be classed under ________________ waste.

7. Discarded food is classed under ________________ waste.

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. Three logical steps in work simplification are:

(a) ________________ (b) ________________ (c) ________________

2. Proper waste control should be concerned with:

(A) ______________________ (E) ______________________

(B) ______________________ (F) ______________________

(C) ______________________ (G) ______________________

(D) ______________________ (H) ______________________

3. Avoidable waste will include all foods, or parts, that should be edible but are not because of poor:

(A) ______________________ (C) ______________________

(B) ______________________ (D) ______________________

4. Unavoidable waste may include such items as:

(A) ______________ (B) ______________ (C) ______________

TRAINING PLAN AND PROGRESS RECORD
for
Chef

Student's Copy

JOB TRAINING: What the Worker Should Be Able to Do	Proficiency Shown	RELATED INFORMATION: What the Worker Should Know
	The Chef	
Carry out duties and responsibilities; cooperate with others Time in hours ________	☒	Duties and responsibilities; relationship with other areas; personal requirements; training and experience
	Operation and Care of Equipment and Facilities	
Clean, adjust, and perform simple maintenance of tools, machines, and fixtures Time in hours ________	☒	Functions, advantages, and implications of economical use of facilities
	Sanitation and Accident Prevention	
Maintain sanitary standards; inspect and operate equipment; keep sanitary and safety records Time in hours ________	☒	Personal health and appearance; handling food; sanitary standards; proper care and use of equipment; safety procedures
	Selection of Food	
Select food in an efficient, economical manner Time in hours ________	☒	Clientele's needs and eating habits, seasonal availability of food and nutrition
	The Preparation of Food	
Follow correct timing and temperature; store, freeze, and preserve foods; prepare and use leftovers Time in hours ________	☒	Times and temperatures in cooking foods; methods of cooking and uses of foods; storage of foods
	Kitchen Management	
Maintain efficient kitchen; plan for food preparation; check food quality; determine and follow measurements Time in hours ________	☒	Principles of food preparation; standard preparation procedures; weights and measures
	Food Purchasing	
Purchase quality products; calculate food needs; write specification; check and store products Time in hours ________	☒	Buying guides; sources of supply; quality; sizes and grades; calculate food needs; receive, store, and preserve foods

Menu Planning

Follow accepted menu planning procedures; construct and file recipes; use correct menu terminology ☒ Nutritional needs; adequate and appropriate diets; food patterns; plan menus; food acceptance

Time in hours ______

Work Simplification and Waste Control

Operate in the most economical manner; conserve time, energy, and food products ☒ How to apply economical methods; figure means of saving and minimizing waste

Time in hours ______

Code for employer's use in marking student's progress

Performed some operations in area ☒ Performed some operations with reasonable proficiency ☒

Performed most operations in area ☒ Performed most operations satisfactorily ☒

TRAINING PLAN AND PROGRESS RECORD
for
CHEF

JOB TRAINING: What the Worker Should Be Able to Do	Proficiency Shown	RELATED INFORMATION: What the Worker Should Know
	The Chef	
Carry out duties and responsibilities; cooperate with others Time in hours ______	☒	Duties and responsibilities; relationship with other areas; personal requirements; training and experience
	Operation and Care of Equipment and Facilities	
Clean, adjust, and perform simple maintenance of tools, machines, and fixtures Time in hours ______	☒	Functions, advantages, and implications of economical use of facilities
	Sanitation and Accident Prevention	
Maintain sanitary standards; inspect and operate equipment; keep sanitary and safety records Time in hours ______	☒	Personal health and appearance; handling food; sanitary standards; proper care and use of equipment; safety procedures
	Selection of Food	
Select food in an efficient, economical manner Time in hours ______	☒	Clientele's needs and eating habits, seasonal availability of food and nutrition
	The Preparation of Food	
Follow correct timing and temperature; store, freeze, and preserve foods; prepare and use leftovers Time in hours ______	☒	Times and temperatures in cooking foods; methods of cooking and uses of foods; storage of foods
	Kitchen Management	
Maintain efficient kitchen; plan for food preparation; check food quality; determine and follow measurements Time in hours ______	☒	Principles of food preparation; standard preparation procedures; weights and measures
	Food Purchasing	
Purchase quality products; calculate food needs; write specification; check and store products Time in hours ______	☒	Buying guides; sources of supply; quality; sizes and grades; calculate food needs; receive, store, and preserve foods

Menu Planning

Follow accepted menu planning procedures; construct and file recipes; use correct menu terminology	☒	Nutritional needs; adequate and appropriate diets; food patterns; plan menus; food acceptance

Time in hours ________

Work Simplification and Waste Control

Operate in the most economical manner; conserve time, energy, and food products	☒	How to apply economical methods; figure means of saving and minimizing waste

Time in hours ________

Code for employer's use in marking student's progress

Performed some operations in area	☒	Performed some operations with reasonable proficiency	☒
Performed most operations in area	☒	Performed most operations satisfactorily	☒

TRAINING PLAN AND PROGRESS RECORD
for
CHEF

Employer's Copy

JOB TRAINING: What the Worker Should Be Able to Do	Proficiency Shown	RELATED INFORMATION: What the Worker Should Know
The Chef		
Carry out duties and responsibilities; cooperate with others Time in hours ______	☒	Duties and responsibilities; relationship with other areas; personal requirements; training and experience
Operation and Care of Equipment and Facilities		
Clean, adjust, and perform simple maintenance of tools, machines, and fixtures Time in hours ______	☒	Functions, advantages, and implications of economical use of facilities
Sanitation and Accident Prevention		
Maintain sanitary standards; inspect and operate equipment; keep sanitary and safety records Time in hours ______	☒	Personal health and appearance; handling food; sanitary standards; proper care and use of equipment; safety procedures
Selection of Food		
Select food in an efficient, economical manner Time in hours ______	☒	Clientele's needs and eating habits, seasonal availability of food and nutrition
The Preparation of Food		
Follow correct timing and temperature; store, freeze, and preserve foods; prepare and use leftovers Time in hours ______	☒	Times and temperatures in cooking foods; methods of cooking and uses of foods; storage of foods
Kitchen Management		
Maintain efficient kitchen; plan for food preparation; check food quality; determine and follow measurements Time in hours ______	☒	Principles of food preparation; standard preparation procedures; weights and measures
Food Purchasing		
Purchase quality products; calculate food needs; write specification; check and store products Time in hours ______	☒	Buying guides; sources of supply; quality; sizes and grades; calculate food needs; receive, store, and preserve foods

Menu Planning

Follow accepted menu planning procedures; construct and file recipes; use correct menu terminology	☒	Nutritional needs; adequate and appropriate diets; food patterns; plan menus; food acceptance

Time in hours ____________

Work Simplification and Waste Control

Operate in the most economical manner; conserve time, energy, and food products	☒	How to apply economical methods; figure means of saving and minimizing waste

Time in hours ____________

Code for employer's use in marking student's progress

Performed some operations in area	◔	Performed some operations with reasonable proficiency	◕
Performed most operations in area	◑	Performed most operations satisfactorily	●

VT002 061

VT 002 061
Hardware Retailing, A Course of Study, Designed for Cooperative Part-Time Students Employed in Hardware Retailing.

Karnes, James B.
Missouri Univ., Columbia. Dept. of Industrial Education
Missouri State Dep of Educ, Jefferson City. Ind Educ Sect

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*STUDY GUIDES, *DISTRIBUTIVE EDUCATION, *HARDWARE STORES, HIGH SCHOOLS, *RETAILING, INDIVIDUAL INSTRUCTION, *COOPERATIVE EDUCATION,

This study guide is for directed individual student use in acquiring job skills and procedures, related information, and personal-social traits necessary for a career in hardware retailing. It was developed by advisory consultants and research assistants at local and state levels. Major content areas include--(1) salesmanship, (2) management, (3) merchandising, (4) hardware, (5) tools, (6) sporting goods and recreational equipment, (7) paint and paint sundries, (8) electrical fixtures, supplies, housewares, and gifts, (9) housewares, (10) cleaning and laundry supplies, and (11) plumbing, heating, and building materials. A two-column form correlates elements of the job analysis and related information. Each of the 23 assignment sheets, covering 154 units, contains introductory information, assignment, a list of required references, and objective-type questions. Students should be juniors and seniors in high school, and the teacher should be a qualified coordinator. The suggested time allotment is 180 hours. A training plan and progress record are included. A necessary reference book, "Advanced Course in Hardware Retailing (1964 Edition)," is available for $10.00 from National Retail Hardware Association, 964 North Pennsylvania Street, Indianapolis, Indiana. The study guide is available for $1.50 from Industrial Education, 103 Industrial Education Building, University of Missouri, Columbia, Missouri 65201. (MM)

HARDWARE RETAILING

A Course of Study

Designed for
Cooperative Part-Time Students
Employed in Hardware Retailing

Issued by

Department of Industrial Education
College of Education
University of Missouri
Columbia, Missouri

In Cooperation with

Industrial Education Section
State Department of Education
Jefferson City, Missouri

MEMORANDUM

TO: The ERIC Clearinghouse on Vocational and Technical Education
The Ohio State University
980 Kinnear Road
Columbus, Ohio 43212

FROM: (Person) James B. Karnes (Agency) University of Missouri at Columbia

(Address) 103 Industrial Education Bldg., Columbia, MO.

DATE: September 26, 1967

RE: (Author, Title, Publisher, Date) Industrial Education Dept., Univ. of Mo. at Columbia, HARDWARE RETAILING, cooperatively with Industrial Education Dept. (U. of Mo. at Columbia) and Missouri Dept. of Education

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Appropriate School Setting Secondary and post secondary schools
Type of Program High School preparatory or in service training program
Occupational Focus Specific job
Geographic Adaptability United States
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Student Selection Criteria Junior and High School with proper prerequisites
Time Allotment 180 hours

Supplemental Media --
Necessary x
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REFERENCE FOR HARDWARE RETAILING

1. <u>Advanced Course in Hardware Retailing</u>, National Retail Hardware Association, 964 North Pennsylvania Street, Indianapolis 4, Indiana, 1964 edition, (Specify: ungraded - Reference only), $10.00

   The original series of 16 booklets for the advanced course in HARDWARE RETAILING has been rewritten into one volume, contained within one loose leaf binder. It should be ordered direct form the publisher for $10.00 for each volume.

FOREWORD

This course of study, consisting of an analysis of HARDWARE RETAILING together with assignment sheets covering the related (occupational) information to be taught by the school, has been prepared for teaching hardware retailing on an individual basis in a cooperative part-time program.

The original analysis was prepared by Dr. John W. Horine, while Research Assistant in Industrial Education at the University of Missouri. The assignment sheets in this revision were prepared by Mr. Grant Ree Wood and Mr. Roy Roberson, Research Assistants in Industrial Education at the University of Missouri.

We wish to acknowledge our indebtedness to Dr. H. H. London, Professor of Industrial Education at the University of Missouri, for the direction and administration of the Curriculum Materials Laboratory in which this material was prepared, and to Mr. James B. Karnes, Instructor in Industrial Education at the University of Missouri, who supervised the preparation of the material and edited the manuscript. Credit is due to Mr. B. W. Robinson, Assistant Commissioner of Education, Mr. Merton Wheeler, Director of Industrial Education, and to other staff members of the State Department of Education for their efforts in the development of the Industrial Education Curriculum Series of which this course of study is a part.

HUBERT WHEELER

Commissioner of Education

October, 1965
500

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Assignment Sheets:

Training Plan and Progress Record

INTRODUCTION

In preparing this course of study, it has been assumed that the attainment of occupational competency in any type of work involves three different, yet closely related, types of learning. They are:

1. Mastery of the practical Job Skills and Procedures performed by the worker in the occupation.

2. Comprehension of the Technical and Related Information basic to an intelligent understanding and practice of the occupation.

3. Development of those Personal-Social Traits which are essential for the successful worker.

The first group of these "learning units"--the job skills and procedures--has been arranged in the analysis under the heading of "Job Training." The second group of learning units--the technical and related information--has been arranged under the heading of "Related Information." The third group--the personal-social traits--has been listed under "Personal Qualifications" in the introductory section addressed to the student.

In a cooperative educational program it is necessary for both cooperating agencies--the school and the employer--to understand clearly just what each is to be responsible for in the training of the student-worker. Experience has shown that most of the practical job skills and procedures of an occupation can best be learned through supervised work on the job. Experience has shown also that the school can best teach most of the technical and related occupational information needed by young student-workers. This division of responsibility has been made in the arrangement of the course of study; that is, it is expected that the student-worker will master the job skills and procedures through practical work on the job under the immediate supervision of the employer, and that he will receive instruction in related occupational information in the school under the direction of the coordinator.

In the back of this course of study will be found three copies of the TRAINING PLAN AND PROGRESS RECORD FOR HARDWARE RETAILING. One copy is marked "Student" in the upper right hand corner. On this copy, in the space Time in Hours, the student will keep a tally of the hours he spends on his job performing operations in each area. The next copy marked "Employer," should be given to the employer for recording the student's job performance in each area. The third copy may be used by the coordinator for his record.

Skills and related information are matters for direct instruction, but personal-social traits are acquired only through practicing them during the process of acquiring skills and information and in one's daily conduct. Therefore, both the employer and the school, as well as the home, must assume responsibility for developing in the student-worker those habits, attitudes and character traits which are essential for success in his occupation and in life. Both the employer and the school should be constantly on the alert to see that the student-worker places desirable interpretations on his experiences and that he does not practice habits and exhibit character traits detrimental to his success.

Since the coordinator's class will be made up of fifteen or more students, each differing from the other significantly, studying a dozen or more occupations which differ markedly in their requirements, it follows that it will be impossible for him to teach, through the group method, the occupational information which relates to the specific job of each student-worker. In order to be effective, this type of instruction must be individualized. There is, of course, some related information, such as occupational health and safety, workmen's compensation, wage-hour laws, fair labor standards, unemployment compensation, and the like, which is of common interest and concern to all student-workers, and may be effectively taught by the group method. But if the coordinator is to make a real contribution to the in-service vocational education of his students, he must devote a major portion of his classroom instruction to content which deals specifically with the work of each boy and girl enrolled.

With this requirement in mind, and in order to facilitate individual instruction, these assignment sheets have been prepared under twenty-three major areas of the hardware retailing trade. Some section sections of the reference material were quite long, therefore, they are broken down into a part I and part II assignment. Each assignment contains certain record data as to number and range of units covered; introductory paragraphs designed to develop interest, explain the importance of the assignment, and to convey to the student what he is expected to learn, specific assignments including reading, learning activities and a series of questions designed to check his attainment.

Obviously, it is desirable to teach the related information in the school at the time it will be used most advantageously on the job. This means that the two phases of the student-worker's training should parallel each other in a progressive manner. The coordinator will find the assignment sheets well adapted to this end. He can select from day to day the assignment which covers the informational units related to the work being done on the job. With this arrangement, the coordinator will become, during a major portion of his classroom time, a supervising study and helping teacher.

In selecting books for the course, an effort has been made to restrict the number to an adequate coverage of the material, and to select those of recent publication so that current practices can be consistently presented. It is recommended that copies of these books be secured and kept in the coordinator's classroom for ready use by the student.

The key sheets, available in a separate manual, have been prepared to enable the coordinator to score quickly the questions included in each assignment sheet. These key sheets give the correct answers to the questions, as well as the reference and the page on which each answer can be found. The key skeets should be kept in the coordinator's possession.

TO THE STUDENT-WORKER

In the past many workers, especially youth, have entered the retail trades largely by chance. Few have chosen the vocation as a result of definite investigation and planning. Now, however, retail marketing and merchandising have advanced to the point where it is advantageous to make systematic preparation if one wishes to enter and advance in these occupations.

Opportunities in Hardware Retailing

There are more than 100,000 dealers, store managers, and salespeople in hardware retailing in the United States. Advantages, other than regular employment offered in this field, include the opportunity to meet many types of people, to serve society in a useful manner and, through study and effort, to advance to the position of manager of a store. Wages in the hardware retailing business are quite varied. Wages in rural areas are generally less than those in urban areas. Experienced salespersons will receive $10 to $25 more per week than beginners in the same stores.

Requirements for Entering Hardware Retailing

In order to enter the hardware business as a full-time worker, one must be sixteen to eighteen years of age and in good health. He must be industrious and interested in selling.

The youth of high school age who plans to enter the hardware business as a career, or who has already entered the business on a part-time basis, should first acquire a broad general education. In addition, he must acquire a wealth of information regarding merchandise, a working knowledge of business English, commercial arithmetic, commercial art, economics, general science, and bookkeeping. Much of this information may be acquired through work on the job and through study in his COE class. Some may best be acquired through special courses.

Personal Qualifications

Desirable personality traits are of extreme importance for success in life. They are the factors by which one primarily is judged when meeting people and when attempting to obtain a job. They are vitally important in holding a job. In fact, studies reveal that the chief cause for ninety per cent of the persons being discharged from their jobs is due to a lack of desirable personal-social traits, while only ten per cent of the discharges are due to a lack of job skills. It should be noted, however, that without job skills it is exceedingly difficult to find employment.

The following are some of the more important personal-social traits which a hardware worker should possess:

Personal Cleanliness - Dirty hands or clothing repel customers.

Good Health - The hardware retailer must have a vigorous constitution, abundant energy, and the ability to stand on his feet for long hours. He must have no health problems that are offensive to customers.

Pleasing Personality - The hardware retailer must be pleasant to meet, approachable, emotionally stable, and have a sense of humor.

Courtesy - The practice of being polite, considerate, and sympathetic with others will pay dividends in any business, especially the hardware business.

Attentiveness - The ability to pay close attention, to respond quickly and to concentrate on his work is essential to the hardware retailer.

Cooperation - The ability and disposition to work harmoniously with others, to be helpful, and to do one's share are necessities.

Honesty - The groceryman must give full value for every cent received, be strictly accurate in giving merchandise information, and scrupulous in every way.

Initiative - The ability to see things that need to be done and to keep busy doing them without constant supervision is one of the most marketable traits of the hardware salesman.

REFERENCE FOR HARDWARE RETAILING

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ANALYSIS
FOR
HARDWARE RETAILING

JOB TRAINING: What the Worker Should Be Able To Do	Assign. No.	RELATED INFORMATION: What The Worker Should Know
	Techniques of Selling	
1. Take a self-inventory	1	1. Personal qualifications of the salesman
2. Evaluate customers	1	2. Variations among customers
	1	3. Improving your sales personality
4. Sell related items	1	4. Importance of related selling
	1	5. Customer motives for buying
6. Give service information to customers	1	6. Importance of product information
	1	7. Store services and their importance to sales
	1	8. Four attributes of a good salesman
9. Greet customers	1	9. Proper approach to the customer
10. Direct customer to desired department		
	1	11. Sales presentation planning
	1	12. Advantages of standard sales presentation
13. Demonstrate merchandise	1	13. Characteristics of a good demonstration
14. Handle objections	1	14. Types of objections and how to handle them
15. Quote prices		
16. Close sale	1	16. Kinds of closing signals
17. Weigh material		
18. Figure scale prices		
19. Operate cash register		
20. Make change		
21. Wrap merchandise		
	1	22. Quick service selling
	Store Management and Record Keeping	
	2	23. Reasons for keeping records
24. Write sales ticket	2	24. Types of records of original sale
25. Compile cash register records and receipts		
26. Fill out daily balance report form	2	26. Importance of daily records of receipts and disbursements

JOB TRAINING: What the Worker Should Be Able To Do	Assign. No.	RELATED INFORMATION: What the Worker Should Know
27. Write charge tickets	2	27. Types of charge sales records
28. Post charge sales information		
	2	29. Information required for payroll records
30. Figure social security		
31. Figure witholding tax		
32. Make out payroll records		
	2	33. Methods of merchandise control
34. Inventory stock	2	34. Importance of store inventory
	2	35. Meaning of margin and mark-up
36. Select item for special price	2	36. Factors in choice of items for special sale prices
	2	37. Choosing quality lines of merchandise
	2	38. Relationship of stock turnover to store profit
	2	39. Kinds of credit sales and advantages of each
40. Make a credit sale	2	40. The salesman's part in budget selling
	2	41. Information required on merchandise control card
42. Order merchandise	2	42. Requirements in wise buying
43. Mark merchandise in code	2	43. Coding of merchandise
	2	44. Fixed expense items
	2	45. Variable expenses and their reduction
	2	46. Reduction of outside expenses
47. Price hardware items		
	2	48. Relationship of management to total store operation
49. Ascertain store profit or loss		
	2	50. Departmentalizing in the hardware store

Merchandising

	3	51. Development of hardware merchandisng

JOB TRAINING: What the Worker Should Be Able To Do	Assign. No.	RELATED INFORMATION: What the Worker Should Know
	3	52. Advantages of quick service type merchandising
	3	53. Significance of various types of store locations
	3	54. Importance of store exteriors
	3	55. Modernizing store fronts
	3	56. Types of store windows
57. Make a window display	3	57. Window display themes
	3	58. Principles of sales floor layout
59. Stock wall departments	3	59. Wall departments
60. Stock display islands	3	60. Merchandising display islands
61. Make bins for hardware merchandising	3	61. Principles of binning
62. Clean and dust counters and fixtures	3	62. Types of sales floor fixtures
	3	63. The advantages and uses of color in merchandising
	3	64. Proper store lighting
65. Clean and care for floor	3	65. Kinds of floors, advantages and care of each
66. Receive and check shipments		
67. Inspect stock and report damages and shortages	3	67. Importance of reporting damages and shortages
68. Prepare and attach price markers		
69. Place stock in storeroom shelves	3	69. Planning the stockroom layout
70. Dust stock		
71. Wash windows		
72. Dispose of trash		
	3	73. Types of manufacturer-provided dealer aids

Promotion and Advertising

	4	74. Importance of advertising
75. Prepare an advertising budget	4	75. Budgeting and planning advertising
76. Determine when and what to advertise	4	76. Purposes of advertisement
77. Plan a special promotion sale	4	77. The why and when of special promotions and sales
78. Make a showcard		
79. Plan and make a display	4	79. Advertising with displays

JOB TRAINING: What the Worker Should Be Able To Do	Assign. No.	RELATED INFORMATION: What the Worker Should Know
80. Prepare a newspaper advertisement	4	80. Advantages of newspaper advertising
81. Prepare a mailing list	4	81. Reasons for direct-by-mail advertising
82. Write advertising letter		
83. Compose advertising handbill		
84. Plan radio advertisement	4	84. Advertising by radio and television
	4	85. Cooperative and group advertising
86. Keep an advertising record	4	86. Importance of measuring the effectiveness of advertising
	Hardware	
87. Sell items of hardware	5	87. Techniques of selling and merchandising hardware
88. Advise customer on selection of hardware	5	88. Types of cabinet hardware
	5	89. Kinds of locks
	6	90. Selection of door and window hardware
	6	91. Fasteners and their uses
	6	92. Kinds of metals
	6	93. Types of metal finishes
	Hand Tools	
94. Sell hand tools	7	94. Kinds of axes and hammers
95. Explain characteristics and functions of hand tools	7	95. Bits and drilling tools
	7	96. Kinds and uses of various handsaws
	7	97. Types of rules and levels
	7	98. Kinds of holding tools
	7	99. Identification of other common hand tools
	8	100. Types of pliers and wrenches
	8	101. Purposes and sizes of screwdrivers, chisels and punches
	8	102. Advertising and selling hand tools

JOB TRAINING: What the Worker Should Be Able To Do		Assign. No.	RELATED INFORMATION: What The Worker Should Know	
		Power Tools		
103.	Sell power tools	9	103.	Hints on selling and merchandising power tools
		9	104.	Function of portable power tools
		9	105.	Function of stationary power tools
		9	106.	Types of grinding wheels
107.	Rent a tool to a customer	9	107.	Tips on operating a tool rental department
		Lawn, Garden, and Farm Tools		
108.	Sell items from the lawn, garden and farm department	10	108.	Techniques of selling lawn, garden, and farm tools
109.	Make recommendations on lawn, garden and farm tools	10	109.	Types of lawn and yard tools
110.	Prepare display for lawn, garden and farm tools	10	110.	Kinds of garden equipment
		11	111.	Techniques of selling lawn, garden, and farm tools
		11	112.	Types of heavy farm tools
		11	113.	Wire screening and glass substitutes
		11	114.	Fencing, gates, and electric fence controllers
		Sporting Goods		
115.	Prepare a sporting goods display	12	115.	Tips on advertising sporting goods
116.	Sell sporting goods	12	116.	Sporting goods sales techniques
		13	117.	Items of hunting equipment
		13	118.	Kinds of equipment for fishermen
		13	119.	The appeal of outdoor cooking
		Recreational Equipment		
120.	Sell recreational equipment	14	120.	Advertising, merchandising and selling recreational equipment

JOB TRAINING: What the Worker Should Be Able To Do	Assign. No.	RELATED INFORMATION: What The Worker Should Know
	14	121. Athletic equipment for various sports
	14	122. Kinds of toys, games, etc.
Paint and Paint Sundries		
	15	123. Kinds of finishing material
	15	124. What the salesman should know about painting
125. Sell paint and paint sundries	16	125. The art of pleasing paint customers
126. Make a paint display	16	126. Paint advertising and display techniques
	16	127. Types of painting equipment
	16	128. Kinds of paint department sundries
Electrical Fixtures and Supplies		
	17	129. Types of electrical fixtures and supplies
	17	130. Kinds and sizes of light bulbs
131. Sell electrical equipment and supplies		
Housewares		
132. Sell housewares	18	132. Techniques of selling housewares
133. Advise customer on housewares	18	133. Types of kitchen tools
	18	134. Materials used in making cooking utensils
	19	135. Metal household furniture
	19	136. Cutting tools used in the home
	19	137. Miscellaneous household items
Electrical Housewares and Gifts		
138. Prepare a display in the gift department	20	138. Advertising electrical housewares and gifts
	20	139. Valuable sales information on electrical housewares

JOB TRAINING: What the Worker Should Be Able To Do		Assign. No.		RELATED INFORMATION: What The Worker Should Know
		20	140.	Product knowledge of weather instruments and clocks
141.	Sell electrical housewares	20	141.	Techniques of selling electrical housewares
142.	Sell giftwares	20	142.	Techniques of selling giftware

Cleaning and Laundry Supplies

143.	Sell cleaning and laundry supplies	21	143.	Advertising and selling cleaning and laundry supplies
		21	144.	Cleaning supply information
		21	145.	Kinds of brooms and brushes
		21	146.	Floor maintenance and furniture care
		21	147.	Helpful hints for clean-up time

Plumbing, Heating and Building Materials

148.	Sell plumbing, heating and building materials	22	148.	Merchandising and selling plumbing, heating, and building materials
		22	149.	Kinds of plumbing tools
		22	150.	Types of plumbing repairs and accessories
		22	151.	Heating information
		23	152.	Aluminum and its growth in the do-it-yourself market
		23	153.	Kinds of building materials
		23	154.	Types of floor coverings

Assignment
Sheet No. 1

Covering
Units 1-22

SALESMANSHIP

If you, as a sales trainee, are to become an effective hardware salesperson, it will be necessary for you to fully understand the components of any selling situation you might possibly be confronted with. You will benefit both your store and yourself by studying and putting into practice the sales techniques portrayed in this assignment.

By studying the material on hardware salesmanship you will learn that desirable personal qualities a salesman should possess and how he can best utilize these qualities to make sales. While working this assignment you should begin to realize how essential it is for a salesman to be well versed in hardware merchandise information and how this knowledge can be effectively demonstrated to the prospective buyer. The climax of this assignment is the analysis of the customer; how to discover his wants and needs, and the techniques involved in serving him. Study the material presented in this assignment, practice the techniques that are presented, and you should begin to master the merchandising techniques necessary to making a good sales record, along with a long list of satisfied customers.

This assignment will point out many sales techniques that have worked well for other salespeople. Many variations of the sales situation itself are discussed. This lesson is designed to help you become more acquainted with: (a) yourself as a salesperson; (b) your customer as a buyer; (c) the product you are selling; and (d) customer motives for buying.

Assignment:

1. Read the reference listed below.
2. Objectively analyze your own personality and knowledge of salesmanship. In a paper not exceeding three pages, identify four of your major weaknesses and list steps which you will take to correct and strengthen them. At the end of one month, turn in a one page report to your your coordinator evaluating your progress; attach an a additional page or two outlining four problem areas and corrective steps which you will work on over the next four weeks. Continue these monthly papers for the entire length of the course.
3. Answer the questions below and turn in this assignment by ________________________.

Reference:

A. ACHR, "Salesmanship," pp. 1-32.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. Almost all the experts state that salesmanship is not needed in this era of mass merchandising.

T F 2. Salesmanship in independent retail hardware stores is just about the same as it was thirty years ago.

T F 3. Modern hardware retailing requires only attractive displays coupled with quick processing at the check out counter.

T F 4. Most independent hardware stores cannot compete pricewise with discount and mass merchandising chain stores.

T F 5. Many of today's customers differ from the customers of years ago in that present customers possess little knowledge about the product they wish to buy.

T F 6. Good salesmanship is especially effective on high priced merchandise as opposed to incidental, inexpensive, or impulse purchases.

T F 7. Most star salesmen are not born that way but develop their talents through training.

T F 8. Salesmen with pleasant personalities should continually strive to develop and improve them still more.

T F 9. Saleswork is generally considered to be relatively easy work by most successful salesmen.

T F 10. A salesman who is enthused with his work and his merchandise can make this apparent to the customer with a charming smile and pleasant voice.

T F 11. Poor scheduling of work leads to hurried, pressured, and harassed salesmen.

T F 12. Formal schooling is unimportant in saleswork as practical sales experience is the best teacher.

T F 13. Practice makes perfect only if the techniques to be mastered are repeated correctly with a constant desire to eliminate errors.

T F 14. John Wilson of the National Cash Register Company attributes his success as a salesman to his natural sales ability.

T F 15. It is more difficult for a salesman to obtain product knowledge than it was in the past.

T F 16. Many manufacturers spend thousands of dollars in research to learn what factors influence people to buy.

T F 17. Even expert salesmen must devote regular study time to keep up-to-date on merchandise knowledge.

T F 18. Customers would rather listen to facts about a product than simply see it operate.

T F 19. Common features of a product should be played up and exclusive ones downstaged during demonstrations.

T F 20. Ordinarily it is best not to have the customer take part in a demonstration.

T F 21. General customers are interested in hearing about the product's utility, service, satisfaction, economy and beauty; while contractors and business customers are more interested in profits, quality, consumer demand and satisfied customers

T F 22. As applied to merchandise, features and benefits are synonymous terms.

T F 23. Because customer needs can be categorized into several major areas, it is possible to present any one specific item to all customers in the same manner.

T F 24. Most "lookers" are easily recognized by the salesman and therefore can be ignored in favor of the "buyers."

T F 25. One of the best customer greetings, though somewhat old, is the traditional, "May I help you?"

T F 26. Lookers who have nothing specific in mind should be encouraged to pursue some specific area, such as lady lookers to the kitchenware or to some special display or sale item.

T F 27. It is best to stay with lookers constantly so as to be able to explain the benefits of any item in which the customer may become interested.

T F 28. Generally speaking, the lower the price of the merchandise, the less need there is for a salesman.

T F 29. It is generally true that the average customer wants the lowest priced item he can find.

T F 30. A salesman who believes in the high quality of his products radiates his confidence to his customer.

T F 31. Cheap products sold by other businesses should be pointed out and criticized when discussing the benefits of high quality merchandise.

T F 32. Quality products go hand-in-hand with quality service.

T F 33. A tenable assumption is that if a customer needs something, he will always realize it and make the purchase.

T F 34. Customer objections should be quickly counteracted or ignored.

T F 35. Objections are hinderences which sometimes exist and should be avoided at all costs by the salesman.

T F 36. Objections can give valuable information to the salesman for closing the sale.

T F 37. It is an acceptable practice to prod a customer into buying by asking him to make a choice between two models of the item.

T F 38. It is generally not wise to contact a customer following the sale of a major item since correcting any complaints and dissatisfactions can add considerable expense to the store's overhead.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. A lot of the modern hardware store's merchandise is ______________ before the customer enters the store.

2. The two greatest advantages that a hardware store can capitalize on over other retail outlets are good ______________ and good ______________.

3. A basic principle that salesmen should capitalize upon is that, "people buy from people they ______________."

4. Only a few ______________ of the ______________ to ______________ items normally carried in a hardware store are ______________ by advertising.

5. The success of a retail store is in the hands of its salesmen because "Customers buy ______________ from ______________ salesmen."

6. Some sales authorities estimate that ________ per cent of retail selling is accomplished by ________ per cent of the salesmen.

7. A salesman should always be ______________ as this will be transmitted to his customer and an ______________ customer is a buying customer.

8. The progressive salesman must first acquire a thorough knowledge of the basic fundamentals of salesmanship and then put these fundamentals into ______________.

9. When a sales effort falls through, the salesman should ______________ what he did wrong and make concentrated efforts to correct his mistakes.

10. A systematic learning device useful for improving salesmanship is a ______________ ______________ of important points upon which to work for perfection.

11. It is imperative for the salesman to know what products his store handles and exactly ______________ they are ______________.

12. A demonstration should be ______________ so every point will be portrayed in an effective, dynamic manner to hold and attract the customer's attention.

13. Successful demonstrations should create customer ______________ in the product.

14. Complete the following axiom: "Customers buy the ______________ they will gain from using, owning, or giving the product."

15. A customer may be defined as a person who is willing to ______________ his ______________ for products on sale.

16. Merchandise should be discussed, and demonstrated from the ______________ viewpoint.

17. The salesman makes a sale when he is able to point out why a ______________ thing will satisfy a ______________ need for a ______________ prospect at a ______________ time.

18. The salesman convinces the prospective customer to buy by turning a ______________ into a ______________.

19. It is imperative for independent hardware retailers to emphasize ______________, ______________, and offer more to every customer for their money if they are going to successfully compete with mass merchandisers and discount houses.

20. Common major objections should be anticipated, brought up and answered ______________ the ______________ raises them.

21. Customer objections should be rephrased into the form of a ______________ and then turned into a reason for buying.

22. A salesman can increase his sales ________ to ________ per cent by making a continuous ________________ of why a customer bought or didn't buy.

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. List five qualities which contribute to a successful sales personality.

(A) ______________________ (D) ______________________

(B) ______________________ (E) ______________________

(C) ______________________

2. List the two kinds of customers who come into hardware stores--what he wants in the way of service.

(A) ____

____

(B) ____

____

____

3. List five reasons why customers will purchase a product.

(A) ____

(B) ____

(C) ____

(D) ____

4. List four sample greetings which are acceptable and effective.

(A) ____

(B) ____

(C) ____

(D) ____

5. List the two essential keys points to quality selling.

(A) ____

____

(B) ____

____

6. List the major points discussed in this assignment.

(A) ____________________

____

(B) ____________________

____

(C) ____________________

____

(D) ____________________

____

Assignment
Sheet No. 2

Covering
Units 23-50

MANAGEMENT

Controlling the expenses of the store, along with well-planned merchandise buying, is very important to your store if it is to maintain a profitable operation. This is a fundamental responsibility of store management. Upon management falls the responsibility for setting the selling price of goods. Management sets the policies of credit sales and other store services designed to increase profits. The salesman who understands the problems of management can better serve the store and help to increase profits. Increased profits for the store can mean more take-home pay for employees.

You, as a salesperson, will have an opportunity to assist management in planning the operation of the store. You can help through the keeping of accurate records and inventories. As an employee embarking upon a career in hardware retailing, you should be interested in the managerial processes involved in your newly chosen occupational field. In fact, if you expect to advance to a responsible and well paying position, it will be an absolute necessity to be well grounded in the employee-employer aspects of hardware management.

This assignment will give you the opportunity to gain a good bit of basic management knowledge. It should help you to better understand the tools of management. You should become aware of how you might develop your talents so that you will be eligible for promotion when openings occur.

<u>Assignment</u>:

1. Read the reference listed below.
2. Your reference book on page 11 states that school textbooks often leave the wrong impression in the student's mind regarding profits. It specifically notes the example that school texts imply that the difference between cost price and selling price is all profit. Examine five different retailing texts and five general mathematics books used in your school to see if this statement is true. Write and turn in to your coordinator a report of your investigation giving bibliographical data of the books you surveyed, your findings, and your conclusions.
3. Answer the questions below and turn in this assignment by ______________________.

<u>Reference</u>:

A. <u>ACHR</u>, "Management," pp. 1-18.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. Trade unions were organized to correct the abuses of labor by management.

T F 2. The abuses of labor by management in the early 1900's and the unscrupulous actions of many labor unions at the present time are due to the misuse of power.

T F 3. Recent technological improvements have lessened the importance and the complexity of the management process.

T F 4. The amount of local, state and Federal taxes that are paid depend upon, in part, the nature of the business.

T F 5. The degree to which a boss successfully solves his problems, though directly affecting himself, have little or no impact upon his employees.

T F 6. Some employees feel there is no need to study management.

T F 7. Employees who are given departmental responsibilities sometimes feel that overall management decisions are not within their scope.

T F 8. The assignment of new duties or jobs to an employee usually indicates that the manager is displeased with him and wishes to harrass the employee into quitting.

T F 9. A good way to develop management ability is to develop the capabilities of a good employee.

T F 10. Employees are important to management in that the former reflect the store image either good or bad, to the customer.

T F 11. Regardless of their ability, most new employees represent a loss to the business during the initial period of employment.

T F 12. All good salespeople have about the same degree of efficiency.

T F 13. An employee should exhibit self-centeredness and confidence, keeping in mind that it takes more than just doing your job to improve your position.

T F 14. You should always work to perfect your talents regardless of your future plans.

T F 15. A switch from employee status to managerial positions is usually accompanied with a complete change of viewpoint.

T F 16. Regarding profits, in the minds of some people there presently seems to be somewhat of a trend toward a "something for nothing attitude."

T F 17. The major reason for successful farming in this country as opposed to the rather dismal results of Communist countries is due to our rich soil and excellent climatic conditions.

T F 18. The cost of merchandise paid to the suppliers is paid out of net sales.

T F 19. Salaries, taxes and other expenses are paid out of net earnings.

T F 20. An increase in a salesman's daily gross sales record will result in a higher margin, more store profit and an increased chance of a promotion and salary increase.

T F 21. Dissatisfied customers undoubtedly will not return and may, in fact, contribute toward driving other customers away from your store.

T F 22. Ignoring assignments and losing or damaging merchandise may result in such a decrease in profits that the employee will lose his job.

T F 23. Generally efficiency is viewed alike by both employer and employee.

T F 24. Adverse discussion of management should be avoided by employees as it builds up a negative attitude which may influence his saleswork.

T F 25. Engaging in lengthy time consuming conversations is just as dishonest as taking money from the till.

T F 26. Most firms pay all or part of the cost of various kinds of insurance for employees.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. The term ______________ ______________ was used at the turn of the century to denote the abuses of labor by management.

2. Labor and management are both essential with labor supplying ______________ and usage of tools and management providing the ______________ and tools for the job.

3. A major cause for failure of independent hardware retail stores is ______________ ______________.

4. The portion of the average hardware stores total operating expenses devoted to payroll expense is about ________ per cent.

5. Some types of businesses must pay Federal taxes as high as ________ per cent of their total yearly profits.

6. Some of the erroneous viewpoints held by both management and labor are the result of ______________ opinions.

7. Even beginning employees should have a knowledge of management responsibilities as there is a direct relationship between this knowledge and future ______________.

8. The manager of a hardware store makes job assignments according to a careful evaluation of the ______________ and ______________ of his employees.

9. A good way to gain experience to lead to promotions and management positions is through training and undertaking new ______________.

10. The difference between the cost of an item and its selling price is defined as the gross ______________ or is sometimes called ______________.

11. It has been proven that over ________ per cent of all hardware store purchases are impulse sales.

12. The cost to store a hundred dollars worth of goods which does not move averages about ________ dollars per year.

13. Payroll deductions for tax purposes generally range from ________ to ________ per cent of total earnings.

14. For $1.00 per year you can subscribe to the ______________ ______________ trade magazine.

15. Of the three categories of people described in your text, star sales people should be in the group which ______________ ______________ ________ ______________.

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. List six erroneous views of management which are often held by employees.

(A) ______________________________

(B) ______________________________

(C) ______________________________

(D) ______________________________

(E) ______________________________

(F) ______________________________

2. List seven items which portray the owners view of management.

(A) ______________ (E) ______________

(B) ______________ (F) ______________

(C) ______________ (G) ______________

(D) ______________

3. List four attributes upon which your employer is likely to judge your efficiency.

(A) ______________ (C) ______________

(B) ______________ (D) ______________

4. List items which make up, from managements viewpoint, an employee's salary.

(A) ______________ (E) ______________

(B) ______________ (F) ______________

(C) ______________ (G) ______________

(D) ______________

5. List four ways in which store managers may undertake to increase employee efficiency.

(A) ______________________________

(B) ______________________________

(C) ______________________________

(D) ______________________________

Assignment
Sheet No. 3

Covering
Units 51-73

MERCHANDISING

"Merchandising" may be described as the act of utilizing all available store space and every piece of merchandise in the store for the most effective display for all of the seasons of the year. It is from this viewpoint that this assignment approaches hardware merchandising.

A study of the development of hardware merchandising will show the progress that has been made through the years. Information such as this enables the hardware store owner to evaluate his merchandising techniques and keep them up to date. Only by use of modern devices and techniques can the hardware retailer expect to stay in competition and expect to make a profit. When the prospective customer enters your store, he should be able to locate the department he wants. The general atmoshpere of the store should be pleasant with the merchandise arranged in a pleasing, eye-catching manner.

This assignment is designed to make you, the student, aware of the fundamentals of store layout, to show you appealing and efficient ways to effectively "merchandise" your merchandise. You will study factors that should be considered when planning a store layout; techniques in using color, lighting, motion, close-out items and similar display ideas; methods for constructing window displays, and factors that should be considered in the efficient utilization of display materials furnished by merchandise manufacturers.

Assignment:

1. Read the reference listed below.
2. Make a scale floor plan of your hardware store showing fixture, gondola, check out, door storage, window, and departmental locations. Then, using the data gleaned from the reading assignment, evaluate the floor plan. Make another plan showing any changes which you believe should be made to make merchandising more effective. Write a justification for each suggested change. Submit both the plan and the justification first to your employer for his comments and then to your coordinator.
3. Answer the questions below and turn in this assignment by ______________________.

Reference:

A. ACHR, "Merchandising," pp. 1-24.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. The interior of a hardware store should be arranged to conform to the customer's shopping habits.

T F 2. Merchandise stacked in the isle can result in lost sales as it restricts customer mobility to other merchandise in the store.

T F 3. Modern housewives pay little attention to the arrangement or appearance of the hardware store as long as quality goods are displayed.

T F 4. Employees should be encouraged to try out new merchandising procedures and techniques even if the management is skeptical.

T F 5. Most hardware customers are lookers and do not have a definite clear-cut need in mind.

T F 6. Bulk and service items should always be displayed above the minimum height used for impulse items.

T F 7. Merchandise displayed along the wall should never be placed at a height exceeding six feet.

T F 8. The floor plan shown in your text is meant to be a general guide and not an ideal plan to be adopted by all hardware stores.

T F 9. It doesn't seem to make too much difference if ladies' impulse items are displayed on the left or right hand of the store.

T F 10. Although items of interest to men are usually located in different departments from ladies' interest items, tests have proven that sales will rise if the items are on mixed display.

T F 11. Impulse items are generally the same for customers who come in to pay bills and those who are electricians or plumers.

T F 12. Though sales may go up if departments are shifted about as the seasons change, the cost of moving the merchandise more than eats up any additional sales due to the move.

T F 13. It is not necessary to have the store's better known items of merchandise on display.

T F 14. The N R H A's Basic Stock List and Merchandising Arrangement is useful only for ordering stock.

T F 15. Items which are not marked may cause lost sales because customers usually imagine the price as being higher than the actual retail value.

T F 16. Unmarked items are frequently sold at a price below the actual replacement cost of the item.

T F 17. Unsightly ceilings may be disguised by painting them a light color.

T F 18. Generally all displays received from manufacturers have been tested for customer appeal and therefore should be used by the hardware retailer.

T F 19. Modern retailing has little or no use for display windows.

T F 20. An advantage to the modern visual front windows where the whole store is on display is that they do not require attention.

T F 21. Gondolas should not be used in visual display windows.

T F 22. Despite modern merchandising and mass advertising, window space is still very valuable for displaying products.

T F 23. Fixtures are designed primarily to provide shelf storage space for the merchandise.

T F 24. Items lost through theft from open displays are less costly than lost sales due to merchandise under the counter or in glass showcases.

T F 25. A tax credit allowance of 7 per cent can be taken the first year that modern fixtures are installed in a store.

T F 26. Good hardware fixtures should be designed specifically to display hardware merchandise.

T F 27. Fixtures should be purchased from merchandisers who know hardware retailing.

T F 28. A store that undertakes a do-it-yourself fixture installation can loose money if customer confusion is created over a long period of time.

T F 29. Do-it-yourself fixture installations may lack flexibility and appearance.

T F 30. Surplus stock which can't be placed on the fixture should be stored in the back room.

T F 31. Gondolas and sidewall displays made available to the retailer by merchandise manufacturers should always be taken advantage of because they usually are offered at or below cost.

T F 32. Many manufacturers design either or both of their shipping and inner cartons for display purposes.

T F 33. Display kits supplied by manufacturers are specialized and have no re-use value.

T F 34. Prepackaged merchandise is handy and saves wrapping time but have very little or no display value.

T F 35. Printed materials have a rather potent value in hardware retailing.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. The one purpose of the interior of a retail hardware store is to ______________ ______________ effectively.

2. The responsibility for the overall merchandise arrangement of the store rests with the ______________.

3. Gondola-type display fixtures should not exceed ________ inches in overall height so that other departments can easily be seen.

4. Impulse merchandise should be displayed between ________ inches and ______ inches.

5. Bulk and service merchandise may be displayed ______________ the standard ________ inch minimum height for impulse items.

6. Wall fixtures should not exceed ________ feet in height though ______________ displays may extend to the ceiling in some departments.

7. Impulse items are placed at the ______________ of the store.

8. Most hardware retailers display ladies' impulse items on the ______________ side of the store.

9. The rear wall of a store is most effective when the entrance of the store is located at the ______________ of the store.

10. The heaviest travel is usually around the ______________ ______________ and would thus be an ideal location to display ______________ items.

11. Except in large stores, it is generally the task of the ______________ to keep the merchandise clean.

12. The name of the booklet published by the National Retail Hardware Association dealing with the display of merchandise is called ______________ ______________ and ______________ ______________.

13. Store aisles should range in width from ________ to ________ inches.

14. Slow moving merchandise can be turned into profitable traffic builders by advertising them as "______________ ______________ ______________."

15. Stores having complex and confusing layouts should have permanent ______________ to direct ______________.

16. Displays may be effectively lighted with ______________, ______________ ______________, and ______________.

17. Long narrow stores may be given an illusion of width by painting the side walls a ______________ color and the rear wall a ______________ color.

18. The use of mirrors to make displays seem larger is especially effective for ______________ or ______________ merchandise.

19. Mass displays are useful in building future sales because their impact on the customer has a high ______________ value.

20. Many useful tips for displaying merchandise are contained in the "______________ ________ ______________" section of the ______________ ______________ trade magazine.

21. Window displays formerly were used to show ______________ items to attract ______________ and customers who usually were quite familiar with the store.

22. Many modern hardware stores utilize the entire ______________ of the store to attract ______________ traffic.

23. A closed display window that is converted by removing either part or all of the back is called an ______________ ______________ display window.

24. Merchandising requires certain display heights, lighting effects and flexibility which are obtained through the use of ______________.

25. Merchandise which does not sell costs the store about ________ dollars per year per thousand just for storage.

26. The cost to install modern merchandise fixtures for an average size hardware store range from ________ to ________ dollars.

27. The average life of a hardware fixture is ________ years.

28. If the average minimum cost to install hardware fixtures are amortized over the average life of the fixtures, the cost of the fixtures will be ________ or ________ dollars per day.

29. Wide stores may obtain convenient surplus item storage space by placing their wall fixtures ________ feet from the wall with access aisles located every ________ to ________ feet.

30. The nation's hardware manufacturers spend about ______________ dollars annually for displays and point-of-sale materials.

31. Special unit displays generally are very ______________ and yield a maximum ______________ for a minimum of ______________.

Matching

Directions: In the left hand column is a list of hardware departments. The right hand column contains colors recommended for various hardware departments. Match the colors to the department by placing the letter of the color in the blank at the left of the appropriate term.

_____	1. Builders' hardware	A. Burgundy
_____	2. Carpenter's tools	B. Rose
_____	3. Cleaning supplies	C. Yellow or green
_____	4. Garden tools	D. Green
_____	5. Giftware	E. Blue
_____	6. Housewares	F. Yellow
_____	7. Sporting goods	G. Blue or green

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. List the two general catagories into which most hardware items can be grouped and give four examples of each.

(A) ______________________ (B) ______________________

(1) __________________ (1) __________________

(2) __________________ (2) __________________

(3) __________________ (3) __________________

(4) __________________ (4) __________________

2. Where are service items placed in the hardware store and why are they placed there?

Where: __________________________________

Why:

(A) __________________________________

(B) __________________________________

3. List five factors that must be considered when locating departments within a store.

(A) __________________________________

(B) __________________________________

(C) __________________________________

(D) __________________________________

(E) __________________________________

4. List six items which must be determined before choosing the best window treatment.

(A) __________________________________

(B) __________________________________

(C) __________________________________

(D) __________________________________

(E) __________________________________

(F) __________________________________

5. What are the characteristics of a good fixture arrangement?

(A) __________________________________

(B) __________________________________

(C) __________________________________

(D) __________________________________

6. List the eleven basic rules for maintaining valuable window displays.

(A) ______________________________

(B) ______________________________

(C) ______________________________

(D) ______________________________

(E) ______________________________

(F) ______________________________

(G) ______________________________

(H) ______________________________

(I) ______________________________

(J) ______________________________

(K) ______________________________

Assignment
Sheet No. 4

Covering
Units 74-86

PROMOTION AND ADVERTISING

It takes more than quality merchandise, good management personnel and a trained sales staff to make a retail hardware store a going concern -- customers are needed "to purchase your wares." But how does the customer know about your store and the products within its walls offered for sale? Constant advertising and sales promotional activities are needed to keep the public informed of what you have for sale.

The advertising and promotional activities of a store must be very carefully formulated, for the carrying out of these activities will be one of the strongest, most powerful influences on the general public's impression of the store's personality. The growth--sometimes, even the survival--of any store may ultimately depend on effective advertising and promotion. Advertising and promotional activities in almost every conceivable form make up today's message to the buying public. Any person employed in business today needs a basic knowledge of advertising. To be effective, advertising and sales promotion must be well planned and tied in with the total selling process of the store. Effective advertising pays while advertising without planning is costly.

This lesson is meant to introduce advertising and sales promotion fundamentals essential to the novice hardware man. This assignment should give the student a working knowledge of the importance of advertising, local and national aspects of hardware promotion, co-op funds and their place in modern hardware retailing, and the philosophy and methodology of promotional activities.

Assignment:

1. Read the reference listed below.
2. Make a list of the manufacturers, wholesalers and associations with which your store is engaged in co-op advertising programs. Ascertain what products your store carries which are advertised by this means. Conclude your written report by showing how you can turn this information into use when making face-to-face customer sales.
3. Compose a second list of the different advertising media which your store utilizes. In light of your reference readings, examine the list to pinpoint strong and weak areas. Report your findings in a 2-3 page report along with suggested changes in the store's master advertising plan. Turn in the paper to your coordinator for his suggestions, revise the paper if necessary, and then show and discuss your report with your employer.
4. Answer the questions below and turn in this assignment by ____________________.

Reference:

A. ACHR, "Promotion and Advertising," pp. 1-36.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. It is normal for a hardware store to have a steady loss of customers.

T F 2. Each and every ad should have a very specific goal.

T F 3. It is best to hand over all advertising in the form of long-range plans to the local newspaper.

T F 4. National advertising can be very valuable if the retailer "ties in" his store at the local level.

T F 5. Ads designed to sell specific items of merchandise should be slanted toward long-range appeal.

T F 6. Items featured in ads should be displayed along with related merchandise.

T F 7. Perhaps the best manner in which you can utilize the step-up sales method is to possess a complete product knowledge of your department or store.

T F 8. Institutional ads are effective only if the store lives up to the image it wishes to portray.

T F 9. Advertising programs should be continuously designed, tested, and remodeled to find the most effective methods for a particular store in its particular area.

T F 10. Dead stock can be effectively advertised to sell it to the customer.

T F 11. Advertising should be timely, truthful and emphasize quality.

T F 12. The emphasis of ads should not be too heavy on cheap product leaders since you can't say many good things about low quality merchandise.

T F 13. All ads should emphasize price which in turn should project the store image as a high priced outlet.

T F 14. Newspaper ads should never be crowded as customers often "don't get the message."

T F 15. The ad copy and layout usually should be simple and plain with an emphasis on current, up-to-date merchandise.

T F 16. Many stores fail to fully capitalize on such items as credit purchases and delivery services in their advertising.

T F 17. The amount of money spent for advertising should be spread out evenly throughout the year.

T F 18. Co-op funds distributed through wholesalers have conditions tied to them to make them undesirable to independent hardware retailers.

T F 19. An advantage of the NRHA co-op advertising program is its proported lack of red tape and fast repayment of funds.

T F 20. Manufacturers are more interested in what happens to their product after it leaves their hands than they were formerly.

T F 21. A retailer's reputation can be built up by selling well-known quality brands.

T F 22. Costs per exposures of ads in national magazines are quite cheap and reasonable.

T F 23. Your text claims that good national advertising lowers distribution costs, creates new markets and adds jobs.

T F 24. Independent, chain, and syndicate hardware retailers cannot pay the high cost for individual national advertisements.

T F 25. Modern communications have brought national advertising to every town, village, community and remote rural areas.

T F 26. National advertising helps to sell items which are not usually considered as being "presold."

T F 27. Though expensive, the large circulation of large city newspapers make them especially valuable as an advertising media for independant retailers.

T F 28. The "free" circulation type of paper is not effective for independent hardware advertisements.

T F 29. An occasional change-of-pace by advertising in the classified ad column is often effective.

T F 30. Radio advertising in areas where there is good newspaper coverage is of little value.

T F 31. For best results, radio ads should be on a constantly changing time schedule.

T F 32. Retailers should not advertise on FM stations because the audience is too small for the cost involved.

T F 33. Under no circumstance should the retailer make the mistake of relating his radio promotions to his newspaper ads.

T F 34. Retailers make very little use of billboards as an advertising media.

T F 35. All advertising methods must be tried and evaluated before an effective, consistent master advertising pattern is set up by any one retailer.

T F 36. Manufacturers believe co-op advertising is the most effective method for stimulating sales at the local level.

T F 37. Small independent hardware retailers do not get their fair share of co-op funds.

T F 38. Co-op funds are included in the cost of the product to the dealer.

T F 39. Manufacturers are quite satisfied in how their co-op funds are used.

T F 40. There are a great many hardware dealers who do not know that co-op funds are available.

T F 41. Some people feel that co-op advertising is not worth the red tape involved in the normal rebate method.

T F 42. Manufacturers are doing little to correct the problems involved with co-op advertising.

T F 43. The co-op program of the NRHA rebates the retailer 25% of the local advertising rate.

T F 44. All mats handled by the NRHA co-op program are furnished by the manufacturers.

T F 45. Under the NRHA co-op program, the retailer is required to send in a tear sheet of the ad along with the paid advertising invoice to eliminate the possibility of cheating.

T F 46. The NRHA co-op program is intended to replace present manufacturer and wholesale co-op programs.

T F 47. Free news items about the hardware store or its personnel are valuable advertising for creating a desirable store image.

T F 48. A retailer should make it a point to dig up items so as to build his reputation as a publicity seeker with the news media.

T F 49. Departmental promotions are easier and less expensive than store promotions.

T F 50. The best person to evaluate the effectiveness of a store is the customer.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. Advertising may be defined as all ______________ other than personal salesmanship which help to motivate a sale.

2. A store which is little known or has a poor service reputation may drive customers to ______________ firms when engaging in ______________ advertising to create desire on the part of the customer.

3. The pooled effort of most of the area retailers in advertising such as "Dollar Day" is a ______________ type of advertising and is most effective if used only ____________ or ____________ a year.

4. An excellent example of advertising to sell specific merchandise items is the annual ____________ ______________ sale.

5. Your text notes the advertising consists of three basic ingredients, the ______________, the ______________ and the ______________.

6. It is imperative to have adequate ________________ stock of items which are featured in ads.

7. Consumer interest can be built by advertising groups of merchandise in related ______________.

8. An advertising schedule should be set up on a ____________ basis.

9. Written copy should be aimed or addressed to a select ____________ group.

10. Copy should always be ______________ but the store ____________ should remain the same to build customer identification and ad retention.

11. Hardware manufacturers spend approximately ___________ dollars each spring to advertise ____________ ______________.

12. Wholesalers tie-in to the manufacturers spring advertising campaign by printing circulars with the "_______________ ______________ ______________" theme.

13. The average amount of money devoted to advertising is about ___________ per cent of gross sales.

14. The NRHA has a co-op advertising kitty of over __________ dollars.

15. Despite modern advertising, it is estimated that there are over ____________ items in the average hardware store which are not presold.

16. Advertisements in issues of such nationally known magazines as the ______________ ______________ ______________ often cost as much as ______________ dollars.

17. Independent hardware retailers can afford advertising on a regional basis by joining advertising ________________ plans.

18. About ____________ per cent of the merchandise handled in the hardware store is not presold.

19. The most effective advertising medium is at the _______________ level.

20. All retailers should _______________ all of his local ads along with an evaluation of its __________________.

21. One of the most effective radio programs on which to schedule ads is the _______________ ______________ program.

22. The most common type of hardware circular is a multi-colored wholesale ______________ of __________ to ____________ pages.

23. A popular circular is the toy and gift ________________ of __________ to ___________ pages which often contain reduced price ________________.

24. The retailer must have a ________________ _________________ ________________ in order to make direct mail promotions pay off.

25. Box holder mailing has a rather _______________ readership level.

26. Inequity creeps into the use of co-op advertising funds when ________________ keep the funds as a rebate.

27. Sometimes retailers cheat manufacturers out of co-op funds by _______________ billing or by printing _______________ papers.

28. Retailers receive about __________ per cent of the printing cost for running a manufacturers co-op mat.

29. Possible cheating on the part of suppliers is eliminated in the ______________ ______________ ______________ as they are not involved in the system.

30. A retailer should be cautious not to overdo his efforts in obtaining ________________ news releases and incur customer ________________.

31. Your text defines promotion as ______________ effort which encourages buying by ______________ ______________ ______________.

32. The final responsibility for planning the usual one or two yearly promotional programs rests with the ______________.

33. The NRHA publishes a brochure useful in planning promotions entitled ______________ ______________.

34. Good promotions depend on the ______________ of the efforts of the manufacturer, wholesaler and retailer to make the maximum use of national, regional and local advertising.

35. A promotion requires that sufficient merchandise is ______________, ______________, and displayed in ______________ so no customer will be disappointed due to sell outs.

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. What are the three purposes of advertising?

(A) ______________________________

(B) ______________________________

(C) ______________________________

2. What are three requirements of the message of advertising copy?

(A) ______________________________

(B) ______________________________

(C) ______________________________

3. What materials are made available by manufacturers which the retailer can use to tie-in to national advertisements?

(A) ______________________________

(B) ______________________________

(C) ______________________________

(D) ______________________________

(E) ______________________________

(F) ______________________________

(G) ______________________________

4. List <u>in order of use</u> the various media utilized for local hardware advertising.

(A) ______________________

(B) ______________________

(C) ______________________

(D) ______________________

(E) ______________________

(F) ______________________

5. What are some of the types of direct mail material useful for hardware promotion?

(A) ______________________

(B) ______________________

(C) ______________________

(D) ______________________

(E) ______________________

(F) ______________________

(G) ______________________

(H) ______________________

(I) ______________________

6. What types of free news items should the retailer seek to have published?

(A) ____

(B) ____

(C) ____

(D) ____

(E) ____

(F) ____

7. What are the two requirements for a good promotion?

(A) ____

(B) ____

____

Assignment
Sheet No. 5

Covering
Units 87-89

HARDWARE -- PART I

The hardware area of the retail hardware store is usually the largest single department and should account for the highest departmental sales volume. The "jewelry" of the hardware business is cabinet hardware that comes in matched sets to harmonize with designs, finishes and quality of construction. Sterling quality provides an extra value that customers would not refuse if the salesperson can talk intelligently about design, finish, construction, features, and types of hinges, knobs, pulls and catches. Only those stores which stock a wide variety of hardware items as well as many sizes, styles, designs, etc., of any single item can be considered true hardware stores.

Locks are required as barriers to stop the meddler or thief. A lock customer is seeking the peace of mind that comes from security. Hardware sales personnel should know what types of locking mechanisms are available on the market and for what type of installation each is most appropriate.

This assignment is an introduction to the importance of the hardware department. The material puts special emphasis on two of the basic merchandise areas: (1) cabinet hardware, and (2) locks. This lesson will help the student increase his knowledge of and sales of cabinet hardware.

Assignment:

1. Read the reference listed below.
2. Answer the questions below and turn in this assignment by _________________________.

Reference:

A. ACHR, "Hardware," pp. 1-24.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. Such merchandise as paint and housewares are usually included in the basic hardware group.

T F 2. The hardware department is complex and is composed of thousands of different items of all sizes and variations.

T F 3. Some hardware department items may consume considerable selling time without adding much to sales volume but are considered to be good traffic builders.

T F 4. Hardware items tend to move slower than merchandise sold in other departments.

T F 5. The lack of emphasis on built-in cabinets in today's modern home has led to a decrease in retail sales volume of cabinet hardware.

T F 6. There is little opportunity for selling cabinet hardware to owners of older homes.

T F 7. People who are "price buyers" simply cannot be convinced or "see" the features of quality cabinetware as in other lines of hardware merchandise.

T F 8. Chemical cleansing agents must be used to clean most cabinet hardware.

T F 9. Semi-concealed hinges are available for both lip (overlapping) and flush cabinet doors.

T F 10. The most popular size for semi-concealed hinges is for 3/4" lip doors.

T F 11. Semi-concealed hinges come in plated finishes only and therefore are not well suited for painting.

T F 12. Quality hinges should always be sold if possible because the cost of the hinge is less than the labor cost for replacing a worn out hinge.

T F 13. Surface type hinges are available for flush cabinet doors but not for offset doors.

T F 14. A flush overlay cabinet door completely covers the cabinet frame.

T F 15. Concealed hinges are decreasing in popularity for modern type kitchen cabinets.

T F 16. A quality craftsmanship installation of concealed flush overlay hinges requires mortising out the wood for the hinge.

T F 17. There are no concealed hinges available for overlapping or lip type cabinet doors.

T F 18. Most concealed hinges for ordinary flush cabinet doors (not flush overlay) expose the pin knuckle joint when the installed door is closed.

T F 19. A very pleasing decorative effect can be created by choosing cabinet pulls with patterns, designs, or finishes different from that of the hinges.

T F 20. From the labor standpoint, knobs are considered as being cheaper to install than are pulls.

T F 21. The lever spring action friction catch cannot be mounted on a door to shelf type of installation.

T F 22. All spring roller cabinet catches have two rollers between which the catch is "pinched" or caught.

T F 23. Though magnetic catches are both novel and popular, they really are not too practical or functional.

T F 24. Magnetic catches are available in styles that permit the magnetic units to be mounted on the frame, door, or shelf.

T F 25. Elbo catches may be used on either one (but not both) of a pair of doors.

T F 26. Cabinet locks are available in either mortised or half-mortised style.

T F 27. An important selling feature of pull-up shelves is to point out to the housewife how much valuable counterspace they can save.

T F 28. Sample panels for displaying cabinet hardware are useful for lumber yard outlets but have little to offer in retail hardware stores.

T F 29. The disc tumbler lock has a limited number of key changes.

T F 30. The warded lock can be keyed alike and master keyed.

T F 31. A great selling feature of pin tumbler locks is that they can be keyed alike, master keyed, and grandmaster keyed.

T F 32. To protect the purchaser of a master key system, manufacturers may register the system to prevent the keys from duplication.

T F 33. Standard duty locks are usually installed as original equipment on medium cost homes.

T F 34. Heavy duty locks are generally installed as original equipment on high cost homes.

T F 35. Locks for industrial plants, schools, or office buildings generally should be recommended only after consulting the manufacturer for specifications.

T F 36. On the outside of a mortise cylinder lock, the knob turns the dead bolt and the key controls the latch bolt.

T F 37. Spring latch locks are mounted to the inside of the door and are primarily to perform a latching function.

T F 38. Padlocks come in the same basic locking mechanism types as those used for door locks.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. Hardware sales account for ________ percent of the stores gross sales.
2. The hardware department makes the hardware store ______________ from other retail outlets.
3. The hardware department is considered to be the most ___________ of all the departments within the store proper.
4. The hardware department builds the _______________ image of the store.
5. Retailers must order much of the hardware stock in ____________ rather than carrying just a few sizes of merchandise.
6. Hardware items are considered excellent for _______________ sales by recommending items _______________ to the initial customer request.
7. Aside from quality, the most important point in selling cabinet hardware is emphasis on _______________ features.
8. Cabinet hardware can be divided into _______________ basic _______________ designs.
9. The most practical and easiest finishes to take care of are _______________ plating and _______________ finishes.
10. Quality copper, brass, and bronze platings have heavy _______________ and are protected with a _______________ liquid _______________ coating.
11. The most popular cabinet hinge on the market today is the _______________ type showing only the small _______________ and joint.
12. The hinge which has three knuckle joints and "V" shaped edges usually has a _______________ _______________ finish designed for _______________.
13. Surface type hinges are mounted on the _______________ of the cabinet _______________ and _______________.
14. The hinge which is very useful for covering up holes and marks from old hinges when doing remodeling work is the _______________ type.
15. There are ________ types of concealed hinges for overlay doors.
16. The most popular size of concealed hinges for ordinary flush doors have ________ inch insets.

17. Two cabinet pulls or knobs are required for drawers over ________ inches wide.

18. Usually cabinet ______________ are installed on doors and drawers where cabinet ______________ would look too large.

19. Knobs are installed for their ______________ effect and/or to serve a ______________ purpose.

20. The two parts of a friction catch are the ______________ which is located on the ______________ and the ______________ which is located on the ______________, ______________, or ______________.

21. The friction catch which often exposes dangerously sharp edges when broken is the ______________ type.

22. A magnetic catch should have a pull of ________ to ________ pounds for the average cabinet door.

23. To assure perfect contact and maximum holding power of magnetic catches, either the ______________ ______________ or the ______________ should have a built-in ______________ action.

24. Elbo catches are generally installed with the ______________ attached to the shelf or frame of the cabinet.

25. A catch designed for furniture where concealment of the catch is necessary is the ______________ catch.

26. A very important consideration when selling cabinet locks is how ______________ the ______________ is into which the lock will be installed.

27. Many hardware retailers make a nice profit from the sale of the fingertip or ______________ hardware, such as revolving shelves, wanted by many housewives.

28. Sticking cabinet drawers can be eliminated by installing ______________ and ______________.

29. An important sales aid for prepackaged cabinet hardware is the use of ______________ packages.

30. The lock which has the greatest capacity for key changes is the ______________ ______________ type.

31. The primary purpose for purchasing locks is for ______________.

32. A key that will unlock several "keyed alike" and some "all different" locks but which will not unlock all the locks in the building is called a ______________ key.

33. Master and grandmaster key systems are usually designed and made up special by the ______________.

34. A lock set usually contains a ____________ which gives the exact size, shape, and location of the mounting hole(s).

35. A desirable selling feature found on many exterior and bathroom locks is a __________ ____________ lock mechanism to prevent ____________ ____________.

36. Cylinder locks on bath and bedroom doors are installed mostly for the purpose of ______________.

37. Some owners of older homes try to reproduce an antique effect by installing ____________ ______________ locks.

Matching

Directions: The right hand column is a list of cabinet hardward designs. The left hand column contains hardware finishes or phrases which describe the various cabinet hardware designs. Match the design to the descriptions by placing the letter of the design in the blank at the left of the appropriate item. You may use the letters of the designs as often as you wish.

_____ 1. hand hammered pattern

_____ 2. polished chromium

_____ 3. polished brass with black accents finish

_____ 4. elegance and grace of period styling

_____ 5. black copper finish

_____ 6. gold finish

_____ 7. for baths and kitchens

_____ 8. the modern look

_____ 9. antique brass plated finish

_____ 10. antique copper finish

_____ 11. ivory finish

_____ 12. lovely as fine china

_____ 13. satin copper finish

_____ 14. baked finish

_____ 15. up-to-the minute styling

_____ 16. weathered look

A. Modern Contemporary Design

B. Colonial or Early American

C. Modern Provincial Design

D. Ceramic Design

Group II

<u>Directions:</u> The left hand column is a list of terms. The right hand column contains definitions of these terms. Match the definitions to the terms by placing the letter of the definition in the blank at the left of the appropriate term.

______ 1. Escutcheon

______ 2. Pin tumbler

______ 3. Master-keyed lock

______ 4. Tumbler

______ 5. Changes of a key

______ 6. Box strike

______ 7. Key way

______ 8. Spring latch

______ 9. Cylinder

______ 10. Strike

A. the opening to receive the bolt is completely enclosed to prevent rear access

B. number of different combinations of key and tumbler arrangements possible

C. a round case containing the key way and tumbler mechanism

D. ornamental plate

E. aperture running the length of a cylinder into which the key fits

F. one key which opens a set of locks which may all use different keys

G. cut in two or more sections and, when actuated by the key, allow the tumbler to turn in the case of the key plug

H. one which automatically closes and latches when the door closes

I. fastened to the frame to engage the bolts

J. the part which prevents the bolts from sliding, until operated by the key.

Listing

<u>Directions:</u> List the items called for in each of the following. Select your answers carefully.

1. What are the three major classifications of cabinet hardware?

(A) ______________________________

(B) ______________________________

(C) ______________________________

2. In what inset sizes can semi-concealed hinges be obtained?

(A) ____________________ (C) ____________________

(B) ____________________ (D) ____________________

3. List the desirable features of good quality pin type hinges.

(A) ____

____

(B) ____

____

(C) ____

____

(D) ____

____

4. What are quality features of unconcealed flush overlay hinges?

(A) ____

(B) ____

(C) ____

____

5. What are three purposes for which back plates for cabinet knobs are installed?

(A) ____

(B) ____

6. What are some desirable features of the lever spring action friction catch?

(A) ____

(B) ____

(C) ____

(D) ____

(E) ____

7. List four advantages of spring roller cabinet catches.

(A) ____________________

(B) ____________________

(C) ____________________

(D) ____________________

8. What are some ways in which prepackaged cabinet hardware can be displayed?

(A) ____________________

(B) ____________________

(C) ____________________

(D) ____________________

9. Note three advantages of open displays of cabinet hardware.

(A) ____________________

(B) ____________________

(C) ____________________

10. What six practices will contribute to building a good cabinet hardware sales volume?

(A) ____________________

____

(B) ____________________

(C) ____________________

(D) ____________________

(E) ____________________

(F) ____________________

____

11. List the pin, disc tumbler, warded, lever tumbler and combination locks in the order of the degree of security they offer from the highest to the lowest.

(A) ____________ (D) ____________

(B) ____________ (E) ____________

(C) ____________

12. List some desirable selling features of cylinder locks and latches.

(A) ______________________________

(B) ______________________________

(C) ______________________________

(D) ______________________________

(E) ______________________________

Assignment
Sheet No. 6

Covering
Units 90-93

HARDWARE -- PART II

"Hard selling" does not apply to selling hardware. Customers come in this department looking for items to do a specific job and to fill a specific need. If the "right" merchandise is presented to them in an effective manner, they will buy.

This is the second and last assignment dealing with hardware merchandise. As the reference text points out, no single book can discuss the thousands of hardware items on the market. Therefore, you, as a student salesman, should study the material presented in these two assignments as being but an introduction to hardware merchandising. It is important that you continue to accumulate product knowledge of hardware throughout your career as a hardware man. You can do this by daily exploring the stock on the shelves, reading manufacturer's brochures, catalogues and other printed matter sent out by suppliers. You will also find hardware buyers' trips, shows, and conventions useful for gaining new product knowledge. Above all, you should maintain an outgoing curiosity about all merchandise in the hardware retail market.

This assignment is designed to help you increase sales by giving you product information. In this unit you should gain valuable information about window and door hardware, fasteners, and such other hardware items as casters, glides, mail boxes, etc. In addition, you will explore the importance, need, benefit, use, and cost of factory and in-store prepackaging.

Assignment:

1. Read the reference listed below.
2. Visit other hardware retail stores in your area. Note what lines of merchandise they carry, what items generally are prepackaged, and how various goods are displayed. Write a report pointing out weak and strong areas of your store in comparison to the other outlets you visited. Point out those features your store has which should be especially capitalized upon to build new customer traffic.
3. Answer the questions below and turn in this assignment by ______________________.

Reference:

A. ACHR, "Hardware" pp. 25-62.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. One of the first steps in selecting a correct door hinge is to determine the type of door and frame on which the hinge will be installed.

T F 2. Handy charts are available to help determine the correct type of hinge to be choosen for a particular job.

T F 3. Regular weight bearing hinges are required for doors classified as large.

T F 4. The weight of doors is calculated in pounds per cubic foot.

T F 5. The width of a hinge is measured across the leaves when the hinge is fully opened.

T F 6. The hinge width is standardized in proportion to the hinge length for half mortise, half surface, and full surface hinges.

T F 7. If you are standing outside and the door opens to the right, it takes right hand butt hinges.

T F 8. A half mortise hinge can be adapted for either right or left hand mounting by reversing the pin and plug.

T F 9. Though "T" hinges come in light, heavy and extra heavy weights, only the first two are generally carried in hardware stores.

T F 10. The statement in your text which says the three by-pass sliding doors "provide a passage way equivalent to the approximate width of two of the door sections" is incorrect.

T F 11. Locks are available for sliding doors.

T F 12. There is a trend toward streamlining and completely concealing both pneumatic and liquid closures.

T F 13. Door closers should not be applied to the outside of exterior doors unless they are protected by a canopy or similar device.

T F 14. Barn door accessories such as flush pulls, stay rollers, bow handles, etc., are generally zinc or cadmium plated.

T F 15. Ventilating sash locks permit the window to be locked in an open position.

T F 16. Windows may be opened by a bar, flush or hook sash lifts.

T F 17. Sale of window hardware may be stimulated by pointing out to the customer the desirability for all pieces in the room to match in design.

T F 18. Most customers know exactly what type and size fasteners they need for their job.

T F 19. Box nails are thicker than common nails and therefore are considerably more heavy.

T F 20. The majority of nail sales will be for common nails.

T F 21. The length of a flat head bolt is from the extreme end of the threaded section to the top of the flat of the head.

T F 22. One of the most commonly used bolts is the machine bolt.

T F 23. Cap screws are high quality fasteners designed for conditions requiring maximum holding power.

T F 24. Machine screws come only in fine cut threads.

T F 25. Nuts are furnished with matching bolts, carriage bolts, and stove bolts, but not with machine screws (i.e., must be purchased separately.)

T F 26. Anchors such as toggle bolts are to fasten things to solid masonry walls or floors.

T F 27. There are at least five styles of lock washers on the market.

T F 28. Usually square nuts come plain or chamfered on one side only whereas hex nuts always have at least one side chamfered.

T F 29. A socket set screw has a hole with eight sides for special keys or wrenches.

T F 30. All masonry drive anchors are used to permanently fasten objects into place.

T F 31. Sheet metal screws are designed to self thread themselves into sheet metal.

T F 32. The hardware items not covered in the hardware section of your text are also important; therefore, you should make every effort to obtain information about them as you work, i.e., learn as you earn.

T F 33. Spherical casters are most popular for household items which roll on linoleum and tile floors.

T F 34. Tea wagon casters are the ultimate in design and quality.

T F 35. Truck casters are designed to carry up to as much as 1000 pounds per caster.

T F 36. Plastic caster wheels have excellent non-marking qualities.

T F 37. The cushion glide is the most economical glide to initially purchase.

T F 38. The large size rural mail box enjoys the largest sales volume, especially in suburban areas.

T F 39. Key making machines are an economical addition to the stores' service feature and is a profitable traffic builder.

T F 40. Prepackages are designed to present the goods to maximum advantage while occupying a minimum of space.

T F 41. All items shipped in bulk should be prepackaged in the store to encourage customer sales.

T F 42. It takes more time and money to in-the-store prepackage small items like wood screws than it does to quickly count out and bag exactly what the customer orders.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. Most house doors fall into a ______________ frequency of use and require ______________ ______________ ______________ bearing hinges.

2. Most commercial building doors fall into either ______________ or ______________ frequency of use categories.

3. A door ________ inches or more in thickness and over ________ feet in width is classified as a large door.

4. The length of a hinge is determined by the ______________ and ______________ of the door.

5. Doors under ________ inches in height require two hinges and doors ________ to ________ inches require three hinges.

6. In order to look up the correct height of butt hinges (length of joint) on the chart provided in the text, you must know the door ______________ and door ______________.

7. A left hand reverse door means it is a left hand door which opens ______________.

8. Continuous or ______________ hinges are available in a minimum width of ________ inches and a maximum length of ________ inches.

9. Strap hinges are intended for rough work and come in ______________ and ______________ weights.

10. Ornamental "T" and strap hinges generally are reversible for ______________ or ______________ ______________ applications with the most popular finishes being ______________ or ______________.

11. Sliding door hardware generally comes ______________ to eliminate the chance of errors.

12. A liquid closure generally requires a minimum space of ________ inches between doors for installation and a pneumatic closure requires ________ inches.

13. Barn door hangers are available with ______________ or ______________ bearings and are designed to carry weights from ________ to ________ pounds.

14. Window rattles and drafts may be eliminated by installing crescent ______________ ______________ sash locks.

15. The bolt which has a square section beneath a rounded head is called a ______________ bolt.

16. Stove bolts are available in ______________, ______________ and ______________ heads with ______________ nuts and are used to assemble small parts and in ______________ ______________ work.

17. Lag bolts can be fastened into wood or into masonry with the aid of lag bolt ______________.

18. A very common anchor which utilized wood screws for fasteners is the ______________ ______________ ______________ anchor.

19. Hammer set or lead anchors generally use ______________ ______________ as the fastening agent.

20. Holes can be hand drilled into masonry by using a **hammer** and ______________ drill.

21. Turn buckles are used for tightening wire, straightening warped screen doors, or many other applications where ______________ is required.

22. The most common wood screw sizes range from ________ to ________ inches in length and from ________ to ________ in diameter.

23. Wood screws come with ___________, ______________ or ______________ heads.

24. Type A sheet metal screws are for fastening sheet metal under 18 gauge in thickness and type B is for sheet metal up to ________ gauge.

25. The two types of casters are the ______________ and ______________ types.

26. Casters are mounted on ______________ to provide directional ______________.

27. Most caster sales will be for ______________ ______________ casters designed for light furniture usage.

28. The new type spherical caster uses a completely enclosed ______________ to eliminate fouling and has ______________ bearings.

29. Spherical casters treads are available in either ______________ or ______________.

30. Some caster glides have a ________ degree range of movement or tilt suitable for replacing casters in the modern, splayed furniture legs.

31. Rural mail boxes come in ________ sizes and are made of heavy gauge ______________ ______________.

32. The two major purposes of packaging are to ______________ the merchandise while in ______________ and to ______________ it on arrival.

33. Over ________ manufacturers have used the NRHA laboratory store at ______ _________, ______________ to test prepackaging and display ideas.

34. Bags suitable for in-store prepackaging made from ______________ and printed with the store's name and address can be purchased from retail ______________ ______________ or ______________ ______________.

35. It costs about ________ cents per package to place small items in prepackaged containers.

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. List the four types of door hinges and tell how each is mounted.

(A) ____

(B) ____

(C) ____

(D) ____

2. What are the three most common types of sliding doors?

(A) ____________________

(B) ____________________

(C) ____________________

3. List the most important feature for each of the following terms as they apply to sliding doors.

(A) Aluminum track - ____________________

(B) Nylon rollers - ____________________

(C) "T" frames - ____________________

(D) Information necessary to choose closing door hardware - ____________________

4. List the attributes of liquid and pneumatic closures.

Liquid	Pneumatic
(A) ________	(A) ________
(B) ________	(B) ________
(C) ________	(C) ________
(D) ________	(D) ________
	(E) ________

5. What common faults are responsible for door closure malfunctions?

(A) ____________________

(B) ____________________

(C) ____________________

(D) ____________________

6. List 4 types of screen door closures.

(A) ____________________

(B) ____________________

(C) ____________________

(D) ____________________

7. What four different types of screen door catches are available?

(A) ____________________

(B) ____________________

(C) ____________________

(D) ____________________

8. List 6 of the most common shapes of bolt and screw heads:

(A) ____________________ (D) ____________________

(B) ____________________ (E) ____________________

(C) ____________________ (F) ____________________

9. The three main parts of a caster are as follows:

(A) ____________________ (C) ____________________

(B) ____________________

10. List the three types of bearings available in casters and the conditions for which each is recommended.

	Bearing type	Recommended Use
(A)	____________________	____________________ ____________________
(B)	____________________	____________________ ____________________
(C)	____________________	____________________ ____________________

11. What are some items which must be considered when selecting casters?

(A) ____

(B) ____

(C) ____

(D) ____

12. What are the two purposes of glides?

(A) ____

(B) ____

13. List some of the major assets of prepackaging.

(A) ______________________________

(B) ______________________________

____

(C) ______________________________

(D) ______________________________

(E) ______________________________

____

(F) ______________________________

(G) ______________________________

____

(H) ______________________________

____

(I) ______________________________

(J) ______________________________

____

Matching

Directions: The left hand column is a list of materials used in mail box construction. The right hand column contains descriptive phrases regarding quality and price. Match the descriptions to the types of construction materials by placing the letter of the description in the blank at the left of the appropriate term.

Material

_____ 1. sheet metal stampings

_____ 2. aluminum

_____ 3. brass and forged iron

_____ 4. solid forged iron

_____ 5. wrought sheet metal

_____ 6. solid brass

Quality-price

A. Top quality, high priced

B. Medium quality and price

C. Functional, economically priced

Assignment
Sheet No. 7

Covering
Units 94-99

HAND TOOLS -- PART I

Hand tools, like candy bars, come in many shapes, sizes, and weights. They have many uses and it is the responsibility of the seller to properly advise the customer in the selection of these hand tools. "Coming to grips" with things is an everyday situation we all face. Avoiding "skinned knuckles" is a real challenge in removing and replacing nuts and bolts. Having the right tool to get a job done is what the customer wants.

The hand tool department of any retail hardware store is a very important section since it helps establish the store "image" in the customer's mind. If the tools are well displayed in a manner which will stimulate customer interest and encourage purchases, this area can add materially to the profit of the store. Hand tools that are sold will encourage repeat business if they are the correct tools for the customer's job. They can also cause the customer to go elswehere for his next tool purchase if they are not adequate. A thorough knowledge of all the hand tools in the department is absolutely necessary to aid the customer in wise and intelligent choices.

In this assignment, the student will find specific information about saws, drilling tools, cutting tools, and hammering tools. This unit covers hand tool specifications, terminology and usage. This unit is very important to a student salesman's success in the hardware retail business.

Assignment:

1. Read the reference listed below.
2. Visit the hand tool departments of other hardware stores in your area. Make a list (and sketch if needed) of the desirable features which you see where tools are displayed to good advantage. Especially note any "unique" or unusual sales "tricks" which stimulate interest.
3. Answer the questions below and turn in this assignment by ________________________.

Reference:

A. ACHR, "Hardware," pp. 1-24.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. Widespread use of power equipment has led to a declining hand tool market.

T F 2. Buyers of hand tools to fill an immediate need generally are hard to please and poor prospects for step-up sales.

T F 3. Planned project customers generally have their own tools and are poor prospects for new or additional hand tool sales.

T F 4. Sales of tools to planned project buyers represent a relatively small share of the stores gross sales volume.

T F 5. The tool lover is a small but steady source of sales in the tool department.

T F 6. Cultivation of tool lovers can lead to additional traffic from new customers in the tool department.

T F 7. Carpenters know what they want in a tool and are hard to change but are excellent prospects for new tools.

T F 8. Carpenters should always be given discounts since they purchase many tools.

T F 9. The tool department is popular for browsing which leads to impulse purchasing.

T F 10. At least one sample tool should be on display but carefully fastened down to prevent breakage and stealing.

T F 11. An 8 point saw means it has 8 teeth per inch.

T F 12. The greater the number of teeth on a saw the finer the cut it will make.

T F 13. A miter box saw is an extra long back saw with an attachment for cutting various angles.

T F 14. The blades which come in a nest of saws are intended to saw only soft materials like wood or plastic.

T F 15. Kitchen saws are the same thing as butcher saws but the former is of lower quality.

T F 16. The standard hack saw has a rigid frame which takes 16" disposable blades.

T F 17. The power chain saw is displacing the 5 to 6 foot hand crosscut saw.

T F 18. A saw set is used to sharpen saw teeth.

T F 19. When a customer asks for a "drill" you can be certain that he wants to purchase a mechanism with a crank needed to turn a tool for boring a hole.

T F 20. The breast drill is identical in size and use to the hand drill except for the substitution of the breast plate and its support.

T F 21. Breast drills come in both left and right handed versions.

T F 22. High speed drills or drills marked "HS" are usually used in power driver tools.

T F 23. Bit stock square shank drills have a square tapered shank 1¼ inches long.

T F 24. Fractional size taper shank twist drills require the use of a special three jaw chuck even on machines for which they are suitable.

T f 25. Because of the nature of the tool, one type of hammer is all that is needed in the average household; and the curved claw, nail hammer best fills the need.

T F 26. The poll or neck of the hammer is the upper part of the handle.

T F 27. Because hammers are so common, good quality hammers which break are discarded by the homeowner.

T F 28. Better quality hammers can usually be identified by a baked enamel finish on the head and/or handle.

T F 29. In both the curved claw nail hammer and the ball pein hammer the 16 oz. size is the most popular.

T F 30. A soft faced hammer or mallet should be recommended whenever the blows of a steel hammer might tend to damage the surface area.

T F 31. The newest model tackers are so efficient that they can be used for relatively heavy work.

T F 32. The hand drilling hammer is usually recommended where the customer has a considerable amount of drilling to do with a star drill.

T F 33. The hand drilling hammer and the sledge hammer differ only in the length of the handle.

T F 34. All hatchets can be identified by a cutting blade on the head which runs parallel to the handle.

T F 35. The "wallboard hatchet" is the only hatchet which does not have some provision for pulling nails.

T F 36. Since axes are all used for the same purpose customers will usually accept any pattern as long as the weight and handle are correct.

T F 37. The wedge is a cutting tool designed for splitting tough wood which cannot be split with an ordinary axe.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. Immediate need purchases of hand tools are in the ______________ price range and account for a ______________ share of the store's total tool sales.

2. Customers who purchase tools for planned projects are ______________ prospects for ______________ and ______________ sales.

3. Tool lovers are ______________ buyers and are interested in the ______________ tools and attachments.

4. A ______________ saw is designed to cut across the grain and a ______________ saw is used to cut with the grain.

5. A back saw is a ______________ type saw and is designed to do accurate ______________ work.

6. A compass saw has a ________ to ________ inch ______________ blade and is used to cut ______________ or ______________.

7. A smaller version of the compass saw which is used for the same general type of work is the ______________ saw.

8. Very intricate irregular shapes may be sawn from soft materials using a ________________ saw with a ________ inch wide blade.

9. A good saw set tool should be able to set a ______________ of kinds of saws and anywhere from ________ to ________ points per inch.

10. "Bits" or "drills" used for light work and for small holes are usually called ______________, for heavier work they are called ______________ ______________ or ______________ ______________.

11. The handles of push drills and hand drills are often used for the storage of various sizes of ______________.

12. The expansive type of auger bit is recommended for holes of approximately 2 inches to ________ in diameter.

13. Blacksmith drills have a shank diameter of ________.

14. A masonry drill is used for drilling holes in ____________ materials such as ____________ or ____________.

15. Reamers are used for ____________, ____________ and ____________ holes in a variety of materials.

16. Since the non-professional purchaser of a hammer seldom knows anything about hammer types, he will usually depend upon the ordinary ____________ ____________ for all his jobs.

17. The cheapest hammers have ____________ ____________ heads and can actually be classified as ____________ while the quality hammers have heads made from ____________ ____________ steel.

18. The curved claw type hammer is designed for easy nail pulling while the ____________ ____________ or ____________ hammer is designed for prying boards apart.

19. Claw hammers are available in weights from ________ to ________ ounces with ________ being the most popular.

20. Tack hammers come in sizes ranging from ________ to ________ ozs.

21. The center body portion of a soft faced hammer is made from ____________ to which the ____________ faces and the handles are attached.

22. The entire head of a mallet is made from ____________, ____________, ____________ or ____________.

23. Hammer tackers and automatic tackers both utilize ____________ rather than tacks or nails as the holding media.

24. The "hand drilling" hammer is described as having an extremely ____________ handle with a head weight of ________ to ________ pounds.

25. Hatchets actually combine some of the features of several different tools, the ____________, the ____________ and the ____________.

26. The two basic categories of axes are ____________ ____________ and ____________ ____________.

27. Almost all good quality full size axe handles are about ________ inches in length and have been made from fire hardened ____________.

28. The handle on the ____________ ____________ axe is slightly curved while the ____________ ____________ axe handle is straight.

29. The belt axe is also referred to as the ______________ axe and is a small ______________ bit axe weighing about ________ to ______ pounds.

30. Wedges have two uses, ______________ while sawing and ______________.

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. List some important techniques which can build hand tool sales volume.

(A) ______________________________

(B) ______________________________

(C) ______________________________

(D) ______________________________

(E) ______________________________

(F) ______________________________

____

2. List the five main parts of a handsaw.

(A) ______________ (D) ______________

(B) ______________ (E) ______________

(C) ______________

3. List the blades usually available in a nest of saws:

(A) ______________ (C) ______________

(B) ______________

4. List some features of a good miter box.

(A) ______________________________

(B) ______________________________

(C) ______________________________

(D) ______________________________

(E) ______________________________

5. List the different categories of hand powered "drills."

(A) ______________________ (C) ______________________

(B) ______________________ (D) ______________________

6. The brace is basically a crank used to turn and guide:

(A) ______________________ (C) ______________________

(B) ______________________

7. List the different types of drills or drill bits the tool department must carry.

(A) ______________________ (D) ______________________

(B) ______________________ (E) ______________________

(C) ______________________ (F) ______________________

8. List the types of nail hammers (as classified by handles) available to the customer.

(A) ______________________ (C) ______________________

(B) ______________________

9. List the most common types of hatchets which <u>do</u> <u>not</u> have some provision for removing bent nails.

(A) ______________________ (E) ______________________

(B) ______________________ (F) ______________________

(C) ______________________ (G) ______________________

(D) ______________________

Assignment
Sheet No. 8

HAND TOOLS -- PART II

Covering
Units 100-102

Today, the home craftsman is constantly adding to, taking away, or in some way changing the size or shape of something around the house. This "do-it-yourself" movement has seen tremendous growth since World War II. The results of this trend has caused many manufacturers to initiate constant product improvement and development programs. They bring out new annual models as well as make constant changes in their products. Any good salesman must read and keep up with new product sales information and specifications to keep abreast of the latest tool developments and products.

This is the second and last assignment dealing with hand tools carried for sale in the hardware store. Techniques of aiding the customer in the proper selection of measuring tools, screwdrivers, chisels, ad punches, holding and shaping tools, pliers, wrenches, and other hand tools, are very important to know if one is to be an effective hand tool salesman. A satisfied customer is one that will return and thus be an asset to the business. Persistance, patience and product knowledge is necessary to sell hand tools because there are so many uses for the kinds, sizes, and types that are available. The main objective in selling any hand tool is--will it fit the customer's need?

This lesson will acquaint the student with the many types, sizes, uses and selling points for various hand tools. This assignment will provide sales tips and product information that will enable a sales trainee to do a better job of serving his customers' needs.

Assignment:

1. Read the reference listed below.
2. Read through any recent advertising literature available to you from your place of employment or school especially the advertisements in the mechanics, woodworking and home construction journals and trade journals such as the Hardware Retailer.
3. Answer the questions below and turn in this assignment by ______________________.

Reference:

A. ACHR, "Hardware," pp. 25-62.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. Because of the simplicity of the common carpenters square, practically anyone knows how to read it properly.

T F 2. The first step in filling the customers need is to ask what kind of a tape measure he wants to look at.

T F 3. The two way flat reading rule can be read either from left to right or right to left depending on which end is opened first.

T F 4. The brick mason's rule is marked with its scales on a 16" module with scales on both sides starting at the same end.

T F 5. The two foot boxwood rule folds in such a way that it is only 8" long when folded.

T F 6. Boxwood calipers are available in both left and right hand types.

T F 7. Some new types of steel tape rules have mechanisms which lock the blade in the desired position.

T F 8. The narrower (3/8 inch or less) tapes are preferred because they have less tendency to sway in the wind.

T F 9. In recent years woven fabric tapes have been improved to the point where stretching is no longer a serious disadvantage in ordinary use.

T F 10. Replacement tapes are available for tape rules and they are widely utilized by carpenters and engineers.

T F 11. The pin in a marking gauge actually cuts a line for the saw to follow.

T F 12. The framing table on the square is also referred to as the rafter table.

T F 13. Decimals of an inch cannot be obtained from a steel square.

T F 14. The head of the try square usually contains a scratch awl which is used for marking on the various materials.

T F 15. The vials in most good quality levels are held in place by putty.

T F 16. A good quality carpenters level can always be read in any position and from either side.

T F 17. The quality of a screwdriver will be determined by the type of material from which the handle is made.

T F 18. The "Phillips" type screwdriver is now the most popular type.

T F 19. Cabinet tip screwdrivers and regular tip screwdrivers come in all of the comparable size ranges.

T F 20. Good quality straight slot screwdrivers have been cross ground.

T F 21. Some screwdrivers have square or octagon bits (blades) which enable a wrench to be used for additional torque.

T F 22. Offset screwdrivers can provide additional leverage for removing stubborn screws.

T F 23. The spiral rachet screwdriver is only useful where the user must drive many identical screws.

T F 24. The "screw holder" type screwdriver has a mechanism for holding the screw when starting it in an inaccessible position.

T F 25. The term "wood chisel" refers to the material from which the handle is made.

T F 26. The pocket chisel has the lightest and thinnest blade of the four varieties of chisels.

T F 27. The paring chisel is used for light paring cuts after the work has been roughed out.

T F 28. Butt chisels have a very short blade which enables them to be used in extremely close quarters.

T F 29. Due to the type of use a chisel receives it is always a good idea to recommend chisels of high quality.

T F 30. The pointed end of the nail set is hollowed out or cupped slightly to prevent the nail head from splitting.

T F 31. Awls come in both heavy duty types for use with a hammer and lighter types for use with only hand pressure.

T F 32. "C" clamps were originally developed for the carriage trade and are only found in old type workshops today.

T F 33. The bar clamp is only an extended "C" clamp or vise.

T F 34. Usually the size of the vise is not proportional to the jaw width.

T F 35. The pipe vise is designed for holding any type of round material such as round rods or bar stock.

T F 36. When doing finish sanding the customer should be advised not to jump more than two grit sizes for each sanding step.

T F 37. When measuring the length of a file the tang is included.

T F 38. The majority of files have parallel edges and faces throughout their length.

T F 39. A "safe edge" file has one or more edges (or sides) which have no teeth.

T F 40. A file handle fits onto the part of the file called the heel.

T F 41. File handles should not be recommended for customers who purchase files with a ready made handle in place of a tang.

T F 42. File cards and file brushes are used for the same purpose.

T F 43. The first step in serving a customer who wishes to purchase a plane is to ask him what kind of a plane he wishes to purchase.

T F 44. The block, jack, fore and jointer planes are all variations on the same basic pattern.

T F 45. The jointer plane is especially valuable for smoothing the face of rough boards.

T F 46. The circular plane can cut concave and convex surfaces down to a minimum radius of 20 inches.

T F 47. Forming files use the same blades as the surface forming plane.

T F 48. Replacement blades for the surface forming tools are available in fine to coarse cuts.

T F 49. Some long nose pliers are made with a bent or curved nose to enable easy access to awkward places.

T F 50. Diagonal pliers are always of the curved nose variety.

T F 51. End cutting pliers are designed as dual purpose pliers, to both hold and provide cutting action.

T F 52. Side cutting pliers include both long and short nose varieties.

T F 53. Pliers should be suggested only for cutting or holding action or for nut removal when very small nuts are used.

T F 54. Open end wrenches must be selected which fit the head exactly if damage to the wrench is to be avoided.

T F 55. The box end wrench handle is usually practically straight in order to obtain maximum leverage.

T F 56. The jaws of the open end of combination wrenches are set at a 15° angle for general purpose tools but may be set at any angle for special purpose wrenches.

T F 57. The advantage of the locking type adjustable wrench is that the lock eliminates the slipping of the adjustment after it is once set.

T F 58. Wrenches of various sizes must meet a minimum set of government specifications before they can be sold on the open market and even the lowest quality tools meet this standard.

T F 59. Pipe wrenches are designed so that they bite into the surface of the work which makes them unsuitable for installing plated or polished surfaces.

T F 60. Aluminum pipe wrenches are gaining in popularity and should be recommended only for work in close quarters.

T F 61. The socket is turned by means of a handle which is inserted into its top.

T F 62. The set screw in the handle end enables the plier wrench jaws to be locked in any desired position.

T F 63. Due to its design the plier wrench can be used as a vise or as pliers.

T F 64. The offset ripping chisel is a light duty ripping bar.

T F 65. The electric soldering iron is used primarily by the workers such as plumbers, who must use it extensively.

T F 66. The names Philadelphia and London refer to the locality of manufacture for the two patterns of brick masons trowels.

T F 67. Cement trowels can easily be identified because they are usually narrower and longer than plastering trowels.

T F 68. Utility knives are designed to use easily inserted replacement blades.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. The carpenter routinely must make accurate measurements up to ________ feet.

2. Folding rules have been adapted to suit the needs of the ______________, the ______________, the ______________, the ______________, as well as the carpenter or woodworker.

3. As each additional section of a folding rule is unfolded ________ inches is added to the length of the rule.

4. The engineers rule is graduated to ______________ of a foot on the inside and ______________ of an inch on the outside.

5. The extension rule contains a sliding scale insert ___________ ___________ long which allows accurate ______________ measurements.

6. The Boxwood calipers have scales and are designed for both ______________ and ______________ measurements and are usually found in ___________ or ___________ sizes.

7. The tape rule provides a flexible measuring device for ______________ or ______________ measurements.

8. The tape rules are available in widths of ___________ to ___________ and lengths of ___________ to ___________.

9. Calibrations are imposed on the tape either by ______________ or ______________ directly on the tape.

10. Marking gauges are made from ______________ or ______________ and have a bar about _______ inches long.

11. The two more common and usable tables found on a carpenters steel square are the ______________ and ______________ tables.

12. The carpenters steel square has a body ___________ long and a tongue which is ___________ long.

13. The combination square can be used as a miter square to lay-out or test _______ or _______ angles.

14. Metal levels are usually made from ______________ or ______________.

15. The torpedo level is usually about _______ inches long and is valuable to those working in close quarters.

16. Screwdriver handles are made from ______________ or ______________ and some heavy duty types have a one piece blade which extends through the handle and is ______________ ______________ on the end.

17. The cabinet tip screwdriver is easily identified since it has no ______________ which could mar the surface when driving a recessed or deeply countersunk head screw.

18. Phillips head screws come in _______ sizes ranging from _______ (the smallest) to _______ (the largest) with the number _______ being the most popular.

19. Bit brace screwdriver bits are designed primarily for driving or removing ______________ ______________ size screws.

20. Whenever a customer purchases a nail set he will likely also need to purchase some type of ______________, ______________ ______________ or other filler material.

21. Nail sets are manufactured in sizes ranging from ___________ to ___________.

22. The cheaper cold chisels are made from ______________ ______________ ______________, while the better quality chisels are made from ______________ ______________.

23. Cold chisels come in lengths up to __________ and widths (or diameters) of ___________ up to ___________.

24. Center punches have a ______________ point of _______ to ________ ______________.

25. Bar clamps are available in lengths of from ____________ to ___________.

26. Home workshop vises have jaws ranging in size from ___________ to ___________ in widths.

27. Swivel bases are available on the ______________ or ______________ ______________ vise.

28. The two general categories of abrasive tools are ______________ ______________ and ______________ ______________.

29. The common bench stone is classed as a ______________ ______________ and has one side which is ______________ grit and the opposite side is ______________ grit.

30. The most common size of coated abrasive paper for the workshop is the _______ x ________ size, however, "flint" or "sand" paper comes in 9" x 10" sheets.

31. Coated abrasives are available in ______________, ______________ and ______________ ______________ for use on portable power driven tools.

32. The most popular size bench stone is approximately _______ inches x ________ inches with many other sizes and shapes available.

33. Files are classified according to ______________, ______________ and ______________.

34. A "contact" file refers to a file used to dress ______________ ______________ ______________ or automobile points.

35. ______________ ______________ or ______________ ______________ ______________ are small files of various sizes and shapes used by tool and die makers and also by watch and clock makers.

36. A slim taper or extra slim taper file will most likely be sold for the purpose of sharpening ______________.

37. ______________ gouges are inside ground, while the ______________ gouge is ground on the outside or inside.

38. Sweep refers to the arc of the gouge. Firmer gouges are available in ______________, ______________ and ______________ sweeps.

39. The ______________ plane is the most common size and is usually recommended for general work.

40. The simplest and smallest of the common planes is the ______________ ______________.

41. ______________ planes are used to cut rectangular recesses out of either edges or faces of flat material.

42. The surface forming plane (or tool) is available with either a ______________ (regular) or ______________ pattern cutter.

43. Pliers are generally divided into two categories determined by the joint type, they are sliding or slip joint and ______________ ______________ and can be classified further by their ______________, ______________ ______________ and ______________ ______________.

44. The purpose of plastic coating on plier handles is to minimize ______________ danger and also provide more ______________ for the user.

45. If a production worker needed to clip many wires on his work he would likely select pliers with a ______________ ______________ in the handle.

46. The text refers to the size of the openings in an open end wrench as the "______________."

47. Box end wrenches come in both ________ point and ________ point types.

48. Aluminum pipe wrenches are approximately ________ as heavy as steel wrenches and are available in both the ______________ and ______________ types.

49. In actual operation a socket and handle can most nearly be compared to a ______________ ______________ ______________.

50. Plier wrenches or "vise grips" are available in various sizes running from ________ to ________ inches in length.

51. The "pinch" bar or ripping bar is most commonly found in the ______________ pattern and is used to remove nails too large for the ______________ ______________.

52. Both the __

52. Both the ____________ ____________ type of soldering iron and the ____________ ____________ or ____________ type are rated by the ____________ of the unit.

53. The pistol grip or instant heat soldering iron is often ________________ controlled and is available in a kit with all the necessary components contained in a box.

54. ____________ trowels are usually forged from one piece of steel while ____________ trowels have the post riveted to the blade.

55. The ____________ ____________ blade is often slightly convex but most other trowels have flat blades.

56. Mechanics' tool boxes come in sizes ranging from ________ to ________ inches in length.

57. Users of ____________ tools often prefer wooden tool chests because of the moisture absorbency of the wood which helps prevent moisture condensation and rusting.

58. Utility cabinets are purchased for the storage of small parts such as ____________, ____________ etc.

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. Folding rules fall into the following eight categories:

(A) ______________________ (E) ______________________

(B) ______________________ (F) ______________________

(C) ______________________ (G) ______________________

(D) ______________________ (H) ______________________

2. The end ring serves the following functions.

(A) ____

(B) ____

(C) ____

3. The types of squares covered by the reference are:

(A) ______________________ (C) ______________________

(B) ______________________

4. The combination square consists of the following parts:

(A) ______________ (D) ______________

(B) ______________ (E) ______________

(C) ______________

5. The better grade wood levels usually can be distinguished by the following features.

(A) ______________

(B) ______________

(C) ______________

(D) ______________

6. Special purpose levels include:

(A) ______________ (C) ______________

(B) ______________

7. Metal levels offer the advantages of being:

(A) ______________

(B) ______________

(C) ______________

8. List the three most common basic types of screwdriver tips.

(A) ______________ (C) ______________

(B) ______________

9. The three basic types of wood chisel handle types are:

(A) ______________ (C) ______________

(B) ______________

10. List the classification or types of vises:

(A) ______________ (C) ______________

(B) ______________ (D) ______________

11. The materials, both natural and man made, used in abrasive products are:

Natural Abrasives	Artificial or Manufactured Abrasives
(A) ____________	(E) ____________
(B) ____________	(F) ____________
(C) ____________	
(D) ____________	

12. List the file types (cross sectional shapes) available.

(A) ____________ (D) ____________

(B) ____________ (E) ____________

(C) ____________ (F) ____________

13. The four groupings or characteristics of file tooth types are:

(A) ____________ (C) ____________

(B) ____________ (D) ____________

14. The standard "cuts" of regular files from the coarsest to the finest are:

(A) ____________ (D) ____________

(B) ____________ (E) ____________

(C) ____________

15. The three broad classifications of planes are:

(A) ____________ (C) ____________

(B) ____________

16. The three categories of cutting pliers are:

(A) ____________ (C) ____________

(B) ____________

17. List the three head patterns or types for slip or sliding joint pliers.

(A) ____________ (C) ____________

(B) ____________

18. List the different types of wrenches offered in the hand tool department of the hardware store.

(A) ____________________ (E) ____________________

(B) ____________________ (F) ____________________

(C) ____________________ (G) ____________________

(D) ____________________

19. The two basic types of adjustable "crescent" pattern wrenches are the :

(A) ____________________ (B) ____________________

20. Desirable features of small parts utility cabinets are:

(A) ____________________ (C) ____________________

(B) ____________________

Matching

Directions: In the left hand column is a list of tools. The right hand column contains descriptive phrases or synonymous terms. Match the tool descriptions to the tools by placing the letter of the tool in the blank at the left of the appropriate description. Note: Any item in the left hand column may be used more than once.

1. Wood chisels

   A. Tang chisel

   B. Socket chisel

   C. Heavy duty chisel

_____ steel shank extends completely through the handle

_____ some types intended for very light use with hand only

_____ handle is capped with a steel cap

_____ handle is usually plastic--not wood

_____ has washers on handle to prevent splitting in heavy use

_____ thin blade and light construction

_____ handle is driven into a socket

_____ hammer blow is transmitted directly through the shaft to the cutting edge

2. Punches

   A. Hand punch

   B. Pin punch

   C. Center punch

_____ resembles a hand punch except for the point and the size

_____ used for making small indentations on layout lines

_____ not likely to wedge itself ininto a hole when removing a long pin or rivet

_____ often used for lining up bolt and rivet holes

_____ are not measured by the diameter of the flat point

_____ has a conical point

_____ has a blunt taper from the point

3. Abrasives

   A. Garnet

   B. Silicon carbide

   C. Flint

   D. Aluminum Oxide

   E. Corundum (emery)

_____ hardest and sharpest manufactured abrasive

_____ grayish white--often used by painters

_____ reddish brown natural abrasive

_____ black--used in metal working

_____ for use with carbon and alloy steel

_____ used on low tensile materials, cast iron, copper, aluminum, and plastics

_____ used almost exclusively in woodwork

4. File tooth patterns

A. single cut

B. double cut

C. rasp cut

D. curved tooth

_____ rapid stock removal on harder metals

_____ smooth finish is primary concern

_____ rapid stock removal with reasonably good finish

_____ rapid stock removal on very soft materials or metals

_____ chisel cut teeth intersecting at an angle

_____ should be recommended for saw teeth

_____ large individually punched teeth

_____ milled teeth

Assignment
Sheet No. 9

Covering
Units 103-107

POWER TOOLS

The tool users of our nation can generally be divided into three classifications: (1) those who obtain their livelihood by the use of tools; (2) those who are classified as "tool-lovers" and largely fall into the "do-it-yourself" category; and (3) the property owners who must make repairs and do maintenance from an economic standpoint. The ability of a power tool department to make sales to all three groups will be dependent upon the sales promotion methods used, the types, qualities, and prices of the tools and equipment available for sale. It is especially important that the power tool salesman understand the various features and quality ranges of the items he sells. Good customer relations and continued sales will be dependent upon these factors.

Opportunities for selling power tools have been increasing rapidly in recent years and outlook for the future appears even better. What is the significance of this expanding market to the power tool salesman today? The person selling power tools has the obligation of becoming familiar with all of the many kinds of power tools and their operation and use if he and his store are to profit from the sale of these items.

This assignment will help the student become familiar with many of the power tools sold today, with their uses and the accessories that can be sold for use with the tools to increase their effectiveness and versatility. This unit will show which power tools are most popular and will suggest ways of more adequately serving customers and increasing store profits. The student's ability to be successful as a power tool salesman will depend to a large extent upon how thoroughly he learns this material and the effectiveness with which he uses it in serving his customers.

Assignment:

1. Read the reference listed below.
2. Write to the various power tool manufacturers and obtain their sales promotion literature and latest catalogs.
3. Assume that you have been instructed to organize and conduct a "sawdust carnival." Make a complete list of all the things you would have to arrange and prepare. Submit this list to your instructor for evaluation or approval.
4. Prepare a list (with addresses) of the service centers
4. to which you can send tools for adjustment of guarantee or repairs.
5. Answer the questions below and turn in this assignment by ________________________.

Reference:

A. ACHR, Hardware, pp. 1-39.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. Due to the high cost of repairs almost every home owner must do some home repair and is therefore a good prospective power tool purchaser.

T F 2. Although power tools are mass produced in large quantity, the high cost of production prevents ownership by the average wage earner.

T F 3. An excellent prospective customer is the man with a home workshop who will often purchase new power tools just for the joy of owning them.

T F 4. If your store is to compete in the power tool market, a full range of tools and accessories must be carried for sale.

T F 5. The power tool salesman must realize that many jobs must still be done by hand because no power tool exists to do the job.

T F 6. The desire to own and operate power tools and equipment is an almost universal feeling.

T T 7. Due to "cut" pricing of many tools the profit level for the power tool line will likely be below average.

T F 8. Most power tools are displayed on dealer made racks.

T F 9. Only the customer needs to be conscious of the service and repair reputation of a power tool manufacturer.

T F 10. For promoting sales, mass tool displays showing how to use a tool by pictures are more effective than letting the cust customer handle the tool.

T F 11. When the manufacturer is conducting a demonstration in the "sawdust carnival", customer should not be allowed to participate or handle the tools.

T F 12. Power tool manufacturers do not usually make annual model changes but rather constant improvements through the year.

T F 13. The store manager may be assured that some type of power tool or its attachment has an excellent sales potential during all seasons..

T F 14. A telephone call or post-card advising prospective customers of new power tools or accessories is a good approach for extra sales.

T F 15. A power drill is usually the first power tool purchased by a customer.

T F 16. A power drill can be made more versatile by the use of inexpensive attachments.

T F 17. A power drill should be selected on the basis of how much the customer can afford to pay for it.

T F 18. The "precision helical gears" reduce high motor speed to the much lower figure at which the drill chuck must turn.

T F 19. 3/8 inch and 1/2 inch drills usually have detachable size or top handles which provide extra holding power.

T F 20. The "key" on the "Jacobs" chuck is actually part of a double gear reduction which provides tremendous closing force.

T F 21. The sale and use of drill kit usually leads to reduced interest and sales of drill attachments.

T F 22. Saw attachments for drills are sold which can be used for heavy duty sawing.

T F 23. Jig saw attachments are for light duty work on material of one inch thickness or less.

T F 24. The screw driver attachment will only fit the special heavy-duty drills.

T F 25. Wire wheel brushes can only be used for the removal of paint.

T F 26. A polishing attachment can be used with a horizontal bench stand for polishing small objects.

T F 27. Hole saws with adjustable bars must be "set" for the desired hole size.

T F 28. An "abrasive kit" consists only of an assortment of arbors or pads; the coated abrasives must be purchased separately.

T F 29. A paint mixing attachment can be used for stirring any type of liquid in a small container.

T F 30. Power saws will do practically any job formerly done by hand saws.

T F 31. Power saws will pay for themselves in time and convenience on any job.

T F 32. An 8¼" blade can be used on an 8" portable hand power saw.

T F 33. The 6½" to 7¼" saw is the most inexpensive size.

T F 34. Medium quality and price saws come in the entire size category.

T F 35. When selling a blade for use where nails may be encountered, the largest size which the saw will take should be recommended.

T F 36. Some jig saws can be adjusted for bevel cuts up to 45°.

T F 37. Sabre saws are similar to jig saws except for the position of the blade and their increased power and cutting capacity.

T F 38. Battery operated tools are priced within the range of "quality" tools and above the cheapest lines.

T F 39. Battery powered tools usually lack power or performance when compared to conventional tools.

T F 40. Special extra efficiency accessories must be purchased for use with the battery operated drill.

T F 41. Cordless tools have been largely limited to drills and lawn and garden type tools.

T F 42. A heavy duty professional orbital sander should always be recommended if the user is likely to sand continuously over a long period of time.

T F 43. Power sanders (except disc sanders) cannot be used for flush sanding or feather edging.

T F 44. A rotary disc sander or a disc sanding attachment for a drill both perform exactly the same function.

T F 45. The router is a popular power tool with home workshop users.

T F 46. The ownership and use of portable power tools tends to create a desire for more tools and the ability to use them.

T F 47. The purchase and use of stationery power tools by the homeowner can often be offset by the savings in repair and maintenance costs.

T F 48. Most purchasers of stationary power tools will not pay cash so credit terms must be available.

T F 49. Most newer suburban homes have a basement or activity area which can be used for a workshop and is large enough to accommodate stationary power tools.

T F 50. An experienced tradesman is the best person to hire for a "sawdust carnival" in the store.

T F 51. Stationary power tools manufactured today show a definite trend toward light weight and compactness.

T F 52. The same principles of blade selection and use apply to the power hand saw or the stationary circular saw.

T F 53. The saw-jointer combination tool has a lower cost than comparable quality units purchased separately.

T F 54. The drill press can be used for both metalworking or woodworking.

T F 55. The drill press cannot be used for routing since a router is available for the purpose.

T F 56. The stationary disc sander can be recommended when an individual has an unusual amount of sanding to be done.

T F 57. The scroll saw is safe enough that even children may be allowed to use it.

T F 58. According to the reference, the band saw is essentially a heavier variation of the scroll saw which can cut thicker material.

T F 59. The band saw does not have the same table tilting features of the scroll saw.

T F 60. The wood lathe is a machine on which the carving (or turning) tool is held by a toolholder.

T F 61. The radial arm saw has been considered a production tool and not primarily a tool for the do-it-yourself enthusiast.

T F 62. The reference suggests that the complete stationary workshop should be recommended for the workshop addict.

T F 63. The grinder can be recommended for use in practically any workshop for maintaining tools in good condition.

T F 64. Stationary power tools are often not kept in stock by most hardware stores.

T F 65. Sales promotion of stationary power tools should be combined with sales promotion of portable power tools in order to take advantage of the market potential.

T F 66.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. Customers are usually very "brand name" conscious when purchasing ____________ ________ ____________ tools.

2. A good ____________ ____________ by a manufacturer means the customer can be sure that repairs are readily available and dependable.

3. Due to the sizable investment involved many purchasers of power tools will prefer to use ____________ ____________ rather than pay ____________.

4. Since power tools maintain their value over a long time they represent a good ____________ ____________.

5. Add-on sales potential exists for ____________ and ____________ for the original power unit purchase.

6. When new tool improvements or products which the salesman does not understand are placed on the market the people to ask for explanations are the ____________ ____________ or the ____________ ____________.

7. ____________ ____________ or ____________ are excellent places to obtain new ideas which will assist in promoting sales and increasing profit.

8. The sale of ____________ ____________ power tools will ofte cost the dealer a great deal in lowered customer goodwill and future sales of extra attachments.

9. Power drills come in various qualities and prices ranging from ____________ ________ to more than ____________.

10. Drills are usually rated by the ____________ ____________ and the ____________ ____________ of the motor.

11. A ____________ ____________ drill with a ________ chuck is satisfactory for most homeowners maintenance jobs but ________ and ________ heavy duty drills should be recommended for professional use.

12. A quality drill can usually be recognized by a ____________ ____________ ____________ and ____________ ____________ ____________.

13. The ____________ and size of a heavy duty ¼" drill, and the compact ½" drill are very comparable.

14. The price of a compact ½ inch drill is very comparable to the price of a heavy duty ________ inch drill.

15. 1/2 inch drills of the heavy duty type usually have a ______________ ______________ ________ ______________ on the back housing which can be used to force the drill into the material.

16. The ______________ chuck is found usually on the very low cost economy drills.

17. A drill ______________ enables the user to apply more pressure and to apply it more evenly to the drilling jobs.

18. Saw attachments for drills often are sold with a combination blade which can be used for ______________ or ______________ work.

19. The ______________ ______________ is the most common type of sanding attachment, with the drum or sleeve type also being used.

20. A grinder attachment works most effectively if used with a ______________ ______________ ______________ which keeps the drill from moving.

21. Screwdriver bits are available for the screwdriver attachment to drive ______________ and ______________ ______________ screws.

22. Most wire wheel brushes will fit a ________ wheel arbor.

23. Polishing jobs are best carried out with a sanding pad over which a ______________ ______________ is fastened.

24. Hole saws with saw tooth cutters can be used to drill holes ________ inch to ________ inches in diameter.

25. When framing buildings the principal advantage of using a power saw are ______________ and ______________.

26. A safety feature which should be found on all power saws is the ______________ ______________ ______________.

27. Electric hand saws are rated according to the maximum ______________ ________ ______________ which can be used on the saw.

28. A saw of at least ________ blade diameter is necessary to cut through two inch dressed lumber at a 45° angle.

29. Large or heavy duty electric saws carry blades up to ________ in diameter and weigh almost ________ ______________ what light duty saws weigh.

30. The electric hand jig saw is designed for ______________, ______________ or straight cuts on soft woods up to ________ thick.

31. Blades available for the hand jig saw include fine and coarse tooth blades for metal and wood and _____________ _____________ for rubber and leather.

32. A gear driven gasoline powered chain saw has a cutting speed of approximately _______ feet per minute and the direct driven chain saw runs at _______ feet per minute.

33. An important safety feature of all _____________ _____________ electric hand tools is the absence of a shock hazard.

34. The two approaches to battery type power for tools are the _______________________________ and _____________ _____________ _____________ either of which can be recharged from a _______ to _______ _____________ outlet.

35. A "cordless" drill is capable of drilling over _______ holes in two inch plank and _______ holes in light steel before recharging.

36. Sanding belts are either _______ or _______ in width and normally travel at about _______ feet per minute.

37. Sanding pads or sheets for orbital sanders are usually of two sizes _____________ which is 1/3 of a standard 9 x 11 sheet and 4 1/2 x 11 which is 1/2 of a standard 9 x 11 sandpaper sheet.

38. Grades of sandpaper for orbital sanders range from _____________ _____________ to _____________ _____________.

39. Good merchandising practice dictates that stationary power tools be priced at the _____________ rate rather than the total cash price.

40. A good prospect for the sale of a stationary power tool is the owner of a _____________ _____________ _____________.

41. The jointer is designed to do the work formerly done by the _____________ _____________.

42. Good quality jointers have _______ or _______ knives in each head while the lower quality tools have only _______.

43. Accessories for the drill press enable it to be used for _____________, _____________, _____________, _____________, and many other tasks.

44. The scroll saw features a _____________ _____________ which can be tilted for various cutting angles and a blade which makes about _______ cutting strokes per minute.

45. Both the _____________ _____________ and the _____________ _____________ can be adjusted on the lathe-bed to fit the size of the material.

46. The radial arm saw can be set for both ______________ miters and ______________ miters.

47. The entire weight of the radial arm and saw mechanism is supported by the ______________ and stand.

Multiple-Choice

Directions: In the space at the left of each statement, write the letter of the item which will provide the correct answer to complete the statement.

_____ 1. The customer should be permitted to "get the feel" of the portable power tool by being allowed to (A) attend the sawdust festival; (B) try the tool himself whenever possible; (C) look at the tools in a glass show case; (D) watch the salesman demonstrate the tool.

_____ 2. The sawdust carnival's major disadvantage is that (A) the manufacturers representative must do the demonstrating; (B) sawdust will get on the customers; (C) sawdust will be spread all over the store; (D) it brings many non-purchasers into the store.

_____ 3. Chucks on the electric drills range in size from (A) 1/4" to 1/2" capacity; (B) 1/4" to 3/4" capacity; (C) 1/16" to 1/2" capacity; (D) 3/8" to 1/2" capacity; (E) 1/4" to 3/8" capacity.

_____ 4. For an additional source of power for cordless tools, farmers and other workmen can use a (A) 9 volt radio or fence charger battery; (B) 12 volt auto battery; (C) 6 volt fence charger battery; (D) 6 volt auto battery.

_____ 5. Power to drive the belt on a belt sander is transmitted by (A) both front and back pulleys; (B) direct drive from the motor; (C) the front pulley; (D) chain or belt drive.

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. When a power tool such as a drill is sold to a customer the sales potential for attachments and accessories may be just beginning and may include such items as:

(A) ______________________ (C) ______________________

(B) ______________________

2. List the advantages of tool kits.

(A)

(B)

(C)

3. Power tools can be advertized in window displays as gifts on such occasions as:

(A)

(B)

(C)

(D)

4. A "heavy duty" or "production" type quality drill of any size will usually have the following features:

(A)

(B)

(C)

(D)

5. The accessories and attachments contained in a deluxe drill kit will likely include the following:

(A)

(B)

(C) +

(D)

(E)

(F)

6. The three basic types of electric drill chucks are:

(A)

(B)

(C)

7. The horizontal bench stand holds the drill stationary in such a position that the user can perform:

(A)

(B)

(C)

8. The three parts of a grinder attachment are:

(A)

(B)

(C)

9. List the eight most common types of power saw blades.

(A) ____________________ (E) ____________________

(B) ____________________ (F) ____________________

(C) ____________________ (G) ____________________

(D) ____________________ (H) ____________________

10. Hand electric jig saw attachments include:

(A) ____________________ (C) ____________________

(B) ____________________

11. The factors which will determine the time between battery recharges on any battery operated tool are:

(A) ____

(B) ____

(C) ____

12. The three types of portable electric sanding tools are the:

(A) ____________________ (C) ____________________

(B) ____________________

13. Routers are particularly effective for such jobs as:

(A) ____________________ (C) ____________________

(B) ____________________ (D) ____________________

14. The more common routing bits which are available for different cuts are:

(A) ____________________ (D) ____________________

(B) ____________________ (E) ____________________

(C) ____________________ (F) ____________________

15. The factors which have stimulated the sale of power tools are:

(A) ____

(B) ____

(C) ____

16. The stationary circular saw has the following operator controls or adjustments.

(A) ____________________

(B) ____________________

(C) ____________________

(D) ____________________

17. List the major parts of a drill press.

(A) __________ (C) __________

(B) __________ (D) __________

18. The advantages of purchasing a combination tool rather than all of the individual tools include the following:

(A) ____________________

(B) ____________________

(C) ____________________

(D) ____________________

Matching

Directions: In the right hand column is a list of items. The left hand column contains descriptive phrases or synonymous terms. Match the descriptions to the terms by placing the letter of the description in the blank at the left of the appropriate term.

_____ 1. Crosscuts in soft wood

_____ 2. General rough carpentry use

_____ 3. Cut off on very hard wood

_____ 4. Ripsaw on very hard woods

_____ 5. Reclaimed lumber

_____ 6. Crating or repairing flooring

_____ 7. Finish carpentry work

A. Combination blade

B. Crosscut blade

C. Flooring blade

Assignment
Sheet No. 10

Covering
Units 108-110

LAWN, GARDEN AND FARM TOOLS -- PART I

With the increased leisure time of the middle and upper class, more time is available for the homeowner to work in his yard and develop his own "private recreational area" or patio. Every year the call of spring brings the urge to people to get out-of-doors and work in their yards. No matter how small a home or how varied the interests of a homeowner, they are nearly all in the market for several items of lawn or garden equipment. The area of farm tools should not be overlooked just because the number of farmers is declining in this day of mechanization.

Sell the customer the idea of doing a better job with the correct tools. In order for the hardware salesman to be successful in selling lawn, garden, and farm tools, he must know the capabilities and limits of his tools and equipment. Helpful suggestions and planned displays will help a great deal in completing many sales. Spring will be the time of the year when most lawn, garden, and farm tools will be sold. In order to have a steady return of satisfied customers, it is as important to be able to answer their questions concerning tools as it is to supply the actual tools.

This unit will introduce the student to tools used for digging, to seeds, fertilizers, and cultivation and garden tools. This material should help the student become aware of the wide variation in personal preference for the different styles and types of lawn, garden, and farm tools. Success in this department will be dependent not only upon how well the student becomes acquainted with all aspects of the lawn and garden department in his store, but is also dependent upon how well he knows and can serve the needs of the community.

Assignment:

1. Read the reference listed below.
2. Contact either your local County Agent's Office or the Extension Division of your State University and obtain the latest literature on lawn and garden care. (This material is usually free.)
3. Prepare a list of lawn grasses and/or mixtures for the different types of soils found in your area, and list the best soil conditioning methods for each.
4. Answer the questions below and turn in this assignment by _________________________.

Reference:

A. ACHR, Lawn Garden and Farm, pp. 1-15, Chapters I, II and III.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. Because farm population is decreasing each year the sales of agricultural hand tools are also decreasing.

T F 2. Since the lawn is considered a prestige symbol in suburbia, many residents spend hundreds of dollars each year for seeds and lawn care tools and supplies.

T F 3. There is a constantly growing sales potential for tools among the rapidly increasing urban and suburban population.

T F 4. In a city or surburban area the majority of the tools sold will be those intended for use with gardens.

T F 5. The highest quality shovels are made from good quality carbon steel.

T F 6. Quality and construction features for the long handle square point shovel and the long handle round point shovel are considerably different due to different usage.

T F 7. It can safely be said that square point shovels have far less cutting power than comparable round point shovels.

T F 8. The "handle lift" of a shovel is the distance from the floor to the handle tip when the back of the blade is flat on the floor.

T F 9. Spades are often sold for post hole digging.

T F 10. Two-handle post hole diggers are available in several types but all have hinged frames which allow a hinge action.

T F 11. Most post hole augers have wooden grips on a steel handle.

T F 12. Both the "bow" rake and the "level head" rake have 16 to 18 teeth.

T F 13. Since level head rakes are of forged steel construction, they are used for heavier work than bow rakes.

T F 14. The best quality level head rakes are tempered to prevent breakage near the shank.

T F 15. The mattock hoe is designed for heavier work than the sprouting hoe and has the same type of handle.

T F 16. The rotating action of the tines of a gasoline powered tiller can pulverize almost any type of soil.

T F 17. All cutting tines on gasoline powered tillers are the same.

T F 18. Riding model garden tractors usually have larger motors than walking models.

T F 19. Garden tractors have attachments available only for snow removal and mowing.

T F 20. City and suburban areas are now consuming much of the fertilizer and seed formerly sold only in rural areas.

T F 21. Since 1950 the sale of lawn and garden products has increased exactly four times.

T F 22. Almost all hardware stores sell some type of garden or grass seeds.

T F 23. An important reason for selling individual pre-packaged garden seeds is the excellent possibility for the sale of related lawn and garden tools and materials.

T F 24. The sale of packaged seeds from displays requires as much knowledge as the sale of hybrid seed.

T F 25. The lawn seed business has about reached its peak and is not likely to increase significantly.

T F 26. The seed distributors have developed lawn seed mixtures which are suitable for the different geographical areas of the country.

T F 27. Fertilizer can become a big business item but may profitably be sold only in a rural or farm market area.

T F 28. Pre-mixed and packaged fertilizers which are suitable for most lawn needs are available "off-the-shelf."

T F 29. Fertilizer-weed control mixtures are considerably higher in cost than fertilizers.

T F 30. A lawn-type fertilizer spreader will quickly pay for itself by spreading the fertilizer more evenly with less waste.

T F 31. The "weeder hoe" has a blade which is usually about 1 3/4" in height from the cutting edge.

T F 32. The "warren hoe" has a single sharp edge and can be used as a cultivating tool or a mortar hoe.

T F 33. The "scuffle hoe" is designed for light weeding and only comes in a square pattern.

T F 34. The three or five prong cultivator has a long handle and diamond shaped tines.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. On the average less than ________ per cent of hardware store sales come from the garden and farm tool department.

2. In a city or suburban area the majority of the tools sold will be those intended for the care of ________________ or ________________ ________________.

3. The largest selling shovel type is the ________________ handle ________________ point model.

4. The best quality shovels are manufactured from one piece of steel by ________________ and the lower quality shovels are manufactured by ________________ the stamped parts together before inserting the handle.

5. Most shovels have handles made from straight grain ________________ and are approximately ________ inches in length.

6. Square point shovels are usually intended for use in handling ________________ soil and not for digging.

7. Handle length for the "D" handle shovel is usually approximately ________ or ________ inches.

8. The only square pointed shovels designed primarily for digging are called ________________.

9. Scoop shovels are designed primarily for handling of ________________ or ________________ ________________ on the farm.

10. Spading forks have ________ tines and a ________ type handle.

11. The push plow has been largely replaced with ________________ and other power equipment.

12. The ________________ rake is the most popular type rake.

13. Walking model garden tractors usually have from ________ to ________ horsepower engines.

14. Lawn seed mixtures are basically mixed and pre-packaged according to the ________________ ________ ________________ and the ________________ ________ ________________ the lawn will receive.

15. Fertilizers fall into the three general classifications of ________________, ________________ and ________________ ________________.

16. The average lawn requires two feedings per year generally near ______________ and again near ______________ ______________.

17. Two-wheel lawn type seeders can be used for spreading both ______________ and ______________.

18. The two types of all purpose cultivating hoes are the ______________ ______________ and ______________, both of which have a blade ________ inches in width.

Multiple-Choice

Directions: In the space at the left of each statement, write the letter of the item which will provide the correct answer to complete the statement.

_____ 1. The "D" handle shovel will likely sell better in the (A) city where flower beds predominate; (B) rural areas; (C) suburban and urban areas; (D) construction industry.

_____ 2. The most effective shovel for hard digging or cutting is is a shovel with (A) long handle and high blade lift with a square point; (B) long handle, low blade lift and square point; (C) "D" handle and round point with low blade lift; (D) long handle, low blade lift and round point.

_____ 3. Shovel handle lengths are measured from the tip of the handle to the (A) top of the blade; (B) tip of the blade; (C) socket or shock band; (D) first rivet.

_____ 4. The sale of bulk seed is largely confined to stores serving (A) rural or city areas; (B) rural and suburban areas; (C) suburban and city areas; (D) only suburban areas.

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. List the various shovel classifications.

(A) ______________________ (E) ______________________

(B) ______________________ (F) ______________________

(C) ______________________ (G) ______________________

(D) ______________________

2. The three types of shovel shanks are:

(A) ______________________ (C) ______________________

(B) ______________________

3. List the three categories of lawn-garden products which exceed one billion dollars in sales each year.

(A) ______________________________

(B) ______________________________

(C) ______________________________

4. In addition to flower seeds the three basic categories of seeds sold by the hardware stores are:

(A) ______________ (C) ______________

(B) ______________

5. The disadvantages of selling bulk seeds are that they:

(A) ______________________________

(B) ______________________________"

6. The three types of seeders available for spreading lawn seed are:

(A) ______________________________

(B) ______________________________

(C) ______________________________

7. The three major plant foods contained in fertilizers are:

(A) ______________ (C) ______________

(B) ______________

8. List the short handled tools which areprimarily intended for use in confined areas.

(A) ______________ (D) ______________

(B) ______________ (E) ______________

(C) ______________

Matching

Directions: In the right hand column is a list of items. The left hand column contains descriptive phrases or synonymous terms. Match the description to the terms by placing the letter of the description in the blank at the left of the appropriate phrase or description.

Group I

_____ 1. fastest acting

_____ 2. least likely to "burn"

_____ 3. definitely will burn the lawn if applied too liberally

_____ 4. most expensive

_____ 5. most concentrated

_____ 6. can be combined with the agents for weed control

A. organic fertilizer

B. chemical fertilizer

Group II

_____ 1. 4 or 5 tines and 12 inch handle

_____ 2. 3 to 5 slightly curved tines

_____ 3. blade with three tines opposite

_____ 4. blade 2½ x 6 inches and curved

_____ 5. 3 or 4 tines, 12 inches overall

_____ 6. long blade with a "V" notch in ends.

A. trowel

B. fork (short handle)

C. cultivator (short handle)

D. hand rake (short handle)

E. hoe (short handle)

F. dandelion digger

Assignment
Sheet No. 11

Covering
Units 111-114

LAWN, GARDEN AND FARM TOOLS -- PART II

When many people talk about a "Hardware Store" they are referring to a store that sells tools, equipment and materials used on the lawn, garden or farm. This unit covers material which includes many of the tools used for lawn care, water pumps, farm hardware, and equipment used for chemical pest control.

The student should realize that the more rural his customers are, the more probable it will be that his store will carry heavy inventories of lawn, garden, and farm tools and supplies. A store doing business of this type will need to offer wide selections of merchandise. To do a good job of supplying his customers a student should study them and their buying habits carefully. The student must be thoroughly familiar with the many types, qualities, and features of water pumps and chemical spray equipment. A customer who is contemplating the purchase of a deep well pump or sprayer will not patronize an establishment whose workers are not able to supply him with technical and operative information.

This assignment presents material designed to acquaint the student with many tools, materials and pieces of equipment, used on the lawn, the farm or in garden work. This unit is an introduction to the type of information a proficient salesman will need. After doing this assignment the student should be more capable of studying and understanding the tools and equipment his store sells. In turn, he should be able to present knowledgeable information to his customers.

Assignment:

1. Read the reference listed below.
2. Obtain from your county agent's office the latest literature on powder and liquid spray methods of insect control and fertilizing.
3. Study the manufacturers literature concerning the various items covered in this assignment.
4. Answer the questions below and turn in this assignment by ________________________.

Reference:

A. ACHR, pp. 15-52, Chapters IV to VII.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. The average lawn has about the same amount spent per square foot each year as the average farm land.

T F 2. The backyard rarely receives much attention compared to the front yard.

T F 3. The reel mower is not suitable for mowing rough lawns or grass of greatly varying height.

T F 4. The reel mower is the easiest to keep adjusted.

T F 5. The reel type mower is the most popular design.

T F 6. The electric lawn mower is usually preferred only by people with small lawns.

T F 7. Power mowers are all essentially of the same quality for a given engine or blade size.

T F 8. Quality mowers use the motor exhaust to help discharge the grass and cuttings.

T F 9. Most power mower users are primarily interested in purchasing a mower made by a reputable manufacturer rather than a mower with many convenience features which cannot be repaired when broken.

T F 10. Self-propelled mowers are available in both rotary and reel types.

T F 11. Riding mowers are not all self-propelled.

T F 12. Under-powered riding mowers will likely suffer from short engine life and repeated complaints.

T F 13. Lawn sweepers are available only in the push type but these can be attached or pulled behind self-propelled mowers.

T F 14. Wheels can be displayed on convenient manufacturers displays which are attractive and occupy very little floor space.

T F 15. Electric hedge trimming attachments powered by electric drills are available.

T F 16. Electric hedge trimmers have motors which develop 1 H.P. or more.

T F 17. Lawn rakes and garden rakes have the same general shape and tooth length.

T F 18. Some models of 2-wheel lawn carts are designed to be attached behind power riding mowers and garden tractors.

T F 19. One-wheel wheelbarrows which have bodies of both steel and wood are available.

T F 20. Areators have a handy tray which enables the user to add weight to push the spikes deeper into the lawn.

T F 21. Many suburban homes must be equipped with their own private water systems by drilling a well and installing a pump on it.

T F 22. "Jet" or "ejector" pumps operate by means of a piston action.

T F 23. The standing water level in a well and the amount of draw down both have the same initial reference point.

T F 24. The submergence of the pump refers to the amount (in feet) of pipe or pump which is below the lowest water level after drawdown.

T F 25. The "setting" refers to the vertical distance from the storage tank to the standing water level.

T F 26. It takes 4 horses to consume as much water as one person uses when figuring water use for a farm.

T F 27. Service pressure and discharge pressure in a water system are the same valve.

T F 28. Rubber hose is reinforced with one or more layers of fabric between the layers of rubber.

T F 29. Plastic hose is usually from 7/16" to 1/2" inside diameter.

T F 30. A 3/4 inch hose has over 4 times the capacity of a 7/16 inch hose.

T F 31. Industrial hose is usually sold by the foot, but only in 25 and 50 foot lengths.

T F 32. A hose hanger is hung on a wall so it may be used to carry the hose into the yard.

T F 33. A "flow-through" reel allows the hose to remain attached to the faucet with the water turned on while the hose is being unreeled for use.

T F 34. Flow-through reels are available in "wall hung" types only.

T F 35. The pistol grip nozzle should only be sold for use with hose which can stand the "line" water pressure.

T F 36. Hand sprinklers are used for small areas where heavy pressure is not needed.

T F 37. All non-rotating sprinklers or sprayers operate by water pressure which creates a fine mist.

T F 38. Plastic sprinkler hose comes in lengths of 30 feet or longer.

T F 39. The four types of "self-powered" sprinkler heads are all operated by air pressure.

T F 40. The "best" of the new chemical weed-pest controls only require two to three applications.

T F 41. Most chemicals have been developed to the point where they are no longer of a poisonous nature.

T F 42. Manufacturers recommendations must be followed religiously in suggesting chemicals for the home gardner to use in weed or plant disease control.

T F 43. Chemicals are available to control only the soft shell insects.

T F 44. A homeowner will readily spend a large sum of money to keep an attractive lawn looking its best.

T F 45. The dry chemicals leave no visual residue after application if properly applied and they can be more effectively controlled when applied in the wind.

T F 46. Aerosol cans of liquid plant chemicals are becoming so efficient they can be used for large areas.

T F 47. The continuous hand sprayer has a liquid capacity ranging from 20 oz. to three quarts.

T F 48. Slide pump sprayers are made only in "continuous acting" types.

T F 49. A pressure of 180 lbs. can spray liquid 20 to 25 feet.

T F 50. Hose nozzle sprayers lack the ability to accurately place the solution when compared to other types of sprayers.

T F 51. Plunger dusters hold only 1/2 lb. of pesticide.

T F 52. The National Sprayer and Duster Association makes recommendations for sprayer and duster applications.

T F 53. Although labeled as poisonous, most dusting chemicals do not require careful handling if they are not allowed to get wet.

T F 54. A hand type continuous sprayer is not recommended for use inside the house.

T F 55. In the type of chain in which the links are made without welding, only flat stock is used from which the links are stamped and folded.

T F 56. Twist link welded chain is as popular as straight link welded chain.

T F 57. Chain display racks tend to increase impulse buying if well located.

T F 58. Swivel repair links, when properly applied, are as strong as an unbroken link in the chain.

T F 59. Ready-cut chain is uneconomical since most users want special lengths.

T F 60. Pre-packaged rope units only come in multiple 100 feet lengths which can be separated for individual sales.

T F 61. Coils of rope are marked at 10 foot intervals and are available only in coils of 2000 feet length.

T F 62. In farm fencing the bars may be closer together at the bottom than the top.

T F 63. Barbed wire is only made with two sharp points on the barb.

T F 64. Electrical fence controls are designed to electrify an entire multiple strand permanent farm fence.

T F 65. Fence stretchers are designed for two-man operation.

T F 66. A 16 x 10 mesh is the most popular size for screen wire.

T F 67. Shade screening is made from thin sheets of aluminum.

T F 68. Wrist type gloves have a long open cuff.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. The two basic cutting actions of lawn mowers are _______________ and _______________ which is always power driven.

2. A mower attachment used to shred leaves and weeds for compost is the _______________ attachment.

3. The three methods of powering mowers are: _______________, which is the most popular, _______________ and _______________.

4. Lawn experts and discriminating homeowners prefer the _______________ type _______________ cutting action lawn mower fo for the professional quality lawn care.

5. The main disadvantage of the electric lawn mower is the _______________ _______________ which restricts its area of use.

6. The two basic categories of gasoline engines used to drive lawn mowers are ________________ ________________ and ________________ ________________.

7. A crankcase which holds the lubricating oil is always present on ____________________________ gasoline engines.

8. Oil and gasoline are mixed together for use in a ________________-________________ engine.

9. A self-propelled mower engine must provide the power to drive the ________________ and the ________________.

10. During the manufacture of the mower, quality control is much more important for a ________________ ________________ mower than for a push type mower.

11. A yard and garden tractor can be used for ________________ ________________, ________________ and many other tasks by adding attachments.

12. Lawn sweepers usually have a hopper capacity of ________ bushels.

13. "V" belts are used widely on ________________ machines and units around the home and come in A, B and C widths.

14. Hand type hedge shears have a scissor type cutting action with blades ________ inches to ________ inches in length.

15. The most popular models of electric hedge shears have a blade length of ________ inches or over and operate at approximately ________ strokes per minute.

16. The battery powered hedge trimmers are capable of trimming a hedge ________ feet in length on the top and both sides before recharging is necessary.

17. Lopping shears are designed for ________________ and trimming with handles ________ to ________ inches in length for cutting heavy growth.

18. Hand type pruning shears have blades from ________ to ________ inches in length.

19. Weed whips are recommended when cutting tall ________________ and ________________ on rough ground.

20. Lawn rollers usually consist of a large drum ________ to ________ in diameter which can be filled with ________________ to provide the necessary weight.

21. Pumps for "shallow" wells are built to raise water up to ________ feet.

22. Average pump discharge pressure is usually ________ lbs.

23. A properly designed pump set up should have enough capacity so that it does not need to operate more than the equivalent of ________ hours per day.

24. "Drawdown" refers to the difference between the ________________ level and the ________ ________ ________________ level with the pump operating.

25. The material from which the largest footage of garden hose made today is ______________________ or ________________.

26. Garden hose is ordinarily sold in ________ foot and ________ foot lengths.

27. Hose reel carts have a capacity of ________ feet of garden hose.

28. High quality nozzles are made of ________________.

29. Soil soakers are usually made of ________________ and are used where water must not be applied to the foliage.

30. Underground sprinkler systems are used primarily on ________________ ________________ and ________________ ________________.

31. A root irrigator consists of a ________________ which can be inserted near the roots of a large plant to force water into the soil to water the tree roots.

32. Knapsack and Compressed Air Sprayers both have capacities of up to ________ gallons.

33. The ________________ type dusters provide a continuous flow of dust from one or two outlets.

34. ________________ dusters are especially suited for treating individual plants and small trees.

35. The two basic types of chains are ________________ and ________________ link type.

36. Sash chain is the common name for ________________ ________________ ________________ and is especially suited for use where the chain must lay flat.

37. ________________ ________________ ________________ chain is made by forming or knotting wire into links and is suitable for many ordinary jobs.

38. Heavy-duty chain with great tensile strength is made with ________________ ________________.

39. The advantage of twist link chain is that during use the slight twist in the links tends to prevent ________________ and ________________.

40. Chain hooks are usually attached to chains by the use of a ____________ ____________.

41. Snaps are available in both ____________ and ____________ end types.

42. Most rope displays carry rope from ________ to ________ in diameter.

43. Twine is made from sisal, ____________ and ____________.

44. Fencing is classified into two categories according to whether it will be used for ____________ or ____________ needs.

45. Double loop ornamental fencing is both tighter and more ornamental than ____________ ____________ fencing.

46. Chain link and ____________ ____________ fencing is more popular for public areas because of its ____________ and ____________ ____________.

47. Farm fencing is manufactured in heights of ________ to ________.

48. Barbed wire is made with ________ or ________ gauge strands.

49. Poultry netting comes in mesh sizes of ________ to ________ and heights up to ________ feet.

50. Hardware cloth is available in ________ to ________ foot widths and rolls of ________ foot length.

51. Glass substitutes are sometimes made from plastic coating over ____________ ____________ or ____________ mesh.

52. Better quality gloves (work) are made from ____________ ____________.

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. List the two main types of lawn edgers.

(A) ____________________ (B) ____________________

2. Battery powered edgers and shears have the following basic advantages:

(A) ____

(B) ____

(C) ____

3. The electric hedge shear is very suitable for use by the homeowner and also:

(A) ______________________ (C) ______________________

(B) ______________________

4. List the two categories which include all pumps.

(A) ______________________ (B) ______________________

5. The four basic questions which must be answered before the proper pump can be selected are:

(A) ____

(B) ____

(C) ____

(D) ____

6. When figuring the "total head," list the factors which must be considered.

(A) ______________________ (D) ______________________

(B) ______________________ (E) ______________________

(C) ______________________ (F) ______________________

7. List the common types of hose clamps and repair connectors.

(A) ______________________ (C) ______________________

(B) ______________________ (D) ______________________

8. The four types of self-directing sprinklers are:

(A) ______________________ (C) ______________________

(B) ______________________ (D) ______________________

9. List the factors needed to decide how economical one method of chemical weed-pest control is compared to a former method.

(A) ____

(B) ____

10. List the objections to liquid chemical mixtures.

(A) ____________________

(B) ____________________

(C) ____________________

(D) ____________________

11. All sprayers and dusters consist of the following basic parts:

(A) ____________________

(B) ____________________

(C) ____________________

12. List the most popular types of hand liquid sprayers.

(A) ____________________ (D) ____________________

(B) ____________________ (E) ____________________

(C) ____________________ (F) ____________________

13. Self-contained dusters fall into three general types:

(A) ____________________ (C) ____________________

(B) ____________________

14. For fruit trees 1 to 5 feet in height, the sprayers or dusters which are recommended by the National Sprayer and Duster Association are:

(A) ____________________ (C) ____________________

(B) ____________________ (D) ____________________

15. Repair links are generally grouped as follows:

(A) ____________________ (C) ____________________

(B) ____________________

16. Screen wire is made from:

(A) ____________________ (C) ____________________

(B) ____________________ (D) ____________________

Matching

Directions: In the right hand column is a list of items. The left hand column contains descriptive phrases or synonymous terms. Match the descriptions to the terms by placing the letter of the description in the blank at the left of the appropriate term.

Group I

_____ 1. swivel head for flat or vertical work

_____ 2. one fixed and one movable blade

_____ 3. hollow ground blades

_____ 4. scissor action-multiple blade

_____ 5. similar to sheep shears

_____ 6. top handle moves vertically

_____ 7. blades can be locked together

_____ 8. clutch protected motor

_____ 9. should only be used for lightest trimming

_____ 10. easiest operation--least effort

_____ 11. 6" width self-sharpening blades

A. hand trimmer

B. scissor type trimmer

C. draw-cut type trimmer

D. electric trimmer

E. heavy-duty electric trimmer

Group II

_____ 1. common chickweed

_____ 2. thistle

_____ 3. dock

_____ 4. spotted spurge

_____ 5. burckhorn plantin

_____ 6. dandelion

_____ 7. mouse ear chickweed

_____ 8. oxalis

A. easy to kill variety

B. hard to kill variety

Assignment
Sheet No. 12

Covering
Units 115-116

SPORTING GOODS -- PART I

The sale of sporting goods is usually surrounded by a pleasant atmosphere. Now days hunting and fishing is thought of as a leisure time activity. Certainly you will take pride in and find great satisfaction in helping people to enjoy themselves.

Remember, the longer you work in a sporting goods department, the more effective you will become, both in sales and in passing on helpful "hints". The finer details of knowledge about hunting and fishing require years of actual experience to master. You, as a salesperson, might need to substitute some reading at first to suppliment personal experience.

This assignment is designed to give the learner a basic knowledge of the better known phases of sporting goods so he may serve his customers more confidently.

Assignment:

1. Read the reference listed below.
2. Prepare a paper, not over one page, fully explaining how the "gauge" of a shot gun is determined. Be sure to include in the explanation information to show understanding of gauges. Cover the 410 gauge in your paper, too.
3. Answer the questions below and turn in this assignment by ________________ .

Reference:

A. Advanced Course in Hardware Retailing, Unit 9, "Sporting Goods", pp. Intro-37.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. Sporting goods departments in hardware stores are becoming more important with the increase of leisure time and income for the average worker.

T F 2. The sale of sporting goods is most usually confined to men.

T F 3. Many men look upon relaxation as a form of therapy.

T F 4. Most Americans do not have to be concerned with the overweight problem.

T F 5. A full line of merchandise is required to attract sports men to this department.

T F 6. Low quality sporting goods is where the retailer makes big profits.

T F 7. Your sporting goods displays should create a proper rustic, outdoors mood.

T F 8. Hunting licenses yield no profit and render no significant benefit to the retailer for selling them.

T F 9. Unit of gauge measurement is based on the number of shot in the shell a shot gun uses.

T F 10. A 410 shot gun is actually a 67 gauge.

T F 11. Most shot patterns of the same type shotgun shells will be the same.

T F 12. Hunters use different degrees of choke boring to control shot patterns.

T F 13. For greater shot spread, it is best to cut off your shotgun barrel.

T F 14. For best results a shooter should add his own recoil pad to his gun.

T F 15. Most hunters consider the large shell capacity of the pump shot gun a desirable feature.

T F 16. The auto-loader shot gun is a true automatic.

T F 17. Lever action .22 rifles are better suited for left rather than right-handed shooters.

T F 18. Auto-loader .22 rifles require more attention and maintenance than other .22's.

T F 19. Many hunters feel the pump action rifle is the fastest manually operated big game rifle.

T F 20. The rim fire cartridge is most popular of rifle ammunition.

T F 21. A #2 shot is much smaller than the #12 shot.

T F 22. Most hunters find it easy to skillfully imitate the call of a duck with a plastic or wood caller.

T F 23. Bait casting rods are used mostly for still fishing.

T F 24. When spin casting one can use a lighter tackle than possible with a regular casting rod.

T F 25. Fly rods were originally designed for casting of bass bugs and lightweight metal spinners.

T F 26. The more experienced fisherman, when fly casting, reels his catch in rapidly.

T F 27. Lighter type salt water fishing is frequently done with fresh water equipment.

T F 28. Casting reels are used primarily for game fishing.

T F 29. Most of today's fishing reels have to be reeled in with the left hand.

T F 30. Single action reels are usually double geared.

T F 31. A wet linin line is stronger than a dry one.

T F 32. Wet flys are used for fishing on the surface of a lake.

T F 33. Better tackle boxes have one or more trays hinged to lift as the box lid is opened.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. In this study, sporting goods are classified as those items used in ________________ games.

2. Some men are not so much interested in what high cost sporting equipment will do but the ________________ it will make on fellow club members.

3. To compete successfully in attracting sportsmen to your store for sporting goods, your merchandise has to be ________________ and ________________ promoted.

4. To do an effective job of selling guns, one must ________________ guns.

5. Shot pattern is the ________________ of shot pellets at any given yardage.

6. Full choke boring is meant to be used for ________________ ________________ shooting.

7. Longer barrels permit more ________________ shooting.

8. The type shotgun stock needed by a customer depends on his ________________ ________________ and ________________ ________________.

9. The .22, by far the most popular rifle, is ____________ weight and ________________ to maintain.

10. The bolt of bolt action rifles is manually operated for ________________, ______________, and __________________ the cartridge.

11. Pistol and revolver sales are regulated by _____________ .

12. A newly developed handgun for target shooting will continuously place accurate shots beyond __________ yards.

13. The gas gun, operating on a CO^2 cartridge, can fire from _______ to _______ shots per cartridge.

14. In either rim fire or center fire cartridges or shotgun shells, the _____________ performs the function of firing the ammunition powder.

15. The drams of powder in the total charge of a shell determines its _____________ .

16. Shot size is determined by the type _____________ the shooter plans.

17. The sighting device of a telescopic sight is called a ________________ .

18. Anyone who purchases a good gun should also be a prospect for a ________________ ________________ .

19. Lower quality duck decoys are made from ______________ ________________ .

20. The better quality hunting knives have light weight blades from _______ to ________ inches long.

21. The most important parts of any fisherman's gear for a fishing trip will be a _____________ and ______________ .

22. Salt water spinning rods range in length from _______ to _______ feet.

23. Salt water rods will generally be _______________ than fresh water rods.

24. To avoid winding a fly line in small coils, the fly reel should be a ______________ ________________ spool type.

25. For removing sand and grit from a reel while fishing, it is necessary that the reel have quick ________________ features.

26. A casting line serves as a _______________ between the angler and his bait.

27. The pound test of a line indicates it will withstand that number of pounds strain in a ____________ pull.

Multiple-Choice

<u>Directions</u>: In the space at the left of each statement, write the letter of the item which will provide the correct answer to complete the statement.

_____ 1. (A) Status seekers; (B) Men looking for relaxation; (C) True lovers of sports are considered the best all around sporting goods customers.

_____ 2. When a gun operator has to work a mechanism to load a new shell into the chamber after each shot, the gun is (A) a manual; (B) a semi-automatic; (C) an automatic.

_____ 3. Choke is the partial constriction of the (A) receiver end; (B) muzzel end; (C) extractor end of a shotgun barrel.

_____ 4. A shotgun shell fired with modified choke would project (A) 70; (B) 60; (C) 40 per cent of its shot pellets inside a 30 inch circle.

_____ 5. In hunting turkey, fox, and ducks, a (A) full choke; (B) modified choke; (C) improved cylinder is recommended.

_____ 6. Most single shot shot guns are of the (A) lever action; (B) magazine load; (C) break-open type.

_____ 7. Bolt action shot guns are best for (A) trap shooting; (B) fast field shooting; (C) beginners.

_____ 8. Automatic pistols are (A) magazine loaded; (B) bolt action loaded; (C) gas loaded.

_____ 9. Almost all fishing rods, tubular or solid, are made of (A) bamboo; (B) steel; (C) glass.

_____ 10. Most reel handle grips are made of (A) plastic; (B) hard-rubber; (C) cork.

_____ 11. (A) Boat rods; (B) Surf rods; (C) Big game rods are used for deep sea trolling for marlin, tuna, and sail fish.

Listing

<u>Directions</u>: List the items called for in each of the following. Select your answers carefully.

1. List four sources of display ideas:

(A) ______________________ (C) ______________________

(B) ______________________ (D) ______________________

2. List eleven ideas in promoting a sporting goods department:

(A) ____________________

(B) ____________________

(C) ____________________

(D) ____________________

(E) ____________________

(F) ____________________

(G) ____________________

(H) ____________________

(I) ____________________

(J) ____________________

(K) ____________________

3. List the five well-known shotgun gauges:

(A) __________ (C) __________ (E) __________

(B) __________ (D) __________

4. List the two styles of double barrel shot guns:

(A) __________ (B) __________

5. List the two basic rifle types:

(A) __________ (B) __________

6. List the three type magazines found on lever action rifles:

(A) __________ (C) __________

(B) __________

7. List the four pistol and revolver calibers, telling which one is best for target practice and which two are used mostly for protection:

Caliber	Use	Caliber	Use
(A) ______	______	(C) ______	______
(B) ______	______	(D) ______	______

8. List the four advantages of the new steel and plastic shotgun shel

(A) ____________________

(B) ____________________

(C) ____________________

(D) ____________________

9. List the four rod and reel classifications:

(A) ____________ (C) ____________

(B) ____________ (D) ____________

10. List the two types of fresh water spin casting rods:

(A) ____________________

(B) ____________________

11. List the four basic types of fishing reels:

(A) ____________ (C) ____________

(B) ____________ (D) ____________

12. List four desirable features of a spinning reel:

(A) ____________ (C) ____________

(B) ____________ (D) ____________

13. List the four types of fly lines:

(A) ____________ (C) ____________

(B) ____________ (D) ____________

14. List the three types of plug lures or bait casting lures:

(A) __________ (B) __________ (C) __________

Assignment
Sheet No. 13

Covering
Units 117-119

SPORTING GOODS -- PART II

One does not have to know how to play basketball or baseball to sell equipment for the two sports, but it certainly would help! The next best thing in increasing sales effectiveness would be to "know your merchandise."

When customers come in to buy sporting goods such as a baseball, boxing gloves, even a flashlight for "snipe" hunting, the sales person should be able to adequately match his merchandise according to their needs and their budget. Some people want quality and never question price. Others let the price factor determine the quality they receive and want all they can get for a certain amount of money.

This lesson is geared toward helping the student understand the meaning of "quality" sporting goods. He should learn to judge which equipment is best for a certain use.

Assignment:

1. Read the reference listed below.
2. Answer the questions below and turn in this assignment by ______________________ .

Reference:

A. Advanced Course in Hardware Retailing, Unit 9, "Sporting Goods", pp. 38-54.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. Many hardware stores promote complete sets of basketball equipment as backyard practice sets.

T F 2. Volley balls are approximately the same size and weight as basketballs.

T F 3. Quite often the sale of one football helmet will lead to the sale of another.

T F 4. Shoulder pads offer good protection for boys during a backyard football game.

T F 5. The design of a catcher's mitt varies considerably.

T F 6. A baseball is larger and softer than a softball.

T F 7. A softball bat is longer and more slender than a baseball bat.

T F 8. A softball glove is very similar to a baseball glove, but has more padding.

T F 9. Low quality catcher's mitts have felt padding.

T F 10. The wire or magnesium frame type softball catcher's mask is much lighter than the baseball type.

T F 11. A woman's sand iron golf club is the same length as the woman's number 9 iron.

T F 12. Golf bags are generally designed to carry only ten clubs.

T F 13. Most hardware retailers feel that flashlights are truly sporting goods.

T F 14. The uses of a flashlight are very limited.

T F 15. Dry batteries contain no moisture and should be stored in a cool place.

T F 16. The zinc container of a dry battery not only serves as the protective covering but also acts as a fuel.

T F 17. Flashlight batteries today have a shorter life than those of a few years ago.

T F 18. Of necessity today, at the very first signs of weakening, batteries have to be removed to prevent corrosion.

T F 19. The popular six volt sportsman lantern battery can be used underwater.

T F 20. The flashlight is made for much rougher treatment than the sportsman light.

T F 21. The heavy duty industrial flashlight is practically unbreakable.

T F 22. A marine lantern is completely waterproof and resistant to salt water corrosion.

T F 23. A two cell flashlight requires a two volt bulb.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. A basketball should be _______ inches in diameter.

2. Basketball shoes should be made with canvas tops and have rubber soles with ________________ quality.

3. For inflating basketballs and volleyballs, a hand type ______________ __________________ is handy.

4. Punching bags are usually made of ______________ with ________________ seams.

5. Football pants should be made with ____________ ____________ material with ______________ padding on the inside.

6. Fielder's gloves come in ______ or _______ finger types, made for ____________ or ____________ handed fielders.

7. The quality of leather in a baseman's mitt is determined by the ________________ of the mitt.

8. Cnly catcher's masks with ________________ __________________ approval should be carried in the junior size group.

9. Baseball bats are listed according to their _______________, _________________, and _______________ .

10. Baseball bats will vary in length from ________ to ________ inches.

11. Tennis balls made of nylon and web fabric, have a ___________________ cover.

12. Quality tennis balls are shipped in _________________ sealed cans.

13. A racket press is designed to hold a tennis racket under pressure to prevent its _______________ .

14. Golf clubs are classified as ______________ and ______________.

15. The most popular of golf club sets is of the ______ piece set variety.

16. Improper storage of a flashlight battery can result in ______________ lived batteries.

17. Usable energy in the form of electricity is created within a dry battery through a _______________ reaction.

18. The zinc covering of a dry battery acts as a _______________ pole.

19. Electrical current flowing through a lamp heats the ________________ until it glows.

20. Batteries are kept fresh over a long period of time by a steel, ________________ case.

21. Most batteries in the heavy duty category develop ________ volts of power.

22. To fit most battery operated lanterns, the six volt lantern battery is made ______________ shaped.

23. During the past few years the ________________ ________________ has developed a large market for the smaller type battery.

24. Sportsman lanterns are designed for use under normal ________________ and ________________ conditions.

25. The headlight type of battery light is popular with workers who need to keep ______________ __________________ free.

Multiple-Choice

Directions: In the space at the left of each statement, write the letter of the item which will provide the correct answer to complete the statement.

_____ 1. Most official size basketballs are made of (A) leather; (B) rubber; (C) plastic.

_____ 2. Quality footballs are made of (A) plastic; (B) rubber; (C) leather.

_____ 3. The lowest quality baseballs are covered with (A) rubber; (B) rubberized fabric; (C) leather.

_____ 4. Quality baseball bats are made of (A) ash; (B) walnut; (C) hickory wood.

_____ 5. Quality tennis rackets have (A) leather; (B) rubber; (C) wooden grip handles.

_____ 6. A standard number 7 golf club iron is (A) 38; (B) 37; (C) 36 inches in length.

_____ 7. High quality golf balls have (A) rubber; (B) liquid; (C) plastic centers.

_____ 8. The best place to display flashlights is (A) in the sporting goods department; (B) near the automobile accessories; (C) not certain.

_____ 9. The (A) zinc covering; (B) paste filler; (C) carbon rod collects dry battery electrical current and makes it available to an outside circuit.

_____ 10. (A) Regular; (B) Heavy duty ignition; (C) hot shot batteries account for the majority of dry battery sales.

_____ 11. The ignition dry cell was primarily designed to be used (A) in automobiles; (B) in lanterns; (C) for rural telephones.

_____ 12. Flashlights are classified according to the (A) number of batteries required; (B) size of the bulb; (C) the type of the batteries used.

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. List the component parts of a Tether Ball set:

(A) ____________________ (C) ____________________

(B) ____________________ (D) ____________________

2. List the three categories of boxing gloves:

(A) ______________ (B) ______________ (C) ______________

3. List three uses for the penlight battery:

(A) ____________________ (C) ____________________

(B) ____________________

4. List three primary uses of the hot shot batteries:

(A) ____________________ (C) ____________________

(B) ____________________

Assignment
Sheet No. 14

Covering
Units 120-122

RECREATIONAL EQUIPMENT

In the past few years outside living has expanded from that of fishing and hunting on to cooking, eating and sleeping under the open sky. Equipment for the new leisure past-time extends from portable refrigerators to barbeque ovens. All work and no play is not the practice of children or adults in this modern day of leisure living.

This lesson will widen the student's knowledge about camp stoves, lanterns, grills, ice chests, vacuum bottles, boats, motors, recreational games, and toys for children. These items can be sold effectively in hardware stores if the salesperson has the "know how."

The student should obtain information from this lesson to help him recommend recreation equipment to his customers. This lesson will help him to be more effective as a salesperson with needed "know how" rather than being just an "order taker."

Assignment:

1. Read the reference listed below.
2. In not more than one page, list advantages and disadvantages of the charcoal, gasoline, and propane camp stoves you might point out in helping a customer decide which type he should buy.
3. Answer the questions below and turn in the assignment by ______________________ .

Reference:

A. Advanced Course in Hardware Retailing, Unit 10, "Recreational Equipment," pp. 1-32.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. Outdoor living has become an established way of life in our country.

T F 2. Quite often it is easier to sell things that customers want but do not need rather than what they actually need.

T F 3. In the spring, retailers have to create customer desire for more outdoor living items.

T F 4. National advertising has little or no effect on creating demand for items in any one area.

T F 5. The power of demonstration is very important in selling outdoor living merchandise.

T F 6. Women do most of the outdoor cooking.

T F 7. Only people in the warmer climate, such as "down south" prefer charcoal cooking.

T F 8. Rotisseries are usually standard equipment on most deluxe portable grills.

T F 9. The briquet form of charcoal is more expensive than the regular form and will not burn as long.

T F 10. Caps, aprons, and gloves not only add color to cook-outs but they are good protection against grease and cooking stains.

T F 11. The folding chair is the most popular type of outdoor furniture.

T F 12. The plastic covered chaise lounge is most popular because it can withstand bad weather.

T F 13. Three point hammocks have two suspension points at the head and are the more stable of the two types made.

T F 14. A camper's tent is light weight and easy to carry.

T F 15. Aluminum treating a tent fabric can reduce the inside temperature up to 15 degrees.

T F 16. Pup tents are designed for protecting three or four people while sleeping.

T F 17. Camp stools and chairs offer some of the comforts of home on a camping trip.

T F 18. Sleeping bags will provide sleeping comfort only under ideal weather conditions.

T F 19. Suction cups hold car utility racks secure in such a way that there is no danger of slippage.

T F 20. Propane camp stoves can be purchased in either one or two burner styles.

T F 21. Charcoal camp stoves are lightweight and very convenient for camping trips.

T F 22. A gasoline camp lantern requires a special type fuel for its operation.

T F 23. In most areas, the pint size vacuum bottle is most popular.

T F 24. Most hardware stores will experience sales with the small fishing and towing type boats.

T F 25. The three to five horsepower model outboard motors weighs about 17 pounds.

T F 26. Marine paint displays should be separated from regular paint lines for greater impulse sales.

T F 27. Boat hardware should be galvanized for longer life around salt water.

T F 28. Snorkel masks permit the swimmer to breathe underwater by means of a self-contained air supply.

T F 29. A kapok boat cushion serves as a life preserver also.

T F 30. The walker stroller is very convenient for mothers with small babies on shopping trips.

T F 31. Better quality gym sets are made of heavy tubular steel.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. Many manufacturers of quality merchandise provide advertising ______________ designed to create desire for their products.

2. In offering terms on large items, it is a good idea to price the merchandise according to how much it will cost the customer per ____________ .

3. A permanent outdoor grill is usually made of ____________ or ______________ .

4. Deluxe portable grills are usually made of ____________ ______________, ______________, or ______________ ______________ .

5. Medium range grills will average _______ to ________ dollars in price.

6. Grill covers are made from ______________ or ______________ fabric.

7. The cast iron hibachi charcoal gril is patterned after the ______________ ______________ grill.

8. Grill brushes can be used to clean grill tops by using the ____________ on one side and a brush usually made of ____________ ______________ on the other.

9. The popularity of patios has brought in a new market in patio ____________________.

10. The seat and back of patio chairs provides the user ____________, ________________, and ________________.

11. Quality picnic tables and benches are made of solid ____________.

12. Inexpensive picnic tables and benches are made of solid ________________, stained to look like higher quality wood.

13. Lawn torches burning ________________ helps to drive away insects.

14. The average retail hardware store usually carries only tents of the ________________ and ________________ type.

15. The house-type tent has a base usually about _______ by _______ feet.

16. A portable electric refrigerator weighs only about _________ pounds and will hold up to _________ pounds of food.

17. Ice chests, kept cold with crushed ice or ice cubes in the chest, are made of ______________, ________________, and __________________.

18. Picnic jugs, of the vacuum type, can keep food ______________ or ________________ for hours.

19. Picnic baskets usually have enough plates, cups and saucers for from ________ to _________ people.

20. The most popular size boat sold through hardware stores is from ___________ to _________ feet in length.

21. For general trolling purposes, a ________ horsepower motor is all that is needed.

22. Most 3 to 1 gear ratio trailer wenches are capable of handling loads up to _________ pounds.

23. Most aluminum or steel frame boat seats are of the __________________ type.

24. The better type swim goggles have water-tight rubber frames with _________________ lenses.

25. Most popular wood or fiberglas water skies vary in length from ________ to _________ feet.

26. The _____________ model preserver can be worn at all times, either in the boat or in the water.

27. The size of a bicycle is determined by the ______________ of the ______________ .

28. The most popular size bicycle is the adult ______ inch size.

29. Velcipedes are often called __________________ .

30. The most popular models of juvenile automobiles are the ____________________, the ______________, and the ______________ car.

31. The rigid frame type wading pool is built to hold up to ________ gallons of water.

32. During the past few years the trend in toys has been toward __________________ and ________________ operated types.

Multiple-Choice

Directions: In the space at the left of each statement, write the letter of the item which will provide the correct answer to complete the statement.

_____ 1. Outdoor living merchandise displays should be (A) scattered; (B) grouped; (C) small.

_____ 2. The (A) deluxe grill; (B) hibachi grill; (C) propane grill offers the easiest of charcoal cooking.

_____ 3. (A) Electricity; (B) Newspaper; (C) Fluid is used in the funnel type starter to get charcoal ignited.

_____ 4. The (A) house-type tent; (B) camper's tent; (C) pup tent usually have zippered doors and nylon screen windows.

_____ 5. (A) Low priced; (B) Medium priced; (C) Deluxe higher priced air mattresses are made with two layers of waterproof cloth and two layers of rubber.

_____ 6. Camping and picnic supplies are considered as (A) a "necessity"; (B) an "only for the rich" (C) an impulse variety of merchandise by hardware retailers.

_____ 7. (A) Plywood; (B) Aluminum; (C) Fiberglas boats are the lowest in purchase price.

_____ 8. (A) Plywood; (B) Aluminum; (C) Fiberglas boats are designed for use with powerful motors at very high speeds.

_____ 9. Outboard motors are rated according to their (A) size; (B) horsepower; (C) speed.

_____ 10. Water skiers require (A) 3 to 5 horsepower; (B) 12 to 25 horsepower; (C) electric trolling motors for their sport.

_____ 11. Quality canoe paddles are made from (A) hickory; (B) oak; (C) laminated wood.

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. List three extra features one might expect to find on a deluxe grill.

(A) ____________________ (C) ____________________

(B) ____________________

2. List the three types of charcoal starters.

(A) ____________________ (C) ____________________

(B) ____________________

3. List the three parts of a "fire tool set".

(A) ____________________ (C) ____________________

(B) ____________________

4. List the three basic fuels used to fire camp stoves.

(A) ____________________ (C) ____________________

(B) ____________________

5. List the three categories of camp lanterns.

(A) ____________________ (C) ____________________

(B) ____________________

6. List component parts of a picnic set.

(A) ____________________ (C) ____________________

(B) ____________________

7. List two reasons many retailers do not handle boats.

(A) ____

(B) ____

8. List three materials most boats are made of.

(A) ______________________ (C) ______________________

(B) ______________________

9. List the three types of ski ropes and give the obvious advantage of each.

(A) ____

(B) ____

(C) ____

10. List five types of recreational game sets stocked by most hardware retailers.

(A) ______________________ (D) ______________________

(B) ______________________ (E) ______________________

(C) ______________________

Assignment
Sheet No. 15

Covering
Units 123-124

PAINT AND PAINT SUNDRIES — PART I

Statistics show that the paint department in many hardware stores is the second in total sales and that with the increasing number of homeowners and the continuous advertising campaigns of the paint manufacturers, paint consumption is likely to rise considerably in the next few years.

New products and application techniques are constantly under development. However, the store, which has a good paint stock and well-trained paint salesmen with a thorough understanding of the many products and merchandising methods, will be the local sales leader.

To remain abreast of the trends and products in this field will require constant reading and attention to manufacturers' literature concerning paint developments, applications and the various sundries associated with painting.

In this assignment you will study sales and merchandising aids, the proper application of paint finishes and the common causes of paint failure, both inside and outside the structure.

Assignment:

1. Read and study the reference listed below.
2. Study the manufacturers literature that is available to you.
3. Read the trade journals and write for sales information dealing with any unfamiliar new products or sundries.
4. Make a "painting layout," both interior and exterior, for (1) a new unpainted home and (2) an older home with unknown finishes on such items as floors, clear finished windows and doors. Have your employer check it with you then give it to your instructor.
5. Answer the questions below and turn in this assignment by ________________________.

Reference:

A. ACHR, "Hardware Study Unit Eleven Chapters I to V, pp. 1-33.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. The average house requires 6 to 10 gallons of paint for a two coat exterior paint job.

T F 2. The cost of paint and sundries for the interior of a house is more than double the cost of paint for the exterior.

T F 3. Since the modern farmer has a larger investment in buildings and equipment he is also likely to use more protective coatings on them.

T F 4. Large industrial paint users will usually contact you in your store but you must be able to sell on a discount basis if you are to have repeat orders.

T F 5. Most paint manufacturers will not cooperate in shipping large quantities directly to your customers.

T F 6. The do-it-yourself paint customer accounts for the largest percentage of retail paint sales.

T F 7. A homeowner will likely purchase better grades of paint than a renter.

T F 8. Paint advertising has always been poorly done because of the many manufacturers.

T F 9. The local retailer must devise all his own advertising mats and layouts.

T F 10. Paint sundries must be promoted vigorously at all times and are usually difficult to make.

T F 11. It is always inadvisable to place a sundries check list where the customer may see it since he may feel it is a reflection on his intelligence.

T F 12. The best shelf arrangement for paint is with the largest cans on the lower shelves and the smallest on the very top shelf.

T F 13. The non-use and mis-use of free sales aids by retailers disturbs the paint manufacturers.

T F 14. Paint and paint sundries items should not be advertised together since this often creates confusion in the customer's mind.

T F 15. Local sales promotions should come at the same time as the paint manufacturers advertising programs.

T F 16. Displaying the ads (or reproductions) which appear in national magazines is an unwise practice in selling a nationally known product.

T F 17. Massed displays of paint may use ribbon to draw attention to the ad and the product.

T F

T F 18. "Spot" radio announcements should be used to back up other advertising efforts.

T F 19. Color cards are too large to be mailed and must be distributed as handouts from the store.

T F 20. Battery operated motion-displays should be used all year around to stimulate interest.

T F 21. Billboard advertising is usually offered to the retailer on a cost sharing basis.

T F 22. Promotional movies are often available from paint manufacturers and can be used or offered for use free to large groups.

T F 23. Store clinics for teaching customers the use of paint sundries and painting techniques can be especially effective in increasing paint sales.

T F 24. The use of substandard paint may eventually cost many times what it saves.

T F 25. Good quality paint will usually last twice as long as poor quality paint.

T F 26. The term "latex" is very confusing and refers to a group of paints using synthetic oil vehicle.

T F 27. The customer should always be allowed to make up his mind on painting materials without any suggestions from the salesman.

T F 28. Three coats of paint make the best job when painting "new" exterior wood surfaces.

T F 29. Paint wear is uniform for all outside surfaces if the paint is the same thickness.

T F 30. For copper, brass and aluminum screens spar varnish is recommended by the paint selection chart.

T F 31. Latex flat wall paint should only be applied to walls since it is difficult to apply to ceilings.

T F 32. Alligatoring may be painted over if it is firmly attached to the house.

T F 33. Discoloration from atmospheric fumes can be removed with a strong bleach.

T F 34. Brown staining of Redwood or Cedar siding is the result of excess moisture within the structure.

T F 35. Once the checking in house paint has cracked completely through the film it must be removed.

T F 36. Crawling is a problem encountered when painting flat horizontal surfaces.

T F 37. Good quality house paints are made so they will not chalk.

T F 38. The only cure for fading paint is to seal the old surface and repaint.

T F 39. Mildew discoloration is caused by fungi that feed on the oils in the paint film.

T F 40. Peeling and blistering of paint is commonly due to water accumulating behind the film.

T F 41. All flat finishes should be brushed in straight parallel strokes.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. In the United States there are _______ paint manufacturers who produce over _______ million gallons of paint annually.
2. It costs about _______ for the materials to paint the exterior of the average house.
3. The paints used during an earlier period were primarily made from _____________ and _____________.
4. During the painting season _____________ magazines and _____________ _____________ in newspapers carry articles and advertisements which stimulate the paint sales.
5. Paint sold to customers for application by professional painters often involves at least a _______ rebate to the painter.
6. Promotion literature and handouts includes _____________ _____________ and hand bills.
7. The main advantage of paint mixing machines is that they enable a retailer to satisfy any color requirement for paint with a limited number of _____________ _____________.
8. "On the spot" demonstrations by factory trained paint experts are good ways to demonstrate the _____________ _____________ features of paint and _____________ techniques.
9. Alligatoring is caused by a paint film that hardens on top with a _____________ layer below.

10. Painted exterior surfaces which have collected excessive dirt may be cleaned with ______________ ______________ ______________, ______________ ______________, or ______________ ______________.

Multiple-Choice

Directions: In the space at the left of each statement, write the letter of the item which will provide the correct answer to complete the statement.

_____ 1. The annual average cost per home for paint and paint sundries is (A) $45 to $90; (B) $120 to $150; (C) $20 to $30; (D) $10 to $20.

_____ 2. Labor costs when repainting are approximately (A) 75 per cent of the total; (B) 50 per cent of the total; (C) 25 per cent of the total; (D) 85 per cent of the total.

_____ 3. Paint manufacturers will usually reimburse the advertising costs of the local retailer at least (A) 35 per cent; (B) 50 per cent; (C) 85 per cent; (D) 100 per cent.

_____ 4. A single coat of paint usually forms a layer with a thickness of about (A) 1 1/2/1000 inch; (B) 2/1000 inch; (C) 4/1000 inch; (D) 6/1000 inch.

_____ 5. "Bleeding" of undercoats may be corrected in severe cases by applying (A) one coat of shellac; (B) two coats of aluminum enamel; (C) two coats of good exterior undercoat; (D) applying a strong bleach.

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. List four factors responsible for the wide use of paints in the do-it-yourself movement.

(A) ______________________ (C) ______________________

(B) ______________________ (D) ______________________

2. Selling aids which manufacturers generally provide paint retailers free of cost include:

(A) ______________________ (C) ______________________

(B) ______________________

3. Give away items which are usually available from paint manufacturers at little or no cost include:

(A) ______________________ (C) ______________________

(B) ______________________

4. The four qualities which a customer expects of the paint he buys are:

(A) ______________________ (C) ______________________

(B) ______________________ (D) ______________________

5. The major faults of poor quality paint are:

(A) ______________________ (D) ______________________

(B) ______________________ (E) ______________________

(C) ______________________ (F) ______________________

6. The operations which may be necessary to prepare a surface or area of a house for painting include:

(A) ______________________ (C) ______________________

(B) ______________________ (D) ______________________

7. From every customer you must find out the following concerning the use of the paint:

(A) ____

(B) ____

(C) ____

(D) ____

(E) ____

8. Crazing, cracking or checking may be caused by:

(A) ____

(B) ____

(C) ____

(D) ____

9. Flaking or scaling away of large areas or flakes of paint is caused by:

(A) ____________________

(B) ____________________

(C) ____________________

(D) ____________________

10. Wrinkling of the paint surface is caused by:

(A) ____________________

(B) ____________________

(C) ____________________

(D) ____________________

11. Listed below are interior paint problems which are different from those of exterior paint. Give the major cause:

(A) bloom ____________________

(B) brush marks ____________________

(C) cement floor paint peeling ____________________

(D) clouding ____________________

(E) cotton blush ____________________

(F) crazing ____________________

(G) deadening ____________________

(H) grain showing ____________________

(I) hot spots ____________________

(J) poor adhesion to enamel ____________________

(K) non-drying ____________________

(L) non-uniform color ____________________

(M) orange peel ____________________

(N) pinholing ____________________

(O) streaks and shadows ____________________

(P) water spots ____________________

Matching

Directions: From the numbered list at the left of the page select the proper type paint and insert in the blank on the left of the page.

_____ 1. usually water thinned

_____ 2. combine pigments in a varnish type base

_____ 3. The fastest drying of all finishes

_____ 4. used to produce a hard, glossy, transparent film

_____ 5. use pigments in alkyd resin vehicle

_____ 6. contain natural oils

_____ 7. odorless very quick drying

_____ 8. replaced the oils in oil base paint to provide better drying cycle

_____ 9. slowest drying with soft finish

_____ 10. include calsomine and emulsion paint

_____ 11. oil pigment

_____ 12. often dry in four hours or less and was developed because natural resin supplies were exhausted

_____ 13. usually baked to speed drying

_____ 14. not-water proof, thinned with alcohol.

Type of Paint or Finish

A. oil base paint

B. alkyd resin paint

C. water thinned paints

D. enamels

E. lacquers

F. stains

G. varnishes

H. synthetic resin varnish

I. shellac or shellac varnish

J. latex (vinyl or acrylin)

K. industrial varnish

Assignment
Sheet No. 16

Covering
Units 125-128

PAINT AND PAINT SUNDRIES -- PART II

A thousand things can go wrong with a paint job. An ounce of prevention by the advice or information from the seller is worth a pound of cures in the task of repeating the job. Customers will return happily for more paint and supplies if they are correctly given what they need along with some good advice (if asked for) on how to use what they buy.

Your success in selling paint will to a large degree depend upon your ability to correctly estimate the amount needed and establish the confidence of your customer in your ability, good judgement and understanding of his problems. A colorful paint salesman may be one who is full of color information. To talk intelligently with paint customers who know their colors, requires color knowledge. To help poor souls who know not their colors, also requires color knowledge.

This assignment will help you become more aware of the paint salesman's responsibility to his customer. This unit presents information on how to correctly estimate the amount of paint needed for a particular customer's use. You will become acquainted with many of the vario various sundries a painter may use or need. Many of the various terms used in a painter's vocabulary are in this lesson.

Assignment:

1. Read the reference listed below.
2. Prepare a list of painter's terms and definitions with which you are not thoroughly familiar.
3. Answer the questions below and turn in this assignment by ____________________.

Reference:

A. ACHR, Hardware, Chapter 11, pp. 34-55.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. Accurate estimating on painting jobs can help forestall complaints by customers.

T F 2. The size of regular windows and doors should be subtracted from the area to be painted on all estimates.

T F 3. Estimating is simply a matter of determining the area (length by width or height) of a series of flat squares and adding together.

T F 4. To find the area of a 1/2 pitch gable and a 1/4 pitch gable different formula must be used.

T F 5. A bicycle will likely take approximately 1/2 pint of paint per coat.

T F 6. When suggesting paint sundries to a customer <u>always</u> suggest first an item he is likely to buy.

T F 7. Modern paint removers dissolve the paint surface.

T F 8. The new water washable chemical paint removers are generally promoted as being non-toxic and "safe."

T F 9. Propane torches are widely used on oil base paint for paint removal.

T F 10. The finish quality will ultimately depend upon the surface preparation.

T F 11. Nylon brushes are now seriously challenging the imported bristles in quality.

T F 12. The most popular width of paint rollers is nine inches.

T F 13. Roller extension handles are only for painting ceilings.

T F 14. Roofing brushes are often made from tampico fibre.

T F 15. Sandpaper is made from a backing, a bonding material and sand.

T F 16. Double strength window glass is 3/32 inch thick.

T F 17. "Alky" refers to alkyd base paint.

T F 18. "Sand finish" is a rough finish plaster wall.

T F 19. "Short paint" has a uniform thin appearance.

T F 20. "Stretch" refers to the flexibility of the paint.

T F 21. "Tooth" refers to the roughness of the paint which will cause the next coat to adhere.

T F 22. "Turps" is painter's language for lacquer thinner.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. The formula for finding the gable area of a 1/2 pitch roof is ____________ x ____________ = the area.

2. When estimating the interior area of a room the area of ________ ________ ________ is found, then doubled, the area of one ________ ________ is found and then doubled, and the ________ times the ________ of the room will give the area of the ________ and ________.

3. The formula given for finding the size of a square is ________.

4. The area of a tank (cylinder) mounted on a stand will be the same as a ________ with two ________.

5. Paint removers must be washed off with ________ or ________ ________ if you are cleaning veneers.

6. A good quality paint roller may be used for applying ________ ________ paint and also ________ and ________ paint.

7. Sanding discs come in ________ inch and ________ inch diameters.

8. The grades of window glass are ________ select quality, ________ commercial and ________ general purposes.

9. Boiled linseed oil is called "________".by painters.

Multiple-Choice

Directions: In the space at the left of each statement, write the letter of the item which will provide the correct answer to complete the statement.

_____ 1. If your customer has a room with an area of 2850 square feet and the finish coat of paint covers 500 to 600 square feet per gallon, you should recommend the purchase of (A) 4½ gallons; (B) 5 gallons; (C) 5½ gallons; (D) 6 gallons.

_____ 2. When suggesting sundries, a good lead in statement is (A) "Why don't you buy some...?" (B) "You'll also need some...." (C) "The last customer bought some..." (D) "Will you also need some...?"

_____ 3. An artists round brush is often made from (A) camel bristle; (B) nylon bristle; (C) fibre; (D) Chinese pig bristle.

_____ 4. Most sandpaper is sold in (A) sheets; (B) rolls; (C) belts; (D) discs.

_____ 5. "Back priming" refers to (A) priming the back of the house; (B) painting back over the old primer; (C) painting the inside of an outside wall; (D) touching-up a previously primed surface.

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. Estimating the correct amount and type of paint involves knowing the answers to such questions as:

(A) ______________________________

(B) ______________________________

(C) ______________________________

2. For the surfaces listed below fill in the blank with the approximate number of square feet which the first coat can be expected to cover.

(A) Wood frame siding ______________ square feet

(B) Cement block ______________ square feet

(C) Shingle siding ______________ square feet

(D) Medium texture stucco ______________ square feet

(E) Asbestos wall shingles ______________ square feet

(F) Brick ______________ square feet

(G) Shingle roof ______________ square feet

3. List in the blank space the formula for

(A) Circle ______________

(B) Sphere ______________

(C) Triangle ______________

(D) Rectangle ______________

4. List the groups of paint sundries which may be suggested to the customer.

(A) ______________________________

(B) ______________________________

(C) ______________________________

(D) ______________________________

(E) ______________________________

5. The woods which require that the wood grains be filled with a paste wood filler are:

(A) ______________________ (C) ______________________

(B) ______________________

6. Paint brushes are made with:

(A) ______________________ (C) ______________________

(B) ______________________

7. List the different types of paint roller covers.

(A) ______________________ (C) ______________________

(B) ______________________ (D) ______________________

8. List the different grit types of sandpaper.

(A) ______________________ (D) ______________________

(B) ______________________ (E) ______________________

(C) ______________________

Assignment
Sheet No. 17

Covering
Units 129-131

ELECTRICAL FIXTURES AND SUPPLIES

Bright lights at special events attract many people. Hardware retailers would like to make their electrical fixture and supply department attract people in a similar manner. In part, this can be done through advertising, mass display, and various departmental promotions.

Electricity is playing an increasingly important part in our daily lives. Most homes that are over ten years old have outgrown their original wiring facilities. Homeowners are constantly replacing circuits, fixtures, and outlets with more adequate and up-to-date materials. After customers come into the store and over to the electrical department, the electric supply salesman's job begins. A salesman must not only be able to identify customer wants from their requests but he should be capable of making helpful suggestions to customers on the safe and proper use of electrical supplies. Sales personnel must possess a superior knowledge of the products they sell by knowing how they are manufactured and for what purpose they are made. Don't be the "bull in the china shop!" Know your products!

This assignment is designed to help the student learn more about light fixtures and electrical supplies. With knowledge gained in working this lesson, a hardware sales trainee should be able to serve his customers better and help his store to increase sales. After working this assignment the student should feel more competent and be more capable of giving advice to his customers as to which fixture or electrical part is right for a particular job.

Assignment:

1. Read the reference listed below.
2. Present to the instructor, either written or oral, information showing you fully understand the make-up of an electrical fuse and the part it plays in an electrical circuit.
3. Answer the questions below and turn in this assignment by ________________________ .

Reference:

A. Advanced Course in Hardware Retailing, Unit XII, "Electrical Fixtures and Supplies," pp. 1-53.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. The majority of homes today are adequately wired for their electrical demands.

T F 2. Modern electrical fixtures are attractive and decorative, as well as being functional.

T F 3. Electrical appliances are only as efficient as the electrical wiring in a home.

T F 4. Electricity is a low cost commodity that serves the public well.

T F 5. Raising lighting levels is a good practice in safeguarding eyesight.

T F 6. Flourescent lamps lend themselves well to decorative treatment.

T F 7. Always use several small bulbs instead of one large one.

T F 8. Colored inside light coatings improve light quality and improves the quantity of light produced.

T F 9. Retailers should stock the new tinted decorative incandescent bulbs since they bring better than average bulb profits.

T F 10. Flourescent and incandescent lamps should never be used in the same room.

T F 11. Miniature appliance and heater connectors are all equipped with an off-and-on switch.

T F 12. The type cord used for extension cords is determined by the kind of cord connector used on it.

T F 13. If starting a motor consistantly blows a fuse on a circuit, use a higher amp ordinary fuse.

T F 14. Voltage will drop when current is run through an extra long extension cord.

T F 15. Silent mercury switches are becoming quite popular.

T F 16. Pig-tail weather-proof lampholders make electric contact with the power line by forcing contact plugs into the wire.

T F 17. Surface wiring devices generally should be flush-mounted in a wall.

T F 18. Wall plates can be made decorative with pieces of drapery or wallpaper to blend into the room color scheme.

T F 19. When a customer indicates a need for a lighting fixture, first show him all you have available then ask questions.

T F 20. "Upright" exterior lanterns look better if the outside outlet is below 2/3 height of the door.

T F 21. If the customer insists on a wrong type fixture for his house, it is the salesperson's duty to sell him the correct fixture.

T F 22. Using a hanging lantern fixture over the table will do little to separate a dinette area from the kitchen unless there is some type of wall separation.

T F 23. Dens with wood interior walls should have a green, copper, or some other type decorative lighting piece.

T F 24. Light bulb wattage is etched on the bulb itself.

T F 25. Bayonet base type incandescent bulbs are used in automobiles.

T F 26. The higher the wattage the more light an incandescent bulb gives.

T F 27. Clear glass bulbs help to reduce glare, diffuse the light, color and control it.

T F 28. Light colored walls help homeowners save money in consumption of electricity.

T F 29. Frosting is painted inside most bulbs.

T F 30. Natural colored light bulbs are excellent for decorative purposes since they are less expensive than color-coated bulbs.

T F 31. Too low voltage will lengthen bulb life and increase its output.

T F 32. It is possible that early excessive bulb blackening is caused from an incorrect burning position.

T F 33. The type of flourescent base used is dependent upon the diameter of the bulb.

T F 34. Floruescent lamps produce three times as much light as an incandescent bulb of similar wattage.

T F 35. Like the incandescent bulb, too frequent starting will not affect the life of a fluorescent lamp.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. For the general public to safely take advantage of electrical conveniences, many homes should be ________________ .

2. New homes are being built at the rate of about a ______________ a year.

3. Good lighting can often be accomplished by combining the proper lighting ______________ with sufficient lamp ____________.

4. Eye efficiency depends upon eye ____________ .

5. There is a trend to use lights to produce a _______________ and an _______________ effect in the home.

6. Many homeowners have hesitated to introduce flourescent lighting because they feel it gives a ____________ appearance.

7. Wiring materials that transfer current from the source to the point of use are thought of as ____________ devices.

8. Three-prong grounding plugs are now required for supplying power to portable tools by the _______________ _______________ _______________ .

9. Fuses or circuit breakers used to protect wiring from becoming overloaded are known as _______________ devices.

10. ______________ _______________ trip and break the circuit when overloading occurs.

11. Most wall outlets are of the type with two _______________ .

12. Outdoor outlets are designed to be completely ________________ .

13. Attachment plugs with _____________ blades assure a firmer, more positive electrical contact.

14. Ceiling lampholders should be mounted on ______________ _______________ .

15. When using pipe heating cable, in all cases, it is recommended the _________________ control be used.

16. For exterior lighting, suggest copper or brass to go with _______________ house exterior.

17. The type lighting fixture needed for a breezeway will depend upon whether the breezeway is open, ________________, or _________________ .

18. For lighting a garden or barbecue area, recommend ________ watt PAR 38 flood lamps.

19. The amount of lighting needed for a front vestibule or reception hall is determined by its actual ______________ .

20. The __________ fixture is considered conventional for kitchen incandescent lighting.

21. Suspended fixtures may be used in the living room if the ceiling is higher than __________ .

22. Perimeter lighting, consisting of recessed ________________, has become popular for living room use.

23. To increase your related sales, never sell a fixture without the __________ or __________ that it should use.

24. The base of an incandescent lamp holds the lamp firmly in the socket and it _____________ the __________ through the lamp.

25. The most widely used incandescent base type is the __________ base.

26. Three contact base incandescent lamps contain two separate ________________ in one bulb.

27. Daylight bulbs yield a more approximated daylight through use of a ______________ glass.

28. PAR and reflector type bulbs have a reflecting surface of ____________ or _____________ sealed inside the bulb.

29. Stores, factories, and schools have made ________________ lighting their standard source of illumination.

30. A flourescent lamp needs its own _____________ operating _____________ control to maintain proper current operating limits.

31. The average home has _______ wired sockets for lighting.

32. Electricity carried by a wire is measured by ___________ .

Multiple-Choice

Directions: In the space at the left of each statement, write the letter of the item which will provide the correct answer to complete the statement.

_____ 1. Modern homes today have well over (A) 19; (B) 30; (C) 50; electrical appliances.

_____ 2. Incandescent bulbs produce light cast that is (A) blue; (B) orange; (C) red in character.

_____ 3. Bulbs that give off a (A) pure white; (B) cool green; (C) warm red coast are best for general use.

_____ 4. (A) Thanksgiving; (B) Christmas; (C) New Year holidays will bring the biggest demand for colored bulbs and outdoor reflector lamps.

_____ 5. Electrical devices recessed in or attached to the wall of a home are in the (A) portable; (B) permanent; (C) speciality wiring device group.

_____ 6. Generally speaking, electrical speciality devices will (A) produce; (B) transfer; (C) consume electricity.

_____ 7. An amateur would probably prefer a (A) quick clamp device; (B) multiple tap; (C) multiple socket for making an outlet repair.

_____ 8. The most popular type appliance cord is (A) super flexible HPH cord; (B) meoprene covered No. 16 cord; (C) No. 18 carton jacketed asbestos insulated HPD cord.

_____ 9. For a circuit with an electric motor on it (A) an ordinary; (B) a time-lag; (C) a cartridge fuse is recommended.

_____ 10. For wires rated to carry 30 amps, a (A) 20; (B) 30; (C) 40 amp fuse will give best protection.

_____ 11. (A) Double pole; (B) Three-way; (C) Single pole switches are used to control one circuit from two points.

_____ 12. A new surface wiring device using a flat, rectangular cable, with nail holes pre-punched, now on the market should prove to be useful for lighting the (A) living room; (B) dining room and kitchen; (C, cellar, attic, or garage.

_____ 13. For the best kitchen flourescent lighting use (A) 2 watts; (B) 1 1/2 watts; (C) 1 watt per square foot of floor space.

_____ 14. (A) Tan; (B) Ivory; (C) Primrose Yellow colored walls will help provide more usable light in a room.

_____ 15. Efficiency of a flourescent lamp increases with the (A) diameter; (B) length; (C) color of the tube.

_____ 16. (A) Starter switches; (B) The ballast; (C) The bipin base preheats the standard flourescent lamp to make the lamp light.

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. List six different electrical supply products a man might need in converting his basement to a den:

(A) ____________________ (E) ____________________

(B) ____________________ (F) ____________________

(C) ____________________ (G) ____________________

(D) ____________________

2. List the three separate product catagories of hardware store electrical supplies:

(A) ____

(B) ____

(C) ____

3. List three examples of portable wiring devices:

(A) ____________________ (D) ____________________

(B) ____________________ (E) ____________________

(C) ____________________

4. List the two basic types of outlet terminals:

(A) ____

(B) ____

5. List three switching mechanisms for incandescent lampholders:

(A) ____________________ (C) ____________________

(B) ____________________

6. List the three most commonly used types of wiring boxes:

(A) ______________ (B) ______________ (C) ______________

7. List five different places where lighting may be placed in a kitchen and dinette area:

(A) ____________________ (D) ____________________

(B) ____________________ (E) ____________________

(C) ____________________

8. List four possible places for light fixtures in a bathroom:

(A) ____

(B) ____

(C) ____

(D) ____

9. List four questions to be answered when selecting a dining room light fixture:

(A) ____

(B) ____

(C) ____

____

(D) ____

10. List four good forms of retail advertising:

(A) ____________________ (C) ____________________

(B) ____________________ (D) ____________________

Multiple-Response

Directions: The following are advantages of either (A) Incandescent lighting, or (B) flourescent lighting. Mark either A or B by the statement, whichever correctly applies.

_____ 1. Longer life.

_____ 2. Greater economy.

_____ 3. Offers a concentrated light source.

_____ 4. Cooler light.

_____ 5. Operates reliably at all temperatures.

_____ 6. Operates on either direct or alternating current.

_____ 7. Life is not reduced by frequenting starting.

_____ 8. More light per watt.

Matching

Directions: In the left hand column is a list of terms. The right hand column contains descriptive phrases or synonymous terms. Match the descriptions to the terms by placing the letter of the description in the blank at the left of the appropriate term.

_____ 1. Alternating Current

_____ 2. Ampere

_____ 3. Candle-power

_____ 4. Cycle

_____ 5. Direct current

_____ 6. Frequency

_____ 7. Indirect lighting

_____ 8. Kilowatt

_____ 9. Ohm

_____ 10. Volt

_____ 11. Watt

A. 1,000 watts

B. denotes rate of flow

C. electrical power unit of measurement

D. point where reflected light meets

E. a complete alternation of AC current

F. one square foot of illumination

G. flows many times per second, one way, then the other way

H. number of AC cycles per second

I. measures intensity of light

J. unit of pressure for supply of electrical current

K. light first reflected to ceiling

L. unit of electrical resistance

M. current flowing in only one direction at all times

Assignment
Sheet No. 18

Covering
Units 132-134

HOUSEWARES -- PART I

Today housewares are not only highly decorative, but they are also well engineered. The agressive hardware merchant will find housewares to be important in producing extra profit. However, here is a field that is becoming very crowded and highly competitive. This makes a knowledge of the selling techniques in this lesson an absolute necessity.

When Mrs. Jones enters a store to shop for cookware, she has every right to expect honest, factual, and up-to-date information on the products offered for sale. To be an expert in this field requires a great deal of knowledge.

This assignment will acquaint the student with the difficulty of handling varieties needed in the housewares and cookware department, in deciding what should be stocked, of what will sell and what might not. The student will learn much of the knowledge needed in making explanations of the use and value of houseware products to his customers.

Assignment:

1. Read the reference listed below.
2. Answer the questions below and turn in this assignment by ______________________.

Reference:

A. Advanced Course in Hardware Retailing, "Housewares," Unit 13, Chapters I and II, pp. Intro.-24.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. Even though profit made through the sale of "housewares" is below average, it does account for 10.9% of total gross sales.

T F 2. Store location plays an important part in determining housewares' volume of sales.

T F 3. Today's housewife is looking for the easiest, quickest, and most efficient method of doing things.

T F 4. The kitchen is considered the "workshop" for the housewife.

T F 5. Cookware today is decorative enough to serve the kitchen much in the same way as pictures do other rooms.

T F 6. Plastics have enabled manufacturers to bring new, exciting colors to the retailers' shelves.

T F 7. The sale of a houseware item seldom leads to the sale of related items.

T F 8. The retailer aims at having his store window and interior displays reflect the same high spirited atmosphere as his accompanying advertising creates.

T F 9. Housewares are considered "seasonal" merchandise.

T F 10. Most new kitchenwares will require little demonstration.

T F 11. One should begin with the most expensive sets in showing customers sets of cooking utensils.

T F 12. Large covered pans and similar large items should be placed on top shelves where they are easier to reach.

T F 13. Customer-participation displays lead to more sales.

T F 14. One should always be sure his interior displays are adequately stocked to backup the store window themes.

T F 15. The term "gadget" suggests quality to the housewife more so than the word "tool."

T F 16. Housewives are continually searching for new and better means of preparing food.

T F 17. Aluminum cookware discoloration is harmful and should be removed as quickly as possible.

T F 18. A dull finished pan will bake pastry quicker than a highly polished finish.

T F 19. Most pie recipes call for an eight inch pie pan.

T F 20. Abrasive-type cleaners will not mar the finish of colored aluminum.

T F 21. Steel wool is necessary and highly recommended for cleaning stainless steelware.

T F 22. In the past few years the copper bottomed stainless steel cookware has become a top seller.

T F 23. The visual attraction of glass makes it a "natural" for a full line display.

T F 24. Glass cookingware will withstand quick temperature changes.

T F 25. Opaque Glass is outstanding with its fashion colors and decorative designs.

T F 26. Goods baked in embossed tinware should not stick to the pan.

T F 27. Pores in cast iron become well lubricated through constant use.

T F 28. Porcelain enameled ware is one of the newer types of cookware.

T F 29. Porcelain enamel ware is highly recommended for coffee makers by those who know good coffee.

T F 30. Waterless cooking is truly cooking without the benefit of water.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. The hardware retailer classifies such items as cutlery, dinnerware, stemware, etc., as ______________.

2. Many housewives express their pride in their new kitchens in the ______________ and ______________ ______________ which they purchase, for this room.

3. The increased use of color in housewares helps to provide more ______________ surroundings for the housewife.

4. Women today do not like to shop in dimly lit, ______________ ______________, __ ______________ merchandise stores.

5. Many leading manufacturers encourage retailers to advertise housewares by reimbursing ________ per cent or more of the cost.

6. A salesperson should keep in mind at all times that a ______________ customer is the best advertisement a store can have.

7. Promoting sales of additional items to a housewife to go with her initial purchase, such as a rubber drainboard with a dishdrainer, is called ______________ selling.

8. In the housewares department, all cookwares should be grouped together according to the ______________ and the ______________ from which they are made.

9. Pans with lids should be displayed with handles pointing to the ___________ so the housewife might use her ___________ hand to remove the lid.

10. A specially designed metal stand for floor displaying of ______________ ______________ and ______________ ______________ can be purchased from manufacturers.

11. A good way to display kitchen tools and cutlery sets is to hang them on a vertical sheet of perforated board called a ______________ ______________ ______________.

12. Related plastic items, merchandised into family groupings, will spur customers into greater use of the "______________________" idea.

13. To show that their products are virtually unbreakable, Melamine manufacturers often use ______________ displays.

14. One important way to get customers into the housewares department is through ______________ displays.

15. Although Thanksgiving is a short season for extra promotions, an interior mass display of ______________, ______________, etc. will help create extra business.

16. Cookware is very suitable as gifts for such occasions as ______________, ______________, and ______________.

17. To make sheet aluminum more decorative for giftware lines with a large array of colors, an ______________ ______________ can be applied.

18. Bakeware utensils are designed primarily for ______________, ______________, and ______________.

19. Sizes of the better quality baking utensils will be shown either on their ______________ or on the outside ______________.

20. For an average sized oven a ______________ size cookie sheet is best.

21. The average recipe calls for the ______________ - ____ size muffin pan.

22. Such items as dishpans, colanders, and food mills are considered ______________ ware items.

23. Top-of-the-range aluminum ware is usually made from ________ to ________ gauge material.

24. Quality grades of stainless steel utensils usually are of three-ply construction or are made with special ______________ to ______________ heat evenly.

25. Copper plating on stainless steel will insure an even distribution of heat, thus preventing ______________ and ______________ spots.

26. Glass manufacturers use borax in the formulation of glass cookware and ______________ each individual piece to specific hardness.

27. Ceramic cookware is more expensive but is selling fast because it is both ______________ and ______________.

28. Since Mayflower days, cooks have chosen cast iron cookware because it is ______________ and ______________.

29. The pressure cooker saves the housewife time by cooking foods ________ to ________ times faster.

Multiple-Choice

Directions: In the space at the left of each statement, write the letter of the item which will provide the correct answer to complete the statement.

_____ 1. Cast iron kitchenware should be placed on lower shelves because of (A) appearance; (B) poor sales; (C) weight.

_____ 2. When you point out the uniform finish and attractiveness of a cooking utensil, you are selling (A) cost; (B) quality (C) utility.

_____ 3. (A) Aluminum; (B) Glass; (C) Cast iron cookware has one of the highest rates of heat conductivity of all cookware materials.

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. List the places a newspaper ad might be posted in the store to best remind you and your customers of the kitchenware specials.

(A) ____

(B) ____

(C) ____

2. In using the 3-D approach to sales, design, display, and demonstration, which one means:

(A) good merchandising - ______________________

(B) wise buying - ______________________

(C) good salesmanship - ______________________

3. List the four types of display that might be used for selling rubber housewares.

(A) ________________ (C) ________________

(B) ________________ (D) ________________

4. In merchandising rubber houseware items, what are four basic rules to follow?

(A) ______________________________

(B) ______________________________

(C) ______________________________

(D) ______________________________

5. List the three types of cooking utensils on the market today:

(A) ______________ (C) ______________

(B) ______________

6. List the different materials that cooking utensils are available in.

(A) ______________ (E) ______________

(B) ______________ (F) ______________

(C) ______________ (G) ______________

(D) ______________

7. List the four principle types of aluminum cookware.

(A) ______________________________

(B) ______________________________

(C) ______________________________

(D) ______________________________

8. List the uses of stainless steel bowls.

(A) ______________ (D) ______________

(B) ______________ (E) ______________

(C) ______________ (F) ______________

9. List the three extraordinary selling points to be used in selling glass cookware.

(A) ______________ (C) ______________

(B) ______________

10. Quality waterless cookware must have what three features?

(A) ______________________________

(B) ______________________________

(C) ______________________________

Assignment
Sheet No. 19

Covering
Units 135-137

HOUSEWARES -- PART II

The slogan "Home Sweet Home" has a new meaning today, since modern housewares dress up the kitchen and help to eliminate drudgery. Beautiful and practical are the by-words for the hundreds of housewares now available to the housewife. Synthetic rubberware and plastic products come in beautiful decorative colors. Glassware is more practical to use and is easier to clean. The housewife now has a cutting tool to fit the job rather than one cutting instrument to do all the cutting duties that she performs.

"A housewife's work is never done" is an expression quoted quite often. The salesman who keeps this in mind in selling kitchen tools could become a volume leader. The salesman must be willing and able to demonstrate the effort and time saving features of newer products. This requires a thorough knowledge of the product and its special features and functions.

This unit will acquaint the student with a variety of household items, including glassware, stainless steel flatware, rubber mats, and scales.

Assignment:

1. Read the reference listed below.
2. Answer the questions below and turn in this assignment by ____________________.

Reference:

A. Advanced Course in Hardware Retailing, "Housewares," Unit 13, Chapters III, IV, V, and VI, pp. 25-57.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. Rubber and plastic housewares have outstanding appeal to the consumer.

T F 2. Color plays a very small part in the sale of rubber and plastic goods.

T F 3. Larger manufacturers of rubber and plastic housewares offer dealers well designed display units.

T F 4. Attractive displays can greatly add to the overall consumer image of your store.

T F 5. "Rubber" housewares means the article is made solely of rubber.

T F 6. Rubber housewares are seldom changed in their styles, however, colors frequently are changed.

T F 7. Housewives can utilize undersink storage to a maximum with a self-stacking storage bin.

T F 8. Products such as diaper pails, door mats, and laundry baskets can only be purchased in metal or fiber materials.

T F 9. The rubber garbage can has a short life and should be replaced in the home often.

T F 10. Intense heat has very little effect on thermoplastic articles.

T F 11. Research shows that a basic housewares department should carry a minimum number of 20 groups of items.

T F 12. Modern bathrooms are more compact yet more functional.

T F 13. When showing a customer a quality bath scale, shake the scale to show absence of rattles.

T F 14. Stainless steel bath scales offer less resistance to rusting than triple-plated chrome.

T F 15. Bathroom scales with fur covers are available.

T F 16. Better toilet seats are made of hardwood, kiln-dried with tongue and groove fitting.

T F 17. To add to sales impact and to increase impulse sales, items used primarily in the bathroom should be featured together.

T F 18. Many houseware items lose their sales appeal merely because something newer has been introduced to fill the same need.

T F 19. Modern glassware items seldom experience a style change.

T F 20. The general style and shape of each barglass will be the same regardless of the manufacturer.

T F 21. Discriminating buyers of glass stemware require more than just an ordinary sales approach.

T F 22. Manufacturers have found hardware stores to be good outlets for metal folding tables and chairs.

T F 23. Stainless steel is taking over the flatware market.

T F 24. Barometers and thermometers make excellent gifts to just about anyone.

T F 25. Kitchen tools are designed to fill certain needs and can be put into groups according to their function.

T F 26. The clamp-on opener is portable, more expensive, and quite an improvement over the knife opener.

T F 27. The single action opener is not portable but it does open any can easily.

T F 28. With so many homes having electric mixers, there is little need for a hand type beater.

T F 29. Quality cooking tools such as turners, spatulas, forks, and ladles, are made from stainless steel.

T F 30. An "outsider" demonstrating an article will project more sales impact than someone well known.

T F 31. Wider bladed knives are best for slicing cold meat or fowl.

T F 32. The American cutlery industry is the world leader in use of accurate methods and the finest steel in mechanically producing quality cutlery.

T F 33. A knife should have a few strokes on a sharpening steel before each use.

T F 34. Scalloped and saw-tooth edges are used only for slicing bread.

T F 35. Balance has no particular significance in the better knives.

T F 36. Shears and pocket knives are considered a part of kitchen cutlery.

T F 37. New type stainless steel pocket knife blades are easy to resharpen.

T F 38. A quality feature of a knife would be its comfortable and secure feeling in the hand.

T F 39. As a knife is opened or closed, a sharp "click" is a sure sign of a well-made knife.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. Display space allowed different groups of merchandise is determined by the ______________ ______________ of that merchandise.

2. For retailers maintaining a certain level stock of their products, some manufacturers will give merchandising ______________.

3. Products such as dishpans, drainers, and sink mats are designed for use in the ______________ ______________.

4. Many colorful counter and stove mats are topped with ______________ to make them ______________ ______________.

5. Hardware dealers and employees can keep current or new items offered by reading ______________ ______________ or ______________ ______________.

6. Plastic materials which soften with the application of heat are called ______________.

7. Polyethylene, nylon, and vinyl, are examples of the ______________ basic type of plastic.

8. Good bath scales should be sold with the thought that they often will last from _______ years to a lifetime.

9. In selling bath scales, approach your customer on a ______________ basis by showing your ______________ priced scales first.

10. A new-type clothes hamper is designed to hang on the back of the ______________ ______________.

11. Not only do tub mats add to bath decor, they contribute a safety feature by helping to prevent ______________.

12. Housewives may lighten many kitchen chores and save many hours of weary standing with a kitchen ______________.

13. A kitchen tray table can be used for ______________, ______________, and ______________.

14. Most housewives share the housekeeping headache of having cluttered, inconvenient ______________ and ______________.

15. Stove mats provide an inexpensive means of preventing ______________ of fine surfaces in the kitchen.

16. Folding tray tables that provide the homemaker with additional serving space are often called ______________ trays.

17. Houseware stock that is out of style should be sold at a ______________ to make room for new items.

18. One disadvantage of the knife type opener is that it leaves ______________ edges that can ______________ the hand.

19. There are two wall type openers on the market, the ______________ and the ______________ ______________.

20. Most of the latest, labor-saving kitchen devices are ______________ in cost and are bought on ______________.

21. Better cooks demand a good ______________ ______________ to know the temperature of the inside of a roast.

22. To provide specific service for several uses, kitchen knives should possess high ______________ and ______________.

23. The two major types of grind for kitchen cutlery are ______________ and ______________.

24. A principle handle material known as mother-of-pearl is used in the manufacture of fine ______________ knives.

25. Scissors are designed for the ______________ tasks of hand cutting.

26. The best selling feature of a pocket knife is the ______________ ______________.

27. Light small, compact knives are called ______________ knives.

Multiple-Choice

Directions: In the space at the left of each statement, write the letter of the item which will provide the correct answer to complete the statement.

_____ 1. Plastics that become hard and brittle with the simultaneous application of high pressure are called (A) rubber housewares; (B) thermoplastics; (C) thermosetting materials.

_____ 2. Many television cabinets are made from (A) rubber; (B) thermoplastics; (C) thermosetting plastics.

_____ 3. To make a sale, a salesman should be prepared to demonstrate a (A) beater; (B) cooking thermometer; (C) food slicer in the store.

_____ 4. Shears usually measure (A) 4; (B) 6; (C) 8 inches or more in length.

_____ 5. Shears made by the (A) hot-forged; (B) cast; (C) cold-forged method are used for barbering and light household work.

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. List the three general categories for classifying rubber houseware.

(A) ____________________

(B) ____________________

(C) ____________________

2. List the three groups included in rubber products for the kitchen.

(A) ____________________

(B) ____________________

(C) ____________________

3. List the five points that should be stressed in selling bath scales.

(A) ____________ (D) ____________

(B) ____________ (E) ____________

(C) ____________

4. List the types of glassware that most glassware sales will be in.

(A) ____________ (D) ____________

(B) ____________ (E) ____________

(C) ____________

5. List the five selling points that good quality juvenile furniture will possess.

(A) ____________________

(B) ____________________

(C) ____________________

(D) ____________________

(E) ____________________

6. List the three basic types of non-electric can openers.

(A) ____________ (C) ____________

(B) ____________

7. List the "basic seven" kitchen set.

(A) ______________________ (E) ______________________

(B) ______________________ (F) ______________________

(C) ______________________ (G) ______________________

(D) ______________________

8. List the four types of edging for flat or hollow types of blade grind:

(A) ____

(B) ____

(C) ____

(D) ____

9. List the four main parts of a fixed blade knife.

(A) ______________________ (C) ______________________

(B) ______________________ (D) ______________________

10. Three of the principle wood handle materials for fixed-blade knives are:

(A) ______________________ (C) ______________________

(B) ______________________

11. List the three ways handles are made to hold on fixed-blade knives.

(A) ______________________ (C) ______________________

(B) ______________________

12. List the eight types of shears:

(A) ______________________ (E) ______________________

(B) ______________________ (F) ______________________

(C) ______________________ (G) ______________________

(D) ______________________ (H) ______________________

13. List the five types of scissors.

(A) ______________________ (D) ______________________

(B) ______________________ (E) ______________________

(C) ______________________

14. Pocket knives generally fall into what three categories?

(A) ______________________ (C) ______________________

(B) ______________________

Assignment
Sheet No. 20

Covering
Units 138-142

ELECTRIC HOUSEWARES AND GIFTS

Proper buying of electrical housewares and gifts is a difficult problem for the manager of a hardware store. New products are being introduced to the market daily. The manager must choose products wisely and use skillful advertising techniques followed up with good interior displays if this department is to be of maximum value to the store.

How does a retailer stay ahead of his competitor? Why do customers come into your store to buy an electrical appliance? Are your products better than the other store's line? What factors make for repeat sales in this department?

This assignment will present some of the information needed to answer the above questions. This is done by taking a look at duties involved in serving customers along with suggestions for increasing the sales and profits from electrical housewares and gifts.

Assignment:

1. Read the reference listed below.
2. Make a list of at least ten electrical houseware items that have come on the market during the past 10-15 years. By each one list the advantages it has in use as compared to to the household item used prior to its introduction. Example: Electric tooth brush - more thorough brushing of teeth, messages gums, faster than the old style manual tooth brush.
3. Answer the questions below and turn in this assignment by ______________________.

Reference:

A. Advanced Course in Hardware Retailing, Unit 14, "Electric Housewares and Gifts," pp. Intro.-43.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. Sales of electric housewares are decreasing.

T F 2. Competition for electric appliance is intense.

T F 3. There is no profit in electrical appliances today.

T F 4. Electric housewares is a type of business that requires a great deal of promotion.

T F 5. Discounting is a relatively new sales trend.

T F 6. Manufacturers show little concern at their products being "footballed" by retailers.

T F 7. The discount store usually features all brand name merchandise.

T F 8. A customer with ready cash, looking for the lowest price, is anyone's customer.

T F 9. Seldom is an electric houseware item purchased on impulse.

T F 10. A display has to be large to really say something or convey an idea.

T F 11. Electric housewares serve very effectively as practical gifts.

T F 12. Most new electric items introduced each year become basic stock items.

T F 13. The majority of coffee drinkers like their coffee brewed the same way.

T F 14. The better automatic percolators keep the coffee at the right serving temperature.

T F 15. The ceramic electric skillet is made with the heating unit in the bottom of the skillet.

T F 16. Today, the electric mixer is considered a luxury.

T F 17. Portable electric mixer sales are increasing each year.

T OF 18. It seems that electric toaster sales have reached a saturation point.

T F 19. The user can make buttered or cinnamon toast on the reflector type toaster.

T F 20. The party type electric grill simplifies the making of hor d' oeuvres.

T F 21. Blenders are considered a very versatile appliance.

T F 22. Use of electric housewares is mostly limited to the kitchen.

T F 23. Housewives would prefer heat degree markings on electric irons rather than the fabric markings.

T F 24. Most electric clocks have a bell type alarm.

T F 25. Customers are likely to spend less for an electric clock when it is to be a gift.

T F 26. Plastic clock cases are more flexible in design than metal.

T F 27. With so many types of hair dryers on the market, personal choice will largely determine which hair dryer a customer purchases.

T F 28. Automatic electric blankets assure comfort by compensating for all changes in the room temperature.

T F 29. The size of the electric heater sold should be based on the size room to be heated.

T F 30. Baby bottle warmers are widely used as gifts to mothers.

T F 31. The electric corn popper is inexpensive and makes a good promotion item.

T F 32. Window fans move cool air from outside into a house and force inside hot air out.

T F 33. When selling air conditioners always be sure to sell a unit large enough for the area to be cooled.

T F 34. There are more cord plug-in type electric toothbrushes sold than the cordless type.

T F 35. Before stocking up on a new electric item it is always wise to buy a limited supply to test customer acceptance.

T F 36. Giftware items in a hardware store are easily catagorized from other items for sale in the store.

T F 37. Many hardware dealers readily admit that buying for the giftware department is a gamble.

T F 38. Your customers will often want new and different gift items.

T F 39. Men seem to supervise gift ware departments best because they are better judges of what appeals to women.

T F 40. Many people pay almost as much attention to the wrapping of a gift as to the gift itself.

T F 41. A bow tying machine requires considerable experience for the operator to turn out professional looking work.

T F 42. A store's ability to provide electric appliance service and repair will often be a determining factor in the success of its electric housewares business.

T F 43. The word "guaranteed" has a set, standard meaning.

T F 44. If possible, customers should be told in advance what an appliance repair bill will be.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. If a retailer is to successfully compete for the consumer dollar, his sales promotion and advertising program will have to be ______________ and well ______________.
2. Quite often a manufacturer will pay up to _______ per cent of the retailer's cost of advertising that manufacturer's line.
3. The automatic coffeemaker is becoming virtually a necessity in the home because _______ per cent of American homes make coffee daily.
4. The ______________ ______________ of quality percolators allows the coffee to be brewed either mild or strong.
5. Each manufacturer's percolator has a distinctive shape and design to give it ______________, which often is its best sales feature.
6. The _______ to _______ cup size percolator is the best seller in many areas.
7. Electric mixers save work by completely ______________ the mixer's hand to do other work.
8. Mixer attachments are all considered to be ______________ ______________ devices for the housewife.
9. The most popular electric toaster is the ______________ model
10. The more practical electric sauce pans should be ______________ in shape.
11. The electric kettle should appeal to the customer who likes to prepare ______________ drinks.
12. Tests have shown that electric irons produce best results with ______________, not ______________.
13. Most spring alarm clocks have _______ hour movements.
14. The most widely used electric fan is the _________________ type.
15. For maximum comfort in hot climates, air should be completely circulated in a room every _______ or _______ minutes.

16. As a first step toward increasing giftware sales, the retailer should make his sales personnel gift ______________.

17. A definite factor in selling more expensive giftware items is ____________________.

18. Two very good low-cost aids for bringing in additional gift business are __________________ and __________________ services.

19. The average charge for gift wrapping, when a charge is made, is ________ cents.

20. An important thing to consider in building a good service reputation is to handle merchandise made by a ______________ manufacturer.

Multiple-Choice

Directions: In the space at the left of each statement, write the letter of the item which will provide the correct answer to complete the statement.

_____ 1. Window displays should function as (A) decoration; (B) a place for out-of-date items; (C) traffic-stopping for the store.

_____ 2. Most percolators are made of (A) ceramic; (B) chrome; (C) steel or aluminum.

_____ 3. The party size percolator makes up to (A) 35; (B) 50; (C) 80 cups of coffee.

_____ 4. (A) 40; (B) 60; (C) 80 per cent of a home's cooking is done on the top of the range.

_____ 5. The most popular models of the electric irons are the (A) steam; (B) steam and dry; (C) dry types.

_____ 6. As wedding gifts, clocks rank (A) first; (B) second; (C) third in popularity.

_____ 7. Strike and chime clocks are usually the (A) lower; (B) medium; (C) higher priced clocks.

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. List six special events many retailers tie-in their promotions with:

(A) ________________________ (D) ________________________
(B) ________________________ (E) ________________________
(C) ________________________ (F) ________________________

2. List four uses of the electric fry pan, other than frying:

(A) ____________ (C) ____________

(B) ____________ (D) ____________

3. List three characteristics of the quality electric can opener:

(A) ____________

(B) ____________

(C) ____________

4. List the two types of steam irons:

(A) ____________ (B) ____________

5. List the three types of clocks on the market today:

(A) ____________ (C) ____________

(B) ____________

6. List five advantages your store will realize in setting up a giftwares section:

(A) ____________

(B) ____________

(C) ____________

(D) ____________

(E) ____________

7. List three neighborhood factors to consider when buying for a giftware department:

(A) ____________

(B) ____________

(C) ____________

Assignment
Sheet No. 21

Covering
Units 143-147

CLEANING AND LAUNDRY SUPPLIES

Housecleaning could be a dull chore for the housewife, however, today a home can be kept clean much easier with the aid of dozens of helpful items of every design, style and brand. Brooms and brushes are available in a wide variety of types and sizes. Even rust proof garbage cans and light weight ladders play a part in our high standard of easy living.

The purpose of this lesson is to point out ways to inform the housewife of modern devices and supplies and thereby to increase your sales from this department.

Every housewife needs an assortment of labor-saving devices to adequately meet her needs. If you are to be of assistance to your customers in this regard you must know something about the cleaning and laundry supplies you have for sale. This lesson is designed to help you acquire this information.

Assignment:

1. Read the reference listed below.
2. Prepare a paper, for your instructor, of not more than one page, of questions you might use and answers needed for you to make a sale of one or more items to a customer who "has a floor to wax," keeping in mind the need to serve him properly so he will be satisfied and will return to your store as a customer. You do want the customer to have adequate supplies for his task.
3. Answer the questions below and turn in this assignment by ____________________ .

Reference:

A. Advanced Course in Hardware Retailing, "Cleaning and Laundry Supplies," Unit 15, pp. Intro.-61.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. Cleaning and laundry departments in the average retail hardware store have shown increases in sales.

T F 2. Cleaning and laundry supplies offer the opportunity for bringing customers back into the store.

T F 3. For most homemakers cleaning is a pleasant task.

T F 4. Beautiful floors and furniture are very important to the decorative features of a pretty house.

T F 5. Housewives are finding electric floor polishers and waxers to be easy to use and more thorough than older methods of cleaning floors.

T F 6. Hardware stores have very little competition in the cleaning and laundry business.

T F 7. Holiday seasons are good times to feature cleaning supplies.

T F 8. A salesperson working in the cleaning supply department should be an expert on giving house cleaning advice.

T F 9. The old fashioned cotton yarn mop still offers more advantages than the cellulose sponge yarn mop.

T F 10. The saran dust mop's static charge is dissipated into the air when the mop is shaken out, releasing the dust and dirt.

T F 11. Dust mops should not be washed too frequently.

T F 12. Rough floors with heavy dirt should be swept with brooms filled with soft natural or synthetic fibers.

T F 13. Brooms are used in all business and industrial buildings.

T F 14. Many brushes, dirty from use, may be washed thoroughly with soap and water to make them fresh again.

T F 15. All hard-surface floor coverings can be improved in appearance by waxing.

T F 16. Water is used as a carrier for the small solids in self-polishing waxes.

T F 17. Self-polishing waxes should be recommended for most wood floors.

T F 18. The solvent in polishing wax hardens the old wax on floors, resulting in increased beauty with each new application.

T F 19. It is good advice to caution your customers to thoroughly shake self-polishing waxes before using.

T F 20. The amount of traffic has a lot to do with the type wax to be used on a floor.

T F 21. Only self-polishing wax should be used on vinyl.

T F 22. A wax coating on a tile floor reduces the amount of soil embedded in the tile.

T F 23. One should always use a polishing type wax on asphalt tile floors.

T F 24. Concrete floors in homes should be waxed so as to minimize its dirt catching characteristics.

T F 25. The use of waxes, cleaners and polishes is mostly limited to use on floors.

T F 26. Silicone wax is highly recommended for use on floors.

T F 27. No polish or wax on the market will completely protect furniture from abuse and neglect.

T F 28. A creamy white self-polishing wax will remove the yellowing on old ivory piano keys.

T F 29. Since a supply can be used over and over, the continued use of calcium chloride in controlling humidity will result in its costing less and less.

T F 30. The modern housewife of today, with the latest tools and cleansers, can keep a cleaner house than even the wealthiest could yester year.

T F 31. The electric polisher-scrubber can save the housewife many hours of back-aching work.

T F 32. The non-electric floor washer has been found to perform as well as the electric model.

T F 33. The savings realized by a housewife in using an electric rug cleaner will more than pay for the cost of the machine.

T F 34. The solid top ironing board is best fo. steam ironing.

T F 35. Some drying racks, although very compact, offer as much as fifty feet of drying space.

T F 36. Magnesium ladders are of a rigid structure and will break before bending.

T F 37. Weight is always a symbol of quality in galvanized products.

T F 38. Galvanized steel garbage cans are required for households by the health and sanitation ordinances of most American cities.

T F 39. The smaller the spacing between trash burner wires, the more wires used, the more rigid and longer lasting the container will be.

T F 40. The natural sponge is the skeleton of an animal.

T F 41. The cellulose sponge has not been accepted as a good substitute for the natural sponge.

T F 42. Present day chamois is made of certain types of sheepskin.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. A clean home is a symbol of a ____________ housekeeper.

2. Many housewives prefer the nylon dry mop because it is highly ________________, enabling it to pick up and hold more dust.

3. For factories, where sweeping areas are larger than in the home, ________________ brooms are easier to use.

4. Solvent waxes come in ____________ or ______________ form and must be rubbed to a shine.

5. For the prettiest, most durable and lasting floor protection, ________________ wax is best.

6. Less rubbing will be required if wax is polished before it is ______________ .

7. Floor experts tell us that the life of a linoleum floor would be extended ______ to _________ times if kept waxed.

8. After cork flooring is sanded a good coating of floor ______________ should be applied before waxing.

9. Paste wax offers a ________________ protection for wood floors.

10. Only use self-polishing wax for wood floors that are well sealed and that have a good ______________ .

11. Waxing is recommended for marble and terrazzo floors to bring out the ______________ and _______________ .

12. On the "Use and Care" chart, it is recommended that ________________ floor surfaces be cleaned and waxed more than three times a year.

13. For best protection, oil polishes should be applied at least once a _______________ .

14. Dust will not stick to a ____________ and ____________ surface.

15. In the average home every year, cooking will vaporize about __________ pounds of grease that will condense upon touching exposed surfaces.

16. To retard tarnish and enhance the beauty of silver, brass, or copper, the housewife should use a _____________, ___________________ cream wax.

17. Some oven cleaners contain a high percentage of ______________, a chemical that could cause skin burns or eye injury if carelessly used.

18. Electric brooms and vacuum sweepers can best be sold by ___________________ their power to the customer.

19. The portable vacuum sweeper is primarily designed for use on items such as drapes, furniture, etc., but can be used on floors on a _ _____________ basis.

20. Good displays in your store can ______________ sales and _________________ demands for products you do not stock.

21. The type of ladder purchased should be determined by the _____________ intended for it.

22. Manufacturers do not paint ladders so inspection for
________________ __________________, __________________
failures and ______________ wood can be made.

23. The most common objection to the metal ladder is the
________________ ________________ .

24. An excellent opportunity for related sales is to suggest a matching _______________ to go with the purchased clothes hamper.

25. When selling water soluble weed killers, there will often be an opportunity to sell a _______________ can.

<u>Multiple-Choice</u>

Directions: In the space at the left of each statement, write the letter of the item which will provide the correct answer to complete the statement.

_____ 1. Broom sales in hardware stores account for (A) 6; (B) 15; (C) 25 per cent of total broom sales.

_____ 2. Advertising for cleaning supplies should be held (A) every spring; (B) every season; (C) consistently.

_____ 3. The number of sales a store ultimately makes is dependent upon its (A) advertising; (B) sales force; (C) management.

_____ 4. Bath brushes are not made with (A) horsehair; (B) bronze wire; (C) synthetic bristles as filling materials.

_____ 5. (A) Polishing; (B) Self-polishing; (C) Water-emulsion wax for floors can also be used on furniture.

_____ 6. Excessive humidity, or too much air moisture, is a problem faced by homeowners in approximately (A) 1/3; (B) 1/2; (C) 2/3 of the United States.

_____ 7. Clothes hampers should be (A) well ventilated; (B) air-tight; (C) made of chrome.

_____ 8. (A) Aluminum; (B) Galvanized steel; (C) Polyethylene garbage cans are noiseless, break-resistant, non-rusting, non-denting, light weight, colorful and easy to clean.

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. List the two general categories of floor mops:

(A) ______________________ (B) ______________________

2. List four uses for the block sponge mop:

(A) ______________________ (C) ______________________

(B) ______________________ (D) ______________________

3. List four disadvantages of the wool mop:

(A) ______________________ (C) ______________________

(B) ______________________ (D) ______________________

4. List the four types of brooms:

(A) ______________________ (C) ______________________

(B) ______________________ (D) ______________________

5. List the two basic types of brushes and brooms:

(A) ______________________ (B) ______________________

6. List the eight types of brush filling materials:

(A) ______________ (E) ______________

(B) ______________ (F) ______________

(C) ______________ (G) ______________

(D) ______________ (H) ______________

7. List four advantages of waxing floors:

(A) ______________________________

(B) ______________________________

(C) ______________________________

(D) ______________________________

8. List the four types of furniture polishes:

(A) ______________ (C) ______________

(B) ______________ (D) ______________

9. List the two newer waxes that enjoy the largest sales volume of all wax polishes:

(A) ______________ (B) ______________

10. List the four major types of commercial glass cleaners:

(A) ______________ (C) ______________

(B) ______________ (D) ______________

11. List the two main reasons accounting for the popularity of home rug and upholstery cleaners:

(A) ______________________________

(B) ______________________________

12. List three related items a housewife might need with her new ironing board purchase:

(A) ______________ (C) ______________

(B) ______________

13. List the three broad classifications of ladders:

(A) ______________________ (C) ______________________

(B) ______________________

14. List four advantages of using zinc-coated steel for galvanized cans, pails, and tubs:

(A) ______________________

(B) ______________________

(C) ______________________

(D) ______________________

Assignment
Sheet No. 22

Covering
Units 148-151

PLUMBING, HEATING AND BUILDING MATERIALS -- PART I

Through advertising, proper merchandising, and a service attitude of store personnel, sales of plumbing, heating, and building materials can be increased. New building and home construction is a major factor in helping our economy to grow. Building costs are high as well as repair costs to homeowners. During the past few years many home craftsmen, along with those that are not handy with tools, are doing most of the minor repairs around the house. Most retail hardware sales will be to the homeowner who is doing his own repair work.

An important aspect of the do-it-yourself movement is the changing and improvement of the facilities in the home which are dependent on plumbing. Fittings, fixtures and tools for home repair work must be stocked and displayed in an adequate and proper manner. A sales trainee needs to be thoroughly familiar with the tools, materials, and equipment in his department. A detailed study of manufacturer's literature and a review of trade publications will help the student become more proficient in sales. Manufacturer's literature on new items, such as the new plastic pipe and fitting lines, will be most helpful.

Repairs and accessories and heating are the major part of the sales of plumbing and heating materials. This lesson will help the student become acquainted with home plumbing and heating problems. It will show him how he can help customers solve their problems and, at the same time, increase sales.

Assignment:

1. Read the reference below.
2. Study manufacturers literature and other reference books to determine the methods of pipe measurement and terminology until you can identify the various sizes by sight.
3. Study manufacturers information dealing with the new types of plastic pipe.
4. Answer the questions below and turn in this assignment by ________________ .

Reference:

A. ACHR, Hardware, Unit 16, pp. 1-33.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. Burring is the same operation as reaming.

T F 2. Chamfering is the process of tapering the inside edge of a pipe so it will not obstruct the flow of water.

T F 3. A hex pipe wrench has serrated gripping cuts on the jaws like a regular pipe wrench.

T F 4. A stillson wrench is more subject to damage from abuse than a one piece regular pipe wrench.

T F 5. There is a metal to metal contact when using a strap wrench.

T F 6. A monkey wrench has no teeth.

T F 7. The chain wrench slips in one direction and grips in the other.

T F 8. All pipe reamers are cone shaped.

T F 9. The most commonly used pipe and tubing cutters differ only in size and have a single cutting wheel.

T F 10. Grooved rollers are found on tubing cutters designed to cut close to the flare.

T F 11. Four wheel pipe cutters are made only for rapid cutting action on pipe 2 1/2 inches or larger.

T F 12. Pipe vises which hold the work piece with the aid of a chain usually have a greater range of uses than those with fixed and movable jaws.

T F 13. Power threading and cutting tools are carried by most hardware stores since professionals use them.

T F 14. The sale of a faucet washer can lead to the sale of other items needed to complete the job--such as hand tools.

T F 15. Swing spout washers have a steel retaining ring.

T F 16. A bibb screw holds the bonnet packing in place.

T F 17. Pipe joint compounds must be carefully selected to adequately do the job in <u>each</u> particular case.

T F 18. Penetrating solvent is available which can loosen or free pipes and parts which are frozen and can be profitably sold even when it is not prominently displayed and an unknown brand.

T F 19. Bath accessories can be sold just as effectively and profitably if they are kept in the stock room as on an open self-service display.

T F 20. Water pipe comes only in galvanized finish.

T F 21. Plastic pipe is suitable only for use in carrying water.

T F 22. Plastic pipes cannot be joined with metal plumbing.

T F 23. Manufacturers say that plastic pipe should not be used at temperatures over 120-130 degrees F.

T F 24. Some rigid plastic pipe must not be exposed to freezing temperatures.

T F 25. All plastic pipe can be used to carry liquids for human consumption.

T F 26. Copper pipe and tubing has some of the same advantages as plastic pipe over steel or iron pipe.

T F 27. Fibre soil pipe is joined with threads and couplings or "O" rings.

T F 28. Streel elbows have an inside thread on both ends of the bend or elbow.

T F 29. A side outlet elbow is the same shape as a tee with three outlets.

T F 30. A side outlet cross has five threaded openings.

T F 31. Copper pipe fittings always have at least one end which is smooth so they can be soldered.

T F 32. Soil pipe fittings are the same basic patterns whether for use with plastic or cast iron pipe.

T F 33. An angle valve and a globe valve are built with the same inside construction and design.

T F 34. Check valves are so installed that the ball or clapper will fall shut by gravity.

T F 35. Flush valves use less water than flush tanks.

T F 36. Common mixing faucets can always be depended upon to mix cold and hot water to a uniform temperature.

T F 37. In frost free hydrants the valve is located in the head under the handle.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. Plumbing tools fall into two groups: those which (a) __________ the parts for the job and those which (b) __________ the parts.

2. Pipes are joined by __________, __________ and __________ and __________ or __________.

3. Regular pipe wrenches are offered in sizes from ______ to ______ in length.

4. A "hex" pipe wrench may be used on ______ sided or ______ sided fittings.

5. A strap wrench is the preferred type for use on __________ pipe or tubing and on pipe made from __________, __________ and __________.

6. The two types of pipe reamers are the __________ and the __________.

7. Pipe reamers can be used to __________ __________ from pipe and __________ __________ __________ __________ __________.

8. Steel pipe may be cut with a __________ but a straight, clean cut is difficult.

9. The tool used to thread pipe is called either a __________ __________ or a __________ __________.

10. The two types of pipe vises are __________ and __________.

11. The most common plumbing problem is __________ __________.

12. To prevent premature faucet washer failure, scored or pitted faucet seats must be __________.

13. Two causes of broken pipes are __________, and __________ __________ or __________.

14. Beveled slip joint washers or cone washers should have a brass __________ __________ under them.

15. Sink frames are made from two types of material: __________ __________ and __________.

16. Because plastic pipe is easily cut and scarred ____________ wrenches must be used when installing.

17. Plastic pipe is about ________ the weight of iron pipe.

18. Copper tubing or pipe is commonly sold in sizes from ________ to ________ for plumbing use.

19. Soil pipe is made in both __________ and ____________ _______________ types.

20. Unions with ____________ ____________ seats are used primarily where high steam pressures are encountered.

21. Insert type plastic fittings use a _____________ _____________ to hold the plastic pipe in place.

22. ____________ valves and ____________ or ____________ valves both allow unobstructed water flow especially for low pressure applications.

23. Flush valves should generally be installed only on pipe of ________ or larger diameter.

24. Flush valves should only be sold where _____________ _______________ in g.p.m. and the pressure is adequate.

25. Automatic mixing valves are used mostly for ______________ .

Multiple-Choice

Directions: In the space at the left of each statement, write the letter of the item which will provide the correct answer to complete the statement.

_____ 1. The chief advantage of an end pipe wrench is the ability to (A) stand great strain for disassembling pipes; (B) stand stillson pattern; (C) ability to work in close quarters; (D) ability to fit a wider range of pipe sizes.

_____ 2. Recent trends in bath accessories have not included (A) gift sets of multiple items; (B) self-service displays; (C) pre-packaging of individually carded items; (D) display panels with accessories permanently attached; (E) development of unique items such as ash trays, etc.

_____ 3. Floor flanges are used when (A) fastening a pipe structure to the wall or floor; (B) making a neat joint of pipes which enter the floor; (C) joining lengths of pipe which go through a wall; (D) flanging pipe at a union.

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. Fittings into which threaded pipe may be screwed are:

   (A) ____________________ (D) ____________________
   (B) ____________________ (E) ____________________
   (C) ____________________

2. Give the full name and the initials for the three common types of pipe threads.

   (A) ____
   (B) ____
   ____
   (C) ____
   ____

3. The more common types of sink frames are the:

   (A) ____________________ (C) ____________________
   (B) ____________________

4. Pipes used by the homeowner fall into the following broad categories:

   (A) ____________________ (C) ____________________
   (B) ____________________ (D) ____________________

5. List the three types of flush valves.

   (A) ____________________ (C) ____________________
   (B) ____________________

Assignment
Sheet No. 23

Covering
Units 152-154

PLUMBING, HEATING AND BUILDING MATERIALS -- PART II

This section of Study Unit 16 covers chapters IV, V, VI and VII and will seek to acquaint you with building materials, floor and wall coverings, heating equipment and other miscellaneous supplies.

Whenever you are selling items in these areas the changes for related sales are particularly good. You must learn to always be watchful for an appropriate opportunity to suggest items of this sort and demonstrate or at least discuss their benefits.

The do-it-yourself movement has created great demand for aluminum products and supplies related to covering floors, walls, counter tops and bathroom areas.

This assignment sheet attempts to cover this important area of hardware supplies and materials.

Assignment:

1. Read the reference listed below.
2. Collect information from the various floor covering manufacturers concerning the tile and adhesives appropriate for specific applications.
3. Answer the questions below and turn in this assignment by ____________________.

Reference:

A. ACHR, Hardware, Unit 16, pp. 34-68.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. The word sash when referring to wood products means a single unit with any configuration or pattern of movement.

T F 2. The sash used in home construction are 1¼" thick.

T F 3. When sash is "glazed" the choice of glass is usually left up to the purchaser.

T F 4. Awning windows and jalousie windows both pivot open to admit ventilating air.

T F 5. Asphalt roofing is simply cellulose fibres saturated with asphalt.

T F 6. "Roll roofing" and "saturated felt" are different names for the same product.

T F 7. Hip roofs require 15% more material because of waste.

T F 8. An entirely different procedure <u>must</u> be followed when estimating roof area for roofing materials than when estimating for painting.

T F 9. Reducing house cleaning is an important advantage in insulating.

T F 10. Cement which contains hard lumps is all right to use if the lumps are removed.

T F 11. Aluminum requires special finishing techniques and materials if painting is necessary.

T F 12. Home workshop aluminum has been especially tempered for easy workability.

T F 13. All the common woodworking tools can be used on the do-it-yourself aluminum materials.

T F 14. Aluminum nuts, bolts and screws are only plated so they must be handled carefully to avoid damaging the plating and causing corrosion after short exposure to the weather.

T F 15. Linoleum may be installed on concrete which is in contact with the ground.

T F 16. Plastic flooring may be installed on any type of suspended floor.

T F 17. "Tile" flooring refers only to the shape of the section not the material.

T F 18. Asphalt tile was developed for use on concrete floors the dampness and alkali from the cement were problems

T F 19. Most types of floor tile are sold in 9 x 12 squares.

T F 20. Cork tile is the least resilient of all flooring materials.

T F 21. Cork tile is unaffected by oils, fats and greases.

T F 22. "Felt base" floor coverings with printed enamel surface patterns are low in cost and suited for people who do not want a permanent installation.

T F 23. High pressure plastic laminates are used for floor coverings in high traffic areas.

T F 24. A feature of many new tiles and floor coverings is that they can be installed over rough and worn floors after proper cleaning so the adhesive will stick.

T F 25. The seasonal expansion of floor boards can crack linoleum or sheet flooring.

T F 26. The same adhesive may be used to install both rubber tile and vinyl tile.

T F 27. Some adhesives will stain the tile with which they are used if excess is spilled on the surface.

T F 28. The unvented gas circulating heater cannot be equipped with automatic controls.

T F 29. Some models of the electric heaters can be equipped with automatic thermostat and controls.

T F 30. Portable room heaters are often sold to heat an area not covered by a home's normal heating system.

T F 31. Fibre glass insulation material can be sold for sound control in hi-fi equipment.

T F 32. Furnace filters (renewable) are usually replaced at least once during the year.

T F 33. Related merchandise should be grouped in one area of the store.

T F 34. Door mats can be sold for use wherever floor wear is heavy.

T F 35. The primary function of metal mouldings is that of decoration.

T F 36. Metal mouldings which are installed before the panel of material is put into place do not hide the fastening method from view.

T F 37. Stainless steel mouldings are more popular than aluminum.

T F 38. Counter edgings may be applied with drive screws.

T F 39. Angle strips cannot be bent; they must be mitered for a corner.

T F 40. Cap sections are usually of the under-applied type.

T F 41 Some inside corner and cove mouldings are the same shape.

T F 42. Aluminum door saddles are used primarily for inside areas where traffic is not a factor.

T F 43. The door must usually be cut to get the proper clearance over an aluminum saddle.

T F 44. Cushion type weather strip comes in rolls and is cut to length as needed.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. When estimating the amount of plywood needed to cover a large area ________ per cent should be added for scrap.

2. Unit type windows may be made from ______________, ______________ or ______________.

3. For a roof with a slope of ________ to 1" or more, 16" or 18" cedar shingles may be used if they are installed with the correct exposure.

4. Only the number ________ grade of cedar shingles is recommended for the roofing of permanent buildings.

5. All roof coverings except those made from ______________ are packaged to cover 100 square feet of surface per package.

6. Aluminum bar stock and shapes for do-it-yourself work come in either ________ or ________ foot lengths.

7. Linoleum consists of a "mix" bonded to a ______________ or ______________ backing.

8. Tiles (floor) are sold in ________ or ________ thickness or gauges.

9. Linotile and rubber tile are both sold in ________ x ________ oblongs and ________, ________ and ________ squares.

10. Tiled granulated cork wall coverings come in sizes of ________, ________ and ________.

11. When determining the size of a heater the ______________ ______________ must always be known.

12. Fibre glass batts can be cut with ______________, ______________ ______________ or a ______________.

13. Fibre glass insulation comes in rolls ________ feet long and ________ inches wide.

14. The adequacy of an attic fan will depend upon two factors: (1) the ______________ of the house and (2) the ______________ of desired air changes per minute.

15. The cost of ______________ and the ______________ cost are the two largest factors when considering a fan type cooling system.

16. The two types of metal mouldings are the ______________ type and the under-applied type.

17. Moldings are fastened with either __________ __________ or __________ __________ screws.

18. Caps sections are made with openings for material of ______, ______ and ______ thickness.

19. __________ __________ channel is made so that no fasteners are required to hold it in place on the counter edge or sink top.

20. Spring type metal weather strip is sold in rolls ______ feet in length.

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. List the kinds of materials normally sold through a hardware store for roofing purposes.

(A) ____________________ (C) ____________________

(B) ____________________ (D) ____________________

2. The five general types of insulation materials are:

(A) ____________________ (D) ____________________

(B) ____________________ (E) ____________________

(C) ____________________

3. The four types of dry pre-mixed cement or lime products are:

(A) ____________________ (C) ____________________

(B) ____________________ (D) ____________________

4. The three types of Portland Cement are:

(A) ____________________ (C) ____________________

(B) ____________________

5. List the materials used in an aluminum screen.

(A) ____________________ (C) ____________________

(B) ____________________ (D) ____________________

6. The different types of linoleum which are available are:

(A) ______________________ (D) ______________________

(B) ______________________ (E) ______________________

(C) ______________________ (F) ______________________

7. The tools required for properly installing tile could include the following:

(A) ______________________ (E) ______________________

(B) ______________________ (F) ______________________

(C) ______________________ (G) ______________________

(D) ______________________ (H) ______________________

8. Gas heaters are divided into four categories.

(A) ______________________ (C) ______________________

(B) ______________________ (D) ______________________

TRAINING PLAN AND PROGRESS RECORD
FOR
HARDWARE RETAILING

Student's Copy

JOB TRAINING: What the Worker Should Be Able to Do	Proficiency Shown	RELATED INFORMATION: What the Worker Should Know
	Techniques of Selling	
Greet customer; demonstrate merchandise; quote prices and sell hardware Time in hours ______	☒	Planning sales presentation; characteristics of a good demonstration; improving your sales personality; importance of related selling
	Store Management and Record Keeping	
Write sales and charge tickets; inventory stock; make out daily balance report form; order merchandise and price hardware items Time in hours _____	☒	Types of records; information required for payroll; meaning of margin and mark-up; reduction of expenses; function of management
	Merchandising	
Make window and interior displays; stock various departments and islands; dust stock and shelves and clean and care for store floors Time in hours _____	☒	Types of hardware merchandising; importance of displays and principles of their construction; principles of sales floor layout and types of fixtures; proper use of color and lighting
	Promotion and Advertising	
Prepare an advertising budget and plan a special promotion sale; plan a newspaper and radio advertisement; make posters and handbill layouts Time in hours _____	☒	Importance of advertising; methods of planning and budgeting advertising; methods and types of advertising; how to measure the effectiveness of an advertising campaign
	Tools and Hardware	
Demonstrate; display and sell merchandise from the hardware, handtool, power tool; and lawn, garden and farm tool departments Time in hours _____	☒	Product information; display and demonstration techniques; customer needs related to various kinds of tools and various sales tips

Sporting Goods and Recreational Equipment

Demonstrate; display and sell merchandise from the sporting goods and recreational equipment departments	☒	Kinds of materials; types of customer needs; and display techniques of value in selling sporting goods and recreational equipment

Time in hours ______

Paint and Electrical Departments

Display and sell merchandise from paint and electrical fixtures and supplies departments	☒	Product information and techniques of displaying and selling paint and paint sundries and electrical fixtures and supplies

Time in hours ______

Housewares and Cleaning Supplies

Demonstrate; display; advertise and sell housewares and cleaning and laundry supplies	☒	Product information and techniques of displaying and selling housewares and cleaning supplies

Time in hours ______

Plumbing, Heating and Building Materials

Display and sell plumbing, heating and building materials	☒	Kinds and types of plumbing, heating and building materials; techniques of displaying and selling them

Time in hours ______

Code for employer's use in marking student's progress

Performed some operations in area	☒	Performed some operations with reasonable proficiency	☒
Performed most operations in area	☒	Performed most operations satisfactorily	☒

TRAINING PLAN AND PROGRESS RECORD
FOR
HARDWARE RETAILING

Employer's Copy

JOB TRAINING: What the Worker Should Be Able to Do	Proficiency Shown	RELATED INFORMATION: What the Worker Should Know
Techniques of Selling		
Greet customer; demonstrate merchandise; quote prices and sell hardware Time in hours _____	☒	Planning sales presentation; characteristics of a good demonstration; improving your sales personality; importance of related selling
Store Management and Record Keeping		
Write sales and charge tickets; inventory stock; make out daily balance report form; order merchandise and price hardware items Time in hours _____	☒	Types of records; information required for payroll; meaning of margin and mark-up; reduction of expenses; function of management
Merchandising		
Make window and interior displays; stock various departments and islands; dust stock and shelves and clean and care for store floors Time in hours _____	☒	Types of hardware merchandising; importance of displays and principles of their construction; principles of sales floor layout and types of fixtures; proper use of color and lighting
Promotion and Advertising		
Prepare an advertising budget and plan a special promotion sale; plan a newspaper and radio advertisement; make posters and handbill layouts Time in hours _____	☒	Importance of advertising; methods of planning and budgeting advertising; methods and types of advertising; how to measure the effectiveness of an advertising campaign
Tools and Hardware		
Demonstrate; display and sell merchandise from the hardware, handtool, power tool; and lawn, garden and farm tool departments Time in hours _____	☒	Product information; display and demonstration techniques; customer needs related to various kinds of tools and various sales tips

Sporting Goods and Recreational Equipment

Demonstrate; display and sell merchandise from the sporting goods and recreational equipment departments Time in hours ______	☒	Kinds of materials; types of customer needs; and display techniques of value in selling sporting goods and recreational equipment

Paint and Electrical Departments

Display and sell merchandise from paint and electrical fixtures and supplies departments Time in hours ______	☒	Product information and techniques of displaying and selling paint and paint sundries and electrical fixtures and supplies

Housewares and Cleaning Supplies

Demonstrate; display; advertise and sell housewares and cleaning and laundry supplies Time in hours ______	☒	Product information and techniques of displaying and selling housewares and cleaning supplies

Plumbing, Heating and Building Materials

Display and sell plumbing, heating and building materials Time in hours ______	☒	Kinds and types of plumbing, heating and building materials; techniques of displaying and selling them

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Code for employer's use in marking student's progress

Performed some operations in area	☒	Performed some operations with reasonable proficiency	☒
Performed most operations in area	☒	Performed most operations satisfactorily	☒

Sporting Goods and Recreational Equipment

Demonstrate; display and sell merchandise from the sporting goods and recreational equipment departments	☒	Kinds of materials; types of customer needs; and display techniques of value in selling sporting goods and recreational equipment

Time in hours ______

Paint and Electrical Departments

Display and sell merchandise from paint and electrical fixtures and supplies departments	☒	Product information and techniques of displaying and selling paint and paint sundries and electrical fixtures and supplies

Time in hours ______

Housewares and Cleaning Supplies

Demonstrate; display; advertise and sell housewares and cleaning and laundry supplies	☒	Product information and techniques of displaying and selling housewares and cleaning supplies

Time in hours ______

Plumbing, Heating and Building Materials

Display and sell plumbing, heating and building materials	☒	Kinds and types of plumbing, heating and building materials; techniques of displaying and selling them

Time in hours ______

Code for employer's use in marking student's progress

Performed some operations in area	☒	Performed some operations with reasonable proficiency	☒
Performed most operations in area	☒	Performed most operations satisfactorily	☒

TRAINING PLAN AND PROGRESS RECORD
FOR
HARDWARE RETAILING

JOB TRAINING: What the Worker Should Be Able to Do	Proficiency Shown	RELATED INFORMATION: What the Worker Should Know
	Techniques of Selling	
Greet customer; demonstrate merchandise; quote prices and sell hardware Time in hours _____	☒	Planning sales presentation; characteristics of a good demonstration; improving your sales personality; importance of related selling
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Make window and interior displays; stock various departments and islands; dust stock and shelves and clean and care for store floors Time in hours _____	☒	Types of hardware merchandising; importance of displays and principles of their construction; principles of sales floor layout and types of fixtures; proper use of color and lighting
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Prepare an advertising budget and plan a special promotion sale; plan a newspaper and radio advertisement; make posters and handbill layouts Time in hours _____	☒	Importance of advertising; methods of planning and budgeting advertising; methods and types of advertising; how to measure the effectiveness of an advertising campaign
	Tools and Hardware	
Demonstrate; display and sell merchandise from the hardware, handtool, power tool; and lawn, garden and farm tool departments Time in hours _____	☒	Product information; display and demonstration techniques; customer needs related to various kinds of tools and various sales tips

VT002 072

VT 002 072

Cabinetmaking, A Course of Study Designed for Cooperative Part-Time Students Employed in Cabinetmaking Trades.

Kirby, Jack * Robinson, Orin
Missouri Univ., Columbia. Dept. of Industrial Education
Missouri State Dept. of Education, Jefferson City

Pub Date - Jan65
MF AVAILABLE IN VT-ERIC SET 166p.

*STUDY GUIDES, *TRADE AND INDUSTRIAL EDUCATION, *CABINETMAKERS, *CABINETMAKING, GRADE 11, GRADE 12, *COOPERATIVE EDUCATION,

This study guide is for use by preparatory or cooperative students at the secondary or post-secondary level. It was developed by teacher educators and research assistants with help from a consultant committee. Unit titles are (1) The Cabinetmaker and His Work, (2) Selection, Use, and Care of Hand Tools, (3) Selection, Use, and Care of Basic Power Equipment, (4) Specialized Cabinetmaking Equipment, (5) Safety for the Cabinetmaker, (6) Tool Sharpening, (7) Reading Drawings and Planning the Work, (8) Estimating Material and Calculating Costs, (9) Lumber and Lumber Processing, (10) Plywood, Veneers, and Special Materials, (11) Framing Square and Geometric Layout, (12) Wood Joinery, (13) Construction of Cabinets and Built-Ins, (14) Construction of Cabinet Parts and Special Features, (15) Furniture Manufacturing, (16) Finishing Procedures, (17) Doors, Windows, and Sash Construction, (18) Sash, Trim, and Frames, (19) Fasteners and Hardware, (20) Adhesives, (21) Furniture Restoration and Refinishing, and (22) The Small Woodworking Enterprise. Assignment sheets for each unit include the assignment, references, and objective-type questions. Supplementary materials include a job analysis and a progress record. Students should be at least high school juniors, and the teacher should be a qualified coordinator or trade teacher in this 180-day course. An answer key (VT 002 073) is available for 50 cents. This document is available for $1.50 from Industrial Education, 103 Industrial Education Building, University of Missouri, Columbia, Missouri 65201. (EM)

CABINETMAKING

A Course of Study

~~Incorporated in the Course of Study~~
Designed for
Cooperative Part-time Students
Employed in Cabinetmaking Trades

Issued by

Department of Industrial Education
College of Education
University of Missouri
Columbia, Missouri

In Cooperation with

Industrial Education Section
State Department of Education
Jefferson City, Missouri

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MEMORANDUM

TO: The ERIC Clearinghouse on Vocational and Technical Education
The Ohio State University
980 Kinnear Road
Columbus, Ohio 43212

FROM: (Person) James B. Karnes (Agency) University of Missouri at Columbi

(Address) 103 Industrial Education Bldg., Columbia, Missouri

DATE: December 6, 1967

RE: (Author, Title, Publisher, Date) Industrial Education Dept.

CABINETMAKING, cooperatively with Industrial Education Dept.

(U. of Mo. at Columbia) and Missouri Dept. of Education

Supplementary Information on Instructional Material

Provide information below which is not included in the publication. Mark N/A in each blank for which information is not available or not applicable. Mark P when information is included in the publication. See reverse side for further instructions.

(1) Source of Available Copies:
Agency Industrial Education Dept., Univ. of Mo. at Columbia
Address 103 Industrial Education Bldg.
Limitation on Available Copies quantity Price/Unit $1.50
(quantity prices) same
Teacher's Key $.50

(2) Means Used to Develop Material:
Development Group Consultant Committee, teacher educators, research assistant
Level of Group State
Method of Design, Testing, and Trial Analysis of occupation, consultation with specialists, periodic revisions after use in the field

(3) Utilization of Material:
Appropriate School Setting High school or post high school incuding area vocational
Type of Program cooperative or preparatory
Occupational Focus Limited job family
Geographic Adaptability United States
Uses of Material Study Guide for related instruction on individual basis
Users of Material student

(4) Requirements for Using Material:
Teacher Competency Qualified coordinator or competent trade teacher
Student Selection Criteria junior in high school with proper prerequisites
Time Allotment 180 days

Supplemental Media --
Necessary x)
Desirable) (Check Which)

Describe p

Source (agency) see attached list for references
(address)

REFERENCES FOR CABINETMAKING

A. Feirer, John L., Woodworking For Industry, Chas. A. Bennett Co., 237 N. E. Monroe Street, Peoria, Illinois 61602, 1963, $6.80* (19)**

B. Dahl, Alf and J. Douglas Wilson, Cabinetmaking and Millwork, American Technical Society, 848 E. 58th Street, Chicago, Illinois 60637, 1956, $6.50* (18)**

C. Towers, Whitney K., Cabinetmaker's Manual For Amateurs and Professionals, The Home Craftsman Publishing Corporation, Rock Island, Illinois, 1957, $6.95* (15)**

D. Seigele, H. H., Cabinets and Built-Ins, Frederick J. Drake and Co., 9 South Clinton Street, Chicago 6, Illinois, 1961, $2.50* (2)**

* Subject to educational discount
** Frequency of use in assignments

ADDENDUM

CABINETMAKING Study Guide

Please note the above reference C, CABINETMAKER'S MANUAL FOR AMATEURS AND PROFESSIONALS, is no longer available from The Home Craftsman Publishing Corp. It should be ordered from:

Woodworker's Digest
Bench Crafts
2718 W. Indian School Road
Phoenix, Arizona 85017.

FOREWORD

This course of study, consisting of an analysis of CABINETMAKING, together with assignment sheets covering the related (occupational) information to be taught by the school, has been prepared for teaching cabinetmaking on an individual basis in cooperative part-time programs.

The original analysis was prepared by Mr. Robert C. Rosenquist, formerly of Illmo-Fornfelt High School, Illmo, Missouri and the original assignment sheets were prepared by Dr. Merlin H. Kleinbach, formerly Research Assistant in Industrial Education at the University of Missouri.

Special credit is due to Mr. Jack Kirby and Mr. Orin Robinson, Research Assistants in Industrial Education at the University of Missouri, who prepared the present revision.

We wish to acknowledge our indebtedness to Dr. H. H. London, Professor of Industrial Education, University of Missouri, for the direction and administration of the Curriculum Materials Laboratory in which this material was prepared, and to Mr. James B. Karnes, Instructor in Industrial Education, University of Missouri, who supervised the preparation of this manual and edited the manuscript. Credit is due Mr. B. W. Robinson, Assistant Commissioner of Education, Mr. Merton Wheeler, Director of Industrial Education, and to other staff members of the State Department of Education for their efforts in the development of the Industrial Education Curriculum Series of which this course of study is a part.

HUBERT WHEELER

Commissioner of Education

January, 1965
500

TABLE OF CONTENTS

Assignment Sheets:

INTRODUCTION

In preparing this course of study, it has been assumed that the attainment of occupational competency in any type of work involves three different, yet closely related, types of learning. They are:

1. Mastery of the practical job skills and procedures performed by the worker in the occupation.

2. Comprehension of the technical and related information basic to an intelligent understanding and practice of the occupation.

3. Development of those personal-social traits which are essential for the successful worker.

The first group of the "learning units"--the job skills and procedures--has been arranged in the analysis under the heading of "Job Training." The second group of learning units--the technical and related information--has been arranged under the heading of "Related Information." And the third group--the personal-social traits--has been listed under "Personal Qualifications of the Cabinetmaker" in the introductory section addressed to the student.

In a cooperative educational program it is necessary for both cooperating agencies--the school and the employer--to understand clearly just what each is to be responsible for in the training of the student-worker. Experience has shown that most of the practical job skills and procedures of an occupation can best be learned through supervised work on the job. Experience has shown also that the school can best teach most of the technical and related occupational information needed by young student-workers. This division of responsibility has been made in the arrangement of the course of study; that is, it is expected that the student-worker will master the job skills and procedures through practical work on the job under the immediate supervision of the employer, and that he will receive instruction in related occupational information in the school under the direction of the coordinator.

Skills and related information are matters for direct instruction, but personal-social traits are acquired only through practicing them during the process of acquiring skills and information and in one's daily conduct. Therefore, both the employer and the school, as well as the home, must assume responsibility for developing in the student-worker those habits, attitudes and character traits which are essential for success in his occupation and in life. Both the employer and the school should be constantly on the alert to see that the student-worker places desirable interpretations on his experiences and that he does not practice habits and exhibit character traits detrimental to his success.

Since the coordinator's class will be made up of fifteen or more students, each differing from the other significantly, studying a dozen or more occupations which differ markedly in their requirements, it follows that it will be impossible for him to teach, through the group method, the occupational information which relates to the specific job of each student-worker. In order to be effective, this type of instruction must be individualized. There is, of course, some related information, such as occupational health and safety, workmen's compensation, wage-hour laws, fair labor standards, unemployment compensation, and the like, which is of common interest and concern to all student-workers, and may be effectively taught by the group method. But if the coordinator is to make a real contribution to the in-service vocational education of his students, he must devote a major portion of his classroom instruction to content which deals specifically with the work of each boy and girl enrolled.

With this requirement in mind, and in order to facilitate individual instruction, these assignment sheets have been prepared. Each contains certain record data as to number and range of units covered, introductory paragraphs designed to develop interest, explain the importance of the assignment, and to convey to the student what he is expected to learn, specific assignments including reading, learning activities and a series of new-type questions designed to check his attainment.

Obviously, it is desirable to teach the related information in the school at the time it will be used most advantageously on the job. This means that the two phases of the student-worker-s training should parallel each other in a progressive manner. The coordinator will find the assignment sheets well adapted to this end. He can select from day to day the assignment which covers the informational units related to the work being done on the job. With this arrangement, the coordinator will become, during a major portion of his classroom time, a supervising study and helping teacher.

In selecting books for the course, an effort has been made to restrict the number to an adequate coverage of the material, and to select those of recent publication so that current practices can be consistently presented. It is recommended that copies of these books be secured and kept in the coordinator's classroom for ready use by the student.

The key sheets available in a separate manual, have been prepared to enable the coordinator to score quickly the objectives tests which are a part of each assignment sheet. These key sheets give the correct answers to the questions, as well as the reference and the page on which each answer can be found. The key sheets should be kept in the coordinator's possession.

TO THE STUDENT WORKER

Cabinetmaking is one of the most highly skilled of the woodworking trades. The cabinetmaker has been called "the aristocrat of the carpenters." The finished work of the cabinetmaker is subject to much closer inspection by the purchaser than is the work of others in the field of woodworking. The cabinetmaker works with the finer hardwoods and fits them together with close accuracy and attention to details of grain and color.

The term cabinetmaker originally meant one who could produce a finished article from plans to the completed product without the assistance or the skills of any other person. The term has come to mean any person who performs any one of the operations of the processing of wooden cabinets, furniture or other specialty items.

With the increase in specialization in all phases of industry today, the individual with the greatest amount of training in an occupation is the one most likely to be hired and promoted on a particular job. With this in mind, the youth who desire to enter the cabinetmaking field will find it advisable to be well prepared for entrance into that field.

Opportunities in Cabinetmaking

The cabinetmaker has the opportunity to work with both hand tools and power equipment to produce articles of beauty and function. His work, though comparatively specialized, covers a relatively wide range of activity. The nature of the work of a cabinetmaker places him indoors much of the time so that he is not exposed to the elements as other building trades workers are.

The wages of the skilled cabinetmaker are in general among the highest in the building trades. It is not unusual for a cabinetmaker to earn over $4.00 an hour. The work-week is usually forty hours, with time-and-a-half paid for any time worked beyond a standard workday of eight hours. Building trades workers are ordinarily included in health and insurance programs paid for primarily by the employer. Some have the benefit of pension plans.

Requirements for Cabinetmaking

A broad general education on the high school level will aid the individual who has entered cabinetmaking on a part-time basis. His course work should have included such subjects as industrial arts drafting and blueprint reading, woodwork, mathematics applicable to layout work, general science or elementary physics. He may, if possible, take a preparatory course in vocational cabinetmaking and enter on the job training as a more advanced learner.

An apprentice cabinetmaker must be between 16 (and in some cases 17) and 24 years of age. The training usually extends over a four-year period and covers the use of tools, materials and machines used in the trade, instruction in drafting and blueprint reading, mathematics, standards of construction and design, as well as standards for wood and other materials. This type of training enables one to become a journeyman cabinetmaker. Although the standards for these requirements are high they may be expected to increase in view of the technological developments which have and are continuing to take place.

Personal Qualifications of the Cabinetmaker

More and more, men who are seeking jobs or wanting to go into business for themselves need good personal qualifications. Holding a job is also largely dependent upon one's personality. Satisfaction on the job will be determined by the willingness, respect and cooperative attitude that one has toward his job and his fellow workers.

With a conscientious effort, one can improve his personal-social traits. In order to do this, one must know what to improve, how to improve, and why improvement is necessary.

Among the personal-social traits of chief importance to the cabinetmaker are the following:

Good Health. The cabinetmaker must have a healthy physical make-up with abundant energy, muscular coordination, mechanical dexterity, good eyesight, and steady nerves.

Industry. This character trait means a habit of careful, thoughtful energetic attack upon the job without loitering or wasting time.

Cooperation. Cabinetmaking requires a willingness to work cooperatively with fellow workers. This means an attitude of readiness to assist others when they need help, and to join in group undertakings.

Personal Appearance. Clothing should be worn that affords safety and efficiency on the job and makes a pleasing impression upon the people he serves.

Consideration of Others. A thoughtful attitude toward making things easy and pleasant for others, such as keeping things in order, putting tools away, and doing his full share of work is an important trait for a cabinetmaker to possess.

Initiative. The ability to see what needs to be done and to go ahead without constant supervision is an essential trait of a cabinetmaker.

Patience. Much of the work of the cabinetmaker is with small parts and involves delicate manipulation, and it requires patience as well as skill to do the things necessary to complete a product.

Alertness. The ability to pay close attention, to respond quickly and to concentrate on one's work.

Self-Control. Maintain a pleasant disposition and keep your temper under control.

Courtesy. Respect the other person's point of view, his interests, and wants. This may require effort at times, but it will pay off.

Readiness to Assume Responsibility. This means that you should not refuse to undertake a task because it is difficult and when once undertaken you should carry it through to completion.

REFERENCES FOR CABINETMAKING

A. Feirer, John L., Woodworking For Industry, Chas. A. Bennett Co., 237 N. E. Monroe Street, Peoria, Illinois 61602, 1963, $6.80* (19)**

B. Dahl, Alf and J. Douglas Wilson, Cabinetmaking and Millwork, American Technical Society, 848 E. 58th Street, Chicago, Illinois 60637, 1956, $6.50* (18)**

C. Towers, Whitney K., Cabinetmaker's Manual For Amateurs and Professionals, The Home Craftsman Publishing Corporation, Rock Island, Illinois, 1957, $6.95* (15)**

D. Seigele, H. H., Cabinets and Built-Ins, Frederick J. Drake and Co., 9 South Clinton Street, Chicago 6, Illinois, 1961, $2.50* (2)**

* Subject to educational discount
** Frequency of use in assignments

ANALYSIS OF CABINETMAKING

JOB TRAINING: What the Worker Should Be Able To Do	Assign. No.	RELATED INFORMATION: What the Worker Should Know
<u>Introduction to Cabinetmaking</u>		
	1	1. Work of the cabinetmaker
	1	2. Branches of cabinetmaking
	1	3. Classifications of work in cabinetmaking
	1	4. General requirements for cabinetmaking industry
	1	5. Working conditions in the cabinetmaking industry
	1	6. Names and characteristics of period furniture
<u>Hand Tools</u>		
<u>Measuring and Layout Tools</u>		
7. Measure and divide spaces with rule	2	7. Kinds and types of measuring and marking tools
8. Lay out square cuts with square	2	8. Type of work for which layout tools are designed
9. Read and check measurements with square		
10. Lay out parallel lines with marking gauge		
11. Mark duplicate parts with a square		
12. Divide spaces with divider		
13. Scribe circles with compass		
14. Lay out angles with sliding T-bevel		
15. Gauge with pencil		
16. Mark centers		
17. Measure inside and outside diameters with calipers		
18. Draw circles of large diameter with trammel		
19. Establish horizontal lines with spirit level		

JOB TRAINING: What the Worker Should Be Able To Do	Assign. No.	RELATED INFORMATION: What the Worker Should Know
20. Establish vertical lines with plumb bob		
<u>Saws</u>		
21. Rip to line	2	21. Kinds and types of saws
22. Crosscut to line	2	22. Sizes of saws
23. Saw to line with back saw.		
24. Cut miters		
25. Saw inside and outside curves		
26. Sharpen saw	2	26. Types and purposes of oil and emery stones
<u>Planes and Scrapers</u>		
27. Plane surface	2	27. Common wood planes and their uses
28. Plane edge grain		
29. Plane end grain		
30. Adjust plane		
31. Sharpen plane iron		
32. Plane curved edge		
33. Cut chamfer or bevel		
34. Sharpen scraper blade	2	34. Types of scrapers and their uses
<u>Drills</u>		
35. Bore holes in wood	2	35. Types and sizes of drills and boring tools
36. Countersink holes in wood		
37. Sharpen drill and auger bits		
<u>Shaping and Forming Tools</u>		
38. Trim or pare with chisel	2	38. Types and sizes of shaping and forming tools
39. Do gouge work		
40. Rough out curves with draw knife		
41. File curved edge		
42. Sharpen chisel		
<u>Fastening Tools</u>		
43. Drive and draw nails	2	43. Kinds and types of assembling tools

JOB TRAINING: What the Worker Should Be Able to Do	Assign. No.	RELATED INFORMATION: What the Worker Should Know
44. Set nail or brad		
45. Select and drive screws	2	45. Kinds and types of sharpening tools
46. Clamp stock for gluing		
47. Dress screwdriver		

Power Equipment and Safety Rules

Circular Saw

48. Adjust circular saw	3	48. Types and sizes of saws
49. Make finger board for ripping on circular saw	3	49. Range of work which can be done on saws
50. Rip stock to width		
51. Cut stock to length		
52. Cut coves on circular saw		
53. Taper rip on circular saw		
54. Change saw blades		
55. Sharpen, set and gum circular saw blade	5	55. Rules for safe operation of a circular saw

Band Saw

56. Adjust band saw	3	56. Types and sizes of band saws
57. Make circle cutting jigs for the band saw	3	57. Range of work which can be done on a band saw
58. Saw curves	5	58. Rules for safe operation of a band saw
59. Rip stock		
60. Cut off stock		
61. Resaw stock		
62. Make patterns for cutting duplicate parts		
63. Repair broken blades		
64. Sharpen and set blades		

Jig Saw

65. Adjust jig saw	3	65. Types and sizes of jig saws
66. Saw inside curves	3	66. Range of work which can be done on a jig saw
67. Saw outside curves	5	67. Rules of safe operation of a jig saw
68. File with jig saw		
69. Sand with jig saw		

JOB TRAINING What the Worker Should Be Able to Do	Assign. No.	RELATED INFORMATION: What the Worker Should Know
Jointer		
70. Adjust jointer	3	70. Types and sizes of jointers
71. Joint an edge	3	71. Range of work which can be done on jointers
72. Square stock	5	72. Rules for safe operation of a jointer
73. Cut chamfer or bevel		
74. Surface narrow stock		
75. Cut rabbet		
76. Cut taper		
77. Sharpen and replace jointer knives		
78. Adjust planer	3	78. Range of work which can be done on planers
79. Surface stock to thickness	5	79. Rules for safe operation of a planer
80. Sharpen and replace planer knives		
Drill Press		
81. Adjust drill press	4	81. Types and sizes of drill presses
82. Change drills	4	82. Range of work which can be done on drill presses
83. Drill holes with drill press	5	83. Rules for safe operation of a drill press
84. Make L-shaped and inclined jigs for production drilling		
85. Rout with drill press		
86. Sharpen drill bits		
Shaper		
87. Adjust shaper	4	87. Range of work which can be done on wood shapers
88. Shape straight edges	5	88. Rules for safe operation of a shaper
89. Make guide fences for shaping circular stock		
90. Shape inside and outside curves		
91. Make patterns and set-ups for shaping irregular designs		
92. Change shaper knives		

JOB TRAINING: What the Worker Should Be Able to Do	Assign. No.	RELATED INFORMATION: What the Worker Should Know
Lathe		
93. Adjust and care for lathe	4	93. Types of wood lathes
94. Center stock	4	94. Range of work which can be done on lathes
95. Mount stock on face plate	5	95. Rules for safe operation of a lathe
96. Lay off and turn stock between centers		
97. Sharpen turning tools	6	97. Kinds of materials used for cutting tools
	6	98. Angles at which various cutting tools are sharpened
Sander		
99. Adjust sander	4	99. Types and kinds of sanding equipment
100. Sand flat work	4	100. Range of work which can be done onsanders
101. Make pivot jig for sanding circular stock	5	101. Rules for safe operation of a sander
102. Sand curved work		
103. Change sanding belts or disks		
	4	104. Range of work which can be done on routers
	3	105. Range of work which can be done on radial arm saws
	4	106. Types of portalbe power tools
	4	107. Names and types of the more specialized production machines
	4	108. Range of work which can be done on specialized machines
	4	109. Range of work which can be done with portalbe power equipment
110. Render first aid for injuries	5	110. General safety practices
	6	111. Types and grades of abrasive materials
	6	112. Prevent drawing the temper of a tool

JOB TRAINING: What the Worker Should Be Able to Do	Assign. No.	RELATED INFORMATION: What the Worker Should Know
Reading Drawings and Planning the Work		
113. Draw and sketch plans for cabinetwork items	7	113. Types of drawings
	7	114. Various lines and symbols used in drafting
115. Make blueprints from drawings		
116. Write specifications for the construction and installation of cabinetwork		
Estimating Material and Calculating Costs		
117. Compute board measure of lumber and plywood	8	117. Lengths, widths and thicknesses to which various species of wood are cut
118. Compute cost of lumber	8	118. Various types of records used in connection with the production of orders
119. Make out stock bill		
120. Select and cut stock to rough size for shop order		
121. Tally on tally sheet		
Lumber and Lumber Processing		
122. Recognize and identify different woods	9	122. Characteristics of hardwoods and softwoods
	9	123. Effect of moisture on wood.
124. Identify quarter- and plain-sawed lumber	9	124. Types of cuts used to saw logs into lumber
125. Identify heartwood and sapwood	9	125. How wood is seasoned
	9	126. Defects found in lumber
	9	127. Grading standards for hardwoods and softwoods
	9	128. How knots are formed
	9	129. More important hardwood and softwood lumber trees in the United States
	9	130. Advantages of plain- and quarter-sawed lumber

JOB TRAINING: What the Worker Should Be ABle to Do	Assign. No.	RELATED INFORMATION: What the Worker Should Know
	9	131. Advantages of kiln drying and of air drying lumber
132. Select and order lumber for cabinet work	9	132. Methods by which hardwood lumber is graded
133. Cut stock for most economical use	9	133. Methods by which softwood lumber is graded
	9	134. How modular construction can reduce building costs
	9	135. Types and sizes of standard materials and millwork
	9	136. Terminology and abbreviations used in describing lumber
	9	137. Types and kinds of stock moldings available
	9	138. Associations responsible for lumber grading

Plywood, Veneers, and Special Materials

	10	139. Differences and similarities between veneer and plywood
	10	140. Methods of cutting veneers and plywood
	10	141. Advantages of veneers over solid woods
	10	142. Veneers are matched
	10	143. Advantages of plywood
	10.	144. Types and kinds of manufactured modified wood products

Framing Square and Geometric Layout

	11	145. Mark and lay out parts involving the use of the steel square
146. Determine diagonals of squares and solids with square	11	146. Methods of laying out geometric forms involving the use of the steel square
147. Lay out ellipses and circles with steel square		

JOB TRAINING: What the Worker Should Be Able to Do	Assign. No.	RELATED INFORMATION. What the Worker Should Know
148. Lay out and cut stock with intersecting inclined surfaces		

Wood Joinery

JOB TRAINING: What the Worker Should Be Able to Do	Assign. No.	RELATED INFORMATION. What the Worker Should Know
149. Select, lay out and cut more commonly used wood joints	12	149. Types and kinds of joints
	12	150. Advantages and disadvantages of various types of joints

Construction of Cabinets and Built-Ins

JOB TRAINING: What the Worker Should Be Able to Do	Assign. No.	RELATED INFORMATION. What the Worker Should Know
151. Read specifications for cabinet orders		
152. Make layout on rod	13	152. Correct order of listing dimensions for cabinets and drawers
153. Lay out and construct skeleton frames	13	153. Methods of joinery
154. Lay out and construct face frames	14	154. Function of standard cabinet parts
	14	155. Types of shelf supports
156. Lay out and construct cupboard doors and sash	14	156. Importance of clearance in door and drawer construction
157. Lay out and construct drawers and trays		

Furniture Construction

JOB TRAINING: What the Worker Should Be Able to Do	Assign. No.	RELATED INFORMATION. What the Worker Should Know
	15	158. Work performed by common and special woodworking machines
	15	159. Factors to consider in selecting furniture woods
	15	160. Suitable plywoods for furniture construction
161. Construct an indoor piece of furniture	15	161. Contemporary furniture styles
	15	162. Table designs and the characteristics of each
	15	163. Basic furniture proportions and construction features

JOB TRAINING: What the Worker Should Be Able to Do		Assign. No.	RELATED INFORMATION: What the Worker Should Know	

Finishing Procedures

164.	Sand wood for finishing	16	164.	Types and grades of sandpapers
165.	Prepare surface and fill	16	165.	Kinds of fillers and their application
		16	166.	Types of finishing materials
167.	Apply finish with brush	16	167.	Ways of applying finishes
168.	Apply finish with spray gun			
169.	Clean and store finishing equipment			

Doors, Window and Sash Construction

170.	Lay out and hang single door	17	170.	Names and uses of door parts
171.	Lay out and hang pair of doors	17	171.	Types of construction used for exterior and interior doors
172.	Lay out and hang folding or accordian doors	17	172.	Correct order of listing dimensions for doors
		17	173.	Information necessary when ordering doors
174.	Hand doors and windows	18	174.	Names of parts used in frames
175.	Lay out and construct window frames	18	175.	Classes of frames
176.	Lay out and construct inside and sliding door frames	18	176.	Types and styles of interior and exterior molding
		18.	177.	Standard pitch dimensions of sills
		18	178.	Types and kinds of sash and frame hardware
		18	179.	Principal stock frames constructed

Fasteners and Hardware

180.	Fasten with screws and other threaded fasteners	19	180.	Types and sizes of screws
		19	181.	Finishes available on screws

JOB TRAINING: What the Worker Should Be Able to Do	Assign. No.	RELATED INFORMATION: What the Worker Should Know
182. Cut glass for window and door frame openings	19	182. Types and grades of glass
	19	183. More commonly used types of cabinet hardware
	19	184. Types and sizes of nails and other miscellaneous fasteners

Adhesives

JOB TRAINING: What the Worker Should Be Able to Do	Assign. No.	RELATED INFORMATION: What the Worker Should Know
185. Prepare stock for gluing	20	185. Types and kinds of adhesives
186. Glue and clamp stock	20	186. Range of work which can be glued with various adhesives
	20	187. Working properties and strengths of various adhesives
	20	188. Drying time required for various adhesives

Furniture Restoration

JOB TRAINING: What the Worker Should Be Able to Do	Assign. No.	RELATED INFORMATION: What the Worker Should Know
189. Repair or replace broken and split solid furniture members	21	189. Types of wood used for repair and restoration
190. Flatten blisters and repair breaks in veneers and plywoods	21	190. Effects of heat and moisture in repair work
191. Repair small scars and blemishes with stick shellac		
192. Repair and reglue loose joints	21	192. Importance of removing dirt and old finish before regluing
193. Remove warp from wide boards and panels	21	193. Methods of straightening warped boards
194. Remove old finish	21	194. Materials available to remove old finishes

The Small Woodworking Enterprise

JOB TRAINING: What the Worker Should Be Able to Do	Assign. No.	RELATED INFORMATION: What the Worker Should Know
	22	195. Qualities necessary to be a good businessman
196. Estimate building, expansion and equipment costs	22	196. Costs involved in a cabinetmaking business

JOB TRAINING: What the Worker Should Be Able to Do	Assign. No.	RELATED INFORMATION: What the Worker Should Know
	22	197. Capital needs and financial aspects of a business
	22	198. Importance of location
199. Lay out equipment for job production	22	199. Principles involved in shop layout
200. Lay out equipment for custom production	22	200. Tools and equipment necessary
	22	201. Types of business organization, their advantages and disadvantages
	22	202. Sales and marketing methods
203. Keep records of purchases, sales and accounts	22	203. Records and their importance

Assignment
Sheet No. 1

Covering
Units 1-6

THE CABINETMAKER AND HIS WORK

One of the more attractive occupations open to individuals interested in the woodworking industry is that of the cabinetmaker. Even though mass production methods and specialization of jobs are used extensively, the individual with a broad background of training and experience in the field will always find an outlet for his talents. There is enough variety of work, also, to keep the job interesting.

The occupation requires an individual who can make intelligent use of his ability to use arithmetic. He needs keen vision and a high degree of eye-hand coordination where precision work is concerned. The minimum age limit is usually specified by state and federal requirements but the maximum age of the working cabinetmaker is limited only by a person's physical and mental ability to perform competently on the job.

In this assignment you will have an opportunity to learn the general classifications of the cabinetmaker's work, the divisions of the industry, and the general working situation.

<u>Assignment</u>:

1. Read the references listed below.
2. Answer the questions below and turn in this assignment by ____________________.

<u>References</u>:

A. Feirer, <u>Woodworking For Industry</u>, p. 25.
B. Dahl and Wilson, <u>Cabinetmaking and Millwork</u>, pp. 1-9.
C. Towers, <u>Cabinetmaker's Manual</u>, pp. 11-22.

<u>Questions</u>:

<u>True-False</u>

<u>Directions</u>: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. Cabinets of years ago were quite elaborate and fancy.

T F 2. The work of the cabinetmaker and the millman are very close to being the same.

T F 3. A knowledge of blueprints and the ability to use them is essential to the cabinetmaker.

T F 4. The present trend in cabinetmaking is toward specialization.

T F 5. The items supplied by the millwork plants are generally attached to a building and become a part of it.

T F 6. Unlike other industries, cabinetmaking has not been placed on a mass-production basis.

T F 7. A cabinetmaker needs to be able to perform all of the basic arithmetic processes easily.

T F 8. A knowledge of the various products used in the wood industry is essential for the cabinetmaker.

T F 9. Cabinetmaking is ordinarily a seasonal job, even for the highly skilled worker.

T F 10. A cabinetmaker works only with hand tools.

T F 11. The training and education of the cabinetmaker should be more than just a regular high school education.

T F 12. The outlook for employment in the cabinetmaking field is extremely good.

T F 13. As the requirements grew for a variety of home furnishings, skills evolved which became known as cabinetmaking.

T F 14. Specialized woodworking functions were beginning to emerge in France as early as Fifteen Hundred A.D.

T F 15. Today, the cabinetmaker may build a variety of products, such as, store fixtures, office equipment, and household furnishings.

T F 16. Wood turning is a specialized function in furniture manufacturing.

Completion

Directions: Fill in the blank's) in each statement with the word(s) required to complete the sentence correctly.

1. Woodworkers who specialize in trim work are known as ______________ carpenters.

2. A cabinetmaker, to be successful, must perform his duties with ______________ and ______________.

3. Items such as sash, cabinets, and paneling are all included under the heading of ______________.

4. Display and storage cases, show windows, and paneling are produced in a(an) ______________ plant.

5. The individual who specializes in the set up, maintenance, and the operation of power equipment and the shaping of wood with machines is called the ______________.

6. Planning the sequence of assembly is the job of the ____________.

7. The work of the layout man involves laying out and marking the stock and many times is classified as a __________ ____ job.

8. The minimum age requirements for cabinetmakers is subject to ______________ and ______________ laws.

9. The number of workers in cabinetmaking is about ______________.

10. A cabinetmaking apprenticeship usually takes from __________ to __________ years.

Multiple-Choice

Directions: In the space at the left of each statement, write the letter of the item which will provide the correct answer to complete the statement.

_____ 1. In the more specialized shops the work of the benchman usually involves just (A) layout; (B) assembly; (C) cut out work; (D) drawing.

_____ 2. Work including making up bills of material, making working drawings, and deciding construction details is usually done by the (A) benchman; (B) layout man; (C) detailer; (D) foreman.

_____ 3. The maximum age limit for a cabinetmaker is (A) 60; (B) 65; (C) 70; (D) usually not set at any particular age.

_____ 4. Cabinetmakers are usually paid (A) on an hourly basis; (B) on a piece rate basis; (C) at the completion of the job; (D) on a yearly basis.

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. Cabinetmaking became a fine art in the eighteenth and nineteenth centuries because of the work of such men as:

(A) ________________________ (D) ________________________

(B) ________________________ (E) ________________________

(C) ________________________

2. The four general classifications of workers in the cabinetmaking field are:

(A) ____________________ (C) ____________________

(B) ____________________ (D) ____________________

3. Speciality plants in the woodworking industry include those making:

(A) ____________________ (F) ____________________

(B) ____________________ (G) ____________________

(C) ____________________ (H) ____________________

(D) ____________________ (I) ____________________

(E) ____________________ (J) ____________________

Assignment
Sheet No. 2

Covering
Units 7-47

SELECTION, USE, AND CARE OF HAND TOOLS

One of the best ways to judge a fine craftsman is by the way he chooses, handles, and cares for his equipment. Carefully chosen equipment will assure the cabinetmaker of quality tools and these, in turn, will facilitate better work. Careful use and maintenance of these tools will insure their accuracy and long life.

While it is true that many operations in cabinetmaking are performed with power equipment, a good deal of hand fitting is still necessary in certain phases of the industry. It is therefore essential that the cabinetmaker have a good knowledge of hand tools and their uses.

In this assignment one will have an opportunity to learn the names and types of the most important hand tools used in cabinetmaking. One will further learn how to use and care for them. One will also observe how certain jigs and fixtures can be used to facilitate and permit certain work.

Assignment:

1. Read the references listed below.
2. On page 22 of Reference B is a table showing the various files to be used in sharpening hand saws. Make a list of the different saws by type and size at your place of employment and opposite each type indicate the file that should be used for sharpening it.
3. Answer the questions below and turn in this assignment by ____________________.

References:

A. Feirer, Woodworking For Industry, pp. 173-184.
B. Dahl and Wilson, Cabinetmaking and Millwork, pp. 17-41.
C. Towers, Cabinetmaker's Manual, pp. 153-195.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. Rules used in woodworking are usually divided into fractions of 1/32 of an inch.

T F 2. A bench rule should not be used as a straightedge.

T F 3. The marking gauge is used to mark off lines parallel to the grain of stock.

T F 4. The auger bit file is made with both ends alike.

T F 5. In general, the larger the teeth of a saw, the larger the file needed to sharpen it.

T F 6. The number of points per inch on a saw is always equal to the number of teeth per inch.

T F 7. A coarse-tooth saw would be better for cutting green lumber than a fine-toothed saw.

T F 8. A skew-back saw can be used as a straight edge in an emergency.

T F 9. A crosscut saw can be used to cut with the grain.

T F 10. The backsaw receives its name from the fact that it cuts primarily on the back stroke.

T F 11. The cabinet saw is a rip saw and crosscut saw combined.

T F 12. The smooth plane is used to smooth the edge of a long board to make a close-fitting joint.

T F 13. A draw knife is used for removing small amounts of wood.

T F 14. The cutter of a block plane is set at a low angle.

T F 15. The Surform tool comes only in the flat file shape.

T F 16. Scrapers are used to smooth a surface after it has been sanded.

T F 17. A hand scraper should actually remove shavings when used to scrape a surface.

T F 18. A socket type chisel is better to use with a mallet than a tang type.

T F 19. A cabinet scraper is used to shape irregularly shaped objects or edges.

T F 20. The expansion bit is used to enlarge holes.

T F 21. A bit stock drill may be used to drill holes in either wood or metal.

T F 22. Straight shank twist drills are available in both fractional and decimal sizes.

T F 23. A bit gauge is used to check the size of a bit.

T F 24. A sixteen-ounce hammer is preferable for use with heavier nails.

T F 25. A nine-ounce ball peen hammer is used to drive brads and small nails.

T F 26. Mallets are used to provide an impact which will not cause damage to the head of a tool handle.

T F 27. Nail sets are sets of nails containing a variety of sizes.

T F 28. A nail punch is used to drive nails below the surface of the wood.

T F 29. Calipers may be used to step off equal distances.

T F 30. A good rule to follow when sawing is to always saw on the waste side of the line.

T F 31. The block plane has its plane iron set at a lower angle than other bench planes.

T F 32. The duplex rabbet plane gets its name from the fact that its blade may be placed in two different positions.

T F 33. The jointer plane gauge is used to measure the angle of bevels cut with a jointer plane.

T F 34. The edge of a cabinet scraper blade is sharpened to an angle of 45 degrees.

T F 35. The cabinet scraper is pushed rather than pulled for ordinary work.

T F 36. A chisel should be driven into the wood at a slight angle.

T F 37. When chiseling end grain always work away from the center.

T F 38. In cutting along the grain of the wood, the chisel is used with the bevel side up.

T F 39. Mallets can be used to drive tight-fitting joints together.

T F 40. A regular wing-tip screw driver may be used to drive screws into counterbored holes.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. Tools used to measure distances and to lay out circles, angles, plumb lines, and level lines are called _______________ tools.

2. Steel square gauges or clips are technically called _______________ _______________.

3. When circles of a large radius are to be drawn, ____________ ____________ attached to a straight rod are used.

4. Measurements of cylindrical surfaces are taken with the aid of ____________.

5. The mortise gauge has ________ marking pins.

6. The edge of a scraper blade is turned by using a(an) ____________

7. For average work a rip saw should have from ________ to ________ points per inch.

8. A general purpose crosscut saw should have about ________ points per inch.

9. Small openings in wood are cut with a ____________ saw.

10. Very smooth joint cuts can be made with a ____________ saw.

11. The length of a hand saw is measured from the ____________ to the ____________.

12. Work is held and sawed to specified angles in a(an) ____________ ____________.

13. It is best to have a plane with a ____________ bottom for cabinetmaking.

14. The longest of the hand planes is the ____________ plane.

15. The plane used for all-around purposes is the ____________ plane.

16. The jointer plane is used primarily on the ____________ of boards.

17. End grain is best planed with a ____________ plane.

18. Cabinet scrapers are used to remove ____________ or ____________ ____________ left by a plane.

19. The two types of chisels are the ____________ type and the ____________ type.

20. In chisels which measure from ________ to ________ inches in size, the blade widths are graduated.

21. A 5/8 inch hole would be bored by a number ________ auger bit.

22. Expansion bits with 2 cutters will bore holes from one inch to ________ inches.

23. Wood is removed to receive the heads of flat head screws by using a(an) ______________ bit.

24. Sizes of hammers are indicated by the weight of the head which is given in ______________.

25. Phillips head screwdrivers are available in __________ sizes.

26. Measurements of cylindrical surfaces are taken with the aid of ______________.

27. The try square has its blade set permanently at __________ degrees.

28. Angles needed for miter fitting of trim and moulding may be easily determined with the use of the ______________ ______________.

29. The teeth of the ______________ look and perform like a series of little chisels in the sawing action.

30. Curved saw cuts can be made with the ______________ saw or the ______________ saw.

31. When possible, planing should be done ______________ the grain.

32. Rough boards are cleaned up with a(an) ______________ plane.

33. Bench planes are available with either ______________ or ______________ bottoms.

34. The grooving plane is used most by men engaged in installing ______________.

35. The grooving plane is equipped with __________ cutters and cuts grooves ranging in width from __________ of an inch to __________ of an inch.

36. When boring a hole, a piece of waste stock may be placed on the side opposite where the hole was started in order to prevent ______________.

Multiple-Choice

Directions: In the space at the left of each statement, write the letter of the item which will provide the correct answer to complete the statement.

_____ 1. The tool used to measure and lay out angles of any desired degree is the (A) steel square; (B) sliding T-bevel; (C) try square; (D) steel square gauge.

_____ 2. A level is used to check a surface for (A) true horizontal; (B) true vertical; (C) both true horizontal and true vertical; (D) small deviations from horizontal.

______ 3. To establish a vertical line of considerable length, you should use (A) a plumb bob and line; (B) trammel points; (C) a sliding T-bevel; (D) a framing square.

______ 4. A common size cross cut saw is (A) 20", 18 point; (B) 22", 10 point; (C) 26", 10 point; (D) 30", 8 point.

______ 5. The number found on the heel of the saw indicates the (A) number of teeth per inch; (B) width of saw in inches; (C) number of points per inch; (D) inspection number.

______ 6. Curves in wood can be cut with a (A) back saw; (B) cross-cut saw; (C) coping saw; (D) dovetail saw.

______ 7. The router plane is used to (A) level the bottom of dadoes; (B) cut dadoes and rabbets; (C) rout rough places out of wood; (D) cut a variety of shapes in molding.

______ 8. Irregularly shaped edges are formed with a (A) cabinet scraper; (B) draw knife; (C) handscraper; (D) spokeshave.

______ 9. A number 8 auger bit will bore a hole with a diameter of (A) 1/8"; (B) 1/2"; (C) 5/8"; (D) 8/32".

______ 10. Partial turns with a brace can be accomplished because of a: (A) bit extension; (B) gimlet; (C) ratchet; (D) pinion.

______ 11. An automatic drill is designed to use drills that are (A) fluted twist; (B) fluted without twist; (C) double twist; (D) single twist.

______ 12. Edge clamping of large pieces is usually done with (A) bar clamps; (B) hand screws; (C) C-clamps; (D) braces.

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. The four broad classifications of hand tools are:

(A) ______________________ (C) ______________________

(B) ______________________ (D) ______________________

2. Three main uses for a try square are:

(A) ____

(B) ____

(C) ____

3. Three uses of dividers are:

(a) ______________________________

(b) ______________________________

(c) ______________________________

4. The most commonly used planes for flat surface work are:

(a) ________________ (d) ________________

(b) ________________ (e) ________________

(c) ________________

5. Four uses of a Forstner bit are:

(a) ______________________________

(b) ______________________________

(c) ______________________________

(d) ______________________________

6. Two important considerations when selecting a claw hammer are:

(a) ________________ (b) ________________

7. Four types of clamps generally used by a cabinetmaker are:

(a) ________________ (c) ________________

(b) ________________ (d) ________________

Assignment
Sheet No. 3

Covering
Units 48-54, 56, 57,
59-66, 68-71, 73-78,
104

SELECTION, USE, AND CARE OF BASIC POWER EQUIPMENT

Power equipment has come to play an important part in the work of the cabinetmaker. Most cabinet shops will have a certain amount of this type of equipment, some more than others. While power equipment will not replace hand tools entirely, they do enable the cabinetmaker to speed up his work, to perform the work easier, and to permit better accuracy and precision.

However, power equipment is expensive and can be dangerous if not used properly. It is important that the cabinetmaker know what kinds of power equipment are available, what their uses and limitations are, and how to operate them safely. Advancement in cabinetmaking can depend a lot on the correct use of woodworking machines.

In this assignment you will have the opportunity to study the basic power machines, to learn what they can do for the cabinetmaker and to learn how to correctly and safely operate them.

Assignment:

1. Read the references listed below.
2. Make a list of the various jigs and fixtures available at your work station for use on machines. Indicate their uses.
3. Answer the questions below and turn in this assignment by ____________________.

References:

A. Feirer, Woodworking For Industry, pp. 191-244, 252-258.
B. Dahl and Wilson, Cabinetmaking and Millwork, pp. 41-44.
C. Towers, Cabinetmaker's Manual, pp. 207-258.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. When surfacing a board, it is best to have more rather than fewer knife marks.

T F 2. Rate of feed is very difficult to control when planing wood.

T F 3. Extremely cross-grained or curly-grained wood requires a slower feed than straight-grained, dry lumber.

T F 4. Too light a cut will tend to cause poor quality work.

T F 5. Wood that is cut with carbide-tipped saws can usually be glued together without jointing.

T F 6. When connected by the same belts, the larger of two pulleys always turns the faster.

T F 7. On machines with step-pulleys, if the belt is placed on the largest pulley of the motor and the smallest of the machine, the machine will run at its highest speed.

T F 8. When a machine has variable-speed pulleys, the speed must be changed only when the machine is stopped.

T F 9. Some machines have more than one type of driving mechanism.

T F 10. All work on the radial arm saw is done with the work stationery and the blade moved through the work.

T F 11. The blade of a radial arm saw should be mounted so as to turn away from the operator at the point of cutting.

T F 12. One should adjust the saw blade on the radial arm saw so as not to cut into the table.

T F 13. The single surfacer is more common than the double surfacer.

T F 14. The purpose of the chip breaker on a surfacer is to break up the chips of wood as they are cut.

T F 15. The surfacer differs from most other woodworking machines in that the stock is fed through automatically.

T F 16. Stock to be put through the single surfacer should first have one surface faced on the jointer.

T F 17. The distance between the infeed and outfeed should determine the minimum length of board to run through a planer.

T F 18. To reduce warpage, cuts should all be made from the same surface of the stock if many cuts are necessary.

T F 19. When squaring up legs on a planer, all four surfaces should be planed on the surfacer.

T F 20. Stock less than 1/2" in thickness should not be run through a surfacer.

T F 21. On some circular saws the table tilts rather than the arbor and blade.

T F 22. The trim saw is used primarily for production work.

T F 23. All combination blades are hollow ground in design in order to do both crosscutting and ripping.

T F 24. All arbors have lefthand threads.

T F 25. The blade guard should always be used on the circular saw.

T F 26. The rip fence serves as an excellent gauge for cutting a number of small pieces to length.

T F 27. The stop rod fits on the miter gauge.

T F 28. A mitering jig must be used to cut miters on a circular saw.

T F 29. While ripping, the stock should have one smooth face and one smooth edge.

T F 30. A roller support is used to hold up the end of a long board when ripping.

T F 31. When cutting plywood on a circular saw, the good side of the plywood should be up.

T F 32. Dadoes can be cut using just the fence as a stop.

T F 33. Tenons should never be cut with a dado head.

T F 34. When cutting a tenon on a circular saw, the shoulder cuts should always be made first.

T F 35. Large band saws are used to cut logs into planks and timbers.

T F 36. The band saw is a relatively complicated machine.

T F 37. The tables on the band saw will tilt only in one direction.

T F 38. The wheel-tilting mechanism of the band saw is used to tilt the wheel for bevel cutting.

T F 39. There should be more "give" on the tension of a wide blade than for a narrow blade on the band saw.

T F 40. The blade support wheels on a band saw should be adjusted so that they just touch the blade when it is not running.

T F 41. The sharper the curves to cut, the narrower the band saw blade should be.

T F 42. A narrow blade should be used when resawing on the band saw in order to reduce friction.

T F 43. As a general rule, short cuts should be made first on a band saw.

T F 44. When sawing several pieces that are identical in shape, they may be nailed together and cut as one piece on the band saw.

T F 45. The jig saw does the same type of work as is done with the hand coping saw.

T F 46. The scroll saw can do fancier cutting than the jig saw.

T F 47. Only wood should be cut on the jig saw.

T F 48. Narrow blades should be used for cutting sharp curves on the jig saw.

T F 49. When inserting the blade in a jig saw, you should make sure that the teeth point towards the table.

T F 50. Too little tension on a jig saw blade will cause it to buckle.

T F 51. The jig saw table can tilt in two directions.

T F 52. Long stock can be cut on the jig saw by turning the chucks that secure the blade 90 degrees.

T F 53. The size of a jointer is indicated by the length of the knives.

T F 54. Most jointers are fed by a system of pressure feed rolls.

T F 55. When a jointer leaves a small, concave cut at the end of the stock, it means that the rear table is too low.

T F 56. Jointer blades may be honed without removing them from the cutter head.

T F 57. One should never run end grain on a jointer since it will cause the wood to splinter at the edges.

T F 58. A taper may be cut on the jointer and requires only the lowering of the infeed table.

T F 59. Bevel sawing should always be done with the bevel cut on the lower side of the work.

T F 60. Too much tension on a band saw blade may cause it to break.

T F 61. Too little tension on a band saw blade will allow the blade to wander from side to side on the wheels.

T F 62. Setting the guides on the band saw too far forward will cause the saw teeth to be dulled.

T F 63. The only change necessary in order to cut metal on a band saw is to change to a metal cutting blade.

T F 64. Stock should be fed into a jointer in the direction of the grain.

T F 65. For narrow boards, an auxiliary fence is fastened to the regular fence of a jointer and serves to support the stock during edge jointing.

T F 66. In general, a faster rate of feed is used for jointing rough work than for finish jointing.

T F 67. The smaller sized planers ordinarily surface stock on both surfaces, while the larger sizes ordinarily surface one side only.

T F 68. Warp and wind cannot be removed from a board with a planer because of the spring back after it passes through the feed rolls.

T F 69. With the surfacer properly adjusted, feed roll marks should be removed with each cut.

T F 70. It is not always possible to avoid tearing out the grain when using a surfacer.

T F 71. Equal amounts of material should be removed from both sides of stock, whenever possible, to prevent warping.

T F 72. The end of the circular saw arbor is threaded so that when the saw is running the nut has a tendency to tighten against the collar and blade.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. A rectangular-shaped opening in a piece of wood is called a ________________.

2. When machining end grain, it is important that the cutter head of the machine be running at ________________ speed.

3. Machines usually transmit less force than is put into it due to ________________.

4. Drive on a machine serves to either obtain a gain of ______________ or a gain in ________________.

5. When two pulleys are linked together with a belt, the one on the motor is referred to as the ________________ while the one on the machine is called the ________________ pulley.

6. The prime purpose of the cut-off saw is to cut ____________ ____________ to approximate length.

7. When crosscutting, the anti-kickback device on the radial arm saw should be set about ________ inch above the wood surface.

8. Compound bevel and miter cuts are referred to as ____________ cuts.

9. Each turn of the handle on the radial arm saw will lower the blade ____________ inch.

10. When swinging the motor and blade on the radial arm saw for ripping, make sure the blade is turning ____________ the operator before feeding the board.

11. Planers range in size from ________ inches to ________ inches.

12. A planer designed to surface all four sides of stock in one operation is called a ____________.

13. The normal thickness of cut on a planer is ________ inch.

14. On a single surfacer, the jointed face of the stock should be placed ____________ when feeding it into the machine.

15. The cut that a surfacer makes should be ____________ the grain when possible.

16. A circular saw which has two arbors is called a ____________ saw.

17. A saw blade used on a circular saw for both crosscutting and ripping is called a ____________.

18. Before cutting wood which contains considerable pitch or resin, it is a good idea to place some ____________ on the blade.

19. The saw blade on a circular saw should be adjusted so that it extends about ________ inch above the stock before cutting.

20. One should never cut cylindrical stock on a circular saw without using a ____________.

21. When cutting a number of short pieces to the same length on a circular saw one should clamp a ____________ or ____________ block to the front end of the fence.

22. If a blade heats up while making a cut, the best way to cool it off is to remove the stock and keep the saw ____________.

23. Sawing a thick board into two or more thinner boards is called ____________.

24. With the proper combination, the dado head will cut a groove from __________ inch(es) to a maximum of __________ inch(es) wide.

25. When putting a new blade in a band saw one should make sure that the teeth point _______________ the table.

26. The blade guide on the band saw should be adjusted so that it is about __________ inch above the work.

27 When cutting a sharp curve it is helpful to make a series of _______________ cuts first.

28. Circles can best be cut on a band saw by using a _______________ _______________.

29. When replacing a blade in the jig saw, the blade should be secured in the lower chuck and then the pulley turned by hand until the blade is at the _______________ of the stroke.

30. The hold-down on a jig saw should be just _______________ the work.

31. Jointers range in size from __________ to __________.

32. The _______________ table of the jointer is usually not moved except for special cuts or alignment.

33. The rear table alignment on the jointer can be checked with a _______________.

34. The fence on a jointer should be checked for perpendicularity to the table with a _______________ _______________.

35. When surfacing on a jointer, one should always use a _______________ _______________.

36. Before surfacing stock on a jointer, the stock should be checked for _______________ and _______________.

37. For a very smooth finish on the jointer, the cut should be about __________ or less.

38. When surfacing on a jointer, if the board is warped, the concave side should be placed _______________.

39. Safety features of the circular saw should include a guard to cover the _______________, and a _______________ which keeps the saw kerf open.

40. The dado head or set is usually equipped with __________ outside cutters, __________ inch(es) in thickness, and __________ inside cutters ranging from __________ inch(es) to __________ inch(es) in thickness.

41. Stock less than three inches in width should be fed through the saw with a ______________ ______________.

42. When making a miter cut, the stock has a tendency to move into the blade a distance equal to the ______________ or to the ______________ ______________ of the blade.

43. If the band saw blade rubs against the support bearings constantly, it will become ______________ and may ______________.

44. Jig saw blades held only in the lower chuck are called ______________ blades.

45. When the outfeed bed of a jointer is too high, a ______________ will be cut on the stock.

46. Jointer knives are ground at an angle of __________ degrees.

47. Jointer knives are held in place with a ______________ while the set screws are tightened.

48. The most common jointer operation is ______________.

49. The depth of cut for jointing end grain should be __________ to __________ inch(es).

50. Band saw blades most widely used, range in width from 1/8" to 3/4" and are __________ to __________ thick.

Multiple-Choice

Directions: In the space at the left of each statement, write the letter of the item which will provide the correct answer to complete the statement.

_____ 1. A disadvantage of carbide-tipped tools is that (A) they last so long that they become outdated; (B) they do not cut well on wood; (C) they must be resharpened on special equipment; (D) they come in only a few sizes.

_____ 2. A 3" motor pulley turns at 1500 rpm to drive a 6" pulley on a jigsaw. How many strokes per minute will the jigsaw make? (A) 750; (B) 7500; (C) 75; (D) 3000.

_____ 3. A jointer has a 3" pulley on the motor that operates at 1750 rpm and you want the jointer head to revolve at 3000 rpm. What size driven pulley do you need? (A) 6"; (B) 1 3/4"; (C) 2 1/2"; (D) 5".

_____ 4. A shaper has a driven pulley of 3" and must operate at 3600 rpm. If the motor operates at 1725, what diameter drive pulley must be used? (A) about 5"; (B) about 1 1/2"; (C) about 4"; (D) about 6".

_____ 5. If the stock should stick as it goes through the planer, the first thing that one should do is (A) turn off the power. (B) increase the depth of cut; (C) get behind the stock and push; (D) lower the table.

_____ 6. To rip narrow stock on a circular saw one should use a (A) push block; (B) push stick; (C) stop rod; (D) feather board.

_____ 7. When resawing on a circular saw it is advisable to support the stock against the fence with a (A) feather board; (B) stop rod; (C) stop block; (D) roller support.

_____ 8. When cutting a dado on the circular saw, it requires the use of a special (A) miter gauge; (B) jig; (C) insert plate; (D) fence.

_____ 9. A tenon should not be cut on the circular saw without a jig or dado head unless the stock is at least (A) 4" wide; (B) 2" wide; (C) 6" wide; (D) doesn't matter.

_____ 10. The tendency for a band saw blade to pull to one side while making a straight cut is called (A) crossfeed; (B) wind; (C) drift; (D) lead.

_____ 11. When the band saw blade pulls to one side, it is usually caused by (A) wrong size blade; (B) improper adjustment of guides; (C) too much tension on the blade; (D) blade support wheels stuck.

_____ 12. The number of teeth on a jig saw blade that should be in contact with the stock at all times is (A) 2; (B) 8; (C) 10; (D) 3.

_____ 13. For regular work, the rear or outfeed table on the jointer should be (A) slightly below the height of the knives; (B) the same height as the knives; (C) considerably lower than the height of the knives; (D) slightly above the height of the knives.

_____ 14. If the outfeed table on a jointer is too high, it will tend to cut (A) a taper; (B) a "snipe"; (C) a bevel; (D) a chamfer.

_____ 15. One should never attempt to surface on the jointer a piece of stock that is shorter than (A) 6"; (B) 8"; (C) 12"; (D) 4".

_____ 16. You should never attempt to end plane stock on a jointer if the stock is narrower than (A) 10"; (B) 5"; (C) 12"; (D) 8".

_____ 17. Wobble washers are used to (A) level a saw frame; (B) cut dadoes with a single blade; (C) equalize the load of a molding head; (D) cut material with resin content.

_____ 18. A band saw blade which twists while sawing indicates (A) the guide pins are too far back; (B) the guide pins are too far forward; (C) the guide pins are not in line; (D) the ball-bearing supports are too close to the blade.

_____ 19. In order to eliminate strain on a blade while sawing sharp curves on the band saw, the cabinetmaker would best make use of (A) rough sawing; (B) relief cuts; (C) a 270 degree turn; (D) changing to a narrower blade.

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. The "trim saw" is also known as:

(A) ____________________ (D) ____________________
(B) ____________________ (E) ____________________
(C) ____________________

2. List the common cuts made on woodworking machines.

(A) ____________________ (E) ____________________
(B) ____________________ (F) ____________________
(C) ____________________ (G) ____________________
(D) ____________________ (H) ____________________
(I) ____________________

3. Four things one should know when machining wood are:

(A) ____
(B) ____
(C) ____
(D) ____

4. Common troubles encountered when surfacing wood are:

(A) ____________________ (D) ____________________
(B) ____________________ (E) ____________________
(C) ____________________

5. Raised grain on surfaced wood is usually caused by:

(A) ______________________ (C) ______________________

(B) ______________________ (D) ______________________

6 List the six basic machines that make up all machines.

(A) ______________________ (D) ______________________

(B) ______________________ (E) ______________________

(C) ______________________ (F) ______________________

7. List five devices for transmission of energy on machines.

(A) ______________________ (D) ______________________

(B) ______________________ (E) ______________________

(C) ______________________

8. The radial arm saw is better than the circular saw for the operation of:

(A) ____

(B) ____

(C) ____

(D) ____

(E) ____

(F) ____

9. List four types of saw blades used on a circular saw:

(A) ______________________ (C) ______________________

(B) ______________________ (D) ______________________

10. List three jigs that can be used for cutting tapers on the circular saw.

(A) ____

(B) ____

(C) ____

11. List four main uses for a jointer.

(A) ______________________ (C) ______________________

(B) ______________________ (D) ______________________

12. The smoothness of cut on a jointer depends on:

(A) ____

(B) ____

(C) ____

13. Dull knives on a jointer will usually be indicated by:

(A) ____

(B) ____

(C) ____

Matching

Directions: In the left hand column is a list of terms. The right hand column contains descriptive phrases or synonymous terms. Match the descriptions to the terms by placing the letter of the description in the blank at the left of the appropriate term.

_____ 1. crosscut blade

_____ 2. planer blade

_____ 3. abrasive blade

_____ 4. combination blade

_____ 5. rip blade

_____ 6. dado head

_____ 7. molding head

A. makes any type cut

B. cuts at right angles with wood grain

C. chisel shaped teeth for cutting with the grain of the wood

D. hollow ground

E. cuts 1/2 inch grooves

F. cuts metal

G. cuts special shapes

Assignment
Sheet No. 4

Covering
Units 81, 82, 84-87, 89-
94, 96-99, 101-103
105-108

SPECIALIZED CABINETMAKING EQUIPMENT

While the basic woodworking operations can be done on certain machines, more specialized operations are done with special purpose equipment. Some of these specialized machines have been in use for many years while some others are fairly recent. Lately many new developments in portable machines have been a real aid to the cabinetmaker.

It is important for the cabinetmaker to know how to operate these special purpose machines since many of the operations that they perform are important in the cabinetmaker's work. It is the quality of these specialized operations that determine, to a large extent, the success of the cabinetmaker.

In this assignment you will have the opportunity to study some of these more specialized machines. You will see how valuable they are to a skilled cabinetmaker and learn what they can do and how you should use them.

Assignment:

1. Read the references listed below.
2. Make a complete list of the machines covered in this unit that are available at your work station.
3. Answer the questions below and turn in this assignment by ______________________.

References:

A. Feirer, Woodworking for Industry, pp. 245-251, 259-295, 372-377.
B. Dahl and Wilson, Cabinetmaking and Millwork, pp. 44-48.
C. Towers, Cabinetmaker's Manual, pp. 258-351.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. The electric cut-off saw has the same types of blades as a circular saw.

T F 2. When using the electric cut-off saw you should always turn on the switch before placing the saw on the work.

T F 3. If the electric cut-off saw slows down or stalls while cutting, one should first back it out of the work.

T F 4. When cutting plywood with the electric cut-off saw, the best side of the plywood should be down.

T F 5. The depth of cut possible when bevel cutting with the electric cut-off saw is less than for a straight cut.

T F 6. It is permissible, when making a pocket cut, to lower the electric cut-off saw into the work with the blade revolving.

T F 7. The saber saw will only cut straight lines.

T F 8. The ripping guide of a saber saw can be used to cut circles.

T F 9. The power block plane can be used only on edges of work.

T F 10. A floor-type router is used for routing flooring.

T F 11. The portable hand router should be fed into the work as slowly as possible to insure smooth clean cuts.

T F 12. The portable hand router can be used for making mortise-and-tenon joints if power tools for this purpose are not available.

T F 13. The shaper is a machine that requires great care when operating.

T F 14. The spindle shaper is designed to shape moldings on both straight and curved stock.

T F 15. The fence should never be removed for cutting on the shaper.

T F 16. Shaping can also be done on the drill press provided a speed of at least 5,000 r. is possible.

T F 17. The bit of a mortiser will cut a square hole.

T F 18. The chisel of the mortiser should be inserted so that its shoulder is tight against the socket before inserting the bit.

T F 19. When cutting a mortise it is best to skip a space between cuts rather than cut continuously.

T F 20. Mortising attachments are available for drill presses.

T F 21. The vertical boring machine differs from the drill press in the type of cutters it uses.

T F 22. Some carbon steel drills are designed to be used only on wood.

T F 23. The auger bit used with a brace can also be used in a drill press.

T F 24. A plug cutter cuts plugs to fill up holes.

T F 25. The size of a drill press is determined by the largest drill that can be used in it.

T F 26. Both twist drills and specially designed auger type bits can be used in the drill press.

T F 27. It is important that the skilled cabinetmaker be quite proficient at operating a lathe.

T F 28. The operation of the automatic lathe requires a high degree of skill.

T F 29. Cutting is easier than scraping on a lathe.

T F 30. The live center of the lathe is the moving center.

T F 31. The larger the stock that is being turned on the lathe the slower the speed should be.

T F 32. Rough cutting or scraping on the lathe should always be done from left to right.

T F 33. Once the tool rest is positioned it should not be moved until the stock has been turned to with 1/8" of the finished dimension.

T F 34. All faceplate turning is done by the scraping method.

T F 35. Special tools are required for faceplate turning.

T F 36. Stock revolving at high speed is fed into the stationery cutters of the back-knife lathe.

T F 37. Belt and disc sanders are sometimes combined into one machine.

T F 38. A portable belt sander should be kept moving to prevent gouging the wood.

T F 39. Orbital action is the best for very fine finish sanding.

T F 40. The single-end tenoner is more adaptable for custom work than the double-end tenoner.

T F 41. Drilling in metals requires a slower speed than drilling in wood.

T F 42. The safest of the four basic shaper operations is the operation making use of the fence.

T F 43. The direction of feed with the shaper should always be into the rotation of the cutter.

T F 44. Disk sanding is generally confined to end grain operations.

T F 45. Sanding should be performed on the side of the disk which is moving upward.

T F 46. Disk sanding allows the use of a coarser grit to produce the same finish as a finer grit would provide on a belt sander.

T F 47. Stock should be cut on the radial arm saw by pushing the blade toward the column.

T F 48. Variety saws usually are equipped with a tilting table.

T F 49. Boring machines generally have a greater capacity than the drill press.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. Most electric cut-off saws have a ____________ ____________ which allows the motor to run even though the blade may be stopped.

2. The corners of a pocket cut made with the electric cut-off saw will have to be cleaned out with a ____________ ____________.

3. The teeth on a saber saw should be pointing forward and ____________.

4. Curve cutting with a saber saw is done ____________.

5. Making inside cuts with a saber saw without first drilling a hole is called ____________ ____________.

6. A good portable tool designed for cutting rabbets in cabinet doors is the ____________ ____________ ____________.

7. If the motor of a portable router screws into the base, each revolution will change the depth of cut ________ of an inch.

8. For irregular or circular cutting with the portable router, the router should be moved in a ________________ direction.

9. A router cutter with a pilot end will aid in preventing too ____________ a cut.

10. Routing without the use of a guide is called _______________ routing.

11. The safest type of shaper cutter is the _______________, solid type.

12. Stock should be fed into a shaper cutter in a direction that is ___________________ to the cutter rotation.

13. When shaping irregular work, a _______________ _______________ ___ should be used.

14. When shaping completely around rectangualr stock the end grain should be shaped _______________ .

15. When shaping the entire edge of the stock, the _______________ fence should be even with the edge of the cutter.

16. A mortiser cuts a _______________ opening in wood.

17. Two of the most commonly used sizes of mortising chisels are ________ and ________ .

18. Besides the bit and chisel, a _____________________ for the chisel must be used when setting up the mortiser.

19. The bit on a mortiser should extend below the chisel slightly so the bit will cut the hole _______________ the chisel squares it up.

20. A drill press should run at ________ rpm for mortising.

21. Two types of boring machines are _______________ and _______________ .

22. Probably the fastest and cleanest cutting bit for making holes in wood is the _______________ _______________ bit.

23. A bit with a _______________ should not be used in a power drill.

24. Circle and hole cutters will cut holes up to ________ inches in diameter.

25. The most common sizes of portable electric drills are ________ and ________ .

26. For boring or drilling holes in wood, the drill press should be run at speeds from ________ to ________ rpm.

27. A 9" lathe will handle work that is ________ inches in diameter.

28. Stock is roughed out on a lathe with a _______________.

29. Spindle turning requires a speed of about ________ rpm whereas faceplate turning can be done at about ________ rpm.

30. You should always remove the ____________ ______________ when sanding between centers on a lathe.

31. The two basic methods of wood turning are ____________ and ____________ .

32. When work is held between both centers for work on the lathe, it is called ____________ turning.

33. The correct position for the tool rest for turning on the lathe is about _______ from the work and about _______ above the center of the work.

34. The part of the stock that is fastened to the ______________ center when spindle turning should be lubricated before starting to work.

35. The single screw center faceplate should be used on stock that is ____________ than 4" in diameter

36. The belt sander is used to sand ____________ surfaces and edges.

37. Large surfaces are usually sanded with _________________ or _______________ sanders.

38. Besides moving up and down, a spindle sander also ___________ .

39. An excellent sander for assembled cabinet work is the ____________ _______________ sander.

40. When using the portable belt sander, the _______________ of the sander should touch the work first.

41. The standard drill press is equipped with a ______________ chuck which will handle drills up to ________ inch(es) in diameter.

42. Twist drills used for metal are sharpened at an angle of ________ degrees, while those used exclusively for wood are sharpened at a _________ degree angle.

43. A ________ ________ is used to start the cut when shaping against a collar.

44. Long, slender work is supported on the lathe by the ___________ _______________ .

45. The ____________ _________ is used to cut into stock to mark it for further cuts.

46. Scraping cuts on the lathe are made primarily with ____________ and ______________ nose chisels.

47 Portable electric drills are rated by the capacity of their ________________ .

48. Production shapers are available in both _________________ and ____________________ .

49 The chief advantage of double-spindle shapers is in the use of ____________________ spindles.

50. The machine designed to surface all four sides of stock at once is the ____________________ .

Multiple-Choice

Directions: In the space at the left of each statement, write the letter of the item which will provide the correct answer to complete the statement.

_____ 1. When using a 100 ft. extension cord with the electric cut-off saw, the cord should be at least (A) 6 gauge; (B) 8 gauge; (C) 10 gauge; (D) 12 gauge.

_____ 2. When cutting plywood with a saber saw, the blade should have (A) 6 teeth per inch; (B) 10 teeth per inch; (C) 12 teeth per inch; (D) 16 teeth per inch.

_____ 3. The shortest peice that should be run on a shaper is (A) 6"; (B) 8"; (C) 10"; (D) 12".

_____ 4. When using a collar on the shaper, it is best to have it (A) below the cutter; (B) above the cutter; (C) between two cutters; (D) on both sides of the cutter.

_____ 5. Work to be turned on the lathe should be cut to octagon shape before turning if it is larger in diameter than (A) 2"; (B) 3"; (C) 4"; (D) 5".

_____ 6. Before working on the lathe after setting it up, one should (A) turn the stock over by hand; (B) run it at slow speed; (C) run it at high speed; (D) sand off sharp edges.

_____ 7. Wood turned on a lathe should be checked for size frequently with a (A) micrometer; (B) dividers; (C) ruler; (D) calipers.

_____ 8. To install a new sanding disc on the disc sander, the old disc should be (A) peeled off with a putty knife; (B) removed by running a stick on it; (C) soaked in water; (D) left on.

_____ 9. When sanding with a portable belt sander on fir or other woods with soft and hard spots, you should (A) always sand with the grain; (B) sand cross-grain first; (C) always sand cross-grain; (D) sand with the grain first.

_____ 10. When using the portable disc sander, it should be (A) tipped slightly; (B) held as flat as possible; (C) rocked back and forth; (D) moved sidewise.

_____ 11. A long, wide board could probably be crosscut most easily and safely with the (A) table saw; (B) variety saw; (C) portable electric hand saw; (D) radial arm saw.

_____ 12. The most commonly used portable electric tool used by the cabinetmaker is the power (A) hand drill; (B) hand saw; (C) sander; (D) jig saw.

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. List five methods of controlling the sidewise movement of the portable router.

(A) ______________________________

(B) ______________________________

(C) ______________________________

(D) ______________________________

(E) ______________________________

2. List four joint cuts that can be made with the portable router.

(A) ______________________________

(B) ______________________________

(C) ______________________________

(D) ______________________________

3. List six operations that can be done with a portable electric drill and attachments.

(A) _______________ (D) _______________

(B) _______________ (E) _______________

(C) _______________ (F) _______________

4. List the five basic lathe tools and indicate their main uses.

	Tool	Use
(A)	____________________	____________________
(B)	____________________	____________________
(C)	____________________	____________________
(D)	____________________	____________________
(E)	____________________	____________________

5. List the three kinds of action possible with a finishing sander.

(A) ____

(B) ____

(C) ____

6. Special operations which may be performed on the drill press include:

(A) ______________ (C) ______________ (E) ______________

(B) ______________ (D) ______________

7. The four methods of shaper operation are:

(A) ____

(B) ____

(C) ____

(D) ____

Assignment
Sheet No. 5

Covering
Units 55, 58, 67, 72, 79, 83, 88, 95, 100, 109

SAFETY FOR THE CABINETMAKER

A good worker is characterized by his knowledge and application of safety to his particular job. Safety involves safeguarding of machines as well as preventing personal injury. However, your safety comes first. Safety begins with the worker and has its basis in the attitude of the worker toward his job.

Attitude is a state of mind based on the correct knowledge of working conditions, the range and limitations of the equipment, and the extent of the worker's own skill. Rules of safety and their application must be learned and practiced as each phase of work is learned. Safe practice can only be as effective as the worker desires them to be.

Although this unit is organized to give you an opportunity to learn some of the common general rules and practices of safety, safety practices for specific applications will be stressed in most of the units. Safety is a continuous thing and should not be studied here and then forgotten.

Assignment:

1. Read the references listed below.
2. Answer the questions below and turn in this assignment by ____________________.

References:

A. Feirer, Woodworking for Industry, pp. 28-31.
B. Dahl and Wilson, Cabinetmaking and Millwork, pp. 10-16.
C. Towers, Cabinetmaker's Manual, pp. 369-374.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. First aid is necessary no matter how slight the injury.

T F 2. Objects may be tossed from worker to worker if they are not sharp.

T F 3. Waste and debris should be swept off benches and machine and onto the floor.

T F 4. A sharp tool is easier to control than a dull one.

T F 5. It is dangerous to speak to someone while he is operating a machine.

T F 6. The hand should be placed palm down and flat on the stock while feeding stock through the saw.

T F 7. Freehand cutting may be done on the circular saw if the stock is small.

T F 8. Fingers should not project over the edges or ends of stock being jointed.

T F 9. Stock of different thicknesses should not be run through the planer at the same time.

T F 10. One should not look into the planer while it is running.

T F 11. If the upper guide wheels of the band saw need to be adjusted, the machine should be stopped.

T F 12. An unbalanced set of shaper knives can be a hazard.

T F 13. When grinding on the grinder, it is best to hold small objects with a rag to prevent burns.

T F 14. Safe practices aid efficient work.

T F 15. One should always wear a short-sleeved shirt when working around machines.

T F 16. Good housekeeping affects safety.

T F 17. Sharp tools should not be left on machines while working but rather should be placed in your pocket.

T F 18. 110 volts will not kill you but it can cause serious burns.

T F 19. A machine should be turned off before any adjustments are made.

T F 20. One should not operate a machine without first receiving instructions.

T F 21. Chips from a mushroomed chisel head can break off with enough force to cause serious injury.

T F 22. Nails should be held with the fingers placed near the wood to prevent serious injury if the hammer should slip off the head of the nail.

T F 23. Never leave a machine which is running unattended, unless you are going to return in a few seconds.

T F 24. Wear gloves when sawing or jointing rough stock.

T F 25. Saws should be completely shielded to prevent contact with moving parts.

T F 26. The power saw operator should stand directly behind the stock he is feeding into the machine.

T F 27. Work to be mortised should be clamped to the table.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. Most personal injuries received in accidents are caused by ____________.

2. Heavy objects should be lifted by using the muscles of the ____________ for most of the power.

3. Lumber stacks will have less tendency to fall if one ____________ the load.

4. If one should have an accident, one should ____________ it immediately and seek ____________ ____________.

5. Rotating machinery will catch on loose objects such as ____________ ____________, ____________, or ____________ ____________ of any sort and pull them into the machine.

6. A good foot protection against sharp objects is ____________ shoes.

7. When using sharp-edged hand tools, one should be sure to always cut away from the ____________.

8. Never use a file without a ____________.

9. Crowding a saw blade may result in ____________ the saw.

10. Stock should be examined for ____________ and ____________ before running it on the jointer.

11. Cuts should be made on the tenoner while the sliding bed is moving away from the ____________.

12. Whenever possible one should use a ____________ when working on the shaper.

13. Do not operate a grinder without ____________ ____________ and the use of ____________.

14. Small stock should not be ground on the grinding wheel without a proper ____________.

15. A ______________ shop is usually a safe shop.

16. Be sure that a portable electric tool is ______________ before using it.

17 When unplugging a portable electric tool, one should pull the ______________ not the ______________.

18. When spraying one should use a ______________.

19. For proper use, a ladder should be placed at an angle of about ______________ degrees.

20. Oily rags should be kept in covered ______________ containers.

21. When two or more people are carrying a load, they should be on the ______________ side of the load and should stay in ______________.

22. The tool rest of a grinder should never be more than ______________ inch from the wheel.

23. Remove dust and scraps from benches and machines with the ______________ ______________.

24. The second largest number of woodworking injuries occur on the ______________.

25. The heavier the cut on a jointer, the greater the danger of ______________.

26. Adjustments should be made on the tool rest or the tail stock only when the lathe is ______________.

Multiple-Choice

Directions: In the space at the left of each statement, write the letter of the item which will provide the correct answer to complete the statement.

_____ 1. If violations of safety rules occur, one should (A) correct the situation himself; (B) change the rule; (C) notify his immediate superior; (D) assume his boss will see it.

_____ 2. The most important thing to remember to do before turning on the power for a machine is to (A) be sure all guards are in place; (B) check all adjustable parts; (C) be sure the stock to be worked is close enough to reach; (D) be sure the power cord is plugged in.

_____ 3. Only an experienced operator using the proper accessory should use a band saw for cutting (A) cylindrical stock; (B) rough stock; (C) sharp curves; (D) plywood.

_____ 4. When using portable electric tools it is especially important to avoid (A) holding the tool with both hands; (B) standing on damp or wet surface (most usual); (C) hardwoods; (D) wearing rings.

_____ 5. Most shop accidents (A) are serious; (B) are too minor to worry about; (C) occur in the afternoon; (D) can be avoided.

_____ 6. Most woodworking injuries happen on the (A) band saw; (B) jointer; (C) circular saw; (D) planer.

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. Most accidents can be prevented by following these general rules:

(A) ______________________________

(B) ______________________________

(C) ______________________________

2. Hand tool injuries are usually caused by:

(A) ______________________________

(B) ______________________________

(C) ______________________________

3. Before using a portable electric tool one should check it for:

(A) ______________ (C) ______________

(B) ______________ (D) ______________

4. Most accidents on the circular saw occur when doing the following things while the saw is running:

(A) ______________________________

(B) ______________________________

(C) ______________________________

Assignment
Sheet No. 6

Covering
Units 110-113

TOOL SHARPENING

Good workmanship and sharp tools go hand in hand. The cabinetmaker must have sharp tools in order to turn out quality work. Without sharp tools mediocre work will result and much more effort will be required. Also, as has been pointed out before, dull tools are dangerous and tend to cause accidents.

It is therefore essential that the cabinetmaker keep his tools sharp at all times. Some will require professional sharpening but most can be done by the cabinetmaker himself. This will save time and the expense of extra tools and will result in more profits in the end.

In this assignment you will have the opportunity to learn how the common tools of the cabinetmaker are sharpened. You will also study the equipment that is used and the precautions that must be observed when sharpening tools.

Assignment:

1. Read the references listed below.
2. Answer the questions below and turn in this assignment by ______________________.

References:

A. Feirer, Woodworking for Industry, pp. 185-190.
B. Dahl and Wilson, Cabinetmaking and Millwork, pp. 21-23.
C. Towers, Cabinetmaker's Manual, pp. 352-369.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. Natural abrasive stones come in varying grades of hardness.

T F 2. Artificial stones will sharpen tools faster than natural stones.

T F 3. Silicon-carbide stones are the best for sharpening high-carbon tool steels.

T F 4. The oil used when sharpening with a stone should be left to soak into the stone after using.

T F 5. When sharpening a plane iron it should always be ground on the grinder.

T F 6. Friction causes a tool to heat up and it will lose its hardness if it gets too hot.

T F 7. Whetting means to dip the tool in water to cool it off.

T F 8. When honing a plane iron, the bevel should be kept flat on the stone.

T F 9. When honing a plane iron, only a figure-eight motion should be used.

T F 10. When honing the non-beveled side of a plane iron, it should be kept flat on the stone.

T F 11. A countersink should not need any sharpening.

T F 12. Rounded edges on the screwdriver will not permit easy and correct use of the screwdriver.

T F 13. When sharpening a gouge, the first grinding should be at right angles to the grinding wheel.

T F 14. One should never grind on the side of a grinding wheel.

T F 15. Woodturning tools should be sharpened in much the same manner as chisels.

T F 16. Machine tools should always be ground when sharpening them.

T F 17. The honing of jointer knives should be done often.

T F 18. Honing jointer knives can be done with the knives left in the cutter head.

T F 19. Carbide-tipped saw blades will need more frequent grinding than regular blades.

T F 20. A mortising chisel should be ground while it is in the drill press.

T F 21. A saw set has the correct angle permanently set on it.

T F 22. A saw clamp is used to hold a saw when the handle is broken or when two people are using the saw together.

T F 23. Some oil stones have both a coarse and a fine side.

T F 24. A heavier cut can be taken with an aluminum oxide grinding wheel without drawing the temper of the tool being sharpened.

T F 25. Nicks in chisels and plane irons should be removed by grinding the edge square to the depth of the nicks.

T F 26. Chisels, when hollow-ground, may be honed several times before regrinding.

T F 27. Light reflected from a cutting edge indicates that it is sharp.

T F 28. Plane irons should be ground square with sharp corners.

T F 29. Handsaw teeth are usually set equal to a depth of one-half the length of the tooth.

T F 30. Woodturning tools have perfectly flat bevels.

T F 31. Carbide-tipped tools may be ground on ordinary grinding wheels.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. The two classes of sharpening stones are ______________ and ______________.

2. The two common types of artificial stones are ______________ ______________ and ______________ ______________.

3. A new stone should be soaked a few hours in ______________ before using.

4. An abrasive stone should be cleaned occassionally with ammonia or ______________.

5. The angle on a plane iron should be between ________ and ________ degrees.

6. When grinding a tool, it should be dipped frequently in ______________.

7. When sharpening a draw knife it should be drawn diagonally across the stone so that all parts of the edge are ______________ honed.

8. When sharpening an auger bit the spurs should be sharpened on the ______________ only.

9. A gouge should be deburred with the ______________ ______________ ______________.

10. When sharpening a shaper cutter, care must be taken not to change the ______________ of the cutter.

11. The file that should be used for sharpening scraper blades is a ______________ ______________.

12. The tool used to adjust the teeth on the handsaw to provide clearance for the blade while sawing is called a ______________ ______________.

13. The temper of a tool is being drawn when ______________ ______________ appear along the edge of the tool while grinding.

14. When honing, oil stone wear may be equalized by using a(n) __________________ motion.

15. An extremely fine edge may be produced on a tool by strapping it on a piece of ______________.

16. Rough, torn edges of a bored hole indicate the auger bit ______________ need sharpening.

17. Chips of uneven thickness indicate the auger bit ______________ are dull.

Multiple-Choice

Directions: In the space at the left of each statement, write the letter of the item which will provide the correct answer to complete the statement.

_____ 1. A grinder for ordinary tool sharpening would have a (A) 40 grit aluminum oxide; (B) 40 grit silicon carbide; (C) 60 grit aluminum oxide; (D) 60 grit silicon carbide grinding wheel.

_____ 2. The length of the honed bevel should be approximately (A) one-fourth; (B) one-third; (C) one-half; (D) three-fourths the length of the ground bevel.

_____ 3. The process of leveling the teeth of a handsaw is known as (A) evening; (B) smoothing; (C) milling; (D) jointing.

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. Lubricating oil should be used on sharpening stones to:

(A) ____

(B) ____

(C) ____

2. List two machines on which jointer knives can be sharpened other than the grinder.

(A) _________________________ (B) _________________________

3. List three kinds of files used for sharpening tools:

(A) ______________ (B) ______________ (C) ______________

4. List the four taper sizes of saw files:

(A) ______________ (C) ______________

(B) ______________ (D) ______________

5. List the three grits of oil stones.

(A) __________ (B) __________ (C) __________

6. The sharpening of tools involves two types of operations:

(A) ______________ (B) ______________

7. A wood chisel should be reground if:

(A) ______________________________

(B) ______________________________

(C) ______________________________

(D) ______________________________

8. The steps in sharpening a circular saw blade are:

(A) ______________ (D) ______________

(B) ______________ (E) ______________

(C) ______________

9. A twist drill will not drill to correct size unless:

(A) ______________________________

(B) ______________________________

(C) ______________________________

Matching

Directions: Place the letter of the correct angle indicated in the right hand column in front of the correct sharpening process in the left hand column. Answers may be used more than once.

_____ 1. plane iron grinding

_____ 2. chisel

_____ 3. skew cutting edge

_____ 4. flat nose bevel

_____ 5. plane iron honing

_____ 6. round nose bevel

_____ 7. jointer knive angle

_____ 8. gouge bevel

_____ 9. pocket knife

_____ 10. included angle of parting tool

A. 30-35 degrees

B. 30 degrees

C. 20-30 degrees

D. 45 degrees

E. 40 degrees

F. 60 degrees

G. 25 degrees

H. 36 degrees

Assignment
Sheet No. 7

Covering
Units 114-11[illegible]

READING DRAWINGS AND PLANNING THE WORK

Drawings are the means by which the designer conveys his ideas to the worker. Drawings give a picture of the object, showing what it looks like, how it will be built, and its size. The great variety of objects requires that different types of drawings be used for the various objects.

It becomes very important for the craftsman to be able to read and understand drawings. Without this ability it would be difficult to understand what the customer wants and to produce it as he desires it. Reading and understanding drawings also permits the worker to plan and prepare his work. From the drawings he will be able to determine what materials he will need, what operations need to be performed, and to plan his work in an efficient manner.

In this assignment you will have the opportunity to learn the various kinds of drawings and what information can be found on them. Also you will learn how to plan your work by utilizing the drawings and the information that they contain.

Assignment:

1. Read the references listed below.
2. Answer the questions below and turn in this assignment by ____________________.

References:

A. Feirer, Woodworking for Industry, pp. 43-77.
B. Dahl and Wilson, Cabinetmaking and Millwork, pp. 57-80.
C. Towers, Cabinetmaker's Manual, pp. 23-38.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. The term "blueprint" usually refers to any type of print no matter what the method of reproduction.

T F 2. Actual blueprints (white lines on blue paper) are not used much anymore because they tend to fade when exposed to light for a long time.

T F 3. Copies of the original drawing are printed so that there will be copies available if the original is lost out on on the job.

T F 4. The perspective drawing will give the most realistic appearance of the object of any of the pictorial drawings.

T F 5. A cabinet drawing is the type of drawing that a cabinetmaker will usually work from.

T F 6. Pictorial drawings usually just show how the finished object will look and usually are not used to work from.

T F 7. Working drawings show surfaces as they would appear when the line of vision is at right angles to that surface.

T F 8. Cylindrical objects can sometimes be drawn and described in one view.

T F 9. A dotted line on a drawing represents an edge of the object that is not visible when looking at the surface of the object that is shown in that particular view.

T F 10. Knowledge of the alphabet of lines is of value only to the person making the drawing.

T F 11. A drawing that is drawn to scale is drawn full size.

T F 12. When a drawing is drawn to scale the dimensions that are used are the actual dimensions of the finished object.

T F 13. In a woodworking drawing the views are not always in their proper position as would be expected in conventional orthographic projection.

T F 14. In a woodworking drawing the kind of joint or fastener to be used is always shown.

T F 15. It is not necessary for a cabinetmaker to be able to read architectural drawings since they do not contain any information of value to him.

T F 16. If details of construction are not shown, the cabinetmaker can use the type of construction that he prefers.

T F 17. Usually certain information will be found in the same place on drawings for different objects.

T F 18. A multiview drawing is also called an orthographic projection.

T F 19. Symbols are used to show some millwork on drawings.

T F 20. In determining the amount of wood needed for a job, some amount needs to be added to the dimensions on the print.

T F 21. Specifications are not likely to contain any information of value to the cabinetmaker.

T F 22. The height of an object can be determined from the top or plan view.

T F 23. Dimensions shown on a drawing are actual drawing dimensions.

T F 24. Construction sections are quite often shown on architectural drawings.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. Drawing is a ________________ which describes an object in sufficient detail so that the workman can ________________ the object without having actually seen it.

2. Drawings are composed of ________________, ________________, and ________________.

3. A print is an exact copy of a ________________.

4. The techniques used in preparing woodworking drawings and prints depend largely on the ________________ involved.

5. An elevation drawing is one that shows the ________________ and width.

6. The view looking directly down on an object from above is called the ________________ view.

7. Besides hidden lines, inside details can be shown by means of ________________ views.

8. The drawings of a house are called ________________ drawings.

9. The construction of kitchen cabinets would most likely be found on drawings called ________________.

10. The key to blueprint reading is the ability to visualize the ________________ from which the draftsman was viewing the object.

11. The location of cabinets, windows, and doors can be found on the ________________ plan of a house.

12. A tabulated list of the materials required for a particular job is called a ________________ of ________________.

13. A list of the steps for making an object is called a ________________ of ________________.

14. The construction of each part of a piece of furniture is planned on a ________________ ________________.

Multiple-Choice

Directions: In the space at the left of each statement, write the letter of the item which will provide the correct answer to complete the statement.

_____ 1. The true size and shape of objects is shown on (A) pictorial; (B) isometric; (C) cabinet; (D) working drawings.

_____ 2. The minimum number of views of an object usually necessary to describe it is (A) 1; (B) 2; (C) 3; (D) 4.

_____ 3. A view looking directly at a slanted surface is the (A) auxiliary; (B) scale; (C) section; (D) plan view.

_____ 4. On a drawing that is drawn to a scale of ¼"=1"-0", a true measure of 5/8" on the drawing will represent (A) 1"-6"; (B) 2"; (C) 2"6"; (D) 2"-10" of the object.

_____ 5. A chart including information and specifications regarding certain units or parts is the (A) symbol chart; (B) specifications; (C) schedule; (D) detail.

_____ 6. The term "square" represents (A) 10 square feet; (B) 25 square feet; (C) 50 square feet; (D) 100 square feet.

_____ 7. The usual allowance added to the finished length to get the cut-out size is (A) 1/4"; (B) 1/2"; (C) 3/4"; (D) 1".

_____ 8. Two square feet of area will require (A) 1.5 feet of 12" material; (B) 2.0 feet of 8" material; (C) 2.5 feet of 10" material; (D) 3 feet of 8" material.

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. Four types of drawings used in cabinetmaking are:

(A) ______________________ (C) ______________________

(B) ______________________ (D) ______________________

2. Specifications usually contain:

(A) ____

(B) ____

(C) ____

(D) ____

(E) ____

(F) ____

3. A set of drawings will usually consist of:

(A) ______________________ (D) ______________________

(B) ______________________ (E) ______________________

(C) ______________________

4. In order to properly estimate material needs and plan the method of doing the work, the woodworker needs to know:

(A) ____

(B) ____

(C) ____

5. A materials list shows in detail the:

(A) ______________________ (D) ______________________

(B) ______________________ (E) ______________________

(C) ______________________

6. List three items of planning that a cabinetmaker should have before beginning to work.

(A) ______________________ (C) ______________________

(B) ______________________

7. A route sheet includes:

(A) ____

(B) ____

(C) ____

(D) ____

Matching

Group I

<u>Directions</u>: Match the line description in the left hand column with the name of the line in the right hand column.

_____ 1. Heavy solid line

_____ 2. Short dashes for invisible parts

_____ 3. Center of symmetrical objects

_____ 4. Part outline extended

_____ 5. Fine line with arrowheads

_____ 6. Heavy dashed line with arrowheads

_____ 7. Fine spaced lines usually inclined

A. Section line

B. Cutting plane line

C. Center line

D. Dimension line

E. Extension line

F. Break line

G. Ditto line

H. Hidden line

I. Part outline

Group II

<u>Directions</u>: Place the letter of the material symbol in the blank in front of the correct term in the left hand column.

_____ 1. Brick

_____ 2. Tile

_____ 3. Concrete

_____ 4. Concrete block

_____ 5. Cut stone

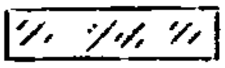
_____ 6. Plaster

_____ 7. Wood

_____ 8. Wall partitions

_____ 9. Glass

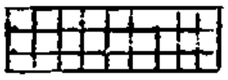
_____ 10. Metal

A 

B. 

C. 

D. 

E. 

F. 

G. 

H. 

I. 

J. 

80
3

Short-Answer

Directions: Study the drawing of the desk on page 45 in reference A. Then answer the questions below.

1. What are the total dimensions of the desk top? ______________
2. Is the top made of one solid piece of wood? ______________
3. Are all of the drawers the same size? ______________
4. What are used to fasten the frame to the legs? ______________
5. What is the total height of the desk? ______________
6. To what radius are the corners of the legs rounded? ______________
7. How many drawers are there? ______________
8. What is the total length of the legs? ______________
9. How far from the bottom of the desk should it be to the center of the stretchers? ______________
10. How far in from the front and back edges of the top should the inside of the legs be located? ______________

Assignment
Sheet No. 8

Covering
Units 118-122

ESTIMATING MATERIAL AND CALCULATING COSTS

Cabinetmaking materials come in a wide variety of kinds and grades. When obtaining these materials it is necessary to designate exactly what is wanted in order to get the materials needed to do the job correctly. The addition of new materials on the markets has necessitated the use of systematic and accurate orders.

The cabinetmaker, therefore, must have a good knowledge of how materials are bought and sold. He must have some basic mathematical ability in order to calculate material amounts, their costs, and the cost of the total job.

In this assignment you will have an opportunity to learn how materials are designated with regard to size, grade, quantity, etc. You will also learn how to calculate the amount of material, the cost, and some of the methods of recording this information.

Assignment:

1. Read the references listed below.
2. Answer the questions below and turn in this assignment by ____________________.

References:

A. Feirer, Woodworking for Industry, pp. 122-126.
B. Dahl and Wilson, Cabinetmaking and Millwork, pp. 81-111.
C. Towers, Cabinetmaker's Manual, pp. 50-58.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. Certain kinds of lumber are cut to odd numbered lengths.

T F 2. The finished size of a board is referred to as the nominal size.

T F 3. Finished lumber sizes have been standardized so that lumber of a given size from one mill can be used interchangeably with lumber from another mill.

T F 4. Dressed hardwood generally will be smaller in thickness than dressed softwood of the same nominal size.

T F 5. The term "tally" refers to the actual count of pieces of stock and the amount of lumber contained.

T F 6. The first thing to determine is the board length when figuring board measure with a board rule.

T F 7. It is possible to use certain framing squares for figuring board measure.

T F 8. All fractions of a board foot are dropped when tallying lumber.

T F 9. The tally sheet is used whether the board rule is used or not.

T F 10. In tallying random widths and lengths no record is made of the size of each particular piece.

T F 11. Lumber less than 1" in thickness is still considered 1" whereas lumber over 1" is figured at its exact thickness.

T F 12. All boards less than an even number of inches in width are counted as the next even width.

T F 13. Lumber that is milled to detail or odd measure is figured to the next larger rough nominal size.

T F 14. Plywood is figured the same as solid stock lumber.

T F 15. Full size details and supporting stock bills are received by the cabinet shop with the contract order.

T F 16. Shop drawings for specially designed items are made by the detailer.

T F 17. The stock biller and the detailer may be the same person.

T F 18. The stock cutter is a power tool specialist.

T F 19. The term "net" refers to stock which must be cut to the exact dimensions listed.

T F 20. Stock bills ordinarily carry all three dimensions in net size.

T F 21. Both the foot mark and the inch mark are underscored with a horizontal line to prevent mistaking them for numbers.

T F 22. The stock cutter always selects the lumber to be used.

T F 23. When material is routed to the trim sawyer it means that a decorative cut is put on by the trim sawyer.

T F 24. The stock biller need not be concerned with milling allowances.

T F 25. The efficiency of the stock cutter can be determined by inspecting the stock pile.

T F 26. Board measure is figured on the basis of the size of the board as it is cut at the sawmill.

T F 27. Any board less than one inch in thickness is figured as one inch in determining its board measure.

T F 28. Hardwoods can be purchased in specified widths.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. The order of dimensions of lumber should always be ____________ first, ____________ second, and ____________ third.

2. Lumber is usually sold by the ____________ ____________.

3. A piece of lumber that is 1" thick, 12" wide, and 12" long is referred to as a ____________ ____________.

4. The number of board feet contained in a piece of stock can be measured by placing the ____________ ____________ across the width of the stock and reading the measurement on the scale which corresponds to the ____________ of the board.

5. The numbers on the left hand side of a tally sheet represent the ____________ ____________ content in a single piece of lumber, 1" ____________ thickness.

6. Random lengths and widths are common with ____________ because of their scarcity.

7. Lumber prices are usually based on quantities of ____________ ____________ board feet.

8. Plywood and veneers are priced by the ____________ ____________.

9. A list giving the exact number and finished size of every item required for a mill order is called the ____________ ____________.

10. Before the stock billing is made a(n) ____________ ____________ should be made.

11. Factory orders are also known as ____________ or ____________ orders.

12. Measurements of cabinetwork and openings of a building are checked by the ____________.

13. Lists of items of hardware are placed in the ____________ ____________ of the stock bill.

14. Moldings are usually listed by ______________ feet.

15. The name identifying the stock bill order is that of the ______________.

16. The additional amount of material added to dimensions of stock to allow for finishing is the ______________ ______________.

17. Accurate estimating of lumber needed for a job should result in very few ______________ ______________.

18. A "two-by-four" will actually measure about ________ by ________ after it has been ______________ and ______________.

19. Standard thicknesses of softwoods are figured in ______________ while hardwood thicknesses are figured in ______________ of an inch.

20. Lengths of hardwood lumber vary from ________ feet and up and are usually ordered as ______________ length.

Multiple-Choice

Directions: In the space at the left of each statement, write the letter of the item which will provide the correct answer to complete the statement.

_____ 1. The measurement of stock used in a particular job is given in board feet according to (A) exact; (B) finished; (C) approximate; (D) nominal size.

_____ 2. A board foot contains (A) 12; (B) 24; (C) 128; (D) 144 cubic inches.

_____ 3. A board 1" x 10" x 72" contains (A) 2; (B) 3; (C) 5; (D) 7 board feet.

_____ 4. A board 1" x 8" x 12' contains (A) 4; (B) 8; (C) 10; (D) 12 board feet.

_____ 5. A board 1½" x 4" x 14' contains (A) 2; (B) 5; (C) 7; (D) 10 board feet.

_____ 6. If certain lumber sells for $370 per M it will cost (A) $.037; (B) $.37; (C) $3.70; (D) $10.40 for one board foot.

_____ 7. In cabinetmaking language FAS means (A) front and side; (B) firsts and seconds; (C) for all sides; (D) file and saw.

_____ 8. A group of readings obtained by using a tally stick that read 3½, 7½, 2½, 6½, 5½, and 4½ would have a total board foot amount, that would normally be used, of (A) 29; (B) 29½; (C) 30; (D) 30½.

_____ 9. Milled lumber lengths are figured as (A) even foot lengths; (B) odd foot lengths; (C) odd foot lengths under 8'; (D) odd and even foot lengths under 8'.

_____ 10. The cost of 130 bd. ft. of lumber that sells for $.21 per bd. ft. is (A) $2.73; (B) $27.30; (C) $273; (D) $25.

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. Items to consider when ordering softwood lumber are:

(A) ______________ (E) ______________

(B) ______________ (F) ______________

(C) ______________ (G) ______________

(D) ______________ (H) ______________

2. The detailer's responsibilities include:

(A) ______________ (C) ______________

(B) ______________

3. Factory orders may include three types of orders; namely:

(A) ____________________________

(B) ____________________________

(C) ____________________________

4. The first four items listed in order of take-off for stock cutting are:

(A) ______________ (C) ______________

(B) ______________ (D) ______________

5. The information that a tally lists is:

(A) ______________ (C) ______________

(B) ______________ (D) ______________

Short Answers

Directions: Indicate, in the blank space following the abbreviation, what the abbreviation represents.

1. rgh. ____________________
2. M ____________________
3. Bd. ft. ____________________
4. S2S ____________________
5. S4S ____________________
6. KD ____________________
7. T ____________________
8. L ____________________

Assignment
Sheet No. 9

Covering
Units 123-139

LUMBER AND LUMBER PROCESSING

Wood is, of course, the most important material used in cabinetmaking. There are a number of different kinds of wood and each one has certain characteristics and properties that make it more suitable for certain jobs than for others. Wood also varies within the same kind, is processed differently, and comes in various grades.

It is important for the cabinetmaker to know about wood so that he can select the right kind for the right job. He also needs to know how to handle certain wood that may have defects, undesirable features, and the like. This ability comes from a thorough understanding of the composition and processing of lumber.

In this unit you will have an opportunity to learn the structure of a tree, how it is processed, how to recognize certain woods and their uses, how lumber is graded, and some of the important things to consider when working with various woods.

Assignment:

1. Read the references listed below.
2. Select five different types of wood used at your place of employment. On a separate sheet of paper, using the form indicated below, list the names of the woods and the other information called for by referring to pages 79-85 in Reference A, pages 186-187 in Reference B and pages 8-9 in Reference C.

Name of Wood	Where Grown	Color of		Grain or Pattern	Good Qualities	Primary Uses
		Heartwood	Sapwood			

3. Answer the questions below and turn in this assignment by ____________________.

References:

A. Feirer, *Woodworking for Industry*, pp. 78-122.
B. Dahl and Wilson, *Cabinetmaking and Millwork*, pp. 163-188, 206-215.
C. Towers, *Cabinetmaker's Manual*, pp. 59-81, 433-435.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. Only about 100 varieties of trees in the forests of the United States have commercial value.

T F 2. Hardwoods differ considerably from softwoods in some of their uses and properties.

T F 3. Hardwoods are harder than softwoods but softwoods usually are tougher.

T F 4. Hardwoods tend to shrink more than softwoods.

T F 5. Some softwoods are actually harder than some hardwoods.

T F 6. The weight of wood tends to be a pretty good indicator of the relative strength of wood.

T F 7. There are some woods that are so heavy that they will not float in water.

T F 8. Since wood is cut so that the length is with the grain, most shrinkage occurs in length.

T F 9. With the newer drying methods that are now being used, very little waste of lumber results from warping.

T F 10. It is extremely important that the wood used in cabinetmaking and furniture production does not change in size.

T F 11. Woods that are dense and hard usually have the best nail-holding power.

T F 12. Of the commonly used nails, the barbed has the best holding power.

T F 13. When nailing lumber, it is best to have high moisture content in the wood to prevent splitting which reduces holding power.

T F 14. Defects in wood such as knots and checks seriously affect the stiffness of the wood and therefore should be avoided when stiffness is a desired quality.

T F 15. There are no softwoods that are high in toughness.

T F 16. Wood must contain about 7 per cent moisture, otherwise "dry rot" will set in.

T F 17. Wood will decay only when too much moisture is present.

T F 18. Wood that has been quarter-sawed will generally have better grain appearance than if it were plain-sawed.

T F 19. Wood has a natural, weather protecting surface and does not need to be painted to prevent decay.

T F 20. A knowledge of the structure of wood will be helpful in understanding how to work with wood.

T F 21. Imported woods are not important in the United States since we have all of the types of wood that we need.

T F 22. Heartwood is generally darker than sapwood and located in the center part of the tree.

T F 23. Hardwoods are usually composed of relatively larger cells which causes open or porous grain.

T F 24. Heartwood does not contribute to the growth of the tree.

T F 25. The vertical arrangement of wood cells results in the straight grain of wood.

T F 26. The amount of water that a wood cell contains is the same for both heartwood and sapwood.

T F 27. A tree usually grows more in the spring than in the summer.

T F 28. When both are dry, heartwood tends to be heavier and stronger than sapwood since heartwood is older and found near the center of the tree.

T F 29. "Quarter-sawed" is a term used mainly to describe hardwood boards that have been sawed a particular way.

T F 30. Plain-sawed lumber has a high tendency to shrink and warp.

T F 31. Close-grained woods are generally stronger than open-grained woods.

T F 32. Hardwoods are obtained from deciduous trees which means they shed their leaves annually.

T F 33. For purposes of use, woods are grouped according to their actual hardness and other properties rather than whether they lose their leaves or not.

T F 34. About the only products that wood can be used for are lumber and paper.

T F 35. The fiber saturation point is reached when each cell is filled with free water.

T F 36. Wood begins to shrink when the moisture content gets below the fiber saturation point.

T F 37. Cell walls shrink uniformly in all directions.

T F 38. Wood shrinks most in the direction of the annual rings.

T F 39. Wood tends to increase in strength, hardness, and stiffness as it dries.

T F 40. It is never desirable to both air dry and kiln dry lumber.

T F 41. The drying of lumber tends to cause some defects that lower the quality of the lumber.

T F 42. Wood that has been properly dried will tend to remain at the moisture content that was obtained by the drying process.

T F 43. Air-dried lumber is preferred when strength is desired.

T F 44. Moisture meters will give a more accurate reading than will oven samples.

T F 45. The best lumber is usually found in the lower part of the tree.

T F 46. There is usually quite a range within a lumber grade.

T F 47. Lumber is initially graded in the rough but may be put into a different grade if surfacing reveals some defects.

T F 48. Stain is a defect that is any color other than the natural color of the wood.

T F 49. A sound knot will usually have some decay.

T F 50. The number and size of defects in a piece of lumber are used to determine its grade.

T F 51. The first two grades of hardwood are usually sold as a group called firsts and seconds.

T F 52. Cypress and eastern red cedar are termed commercial hardwood but are actually softwoods.

T F 53. Softwood lumber may be graded differently in different parts of the United States.

T F 54. Hardwood interior trim and molding are listed only in a single grade.

T F 55. It is usually best to purchase lumber that is better than that which is actually needed.

T F 56. Retail lumber yards handle only softwood.

T F 57. Due to standardization, a cabinetmaker can move from one locality to another with little difficulty of adjusting to new technical problems.

T F 58. Standardized items of millwork are somewhat difficult to obtain.

T F 59. Although methods of door construction change, the sizes are fairly well standardized.

T F 60. Window and sash sizes are quite inconsistent throughout the various parts of the country.

T F 61. Paneling is a standard mill item usually carried in stock.

T F 62. Since the dimensions of a stairway cannot be exactly determined until a building has been constructed, details of stairway construction cannot be determined in advance.

T F 63. Dimension lumber is often kiln dried.

T F 64. A single log can produce lumber of several grades.

Completion

<u>Directions</u>: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. Extensive use is being made of about ________ species of softwoods and about ________ species of hardwoods.

2. Prime requirements of wood for furniture construction are _______________ appearance and desirable _______________ _______________.

3. Softwoods are used primarily for _______________ _______________.

4. One of the main disadvantages of hard woods is the difficulty of _______________ them.

5. The best direct method of checking the moisture content of wood is with a _______________ _______________.

6. Any variation from a true or plane surface in lumber is referred to as _______________.

7. For wood to remain in place after being used, there must be a minimum of _______________ and _______________.

8. The weakest parts of any construction are the _______________.

9. The wood which is considered to have the most toughness is _______________.

10. One of the most important imported woods is _______________.

11. The actual wood of a tree is composed of just the _______________ and _______________.

12. Growth rings are composed of ________ distinct parts.

13. Thin, hard growths radiating out from the center of the tree are called _______________ _______________.

14. When the fibers of wood are not straight, the wood is said to have _______________ _______________.

15. One cause of cross grain might be that the board was not cut parallel to the _______________.

16. When a log is cut so that the cuts are tangent to the annual rings it is said to be _______________ _______________ if hardwood or _______________ _______________ if softwood.

17. Quarter-sawed lumber is produced by cutting so that the cuts are approximately _______________ to the annual rings.

18. Quarter-sawed lumber tends to shrink, warp, and swell less and usually costs _______________ than plain sawed lumber.

19. Conifer is a term used in connection with softwoods and actually means _______________ _______________.

20. Moisture content of wood is indicated as a _______________.

21. Wood that contains over ________ per cent of moisture for an extended period of time will tend to decay.

22. Shrinkage across a plain-sawed face is about _______________ that across an edge-grained face.

23. The process or treatment used to reduce the moisture content of lumber to required limits is called _______________.

24. Lumber containing the moisture of the growing tree is said to be _______________.

25. Lumber may be dried either by _______________ drying, _______________ drying, or both.

26. The recommended moisture content for interior finishing of woodwork in the United States ranges from ________ per cent to ________ per cent.

27. A knot is formed where a _______________ once joined the trunk of the tree.

28. An unsound knot has some _______________.

29. Wane is the presence of _______________ or lack of _______________ on the corners of a board.

30. When grading firsts and seconds, it must be done from the _______________ side of the board.

31. Hardwood lumber that is classified as firsts must be ________ inches or more in width and from ________ to ________ feet in length.

32. The first step in grading a board for firsts is to determine the ______________ ______________.

33. A set of the grades of hardwood lumber is available from the ______________ ______________ ______________ ______________.

34. Yard lumber is classified into two grade qualities: ______________ and ______________ grades.

35. The major differences in the common grade of yard lumber are in the number of ______________ and the amount of ______________.

36. Structural lumber is ________ inches or more in thickness and width.

37. Pieces of strip lumber cut to common shapes and used for a finished appearance are called ______________.

38. When sections, parts, or units of a building are constructed to conform to a specific unit of measure or its multiples, it is called ______________ construction.

39. The most widely accepted unit for this purpose is a ________ ______________.

40. Door construction is usually of either ______________ ______________ ______________ or ______________ type.

41. The shape of interior and exterior trim items is always some variation of a ______________ ______________.

42. The cabinets usually required for a four or five room house are usually termed ______________ cabinets.

43. A large surface of wood enclosed in a narrow wooden frame is called a ______________.

44. Store fixtures designed to fit a particular wall space are called ______________ ______________.

45. Store fixtures that are generally standardized are those classified as ______________.

46. Wood is composed of about ________ per cent cellulose, ________ per cent lignin and 12 per cent other materials.

47. A 10 per cent moisture content can usually be maintained in cold, damp weather by heating the lumber to about ________ degrees above the outside temperature.

48. The noted diameter of a knot is found by adding its ______________ and ______________ diameters and dividing by ________.

49. Pitch pockets are found in certain species of ______________ and ______________ ______________.

50. Checks are commonly found in kiln dried ______________ and ______________ lumber.

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. Two things you should know in order to select wood properly are:

(A) ____

(B) ____

2. Three considerations for furniture construction are that the wood:

(A) ____

(B) ____________ ________________________________

(C) ____

3. List three hardwoods that are considered easy to work with hand tools.

(A) ______________________ (C) ______________________

(B) ______________________

4. Characteristics of wood which may be considered in identifying them are:

(A) ______________ (D) ______________ (G) ______________

(B) ______________ (E) ______________ (H) ______________

(C) ______________ (F) ______________

5. The advantages of kiln drying are:

(A) ____

(B) ____

(C) ____

(D) ____

6. Defects that may result from seasoning are:

(A) ____________________

(B) ____________________

(C) ____________________

(D) ____________________

(E) ____________________

7. The five standard grades of hardwood are:

(A) ____________________

(B) ____________________

(C) ____________________

(D) ____________________

(E) ____________________

8. The three main classifications of softwood lumbers are:

(A) ____________________

(B) ____________________

(C) ____________________

9. The decorative value of wood depends upon its:

(A) ____________________

(B) ____________________

(C) ____________________

(D) ____________________

10. Built-in cabinets can be classed into groups such as:

(A) ____________________

(B) ____________________

(C) ____________________

(D) ____________________

(E) ____________________

11. The six most important hardwood lumber trees in the United States from the standpoint of volume logged are:

(A) ______________

(B) ______________

(C) ______________

(D) ______________

(E) ______________

(F) ______________

Matching

Directions: In the left hand column is a list of terms. The right hand column contains descriptive phrases or synonymous terms. Match the descriptions to the terms by placing the letter of the description in the blank at the left of the appropriate term.

_____ 1. pitch pocket

_____ 2. check

_____ 3. split

_____ 4. heart shake

_____ 5. wind shake

_____ 6. pith

_____ 7. cross grain

_____ 8. crook

_____ 9. bow

_____ 10. cup

_____ 11. twist

_____ 12. warp

_____ 13. bark pocket

_____ 14. decay

_____ 15. stain

_____ 16. wane

A. soft, spongy, cullular tissue from the center of the tree

B. turning or winding of the edges of a board

C. holes caused by insects

D. disintegration of wood from any cause

E. an opening parallel to the annual rings, containing pitch

F. bark, or lack of wood, on a board edge

G. a lengthwise separation of the wood

H. grain not parallel to the length of the board

I. any deviation of a board from a straight line

J. discoloration caused by fungi or chemical action

K. a curve across the width of the board

L. tearing apart of cells because of improper handling

M. a board with the edge either convex or concave

N. shrinkage at the center of a log caused by decay

O. a board with the face warped along its length

P. a parch of bark encased by wood

Q. separation of annual rings

Assignment
Sheet No. 10

Covering
Units 140-145

PLYWOOD, VENEERS, AND SPECIAL MATERIALS

Many varieties of solid wood have a combination of strong points and defects which makes it difficult or impossible to use the wood to its best advantage. Much of the top grade of lumber in our forests is being rapidly depleted. To help preserve the lumber still available and to make more efficient use of the wood which is cut, new methods of manufacture have been devised. The cutting of veneers and the construction of plywood has permitted the use of many of these woods which might not be desirable nor strong enough as solid lumber. Also, recent research has developed many new materials that can be used very much like wood and now are an important part of cabinetmaking.

It is essential that the present day cabinetmaker be familiar with the other wood and wood related products. In most cases they require a somewhat different method of handling and use. Their use enables the cabinetmaker to expand his designs and to produce articles of more desirable appearance and construction.

In this assignment you will have the opportunity to become familiar with these products, especially how they are made and used.

Assignment:

1. Read the references listed below.
2. Make a list of the materials, other than solid wood, that are used in your place of employment and indicate some of the uses of each.
3. Answer the questions below and turn in this assignment by ____________________.

References:

A. Feirer, Woodworking for Industry, pp. 127-172.
B. Dahl and Wilson, Cabinetmaking and Millwork, pp. 194-205.
C. Towers, Cabinetmaker's Manual, 93-112, 116-122.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. Veneers are thin sheets of wood usually cut from poorer grades of weak structured softwoods.

T F 2. Laminating layers of wood for additional strength is an old practice.

T F 3. The use of plywood is still largely restricted to the making of cabinets and built-ins.

T F 4. Plywood is usually made up of an odd number of layers.

T F 5. Softwood plywoods are made entirely of plies of veneer.

T F 6. Rotary cutting of veneer is done on a lathe.

T F 7. Quarter slicing is desirable on most of the finer, imported woods.

T F 8. The greater number of plies for any one thickness, the greater the chance of splitting.

T F 9. The face and the back of plywood should always be of the same kind of wood.

T F 10. During and after redrying of face veneers, they are kept in the same order as when they were cut, to facilitate matching.

T F 11. A strip of plywood is not as strong in tension or compression as a strip of solid wood the same size.

T F 12. Plywood is stronger than steel of the same weight.

T F 13. The Sound Grade of hardwood plywood would be desirable for all cabinetwork.

T F 14. Type III plywood is best for exterior use.

T F 15. Hardwood plywood panels are usually sanded on both sides.

T F 16. Most softwood plywood in the United States is made of Douglas fir.

T F 17. Compreg is highly resistant to solvents.

T F 18. Regular woodworking equipment should be used when cutting Compreg.

T F 19. In order to protect the surface, plywood should be stored vertically, on edge when possible.

T F 20. No matter what method is used for cutting plywood, the good side should always be up.

T F 21. Nails and screws do not hold well in plywood.

T F 22. Tempered hardboard contains more than just wood fibers.

T F 23. Hardboard is available either with two smooth surfaces or with one smooth surface and one rough surface.

T F 24. Hardboard can be worked with regualr woodworking tools.

T F 25. Hardboard may be bent but should be bent in one direction only.

T F 26. Particle board contains larger bits of wood than hardboard and, due to these large bits and the adhesive, it is difficult to work with regular wood tools.

T F 27. Sheetboard is made from the lower grades of lumber.

T F 28. Since sheetboard has a covering of paper, it is not suitable for any type of cabinet.

T F 29. Plastics play an important part in modern cabinetmaking.

T F 30. When using contact cement to apply plastic laminate, it is necessary to apply the contact cement to both the laminate and the surface to which it is to be secured.

T F 31. When applying plastic laminate it is not possible to position the material once the cemented surfaces touch.

T F 32. On areas where it is impossible to use a roller to apply pressure on applied plastic laminate, it should be hammered directly with the face of the hammer.

T F 33. Once plastic laminate has been secured with a contact cement it cannot be removed.

T F 34. When using plastic laminate on a kitchen counter, it is best to make the sink cutout after the laminate has been bonded to the counter.

T F 35. Plastic laminate edge-banding can be used on round corners but should always be heated before bending.

T F 36. The cost of veneered furniture is higher than for solid furniture of the same wood.

T F 37. Duplicate grained veneers obtained from adjacent sheets is limited to four recognized matched designs.

T F 38. Almost all hardwood veneers are produced by slicing.

T F 39. Exterior plywood is moisture resistant and may be used for boats and other outdoor uses.

T F 40. Contact cements permit the installation of laminated plastic sheeting without the use of clamps.

T F 41. A disadvantage of laminated plastic is that it cannot be cut with the aid of power tools.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. Several thin sheets of wood glued with the grain of adjacent sheets at right angles to each other is called ____________ .
2. Matched designs of figured wood are made with veneers that come from the ____________, ____________, or ____________ part of the tree.
3. Logs too hard to be easily cut for veneers are conditioned by the use of ____________ or ____________ ____________ .
4. Hardwood plywoods are classified as either ____________ core or ____________ core.
5. The most common method of cutting veneer for plywood is ____________ ____________ .
6. Standard American veneer is ________ inches thick.
7. The center layer or layers in plywood is known as the ____________ .
8. Strong, but unattractive wood can be used for cabinets when it is ____________ .
9. Resin-treated modified wood is made in two forms: uncompressed or ____________ and compressed or ____________ .
10. Plywood that is covered with hardboard is called ____________ .
11. When working with plywood after it has been cut, the face corners can be protected from chipping by applying ____________ to them.
12. Due to the thinness of veneer, it is important in preparing the surface not to ____________ the surface of plywood too much.
13. Particle board combines the better utilization of wood with the new developments in ____________ .
14. Particle board is used to considerable extent as ____________ stock in cabinetwork.
15. Particle board has screw holding power that is similar to ____________ .
16. The letters EXT-DFPA stand for ____________ ____________ ____________ ____________ ____________ .

Multiple-Choice

Directions: In the space at the left of each statement, write the letter of the item which will provide the correct answer to complete the statement.

_____ 1. The layer just under the face ply of a 5-ply panel is the (A) module; (B) flitch; (C) feather; (D) crossband.

_____ 2. Many problems of plywood manufacture are eliminated by the use of (A) balanced; (B) sandwich; (C) striated; (D) matching construction.

_____ 3. Hardwood veneer core plywood that is ½" thick is usually composed of (A) 3; (B) 5; (C) 7; (D) 9 plies.

_____ 4. A special plywood product that contains a thin layer of aluminum foil for beautifying effects and resistance to heat is (A) plyron; (B) striated plywood; (C) finishield; (D) prefinished plywood.

_____ 5. When nailing plywood, the nails should usually be spaced (A) 3; (B) 6; (C) 8; (D) 10 inches.

_____ 6. When using screws with 3/4" plywood, the length of the screws should be (A) 3/4" or longer; (B) 1" or longer; (C) 1 1/4"; (D) 1 1/2" or longer.

_____ 7. The best joint for plywood corners is the (A) miter; (B) butt; (C) rabbet; (D) lap joint.

_____ 8. Plastic laminates are made of (A) polyethylene; (B) vinyl; (C) melamine and phenolic; (D) polyester.

_____ 9. Plastic laminates are usually (A) 1/32"; (B) 1/16"; (C) 3/32"; (D) 1/8" thick.

_____ 10. When edge-banding with plastic laminate around a corner, there should be a flat surface on each side of the curved portion of at least (A) 2"; (B) 4"; (C) 6"; (D) 8".

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. The major parts that make up a piece of plywood are the:

(A) ____________________ (C) ____________________

(B) ____________________

2. The wood grain and figure pattern of face veneers are determined primarily by:

(A) ______________________________

(B) ______________________________

(C) ______________________________

3. The three methods of cutting veneer from logs are:

(A) ______________________ (C) ______________________.

(B) ______________________

4. Matching plywood involves the selecting of plies that are nearly identical in:

(A) ______________________ (C) ______________________

(B) ______________________

5. Matching of veneers falls into three main classifications, namely:

(A) ______________________ (C) ______________________

(B) ______________________

6. List five advantages of plywood.

(A) ______________________ (D) ______________________

(B) ______________________ (E) ______________________

(C) ______________________

7. List the five grades of hardwood plywood.

(A) ______________________ (D) ______________________

(B) ______________________ (E) ______________________

(C) ______________________

8. List the seven items that should be specified when ordering hardwood plywood.

(A) ______________________ (E) ______________________

(B) ______________________ (F) ______________________

(C) ______________________ (G) ______________________

(D) ______________________

9. List seven advantages of hardboard.

(A) ______________________ (E) ______________________

(B) ______________________ (F) ______________________

(C) ______________________ (G) ______________________

(D) ______________________

10. List five items to specify when ordering hardboard.

(A) ______________________ (D) ______________________

(B) ______________________ (E) ______________________

(C) ______________________

11. Four trade names for laminated plastics are:

(A) ______________________ (C) ______________________

(B) ______________________ (D) ______________________

Assignment
Sheet No. 11

Covering
Units 146-149

FRAMING SQUARE AND GEOMETRIC LAYOUT

The framing square, sometimes called "steel square," is a very versatile tool. Its use is not restricted to building construction but rather is a valuable tool for cabinetmaking, also. Its use will enable the cabinetmaker to be more efficient and will help in some of the mathematical computations.

Geometry also plays an important part in a cabinetmaker's work. Most layout and design work can be divided into relatively simple geometric problems. A good knowledge of geometry will enable the cabinetmaker to vary his designs and to expand his abilities. Application of such knowledge has a direct bearing on the competency of the cabinetmaker.

In this assignment you will have the opportunity to study the ways in which the steel square can aid the cabinetmaker. You will also learn how geometric constructions can be used to advantage for layout and fitting of cabinets.

Assignment:

1. Read the reference listed below.
2. Answer the questions below and turn in this assignment by ______________________ .

Reference:

B. Dahl and Wilson, Cabinetmaking and Millwork, pp. 120-125, 132-162.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. A steel square to be used for cabinetmaking should have scales graduated in tenths, twelfths, and sixteenths of an inch.

T F 2. The hypotenuse of any right-angle triangle can be found on the steel square.

T F 3. The diagonal of a 12-inch square measures about 20 inches.

T F 4. The diagonal of a rectangular solid can be found on the steel square.

T F 5. Certain layouts will require the use of the inside edge of the tongue of the square with the outside edge of the body of the square.

T F 6. The body and the tongue of a steel square are the same width.

T F 7. When butt joints are used on square hoppers, two of the sides are smaller by the thickness of the material of the other two sides.

T F 8. The construction of a hexagon should begin with a circle.

T F 9. The drawing of a spiral starts with a small circle.

T F 10. Miter cuts on boards of unequal widths are laid out by laying one board on top of the other at the desired angle, marking the edges at the outside and inside intersections and connecting the points.

T F 11. A circle may be drawn by using a steel square, two nails, and a pencil.

T F 12. When laying out a large, accurate ellipse by means of a wooden trammel, the trammel should be constructed a little longer than the major axis.

T F 13. A pipe that is to pass through a board at an angle will require an elliptical opening in the board.

T F 14. A pediment is a triangular frame resembling a gable crowning the front of an entrance.

T F 15. The layout of an inclined die counter with a curved end should be done on large paper and transferred to the stock.

completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. A steel square with a tongue that is __________ inches long is best for cabinetmaking.

2. Since the body and tongue of a steel square are at right angles to one another, it can be used for solving any __________________ problem.

3. The square of the hypotenuse of a right triangle is equal to the _______________ of the _______________ of the other two sides.

4. When working with triangles larger than are possible full size on the steel square, it may be necessary to perform _____________ ______________________ in order to get the desired accuracy.

5. The job of laying out miter and butt joints for polygons can be simplified by the use of a ______________ of polygon cuts.

6. A hopper is wider at the ______________ than at the ____________.

7. Jointing on a hopper requires a butt joint of ________________ than 90 degrees and a miter cut of ____________ than 45 degrees.

8. The area of mathematics that is of great value for cabinetmaking layout is ______________.

9. A plane surface intersecting a cylinder at an oblique angle forms a(n) ______________ at the intersection.

10. The distance from one end of the minor axis of an ellipse to the focus on the major axis is equal to ______________ the major axis.

11. Molding placed in a slanting position is known as ______________ molding.

12. The vertical front face of a counter is called a(n) ____________ .

13. Folding leaves of table tops are usually fastened with ______________ joints.

14. Practice in layout work is usually done on the ______________ ______________ .

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. List three types of polygons.

(A) ________________ (B) ______________ (C) ________________

2. Some of the more commonly used layout tools for cabinetwork are:

(A) ________________________ (F) ________________________

(B) ________________________ (G) ________________________

(C) ________________________ (H) ________________________

(D) ________________________ (I) ________________________

(E) ________________________

3. Measurements that must be available in order to layout a curved and slanted counter front are the:

(A) ____________________

(B) ____________________

(C) ____________________

Assignment
Sheet No. 12

Covering
Units 150, 151

WOOD JOINERY

Every construction project which is made of more than one part must be fastened in some way with one or more types of joints. Sometimes these joints need special additions to make them effective and acceptable. The type of wood, the way that the parts come together, and the function of the finished object are considerations that must be made in selecting the joint to use. Some joints can be constructed quite rapidly but will not stand up over a period of time.

It is important that the cabinetmaker select the proper joint to use so that the object will have a pleasing appearance and will hold together for the desired time. Selection of the wrong joint or poor workmanship on the joint will quickly hurt the cabinetmaker's reputation if this results in poor appearance or the object pulling apart.

In this assignment you will have an opportunity to learn what some of the common joints are that are used in cabinetmaking. You will learn the advantages and disadvantages of each, when they should be used, and how to construct them.

Assignment:

1. Read the references listed below.
2. Examine a completed piece of cabinetwork and list the different joints that were used. Indicate the place on the object where they were used and whether it was the best choice of joint.
3. Answer the questions below and turn in this assignment by ____________________.

References:

A. Feirer, Woodworking for Industry, pp. 296-320.
B. Dahl and Wilson, Cabinetmaking and Millwork, pp. 49-56.
C. Towers, Cabinetmaker's Manual, pp. 123-145.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. When making duplicate parts, one should perform the same operation on all parts before starting a new step.

T F 2. When selecting a joint it is a good idea to select the simplest one that will do the job.

T F 3. The holding power of a joint depends primarily on the use of good, strong glue.

T F 4. Since a mortise-and-tenon joint requires considerable work and effort the butt joint reinforced with dowels and corner blocks is sometimes used.

T F 5. Dowels used for strengthening joints should be cut so that they fit right up to the bottoms of the holes.

T F 6. The spiral groove on dowel pins is a result of the manufacturing process and it does not serve any functional purpose.

T F 7. For proper strength the diameter of the dowel should be about three-fourths the thickness of the stock.

T F 8. All splines should be made of wood.

T F 9. An end-butt joint by itself has very little, if any, strength.

T F 10. The angle for a scarf joint should be very shallow.

T F 11. Edge joints, correctly made with a good grade of glue under proper conditions, will be as strong as the wood.

T F 12. Milled joints are usually stronger than non-milled edge-to-edge joints.

T F 13. Milled joints permit faster assembly time.

T F 14. The rabbet is cut easiest on the circular saw.

T F 15. The dado joint can usually be secured with glue alone.

T F 16. The plain lap joint is only as strong as the fasteners used.

T F 17. A lap joint should be used only when the two pieces cross at right angles.

T F 18. The miter joint is a relatively strong joint.

T F 19. A miter joint must always be cut at 45 degrees.

T F 20. Even though the lock miter joint is a strong joint and somewhat complicated, it can be cut on the circular saw.

T F 21. The dovetail joint provides great strength.

T F 22. The miter joint by itself is particularly weak when used with plywood.

T F 23. The dovetail dado joint requires special equipment to make.

T F 24. The time needed to construct a joint is an important thing to consider.

T F 25. Bottoming is a term used to describe the cutting of a groove or mortise.

T F 26. Milled glue joints are cut by passing each piece through the shaper with the face down.

T F 27. End-grain glue joints are very weak.

T F 28. End- and middle-lap joints are seldom used in exposed construction.

T F 29. The miter joint needs no further reinforcement.

T F 30. The maximum mortise width on thin stock should be about one-half the thickness of the stock.

T F 31. The tenon member requires no machining in the case of the housed mortise and tenon.

T F 32. Inferior cabinetwork is usually fastened with glue.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. In cabinetmaking, stock is brought to correct thickness and width by planing and jointing, and to correct length by ______________.

2. Before stock is rough cut to size it should be checked for ______________ and ______________ ______________.

3. When selecting the type of joint to use for construction, you should consider its final ______________ and its ______________.

4. The best joint for fastening the front of a drawer to the sides is a ______________ joint.

5. Coped joints are often used in ______________ work and in ______________ work.

6. A new and important joint for end grain that has had an important influence in industrial woodwork is the ______________ joint.

7. The simplest and easiest joint to construct is the ______________ joint.

8. A rabbet joint should be cut to a ______________ equal to the thickness of the material and to a ______________ of one-half to two-thirds the thickness.

9. A groove cut across grain to receive the butt end of another piece is called a ______________.

10. An angle joint that hides the end grain of both pieces is a ______________ joint.

11. Grooves cut into the edges of stock to be joined are used when the ______________ joint is constructed.

12. The angle for the ordinary dovetail joint is one to ____________.

13. The lock corner joint is used in ______________ manufacturing.

14. Off-center dowel holes will make surfaces ______________.

15. Dowel holes which are not perpendicular will cause the surfaces to be ______________ ______________ ______________.

16. Dowel ends should be ______________ to make them easier to drive.

17. Dowel stock may be purchased in diameters from __________ inch to __________ inch.

Multiple-Choice

Directions: In the space at the left of each statement, write the letter of the item which will provide the correct answer to complete the statement.

_____ 1. The maximum that the angle for a scarf joint should be is (A) 6; (B) 12; (C) 18; (D) 30 degrees.

_____ 2. A good joint to use to fasten the backs of cabinets and bookcases would be the (A) rabbet; (B) dado; (C) miter; (D) lap joint.

_____ 3. A dado that goes only part way across the board is called a (A) dovetail; (B) partial; (C) blind; (D) half dado.

_____ 4. A good joint for leg-and-rail construction is the (A) mortise-and-tenon; (B) dovetail; (C) dado; (D) rabbet joint.

_____ 5. A spline should usually be about (A) 1/16"; (B) 1/8"; (C) 3/16"; (D) 1/4" thick

_____ 6. The distance that the tenon of a mortise-and-tenon joint should project into the other piece is (A) about 1/4 the thickness of the stock; (B) always 1/2"; (C) about 1/2 the thickness of the stock; (D) at least 3/4".

_____ 7. The length of a tenon should be at least (A) 1"; (B) 1 1/4"; (C) 1 1/2"; (D) 2".

_____ 8. The depth of the mortise of a mortise-and-tenon joint should be (A) the same as the projection of the tenon; (B) 1/8" less than the tenon; (C) 1/8" deeper than the tenon; (D) 1/4" deeper than the tenon.

_____ 9. A joint with both parts having their grain parallel is (A) an end joint; (B) an edge joint; (C) a parallel joint; (D) a mitered joint.

_____ 10. The thickness of a spline should be equal to (A) one-eighth; (B) one-fourth; (C) one-third; (D) one-half the thickness of the stock.

_____ 11. The width of the spline should be (A) one-fourth; (B) one-half; (C) equal to; (D) twice the thickness of the stock.

_____ 12. Cleated edge joints are used for (A) sub-assembly work; (B) finished surfaces; (C) building up stock to width; (D) structural reinforcement.

_____ 13. A sloping cut made on the end of each piece of stock to be joined is called the (A) end-lap; (B) face-lap; (C) finger; (D) scarf joint.

_____ 14. A spline running at right angles to a miter joint creates the (A) slip-feather; (B) slip; (C) miter-spline; (D) miter-feather joint.

_____ 15. One of the strongest joints is the (A) doweled; (B) mortise and tenon; (C) miter; (D) scarf.

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. The type of joint to be used on a particular project depends upon:

(A) _____________________ (D) _____________________

(B) _____________________ (E) _____________________

(C) _____________________

2. List six methods, other than glue, nails, and screws, for strengthening joints.

(A) _____________________ (D) _____________________

(B) _____________________ (E) _____________________

(C) _____________________ (F) _____________________

3. List the nine basic types of joints.

(A) ______________________

(B) ______________________

(C) ______________________

(D) ______________________

(E) ______________________

(F) ______________________

(G) ______________________

(H) ______________________

(I) ______________________

Assignment
Sheet No. 13

Covering
Units 152-154

CONSTRUCTION OF CABINETS AND BUILT-INS

Actual construction of cabinets can be broken down into two divisions--the cabinet or built-in carcass, and the individual parts that are included in most cabinets. This assignment is concerned with the first division named, that of the cabinet or built-in itself. Since more than one worker may work on the entire cabinet, it is necessary that some means of layout and measurement be used to assure uniformity and correct assembly. The layout rod is used for this purpose. There are also different ways of constructing the main part of a cabinet, the type and style of cabinet determining which methods should be used.

The cabinetmaker needs to be familiar with rod layout in order to perform his duties and work with others.. He also needs to know the various ways of constructing cabinets in order to understand how a cabinet is constructed and to construct those that are required of him.

In this assignment you will learn how to use rod layout for laying out cabinet work. You will also study the various ways of putting cabinets together.

Assignment:

1. Read the references listed below.
2. Answer the questions below and turn in this assignment by ____________________.

References:

A. Feirer, Woodworking for Industry, pp. 388-400, 418-424, 553-558.
B. Dahl and Wilson, Cabinetmaking and Millwork, pp. 112-119, 240-246.
D. Siegle, Cabinets and Built-Ins, pp. 9-13, 19-27, 32-41, 46-50, 71-79.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. A layout rod is a long piece of flat stock on which measurements are made for stock layout.

T F 2. Layout rods are used only on jobs that will have repeat orders.

T F 3. One face of the rod is trued up and used for all dimensions.

T F 4. A definite order of layout is followed in marking with the rod.

T F 5. The rod goes with the stock through its route in the shop.

T F 6. The dimensions of the various layouts are not written on the rod.

T F 7. In skeleton construction the legs are almost always joined to the rails with the mortise-and-tenon joint.

T F 8. A drawer is an example of simple case construction.

T F 9. Case construction is found in most cabinets and built-ins.

T F 10. Carcass construction contains fewer internal details than case work.

T F 11. Since panel construction is composed of different parts there tends to be more warpage than with solid stock.

T F 12. Drawer guides are sometimes made as a part of the case.

T F 13. Generally, in panel construction, just the joints of the frame should be glued and not the panel in the groove.

T F 14. Some doors are constructed much like panels.

T F 15. In case construction, the first problem is to decide the means of fastening the bottom.

T F 16. An open frame is usually found on more expensive construction.

T F 17. Glue blocks should never be nailed.

T F 18. Building a built-in for a particular house and making a standard piece of cabinetwork involves about the same work.

T F 19. Factory-built kitchen units tend to have more elaborate construction in the base cabinets than do carpenter-built.

T F 20. The use of plywood for built-ins has practically eliminated the need for moldings and panelwork.

T F 21. Plywood doors can be reinforced and given a nice edge finish by grooving and inserting a strip of wood.

T F 22. The mortise-and-tenon joint is a typical joint used on the rough frame of a cabinet.

T F 23. Remodeling of old kitchens represents a real challenge to the cabinetmaker and a source of good business.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. When laying out the height, width, or length of the cabinet and its parts, the ____________ dimension should usually be laid off first.
2. A rod layout consists of ____________ only.
3. The overall dimensions of a cabinet do not include any ____________ or ornamentation.
4. The vertical parts of the frame in panel construction are called ____________ and the horizontal parts are called ____________.
5. The center rails of a panel, if they are included, are called ____________.
6. When assembling a panel construction, the edges of the panel should be covered with ____________ before final assembly.
7. Great care must be taken in leg-and-rail construction since the legs have a tendency to ____________ _________ ____________.
8. Dividers used in case construction should be ____________ into the other members.
9. The corners of a frame should be made with ____________ joints.
10. Built-ins must be made to ____________ the irregular surfaces.
11. The construction of cabinets depends to some degree on the ____________ of the house.
12. Old-style medicine chests are many times being replaced by ____________.
13. Tile used on the tops of bathroom cabinets are bedded in cement which is reinforced with ____________ ____________.
14. Toe room around cabinets and built-ins is usually ____________ x ____________.

Multiple-Choice

Directions: In the space at the left of each statement, write th letter of the item which will provide the correct answer to comple the statement.

_____ 1. The shell of a cabinet is known as the (A) cabinet frame; (B) casework; (C) carcass (D) cabinet standard.

_____ 2. When gluing up stock to make a large area of solid stock, the pieces to be glued should be about (A) 1 to 2; (B) 2 to 4; (C) 4 to 6; (D) 6 to 8 inches wide.

_____ 3. The most common method of treating the edges of plywood is with (A) veneer; (B) thin solid stock; (C) tongue and groove; (D) molding.

_____ 4. The most common method of joining legs to cross rails is with (A) a blind mortise-and-tenon; (B) dowels and a corner block; (C) an open mortise-and-tenon; (D) a dovetail joint.

_____ 5. The standard dimension for the height of kitchen cabinet counters above the floor is (A) 25; (B) 30; (C) 36; (D) 42 inches.

_____ 6. The standard distance from the top of the refrigerator to the bottom of a cabinet above the refrigerator is (A) 6; (B) 8; (C) 10; (D) 12 inches.

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. List the five basic ways in which cabinetwork is put together.

(A) ____________________ (D) ____________________

(B) ____________________ (E) ____________________

(C) ____________________

2. List three common ways of covering large areas or surfaces in cabinetmaking.

(A) ____________________ (C) ____________________

(B) ____________________

3. List four considerations in arranging pieces to be glued up to make wider stock.

(A) ____________________

(B) ____________________

(C) ____________________

(D) ____________________

4. List three methods of taking care of space above wall cabinets in a kitchen.

(A) ______________________ (C) ______________________

(B) ______________________

5. List three important requirements of any bathroom.

(A) ______________________ (C) ______________________

(B) ______________________

6. List two requisites of a cabinetmaker who intends to work in the modernizing of old kitchens.

(A) ____

(B) ____

Assignment
Sheet No. 14

Covering
Units 155-158

CONSTRUCTION OF CABINET PARTS AND SPECIAL FEATURES

The quality of the finished cabinet will usually be no better than the quality of the parts that make up the cabinet. Some parts are machined and go directly into the casework while others are assembled to form separate units that fit into the total cabinet. There are also special features that the cabinetmaker is called on to do which require a somewhat specialized knowledge and skill.

It is important for the cabinetmaker to be able to construct the various parts of the cabinet and to understand the functions of these parts. It is also essential that the cabinetmaker, in order to maintain his job, perform some of these specialized duties.

In this assignment you will learn what the various parts of a cabinet are used for and how they are constructed to become part of the cabinet. You will also learn of some of the special features that are sometimes part of cabinets and the cabinetmaker's work.

Assignment:

1. Read the references listed below.
2. Answer the questions below and turn in this assignment by ____________________.

References:

A. Feirer, Woodworking for Industry, pp. 400-418.
B. Dahl and Wilson, Cabinetmaking and Millwork, pp. 222-239.
D. Seigele, Cabinets and Built-Ins, pp. 14-18, 80-88, 93-100.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. The top of a cabinet is usually constructed in only one way.

T F 2. A skeleton frame usually consists of stiles and rails only.

T F 3. The edge of an open shelf may be faced with material of the same type as the exterior.

T F 4. The finish thickness of a face frame is made the same thickness as the doors which fit in it.

T F 5. Cabinetmakers, in some parts of the country, refer to all paneled or flush cabinet doors as china closet doors.

T F 6. The correct order of listing drawer dimensions is width, height, and depth.

T F 7. Square sticking refers to sash or frame stock cut in square or rectangular cross-section with no decorative edge cuts.

T F 8. A drawer kicker is used to prevent a drawer from being pulled out too far.

T F 9. Before constructing a door for a cabinet it is important to determine what type of hinge to use.

T F 10. Butt hinges tend to be rather plain with not much eye appeal and therefore are not used much for fine construction.

T F 11. Surface hinges are easier to use on flush doors than butt hinges.

T F 12. If an opening for a flush door is not square, it must be corrected before the door is cut.

T F 13. The hinge side of a flush door is usually cut at a slight bevel so that the door will open and close without striking the frame.

T F 14. A lip door is easier to fit than a flush door.

T F 15. Semi-concealed hinges are good to use on lip doors made from plywood.

T F 16. Sliding doors should always have purchased tracks to run on.

T F 17. Doors should usually be hung with at least three hinges.

T F 18. The simplest drawer utilizes a dovetail joint to fasten the front to the sides.

T F 19. The drawer-corner joint is not too strong but is easy to make.

T F 20. If a center guide and runner are used for a drawer, the bottom of the drawer should not be any higher than 1/4" from the bottom of the sides.

T F 21. The bottom of a drawer should not be glued into the grooves.

T F 22. If a side guide and runner are used for a drawer, the groove on the side of the drawer should be below center in order to best support the weight that may be put into the drawer.

T F 23. The best drawer guide to use is the center drawer guide and runner.

T F 24. When using the center guide and runner, the drawer can be prevented from being pulled out too far if the runner opening is not extended through the back of the drawer.

T F 25. The guide and runner of a drawer should never be painted or finished.

T F 26. Complicated cabinets should be assembled in stages.

T F 27. A cabinet should be clamped up temporarily without fasteners or glue to see if it will assemble properly before fastening permanently.

T F 28. A door that is closed and has concealed hinges will not reveal any portion of the hinges.

T F 29. When using commercial roller guides for drawers, the commercial guides come in one piece and the bottom edges of the drawer sides ride on the guides.

T F 30. A cabinet that is to be hung on the wall must have a back in order to hang it.

T F 31. Cabinet work today is still done almost entirely by hand and requires exceptional skill with hand tools.

T F 32. A soffit can be constructed after the cabinets have been hung.

T F 33. Drawer bumpers are added to the drawers to prevent the lip from cracking or breaking.

T F 34. The primary purpose of a cabinet should never be to conceal other constructions.

T F 35. Lazy susan or revolving shelves can be placed directly above one another and supported on the sides.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. A cabinet end is sometimes called a(an) ________________ if it is covered, or a(an) ________________ or side if it is exposed.

2. If a paneled end is butt jointed to the face frame, the front stile is made ________________ than the back stile to compensate for the thickness of the face frame.

3. Dividers of solid glued-up stock placed between shelves are known as ________________ or ________________.

4. The bottom shelf of a cabinet is supported in the center by _______________.

5. Shelves can be fitted into a cabinet so that they are either _______________ or _______________.

6. Cupboard door and sash dimensions are listed, in order, as _______________, _______________, and _______________.

7. Drawers are usually classified as _______________ front or _______________ front.

8. A drawer should have a clearance of __________ inch in height and __________ inch in width.

9. The cheapest type of drawer will probably have the sides fastened to the front by means of a _______________ joint.

10. A butt hinge must be mortised in and requires that a _______________ be cut in both the door and the frame.

11. A drop door will function best when a _______________ hinge is used.

12. When space is limited, _______________ doors are commonly used.

13. When cutting grooves to install sliding doors, the _______________ groove should be cut twice as deep as the _______________ so that the doors can be removed.

14. A gain is the opening made for a _______________.

15. A dropleaf table joint is sometimes called a _______________ joint.

Multiple-Choice

Directions: In the space at the left of each statement, write the letter of the item which will provide the correct answer to complete the statement.

_____ 1. A pre-assembled unit which forms the opening into which doors are fitted is called a (A) face frame; (B) carcass; (C) cabinet case; (D) cupboard sash.

_____ 2. Drawer bottoms should be cut to allow a clearance in the grooves of the drawer sides of (A) 1/8"; (B) 1/16"; (C) 1/32"; (D) none.

_____ 3. The depth of a drawer should be less than the depth from the face to back of the case by (A) 1/16"; (B) 1/4"; (C) 1/2"; (D) 1".

____ 4. If a door binds on the hinge side when using butt hinges it requires (A) a deeper gain; (B) the position of the hinge to be changed; (C) a piece of material glued under the hinge; (D) a bevel cut on the hinge side of the door.

____ 5. From grooves for the drawer bottom to the bottom edge of the drawer, there should be at least (A) 1/16; (B) 1/8; (C) 1/4; (D) 1/2 inch.

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. The purposes of the skeleton frame are:

(A) ____________________

(B) ____________________

(C) ____________________

2. Methods used to guide a drawer as it slides include:

(A) ____________________

(B) ____________________

(C) ____________________

(D) ____________________

3. The four most common joints for fastening the front of a drawer to the sides are:

(A) __________ (C) __________

(B) __________ (D) __________

4. List three methods of installing tops to tables.

(A) ____________________

(B) ____________________

(C) ____________________

5. List four ways of installing shelves.

(A) __________ (C) __________

(B) __________ (D) __________

Assignment
Sheet No. 15

Covering
Units 159-164

FURNITURE MANUFACTURING

There are some who consider furniture manufacturing as part of cabinetmaking and there are others who do not. In a sense, it is quite similar to the making of cabinets, utilizing the same types of joints, layout, finishing, etc. There are, however, some differences, particularly in mass production shops. It should be noted that the general procedure is much the same in either mass production or small job shop production.

This unit will give you an opportunity to study furniture manufacturing in a limited sense, particularly from the large industrial standpoint.

Assignment:

1. Read the reference listed below.
2. Answer the questions below and turn in this assignment by ____________________.

Reference:

A. Feirer, Woodworking for Industry, pp. 425-443.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. Machines used in industry for furniture making are larger and faster than those found in schools but they perform the same operations.

T F 2. The double planer and surfacer combines the operations of the power jointer and the planer and trues up all four sides of a board in one operation.

T F 3. A single-end tenoner will only cut tenons.

T F 4. A double-end tenoner is capable of making many different types of cuts and on both ends of the board at the same time.

T F 5. Some automatic lathes will do everything except load the machine.

T F 6. The double-spindle shaper has two cutters rotating in opposite directions.

T F 7. Automatic shapers are used primarily for custom work and therefore are not too important in furniture production work.

T F 8. A gang borer is a machine that bores several holes, one after the other, automatically.

T F 9. Drum sanders have a single large disk against which the ends of boards are sanded.

T F 10. The furniture designer of today relies entirely on his own creativity for his designs.

T F 11. As a last step in the design of a piece of furniture, the designer makes a full-size working drawing.

T F 12. Cabinetmakers who work on experimental models must also make their own jigs and fixtures.

T F 13. A sample must always be made before the final product is produced.

T F 14. The length of time from the purchase of the lumber to the making of it into furniture is normally about one month.

T F 15. Most furniture manufacturers make their own lumber-core plywood.

T F 16. Core stock for inner layers of plywood is usually made from cheaper woods.

T F 17. Structural parts of furniture such as legs and arms are made of solid stock rather than plywood.

T F 18. Only about 60% of lumber is finally usable in the finished furniture.

T F 19. With the advent of new and better machines, skilled hand work is not necessary any more except to operate the machines.

T F 20. Even with new machines, hand sanding of furniture is still required.

T F 21. Most commercial furniture is finished with varnish.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. Boards that have been run through the double planer should be perfectly ________________ and uniformly ________________.

2. The molding machine or sticker is a variation of the ______________.

3. Boring machines are commonly used to bore holes for ______________ work.

4. A coat of adhesive may be applied to wood surfaces by means of ______________ ______________.

5. The designer's first step in the actual designing of a new piece or line of furniture is to make several ______________.

6. An elevation is usually the ______________ view drawing of the proposed design.

7. The moisture content of raw lumber should range from __________ to __________ per cent just before processing.

8. The cutting of lumber to rough length in a factory is called ______________.

9. Although machines now do much of the work in furniture construction, skilled hand woodworkers are still needed for ______________ and ______________.

10. Rubbing is handwork that takes place during the ______________ operations.

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. Wood used in manufacturing, especially furniture manufacturing, must be carefully checked regarding its variable features. These are:

(A) ______________________ (C) ______________________

(B) ______________________ (D) ______________________

2. List three operations the gang rip saw will do.

(A) ______________________ (C) ______________________

(B) ______________________

3. The process route sheet is prepared by the engineering department and contains such items as:

(A) ______________________ (E) ______________________

(B) ______________________ (F) ______________________

(C) ______________________ (G) ______________________

(D) ______________________ (H) ______________________

Assignment
Sheet No. 16

Covering
Units 165-170

FINISHING PROCEDURES

The finishing of cabinets and other items is extremely important to all cabinetmakers. An excellent finish can, in some instances, cover up some flaws in the workmanship of a mediocre cabinetmaker. It can also complete a high quality product of the expert craftsman.

It may be that the cabinetmaker is not required to do the finishing. However, a good cabinetmaker should be ready to perform this duty if need be.

Finishing can be divided into two phases - preparation for finish and application of the finish. One is as important as the other and they both require skill and hard work. In this unit you will learn what materials are used in the preparation for finishing and how to properly prepare surfaces for finishing. Further, you will study different kinds of finishes and the techniques involved in their application.

Assignment:

1. Read the reference listed below.
2. Answer the questions below and turn in this assignment by ____________________.

Reference:

A. Feirer, Woodworking for Industry, pp. 367-372, 576-591, 596-597, 598-610.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. Flint is considerably harder than quartz.

T F 2. Paper backing for abrasives comes in different weights.

T F 3. A grit size of 120 in regard to garnet paper would be very coarse.

T F 4. Paper and cloth are sometimes used together as backing for abrasives.

T F 5. Mesh number and grit sizes are one and the same.

T F 6. The larger the number designation on abrasives, the finer the grit.

T F 7. The very fine grade of abrasive should be used just before staining and sealing.

T F 8. 2/0 is a finer abrasive than 3.

T F 9. 1/0 and 0 indicate the same grit size of abrasive.

T F 10. Sheet abrasives come only in the 9" x 11" size.

T F 11. To do finish sanding with a portable sander a 2/0 to 5/0 abrasive should be used for most hardwoods.

T F 12. Surfaces that are to be glued should not be sanded.

T F 13. Since pencil marks are liable to go into the wood somewhat, a coarse abrasive should be used to sand them off.

T F 14. The sanding of curved or irregular surfaces must still be done largely by hand.

T F 15. An abrasive with a cloth backing is best for curved or irregular surfaces.

T F 16. Extra sanding must be done to adequately prepare wood when a clear or natural finish is applied.

T F 17. A new brush should be broken in before using by soaking in a solvent for a period of time.

T F 18. Rollers commonly used to apply paint may also be used to apply such finishes as shellac and lacquer.

T F 19. Most industrial finishes are applied with a brush.

T F 20. Forty per cent of all furniture items is finished with a sprayed-lacquer finish.

T F 21. External mix refers to the mixing of air and fluid outside the gun.

T F 22. Spraying in a spray booth with proper ventilation will eliminate the need to wear a respirator.

T F 23. There are various types of nozzles for spray guns that need to be used if different spray patterns are desired.

T F 24. A spray gun should always be kept at right angles to the surface being sprayed.

T F 25. Spray strokes should always be horizontal.

T F 26. Once the spraying has been started, the trigger of the gun should not be released until the surface has been completely sprayed.

T F 27. If the holes become clogged in the cap of the spray gun, they should be cleaned with a toothpick.

T F 28. There are some woods that take paint better than others.

T F 29. Enamel will produce more of a gloss finish than a latex paint.

T F 30. Plywood will usually require three coats of paint for good protection.

T F 31. Applying a good finish generally will not serve to cover up mistakes.

T F 32. When preparing the wood for finishing, all of the excess glue should be sanded off.

T F 33. Small dents in wood can be removed by putting water on the dented area and allowing it to dry.

T F 34. Open-grained wood should be scraped before sanding.

T F 35. Mineral spirits serves the same purposes as turpentine.

T F 36. Pumice comes in just one grade.

T F 37. Rottenstone is a finer abrasive than pumice.

T F 38. Oxalic-acid crystals will do an excellent job of bleaching and, although difficult to use, are far superior to any other materials.

T F 39. There are available now finishes that can be applied with a cloth.

T F 40. Most industrial finishing is done with a stain having naphtha and turpentine as its solvent base.

T F 41. A washcoat of shellac serves as a good sealer for many stains.

T F 42. Mahogany is a wood that requires a paste filler.

T F 43. Lacquer can be either sprayed or brushed on.

T F 44. It is extremely difficult to obtain an outstanding finish on plywood.

T F 45. To obtain a high-gloss paint finish, a second coat consisting of equal parts of undercoat and high-gloss enamel should be used.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. The abrasive that is reddish-brown in color is ______________.

2. Flint and ______________ papers are generally used for sanding ________________.

3. Abrasives that also work well on metal are ______________ ______________ and ______________ ______________.

4. Drum sanding and spindle sanding each involve the use of abrasive sheets mounted on ______________.

5. When hand sanding one should always sand ______________ the grain.

6. One should sand only in one direction when sanding ______________ ______________.

7. Furniture finishing in large factories is broken down into a series of jobs including the preparation of surfaces, ______________, ______________, ______________, ______________, and rubbing.

8. Knots in wood should be covered with ______________ before applying the paint.

9. The bristles of brushes that have been used and cleaned should be covered with ______________ before storing.

10. The air pressure delivered to the spray gun is reduced to the proper pressure by a ______________ or regulator.

11. When spraying, the spray gun should be kept about __________ to __________ inches from the work.

12. When spray painting, the ______________ are always done first.

13. The most popular interior paints are ______________ paints.

14. In painting cabinets or other interior work all ______________ should be removed or covered with masking tape.

15. The solvent for shellac is ______________.

16. The main disadvantage in using water stains is that they ______________ the wood and ______________ the grain.

17. Paste wood filler should be applied with a ______________.

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. In most woodworking plants sanding of the product and its finishes is classified in three ways:

(A) ______________________________

(B) ______________________________

(C) ______________________________

2. Three things that you should be familiar with concerning coated abrasives are:

(A) ______________ (C) ______________

(B) ______________

3. List the five kinds of materials used for abrasives and indicate if they are natural minerals, or man-made (synthetic).

(A) ______________________________

(B) ______________________________

(C) ______________________________

(D) ______________________________

(E) ______________________________

4. The four common backings for abrasives are:

(A) ______________ (C) ______________

(B) ______________ (D) ______________

5. Five different types of bonds for abrasives are:

(A) ______________ (D) ______________

(B) ______________ (E) ______________

(C) ______________

6. Four kinds of sanding in relation to grit size are:

(A) ______________ (C) ______________

(B) ______________ (D) ______________

7. Abrasives come in the following forms:

(A) ____________________ (C) ____________________

(B) ____________________ (D) ____________________

8. Four things to consider when selecting an abrasive are:

(A) ____

(B) ____

(C) ____

(D) ____

9. List four materials that can be used to fill nail holes, cracks, etc.

(A) ____________________ (C) ____________________

(B) ____________________ (D) ____________________

10. Give three purposes of washcoating.

(A) ____

(B) ____

(C) ____

Assignment
Sheet No. 17

Covering
Units 171-174

DOORS, WINDOWS, AND SASH CONSTRUCTION

Doors and windows have an important place in all buildings although modern ventilation systems have reduced somewhat the importance of windows. Mass production methods have also created a standardization of door designs and have reduced the large varieties formerly available.

It, however, is still important that proper doors and windows be installed and that they perform their intended function properly. Considerable skill and knowledge is required to adequately construct and install doors and windows, especially those custom ordered.

In this assignment you will have the opportunity to learn the names of the various parts of doors and windows, the different types of doors and windows, and some of the procedures necessary to construct them.

Assignment:

1. Read the references listed below.
2. Answer the questions below and turn in this assignment by ____________________.

References:

A. Feirer, Woodworking for Industry, pp. 528-537.
B. Dahl and Wilson, Cabinetmaking and Millwork, pp. 247-287.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. The cost of specially designed or odd size doors is only slightly more than for standard construction.

T F 2. A "standard" door design is standard throughout the cabinetmaking industry.

T F 3. Door dimensions are listed in order as: width, height, and thickness.

T F 4. A diagonal line drawn between two numbers of a door listing indicates a separation of feet and inches.

T F 5. A detail drawing usually accompanies an order for special or odd size doors.

T F 6. On standard doors, the mortise is centered, and the molded reveal is the same on both sides.

T F 7. Solid hardwood doors are expensive but are the most desirable and practical.

T F 8. A hollow core door is not as durable as a solid core door.

T F 9. No light should pass through the crack between two doors hinged to the same frame.

T F 10. A door-standards catalog is available outlining the requirements for materials, workmanship and construction.

T F 11. The louver door is used where ventilation is desired.

T F 12. The major difference between interior and exterior doors is in the thickness.

T F 13. The overall dimensions of sash and windows are based only on even sizes of glass.

T F 14. The thickness dimension of sash is always given before the width.

T F 15. The number of lights specified for a pair of casement windows refers to the number in one window.

T F 16. Horns are trimmed off just before assembly.

T F 17. The height of casement windows in pairs should usually be one and one half times the height of standard windows.

T F 18. Hardwood sash are usually veneered.

T F 19. Manufacturers of windows and sash who do not belong to lumber associations often follow traditional methods of construction which vary considerably from those of the associations.

T F 20. Both Eastern and Western standards specify that the width of a window or sash be even to the inch in size.

T F 21. The height of the Eastern Standard window is based on even-inch glass sizes.

T F 22. The height of the Western Standard window is based on odd-inch size glass.

T F 23. Western Standard provides for either dowel or mortise-and-tenon construction.

T F 24. Awning type windows and jalousie windows both open in much the same manner.

T F 25. The wood double-hung window is still the most commonly used window.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. Doors are classified by the manufacturer according to __________ and the problems of ____________.

2. The width and height of doors are listed in units of __________ and ____________.

3. Stiles and rails of a door may be made of either ____________ or ____________ stock.

4. Door panels may be made of ____________ or ____________ stock.

5. The length of the mortise is determined by the ____________ of the rail.

6. To prevent cutting into a dowel when fitting a door, the outside dowel should be placed no closer than ____________ ____________ ____________ from the outside edge of the rail.

7. A door in which the two faces form a flat surface is called a ____________ door.

8. Of particular importance in door layout is the direction of ____________.

9. One type of face mark resembles the figure ________ with the tail pointing to and ending at the ____________ ____________.

10. Glazed doors are doors that utilize ____________.

11. Doors which receive panes of glass must have the inside edges of the stiles and rails ____________.

12. Doors which are not standard in design are called ____________ doors.

13. Many leading woodwork manufacturers belong to the ____________ ____________ ____________ Association (USA).

14. Interior doors are usually ________ inches thick.

15. Main entrance doors should not be less than ________ feet ________ inches high.

16. Glass used for normal window purposes is usually ____________ strength ____________ quality.

17. D.S.A. is the designation for ____________ strength ___________ quality glass.

18. Eastern standards call for a _________ inch depth rabbet on stock sash.

19. In sash layout the mortise is usually cut in the ____________ and the tenon is cut on the _____________.

20. Lugs are used to _____________ the sash of a double-hung window.

21. The most common wood for sash throughout the United States is _____________ ______________.

22. The standards published by the National Woodwork Manufacturers Association are referred to as _____________ ______ ________ and those published by the Southern California Lumber Dealers Association as _____________ ______________.

Multiple-Choice

Directions: In the space at the left of each statement, write the letter of the item which will provide the correct answer to complete the statement.

_____ 1. A door design not ordinarily carried in stock but for which designs are readily available would be considered as (A) standard size; (B) standard design; (C) special design; (D) stock size.

_____ 2. Doors of a particular size and design which are carried in stock are (A) standard design; (B) standard size; (C) stock size; (D) detail design.

_____ 3. A door which is 1 1/2 inches thick would require dowels with a diameter of (A) 1/8"; (B) 1/4"; (C) 3/8"; (D) 1/2".

_____ 4. The overall size of a double-hung window with two 20" x 20" lights is (A) 1'8" x 1'8"; (B) 2'0" x 3'10"; (C) 2'0" x 4'0"; (D) 2'4" x 4'2".

_____ 5. The size of the glass opening in a sash should be (A) the same as; (B) 1/16" larger than; (C) 1/8" larger than; (D) 1/16" smaller than; the glass.

_____ 6. Lumber is selected for sash and windows primarily because of its (A) toughness; (B) ease of working; (C) availability; (D) appearance.

Listing

Directions: List the item called for in each of the following. Select your answers carefully.

1. The following information is necessary when listing doors:

(A) ______________________

(B) ______________________

(C) ______________________

(D) ______________________

(F) ______________ ________

(F) ______________________

(G) ______________________

(H) ______________________

2. A door consists basically of:

(A) ______________________

(B) ______________________

(C) ______________________

3. Face marking is used to:

(A) ____

(B) ____

(C) ____

(D) ____

4. Light is prevented from passing through the crack between matching doors by using either:

(A) ______________________

(B) ______________________

5. List four styles of doors common for both interior and exterior doors.

(A) ______________________

(B) ______________________

(C) ______________________

(D) ______________________

6. List <u>five</u> types of windows found in homes.

(A) ______________________

(B) ______________________

(C) ______________________

(D) ______________________

(E) ______________________

7. Significant differences between the two accepted standards of construction for double-hung windows include:

(A) ____

(B) ____

(C) ____

Matching

Directions: In the left hand column is a list of terms. The right hand column contains descriptive phrases or synonymous terms. Match the descriptions to the terms by placing the letter of the description in the blank at the left of the appropriate term.

Group I

_____ 1. muntin

_____ 2. rail

_____ 3. sticking

_____ 4. stile

_____ 5. panel

_____ 6. opening

_____ 7. mullion

_____ 8. raised panel

_____ 9. bar

_____ 10. face

_____ 11. reveal

A. outside vertical member of a door

B. inside full length horizontal member

C. inside full length vertical member

D. short, light member, running either vertically or horizontally

E. light member extending through glazed openings

F. portion of filled space between stiles, rails, or muntins.

G. thick panel with shaped edges

H. offset measurement from panel surface to stile or rail face

I. pane of glass or its opening

J. exposed surface of a door member

K. molded edge of a stile or rail

L. size of the frame into which a door or window is to be fitted

Group II

______ 1. edge strip

______ 2. rabbet

______ 3. spline

______ 4. finished size

______ 5. core

______ 6. planted molding

______ 7. haunch

______ 8. raised molding

______ 9. face veneer

______ 10. relish

______ 11. backing

______ 12. ripping size

A. a rectangular cut made in the face or edge of a board to receive another member

B. base or center of a veneered piece of stock

C. layer of veneer next to the core

D. exposed finish layer of veneer on face of plywood

E. exposed layer of veneer on the back of plywood

F. piece of finished material glued to edges of core of plywood

G. separate piece of molding fastened in place after a door is assembled

H. planted molding flush with face of stile or rail

I. planted molding projecting above face of stile or rail

J. strip of wood fitted into opposed grooves of two pieces of wood to be joined

K. part of tenon cut out to form a haunch

L. shoulder formed by relishing a tenon

M. rough-ripped width of stock before milling and sizing

N. over-all dimension of finished stock

Group III

______ 1. plain rail window

______ 2. face puttying

______ 3. casement sash

______ 4. double hung window

______ 5. glazed sash

______ 6. light

______ 7. transom sash

______ 8. back puttying

______ 9. open sash

______ 10. bedding

A. pane of glass or an opening for a pane of glass

B. application of putty in a rabbet before the glass is set

C. filling the rabbet with putty to make an exterior water-tight joint

D. forcing putty between the glass and the rabbet to fill voids due to unevenness of the glass

E. two sash made to slide vertically and separated by a parting stop or bead

F. same as (E) above but without a parting stop

G. a single sash made to fill an opening over a door or window

H. one or more sashes made to fill an opening and to swing in or out

I. casement sash extending to door height, usually hinged in pairs

J. sash frame in which glass has not been installed

K. sash frame in which glass has been installed

Assignment
Sheet No. 18

Covering
Units 175-180

SASH, TRIM, AND FRAMES

Each wall opening in a building presents an individual problem concerning its finish construction and the factors involved in its layout. The opening must be considered with such features as the overall exterior construction and placement of other openings if it is in an exterior wall. Interior decor and the trim of related rooms or areas must be considered for openings through inside walls.

A new building is designed and constructed with these considerations in mind but when rooms or entire buildings are being rebuilt, the original structure limits, to a certain extent, the type of frame and trim to be used.

In this assignment you will have an opportunity to learn the names and functions of the more commonly used frame and sash parts, the manner in which they are combined and used, and the basic principles of molding design.

Assignment:

1. Read the references listed below.
2. Answer the questions below and turn in this assignment by ______________________ .

References:

A. Feirer, Woodworking For Industry, p. 553
B. Dahl and Wilson, Cabinetmaking and Millwork, pp. 288-318.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. Mullions separate the openings vertically in all multiple-opening frames.

T F 2. The head jamb is usually the same width as the side jamb.

T F 3. The term "jamb" may refer to the entire side assembly of a window frame.

T F 4. The groove in a drip cap serves only as a decorative feature.

T F 5. There is considerable difference between sash jambs and door jambs.

T F 6. Exterior doors on all buildings swing out to permit quick opening in an emergency.

T F 7. The transom bar is always a single solid piece of stock.

T F 8. Both edges of a window sill are beveled to make them parallel to the edge of the jamb.

T F 9. An interior door usually has no sill.

T F 10. Horns on sills must always be trimmed to finish frame size.

T F 11. Coil spring sash balances are used to reinforce sash weights.

T F 12. Trim refers to decorative and finish woodwork applied both to the interior and exterior of a building.

T F 13. Modern molding designs are based on traditional types of Roman and Greek architecture.

T F 14. Standing trim refers to trim items used in a vertical position.

T F 15. Base, baseboard, and mop board all refer to the same thing.

T F 16. Running trim is ordinarily ordered in linear amounts.

T F 17. Ceiling molding is not used much in modern homes.

T F 18. The corners of baseboard are always mitered.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. A frame with one opening is called a ______________ frame.

2. Archway or cased opening frames are used for openings in partition walls that will not have __________ .

3. Jambs form the ______________ and ______________ of the frame.

4. Outside casings are either ________ inch(es) or ________ inch(es) thick.

5. The rabbet for a door or sash is made 1/16" to 1/8" ____________ than the thickness of the door or sash.

6. A window sill is usually sloped to permit ______________ __________.

7. A typical door sill has a pitch of ________ inches to 12 inches.

8. Stock window frames sold wholesale by the members of the National Woodwork Manufacturers Association are designed for ______________ construction.

9. The extra stock extending beyond the sill and head of a jamb is called the ______________ .

10. The width of a frame is measured between the ______________ of plain jambs and between the ______________ of rabbeted jambs.

11. A plain inside door frame consists simply of two ______________ and a ______________ .

12. Split frame construction is used to accommodate walls of ______________ ______________ .

13. Moldings get their names from their ______________ or their ______________ .

14. Cornice mold refers to moldings used for ______________ cornices.

15. Interior trim is classified as either ______________ trim or ______________ trim.

16. A solid or built-up projection which appears to be supporting weight but is primarily decorative is called a ______________ .

17. Interior trim might also be referred to as ______________ .

18. Base molding consists of a __________ and a __________ __________ .

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. Frames may be classed as:

(A) ______________________ (C) ______________________

(B) ______________________

2. Frame design is determined by factors such as:

(A) ______________________ (D) ______________________

(B) ______________________ (E) ______________________

(C) ______________________ (F) ______________________

3. The basic parts of a single-opening frame are:

(A) ________________ (B) ________________ (C) ________________

4. The width of a jamb is determined by:

(A) ______________________________

(B) ______________________________

(C) ______________________________

(D) ______________________________

(E) ______________________________

5. Two advantages of horns are:

(A) ______________________________

(B) ______________________________

Matching

Directions: In the left hand column is a list of items. The right hand column contains descriptive phrases or synonymous terms. Match the descriptions to the terms by placing the letter of the description in the blank at the left of the appropriate term.

_____ 1. parting stop

_____ 2. drip cap

_____ 3. outside casing

_____ 4. stucco mold

_____ 5. sill

_____ 6. blind stop

_____ 7. brick mold

A. forms one side of the sash groove

B. pulley stile against which the sash is fitted

C. separates the top and bottom sash

D. outside trim used with a framed wall covered with lath and plaster

E. used to finish a frame set in a concrete, brick, or brick veneer-wall

F. head jamb for the lower of two openings

G. encloses the space between the jambs and the framed wall

H. prevents seepage into the wall

I. horizontal bottom member of a sash, door, or window frame

Assignment
Sheet No. 19

Covering
Units 181-185

FASTENERS AND HARDWARE

There are many different kinds of fasteners used in cabinetmaking. Although some have very specific uses, most of them can be used for many different situations. The selection of the proper fastener for the particular situation is the responsibility of the cabinetmaker.

Hardware also comes in a large variety of styles and sizes and it is important for the cabinetmaker to select the proper hardware and to install it correctly so that the cabinet functions easily and properly. The hardware should also add to the appearance of the cabinet.

In this assignment you will have an opportunity to learn the names of some of the more common fasteners and the types of hardware used in cabinetmaking. You will also have an opportunity to learn the uses and limitations of these items and how the use of each depends upon the type and quality of construction.

Assignment:

1. Read the references listed below.
2. Answer the questions below and turn in this assignment by ____________________.

References:

A. Feirer, Woodworking For Industry, pp. 336-355, 378-387.
B. Dahl and Wilson, Cabinetmaking and Millwork, pp. 215-221.
C. Towers, Cabinetmaker's Manual, pp. 145-152, 436-442.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. In cabinetwork the nail should not be driven flush with the surface with just the hammer.

T F 2. Stationary nailing machines require specially designed nails.

T F 3. A 10d nail is smaller than a 6d nail.

T F 4. A 10d common nail is larger in diameter than a 10d finishing nail.

T F 5. If nails are driven at a slight angle they will have greater holding power.

T F 6. In selecting nails for fastening where there is a likelihood of splitting the wood, choose the smallest diameter that is suitable for the job.

T F 7. Holding power and the possibility of splitting both increase with the diameter of the nail.

T F 8. A sharp, taper-pointed nail will tend to cause less splitting than a blunt-pointed nail.

T F 9. A pre-bored hole for a nail should be slightly larger than the shank of the nail.

T F 10. If a nail bends you should first try to straighten it since pulling it out will tend to leave a large hole.

T F 11. Casing nails are heavier than finishing nails.

T F 12. Nails are purchased by the gross.

T F 13. A 6 gauge wood screw is larger than a 4 gauge wood screw.

T F 14. Different size screws require different size screwdrivers.

T F 15. The length of all wood screws includes the head.

T F 16. A 1 1/2 inch wood screw is available in gauges from 6 to 18.

T F 17. The head of a screw should never be hammered into a hole.

T F 18. A Phillips head screw requires a special screwdriver.

T F 19. Steel screws should not be used where corrosive action might occur.

T F 20. Screws are available in at least a dozen different finishes.

T F 21. A lag screw is secured with a wrench.

T F 22. The size of the hole for a bolt is not too important as long as it isn't larger than the bolt head nor smaller than the body of the bolt.

T F 23. Bolts are used where great holding strength is required.

T F 24. One advantage of molly bolts over toggle bolts is that the supported material can be removed and replaced without the loss of the anchor.

T F 25. Most of the hardware that is available can be obtained in the hardware stores.

T F 26. Semi-concealed loose pin hinges are good to use on flush plywood doors.

T F 27. Piano hinges come in a large variety of lengths.

T F 28. Magnetic catches are quite popular for kitchen cabinets.

T F 29. Roller catches work better than friction catches.

T F 30. The cabinetmaker usually installs the hardware on all types of cabinets.

T F 31. Heavy window glass or Crystal Sheet is similar in quality to plate glass but lighter in weight.

T F 32. Distortion of vision is a problem with polished plate glass.

T F 33. Mirrors can be made from any quality glass.

T F 34. Crystal mirrors are first quality mirrors.

T F 35. Shock mirrors are made to withstand high impact.

T F 36. Metal fasteners are often used in joining parts of wood products of low quality.

T F 37. The size designation of a nail is believed to have come from the price paid by the English for 100 nails.

T F 38. Wire brads are of finer gauge wire and usually shorter than ordinary nails.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. The tool used to sink the heads of nails below the surface of the wood is called a ______________ ______________ .

2. General purpose nails are made of either ______________ ______________ or ______________ .

3. The letter "d" in nail designations means ______________ .

4. The nail designation (2d, 4d, etc.) represents the ______________ of the nail.

5. The two common methods of nailing are ______________ ______________ and ______________ .

6. A Phillips head screw might also be called a ______________ head.

7. Two holes needed for pre-boring for screws are the ______________ hole and the ______________ hole.

8. Screws are standardized according to ____________, ____________, and ____________ .

9. Two common types of miter joint fasteners are ____________ and ____________ ____________ .

10. The standard glazing quality glass is grade ________ .

11. Obscure sheet glass is a result of one surface of the glass being ____________ .

12. Plate glass has both surfaces ____________ and ____________ .

13. Standard plate glass is ______ inch(es) thick with slight variations.

14. The quality of a mirror is governed by the ____________ of ____________ used.

15. First quality mirrors are made from a top grade of ____________ glass.

16. When hinges have a slight offset to permit the leaves to come close together they are said to be ____________ .

17. Hinges that are very good for cabinets without frames are ________ hinges.

18. A catch that will hold one side of a double door closed while the other is pulled open is called a ________________ catch.

19. Common nail sizes range from ________________ to ________________ .

20. Wire brads are used in ________ ____________ work and for fastening ____________ ____________ .

21. Escutcheon pins are usually made of ____________ in lengths from __________ inches to ________ inches.

22. Wood will not split as easily when screws are driven if a ____________ ____________ is made.

23. The parts of a hinge include the ________, ____________ and ____________ .

Multiple-Choice

Directions: In the space at the left of each statement, write the letter of the item which will provide the correct answer to complete the statement.

_____ 1. Nails ideal for most cabinetwork would be (A) casing; (B) box; (C) finishing: (D) common.

______ 2. For toenailing the angle of the nail should be about (A) 10; (B) 15; (C) 30; (D) 45 degrees.

______ 3. The range of the guage of wood screws is (A) 0 to 24; (B) 0 to 15; (C) 2 to 60; (D) 5 to 30.

______ 4. A number 22 gauge wood screw would be (A) .286; (B) .346; (C) .350; (D) .436 inches in diameter.

______ 5. A properly selected screw will project into the second part about (A) one-fourth; (B) one-third; (C) one-half; (D) two-thirds its length.

______ 6. Which of the following wall fasteners would not be used on solid masonry walls? (A) rawl plug; (B) molly bolt; (C) anchor bolt; (D) lead shield.

______ 7. Most clear window glass is produced in (A) AA quality; (B) A quality; (C) B quality; (D) C quality.

______ 8. Tacks are used primarily (A) where holding power is necessary; (B) where they can be covered; (C) for fastening light hardware; (D) in upholstery work.

______ 9. Double pointed U-shaped fasteners are called (A) tacks; (B) escutcheon pins; (C) staples; (D) corrugated fasteners.

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. General purpose nails include:

(A) ______________________ (C) ______________________

(B) ______________________ (D) ______________________

2. List five types of nails commonly used in cabinetmaking.

(A) ______________________ (D) ______________________

(B) ______________________ (E) ______________________

(C) ______________________

3. Common head shapes of screws are:

(A) ______________________ (C) ______________________

(B) ______________________

4. Materials that screws might be made of include:

(A) ____________________ (D) ____________________

(B) ____________________ (E) ____________________

(C) ____________________

5. Four things that a screw-mate drill countersink will do are:

(A) ____

(B) ____

(C) ____

(D) ____

6. List four types of heavy screws and bolts.

(A) ____________________ (C) ____________________

(B) ____________________ (D) ____________________

7. List four types of hinges.

(A) ____________________ (C) ____________________

(B) ____________________ (D) ____________________

8. List the five common kinds of door catches.

(A) ____________________ (D) ____________________

(B) ____________________ (E) ____________________

(C) ____________________

9. Cabinet hardware includes items such as:

(A) ______________ (C) ______________ (E) ______________

(B) ______________ (D) ______________ (F) ______________

10. Hinges are available in several styles including:

(A) ____________________ (C) ____________________

(B) ____________________ (D) ____________________

11. Hinges are available in several finishes includeing:

(A) ____________________ (E) ____________________

(B) ____________________ (F) ____________________

(C) ____________________ (G) ____________________

(D) ____________________

Assignment
Sheet No. 20

Covering
Units 186-189

ADHESIVES

The Egyptians used glue as an adhesive thousands of years ago. Museums today contain cabinets made by the ancient Greeks and Romans with the glue joints still intact and holding. Only a few types of glues were available in those days; today many types of adhesives are available with many recent developments creating new possibilities for the cabinetmaker.

Although the many new developments in the field of adhesives have aided the work of the cabinetmaker, they have also required that the cabinetmaker have a knowledge of these various adhesives in order to properly perform his work. He needs to know the correct adhesive to use for a particular situation, the conditions that will ensure proper gluing, and the procedure for gluing. Quality work demands good gluing.

In this assignment you will have an opportunity to learn the names and uses of the glues commonly used in cabinetwork. You will also learn the characteristics of these adhesives and the conditions under which each can be used.

Assignment:

1. Read the references listed below.
2. Answer the questions below and turn in this assignment by ________________________ .

References:

A. Feirer, Woodworking For Industry, pp. 321-335.
B. Dahl and Wilson, Cabinetmaking and Millwork, pp. 188-194.
C. Towers, Cabinetmaker's Manual, pp. 112-116.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. No glue will do a good job of holding if the joint fits loosely.

T F 2. It is usually desirable to have an unsanded surface for gluing.

T F 3. Lighter wood is usually easier to glue than heavier wood.

T F 4. Hand screws are permanent fasteners that strengthen a glued joint.

T F 5. Water-resistant glues will withstand exposure to moisture better than waterproof glues.

T F 6. White liquid resin glues are easily affected by temperature.

T F 7. Powdered resin glue requires less clamping time than does powdered casein.

T F 8. Liquid hide glue is considered a good cabinetmaking glue.

T F 9. One of the advantages of liquid hide glue is that it gives strength to poorly fitted joints.

T F 10. The moisture content of the wood is less of a problem with casein glues than it is with other glues.

T F 11. Epoxy resins can be used to join wood to other materials.

T F 12. It should be assumed that the moisture content of the wood will increase slightly upon application of glue.

T F 13. It may sometimes be necessary to sand plywood surfaces before gluing.

T F 14. Most glues that require mixing will have directions for mixing on the container.

T F 15. End grain requires a low glue-to-water ratio.

T F 16. Double spreading means putting glue on a surface, allowing it to become tacky, and then putting on another layer.

T F 17. Double spreading will result in better gluing than single spreading.

T F 18. Some glues have a longer assembly time than others.

T F 19. As much pressure as possible should be obtained when clamping up a joint.

T F 20. Dry bits of glue should be removed from an assembled object with a knife or chisel.

T F 21. A properly made glue joint will be stronger than the wood itself.

T F 22. The term animal glue usually refers only to glue made from the skin and bones of cattle.

T F 23. Bacterial action is necessary for animal glue to reach its highest strength.

T F 24. The term "synthetic resin" currently applies just to synthetic chemical compounds that resemble resins.

T F 25. Casein glues will produce joints that are waterproof for short periods of time.

T F 26. Vegetable glues are not usually used in cabinet work.

T F 27. Starch glues stain some woods.

T F 28. Relatively high temperatures are required to cure melamine resin glue.

T F 29. Polyvinyl resin glue can be applied and dried at room temperature.

T F 30. Tests by the Forest Products Laboratory show that a surface to be glued up should be roughened by sanding for the strongest joint.

T F 31. Heating with high frequency currents will completely cure a glue line in a few seconds.

T F 32. Most glues, if correctly applied, will provide a bond for an indefinite period of time within the limits of the service conditions.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. When using C clamps for clamping wood, ______________ should also be used to protect the wood.
2. Large surfaces are usually clamped with ______________ clamps.
3. Until recently the only two types of glue used were ______________ or ______________ and ______________ or ______________.
4. Glues can be grouped either according to their ______________ or according to their ______________ to ______________.
5. Resorcinol glues are highly resistant to ______________.
6. A big problem with resorcinol glues is the creation of a ____________ ____________ ____________.
7. Powdered resin glue will set faster at __________ degrees than it will at 70 degrees.
8. When mixing powdered casein glues, the proportions of glue and water should be equal by ______________.

9. An adhesive that is particularly good for applying plastic laminate countertops is ______________ ______________ .

10. Top quality glue joints cannot be made on ___________ wood.

11. Mixed glues are at the right consistency when they are about as thick as ______________ ______________ .

12. When assembling a cabinet one should always make a ______________ ______________ before applying glue.

13. The curing or setting of glue can be speeded up by the use of ______________ and ______________ .

14. Proper gluing temperature is usually between __________ and __________ degrees.

15. The higher grades of flake animal glues are usually ____________ in color and nearly ______________ .

16. Low grade animal glues are sometimes ______________ to make them appear to be of high quality.

17. Thin glue requires a setting up pressure of about __________ to __________ pounds per square inch.

18. Substances furnished by the manufacturer to be added to synthetic resin glue to modify or improve the working properties are called _______________ .

19. Materials added to synthetic resin glues to reduce the cost are called _______________ .

20. Casein glues have a tendency to ______________ some woods such as oak and maple.

21. Vegetable glues are used primarily for making ______________ .

22. A glue joint is satisfactory when the strength of the ______________ is equal to that of the ______________ .

23. Animal glues are available in ______________ form which can be used without _______________ .

24. Veneers for furniture manufacturing are often glued with ______________ ______________ glue.

25. Where a colorless, moisture-resistant glue line is desired ________________ ________________ glue is used.

26. Water resistant plywood is glued with ______________ ______________ glue.

27. Polyvinyl glue joints are strong enough to be worked after ______________ _______________ .

28. Clamping pressures of ______________ to ______________ pounds per square inch are considered best for glue of meduim consistency.

29. End to end grain joints or end to side grain joints seldom are as much as ______________ as strong as the wood itself.

Multiple-Choice

Directions: In the space at the left of each statement, write the letter of the item which will provide the correct answer to complete the statement.

_____ 1. When gluing edge to edge, clamps should be placed every (A) 5 to 8; (B) 8 to 10; (C) 10 to 12; (D) 15 to 18 inches.

_____ 2. At 70 degrees F., most synthetic resin glues have a working life of (A) up to 1 hour; (B) 1 to 3 hours; (C) 4 to 6 hours; (D) 6 to 8 hours.

_____ 3. Resin glued surfaces in closed assembly permit a working time up to (A) two minutes; (B) ten minutes; (C) thirty minutes; (D) one hour.

_____ 4. The curd of sour milk is the principal ingredient of the type of glue known as (A) casein; (B) synthetic resin; (C) animal; (D) starch.

_____ 5. Joints made with animal glues will be (A) strong, water resistant; (B) strong, not water resistant; (C) weak, water resistant; (D) weak, not water resistant.

_____ 6. The moisture content of lumber for interior cabinetwork should be about (A) one to two per cent; (B) five to six per cent; (C) 10 to 12 per cent; (D) 14 to 16 per cent.

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. Problems to be understood in order to obtain a good gluing job include:

(A) ______________________________

(B) ______________________________

(C) ______________________________

(D) ______________________________

(E) ______________________________

(F) ______________________________

(G) ______________________________

2. Five important points to consider in making a good glue joint are:

(A) ______________________________

(B) ______________________________

(C) ______________________________

(D) ______________________________

(E) ______________________________

3. List three common types of clamps used in gluing.

(A) ______________ (C) ______________

(B) ______________

4. The spreading of glue can be done with a:

(A) ______________ (C) ______________

(B) ______________ (D) ______________

5. List three conditions related to gluing that will cause a weak joint.

(A) ______________ (C) ______________

(B) ______________

6. Proper gluing practice requires consideration of:

(A) ______________ (E) ______________

(B) ______________ (F) ______________

(C) ______________ (G) ______________

(D) ______________ (H) ______________

(I) ______________

7. The strength of glue joints is dependent upon:

(A) ______________ (C) ______________

(B) ______________ (D) ______________

(E) ______________

Matching

Directions: In the left hand column is a list of several types of woods. The right hand column contains phrases describing the ease or difficulty with which these woods may be glued. Match the descriptions to the terms by placing the letter of the description in the blank at the left of the appropriate term.

________ 1. oak

________ 2. hard maple

________ 3. yellow poplar

________ 4. pine

________ 5. basswood

________ 6. soft maple

________ 7. birch

________ 8. western red cedar

________ 9. ash

________ 10. Douglas fir

________ 11. redwood

________ 12. walnut

A. glues very easily under a wide range of gluing conditic

B. glues well under a moderately wide range

C. glues satisfactorily under well controlled gluing conditions

D. very close control of gluing conditions required

Assignment
Sheet No. 21

Covering
Units 190-195

FURNITURE RESTORATION AND REFINISHING

Many custom cabinet shops are called upon to repair and refinish furniture and cabinets which have been damaged or worn through long years of use. Many people prefer older furniture and cabinets to the newer and modern ones. However, the repair and refinishing of older items can be as much work and as costly as making a new one.

Although the repairing and refinishing procedures are much the same as when constructing new pieces, there are certain techniques that are different. It is important, in many cases, for the cabinetmakers to duplicate exactly the repaired parts which may require more skill and knowledge than for ordinary cabinetwork.

In this assignment you will have an opportunity to learn some of the techniques used in restoring, repairing, and refinishing older items.

Assignment:

1. Read the reference listed below.
2. Answer the questions below and turn in this assignment by ______________________.

Reference:

C. Towers, Cabinetmaker's Manual, pp. 375-388.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. Restoration commonly means the complete rebuilding of an article of furniture.

T F 2. Minor surface blemishes often enhance the beauty and charm of old or antique furniture.

T F 3. Old lumber is used in best quality restoration work.

T F 4. Wood for restoration of old furniture can usually be obtained from local lumber dealers.

T F 5. Early pieces of antique furniture depended upon much glue joint construction for fastening parts together.

T F 6. Small veneer blisters may be flattened and reglued with moisture, heat, and pressure.

T F 7. At no time should a blister in veneer be cut in order to repair it.

T F 8. Two or more shellac sticks may be melted together to get an exact color to match the wood.

T F 9. Veneer patches should be made so the cuts are at right angles to the grain.

T F 10. If the correct shade of wood cannot be located to match a corresponding piece, then a lighter colored piece should be used.

T F 11. Careful consideration must be given to the edges of wood that has been used to replace damaged pieces.

T F 12. A sliver of wood from the bottom side of a table is often used to fill in a crack in the top surface which cannot be closed by clamping.

T F 13. Wood putty repairs can be satisfactorily made where transparent finishes are used.

T F 14. The cost of restoration may often be reduced considerably by using screws to replace glued joints.

T F 15. Brads and finishing nails may be used to reinforce splits and cracks near the edge of a surface.

T F 16. An enlarged socket may be repaired by drilling it out large enough to receive a plug, then redrill the plug to proper size.

T F 17. One method of repairing a damaged tenon is to cut off the tenon, mortise it out, and replace it with a spline or dummy tenon.

T F 18. Glue blocks may be held in place by brads until the glue has set.

T F 19. The most severe warping or cupping in old furniture usually occurs on the top side of a surface.

T F 20. Badly warped boards can usually be straightened by clamping.

T F 21. It is always best to refinish just those areas that are in need of refinishing.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. In the last one hundred years _______ _______ glue has been widely used in furniture construction.

2. Furniture fastened with this type of glue can be loosened with the aid of _______________ .

3. Large veneer blisters must sometimes be _______________ _______________ and fresh _______________ worked into the opening.

4. Stick shellac is _______________ until it starts to flow and then is forced into place with a _______________ .

5. A veneer patch which is wider at the bottom than at the surface and which must be sprung into place is called a(n) _______________ _______________ .

6. Loose glue joints can often be secured by forcing _______________ into the joint.

7. Cracks or breaks in wood surfaces must be cleaned of ____________, _______________, _______________, or _______________ before fresh glue can be applied.

8. Old screw holes should be plugged with _______________ _______________ or _______________ _______________ before replacing the screws.

9. Screws which cannot be removed by ordinary means may be loosened with the application of _______________ or _______________ _______________ .

10. Extremely loose glue joints are often reinforced with _______________ _______________ .

11. A tenon which is worn too small may be _______________ to the required size.

12. A broken tenon may be repaired by replacing it with a(n) _______________ _______________ .

13. Padded chair frames can be reinforced with the use of _______________ _______________ .

14. The most stubborn cases of warp may be removed with the use of _______________ without damaging the board.

15. When a restored surface cannot be finished immediately, it should be given a coat of _______________ _______________ _______________ and _______________ to prevent moisture absorption.

16. Shellac finishes may be softened with ____________ ____________ before refinishing operations.

17. Finish remover should be allowed to stand from __________ to __________ minutes before the finish is removed with a(n) ____________ ____________ ____________.

18. Wax from the old finish or from the finish remover can be removed with ____________ ____________.

19. Stains or dirt which cannot be removed should be ____________ to make them less noticeable.

20. Grease stains may be removed with ____________ or any ____________ ____________.

Multiple-Choice

Directions: In the space at the left of each statement, write the letter of the item which will provide the correct answer to complete the statement.

_____ 1. Small holes, scars or blemishes in the surface of wood may be filled with (A) sealing wax; (B) stick shellac; (C) sawdust and glue; (D) veneer slices.

_____ 2. In patching veneer work, the best quality of patch is obtained when the sides of the recess are (A) straight up and down; (B) tapered with the largest part of the opening at the top; (C) tapered with the largest part of the opening at the bottom; (D) irregular.

_____ 3. A method of marking joints for ease in matching for reassembly that is least likely to be lost in refinishing is (A) pencil marks; (B) knife cut; (C) punch marks; (D) paint spots.

_____ 4. One of the fastest methods of removing warp from a table top is to (A) steam the entire piece; (B) saw into narrow boards and reglue; (C) clamp the surface down with screws; (D) saw grooves into the underside.

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. Table tops and other wide surfaces may be prevented from warping by using techniques such as:

   (A) ______________________________

   (B) ______________________________

   (C) ______________________________

2. Furniture should be refinished when:

   (A) ______________________________

   (B) ______________________________

   (C) ______________________________

   (D) ______________________________

Assignment
Sheet No. 22

Covering
Units 196-204

THE SMALL WOODWORKING ENTERPRISE

After you have worked in the cabinetmaking field for a time, you may consider going into business for yourself, or in partnership with someone else. To be successful in either instance, you must have information concerning a business and take the time and effort to plan each phase of that business.

In this assignment you will have an opportunity to learn what information it is necessary to have before a business can be set up. In addition, you will have an opportunity to learn some of the advantages and disadvantages of the different forms of business, how to select a location, how to plan for production and the importance of being a good manager of your business.

Assignment:

1. Read the reference listed below.
2. Answer the questions below and turn in this assignment by ____________________.

Reference:

C. Towers, Cabinetmaker's Manual, pp. 389-425.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. The sales market for specialty items is often unpredictable.

T F 2. Most of the products of a general cabinet shop will have a relatively long life which may prevent potential customers from purchasing replacements.

T F 3. Cabinet shops, to be successful, must be located in the surburbs of large cities.

T F 4. The advantage of leasing or renting lies in the ease of relocation of a business.

T F 5. The ideal production shop layout is in the form of a straight line.

T F 6. Hardware and finish items should be stocked in large quantities as soon as a cabinet shop is opened.

T F 7. All of the personal property of an individual proprietor is subject to payment for business debts.

T F 8. The corporation form of business has the greatest amount of personal control.

T F 9. A partnership agreement need not be in written form.

T F 10. Each partner in a partnership can be held liable for all the debts and liabilities of the business.

T F 11. When one partner in a partnership dies, sells his interest or is declared bankrupt the partnership is generally automatically dissolved.

T F 12. Nails and sandpaper to be used in the construction of an article are included in the bill of materials.

T F 13. The costs for overhead often equal the cost of labor.

T F 14. Membership in church, business and technical organizations is a good means of obtaining business publicity.

T F 15. Advertisements, even when carefully worded, seldom pay for themselves.

T F 16. A good product will always sell, even if it isn't marketed in the best manner.

T F 17. In order to be sure of covering all of a retail sales territory, it is best to sell the same product to several retailers in that area.

T F 18. A merchant's opinion on the saleability of an article is better than that of friends or relatives.

T F 19. A man with limited working capital and a small volume of business should encourage a large number of credit sales.

T F 20. Unpaid accounts should be turned over to a lawyer for legal action only as a last resort.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. In order to succeed in the operation of a woodworking shop, a person must have both ______________ ability and ______________ ability.
2. One of the largest job costs will be the ______________ costs.
3. Over __________ per cent of small businesses fail in their first year of operation because they lack adequate ______________.

4. The money used in financing your work until the customer pays for it is called ______________ ______________.

5. The radial arm or cutoff saw is usually placed near the ______________ ______________ area.

6. When installing a spray booth for finishing, the local ______________ ______________ should be used as a source for health and safety regulations.

7. When a business is operated under a company name, both the ______________ and ______________ of the company should be registered in the ______________ ______________ office.

8. An association of two or more business owners is called a(an) ______________.

9. A form of business in which you invest your money without becoming personally liable for the overall business is called a(an) ______________.

10. Scrap, rippings and board ends may add up to __________ per cent of the lumber cost of an article.

11. Profit on a particular article is usually set between __________ and __________ per cent of the total cost.

12. When all costs of the production of an article are not known, the manufacturer will sometimes produce the article on a(an) ______________ basis.

13. The two general types of selling are ______________ and ______________.

14. Where only a few items need to be sold, ______________ selling is best.

15. Slow paying accounts should be followed up with a(an) ______________ ______________.

16. The largest single cause of business failure is the failure to keep adequate ______________ ______________.

17. Items such as machinery are depreciated at the rate of about __________ per cent per year.

18. Small hand tools are usually depreciated within a __________ year period.

19. The most important accounting record is the ______________.

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. The qualifications needed in order to be successful in a small business include:

(A) ____________________ (E) ____________________

(B) ____________________ (F) ____________________

(C) ____________________ (G) ____________________

(D) ____________________

2. Some of the taxes a businessman may be expected to pay include:

(A) ____________________ (E) ____________________

(B) ____________________ (F) ____________________

(C) ____________________ (G) ____________________

(D) ____________________

3. Capital requirements include the costs of:

(A) ____________________ (E) ____________________

(B) ____________________ (F) ____________________

(C) ____________________ (G) ____________________

(D) ____________________

4. Three forms of organization for small businesses are:

(A) ____________________ (C) ____________________

(B) ____________________

5. The advantages of a partnership include the pooling of:

(A) ____________________ (C) ____________________

(B) ____________________

6. The advantages of a corporation include:

(A) ____

(B) ____

(C) ____

7. Disadvantages of incorporating are:

(A) ____________________ (C) ____________________

(B) ____________________ (D) ____________________

8. The cost of an article must include these items:

(A) ____________________ (C) ____________________

(B) ____________________ (D) ____________________

9. A bill of materials includes columns indicating:

(A) ____________________ (D) ____________________

(B) ____________________ (E) ____________________

(C) ____________________

10. The labor cost on an article may be subdivided according to the time needed for:

(A) ____________________ (D) ____________________

(B) ____________________ (E) ____________________

(C) ____________________ (F) ____________________

11. Overhead costs include items such as:

(A) ____________________ (E) ____________________

(B) ____________________ (F) ____________________

(C) ____________________ (G) ____________________

(D) ____________________

12. The small businessman should be familiar with the following types of insurance:

(A) ____________________ (D) ____________________

(B) ____________________ (E) ____________________

(C) ____________________

TRAINING PLAN AND PROGRESS RECORD
for
CABINETMAKING

JOB TRAINING: What the Worker Should Be Able To Do	Proficiency Shown	RELATED INFORMATION: What The Worker Should Know
	Introduction to Cabinetmaking	
	☒	Classifications of jobs within various branches of cabinetmaking, requirements and working conditions in the industry.
	Tools, Equipment and Safety	
Perform hand and power tool operations; sharpen tools. Time in hours ______	☒	Types and kinds of hand and power tools, range of work of each, safe practices in use of all.
	Reading Drawings and Blueprints	
Make and read drawings and blueprints for cabinetwork items. Time in hours ______	☒	Types of drawings, process of making blueprints
	Mathematics, Board Measure and Stock Billing	
Compute board measure and cost of lumber, select and cut stock from stock bills, make stock bills and tally sheets. Time in hours ______	☒	Standard measurements of various species of wood, records used with production of orders.
	Lumber and Lumber Materials	
Identify woods, cuts and parts of wood. Time in hours ______	☒	Characteristics of wood, moisture and effects of seasoning, grading standards and lumber defects, standard materials and sizes.

Layout and Construction

Make a rod layout, lay out and cut stock having geometric shaped surfaces, read specifications and construct items of door, sash, frame and drawer construction.

Time in hours _______

☒

Methods used in geometric layout, order of listing dimensions, names and uses of door and sash parts, styles of frames and molding, types of joints, their advantages and disadvantages.

Hardware, Repair and Finishing

Fasten with screws and nails, cut and fit glass, prepare and glue stock, prepare stock for finishing, finish stock, select hardware, repair and/or replace damaged or broken furniture parts and joints.

Time in hours _______

☒

Types and sizes of screws, nails and hardware, grades of glass, types and kinds of adhesives, range of work which can be glued with various adhesives, types and kinds of finishes.

The Small Woodworking Enterprise

Estimate costs for establishing or expanding plant and facilities, layout equipment for production, keep records, advertise and sell merchandise.

Time in hours _______

☒

Qualifications necessary for operating a business, costs involved, shop layout, tools and equipment necessary, sales and marketing methods, records.

Code for employer's use in marking student's progress

Performed some operations in area ☒

Performed some operations with reasonable proficiency ☒

Performed most operations in area ☒

Performed most operations satisfactorily ☒

TRAINING PLAN AND PROGRESS RECORD
for
CABINETMAKING

Employer's Copy

JOB TRAINING: What the Worker Should Be Able To Do	Proficiency Shown	RELATED INFORMATION: What The Worker Should Know
	Introduction to Cabinetmaking	
	☒	Classifications of jobs within various branches of cabinetmaking, requirements and working conditions in the industry.
	Tools, Equipment and Safety	
Perform hand and power tool operations; sharpen tools. Time in hours ______	☒	Types and kinds of hand and power tools, range of work of each, safe practices in use of all.
	Reading Drawings and Blueprints	
Make and read drawings and blueprints for cabinetwork items. Time in hours ______	☒	Types of drawings, process of making blueprints
	Mathematics, Board Measure and Stock Billing	
Compute board measure and cost of lumber, select and cut stock from stock bills, make stock bills and tally sheets. Time in hours ______	☒	Standard measurements of various species of wood, records used with production of orders.
	Lumber and Lumber Materials	
Identify woods, cuts and parts of wood. Time in hours ______	☒	Characteristics of wood, moisture and effects of seasoning, grading standards and lumber defects, standard materials and sizes.

Layout and Construction

Make a rod layout, lay out and cut stock having geometric shaped surfaces, read specifications and construct items of door, sash, frame and drawer construction.	☒	Methods used in geometric layout, order of listing dimensions, names and uses of door and sash parts, styles of frames and molding, types of joints, their advantages and disadvantages.

Time in hours _______

Hardware, Repair and Finishing

Fasten with screws and nails, cut and fit glass, prepare and glue stock, prepare stock for finishing, finish stock, select hardware, repair and/or replace damaged or broken furniture parts and joints.	☒	Types and sizes of screws, nails and hardware, grades of glass, types and kinds of adhesives, range of work which can be glued with various adhesives, types and kinds of finishes.

Time in hours _______

The Small Woodworking Enterprise

Estimate costs for establishing or expanding plant and facilities, layout equipment for production, keep records, advertise and sell merchandise.	☒	Qualifications necessary for operating a business, costs involved, shop layout, tools and equipment necessary, sales and marketing methods, records.

Time in hours _______

Code for employer's use in marking student's progress

Performed some operations in area	☒	Performed some operations with reasonable proficiency	☒
Performed most operations in area	☒	Performed most operations satisfactorily	☒

TRAINING PLAN AND PROGRESS RECORD
for
CABINETMAKING

Student's Copy

JOB TRAINING: What the Worker Should Be Able To Do	Proficiency Shown	RELATED INFORMATION: What The Worker Should Know
Introduction to Cabinetmaking		
	☒	Classifications of jobs within various branches of cabinetmaking, requirements and working conditions in the industry.
Tools, Equipment and Safety		
Perform hand and power tool operations; sharpen tools. Time in hours _______	☒	Types and kinds of hand and power tools, range of work of each, safe practices in use of all.
Reading Drawings and Blueprints		
Make and read drawings and blueprints for cabinetwork items. Time in hours _______	☒	Types of drawings, process of making blueprints
Mathematics, Board Measure and Stock Billing		
Compute board measure and cost of lumber, select and cut stock from stock bills, make stock bills and tally sheets. Time in hours _______	☒	Standard measurements of various species of wood, records used with production of orders.
Lumber and Lumber Materials		
Identify woods, cuts and parts of wood. Time in hours _______	☒	Characteristics of wood, moisture and effects of seasoning, grading standards and lumber defects, standard materials and sizes.

Layout and Construction

Make a rod layout, lay out and cut stock having geometric shaped surfaces, read specifications and construct items of door, sash, frame and drawer construction.	☒	Methods used in geometric layout, order of listing dimensions, names and uses of door and sash parts, styles of frames and molding, types of joints, their advantages and disadvantages.

Time in hours _______

Hardware, Repair and Finishing

Fasten with screws and nails, cut and fit glass, prepare and glue stock, prepare stock for finishing, finish stock, select hardware, repair and/or replace damaged or broken furniture parts and joints.	☒	Types and sizes of screws, nails and hardware, grades of glass, types and kinds of adhesives, range of work which can be glued with various adhesives, types and kinds of finishes.

Time in hours _______

The Small Woodworking Enterprise

Estimate costs for establishing or expanding plant and facilities, layout equipment for production, keep records, advertise and sell merchandise.	☒	Qualifications necessary for operating a business, costs involved, shop layout, tools and equipment necessary, sales and marketing methods, records.

Time in hours _______

Code for employer's use in marking student's progress

Performed some operations in area	☒	Performed some operations with reasonable proficiency	☒
Performed most operations in area	☒	Performed most operations satisfactorily	☒

VT002 076

VT 002 076
Printing, A Course of Study Designed for Cooperative Part-Time Students Employed in Printing Shops.

Karnes, James B., ed.
Missouri Univ., Columbia. Dept. of Industrial Education
Missouri State Dep of Educ, Jefferson City. Ind Educ Sect

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*STUDY GUIDES, *TRADE AND INDUSTRIAL EDUCATION, *PRINTERS, *PRINTING, GRADE 11, GRADE 12, *COOPERATIVE EDUCATION,

This study guide is for use by individual preparatory or cooperative students at the secondary or post-secondary level. It was developed by teacher educators and research assistants with help from a consultant committee. Assignment sheet titles are (1) History of Printing, (2) Printing as a Vocation, (3) Accident and Health Hazards, (4) The California Job Case, (5) Characteristics of Type and Spaces, (6) The Printer's System of Measurement, (7) The Process of Setting Type, (8) The Handling of Type, (9) Processing Good Proofs, (10) Standard Proofreaders' Marks, (11) Distribution, (12) Printing Layouts, (13) Paper, (14) Job Composition, (15) Imposition and Lock-Up, (16) Letterpresses, (17) Platen Press Preparation, (18) Bindery Room Operations, (19) Printing Plates, (20) Typecasting Machines, (21) Linotype Matrix Mechanisms, (22) Linotype Casting Mechanism, (23) Linotype Distribution Mechanisms, (24) Problems in Linotype Operation, and (25) Printing--Buying, Selling, and Producing. Each assignment sheet gives the assignment, references, and objective-type questions. Suggested time allotment is 180 days. An analysis of the necessary jobs and related information and progress records for use by student, teacher, and employer are included. An answer key (VT 002 075) is available for 50 cents. This document is available for $1.50 from Industrial Education, 103 Industrial Education Building, University of Missouri, Columbia, Missouri 65201. (EM)

PRINTING

A Course of Study

Designed for
Cooperative Part-time Students
Employed in Printing Shops

Issued by

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College of Education
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In Cooperation with

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Jefferson City, Missouri

2076

MEMORANDUM

TO: The ERIC Clearinghouse on Vocational and Technical Education
The Ohio State University
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Columbus, Ohio 43212

FROM: (Person) James B. Karnes (Agency) University of Missouri at Columbi

(Address) 103 Industrial Education Bldg., Columbia, Missouri

DATE: December 6, 1967

RE: (Author, Title, Publisher, Date) Industrial Education Dept., PRINTING, cooperatively with Industrial Education Dept. (U. of Mo. at Columbia) and Missouri Dept. of Education

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(2) Means Used to Develop Material:
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Level of Group State
Method of Design, Testing, and Trial Analysis of occupation, consultation with specialists, periodic revisions after use in the field.

(3) Utilization of Material:
Appropriate School Setting High school or post high school including area vocational
Type of Program cooperative or preparatory
Occupational Focus Limited job family
Geographic Adaptability United States
Uses of Material Study Guide for related instruction on individual basis
Users of Material student

(4) Requirements for Using Material:
Teacher Competency Qualified coordinator or competent trade teacher
Student Selection Criteria junior in high school with proper prerequisites

Time Allotment 180 days

Supplemental Media --
Necessary x
Desirable
(Check Which)

Describe P

Source (agency) See attached list for references
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REFERENCES FOR PRINTING

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* Subject to educational discount.
** Frequency of use in assignments.

FOREWORD

This course of study, consisting of an analysis of the work of the printer, together with the assignment sheets covering the related (occupational) information to be taught by the school, has been prepared for teaching printing on an individual basis in part-time Cooperative Occupational Education programs.

The original course of study was prepared by Mr. Ewell S. Thurman, formerly coordinator at Marshall, Missouri; subsequent revisions were made by Mr. Norman Crouch, while on the staff of the State Department of Education, Jefferson City, Missouri, Dr. Charles Rischer and later by Dr. Charles Bunten, both formerly Research Assistants in Industrial Education at the University of Missouri. The present revision of this course of study was prepared by Mr. Jack A. Luy, Research Assistant in Industrial Education at the University of Missouri.

We wish to acknowledge our indebtedness to Dr. H. H. London, Professor of Industrial Education at the University of Missouri, for the direction and administration of the Curriculum Materials Laboratory in which this material was prepared, and to Dr. James B. Karnes, Assistant Professor of Industrial Education at the University of Missouri, who supervised the preparation of the material and edited the manuscript. Credit is due to Dr. H. Pat Wardlaw, Assistant Commissioner of Education, Mr. Merton Wheeler, Director of Industrial Education, and to other staff members of the State Department of Education for their efforts in the development of the Industrial Education Curriculum Series of which this course of study is a part.

HUBERT WHEELER

Commissioner of Education

May, 1963
500

Revised August, 1966
500

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Assignment Sheets:

Information Sheets:

Training Plan and Progress Record

INTRODUCTION

In preparing this course of study, it has been assumed that the attainment of occupational competency in any type of work involves three different, yet closely related, types of learning. They are:

1. Mastery of the practical job skills and procedures performed by the worker in the occupation.
2. Comprehension of the technical and related information basic to an intelligent understanding and practice of the occupation.
3. Development of those personal-social traits which are essential for the successful worker.

The first group of these "learning units"--the job skills and procedures--has been arranged in the analysis under the heading of "Job Training". The second group of learning units--the technical and related information--has been arranged under the heading of "Related Information". And the third group--the personal-social traits--has been listed under "Personal-Social Traits Essential for the Printer" in the introductory section addressed to the student.

In a cooperative educational program it is necessary for both cooperating agencies--the school and the employer--to understand clearly just what each is to be responsible for in the training of the student-worker. Experience has shown that most of the practical job skills and procedures of an occupation can best be learned through supervised work on the job. Experience has shown also that the school can best teach most of the technical and related occupational information needed by young student-workers. This division of responsibility has been made in the arrangement of the course of study; that is, it is expected that the student-worker will master the job skills and procedures through practical work on the job under the immediate supervision of the employer, and that he will receive instruction in related occupational information in the school under the direction of the coordinator.

Skills and related information are matters for direct instruction, but personal-social traits are acquired only through practicing them during the process of acquiring skills and information and in one's daily conduct. Therefore, both the employer and the school, as well as the home, must assume responsibility for developing in the student-worker those habits, attitudes and character traits which are essential for success in his occupation and in life. Both the employer and the school should be constantly on the alert to see that the student-worker places desirable interpretations on his experiences and that he does not practice habits and exhibit character traits detrimental to his success.

Since the coordinator's class will be made up of fifteen or more students, each differing from the other significantly, studying a dozen or more occupations which differ markedly in their requirements, it follows that it will be impossible for him to teach, through the group method, the occupational information which relates to the specific job of each student-worker. In order to be effective, this type of instruction must be individualized. There is, of course, some related information, such as occupational health and safety, workmen's compensation, wage-hour laws, fair labor standards, unemplo ment compensation, and the like, which is of common interest and concern to all student-workers, and may be effectively taught by the group method. But if the coordinator is to make a real contribution to the in-service vocational education of his students, he must devote a major portion of his classroom instruction to content which deals specifically with the work of each boy and girl enrolled.

With this requirement in mind, and in order to facilitate individual instruction, these assignment sheets have been prepared. Each contains certain record data as to number and range of units covered, introductory paragraphs designed to develop interest, explain the importance of the assignment, and to convey to the student what he is expected to learn, specific assignments including reading, learning activities and a series of new-type questions designed to check his attainment.

Obviously, it is desirable to teach the related information in the school at the time it will be used most advantageously on the job This means that the two phases of the student-worker's training shoul parallel each other in a progressive manner. The coordinator will find the assignment sheets well adapted to this end. He can select from day to day the assignment which covers the informational units related to work being done on the job. With this arrangement, the coordinator will become, during a major portion of his classroom time, a supervising study and helping teacher.

At the back of this course of study will be found three copies of the TRAINING PLAN AND PROGRESS RECORD FOR PRINTING. One copy is marked "Student" in the upper right hand corner. On this copy, in the space <u>Time in hours</u>, the student will keep a tally of the hours he spends on his job performing operations in each area. The next copy marked "Employer". should be given to the employer for recording the student's job performance in each area. The third copy may be used by the coordinator for his record.

In selecting instructional materials for this course, an effort was made to restrict the number to only those including information considered to be most important for the printer to know. Among other criteria, the recency of publication was considered. It is recommende that these materials be purchased and made available for student use.

Key answer sheets have been prepared to enable the coordinator to score quickly the objective tests which are a part of each assignment sheet. These key sheets give the correct answers to the questio and should be kept in the coordinator's possession.

TO THE STUDENT-WORKER

For thousands of years men have exchanged their thoughts and ideas by means of symbols or marks. These symbols or marks have been scratched in stone, burned in wood, painted on skins, marked on paper, etched in metal, and signaled with smoke.

The purpose of printing is to record ideas and thoughts in a legible and attractive style, suited to the purpose intended. In the simplest kinds of printing, type is set in lines, locked in a form, placed in a press, inked, and impressed on some medium. The result of this process may be a calling card, letterhead, program or printed item.

In this course you will learn the operations in typesetting and presswork used in the production of the printed page. You will also study the methods used in printing books, magazines, and newspapers, as well as the materials, processes, and machines used in commercial plants in the manufacture of printed products.

The art of printing has contributed more to man's progress than any other art. By means of printing the knowledge accumulated through the ages is made available to all, regardless of class, caste, or creed.

Opportunities and Requirements

Because of the need for printed matter in nearly all of man's activities, printing has in modern times ranked consistently high among this nation's great industries. The wide variety of products of the press, and the demand for a constant supply requires the efforts of many skilled persons in printing firms ranging from the small "one-man" establishments to large plants employing hundreds of workers.

Printing as a vocation attracts many young men and women because it offers genuine opportunities for steady work, good pay, and advancement. The trade has several branches and numerous allied industries. The most familiar area, letterpress printing, has three distinct branches of work: composition, the preparation of the printing surface; presswork, the actual printing of the composed matter; and binderywork, the folding or joining together of the printed sheets so they may be distributed to the public.

Young people who enter the printing trade will find it offers abundant opportunities. While there are more men than women in the trade, women find places in all branches except where heavy lifting is done. For typographic printing the usual requirements include a good education--a high school education is preferred and is rapidly becoming an essential--good health, good eyesight, and a sense of design and proportion. For the most part the work of printing requires exceptional patience and a greater than average interest for creative work.

Opportunities for advancement are especially favorable at the present time when there are few apprentices in proportion to the total number of journeymen. The work is not heavy as a rule, and the fact that it is indoors makes it attractive to many persons as a year-around occupation.

In spite of a former widespread belief that printing occupations are injurious to health, there is little evidence on which to base this belief. There are, of course, shops in which the best conditions still do not exist, and the worker must be able to recognize them. While there are accident hazards in the use of the machinery in a printing shop, exercising reasonable care, and using the safety devices which are provided will make serious accidents unlikely.

Personal-Social Traits Essential for the Printer

Personality traits are of extreme importance, not only in securing and holding a desirable position, but in life in general. Personal-social traits can be improved through training when the individual learns what to improve, and why improvement is advisable. Among the personal-social traits of chief importance to the printer are the following:

Accuracy: It is of prime importance that the printer be accurate, since accuracy is basic in the printing business.

Honesty: This means giving full value for pay received, truthfulness, unqualified loyalty to one's employer.

Dependability: The ability to do good work in a businesslike way without supervision.

Intelligence: The printer must be above average in general intelligence, with at least a high school education.

Cooperation: This implies the ability and disposition to work harmoniously with others, to be helpful, to work together.

Health: A printer needs good health, especially good eyesight and endurance. One who is not physically and mentally able to stand long irregular hours should not undertake the work.

Personality: A printer should be able to build up good will among his customers so that they will come back. He should be a go-getter, a person of ideas, ready with helpful suggestions for potential customers. He must possess a pleasing personal appearance, a good speaking voice, and a sense of humor.

Alertness: For the printer who operates his own machines, manual dexterity and mental alertness are essential.

Ambition: The printer must have love of his work, a singleness of purpose, and an ambition to expand his business, with caution in expanding beyond his capacity to make his business pay.

Tactfulness: The ability to do and say things without offending people.

Courtesy: This involves respect for the point of view, interests, and wants of others, and although at times it will require effort, it pays well in business and human relations.

REFERENCES FOR PRINTING

A. Cleeton, Glen U., and Pitken, Charles W., General Printing, McKnight and McKnight Publishing Company, Bloomington, Illinois, 1963, $5.20.* (19)**

B. Karch, R. Randolph, Graphic Arts Procedures, 3rd edition, American Technical Society, Chicago, Illinois, 1965, $5.25.* (19)**

C. Polk, Ralph W., The Practice of Printing, Chas. A. Bennett Co., Inc., Peoria, Illinois, 1964, $6.00.* (17)**

D. Mergenthaler Linotype Company, Linotype Machine Principles, 29 Ryerson Street, Brooklyn 5, New York, 1940, $3.05. (5)**

E. Mergenthaler Linotype Company, Linotype Keyboard Operation, 5th edition, 29 Ryerson Street, Brooklyn 5, New York, 1957, $3.00. (1)**

F. Pollack, Phillip, Printing: Careers and Opportunities for You, Chilton Company, Book Division, 56th and Chestnut Streets, Philadelphia 39, Pennsylvania, 1959, $2.50.* (1)**

* Subject to educational discount.
** Frequency of use in assignments.

ANALYSIS OF PRINTING

JOB TRAINING: What the Worker Should Be Able to Do	Assign. No.	RELATED INFORMATION: What the Worker Should Know
		Fundamental Information
	1	1. History of printing
	2	2. Opportunities, requirements and future outlook of printing industry
	3	3. Accident and health hazards in the printing shop
		Elementary Composition
	4	4. Kinds of type cases and cabinets
5. Set type from type case	4	5. Layout of California Job Case
6. Lay type case		
7. Clean type case		
8. Identify type characters	5	8. Type materials; parts, size, fonts, faces, families, and series
9. Identify spaces and quads	5	9. Names and sizes of spaces and quads
10. Identify leads and slugs	5	10. Sizes of leads and slugs
	5	11. Market units of type
	5	12. Cleaning and care of type materials
13. Measure type and space material	5	13. Standard type material sizes
14. Calculate with point system	6	14. Printing system of measurement
	7	15. Styles and care of composing sticks
16. Set a composing stick to measure		
17. Set a composing stick with half-pica level	7	17. Half-pica marks
18. Set a sliding knee stick to measure	7	18. Characteristics of Buckeye Stick
19. Center line	7	19. Techniques of centering line
20. Test for line justification	7	20. Methods of justification
21. Set straight matter	7	21. Rules for word division
22. Justify by spacing in	7	22. Substitution of spaces
23. Put line on its feet		
24. Space out line	7	24. Arrangement of spaces and quads in line
25. Quad out line	7	25. Arrangement of spaces and quads at the end of line

JOB TRAINING: What the Worker Should Be Able to Do	Assign. No.	RELATED INFORMATION: What the Worker Should Know
26. Work at bank	8	26. Position of compositor and galley at bank
27. Dump stick	8	27. Methods of lifting type from stick
28. Tie small form	8	28. Methods of blocking and typing straight matter
29. Tie large form		
	8	30. Care of string

Proofing and Distributing Type

	9	31. Proof presses; kinds used and advantages
32. Ink proof press	9	32. Care and use of brayer
33. Position and ink form	9	33. Principles of positioning and inking
	9	34. Function of bearers
35. Pull proof		
36. Operate proof press with grippers		
37. Eliminate proof slurs		
38. Wash form	9	38. Solvents and their uses
39. Keep type on its feet	9	39. Causes of type getting off its feet
40. Make minor corrections	9	40. Methods of correcting in galley
41. Make corrections effecting justification	9	41. Methods of correcting in stick
42. Overrun type	9	42. Method of correcting lines involving resetting of lines
43. Mark revised proof		
44. Wash proof press	9	44. Care of proof press
45. Take planer proof	9	45. Principles of stone proofing
46. Proofread and proofmark	10	46. Standard proofreaders' marks and usage
47. Identify type for distribution	11	47. Methods of distinguishing cases and type for distribution
48. Distribute type	11	48. Distribution techniques for type, leads, and slugs

Commercial Display and Special Composition

49. Make working layout for job of printing	12	49. Basic considerations of good layout
	12	50. Principle of fitness
	12	51. Principle of balance

JOB TRAINING: What the Worker Should Be Able to Do	Assign. No.	RELATED INFORMATION: What the Worker Should Know
	12	52. Principle of proportion
	12	53. Principle of shape harmony
	12	54. Principle of tone harmony
	12	55. Legibility of type faces
	12	56. Use of decorations in printing
57. Select appropriate paper	13	57. Paper manufacture
	13	58. Paper varieties and characteristics
59. Identify paper	13	59. Kinds of paper, standard sizes, care and uses
60. Specify and estimate paper	13	60. Calculations for cutting paper
61. Cut leads and slugs with slug cutter	14	61. Functions of the micrometer gauge
62. Set mitering machine		
63. Miter rectangularly	14	63. Selection of proper material for mitering
64. Miter other shapes		
65. Operate power saw trimmer		
66. Build border	14	66. Styles of border material
	14	67. Methods of aligning rule with type
	14	68. Methods of butting corners of rule
69. Set initial letter	14	69. Typographical considerations of initial letter
70. Set hanging indention	14	70. Uses of hanging indention
71. Set lines for poetry	14	71. Rules for indention of poetry
72. Set quoted paragraph	14	72. Rules for placing quotations in "quoted" paragraphs
73. Set cut-in notes	14	73. Typographical considerations of cut-in notes
74. Construct tabular forms	14	74. Various divisions and characteristics of tabular forms
75. Set column to odd measure	14	75. Application of odd measure in tabular composition
76. Set a job for work and twist run	14	76. Advantages of work and twist methods with tabular forms
77. Set a job with leaders	14	77. Functions of leaders in programs and tabular forms
78. Set a business card	14	78. Standards of business card composition and display
79. Set a letterhead	14	79. Standards of letterhead composition and display

JOB TRAINING: What the Worker Should Be Able to Do	Assign. No.	RELATED INFORMATION: What the Worker Should Know
80. Set a bill-head-statement	14	80. Standards of bill-head-statement composition and display
81. Set envelope corner card	14	81. Standards for envelope composition and display
82. Set calendar	14	82. Vertical alignment of type and figures
83. Set ticket	14	83. Standards for ticket composition and display
84. Set program	14	84. Standards for program composition and display
85. Set menu	14	85. Standards for menu composition and display
86. Set cover and title page	14	86. Standards for cover and title page composition and display
87. Set informal booklet	14	87. Standards for booklet composition and display
88. Set advertisement	14	88. Standards for advertisement composition and display
89. Plan composition for book	14	89. Legibility of type faces for books
	14	90. Proper order of contents of book
	14	91. Technique of figuring ems of type for paging
	14	92. Application of color to printing
Lock-Up and Imposition		
93. Position form for lock-up	15	93. Basic factors involved in positioning form
	15	94. Characteristics of wood, reglet,and metal furniture
95. Place furniture for lock-up	15	95. Different methods of lock-up
	15	96. Disadvantages of pyramid lock-up
97. Place quoins for lock-up	15	97. Types of quoins and quoin keys; their position and use
98. Make preliminary test on lock-up	15	98. Methods of testing for "lift" and "spring"
	15	99. Methods of planning forms
100. Make final lock-up of form	15	100. Proper order of locking quoins
101. Handle standing forms	15	101. Methods of handling and storing forms

JOB TRAINING: What the Worker Should Be Able to Do	Assign. No.	RELATED INFORMATION: What the Worker Should Know
102. Unlock form	15	102. Order of unlocking form
103. Break up form	15	103. Methods of material storage
104. Lock up form for work and turn run	15	104. Arrangement of forms for work and turn jobs
105. Lock up form for sheetwise run	15	105. Arrangement of forms for sheetwise run
106. Lock up rule border	15	106. Care of mitered corner in lock-up
107. Impose form for two-page lock-up	15	107. Arrangement of forms for margin
108. Lock up form for two-color run		
109. Impose form for four-page lock-up	15	109. Compute allowances for fold, guide, grippers and trim
110. Impose form for eight-page lock-up	15	110. Function of dummy layouts
	15	111. Function of signature marks

Platen Press Operations

	16	112. Kinds of presses; their advantages and uses
113. Wash platen press	16	113. Methods of washing press
	16	114. Care and composition of rollers
	16	115. Methods of mixing colored inks
116. Oil platen press and motor	16	116. Qualities and use of lubricants
117. Start platen press	16	117. Functions of parts of platen press
	16	118. Safety precautions to observe when working on platen presses
119. "Throw off" press		
120. Stop platen press		
121. Put on tympan	17	121. Types of packing
122. Put chase in press	17	122. Precautions when lifting and handling forms
123. Position grippers	17	123. Function of grippers
124. Prepare platen	17	124. Steps in preparation of platen
	17	125. Purpose of friskets
126. Ink press	17	126. Composition, kinds, colors and care of inks
127. Position guide pins	17	127. Kinds of guide pins
128. Makeready composed forms	17	128. Method of marking out and making ready

JOB TRAINING: What the Worker Should Be Able to Do	Assign. No.	RELATED INFORMATION: What the Worker Should Know
	17	129. Preparation of underlays, interlays, and overlays
130. Makeready for illustrations and half-tones		
131. Feed platen presses	17	131. Methods of positioning, fanning out and handling stock
	17	132. Kinds of automatic press-feeders
133. Maintain even color	17	133. Precautions when regulating ink supply
134. Handle fresh printed sheets	17	134. Purpose of slip sheeting
	17	135. Suiting ink to paper
136. Remove chase from press	17	136. Methods in caring for and storing forms
	17	137. Uses of color in printing
138. Print two-color job	17	138. Value of good register
139. Print with numbering machine	17	139. Kinds of automatic numbering machines; their care and use
140. Perforate sheets	17	140. Methods of making ready for perforating
	17	141. Special precautions for rollers
142. Score sheets	17	142. Methods of making ready for scoring
143. Cut out blanks	17	143. Methods of making ready for cutting
144. Print on ribbons		
145. Print on felt		
146. Print on celluloid		
147. Print on aluminum		

Stockroom and Bindery Work

148. Care for and handle paper stock	18	148. Cautions to be taken in paper handling
149. Cut paper	18	149. Kind of paper cutters; their care and use
150. Handle fresh printed sheets		
151. Job paper	18	151. Methods of jogging paper
152. Count paper		
153. Make pads	18	153. Kinds of tabbing compounds their care and use
154. Side stitch (staple)	18	154. Kinds of stapling machines their care and use
155. Saddle stich (staple)	18	
156. Run folder	18	156. Methods of folding booklets
	18	157. Various types of spiral bindings

JOB TRAINING: What the Worker Should Be Able to Do	Assign. No.	RELATED INFORMATION: What the Worker Should Know
	Printing Plates	
	19	158. How plates print
159. Make line engraving	19	159. Chemical processes in platemaking
160. Make photoengraving	19	160. How plates produce color
161. Make stereotype	19	161. Methods of duplicating type forms
162. Make lithographic plate	19	162. Principle of offset printing
	19	163. Principle of gravure process
	19	164. Principle of photogelatin process
	Linecasting Machine Operations	
	20	165. Kinds of linecasting and typecasting machines
	20	166. Linotype mechanism functions
167. Start linecasting machine		
168. Stop linecasting machine		
169. Position control lever to "off" position		
170. Position control lever to normal (neutral) operating position		
171. Position control lever to re-casting position		
172. Prepare keyboard for operation	21	172. Methods of locking keyboard
173. Prepare magazine for operation	21	173. Method of checking magazine for contents
174. Change magazine with raising and lowering mechanism	21	174. Method of raising and lowering magazine
175. Change magazine by	21	175. Method of locking magazine
176. Finger the key board	21	176. Lay of keyboard
	21	177. Position of fingers on keyboard
	21	178. Use of "touch system"
	21	179. Function of keyboard
180. Set assembler slide to measure	21	180. Steps in setting machine to measure
181. Set delivery slide to measure	21	181. Steps in setting delivery slide
	21	182. Function of vise

JOB TRAINING: What the Worker Should Be Able to Do	Assign. No.	RELATED INFORMATION: What the Worker Should Know
183. Set locking block to measure	21	183. Function of locking jaw
	21	184. Function of first elevator cam
185. Set first elevator jaw line stop	21	185. Steps in setting first elevator jaw
	21	186. Function of first elevator
187. Set assembling elevator duplex rail	21	187. Function of duplex rail
188. Set "flap" (two-letter attachment)	21	188. Various adjustments and uses of "flap"
189. Justify line in assembling elevator		
	21	190. Function of matrices
	21	191. Function of spaceband
	21	192. Kinds of spacebands
	21	193. Parts of spacebands
	21	194. Allowance for spaceband in justification
	21	195. Function of justification lever
196. Release spaceband	21	196. Function of spaceband pawl lever
197. Return spacebands to spaceband box	21	197. Parts of spaceband box
	22	198. Function of mold disk
199. Back up machine		
	22	200. Function of locking stud blocks
	22	201. Position of linecasting control lever
	22	202. Function of driving clutch
	22	203. Position of mold disk cam lever
204. Pull out mold disk wheel	22	204. Position of mold disk wheel
205. Remove mold	22	205. Kinds of molds; their functions, care, and uses
206. Clean mold	22	206. Materials used in cleaning mold
207. Replace mold		
208. Set liners in mold	22	208. Function of liners; their sizes, care, and use
	22	209. Positioning liners in molds
210. Position the mold for its normal casting operations	22	210. Importance of aligning mold disk bevel pinions to disk
	22	211. Location of timing marks
212. Clean mouth piece	22	212. Parts of mouth piece

JOB TRAINING: What the Worker Should Be Able to Do	Assign. No.	RELATED INFORMATION: What the Worker Should Know
	22	213. Function, care, and uses of mouth piece
214. Check trim knives for type high trim	22	214. Function of back knives
	22	215. Methods of removing burrs from back knives
216. Check ejector blade for size	22	216. Action of Universal ejector blade selector
	22	217. Alignment of ejector blade through mold
	22	218. Manual method of changing ejector blade
219. Clean face and back of mold disk and mold	22	219. Importance of good maintenance of mold disk wheel
220. Clean back and front mold disk wiper	22	220. Function of mold disk wipers
221. Replace and position the mold casting disk	22	221. Functions of mold disk bevel pinion gear
	22	222. Timing mold disk wheel
223. Return machine to normal casting position	22	223. Precautions in alignment of second elevator
	22	224. Precautions in use of linecasting control lever
225. Lock up vise	22	225. Steps in final check-up and positioning of casting disk after a complete change over
	22	226. Functions of vise automatic
227. Set knife blocks for measure	22	227. Universal knife block
	22	228. Function of knife wiper
	22	229. Old style knife block
230. Recheck assembly, delivery, and casting mechanism before first line is set in	22	230. Functions of first elevator cam, distributor shifter cam, mold turning cam, vise closing cam, justification cam, pot pump cam, mold cam and driving gear, delivery and elevator and transfer cam
231. Send in assembled lines	23	231. Function of assembling elevator, delivery slide, first elevator, vise jaws, justification mechanism, mold casting disk, mold, ejector blade, knife block, galley and slug lever, first horizontal transfer, second horizontal, single distributor, distributor clutch, clutch assembly, and cam actions

JOB TRAINING: What the Worker Should Be Able to Do	Assign. No.	RELATED INFORMATION: What the Worker Should Know
232. Return tight line to assembling elevator		
233. Set up machine for casting border materials		
234. Insert Border slides in block		
235. Cast borders		
236. Dump galley		
237. Replace galley	23	237. Function of various galleys
	23	238. Function of slug lever
239. Release stuck matrix in magazine	24	239. Kinds of magazines; their care and use
240. Clean out jaw of matrices in assembling entrance	24	240. Function of star wheel
	24	241. Function of matrix delivery belt
	24	242. Function of idler and driving pulley
	24	243. Function of chute finger and plate guide extension
244. Clean out distributor stoppage	24	244. Function of second horizontal transfer
245. Change matrix selector	24	245. Function of single distributor, box, and font distinguisher
246. Back up distributor screws	24	246. Function of distributor chute
	24	247. Method of starting distributor after clearing of stoppage
248. Change magazine		
	24	249. Safety precautions to be observed in changing magazine
250. Store magazines	24	250. Storage of magazines
251. Clean well and well holes		
	24	252. Maintenance of Linotype metal pot
	24	253. Various characteristics of artificial gas, natural gas, and kerosene pots
	24	254. Various characteristics of electric pots and thermostat
	24	255. Function of throat
256. Clean plunger	24	256. Parts of pot pump plunger
	24	257. Maintenance of plunger
	24	258. Characteristics of Linotype metal

JOB TRAINING: What the Worker Should Be Able to Do	Assign. No.	RELATED INFORMATION: What the Worker Should Know
259. Clean back squirt	24	259. Causes of back squirt
260. Clean front squirt	24	260. Causes of front squirt
261. Remove stuck slug	24	261. Various causes of failure of slugs to eject
262. Oil linecasting machine	24	262. Amounts and kinds of lubrication for linecasting machines
263. Clean keyboard cam	24	263. Maintenance of the keyboard cam
264. Clean keyboard cam roller	24	264. Maintenance of keyboard cam roller
265. Clean and care for matrices	24	265. Parts of matrices, care and use
266. Clean and care for spacebands	24	266. Care of spacebands
267. Make Linotype adjustments	24	267. Specification for Linotype adjustments
Printing Shop Operations		
268. Estimate job prices	25	268. Factors involved in price policy and estimating
	25	269. Considerations when selling and buying
270. Compile list of sources of printing supplies		
	25	271. Factors in production management and operations
272. Prepare proof press logotype		
273. Design job jacket		

Assignment Sheet No. 1	Covering Unit 1

HISTORY OF PRINTING

Printing is a dynamic industry, contributing greatly to our means of communication. Originating in China over ten centuries ago, printing techniques were advanced in Germany, making possible the further extension of human knowledge. As printed books, newspapers, and pamphlets were published in ever increasing numbers, they played a vital part in the spreading of ideas, influencing public opinion and aiding the people to obtain a voice in government. The contribution of the printed word to the growth of democracy is so fundamental that freedom of the press has become one of America's "Four Freedoms."

Although challenged by radio, motion pictures, and television, the printed page has continually held its place as an important means of exchanging information and providing a permanent record of human effort.

As one who will carry on the traditions of the printing industry, you will be interested in exploring the past history of your chosen work. This assignment will give you a valuable background of the history of printing.

Assignment:

1. Read the references listed below.
2. Answer the questions and turn in this assignment by ______________________.

References:

A. Cleeton and Pitkin, General Printing, pp. 128-130; 139-149; 162.
B. Karch, Graphic Arts Procedures, pp. 13-21.
C. Polk, The Practice of Printing, pp. 1-12.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. The first printed books were attempts to reproduce the manuscript books which had been hand written by scribes.

T F 2. The earliest printing was done from hand carved wooden blocks.

T F 3. The Chinese had developed inks for printing as early as 400 A.D., but printing did not develop in China because the knowledge of paper-making was lacking.

T F 4. The Chinese used movable type for printing many years before Gutenberg's time.

T F 5. Papyrus was used as the raw material for the first paper.

T F 6. The first book printed in English was The History of Troy.

T F 7. England permitted freedom of the press as early as the middle 1500's.

T F 8. The Oxford University Press has operated continuously since 1585.

T F 9. Because of the printed account of the voyage of Vespucci, we live in a country known as America.

T F 10. The oldest continuously operating printing establishment in America is the Harvard University Press.

T F 11. The first printing establishment and the first regularly published newspaper originated in what is now the state of Massachusetts.

T F 12. Printing had moved to what is now Missouri by 1808.

T F 13. Prior to 1700 the British government had suppressed two attempts to publish newspapers in American colonies.

T F 14. For the 25 years it was published, Poor Richard's Almanac had an average yearly circulation of 10,000 copies.

T F 15. A book published over 150 years ago remains the best source book on colonial printing.

T F 16. The early printing presses resembled the wine and cheese presses of that period.

T F 17. Joseph Niepce made the first engraving on metal by photographic methods.

T F 18. Photo-engraving has been commercially profitable for around 75 years.

T F 19. Movable types were first used in Europe around the middle of the 1400's.

T F 20. The Bible was the first book to be printed in England.

T F 21. The carved stone tablets of the Assyrians represent the earliest attempt of man to record an important event.

T F 22. The twenty-six character alphabet as we use it today was developed by the Phoenicians.

T F 23. Hieroglphics, a very elaborate system of picture writing, was developed by the Assyrians.

T F 24. Johann Gutenberg is generally given credit for the first book printed from movable type.

T F 25. William Caxton introduced printing into England.

T F 26. William Caslon is best known for his printed works.

T F 27. The first printing in North America was done in Mexico.

T F 28. The <u>Freeman's Oath</u> was printed in 1639 and was the first material printed in Colonial America.

T F 29. Benjamin Franklin was one of the most widely known printers of early America.

Completion

<u>Directions</u>: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. The printing establishment which has had the longest continuous operation in history is the ______________ ______________ ______________ in ______________.

2. William Caslon made his most notable contribution to the progress of printing in the field of ______________ ______________.

3. The first printer in the American colonies was ______________ ______________.

4. The American printing establishment which has the longest period of continuous operation is the ______________ ______________ ______________.

5. The oldest continuously published newspaper in America is the ______________ ______________.

6. The first regularly published newspaper in America was established in the opening years of the ______________ century.

7. The forerunner of the modern printed book was the ______________ ______________.

8. Gutenberg's first known work was the ________________________.

9. The modern style of type faces was designed by ______________.

10. The first book printed in the Western Hemisphere was published in ______________ in the year ______________.

Matching

Directions: In the right column are descriptive words and phrases, and in the left, various words. Match the letters of the item on the right with the word(s) on the left by placing the proper letter in each blank on the left.

I.

_____ 1. Cuneiform

_____ 2. Egyptian

_____ 3. Phoenicians

_____ 4. American Indians

_____ 5. Jan de Printere

_____ 6. Churches and monasteries

_____ 7. Gutenberg

_____ 8. Pannartz and Sweinheym

_____ 9. Manutius

_____10. Jenson

A. Books and scrolls were written by scribes

B. Developed Roman to its finest form and beauty

C. Development of alphabet

D. Wedge-shaped characters

E. Hand carved wooden block in 1417

F. Invented Italic type

G. Papyrus scroll

H. Originated first Roman type

I. Genesis of typefaces

J. Picture writings

K. First movable metal type

II.

_____ 1. Caslon

_____ 2. Caxton

_____ 3. Garamond

_____ 4. Tory

_____ 5. Bodoni

_____ 6. Franklin

_____ 7. Bradford

_____ 8. Cromberger

_____ 9. Stephen Daye

_____10. Printing Education Week

A. Promoted early French printing

B. Introduced printing into England

C. Page from the "Diamond Sutra"

D. Benjamin Franklin's birthday

E. Became famous American colonial printer

F. Originated modern-face type

G. First colonial printer

H. Began type foundry as a separate activity

I. Became first printer in Pennsylvania

J. America's first printer

K. Became famous English printer and type founder

Assignment
Sheet No. 2

Covering
Unit 2

PRINTING AS A VOCATION

In the printing industry, sometimes called the graphic arts industry, there is a great need for well-trained workers. Although there exists a vast array of machinery, materials, and appliances of the trade, there is a shortage of skilled printers who can use this equipment to turn out products of the quality demanded by today's consumers of printed materials.

If one expects to remain in, and advance in, the printing industry, it is not adequate merely to know of the existence of job openings. The extent of these opportunities, the requirements of the various jobs, wage trends, how the field of work compares with others in the nation, future expectations of the industry and a vast amount of other pertinent information relative to the printing industry must also be known.

In order that you will not fall into the category of uninformed workers, this unit is designed to acquaint you with various items of factual information which will enable you to become well rounded in your knowledge of the printing industry as a whole. It is also designed to make you aware of the position of the industry in our national economy.

Assignment:

1. Read the references given below.
2. Answer the questions and turn in this assignment by ____________________ .

References:

A. Cleeton and Pitkin, General Printing, pp. xi-xiv, 13-16, 184-188.
B. Karch, Graphic Arts Procedures, pp. 337-353.
F. Pollack, Printing: Careers and Opportunities for You, pp. 13-39.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. Printing is the fourth largest industry in the United States in terms of the number of establishments.

T F 2. Most printing craftsmen are employed by newspapers.

T F 3. Printing employment tends to be less affected by declines in general business activity than employment in manufacturing as a whole.

T F 4. Printing is a seasonal occupation.

T F 5. One of the primary disadvantages of employment in the printing industry is forced retirement at an early age due to the nature of the work.

T F 6. Most printing craftsmen are members of trade unions.

T F 7. Few technological changes are expected in printing processes within the next twenty-five years.

T F 8. In the past, technological advancements in the printing industry have caused a decrease in the number of people employed in the industry.

T F 9. The training of workers has kept pace with the employment demands of the printing industry.

T F 10. The majority of workers in the printing industry are women.

T F 11. The purposes of printing is to record messages on paper or other surfaces.

T F 12. Printing has a broader context than graphic arts.

T F 13. The proportion of skilled workers to other workers in printing is about twice that for other industries.

T F 14. Unlike other industries, workers in printing establishments have not become specialists.

T F 15. The copyholder holds the copy so the proofreader can mark any corrections.

T F 16. A worker familiar with platen and job cylinder presses should be able to enter any of the printing fields as a pressman without further experience or training.

T F 17. The majority of men employed in the printing industry perform jobs requiring little or no special skill.

T F 18. In 1950, over 65,000 persons employed in the printing industry were under twenty years of age.

T F 19. The supply of professionally qualified personnel for the printing industry falls far short of the demand.

T F 20. Printing is a stable industry.

T F 21. Too many apprentices are being trained for the printing industry.

T F 22. The graphic arts industry has many small establishments.

T F 23. In general, graphic arts work is clean.

T F 24. In order to impress a prospective employer, the printing school graduate should claim to be able to perform all of the skills of the trade, regardless of his actual ability to do these things.

T F 25. Most employers are satisfied with a job well done regardless of the time taken to complete the job.

T F 26. The minimum requirements for a compositor is the completion of a five-year apprenticeship as a hand compositor or the equivalent.

T F 27. The proofreader must have a thorough knowledge of the English language.

T F 28. Pressroom positions require a thorough knowledge of the mechanics of the press operated.

T F 29. Photoengravers never perform all of the operations required in making letterpress original plates.

T F 30. Lithographic artists perform the work of dot etching, Ben Day, tusching, and opaquing.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. The term of apprenticeship in printing is generally from ______ to _______ years and must be supplemented by courses of study amounting to a minimum of _______ hours for each year of training.

2. The two largest printing centers in the United States are _______________ and _______________ .

3. Printing plants that employ such workers as photographers, strippers, printers, tint layers, artists, etchers, finishers, and proofers are known as _______________ plants.

4. The greatest number of men workers in the specialized printing crafts are _______________ _______________ or _______________ _______________ _______________ .

5. Normally, the printing industry has over _______________ _______________ apprentices in training.

6. Graphic arts workers number about _______________ in the United States.

7. The ______________ sets type and assembles the products of type composing machines into pages for books, newspapers, and commercial printing of all kinds.

8. The ____________ ____________ draws and writes exact typographic specifications to scale for the other workers in the shop.

9. The minimum requirements for a linotype operator include the completion of a ________ ____________ apprenticeship in a composing room, including ____________ ____________ as a linotype operator or completion of a school course in __________ ________________ and ________________.

Listing

Directions: List the items called for in each of the following statements. Select your answers carefully.

1. Three methods of entering the printing industry are:

(A) ____

(B) ____

(C) ____

____

____

2. The composing room jobs are:

(A) ____________________ (D) ____________________

(B) ____________________ (E) ____________________

(C) ____________________

3. The jobs in letter press are:

(A) ____________________ (D) ____________________

(B) ____________________ (E) ____________________

(C) ____________________

4. The major fields of offset-lithographic tasks are in:

(A) ____________________ (C) ____________________

(B) ____________________ (D) ____________________

5. The professional positions are:

(1) ____________________

(2) ____________________

(3) ____________________

(4) ____________________

(5) ____________________

(6) ____________________

(7) ____________________

6. Graduates of vocational and printing schools generally secure employment by:

(1) ____________________

(2) ____________________

(3) ____________________

(4) ____________________

Assignment
Sheet No.3

Covering
Unit 3

ACCIDENT AND HEALTH HAZARDS

Considered as a general group, printers usually enjoy good health Government surveys have shown that long and continuous employment in the printing trades is compatible with reasonably good health.

You who have elected to work in the printing industry, and who will work in the printing shops should realize that accident and health hazards are found in the printing industry as in any other major production industry. Because these conditions do exist, the hazards, their results, and means of prevention must be known in order to provide a background of knowledge about the particularly dangerous machines, and personal conduct necessary to prevent injury or illness.

A careful study of the references assigned in this unit will provide information necessary to aid in accident prevention, and develop an attitude which will enable you to protect your personal health.

Assignment:

1. Read the references listed below.
2. Answer the questions and turn in this assignment by ____________________

References:

B. Karch, Graphic Arts Procedures, pp. 273-274.
I. Information Sheet No. 1.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. A worker in the printing trades must expect to work around numerous accident and health hazards which cannot be corrected or prevented.

T F 2. Long neckties and loose clothing constitute a serious hazard around moving machinery.

T F 3. Because individuals do similar tasks in different ways, it is advisable to lift all forms, light and heavy, alone.

T F 4. Because it lies flat, paper on the workroom floor presents an insignificant accident hazard.

T F 5. Machinery must be oiled or wiped while in operation.

T F 6. When lifting, the leg muscles, not the abdominal muscles, should be used.

T F 7. Talking to a beginning pressfeeder should be prohibited, but standing behind him to watch him at work can do no harm.

T F 8. Oil should be kept on the workroom floor at all times in the interest of safety.

T F 9. An open knife can be safely carried in a worker's pocket so long as the point of the blade is down.

T F 10. If a sheet slips from the platen when hand feeding a press, the operator should quickly reach into the press to recover it.

T F 11. Wrestling and horseplay in the plant should be absolutely prohibited.

T F 12. All work areas should receive a proper amount of illumination, but this is impossible because the glare cannot be controlled.

T F 13. Skin infections can result from the use of benzine for cleaning purposes.

T F 14. The lack of dust control within the workroom may cause diseases of the respiratory system.

T F 15. To avoid being burned, pigs of metal may be pitched into the pot for melting.

T F 16. Once they have been adjusted, automatic stops need not be checked for adjustment.

T F 17. Cleaning liquids may be stored in the workroom.

T F 18. The worker who smokes while at work should not wear a celluloid eyeshade.

T F 19. Tuberculosis may be spread by the use of a common drinking cup or common towel.

T F 20. Spitting on the floors of the plant should be prohibited of all workers.

T F 21. In the composing room, a bellows should be used to clean the compartments of the type cases.

T F 22. A headache or feeling of weariness may be one of the first indications of the presence of carbon monoxide within a poorly ventilated shop.

T F 23. Proper ventilation and adequate washing facilities should be provided when benzine is used to wash presses.

T F 24. The fumes from gas heated pots should be vented to the back of the linotype.

T F 25. Pot plungers should be cleaned at the machines.

T F 26. Lead poisoning, while causing discomfort, is not a serious health hazard.

T F 27. In the interest of health, sterilized wiping cloths should be used for cleaning presses.

T F 28. When cases are left for only a few minutes, they may be left open, but when left for 15 minutes or longer, they should be closed.

T F 29. A thoughtless or careless workman can cause a well-guarded machine to become dangerous.

T F 30. Injuries occur when the worker has his attention diverted from his job.

T F 31. Open type cases, especially the lower ones, constitute a serious accident hazard.

T F 32. Paper stock should be cut by teams of two or three workers.

T F 33. Holding a piece of type in the mouth is permissible if the dust is first rubbed off with the fingers.

T F 34. Very small cuts need not be treated to prevent infection.

T F 35. Fatigue and the weakening of body resistance are the results of improper ventilation.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. Colic, constipation, heart and kidney diseases are the results of ____________ ____________.

2. Headache, nervousness, and digestive ailments may result from the continued exposure to ____________ ____________.

3. A common drinking cup and spitting on the floors are means of spreading ____________.

4. Sterilized wiping cloths can usually be secured from a ____________ ____________ or ____________ ____________.

5. Convulsions and death may result from the use of cleaning solutions with a base of ____________ ____________.

Matching

Directions: In the right column are descriptive words and phrases and in the left various words. Match the letters of the items on the right with the words on the left by placing the proper letter in each blank on the left.

_____ 1. Tripping and falling

_____ 2. Saws and saw trimmers

_____ 3. Paper cutters

_____ 4. Dust

_____ 5. Lead poisoning

_____ 6. Benzine

_____ 7. Talking with workmen

_____ 8. Fatigue

_____ 9. Platen presses

_____ 10. Handling paper

A. Colic, heart and kidney diseases, death

B. Loss of fingers or hand

C. Cuts, rupture, strains

D. Bruises or broken bones

E. Getting caught in rollers and belts

F. Burns and mangled hands

G. Ill health

H. Skin infection, dizziness, headaches

I. Burns

J. Crushed fingers or hands

K. Mangled hands and eye injuries

L. Respiratory diseases

M. Getting out of time with machines

Information
Sheet No. 1

ACCIDENT AND HEALTH HAZARDS

This information sheet will present certain accident and health hazards as well as their ultimate results and means of prevention.

Accident Hazards

Platen Presses: Careless press feeding can result in crushed hands or fingers. To prevent injury install proper guards; do not try to feed very small or odd-shaped sheets. Do not reach for falling sheets.

Cylinder and Rotary Presses: Crushed or cut hands or feet result from carelessness when using these machines. To eliminate injuries, guard all hand and foot hazards; get aid when removing and replacing rollers.

Saw and Saw Trimmers: Mangled hands can result from contact with the moving blade, or eye injuries can result from the eyes being struck by metal pieces thrown by the moving blade. To prevent hand injuries from saws and trimmers, use guards and work holders at all times. To prevent eye injuries, wear goggles whenever operating saws and saw trimmers.

Composing Machines: With careless and improper adjustment, composing machines can cause burns and mangled hands. To prevent such injuires, see that all automatic stops are adjusted and work correctly; do not throw pigs of metal into pot; guard molds, gears, and belts.

Paper Cutters: These machines can cause the loss of one or more fingers or a hand. To prevent these losses, work alone when cutting paper; do not catch scrap as it comes from the knife. See that non-repeating devices work properly.

Slug Cutters and Mitering Machines: Although these machines are hand operated, their use can result in crushed, torn or cut fingers or hands. Safety demands that great care be taken when using unguarded machines. When guards are provided, they should be used.

Unguarded Belts and Gears: To avoid being caught and injured by these means of power transmission, see that all belt and gear hazards are well guarded.

Staplers, Stitchers, and Cornering Machines: These machines can cause crushed fingers or hands. To avoid such injury, install guards where possible and take care when operating.

Tripping and Falling: Painful bruises are a frequent result of this hazard, with broken bones or other serious injuries possible from falling against or into machinery. The prevention of these injuries requires all type cases to be closed when not in use. Trouser cuffs should be rolled inside.

Folding Machines: The greatest hazard with this machine is getting caught in rollers or belts. The prevention of these injuries demands that guards be placed at danger points.

Fire: From this hazard, burns are the usual result. To prevent fires and the subsequent injuries, use safety cans for benzine, gasoline and kerosene; do not keep stores of inflammable liquids in the workroom. Do not use a celluloid eyeshade if smoking on the job is permitted.

Paper Handling: From this activity paper cuts, ruptures, and strains are possible results. To avoid strains and ruptures, do not lift excessively heavy loads. When paper cuts occur, they should be properly treated to prevent infection.

Plate Handling: Cuts on the hands are the usual result from the careless handling of plates. To prevent these cuts, take care when removing plates from the patent base; however, if they do occur, treat the cuts to prevent infection.

Horseplay: Childish actions are extremely undesirable in a plant employing men and usually result in falls against workmen who are operating machines, or falling against or into the machine themselves. Horseplay can be prevented by refraining from wrestling or engaging in other play.

Talking with Machine Operators: The most serious result is usually to the machine operator who runs the risk of serious hand injuries if the conversation causes him to get out of time with the machine. To eliminate this hazard, do not talk to machine operators.

Press-Feeding Difficult Jobs: This is closely akin to the injuries which result from careless platen press operation - crushed hands or fingers. The prevention of these injuries requires that narrow, long jobs be run two or more up; and no reaching through the press to save a fallen sheet.

Static Electricity: The flinch from a static electricity charge, or the "stickiness" of charged sheets can cause a loss of timing when pressfeeding and can cause crushed hands or fingers. These injuries can be prevented by not attempting to pressfeed electrically charged sheets by hand.

Unauthorized Use of Machines: The variety of injuries resulting from the unauthorized use of machinery and equipment is too enormous to make a specific list of them. In order to avoid injuries from this source, all workers should heed the danger signs posted to indicate those machines which require special instruction for their operation, and refrain from operating those machines, until given the proper instruction in their use or operation.

Health Hazards

Lead Poisoning: Depending upon the amount and length of exposure this hazard may manifest itself in any one or more of the following ways: colic, constipation, paralysis, disease of the heart, blood vessels, and kidneys, insanity or death. To prevent lead poisoning, the following precautions should be taken: do not create lead dust by splashing pigs in the metal pot; keep pieces of type from the mouth; avoid dry sweeping; do not eat in the workroom; wash hands before eating; clean nails frequently; and do not chew or smoke while working.

Improper Ventilation: This hazard is especially dangerous during the winter months when windows and doors are kept closed against the cold. The results of improper ventilation are fatigue, weakening of body resistance, poisoning from gas and fumes. To prevent this hazard all fumes and gases should be piped from the shop.

Carbon Monoxide: This hazard results from improper ventilation and causes headaches, dullness, lassitude, nervousness, insomnia, digestive ailments, and possibly death. Proper ventilation and the piping of fumes and gases from the shop will remove this hazard.

Tuberculosis: The result of this hazard is general sickness, and possible death. To offset the effects of this hazard, do not use a common drinking cup or towel; prohibit spitting on the floor; exercise in open air and in sunlight; have good ventilation in the workroom.

Benzine: This cleaning fluid is highly volatile, and therefore can present hazards both as a liquid and a gas, causing skin infections, faintness, dizziness, headaches, and vomiting. To prevent these conditions, proper ventilation should be provided, use gloves when cleaning presses, and provide adequate washing facilities. Also, see fire discussed previously for the fire hazards of benzine.

Cleaning Mixtures: The use of cleaning solutions with anilin oil bases can cause convulsions and death. If these cleaning mixtures are used, gloves should be worn, proper ventilation provided, and the user should avoid splashing the mixture on hands or clothing.

Poor Blood Circulation: The result of this condition is general ill health. Exercise in sunshine and open air after working hours will usually correct this condition.

Bad Lighting: Improper lighting causes impaired eyesight, which can be prevented by the amount of illumination, shaded and located to prevent glare.

Unclean Wiping Cloths: The skin infections caused by the use of unclean wiping rags can be eliminated by the use of sterilized wiping cloths. Local laundries usually provide a towel and wiping cloth service for those establishments requesting this service. There are also towel services located in larger cities which also offer this service.

Fatigue: The ill health caused by fatigue can be eliminated by proper rest.

Dust: The inhalation of dust results in diseases of the respiratory system. These diseases may be prevented by eliminating dust from the workroom, by prohibiting dry sweeping, by cleaning pot plungers outside the plant, and by prohibiting the use of a bellows to clean type cases while the cases are in the workroom.

Assignment
Sheet No. 4

Covering
Unit 4

THE CALIFORNIA JOB CASE

In the five hundred years that movable type has been in use, numerous systems and containers for type storage have been developed. Although applying some of the terminology of earlier systems, the California Job Case is in this country, the most widely used container for storing type at the present time.

These cases are unique in that none of the individual compartments or "boxes" are marked to identify the characters they contain. The compositor must rely wholly upon his memory to determine the location of specific "boxes" when selecting or distributing type characters. Because of this, it is necessary for the beginner to develop a complete knowledge of the location of the various type characters within the job case.

This assignment will provide you with an opportunity to extend your knowledge of the printing industry by learning the location of the various type characters in the California Job Case.

Assignment:

1. Read the references listed below.
2. Draw, freehand, three plans of the California Job Case. Learn the location of the various characters by the method described on page 23 of reference A. Use the lay of the case shown in Fig. 8-A of reference A. Submit the third sheet to your coordinator for use in checking your knowledge of the lay of the case.
3. Answer the questions, complete item 2 above, and turn in this assignment by ______________________ .

References:

A. Cleeton and Pitkin, General Printing, pp. 22-23.
B. Karch, Graphic Arts Procedures, pp. 129-130.
C. Polk, The Practice of Printing, pp. 26-30.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. Font is the term used to designate an assortment of one size and face of type.

T F 2. The "lay of the case" refers to the position of the type case on the work bank.

T F 3. A "dirty" type case is one which has many pieces of broken type in its compartments.

T F 4. When learning the position of the various characters in the case, the position of the fractions, commercial signs, etc., should be learned first.

T F 5. A "pied" type case and a "dirty" type case are the same.

T F 6. The New York Job Case and News Cases are used in some printing plants.

T F 7. The California Job Case is made after the pattern of News Cases.

T F 8. The letters J and U were added to the alphabet after type cases were designed.

T F 9. The upper News Case held only large capitals.

T F 10. News Cases were used in pairs.

T F 11. The California Job Case occupies a space 32 3/16 x 16 5/8 x 1 1/16 inches, and holds approximately twenty pounds of type.

T F 12. The California Job Case is divided into compartments of equal size.

T F 13. The lower News Case contains both lower case characters and small capitals.

T F 14. The largest compartment in the California Job Case contains the most frequently used type character.

T F 15. The California Job Case is a triple case.

T F 16. The numerals in the California Job Case are placed out of sequence.

T F 17. The capitals in the California Job Case are placed in sequence.

T F 18. For storing ordinary type, the California Job Case is almost universally used.

T F 19. It is customary to place type made only in upper-case into what is termed an "all cap case."

T F 20. New schemes must be learned for each new type case used.

Sequence

Directions: The lists which follow are the steps involved in performing certain jobs. Indicate the order recommended in your references by placing the proper number in the blanks at the left.

1. Steps of procedure to follow when learning the "lay of the case."

____ A. Locate the lower case letters of the alphabet several times.

____ B. Learn the location of the capitals.

____ C. Take a blank diagram and mark the spaces from memory.

____ D. Draw a diagram of the California Job Case.

____ E. Learn the location of the figure.

____ F. Learn the location of the punctuation marks, special characters and spaces.

____ G. Mark the letters in their proper area.

____ H. Check for errors and concentrate on their correction.

2. Steps of procedure to follow when working with a type case.

____ A. Pull out halfway, the case immediately below the desired case.

____ B. Locate the case containing the desired type.

____ C. Place desired case on work bank.

____ D. Pull out desired case.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. The last of the letters to be added to the alphabet were the ________ and the ________ .

2. The time necessary to learn the position of the various type characters within the case should be approximately ________ ________________ .

3. The New York Job Case contains ________ sets of capital.

4. The most frequently used of the letters is the ________________ ________ .

5. The letters used least are the ________, ________, ________, ________, and ________ .

The following questions refer specifically to the California Job Case.

6. The capitals are found in the ______________ section.

7. The numerals are found in the ______________ section.

8. The quads are found in the ______________ section.

9. The punctuation marks are found in the ______________ and ______________ sections.

10. The least frequently used lower case letters are found in the ______________ section.

Assignment
Sheet No. 5

Covering
Units 8-13

CHARACTERISTICS OF TYPE AND SPACES

One of the earmarks of a good worker centers around the fact that he or she is well informed as to the nature of the materials in daily use in the industry.

Since printers build their results from a display of type faces which are in turn printed into thousands of copies, it is most important that each of these type faces be analyzed to the extent that the worker will be able to select suitably designed type to carry the message to be delivered to the public.

In this unit you will learn various type faces as well as the various types and kinds of spacing material. You will also learn of the manner in which these are kept, cared for and used.

Assignment:

1. Read the references listed below.
2. Answer the questions and turn in this assignment by ______________________________ .

References:

A. Cleeton and Pitkin, General Printing, pp. 19-22.
C. Polk, The Practice of Printing, pp. 18-25, 31-38, 182-190.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. The nick on a piece of type is the depressed area between the feet of the type.

T F 2. The point size of type corresponds to the distance in points between the back and the belly of the type.

T F 3. The very large type used for poster printing is cut from wood.

T F 4. Spaces are shorter than type and have no characters on them.

T F 5. Three 3-em spaces and one em quad occupy the same amount of space in a line of type.

T F 6. Two en quads will occupy the same amount of space in a line of type as an em quad.

T F 7. Leading refers to the separating of lines of type by means of leads and slugs.

T F 8. Leads and slugs more than 10 picas long are cut in half-pica graduations.

T F 9. The most commonly used leads are two points thick.

T F 10. The face of the type serves as the printing surface.

T F 11. The beard of a piece of type may be the serif or the finishing stroke.

T F 12. All type in North America is of uniform height, approximately 11/12 of an inch or .918 inches.

T F 13. The nicks on the type body serve only to indicate the correct position of the type in composition.

T F 14. A font of type is an assortment of type, in a single style and size, as put up by the type founders.

T F 15. A type series is made up of the various sizes of any one kind of type.

T F 16. A type family is composed of a number of type series bearing the same name and design characteristics.

T F 17. Body type is more legible than display type and is designed to attract the attention of the reader.

T F 18. The "em quad" is always the square of the type body, regardless of the size of the type.

T F 19. A 3-em quad will occupy the same amount of space in a line of type as 9 3-em spaces.

T F 20. Leads and slugs are stored in the type case.

T F 21. Reglets and slugs are made from the same material.

T F 22. Modern-face types may be identified by the contrast of heavy and light strokes.

T F 23. Nicholas Jenson first developed a modern-face type.

T F 24. A modern-faced type may be identified by the serifs which join the strokes at right angles.

T F 25. Oldstyle types are characterized by angular serifs and heavy, uniform body elements.

T F 26. Text letter types are most legible when set in capitals.

T F 27. In the sans-serif types, the letters have no serifs and the strokes are of uniform weight.

T F 29. Because of the kerns present on script types, they require special handling.

Multiple Choice

Directions: Listed with each of the incomplete sentences which follow are several responses, one of which will complete the statement and make it true. Indicate your choice by placing the appropriate letter in the blank at the left.

____ 1. Kerned letters refer to (A) sans-serif letters; (B) letters with portions of the face extending beyond the body; (C) sized letters of any one kind; (D) arrangement of type in a stick.

____ 2. Groove on a piece of type is the (A) area between lines of type; (B) area across belly of piece of type; (C) depressed area between the feet; (D) slanting area from face to shoulder.

____ 3. Sorts are (A) assortments of type within a font; (B) individual type characters packed separately and usually included with each purchase of type; (C) individual type characters that may be obtained separately on special order; (D) mixed groups of kerned letters.

____ 4. An en quad is (A) one-half the size of one 2-em quad; (B) the same size as three 3-em spaces; (C) the same width as three 3-em spaces; (D) one-half the size of one em quad.

____ 5. Swash letters refer to (A) uncial letters; (B) sans-serif letters; (C) ornamental italic letters; (D) square-serif letters.

Listing

Directions: List the items called for in each of the following statements. Select your answers carefully

1. The parts common to all pieces of type.

(A) ____________________ (G) ____________________

(B) ____________________ (H) ____________________

(C) ____________________ (I) ____________________

(D) ____________________ (J) ____________________

(E) ____________________ (K) ____________________

(I) ____________________ (L) ____________________

2. Types are classified into five groups according to method of composition. They are

(A) ____________________ (D) ____________________

(B) ____________________ (E) ____________________

(C) ____________________

3. List in order of decreasing size the spacing material normally found in the type case.

(1) ______________________ (5) ______________________

(2) ______________________ (6) ______________________

(3) ______________________ (7) ______________________

(4) ______________________

4. All type faces may be divided into seven groups. List these seven groups.

(1) ______________________ (5) ______________________

(2) ______________________ (6) ______________________

(3) ______________________ (7) ______________________

(4) ______________________

Assignment
Sheet No. 6

Covering
Unit 14

THE PRINTER'S SYSTEM OF MEASUREMENT

At one time in the development of measurements, an inch was equal to one-eighteenth the length of the human forearm. Later a royal decree made an inch equal to the combined lengths of three barley-corns. This lack of any definite standard of measurement made it necessary that craftsmen adopt some system of measurement to avoid poor workmanship. In 1878 American type founders adopted a uniform standard system for type sizes.

As you work at the printing trade you will have occasion to use the terms which make up this measuring system, both in conversation and composition. Until you are completely familiar with these terms, you will not be capable of performing the job situation which will be presented to you, nor will you be able to discuss the problems which will arise.

In this unit you will learn to use the terms which make up the printer's system of measurement, and work out basic problems with which the printer must cope.

Assignment:

1. Read the references listed below.
2. Answer the questions and turn in this assignment by ______________________.

References:

A. Cleeton and Pitkin, General Printing, p. 17.
B. Karch, Graphic Arts Procedures, p. 125.
C. Polk, The Practice of Printing, pp. 67-71.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. Wooden line gauges are preferred by printers because they are lighter in weight than brass or steel gauges.

T F 2. There are two "nonpareils" in one "pica" and six "picas" in one inch.

T F 3. Agate lines are used when setting up newspaper advertisements.

T F 4. The "pica" is the smallest unit of measure used by printers.

T F 5. A "pica" is made up of two "nonpareils."

T F 6. There are approximately 72 "picas" to the inch.

T F 7. A line of 8-point type set 24 picas wide contains 36 ems of type.

T F 8. A line of type set 19 picas wide contains 228 points.

T F 9. A line of 6-point type set 24 picas wide contains 24 ems of type.

T F 10. The number of ems per page can be calculated by multiplying the size of type by the number of lines.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. A line 2 inches long will equal ________ nonpareils.
2. One-fourth inch will equal __________ points.
3. A line 5 1/2 inches long will equal _________ picas.
4. A good type rule will usually measure up to _________ picas.
5. The smallest common type is _________ point.

Matching

Directions: In the right column are various terms used in printing measurements. Match the letters of the items on the right with the word(s) on the left by placing the proper letter in each blank on the left.

____ 1. Pica
____ 2. Inch
____ 3. Page sizes
____ 4. Nonpareil em
____ 5. Small pica
____ 6. Long Primer
____ 7. 1000 ems
____ 8. 24 picas wide
____ 9. 6 points
____10. Ems per page

A. 11 points
B. Inches
C. 12 points
D. Unit of calculating printed matter
E. 24 ems of 12 point
F. Ems per line x number of lines
G. 6 points
H. 48 ems in 24 pica line
I. 13 inches
J. 6 points thick
K. 10 picas
L. 72 points

Assignment
Sheet No. 7

Covering
Units 15-25

THE PROCESS OF SETTING TYPE

Although much of the type today is set by machines, the most satisfactory way to learn printing thoroughly is to begin with the elementary processes of hand composition and build on this solid foundation. In addition to this consideration, many sizes and faces of type, as well as special job plans, will always be set by hand.

Despite the fact that many trades require the use of a large number of hand tools, the printer needs but a few to work at this trade. The most important of these is the composing stick in which single pieces of type are assembled and justified by the compositor.

Just as the first movable types were carved of wooden blocks, so were the first composing sticks also carved of wood. As type size became standardized with the progress of the printing industry, the composing sticks were also improved until they became an expensive, precision hand tool of brass or steel. Modern composing sticks are usually made of alloy steel or are plated to prevent rust or corrosion.

This unit will provide an opportunity for you to acquire information concerning the care of the composing stick and its use in composition. In connection with the use of the composing stick, you will also learn about the process of setting straight matter composition, and of the typographical considerations involved in the division of words.

Assignment:

1. Read the references listed below, noting in particular the various illustrations.
2. Answer the questions and turn in this assignment by ______________________________.

References:

A. Cleeton and Pitkin, General Printing, pp. 24-34.
B. Karch, Graphic Arts Procedures, pp. 138-145.
C. Polk, The Practice of Printing, pp. 39-52, 72-84.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. The location of the composing stick knee determines the width of the composition.

T F 2. The composing stick is sometimes referred to as a "job stick" or merely as a "stick."

T F 3. The Rouse and micrometer composing sticks require the use of metal furniture to set the knee.

T F 4. The Rouse composing stick is adjusted to six-point graduations by means of the half-pica lever.

T F 5. The majority of the references prefer the placing of a slug, rather than a lead, in the composing stick before the first line of type is set.

T F 6. A line is correctly justified when it cannot be removed from the stick without releasing the knee.

T F 7. Each line of type should be corrected, if necessary, before it is justified.

T F 8. Insufficient space between words will cause them to run together and form "lakes" and "rivers."

T F 9. Properly spaced composition will present a uniform tone of gray to the eye of the reader.

T F 10. A line of type may be perfectly justified, and yet be poorly spaced.

T F 11. When it is necessary to alter the spacing between words, "spacing out" is preferable to "spacing in."

T F 12. The original spacing in a line of type may be altered to facilitate justification.

T F 13. When "quading out," the largest pieces of type are placed nearest the punctuation mark.

T F 14. Sentences should be separated by two 3-em spaces.

T F 15. The comma face and the nick are on the same side of a piece of type.

T F 16. Squared indentions are used to give prominence to a certain section of composition.

T F 17. Indention for poetry consists of having each of the rhyming lines indented equally.

T F 18. The half-diamond type of indention is used to give display properties to a section of printed matter.

T F 19. A square and centered paragraph is indented an equal amount on each side.

T F 20. Letterspacing between lowercase letters is considered good form and is desirable due to the improved appearance of the composition.

T F 21. Regular paragraph indention consists of having the first line set full measure and each of the other lines indented an equal amount.

T F 22. Figures set in vertical composition should always be aligned at the right.

T F 23. When setting type, the thumb is used to hold the type against the knee of the composing stick.

T F 24. The hand which holds the stick should "follow" the hand which selects the pieces of type.

T F 25. Type should always be read in the stick, upside down, and from left to right.

T F 26. An "out" is a repeated word which should be removed.

T F 27. Any of the "four demons" may be identified by holding the piece of type with the nick up, and imagining the straight stem running in the opposite direction.

T F 28. In spacing of lines, it is more important to have equal spaces between words than it is to vary the spaces so that the printed matter appears to have equal spaces.

T F 29. When there is no way to avoid dividing a word at the end of a line of type, the word may be divided anywhere.

T F 30. The word align may be divided between the first and second letters.

T F 31. The indention of a paragraph 18 picas wide should be one em of the type.

Completion

Directions: The following spaces and combinations of spaces represent divisions of an em quad. Place in the blanks the correct fractional and percentage values of the indicated spaces and combinations of spaces.

	Fraction of em	Per cent of em
1. 5 em space	____________	____________
2. 4 em space	____________	____________
3. 3 em space	____________	____________
4. 5 em + 5 em	____________	____________
5. 5 em + 4 em	____________	____________
6. en quad	____________	____________
7. 5 em + 3 em	____________	____________

7. 5 em + 3 em __________ __________
8. 3 em + 4 em __________ __________
9. 3 em + 3 em __________ __________
10. en quad + 5 em __________ __________
11. en quad + 4 em __________ __________
12. en quad + 3 em __________ __________

Listing

Directions: List the items called for in each of the following statements. Select your answer carefully.

1. The common ligatures found in the type case.

(A) __________ (D) __________
(B) __________ (E) __________
(C) __________

2. The punctuation marks found in the type case.

(A) __________ (F) __________
(B) __________ (G) __________
(C) __________ (H) __________
(D) __________ (I) __________
(E) __________ (J) __________

Assignment
Sheet No. 8

Covering
Units 26-30

THE HANDLING OF TYPE

Throughout the years in which the printing trade has developed, certain practices in the handling of type have become standardized through use. Unlike many procedures, only one school of thought has been developed regarding these practices indicating the total agreement of past and modern printers as to their desirability.

To advance in the printing trade it is essential that the beginner master the techniques of handling type from the very beginning of his training. Any deviations from standard practice usually result in poor workmanship and damage to the equipment in the shop. The manner in which he stands at his work station, removes the composed matter from the composing stick, or ties up the form must conform to the standard practices of the trade. The manner in which beginners master and use these practices will distinguish those who are working to advance in the printing trade from those who are just working.

In this unit you will learn some of the standard practices used in the handling of type, as well as the names and uses of equipment involved in further preparation of composed material for the initial inked impression.

Assignment:

1. Read the references listed below.
2. Answer the questions and turn in this assignment by ______________________________.

References:

A. Cleeton and Pitkin, General Printing, pp. 35-39.
B. Karch, Graphic Arts Procedures, pp. 144-147.
C. Polk, The Practice of Printing, pp. 53-56.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. It is advisable to "dump" the stick only when it is full.

T F 2. The composing stick may be unclamped for the easier removal of composed matter.

T F 3. The majority of the references agree the composed matter should not be lifted when being transferred from stick to galley.

T F 4. When quadding out a line, the wider quads and spaces are placed next to the punctuation mark.

T 5. A "bank" is a slanted or flat working surface in the composing room.

T F 6. The "alley" is a storage for unused spacing material.

T F 7. A line of type which seems tight when off its feet will become loose when put on its feet.

T F 8. The "galley" is the lower corner of the bank where type is stored after being removed from the stick.

T F 9. The make-up galley is very carefully made and has pica graduations on its side.

T F 10. A small form may be kept on its feet in the galley by increasing its size with metal furniture.

T F 11. Twice around the form with a string is sufficient to hold it.

T F 12. When tying up a form, the typing process is begun at the open corner and ended at the opposite corner.

T F 13. The majority of references agree a knot should be tied in the string when a form is tied up.

T F 14. Excess string should be cut off the tied form.

T F 15. When transferring type from the composing stick, the second finger of each hand is placed against the ends of the lines of type.

T F 16. Any type form should have a slug at both the head and the foot before it is handled.

T F 17. When placing type in the galley, the head of the type should always be in contact with the head of the galley.

T F 18. When tying up a form, the string will be kept taut if it is drawn tightly just prior to passing it around each corner.

T F 19. Type forms, which have been tied, are carried from the galley and placed on the stone.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. Nearly all type cabinets have a working surface, either flat or slanted, called a ________________ .

2. The ______________ should always be placed in one of the lower corners of the bank.

3. When the form has been tied up, the excess string is cut off with the sharp edge of the ______________ ______________ .

4. Mixed or jumbled type is referred to as ______________ .

5. Type should be placed in the galley with the head of the type against the ______________ end of the galley.

Sequence

Directions: The lists which follow are the steps involved in performing certain jobs. Indicate the order recommended in your references by placing the proper numbers in the blanks at the left.

1. The following steps are involved in dumping the composing stick.

____ A. Place fingers and thumbs in possition for pressing type from the stick.

____ B. Move type so the head of the type engages the head of the galley.

____ C. Allow thumbs to go to the bottom of the stick.

____ D. Place galley in position on the bank.

____ E. Slide type from stick to the bottom of the galley

____ F. Set stick against lower edge of galley.

____ G. While holding the stick against the galley, push the lines forward in the stick.

2. The following steps of procedure are involved in tying up a form.

____ A. Begin at proper corner and wind string clockwise around form.

____ B. Place necessary slugs or furniture around form.

____ C. Wind string around form a sufficient number of times.

____ D. Place head of form against head of galley.

____ E. Select string of adequate length.

____ F. Push string down to center of the form.

____ G. Draw loop tight.

____ H. Cut off excess string.

____ I. Push a loop between the string and the form

Assignment
Sheet No. 9

Covering
Units 31-45

PROCESSING GOOD PROOFS

It is a well-known fact that "Pride of Workmanship" is one of the basic factors which motivate the workman to develop his ability to the highest possible level. One of the advantages printing offers a conscientious worker is the comparative ease by which the results of his work may be checked at any step of the job through the medium of a printed proof.

Whether the proof is designed for a simple check by the compositor, or as a final sample to be reviewed by the foreman of the shop or the customer, it is very important that the compositor develop techniques leading to correct, clear, and well-margined proofs. Offset, lithographic, and photo processes also make it imperative that letter-perfect proofs be struck by the compositor.

In this unit you will learn the accepted standards of the printing trade in regard to processing proofs, as well as certain techniques for the correction and review of proofs.

Assignment:

1. Read the references given below.
2. Answer the questions and turn in this assignment by ______________________.

References:

A. Cleeton and Pitkin, General Printing, pp. 39-47, 51-54, 60-61.
B. Karch, Graphic Arts Procedures, pp. 148-150.
C. Polk, The Practice of Printing, pp. 57-63.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. A brayer is used to remove ink from the composed form.

T F 2. Commercial writing ink is used to take proofs.

T F 3. When using the brayer, the lugs point downward.

T F 4. String or thin spacing material is often placed under one corner of the galley to make it level.

T F 5. The galley substitute plate is used when the proof is made of a form not a galley.

T F 6. The brayer is applied to the form from the open corner to the closed corner.

T F 7. Type high bearers are placed outside the galley to make the inking of forms for proofing easier.

T F 8. A register bar is used to obtain correct margins on proof presses not equipped with grippers.

T F 9. Proof slurs may be eliminated by using two strings of rubber bands to secure the proof paper to the cylinder.

T F 10. The type should be cleaned immediately after pulling the proof.

T F 11. Kerosene is a very good solvent for cleaning the type.

T F 12. A type brush with copper wire bristles is used to scrub out the counters of the type.

T F 13. The type form is washed by wiping with a solvent-dampened cloth from open to closed corners.

T F 14. The washing process may be hastened by flooding the form with solvent.

T F 15. It is necessary to replace a line in the stick to make corrections, regardless of the kind of correction.

T F 16. Corrections which do not affect justification may be made in the galley.

T F 17. If the "ff" ligature is substituted for two "f" pieces of type, the justification is not affected.

T F 18. Over-running is the resetting of composed type to permit the insertion or elimination of words.

T F 19. Re-running is the taking of another proof due to slurring on the previous proof.

T F 20. A proof "planer" is used to take stone proofs.

T F 21. The proof planer may be used as a substitute for the type planer.

T F 22. Planer or stone proofs are always taken with damp or wet paper.

T F 23. The proof planer is always laid on the imposing table felt side down to prevent its collecting dust particles from the air.

T F 24. The midget planer is used for "pulling proofs" from small forms.

T F 25. The quality of a stone proof makes it almost impossible to distinguish from a proof taken on a proof press.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. Spreading the ink on the ink plate by means of the brayer is called ______________.

2. If an accident should occur to equipment or shop personnel, it should be reported immediately to the ______________.

3. A proof press equipped with grippers will smash any part of the form placed beyond the ______________.

4. A plate brush contains two kinds of bristles, ______________ ______________ bristles and ______________ bristles.

5. The three most common causes of getting type off its feet are ______________ ______________, ______________ ______________, and ______________ ______________.

Sequence

Directions: The lists which follow are the steps involved in performing certain jobs. Indicate the order recommended in your references by placing the proper number in the blanks at the left.

1. The following steps are involved when taking a wet paper stone proof with the type in a chase.

____ A. Take impression of middle of form

____ B. Tighten quoins with fingers

____ C. Place proof sheet on form

____ D. Ink the form

____ E. Unlock quoins

____ F. Plane type with type planer

____ G. Dampen one side of proof paper

____ H. Lift sheet by one corner

____ I. Take impression of outer edges of form

____ J. Relock form

____ K. Wash form

____ L. Check proof for slurs (assume proof shows none)

Matching

Directions: In the right column are descriptive words and phrases, and in the left, various words. Match the letters of the items on the right with the word(s) on the left by placing the proper letter in each blank on the left.

____ 1. Proof reader
____ 2. Brayer
____ 3. Bearers
____ 4. Grippers
____ 5. Register bar
____ 6. Type brush
____ 7. Plate brush
____ 8. Gasoline
____ 9. Proof planer
____ 10. Type planer (midget planer)
____ 11. Over-run
____ 12. Proof
____ 13. Sheet off
____ 14. Revised proofs
____ 15. Tweezers

A. First inked impression
B. Proof taken after making correction
C. One who checks proofs for errors
D. Felt-bottomed planer
E. Inking device
F. Proofs of long columns of body composition
G. Fiber and copper wire bristles
H. Benzine or naptha
I. Corrections involving two or more lines of type
J. Oily deposit on type
K. Kerosene
L. Supports brayer when inking form
M. Counter
N. Remove excess ink from form
O. Logotype
P. Holds sheet when press proof is taken
Q. Tool for removing damaged letters
R. Ligature
S. Correct margins without grippers
T. Fiber bristles
U. Used for leveling type in chase

Assignment
Sheet No. 10

Covering
Unit 46

STANDARD PROOFREADERS' MARKS

A universal language among printers exists in the system of marks used to indicate errors in composition, and the changes necessary for the correction of these errors. This system is known as Standard Proofreaders' Marks.

It is essential the compositor master the formation and interpretation of these marks regardless of the size of the shop in which he works. Large commercial printing firms, such as those printing newspapers and magazines, employ trained proofreaders who check proofs for errors. The compositor must be able to interpret the proofreaders' marks in order to make the indicated corrections in the composed form. In smaller printing establishments, the compositors also do the proofreading. To correctly indicate errors on the proof, and then make the corrections, the formation and interpretation of proofreaders' marks must have been mastered by the compositor.

The reference material in this unit outlines the general procedures of proofreading and provides the information necessary for a working knowledge of proofreading marks. You will have the opportunity to acquire additional knowledge of your chosen occupation, and the unusual distinction of knowing the printers' "shorthand." You will need a thorough knowledge of this system to perform your duties as a compositor.

Assignment:

1. Read the references given below.
2. Answer the questions, do the exercise, and turn in this assignment by ____________________.

References:

A. Cleeton and Pitkin, General Printing, pp. 48-50.
B. Karch, Graphic Arts Procedures, pp. 189-196.
C. Polk, The Practice of Printing, pp. 85-89.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. An "office reading" is the proofreading done by the author in his own office.

T F 2. Proofs are taken on paper at least three inches wider than the type.

T F 3. Ink or dark colored pencil should be used to mark proofs.

T F 4. Newspaper proofs are usually proofread only once.

T F 5. A proofreader is responsible for errors only on the proofs he reads.

T F 6. The copyholder holds the copy while the proofreader compares it with the "first proof."

T F 7. The "first revise" is taken after the "first proof" has been marked and the corrections made in the form.

T F 8. A "railroaded" type form is one printed without being proofread.

T F 9. A "horsed" type form has been proofread by the proofreader without the assistance of the copyholder.

T F 10. "Out; see copy," refers the compositor to the original copy.

T F 11. A comma is placed in a capital V to distinguish it from an apostrophe.

T F 12. A word underscored once is to be set in Italic letters.

T F 13. Letters underscored twice are to be set in large capital letters.

T F 14. Letters underscored three times are to be set in small capital letters.

T F 15. No notes are necessary when proofreading marks are used to correct a proof.

T F 16. The proofreader should make corrections in the author's original copy if it is obviously wrong.

T F 17. When marking a proof, the errors are indicated in the top and bottom margins.

T F 18. To mark a proof with a (?) is to call attention to the author's copy.

T F 19. If two or more errors are marked in the same margin, they are separated by diagonal lines.

T F 20. If a proof contains no errors, then mark "O.K." and the reader's initial or signature will appear in the lower right hand corner of the sheet.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. The copyholder spells out unusual words and proper names, and also indicates ______________, ______________, and ______________.

2. When a proof is first read, it is checked for consistency with the original copy, as well as for ____________ ____________.

3. The proof taken after the composition has been corrected from the second revise is marked ____________ ____________ .

4. When the compositor has omitted a number of words, the marginal mark on the proof will be ____________ ____________ ____________ .

5. If the proof of a job is to be sent out for reading, such information will appear on the ____________ ____________ .

Multiple-Choice

Directions: Listed with each of the incomplete sentences which follow are several responses, one of which will complete the statement and make it true. Indicate your choice by placing the appropriate letter in the blank at the left.

____ 1. The marginal mark "bf" combined with a word underlined with a wavy line in the text of the proof means (A) broken font; (B) delete word; (C) set in small italics; (D) bold face.

____ 2. "Follow copy, even if it goes out the window," means (A) check proof with copy; (B) follow the copy from the composing room, to press, to loading dock; (C) when in doubt about copy, compose according to copy; (D) go after the copy if the wind blows it away.

____ 3. The proofreaders' mark $\frac{2}{M}$ should indicate to the compositor (A) one hyphen is to be inserted; (B) one em quad is to be inserted; (C) two-em dash is to be inserted; (D) paragraph is to be indented one en quad.

____ 4. The mark "stet" in the margin of a proof means (A) set this eliminated text; (B) let it stand; (C) second revise; (D) scrap time every time.

____ 5. The mark l.c. in the margin of a proof means (A) lower caps; (B) less capitals; (C) lower case; (D) leaded counter.

Exercise in Proofreading

Directions: Immediately below is an excerpt from an author's copy submitted for publication. After the author's copy is the first proof pulled from the composed form. Indicate the errors in composition as are shown in the proof and place the appropriate proofreaders' marks in the margins.

PURPOSE OF PART-TIME COOPERATIVE EDUCATION

The controlling purpose of the part-time cooperative program is to provide both general and vocational education for youth to the end that they may become economic assets and good citizens in their communities at the completion of their school training.

The great majority of youth enter directly into the business and industrial world at the completion of their high school work. It is highly essential therefore, that every opportunity be provided for a practical education which will fit high school youth into the world of work. Although the primary purpose of the part-time cooperative program is to serve this need, many students enrolled in the course may change their plans and continue their educational training in college. The work is accepted as entrance credit by the colleges of Missouri.

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Assignment
Sheet No. 11

Covering
Units 47-48

DISTRIBUTION

One of the most trying jobs to confront the printing industry has been the distribution of materials. In any well-organized shop, upon the completion of a job, the tools and materials used are returned to their proper places, the scrap materials discarded, and the shop made ready for the next job. A shop engaged in printing utilizes this same sequence of events.

It is not the usual policy of printing establishments to sell the composed form with the printed job. Because many fonts or assortments of type contain only one or two of certain characters it is very important the characters be returned, in good condition, to their proper places for later use. The returning of the pieces of type to their proper compartments is called "distribution."

Although many printing firms make use of type setting machines, certain of the heading and display materials are set by hand, and, therefore, must be distributed by hand. This fact, coupled with the knowledge that small printing establishments will always depend upon the hand distribution of type materials, makes evident the importance of this segment of the printing trade.

In order that you will have the opportunity to study operations involved in this vital part of the printing industry, this unit is designed to acquaint you with the accepted techniques in regard to the distribution of type.

Assignment:

1. Read the references listed below.
2. Answer the questions and turn in this assignment by
   ________________________________.

References:

A. Cleeton and Pitkin, General Printing, pp. 54-59.
B. Karch, Graphic Arts Procedures, pp. 147-148.
C. Polk, The Practice of Printing, pp. 64-66.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. To check the type before distributing, it is best to select some narrow letter.

T F 2. All ink should be removed from the type before it is distributed.

T F 3. The checking of type prior to distribution should include both upper and lower case characters.

T F 4. The nick in a piece of type is the most certain individual check to use when comparing type for distribution.

T F 5. The test of type width is the check requiring the most care.

T F 6. Type characters are distributed by picking them up, one at a time, from a galley.

T F 7. The "lift" is held in the hand for distribution with the nick down.

T F 8. A "lift" is the portion of the type form transferred to the hand for distributing.

T F 9. The hand, which holds the stick when composing, selects the type character for distributing.

T F 10. Extreme care must be exercised when placing type characters in the type case.

T F 11. Spacing material, as well as leads and slugs, should be sorted in the galley and distributed after the type has been distributed.

T F 12. Live matter is type held for reprinting.

T F 13. Dead matter is type in a form which has not yet been printed

T F 14. Standing matter is type ready for distribution.

T F 15. "Throwing-in" refers to those pieces of type material which may be thrown into the type cases without serious damage.

T F 16. If a form contains more than one font, the fonts should be separated and distributed separately.

T F 17. When type is to be distributed from the stone, it should be supported by furniture on three sides.

T F 18. To avoid "pi-ing" the lines, lifts of type should be taken from the head of the matter.

T F 19. When leads and slugs are sorted in the proper manner, they resemble stairsteps.

T F 20. In the distribution of type, speed is considered more important than accuracy.

Multiple-Choice

Directions: Listed with each of the incomplete sentences which follc are several responses, one of which will complete the statement and make it true. Indicate your choice by placing the appropriate letter in the blank at the left.

____ 1. To prevent mixing type fonts in distribution (A) the composi tor should ask the foreman; (B) nicks should be compared; (C) faces should be compared; (D) compare upper and lower case characters from form and case.

____ 2. In general practice, small sections of straight matter or display lines are distributed directly from the (A) imposinc table; (B) galley; (C) hand; (D) chase; (E) stick.

____ 3. The best practice in distributing leads and slugs is (A) pla them back in the rack one by one as found in the distributic (B) measure them first in a galley and arrange them in sizes for distribution; (C) stand them first in a galley and arrar them in sizes for distribution; (D) stand them on the bank.

____ 4. During distribution, the spaces in the form are (A) placed c the galley; (B) placed with the em quads; (C) distributed wi the type characters; (D) placed in the chase.

____ 5. Type matter ready to go to press is called (A) straight matter; (B) dead matter; (C) live matter; (D) real material; (E) copy material.

Sequence

Directions: The lists which follow are the steps involved in perforn ing certain jobs. Indicate the order recommended in your references by placing the proper numbers in the blanks at the left.

____ A. Slide "lift" away from rest of form

____ B. Position fingers for "lift"

____ C. Check characters from type form and type case

____ D. Place slugs so "lift" is between them

____ E. Execute "lift"

____ F. Remove top slug

____ G. Select two slugs of same measure as lines of type

____ H. Read, spell out, and distribute first word

____ I. Return spaces to galley

____ J. Continue distributing this font, allowing spaces to collect in hand

____ K. Place slugs in proper case

____ L. Sort leads and slugs

____ M. Separate leads from slugs

____ N. Sort and distribute spaces

Assignment
Sheet No. 12

Covering
Units 49-56

PRINTING LAYOUTS

Printed displays which attract one's attention and are pleasing in appearance are not accidental in their creation. These displays are the result of careful planning, based upon the combined knowledge of those who have worked with displaying of printed matter.

Before setting type for a display job, the arrangement of the various printed areas is carefully planned to show how the finished job will appear. This carefully planned arrangement is called a printing layout. In large establishments the layouts are made by layout men, or typographers as they are sometimes called. In smaller printing shops the layouts will be made by the foreman or chief compositor. The time required to make a layout for any display job is justified by the elimination of waste and delay which results when jobs are set and reset by the trail and error method.

This unit will provide you an opportunity to study examples of well-planned composition and to learn the rules which have been applied in the planning of these examples.

Assignment:

1. Read the references listed below.
2. Answer the questions, do the exercise, and turn in this assignment by ______________________________.

References:

A. Cleeton and Pitkin, General Printing, pp. 111-116, 122-125.
B. Karch, Graphic Arts Procedures, pp. 65-94.
C. Polk, The Practice of Printing, pp. 148-157, 170-181, 191-217.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. The most pleasing contour shapes for printed groups are those suggesting ovals or inverted pyramids.

T F 2. Layouts are classified as being either conventional or old-style.

T F 3. A dummy is always a plan, but all layouts are not dummies.

T F 4. The terms copy and layout are two different names for the same thing.

T F 5. On a layout, matter to be set in small type is handlettered.

T F 6. In simple terms, display means a contrast of shape, color, size or weight.

T F 7. When special effects are desired, the layout man may use handlettering.

T F 8. Centered line layout is easiest for beginners, and the most used form today.

T F 9. The selection of border and type should be labeled by name and point size on the layout.

T F 10. A cut is a photoengraved plate.

T F 11. Soft surface papers tend to thicken type.

T F 12. For the more complex jobs, an accurately drawn layout should be made.

T F 13. For books and other general straight matter composition, oldstyle Roman is the most legible.

T F 14. So-called text type is easily scanned by the reader.

T F 15. Because of their uniform shape, words composed of capitals are easily read.

T F 16. The principle of fitness refers to the suitability of the type style and size to the job at hand.

T F 17. Fitness tends to select the important content of a copy and eliminate the unimportant.

T F 18. Fitness suggests the use of many sizes and styles of type.

T F 19. The term "balanced" means the optical center of a page is identical to the mathematical center.

T F 20. A design centered on a vertical or through the center axis is said to be in an "out-of center balance."

T F 21. When doing bordered work, the portion of the margin outside the border should be three-fifths of the total margin.

T F 22. Contrast and variety are necessary in printing.

T F 23. One of the most pleasing page sizes has its length 1 1/2 times its width.

T F 24. A 9 x 6 inch page is longer than it is wide.

T F 25. On a wide page, the best form is to use narrow type groupings.

T F 26. The shape of the total page determines the shape of the form placed on it.

T F 27. Bold type requires the use of dainty or ornamental letters to give a pleasing contrast.

T F 28. Squared groups are most pleasing when words have been wide spaced to maintain the squareness of the group.

T F 29. A plain type requires an elaborate border as an aid to carry the desired message.

T F 30. Good tone harmony in composition refers to a high degree of contrast in the appearance of ornaments, borders, and rules.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. If a mimeographed form of advertising content were submitted to widely scattered printing concerns, the ____________ in each case would be the same, but the resulting ____________ would be different.

2. The customer's okay of a layout may be secured on either the ____________ ____________, sometimes referred to as the visual, or the ____________ ____________.

3. Too much display is the same as ________ ____________.

4. On a printing layout using more than one type family, __________ type name is designated.

5. The abbreviation c & lc refers to ____________ ____________ ____________ ____________.

6. Center-face, double-face, and most patterned rules cannot be formed into boxes without the use of ____________ corners.

7. Because we read words and not letters ____________ ____________ are less legible than ____________ ____________.

8. The width of the most effective composition is ________ times the length of the lower-case alphabet being used.

9. Traditionally, oldstyle type has been associated with __________ __________ and its appearance is most pleasing when printed on __________ papers.

10. Legibility is decreased and eye strain is increased by the use of ____________ ____________ finish papers.

Multiple-Choice

Directions: Listed with each of the incomplete sentences which follow are several responses, one of which will complete the statement and make it true. Indicate your choice by placing the appropriate letter in the blank at the left.

____ 1. The most pleasing contour pattern for printed groups is the (A) square; (B) round; (C) pyramid; (D) inverted pyramid

____ 2. For unity, type should be massed around (A) one or two main points; (B) two or three main points; (C) three or four main points; (D) exactly three main points.

____ 3. A dummy is similar to a layout, but (A) it contains less information; (B) it contains fewer pages; (C) is made on slick paper; (D) contains more than one page.

____ 4. Display is considered to mean (A) pleasing proportion; (B) pleasing harmony; (C) pleasing contrast; (D) pleasing similarity.

____ 5. Type faces reproduce heavier when printed on (A) coated paper; (B) antique paper; (C) sized paper; (D) enameled paper.

____ 6. The printing process, which always screens type faces, is (A) letterpress; (B) lithography; (C) gravure; (D) stone composing.

____ 7. Layout measurements are made in (A) picas and points; (B) inches and fractions of inches; (C) picas and half-picas; (D) elites and half-elites.

____ 8. The thumbnail sketches and made by the layout man are (A) comprehensive; (B) smaller than the printed job; (B) the same size as the printed job; (D) larger than the printed job.

____ 9. The type size affording the maximum legibility when properly leaded is (A) 12 point; (B) 8 point; (C) 6 point; (D) 10 point.

____ 10. Proportion refers to (A) the optical center of a page; (B) the mathematical center of the page; (C) having largest areas of white toward the top of the page; (D) margins, page dimensions, and the relative sizes of the type page and paper page.

Sequence

Directions: The lists which follow are the steps involved in performing certain jobs. Indicate the order recommended in your references by placing the proper numbers in the blanks at the left.

1. The following steps are involved when laying out and setting up a display job.

____ A. Make the rough layout

____ B. Make the comprehensive layout

____ C. Secure customer's approval

____ D. Secure all information relative to the job of printing to be done

____ E. Make the finished layout

____ F. Make a number of thumbnail sketches

____ G. Set the type

____ H. Decide upon the device or devices to be used to attract attention

Layout Exercise

Directions: Make a layout for a two-column ad from the copy given below. All the words need not be used. See page 122 of reference A and page 172 and 253 of reference C for accepted layout techniques.

> Learn while you earn. Boys and girls should take advantage of Cooperative Occupational Education offered by (name of your school). It has the following advantages for you: places you in part-time work of your interest; helps you learn a business or a trade; earn two to four units of high school credit; earn a weekly salary; prepares you for the future by giving you actual work experience. For additional information, contact the local school officials. (Name of proper person)

Composition Exercise

Directions: After completing the above exercise to the satisfaction of your coordinator and employer, make the necessary arrangements to reproduce the ad. Secure two revised proofs and submit one copy to your coordinator and one to your employer.

Assignment
Sheet No. 13

Covering
Units 57-60

PAPER

Tree bark, animal skins, beaded belts, cloth, plant fibers -- each has been used at some time to carry messages, and to record memorable events. In modern times, man-made paper fills this all-important function.

The annual production of paper in this country alone is in excess of twenty-one million tones -- enough to give every man, woman, and child two-hundred fifty pounds. Approximately one-half this total production, at some time, passes through the hands and machines of the printing industry. With the wide public consumption of printed products and the printing industry's wide use of paper as a raw product, you will want to know how paper is produced as well as the various types and characteristics of paper products.

This unit will give you an overview of the paper-producing processes, as well as providing you the opportunity to learn additional technical information necessary for your advancement in printing industry.

Assignment:

1. Read the references listed below.
2. Answer the questions, and turn in this assignment by ____________________.

References:

A. Cleeton and Pitkin, General Printing, pp. 169-177.
B. Karch, Graphic Arts Procedures, pp. 279-295.
C. Polk, The Practice of Printing, pp. 133-140.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. Rag pulp papers are more durable than cellulose pulp papers.

T F 2. Antique finish paper is produced on special calendering rolls

T F 3. Papers used for lithographic or offset printing must be resistant to the effect of water.

T F 4. Inches are the units used to express the size of paper in sheet form.

T F 5. The weight of paper may be indicated by the "old" basis -- the weight per thousand sheets, or the "new" basis -- the weight per ream.

T F 6. Paper will expand on a cool, dry day and contract on a hot, humid day.

T F 7. Paper contains 4 per cent to 8 per cent of moisture after leaving the papermaking machine.

T F 8. It is common practice to make allowances for spoilage.

T F 9. The allowance for spoilage increases as the length of the press run increases.

T F 10. Paper was first manufactured in America in 1690.

T F 11. Papyrus was made of animal skin.

T F 12. The process of making paper such as we have today was developed by the Chinese.

T F 13. Paper boxes and cartons utilize just under one-half the country's paper production.

T F 14. Calendering rollers are used to print calendars on continuous rolls of paper.

T F 15. The felt side of paper is the better printing side.

T F 16. The manufactured sizes of paper are based on the sizes of printing presses, etc.

T F 17. Very thin sheets of paper are measured for thickness by the weight.

T F 18. Paper of 70 pound substance will weigh 70 pounds per 1000 sheets.

T F 19. Paper may be purchased by the pound, hundred weight, or ton.

T F 20. Seasoned paper contains more moisture than the air in the press room.

T F 21. Paper folds easier against the grain than with the grain.

T F 22. Paper will expand and shrink a greater amount across the grain than with the grain.

T F 23. A wet sheet of paper, when drying will curl in the direction of the grain.

T F 24. S. & S. C. designates paper which has been smoothed and slick calendered.

T F 25. Coated papers are given a smooth finish by the addition of clay during the calendering process.

T F 26. A penalty is imposed when paper is purchased in less than standard package amounts.

T F. 27. When using a paper cutter, a piece of cardboard should be placed between the gauge and the clamp to avoid creasing the paper.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. The durability of a paper is dependent upon the quantity of ______________ it contains.

2. Paper made of ground wood pulp contains about _______ per cent cellulose.

3. Paper that has not been run between calenders has a soft blotter-like finish known as ______________ .

4. The ornamental edge appearing on some uncalendered papers is called a ______________ .

5. The basic size of writing and ledger papers is _______ x _______ inches.

6. The basic size of cover papers is _______ x _______ inches.

7. All the papers have two sides, the _______ side and the _______ side; however, the _______ side is best for printing.

8. In the paper designation 28x44 -- M, the grain lies parallel to the _______ inch dimension.

9. The printer's product is composed of four items: technical skill, ______________, ______________, and ______________ .

10. Two commonly used abbreviations referring to paper are M.F., meaning ______________ ______________, and S.&S.C., meaning ______________ ______________ ______________ .

Multiple-Choice

Directions: Listed with each of the incomplete sentences which follow are several responses, one of which will complete the statement and make it true. Indicate your choice by placing the appropriate letter in the blank at the left.

____ 1. When comparing 17 x 22-13 paper with 17 x 22-26M paper, the 17 x 22-13 paper will be (A) heavier than the 17 x 22-26M; (B) lighter than the 17 x 22-26M paper; (C) darker in color than the 17 x 22-26M paper; (D) the same weight as the 17 x 22-26M paper.

____ 2. If one thousand sheets of paper 25 x 38 inches weigh 90 pounds, the substance weight of the paper is (A) 90 pounds; (B) 180 pounds; (C) 45 pounds; (D) 22 1/2 pounds.

____ 3. The basic size of bond and writing paper is (A) 17 x 22 inches; (B) 16 x 21 inches; (C) 34 x 28 inches; (D) 21 x 32 inches.

____ 4. The purpose of the calendering rollers is to (A) dry the web of paper; (B) apply casein and coloring to the paper; (C) press the paper against the watermarking screen; (D) produce the desired finish on the paper.

____ 5. The purpose of the dandy roll is to (A) coat the paper; (B) produce a felt finish; (C) watermark the paper; (D) glaze the paper.

____ 6. Newsprint is used most frequently for newspapers and (A) folders; (B) handbills; (C) booklets; (D) stickers.

____ 7. The cost of 1200 sheets of 20 x 26-50 at thirty cents per pound is (A) $3.60; (B) $36.00; (C) $360.00; (D) $12.00.

____ 8. Bond paper is used most frequently for (A) letterheads; (B) postal cards; (C) card files; (D) booklets.

Sequence

Directions: The lists which follow are the steps involved in performing certain jobs. Indicate the order recommended in your references by placing the proper numbers in the blanks at the left.

1. Steps involved in the manufacture of paper.

____ A. Web of paper moves to calendering rolls
____ B. Pulp moved to "Jordans"
____ C. Pulp made finer by iron bars in beaters
____ D. Pulp moves to Fourdriniers
____ E. Water removed by pressure and heat
____ F. Clay or coloring materials added
____ G. Pulp screened, strained, and large amounts of water added
____ H. Surface sizing applied
____ I. Pulp produced by mechanical grinding or chemical "digestion"
____ J. Sizing added to make paper stiffer

2. Steps involved in cutting paper with a paper cutter.

____ A. Back gauge is set proper distance from knife
____ B. Blade is brought into motion to cut paper stock
____ C. Paper is placed on strawboard or tag
____ D. Clamp is brought to bear on paper stock
____ E. Paper is placed snugly against back gauge
____ F. Place strawboard or tag on cutting table
____ G. Strawboard or tag is placed on top of paper

3. Steps involved when finding the cost of paper for a job.

_____ A. Ascertain size of stock from which finished sheets are to be cut

_____ B. Calculate number of full stock sheets required for job

_____ C. Determine how many finished sheets can be cut from one full sheet of stock

_____ D. Multiply cost per thousand stock sheets by the number of stock sheets used divided by one thousand

_____ E. Ascertain size of finished sheets required for the job

_____ F. Multiply per pound cost of stock sheets by weight per M of stock sheets

_____ G. Find total number of finished sheets required for job plus spoilage allowance

_____ H. Cost of printing job has been calculated

_____ I. Mark off three decimal places in the number of full stock sheets required for job

_____ J. Mark off decimal places and use first two significant figures

_____ K. Double the weight of one ream of stock sheets used for job

Assignment
Sheet No. 14

Covering
Units 61-92

JOB COMPOSITION

From time to time printers are called upon to compose specialty printing jobs involving elements and techniques not ordinarily found in straight composition. For the purpose of this unit, these specialty printing jobs have been classified as "special composition."

It is not uncommon for a printing shop to specialize in a particular sort of composition if the compositor is unusually adept at that type of composition. As all printing shops are called upon at some time to do "special composition" jobs, it is essential that you learn some of the rules, principles, and special techniques used in this type of printing job. By composing these various specialty jobs, a definite ability for some type of composition may reveal itself.

In this unit the basic typographical considerations of "special composition" are outlined; and you will learn interesting and useful technical facts about initial letters, borders, decorations, and various other details of this specialized composition.

Assignment:

1. Read the references listed below, directing special attention toward the illustrations.
2. Answer the questions which follow, and turn in this assignment by ______________________ .

References:

A. Cleeton and Pitkin, General Printing, pp. 62-69, 99-101, 104-108, 112-115.
B. Karch, Graphic Arts Procedures, pp. 55-61, 72-75, 132-133, 142-144.
C. Polk, The Practice of Printing, pp. 148-169, 218-272.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. Even at best, butted rule joints are seldom satisfactory.

T F 2. After rule is cut on the lead and rule cutter, the ends should be trimmed to make more satisfactory borders.

T F 3. A narrow strip of cardboard inserted under the work holder near the knife of a mitering machine will cause the top of the rule to be cut slightly shorter than the bottom.

T F 4. Poorly formed rule corners do much to make the appearance of any printing job unsatisfactory.

T F 5. Even by exercising the utmost care, it is difficult to make perfect corner joints with mitered rule.

T F 6. When the mitering machine is used to trim rule for the sides of an equilateral triangle, the spring projection of the work holder should be in the number three notch.

T F 7. A make-up widow falls at the top of a page and should be three-fourths the width of the type line in length.

T F 8. The purpose of multiple justification is to bring about the vertical alignment of adjacent columns.

T F 9. Brass rule is available in lengths from ten to thirty-six picas by half picas.

T F 10. A line or nick is scribed near the registering edge of most brass rule.

T F 11. Brass rule is available in lengths from one to ten picas by points.

T F 12. Rule should be pieced as infrequently as possible.

T F 13. Hairline rule is used for the cross lines on most forms.

T F 14. When short rule is used between words, the face of the rule need not be aligned with the base line of the words.

T F 15. The border skeleton of an ad is a layout containing only the main elements exclusive of any border or marginal material.

T F 16. Work-and-twist printing jobs are printed twice on the same side of the sheet used.

T F 17. Work-and-turn describes a printing technique consisting of two different registers on the same side of the sheet, the sheet being rotated 90° between impressions.

T F 18. To decrease the decorative qualities of an initial letter it is advisable to use a condensed initial letter on a wide page.

T F 19. Initial letters are usually followed by caps or small caps and must align with the top and bottom of the lines covered by the letter.

T F 20. Cool colors must be used sparingly, whereas, warm colors may be safely used over large areas.

T F 21. Four words which will describe a well-designed letterhead are neat, dignified, simple, and orderly.

T F 22. Standard letterheads are printed on standard size paper, 8 1/2 x 11 inches.

T F 23. Standard newspaper columns are 12 picas wide with 6 point spaces between columns.

T F 24. Although most programs carry leaders, some styles of program composition make them unnecessary.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. The rule holder setting to cut rule to form a square or rectangle should be ________ in order to produce an angle of ________ degrees.

2. The definition of a printing job is a (an) ____________ for a (an) ____________ of ____________ ____________ .

3. Cross lines on most forms are made by ____________ ____________.

4. Vertical lines on most forms are made by ____________, ____________ point or ____________ point face rule.

5. Rule forms should be set in the ________ ________ , rather than in a stick.

6. Head and foot rules usually have ____________ or ____________ faces.

7. A type face which contrasts sharply with the regular body type of a paragraph is called a ____________ face.

8. Rule is made of either ____________ or ____________ ____________ .

9. Quotation marks used at the left end of a line are placed ____________ the alignment.

10. To carry a reader's eye across a type line, especially in tables, ____________ are used.

11. Big starting letters are called ____________ letters.

12. Roman numerals set in vertical columns are always aligned at the ____________ .

13. Colors which attract and enliven interest but which may become irritating when over-used are ____________ ____________ .

14. The three colors producing a sense of ease and comfort for the reader are ____________, ____________, and ____________.

15. The usual size range of tickets is from ______ x ______ to ______ x ______ inches.

Multiple-Choice

Directions: Listed with each of the incomplete sentences which follow are several responses, one of which will complete the statement and make it true. Indicate your choice by placing the appropriate letter in the blank at the left.

____ 1. The purpose of a "sinker" is to (A) make printed jobs heavier; (B) correct inaccuracies of machine slugs; (C) make ink penetrate paper; (D) emboss paper.

____ 2. Of the printed material that comes before him, the average reader has time to read (A) less than 5 % of it; (B) about 10% of it; (C) about 20 % of it; (D) about 25 % of it.

____ 3. Machine-made borders are made in (A) strips; (B) single units; (C) specific lengths; (D) strips and single units.

____ 4. Foundry-made borders are made in (A) strips; (B) single units; (C) specific lengths; (D) strips and single units.

____ 5. Leaders are used on a printed sheet to (A) form wide stroke letters; (B) lead the eye across the page; (C) form the spacing material between lines; (D) take the place of slugs.

____ 6. The style of rule which may be used to form panels without mitering is (A) face in center; (B) doublefaced; (C) face on side; (D) patterned.

____ 7. The primary colors are (A) blue, green, and violet; (B) red, yellow, and orange; (C) red, yellow, and blue; (D) orange, green, and violet.

Listing

Directions: List the items called for in each of the following statements. Select your answers carefully.

1. The methods of securing color harmonies in printing are:

(A) ____

(B) ____

(C) ____

(D) ____

2. In order to fulfill its purpose an advertisement must:

(A) ____

(B) ____

(C) ____

3. In order of decreasing prominence the items contained on the title page of a book are:

(A) ____

(B) ____

(C) ____

4. The details frequently marring a printed page are:

(A) ____

(B) ____

(C) ____

(D) ____

(E) ____

(F) ____

(G) ____

(H) ____

(I) ____

Sequence

Directions: The lists which follow are the steps involved in performing certain jobs. Indicate the order recommended in your references by placing the proper numbers in the blanks at the left.

1. Steps in setting up a job with a border.

____ A. Compose type

____ B. Tie up the form

____ C. Place type on galley

____ D. Place right and bottom border in position

____ E. Study job requirements on job ticket

____ F. Place top and left border into position

____ G. Space out type

____ H. Cut and miter border material

2. Steps in setting up a rule form.

_____ A. Measure copy depth
_____ B. Make allowance for rule
_____ C. Measure width of copy
_____ D. Compose heading and place in galley
_____ E. Make rough sketch of form
_____ F. Place foot rule in position
_____ G. Make list of rule needed for top
_____ H. Place head rule in position
_____ I. Secure needed rule or cut needed lengths
_____ J. Complete form and tie up
_____ K. Compose box headings and insert vertical rule
_____ L. Make list of needed spacing material
_____ M. Collect spacing material and bring to bank

Assignment
Sheet No. 15

Covering
Units 93-111

IMPOSITION AND LOCK-UP

Since the invention of the printing press, it has been necessary to place composed type forms on some rigid platform prior to locking the forms in the chase. For many centuries this rigid platform was a smooth slab of stone set on a wooden frame. The stone and its supporting structure was known as the imposing stone. Those workers who arranged or imposed the forms on this stone came to be known as stonemen, and the activities in which they engaged were called stone work. Although in the present day precision imposing surfaces of iron and steel are fast replacing the stone slabs, the time-honored names which have grown up around these stones remain as a part of the terminology of the trade.

The stone is the proving ground for the work of the compositor. On these oblong tables, topped by their smooth surfaces, the forms are imposed and made secure for the presses that turn out the thousands of copies of printed material.

The stoneman, whether he is a specialist or a multiple duty man, holds a key position. He must not only possess the ability to apply the technical knowledge required to arrange the forms in their relatio to each other, but must also compute and allow for margins and trimming on the finished job. Expert stonemen are very scarce and rank next to the shop foreman in taking responsibility for eliminating costly errors and maintaining a smooth production flow. Becoming a stoneman is a worthy goal for anyone beginning in the printing industr

In this unit you will study material regarding imposition and lock-up, and you will have an opportunity to learn many technical "know how s" concerning the arrangement and lock-up of composed forms.

Assignment:

1. Read the references listed below.
2. Answer the questions below, and hand in this assignment by

______________________________.

References:

A. Cleeton and Pitkin, General Printing, pp. 70-75, 102-103.
B. Karch, Graphic Arts Procedures, pp. 134-135, 197-207.
C. Polk, The Practice of Printing, pp. 36-38, 90-111.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. The point of maximum impressional strength of the press on the platen must be considered when positioning a form.

T F 2. When locking up a form, the string is removed just after the outside quoins have been inserted and the reglets placed in position.

T F 3. The solid side of a lock-up is the side containing the quoins.

T F 4. An electrotyper's finishing rubber rubbed over the joints of a ruled form can improve the corners.

T F 5. With the exception of that near the form, the furniture used in lock-up should be the widest available.

T F 6. The pyramid lock-up is as unsatisfactory as the method of filling the entire chase with furniture.

T F 7. Warped or twisted furniture may be as effective as straight furniture for locking a form.

T F 8. The "chaser" method of positioning is likely to produce bind.

T F 9. Between the form and the quoins, the furniture should be from four to six picas wide.

T F 10. When locking-up a form in a chase, the available space determines the number of pairs of quoins which may be used.

T F 11. Binds usually result when forms are locked up by the squared up method.

T F 12. The chaser method of lock-up seldom causes "binds."

T F 13. When locking-up a small form, the area enclosed by the chase should be filled.

T F 14. Cuts out of square will cause a springy form.

T F 15. Squeeze can often be increased by the insertion of an extra lead at the bottom of a page form.

T F 16. The use of sinkers may cause the edges of a chase to spring up when locked, and this must be avoided.

T F 17. The insertion of sinkers around a form will eliminate spring.

T F 18. Stone and imposing table refer to the same item in a print shop.

T F 19. Type resting firmly on the composing stone will cause a springy form.

T F 20. Patent base is made of marble.

T F 21. There are three different ways of locking-up a four-page form.

T F 22. The line-up table is used for positioning of forms for lock-up.

T F 23. Wood furniture is cut to accurate pica measurements, and is reliable where accurate spacing is required.

T F 24. A groove is found only on wood furniture four and one-half picas wide.

T F 25. Wood furniture lengths are stamped on the end of each piece.

T F 26. Wood furniture is impervious to moisure or atmospheric change.

T F 27. Reglet is thin wooden furniture.

T F 28. Stone is a term used when speaking of furniture.

T F 29. Experienced stonemen will usually rub a stone with a wire brush before using the stone for lock-up.

T F 30. Quoins are key tightened before the form is planed.

Completion

Directions: Fill in the blank(s) with the word(s) required to complete the sentence correctly.

1. Preparatory to planing, quoins are tightened with the ____________.

2. Quoins are considered as being composed of one and two pieces; and example of the one piece quoin is the ________________ and of the two piece quoin is the ________________ .

3. The object used to force type to rest on its feet is called a ________________ .

4. A form locked-up in a chase for a platen press should be located near the ________________ of the chase.

5. Quoins are placed at the ________________ and ________________ side of the chase.

6. A form locked up in a chase for a cylinder press should be positioned so it will not be struck by the ________________ ________________ .

7. A large sheet of paper on which a number of page forms are printed is called a ________________ .

8. Placing pages properly in a form, allowing for spacing, and locking-up the form is called ________________ .

9. The signature is folded at the back, or ________________, margin of a book.

10. If two pages, each having equal side margins are locked in a chase, the space between the two forms should be ____________ the width of each side margin.

11. The allowance made in imposition for trimming the pages of books is usually ______________ inch.

Multiple-Choice

Directions: Listed with each of the incomplete sentences which follow are several responses, one of which will complete the statement and make it true. Indicate your choice by placing the appropriate letter in the blank at the left.

____ 1. To protect wood furniture from the pressure of the quoins (A) paper is placed on each side of the quoins; (B) leads are placed on each side of the quoins; (C) letterboards are placed on each side of the quoins; (D) reglets are placed on each side of the quoins.

____ 2. The term, "imposition," means (A) locking up a form in a chase; (B) proofing on the imposing table with the form in a chase; (C) the proper placing of two or more pages in a chase; (D) breaking up a form while still in a chase.

____ 3. Quoins are (A) small iron tools which act as wedges in locking forms; (B) an iron or steel frame which holds forms in position on a press; (C) nonpareil and pica lengths of spacing material used in locking forms for the press.

____ 4. Furniture consists of (A) small iron tools which act as wedges in locking forms; (B) iron or steel frames which hold forms in position on a press; (C) spacing material.

____ 5. Reglet refers to (A) an iron or steel frame which holds forms in position on a press; (B) narrow strips of wood used when locking forms in a press; (C) nonpareil and pica lengths of spacing material used in locking forms for the press; (D) a block used to knock type in a form to its feet.

____ 6. A chase consists of (A) a group of small iron tools used to lock up forms; (B) an iron or steel frame which holds forms in position on a press; (C) any spacing material used in locking forms in a press; (D) a block used to knock type in a form to its feet.

____ 7. A sheet-wise form is (A) a form backed up with the same form; (B) a book form, printed on one side of paper only; (C) printe on one side then turned and backed up with another form; (D) a ruled form, with crossed lines, printed in two impressions.

____ 8. In a two page lock-up, if the type is to be in the center position of each page, the space between the printed areas must be (A) one and one-half the width of one page margin; (B) twice the width of one page margin; (C) four times larger than one page margin; (D) two and one-half the width of one page margin.

Sequence

Directions: The lists which follow are the steps involved in performing certain jobs. Indicate the order recommended in your references by placing the proper numbers in the blanks at the left.

1. Steps involved in locking up a form.

____ A. Lower to composing table
____ B. Lock form more securely and check for spring
____ C. Insert quoin key under end of chase
____ D. Clean imposing stone
____ E. Position quoins
____ F. Make sure all type is in down position
____ G. Raise one end of chase
____ H. Unlock, make corrections, relock, plane, and recheck
____ I. Tighten quoins slightly
____ J. Place furniture around form
____ K. Remove string from form
____ L. Plane lightly
____ M. Check loose elements in lock-up
____ N. First planing for spring
____ O. Place chase around form on stone
____ P. Insert reglets between quoins and furniture

2. Steps followed when locking up a form with a border

____ A. Loosen quoins and make finger tight
____ B. Place form in chase
____ C. Test for lift
____ D. Plane the form
____ E. Tighten quoins
____ F. Tighten quoins so form will lift
____ G. Place three corners of border into position
____ H. Tighten quoins slightly with key

Matching

Directions: In the right column are descriptive words and phrases, and in the left, various words. Match the letters of the items on the right with the word(s) on the left by placing the proper letter in each blank on the left.

____ 1. Check for alignment after sheet is printed

____ 2. Imposition

____ 3. Imposition dummy

____ 4. Oblong books

____ 5. Bottom of chase

____ 6. Inside quoins

____ 7. Side quoins placed at left of form

____ 8. Work-and-back

____ 9. Work-and-turn

____ 10. Layout of four-page folder work-and-turn

A. Lock-up for cylinder press

B. Same form on both sides of printed sheet

C. Used for figuring margins and trim

D. Any quoin used inside a chase

E.

1	4	3	2

F. Incorrect lock-up

G.

1	3	4	2

H. Concise knowledge of paper qualities and sizes

I. The long side nearest the stoneman

J. Line-up table

K. Quoins pointing to solid side of lock-up

L. Different form on each side of sheet

M. Positioning of pages in the form or positioning of form in chase

N. Long dimension across the top

Assignment
Sheet No. 16

Covering
Units 112-118

LETTERPRESSES

With proper use and servicing, printing presses will last indefinitely; they are seldom sold for scrap. The practice common to the printing industry is to sell the replaced presses, rebuild or recondition them, and put them in service again in other parts of the country. One press has been traced from the beginning of the Missouri territory, through Kansas and Oregon settlements where it dropped from sight, only to be found again in California. Thus, by tracing printing presses, one can almost trace the progress of civilization.

In establishments where the number of workers is limited, the number of jobs each worker does is increased. This is especially true in many small printing concerns where it is actually necessary for a compositor to be a pressman also. Certainly a competent compositor should be familiar with the operations of a press, and the quality of workmanship demanded in a printed form.

Because cylinder and rotary presses are usually manned by highly specialized crews, this unit will place emphasis upon the platen type presses. In this unit you will study the care and operating principles of platen presses.

Assignment:

1. Read the references listed below.
2. Answer the questions and turn in this assignment by

   ____________________.

References:

A. Cleeton and Pitkin, General Printing, pp. 88-91, 147-153.
B. Karch, Graphic Arts Procedures, p. 1-2, 253-256, 273-274.
C. Polk, The Practice of Printing, pp. 112-121.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. Water will cause blisters to appear on ink rollers.

T F 2. When an ink roller has been washed, it should be rubbed briskly to restore the polish.

T F 3. Rollers should be stored in an upright position and away from excessive heat.

T F 4. Cleaning solutions deteriorate the rollers and they should never be cleaned more often than once a day.

T F 5. It is important to clean and oil the ends of the ink rolle

T F 6. Letterpress printing began in the western world nearly five centuries ago.

T F 7. Letterpresses print from relief surfaces.

T F 8. Letterpress printing is one of the slowest printing processes.

T F 9. The Kelly Press is capable of delivering fifty to seventy printed sheets per minute.

T F 10. The bed and platen move toward each other on a clamshell action press.

T F 11. The drum type cylinder press revolves twice for each impression it makes.

T F 12. The web on platen presses should be cleaned daily.

T F 13. The two-revolution cylinder press will print a different form during each revolution.

T F 14. A web perfecting press prints on both sides of the paper a it passes through the press.

T F 15. Type forms used on rotary presses are composed of pieces of type especially shaped for use on rotary press cylinder

T F 16. The majority of rotary presses print on a continuous strip of paper.

T F 17. The platen of a rotary press is a flat metal surface.

T F 18. When a web perfecting rotary press is used, the sheets are cut to size after printing.

T F 19. When a sheet-fed rotary press is used, the sheets are cut to size before printing.

T F 20. Most of the small job presses for general work are of the rotary type.

T F 21. Glycerin and paraffin are the major ingredients of the rollers.

T F 22. Syrup is used in the composition of rollers to increase the friction between them and the paper.

T F 23. The platen press should be oiled daily.

T F 24. When a press is idle, the ink rollers should be left in contact with the type form.

T F 25. The first signs of wear on a press will show up on the cams and rollers.

Multiple-Choice

Directions: Listed with each of the incomplete sentences which follow are several responses, one of which will complete the statement and make it true. Indicate your choice by placing the appropriate letter in the blank at the left.

____ 1. Ink should be washed off the press with (A) water; (B) benzene; (C) kerosene; (D) light oil.

____ 2. One of today's major printing processes is (A) collotype printing; (B) silk screen printing; (C) letter press printing; (D) engraved copper plate printing.

____ 3. The only hand fed press in the following group is (A) Kelly No. 1; (B) Miehle Vertical 50; (C) Miller Simplex; (D) Lee No. 38.

____ 4. In the interests of safety, one should not (A) bend the knees when lifting or carrying heavy loads; (B) lubricate machinery when it is not turning; (C) miss an opportunity to play a practical joke on a fellow-worker; (D) smoke when cleaning a press.

____ 5. Grippers on the cylinder press (A) hold the sheet being printed on the type form; (B) hold the sheet being printed on the cylinder; (C) hold the printed sheet on the tympan; (D) hold the sheet to be printed on the feed board.

____ 6. The letterpress which prints all of the type form at once is the (A) cylinder press; (B) platen press; (C) rotary press; (D) drum press.

____ 7. Gripper fingers on a platen press (A) hold the printed sheet against the tympan; (B) hold the sheets to be printed on the feed board; (C) hold the sheets being printed on the type form; (D) hold the printed sheets on the delivery board.

____ 8. The throw-off lever is operated to (A) set the press in motion; (B) build up pressure on a "perfecting press"; (C) keep the flywheel in motion; (D) cause the press to miss an impression.

____ 9. The rollers for year-round use are (A) manufactured from glue, glycerine and some other materials; (B) Sommers rollers; (C) synthetic rollers; (D) rubber rollers.

____ 10. After finishing a run, rollers should be (A) stopped on the beginning of the type form; (B) stopped just below the ink fountain; (C) coated with an emulsion of benzene and light oil; (D) cleaned and coated with light oil.

Matching

Directions: In the right column are descriptive words and phrases, and in the left, various words. Match the letters of the items on the right with the word(s) on the left by placing the proper letter in each blank on the left.

____ 1. Drum cylinder press

____ 2. Two-revolution press

____ 3. Platen

____ 4. Chase clamp

____ 5. Tympan

____ 6. Draw-sheet

____ 7. Ink disc

____ 8. Grippers

____ 9. Ink Rollers

____ 10. Throw-off lever

____ 11. Feed board

____ 12. Flywheel

____ 13. Delivery board

____ 14. Ink fountain

A. Flat metal surface which swings to vertical position during the impression

B. Distributes ink to form

C. Cylinder rises during alternate revolutions

D. Hold paper sheet against tympan

E. Holds steel rim in which type is locked securely against press bed and lugs

F. Packing placed on platen

G. Holds sheets to be fed into press

H. Heavy oiled manila paper

I. Feeds ink to rollers

J. Holds sheets which have been printed

K. Surface upon which ink is evenly distributed

L. One impression per revolution

M. Causes press to have steady motion while in operation

N. Causes press to miss an impression

Sequence

Directions: The lists which follow are the steps involved in performing certain jobs. Indicate the order recommended in your references by placing the proper numbers in the blanks at the left.

1. Steps involved in cleaning a press.

____ A. Use kerosene to wash ink disc

____ B. Wash rollers while on ink disc

____ C. Check ink disc for any spots missed on rollers

____ D. Wipe ink disc dry

____ E. Dry rollers individually

____ F. Release tension on roller springs

____ G. Clean off ink or kerosene that may have dropped on press

Assignment
Sheet No. 17

Covering
Units 121-143

PLATEN PRESS PREPARATION

To run a press job, two carefully prepared surfaces are necessary. One of these is prepared when the form is planed and locked in the chase. The other must be prepared on the platen to back up the sheet being printed. The preparation of the surface on the platen, inking the press, and placing the chase in position are a few of the operations which must be performed prior to running a press job.

Some large printing establishments employ specialized workmen to perform the highly skilled operations, however, the worker who is most valuable is the one capable of performing the processes and activities which take place in the shop. The conditions which enable the worker to secure a good general knowledge of printing shop processes are best provided by the smaller shop manned by competent workmen.

To enable you to further expand your knowledge of the printing trade, this unit will provide the opportunity to study the processes and activities which must be performed on the platen press before a job can be run.

Assignment:

1. Read the references listed below.
2. Answer the questions below and turn in this assignment by ________________ .

References:

A. Cleeton and Pitkin, General Printing, pp. 76-89, 95-97.
B. Karch, Graphic Arts Procedures, pp. 256-272.
C. Polk, The Practice of Printing, pp. 122-128.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. A hard packing consists of a draw sheet, a pressboard, and four sheets of 50 pound super.

T F 2. The thickness of the platen packing depends upon the amount of wear to which the type in the form has been previously subjected.

T F 3. A thin packing may cause type to be smashed on the platen.

T F 4. Reaching into a moving press to retrieve fallen sheets should be barred in the interest of safety.

T F 5. Leaving the press while the tympan bails are unclamped may cause the press to be seriously damaged.

T F 6. The press should be inked with the type form in place to insure even distribution of ink on the type form.

T F 7. The guides are driven through the packing to prevent them from moving during a press run.

T F 8. As an additional precaution to prevent guide pins moving during a press run, they are secured to the draw sheet with sealing wax.

T F 9. Make-ready with a soft packing not only enables jobs to be started more quickly on the press, but also causes a minimum of wear on the type.

T F 10. Make-ready with a soft packing consists of adding additional sheets to the packing, until the center of the form prints.

T F 11. Fifty pound super is a good weight paper for marking out a type form for make-ready.

T F 12. An out-of-parallel platen can be detected by one edge of a sheet of printing uniformly light, while the other prints uniformly heavy.

T F 13. When the platen packing is damaged, only the draw sheet need be replaced.

T F 14. A sheet used in make-ready is first spotted and then marked out before cutting.

T F 15. When the spot-up sheet swells and wrinkles, too much paste has been used.

T F 16. To insure adequate pressure for printing, no sheets are removed from the packing when a spot-up sheet is inserted.

T F 17. A spot-up sheet should be inserted into the packing from the bottom of the platen to avoid moving the upper tympan bail.

T F 18. When quads are used as guides, fenders are utilized to prevent the sheets going over the guides.

T F 19. When press feeding, two inches should be the maximum height of the pile of paper on the feed board.

T F 20. While a job is being run in the press, the pressfeeder is the one who is responsible for presswork of high quality.

T F 21. Sandpaper is placed on the right middle finger as an aid to pressfeeding.

T F 22. Interlaying is one method used to raise the height of the wood backed printing surfaces.

T F 23. An underlay is added to the bottom of a wood based cut.

T F 24. Work-up refers to the pressfeeder when he increases his speed of placing sheets into the press.

T F 25. Driers are added to ink to make them thicker.

T F 26. Ink reducers are used to make ink dry faster.

T F 27. Paste driers shorten the time needed for an ink to dry.

T F 28. When printing a job on an ink blotter, japan drier should be added to the ink.

T F 29. A letterhead printed on a bond paper should be printed with ink to which cobalt has been added.

T F 30. If ink is to be added during a run, it should be placed on the rollers to insure quicker distribution.

T F 31. Guides must be placed so they will not strike the gauge pins.

T F 32. There is danger of "set-off" if too high a lift of freshly printed sheets are placed on the delivery board.

T F 33. Papers with soft or rough finishes offset very readily.

T F 34. Speed and the mechanics of pressfeeding are best learned by diligent practice at the press.

T F 35. Hard finished and smooth paper should be slip-sheeted.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. The activities involved in modifying the pressure between the form and the sheet to be printed so the complete form will be produced in ink is called ________________ .

2. The conditions which cause the edges of a level form to exert more pressure against the platen than the center of the form make necessary the process of ________________.

3. Too little ink results in a ________________ print; whereas too much ink will cause ________________ and ________________ .

4. So heavy cover stock will fold smoothly without breaking, they are usually ________________ .

5. When two or more colors of ink are to be used on a printed job, the best effects are secured by the use of ______________ inks.

6. All printing inks are composed of two classifications of materials, the ______________, which produces the color, and the ______________ which acts as a binder.

7. For one color runs ______________ inks are used.

8. To produce brown ink, the colors to be mixed together should be ______________, ______________, and ______________ .

9. The original guides for positioning sheets on the platen were ______________ .

10. Placing sheets of coarse paper between freshly printed sheets is called ________________ and is used to eliminate ____________ and slur.

Multiple-Choice

Directions: Listed with each of the incomplete sentences which follow are several responses, one of which will complete the statement and make it true. Indicate your choice by placing the appropriate letter in the blank at the left.

____ 1. The purpose of make-ready is (A) to put thicker packing on the platen; (B) to prepare the press for placing the chase; (C) to be certain the grippers and gauge pins are in place; (D) to equalize the height of the various parts of the form to the paper.

____ 2. When a sheet does not contact all three gauge pins, the operator should (A) attempt to straighten the sheet before the platen closes; (B) trip the throw-off lever; (C) let the sheet print crookedly; (D) stop the press.

____ 3. When a pressfeeder adds color, he (A) mixes two or more inks; (B) adds blank ink to the ink on the press; (C) adds more ink to the color being used; (D) re-runs the job using a different color of ink.

____ 4. If there is a doubt about the amount of packing to be used on the platen, one should (A) leave it out and add later if the impression is too light; (B) put it in and remove later if the impression is too heavy; (C) put it in and remove some ink from the disk if the impression is too heavy; (D) leave it out and add ink to the disk if the impression is too light.

____ 5. The term set-off is used to describe (A) the transfer of fresh ink from the face of one sheet to the back of the sheet above it; (B) the interleaving of [illegible] sheets between two freshly printed sheets; (C) setting a lift of printed and jagged sheets off the delivery board; (D) the placement of a lift of sheets from the stockpile to the feedboard.

Sequence

Directions: The lists which follow are the steps involved in performing certain jobs. Indicate the order recommended in your references by placing the proper numbers in the blanks at the left.

1. Steps involved when preparing a platen press for a job run.

____ A. Remove dust, lint, and oil from ink plate and rollers

____ B. Move grippers to outer ends of gripper bars

____ C. Remove old packing from platen

____ D. Clamp top bail in position

____ E. Insert chase behind lugs at bottom of chase bed

____ F. Pull an impression on the tympan sheet

____ G. Ascertain the type of packing to be placed on the tympan

____ H. Turn press over by hand, and then turn on power and run press at slow speed.

____ I. Cut, clip, and crease packing sheets and tympan

____ J. Insert the pressboard

____ K. Pull impression on stock size sheet and secure a "position o.k."

____ L. Clamp lower bail in place

____ M. Sight grippers to be certain they will not strike form

____ N. Place a small amount of ink on the left side of the ink disc

____ O. Wipe chase bed and back of form after testing form for spring and lift

____ P. Raise and engage chase clamp to hold chase securely

____ Q. Make certain tympan bails are in place

____ R. Check position of guides and stripping devices and proceed with the make-ready

____ S. Position guides

____ T. Turn off power to press and turn over by hand until rollers are at lowest point

2. Steps involved in pressfeeding.

____ A. Fingers drag sheet to left while resting on bottom guides

____ B. Jog printed sheet as it is placed on delivery board

____ C. Drag top sheet from pile on feed board

____ D. Sheet contacts bottom guides

____ E. Grasp printed sheet between thumb and finger of left hand

____ F. Place sandpaper covered finger on margin of printed sheet and draw sheet over edge of platen

____ G. Pile printed sheet on delivery board

____ H. Fingers move sheet to left until stopped by side guide and fingers continue sweeping motion out of press and back to pile on feed board

____ I. Withdraw thumb from sheet

____ J. Grasp second sheet in pile on feed board and allow finger to rest on feed board

____ K. Fan out pile of stock and place on feed board

Assignment
Sheet No. 18

Covering
Units 148-157

BINDERY ROOM OPERATIONS

In small printing shops it is common practice to make the learners, who have reached some acceptable degree of ability, responsible for the final operations which are performed on printed jobs. These operations -- gathering, binding, packaging, and so forth -- are performed in the bindery section of the printing establishment.

To one who has never had occasion to perform any of the bindery operations, they may seem simple and of minor importance. However, having to report to the supervisor a job ruined by a careless error will quickly amend any unfounded idea concerning the ease or simplicity of bindery operations.

This unit will enable you to study and learn of the machines and operations common to bindery rooms, and to learn of the operations necessary after the press-run to complete a printed job.

Assignment:

1. Read the references listed below.
2. Answer the questions below and turn in this assignment by ________________________ .

References:

A. Cleeton and Pitkin, General Printing, pp. 180-183.
B. Karch, Graphic Arts Procedures, pp. 300-316.
I. Information Sheet No. 2, "Gathering and Binding"

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. Most printing jobs require no trimming because they have been run on standard size sheets or paper.

T F 2. "Off angle" cutting results when paper is improperly clamped in the cutting machine.

T F 3. Finishing operations for both pamphlet binding and bookbinding are quite similar.

T F 4. Even though there has been considerable mechanization in other phases of the printing industry, bookbinding has remained largely a hand process

T F 5. Mechanical bindings are being more widely used for library and school books than for commercial documents.

T F 6. When gathering, an error is of little importance as one can depend on the checkers to correct any such error.

T F 7. If a book is to be side-wire bound, the signatures are placed one upon the other.

T F 8. Sections and pages are usually gathered in the order of consecutive page numbers.

T F 9. The construction of a book will determine the method of gathering.

T F 10. The original book signatures were composed of four pages.

T F 11. Stephen Daye developed the first paper folding machine.

T F 12. The book <u>General Printing</u> by Cleeton and Pitkin is saddle-wire bound.

T F 13. A side-wire bound book must have narrower inside margins than a saddle-wire bound book.

T F 14. <u>Graphic Arts Procedures</u> by Karch is an example of a "perfect binding."

T F 15. Book sections are commonly known as signatures.

T F 16. Signatures are not necessary when books are constructed with loose-leaf bindings.

T F 17. Overwire is a type of spiral binding.

T F 18. A bone folder is used in hand folding to prevent wear on the thumb.

T F 19. When printed sheets are folded to register, the edges of the sheets are always kept even.

T F 20. When a pile of paper is jogged, the pile is straightened.

T F 21. Paper should be stored flat and kept clean by leaving covers intact.

T F 22. Modern folding machines can deliver only 16 page signatures.

T F 23. Two men can work on a hand-lever cutter with more safety than one.

T F 24. When using a power paper cutter, a straw board should be placed at the top of the pile of paper to protect the paper from being marred by the clamp.

T F 25. Padding and tabbing are two terms which refer to the same operation.

T F 26. A paper punching machine can handle more sheets at one time than a paper drill.

T F 27. Staplers use ready-made staples and can be used to fasten work to one inch of thickness.

T F 28. Books and other printed material, to a maximum thickness of one-half inch, can be bound on a stitcher.

T F 29. Folding machines may be safely adjusted while in operation.

T F 30. When lifting heavy lifts of paper, the body and not the knees should be bent.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. The first folding machine was used by the ____________ ____________ in the year ________ .

2. The type of binding which is simple, cheap, and used for small thicknesses is the ______________ .

3. The "perfect binding" holds the book together with a special type of ____________.

4. The type of binding which offers maximum permanence is the ____________ ____________ .

5. A rounded back will indicate a book has been ____________ ____________ .

6. When signatures have been folded so the printed pages are aligned, the pages are said to have been ____________ ____________ ____________ .

7. Paper may be delivered to the printer in ________ sheet packages, ________ sheet packages, or ________ sheet packages.

8. The aligning of sheets delivered from the press in a haphazard pile is called ____________ .

9. Printed materials which are made of stiff papers and are to be subjected to severe usage usually are ______________ to prevent damage.

10. The colored lines found on various types of printed forms are ____________ ruled on special bindery equipment called ____________ ____________ .

Multiple-Choice

Directions: Listed with each of the incomplete sentences which follow are several responses, one of which will complete the statement and make it true. Indicate your choice by placing the appropriate letter in the blank at the left.

____ 1. Stiff covers are used on books which (A) have sewn casebindings; (B) utilize binding posts to hold the sheets together; (C) are saddle-wire bound; (D) are side-wire bound.

____ 2. Packages or cases of paper should be stored (A) on end; (B) on edge; (C) flat; (D) leaning at an angle.

____ 3. When a cutting machine is used, the paper is protected by clamping the paper (A) as tight as the second machine operator states; (B) sufficiently tight to hold the paper; (C) very loosely; (D) as tight as possible.

____ 4. When gold leaf is applied to a book, the type used is (A) brass type; (B) Ludlow type; (C) monotype; (D) factory type.

____ 5. Books of blank forms which contain many colors of lines have the lines produced by a (A) rotary press; (B) lithographic stone; (C) stripping machine; (D) ruling machine.

Sequence

Directions: The lists which follow are the steps involved in performing certain jobs. Indicate the order recommended in your references by placing the proper numbers in the blanks at the left.

1. The following are the steps for tabbing "scratch pads."

____ A. Insert straw boards

____ B. Place heavy weight at top of carefully aligned piles

____ C. Remove weight

____ D. Count sheets into piles of 50 or 100 sheets

____ E. Allow glue to dry

____ F. Combine piles, carefully jog, and trim binding edge if necessary

____ G. Apply tabbing glue as often as necessary

____ H. Cut pads apart with sharp knife

____ I. Secure and prepare tabbing glue

[illegible]

Information
Sheet No. 2

GATHERING AND BINDING

Most books are composed of folded sections which are of a definite and consistent number of pages, usually 16 or 32. Before the pages are bound, they must first be gathered or assembled in the order of consecutive page numbers.

When gathering sections for books, stacks of the separate sections are placed in consecutive order on a table, and one section after another is collected from each pile to form the printed part of a book.

Extreme care must be taken to keep the sections in their proper sequence. An error in sequence, missing a section, or selecting two sections from any pile will mean an error in the book. Usually each book is checked for accuracy of gathering before it is bound.

The method of construction of the book determines not only the manner in which the forms are locked up, but also the method of gathering. If a book is to be side-wire bound, the folded sections are placed one upon the other in sequence; if, however, the book is to be saddle-wire bound, the sections are inserted one within the other in consecutive order. When this second type is completed, the outside section will contain the first and last pages of the book, and the center section will contain the pages which come numerically together.

Assignment
Sheet No. 19

Covering
Units 158-164

PRINTING PLATES

An ancient Chinese proverb states, "One picture is worth a thousand words." The wide circulation of weekly magazines, which present news coverage in pictures, provides much basis for the assumption that one picture conveys a message it would be extremely difficult to duplicate with only a thousand words.

The widespread use of pictures to supplement news stories and advertising has made it necessary for the worker in the small print shop to be familiar with the various plate types used in the production of printed illustrations. In larger plants, where these plates are produced, it is necessary that the processes used to manufacture these plates be known and understood.

The increasing use and popularity of illustrations in conjunction with printed material and the expected continuation of this trend, makes necessary the study of this essential part of the printing industry.

In this assignment you will learn the different types of plates, the principles involved in producing each type, and the special adaptabilities of each.

Assignment:

1. Read the references listed below.
2. Locate and identify ten types of plate illustrations.
3. Answer the questions, turn in this assignment and the identified illustrations by ____________________ .

References:

A. Cleeton and Pitkin, *General Printing*, pp. xv-12 92-93, 162-168.
B. Karch, *Graphic Arts Procedures*, pp. 1-9, 208-240, 246-251, Colophon.
C. Polk, *The Practice of Printing*, pp. 272-316.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. It may be expected in the near future that offset printing may supercede letter-press printing.

T F 2. The dots in a highlight area of a halftone are very small, surrounded with large areas of white.

T F 3. The range of highlights, middle tones and deep shadows on a halftone photoengraving is achieved by cross-hatching and varying the widths of the lines.

T F 4. Fine-screen halftones may be offset printed on soft antique papers.

T F 5. An engraver can produce solid black areas on a halftone plate.

T F 6. Coarse screens are needed for plates which are to print on rough papers.

T F 7. Wood cuts were the original means of producing book illustrations.

T F 8. Intaglio engraved copper plates have only been in use since 1850.

T F 9. Colored illustrations were not successfully produced prior to 1892.

T F 10. Halftone plates print from relief surfaces.

T F 11. The original lithographic process made use of a porous stone upon which designs were drawn in reverse.

T F 12. The white areas in a gravure illustration are produced by the paper itself.

T F 13. Gravure plates print from ink which is carried in wells in the plate.

T F 14. Offset plates register with the paper sheets being printed as do letterpress plates.

T F 15. Offset printing eliminates the need of performing make-ready

T F 16. A genuine engraving may be distinguished from an imitation engraving by the indention in the back of the former.

T F 17. Plates for line engraving are etched with "dragon's blood."

T F 18. Coarse screen halftones are made with screens having 50 to 100 lines per inch.

T F 19. A halftone plate is prepared from a photograph made through a fine silk screen.

T F 20. The Ben Day Process is a mechanical method for producing a shaded effect on line plates after they are etched.

T F 21. Odd shaped photoengravings are less expensive than regular shapes.

T F 23. For process color printing, opaque inks are used.

T F 24. Wax electrotype molds are sprayed with graphite to make them electrical conductors.

T F 25. In the production of electrotypes, the positive power source is attached to the mold.

T F 26. Nickeltypes wear longer than copper electrotypes.

T F 27. Stereotype plates are cast from paper matrices.

T F 28. National advertisers usually ship stereotypes rather than stereotype matrices to newspapers.

T F 29. The foremost advantage of plastic duplicating plates is their lightness in weight.

T F 30. Aniline dyes do not attack rubber duplicating plates.

T F 31. Acetate proofs are dusted with powder to prevent their sticking together during shipment.

T F 32. Offset lithographers prefer deep-etch plates to albumen plates because of the longer life and sharper detail they give.

T F 33. Both ink and moisture are used on offset presses.

T F 34. Dots of gravure plates and cylinders prepared by the Dultgen process vary in size and depth.

T F 35. Prior to etching, the hardened gelatin on gravure plates is thickest on highlight areas.

T F 36. Zinc etchings are also commonly known as line engravings.

T F 37. Usually, finished plates are somewhat smaller than original copies.

T F 38. Reducing or enlarging a copy will alter the proportion of height to width.

T F 39. After electrotype shells have been backed with lead, they are shaved to a thickness of 11 points if they are to be used unmounted.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. Social custom demands the elegance of work produced from ______________ or ______________ plates.

2. The only printing process which gives a continuous printing tone without the use of a screen is ______________ or ______________.

3. The colors of the plates used in process color printing requires the use of ______________, ______________, ______________, and ______________ colored plates.

4. The most used processes for duplicating printing plates are ______________ and ______________.

5. Stereotypes are produced type high or in ______________ ______________.

6. The proofs of type made for offset printing are called ______________ ______________.

7. The offset-lithographic press prints from a ______________ surface, whereas a letter press prints from a ______________ surface.

8. Offset presses operate on the principle that ______________ and ______________ do not mix.

9. An illustration in which the gray tone fades into white at the edges is called a (an) ______________.

10. The term used to include all types of printing from flat surfaces is ______________.

Sequence

Directions: The list which follows contains significant developments in the history of printing plates. Show the sequence of these developments as indicated in your references by placing the appropriate numbers in the blanks at the left.

1. Events in the history of printing plates.

____ A. Engraving on metal by means of photography
____ B. Development of photoengraving sensitizing method
____ C. Wooden blocks cut with the grain
____ D. Application of color printing to halftone process
____ E. Hand engraving of copper plates
____ F. Discovery of screen principle

Matching

Directions: In the right column are descriptive words and phrases and in the left various words. Match the letters of the items on the right with the word(s) on the left by placing the proper letter in each blank on the left.

1. Certain events and discoveries related to plates for printing.

____ 1. Senefelder

____ 2. 1894

____ 3. Imitation copperplate engraving

____ 4. 1892

____ 5. Steel plates

A. Successful color process

B. Rotogravure

C. Maso Finiguerra

D. U. S. Bureau of Engraving and Printing

E. Photoengraving commercially profitable

F. Slow-drying ink, resinous powder, and heat

G. Writing on stone

Assignment
Sheet No. 20

Covering
Units 165-166

TYPECASTING MACHINES

Not too long ago, a controversy existed among compositors regarding the question of Machine vs. Man in the accomplishment of work in the composing room. Many old printers, upon the advent of the linecasting machine around the turn of this century, raided large newspaper plants and destroyed machines that were to produce six times the daily amount of composition that a man could produce. Yet, today, the linecasting machine has embedded itself into the compositor's world, and contrary to his original thoughts, has made composition less expensive and more plentiful -- hence more in demand, and in turn demanding more compositors to arrange and display it to the public.

Certain machines, in their infancy today, will revive the old question again. One of these is the teletype attachment for the linecasting machine which operates the machine by tape, eliminating the need for an operator. Another, is a machine to produce cuts (newspaper photos) for the trade whereby electrically heated needles drill dots into plastic plates and thus eliminate photo engravers.

A careful survey of modern compositors will indicate to you that the linecasting and lettercasting machines are regarded as necessary to their world. Very few would desire to return to the old hand-set straight-matter days. Because these machines are a part of his world, the compositor finds it necessary to learn their basic operations; therefore, the principles involved must be understood by the craftsmen for daily production of quality work.

In this unit the principles of operating linecasting machines will be studied. This will provide you with background information, an appreciation of the machine, and the introduction of its product into your work.

Assignment:

1. Read the references listed below.
2. Observe the operation of the linecasting machine where you work, noticing particularly the operation principles outlined in the references.
3. Answer the questions below and turn in this assignment by ____________________ .

References:

A. Cleeton and Pitkin, General Printing, pp. 153-158.
B. Karch, Graphic Arts Procedures, pp. 151-173.
C. Polk, The Practice of Printing, pp. 141-147.
D. Mergenthaler Linotype Company, Linotype Machine Principles, pp. 3-37.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. Typecasting machines were first introduced by William A. Reade in 1862.

T F 2. The first typesetting machine was designed in 1822.

T F 3. Perforations on a paper ribbon cause a complete font of Monotype matrices to move over a mold.

T F 4. The Linotype system requires two machines, one for composin and one for casting.

T F 5. It was not until composing preceded casting that a satisfactory typesetting machine was developed.

T F 6. Typecasting metal is composed of lead, tin, and silver.

T F 7. Linotype machines cast lines of type whereas Intertype machines cast individual letters of display type.

T F 8. A Linotype matrix is a small piece of brass having one or two characters cut into one edge.

T F 9. A magazine is the storage compartment for matrices while they are not being used.

T F 10. Most Linotype matrices will cast two type faces.

T F 11. The spacing between words on Linotype slugs are equal.

T F 12. A row of composed matrices and spacebands form the mold for a Linotype slug.

T F 13. The galley of a Linotype machine holds the cast and trimmed slugs.

T F 14. Each Linotype matrix must have the same combination distributor of teeth to be carried along the distributor bar.

T F 15. The quadder enables the Linotype operator to cast a line flush right, flush left, or indented equally at each end.

T F 16. Linotype and Intertype machines are identified by model designations consisting of various letters or number combinations.

T F 17. The Monotype keyboard produces a paper strip into which holes are punched by compressed air.

T F 18. The Monotype, like the Linotype, contains the keyboard and casting mechanism in one machine.

T F 19. The Monotype composition caster casts single letters.

T F 20. Ludlow Typograph matrices are hand set in a stick.

T F 21. Most of the type used in present day printing is set by composing machines.

T F 22. Spacebands provide the space between words on the Linotype slugs.

T F 23. Cast slugs are apt to become mixed and individual matrices are likely to become pied in a linecasting machine.

T F 24. When the cast slug is delivered to the Linotype galley, it is ready for use.

T F 25. The magazine of a linecasting machine serves the same purpose as the type case used in hand composition.

T F 26. The printer who owns a Linotype machine is his own type founder.

T F 27. The Linotype machine is a typesetting machine.

T F 28. Spacebands are wedge-shaped pieces of metal tapered in opposite directions.

T F 29. The assembling elevator is the "composing stick" of the Linotype machine.

T F 30. Because of the complex system of levers and links, a very firm pressure is required on Linotype keys to release a spaceband or matrix.

T F 31. The average Linotype operator is able to release one hundred-fifty matrices per minute.

T F 32. Depressing any two adjacent keys on a Linotype keyboard will release a spaceband.

T F 33. Mold disks normally have accommodations for six molds, but disks accommodating four molds can be secured for special needs.

T F 34. All matrices must be replaced by hand.

T F 35. Conveyor screws automatically stop if a matrix becomes jammed on the distributor bar of the Linotype.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. The Monotype composition caster is actuated by a ______________ ______________ .

2. The Monotype system uses two types of matrices, ______________ matrices and ______________ matrices.

3. Each Monotype matrix case can cast ______________ type faces.

4. The Monotype system of composition produces ______________ ______________

5. The purpose of the Ludlow Supersurfacer is to produce a ______________ ______________ for printing.

Matching

Directions: In the right column are descriptive words and phrases, and in the left, various words. Match the letters of the items on the right with the word(s) on the left by placing the proper letter in each blank on the left.

____ 1. William Reade

____ 2. Intertype

____ 3. Teletypesetter

____ 4. Overhang slug composition

____ 5. Ludlow Typograph

____ 6. Justification bar

____ 7. Back knife

____ 8. Automatic font distinguisher

____ 9. Conveyor screws

____ 10. Seldom used characters

A. Prevents mixing of two sizes of matrices

B. Trims bottom of slug to type height

C. Matrix slide box

D. Activates spacebars to expand line full width of measure

E. Utilizes Linotype principle

F. Ride entire length of distributor bar

G. Spaceband box

H. Moves matrices along distributor bar

I. Advertising composition

J. Trims back of slug to type height

K. Perforation of casting machine types by electrical impulses

L. Hand distributed matrices

M. Developed Ludlow Typograph

Listing

Directions: List the items called for in each of the following statements. Select your answer carefully.

. The four major divisions of the Linotype are:

(A) ____________________ (C) ____________________

(B) ____________________ (D) ____________________

2. The advantages which recessed slugs have over solid slugs are:

(A) ____

(B) ____

(C) ____

Sequence

Directions: The lists which follow are the steps involved in performing certain jobs. Indicate the order recommended in your references by placing the proper numbers in the blanks at the left.

1. The course of Linotype matrices from the magazine, through the mechanism and back to the magazine.

____ A. Matrices assembled on assembling elevator

____ B. Matrices lifted by elevator to distributor box

____ C. Matrices drop into proper slot in magazine

____ D. Operator depresses keys on keyboard

____ E. Matrices fed to distributor screws

____ F. Matrices fall from magazine

____ G. Spacebands are separated from the matrices

____ H. Matrices go to casting mechanism

____ I. Matrices carried by conveyor belt

____ J. Slug is cast and matrices travel to point above casting machanism.

Assignment
Sheet No. 21

Covering
Units 172-197

LINOTYPE MATRIX MECHANISMS

During the training period of every ambitious learner in the printing industry, the time arrives when he is ready to learn to operate a linecasting machine.

If this learning opportunity is carelessly handled by the learner, another opportunity to operate the machine will be long postponed, if ever occurring again. A Linotype machine represents a sizable investment and is of extreme importance in keeping the presses of the printing establishment operating. The production of cast slugs, or the lack of them, may well determine the daily schedule of the press room and bindery. The selection of the proper magazine, its safe positioning, proper care of the machine, and correct keyboard operation must all be performed in an orderly manner with an economy of time.

In this unit, information has been selected which; if studied thoroughly, will provide the information needed to enable you to assemble the first line of matrices in the machine. In addition to learning this information, you will also learn of the various machine mechanisms which manipulate the matrices as they are made ready for the casting of the Linotype slug.

Assignment:

1. Read the references listed below and study the illustrations carefully.
2. Memorize the Linotype keyboard.
3. Arrange with your employer for time to operate a Linotype machine under the direction of an experienced operator.
4. Answer the questions below and turn in this assignment by ____________________.

References:

D. Mergenthaler Linotype Company, Linotype Machine Principles, pp. 38-132, 348-353.
E. Mergenthaler Linotype Company, Linotype Keyboard Operation, pp. 1-16, 29-33.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. A "pi" matrix will drop off the distributor bar and fall into a channel in the middle of the magazine.

T F 2. Spacebands must be cleaned a minimum of once during each eight hours of operation.

T F 3. Excessive amounts of oil on the matrices will create conditions causing the matrix side walls to be damaged.

T F 4. A good quality of oil should be placed on the distributor screws once every eight hours to prevent excessive wear on the matrix teeth.

T F 5. A firm pressure is required on the keybutton to release a matrix.

T F 6. The sequence of operations from the release of the matrix to the casting of the slug is activated by the touch of a keybutton.

T F 7. Keybuttons never contain more than one character.

T F 8. The first step in swinging the keyboard is to remove the keyboard roller driving belt.

T F 9. There are three ways to clean cams and yokes, but if there is no oil on the yokes, dry cleaning is best.

T F 10. The rubber keyboard cam rollers should be cleaned with alcohol.

T F 11. As a safeguard to prevent damage to the machine, the keyboard should be locked when not in use.

T F 12. A gummy residue on the sides of key levers may cause unwanted "doublets" to be deposited on the assembling elevator.

T F 13. Magazine channels are all the same width, and .010" wider than the matrices which slide in them.

T F 14. There are two general types of magazines which are of equal size, but vary in general construction.

T F 15. The magazine channels are wider at the back than at the front.

T F 16. The "Model 20" magazine is a 90-channel magazine.

T F 17. The 90-channel magazine contains 91 channels.

T F 18. Main magazines contain two channels for the lower case "e," and the matrices may be released from either channel independently of the other or alternately from both.

T F 19. Main magazines are of three length: full length, three-quarter length, and one-half length.

T F 20. A "split" magazine contains either the right or left half of a main magazine.

T F 21. When the open end of the multiple key rod shifter handle reveals the symbol "e-e," lower case "e" matrices are released alternately from each "e" channel of the magazine.

T F 22. Linotypes which are not equipped with auxiliary magazines will not be equipped with bail boxes.

T F 23. Graphite should be used instead of oil for lubricating the magazine channels.

T F 24. New magazines require more cleaning attention than magazines which have been used for a considerable length of time.

T F 25. An excessive amount of oil in the magazine is preferable to no oil at all.

T F 26. If a matrix clogs the star wheel in the assembler block, the matrix will be either bent or broken.

T F 27. The chute finger at the entrance of the assembler block holds the matrix close to the assembler rails and causes the matrix to strike the star wheel at the proper angle.

T F 28. The "regular" spaceband is identified by a single line on the lower front edge.

T F 29. The kinds of spacebands may be distinguished by the lines which appear on the lower front edge of the spaceband.

T F 30. The matrix releasing mechanism has more lost motion in its linkage than the spaceband releasing mechanism.

T F 31. The delivery slide receives a line of assembled matrices from the assembling elevator between a short fixed finger on its right and long movable finger on the left.

T F 32. From the assembling elevator to the first elevator jaw, the line of assembled matrices travels about nine inches.

T F 33. The first elevator jaw consists of a front jaw, a back jaw, and a separating block.

T F 34. All of the five different movements of the first elevator are controlled solely by the shape of the first elevator slide cam.

T F 35. The trimming knives are cleaned by a brass wiper called a "flag."

T F 36. Theoretically squirts can occur, but in actual practice they do not.

T F 37. The process of second justification causes the spacebands to again be pushed upward, thereby forcing the spacebands and matrices to be wedged tightly between the vice jaws.

T F 38. Accuracy and good spacing are the basic considerations in keyboard operation.

T F 39. A swift operator is always the most desirable type of operator.

T F 40. Speed at the keyboard can only be secured by a combination of practice plus experience.

T F 41. The keyboard layout of the capital alphabet is the same as the arrangement of the lower case alphabet.

T F 42. The third finger of the left hand is used to strike the spaceband key.

T F 43. When fingering the keyboard, the striking motion should be made from the wrist.

T F 44. When double letters are necessary in a word, these may correctly be secured by holding down the particular key-button.

T F 45. A slow, even operating speed is better than speedy, jerky movements when fingering the keyboard.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. The "Model 5" magazine was first used on the ____________ Linotype and is a ________ channel magazine.

2. Auxiliary or side magazines are also called ____________ or ____________ magazines, which are ____________ in shape, having matrix channels ____________ to each other.

3. When a single lower case "e" shows at the open end of the multiple key rod shifter lever handle, lower case "e" matrices are released from the ____________ "e" channel only.

4. The bail box permits the regular keyboard to operate ____________ ____________.

5. Linotype operation requires the trained coordination of the eyes, ____________, ____________, and ____________ .

6. The first essential for Linotype operation is familiarity with the ____________ .

7. Shop production of slugs is in terms of ____________ ____________ .

8. When studying the keyboard, only one ____________ should be attempted at a time, studying the buttoms first ____________ and then ____________ .

9. Of the fingers of the right hand, the ______________ finger strikes the largest number of lower case keys.

10. Variable fingering of certain words will result in faster and smoother keyboard fingering only when a speed of ______________ ______________ per hour has been attained.

Matching

Directions: In the right column are descriptive words and phrases and in the left various words. Match the letters of the items on the right with the words on the left by placing the proper letter in each blank on the left.

____ 1. Extra thick spaceband

____ 2. Wide range spaceband

____ 3. Thick spaceband

____ 4. Extra thin spaceband

____ 5. Roman position

____ 6. Italic position

____ 7. Squirt

____ 8. Linotype

____ 9. Hang the elevator

____ 10. Black keys

A. Five lines

B. Auxiliary position

C. Upper case matrices

D. Two lines

E. Regular position

F. Figures and miscellaneous marks

G. First elevator

H. Three lines

I. Not tolerated in first-class shops

J. Regular spaceband

K. Tool for more rapid assembling of line of type

L. Disagreement of theory and practice

M. Keyboard locking plate

N. Lower case matrices

Sequence

Directions: The list which follows contains the steps involved in performing a certain job. Indicate the order recommended in your references by placing the proper numbers in the blanks at the left.

1. The course of the matrices prior to the casting of the slug.

____ A. Matrices taken by first elevator jaw for alignment and justification

____ B. Matrices are forced onto assembler slides

____ C. Matrices pass through assembler block

____ D. Assembling elevator carries the matrices vertically about 5".

____ E. Matrices move horizontally about nine inches through the delivery channel

Assignment
Sheet No. 22

Covering
Units 198-230

LINOTYPE CASTING MECHANISM

The casting mechanism is potentially the most dangerous part of the Linotype. It is in this mechanism that molten type metal is released by the operator. If this molten metal is properly channeled by a well-adjusted machine, the metal is an obedient servant; however, if the machine is permitted to remain out of adjustment, and is carelessly used, the molten metal will not only clog the casting mechanism, but will also place the operator in danger of serious injury.

Casting is a continuous operation and it is necessary that proper care be given the casting mechanism. Linotype operators so frequently shift mold positions and adjust slug widths that the practice becomes automatic and an auditory alertness must be developed to check the casting operations at all times. While the operator is reading the copy and fingering the keyboard, this auditory alertness must enable the operator to know by the sound whether the operations of the casting mechanism, casting, trimming, and ejecting are taking place properly.

In this unit information is presented which will enable you to gain a complete picture of the casting operation. The information secured here will advance you in the development of a keen auditory perception necessary for the continuous checking of the casting operations.

<u>Assignment</u>:

1. Read the reference listed below.
2. Observe a Linotype operator cleaning the mold disk.
3. Observe a Linotype operator removing and replacing liners for casting different slug lengths and body sizes.
4. Secure permission from your employer to remove and replace mold liners <u>under the direction of the operator</u>.
5. Answer the questions which follow and turn in your paper by ______________________.

<u>Reference</u>:

D. Mergenthaler Linotype Company, <u>Linotype Machine Principles</u>, pp. 133-149, 152-173, 206-231.

<u>Questions</u>:

<u>True-False</u>

<u>Directions</u>: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. It is possible to set up a regular mold disk to cast four different sizes of slugs without further adjustment.

T F 2. The universal adjustable mold may be adjusted in terms of both picas and points.

T F 3. The liners are held firmly in place by mold cap screws and keys on the bottom of the liners.

T F 4. When the length of a line is to be changed, only one liner must be changed.

T F 5. When large body sizes are cast, the universal adjustable mold will produce more perfect slugs than the recessed mold.

T F 6. Mold liners may be secured for bodies from 5 to 18 points in thickness and from 4 to 30 picas by picas in length.

T F 7. The left liner for a recessed mold is interchangeable and may be used in any other type mold.

T F 8. Liners may be removed by placing a screwdriver in the mold slot and freeing the liner by prying.

T F 9. The mold cap of a recessed mold carries projections which form cavities in the recessed slug.

T F 10. The weight of a recessed slug is about two-thirds that of a solid slug of the same dimensions.

T F 11. A screwdriver is the only tool necessary to change mold liners.

T F 12. The back mold wiper has little effect upon the prevention of back squirts.

T F 13. The back knife must be kept razor sharp.

T F 14. While the mold disk is making the three-quarter revolution between casting and ejection, the back knife trims the slug to type height.

T F 15. The molds for a four mold disk and those for a six mold disk can be distinguished only by part numbers.

T F 16. The mold disk is properly timed so long as any timing mark on the mold disk matches any mark on the pinion.

T F 17. Vents in the pot mouthpiece are for the purpose of allowing metal to form the base of the slug.

T F 18. The gas governor is based upon the principle of the equal expansion of two pieces of metal when heated.

T F 19. If a gas burner is used to heat the type metal, the air mixing valve should be adjusted until the flame is blue with a yellow tip.

T F 20. Gas governors for natural gas cannot be used on artificial gas line; however, an artificial gas governor may be used on natural gas lines.

T F 21. All the fittings and materials used in the electric pot heaters conform to the requirements of the National Electrical Code.

T F 22. The Linotype electric pot heater has not been approved by the National Board of Fire Underwriters.

T F 23. Electrically heated pots have four heaters -- two crucible heaters within the pot, one at the mouth, and one on the throat of the pot.

T F 24. The envelope heaters are sealed by autogenous welding.

T F 25. Throat and mouth heaters designed for 110 volt circuits cannot be used on a 220 volt circuit.

T F 26. Crucible heaters are connected in parallel for 110 volt circuits and in series for 220 volt circuits.

T F 27. The expansion element of the mechanical thermostat must be free to expand in all directions.

T F 28. The pot control panel is located to the right and slightly to the rear of the keyboard.

T F 29. When fuses in the control panel blow, they should be replaced by fuses with higher amperage ratings.

T F 30. When using a bank of lamps as an emergency resistance coil for the pot circuit, only lamps bearing the trademark "NOMA" should be used.

T F 31. After long periods of use, mouthpiece holes should be reamed to remove accumulated metal, dross, or burrs.

T F 32. Mouthpiece vents may be scraped to remove accumulated metal or dross.

T F 33. If a "back squirt" occurs, the first thing to check is the lockup of the pot mouthpiece against the mold.

T F 34. The Micro-Therm controls may be damaged in the temperature of the mouthpiece exceeds 525 degrees Fahrenheit.

T F 35. Best casting results are secured when the temperature of the type metal is between 575 degrees Fahrenheit and 600 degrees Fahrenheit.

T F 36. Ejector blades may be arranged to eject any size slug the machine will cast.

T F 37. The ejector serves two functions: it pushes the cast slug from the mold, and it also forces the slug between knives which trim the slug to accurate point thickness.

T F 38. The slug has completely cleared the mold before the trimming is begun.

T F 39. The right knife shaves the ribs of the slug to make the slug the proper thickness.

T F 40. The left knife removes "fins" or overhang from the smoot side of the slug.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. The back of the molds are kept clean by the ______________ ______________ ______________.

2. The mold disk and pinion gear are aligned by means of the ______________.

3. Two devices that have been used to control the heating of electric pots are the ______________ ______________ and the ______________ ______________.

4. When a magnet switch resistance coil has burned out on a 115 volt, 60 cycle alternating current line, an emergency 40 ohm resistance may be produced by substituting ________ 150 watt lamps wired in ______________.

5. Molten metal splashing over the back of the mold disc is called a ______________ ______________

6. The best casting results are secured when the temperature of the type metal is between ________ and ________ degrees Fahrenheit.

7. Slugs are pushed from the mold by the ______________ ______________.

8. If the trimming blades are dull but not nicked, they may be dressed with a ______________ ______________ and a (an) ______________ which has been moistened with ______________.

9. Early Linotype machines used the ______________ galley.

10. If a metal deposit forms under the slug buffer and interferes with the slugs as they slide onto the galley, the difficulty can be remedied by rubbing the deposit with a ______________ on which ______________ has been placed.

Matching

Directions: In the right column are descriptive words and phrases and in the left various words. Match the letters of the items on the right with the word(s) on the left by placing the proper letter in each blank on the left.

____ 1. Recessed mold

____ 2. Body size of line changed

____ 3. Type high

____ 4. Length of line changed

____ 5. Back squirt

____ 6. Ejector

____ 7. Slugs 4-points thick

____ 8. Right-hand knife

____ 9. Reversible galley

____ 10. Short measure slugs

A. Back knife

B. Right and left liners changed

C. Secondary stop strip

D. Body size of slug

E. Vertical galley

F. Left liner replaced

G. Forces slug between trimming knives

H. Water circulation

I. Uncontrolled molten metal

J. English and Hebrew composition

K. .040" ejector blades

L. Cavities or recesses in slug

Assignment
Sheet No. 23

Covering
Units 231-238

LINOTYPE DISTRIBUTION MECHANISMS

Having previously studied how the matrices are assembled and how the slugs are cast and ejected onto the galley, you are now ready to study the final movements of the matrices as they travel through the various mechanisms which carry them back to the magazine for storage until needed.

This final part of the matrices' cycle is referred to as "distribution" in that it includes not only the return of the matrices to the magazine, but also the return of the spacebands to the spaceband box. In this respect, the distribution function of the Linotype is quite similar to the distributing of type and spacing material by the hand compositor.

In this unit you will further develop your understanding of the Linotype by learning the function and operating principles relative to the distribution of matrices and spacebands after the slugs are cast.

Assignment:

1. Read the reference listed below.
2. While a Linotype is in operation, observe closely several groups of matrices and spacebands as they move from the mold disk to their proper storage places.
3. Answer the questions below and turn in this assignment by ______________ __________ .

Reference:

D. Mergenthaler Linotype Company, Linotype Machine Principles, pp. 232-275.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. Distribution includes all those mechanisms which return spacebands and matrices from the first elevator jaw back to the magazines from which they came.

T F 2. The teeth of pi matrices are used during the casting operation.

T F 3. The second elevator conveys the matrices and spacebands to the distribution box.

T F 4. The distributor shifter pushes the matrices from the second elevator bar into the distributor box.

T F 5. The sole function of the distributor box is to lift the matrices onto the distributor screws.

T F 6. A primary distributor box is found on all single distributor Linotypes.

T F 7. The function of the upper distributor box is to separate matrices and spacebands.

T F 8. Before being distributed, all matrices pass through the distributor box.

T F 9. Matrices and spacebands are pushed along the distributor box rails and lifted by the matrix lift into the distributor screws.

T F 10. The clutch of the distributor screw driving mechanism is disengaged by the retardation of the back distributor screw.

T F 11. A single distributor Linotype may be described as having only one distributor screw.

T F 12. A "Two-in-One" model Linotype will distribute matrices to 90-channel and 72-channel magazines simultaneously

T F 13. The Linotype designated as a "Two-in-One" mixing machine carries six distributor screws and two distributor bars.

T F 14. Spiral automatics magnify any drag on the lower distributor screw to such proportions that the distributor clutch disengages.

T F 15. The primary purpose of the spiral automatics is to lock the front distributor screws.

T F 16. The spiral automatics consist of an application of two sections of coarse pitch V-screw threads.

T F 17. The distributor bar contains seven levels of combination rails.

T F 18. The brass plate at the back of the distributor bar is designed to keep excess dust from falling into the channel entrance.

T F 19. Kerosene will generally clean gummy distributor screw bearings.

T F 20. The clutch of the distributor screw driving mechanism is referred to as "the spiral automatic."

T F 21. Once the obstruction in the distributor has been cleared, the distributor clutch will automatically remesh and start the distributor screws.

T F 22. To start the distributor after it has been locked by the spiral automatics, one need only to grasp the starting lever flange and turn it slightly backward.

T F 23. The spiral automatics are unlocked by turning the starting flange lever backward slightly.

T F 24. The rails of the distributor bar provide for 127 different combinations of matrix teeth.

T F 25. On the distributor bar for a 90-channel main magazine, the "l" matrix will travel a greater distrance than the "f" matrix.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. Spacebands are not lifted to the level of the distributor box, because they lack a ______________ ______________ .
2. The matrix teeth are first used during the movement into the ______________ ______________ where they engage the ______________ ______________ ______________ .
3. Matrices are pushed from the ______________ ______________ ______________ into the distributor box by the ______________ ______________ .
4. In order to engage the clutch after clearing the spiral automatic the starting flange lever must be ______________ ______________ to mesh the ______________ ______________ ______________ .
5. The type of matrix which has none of its teeth removed is called a (an) ______________ ______________ .

Sequence

Directions: The list which follows is the steps involved in performing certain jobs. Indicate the order recommended in your references by placing the proper number in the blanks at the left.

1. Trace the path of a single matrix as it approaches a main magazine.

____ A. Conveyed to level of distributor box

____ B. Moves into distributor box

____ C. Carried onto railed bar

____ D. Rises to level of transfer channel

____ E. Moved by distributor shifter

____ F. Lifted by matrix lift

____ G. Pushed onto second elevator bar

Matching

Directions: In the right column are descriptive words and phrases and in the left various words. Match the letters of the items on the right with the words on the left by placing the proper letter in each blank on the left.

____ 1. Transfer mechanism

____ 2. Second elevator bar

____ 3. Second elevator

____ 4. Distributor shifter

____ 5. Distributor box

____ 6. Font distinguisher

____ 7. "Two-in-One" model

____ 8. Starting lever flange

____ 9. Teeth

____ 10. Pi matrix

A. Receives matrices in transfer channel

B. Matched full projections inside V notch of matrix

C. Transports matrices from intermediate channel to level of distribution box.

D. Matched projections on front and back of distributor bar.

E. Pushes matrices into distributor box

F. Two sets of distributor screws and two distributor bars

G. Carries matrices and spacebands to and from casting

H. Removes matrices and spacebands from vise jaw, places spacebands in spaceband box and matrices in distributor box

I. Matched full or partial projections inside V notch of matrix

J. Guides matrices and lifts them into distributor screws

K. Pulled out to mesh clutch stop blocks

L. Carries matrices and spacebands to first elevator

M. Stops turned matrices or wrong font matrices.

Assignment
Sheet No. 24

Covering
Units 239-267

PROBLEMS IN LINOTYPE OPERATION

The Linotype machine will present operational problems due in part to the manner in which the operator uses the machine, and in part to the wear which is normal for a machine in daily use.

The Linotype operator in a smaller printing establishment is expected to develop a technical background which will enable him to make minor adjustments and otherwise get his machine back into production. Usually production stoppages are due to type metal deposits, dirt, gum, or improper lubrication. The operator who is capable of caring for the maintenance and repair requirements of his machine is designated as an "operator machinist." Large printing establishments which require the use of many Linotypes employ a Linotype machinist for every five machines. His sole responsibility is to adjust and place new parts on the machines in his care.

In this unit the points where work stoppages most frequently occur are considered. By studying the reference material, you will learn the technical information necessary to enable you to correct minor mechanical difficulties as they occur.

Assignment:

1. Read the reference listed below.
2. Observe the Linotype operator as he corrects machine difficulties from time to time.
3. Ask for the extra duties of cleaning spacebands, matrices, and general oiling and care of the machine.
4. Answer the questions and turn in your paper by ______________________________.

Reference:

D. Mergenthaler Linotype Company, Linotype Machine Principles, pp. 34-35, 43-46, 53-56, 75-78, 81-84, 87-89, 119-122, 163-196, 206-212, 216-218, 246-249, 260-263, 267-268, 382-386, 410-435.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. Several styles of racks are available for the storage of full-length magazines, but as yet no racks are available for split or auxiliary magazines.

T F 2. The magazines rest upon the keybuttons when being changed.

T F 3. Matrix sidewalls may be crushed as a result of excessive oil on the back mold wiper.

T F 4. "Hair lines" are common when new matrices are first used.

T F 5. Spacebands in constant use should be cleaned once each week.

T F 6. Metal which does not readily rub from spacebands may be removed by scraping with a piece of brass.

T F 7. The matrix holder and buffer provide a quick means of polishing a font of matrices.

T F 8. Misalignment of the first elevator jaw and second elevator will cause excessive wear on matrix teeth.

T F 9. The magazines on the three-magazine-model Linotype must be brought to the operating position before they can be removed

T F 10. To remove the middle magazine of a three-magazine-model Linotype, the upper magazine must be removed.

T F 11. When the machine or the matrices are new, the magazines must be cleaned frequently to remove oil and grit.

T F 12. Oil in the magazine may be washed out with alcohol.

T F 13. A pencil rubbed over the escapement verge at the point where it contacts the escapement plunger will provide adequate lubrication if the parts are not worn excessively.

T F 14. Star wheels are excessively expensive and should be replaced only when adjustments fail to prevent "oversetting."

T F 15. The oil hole for the star wheel shaft can be reached when the assembling elevator is raised.

T F 16. A long strip of metal formed between the duplex rail and the matrix adjusting bar as a result of a squirt can be driven out with a piece of brass or a six-point Linotype slug.

T F 17. Clutch leathers should be gritty in order that they may have increased friction on the clutch faces.

T F 18. Electric crucible heaters for 110 volt A.C. circuits can also be used on 220 volt A.C. circuits.

T F 19. When electrical fuses burn out, they should be replaced with a fuse of exactly the same rating.

T F 20. A strip of smooth cardboard may be used to clean the metal contact surfaces of a magnetic switch.

T F 21. When scraping mouthpiece vents to remove dross, the vents should be scraped toward the bottom of the mouthpiece.

T F 22. The lockup of the mouthpiece against the mold is the first thing to check when a back squirt occurs.

T F 23. A ring of dross in the well will prevent the pot pump plunger from making a full stroke.

T F 24. One cause of back squirts is using type metal which is not at the proper temperature.

T F 25. The back distributor screw may be opened in order to locate distribution difficulties.

T F 26. The distributor beam may be adjusted vertically as well as horizontally.

T F 27. The distributor is started after being cleared of matrices by revolving the spiral automatics by hand.

T F 28. The matrix delivery belt is kept tight by adjusting the idler pulley.

T F 29. The release of all matrices in a particular magazine channel will usually indicate a broken keyboard cam stop pin.

T F 30. Hair lines are caused by metal accumulations on the spaceband sleeves.

T F 31. If the pot mouthpiece rests against the mold for an excessive length of time, the mold may warp or have the temper drawn from it.

T F 32. Mold wipers are lubricated with oil.

T F 33. If the pot well is worn oversize, the entire metal pot assembly must always be replaced.

T F 34. The plunger should be cleaned daily while the machine is new, but as the machine becomes broken in and the plunger fits more loosely in the well, daily cleaning becomes more detrimental than beneficial.

T F 35. If slugs do not eject properly due to the trimming knives being set to a smaller size than the body of the slug cast, the slug must be forced through the knife block before trimming knives can be adjusted.

T F 36. Burrs on the magazine channel may be removed with a fine file.

T F 37. When the matrices and magazine are cleaned, the channel entrance should also be polished.

T F 38. If matrices stick in the magazine channels, the channels may be lubricated with graphite.

T F 39. When placing a magazine on the machine frame, it must be moved into place without excessive jarring or slamming.

T F 40. Inexpensive vegetable oils are as satisfactory for Linotype lubrication as expensive machine oils.

Matching

Directions: In the right column are descriptive words and phrases and in the left various words. Match the letters of the items on the right with the words on the left by placing the proper letter in each blank on the left.

_____ 1. Star wheels

_____ 2. Three-cornered file

_____ 3. Hollow slug

_____ 4. Short distributor box bar point

_____ 5. Back and front distributor gears

_____ 6. Heavy mark off-center

_____ 7. Start distributor

_____ 8. Distributor box lift

_____ 9. Locking bar

_____ 10. Linotype X-24

A. Opens safety latch when magazines are raised from escapement

B. S. A. E. 20

C. Raises matrices into distributor screws

D. Turn knurled flange backward, then pulled outward

E. Turn knurled flange forward, then pull outward

F. Used on machines with 90-channel magazines

G. Meshed by means of locating pin and cut-out portion

H. Method of aligning spiral automatics to maintain timing when being reassembled.

I. Used on machines with 90-channel magazines

J. Cause of failure of slug to eject

K. Can be ground to ream holes in pot mouthpiece

L. Inexpensive and should be replaced rather than adjust assembler slide stop screw

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. Before any magazine can be changed, the magazine must be in its ____________ ____________ .

2. If oil should get into the magazine channels, the channels should be cleaned with a brush and ____________ .

3. If distributor screws do not turn due to gummy bearings, the gum may be cut by the use of ____________ .

4. Spacebands should be cleaned with graphite once during each _______________ _______________ period of operation.

5. The misalignment of the pot mouthpiece and the mold will cause _______________ _______________ .

6. When removed from the machines, the magazines should be placed in a _______________ position on special racks.

7. The partitions of the channel entrance must be in line with the _______________ of the _______________ .

8. A substitute equivalent in viscosity and quality to Linotype oil X-24 can be found in standard _______________ ________ motor oil.

9. The bearings of the assembling elevator lever shaft should be lubricated with Linotype approved lubricant No. ________ .

10. The second elevator guide (lower) should be lubricated with Linotype approved lubricant No. ________ .

Assignment
Sheet No. 25

Covering
Units 268-271

PRINTING: BUYING, SELLING AND PRODUCING

Printing opportunities exist for the young apprentice-compositor who has mastered the trade. True to American ideas of free enterprise, he may decide to "go out on his own" and establish and operate his shop.

The success or failure of such a business will depend upon your ability to price your work correctly. You must acquire the knowledge and skill necessary in estimating printing costs before advancing very far as an employee, or before going into business for yourself. If you price your work too high, you will not get the necessary business. Pricing it too low, you are doomed to failure.

In this unit you will have the opportunity to study information relative to establishing and operating a print shop. Review this material with care. Double check your answers by talking to experienced persons in your community.

Assignment:

1. Read the reference listed below.
2. Answer the questions which follow and turn in this assignment by ________________ .

References:

I. Information Sheet No. 3, "Price Policy and Estimating."

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. A press may run only 50 to 60 per cent of the time.

T F 2. Every job must help pay for maintenance and eventual replacement of equipment.

T F 3. Cost of paper should include the cost of spoilage and unused remnants.

T F 4. The cost of ink in a job does not include the cost of ink wasted in cleaning presses, or otherwise.

T F 5. Idle time of workers is not figured into the costs of an individual printing job.

T F 6. It is better to do something at any price than to do nothing at all.

T F 7. It is not necessary to provide for a profit on every job.

T F 8. The margin of profit on most jobs will be around 35 to 50 per cent.

T F 9. Making accurate estimates is a major problem for every printer, but it is one which all successful printers find themselves able to solve.

T F 10. Price cutting is a good basis to use for securing business.

T F 11. Low prices have a tendency to increase the number of print jobs.

T F 12. The lack of quality in your work, and promptness and reliability of service, cannot be offset by lower prices.

T F 13. Too much emphasis on low prices may mark you as a cheap printer and actually lose business for you.

T F 14. The chief reason a large number of new printing establishments fail each year is a lack of adequate equipment.

T F 15. The safest approach to meeting competitive prices is through careful use of the cost system.

T F 16. The cost system furnishes the facts about your business which make remedial action relatively simple.

T F 17. If your competitor can seriously undersell you on certain classes of printing, it would be better for you to drop this phase of work rather than to take a loss on the jobs.

T F 18. One satisfactory way to arrive at printing prices and meet competition is to learn your competitor's prices and cut yours slightly.

T F 19. The published schedules of average printing costs are of little value to most printers.

T F 20. In order to assure that every item is taken into account in a printing job, all estimates should be figured on an estimate sheet.

T F 21. The limitations on jobs that can be handled work a hardship on the small print shop owner.

T F 22. Labels, tags, and tickets cannot be produced economically in a small print shop.

T F 23. Printers who practice making estimates by the calculating method will find this sufficient.

T F 24. Experienced printers sometimes make gross errors with decimal places in figuring paper.

T F 25. It is never considered good business to send a customer to another printer.

T F 26. When you honestly indicate to a customer you are specialists in the type work about which he has inquired, this is a better approach than price.

T F 27. You are not apt to be successful at selling printing without knowing every phase of printing.

T F 28. Most printing jobs coming into the shop will have already been designed.

T F 29. Since the production manager in a print shop deals with jobs, men, and machines, little imagination and artistic talent is required to do his job successfully.

T F 30. The production manager has many details to check and coordinate for every printing job in the shop.

T F 31. Every job that comes in does not require a production check sheet.

T F 32. A daily calendar should be maintained for every press and every other production unit, man, or machine.

T F 33. A common mistake in printing shops is failure to provide enough spacing material, with constant loss of time by compositors.

T F 34. Completed jobs should be distributed as soon as possible rather than held for possible rerun.

T F 35. It is the responsibility of the production manager to plan the work of the men and machines so that both may produce profitably.

T F 36. Work should be planned so that at least one press is rolling all the time

T F 37. Even though there is work to do, it is sound business to operate printing presses at moderate speeds to conserve on wear.

T F 38. Sloppy proofs usually indicate sloppy printers.

T F 39. If possible, color work should be held until afternoon when other work is out of the way.

T F 40. Packaging work as soon as possible after it is completed often prevents its being soiled or damaged.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. The only sound price policy for a print shop is one based on charging ______________ plus ______________ ______________ on every job.

2. The real basis for estimating printing jobs in your shop is the ______________ ______________ .

3. You may analyze your costs against a schedule of printing ratios published periodically by the ______________ ______________ ________ ______________ .

4. Your calculated estimate of a printing job should be double checked by making a ______________ ______________ estimate.

5. One of the prime responsibilities of the printing salesman is to assist the buyer in ______________ the ______________ of printing which is best adapted to the purpose of his particular job.

6. It is the duty of the production manager to translate the customer's ______________ into an attractive, practical printed job.

7. A proof which makes a good impression on the customer will often forestall troublesome ______________ and ______________ .

8. Nothing creates a better impression than a ______________ ______________ tied, and labeled package.

Listing

Directions: List the items called for in each of the following statements. Select your answers carefully.

1. In figuring the labor cost of a printing job it is necessary to figure the time spent

   (A) ______________________ (C) ______________________

   (B) ______________________ (D) ______________________

2. Factors which affect the placing of printing orders and their order of importance are:

   (A) ______________________ (C) ______________________

   (B) ______________________ (D) ______________________

3. Three items suggested by the information sheet which may prohibit a shop from meeting competitive prices:

(A) ______________________________

(B) ______________________________

(C) ______________________________

4. Three general factors which can enable a printer to buy at an advantage are:

(A) ________________ (C) ________________

(B) ________________

Multiple-Choice

Directions: Listed with each of the incomplete sentences which follow are several responses, one of which will complete the statement and make it true. Indicate your choice by placing the appropriate letter in the blank on the left.

____ 1. The average small print shop owner prices his work (A) too low; (B) according to the customer's means; (C) too high; (D) slightly less than larger shops.

____ 2. A delivery receipt for 5000 copies of letterheads packed in ten packages of 500 each should be specified (A) Letterheads--5000 total; (B) Letterheads--10 pkgs.; (C) Letterheads--5000 total--10 pkgs.; (D) Letterheads--10pkgs.; 500 each.

Information
Sheet No. 3

PRICE POLICY AND ESTIMATING*

The success or failure of your business will depend upon your ability to price your work correctly. If you price your work too high, you will not get, or at least will not hold, your necessary business. Pricing it too low, you are doomed to failure.

Correct Pricing: For example, the labor cost of a job includes not merely the time spent on it directly, but also the time spent getting ready for it and cleaning up after it, distributing type, etc.; moreover the idle time of your workers must be paid out of the charges for work. The press may run only 50 to 60 per cent of the time, but the pressman must be paid for 100 per cent of his working day.

The cost of paper is not merely the cost of the paper in the completed job, but includes the cost of spoilage and unused remnants of quantities purchased. The cost of ink includes cost of ink wasted in cleaning presses, or otherwise. Good management will hold all waste down to a minimum.

Your equipment is constantly wearing out and becoming obsolete. Every job must help pay for its maintenance and eventual replacement. Type and spacing material must be constantly replenished and each job must pay its share toward this.

Unless you provide for a profit on every job you had better be working for someone else free from the risk of loss.

The small print shop owner is prone to price his work too low, particularly at times when work is hard to get. He usually reasons that anything is better than nothing.

The difficulty is that low prices seldom actually create much printing business. But generally, there is just so much printing to be done at any particular time. Lower pricing may divert work from one print shop to another, but it won't make two print jobs grow where one grew before.

Printing orders are generally placed on the basis of quality, service, price, and personalities; probably in that order of importance. It is necessary that you operate your shop efficiently enough that you can charge reasonable prices; but unless the quality of your work and the promptness and reliability of your service meet competitive standards, low prices are unlikely to attract business.

A little thought will indicate that price-cutting is not a very sound basis for securing business. The margin of profit in printing is narrow; 6 per cent on volume is considered excellent in the industry.

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*Adapted from Establishing and Operating a Small Print Shop, U.S. Department of Commerce, U.S. Government Printing Office, Washington, D.C., 1947.

On a $50 printing order, few customers are as much persuaded by a $3 price reduction as they are by a consideration of the quality you may provide. Too much emphasis on price in seeking work may mark you as a cheap printer, and actually lose more business for you than it gains.

All of the weight of experience in the industry points unanimously to the conclusion that the only sound price policy for a print shop is one based on charging cost plus a fair profit on every job. A big percentage of all new printing businesses fail within a year or two of their opening; failure to charage adequate prices is the major cause of their failures.

There are many systems used in estimating; but to be of practical value, they must be reinforced with a cost system which will enable yo to check on your estimates and revise your system to make it correspon with your actual costs. The cost system is the real basis for your estimating. The published schedules of average printing costs, which you will undoubtedly make use of, are practical only when modified to fit your own special conditions. Often it is possible to revise the book prices downward, and sometimes it is necessary to revise them upward. Your prices must be based on the actual costs in your plant, not someone else's. If you exhaust every means possible to bring costs down, and find that on certain classes of printing your competitor can still seriously undersell you, you had better get out of that particula category of printing. Why do business at a loss?

The right kind of a cost system turns the printer from a policy of ruinous price-cutting to a constructive effort to cut costs. Your equipment may not be turning out work at a rate which permits profits at competitive rates, your production techniques may need improvement, or your overhead may be excessive. The Printing Industry of America publishes, periodically, a schedule of printing ratios against which you may analyze your costs. The cost system furnishes the facts about your business; these available printing cost ratios show what the facts about your business; these available printing cost ratios show what the facts are in other and successfully operated print shops. Remedial action becomes relatively simple when you are supplied with facts.

All estimates, large and small jobs included, should be systematically prepared on a proper estimate sheet which will list every item to be taken into account. Omit nothing and carefully recheck your estimate after it is made. Watch your decimal places in figuring pape It is a good idea to make an additional check on every estimate by making a short cut estimate, independent of your calculated estimate. If there is much variation in the results, recheck your figures.

Specialization: Specialization in the printing industry calls for narrowing down the kinds of printing done to those that the shop is capable of doing well, promptly, and economically. Your specialities must lie in the field of small work. Other types of work are barred to you because they are produced on highly specialized machinery at a cost so low that you are unable to compete in their field without identical machinery. Labels, tags, and tickets are examples of this class. This limitation of scope is not a bad thing for you by any means. You must determine not only what kind of work you can do well and economically, but the kind of work you can do best and most ecomically. Do not hesitate to send a customer to another printer if you know that he can serve the customer better than you in the particular field involved. By doing so you will make a friend of the customer and the printer alike.

Selling and Buying

Knowing Your Business: An experienced printer once said, "You only have to know three things to sell printing; one, all about printing; two, all about salesmanship; three, all about your customer's business." His analysis covered lots of territory, but was exceedingly sound. In order to sell printing, you must know every phase of printing.

A piece of printing which is overelaborate, or overexpensive, for the job in question is not good work, no matter how tricky or interesting it may be. A primary responsibility of the printing salesman is to assist the buyer in selecting the type of printing which is best adapted to the purpose of his particular job.

Knowing Your Customer: Know your customer and his business. This is commonplace advice to salesmen, and is considered without question to be an essential. If you are selling hardware, you need only learn about the hardware business and you can talk to all of your customers about their business problems with reasonable authority. But you are a printing salesman. Your customers are in every line of business in the world, and you cannot expect to know all about every business. When you advise a buyer about one of his printing jobs, you are getting into his business, and you had better know as much about it as you can. The more you know about what the customer wants to accomplish with a piece of printing, why he is trying to accomplish it and how, the better service you will be able to render.

Buying: Prices for printing supplies are generally standardized for any particular item, and there is little advantage in shopping around. But the following three general factors can enable a printer to buy to advantage:

(1) Quantity purchases -- There are certain grades of paper and envelopes that can be bought cheaper in quantities. As long as you are certain that you will be able to use all of it, you should purchase such items in the quantities which gain the best rate, subject only to your available storage space, and your cash or credit position. (2) Another possibility of advantageous buying for the small printer is in watching the price lists on seconds, or job lots. (3) Finally, to buy properly you should know exactly what grade of paper and ink a job calls for.

Considering the narrow margin of profit in printing, it is obvious that the printer must have the most intimate and exact knowledge of costs and values of every commodity that enters into his finished product.

Production Management and Operations

Effective production management is vitally important to all print shops, regardless of size. Whether the proprietor of a small shop undertakes these duties himself or assigns them to an assistant, he must see that they are carried out with great skill and efficiency.

Duties of the Production Manager: It is the production manager's job to take the customer's copy or ideas and translate them into an attractive, practical, and effective printed job, at a cost that will make the job profitable to the shop. Occasionally, jobs have already been designed before they come to the plant. However, a great deal of the work coming into a shop is not in such good shape, and the production man must be able to handle whatever kind of copy is presented.

The production man must make a mental review of all the ways a job might be handled, select the most promising, and develop this into a general design. Usually the customer will be called upon to approve the initial design. After his approval has been secured, the working layout must be prepared. The lay-out is the blueprint of the job. It must be accurate, or the job will not turn out as desired. It must be clear and simple, so that the work to be done can be accomplished without hesitation, or the necessity for constant questions from the compositor.

Having passed from the design to the layout, the production manager must assign the work for performance. Art work may be involved and engravings may be required. It is the production man's responsibility to have all of these details worked out at the correct time. The text and display type must be set and everything assembled into the make-up of the forms. Again it is the production man's responsibility to see that no errors slip by, and that the design has been adhered to in every respect. He is responsible for seeing that the paper and ink are on hand and that a press is available when the forms are ready to be printed. He must arrange that the bindery be ready to handle the work when the pressroom is through with it. He is responsible for the job being done on time. He must control the job at every point from the hour it is received until the time it is delivered

Coordination: Thus, it is his responsibility to coordinate the efforts of every man and every machine in the production department.

Check Sheets: A production check sheet should be made out for every job that comes in . Then as the details are taken care of, the sheet is checked. It is thus possible at any moment to glance at a sheet and see if anything has been omitted. Similarly, a daily calendar should be maintained for every press and every other production unit, man, or machine.

The Composing Room: The composing room of a small shop often fails to show a profit, although there is no good reason why it should not be as profitable as any other branch of the business. Operate your composing room efficiently and it will show a profit.

Keep your furniture racks, lead, slug, and reglet cabinets well fonted up, and maintain at all times ample spacing materials. Distribute completed jobs as soon as possible. The place for movable type is in the case, not tied up in standing jobs, waiting for possible rerun.

A proof which makes a good impression on the customer will often forestall troublesome changes and criticism. The less allowance the customer has to make for the difference between the proof and the finished job, the better off you will be. Sloppy proofs are the trademark of sloppy printers.

Pressroom: The success of a print shop hinges on the ability of its presses to turn out quality work in volume. A competent pressman, working with a good press, can certainly achieve quality work. Good management will enter into the matter of the volume produced. Necessary repairs can usually be made at convenient times and without the necessity for a shut-down, interfering with operations. When running your presses, run them at near maximum speeds to assure maximum production.

Plan your work so that at least one press is rolling all the time. If one press is turning out impressions for you while another is being set, or the pressman is making ready on it, the second press will, in turn, be in operation while the first one is being serviced. Keep long- and short-run jobs running at the same time to avoid having more than one press idle at a time.

Watch your order of colors in scheduling your presses. Start color work in the morning, if possible, when the presses have first been cleaned. All of this will sound pretty elementary and perhaps unnecessary to the pressman; but these are little points often overlooked in shops where they are well known. The small shop can't afford to overlook anything.

Bindery Operations: When setting up your bindery, the first consideration is to provide enough space. It is doubtful if there ever was a bindery that had enough room. If you do not have sufficient space, the next best thing is to make the most effective use of what you have through good layout design and through good use of the layout.

Shipping and Receiving: In a small shop it may appear absurd to describe the organization of a shipping department. It is quite likely that the functions of this so-called department may be divided among everyone in the plant.

Even in well-operated printing plants, it is amazing how often the receipt of shipments is handled rather casually. As a small operator, you can't afford this. Paper and everything you buy is expensive. When it is received it must be carefully checked as to quantity and condition, then verified that it is what was ordered and is all alike. Suppliers can, and do, make mistakes. In your position you must know whether they have done so or not.

Nothing creates a worse impression on a customer than a sloppily wrapped package. Nothing creates a better impression than a neatly wrapped, tied and labeled package. One of your most effective advertisements may be your shipping label on packages of printing that reach your customer's hands, provided that the package and label are attractive and professional looking. See that work is packaged as quickly as possible after it is completed. It is not unusual for work to become soiled or damaged from lying around unprotected.

Deliver your work promptly! There is no sense in rushing to complete a job and then allowing it to lie around the plant for hours, undelivered.

TRAINING PLAN AND PROGRESS RECORD
FOR
PRINTING

Employer's Copy

JOB TRAINING: What the Worker Should Be Able To Do	Proficiency Shown	RELATED INFORMATION: What the Worker Should Know

Fundamental Information

	☒	Opportunities, requirements and outlooks in printing industry, accident and health factors

Elementary Composition

Set type from case, set composing stick, space out, justify lines, tie up forms. Measure with point system. Time in hours ________	☒	Types of cases, sticks, materials. Sizes of spaces, leads, materials. Type varieties and nomenclature.

Proofing and Distributing Type

Ink and position forms, pull proofs, make corrections, wash forms and press, identify and distribute type. Time in hours ________	☒	Types and kinds of proof presses and brayers. Clean and care for proof press and brayers. Principles of proofing, standard proofreaders' marks, distribution techniques

Commercial Display and Special Composition

Make layouts, select paper, cut and set borders, set different types of special composition jobs, plan book composition. Time in hours ________	☒	Basic considerations and principles of good layout, selection and styles of border material. Characteristics and rules of spacing, types of and standards of special composition jobs. Types and kinds of papers.

Lockup and Imposition

Position form, place furniture and quoins, test lockup, impose forms. Time in hours ________	☒	Characteristics of and types of furniture and quoins, methods of lockup, arrangements, computations of allowances, functions of dummy layouts and signature marks.

JOB TRAINING: What the Worker Should Be Able To Do	Proficiency Shown	RELATED INFORMATION: What the Worker Should Know
Platen Press Operations		
Wash and care for platen press, operate platen press, perform makeready operations, feed and print various jobs. Time in hours ________	☒	Types, kinds and care of presses, types and selection of inks, press safety, principles, purposes, and materials used in makeready, methods of cutting and scoring.
Stockroom and Bindery Work		
Handle, count, and job paper and printed matter, make pads, staple and fold paper. Time in hours ________	☒	Kinds and types of cutters, stapling machines, and folders types of tabbing compounds and spiral bindings.
Printing Plates		
Make engravings, stereotypes, and lithographic plates. Time in hours ________	☒	Principles of platemaking, offset, gravure and photo-gelatin processes.
Linecasting Machine Operations		
Set, operate, adjust and care for linecasting machine. Time in hours ________	☒	Kinds, methods, principles, functions, and maintenance of linecasting machines, specifications, precautions to be observed.
Printing Shop Operations		
Estimate jobs, prepare logotypes, design job jackets, order supplies, meet customers. Time in hours ________	☒	Factors and considerations of price policy, buying and selling, production management and operations.

Code for employer's use in marking student's progress

Performed some operations in area ☒

☒ Performed some operations with reasonable proficiency

Performed most operations in area ☒

☒ Performed most operations satisfactorily

TRAINING PLAN AND PROGRESS RECORD
FOR
PRINTING

Student's Copy

JOB TRAINING: What the Worker Should Be Able To Do	Proficiency Shown	RELATED INFORMATION: What the Worker Should Know
Fundamental Information		
	☒	Opportunities, requirements and outlooks in printing industry, accident and health factors
Elementary Composition		
Set type from case, set composing stick, space out, justify lines, tie up forms. Measure with point system. Time in hours __________	☒	Types of cases, sticks, materials. Sizes of spaces, leads, materials. Type varieties and nomenclature.
Proofing and Distributing Type		
Ink and position forms, pull proofs, make corrections, wash forms and press, identify and distribute type. Time in hours __________	☒	Types and kinds of proof presses and brayers. Clean and care for proof press and brayers. Principles of proofing, standard proofreaders' marks, distribution techniques
Commercial Display and Special Composition		
Make layouts, select paper, cut and set borders, set different types of special composition jobs, plan book composition. Time in hours __________	☒	Basic considerations and principles of good layout, selection and styles of border material. Characteristics and rules of spacing, types of and standards of special composition jobs. Types and kinds of papers.
Lockup and Imposition		
Position form, place furniture and quoins, test lockup, impose forms. Time in hours __________	☒	Characteristics of and types of furniture and quoins, methods of lockup, arrangements, computations of allowances, functions of dummy layouts and signature marks.

JOB TRAINING: What the Worker Should Be Able To Do	Proficiency Shown	RELATED INFORMATION: What the Worker Should Know
	Platen Press Operations	
Wash and care for platen press, operate platen press, perform makeready operations, feed and print various jobs. Time in hours ______	☒	Types, kinds and care of presses, types and selection of inks, press safety, principles, purposes, and materials used in makeready, methods of cutting and scoring.
	Stockroom and Bindery Work	
Handle, count, and job paper and printed matter, make pads, staple and fold paper. Time in hours ______	☒	Kinds and types of cutters, stapling machines, and folders types of tabbing compounds and spiral bindings.
	Printing Plates	
Make engravings, stereotypes, and lithographic plates. Time in hours ______	☒	Principles of platemaking, offset, gravure and photogelatin processes.
	Linecasting Machine Operations	
Set, operate, adjust and care for linecasting machine. Time in hours ______	☒	Kinds, methods, principles, functions, and maintenance of linecasting machines, specifications, precautions to be observed.
	Printing Shop Operations	
Estimate jobs, prepare logotypes, design job jackets, order supplies, meet customers. Time in hours ______	☒	Factors and considerations of price policy, buying and selling, production management and operations.

Code for employer's use in marking student's progress

Performed some operations in area	☒	☒	Performed some operations with reasonable proficiency
Performed most operations in area	☒	☒	Performed most operations satisfactorily

TRAINING PLAN AND PROGRESS RECORD
FOR
PRINTING

JOB TRAINING: What the Worker Should Be Able To Do	Proficiency Shown	RELATED INFORMATION: What the Worker Should Know
	Fundamental Information	
	☐	Opportunities, requirements and outlooks in printing industry, accident and health factors
	Elementary Composition	
Set type from case, set composing stick, space out, justify lines, tie up forms. Measure with point system. Time in hours ________	☒	Types of cases, sticks, materials. Sizes of spaces, leads, materials. Type varieties and nomenclature.
	Proofing and Distributing Type	
Ink and position forms, pull proofs, make corrections, wash forms and press, identify and distribute type. Time in hours ________	☒	Types and kinds of proof presses and brayers. Clean and care for proof press and brayers. Principles of proofing, standard proofreaders' marks, distribution technique.
	Commercial Display and Special Composition	
Make layouts, select paper, cut and set borders, set different types of special composition jobs, plan book composition. Time in hours ________	☒	Basic considerations and principles of good layout, selection and styles of border material. Characteristics and rules of spacing, types of and standards of special composition jobs. Types and kinds of papers.
	Lockup and Imposition	
Position form, place furniture and quoins, test lockup, impose forms. Time in hours ________	☒	Characteristics of and types of furniture and quoins, methods of lockup, arrangements, computations of allowances, functions of dummy layouts and signature marks.

JOB TRAINING: What the Worker Should Be Able To Do	Proficiency Shown	RELATED INFORMATION: What the Worker Should Know
Platen Press Operations		
Wash and care for platen press, operate platen press, perform makeready operations, feed and print various jobs. Time in hours __________	☒	Types, kinds and care of presses, types and selection of inks, press safety, principles, purposes, and materials used in makeready, methods of cutting and scoring.
Stockroom and Bindery Work		
Handle, count, and job paper and printed matter, make pads, staple and fold paper. Time in hours __________	☒	Kinds and types of cutters, stapling machines, and folders types of tabbing compounds and spiral bindings.
Printing Plates		
Make engravings, stereotypes, and lithographic plates. Time in hours __________	☒	Principles of platemaking, offset, gravure and photogelatin processes.
Linecasting Machine Operations		
Set, operate, adjust and care for linecasting machine. Time in hours __________	☒	Kinds, methods, principles, functions, and maintenance of linecasting machines, specifications, precautions to be observed.
Printing Shop Operations		
Estimate jobs, prepare logotypes, design job jackets, order supplies, meet customers. Time in hours __________	☒	Factors and considerations of price policy, buying and selling, production management and operations.

Code for employer's use in marking student's progress

Performed some operations in area	☒	☒	Performed some operations with reasonable proficiency
Performed most operations in area	☒	☒	Performed most operations satisfactorily

VT002 077

VT 002 077
Sheet-Metal, A Course of Study Designed for Cooperative Part-Time Students Employed in Sheet Metal Occupations.

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*STUDY GUIDES, *TRADE AND INDUSTRIAL EDUCATION, *SHEET METAL WORKERS, *SHEET METAL WORK, HIGH SCHOOLS, JOB ANALYSIS, *COOPERATIVE EDUCATION, INDIVIDUAL INSTRUCTION,

This study guide is for student use in related occupational instruction for the sheet metal trade in high school cooperative education programs. It was developed by a committee of teacher coordinators and teacher educators from an analysis of the trade and has been field tested and periodically revised. The 18 assignment sheets are designed to facilitate individual instruction and contain introductory paragraphs to develop interest, explanations of the importance of the assignments, references, learning activities, and objective-type study questions. Representative titles are (1) Sheet Metal Fabricating Materials, (2) Sheet Metal Seams and Hems, (3) Measurement, Linear and Angular, (4) Layout Tools, and (5) Triangulation. Information sheets are provided on Fire Extinguishers, First Aid, Safety, and Establishing and Operating a Sheet Metal Business. The material is to be used by individual students under teacher supervision for 1 year of 180 days. The teacher should be a qualified coordinator or competent trade teacher, and the student should be in the eleventh or twelfth grades and employed as a cooperative education student in the sheet metal trade. Supplementary materials include a list of references, an analysis of sheet metal work, and progress records for use by the student, teacher, and employer. Answers to study questions are available in VT 002 058. This document is available for $1.50 from Industrial Education, 103 Industrial Education Building, University of Missouri, Columbia, Missouri 65201. (HC)

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SHEET METAL

A Course of Study

Designed for
Cooperative Part-time Students
Employed in Sheet Metal Occupations

Issued by

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Jefferson City, Missouri

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MEMORANDUM

TO: The ERIC Clearinghouse on Vocational and Technical Education
The Ohio State University
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Columbus, Ohio 43212

FROM: (Person) James B. Karnes (Agency) Univ. of Mo. at Columbia

(Address) 103 Industrial Education Building, Columbia, Mo.

DATE: October 19, 1967

RE: (Author, Title, Publisher, Date) Indus. Ed. Dept., Univ. of Mo. at Columbia SHEET METAL, cooperatively with Indus. Educ. Dept. (U. of Mo. at Columbia) and Mo. State Dept. of Ed. (1967)

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Provide information below which is not included in the publication. Mark N/A in each blank for which information is not available or not applicable. Mark P when information is included in the publication. See reverse side for further instructions.

(1) Source of Available Copies:
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instructor's key $.50

(2) Means Used to Develop Material:
Development Group Development Committee of Teacher-Coord. & Teacher-Educ.
Level of Group State
Method of Design, Testing, and Trial Subject matter specialist and teacher educators based on an analysis of the trade tested in the field over several years and periodically revised

(3) Utilization of Material:
Appropriate School Setting H.S. and post high school, and area vocational
Type of Program Cooperative education and preparatory programs
Occupational Focus job cluster covering various phases of sheet metal
Geographic Adaptability United States
Uses of Material Study guide for related instruction
Users of Material Student

(4) Requirements for Using Material:
Teacher Competency qualified coordinator or competent trade teacher
Student Selection Criteria junior in high school with proper prerequisites
Time Allotment 180 days

Supplemental Media --
Necessary x
Desirable ___ (Check Which)

Describe P

Source (agency) (see attached list)
(address)

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* Subject to educational discount
** Frequency of use in assignments

FOREWORD

This course of study, consisting of an analysis of Sheet Metalwork, together with assignment sheets covering the related (occupational) information to be taught by the school, has been prepared for teaching sheet metalwork on an individual basis in part-time cooperative occupational education programs.

The original course of study for sheet metalwork was prepared by Mr. E. C. Minnick, Coordinator, Richmond, Missouri, while a graduate student in Industrial Education at the University of Missouri. Subsequent revisions were made by Dr. Charles R. Hill in 1952 and by Dr. Austin G. Loveless, in 1962, while Research Assistants in Industrial Education at the University of Missouri. The present revision was prepared by Mr. Tommy R. Koonce, Research Assistant in Industrial Education at the University of Missouri.

We wish to acknowledge our indebtedness to Dr. H. H. London, Professor of Industrial Education at the University of Missouri, for the direction and administration of the Curriculum Materials Laboratory in which this material was prepared, and to Dr. James B. Karnes, Assistant Professor of Industrial Education at the University of Missouri, who supervised the preparation of the material and edited the manuscript. Credit is due to Mr. B. W. Robinson, Assistant Commissioner of Education, Mr. Merton Wheeler, Director of Industrial Education, and to other staff members of the State Department of Education for their efforts in the development of the Industrial Education Curriculum Series of which this course of study is a part.

HUBERT WHEELER

Commissioner of Education

January, 1967
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INTRODUCTION

In preparing this course of study, it has been assumed that the attainment of occupational competency in any type of work involves three different, yet closely related, types of learning. They are:

1. Mastery of the practical job skills and procedures performed by the worker in the occupation.
2. Comprehension of the technical and related information basic to an intelligent understanding and practice of the occupation.
3. Development of those personal-social traits which are essential for the successful worker.

The first group of these "learning units"--the job skills and procedures--has been arranged in the analysis under the heading of "Job Training." The second group of "learning units"--the technical and related information--has been arranged under the heading of "Related Information." And the third group--the personal-social traits--has been listed under "Personal Qualifications of the Sheet Metal Worker" in the introductory section addressed to the student.

In a cooperative educational program it is necessary for both cooperating agencies, the school and the employer, to understand clearly just what each is to be responsible for in the training of the student-worker. Experience has shown that most of the practical job skills and procedures of an occupation can best be learned through supervised work on the job. Experience has shown also that the school can best teach most of the technical and related occupational information needed by young student-workers. This division of responsibility has been made in the arrangement of this course of study; that is, it is expected that the student-worker will master the job skills and procedures through practical work on the job under the immediate supervision of the employer, and that he will receive instruction in related occupational information in the school under the direction of the coordinator.

Skills and related information are matters for direct instruction, but personal-social traits are acquired only through practicing them during the process of acquiring skills and information and in one's daily conduct. Therefore, both the employer and the school, as well as the home, must assume responsibility for developing in the student-worker those habits, attitudes, and character traits which are essential for success in his occupation and in life. Both the employer and the school should be constantly on the alert to see that the student--worker places desirable interpretations on his experiences and that he does not practice habits and exhibit character traits detrimental to his success.

Since the coordinator's class will be made up of fifteen or more students, each differing from the other significantly, studying a dozen or more occupations which differ markedly in their requirements, it follows that it will be impossible for him to teach, through the group method, the occupational information which relates to the specific job of each student-worker. In order to be effective, this type of instruction must be individualized. There is, of course, some related information, such as occupational health and safety, workmen's compensation, wage hour laws, fair labor standards, unemployment compensation, and the like, which is of common interest and concern to all student-workers and may be effectively taught by the group method. But if the coordinator is to make a real contribution to the in-service vocational education of his students, he must devote a major portion of his classroom instruction to content which deals specifically with the work of each boy and girl enrolled.

With this requirement in mind, and in order to facilitate individual instruction, the series of assignment sheets has been prepared. They contain certain record data as to number and range of units covered; introductory paragraphs designed to develop interest, explain the importance of the assignment, and to convey to the student what he is expected to learn; specific assignments including readings, learning activities, and a series of objective-type questions designed to check his attainment.

Obviously, it is desirable to teach the related information in the school at the time it will be used most advantageously on the job. This means that the two phases of the student-worker's training should parallel each other in a progressive manner. The coordinator will find the assignment sheets well-adapted to this end. He can select from day to day the assignment which covers the units with which the student is working. With this arrangement, the coordinator will become, during a major portion of his classroom time, a supervising study and helping teacher.

In selecting reference books for the course, an effort was made to restrict the number to only those including information considered to be most important for the sheet metal worker to know, and to those of recent publication. It is recommended that these materials be secured and kept in the coordinator's classroom for ready use by the student.

Key answer sheets have been prepared to enable the coordinator to score quickly the objective tests which are a part of each assignment sheet. These key sheets give the correct answer to the questions, as well as the reference and page on which each answer can be found. The key sheets should be kept in the coordinator's possession.

TO THE STUDENT-WORKER

The beginning of the sheet metal trade dates back to the early trade guilds of the Middle Ages, when the tinsmith was an important worker. He was the craftsman responsible for making and repairing of the knights' armor. As time went on and the manufacture of metals increased, new uses were introduced which created a greater need for sheet metalworkers.

Persons engaged in the sheet metal trade vary greatly in the amount of training and skill required to do their respective jobs. Some jobs are in semi-skilled factory occupations where articles are manufactured from sheet metal by stamping, die-forming, and other repetitive methods. However, the sheet metalworker **is usually considered** to be one skilled in layout, fabrication, installation, or repairs sheet metal products, fixtures, or equipment. Although specialization in these areas is on the increase, it is highly desirable for the skilled worker to be proficient in all branches of the trade.

Opportunities in Sheet Metalwork

Employment of sheet metalworkers during the 1960's is expected to increase rapidly. In addition to job openings arising from the growth of the trade, opportunities for new workers will result from the need to replace the experienced workers who will retire, or those transferred to other fields of work.

A large increase in the employment of sheet metalworkers is expected mainly as a result of the anticipated large expansion in new residential, commercial, and industrial construction with permanently installed air-conditioning systems.

The largest field for specialization is in that of heating and air conditioning. Others include roofing, design and layout work, and intricate cutting. Most of this work is done by skilled sheet metalworkers in contractors' shops rather than by semi-skilled factory operatives.

Wage rates established through collective bargaining in the principal cities of the United States average $4.50 an hour. This rate is usually somewhat lower in the small towns and villages than in the large cities. Apprentice wages average about half the journeyman rate. The work week is usually forty hours.

Those in the building trades may work only 9 or 10 months each year, because of the seasonal nature of construction. As a result, these workers frequently turn to maintenance and repair work during the off-season.

Requirements for Entry into Sheet Metalwork

Entry into the sheet metal trade is usually accomplished through on-the-job training, such as that provided by the Cooperative Occupational Education program, or through apprenticeship. Apprenticeships usually run for a period of four years. Each year they include

144 hours of related classroom instruction in such things as shearing, punching, rolling, bending, seaming, soldering, and layout. Apprenticeships may be shortened somewhat for persons who have had certain vocational courses.

High school courses particularly helpful to one planning to enter the sheet metal trade include industrial arts shop and drawing courses, mathematics, physics, chemistry, economics, and English.

Although no license is required to work in the sheet metal trade, one is generally required to join a union in the larger cities.

The beginner should be aware of the working conditions he will be exposed to in this trade. Forming and shaping operations are noisy. Occasionally installation or repair work must be done in a cramped position. Other inconveniences may be encountered due to inclement weather, since installation and repair work are frequently done outside. Cuts and burns are not uncommon. Falls from ladders and scaffolding used for installation purposes may result in serious injuries. Even though these inconveniences are apparent, persons interested in shop work and drawing will find that sheet metalwork provides a challenge and an opportunity to earn good wages, while performing a useful service.

<u>Personal Qualifications for the Sheet Metalworker</u>

Desirable personality traits are of extreme importance for success in life. They are the factors on which one is most largely judged when meeting people and when attempting to secure a job; they are also vitally important in holding a job. In fact, studies reveal that the chief cause for 90 per cent of the discharges is due to the lack of desirable personal-social traits, while only 10 per cent is due to lack of job skills. It must be noted, however, that without job skills one would find it exceedingly difficult to become employed. Personal-social traits can be improved only through conscientious effort, when one knows what to improve, how to improve and why improvement is advisable. Among the personal-social traits of chief importance to the sheet metalworker are the following:

<u>Carefulness</u>--Conserve tools, equipment, and materials.

<u>Cooperativeness</u>--Works harmoniously with others.

<u>Courtesy</u>--Respects other's opinions, interests, and desires.

<u>Dependability</u>--Performs as agreed.

<u>Health</u>--Observes habits that promote vitality and vigor.

Initiative--Ability to see what needs to be done and does it without constant supervision or prodding.

<u>Promptness</u>--Seldom tardy or absent from his responsibilities.

<u>Self-Control</u>--Maintains a pleasant disposition and keeps temper under control.

<u>Voice</u>--Uses good English and speaks in a pleasant manner.

REFERENCES FOR SHEET METAL WORK

A. Bruce, Leroy F. and Meyer, Leo A., Sheet Metal Shop Practice, American Technical Society, Chicago, 1965, $5.50.

B. New York State Education Department, Hand Processes (Sheet Metal Series), Delmar Publishers, Inc., Albany, New York, 1946, $2.32.*

C. New York State Education Department, Measurement and Layout (Sheet Metal Series), Delmar Publishers, Inc., Albany, New York, 1946, $2.12.*

D. Daugherty, James S. and Robert E. Powell, Sheet Metal Pattern Drafting and Shop Problems, Chas. A. Bennett Co, Inc., Peoria, Illinois, 1961, cloth $5.84, paper $3.40.*

E. New York State Education Department, Sheet Metal Mathematics, Delmar Publishers, Inc., Albany, New York, 1960, $4.00.*

F. Smith, Robert E., Sheet Metal Work, McKnight and McKnight Publishing Company, Bloomington, Illinois, 1961, $1.60.*

G. New York State Education Department, Machine Processes (Sheet Metal Series), Delmar Publishers, Inc., Albany, New York, 1946, $2.12.

H. Kaberlein, Joseph J., Triangulation Short-cut Layouts, The Bruce Publishing Company, Milwaukee, 1956, $6.95.

* Subject to educational discount
** Frequency of use in assignments

ANALYSIS OF SHEET METAL WORK

JOB TRAINING: What The Worker Should Be Able To Do	Assign. No.	RELATED INFORMATION: What The Worker Should Know
Sheet Metal Materials		
1. Plan jobs		
2. Make bills of material	1	2. Manufacture of sheet metal
3. Select stock for jobs	1	3. Properties and specifications of sheet metal
		4. Description and use of metal gages
Safe Practices		
5. Prevent accidents in shop	2	5. Employer safety considerations
6. Extinguish fires	2	7. Employee safety considerations
8. Administer first aid	2	8. Accident reporting
9. Report accidents		
Hand Processes		
10. Select, tighten, and loosen threaded fasteners	3	10. Types, parts, and uses of screw drivers
11. Sharpen tools	3	12. Hammers used in sheet metal work
13. Fasten handles to hammer heads		
14. Hold work in clamping devices	3	14. Clamping devices used in sheet metal work
15. Bend metal with pliers	3	15. Types and uses of pliers
16. Cut wire		
17. Transfer patterns	3	17. Types of patterns and their uses
		18. Methods of transferring patterns
		19. Types and uses of bench plates
20. Form sheet metal by hand	3	20. Sheet metal stakes and their uses
21. Cut sheet metal with hand snips	4	21. Types and uses of hand snips
22. Rough and finish file	4	22. Description, care and use of files

JOB TRAINING	Assign. No.	RELATED INFORMATION
23. Clean files		
24. Cut metal with chisel	4	24. Types, care, and uses of chisels
25. Punch holes	4	25. Punches used in sheet metal work
26. Drill holes	4	26. Twist drill parts and sizes.
	4	27. Description of hand and breast drills
28. Cut metal with hack saw	4	28. Types of hack saw blades and frames
29. Make grooved seams	5	29. Kinds of sheet metal seams and hems, their specifications and uses
30. Make dovetailed seams	5	30. Tools used in forming seams and hems
31. Flange edges		
32. Set rivets	5	32. Description, specifications, and uses of rivets
	5	33. Tools used in riveting
	5	34. Selection and spacing of rivets.
35. Make tee-joints	5	
36. Wire edges	5	36. Types and sizes of wire used in sheet metal shops
37. Make single seams		
38. Make double seams		
39. Make Pittsburgh locks		
40. Forge and file soldering coppers	6	40. Factors in selecting soldering coppers
41. Light and adjust soldering copper heating devices	6	41. Heating devices used in soldering.
42. Tin soldering coppers	6	42. Characteristics and use of sal ammoniac
	6	43. Nature and use of rosin
44. Solder seams	6	44. Composition and characteristics of soft solders
	6	45. Soldering fluxes
	6	46. Dipping solutions used in soldering

JOB TRAINING	Assign No.	RELATED INFORMATION
	Machine Processes	
47. Form sheet metal with bar folders	7	47. Description and use of sheet metal forming machines
48. Form sheet metal with hand brakes		
49. Form sheet metal with roll forming machines		
50. Form beads with beading machines		
51. Crimp sheet metal		
52. Turn edges on sheet metal with turning machine		
53. Burr edges with burring machine		
54. Cut sheet metal with squaring shears	8	54. Machines used for cutting and boring sheet metal
55. Cut sheet metal with circle-cutting machine		
56. Drill holes		
57. Dress grinding wheels	8	57. Characteristics and uses of grinding wheels
58. Clean, oil, and adjust sheet metal machines		
	Sheet Metal Mathematics	
	9	59. Methods for adding, subtracting, multiplying, and dividing fractions
	9	60. Methods for adding, subtracting, multiplying, and dividing decimals
	9	61. Conversion of fractions and decimals
	9	62. Linear measurement
	9	63. Types, construction, and measurement of geometric figures
	10	64. Methods for computing perimeter

JOB TRAINING	Assign. No.	RELATED INFORMATION
	10	65. Methods for computing area
	10	66. Methods for computing volume
	10	67. Types and uses of graphs
	11	68. Sheet metal layout formulas
	11	69. Methods for computing the speed of rotating cylinders
	11	70. Methods of solving equations
	11	71. Solving unknowns by proportion
	11	72. Trigonometry procedures and uses
	<u>Layout</u>	
73. Measure with scales	12	73. Sheet metal measuring and layout tools
74. Measure with circumference rules		
75. Measure angles		
76. Measure with micrometer calipers		
77. Layout straight lines		
78. Layout angles		
79. Mark points with price punch and center punch		
80. Layout parallel lines		
81. Layout arcs and circles		
82. Layout curved lines		
	13	83. Principles of orthographic projection
84. Layout square jobs	13	84. Simple layout procedures
85. Layout rectangular jobs		
86. Layout boxes		
87. Layout circular jobs		
88. Layout semicircular jobs		
89. Layout square or rectangular elbows		
	14	90. Specifications and uses of seams and hems

JOB TRAINING		Assign. No.	RELATED INFORMATION	
91.	Layout single hems	14	91.	Notches, their specifications and use
92.	Layout double hems			
93.	Layout wired edges			
94.	Layout lap seams			
95.	Layout grooved seams			
96.	Layout dovetailed seams			
97.	Layout burred bottom seams			
98.	Layout set-in bottom seams			
99.	Layout single seams			
100.	Layout double seams			
101.	Layout Pittsburgh locks			
102.	Layout square and rectangular jobs cut off at an angle	15	102.	Principles and application of parallel line development
103.	Layout cylindrical jobs cut off at an angle			
104.	Layout straight tee-joints			
105.	Layout inclined tee-joints			
106.	Layout elbows			
107.	Layout cornices			
108.	Layout cone-shaped jobs	16	108.	Principles and application of radial line development
109.	Layout pyramid-shaped jobs			
110.	Layout cone-shaped jobs cut off at an angle			
111.	Layout pyramid-shaped jobs cut off at an angle			
112.	Layout jobs consisting of cones that intersect with cylinders			
113.	Layout scalene cones by radial line development			

JOB TRAINING		Assign. No.	RELATED INFORMATION	
114.	Layout scalene cones by triangulation	17	114.	Principles and application of triangulation
115.	Layout twisted square pipes			
116.	Layout square-to-round transition pieces			
117.	Layout straight- sided reduced pipes			
118.	Layout offset for round pipes			
119.	Layout elbow for round pipes			
120.	Layout square-to-round elbows			
121.	Layout transforming tee-joint			
122.	Layout Y branches			
	Sheet Metal Business			
		18	123.	Business entry considerations
		18	124.	Considerations involved in locating a business
		18	125.	Capital investment problems
		18	126.	Business organization, regulations, and insurance
		18	127.	Shop building, layout, and equipment consideration
128.	Prepare and maintain shop for efficient use			
129.	Attract customers and maintain customer satisfaction	18	129.	Business promotional activities and ideas
130.	Make sales			
131.	Quote prices	18	131.	Factors to be considered in determining prices
132.	Extend credit and collect accounts	18	132.	Credits and collections
		18	133.	Financing a sheet metal business

Assignment
Sheet No. 1

Covering
Units 2-4

SHEET METAL FABRICATING MATERIALS

The success or failure of a particular job does not depend entirely upon the manual skills possessed by the workman. Other factors must be considered. Among them is the nature of the material itself. If the material specified for a job will not stand up under the conditions it is exposed to, expert workmanship is wasted.

Probably the chief factor to consider in attempting to make an intelligent choice of material for a job is its ultimate use. In some cases appearance will be the main determinant, in others it may be corrosion-resistant qualities or ease of fabrication. The important thing is to weigh all the advantages and disadvantages of a particular metal against those of others, and then make the final choice in light of these comparisons.

You are expected to become acquainted with the basic fabricating materials used in the sheet metal trade while completing this assignment. This acquaintance should include knowledge of these materials' outstanding characteristics and uses, as well as the specifications related to them. Additional reading is assigned concerning processes involved in the manufacture of sheet metal fabricating materials.

Assignment:

1. Read the references listed below.
2. (a) Send a postcard to the address below requesting a free copy of the handbook, The Pocket Reference Book.
   Carnegie-Illinois Steel Corporation
   Carnegie Building, 434 Fifth Avenue
   Pittsburgh, Pennsylvania
   (b) Gather and prepare sample pieces of various types of sheet stock used in the sheet metal trade. Cut sample pieces 3" x 5" in size. Note each material's main uses and characteristics on a 3" x 5" card that is to be glued to the back of each sample.
3. After completing items 1 and 2, answer the questions below and turn in this assignment by ____________________.

References:

A. Bruce and Meyer, Sheet Metal Shop Practice, pp. 40-55
B. New York, Hand Processes, pp. 1-7, 121-122.
F. Smith, Sheet Metal Work, pp. 10-22.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. High-carbon steel is harder than low-carbon steel.

T F 2. The base weight of tin plate varies with its thickness.

T F 3. Black iron sheets are available in standard widths ranging from 2 to 3 feet.

T F 4. An IC coating on tin plate is heavier than a 5X coating.

T F 5. The price for wire and rod is based upon a fixed rate per pound.

T F 6. Galvanized iron is easier to work than black iron.

T F 7. Galvanized wire should generally be used for wired edges on galvanized jobs.

T F 8. Terne plate is used extensively for food containers because of its corrosion-resistant qualities.

T F 9. Tin plate is made from sheets of iron or steel that have been coated with tin.

T F 10. Iron and steel stock should be kept in a dry place to reduce its tendency to corrode.

T F 11. When ordering wire, it is recommended that the diameter be expressed in terms of a gage number.

T F 12. There would be more 18-gage black iron sheets in a bundle than there would be in a bundle of 32-gage black iron.

T F 13. Hard drawn, rather than annealed, steel wire is the type generally used in the sheet metal trade.

T F 14. The base plate of galvanized iron will corrode if the coating comes off.

T F 15. Blooms are rolled from ingots.

T F 16. Coated wire is generally used for jobs made of black iron.

T F 17. Jobs made from uncoated sheet steel should ordinarily be painted.

T F 18. Galvanized iron runs slightly thicker than the corresponding gages of black iron.

T F 19. Wire is usually less expensive than rod.

T F 20. Terne plate has a brighter finish than coke tin plate.

Completion

Directions: Fill in the blank (s) in each statement with the word (s) required to complete the sentence correctly.

1. The "32" of the figures "32 x 36 x 96" which appear on the top sheet of a bundle of black iron refers to the metal's ________.

2. More care is required in working galvanized iron than black iron because the brittle ____________ coating is apt to ____________ ______.

3. The cost of galvanized iron is determined at a fixed rate per ______________.

4. The tool used to measure the thickness of sheet metal is called a ______________.

5. Black plates coated with a mixture of lead and tin are called ______________ plate.

6. Tin plate is a thin sheet of ____________ coated on both sides with pure tin.

7. Round stock obtained in coils is usually called ____________.

8. The primary use of limestone in the manufacture of iron and steel is to remove __________________.

9. Tin plate made with a coating weighing less than two pounds per case is called ______________ tin plate.

10. Round stock obtained in straight lengths is usually called ______________.

11. Galvanized iron is coated with molten ______________.

12. The heating device used in producing pig iron from iron ore is called a ______________ furnace.

13. The finish of sheet and strip steel usually requires no further treatment, when the ___________ rolling process is used.

14. Band iron and angle iron are made from ____________ carbon steel.

15. Sheet steel that has a thickness of ____________ or over is called a plate.

16. Wire is made by drawing rod through a series of consecutively smaller holes in plates which are called ______________.

17. Grades of iron or steel with relatively few impurities have ______________ tendency to corrode than those grades with higher amounts.

18. A sheet of 18-gage galvanized iron is ______________ than a sheet of 32-gage tin plate.

19. Black iron sheets come in bundles weighing approximately ________________ pounds.

20. Sheet metal similar to galvanized iron but with a dull finish of zinc, and does not crack or peel is known as ________________ iron.

21 The price charged for black iron is fixed at so much a ________.

22. The substance that remains after baking coal in ovens to remove its volatile substances is called ________________.

23. The coating on the better grades of galvanized iron is less apt to ________________ than that on the poorer grades.

24. From the open hearth furnace the molten steel is poured into ________________ ______________________________.

25. The process that softens the metal and releases strains caused by rolling is called ________________.

26. Congress adopted the ________________ ________________ ________________ Gage in 1893 as the standard gage for measuring the thickness of iron and steel sheets.

27. The two methods used to plate steel with tin are ______________ and ________________.

28. Sheet steel that has a light coating of tin is referred to as ______________; those with a heavy coating as ___________ tin plates.

29. The greater proportion of tin plate is of the ________________ variety and is used primarily in the manufacture of ______________________.

30. Steel wire may be purchased in gage sizes from ________ to ______________.

Multiple-Choice

Directions: In the space at the left of each statement, write the letter of the item which will provide the correct answer to complete the statement.

_____ 1. Black iron sheets are available in standard lengths ranging in feet from (A) 4 to 6; (B) 6 to 8; (C) 8 to 10; (D) 10 to 12.

_____ 2. The uncoated sheets rolled from iron or a low-carbon steel are referred to by the sheet metalworker as (A) sheet steel; (B) sheet iron; (C) black iron; (D) sheet metal.

_____ 3. Tin plate made with a coating weighing between 7 and 14 pounds per case is called (A) coke tin plate; (B) charcoal tin plate; (C) dairy plate; (D) terne plate.

_____ 4. The unit of measurement for 112-14 x 20-inch sheets of tin plate is called (A) double box, (B) case; (C) base box; (D) base weight.

Matching

Directions: Read statements listed alphabetically in the right hand column, and match them with the appropriate item by placing the letters from the right hand listing in the space provided adjacent to the numbers in the left hand column.

_____ 1. strength
_____ 2. ductility
_____ 3. malleability
_____ 4. hardness
_____ 5. toughness
_____ 6. brittleness
_____ 7. cold-work
_____ 8. corrosion

A. ability of metal to be stretched without breaking
B. ability of metal to resist penetration, wear or cutting action
C. causes metal to become harder and more brittle
D. ability of metal to resist high shock impact
E. ability of metal to hold loads without breaking
F. caused by exposing metal to fumes, water, acids, and moist air
G. shatters easily
H. metal can be rolled, forged, or hammered without cracking
I. ability of metal to retain its original shape
J. ability of metal to resist tearing or shearing

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. List the reasons for galvanizing sheet steel.

(A)______________________ (C)______________________

(B)______________________

2. List the metals that are generally used to coat iron and steel in order to protect their surfaces from corrosion.

(A)______________________ (C)______________________

(B)______________________ (D)______________________

3. List the reasons why wired edges are used on some jobs.

(A)______________________________ (C)____________________________________

(B)______________________________

Assignment
Sheet No. 2

Covering
Units 5-8

HAZARDS AND SHOP PRACTICES

Your chances for being injured are greater than you realize! Did you know that some statisticians estimate that industrial workers average nearly five injuries each year? Moreover, it is claimed that eac year one out of every six industrial workers will have one lost-time accident, and one out of every 780 persons involved in an accident wi be fatally injured. What will be your record in regard to these figures at the end of the next year?

Fortunately, there is something we can do about accidents. The National Safety Council reports that improper attitudes and lack of skill and knowledge are the chief causes of personal accidents. By following certain precautions and suggestions you can help to reduce the annual loss of nearly one billion dollars that is incurred throug lost wages, medical treatment, and insurance expenses.

In this assignment you will have an opportunity to learn some of the ways of avoiding accidents through the proper use of tools and equipment. Suggestions will also be given on how to cope with certain hazards that may arise in the shop.

Assignment:

1. Read the references listed below.
2. Prepare a list of things you would look for if you were to make a safety inspection of a sheet metal shop.
3. After completing items 1 and 2, answer the questions below and turn in this assignment by ________________.

References:

F. Smith, Sheet Metal Work, pp 9-10.
I. Information Sheets No. 1, No. 2 and No. 3 (this manual).

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. Small metal parts should not be placed in one's mouth because of the chance for infection.

T F 2. The gas should be turned on before striking a match when lighting a gas furnace.

T F 3. In order to prevent burns from soldering coppers, it is good practice to always assume that they are hot.

T F 4. A person with long hair should wear some kind of hat or cap to keep the hair from being caught in moving machinery.

T F 5. Most accidents involving squaring shears occur when one person handles the material and the other operates the foot treadle.

T F 6. Loose neckties and open sleeve cuffs are frequently responsible for accidents in the shop.

T F 7. The soda-acid type of fire extinguisher is recommended for use on class "B" fires (oils, greases, and paints).

T F 8. Carbon dioxide type fire extinguishers are used to extinguish class "B" fires (oils, greases, and paints) and "C" (live electrical equipment).

T F 9. Rings worn on fingers frequently cause shop accidents.

T F 10. Fire extinguishers are recommended for extinguishing clothing fires.

T F 11. One should avoid breathing the fumes that are given off when tinning a copper on a salammoniac block.

T F 12. A tool with a mushroomed end is apt to chip.

T F 13. It is good shop practice to hold parts to be ground or buffed with a cloth in order to prevent the fingers from being burned.

T F 14. The first thing to do in the case of a major accident is to render first aid treatment.

T F 15. A person may be seriously injured from a blast of air that is under high pressure.

T F 16. Regular shop-safety inspections will help reduce the occurrence of accidents.

T F 17. Class "A" fires (wood, rubbish, textiles, etc.) should be extinguished with the dry-powder type of fire extinguisher.

T F 18. If a tool needed for a job is not available, one should use the best substitute handy to get the job done.

T F 19. Individual lack of precaution is the chief cause for most of the accidents that occur in the shop.

T F 20. When two workers operate a slip roll forming machine together, the likelihood for accidents decreases.

T F 21. Scrap material should be placed in suitable containers to avoid cluttering up floor space.

T F 22. Acid should always be added to water when making an acid solution.

T F 23. The work should be held on the top part of the wheel when buffing.

T F 24. The face of a sheet metal stake should not be struck directly with a steel-face hammer.

T F 25. Every shop should have first-aid supplies available and someone trained to administer first aid.

T F 26. If a person receives a second or third degree burn, he should be taken to a physician immediately.

T F 27. Winking is a good way to remove foreign particles from one's eye.

T F 28. Concentrated acid that comes in contact with skin will cause burns.

T F 29. The danger of electrical shocks may be reduced when connecting electrical appliances by not touching any pipes.

T F 30. Acid will eat holes in clothing.

T F 31. It is good practice to stand directly in front of a grinder or buffer when turning on the power.

T F 32. No matter how slight a cut or bruise may appear, first aid should always be applied.

T F 33. The soda-acid type of fire extinguisher is recommended for use on class "C" fires (live electrical equipment).

T F 34. Class "A" fires (wood, rubbish, textiles, etc.) are extinguished with either the foam or soda-acid type of fire extinguisher.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. Removal of coats or sweaters while working in the shop will help to reduce the danger of catching ____________________.

2. Large sheets of metal should be carried on ________________.

3. Oily rags should be stored in closed ________________ containers.

4. The best way for a person to extinguish the flames when his clothes have caught fire is to roll up in a ________________.

5. Chisels with wooden handles should be driven with a ___________.

6. Steel-face hammers should not be struck against each other because they may ___________________.

7. When drilling holes in metal it is sometimes necessary to use a ____________ or ______________ to hold the material.

8. When the tools and machines in a shop are used by several people, you should wash your hands ____________ and ________________ work to keep from spreading ____________ ______________.

9. A person who has a low accident record may be classified as habitually ______________, ______________, ______________, and ______________.

10. The safe way is the ______________________ way to use a tool or machine.

11. The chance for back injuries is less if the knees are __________ when lifting a heavy object.

12. In order to keep one's fingers from being smashed when cutting sheet metal, they should be kept out of the space between the tin snip's ____________.

13. When carrying edge tools, the cutting edges should point toward the ________________.

14. All grinding should be done on the ___________ of most grinding wheels.

15. Of all the accidents that occur in school shops and industrial plants, approximately ____________ per cent are caused by human carelessness.

16. There is less danger of shop apron strings getting caught in machine parts if they are tied in the ______________.

17. Hand injuries may be reduced when handling large sheets of metal by using ______________ or pads of heavy _______________.

18. The danger of electrical shocks may be reduced when connecting electrical appliances if one's hands and feet are ____________.

19. Oil or water that has been spilled on the floor should be cleaned up immediately to prevent _______________ hazards.

20. When a cold chisel is used for cutting or chipping, ____________ should be worn.

21. In order to reduce hand injuries, files should be furnished with _________________.

22. Burrs should be removed from the edges of sheet metal with a _________________.

23. Stairways should be adequately lighted and kept ______________ of all materials.

24. A person should never use a cold chisel that has a ______________ head.

25. A person should never turn or start a machine without first making sure all safety appliances are in ______________ and ______________ ______________.

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. List two cases where speed is essential in administering first aid

   (A) ______________________ (B) ______________________

2. List four precautions that should be followed before connecting any electrical appliance.

   (A) ____

   (B) ____

   (C) ____

   (D) ____

3. List the things that must be considered in order to keep from being hurt in the shop.

   (A) ____

   (B) ____

   (C) ____

FIRE EXTINGUISHERS

Fire is a danger that must be constantly guarded against. Good housekeeping and habits of work will serve as important deterrents, but they will not eliminate the chance of fire occurring. Therefore, the know-how of what to do in the case of fire must be clearly understood.

Fire extinguishers can well be worth their weight in gold during the first few minutes after a fire starts and the time the fire trucks arrive. Since different types of extinguishers are used for different classes of fires, it is important to know the types of extinguishers that may be used on a particular class of fire. For example, the use of an extinguishing agent that conducts electricity on a fire in live electrical equipment is apt to produce fatal results. Directions concerning the use, precautions, charging, and inspection are usually shown on the front of the extinguisher.

The chart shown below summarizes the types of extinguishers that are suitable for extinguishing various classes of fire.

<u>Fire Extinguisher Chart</u>

Types	Foam	Dry Powder	Anti-Freeze	Soda and Acid	Carbon Dioxide
<u>Class "A",</u> <u>Fires</u> (Wood rubbish, Textiles, etc.)	x		x	x	
<u>Class "B"</u> <u>Fires</u> (Oils, Greases, and paints)	x	x			x
<u>Class "C"</u> <u>Fires</u> (Live electrical equipment)		x			x

Information
Sheet No. 2

Covering
Units 5-8

FIRST AID

The primary purpose of school or industrial plant first aid is t give prompt treatment to all who suffer injury while at school or work. Every other consideration is secondary to this. First aid is the immediate and temporary care administered to the victim of a serious accident or sudden illness until the services of a doctor can be obtained. Often an accident victim is hurt rather than helped by persons who want to do something but have not had adequate training in giving first aid properly. Competent first-aid people must be abl to find out what the injuries are and must know how to give temporary care for the injuries.

Unless it is known that the injury will not be further aggravate an injured person should not be moved. Improper, careless moving may increase the severity of the injury and may even cause death. It is important to know not only what should be done for an injured person but also what NOT to do.

All schools and industrial plants should have first-aid material available to provide emergency first aid, and they should also have someone on hand at all times who is especially trained to use these materials. Students and workers should report all injuries to their instructors or foremen, no matter how small the injury may seem to be Many small injuries have developed into rather serious cases.

27B
Information
Sheet No. 3

Covering
Units 5-8

SAFETY

Safety in the school shop and in industrial plants is the responsibility of everyone. Regular inspections of the facilities will do a great deal to reduce accidents. This may be accomplished by removing potential causes of accidents, as well as making the people who work in the shops and plants more safety-conscious.

In most of the cases, injury could have been avoided if the proper precaution had been taken. Keeping from being hurt consists of three major ideas:

1. Knowing where an accident might happen.

2. Using safe practices to reduce the chances of an accident.

3. Taking precautions to keep from being hurt if the accident happens in spite of your efforts to prevent it.

Each precaution or safety practice applies to you personally. Remember, learning to use a tool or machine the correct way is learning to use it the safe way.

Listed below are some precautions and suggestions one should observe in his everyday routine. You can not turn on and off safety practices at your convenience; they must become an established habit.

1. Occasionally you may find it convenient to place rivets or screws in the mouth. This procedure is unwise because of the chance of infection from objects which are not sterile.

2. To light a soldering furnace, have the match, or preferably a spark lighter ready, and stand to one side.

3. You can not tell if a soldering copper or piece of metal is hot or cold by looking at it. To prevent a burn, always assume that the object in question is hot.

4. Only one person should be permitted to operate the squaring shears at one time. Most accidents on the squaring shears occur when one person is handling the material and another is operating the foot treadle.

5. Jewlery worn on the hands may get caught in moving parts of machines and cause serious injury. Always remove your rings and wrist watch before going to work, either keeping them in your pocket or locking them in a safe place.

6. In shops which contain open-flame soldering equipment, gas forges, gas furnaces, and welding equipment, there is always a chance that your clothing may catch on fire. The recommended procedure for extinguishing a clothing fire is to smother the flames with the fire blanket.

7. Fumes are given off when a hot copper is placed on a cake of sal-ammoniac during the tinning process. Stand to one side and avoid breathing them. Fellow workers should be protected by proper ventilation.

8. Cold chisels, rivet sets, hand groovers, and punches driven with a hammer become mushroomed with use. A piece from the end could break off when struck by a hammer and cause an injury. To prevent this, periodically grind a bevel on top.

9. Buffing causes most materials to become uncomfortably warm. To prevent the fingers from being burned, students sometimes attempt to hold the work with a cloth or apron. This is a very dangerous practice, since the cloth may be caught in the machine. This situation can be reduced if a container of water is available for cooling the work.

10. Before using a pneumatic tool such as a riveting hammer, blow out any moisture and dirt from the airline prior to attaching the hammer. This prevents clogging the air passages in the hammer. Make sure no one is in line with the blast of air because serious accidents have occurred because of the released pressure of air lines.

11. Always select the correct tool and use it as at was intended to be used. Accidents happen when an improper or a makeshift tool is substituted for the correct tool.

12. Most equipment and power machinery was designed to be operated by one person. Serious accidents may happen when two people try to use or operate equipment or machinery at the same time. This is especially true with the squaring shears, slip roll former, power grinder, and drill press.

13. One of your responsibilities is to keep the floor around you free of scrap material. Place scrap material in containers provided for that purpose. Make a habit of keeping the floor clean.

14. Acid is destructive if allowed to splash on clothing. Acid causes severe and painful burns, especially if not diluted. If it is splashed on the skin, wash it with water at once and report to the teacher. To avoid accidents, always add sulphuric acid to the water. Never add water after the acid is placed in the container.

15. The buffer is a power machine used for polishing the surface of copper, brass, pewter, plastic, and art metals. The operator must know the safe practices that are to be observed before he attempts to use this machine.

    A. Never attempt to use power to attach a buffing wheel to the motor shaft.

    B. Inspect the mounting and shaft fastening to make sure both are in good operating condition.

C. Always wear a good pair of goggles.

D. As the power is turned on, there is rapid increase in the speed and a great strain is placed upon the buffing wheel. It is a good practice to stand to one side when turning on the power.

E. Hold the work being buffed securely with both hands to keep the work from being pulled from the operator.

F. Hold small pieces of work with an approved jig.

G. Hold the work being buffed below center as the wheel revolves toward you.

H. Use a small wheel when polishing the inside of a bowl.

I. Only one person at a time is permitted to use the buffing wheel.

J. Do not use a cloth to hold material being buffed.

K. Do not permit others to stand behind a revolving buffing wheel.

L. Give your full attention to the job.

16. In forming sheet metal with a stake, one should use the hands or a mallet, but never a hammer. Misplaced hammer blows leave marks on the stake and tend to break down the sharp edges.

17. If dust or a small piece of material gets into your eye, hold your eye closed. Never irritate your eye by rubbing it with your hand or blinking your eyelid.

18. Shops often contain a number of electrical appliances having electrical cords, such as lamps, soldering coppers, and portable drills. Four precautions must be taken before connecting any electrical appliances:

A. Your hands must be dry.

B. The switch, if any, must be turned off.

C. The electrical cord should be in good condition.

D. You must not be standing in a damp place or touching a plumbing fixture or any metal pipe.

19. Good personal habits that help prevent accidents are:

A. Wear a shop apron. Always tie your apron in the back.

B. Remove outer garments. When you leave at the end of the work period, there is less chance of catching cold if you have a coat or sweater to put on.

C. Wash your hands. Washing your hands before going to work and again at the end of the work period is good practice.

D. Roll long sleeves or button securely and tuck in or remove your tie.

E. Keep long hair in place. Loose hair may cause distraction and may be caught by belts or revolving parts.

F. Remove your rings and wrist watch.

G. Report all injuries at once.

H. Always walk in the shop.

I. No horseplay.

20. When handling large sheets of galvanized or black iron, always protect your hands with a pad made by folding a piece of heavy paper or heavy gloves. Carry large sheets of metal on edge.

21. Always put oily rags and cleaning cloths into a safety metal container. This will prevent spontaneous combustion.

22. Several safe practices that apply to hand tools are:

A. Carry edge tools and tools with sharp points with the point or cutting edges down.

B. Never use a tool with a loose part or broken handle.

C. Use a mallet to drive tools with wooden handles.

D. Wear goggles when cutting rivets or when chipping with a cold chisel.

E. Always put a handle on a file before using it.

F. Never strike a hardened steel surface with a hammer because the faces may chip and cause injury.

G. Keep your fingers from between the handles when finishing a cut with tin snips. This will prevent them being smashed.

23. Safe practices that apply to machine tools for sheet metal are:

A. Use a vise and clamp to hold material when drilling holes in sheet metal.

B. Grind only on the face of the grinding wheel.

C. Always wear goggles to trim metal.

24. When lifting a heavy object, keep your back straight and bend your knees.

25. Spilled oil and paint make floors slippery. Remove any oil or paint at once. If you find that the floor around your work station is not safe, report it to the foreman or instructor.

26. Some precautions concerning stairways and ladders are:

    A. Never use a defective ladder.

    B. Be sure the ladder has a solid footing.

    C. Avoid standing on the top of a stepladder.

    D. Always face the ladder when going up or down.

    E. Keep stairway landings free of all materials; do not place tools or materials on stair treads.

Assignment
Sheet No. 3

Covering
Units 10-20

BASIC NON-CUTTING HAND TOOLS AND PROCESSES

In ancient times a man's skills depended mainly upon the strength of his hands, for there were no tools as we know them today. They influenced directly his freedom and nature of living. Gradually man discovered that he might obtain certain added advantages by using various implements which he developed along with his skills. It was through this combination of invention and development of skill that our forefathers were able to give birth to our present-day industrial system.

Although industry is considered by some to be simply a combination of men and machines, it involves far more. It includes, among other things, skills in the care and use of tools. Tools are not only vital in manufacturing, but also in repair and maintenance work. Some individuals tend to disregard the importance of learning how to use and care for tools properly, since they are relatively simple compared to the ingenuity of mass-production machines. This point of view is a mistake because it is essential for the well-trained tradesman to be proficient with tools as well as machines.

You will be expected to use the basic non-cutting sheet metal tools correctly and to care for them properly after studying this assignment and practicing on the job.

Assignment:

1. Read the references listed below.
2. Send a post card to the address below requesting a free copy of the booklet, A B C's of Hand Tools.
   General Motors Corporation
   Detroit, Michigan
3. After completing items 1 and 2, answer the questions listed below and turn in this assignment by ________________.

References:

A. Bruce and Meyer, Sheet Metal Shop Practice, pp. 1-21
B. New York, Hand Processes, pp. 8-25, 33-47.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. Bench plate and stakeholder are synonymous.

T F 2. The face of a hammer used for setting down an edge is slightly concave.

T F 3. A job's stretchout is the same as its layout.

T F 4. Allen wrenches are usually of the adjustable type.

T F 5. A half pattern would not ordinarily be used to lay out each part for a job, if several duplicate parts are required.

T F 6. The maximum number of 5½" x 9" pieces that may be cut from a 30" x 96" piece of sheet metal is 40.

T F 7. The tip of a screw driver should be hardened and tempered.

T F 8. Care should be taken to clean dirt and burrs from the surfaces that are to be clamped.

T F 9. For best results a hammer handle should be grasped rigidly.

T F 10. The quality and condition of a mechanic's tools are frequently an indication of the quality of his work.

T F 11. The peen end of a hammer used for riveting is single-tapered.

T F 12. A thoughtful sheet metalworker never uses a stake to back up stock that is to be cut with a cold chisel.

T F 13. The better sheet metalworkers use both faces of a soft-head hammer to facilitate more equal wear.

T F 14. Brake lines should be scribed with a scratch awl.

T F 15. The point of the tool used for scribing around a pattern should be sharpened at approximately 60 degrees.

T F 16. The range of weights for ball-peen hammers is less than that for riveting hammers.

T F 17. Wedges are used as a means of holding the hammer head on its handle.

T F 18. Setting hammers are available in a greater range of sizes than those used for riveting.

T F 19. The use of too large size monkey wrench is apt to result in a broken fastener.

T F 20. Copper is a satisfactory material for soft removable vise jaw coverings.

T F 21. A hard pencil (9H) is recommended for layout work on such metals as stainless steel, monel, and aluminum.

T F 22. The cheek of a hammer used for setting down an edge is slightly convex.

T F 23. It is impossible to grip work rigidly between vise jaws that have been serrated.

T F 24. The tip of a screw driver is tanged to prevent turning in the handle.

T F 25. The best grade wrenches are made from a high-quality steel that has been alloyed with chromium and vanadium.

T F 26. It is advisable to place sheet metal upon a ferrous metal surface when laying out a job.

T F 27. Poor judgment in applying force to small tools is apt to result in injury to one's hands or fingers.

T F 28. To facilitate its efficient use, the sides of a screw driver tip should be slightly convex.

T F 29. A paper pattern should not be used to lay out a series of duplicate parts.

T F 30. A screw driver is apt to be broken if it is used as a chisel or pry bar.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. An improperly shaped screw driver tip is apt to burr or damage the screw ________________.

2. The tip of a Phillips screw driver is shaped like a _____________.

3. A nut that does not start easily may generally be loosened by striking the handle of the wrench with the heel of one's ________.

4. Hammers that have heads made entirely of soft material are called ________________.

5. The jaws of a monkey wrench should be placed so that they point in the ____________ direction in which the work is being turned.

6. For best results the hammer handle should be grasped near the ________________.

7. Conservation of material may be achieved in layout work by ________________ irregular-shaped patterns.

8. Usually it is best to place a pattern at one ________________ of a piece of sheet metal for economy in layout.

9. The surface of aluminum should not be ________________ because it is apt to weaken it or ruin its surface.

10. Soft removable vise jaw coverings are used to prevent ____________ material that is to be clamped in a vise.

11. The handle of a screw driver is apt to split when struck with a ________________.

12. Patterns involving many details and accurate fitting may be held in proper place most satisfactorily by means of ______________.

13. Soft-head hammers will not damage the surface of a material that is ______________ than the head of the hammer itself.

14. Special care must be taken in using a ____________ clamp to see that both jaws are in complete contact with the work.

15. Pliers are used by sheet metalworkers for the purpose of holding and ____________ sheet metal parts.

16. A light application of _______ on the threads of a machine screw will facilitate its being driven into a tapped hole.

17. The size and shape of screw drivers are largely determined by the ____________ for which they are intended.

18. Stakes are used primarily when machines are not ____________ or ______________for the job at hand.

19. A stake that is square on one end and round on the other and flat on top will probably be a _____________________stake.

20. A universal holder is used for _________________.

21 Stakes are used as an aid in ____________________ sheet metal.

22. Screw drivers are used primarily for ___________________ or ___________________ slotted screws.

23. The accuracy of a pattern may be ______________ by using a dull prick punch for layout work.

24. The portable anvil which is used for backing or bucking up rivet heads and straightening out kinks, is called a hand____________.

25. When striking a center punch with a hammer the point of action should be watched, rather than the head of the _______________.

26. The tip of a screw driver blade should be in ________________ condition.

27. It is advisable to keep one face of a soft-head hammer ________ for flat work.

28. One who tightens a vise by striking its handle with a hammer is apt to be accused of possessing _______________ work habits.

29. The handle of a file is protected from splitting by a ________ ________________.

30. The proper size Phillips screw driver will not ______________ and burr the end of a Phillips head screw.

31. The final adjustment of a ____________ clamp is made with the rear screw.

32. It is important to keep prick punches ____________ for layout work.

33. The use of too large a size open-end wrench frequently results in ____________ to one's hands and the fastener.

34. Layout work on ordinary metals is done with a sharp ________________.

35. The maximum number of 9" x 11" pieces that may be cut from a 30" x 96" piece of sheet metal is ____________.

36. In transferring a pattern to a piece of sheet metal, the pattern should usually be held in position with ______________ or ________________.

37. A high degree of accuracy may be achieved in transferring a pattern by tilting the scratch awl with the point ____________ the pattern.

38. The points where holes are to be punched are marked with a ______________ ______________.

39. Tools will last longer, give better service, and be less expensive over a long period of time if they are properly ____________ and ____________ for.

40. The chisel used most by sheet metalworkers is a (an) ____________ ____________ ____________.

41. The instrument used to draw large arcs and circles is called a (an) ____________ ____________ or ____________ ____________.

42. The cup-shaped hole in a rivet set is used to form the ____________ ____________ of a rivet.

Listing

Directions: List the items called for in each of the following statements. Select your answers carefully.

1. The types of clamps used in bench work are:

(A) ______________________ (B) ______________________

2. List the component parts of a standard blade screw driver.

(A) ______________________ (C) ______________________

(B) ______________________

3. List the common-shaped pieces of iron that are usually found around any metal shop.

(A) ________________ (C) ________________ (E) ________________

(B) ________________ (D) ________________

4. List the three types of patterns used in sheet metalwork.

(A) ________________ (C) ________________

(B) ________________

5. The commonly used types of pliers for sheet metalwork are:

(A) ________________ (C) ________________

(B) ________________

6. The materials used for soft-head sheet metal hammers are:

(A) ________________ (D) ________________

(B) ________________ (E) ________________

(C) ________________ (F) ________________

7. Five types of hammers that the sheet metalworker should have for his work are:

(A) ________________ (D) ________________

(B) ________________ (E) ________________

(C) ________________

8. List the different kind and shapes of files used most commonly in sheet metalwork.

(A) ________________ (E) ________________

(B) ________________ (F) ________________

(C) ________________ (G) ________________

(D) ________________

Matching

<u>Directions:</u> In the left hand column is a list of items. The right hand column contains descriptive phrases or synonymous terms. Match the descriptions to the terms by placing the letter of the description in the blank at the left of the appropriate term.

_____ 1. square stake

_____ 2. hatchet stake

_____ 3. conductor stake

_____ 4. needlecase stake

_____ 5. hollow mandrel stake

_____ 6. candlemold stake

_____ 7. beakhorn stake

_____ 8. creasing stake

_____ 9. double-seaming stake

_____ 10. bottom stake

A. has two cylindrical horns of different diameter which are used for seaming, riveting, and forming

B. straight stake with hard-handed edge which may be used for making straight, sharp bends

C. has a slot in which a bolt slides permitting the stake to be clamped rigidly to the bench

D. has one horn tapered for forming conical work, and the other horn has grooved slots for turning, wiring, and heading operations

E. has a fan-shaped end which is used for dressing a flanged circular bottom

F. available in three different shapes of heads; coppersmith, bevel edge and common

G. consists of two horns with elongated heads which are used for backing up small cylindrical jobs when laying down double seams

H. a general purpose stake having a round tapered horn on one end and a square tapered horn on the other

I. has a round slender horn for small tubes and wire rings and a heavier horn of rectangular cross-section for square work

J. has a large diameter horn for general purposes, and a small diameter horn for tube forming or reshaping.

Assignment
Sheet No. 4

Covering
Units 21-28

HAND CUTTING TOOLS

Sheet metalworkers require many different types of cutting tools in doing their work. Such tools are available in a great many different styles in order to meet the various requirements. They are designed for the purpose of cutting both straight and curved parts.

Every job that is made from sheet metal involves a certain amount of cutting at some time or other. Different types of snips and shears are available for cutting material into the desired shapes. Rough edges are frequently removed with a file. Punches and drills are used to shape holes for fasteners. It is essential that one desiring to learn the sheet metal trade become familiar with and develop skills in the performance of such operations.

In this assignment you are being given an opportunity to learn how to use correctly and care for properly the various types of hand cutting tools that are used in the sheet metal trade.

Assignment:

1. Read the references listed below.
2. (a) Make a list of the hand type cutting tools a good sheet metal worker should have in his tool box.

   (b) Estimate the cost of each tool listed above.
3. After completing items 1 and 2, answer the questions below and turn in this assignment by ______________.

References:

A. Bruce and Meyer, Sheet Metal Shop Practice, pp. 8-17, 66-79.
B. New York, Hand Processes, pp. 26-32, 48-55, 76-80, 89-105, 115-120

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. Movable parts of a hand punch should be oiled frequently.

T F 2. A new hack saw blade is apt to be broken if it is started in an old cut.

T F 3. A chisel that does not maintain a sharp cutting edge probably needs to be rehardened and properly ground.

T F 4. The better grade of files will cut on both the forward and return strokes.

T F 5. Hack sawing should be done approximately one-fourth of an inch away from the end of the vise jaws.

T F 6. One set of teeth is cut deeper than the other in a double cut file.

T F 7. The head rather than the cutting edge, should be watched when using a chisel.

T F 8. It is advisable to clamp material in such a way that the greatest number of teeth possible come in contact with the surface being sawed.

T F 9. The center should be marked with a prick punch before a hole is cut with a solid punch.

T F 10. For best results in cutting sheet metal one should use the entire length of the hand-snips blades for each cut.

T F 11. It is permissible to allow hand-snips to be in contact with the bench top when cutting sheet metal.

T F 12. Single-cut teeth form an angle of from 65 to 85 degrees with the edge of a file.

T F 13. The teeth of a file are apt to be damaged if they are allowed to come in contact with other tools.

T F 14. Material that chatters while being filed is apt to result in the breakage of the file's teeth.

T F 15. Files break or chip easily.

T F 16. It is sound shop practice to cut thick sheet metal with the bull dog snips.

T F 17. A drill is likely to stay sharp longer if a lubricant is used.

T F 18. A drill will cut over size if its lips are unequal in length.

T F 19. Punches can be used more successfully on light-gage sheet metal than drills.

T F 20. It is recommended that when light-gage materials are filed, they be filed in a crosswise direction whenever possible.

T F 21. It is recommended that hack sawing be done with only the middle half of a blade.

T F 22. The bend should be started in the middle when forming a round job by hand.

T F 23. A 10-inch hack saw blade would measure 10 inches from end to end.

T F 24. The chuck of a hand drill will hold larger size twist drills than the breast drill.

T F 25. A single-cut second file will cut more rapidly than a single-cut bastard file.

T F 26. A blowhorn stake would be satisfactory to form a square corner by hand.

T F 27. A properly formed job will not have any kinks or marks on its surface.

T F 28. Machine cutting tools frequently cannot be used on a particular job because of its shape, construction, location, or position.

T F 29. Hack saw blades will become soft and useless if one saws too fast.

T F 30. A little oil applied to the sides of a hack saw blade when making a deep cut will help prevent binding.

T F 31. The hardness is apt to be removed from a file if it is heated.

T F 32. The lips of a twist drill must have a clearance angle of 59 degrees for average work.

T F 33. Single-cut files remove material faster than double-cut files.

T F 34. No cutting lubricant is necessary when hack sawing by hand.

T F 35. A piece of scrap metal should be inserted in the groove for a groove seam of a job prior to its being formed round by hand.

T F 36. The full length of the cutting edge of a chisel should be used in starting a cut in light sheet metal.

T F 37. A setting down hammer should be used to form a square corner when using a stake.

T F 38. The lower speed breast drills are used for the smaller size twist drills.

T F 39. A center punch mark should be used to draw the center of an improperly started hole into its correct position.

T F 40. Lard oil is a suitable lubricant to use in drilling a hole in mild steel.

T F 41. A pair of aviation snips may be used to cut either to the right or left.

T F 42. The center portion of vise jaws should be used generally for clamping narrow band iron.

Completion

Directions: Fill the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. If possible, waste material should be cut from a sheet metal part in ______________ continuous piece.

2. The diameter of a stake horn should be ___________ than the diameter of the job formed.

3. A hand punch can be used only when the holes to be punched are near the ___________ of the sheet.

4. The wire brush that is used to clean files is called a file ____________.

5. A cold chisel is used to cut cold metal _________ than itself.

6. The cutting edge of a cold chisel is ground to form an included angle of between _________ and ___________ degrees.

7. The tendency of a chisel to damage the jaws of a vise while cutting light-gage sheet metal is prevented by protecting the jaws with two pieces of angle ___________.

8. The centers of holes to be laid out on 24-gage or less material should be marked with a ___________ punch.

9. Chipping refers to the operation for removing stock from _____________ surfaces.

10. The wire brush used to clean a file should be moved in a direction ____________ to the file's teeth.

11. Files with loose handles, or no handles at all, frequently cause injury by causing the file's _____________ to be drawn into the palm of a workman's hand.

12. A wingnut is used to tighten the blade in a __________ _________ type of hack saw frame.

13. Every other tooth is bent slightly to the right on an __________ set hack saw blade.

14. The number of teeth required per inch for a hack saw blade should be determined in light of having a minimum of ________ or more teeth in contact with the surface being sawed.

15. The edges of hand snips should be held at _________ angles to the material being cut.

16. When cutting sheet metal with straight snips, one should grasp the ________________ part of the sheet with his free hand.

17. Short sections of teeth are bent in opposite directions on a ___________ set hack saw blade.

18. The edge of a file which does not have any teeth is called a ________________ edge.

19. Single-cut files are used for thin work and _________________.

20. All standard mill files are ______________ cut.

21. The cutting surface of a file is referred to as the ___________.

22. R.P.M. refers to _____________ ______________ _____________.

23. Chisels should be cooled periodically while they are being ground to prevent drawing the _______________.

24. Hand snips should be adjusted when the blades _____________ or are too far apart.

25. The tendency to tear light sheet metal at the corners while it is being cut with a chisel is reduced by starting the cut at the ________________ of the line rather than at the end.

26. A hack saw blade with no set would __________________.

27. Every third tooth is straight on a ________________ set hack saw blade.

28. The pressure should be released on the _______________ stroke of a hack saw.

29. If the teeth in a hack saw blade are too fine for a particular job they will _______________.

30. One handle remains stationary in the operation of ____________ ________________ shears.

31. Bail is the trade term for a ______________ _______________.

32. The metal around a punched hole is flattened with a ____________.

33. Snips for heavy-gage materials have ______________ handles than those used for light materials.

34. The tendency of teeth on a new file to catch and break is reduced if the file is broken in on a ________________ surface.

35. Soft metal particles may be removed satisfactorily from a file with a piece of ______________ _____________.

36. The cutting end of a cold chisel is ________________ and ______________ to make it stand up longer.

37. It is dangerous to use a chisel with a ________________ head because the burrs might fly off and cause an injury.

38. Files designed especially for smoothing lead, solder, aluminum, and stainless steel are called ________________ files.

39. The centers of holes to be laid out on 22 gage or heavier material should be marked with a ________________ punch.

40. Hack saw blades are classified by hardness as being either _________ hard or ________________.

41. The end of the file opposite the portion that fits into the file handle is called the ________________.

42. The all-purpose file particularly adapted for finishing purposes is called a ________________ file.

43. The ease with which a piece of metal may be cut depends on the speed and ________________ applied to the saw.

44. Fine tooth hack saw blades are ________________ set.

45. The necessary opening to start an inside curved cut with hand snips is made with a hammer and ________________ or hollow ____________________.

46. When cutting a circle from sheet metal, handling may be facilitated by cutting off the ________________ of the stock first.

47. Hand punches are used extensively for punching _____________ and bolt holes.

48. Ragged edges or "fins" are removed from sheet metal with a ________________ cut file.

49. When the levers of a properly adjusted hand punch are closed, the punch should enter into the die approximately ______________ to ________________ inch.

50. The included angle of a chisel should be _____________ for hard metals that it is for soft metals.

51. Carbon steel twist drills cannot be operated at as high speeds nor do they stand up as long as drills made from _____________ ________________ steel.

52. The length of a file is specified as the distance from its ________________ to ________________.

53. Nicking sharp corners that are to be hack sawed reduces the tendency to ________________ the blade of its teeth.

54. The starting point on material to be hack sawed should be marked with a ________________.

55. Material can be conserved when cutting large holes, by cutting within ______________ inch of the line with a hammer and chisel.

56. When cutting heavy flat stock with a chisel, the material should be cut approximately ________________ the way through from each side.

57. Holes that are to be punched in sheet metal should be backed up with the ________________ ______________of a block of hardwood or a ________________ cake.

58. The teeth of a properly inserted blade should point away from the hack saw ____________________.

59. A circle the size of the hole to be punched should be scribed on the metal when the hole is to be cut with a ___________ punch.

60. Carbon steel hack saw blades usually have a carbon content varying between _____________ to ___________ per cent.

61. A file should be ________________ a little on its return stroke.

62. The material from which files are made is usually a high grade of ______________ __________________.

63. The number of teeth used for hack saw blades range from ________ to ___________________ per inch.

64. A hack saw cut should be started with the ___________ end of the blade.

65. Holes that have been drilled in light sheet metal are apt to have _________________ on their edge.

66. Adjustable hack saw frames are designed to accommodate blades of _______________ to ____________inches in length.

67. A new file should always be _____________ to reduce the tendency of the teeth to clog.

68. "Pins" should be removed from a file with a wire ______________.

69. There is less tendency for the corners of a cold chisel to dig into a surface if the cutting edge of the chisel has been ground slightly _____________________.

70. Snips that have blades shaped so they will cut either irregular or straight outlines are called ______________________ snips.

71. The compound-lever shears are constructed with handles so arranged as to give sufficient _________________ for cutting______________ gage metal.

72. Snips specially designed for cutting scrolls and circles of any diameter are called ______________ _________________.

73. Hollow punches are used to punch __________ holes than those made with a solid punch.

74. Button punching is done with a __________ __________ punch.

75. In button punching, the die is set so the punch makes __________ but does not punch ________________ the metal.

Multiple-Choice

Directions: In the space at the left of each statement write the letter of the item which will provide the correct answer to complete the statement.

_____ 1. Among the various types of hand snips available (A) straight snips; (B) circle snips; (C) hawk's-bill snips; (D) aviation snips; are the most practical because they may be used for a greater variety of work.

_____ 2. Cold chisels are usually made from steel containing approximately (A) 0.20%; (B) 0.40%; (C) 0.60%; (D) 0.80%; carbon.

_____ 3. The largest size hole that can be cut with a hand punch is approximately (A) 1/4"; (B) 1/2"; (C) 3/4"; (D) 1".

_____ 4. Bulldog snips, rather than straight snips, are recommended for cutting mild steel between (A) 28 and 32; (B) 24 and 28; (C) 20 and 24; (D) 16 and 20; gage.

_____ 5. The teeth of a double-cut file form angles of approximately (A) 50 to 55 and 80 to 90 degrees; (B) 40 to 45 and 70 to 80 degrees; (C) 30 to 35 and 60 to 70 degrees; (D) 20 to 25 and 50 to 60 degrees; with the edge of the file.

_____ 6. Sheet metalworkers generally find greater use for the (A) cape; (B) round nose; (C) flat; (D) gage; type of chisel.

_____ 7. The included angle of a twist drill used for average work should be approximately (A) 30; (B) 60; (C) 90; (D) 120; degrees.

_____ 8. Among the following types of hand snips, the least satisfactory for cutting an inside curve is the (A) hawk's-bill; (B) circular; (C) trojan; (D) aviation.

_____ 9. The capacity of hawk's-bill snips is (A) 10; (B) 15; (C) 20; (D) 25; gage mild steel.

_____ 10. Manufacturers recommend a cutting speed for hack sawing of between (A) 20 to 30; (B) 40 to 50; (C) 60 to 70; (D) 80 to 90; strokes a minute.

_____ 11. The various size holes that may be made with solid punches range from (A) 3/32" to 1/2"; (B) 3/16" to 3/4"; (C) 1/8" to 1"; (D) 1/4" to 1/2".

_____ 12. The various size holes that may be made with hollow punches range from (A) 3/8" to 2"; (B) 1/2" to 6"; (C) 1/8" to 3"; (D) 1/4" to 4".

_____ 13. Among the following types of hand snips, the least satisfactory for notching is the (A) straight; (B) combination; (C) bulldog; (D) stock.

_____ 14. The capacity of aviation snips is (A) 8; (B) 16; (C) 24; (D) 30; gage mild steel.

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. List the two most common types of cuts used for files.

(A) ____________________ (B) ____________________

2. The speed at which twist drills should revolve depends upon:

(A) ____________________ (C) ____________________

(B) ____________________

3. List the commonly used types of hack saw frames.

(A) ____________________ (B) ____________________

4. Sheet metalworkers generally use a cold chisel for:

(A) ____________________ (C) ____________________

(B) ____________________ (D) ____________________

5. List the four common types of shanks used for twist drills.

(A) ____________________ (C) ____________________

(B) ____________________ (D) ____________________

6. Systems for designating drill sizes are:

(A) ____________________ (C) ____________________

(B) ____________________ (D) ____________________

7. Types of alloys steels used for hack saw blades are:

(A) ____________________ (C) ____________________

(B) ____________________

8. List the three main parts of a twist drill.

(A) ______________________ (C) ______________________

(B) ______________________

9. Methods for determining the size of a drill are:

(A) ____

(B) ____

(C) ____

10. Factors in determining the size handle to use for a file are:

(A) ______________________ (B) ______________________

11. Major groups in which hand snips may be classified are:

(A) ______________________ (B) ______________________

12. Shapes of the commonly used files are:

(A) ______________________ (E) ______________________

(B) ______________________ (F) ______________________

(C) ______________________ (G) ______________________

(D) ______________________ (H) ______________________

13. The functions of twist drills flutes are:

(A) ______________________ (B) ______________________

14. A file is made up of the following parts:

(A) ______________________ (D) ______________________

(B) ______________________ (E) ______________________

(C) ______________________

Matching

Directions: In the left hand column is a list of items. The right hand column contains descriptive phrases or synonymous terms. Match the descriptions to the terms by placing the letter of the description in the blank at the left of the appropriate term.

1. Stakes used for various operations:

_____	1.	creasing stake	A.	form square jobs
_____	2.	beakhorn stake	B.	form cylindrical jobs
_____	3.	blowhorn stake	C.	form conical jobs
_____	4.	conductor stake	D.	form end of bail

2. Teeth per inch required for hand hack sawing various materials: (Note: Each letter may be used more than once.)

_____	1.	mild material	A.	14 teeth per inch
_____	2.	thin tubing	B.	18 teeth per inch
_____	3.	angle iron	C.	24 teeth per inch
_____	4.	tool steel	D.	32 teeth per inch
_____	5.	iron pipe		
_____	6.	sheet metals		
_____	7.	brass		
_____	8.	electrical conduit		
_____	9.	high speed steel		

3. Type of snips used for various jobs: (Note: Each letter may be used more than once.)

_____	1.	bulldog snips	A.	valuable for cutting holes in pipe
_____	2.	stock shears	B.	12-gage mild steel maximum capacity
_____	3.	circle snips	C.	blade inlaid with special alloy for cutting stainless steel
_____	4.	hawk's-bill snips	D.	cuts irregular compound lever type and straight patterns with less effort
_____	5.	aviation snips		
_____	6.	trojan snips		

Assignment
Sheet No. 5

Covering
Units 29-39

SHEET METAL SEAMS AND HEMS

Construction materials of industry have at least one characteristic in common--they all must be of such a nature that they can be fabricated. Without this characteristic they would be of relatively little use. Whether the materials be wood, plastic, or ceramic, they all involve special processes that are used in their fabrication. Similarly, sheet metal has special processes that are used in its fabrication.

Seaming and hemming are basic operations in the sheet metal trade. They are used as a means of joining edges together, stiffening, strengthening, and eliminating sharp edges. Every sheet metal worker should be familiar with the uses of the more common types and the procedures for making them, since many jobs will involve their use.

Information is included in this assignment which will enable you to become acquainted with the more common types of seams and hems used in sheet metalwork. Descriptions and specifications, as well as uses and procedures, will be studied concerning the grooved, single, double, dovetail, and Pittsburg types of seams, and single, double, and wired-edge hems.

<u>Assignment</u>:

1. Read the reference listed below.
2. In this assignment you are to complete either part (a) or (b).
    - (a) Prepare a series of small sample seams and hems from scrap stock. Base your selections on the types that are most commonly used in the shop where you work. Indicate on each sample the necessary specifications and formulas.
    - (b) Sketch a series of sample seams and hems that are most commonly used in the shop where you work. Use a small card for each sketch. Indicate below each sketch the necessary specifications and formulas.
3. After completing items 1 and 2, answer the questions below and turn in this assignment by ____________________.

<u>References</u>:

A. Bruce and Meyer, <u>Sheet Metal Shop Practice</u>, pp. 9, 43, 54, 81-172.
B. New York, <u>Hand Processes</u>, pp. 71-75, 81-88, 106-114, 122-145.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. A combination hammer resembles a setting-down hammer more than a riveting hammer.

T F 2. The depth for notching a dovetail seam varies from ¼ to ½ inch.

T F 3. A single seam may be used as a stop on a cover to prevent its slipping into a container.

T F 4. The inner edges of a double seam should be approximately one thirty-second of an inch larger than the over-all width of the seam.

T F 5. Cylindrical jobs having straight sides are usually wired before they are formed.

T F 6. The designated weight of tinners' rivets decreases as the shank diameter size increases.

T F 7. A dovetail seam may be used to join two sections of pipe together.

T F 8. Metal must be shrunk when making an outside circular flange.

T F 9. A rivet set is used to upset a rivet.

T F 10. Double seams are sufficiently strong so that it is not necessary to use rivets or bolts to hold them in place.

T F 11. Wide double seams are easier to form on rectangular than on cylindrical jobs.

T F 12. A double seam is frequently referred to as a hammer lock.

T F 13. The edges of a grooved seam will be cut if the groover is not wider than the seam.

T F 14. Tinners' rivets are available in lengths ranging from approximately 1/8 to 1/2 inch.

T F 15. Wider circular flanges can be formed from light-gage sheet metal rather than heavy-gage.

T F 16. The large ends of tapered jobs are usually wired after they have been formed.

T F 17. A setting hammer is recommended for completing the final fold of a double seam.

T F 18. A hand groover is used to finish a Pittsburgh lock after its edges have been joined.

T F 19. A rivet should not be upset too much because it will distort the metal around it.

T F 20. Soldering is required to make double seams watertight.

T F 21. A hollow mandrel stake may be used for grooving both cylindrical and flat stock.

T F 22. Metal becomes thicker as it is shrunk.

T F 23. The curvature of stake horn should be greater than the curvature of a job on which a grooved seam is to be locked.

T F 24. The ends of the wire for a wired edge should meet at the center of a cylindrical job's grooved seam.

T F 25. The flanged edge of a Pittsburgh lock should always be less than the depth of the pocket.

T F 26. A wavy seam is apt to result on curved work or fittings if the lap of a Pittsburgh lock is more than one-fourth inch wide.

T F 27. The edges of a job with a grooved seam should be folded before its wired edge is completed.

T F 28. The Pittsburgh lock is used frequently in heating and ventilating work.

T F 29. Cracks are less apt to develop in stretching metal than the tendency to buckle.

T F 30. A hard-head rather than a soft-head hammer is recommended for stretching metal.

T F 31. The total allowance for a grooved seam should be added to each side of the pattern.

T F 32. The hole in the main member of a tee-joint is usually laid out and cut before fitting the tee.

T F 33. The allowance for double and single seams are the same.

T F 34. A cross-peen hammer should be used to complete a wire edge.

T F 35. When making a grooved seam, the groove should be started in the middle of the seam.

T F 36. A rivet set may be used to head either countersunk or flat head rivets.

T F 37. The cutting edges of snips and squaring shears will be nicked if they are used to cut wire.

T F 38. Riveting would be more satisfactory than a groove seam for joining 10-gage sheet metal.

T F 39. Collars may be dovetailed to another part of a job without the use of solder, bolts, or rivets.

T F 40. In order for a person to use a micrometer, he will need a good background in mathematics.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. Malleable iron rivets are made more corrosive resistant and easier to solder by coating them with ____________.

2. A space grooving rail is used to ____________ inside grooved seams.

3. The body of a rivet is called the ____________.

4. Grooved seams are seldom formed on material heavier than ________ gage.

5. Dovetail seams must be ____________ if they are to be watertight.

6. The shallow cup-shaped hole in the end of a rivet set is used to ____________ the ____________ on the rivet.

7. A wired edge on 24-gage or lighter material requires an allowance equal to __________ times the diameter of the wire.

8. The hand tool used for locking an outside grooved seam is called a ____________ ____________.

9. Metal must be shrunk when making an ____________ circular flange.

10. Hand riveting may be done either with a hammer and rivet ________ or a pneumatic riveting ____________ and die.

11. Allowances for grooved seams on sheet metal 24-gage or lighter, are equal to __________ times the width of the seam.

12. Rivet holes should be made slightly ____________ than the diameter of the rivet.

13. The ends of a wire for a wire edge should meet approximately ________ to ________ inches from one end of the sheet metal.

14. The head of a flat rivet is thicker and smaller in diameter than the similarly shaped head of a _______________ rivet.

15. The tendency for a flange to buckle may be reduced by using a _______________ head hammer.

16. The depth for notching a dovetail seam varies from __________ to __________ inch.

17. A wide inside circular flange is more apt to _______________ than a narrow flange.

18. Dovetail seam locks can be formed with either _______________ or a hammer and _______________.

19. The length of a _______________ rivet is not equal to the length of its shank.

20. Hammering tends to make metal hard and _______________.

21. Five hundred 8-ounce rivets would actually weigh __________ounces.

22. Theoretically, the metal at the inner edge of the outside circular flange is _______________ than it is at the outer edge.

23. Center lines for rivet holes should not be laid out closer than __________ times the diameter of the rivet from the edge of the stock.

24. Allowances for grooved seams on sheet metal 22-gage or heavier, are equal to __________ times the width of the seam plus ________ times the thickness of the material.

25. The deep hole in the end of a rivet set is used to ______________ the metal and rivets together.

26. The deep hole in the end of a rivet set should be slightly larger in diameter than the _______________ of the rivet to be headed.

27. The peen ends of a combination hammer are slightly ______________ to prevent damage to the metal.

28. Single seams are frequently referred to as _______________ seams.

29. After a seam has been grooved, it should be finished by flattening it with a _______________.

30. Wired edges are _______________ where they cross seams to eliminate the appearance of bulges.

31. In heading a rivet, the set should be held at _______________ _______________ to the job to prevent marring the metal.

32. Wired edges should always be formed on the _______________ of a job unless otherwise specified.

33. The diameter of a flanged bottom to be joined to a cylinder by means of a single seam should be __________ inch larger than the outer diameter of the body flange.

34. The Pittsburgh lock has an advantage over the double seam in that it can be assembled on the job without the use of _______________.

35. The distance between the slits to be cut for a dovetail seam varies from __________ to __________ inch, depending upon the size of the job.

36. The recessed portion of a hand groover should be approximately __________ of an inch wider than the seam to be locked.

37. The allowance for heading a rivet should be equal to __________ times the rivet's diameter.

38. In fitting a tee-joint of less than 90 degrees the ______________ of the tee should be notched and bent over the inside of the main pipe.

39. The length of wire required for a circular opening wired edge is equal to ____________ times the _______________ of the job plus the ______________ of the wire.

40. The flange part of a dovetail seam is held in position between the bent edges known as ________________ and _______________.

41. As a general rule, flanges should be made as narrow as possible to reduce the tendency of ______________.

42. Soft malleable iron is used for rivets because it will not _______________ while the heads are being formed.

43. Tinners' rivets are specified by their type of head and their weight per _______________.

44. The most common types of wire used in wire edges are ____________ and _______________.

45. The manufacturers of wire recommend using ~~the~~ _______________ _______________ _______________ _______________ to determine size of wire when ordering.

46. To get an accurate measurement of thickness of wire one should use a _______________.

47. The Pittsburgh seam is sometimes referred to as a _______________ _______________ or _______________ _______________.

48. The type of seam generally used for assembling cross seams of ducts is called a (an) _____________ _____________ _____________.

49. Generally, rivets should protrude through the pieces being joined from __________ to __________ times the diameter of the rivets.

Multiple-Choice

Directions: In the space at the left of each statement, write the letter of the item which will provide the correct answer to complete the statement.

_____ 1. The smallest size of common hand groovers are approximately (A) 3/64; (B) 3/32; (C) 3/16; (D) 3/8, inch in width.

_____ 2. After notching the end of a pipe for a dovetailed seam, alternate pieces of metal are bent out to form (A) locks; (B) stops; (C) seams; (D) a flange.

_____ 3. A No. 686 rivet set should be used for heading a (A) 10 ounce; (B) 2 pound; (C) 8 pound; (D) 14 pound rivet.

_____ 4. The largest size common hand groovers are approximately (A) 1/4; (B) 1/2; (C) 3/4; (D) 1 inch in width.

Listing

Directions: List the items called for in each of the following statements. Select your answers carefully.

1. List the two main uses of a circular flange.

(A) ____________________

(B) ____________________

2. List the ways used to form sheet metal for wired edges.

(A) __________ (C) __________

(B) __________ (D) __________

3. The most common types of rivets used in sheet metalwork are:

(A) __________ (C) __________

(B) __________ (D) __________

4. List the methods of further locking grooved seams on pipes that are to be crimped.

(A) ____________________

(B) ____________________

(C) ____________________

5. List the points that should be carefully observed in making a good grooved seam:

(A) ______________________________

(B) ______________________________

(C) ______________________________

(D) ______________________________

(E) ______________________________

Matching

Directions: In the left hand column is a list of items. The right hand column contains descriptive phrases or synonymous terms. Match the descriptions to the items by placing the letter of the description in the blank at the left of the appropriate item.

_____ 1. L.W. = 4S + 2d

_____ 2. bottom = 2W

_____ 3. L.W. = 2L + 2W + 2d

_____ 4. 3 times width of lock

_____ 5. W + W + 3/16"

_____ 6. 2½ times diameter

_____ 7. hand groover

_____ 8. grooving rail

A. edges of dovetail seam

B. wire allowance

C. allowance for single seams

D. offset an inside grooved seam

E. allowance for Pittsburgh lock pocket

F. allowance for grooved seam

G. rectangular

H. circular

I. small flanges on outside of cylinders

J. Pittsburgh lock

K. offset an outside grooved seam

L. square

M. heel

Procedure-Rearrangement

Directions: In the column at the right appear various steps or operations involved in completing a job. Indicate the order in which your readings recommend that they be done by placing the proper number in each blank at the left.

1. Procedure for making a grooved seam:

_____ A. Hook edges together.

_____ B. Groove entire seam.

_____ C. Fold edges to proper width and form job.

_____ D. Place hand groover over one end of seam and strike with hammer.

_____ E. Groove other end.

_____ F. Flatten seam closely with mallet.

_____ G. Flatten seam slightly with mallet.

2. Procedure for riveting a seam:

_____ A. Insert rivets in holes.

_____ B. Head rivet.

_____ C. Select rivet and proper rivet set.

_____ D. Draw rivet and material together.

_____ E. Upset rivet.

Assignment
Sheet No. 6

Covering
Units 40-46

THE SOLDERING PROCESS

Soldering is a process that requires careful attention to details in order to secure satisfactory results. Among such details, the temperature of the soldering copper is of prime importance. If the copper is either too hot or too cold, proper fusion is impossible. The temperature of the base metal must be sufficiently high to cause the solder to flow--but not too high. However, proper heat control is not the only factor involved. Joints must be properly formed. Fluxes and solders must be selected in accordance with job requirements. When these conditions have been satisfied, successful soldering will be more likely to result.

Soldering is a vital process in sheet metalwork, just as it is in communication, transportation, and lighting. It is highly probable that without solder, development in these fields would be hampered considerably. In sheet metalwork solder is used mainly to join metals together and to make seams watertight. Although other processes such as welding may be used, solder has several outstanding advantages that contribute to its continued use. It is comparatively inexpensive in terms of equipment and materials as well as being adaptable to a great many uses. Furthermore, soldering does not require much time and it may be done with comparatively little heat.

In this assignment you will be given an opportunity to learn about some of the more important aspects involved in soldering. Information will be included concerning the use and care of gas furnaces and soldering coppers. You will also be expected to know the characteristics and uses of the various types of fluxes, dipping solutions, and solders.

<u>Assignment</u>:

1. Read the references listed below.
2. Send a postcard to the address below requesting a free copy of the bulletin <u>Soldering and Soldering Techniques</u>.
   Kester Soldering Company
   4201 Wrighthood Avenue
   Chicago 39, Illinois
3. After completing items 1 and 2, answer the questions listed below and turn in this assignment by ____________________.

<u>References</u>:

A. Bruce and Meyer, <u>Sheet Metal Shop Practice</u>, pp. 138-148.
B. New York, <u>Hand Processes</u>, pp. 56-70.
F. Smith, <u>Sheet Metal Work</u>, pp. 56-62.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. The fumes from a gas furnace are harmful to breathe.

T F 2. Zinc will dissolve in cut acid.

T F 3. The tinning will be ruined on a soldering copper that is allowed to become red hot.

T F 4. A grooved seam that is to be soldered should be tacked first.

T F 5. Heat causes zinc chloride flux to liberate acid.

T F 6. A 60-40 solder has a higher melting point than 40-60 solder.

T F 7. Zinc chloride fumes are inflammable.

T F 8. Many sheet metal shops prepare their own solder by melting the correct proportions of tin and lead together.

T F 9. The required shape and size of a copper varies with the job to be soldered.

T F 10. Zinc chloride has a corrosive action on the metals for which it is recommended for use as a flux.

T F 11. On jobs where the last traces of flux cannot be removed after soldering, zinc chloride should not be used.

T F 12. The most commonly used soldering coppers range in size from 5 to 10 pounds per pair.

T F 13. Old materials that are to be soldered with rosin flux should first be cleaned with muriatic acid.

T F 14. Zinc chloride is recommended as a flux for soldering black iron.

T F 15. The amount of oxide that forms on the surface of metal being soldered tends to increase as the temperature decreases.

T F 16. Better results will be achieved if a seam can be soldered in one continuous stroke.

T F 17. Copper may be forged without injury to its properties.

T F 18. Muriatic and hydrochloric acids are essentially the same chemically.

T F 19. Excess acid flux should be removed from a soldered seam.

T F 20. A double-cut bastard file is recommended for filing a soldering copper.

T F 21. Flux is used to dissolve oxides from the surface of metal being soldered.

T F 22. Zinc chloride fumes are harmful to breathe.

T F 23. Zinc chloride should be made either near an open window or outdoors.

T F 24. Most wire solders are 40-60 solders.

T F 25. Rosin is used as a flux because it cleans the surface of the metal being soldered.

T F 26. Soldering coppers that are to be tinned should be heated to a temperature that will just melt solder.

T F 27. Flux is used so that solder will adhere to metal.

T F 28. Aluminum cannot be soldered to other metals, such as copper brass, or tin.

T F 29. Acid core solder is recommended for soldering electrical connections.

T F 30. When soldering aluminum a special solder and soldering flux is recommended.

T F 31. When a soldering copper is to be used to solder a joint in a vertical position, the copper should be tinned only on the side that will be in contact with the work.

T F 32. A damp rag is recommended to remove excess solder from the point of a copper.

T F 33. Aluminum is easier to solder than galvanized steel.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. Soft solders have relatively low ______________ points.

2. Soft solder is an alloy composed of ______________ and __________.

3. Soft soldering fluxes are usually made up of solutions or pastes containing ______________ ______________.

4. Rosin is used as a flux for soldering ______________ plate, ______________ plate, and lead.

5. Zinc chloride should be kept in a closed ______________ container.

6. A soldering copper should be heated to a ______________ ________ color before it is filed.

7. Metals used in making 50-50 solder have ______________ melting points than solder itself.

8. Sal ammoniac cakes are apt to be ______________ from grooves cut in them by careless workers.

9. Wire solders may be obtained with either ______________ or ______________ cores.

10. Sal ammoniac may be purchased in either the crystalline or one-pound ______________ form.

11. Zinc chloride should be kept away from machines and tools, because it will cause them to ______________.

12. Soldering copper heads are manufactured out of copper because it ______________ and ______________ heat readily.

13. The operation concerned with coating the point of a copper with solder is referred to as "______________."

14. A satisfactory dipping solution requires about one-half of an ounce of ________ ______________ to each quart of water.

15. The handle of the ______________ copper is inclined in the direction the solder is to flow.

16. The copper end of a soldering copper is called the ______________ or ______________.

17. Light-weight soldering coppers should not be used for heavy-gage metal because they do not hold enough ______________.

18. Black discoloration around soldered joints on galvanized iron can be prevented by adding ______________ to muriatic acid flux.

19. The main alloying element in 60-40 solder is __________.

20. The more tapered the point, the more rapidly a soldering copper will lose its ______________.

21. The head of a 6 pound soldering copper actually weighs __________ pounds.

22. Improperly shaped soldering-copper points should be ____________ and ______________.

23. Solders composed of lead are not recommended for repairing kitchen utensils because of the danger of lead ______________.

24. On jobs where the last traces of flux cannot be removed after soldering, ____________ flux is recommended.

25. The residue that is left after removing the turpentine from the sap of certain pine trees is called ____________.

26. Coppers should not be cleaned in flux used for soldering because the work will be ____________.

27. Soldering coppers should be ____________ often to keep the point smooth and to remove burnt substances.

28. A soldering copper must be retinned every time it is ____________

29. A properly heated soldering copper may be tinned after its point has been rubbed on sal ammoniac by melting a little ____________ on the point.

30. A gas furnace will produce a heat of nearly ________ degrees Fahrenheit.

31. Dipping solutions are used to ____________ the points of soldering coppers.

32. The flame of a gas furnace should be adjusted by turning the ________________ valve.

33. Rivets must be soldered on jobs that are to be __________ tight.

34. The tip of a soldering copper may be changed to meet the needs of of particular job by ______________.

35. It is recommended that ________ seams be tacked before they are soldered.

36. The surface of a common brick is used when tinning a copper with ____________.

37. The melting point for solder goes up as the proportion of ________ is increased.

38. The tip of a ____________ copper is wedge-shaped.

39. Solder used for light-gage metals should have a larger proportion of ________ than __________.

40. If solder is to be easily applied, the surface it comes in contact with must be ____________.

41. Heavy-weight soldering coppers are apt to ____________ light-gage metal.

42. The size of soldering coppers is designated by the weight in pounds for ____________________.

43. Zinc chloride is formed by dissolving zinc in __________ acid.

44. After zinc chloride is formed, the solution should be ________.

45. The acid swab used for applying flux is actually a small________.

46. The hood of a gas furnace is __________ to facilitate cleaning its bed.

47. A copper should be moved along a seam slowly enough so that the metal will_______________enough heat to melt the solder.

48. Cold solder beads or shots are frequently used in soldering cylindrical _______________.

49. In soldered joints or seams where the flux may penetrate into joints more deeply than the solder, a (an) ______________flux should be used.

50. Aluminum can be soldered with 50-50 solder if a _____________ _____________ flux is used.

Multiple-Choice

Directions: In the space at the left of each statement, write the letter of the item which will provide the correct answer to complete the statement.

_____ 1. The tendency for light-gage sheet metal to buckle is reduced by using (A) 60-40; (B) 40-60; (C) 50-50; (D) 30-70 solder.

_____ 2. The best method of heating soldering coppers for use within the shop is by means of (A) a charcoal fire pot; (B) a gasoline torch or furnace; (C) electricity; (D) a gas furnace.

_____ 3. The melting point for soft solder is approximately (A) 212; (B) 400; (C) 600; (D) 1,000 degrees Fahrenheit.

_____ 4. Among the various special types of soldering coppers are included (A) hammer; (B) chisel; (C) hatchet; (D) saw.

Listing

Directions: List the items called for in each of the following statements. Select your answers carefully.

1. The composition of 50-50 solder is:

(A) ________________________ (B) ________________________

2. The period of usefulness will be increased for a pair of coppers by:

(A) ________________________ (B) ________________________

3. The types of soldering coppers most used in the shop are:

(A) __________ (B) __________

4. List three things a copper should do in soldering:

(A) __________ (C) __________

(B) __________

5. Methods used for cleaning heated soldering coppers are:

(A) __________

(A) __________

(C) __________

6. List the names of the valves on a gas furnace that should be closed at the end of each work day.

(A) __________ (C) __________

(B) __________

Matching

Directions: In the right hand column appear various types of metal used in the sheet metal trade, and in the left hand colum are listed various fluxes. Match the letter of the metal with the appropriate flux, by placing the proper letter in each blank at the left. (Note that some of these fluxes may be used for more than one metal.)

_____	1. muriatic acid	A. black iron
_____	2. zinc chloride	B. galvanized iron
_____	3. rosin	C. tin plate
_____	4. soldering salts	

Procedure-Rearrangement

Directions: In the column at the right appear various steps or operations involved in forging a soldering copper. Indicate the order in which your readings recommend that the operations be performed, by placing the proper number in the blank at the left.

_____ A. Reheat soldering copper to a bright red.

_____ B. File and tin soldering copper.

_____ C. Heat soldering copper to a bright red.

_____ D. Form copper on anvil by striking with a large hammer.

_____ E. Clamp copper in vise and remove burnt tinning and pits by filing.

Assignment
Sheet No. 7

Covering
Units 47-53

MACHINE FORMING: FOLDERS, BRAKES, ROLLS, AND ROTARY MACHINES

Mechanical devices have enlarged the scope of work that may be done profitably by the sheet metalworker. The tedious work that would be involved in forming certain jobs by hand has been speeded up by the use of machines. Since machines used for working sheet metal are available in many different types and capacities, they frequently create problems that confuse the beginning worker.

Persons intending to learn the sheet metal trade need to know about these various mechanical devices, if they are to become proficient in the trade. They need to know about the limitations and capacities of the various machines, as well as how to set and adjust them.

In this assignment you will have an opportunity to study the basic hand operated machine tools that are used in forming sheet metal. Information will concern types and uses of folders, brakes, rolls, and rotary machines.

Assignment:

1. Read the references listed below.
2. (a) Make a list of the sheet metal machines a general sheet metal company should have in order to do their work efficiently.

   (b) Make a list of the size and approximate cost of each machine you selected above.
3. After completing items 1 and 2, answer the questions below and turn in this assignment by ________________________.

References:

A. Bruce and Meyer, Sheet Metal Shop Practices, pp. 89-133.
G. New York, Machine Processes, pp. 1-28, 38-48, 56-66, 155-187.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. The maximum thickness metal-crimping machines for light work can generally handle is 24-gage.

T F 2. Molds are used on brakes for the purpose of forming curved shapes.

T F 3. A certain amount of slippage between the metal being formed and the rolls of a forming machine is necessary when forming tapered shapes.

T F 4. The maximum number of thicknesses that can be formed in a bar folder is between two and three.

T F 5. Wire or rod should not be formed in a bar folder.

T F 6. A special angle iron is used on hand brakes when forming long or heavy-gage sheet metal.

T F 7. Heavier-gage materials are easier to form in a slip-roll-forming machine equipped with two-inch diameter rolls than three-inch diameter rolls.

T F 8. Burred edges differ from turned edges in that the burred edge has a sharper radius.

T F 9. A wider edge may be turned on a cylinder than a disc.

T F 10. When burring an edge, the machine-operating handle should be turned rapidly after the first revolution of the job.

T F 11. The upper jaw and bending leaf blades are apt to be damaged if one attempts to bend wire or seamed pieces in a hand brake.

T F 12. The forming of a flange on a disc with a turning machine is essentially a stretching process.

T F 13. The maximum-gage sheet metal that may be formed in a hand brake increases for every one-quarter inch deduction in flange width.

T F 14. The bending leaf of a hand brake should be returned graduall to its usual position.

T F 15. Pipe may be joined together easier if one end of each sectio has been crimped.

T F 16. Wire should never be formed in a slip-roll-forming machine.

T F 17. The edge of a job that is being crimped by a machine should be held in contact with the gage before it passes through the rolls.

T F 18. The upper front roll of a slip-roll-forming machine deflects the metal upward to form the curvature.

T F 19. A knurled nut at the end of the beading machine's crankshaft is used to align the beading rolls.

T F 20. Sheet metal is apt to corrode when exposed to moisture or certain types of fumes if its coating has been injured.

T F 21. The sharpness of the folded edge is controlled by lowering or raising the wing of the bar folder.

T F 22. The gage on a bar folder should be set slightly less than the desirable width when making a grooved seam.

T F 23. The blade of a bar folder is designed to withstand hammering with a mallet.

T F 24. Brakes are used in the process called "braking tin."

T F 25. Hand-brake mold sizes range from approximately five-eighths to three inches in diameter.

T F 26. The work will tend to draw away from the gage of a beading machine as the bead is made deeper.

T F 27. The starting edge of a cylindrical job to be formed in a slip roll forming machine should be prepared by lowering the opposite edge of the metal after it has been just started into the rolls.

T F 28. The seam of a cylindrical job should not be run through the rolls of a beading machine under pressure.

T F 29. The coating on sheet metal is apt to crack or flake if a bead is rolled on its surface in one pass.

T F 30. If the wing binds on the folding blade of a bar folder, it should be adjusted so that it is closer to the blade.

T F 31. Truss rods are used as a means for making adjustments on hand brakes so that sheet metal may be bent evenly.

T F 32. Balancing weights are used in connection with the clamping bar of a hand brake to facilitate its operation.

T F 33. The width of a flange may be increased when using a hand brake as the gage number of the sheet metal increases.

T F 34. The minimum width of fold that can be made on a bar folder is greater for 24-gage than 22-gage mild steel.

T F 35. The wing setting of a bar folder produces the desired sharp or rounded fold.

T F 36. The stops on a bar folder are used in making angles of 45 and 90 degrees.

T F 37. The smaller the diameter of a job to be formed in a slip roll machine, the greater the starting bend should be.

T F 38. Edges for double seams and Pittsburgh locks may be formed in a hand brake.

T F 39. Standard hand brake ratings are determined by the maximum-gage mild steel they are capable of forming a flange one inch or wider, when the angle iron is in place on the bending leaf.

T F 40.. The forming of slight impression on the surface of sheet metal with a turning machine prior to flanging an edge by hand is called "creasing" or "scoring."

T F 41. Grooved seams on jobs to be crimped should be run through the crimping machine at least twice to insure best results.

T F 42. The spacing between the top and bottom front rolls of a slip-roll-forming machine determines the curvature of the job being formed.

T F 43. The width of a bend is limited when using a brake.

T F 44. It is recommended that hand brakes be oiled at least once a week with medium grade machine oil.

T F 45. Bar folders are particularly useful in forming reverse bends at close distances.

T F 46. It is necessary to open both clamping bar handles when feeding a small piece of sheet metal into a hand brake to be bent.

T F 47. The material is clamped between the blade and the jaw of a bar folder by pulling the operating handle.

T F 48. Hand brakes are available in lengths of approximately ten feet.

T F 49. The circular grooves in the top roll of a slip-roll-forming machine are used in forming jobs with an outside wired edge.

T F 50. The gage setting of a bar folder should be increased slightly when making the second fold of a double hem on light material.

T F 51. The distance between the inner edge of the upper roll and the shoulder of the lower roll on the burring machine should be equal to two and one-half times the thickness of the metal to be burred.

T F 52. The wing of a bar folder is not properly adjusted if it binc

T F 53. A screw driver is the only tool required in setting the gage of a bar folder.

T F 54. A special one-quarter inch wide steel bar is used on hand brakes for the purpose of making narrow, reverse bends.

T F 55. The width of an edge that can be formed on a disc by a turning machine decreases as the diameter of the disc increases.

T F 56. Generally, burred edges must be made narrower than it is possible to make turned edges.

T F 57. The desired depth of crimp should be produced in one revolution of the work through the crimping machine.

T F 58. A properly turned edge should have a wavy appearance.

Completion

Directions: Fill the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. Folds for lock seams and wired edges are prepared on the _________ folder.
2. If a series of 54-degree angle folds were to be made in a bar folder, it would necessitate adjusting the split _______________ which clamps on the end of the shaft.
3. The appearance of wrinkles on finished tin plate jobs can be avoided by first ____________________ the tin.
4. Care should be taken to protect the highly polished rolls used in forming aluminum and stainless from _______________ when they are not in use.
5. Formed jobs may be withdrawn from a slip-roll-forming machine without distortion by swinging the upper roll clear of its ______.
6. Basic parts of the brake are: the bed; top leaf; and ____________.
7. When making a wired edge, the gage of a bar folder should be set at a distance equal to _________times the diameter of the wire.
8. One end of the rear roll should be adjusted so that it is slightly higher than the other, when forming ___________shapes in a slip-roll-forming machine.
9. The 9/64 inch thick upper roll of a turning machine is used in forming edges for ________inch or smaller diameter wire.
10. The maximum number thicknesses of sheet metal that may properly be formed at one time in a hand brake is __________________.
11. Bar folders are not generally used for sheet metal over __________ gage in thickness.
12. The type of bead most frequently used as a stop on pipes, to prevent one part of the job sliding over the other, is the _________________bead.
13. The inside bead is placed towards the middle of the job when the ______________bead is used as a stop.
14. A burred edge will be cut if the _____________is tightened too much at one time.

15. The diameter of jobs formed in a slip-roll-forming machine is controlled by raising or lowering the ______________roll.

16. A turning machine may be used to form the narrow edge called a ____________________on a circular job.

17. In order to allow for the spring-back of sheet metal, it is sometimes necessary to raise the bending leaf of a hand brake slightly __________________than the required angle.

18. Friction clamps are used as a means for attaching __________ to a hand brake.

19. The diameter of the end of a pipe that has been crimped will be ________________in diameter.

20. The proper clearance for the pocket of a Pittsburgh lock may be insured by inserting a ________of_________material in the upper fold before the pocket is squeezed together.

21. The chief disadvantage of straightening out flanges and then rebending them in the opposite direction is that it __________the sheet metal.

22. The proper material allowance in turning a wired edge is equal to ___________times the diameter of wire.

23. Two machines commonly used in bending or folding sheet metal to form edges or locks for seams are _______________and_____________.

24. The essential differences between burring and turning machines are the shape of the _________and the location of the ___________.

25. The special wrench used to change the rolls on a turning machine is called a ___________________wrench.

Multiple-Choice

Directions: In the space at the left of each statement, write the letter of the item which will provide the correct answer to complete the statement.

_____ 1. A turning machine comes equipped with two sets of upper rolls. One is 9/64" thick, the other one is (A) 3/16"; (B) 1/4"; (C) 3/8"; (D) 5/8" thick.

_____ 2. The maximum-gage sheet metal beading machines are capable of handling is approximately (A) 12; (B) 18; (C) 22; (D) 28.

_____ 3. The maximum-gage mild steel that a one-half inch wide flange could be formed in a hand brake rated to bend a 1" flange on 18 gage would be (A) 20; (B) 18; (C) 16; (D) 14.

_____ 4. The most commonly used size of bar folder has a working length of approximately (A) 12"; (B) 18"; (C) 36"; (D) 54".

_____ 5. Ordinarily the maximum width fold that can be made in a bar folder is (A) ½"; (B) 1"; (C) 3"; (D) 6".

_____ 6. The strain on the blades of a hand brake may be equalized by placing the short pieces of sheet metal to be bent near the (A) adjustable collar; (B) angle iron; (C) center of the brake; (D) right balancing weight rod.

_____ 7. The maximum capacity for slip-roll-forming machines is usually limited to (A) 10; (B) 14; (C) 18; (D) 22-gage material.

_____ 8. In setting the gage on a turning machine for wiring an edge, one should measure from the gage to the (A) inner edge of upper roll; (B) outer edge of upper roll; (C) center of upper roll; (D) outer edge of lower roll.

Listing

Directions: List the items called for in each of the following statements. Select your answers carefully.

1. Crimping rolls are obtainable in the following types of corrugations:

(A) ______________________ (B) ______________________

2. List the most common shapes of beads used in sheet metal work.

(A) ______________________ (C) ______________________

(B) ______________________

3. List two reasons for rolling curved impressions in sheet metal.

(A) ______________________ (B) ______________________

4. List three types of folders.

(A) ______________________ (C) ______________________

(B) ______________________

5. List the adjustments that should be checked before using a bar folder.

(A) ______________________ (B) ______________________

6. List two factors that are necessary to consider in making an evenly burred edge.

(A) ____

(B) ____

7. List the factors necessary to consider in making a good bead in sheet metal.

(A) ______________________________

(B) ______________________________

(C) ______________________________

8. The maximum thickness of metal that slip roll forming machines will form depends on the jobs:

(A) ______________ (C) ______________

(B) ______________ (D) ______________

9. The causes for an edge being improperly formed by a turning machin are:

(A) ______________________________

(B) ______________________________

(C) ______________________________

Procedure-Rearrangement

Directions: In the column at the right appear various steps to be followed in forming the pocket of a Pittsburgh lock in a hand brake. Indicate the order which your readings recommend these steps be done, by placing the proper number in the blanks at the left.

_____A. Raise bending leaf slightly, offset pocket by striking the outer edge with mallet.

_____B. Insert sheet in brake; close upper jaw flush with prick punch marks; raise bending leaf until sheet is formed slightly less than 90 degrees.

_____C. Insert sheet in brake with upper edge flush with outer edge of upper jaw; close upper jaw.

_____D. Turn sheet over; insert in brake with outer edge of bending leaf; close upper jaw.

_____E. Insert sheet in brake; hold 90 degree bend against edge of upper jaw; close upper jaw; raise bending leaf as far as possible.

_____F. Insert formed edge (small end of job) in brake; hold sheet against bending leaf; close upper jaw; raise bending leaf as far as possible.

Assignment
Sheet No. 8

Covering
Units 54-59

MACHINE SHAPING: SHEARS, DRILL PRESSES, AND GRINDERS

Mechanical devices have not only been developed to facilitate the forming of sheet metal, but also to facilitate the shaping of metal as well. Among such machines are included various types of shears, drill presses, and grinders, which were designed to enable the tradesman to do more and better work.

Workers in the trade need to know how these machines are used to enable them to do better work. Without such an understanding these machines will not be of much value in the efficient performance of work; in fact, they may actually be detrimental in not only performing the work, but to the physical well being of all shop personnel. It is only through intelligent, well-trained workers that such machines can be put to their fullest use.

In this assignment you are to study about some of the machines commonly used in the shaping of sheet metal or tools used in sheet metal work. Specific information concerning the squaring shear, drill press, and grinder will be included.

Assignment:

1. Read the references listed below.
2. (a) Describe the manufacture of abrasive wheels.

   (b) Give the advantages and disadvantages of the various materials used as abrasives in grinding wheels.
3. After completing items 1 and 2, answer the questions listed below and turn in this assignment by ____________________.

References:

A. Bruce and Meyer, Sheet Metal Shop Practice, pp. 69-70.
G. New York, Machine Processes, pp. 29-37, 49-55, 67-85.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T". If it is false draw a circle around the letter "F".

T F 1. Abrasive grains that are closely spaced together are less apt to clog than those with wider spacing.

T F 2. The spindle speed of a drill press is too high if the cutting edge corners of a drill wear away too rapidly.

T F 3. The abrasive grains of a grinding wheel should be bonded closer together for rough grinding than finishing grinding.

T F 4. The upper blade of a squaring shear is set at a slight angle with the lower cutting blade so that the force necessary to cut sheet metal is reduced.

T F 5. One should stand directly in front of a grinding wheel when operating a power grinder.

T F 6. Steel washers are placed between the sides of a grinding wheel and the flanged collars to reduce the danger of the wheel cracking.

T F 7. Accuracy of graduations appearing on the bed of a squaring shear may be checked by measuring with a rule from a graduation to the outer edge of the lower cutting blade.

T F 8. A harder wheel should be used for hard metals than soft metals.

T F 9. Alignment is facilitated when cutting sheet metal with a squaring shear by cutting two short notches and bending them down at the end of the line to be cut.

T F 10. The device used to hold straight-shank cutting tools in a drill press is called a sleeve.

T F 11. A slitting gage is used when making straight cuts with a circle-cutting machine.

T F 12. To prevent work from losing its temper while being ground, it should be cooled in water when it becomes heated.

T F 13. The possibility of sheet metal moving while it is being cut with a squaring shear is eliminated through the use of a hold-down attachment.

T F 14. Both types of circle-cutting machines can be used for making irregular cuts.

T F 15. The value of natural abrasives is limited because of the difficulties involved in producing similar grinding wheels in quantity.

T F 16. Aluminum oxide rather than silicon carbide grinding wheels are preferred for grinding copper and aluminum.

T F 17. Centers of circles to be cut with a circle-cutting machine should be prick punched.

T F 18. The distance between the upper and lower cutters of a circle cutting machine must be adjustable for cutting outside circles.

T F 19. The lower cutting blade is fastened to the crosshead of a squaring shear.

T F 20. Lard oil is recommended as a cutting lubricant for low carbon steel.

T F 21. Burrs and abrasions should be removed from the shank of a drill with a file or oilstone.

T F 22. Silicon carbide crystals are less easily fractured than aluminum oxide.

T F 23. The chief disadvantage of circle shears is that only cuts starting from the outside edge of a sheet can be made.

T F 24. It is a sign that too much pressure is being applied if the drill chips at the cutting edges.

T F 25. Seamed edges should not be cut with a squaring shear because of the danger of damaging the cutting blades.

T F 26. The grit size of an abrasive is determined by the number of openings per inch in the mesh of the smallest screen through which the grains will pass.

T F 27. The graduations marked on the face of a squaring shear bed will remain accurate after the upper cutting blade is reground.

T F 28. The minimum amount trimmed from a sheet with a squaring shear should not be less than the thickness of the sheet being cut.

T F 29. The hardness of a grinding wheel depends on the hardness of the abrasive it is composed of.

T F 30. Sometimes it is considered good practice to insert sheet metal from the rear of a squaring shear to allow more freedom when operating the foot treadle.

T F 31. The sensitive drill press usually requires a tapered-shank cutting tool.

T F 32. When cutting very small circles with a circle-cutting machine, the sliding circle arm should be set nearer on center than when cutting large circles.

T F 33. The lead-bushed hole of a grinding wheel should be scraped to make it fit freely, if it is too tight to fit the spindle of a grinder.

T F 34. The type of cutting lubricant varies with kind and hardness of the metal being drilled.

T F 35. For best results a grinder should be in operation while adjusting the tool rest.

T F 36. The practice of holding work with one's hand while using a drill press usually results in broken drills and injury to the operator.

T F 37. Sheet metal may be cut most rapidly with a squaring shear that is equipped with a hand operated hold-down attachment.

T F 38. The number of thicknesses of sheet metal that may be cut at any one time with a squaring shear is determined by their combined thickness in relationship to the maximum capacity of the machine.

T F 39. A properly adjusted grinding wheel should be drawn tightly enough against its flanged collar to prevent the wheel from turning on the spindle.

T F 40. It is a recommended practice to grind on the side of a grinding wheel.

Completion

Directions: Fill the blanks in each statement with the word or words required to complete the sentence correctly.

1. Slots are provided in the face of a squaring shear bed so that the front____________may be clamped to it.
2. When cutting sheet metal that has been marked, the line to be cut should be placed flush with the edge of the________________ cutting blade.
3. Extension arms are attached to the__________of a squaring shear.
4. Foot-operated squaring shears will cut_______gage or less mild steel.
5. Burrs on the shank of a drill will cause it to run out of________.
6. The majority of grinding wheels are made by the__________________ bonding process.
7. The type of grinding wheel particularly suited for tool grinding has a________________________bond.
8. Twist drills are held in a chuck or sleeve which is attached to the____________________________of the drill press.
9. Lateral clearance between the cutters of a circle-cutting machine is obtained by adjusting the________________shaft.

10. Before any cutting is done with a squaring machine, the __________ should be cleaned.

11. The abrasive grains of a grinding wheel are held together with a binding material called_________________.

12. The wear on the teeth of a drill press chuck will be reduced by pressing____________ ___while turning the key.

13. Aluminum oxide is made by heating _____________ in an electric furnace.

14. Forcing a wheel on the spindle of a power grinder is apt to set up strains which might cause it to _____________.

15. Equipping a grinder with an ________-sized wheel frequently results in the wheel bursting.

16. The clay used to bond abrasives which is converted into a glass-like substance upon being heated in a kiln, is known as a ________________ type of bonding material.

17. The structure of a grinding wheel refers to the _____________ of the abrasive grains.

18. Grinding wheels are attached to the ends of a powergrinder spindle with left and right-hand thread fasteners in order to safeguard against their becoming_______________.

19. The tool post of a grinder should be set so that it is not more than _________inch away from the face of the wheel.

20. The tenacity with which abrasive particles are held in a grinding wheel under grinding pressure is referred to as _______________.

21. In reference to the cutting speed of a drill press, the abbreviations, R.P.M., refer to the number of _______________ ________ __________________ the spindle makes.

22. When cutting light materials with a circle cutting machine, the cutter should be adjusted so that they just ________________.

23. A gap shear is essentially the same as a squaring shear except for the __________________.

24. The wedge-shaped tool used for removing a sleeve, socket, or drill from the spindle of a drill press is called a drill________.

25. The possibility of the sheet moving while being cut is reduced by placing it on the ________ side of the squaring shear.

26. Drill-press spindle speed is adjusted by means of two stepped ________________.

27. Cold chisels should be ground to have an included angle of between ______________ and ____________ degrees.

28. After abrasive particles have been prepared and molded, they are treated with__________to form the grinding wheel.

29. The type of artificial abrasive that is recommended for grinding alloy steels is called_____________ _____ _______.

30. Lubricants are used when drilling to reduce the tendency of _______________the drill.

31. The process of restoring the sharpness of a grinding wheel by breaking away the dulled abrasive crystals is known as__________.

32. When using a grinder that is not equipped with safety glass shields, the operator should wear safety ______________________.

33. The work should be moved back and forth across the face of a grinding wheel to prevent wearing a ____________in the wheel.

34. The side gage on a squaring shear is used for squaring the _______________of the sheet metal.

35. The bevel gage that is attached to the bed of a squaring shear is used to make_____________ _____________.

36. When cutting with a square shear, a common accident to be avoided is putting one's___________under the foot treadle.

37. The back gage that is mounted on the rear of the squaring shear is used for cutting__________ _____________of metal.

Multiple-Choice

Directions: Listed with each of the incomplete sentences that follow are several responses, one of which will complete the statement to make it true. Indicate your choice by placing the appropriate letter in the blank at the left.

_____1. The maximum width of a series of long strips that may be cut from a piece of sheet metal with a gap shear is (A) 18 inches; (B) 22 inches; (C) 36 inches; (D) unlimited.

_____2. The spindle speed of a drill press should be reduced to approximately (A) 25; (B) 50; (C) 75; (D) 90; per cent of that recommended for high speed drills when using carbon steel drills.

_____3. The maximum length of cut that can be made in a gap shear is (A) 36 inches; (B) 72 inches; (C) 120 inches; (D) unlimited.

_____4. A quarter-inch drill should be operated in a drill press at a speed approximately (A) one-half; (B) three-quarters; (C) twice; (D) equal; that recommended for a half-inch drill.

____5. The top of a grinder tool rest should be set at such a height that it is approximately (A) on the same level with; (B) ¼ to ½ inch above; (C) ¼ to ½ inch below; (D) flush with the center of the grinding wheel.

Listing

Directions: List the items called for in each of the following statements. Select your answers carefully.

1. The most widely used types of artificial abrasives for grinding wheels are:

(A)______________________________ (B)______________________________

2. List the more commonly used types of off-hand dressers.

(A)______________________________ (B)______________________________

3. List the two types of circle-cutting machines used in sheet metal work.

(A)______________________________ (B)______________________________

4. List the various types of gages with which squaring shears are equipped.

(A)______________________________ (C)______________________________

(B)______________________________ (D)______________________________

5. List the various devices that are available for holding work to be shaped in a drill press.

(A)______________________________ (C)______________________________

(B)______________________________

6. List the general types of bonds used in grinding wheels.

(A)______________________________ (D)______________________________

(B)______________________________ (E)______________________________

(C)______________________________

7. List the materials that are heated together in an electric furnace to produce silicon carbide.

(A)______________________________ (C)______________________________

(B)______________________________ (D)______________________________

8. List the factors that should be considered in selecting a grinding wheel for a particular job.

(A)________________ (D)________________ (G)____________

(B)________________ (E)________________

(C)________________ (F)________________

9. List the principal parts of a squaring shear.

(A)________________ (F)________________

(B)________________ (G)________________

(C)________________ (H)________________

(D)________________ (I)________________

(E)________________ (J)________________

Assignment
Sheet No. 9

Covering
Units 60-64

MEASUREMENT: LINEAR AND ANGULAR

It is practically impossible for one engaged in the sheet metal trade to avoid using some form of mathematics in his work. For this reason a summary of the basic mathematical concepts relating to sheet metal work is included in this course of study.

The information presented in this assignment will be limited to the study and application of linear and angular measurement. It will include principles and problems pertaining to fractions and decimals. When these are clearly understood by the student, it should help him to become a more adept layout man.

You will be expected to master the fundamentals of linear and angular measurement while reviewing the basic principles and solving the drill problems that are included in this assignment. Particular attention should be given those principles and problems with which you need extra practice.

Assignment:

1. Read the reference listed below. (Omit actually solving the problems in the Assignment Series at this time.)
2. In this assignment you are to confer with your coordinator and with his help select six Assignment Series Units to solve. It is suggested that you work out two Assignment Series Units in each of the three Sections assigned. Your selection should be made in light of the problems for which you feel a need for more practice. (Refer to the table of contents in Reference E, pages vii-ix, for the Assignment Series Units.) Check your answers by referring to the appropriate Basic Principle and then recheck your work.
3. Complete items 1 and 2; answer the questions listed below and turn in this assignment by__________________________.

Reference:

E. New York, Sheet Metal Mathematics, pp. 2-109

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. Confusion and errors will be reduced in problems involving feet and inches if such information is indicated with the computation.

T F 2. The complement of a 65 degree angle is 115 degrees.

T F 3. Vertical angles formed between two straight intersecting lines are equal.

T F 4. The center of the lower edge of a protractor should be placed at the vertex of the angle to be measured.

T F 5. If an answer is to be corrected to three decimal places, three places must be used throughout the computations.

T F 6. Ratio is a method used to show the relationship between two numbers.

T F 7. It is generally best to change decimals to fractions before averaging them.

T F 8. Number 8 gage metal is twice as thick as number 16 gage metal.

T F 9. The quotient is obtained by dividing the dividend into the divisor.

T F 10. Inch marks are frequently omitted from the dimensions of a drawing.

T F 11. A Decimal Equivalent Table speeds up the computation and reduces the possibility of error in the conversion of fractions.

T F 12. The denominators are subtracted from each other when subtracting fractions.

T F 13. Two triangles will be equal in size when their corresponding sides are equal in length.

T F 14. The number of decimal places in the product of two numbers should equal the number of places in the multiplicand.

T F 15. Net price is determined in single discounts by subtracting the amount of discount from the list price.

T F 16. 1C tin plate is a heavier gage metal than 1X tin plate.

T F 17. The product of two or more fractions is equal to the product of the numerators over the lowest common denominator.

T F 18. The lowest common denominator must be found when subtracting fractions.

T F 19. Extreme accuracy is not required for many sheet metal processes.

T F 20. Inches should be divided by 12 to be changed to feet in the decimal form.

T F 21. A mixed number can be changed to an improper fraction by multiplying the whole number by the numerator and adding the denominator.

T F 22. Two triangles will be equal in size when two of their corresponding sides and the included angle are equal.

T F 23. To change .385 inches to 64ths, it is necessary to divide.

T F 24. A tangent touches the circumference of a circle at one point.

Completion

Directions: Fill the blanks in each statement with the word or words required to complete the sentence correctly.

1. If .6 of a number is equal to 42, the whole number is__________.

2. The average of several numbers is obtained by____________their sum by the number of quantities.

3. The symbol for an angle is________________.

4. The variation permitted between the upper and lower limits for a job is called_________________.

5. Mixed numbers should be changed to_______________fractions before dividing.

6. The maximum number of pieces 4 3/8 inches long that can be cut from a piece of wire 20 inches long is____________.

7. If a segment of a line one and one-quarter inches long represents 56¼% of the total, the length of the whole line is______________.

8. Seventy-five per cent of 3 inches is__________inches.

9. The sum of the angles of a triangle equal_________degrees.

10. The altitude of a triangle is measured from the vertex___________ to its base.

11. Feet are designated with a single_______________.

12. The distance measured by one complete revolution of a micrometer's thimble is equal to___________of an inch.

13. When dividing one fraction into another, the divisor should be ______________.

14. Fractions cannot be added unless they have a common______________.

15. The value of a fraction is not changed by________________or ______________the numerator and denominator by the same quantity.

16. In order to change a decimal to a per cent, it is necessary to move the decimal point_________places to the___________and add a per cent sign.

17. A drawing made to the scale of 1/4" = 1'-0" would be reduced to __________ of its full size.

18. An angle containing less than ninety but more than zero degrees, is called an __________ angle.

19. The amount left over after cutting the maximum number of pieces 10'8½" long from a roll of wire 180' long, would be __________ inches.

20. There are three and __________ thirty-seconds inches in .289 feet.

21. The answer when rounding the number .672453 to three decimal places would be __________.

22. When 3 1/8 is multiplied by 3 1/4, the product is __________.

23. An improper fraction can be reduced to a __________ __________ by dividing the numerator by the denominator.

24. The least common denominator of 1/6, 1/5, and 1/4 is __________.

25. One and one-quarter inches is __________ per cent of five and one-half inches.

26. The complement of a 31 degree angle is equal to __________ degrees.

27. The amount of wire required for nine pieces 10' 7 3/4" long, would be ninety-five feet __________ inches.

28. A common fraction is changed to a __________ by dividing its numerator by the denominator.

29. Division may be checked by multiplying the quotient by the __________ and adding the remainder.

30. A fraction is at its lowest terms when the numerator and denominator cannot be __________ by the same number.

Listing

Directions: List the items called for in each of the following statements. Select your answers carefully.

1. List the groups of triangles as classified according to the lengths of their sides.

(A) __________ (C) __________

(B) __________

2. List the factors that must be considered in determining the selling price of an article.

(A) ____________________ (C) ____________________

(B) ____________________

3. List the names of the fixed parts of a micrometer.

(A) ____________________ (C) ____________________

(B) ____________________

4. List the conditions that determine the degree of accuracy necessary when making a particular job.

(A) ____________________ (B) ____________________

5. List the factors that determine the degree of accuracy in measuring.

(A) ____________________ (C) ____________________

(B) ____________________

Matching

Directions: Read statements listed alphabetically in the right hand column, and match them with the appropriate item by placing the letters from the right hand listing in the space provided adjacent to the numbers in the left hand column.

1. Concerning definitions of common fractions:

____(1) Numerator
____(2) Terms
____(3) Proper fraction
____(4) Improper fraction
____(5) Unit fraction
____(6) Mixed number
____(7) Complex fraction

A. Written above the line
B. Numerator less than denominator
C. Numerator larger than denominator
D. 7½
E. Denominator and numerator
F. One or both terms are fractions or mixed numbers.
G. Shows number of parts whole is divided
H. Numerator is one.

2. Concerning angular measurement:

____(1) Semicircle

____(2) Arc

____(3) Concentric circles

____(4) Vertex

____(5) Minutes

____(6) Polygons

____(7) Obtuse angle

____(8) Parallel

____(9) Rectangle

____(10) Trapezoid

A. Intersection at the ends of two straight lines

B. Designated with a single prime

C. One-half of a circle

D. Opposite sides equal and each angle equal to 90 degrees

E. Greater than 90, but less than 180 degrees

F. Less than 90, but more than 0 degrees

G. Lines that are equidistant

H. Curved section of a circle

I. Plane figures formed by three or more straight lines

J. Circles having same centers

K. Four-sides plane figure with only two sides parallel

L. Opposite sides parallel

M. Straight line between ends

N. Opposite sides equal and parallel

O. Scalene

Assignment
Sheet No. 10

Covering
Units 65-67

MEASUREMENT: PERIMETER, AREA, AND VOLUME

Sheet metal workers are confronted with many different types of problems in the practice of their trade. Among the problems that they must be able to solve are the following types: amount of material required, material costs and weights, proper size of sky lights, and the capacities of heating and ventilating pipes. The solution to such problems is an essential phase in the work required before layout and construction can proceed.

Mathematics is essential in solving many of these problems. Perimeter and circumference formulas are used to determine the distance around an object so that stretchouts for jobs may be drawn. Formulas for area are used in calculating costs, weights, and the number of square units in plane surfaces. Formulas for volume are used to determine capacity of tanks and containers. Employees capable of solving such problems will certainly be able to progress much further in their trade than those that cannot.

You will be expected to master the methods for determining perimeter, area, and volume while reviewing the basic principles and solving the drill problems that are included in this assignment. Particular attention should be given those principles and problems with which you need extra practice.

Assignment:

1. Read the reference listed below. (Omit actually solving the problems in the Assignment Series Units at this time.)
2. Confer with your coordinator and with his help select six Assignment Series units to solve. It is suggested that you work out one or two Assignment Series Units in each of the four Sections that are assigned. Your selection should be made in light of the problems for which you feel a need for practice. (Refer to the table of contents on Reference E, pages ix-x and xiii, for the Assignment Series Units.) Check your answers by referring to the appropriate Basic Principle and then recheck your work.)
3. After completing items 1 and 2, answer the questions listed below and turn in this assignment by ________________.

Reference:

E. New York, Sheet Metal Mathematics, pp. 112, 161, 244-259.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. The horizontal scale for a line graph should be approximately twice as long as its vertical scale.

T F 2. The area of a parallelogram and rectangle with the height and length would be equal.

T F 3. The use of squared paper will make the construction of graphs more convenient and accurate.

T F 4. When dividing exponential expressions, the exponents are added together.

T F 5. Parallel-sided solids may be prism-shaped or cylindrical-shaped.

T F 6. Two pi times the radius equals the circumference of a circl

T F 7. When multiplying exponential expressions, the exponents are multiplied together.

T F 8. All the edges of a cube are equal in length.

T F 9. The reasoning underlying the method used for calculating the area of a circle is similar to that used for parallelograms.

T F 10. In order to change square inches to square yards, it is necessary to determine the number of square feet.

T F 11. The cross sections of a parallel-sided cylinder are equal.

T F 12. The bases of a solid right cylinder are equal in area and parallel with each other.

T F 13. Graphs are used frequently because they show relationships more readily than numbers.

T F 14. The length of a oblique cylinder's axis will always differ from its altitude.

Completion

Directions: Fill the blanks in each statement with the word or words required to complete the sentence correctly.

1. The gage number for a piece of sheet metal labeled 26 x 24 x 120 is__________.
2. The distance around a polygon is called the________________.
3. A piece of galvanized iron containing an area of 420 square inches, would equal__________square feet.
4. When $5a^2$ is multiplied by $3a^3$, the product is equal to___________
5. The area of a triangle that has an altitude of 5 3/4 inches and base of 12 1/2 inches is equal to__________square inches.

6. In order to change cubic inches to gallons, it is necessary to divide by____________.

7. A prism that is cut by a plane at an angle to its base, is said to be________________.

8. In order to change 11,928 cubic inches to cubic feet it is necessary to divide by____________.

9. In the construction of a circle graph the decimal equivalent of the total for each quantity to be represented should be multiplied by____________.

10. In order to change square feet to square inches, it is necessary to ______________by 144.

11. When $6a^4$ is divided by 2a, the quotient is equal to_____________.

12. The upper and lower bases of a prism form polygons that are equal in area and________________to each other.

13. When $12x^2$ is subtracted from $24x^2$, the remainder is equal to ____________.

14. The altitude of a parallel-sided solid is always measured ______________to its base.

15. Volume is expressed in terms of units of___________measure.

16. An abbreviated rule expressed in symbols is called a_____________.

17. The number of square units that a plane figure contains is referred to as______________.

18. In order to change square inches to square feet, it is necessary to divide by____________.

19. When dividing exponential expressions, the exponents are ______________________.

20. A parallelogram 12 inches long and 3 1/2 inches high would have an area of_________square inches.

21. The area of a trapezoid with bases 8 1/2 inches and 9 1/2 inches long and an altitude of 3 3/4 inches is equal to______________ square inches.

22. In order to change 763 cubic yards to cubic feet it is necessary to___________________by______________.

23. Lengths are expressed in terms of units of______________measure.

24. A tank one cubic feet in size is capable of holding____________ gallons.

25. The product of three to the fourth power is equal to____________.

26. The approximate value of pi is ______________________.

27. The equivalent number of cubic yards in 282,921 cubic inches is approximately ____________.

28. When the axis of a cylinder forms an angle of other than 90 degrees with its base, it is called an ______________ cylinder.

29. A line that connects the center of the bases of a cylinder is called the ____________.

30. The area of a circle that has a diameter of 20 inches is equal to _______________ square inches.

Multiple-Choice

Directions: Listed with each of the incomplete sentences that follow are several responses, one of which will complete the statement to make it true. Indicate your choice by placing the appropriate letter in the blank at the left.

_____ 1. The number of quarts in one peck is (A) 2; (B) 4; (C) 8 (D) 12.

_____ 2. The number of quarts in one gallon is (A) 2; (B) 4; (C) 8; (D) 12.

_____ 3. The relationship of the parts to the whole is shown especially well in the (A) pictorial; (B) bar; (C) circle; (D) line; type of graph.

_____ 4. Approximate values may be found without computation in the (A) pictorial; (B) bar; (C) circle; (D) line; graph.

_____ 5. The perimeter of a rectangle 2 1/2" by 15" is (A) 5; (B) 15; (C) 25; (D) 35; inches.

Matching

Directions: In the right hand column appear methods for calculating various unknowns and in the left hand column are listed various unknowns. Match the letters of the right hand column with the unknowns, by placing the proper letter in each blank at the left.

_____ 1. Perimeter of squares

_____ 2. Perimeter of rectangles

_____ 3. Circumference of circles

_____ 4. Perimeter of semi-circular-sided figures

_____ 5. Area of squares

A. Two times length plus two times width

B. Pi times diameter

C. Length of side to second power.

D. Product of length and width

_____ 6. Area of rectangles

_____ 7. Area of triangles

_____ 8. Area of trapezoids

_____ 9. Area of circles

_____ 10. Volume of parallel-sided solid

E. Area of base times average height

F. Four times length of side

G. Pi times radius

H. Pi times diameter plus two times distance between half circles

I. Pi times radius plus two times distance between half circles

J. Pi times diameter times altitude

K. One-half sum of base lengths times altitude

L. One-half base times height

M. Pi times radius squared

N. Pi times diameter

Assignment
Sheet No. 11

Covering
Units 68-73

EQUATIONS: FORMULAS AND PROPORTION

What is the allowance for a riveted lap seam? How is the stretchout for the heel of a square elbow determined? Can a grinding wheel rated at 2000 f.p.m. be used safely on a motor that turns at 2000 r.p.m.? What are the lengths of the sides of right triangle when the size of two angles and a side are know.? These problems are not difficult if one has developed a practical working knowledge of a few basic relationships.

Before attempting to solve such problems, one should analyze each problem to gain a clear understanding of what is to be found and the method for its solution. Quantities should be expressed in their proper relationships. Answers should be checked. By doing these things, time and energy can be saved.

You will have an opportunity to become acquainted with some of the basic formulas and specifications that are used in sheet metal layout work in this assignment. In addition you will be expected to master the methods for solving problems involving proportion and trigonometry. Particular attention should be given to those principles and problems with which you need extra practice.

Assignment:

1. Read the reference listed below. (Omit actually solving the problems in this Assignment Series Units at this time.)
2. Confer with your coordinator and with his help select six Assignment Series Units to solve. It is suggested that you work out one or two Assignment Series Units in each of the four Sections that are assigned. Your selection should be made in light of the problems for which you feel a need for more practice. (Refer to the table of contents in Reference E, pages xi-xii, for the Assignment Series Units.) Check your answers by referring to the appropriate Basic Principles and then recheck your work.
3. After completing items 1 and 2, answer the questions listed below and turn in this assignment by________________.

Reference:

E. New York, Sheet Metal Mathematics, pp. 164-241, 259-262.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. Machines operated at speeds above their maximum rating are dangerous.

T F 2. The slant height of a right pyramid is equal to the shortest distance between its apex and base edges.

T F 3. A truncated cone has two parallel surfaces.

T F 4. An equation will balance if the square root is extracted from both members.

T F 5. The span of a roof corresponds to half the length of the hypotenuse of a right isosceles triangle.

T F 6. The linear distance which a point on the edge of a wheel travels as it revolves about its axis in a given period of time is referred to as surface speed.

T F 7. A greater allowance is required for a burred bottom seam than a set-in bottom seam.

T F 8. The members of both sides of an equation will be equal when increased, decreased, multiplied, or divided by the same number.

T F 9. The approximate formula for bend allowance is used for bends with an inside radius.

T F 10. The span is usually less than the rise for most roofs.

T F 11. The slant height of a right circular cone forms a right angle with the plane of the base.

T F 12. In inverse proportion as contrasted with direct proportion, both ratios are inverted.

T F 13. One of the angles of a triangle that has sides drawn to the ratio of 3, 4, and 5 units, will always equal 90 degrees.

T F 14. A truncated pyramid has two parallel surfaces.

T F 15. Trigonometric formulas can be used to calculate the size of the angles or the length of the sides of any triangle.

T F 16. In direct proportion an increase in one ratio produces a decrease in the other.

T F 17. The altitude of a pyramid is equal to the perpendicular distance from the plane of the base to the apex.

T F 18. The base portion remaining after passing a cutting plane through an oblique cone perpendicular to the axis is called a frustum.

T F 19. One-half the metal thickness is added as an allowance to the outside dimensions of a job for each sharp 90 degree bend.

T F 20. Sections of dovetailed seams are similar to corner lap seams.

T F 21. The allowance for a single hem is the same as the width of the hem.

T F 22. Formulas may be used to determine the exact allowances required for bends with large radii.

Completion

Directions: Fill the blanks in each statement with the word or words required to complete the sentence correctly.

1. The allowance for a wired edge is equal to ______ times the diameter of the wire.

2. The acute angles of a triangle with an opposite side and hypotenuse equal to 5 1/2 and 13 1/2 inches respectively, are equal to ______ and ______ degrees. (See Table of Trigonometric Functions, Reference E, p. 231)

3. The maximum number of 7" x 20" pieces that can be cut from a piece of sheet metal 30" x 96" in size is ______.

4. The letters f.p.m., that are used in expressing surface speed, mean ____________ per ____________.

5. The hypotenuse of right triangle is equal to the ____________ ____________ of the sum of ____________ of the two sides.

6. A cone would be classified as oblique when its ____________ forms an angle other than ninety degrees with its base.

7. If the sine of an angle and the opposite side equals .8391 and 3 inches respectively, the hypotenuse will be ______ inches long. (Calculate to closest 64th of an inch.)

8. An allowance equal to three times the width of the seam is required for both edges of a ____________ ____________ seam.

9. If the tangent of a 40 degree angle and the adjacent side equals .8391 and 3 inches respectively, the opposite side will be _______inches long. (Calculate to closest 64th of an inch.)

10. If a rectangular pipe is to be constructed that has a cross-sectional area of 137 square inches and one side four times the length of the other, the dimensions will be ________ by ________ inches. (Use decimals.)

11. The trigonometric function obtained by dividing the opposite side by the adjacent side of a triangle is called the _________.

12. The length of opposite side of a right triangle is equal to square root of the _______________ between the square of the hypotenuse and the square of the adjacent side.

13. The number which equals the original number when taken twice as a factor is called the ________________ ________________.

14. If the cosine of a 40 degree angle and the adjacent side equals .7660 and 3 inches respectively, the hypotenuse will be ________ inches long. (Calculate to closest 64th of an inch.)

15. The allowance required for each edge of a riveted lap seam is equal to ________ times the diameter of the rivets.

16. The trigonometric function obtained by dividing the opposite side by the hypotenuse is called the ________________.

17. The length of an arc of a circle is equal to the ratio of its central angle to 360 degrees, times the _______________.

18. An allowance equal to two times the width of the pocket plus 3/16" is required for making the pocket of a ________________ __________________.

19. The ratio of rise to span is called ________________.

20. To determine the size of an angle by using a table of trigonometric functions, the corresponding ratio should be carried out to ________decimal places.

21. The axis of a tapered solid is drawn from the ______________ of its __________________ to the apex.

22. The letters L. S. and W. S. are used to designate the length and the width of __________________.

23. The size of an angle that has a tangent of .4768 is approximately _______degrees. (See Table of Trigonometric Functions, Reference, Reference E, p. 231.)

24. The sides of a square ventilating pipe must be ___________inches long, if it is to have a cross-sectional area of 75 square inches.

25. When a width and cross-sectional area of a rectangular pipe are 9 inches and 63 square inches respectively, its height is _____ inches.

26. The stretchout radius for a right cone 8 inches high and 6 inches in diameter will be _________ inches. (Use decimals.)

27. The angle of a right cone's stretchout is equal to the ratio of the _________ of its base to the ________________ of the stretchout circle times ________________.

28. The acute angles of a right triangle with opposite and adjacent sides equal to 7 13/16 and 3 9/32 inches respectively, are equal to __________ and __________ degrees. (See Table of Trigonometric Functions, Reference E, p. 231.)

Multiple-Choice

Directions: Listed with each of the incomplete sentences that follow are several responses, one of which will complete the statement to make it true. Indicate your choice by placing the appropriate letter in the blank at the left.

_____ 1. If 107 feet of wire weighs 17 pounds, 159 feet will weigh approximately (A) 20; (B) 25; (C) 30; (D) 33.5 pounds.

_____ 2. The length of the intercepted arc of a 7 inch diameter circle that has a central angle of 45 degrees is equal to (A) 2 45/64; (B) 2 23/32; (C) 2 3/4; (D) 2 25/32 inches.

_____ 3. The angle of the stretchout for a right cone 8 inches high and 6 inches in diameter is equal to 126 degrees and (A) 12; (B) 18; (C) 24; (D) 30 minutes.

_____ 4. The surface speed of a 5 inch diameter grinding wheel that travels at 1000 r.p.m. is equal to (A) 1167; (B) 1273; (C) 1309; (D) 1719; feet per minute.

_____ 5. If an 80 degree elbow is to be made in four pieces the size of the angle for the larger pieces will be approximately (A) 13; (B) 23; (C) 27; (D) 34 degrees.

_____ 6. If the maximum permissible surface speed for a 10 inch diameter grinding wheel is 8000 feet per minute the maximum r.p.m. it can revolve is approximately (A) 2000; (B) 2500; (C) 3000; (D) 3500.

_____ 7. If an 11 inch diameter driver pully of a motor turns at 1200 r.p.m., the driven pulley must be (A) 7 1/2; (B) 12 1/2; (C) 14 1/2; (D) 16 1/2; inches in diameter to turn 800 r.p.m.

Listing

Directions: List the items called for in each of the following statements. Select your answers carefully.

1. List the reasons why the various types of edges are used on sheet metal jobs.

(A) ______________________ (C) ______________________

(B) ______________________

2. List the methods used to form edges on sheet metal.

(A) ______________________ (C) ______________________

(B) ______________________

Procedure-Rearrangement

Directions: In the column below appear various steps involved in extracting the square root of a number. Indicate the order that the steps should be performed, by placing the proper number in each blank at the left.

1. Procedure for computing the square root:

____A. Separate digits into pairs working in both directions from decimal point

____B. Determine the closest and smaller square root and square of the first pair

____C. Double answer for trial division

____D. Repeat process for double the partial answers

____E. Locate decimal point and add two digits for each decimal place desired in answer

____F. Subtract and bring down next pair

____G. Square result before rounding off and then add the remainder

____H. Determine next number for answer and trial division

____I. Multiply

Assignment
Sheet No. 12

Covering
Units 74-83

LAYOUT TOOLS

Proficiency in drawing, shaping, and forming are all important aspects of the sheet metal trade. However, due consideration must be given to the proper procedures for transferring a pattern to metal. This step should be done carefully as inaccuracies will lead to the production of an unsatisfactory job.

In order to transfer a pattern accurately, it is important for the sheet metal worker to know something about the various types of layout tools. This means that he should know how to use and care for them properly. Thus, chances for tool damage will be reduced. He should know how to sharpen layout tools so that they will mark properly and accurately. If the worker knows how to do these things properly, better results will be obtained in the end results.

In this assignment you will be expected to become acquainted with the various types of tools commonly used in sheet metal layout work and the proper methods for using them.

Assignment:

1. Read the reference indicated below.
2. Gage the thickness of five different weight pieces of scrap sheet metal with a U. S. Standard Gage. Compare the decimal equivalent of the gage number with the readings you obtain with a micrometer caliper. (See New York, Hand Processes, p. 4 for table of decimal equivalents of gage numbers.)
3. After completing items 1 and 2, answer the questions below and turn in this assignment by ____________________.

Reference:

C. New York, Measurement and Layout, pp. 1-23.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. The usual trade practice for drawing a series of parallel lines involves clamping a straight edge parallel to a base line.

T F 2. A micrometer should always be opened before removing a part that has been measured.

T F 3. The point of a center punch should be ground to a smaller angle than the angle for the point of a prick punch.

T F 4. The blade of a square should be held in full contact with a surface of an inside right angle that is to be tested for squareness.

T F 5. Dividers should be swung in a clockwise direction when scribing arcs or circles.

T F 6. When a micrometer is closed, the zero mark on the thimble should be even with the horizontal line on the barrel.

T F 7. A center punch is used to make lighter indentations than those ordinarily made by a prick punch.

T F 8. Reading a micrometer is usually the chief difficulty in becoming proficient in its use.

T F 9. A flat steel square may be checked for squareness by placing the square against a straight edge, drawing one line, reversing the square and drawing a second line from the same point.

T F 10. The tendency for dividers to slip is reduced if they are inclined in the opposite direction in which they are rotated.

T F 11. Greater accuracy may be achieved when measuring if the broad part of the scale is held in contact with the work.

T F 12. The points should not be allowed to come in contact with a metal rule when setting a pair of dividers.

T F 13. When drawing a line through two points, the straight edge should be moved into position before the scriber.

T F 14. Inches may be properly designated with a single prime (').

Completion

Directions: Fill the blanks in each statement with the word or words required to complete the sentence correctly.

1. American industry uses the ____________________ system of linear measurement as a standard.

2. The device used for measuring and laying out angles is called a ____________________________.

3. Layout work on paper should usually be done with a pencil of ____________________ hardness.

4. The tool used for layout work on most types of metal is called a ____________________________.

5. The center point of a semicircular protractor should be placed at the ____________ point of an angle that is to be drawn.

6. When smaller units of measurement than sixty-fourths are required, the ________________ system is used.

7. Two straight lines meeting at a vertex are called an ___________.

8. Layout work on stainless steel and aluminum should usually be done with a pencil of ___________ hardness.

9. The final sharpening of a scriber should be done on an ______________________.

10. The point of a scriber will mark closer to the edge of a rule if its top is tipped ___________________.

11. Arcs and circles that are too large to be drawn with dividers are made with _________________ points.

12. The measuring device used to determine the distance around a circle is called a ___________________ rule.

13. Greater accuracy may be achieved when measuring short lengths if the ____________ of the rule are not used.

14. The tool used when transferring a pattern to a piece of metal is called a ______________ punch.

15. The point of a scriber should be ______________ while it is being sharpened.

16. When using an irregular curve in connecting the points of a line, the curve should be set so that it touches at least _______________ of the points.

Listing

Directions: List the items called for in each of the following statements. Select your answers carefully.

1. List the principal movable parts of a micrometer.

(A) _______________________ (B) _______________________

2. List the uses that may be made of a steel scale.

(A) _______________________ (C) _______________________

(B) _______________________

3. List the principal fixed parts of a micrometer.

(A) _______________________ (C) _______________________

(B) _______________________

Assignment
Sheet No. 13

Covering
Units 84-90

SIMPLE LAYOUT WORK

Drawing, the language of industry, is an essential phase in the work of anyone who justly calls himself a sheet metalworker. The ability to read and interpret drawings is of prime importance. The skills and ability to render or execute drawings of varying degrees of complexity have a powerful influence on wages earned.

Practically every job that comes into the shop will necessitate knowledge of drawing, whether it is sketching, patternmaking, or layout work directly on metal. Therefore, trainees in the field of sheet metal work should make special efforts to become proficient in drawing.

In this assignment you will be given an opportunity to review briefly some of the basic principles involved in orthographic projection. Suggestions will be included concerning layout procedures for stretchouts of square, cylindrical, and semicircular jobs, boxes, and square or rectangular elbows.

Assignment:

1. Read the references listed below.
2. Make a pattern of a four piece square-to-round as in Plate 13, page 18, of reference H. Do your layout on heavy paper, then cut out the pattern, fold and tape together. If possible, also do this layout on light gage sheet metal and fold together.
3. Use the calculation method to lay out a 90 degree square elbow on heavy weight paper. (Do not allow material for seams.) Cut out pieces and assemble with cellulose tape. Dimensions are as follows:
   Throat radius. . . 4 inches
   Heel radius. . . . 8 inches
4. After completing items 1 and 2, answer the questions below and hand in this assignment by ______________________.

References:

A. Bruce and Meyer, <u>Sheet Metal Shop Practices</u>, pp. 56-60, 156-162.

C. New York, <u>Measurement and Layout</u>, pp. 24-38.

H. Kaberlein, <u>Triangulation, Short-cut Layouts</u>, pp. 18-19.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. Portions of construction lines parallel to the sides of an angle are used when scribing corner radii.

T F 2. Thin sheet metal is represented by a single heavy line.

T F 3. The front view of an orthographic drawing may differ from the actual front of the job drawn.

T F 4. The shape of the tee of an inclined T-joint is shown in a profile view.

T F 5. It is good practice to place dimensions between the views of an orthographic drawing.

T F 6. The method used for laying out work depends upon the type of job to be done.

T F 7. A broken line is used when only part of a job is shown in a view.

T F 8. Square and rectangular pipe seams should ordinarily meet at a corner.

T F 9. The plan view of an orthographic drawing should be placed to the right of the elevation view.

T F 10. Allowances for edges and seams are referred to as stretchouts.

T F 11. Any view which shows width of a job is called an elevation.

T F 12. A minimum of two views is required to describe the shape of an object completely.

T F 13. A scale should be used to determine the size of dimensions not indicated on a drawing.

T F 14. Pattern drafting is an important part in the development of patterns for sheet metal projects.

T F 15. Much of the layout work for patterns can be done by applying the principles of geometrical construction.

T F 16. One of the most important aspects of pattern development is the ability to visualize the finished job from the flat layout.

T F 17. A pictorial drawing is very good for sheet metal work because it gives accurate information for the fabrication of the project.

T F 18. Seldom will an experienced workman do layouts directly on metal.

Completion

Directions: Fill the blanks in each statement with the word or words required to complete the sentence correctly.

1. Laying out lines on flat surfaces of paper or metal is involved in____________________layout work.
2. Any orthographic view which shows the height of a job is called an____________________.
3. A flat piece of sheet metal cut to the correct shape and size for a job is called a________________before it is formed.
4. One of the chief advantages of an orthographic drawing is that a job may be represented in its true____________________.
5. The heel radius of a rectangular elbow is equal to the throat radius plus the____________________width.
6. The length of the stretchout for the heel is________________ than that for the throat of an elbow.
7. A decimal equivalent table is used to convert decimals to ____________________.
8. Holes to be drilled or punched in sheet metal layouts are marked with____________________.
9. The ends of lines on a stretchout which must be bent or folded are marked with the letter____________________.
10. When laying cut sheet metal work all lines are drawn solid and of the same____________________.
11. A straight line that touches a circle at only one point is called a____________________.
12. Decimals may be converted to nearest sixteenth part of an inch by________________the decimal by________________.
13. A drawing showing the interior construction of a job that is partly cut or broken away, is called a________________.
14. The amount of variation above or below a basic size that is permissable in layout work is called________________.
15. For layout purposes it is more convenient to show the end view of the top of an inclined T-joint as a________________line.

16. A half-size drawing would be made to the scale of ______ = 1'-0."

17. The method of dividing a line into a number of equal parts used in radial line development and triangulation is known as the ______________ method.

18. The metal worker of today must not only be able to perform mechanical operations by hand and by machines, but he must be able to ______________ and ______________ his own patterns.

19. Layout refers to the method of developing the ______________ which form the ______________

20. When tracing around a metal pattern the pattern should be held in place on the metal with ______________ or ______________.

21. Notching and clipping are used to cut away portions of the metal to prevent ______________ and ______________ on seams and edges

22. One of the first steps in preparing to lay out a pattern on the metal is to ______________ the ______________.

Listing

Directions: List the items called for in each of the following statements. Select your answers carefully.

1. List the methods for drawing lines parallel when laying out sheet metal.

(A) ______________________ (B) ______________________

(B) ______________________

2. List the methods that may be used to determine the length of patterns for cylindrically shaped jobs.

(A) ______________________ (C) ______________________

(B) ______________________

3. List the four general methods for laying out sheet metal patterns.

(A) ______________________ (C) ______________________

(B) ______________________ (D) ______________________

Matching

<u>Directions</u>: In the right hand column appear descriptive phrases concerning various terms, and in the left hand column are listed various terms. Match the letter of the descriptive phrases with the terms, by placing the proper letter in each blank at the left.

1. American Standards Association line conventions for blueprints:

_____ 1. outline of parts

_____ 2. section lines

_____ 3. hidden lines

_____ 4. center lines

_____ 5. dimensional extension lines

_____ 6. cutting plane lines

_____ 7. break lines

_____ 8. adjacent parts and alternate positions lines

_____ 9. ditto lines

A. medium weight broken line made up of uniformly spaced long dashes

B. light weight unbroken lines, except at dimensions

C. medium weight broken line made up of uniformly spaced short dashes

D. medium weight free hand line for long breaks

E. heavy weight broken line made up of one long and two short dashes, alternately spaced

F. light weight line made up of long and short dashes, alternately spaced.

G. light weight and uniformly spaced

H. heavy weight line

I. medium weight paired series of short dashes

J. light weight long dashes connected with freehand zigzags

2. Computations for stretchouts:

_____ 1. 4S
_____ 2. 2H + 2W
_____ 3. L + 2H
_____ 4. W + 2H
_____ 5. Pi D
_____ 6. Pi D + 2W
_____ 7. $\frac{\text{Angle}}{360}$ x Pi D

A. length of rectangular box equals
B. square job equals
C. circular job equals
D. width of rectangular box equals
E. semicircular job equals
F. elbows throat equals
G. cone shaped job equals
H. rectangular job equals
I. prisms shaped job equals

Procedure-Rearrangement

<u>Directions</u>: In the column at the right appear various steps or operations involved in sheet metal layout. Indicate the order that your readings recommend that the steps or operations be done, by placing the proper number in each blank at the left.

1. Procedure for laying out square or rectangular jobs:

_____ A. mark brake lines

_____ B. form upper base by connecting points

_____ C. layout lines with flat steel square and straight edge

_____ D. add seams and edges

_____ E. draw stretchout lines slightly longer than sum of sides

_____ F. mark length of job on two end lines with rule dividers

Assignment
Sheet No. 14

Covering
Units 91-102

SEAM AND HEM LAYOUT

As a sheet metal trainee you will frequently see or hear the words, "allowance to be added for seams and hems," when making the stretchouts for various jobs.

These words imply an understanding of not only where the more common types of seams and hems are used, but also a knowledge of the procedures to lay them out. Size specifications for seams and hems may be worked out in advance and indicated on the drawing, or left up to the judgment and experience of the tradesman. Regardless of who determines the size specifications, the competent worker needs to know the proper allowances and layout procedures.

This assignment includes descriptive material pertaining to the more important types of seams and hems along with suggested procedures to be used in layout.

Assignment:

1. Read the references listed below.
2. Complete additional sample models or sketch cards that you started in Assignment Sheet No. 5. (See page 46 in this manual.) Select remainder of samples to be used from material presented in this assignment or other materials you desire.
3. After completing items 1 and 2, answer the questions listed below and hand in this assignment by ________________.

References:

C. New York, Measurement and Layout, pp. 39-54.
D. Daugherty, Sheet Metal Pattern Drafting and Shop Problems, pp. 24-37.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. The strength of lap seams fastened with rivets is greater than those held with solder.

T F 2. The allowance for one side of the bottom of a job with a single seam should equal the width of the seam.

T F 3. The allowance for the flange on the body of a cylindrical job to be joined with a single seam should equal one half the allowance for one side of the bottom.

T F 4. The allowance for a double seam is twice that for a single seam.

T F 5. The allowance for one side of the bottom of a set-in bottom seam should equal one half the allowance for one side of the body.

T F 6. The Pittsburgh lock may be used to join the edges of light weight sheet metal to form flat sections.

T F 7. Notches should be laid out before seams or edges on a pattern.

T F 8. Single hems should generally be wider on heavy sheet metal than on light sheet metal.

T F 9. The allowance for a single hem should be equal to twice the width of the hem.

T F 10. Grooved seams are offset.

T F 11. The allowance for a lap seam is equal to twice the width of the seam.

T F 12. The allowance for one side of the body of a set-in bottom seam should equal the width of the seam.

T F 13. The width of a burred bottom seam should be approximately 3/8 inch.

Completion

Directions: Fill the blanks in each statement with the word or words required to complete the sentence correctly.

1. The allowance for the pocket of a Pittsburgh lock is equal to W + W + ________ inch.

2. Double seams that must be waterproof are ______________.

3. A lap seam must be ______________ when a smooth flush surface is required.

4. The allowance for a wired edge on 24 gage or lighter metal is equal to ______ times the diameter of the wire.

5. A double hem requires an allowance equal to ______ times the width of the hem.

6. The distance between the lock and stop slits of a dovetailed seam may vary from a minimum of ______ to a maximum of ______ inch.

7. The total allowance for a grooved seam is equal to______times the width of the lock.

8. The allowance for each edge of a piece of metal to be joined with a 1/2 inch wide grooved seam is__________inch.

9. The clearance allowed on the straight piece of a riveted corner lap seam is usually__________inch.

10. The total allowance for a lap seam to be fastened with quarter inch diameter rivets should be_______inch.

11. The dimensions required to lay out edges and seams are usually given on the___________________or specifications for a job.

12. The spaces left when pieces of metal are cut from seams and the edges of patterns are called________________________.

13. The sides of a full "V" notch should form a_____________angle.

14. The angle of the notch for a wired edge should start at a distance from the edge of the pattern equal to________times the diameter of the wire.

15. The lower part of the notch for a wired edge usually forms an angle of___________degrees with the edge of the pattern.

16. The kind of edge used on sheet metal is determined by the ___________________and strength of edge required.

17. The width of the flanged edge for a Pittsburgh lock should be ___________________than the width of the seam.

18. The type of clip most widely used to join sections of duct work together is known as a_____________________clip.

19. The allowance for the "S" clip is______________________.

20. The allowance for the government clip is_________________.

Listing

Directions: List the items called for in each of the following statements. Select your answers carefully.

1. List the methods that may be used to form single and double hems.

(A)___________________________ (C)___________________________

(B)___________________________

2. List the advantages derived from notching seams and edges.

(A)___________________________ (B)___________________________

3. List the reasons why various types of edges are formed on sheet metal.

(A) ______________________ (C) ______________________

(B) ______________________

4. List the materials that may be used to form edges on sheet metal.

(A) ______________________ (C) ______________________

(B) ______________________

5. List the factors that must be considered in selecting the types of seams and edges to use on sheet metal problems.

(A) ______________________ (C) ______________________

(B) ______________________ (D) ______________________

Matching

Directions: In the left hand column is a list of terms. The right hand column contains descriptive phrases or synonymous terms. Match the descriptions to the terms by placing the letter of the description in the blank at the left of the appropriate term.

1. Types of notches; their uses and characteristics:

_____ 1. square

_____ 2. straight

_____ 3. slant

_____ 4. "V"

_____ 5. half "V"

_____ 6. wire

A. dovetailing or outside corner flange

B. double seamed box ends and inside flanges on 90 degree bends

C. combination of square and half "V" notches

D. box and pan corners

E. combination of straight and half "V" notches

F. Pittsburgh lock

G. cut at 45 degrees when single hems are to meet at right angles

Assignment
Sheet No. 15

Covering
Units 103-108

PARALLEL LINE DEVELOPMENT

Sheet metal drafting necessitates more than a knowledge of mechanical drawing. It requires a knowledge of the specialized methods used to develop the various types of jobs that confront the sheet metalworker. Among these specialized methods is included parallel line development.

The parallel line method is one of the principal methods of development used in sheet metal drafting. It is used primarily for that group of jobs having uniformly shaped ends. Such jobs include tee-joints, elbows, and cornices. By gaining a thorough understanding of the fundamental principles involved in this method, it should enable one to develop a wide range of sheet metal jobs.

In this assignment you will be expected to gain a clear understanding of the parallel line method by reading about the principles involved and following the step-by-step procedures concerning the development of typical problems. In addition, representative problems of each type are assigned to be developed.

Assignment:

1. Read the references listed below. (It is suggested that you use dividers to follow the step-by-step procedures shown in the references on layout problems that are difficult for you to understand.)
2. Develop each of the jobs listed below on either drawing or heavy weight wrapping paper. Follow the step-by-step procedure shown in the reference to which the job is keyed. Specifications are indicated between the parentheses that succeed the name of each job. The reference and page number are enumerated first, followed by numbers that are used to indicate size dimensions for the letter distances shown in the reference illustration. Make no allowance for seams. Check the layout for each job after completion by cutting it out and assembling it with tape.

   (a) Square pipe and flange (Reference C, page 60: H = 4"; S = 2"; angle = 45 degrees; flange = 6" square)

   (b) Cylindrical pipe and flange (Reference C, page 62: H = 4"; D = 2"; angle=45 degrees; flange = 6" square)

   (c) Straight tee joint (Reference C, page 65: H = 2"; d = 2"; l = 2"; L = 4"; D = 2")

(d) Inclined tee joint (Reference C, page 68: H = 4"; d = 2"; g = 4"; L = 8"; D = 2"; angle = 45 degrees.)

(e) Elbow (Reference C, page 71: D = 2"; r = 2"; angle = 90 degrees)

(f) Ogee gutter miter (Reference C, page 74: H = 4"; W = 4"; w = 2"; L = 4"; l = 4")

3. After completing items 1 and 2, answer the questions listed below and hand in this assignment by ____________________.

References:

A. Bruce and Meyer, Sheet Metal Shop Practice, pp. 58-60, 188-194.
C. New York, Measurement and Layout, pp. 55-75.
D. **Daugherty**, Sheet Metal Pattern Drafting and Shop Problems, pp. 24-54.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. The plan view may be omitted when developing all square-return miters.

T F 2. There is little relationship between geometry which relates to the surfaces of solids and sheet metal pattern drafting.

T F 3. The pattern for a cone could be developed by the parallel line method.

T F 4. Parallel line development is used in developing patterns for tapered forms.

T F 5. Element lines should usually be drawn one-half inch apart.

T F 6. Corresponding element lines are given the same identification number or letter in both the plan and elevation views.

T F 7. Paper patterns are required for most of the simple pipe fittings encountered in duct work.

T F 8. In developing a pattern for a square pyramid you would use the parallel line method.

T F 9. The only difference in developing patterns for oblong pipes as compared with developing round pipes, lies with the profile or plan view.

T F 10. The length of element lines is usually obtained from a drawing in the view represented as a circle.

T F 11. The only difference in developing a pattern for a square-face miter as compared with a square return miter is in the position of the stretch-out line.

T F 12. Plan views are generally drawn first when laying out sheet metal jobs.

T F 13. The number of element lines used in developing a pattern depends on the size of the job.

T F 14. The parallel line method of developing patterns for sheet metal is used very little because so few articles have parallel sides.

T F 15. The irregular cut edge of a pattern for the end pieces is the same as that for middle pieces of an elbow.

T F 16. A face miter rather than a return miter could be made on a cornice by changing the position of the miter line.

T F 17. Element lines run parallel to stretchout lines.

T F 18. The stretchout line should be drawn at right angles to the elevation view in parallel development.

T F 19. Prisms and cylinders are usually developed by the radial line method.

T F 20. The line of intersection between two parts of a job must be determined before the stretchout can be made.

T F 21. In sheet metal work the term elevation view applies to any view which shows the height of the object.

T F 22. A common group of round pipe fittings laid out by parallel line developments are intersecting pipes, commonly called tees.

T F 23. The true lengths of element lines are obtained from a plan view.

T F 24. A knowledge of geometrical constructions is important for the sheet metal draftsman because they are the basis of all developments.

T F 25. The length of a stretchout for a cylindrical pipe is based upon the true length of element lines.

T F 26. The terms girth and stretchout may be used interchangeably in ogee gutter layout work.

T F 27. On a round elbow, the inside radius is called the throat and the outside radius is called the heel.

T F 28. Plan views may be drawn either above or below front elevation views in sheet metal layout work.

T F 29. For developing the round elbow the miter lines are curved and must be developed.

T F 30. In developing a round elbow, the first gore pattern is the only pattern needed if the angles are the same.

Completion

Directions: Fill the blanks in each statement with the word or words required to complete the sentence correctly.

1. The line at which two parts of a job meet is called an__________.

2. The most important step in developing patterns for elbows is the development of the true__________ __________.

3. The length of element lines may be transferred to a stretchout by projecting them at an angle of__________degrees from the proper elevation view.

4. The lengths of element lines are transferred to a pattern in the pickoff method with__________.

5. The more accurate way for determining the length of stretchout lines involves the use of the__________method.

6. In developing patterns for intersecting pipes, the layout of the hole is done by__________.

7. The points along a six-inch steel scale that would ordinarily be marked when dividing a line 3 3/4 inches long into 5 equal parts by the scale method, would be located next to numbers__________, __________, __________, __________.

8. Development of a pattern for a tee joint consists of laying out the true lengths and proper spacing of__________lines.

9. If the line of intersection between two pipes is straight, it is called a__________ __________.

10. The straight line formed between two parts of a job, such as a gutter is called a__________.

11. The plan view of a single cylinder may be represented as a __________ __________in order to save time and space.

12. The layout made to show the actual shape of all the surfaces of an object is called a__________.

13. The parallel line method is used to develop irregularly shaped patterns for jobs with__________sides.

14. In radial line development, the_____________meet at a common center as with____________and___________________.

15. The parallel construction lines used in the development of a cylinder that has been cut off at an angle are called___________.

16. Spacing for element lines as determined from a view represented as a________________________or part thereof.

17. The length of stretchout lines for small diameter circles and arcs should usually be determined by the_____________method.

18. The intersection points between corresponding element lines of a tee joint will locate the_______________of________________.

19. For plain rectangular duct, the measuring lines on the elevation view are the_____________lines of the duct.

Multiple-Choice

Directions: Listed with each of the incomplete sentences that follow are several responses, one of which will complete the statement to make it true. Indicate your choice by placing the appropriate letter in the blank at the left.

_____1. In developing a round elbow, it is standard practice to (A) Keep the seams on the side; (B) Keep the seams staggered; (C) Do both A and B; (D) Keep the seams on the side of the heel.

_____2. The angle formed between the stretchout line and elements for a pattern should equal (A) 30; (B) 45; (C) 3; (D) 4.

_____3. The minimum number of views required to develop a pattern by the parallel line method is (A) 1; (B) 2; (C) 3; (D) 4.

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. List the methods used to determine the length of stretchout lines.

(A)______________________ (B)__________________________

2. List the methods used to develop sheet metal patterns.

(A)______________________ (B)__________________________

(C)______________________

3. List the measurements necessary when developing a pattern for an elbow.

(A)______________________ (C)______________________

(B)______________________

Procedure-Rearrangement

Directions: In the column at the right appear steps or operations involved in sheet metal work. Indicate the order that your readings recommend they be performed, by placing the proper number in each blank at the left.

1. Procedure for laying out a cylindrical pipe cut off at an angle:

____A. Divide plan view into equal spaces and number points

____B. Draw stretchout line

____C. Draw element lines

____D. Draw front elevation

____E. Add material for seams

____F. Project points from plan view to elevation view

____G. Divide stretchout line into equal number of parts

____H. Determine and mark length of element lines

____I. Draw plan view

____J. Connect points with curved lines

2. Procedure for laying out a rectangular pipe cut off at an angle:

____A. Draw plan view, number corners, locate and label seams

____B. Layout and number lines representing edges

____C. Draw front elevation

____D. Project lengths of lines for edges from elevation view

____E. Connect points

____F. Draw stretchout line

Assignment
Sheet No. 13

Covering
Units 109-114

RADIAL LINE DEVELOPMENT

A sheet metal layout man needs to have more than a knowledge of simple layout procedures and parallel line development methods. He requires a knowledge of other specialized methods to develop the various types of jobs that confront the sheet metal worker. Among these specialized methods is included radial line development.

The radial line method of drawing is one of the principal methods of development used in sheet metal drafting. It is used primarily for that group of jobs with tapered sides which meet at a point or are prolonged to meet at a point. Such jobs include funnels, hoppers, and transition pieces. By gaining a thorough understanding of the fundamental principles involved in this method, it should enable one to develop a wide range of jobs.

In this assignment you will be expected to gain a clear understanding of the radial line method by reading about the principles involved and following the step-by-step precedures concerning the development of typical problems. In addition, representative problems of each type are assigned to be developed.

<u>Assignment</u>:

1. Read the references listed below. (It is suggested that you use dividers to follow the step-by-step procedures shown in the references on layout problems that are difficult for you to understand.)
2. Develop each of the jobs listed below on either drawing or heavy weight wrapping paper. Follow the step-by-step procedure shown in the reference to which the job is keyed. Specifications are indicated in some instances between the parentheses that succeed the name of each job. The reference and page number are enumerated first, followed by numbers that are used to indicate size dimensions for the letter distances shown in the reference illustration. In order to reduce confusion, use the corresponding notations on your drawing that appear in the reference illustration. Make no allowance for seams. Check the layout for each job after completion by cutting it out and assembling it with tape.

   (a) <u>Irregular frustum of cone</u> (Reference C, Page 84: H = 6"; h = 4"; D= 3"; angle = 30 degrees.)

   (b) <u>Irregular frustum of pyramid</u> (Reference C, Page 86: H = 6"; h = 4"; S = 3"; angle = 30 degrees.)

   (c) <u>A cone intersected by a vertical cylinder</u> (Reference D, Page 94, Problem 58.)

   (d) <u>A cylinder intersecting frustum of a cone obliquely</u> (Reference D, Page 100, Problem 63.)

3. After completing items 1 and 2, answer the questions below and turn in this assignment by______________________.

References:

A. Bruce and Meyer, Sheet Metal Shop Practice, pp. 161, 162, 215.
C. New York, Measurement and Layout, pp. 76-87.
D. Daugherty, Sheet Metal Pattern Drafting and Shop Problems, pp. 78-103.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. Stretchout arc is a term used to refer to the distance around the base of a cone.

T F 2. The elevation view of the true projection of the line of intersection between a cone and cylinder would appear as a straight line.

T F 3. Knowledge of parallel line development is necessary to develop the parts for an intersecting cone and cylinder.

T F 4. A plan and elevation view is necessary to develop a pattern by the radial line method.

T F 5. The length of element lines for a cone will vary if the base is located perpendicular to the axis.

T F 6. The radius of the stretchout arc should be drawn equal to the true length of the distance around the base.

T F 7. True lengths are usually projected into the plan view.

T F 8. Plan and elevation views are required to determine the line of intersection between a cone and cylinder.

T F 9. Two element lines will appear in their true length on the plan view of a cone.

T F 10. The development of parts for a job may require the use of several layout methods.

T F 11. The length of a stretchout for a pattern developed by the radial line method is determined from the elevation view.

T F 12. The radius of the stretchout arc for a cone should be equal to the altitude of the cone.

T F 13. The position for the plan view of a right pyramid may be selected so that the edges will be shown in their true length in the elevation view.

T F 14. It is usually more convenient for sheet metalworkers to place the plan view above the elevation view.

T F 15. A cylindrical pipe cannot be developed by the radial line method.

T F 16. Developmental procedures for a pyramid will be simplified if the job is placed so that the two closest corners of the base are equal distance from the front plane of projection.

T F 17. Measuring lines and edge lines of a pattern are always radii of the stretchout arc.

Completion

Directions: Fill the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. To develop a pattern by radial line method the stretchout arc must be described with a radius __________ to the length of the __________ __________ of the solid.

2. The spacing of element lines on the stretchout of a cone is determined from the __________ view.

3. The length of the stretchout arc for a cone is equal to the __________ of its base.

4. Radial line developments make __________ shaped patterns.

5. The cross section produced by passing an oblique cutting plane through a cone would be __________ in shape.

6. The portion remaining after the top part has been cut off parallel to the base of a cone or pyramid is called a __________.

7. When the upper portion of a right cone is cut off on an angle with the base, a cone is said to be __________.

8. Dividers are used in the __________ method for laying out the length of arcs for patterns developed by the radial line method.

9. The radius used for the stretchout of a right pyramid is based on its __________ __________.

10. In order to develop a job by the radial line method, its sides or extensions must meet at a __________.

11. All the element lines of a __________ cone are equal in length.

12. The radial line method is used to develop jobs with __________ sides.

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. List the methods used for laying out the length of arcs for patterns developed by the radial line method.

(A)________________________ (B)________________________

Procedure-Rearrangement

Directions: In the column at the right appear various steps involved in laying out jobs by the radial line method. Indicate the order which your readings recommend that these steps be done by placing the proper number in the blank at the left.

1. Layout procedure for cone-shaped jobs cut at an angle:

____A. Connect points from base line to apex of cone

____B. Number true lengths of element lines

____C. Draw elevation view of cone showing apex

____D. Project points where element lines intersect miter line to side of cone

____E. Draw element lines on stretchout and number

____F. Scribe stretchout arc

____G. Project points for elevation view of element lines from plan view

____H. Compute length of stretchout

____I. Mark points on element lines where cone is to be cut off and connect points with a curved line

____J. Add allowance for seams

2. Layout procedure for pyramid-shaped jobs cut at an angle:

____A. Draw a plan view

____B. Add allowance for seams

____C. Determine true length of edges remaining after pyramid is cut off.

____D. Layout perimeter of base on stretchout arc

____E. Draw lines representing edges on stretchout and number

____F. Draw elevation view of job showing apex

____G. Scribe stretchout arc

____H. Connect points indicating where pyramid is to be cut off

____I. Mark points on lines representing edges where pyramid is to be cut off

____J. Mark brake lines

Assignment
Sheet No. 17

Covering
Units 115-123

TRIANGULATION

A knowledge of parallel and radial line development is not enough for the well-trained sheet metal layout man to know. He must have a knowledge of another specialized method to develop the various types of jobs that confront the sheet metalworker. This method is known as triangulation.

Triangulation is one of the principal methods of development used in sheet metal drafting. It is used for irregular-shaped jobs that cannot be developed by either the parallel line or radial line methods, that is jobs having surface lines that are neither parallel nor that converge to a common point. Such jobs include transition pieces, reducers, and Y branches. By gaining a thorough understanding of the fundamental principles involved in this method, it should enable one to develop a wide range of jobs.

In this assignment you will be expected to gain a clear understanding of the triangulation method of development by reading about the principles involved and following the step-by-step procedures concerning the development of typical problems. In addition, representative problems of each type are assigned to be developed.

Assignment:

1. Read the references listed below. (It is suggested that you use dividers to follow the step-by-step procedures shown in the reference on layout problems that are difficult for you to understand.)
2. Develop each of the jobs listed below on either drawing or heavy weight wrapping paper. Follow the step-by-step procedure shown in the reference to which the job is keyed. Reference and page numbers are indicated between the parentheses that succeed the name of each job. In order to reduce confusion, use the corresponding notations for the job you develop as appear in the reference illustration. Make allowance for seams. Check the layout for each job after completing by cutting it out and assembling it with tape.

   (a) Transition piece, square to square (Reference D, page 106, Problem 65).

   (b) Transition piece, rectangular to round (Reference D, page 108, Problem 66).

   (c) Elbow-boot center taper (Reference H, page 49, Plate 29).

   (d) Roof collar having round top and square base (Reference D, page 128, Problem 81).

   (e) Three-piece offset fitting (Reference D, page 130, Problem 82).

(f) Furnace Boot, round to rectangular (Reference D, page 134, Problem 86).

(g) Two-branch Y-joint, round to round (Reference D, page 138, Problem 88).

3. After completing items 1 and 2, answer the questions listed below and turn in this assignment by____________________.

References:

A. Bruce and Meyer, Sheet Metal Shop Practice, pp. 195-209.
D. Daugherty, Sheet Metal Pattern Drafting and Shop Problems, pp. 24, 104-158.
H. Kaberlein, Triangulation, Short-Cut Layouts, pp. 48-49.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. The selection of the layout method may be optional with the sheet metal patternmaker.

T F 2. The triangulation method is just a matter of dividing the surface of a project into triangles, finding the true lengths of the sides of the triangles and then drawing the triangles in proper order.

T F 3. Many projects are too complicated to be developed by the parallel line, radial line, or triangulation methods.

T F 4. Triangulation method of development is used for articles with non-parallel sides.

T F 5. A square-to-round transition on center requires both elevation and full plan view for its development.

T F 6. A diagram of triangles for true lengths can be drawn if the altitude in the elevation and the base lines in the plan are known.

T F 7. The construction of a triangle when only three sides are given is a difficult problem.

T F 8. A single altitude and base line extension may be used to layout right triangles required to find the true lengths of scalene cone element lines.

T F 9. Both a plan and elevation view are necessary to produce the true surface lines for a job when the halves are not symmetrical.

T F 10. A pattern may be developed by using only the plan view in the simplified method of triangulation.

T F 11. Arcs are drawn to step off the distances between the outer ends of the true length lines when laying out a scalene cone.

T F 12. A full view of the upper and lower bases of an irregular flaring roof collar will be exact circles.

T F 13. Triangulation is the method used to develop patterns for irregular forms which cannot be developed by either the radial line method or parallel line method.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. All kinds of irregular forms which cannot be developed by parallel line development and radial line development may be developed by the ______________________________ method.

2. On an elevation view, all lines in a vertical plane which are perpendicular to the line of vision are ____________ ____________.

3. The sheet metal layout man must design duct systems so they will handle large quantities of air________________ and ______________.

4. When radical air flow direction changes must be made, duct turns must be installed in the fitting which directs the air through the fitting with the __________________ amount of______________.

5. A layout man can do a more effective job in the design and layout of all types of air conditioning systems if he thoroughly understands all of the types of __________________ __________________.

6. To find the true length, one method used by sheet metalworkers is to draw the line in a ____________ view and then __________ it.

7. The first process in laying out a triangulation pattern is to find the _____________ for all lines.

8. To find the true length of a foreshortened line by the simplified method, in the elevation view, make the foreshortened line the base of a _______________ _________________, the altitude is the _________________ in heights taken from each end of the line in the ______________ ____________, the hypotenuse will be the _________________ _______________ line.

ELBOW-BOOT CENTER TAPER

Directions: The following questions are based on Plate 29, page 49 of Kaberlein, Triangulation Short-cut Layouts. Place the proper word or words in the blanks provided.

1. This type of fitting is generally used on ______________________ ______________________ where small round pipes may be used very efficiently as basement runs.
2. The top view and side view are drawn in this Plate to show _______ and _________ of the fitting.
3. Line A to B in Figure 3 is equal in length to line _______ and is _____ inches long.
4. Point ________ is used as a center to draw an arc from point 1, 2,3,4,5, and 6 on the circle to intersect the base line of the triangle thus obtaining the ______________________ of the lines.
5. To layout the pattern as in Figure 5, draw line A to A. The length of this line is _________.
6. To get the true-length of the slant (A to 1'), use the triangle, Figure 3 line _________.

Assignment
Sheet No. 18

Covering
Units 124-133

ESTABLISHING AND OPERATING A SHEET METAL BUSINESS

Did you know that on the average for all kinds of new businesses started, approximately one-third fail within the first year, and by the end of five years nearly three-fourths fail? More than half of the metal working shops that failed were established with a capital investment of less than $1,000 and failed in the first year of operation.

Before you think too seriously about entry into the sheet metal business, learn the trade first. Skill and experience are qualifications necessary for success. Obtain all the training that is practical for you to receive. Read and keep up with new developments in the field. Get at least three or four years of all-round work experience in the trade.

Skill and good workmanship alone are not going to insure one success in business, other attributes are necessary. In order to attract business into the shop, one must be able to get along well with people and be a good salesman. He must have a head for figures and a satisfactory system for recording information that will enable him to operate his business efficiently.

Assignment:

1. Read the reference listed below.
2. Assume that you are actually going to enter the sheet metal business in the very near future. Prepare a written report based upon your studies and investigations that includes all data, information, and sketches that you feel are necessary for your entry into business. You might include data in your report concerning the following:
    - (a) Community need and demand for the business
    - (b) Select and justify location
    - (c) Tentative floor plans of shop
    - (d) Supplies and equipment required
    - (e) Organization plans of business
    - (f) Financial problems
    - (g) Business advisors
    - (h) Record forms
    - (i) Education and preparation desired before entering business
3. After completing items 1 and 2, answer the questions listed below and turn in this assignment by ____________.

Reference:

I. Information Sheet No. 3, this manual.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. Offerings of established metal working businesses should ordinarily be considered before entering into competition with them.

T F 2. More than half of the metal working shops established with a capital of less than $1,000 fail within the first year.

T F 3. A light intensity meter may be used to help determine whether general and special lighting are properly arranged.

T F 4. A simple production analysis is necessary to make certain that the shop layout is satisfactory for a particular business.

T F 5. Wood floors are recommended for metal working shops because they are less tiring on the feet.

T F 6. A good method for checking shop layout is by arranging scale "cut outs" of equipment on a scale drawing of the shop's floor plan.

T F 7. There are many desirable localities free of competition in metal working business.

T F 8. Ordinarily when starting a new business it is better to buy than to lease a building.

T F 9. The size and character of a locality's population determines to a large extent the amount and kind of business which can reasonably be expected.

T F 10. A specialized metal working shop generally has a greater chance for success in a small community than in a large city.

T F 11. Zoning restrictions are used to keep stores out of choice residential districts.

T F 12. Generally, it is more feasible to locate a small metal working shop adjacent to a traffic artery than a side street.

T F 13. Mechanical training and experience are essential qualifications for successfully establishing and operating a metal working business.

T F 14. Explanations concerning rule-of-thumb methods for estimating job costs may generally be obtained from supply warehousemen and salesmen.

T F 15. U.S. Department of Commerce surveys reveal that a large proportion of the small businesses that fail each year do not keep adequate records.

T F 16. It will be necessary for a metal working shop to have dealings with a bank as long as it is in business.

T F 17. Business organizations need adequate financial records so that taxes can be accurately calculated.

T F 18. It is considered a poor business practice to charge a customer more than the regular price for a "rush job".

T F 19. Costs based on rule-of-thumb methods differ because of variations in labor costs, rents, competition, and other items in different sections of the country.

T F 20. The original copy of a job sheet used for record keeping purposes is retained for office records.

T F 21. Court action should be used only as a last resort in collection of bad debts.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. One of the best types of advertising for a metal working shop is that which appears in ______________ directories.
2. Jobs for which there is no particular hurry to complete can be used as filler to keep a shop ______________ during slack periods.
3. Rule-of-thumb methods for estimating job costs are based largely on ______________.
4. The lightweight cardboard third carbon copy of a job sheet used for record keeping purposes is known as a ______________ sheet.
5. It is advisable before entering into a legal agreement to obtain the advice of a ______________.
6. Double-entry record books provide spaces for recording ______________ and ______________.
7. Probably the best bookkeeping system for a small new business to adopt would be a ______________ entry system.

8. An important book in a simplified system of accounting is the ________________.

9. An estimate of expected competition for a new business may be determined by glancing at the classified section of a ________ ________________.

10. The lessee should reserve the right to renew a lease by giving notice some ________ days before the lease is expired.

11. Business expenses are usually significantly __________ in the small community than in the large city.

12. A successful sheet metal working shop will generally have a trading area population of not less than _____________persons.

13. The buyer of a business should engage a competent _____________ to draw up the purchasing agreement.

14. The saw-tooth type of roof was developed to permit more _____________ to enter the interior of a building.

15. For the ease of handling materials in and out of the shop, it should be located on the ________________ floor.

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. List the types of organizations helpful in revealing information concerning business opportunities and limitations.

(A)__________________________ (D)__________________________

(B)__________________________ (E)__________________________

(C)__________________________

2. List the two basic methods of keeping accounts.

(A)__________________________ (B)__________________________

3. List the type of information that should be recorded in each of the three main sections of a job sheet record form.

(A)__________________________ (C)__________________________

(B)__________________________

4. List the two principal factors that must be kept in mind when making estimates and quoting prices.

(A)__________________________ (B)__________________________

5. List the most important methods to attract business into a metal working shop.

(A) ______________________ (C) ______________________

(B) ______________________ (D) ______________________

6. List the sources of information that ordinarily provide the most reliable data concerning a prospective customer's credit standing.

(A) ______________________ (C) ______________________

(B) ______________________

Information
Sheet No. 4

ESTABLISHING AND OPERATING A SHEET METAL BUSINESS

You have learned from the previous assignment sheets that the **sheet metalworker** works with tinplate, iron or steel sheets, and light plates. Generally, they do roofing and skylight work, install ventilators and ducts for heating or air-conditioning, and make any number of things which the public demands to be fashioned from sheet metal. It would be possible for you to get into this field with no more than a building, a source of heat such as a blow torch, a few soldering irons, and a pair of tin snips. A person starting out with nothing more than the above would be severely handicapped, however, and would probably not make a success of it. To be able to do the range of work needed to succeed, you would need such machines as shears, bending brakes, work tables of good size, and welding equipment, plus an adequate assortment of hand tools. Mechanical training and experience are also essential. In fact, to be successful in running a sheet metal shop you should have had well-rounded training, because in the beginning you may be faced with the problem of making a minimum of equipment do for a large variety of jobs.

CHOICE OF A LOCATION

In any locality, the size and character of its population and its business activities determine to a large extent the amount and the kind of business which can reasonably be expected. Large metropolitan cities, with their great concentrations of population and immense variety of occupations, offer many opportunities for the proprietor of a sheet metal shop. But competition is likely to be keen because others will surely be equally aware of the chance for business there. One method of getting ahead in a large city is to establish a reputation for expert handling of certain difficult or unusual work. Becoming known as an expert in some area will usually result in considerable business.

Smaller factory cities have many potential sources of business for sheet metal shops. Rural communities that are predominantly agricultural present problems for a person who is interested in sheet metal work only. It is doubtful that there would be enough demand to make a successful business. Business expenses are usually much lower in the small community. Taxes are not as high as they are in the larger cities and overhead is generally less. However, it is generally agreed that one should have a trading area population of not less than 20,000 persons for a sheet metal business to succeed.

If you are thinking of setting up a business in a certain city, in addition to the existing competition there are a number ofother things that you should know about the locality. The telephone directory can give you valuable information about the number of competitors in addition to the number of business concerns and contractors that might be potential customers. Bankers, Chambers of Commerce, businessmen's clubs, and other organizations for the promotion of business, usually have a good deal of helpful data bearing on local commercial prospects. The number of motor vehicles registered in an area in proportion to the population is to some extent an indication of the general level of prosperity. This information is available from the state motor vehicle department. The Bureau of the Census also has a great deal of information on the manufacturing and business activities of a given area.

CHOOSING A SPOT FOR YOUR SHOP

One of the first important business decisions a person must make after deciding to open a shop is the selection of a place to do business. One of the considerations one must think about is checking the zoning ordinances to determine if the location you are considering is restricted. Many sections close to a residential area are zoned to prevent business from moving in. The direction of growth of the city is another important consideration. It is well to locate your shop where the money is being spent. Rental rates is another item that is important. Rent has to be paid every month whether your business is making a profit or not. High rent can strangle your business, especially during a slump. It might pay to check the advantages of leasing your shop rather than renting or buying. Some of the advantages of leasing over buying are that your initial investment will be lower, leaving you more cash for equipment and operating costs, and you will also enjoy freedom from such ownership risks as fires, tornadoes, and value changes. Another important factor to consider in the selection of a building for your shop is the available parking space, and the ease with which the customer can get to your shop. A busy traffic artery is not necessarily the best location. Usually a side street off these busy highways is best.

If the location has been carefully selected, and the rights and obligations of owner and tenant are fully and clearly agreed upon in writing, you need have no hesitation in signing a lease for one year or longer. You should reserve the right to renew it for a similar period by giving notice some 60 days before the end of the period.

Before signing any leases or contracts in starting your business you should see a lawyer. His services will cost you something, but chances are it will save you in the long run.

Once the arrangements on the building have been completed, the next step is to arrange the equipment in the building. A good method for doing this is to draw to scale, on a large sheet of paper, the floor plan of the shop showing all windows, doors, partitions, and columns. Then, to the same scale, cut out of heavy paper the plan of each piece of machinery, equipment, work benches, and storage space. Arrange them on the floor plan for the most efficient flow of work, taking advantage of such things as natural light, power supply, etc.

In the selection of your shop you should also avoid a room with wood floors. In a shop where there is a possibility of grease and oil being spilled on the floor, and where heavy machines are to be used, concrete floors are a <u>must</u>. For the ease of getting material and finished work in and out of the shop, it should be located on the ground floor.

The building should have good window area, or the roof should be of the saw-tooth type to provide a good source of natural light. If not, enough lighting fixtures will need to be installed to insure a light supply adequate for the type of work being done. The light intensity can be easily checked with a light meter available from all electrical supply houses, or most power companies.

Once your business is set up, you will need all the publicity you can get for your shop. Some of the ways of obtaining publicity are by personal contacts with potential customers, telephone solicitation and advertising in the local newspaper. One of the best ways of advertising is to have your business listed in the yellow pages of the telephone directory. As your business gets under way a satisfied customer is an excellent way to increase your future business.

QUOTING PRICES

Your ability to estimate the cost of a job so that your shop makes a profit and your customer is happy will determine whether or not you stay in business. When making estimates and quoting prices you must keep two principal factors in mind: how much it will cost you to do the job, and what the customer is willing to pay. How much to charge is not always easy to determine because the decision rests in part upon things that are beyond your knowledge or control. Actual market prices for various jobs are determined by the prevailing practices in your locality. The extent of your competition will depend on the number of available shops that can do the job. Only the customer will know what the work to be done is worth to him.

In every locality there are rule-of-thumb methods for estimating costs andare learned largely through experience. The salesman from whom you purchase your machinery, or the supply house, will be able to acquaint you with these and will be glad to explain these methods to you. However, if a customer comes in with a rush job, do not hesitate to charge more than your usual rate for such a job. This usually involves changing your routine and may increase costs. Also, if a customer wants quick preferred service, he should be willing to pay for it.

RECORD KEEPING

In a survey made by the United States Department of Commerce to determine why so many small businesses fail in the first, second, or third year, it was found that a large percentage of them kept inadequate records or no records of their business.

There are two basic methods of keeping accounts - the single-entry system and the double-entry system. The single-entry system is a simple system for accounting for the receipts and expenditures of cash. The checkbook, an accounts receivable ledger, and a day book for entering memorandum-type information are all the equipment required.

The double-entry system is more complete and to keep it properly requires a knowledge of bookkeeping and accounting methods. Double-entry means that the accounts are split into two sections - debit and credit. The debit side is always the left and the credit side is the right. For each debit entry a credit entry is made also, and the books must always balance. This system provides the bookkeeper with a means for checking his accuracy.

Although an elaborate bookkeeping system is not necessary for a small shop, you must have certain record-keeping procedures if the shop is to be properly managed. A job sheet is essential and is best handled by utilizing a form which has one original copy and three carbon copies. The original serves as the customer's copy, the first carbon is the customer's receipt, the second carbon is the office copy and the third carbon is a shop card or job ticket. This third carbon in usually printed on lightweight cardboard. These job sheets are usually divided into three sections; the left section is for a description of the work to be done, the middle section is for the estimate of material, and the right section is the estimate for labor.

From the day you open and as long as you stay in business you will have dealings with a bank. Therefore, it is wise to choose one that will best service your needs from the standpoint of convenience and services offered. The best way to build a good reputation with your banker is to operate in a businesslike manner. This means you must pay your bills promptly and keep your account receivable collecte

The need for the small businessman to extend credit to his customers raises a very important issue. A large number of businesses have failed because they were too lenient in granting credit. Knowing this, you will probably be tempted to adopt a "no credit" policy. However, such a course would limit your field of business opportunities to such an extent that you would never be able to earn more than a very meager living. The effectiveness of your collection system will determine the credit that you will be able to extend. No one can afford to give credit unless he is able to collect later. You will have a few bad accounts, but they should be collected because accounts written off come directly out of your profits. If all other means of collecting fail, it may be necessary to bring court action; however, avoid this if at all possible. If it does seem necessary, consult a good lawyer.

To avoid too many bad accounts, it is wise policy to investigate a customer;s credit standing before extending credit. Your bank and other credit organizations can furnish you with helpful information, and also, you can examine your customer's business habits.

The above information was adapted from:
U.S. Department of Commerce, Establishing and Operating a Metal Working Shop, Superintendent of Documents, U.S. Government Printing Office, Washington 25, D.C., 1945. (Out of print)

TRAINING PLAN AND PROGRESS RECORD
FOR
SHEET METAL WORK

Employer's Copy

JOB TRAINING: What the Worker Should be Able To Do	Proficiency Shown	RELATED INFORMATION: What The Worker Should Know
	Sheet Metal Materials	
Plan jobs, make bill of materials and select materials for jobs. Time in hours ________	☒	Properties and specifications of sheet metal, methods of manufacturing, and the use of metal gages.
	Safe Practices	
Safety in the shop, procedures for extinguishing fires and administering first aid. Time in hours ________	☒	Safety practices in the sheet metal trade.
	Hand Processes	
Perform hand tool operations, transfer patterns, bending, cutting, forming, drilling, riveting, wiring, make seams and hems, tin soldering copper and soldering. Time in hours ________	☒	Types and kinds of hand tools, range of work of each and acceptable shop practices.
	Machine Processes	
Perform machine operations on bar folder, brake, squaring shear, turning, beading, crimping and burring machine. Time in hours ________	☒	Description and uses of sheet metal forming machines, cutting machines and grinding wheels.
	Sheet Metal Mathematics	
	☒	Methods of adding, subtracting, multiplying, and dividing fractions, decimals, linear measurements, areas, volumes, sheet metal formulas, and trigonometry procedures and functions.

Sheet Metal Business

Prepare and maintain shop, make sales, quote prices, extend credit and collect accounts.

☒

Qualifications necessary for operating a business, costs involved, shop layout, tools and equipment necessary, sales and marketing methods, and records.

Time in hours ______

Code for employer's use in marking student's progress:

Performed some operations in area ☒

Performed most operations in area ☒

Performed some operations with reasonable proficiency ☒

Performed most operations satisfactorily ☒

TRAINING PLAN AND PROGRESS RECORD
FOR
SHEET METAL WORK

Student's Copy

JOB TRAINING: What the Worker Should be Able To Do	Proficiency Shown	RELATED INFORMATION: What The Worker Should Know
Sheet Metal Materials		
Plan jobs, make bill of materials and select materials for jobs. Time in hours ________	☒	Properties and specifications of sheet metal, methods of manufacturing, and the use of metal gages.
Safe Practices		
Safety in the shop, procedures for extinguishing fires and administering first aid. Time in hours ________	☒	Safety practices in the sheet metal trade.
Hand Processes		
Perform hand tool operations, transfer patterns, bending, cutting, forming, drilling, riveting, wiring, make seams and hems, tin soldering copper and soldering. Time in hours ________	☒	Types and kinds of hand tools. range of work of each and acceptable shop practices.
Machine Processes		
Perform machine operations on bar folder, brake, squaring shear, turning, beading, crimping and burring machine. Time in hours ________	☒	Description and uses of sheet metal forming machines, cutting machines and grinding wheels.
Sheet Metal Mathematics		
	☒	Methods of adding, subtracting, multiplying, and dividing fractions, decimals, linear measurements, areas, volumes, sheet metal formulas, and trigonometry procedures and functions.

Sheet Metal Business

Prepare and maintain shop, make sales, quote prices, extend credit and collect accounts.	☒	Qualifications necessary for operating a business, costs involved, shop layout, tools and equipment necessary, sales and marketing methods, and records.

Time in hours ______

Code for employer's use in marking student's progress:

Performed some operations in area ☒

Performed most operations in area ☒

Performed some operations with reasonable proficiency ☒

Performed most operations satisfactorily ☒

TRAINING PLAN AND PROGRESS RECORD
FOR
SHEET METAL WORK

JOB TRAINING: What The Worker Should Be Able To Do	Proficiency Shown	RELATED INFORMATION: What The Worker Should Know
Sheet Metal Materials		
Plan jobs, make bill of materials and select materials for jobs. Time in hours ________	☒	Properties and specifications of sheet metal, methods of manufacturing, and the use of metal gages.
Safe Practices		
Safety in the shop, procedures for extinguishing fires and administering first aid. Time in hours ________	☒	Safety practices in the sheet metal trade.
Hand Processes		
Perform hand tool operations, transfer patterns, bending, cutting, forming, drilling, riveting, wiring, make seams and hems, tin soldering copper and soldering. Time in hours ________	☒	Types and kinds of hand tools. range of work of each and acceptable shop practices.
Machine Processes		
Perform machine operations on bar folder, brake, squaring shear, turning, beading, crimping and burring machine. Time in hours ________	☒	Description and uses of sheet metal forming machines, cutting machines and grinding wheels.
Sheet Metal Mathematics		
	☒	Methods of adding, subtracting, multiplying, and dividing fractions, decimals, linear measurements, areas, volumes, sheet metal formulas and trigonometry procedures and functions.

Sheet Metal Business

Prepare and maintain shop, make sales, quote prices, extend credit and collect accounts.	☒	Qualifications necessary for operating a business, costs involved, shop layout, tools and equipment necessary, sales and marketing methods, and records.

Time in hours ______

Code for employer's use in marking student's progress:

Performed some operations in area	⊠	Performed some operations with reasonable proficiency	▨
Performed most operations in area	◪	Performed most operations satisfactorily	■

VT002 080

VT 002 080
Auto Mechanics Individual Study, A Course of Study Designed for Cooperative Part-Time Students Employed in Auto Mechanics Occupations.

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Missouri Univ., Columbia. Dept. of Industrial Education
Missouri State Dep of Educ, Jefferson City. Ind Educ Sect

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*STUDY GUIDES, *TRADE AND INDUSTRIAL EDUCATION, *AUTO MECHANICS (OCCUPATION), *MOTOR VEHICLES, HIGH SCHOOLS, JOB ANALYSIS, *COOPERATIVE EDUCATION, INDIVIDUAL INSTRUCTION,

This study guide is for individual student use in related instruction in high school cooperative education programs in auto mechanics. It was developed by a committee of teacher coordinators and teacher educators through an analysis of the trade and has been field tested and periodically revised. The 23 assignment sheets are designed to facilitate individual instruction and contain introductory paragraphs to develop interest, explanations of the importance of the assignments, references, learning activities, and objective-type study questions. Representative assignment sheet titles are (1) Basic Components of the Automobile, (2) Automobile Engine Components, (3) Engine Service, (4) Clutches and Clutch Service, and (5) Automotive Air Conditioning. An information sheet is included on job management. The material is to be used by individual students under teacher supervision for 1 year of 180 days. The teacher should be a qualified coordinator or competent trade teacher. The students should be grade 11 or grade 12 students who are enrolled in a cooperative education program and employed in a phase of auto mechanics. Supplementary materials include a list of references, an analysis of the auto mechanics trade, and progress records for use by student, instructor, and employer. A second study guide (VT 001 628) has been developed for group study. Answers to study questions are available in VT 002 081. This document is available for $1.50 from Industrial Education, 103 Industrial Education Building, University of Missouri, Columbia, Missouri 65201. (HC)

AUTO MECHANICS INDIVIDUAL STUDY

A Course of Study

Designed for
Cooperative Part-Time Students
Employed in Auto Mechanics Occupations

Issued by

Department of Industrial Education
College of Education
University of Missouri
Columbia, Missouri

In Cooperation with

Industrial Education Section
State Department of Education
Jefferson City, Missouri

MEMORANDUM

TO: The ERIC Clearinghouse on Vocational and Technical Education
The Ohio State University
980 Kinnear Road
Columbus, Ohio 43212

FROM: (Person) James B. Karnes (Agency) Univ. of Mo. at Columbia

(Address) 103 Industrial Education Building, Columbia, Mo.

DATE: October 19, 1967

RE: (Author, Title, Publisher, Date) Indus. Ed. Dept., Univ. of Mo. at Columbia AUTO MECHANICS INDIVIDUAL STUDY, cooperatively with Indus. Educ. Dept., (U. of Mo. at Columbia) and Mo. State Dept. of Ed. (1966)

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Address 103 Industrial Education Bldg.
Limitation on Available Copies quantity Price/Unit $1.50
(quantity prices) same
instructor's key $.50

(2) Means Used to Develop Material:
Development Group Development Committee of Teacher-Coordinators & Teacher Educators
Level of Group State
Method of Design, Testing, and Trial Subject matter specialist and teacher educators based on a analysis of the trade tested in the field over several years and periodically revised.

(3) Utilization of Material:
Appropriate School Setting H.S. and post high school, and area vocational
Type of Program Cooperative education and preparatory programs
Occupational Focus job cluster covering various phases of auto mechanic
Geographic Adaptability United States
Uses of Material Study guide for related instruction
Users of Material student

(4) Requirements for Using Material:
Teacher Competency qualified coordinator or competent trade teacher
Student Selection Criteria junior in high school with proper prerequisites.
Time Allotment 180 days

Supplemental Media --
Necessary x
Desirable ____ (Check Which)

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(address)

REFERENCES FOR AUTO MECHANICS

A. Crouse, William H., Automotive Mechanics, Fifth Edition, Webster Division, McGraw-Hill Book Company, Inc., 1154 Reco Avenue, St. Louis, Missouri, 63126, 1965, $6.84* (21)**

B. Stockel, Martin W., Auto Mechanics Fundamentals, The Goodheart-Willcox Company, Inc., 18250 Harwood Avenue, Homewood, Illinois, 60430, 1963, $6.96* (18)**

C. General Motors Corporation, ABC's of Hand Tools, General Motors Corporation, Detroit, Michigan, 1945, Free. (1)**

D. Occupational Outlook Handbook, U. S. Department of Labor, Sold by Superintendent of Documents, U. S. Government Printing office, Washington 25, D. C. (1)**

E. (Obtain from School Guidance Department)
   1. SRA -- Occupational Brief, #610e Automotive Mechanic
   2. Chronicle - Occupational Brief, #5-81.01 Automobile Mechanic (1)**

SUPPLEMENTARY REFERENCE

Toboldt, William K., and Purvis, Jud, Motor Service's Automotive Encyclopedia, The Goodheart-Willcox, Company, Inc., 18250 Harwood Avenue, Homewood, Illinois, 60430, 1964, $6.71*

* Subject to educational discount.
**Frequency of use in assignments.

FOREWORD

This course of study, consisting of an analysis of AUTO MECHANICS, together with assignment sheets covering the related (occupational) information to be taught by the school, has been prepared for teaching auto mechanics on an individual basis in a cooperative part-time program.

The original analysis was developed in 1940 by Mr. R. W. Baker, Director of Industrial Education, Joplin, Missouri, and by Mr. Lloyd E. Estes, Coordinator and Mr. Kenneth Epperson, Auto Mechanics Instructor, Hannibal, Missouri. The original course of study was prepared at the 1947 Summer Conference for Coordinators at the University of Missouri by a committee under the chairmanship of Mr. Lloyd E. Estes. Subsequent revisions of the analysis and the assignment sheets were made by Dr. Charles R. Hill in 1949, Dr. Charles G. Risher in 1951, Dr. James H. Mahoney in 1955, Dr. John W. Horine in 1961, formerly Research Assistants in Industrial Education at the University of Missouri.

Special credit is due to Mr. Kim Baugrud, Research Assistant in Industrial Education at the University of Missouri, who prepared the present revision of the course of study.

We wish to acknowledge our indebtedness to Dr. H. H. London, Professor of Industrial Education at the University of Missouri, for the direction and administration of the Curriculum Materials Laboratory in which this material was prepared, and to Dr. James B. Karnes, Assistant Professor of Industrial Education at the University of Missouri, who supervised the preparation of the material and edited the manuscript. Credit is due to Mr. B. W. Robinson, Assistant Commissioner of Education, Mr. Merton Wheeler, Director of Industrial Education, and to other staff members of the State Department of Education for their efforts in the development of the Industrial Education Curriculum Series of which this course of study is a part.

HUBERT WHEELER

Commissioner of Education

July, 1966
1500

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INTRODUCTION

In preparing this coruse of study, it has been assumed that the attainment of occupational competency in any type of work involves three different, yet closely related, types of learning. They are:

1. Mastery of the practical job skills and procedures performed by the worker in the occupation.
2. Comprehension of the technical and related information basic to an intelligent understanding and practice of the occupation.
3. Development of those personal-social traits which are essential for the successful worker.

In a cooperative educational program it is necessary for both cooperating agencies--the school and the employer--to understand clearly just what each is to be responsible for in the training of the student-worker. Experience has shown that most of the practical job skills and procedures of an occupation can best be learned through supervised work on the job. Experience has shown also that the school can best teach most of the technical and related occupational information needed by young student-workers. This division of responsibility has been made in the arrangement of the course of study; that is, it is expected that the student-worker will master the job skills and procedures through practical work on the job under the immediate supervision of the employer, and that he will receive instruction in related occupational information in the school under the direction of the coordinator.

Skills and related information are matters for direct instruction but personal-social traits are acquired only through practicing them during the process of acquiring skills and information and in one's daily conduct. Therefore, both the employer and the school, as well as the home, must assume responsibility for developing in the student-worker those habits, attitudes and character traits which are essential for success in his occupation and in life. Both the employer and the school should be constantly on the alert to see that the student-worker places desirable interpretations on his experiences and that he does not practice habits and exhibit character traits detrimental to his success.

Since the coordinator's class will be made up of fifteen or more students, each differing from the other significantly, studying a dozen or more occupations which differ markedly in their reqirements, it follows that it will be impossible for him to teach, through the group method, the occupational information which relates to the specific job of each student-worker. In order to be effective, this type of instruction must be individualized. There is, of course some related information, such as occupational health and safety, workmen's compensation, wage-hour laws, fair labor standards, unemployment compensation, and the like, which is of common interest and concern to all student-workers, and may be effectively taught by the group method

But if the coordinator is to make a real contribution to the in-service vocational education of his students, he must devote a major portion of his classroom instruction to content which deals specifically with the work of each student enrolled.

With this requirement in mind, and in order to facilitate individual instruction, these assignment sheets have been prepared. Each contains certain record data as to number and range of units covered, introductory paragraphs designed to develop interest, explain the importance of the assignment, and to convey to the student what he is expected to learn, specific assignments including reading, learning activities and a series of new-type questions designed to check his attainment.

Obviously, it is desirable to teach the related information in the school at the time it will be used most advantageously on the job. This means that the two phases of the student-worker's training should parallel each other in a progressive manner. The coordinator will find the assignment sheets well adapted to this end. He can select from day to day the assignment which covers the informational units related to the work being done on the job. With this arrangement, the coordinator will become, during a major portion of his classroom time, a supervising study and helping teacher.

In selecting books for the course, an effort has been made to restrict the number to an adequate coverage of the material, and to select those of recent publication so that current practices can be consistently presented. It is recommended that copies of these books be secured and kept in the coordinator's classroom for ready use by the student.

The key sheets, available in a separate manual, have been prepared to enable the coordinator to score quickly the objective tests which are a part of each assignment sheet. These key sheets give the correct answers to the questions, as well as the reference and the page on which each answer can be found. The key sheets should be kept in the coordinator's possession.

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A. Crouse, William H., Automotive Mechanics, Fifth Edition, Webster Division, McGraw-Hill Book Company, Inc., 1154 Reco Avenue, St. Louis, Missouri, 63126, 1965, $6.84* (21)**

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**Frequency of use in assignments.

TO THE STUDENT-WORKER

The auto mechanic's trade is a service type of trade which is concerned primarily with the adjustment, repair, and installation of parts, and general maintenance of the automobile. Auto mechanics are classified either as general mechanics or as specialists. The general auto mechanic is capable of performing the great majority of operations necessary to return a vehicle to its normal operating condition. A specialist is one who has all-around knowledge of the trade, but who has, in addition, become especially skilled in one or more particular phases of automotive repair, such as carburetion, brakes, or ignition.

Outlook and Opportunity for the Automotive Mechanic

An increasing number of competent automotive mechanics will be in demand throughout the forseeable future. This upward trend is certain to continue due to the rapidly rising number of cars, trucks and buses on the nation's highways. The increase in farm mechanization will also add to this demand. Today there are approximately one million automotive mechanics. For an occupation this size the Labor Department estimates that retirements and deaths alone create about 12,000 to 15,000 openings each year.

In addition to the increase in numbers needed, there will be a demand for mechanics with more skills and technical knowledge than has been required. The relatively new features such as automatic transmissions, power brakes, power steering, air conditioning and other mechanical innovations requires an understanding of numerous scientific principles and their application in the servicing and repair of motor vehicles.

Earnings for the auto-mechanic vary depending on the location and size of the community, the mechanic's specialty, the type of establishment and other factors. However, regardless of these factors the competent mechanic can look forward to earning good wages. A survey by the Department of Labor in 1958 showed that wages for mechanics ranged from $2.05 to $3.16 an hour, with the average being $2.50 an hour. More important than wages, perhaps, is the fact that the prospective mechanic will not be tied to a dead-end job. Instead, he can look forward to life of challenging experiences as he repairs and services the complex motor vehicles of the future.

Personal-Social Traits Essential for the Auto Mechanic

Personality traits are of extreme importance, not only in securing and holding a desirable position but in life in general. Personal and social traits can be improved through training when the individual learns what to improve, how to improve and why improvement is advisable. Among the personal-social traits of chief importance to the auto mechanic are the following:

Patience. Much of the work of the auto mechanic is in "hard-to-get" places, and it requires patience as well as skill to make the necessary adjustments and repairs.

Personal Appearance. Clothing should be worn that makes for safety, efficiency, and a pleasing impression upon the people you serve.

Good Physical Condition. Physical requirements are not excessive, but the conditions of work are not always ideal. Often it is necessary to work in cold, drafty, and poorly ventilated places. One must be in good physical condition to keep at top efficiency. One must have good muscular coordination, mechanical dexterity, good eyesight, and steady nerves.

Cooperation. Auto mechanics requires a willingness to work cooperatively with fellow workers. This means an attitude of readiness to assist others when they need help, and to join in group undertakings.

Consideration of Others. A thoughtful attitude toward making things easy and pleasant for others, such as keeping things in order, putting tools away, and doing your full share of work is an important marketable trait of a good auto mechanic.

Industry. This character trait means a habit of careful, thoughtful, energetic attack upon the job without loitering or wasting time.

Initiative. The ability to see what needs to be done and to go ahead without constant supervision is an essential trait of an auto mechanic.

Reliability and Trustworthiness. Intrusted in your care are people's lives and valuable property. Negligence on your part as a mechanic can easily cause death and destruction.

ANALYSIS OF AUTO MECHANICS

JOB TRAINING: What The Worker Should Be Able To Do	Assign. No.	RELATED INFORMATION: What The Worker Should Know
Introduction to Auto Mechanics		
	1	1. Importance of automobiles in today's world
	1	2. Nature and opportunities in the auto repair business
	1	3. Occupational and vocational guidance information
	1	4. Sources of auto repair information
	1	5. Things to consider before opening your own business
	2	6. Historical review of the automobile
	2	7. The automotive industry
	2	8. Automobile, design and major components
	3	9. Auto repair hand tools
	3	10. Tool safety and usage
The Engine		
	4	11. Physical principles involved in engine construction
	4	12. Types of engines used in automobiles
	4	13. Engine classifications
	4	14. Gas turbine and experimental engines
	4	15. Engine component identification
	4	16. Engine mounting
	4	17. Two cycle engine operation
	5	18. Engine block design
	5	19. Principles of cylinder construction
	5	20. Piston and connecting rod design
	5	21. Piston ring design and cylinder installation
	5	22. Variations in cylinder head placement
	5	23. Types and purposes of gaskets
	5	24. Function of intake and exhaust manifold

JOB TRAINING: What The Worker Should Be Able To Do	Assign. No.	RELATED INFORMATION: What The Worker Should Know
	5	25. Construction and design of engine bearings
	5	26. Cam, crankshaft design and function
	5	27. Kinds of engine valves
	5	28. Principles of the valve train
	5	29. Function of engine fly wheel
	5	30. Importance of proper valve timing
	5	31. Engine timing devices
	5	32. Crankcase design and function
	5	33. Types and operation of valve lifters
	6	34. Operating characteristic of valve trains and valv
	6	35. Diagnosing valve trouble
36. Free sticky valves	6	36. Methods of servicing valves
37. Adjust valve-tappet clearance		
38. Remove and replace valves		
39. Recondition valves and valve seat		
40. Replace a valve seat insert		
41. Test valve guide wear		
42. Check and repair hydraulic valve lifters		
	6	43. Cylinder head maintenanc
44. Remove, clean, replace cylinder head		
45. Install gaskets		
46. Inspect piston for damage	6	46. Service to pistons and cylinders
47. Check cylinder walls for variation		
48. Remove ridge ring		
49. Refinish cylinder walls		
50. Remove, fit, install pistons		
51. Clean piston ring grooves		
52. Remove, fit and install piston rings	6	52. Types of piston rings
53. Remove, fit and replace piston pin bushings	6	53. Ways of servicing connecting rods
54. Remove, align, install connecting rod		

JOB TRAINING: What The Worker Should Be Able To Do	Assign. No.	RELATED INFORMATION: What The Worker Should Know
55. Align connecting rod to piston		
56. Remove and replace connecting rod bearings		
57. Remove and replace crankshaft	6	57. Methods used to check crankshafts
58. Test and align crankshaft		
59. Clean oil passages		
60. Check and adjust crankshaft end play		
61. Remove and install main bearings		
62. Remove and replace oil seals		
63. Remove and replace camshaft		
64. Test and align camshaft		
65. Remove and replace camshaft bearings		
66. Measure engine efficiency	7	66. Engine measurements
67. Test engine compression	7	67. Testing instruments used in engine service
68. Measure engine vacuum		
69. Diagnose engine troubles	7	69. Principles of trouble shooting the engine
	Fuel System	
	8	70. Chemistry of engine fuels
	8	71. Effects of condensation on fuels
72. Check fuel lines	8	72. Fuel tank design
73. Remove and replace fuel pump, bowl	8	73. Operating theory of fuel pumps
74. Test fuel pump pulsation for output		
75. Remove, clean, replace fuel filter	8	75. Types of fuel filters in use
76. Test venturi tube	8	76. Principles of carburetion
77. Adjust air bleed		
78. Test carburetion with analyzer		
79. Check and adjust discharge jet		
80. Adjust choke lever	8	80. Principles of the choke
81. Adjust automatic choke		
82. Adjust choke control cables		
83. Position the throttle valve	8	83. Throttle valve principles

JOB TRAINING: What The Worker Should Be Able To Do	Assign. No.	RELATED INFORMATION: What The Worker Should Know
84. Test engine RPM		
85. Test engine combustion	8	85. Principles of fuel combustion
	8	86. Malfunctions occurring i carburetion
	8	87. Carburetor types and their functions
	8	88. Manifold design for carburetion
89. Remove, clean, replace air filter	8	89. Air filteration principl
90. Inspect and interpret fuel injector chart	8	90. Fuel injection systems
	8	91. Diesel fuels and their operating principles
	8	92. Carburetion using liquified petroleum
93. Test fuel consumption	8	93. Test instruments used ir fuel system service
94. Analyze exhaust gas		
95. Measure manifold vacuum		
96. Diagnose fuel system troubles	8	96. Trouble shooting the fue system

Engine Lubrication

97. Check, drain, fill crankcase	9	97. Characteristics of engir lubricating oils
	9	98. Principles of crankcase ventilation
	9	99. Function of engine lubri cating system
	9	100. Types of lubricating systems
101. Check oil cooler	9	101. Types and functions of oil coolers
102. Check, repair, oil line damage		
103. Replace oil filter	9	103. Types and function of oil filters
104. Replace oil gauge	9	104. Principles of oil gauge operation
105. Correct low oil pressure	9	105. Testing instruments used in lubrication system
106. Correct excessive oil pressure		
107. Replace diluted oil		
108. Diagnose lubrication troubles	9	108. Introduction to engine lubrication trouble diagnosis

JOB TRAINING: What The Worker Should Be Able To Do	Assign. No.	RELATED INFORMATION: What The Worker Should Know

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JOB TRAINING: What The Worker Should Be Able To Do	Assign. No.	RELATED INFORMATION: What The Worker Should Know
109. Check antifreeze solution concentration	10	109. Types and characteristics of antifreeze solutions
110. Drain cooling system	10	110. Care of cooling systems
111. Examine radiator for restrictions, leaks		
112. Flush radiator rust and scale		
113. Test and install thermostat	10	113. Function of thermostats
114. Examine, replace cooling system hoses		
115. Remove, replace water pump	10	115. Water pump operation
116. Test radiator cap pressure	10	116. Pressurized cooling systems
117. Check overflow line		
118. Check fan blade	10	118. Engine fan operation
119. Adjust fan belt tension		
120. Test hot water heater	10	120. Hot water heater operation

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JOB TRAINING: What The Worker Should Be Able To Do	Assign. No.	RELATED INFORMATION: What The Worker Should Know
	11	121. Electrical terminology
	11	122. Function of electrical system
	11	123. Ohms law and its application
	11	124. Battery construction and operation
125. Determine battery ratings	11	125. Battery ratings and efficiency
	11	126. Wet and dry-charge battery stock maintenance
127. Remove and replace a battery	11	127. Installation procedures of batteries
128. Recharge a battery	11	128. Principles of recharging a battery
	11	129. Factors affecting battery life
130. Test battery specific gravity		
131. Test battery output		
132. Check, fill battery liquid level		
133. Readjust specific gravity of battery		

JOB TRAINING: What The Worker Should Be Able To Do	Assign. No.	RELATED INFORMATION: What The Worker Should Know
134. Determine battery rating		
	11	135. Safety precautions used with batteries
136. Remove, replace a generator	11	136. Servicing a generator
137. Test generator for short		
138. Turn commutator segments on a lathe		
139. Remove mica between commutator segments		
140. Remove, replace generator brushes		
	11	141. Operating principles of three brush generator
142. Test alternator output	11	142. Principles of an alternator
	11	143. DC-AC conversion practices
144. Test starting current voltage	11	144. Starter motor principle and operation
145. Remove, replace starter motor		
146. Check, repair bendix drive		
147. Bench test starter motor		
148. Test starter solinoid		
	12	149. Coil construction and operating principles
150. Test coil polarity	12	150. Functions of coil polarity
151. Test coil primary voltage		
152. Test coil secondary voltage		
153. Remove, replace coil		
	12	154. High voltage theories
	12	155. Principles of rotor action
156. Record engine firing sequence	12	156. Firing sequence theory of engines
157. Remove, replace distributor		
158. Time distributor to engine		
159. Adjust vacuum advance	12	159. Operating principles of vacuum advance
160. Adjust centrifugal advance		
	12	161. Condenser construction and operation

JOB TRAINING: What The Worker Should Be Able To Do	Assign. No.	RELATED INFORMATION: What The Worker Should Know
162. Remove, replace condenser		
163. Remove, replace spark plug	12	163. Construction of spark plugs and relationship of parts
164. Clean and adjust electrode gap	12	164. Spark plug electrode classification
165. Analyze spark plug condition	12	165. Principles of testing and techniques of cleaning spark plug
166. Select spark plug for a specific engine	12	166. Spark plug chart interpretation
	12	167. Pre-ignition factors of a spark plug
	13	168. Regulation of generator output
	13	169. Functions of circuit breakers and relays
170. Remove, adjust, replace regulator	13	170. Voltage and current regulation through separate devices
171. Test regulator input, output		
172. Remove, replace charging circuit wires		
173. Trace regulator circuits		
	13	174. Functions of a three unit regulator
	13	175. Principles of double contact regulation
176. Test indicator light	13	176. Devices to indicate generator output
177. Test ammeter		
	Clutch	
178. Adjust clutch linkage	14	178. Types of clutches and their operation
179. Remove, replace clutch friction disk	14	179. Clutch components
180. Diagnose clutch troubles	14	180. Clutch trouble-shooting
	Transmissions	
181. Adjust fluid level	15	181. Function, types, and operation of transmissions

JOB TRAINING: What The Worker Should Be Able To Do	Assign. No.	RELATED INFORMATION: What The Worker Should Know
182. Adjust control linkage	15	182. Gearshift mechanism operation
	15	183. Synchromesh transmission operation
184. Diagnose transmission troubles	15	184. Operating procedures of transmissions
185. Test an overdrive	15	185. Function and operation of an overdrive
186. Adjust liquid level of transmission	16	186. Operation of fluid overdrive
187. Adjust hydramatic drive	16	187. Operation of hydramatic drives
188. Remove, repair, replace transmission	16	188. Planatory gearing in transmissions
	16	189. Principles of torque conversion and multipliers

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	17	190. Function, types of propeller shafts
191. Remove, replace universal joint	17	191. Selection and operation of universal joint
	17	192. Function of slip joints
193. Remove, replace axle shafts and bearings	17	193. Types of rear-axle drive mechanisms
194. Adjust axel-shaft end play		
195. Remove, replace axle assembly		
196. Remove, replace differential assembly	17	196. Principles of the differential
197. Disassemble, assemble differential	17	197. Service to differentials
198. Remove, replace drive pinion		
199. Remove, replace oil sela and bearings		
200. Adjust pinion bearing		
201. Replace ring gear		
202. Diagnose rear axel trouble	17	202. Trouble shooting the drive mechanism

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203. Replace leaf spring	18	203. Types and functions of springs
204. Replace coil spring		

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206. Adjust shock absorber	18	206 Types and function of shock absorbers
207. Replace shock absorber		
	18	208. Independent wheel suspensions

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	19	209. Operating principles of steering systems
210. Test, adjust camber	19	210. Front end geometry
211. Test, adjust caster		
212. Test, adjust toe-in		
213. Test, adjust king-pin inclination		
214. Remove, replace front-suspension system		
215. Repack wheel bearings		
216. Balance wheels	19	216. Procedures of wheel balancing
217. Adjust steering gear	19	217. Steering system operation and function
218. Adjust fluid level in steering reservoir		
219. Check, adjust fluid level	19	219. Principles of power steering
220. Adjust steering unit belt tension		
221. Inspect system for leakage		
222. Diagnose steering system troubles		

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	20	223. Role of friction in brake operation
224. Adjust brake linkage	20	224. Types of brake systems
225. Check cylinder fluid level		
226. Make wheel brake adjustments		
227. Recondition brake drums		
228. Replace brake lining		
229. Check, repair master cylinders		
230. Bleed brake system		
231. Adjust parking brake	20	231. Principles of brake operation

JOB TRAINING: What The Worker Should Be Able To Do	Assign. No.	RELATED INFORMATION: What The Worker Should Know
232. Test, adjust vacuum booster	20	232. Types and operation of heavy-duty brakes
233. Adjust air brakes		
234. Test electric brakes		
235. Diagnose brake trouble	20	235. Trouble-shooting the brake system

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	21	236. Function and types of tire construction
	21	237. Sources of tire failur
238. Analyze tire condition	21	238. Physical features of abnormal tire wear
239. Sketch tire rotation pattern	21	239. Methods of tire rotatio
240. Repair tube damage	21	240. Repair service given to tires, tubes
241. Repair tubeless tire		
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243. Trace freon flow in air-conditioning unit	22	243. Principles of air-conditioning
244. Test, adjust component parts	22	244. Functions of air-conditioning component parts
245. Adjust freon level	22	245. Uses of freon gas as a coolant

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	23	246. Essentials of advertising
247. Establish customer rapport	23	247. Methods of attracting business
248. Prepare central location for receiving customers	23	248. Techniques of selling service
249. Prepare service order		
	23	250. Sources of off-season income
251. Clean and repair service area	23	251. Off-setting free servi time
252. Estimate and establish prices	23	252. Factors determining price quotations
253. Determine profit loss ratio-scale	23	253. Importance of shop overhead
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Assignment
Sheet No. 1

Covering
Units 1-5

INTRODUCTION TO THE AUTOMOBILE REPAIR BUSINESS

Job opportunities in the automotive industry are expected to continue in a sharp rise over the next two decades. This is due primarily to the increase in the two-car families, general prosperity, and the population explosion. In addition, the increased complexity in the modern engine will open many doors to future jobs for the trained mechanic.

It is important to understand that your job is an investment for the future. Therefore, as a prospective auto mechanic, it is advisable to acquire as much knowledge as possible about the trade before you spend hundreds of dollars and years of time in preparation and then discover it is not what you want as your life's work.

In this assignment you will have an opportunity to learn about the significance of the automobile repairman in our society, and obtain an overall view of the future.

Assignment:

1. Read the references listed below.
2. From the classified section of a metropolitan newspaper, obtain six (6) different job opportunities in the automotive trade. What common requirements, if any, are stated?
3. Write a letter of application for a position you would like to have as obtained from the newspaper.
4. Answer the questions below and turn in the assignment by ________________.

References:

A. Stockel, Auto Mechanics Fundamentals, Chapter 22
B. Occupational Outlook Handbook, (Obtain from Guidance Department) (D.O.T. 5-81.000 through .999)
C. either
    1. SRA -- Occupational Brief, # 610e, Automotive Mechanic.
    2. Chronicle -- Occupational Brief, # 5-81.01 Automobile Mechanic.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T". It it is false, draw a circle around the letter "F".

T F 1. The skilled auto mechanic is usually not trained in diagnosing engine trouble.

T F 2. Automotive specialists usually have an all around knowledge of repair in general

T F 3. Mechanics usually work independently of each other.

T F 4. Mechanics at gasoline service stations are primarily concerned with minor repairs and adjustments.

T F 5. Most auto mechanics learn their trade in a school.

T F 6. It takes from three to four years to become a reliable all -round mechanic.

T F 7. One of the best ways to become an auto mechanic is through an apprenticeship.

T F 8. Most garages furnish the mechanic with hand tools.

T F 9. Experienced mechanics will have under $100 invested in tools.

T F 10. Apprentices are usually paid a percentage of the journeyman's rate.

T F 11. In large shops the mechanic prepares the cost estimate of the job.

T F 12. A knowledge of automobile construction and operation is preferred when starting a young man in auto mechanics.

T F 13. It is often necessary to attend service schools to learn about new features on automobiles.

T F 14. Shop courses in auto repair are not considered valuable in securing jobs.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. A mechanic is usually called upon to _______________ and _______________ the trouble.

2. In large shops the _______________ pr _____________________ assigns each repair job to a mechanic.

3. The normal work week of the mechanic is ________ to ________ hours.

4. If there are no apprenticeship councils or organizations in your state, you may obtain valuable information from this address: _________________________, _________________________ _________________________.

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. Body and fender repairmen are specialists who do:

(A) ______________________ (C) ______________________

(B) ______________________

2. The automobile mechanic usually makes repairs on:

(A) ______________________ (D) ______________________

(B) ______________________ (E) ______________________

(C) ______________________

Assignment
Sheet No. 2

Covering
Units 6-8

BASIC COMPONENTS OF THE AUTOMOBILE

The automotive industry, since it is keenly competitive, is highly specialized. It requires of its people a thorough up-to-date working knowledge of techniques and specializations. However, before specialization can take place, a broad background from which the mechanic can select his specialty must be acquired.

It is important for anyone going into a trade that he learn as much as possible about his trade. Unless the student draws ideas from many sources, his background will be limited.

The purpose of this assignment is to provide a brief overview of the component parts of an automobile.

Assignment:

1. Read the reference listed below.
2. Obtain from several new car dealers literature showing the new features on their new models, place them in a notebook.
3. Answer the questions below and hand in by ______________.

Reference:

A. Crouse, Automotive Mechanics, pp. 1-10, 38-48.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. The engine is usually supported on the frame at three or four places.

T F 2. Shock absorbers are used to restrict spring and wheel movement.

T F 3. Transmissions in "low gear" position permit the wheels to rotate at the same speed as the engine.

T F 4. The rear wheels of an automobile are turned by two separate axles.

T F 5. The up and down movement of a piston is called reciprocating motion.

T F 6. The term "stroke" refers to piston movement.

T F 7. There are three cams for each piston in the engine.

T F 8. The letters "BDC" in auto mechanics mean "bottom dead center."

T F 9. The exhaust valve opens between the intake and compression strokes.

T F 10. A pressure of 600 pounds or more per square inch is placed on the piston when the piston is forced down by combustion.

T F 11. The flow of power produced is more continuous as the number of cylinders increases.

T F 12. A vehicle equipped with springs alone will provide a satisfactory ride.

T F 13. It is necessary for a piston to fit tight to obtain good compression.

T F 14. The terms frame and chassis refer to the identical part of an automobile.

T F 15. The four strokes of an engine require two crank shaft revolutions.

T F 16. As the piston moves down the cylinder, the vacuum created draws the fuel mixture into the cylinder.

T F 17. As a flywheel rotates, it resists any changes that slow down or speed up the rotation process.

T F 18. A valve lifter and a rocker arm perform the same duties.

T F 19. Pressure in a container is due to molecules in motion.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. Because gasoline is burned within its cylinders, the automobile engine is usually referred to as a(an) ______________ ______________ engine.

2. A wrist pin is used to attach the ______________ to a ______________ ______________.

3. Reciprocating motion is transferred into ______________ motion by the connecting rods and crankshaft.

4. The two valves in the enclosed end of the cylinder are designed so that one permits entrance of the ________________ mixture and the other the escape of ______________ gases.

5. The camshaft revolves at ______________ the rate the crankshaft does.

6. The cams on the camshaft raise the valves off their ______________

7. On the ______________ stroke a mixture of ______________ and vaporized ______________ is drawn into the cylinder.

8. During the compression stroke, the fuel mixture may be compressed to less than ___________________ of its original volume.

9. The heavy wheel attached to the crankshaft used to level power impulses is the ______________.

10. Ignition is part of the ______________ system of an automobile.

Listing

<u>Directions</u>: List the items called for in each of the following. Select your answers carefully.

1. The basic components of the automobile are:

   (A) ________________________ (C) ________________________

   (B) ________________________ (D) ________________________

2. The accessory systems necessary to furnish the engine the substances required to operate it are:

   (A) ________________________ (C) ________________________

   (B) ________________________ (D) ________________________

3. Four major parts of a fuel system are:

   (A) ________________________ (C) ________________________

   (B) ________________________ (D) ________________________

4. Four types of springs used on automobiles are:

   (A) ________________________ (C) ________________________

   (B) ________________________ (D) ________________________

5. The parts that make up the power train are:

   (A) ________________________ (D) ________________________

   (B) ________________________ (E) ________________________

   (C) ________________________

6. Cross bracing the frame makes it rigid enough to withstand, while in operation, the following;

(A) ______________________________ (C) ______________________________

(B) ______________________________ (D) ______________________________

Assignment
Sheet No. 3

Covering
Units 9-10

SHOP PROCEDURES AND SAFE PRACTICES

During the early days of the accident prevention movement the emphasis was placed on the task of providing proper safeguards for structures and machinery. Today, over 73 per cent of the accidents surveyed in one study were found to be caused directly by unsafe acts of individuals.

Therefore, always be on the lookout for possible accident situations in your shop. Develop a habit of observing all safety rules. If these rules are well observed by you and your co-workers, many accidents <u>can</u> be prevented.

In this assignment you will have an opportunity to learn some of the ways of avoiding accidents through the proper use of tools and equipment. Suggestions will also be given on how to cope with certain hazards that may arise in the shop.

<u>Assignment</u>:

1. Read the references listed below.
2. In a brief report discuss the procedure you would suggest to organize an effective program of safety for an auto repair shop.
3. A fellow worker is consistently using a tool in the wrong manner, i.e., a wrench as a hammer. Discuss the method and tact you would suggest to help correct the bad work habits he has developed.
4. Answer the questions and hand in the report (2 or 3) prepared by ____________________.

<u>References</u>:

A. Crouse, <u>Automotive Mechanics</u>, pp. 11-38.
B. Stockel, <u>Auto Mechanics Fundamentals</u>, Chaper 21.
C. General Motors Corporation, <u>ABC's of Hand Tools</u>, pp. 3-47.
D. Information sheet No. 1. This manual.

<u>Questions</u>:

<u>True-False</u>

<u>Directions</u>: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. Tools should be wiped dry of oil before using them.

T F 2. The terms bolts, screws, and studs have the same meaning.

T F 3. To facilitate rapid assembly, the tip of the screwdriver should be one-half the thickness of the screw slot.

T F 4. To keep a screwdriver blade from slipping out of a screw slot, dress the blade so that the faces taper out from the tip.

T F 5. Phillips head screwdrivers and screws are desirable because less downward pressure is required driving them.

T F 6. When driving with a hammer, one should not hold it close to the head.

T F 7. Pliers have been developed to such an extent that they are gradually taking over the work done by various sorts of wrenches.

T F 8. When chipping a piece held in a vise, one should chip toward the stationary vise jaw.

T F 9. File teeth are designed to cut only on the forward stroke.

T F 10. The teeth of a hacksaw blade should point toward the front of the frame.

T F 11. The pressure should be applied on both the forward and backward strokes when using a hacksaw.

T F 12. A micrometer is a device for taking precision measurements.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. The tool used for cutting internal threads is called a ________________.

2. The tool used for cutting external threads is called a ________________.

3. A measuring device for use in setting tappets is a ________________ ________________.

4. One of the first tools developed by man was the ________________.

5. Painful burns may be reduced, if one does not wear ______ ________ when working around batteries or starting motors.

6. Loose hammer heads are dangerous because they may ________________ ________________ and cause an accident.

7. The size of a wrench is specified by the distance across the ________________ of the nut or bolt head it is to be used on.

[illegible]

[illegible] wrench, it should usually be ______________ rather [illegible] ______________ to avoid injury to one's hand.

[illegible] most out of an adjustable wrench, the force [illegible] against the ______________ jaw.

[illegible] for the wrench which is inserted into the head of [illegible] is a (an) ______________ wrench.

[illegible] with a cold chisel, ______________ should [illegible] the eyes.

[illegible] ______________ file is frequently used for [illegible] fitting in the auto repair shop.

[illegible] should be equipped with a tight fitting ______________ [illegible] to use them.

Listing

[illegible] called for in each of the following. [illegible] carefully.

[illegible] of wrenches frequently used in an auto repair [illegible]

(A) ______________________ (C) ______________________

(B) ______________________ (D) ______________________

(E) ______________________

[illegible] chisels most generally used by auto mechanics are:

(A) ______________________ (C) ______________________

(B) ______________________ (D) ______________________

[illegible] punches most generally used by auto mechanics are:

(A) ______________________ (C) ______________________

(B) ______________________ (D) ______________________

[illegible] of coarseness or fineness of files are:

(A) ______________________ (D) ______________________

(B) ______________________ (E) ______________________

(C) ______________________ (F) ______________________

5. The six basic classifications each service job will be under are:

(A) ____________________ (D) ____________________

(B) ____________________ (E) ____________________

(C) ____________________ (F) ____________________

Assignment
Sheet No. 4

Covering
Units 11-17

AUTOMOTIVE ENGINE DESIGN

Basically, the engine may be thought of as the power source component of the automobile. It derives its power from the conversion of a fuel into mechanical energy within its walls, and the term internal combustion engine used to denote such action.

The engine not only furnishes power for propulsion, but also, among other things, furnishes power to generate electrical energy. The auto mechanic needs to know about the various parts that make up an engine, their function, and how to repair or replace a malfunctioning part. A large portion of the wages earned by the automechanic, as well as company profit, will be derived from work on the engine.

This assignment will provide the opportunity to learn some of the theories involved in engine operation. The function of the various parts and their relation to engine design will be introduced.

Assignment:

1. Read the references listed below.
2. Examine the literature obtained in Assignment Sheet No. 1. If possible, identify the various types of cylinder arrangements. Record your findings in a notebook.
3. Answer the questions below and turn in this assignment by ____________________.

References:

1. Crouse, Automotive Mechanics, pp. 61-82.
2. Stockel, Auto Mechanics Fundamentals, Chapters 1 & 7.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. Only air is compressed during the compression stroke of a diesel engine.

T F 2. Engine cylinder valves are placed directly opposite each other in two cylinder engines.

T F 3. The crankshaft of a four cylinder engine is supported in two places by bearings.

T F 4. Engines are classified by the type of cooling system used.

T F 5. Ignition takes place as the piston nears "BDC".

T F 6. Slant type engines are placed 30 degrees to one side to allow lower hood lines.

T F 7. The "fins" on a two cycle engine provide for a large radiating surface in cooling.

T F 8. A two cycle engine produces a power stroke on each crankshaft revolution.

T F 9. A free piston engine operates like a diesel engine.

T F 10. The wonkel engine has three power cycles for each revolution.

T F 11. The two cycle engine has one valve and one exhaust part.

T F 12. Compression ratio is compared to the distance a piston moves.

T F 13. The exhaust valve opens when the piston reaches the bottom of the firing stroke.

T F 14. A cam on the camshaft "times" the valves.

T F 15. A flywheel will cause an engine to run more smoothly.

T F 16. Four stroke engines, regardless of size operate on the same principles.

T F 17. Manufactures of V-8 engines designate the engine firing sequence in numerical order of 1 through 8.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. Engines in the American passenger cars have usually ________, ________, or ________ cylinders.

2. The fuel used in a diesel is ignited by ______________ resulting from the compression of ______________.

3. The radial engine is used largely with ______________ and is ______________ cooled.

4. The Chevrolet Corvair uses a ______________ engine.

5. The two timing gears are called the ______________ gear and the ______________ gear.

6. Gasolines are measured in quality ratings called ______________ the higher the rating number, the better the ______________.

7. The engine that is built more rigid permits higher ______________ ______________ and ______________ ______________ with less difficulty from ______________, or ______________ of the block or crankshaft.

8. The I head engine is the same as the ______________ valve engine.

9. A single ______________ actuates all valves regardless of arrangement.

10. "TDC" and "BDC" refer to a ______________ of the piston.

11. A fuel represented by LPG used for some bus and truck engines is the abbreviated form of ______________ - ______________ ______________.

12. The parts of a valve system in their proper position form a ______________ ______________.

13. The ______________ on the timing gears help to line up the ______________ if it is removed.

14. A removable top for a cylinder block is called a ______________ _____ ________.

15. The amount of clearance used when setting hydraulic lifters is ______________.

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. The characteristics of a good automotive engine fuel are:

(A) ______________________ (D) ______________________

(B) ______________________ (E) ______________________

(C) ______________________ (F) ______________________

2. Three types of valve arrangements used in automotive engines are:

(A) ______________________ (C) ______________________

(B) ______________________

3. The seven ways to classify internal combustion automobile engines are:

(A) ______________________________ (E) ______________________________

(B) ______________________________ (F) ______________________________

(C) ______________________________ (G) ______________________________

(D) ______________________________

Assignment
Sheet No. 5

Covering
Units 18-33

AUTOMOTIVE ENGINE COMPONENTS

This assignment is a continuation of the last and we are going to continue our study by going into greater detail concerning some of the various parts that make up the internal combustion engine.

Auto repair deals with more than just taking a car apart and putting it back together again. The successful auto mechanic must learn to make wise use of his time without going up too many "blind alleys." This involves being able to determine what is wrong without taking the engine apart. The services of one who is a good "trouble shooter" will be much sought after. However, before one can do this, he has to know what the parts are that make up the engine and how t they operate.

In this assignment you will have an opportunity to study the function, design, and terminology of certain parts that go together to make up the automobile engine.

Assignment:

1. Read the references below.
2. Select an automobile engine, and list the component parts, the kind of material each part is made from, and why that particular material was chosen. (A three column chart).
3. Answer the questions below and turn in this assignment by ____________________.

References:

A. Crouse, Automotive Mechanics, pp. 83-126.
B. Stockel, Auto Mechanics Fundamentals, Chapter 2.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. Aluminum cylinder blocks have cast iron or steel cylinder sleeves.

T F 2. Normally, the supporting bearings for the crankshaft are found in the upper part of the cylinder block.

T F 3. Cylinder heads are usually cast in one piece.

T F 4. There are four main types of cylinder heads in general use.

T F 5. A gasket is placed between the cylinder block and cylinder head to prevent leakage.

T F 6. The intake manifold is essentially a tube used for carrying the fuel-air mixture from the carburetor to the engine cylinders.

T F 7. The intake manifold is attached to the cylinder head in an L-head type engine.

T F 8. Crankshafts have drilled oil passages through which oil can flow from the main bearings to the connecting rod bearings.

T F 9. The journals of a crankshaft generally are fitted with counterweights.

T F 10. Vibration dampeners are used in an attempt to control torsional vibration.

T F 11. Oil is carried to bearings by the friction of a rotating journal.

T F 12. A journal must be smaller in diameter than its corresponding bearing.

T F 13. Main bearings for crankshafts are frequently made of brass.

T F 14. A large oil clearance is desired in a bearing for more throw off.

T F 15. A bearing back is usually made of steel.

T F 16. There are three different methods of attaching a connecting rod to a piston.

T F 17. The crankshaft end of a connecting rod is attached by means of a wrist pin.

T F 18. Vibrations are likely to occur if the connecting rods are not matched in sets.

T F 19. Piston slap is caused by having too much clearance between the piston and cylinder wall.

T F 20. The heads of some pistons have a rather complex curved surface to aid in obtaining better combustion of the fuel mixture.

T F 21. The intake and exhaust valves are operated by the camshaft.

T F 22. An attempt is made to create as many "hot spots" as possible within the engine, to insure complete combustion of the fuel mixture.

T F 23. A special steel insert ring is used for the intake valve.

T F 24. The clearance on a hydraulic valve lifer is zero.

T F 25. The dimensions of a cylinder wall must be kept extremely accurate.

T F 26. The piston produces a vacuum to draw a fuel charge into the cylinder.

T F 27. A cast iron piston expands more than an aluminum piston.

T F 28. The ring gap of a piston ring closes as the piston gets hot.

T F 29. Compression rings are used to prevent cylinder leakage.

T F 30. The oil ring is used to scrape oil from the cylinder wall.

T F 31. The purpose of the holes in a timing sprocket are for balance.

T F 32. The angle of the valve and the valve seat may vary one degree.

T F 33. Valves are closed through the cam rotation and springs.

T F 34. Mechanical valve lifters are adjustable.

T F 35. Valve rotation increases valve life.

T F 36. Valve timing angles are the same for most engines.

T F 37. A gasket will adapt itself to expansion and contraction.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. One type of gasket consists of two thin sheets of copper with ______________ between them.

2. Counterweights are used on crankshafts to reduce ______________.

3. Flow of engine power is smoothed out by using a ______________ on the rear end of the crankshaft.

4. It is not always necessary to remove the crankshaft when replacing ______________ bearngs because they are so __________ made.

5. The connecting rod is attached to the piston by means of a ______________ or ______________ pin.

6. The oil hole in the connecting rod is used to lubricate the ______ ______ ______ ______________.

7. The upper end of a connecting rod is mounted to the ____________ while the lower end is attached to a ______________ on the ______________.

8. Engine vibration is reduced by having the connecting rods carefully ______________.

9. The expression used to describe the escape of burned gases from the piston chamber to the crankcase is ______________.

10. The rings located on the upper end of the piston are called ______________ rings.

11. The lower portion of the piston is called a ______________.

12. A common device used to convert rotating motion into linear motion is called a ______________.

13. The most generally used valve used in engines is known as the ______________ or ______________ valve.

14. To cool valves in heavy duty engines, a _____ __________-________ valve may be used.

15. Special heat resistant insert rings are often used for the ______________ valve seats.

16. The type of valve that is rotated by engine vibration is known as the ______________ ______________.

17. The hydraulic valve lifter functions using ______________ from the ______________ ______________.

18. The complete cycle of valve timing requires a ________ degree spiral.

19. A ______________ rotator causes the valve to turn a few degrees when the engine is in operation.

20. The valve assembly is held in place through the use of a ______________ and ______________.

21. A piston that is slightly oval in shape when cold is called a ______________-______________ piston.

22. Engine blocks are usually cast from either ______________ ______________ or ______________.

23. The cut end of a piston ring is known as the ______________ ______________.

24. Cylinder sleeves are of the ______________ type and the ______________ type.

[illegible]

[illegible] [illegible] ______________________.

[illegible] [illegible] ______________________.

[illegible] [illegible] ______________ [illegible]

[illegible] [illegible] ______________________.

[illegible]

[illegible]

1. [illegible]

   A ______________ D ______________

   B ______________ E ______________

   C ______________ F ______________

2. [illegible]:

   A ______________ C ______________

   B ______________

3. [illegible]

   A ______________ D ______________

   B ______________ E ______________

   C ______________

4. [illegible]

   A ______________ D ______________

   B ______________ E ______________

   C ______________ F ______________

[illegible] [illegible]

[illegible] ______________________ [illegible] ______________________

[illegible] ______________________ [illegible] ______________________

[illegible]

[illegible]
[illegible]

Covering
Units 34-65

ENGINE SERVICE

[illegible] automechanic might be compared to that of a doctor. [illegible] a doctor proceeds to diagnose the probable cause of his [illegible] before he prescribes a cure. The same procedure [illegible] by the automechanic. First, he should determine [illegible] and then by process of elimination, locate the [illegible]

[illegible] for the trouble shooter to plan a logical pro- [illegible] to work on the automobile. Such a plan will [illegible] time and effort.

[illegible] you will have an opportunity to learn some [illegible] that are used in the repair of basic parts of [illegible]

[illegible]

1. [illegible] listed below.
2. [illegible] x 11 sheet of paper sketch the following and [illegible]
   a. [illegible]
   b. [illegible] and rod assembly
   c. [illegible]
3. [illegible] questions below and turn in this assignment [illegible] ________________________.

[illegible]

1. [illegible] *Automotive Mechanics.* pp. 272-332.

[illegible]

True-False

[illegible] The following statements are either true or false. If [illegible] true, draw a circle around the letter "T." If it [illegible] around the letter "F."

T F 1. [illegible] enemy of engine service is dirt.

T F 2. [illegible] ratio is not an important factor connected [illegible] valve burning.

T F 3. [illegible] valve spring is tested for squareness.

T F 4. [illegible] manifold the sequence for tightning nuts [illegible] is from right to left.

T F 5. The cylinder head must be removed on an I-head engine in order to check valve-tappet clearance.

T F 6. Valves should be rotated from one cylinder to another during each overhaul to insure better engine performance.

T F 7. Modern automobile engines equipped with hydraulic valve lifters require no valves tappet clearance checks or adjustments.

T F 8. To prevent valve assembly parts from accidentally falling into the crankcase, it is recommended that such openings be covered temporarily with clean cloths.

T F 9. The rocker-arm mechanism must be removed from an overhead valve engine before it is possible to remove the valves.

T F 10. Valve spring tension affects engine performance.

T F 11. When the cylinder head is replaced, it is usually necessary to replace the head gasket.

T F 12. A torque wrench is recommended and used to secure correct tension.

T F 13. Lapping is the recommended procedure for reconditioning valves.

T F 14. Valves that are not too badly damaged may be reconditioned by refacing.

T F 15. The lapping of valves and of valve seats is usually done separately.

T F 16. A simplified procedure has been worked out whereby it is unnecessary to remove the valves in order to install a valve-seat insert.

T F 17. Valves should be removed from the engine in order to clean the valve guides.

T F 18. An integral valve guide is the type that is bored directly in the head.

T F 19. Bearing clearance may be checked with a material known as plastigage.

T F 20. The position that the chain should be put on the sprockets of a chain-drive camshaft is indicated by the manufacturer.

T F 21. It is necessary to remove the pistons from the engine when servicing connecting rods.

T F 22. Connecting rods must be removed from the engine to check them for alignment.

T F 23. When testing a connecting rod for alignment the piston pin should be removed.

T F 24. Piston rings must be fitted for each cylinder.

T F 25. New pistons are always semi-finished.

T F 26. It is the usual practice of rebuilders to replace engine bearings when the engine is "torn down".

T F 27. Oversize pistons are available for use in cylinders that have been refinished.

T F 28. Finished pistons must be ground to fit the cylinder rather than having the cylinder ground to fit the piston.

T F 29. The piston, piston rings, and connecting rod are assembled before they are installed into the cylinder of an automobile engine.

T F 30. When adjusting the main bearings on a crankshaft, it is desirable to start with the middle bearings and work toward the end.

T F 31. The journals of the crankshaft may wear as much as 0.008 of an inch without causing trouble.

T F 32. A bent crankshaft cannot be straightened.

T F 33. Factory-installed connecting rods and bearing caps are stamped with a number to indicate the cylinder in which they are to be assembled.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. The ______________ ______________ must be removed before any valve can be removed.

2. The two types of valve seat grinders in use are the ______________ and the ______________.

3. Valve springs should be tested for ______________ and ______________.

4. Care should be exercised when cleaning oil and grease off an engine with steam to avoid getting moisture into the ______________ units.

5. The time required for a complete valve service job on a six-cylinder, overhead-valve engine is approximately ________ hours.

6. Valve-tappet clearance is measured with a ______________ gauge.

7. Valve clearance on an L-head engine may be measured after the valve ______________ ______________ on the side of the engine block have been removed.

8. Variations in cylinder-bore diameter may be measured with a cylinder-bore ______________.

9. If the valve seat faces are badly cracked, pitted, or burned, the valves should be ______________.

10. The first step in servicing valves after they have been removed from an engine is to remove the ______________ from them.

11. Cylinders may be covered with masking tape to prevent their damage from ______________ during the grinding of valves.

12. Servicing camshafts includes checking for cam ______________ and for shaft ______________.

13. Camshafts may be straightened by means of a ______________ ______________.

14. When removing connecting rods without removing the crankshaft, one should first remove the ______________ ______________, if any, from the cylinder bores to avoid damage to pistons or piston-rings.

15. Connecting rods may be restored to proper alignment with a ______________ bar.

16. Any dirt particles that get under a precision insert bearing shell on a crankshaft are apt to cause it to ______________ ______________ and soon fail.

17. Expanders for piston rings are used to advantage for cylinder bores that are ______________.

18. The clearance between the crankshaft journals and the main bearings should usually be less than ________ of an inch.

19. The purpose of an oil seal at the rear main bearing of a crankshaft is to prevent ______________ ______________.

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. Seven causes of bearing failure are:

(A) ____________________ (E) ____________________

(B) ____________________ (F) ____________________

(C) ____________________ (G) ____________________

(D) ____________________

2. Types of valve trouble include:

(A) ____________________ (D) ____________________

(B) ____________________ (E) ____________________

(C) ____________________

Assignment
Sheet No. 7

Covering
Units 66-69

ENGINE TESTS, MEASUREMENTS, AND TROUBLE SHOOTING

Before an automotive tune-up specialist can diagnose an engine malfunction and tune the engine, he must know the basic ways in which engines are tested. An engine analysis cannot be done properly without the use of special instruments designed for each test.

Through these engine tests it is possible to diagnose the difficulty occuring within the engine and recommend a process to change the existing condition.

In this assignment you will have an opportunity to study various ways in which engines are measured, tested and prescribed for treatment.

Assignment:

1. Read the references listed below.
2. In a short paper discuss horsepower as related to engine torque.
3. Compare the engine tests performed on a combustion analyzer with the compression ratio of an engine cylinder. Discuss the changes as the compression ratio is increased.
4. Answer the questions below and turn in this assignment by ______________________

References:

A. Crouse, Automotive Mechanics, pp. 49-61, 248-271.
B. Stockel, Auto Mechanics Fundamentals, Chapter 8.

Questions:

True-False

Directions: The following statements are either true or false. If the statement if true, draw a circle around the letter "T". If it is false, draw a circle around the letter "F."

T F 1. Supplying the engine with sufficient oil greatly reduces engine friction.

T F 2. Energy is the rate of work being done.

T F 3. Chrome plating an engine cylinder improves the resistance to wear.

T F 4. Roller bearings provide for sliding friction.

T F 5. The terms bore and stroke refer to the engine cylinder.

T F 6. The compression ratio of an engine cylinder is the same as the piston displacement.

T F 7. A higher engine compression ratio will give more "power" on the power stroke.

T F 8. If the engine cylinder only fills up half-way with air, the engine has a low volumetric efficiency.

T F 9. To improve the air intake efficiency, simply, provide larger valve stems.

T F 10. The brake horsepower measurement of an engine is taken while the engine speed is restrained.

T F 11. Another name for brake horsepower is indicated horsepower.

T F 12. The amount of power needed to surpass all friction in the engine is power horsepower.

T F 13. An engine tachometer measures primary circuit interruptions.

T F 14. A high compression ratio indicates a leak in the cylinder.

T F 15. An engine vacuum gage is concerned with the intake manifold.

T F 16. The combustion efficiency of an engine is directly related to the fuel ratio under normal conditions.

T F 17. The ignition of an engine is timed for full power speeds.

T F 18. Trouble shooting an automobile engine requires a logical approach.

T F 19. A listening rod will help to locate the source of engine noise.

Matching

Directions: In the left hand column is a list of items. The right hand column contains descriptive phrases or synonymous terms. Match the descriptions to the terms by placing the letter of the description in the blank at the left of the appropriate term.

________ 1. Smoky exhaust

________ 2. Engine noisy

________ 3. Engine backfires

________ 4. Engine will not turn over

________ 5. Engine overheats

________ 6. Rough idle

________ 7. Low oil pressure

A. Excessive oil comsumption

B. Lack of water

C. Ignition timing off

D. Worn engine bearings

E. Valve and tappet

F. Vapor lock

G. Carburetor idle adjustment

H. Run down battery

I. Automatic choke stuck

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. The three classes of engine friction are:

(A) ____________________ (C) ____________________

(B) ____________________

2. Engine horsepower may be classified according to the following three headings:

(A) ____________________ (C) ____________________

(B) ____________________

3. The energy loss of a fuel is distributed over the following items.

(A) ____________________ (C) ____________________

(B) ____________________ (D) ____________________

Assignment
Sheet No. 8.

Covering
Units 70-97

FUEL SYSTEMS AND SERVICE

The fuel system is designed to furnish the engine with fuel. It is transferred from the fuel tank to the engine cylinders where it is ignited to furnish power to run the automobile.

There are certain adjustments and checks that the auto mechanic should be able to make on the various parts of fuel systems. It is important to have a knowledge of fuel systems so that one will be able to diagnose and correct troubles that may arise.

In this assignment you will have an opportunity to study about the principles, functions, and the servicing of various parts of fuel systems.

Assignment:

1. Read the references listed below.
2. Make a pencil drawing or sketch of a simplified fuel system on a sheet of 8 1/2 x 11 paper. Label the main parts. On another sheet of 8 1/2 x 11 paper, explain in 200 words or less how a carburetor works.
3. Answer the questions below and turn in this assignment by ____________________.

References:

A. Crouse, Automotive Mechanics, pp. 127-172, 333-342.
B. Stocket, Auto Mechanics, Fundamentals, Chapter 6.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. The fuel tank should be kept near full to reduce water condensation within the tank.

T F 2. The bimetal-thermostat fuel gauge is of the hydrostatic type.

T F 3. The rocker arm of a fuel pump is operated by the camshaft.

T F 4. Modern fuel systems use a fuel pump that creates a vacuum to draw the fuel from the tank.

T F 5. The diaphragm in a fuel pump must remain absolutely rigid to give the best service.

T F 6. A combination fuel and vacuum pump offers the advantage of more uniform windshield-wiper operation.

T F 7. A richer fuel mixture is required for initial warm-up of an engine than for operating at intermediate speeds.

T F 8. The fuel nozzle of a carburetor does not feed any gasoline during operation with a closed or only slightly opened throttle.

T F 9. The idle port of a carburetor is located between the venturi and throttle valve.

T F 10. Vacuum producad by the engine, pulls gasoline through the low-speed port of a carburetor only when the throttle valve is closed.

T F 11. The opening of a low-speed port of a carburetor may be regulated by the throttle valve.

T F 12. If a very rich fuel mixture is placed in the cylinders, flooding is likely to occur.

T F 13. Gasoline for the high-speed circuit in a carburetor is supplied through the fuel nozzle.

T F 14. An accelerator-pump system is used to provide extra fuel for quick powerful acceleration.

T F 15. The choke is opened when an engine is being started.

T F 16. The choke is a type of butterfly valve that is used to regulate the amount of air that goes through the air horn.

T F 17. A bimetal thermostatic spring and a vacuum piston are linked together to control the operation of an automatic choke.

T F 18. The bimetal thermostatic spring in the automatic choke is operated by engine heat.

T F 19. The automatic choke may go into operation at any time after the engine has been warmed up.

T F 20. Air bleeds are utilized in the high-speed circuit of many carburetors to facilitate better combustion.

T F 21. The volatility of a liquid decreases as the boiling temperature decreases.

T F 22. The anti-knock value of gasoline will be increased as its octane rating goes up.

[illegible] [illegible]

[illegible] [illegible]

[illegible]

[illegible]

[illegible] [illegible]

[illegible] [illegible]

[illegible] [illegible]

[illegible] [illegible]

[illegible] [illegible]

[illegible] [illegible]

[illegible] [illegible]

[illegible] [illegible]

[illegible] [illegible]

[illegible] [illegible]

[illegible] [illegible]

[illegible] [illegible]

[illegible] [illegible]

[illegible]

Listing

[illegible] the [illegible] called for in each of the following. [illegible] carefully.

[illegible] a carburetor are:

[illegible] ______________________ (E) ______________________

[illegible] ______________________ (F) ______________________

[illegible] ______________________ (G) ______________________

[illegible] ______________________

[illegible] parts of an internal combustion engine fuel system [illegible]

[illegible] ______________________ (D) ______________________

[illegible] ______________________ (E) ______________________

[illegible] ______________________ (F) ______________________

[illegible] of a carburetor are:

[illegible] ______________________ (C) ______________________

[illegible] ______________________

[illegible] used to operate the full power circuits [illegible]

[illegible] ______________________ (B) ______________________

Assignment
Sheet No. 9

Covering
Units 98-103

ENGINE LUBRICATION AND SERVICE

In the field of mechanics, there is no single item as important as the proper lubrication of moving parts. Automotive engines of today are lubricated by means of a lubrication system that is engineered to supply the right amount of oil to all bearing surfaces within the engine.

Adequate maintenance of the lubrication system is absolutely essential to the efficient operation of an engine. Irreparable damage may be done within a very few minutes to a bearing service that is operated at high speed without oil. Proper lubrication is the best form of precaution for one to take against undue wear of engine parts.

This assignment will provide you with an opportunity to become acquainted with the types of internal combustion engine lubrication systems, their parts and their functions. Information is also presented that deals with some of the more general aspects involved in servicing engine lubrication systems.

Assignment:

1. Read the references listed below.
2. Obtain two samples (approximately 1/4 cup) of engine lubrication oil. Sample No. 1 should be new oil. Sample No. 2 should be oil that has just been drained out of an automobile engine. Put each sample in a small bottle. Filter each and show the filter and the material filtered out of each oil sample to your coordinator. (Filter paper from the chemistry department or a fine woven piece of cloth may be used for this purpose.) Write a brief paper describing the differences in the material that has been filtered out of each oil sample excluding color.
3. When you have completed items 1 and 2, answer the questions below and hand in with item 2 on ______________________.

References:

A. Crouse, Automotive Mechanics, pp. 172-189, 342-345
B. Stockel, Auto Mechanics Fundamentals, Chapter 5.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. Most engine lubricating systems are cooled by allowing air to circulate around the engine oil pan.

T F 2. The problem of water sludge necessitates more frequent oil changes in warm weather than in cold weather.

T F 3. The formation of water sludge in an engine crankcase is generally caused by water leaking out of the cooling system.

T F 4. Cars that are equipped with oil filters should have the oil changed periodically.

T F 5. One of the common causes for excessive oil consumption is due to worn cylinder walls and worn piston rings.

T F 6. A cracked vacuum-pump diaphragm may cause excessive oil consumption.

T F 7. The floating oil intake is a device used to keep the circulation of foreign particles through an engine lubrication system down to a minimum.

T F 8. The device that is used to strain out dirt and other foreign matter in an engine lubrication system is called an oil filter.

T F 9. A pressure-type bearing oil-leak detector will indicate worn bearings.

T F 10. Most engine lubrication troubles are intimately related to engine troubles.

T F 11. Oil should be changed more often in cold weather.

T F 12. Most oil-level gauges use an electrical device to register the oil level in the engine crankcase.

T F 13. Badly worn bearings will help cause excessive oil pressure.

T F 14. Ordinarily, the oil pump does not require much servicing.

T F 15. A lubricated bearing actually rides on a film of oil, rather than on the metal of the bearing.

T F 16. Crude petroleum is refined by a process of distillation.

T F 17. Crude petroleum is the source of lubricating oil.

T F 18. An S. A. E. number 20 oil is more fluid than a number 30 oil.

T F 19. An oil with a high viscosity rating changes considerable as the temperature fluctuates.

T F 20. A multi-grade oil has a high viscostiy index (S. A. E.).

T F 21. An oil with a rating of S.A.E. 10 is an winter grade oil.

T F 22. The main difference between summer and winter grade oils is the temperature at which the oils are tested.

T F 23. An oil filter that is hot to touch is functioning properly.

T F 24. Oil relief valves are adjusted as the engine gets older.

T F 25. Oil filters tend to eliminate the need for oil changes.

T F 26. The length of time between oil changes should be based primarily on mileage.

T F 27. The American Petroleum Institute has two basic oil classifications, winter and summer, for gasoline engines.

T F 28. An oil that meets S. A. E. requirements for both high and low temperature requirements is S. A. E. 10 W - 30.

T F 29. The purpose of an oil pan baffle is to prevent sloshing.

T F 30. Small one cylinder engines use the splash type oil system.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. Viscosity refers to the tendency of oil to resist ________________

2. The type of oil ventilation used on the crankcase to help in smog control is ________________.

3. Oil is lost from the engine in ________________ different ways.

4. A gear pump is commonly used in the ________________ ________________ type of engine lubricating system.

5. A ________________ ________________ is used on the pressure feed type of engine lubrication system to prevent excessive oil pressure build up.

6. The type of oil pressure indicator that uses a hollow bourdon tube is called the ________________ ________________ type.

7. The oil pressure indicator reveals the oil pressure in the ________________.

8. Some cars use a light to indicate ________________ ________________ in the oil system.

9. The device used to indicate the level of oil in the sump is known as ______________ ______________.

10. ______________ is the term used when two objects rub together and produce wear.

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. The things a good lubricating oil should do for an engine are:

(A) ______________ (D) ______________

(B) ______________ (E) ______________

(C) ______________ (F) ______________

2. Of the many additives used in oil the chief ones used today are:

(A) ______________ (E) ______________

(B) ______________ (F) ______________

(C) ______________ (G) ______________

(D) ______________ (H) ______________

3. The four main jobs that a good oil must do are:

(A) ______________ (C) ______________

(B) ______________ (D) ______________

4. List the main types of engine lubrication.

(A) ______________ (C) ______________

(B) ______________ (D) ______________

5. Two main factors that affect oil consumption are:

(A) ______________ (B) ______________

6. Two types of oil filters are:

(A) ______________ (B) ______________

7. Two general types of oil-pressure indicators that are used are:

(A) ______________ (B) ______________

8. Four of the most commonly experienced lubrication system troubles are:

(A) ____________________ (C) ____________________

(B) ____________________ (D) ____________________

9. The three elements necessary to form engine sludge are:

(A) ____________________ (C) ____________________

(B) ____________________

10. The four most common types of oil pumps in use are:

(A) ____________________ (C) ____________________

(B) ____________________ (D) ____________________

Assignment
Sheet No. 10

Covering -
Units 109-120

ENGINE COOLING SYSTEMS AND SERVICE

Did you know that enough heat can be produced by an ordinary six-cylinder internal combustion engine to heat a six room house? Yes, some experts claim this to be true, for temperatures over 4,000° F. are reached each time the fuel mixture is exploded within an engine's combustion chamber. Under such high temperatures, the engine would not be able to continue operation without some means of dissipating a greater part of this heat into the air.

A cooling system is essential to keep an engine from "burning up." Temperatures that deviate too much from the normal should be investigated to find the cause.

In this assignment you will have an opportunity to become acquainted with types of cooling systems used on internal combustion engines, their various parts and the function of these parts.

Assignment:

1. Read the references listed below.
2. Obtain a cooling system thermostat and test it to see at what temperature the valve opens. (See A-349 for the procedure commonly used.) Write a brief paper summarizing the procedure and findings of your experiment.
3. Answer the questions below and turn in this assignment by ______________________.

References:

A. Crouse, Automotive Mechanics, pp. 189-199, 348-355.
B. Stockel, Auto Mechanics Fundamentals, Chapter 4.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. Engine efficiency is increased by keeping the cylinder walls as cool as possible.

T F 2. Temperatures within the combustion chambers of an automobile engine may be in excess of 4000° F.

T F 3. Nearly 75% of the heat liberated in the combustion chamber is removed by the engine's cooling system.

T F 4. Most automobile engines are classified as being air cooled.

T F 5. A water pump is used on a forced circulation cooling system.

T F 6. Most of the water pumps now used are of the diaphragm types.

T F 7. Most internal combustion engine water pumps are electrically operated.

T F 8. A shroud is used on some engine fans to increase their efficiency.

T F 9. Air is used to cool the water as it flows through the radiator of a liquid-cooled engine.

T F 10. The valve of a thermostat usually is opened at temperatures above 162°F.

T F 11. A thermostat is used to enable an engine to reach operating temperature quickly.

T F 12. A thermostat is needed more to cool an engine than to provide a constant temperature in the engine.

T F 13. The thermostatic valve begins to close when the engine's operating temperature is nearly reached.

T F 14. Water that freezes in a radiator may cause it to burst.

T F 15. A vapor pressure type of temperature indicator system is based upon the action of a bourdon tube.

T F 16. Rust and scale that have formed in an engine's cooling system may cause it to overheat.

T F 17. Exhaust gas leakage into an engine's cooling system may be caused by a defective cylinder head gasket.

T F 18. There are three methods of accurately testing the action of an engine's water pump.

T F 19. A clogged radiator may cause an engine to be slow in warming up.

T F 20. Radiator water passages should be reverse flushed occasionally to insure most effective operation.

T F 21. The fan becomes less important to an engine's cooling system as the speed of an automobile increases.

T F 22. If the circulation within a cooling system were to stop completely, dead spots would form.

T F 23. Fins on air-cooled engine cylinders are primarily for looks.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. The metal shield placed around a fan to prevent air recirculation is called a ______________.

2. The oil film on an engine's cylinder walls will lose its lubricating properties, if the temperature of the cylinder wall is in excess of ______________ degrees.

3. The device used to cool valve seats and guides is called a ______________ ______________ tube.

4. The part within a water pump that forces the water through the cooling system is known as the ______________.

5. A hose is used to connect the inlet of the water pump to the ______________ of the radiator.

6. An engine's cooling system is improved by having a ______________ create a greater draft of air through the radiator.

7. Fan belts are usually of ______________ type.

8. The water in a radiator that is operating properly should be at a ______________ temperature at the top than it is at the bottom.

9. The device used to reduce the temperature at which the water will boil is called a radiator ______________ cap.

10. The temperature may be checked at which the valve of a thermostat will open or close by varying the temperature of the ______________ in which it is suspended.

11. A car engine should be ______________ ______________ before testing a radiator for cold spots with one's hand.

12. Cold spots in the radiator of a car that has been warmed up indicates ______________ sections.

13. Exhaust gas leakage into an engine's cooling system will cause a harmful ______________ solution to form.

14. The instrument used to measure the specific-gravity of a liquid is called a (an) ______________.

15. Radiator air passages should be cleaned with ______________ ______________ to remove dirt accumulation.

16. The part that should be removed from an engine's cooling system before flushing is called a ______________.

17. An accurate method of checking a radiator for leaks includes draining, removing, and then submerging the coil in ______________

18. A series of fins or ribs is generally used on the ______________ cooled type of cylinder.

19. The control unit that operates the temperature gauge on the instrument panel is generally fastened into the water ____________ of the automobile engine.

20. Ethylene glycol base antifreezes have a _______________ boiling point than alcohol base antifreezes.

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. Two general types of cooling systems used on internal combustion engines are:

(A) ___________________________ (B) ___________________________.

2. Two main types of radiators are:

(A) ___________________________ (B) ___________________________

3. The most common bases used for antifreezes are:

(A) ___________________________ (B) ___________________________

4. The general types of temperature indicators are:

(A) ___________________________ (B) ___________________________

5. Five factors relating to an engine's cooling system that may cause it to overheat are:

(A) ___________________________ (D) ___________________________

(B) ___________________________ (E) ___________________________

(C) ___________________________

[illegible]

[illegible]
[illegible]

[illegible]
[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

1. [illegible]
2. [illegible]
3. [illegible]

[illegible]

1. [illegible]
2. [illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible] A cutout relay is an electrical device used to close the circuit between the battery and generator when the generator is not in operation.

[illegible] [illegible] generator produces a current that must be rectified before it can be used.

[illegible] A diode permits electric current to flow in one direction only.

[illegible] The specific gravity of a battery compares the weight of [illegible] acid to water.

[illegible] Battery "dopes" are recommended to restore the chemical condition of an individual cell.

[illegible] [illegible] growler is used to test for short circuits.

[illegible] A battery quick charger can bring a battery up to a full charge in a short time.

[illegible] [illegible] not equipped with some sort of regulating device would soon damage an automobile's electrical equipment.

[illegible] A vibrating voltage regulator supplies voltage at a low [illegible] rate when the battery is low.

Completion

[illegible] Fill in the blank(s) in each statement with the word(s) [illegible] complete the sentence correctly.

[illegible] [illegible] flows in a wire it must overcome an opposition [illegible] ________________ which is measured in ________________.

[illegible] The theory which defines electricity in terms of electron flow is known as the ________________ theory.

[illegible] [illegible] is made of ________________, ________________, and ________________.

[illegible] [illegible] electrons to flow they must have a path or a ________________.

[illegible] [illegible] in the grids of a positively charged battery plate [illegible] ________________.

[illegible] The [illegible] of a battery plate grid is made from an alloy of ________________ and ________________.

[illegible] The electrolyte of a fully charged battery is a solution containing approximately 40 per cent ________________ [illegible] ________________.

8. Each cell of a battery produces approximately ____________ volts of electrical potential.

9. Three two-volt battery cells connected in ____________ would provide six volts at the end terminals.

10. The number of minutes a battery at 0° F will deliver 300 amperes of current, before the cell voltage will drop to 1.0, is known as its ____________ rate.

11. A starting motor is operated on ____________ produced by the battery.

12. The starter drive pinion must make approximately ____________ complete revolutions to cause the flywheel to turn one complete revolution.

13. The shock of meshing the drive pinion with the flywheel is taken up by a ____________ on the Bendix drive.

14. A generator is used to convert ____________ energy into electrical energy.

15. A cutout relay is used to prevent the battery from becoming ____________ when the generator is not in operation.

16. Regulators employ the use of electrical ____________ to reduce the output of generators.

17. A regulator that is ____________ uses vibrating contact points to control generator output.

18. Most regulators are temperature compensated so they will allow the generator to ____________ voltage output during cold weather.

19. When the magnetic field of a cutout relay is reduced to nothing, the contact points are forced apart by means of a (an) ____________.

20. Two methods to wire an AC generator internally are ____________ and ____________.

21. An explosion can occur if a flame is brought near a battery due to the ____________ and ____________ gases given off when the battery is being charged.

22. To determine the polarity of a coil, the ____________ hand rule is used.

23. The insulation material between the copper commutator segments is ____________.

24. Alternating current which has been converted to direct current is said to have been ____________.

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. Three ways in which batteries are rated are:

(A) ________________ (C) ________________

(B) ________________

2. List three examples of static components as used in a transistorized regulator.

(A) ________________ (C) ________________

(B) ________________

3. The three devices within a double contact regulator which utilize coil windings are:

(A) ________________ (C) ________________

(B) ________________

4. The conditions that cause a terminal voltage increase as a battery is being charged are:

(A) ________________ (C) ________________

(B) ________________

Assignment
Sheet No. 12

Covering
Units 149-167

THE ELECTRICAL SYSTEM -- IGNITION AND LIGHTING

A knowledge of the structure, composition, arrangement and correct action of the component parts of an ignition system enables the mechanic to arrive at the cause of malfunctions and to prescribe a remedy.

The ability to read wiring diagrams and trace out electrical defects is important to the success of the auto mechanic.

In this assignment you will have opportunity to become acquainted with the ignition and lighting as part of the automobile electrical system.

Assignment:

1. Read the references listed below.
2. Sketch a typical ignition circuit, with the aid of colored pencils identify the high voltage and low voltage systems.
3. Draw a wiring diagram of an ignition coil and color code the primary and secondary windings.
4. Answer the questions below and turn in this assignment by ______________________.

References:

A. Crouse, Automotive Mechanics, pp. 233-247, 384-390.
B. Stockel, Auto Mechanics Fundamentals, Chapter 3 and Chapter 19, pp. 38, 39.

Questions:

True-False

Directions: The followingstatements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. Every cylinder is fired during one complete revolution of the distributor breaker cam.

T F 2. Spark advance mechanisms are used to give the fuel a shorter time to burn at high speeds.

T F 3. Battery voltage must be stepped up to cause the current to jump the spark plug gap.

T F 4. It is possible to induce a current into a wire that is a conductor of electricity by means of magnet.

T F 5. Self-induction is not possible in an ignition coil.

T F 6. The strength of an electromagnet will increase as its number of coils of wire and the amount of current flowing through them increases.

T F 7. The primary coil of an ignition coil is wired directly to the spark plugs.

T F 8. The current from the battery flows through the condenser when the contact points of the ignition distributor are open.

T F 9. In a transistorized system of ignition, points are necessary to break the coil primary circuit.

T F 10. Longer "cam dwell" in an ignition system results in a hotter spark.

T F 11. A strobe light is used to time an engine.

T F 12. In order to burn a leaner fuel mixture, some spark plugs have a special built-in resistor.

T F 13. A resistor in the coil primary circuit protects the contact points.

T F 14. A relay switch is magnetically operated.

T F 15. Sparks created in each cylinder must be timed earlier at high engine speeds.

T F 16. A balast resistor in a primary circuit operates at a constant temperature.

T F 17. A hot spark plug has a short insulator tip.

T F 18. A spark plug which is too hot for the engine may cause pre-ignition.

T F 19. Magneto action depends on a rotating magnet to produce electricity for a spark.

T F 20. Sealed beam headlights are air tight and need only aiming for adjustment

T F 21. A fuse has a hard steel strip of metal that melts when overheated.

T F 22. The temperature of a spark plug is determind through the distance the heat must travel.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. The device that opens and closes the circuit between the battery and the ignition coil is called a (an) ______________ __________

2. The drive shaft of an ignition distributor is usually operated by the engine ______________.

3. The device used to transfer the high tension voltage from the center of a distributor to each spark plug terminal is a ______________.

4. Spark plugs are adjusted to provide a gap up to ________ of an inch.

5. The instrument used to indicate the amount of current being drawn from or being put into a battery is called a (an) ______________.

6. An induced current is set up in the ______________ wiring of an ignition coil.

7. Condensers are made up of alternate layers of paper and ______________ and ______________.

8. An ignition coil has two circuits, they are the ______________ and ______________ circuits.

9. As the current is shut off in the primary circuit the ______________ ______________ collapses.

10. ______________ and ______________ are two general types of spark advance mechanisms.

11. The two types of ignition coil testers in use are ______________ and ______________.

12. A spark plug cleaner may use both an ______________ blast and a ______________ blast to clean a spark plug.

13. The longer the ______________ path the hotter a plug will operate.

14. Another name for cam angle is ______________ or ______________ angle.

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. The six main items included in an ignition system are:

(A) ______________ (D) ______________

(B) ______________ (E) ______________

(C) ______________ (F) ______________

2. A good condenser tester should be able to test the following:

(A) ______________ (C) ______________

(B) ______________ (D) ______________

3. A spark plug may be divided into three basic parts

(A) ______________ (C) ______________

(B) ______________

Assignment
Sheet No. 13.

Covering
Units 168-177

ELECTRICAL SYSTEM SERVICE

Since the genrator does not include a means of self-regulation or distribution for its output, a device called a regulator is provided for this purpose. Usually a regulator has more than a single unit involved as components, for example, a typical regulator may have means to regulate current, voltage, or simply a cutout device.

To better understand the functions of this part of the system and to provide adequate service, a working knowledge of electricity is needed.

In this assignment, you will learn some of the methods and equipment used in regulating, testing, and servicing an automobile electrical system.

Assignment:

1. Read the reference listed below.
2. Examine a regulator for the control of current obtained from both AC and DC generators. With the aid of a sketch and colored pencils, distinguish the components by color coding.
3. Write a short paper discussing what you would test a regulator for and how malfunctions could be corrected occuring in each unit.
4. Answer the questions below and turn in this assignment by ________________.

Reference:

A. Crouse, Automotive Mechanics, pp. 221-232, 371-383.

Questions:

True-False

Directions: The following statements are either true or false. if the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. A temperature compensator is a feature of most voltage regulators.

T F 2. A vibrating contact regulator is used for AC generator regulation.

T F 3. When generated voltage reaches the valve set in a regulator, the points close.

T F 4. A fully transistorized regulator has no moving parts.

T F 5. The same tests are used on AC regulators as DC regulators.

T F 6. Grounding the generator field circuit on some regulators may cause the points to burn.

T F 7. The generator must be polarized after any regulator tests on D. C. components.

T F 8. Generators may be operated on an open circuit.

T F 9. Heat does not affect a diode.

T F 10. Excessive belt tension on a generator will cause bearing wear.

T F 11. Solvents should be kept away from generator windings.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. The first two components to check for electrical trouble in an automobile are the ____________ and ____________.
2. The purpose of the voltage regulator is to keep circuit voltage from exceeding a safe ____________.
3. As the current passing through the circuit reaches a predetermined value, the regulator causes a ____________ to become part of the current load.
4. The two meters used to check the cutout relay are ____________ and ____________.
5. Brushes in an AC generator are of the ____________ type.
6. When it becomes necessary to replace field windings in a generator a ______________ screw driver and spreader is used.

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. Typical generator service may fall into one of the following three categories.

   (A) ______________ (B) ____________ (C) ____________

2. The three main components of a DC regulator are:

   (A) ____________________ (C) ____________________

   (B) ____________________

3. The three terminals on a DC regulator represent leads to the:

   (A) ____________ (B) ____________ (C) ____________

Assignment
Sheet No. 14

Covering -
Units 178-180

CLUTCHES AND CLUTCH SERVICE

In its simplest analogy the operation of a clutch may best be illustrated by placing your two hands firmly together and rotating the right hand. Notice how the left hand follows the movement. Now, separate your hands by at least one inch (as happens when the clutch pedal is depressed) and rotate your right hand again. Observe that there is no follow movement by the left hand. This is the action of a clutch.

Clutch slipping may be similarily demonstrated by placing a layer of grease on each hand. As you turn the right hand there is a little slippage. The more resistance given, the greater the slippage.

This assignment will give you an opportunity to become acquainted with various types of clutches used in the automobile, as well as their operating functions.

Assignment:

1. Read the references listed below.
2. Prepare a progress check list to be used when adjusting a clutch.
3. Answer the questions below and turn in this assignment by ______________________.

References:

A. Crouse, Automotive Mechanics, pp. 391-405.
B. Stockel, Auto Mechanics Fundamentals, Chapter 9.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. The clutch is a device used to couple and uncouple the engine from the transmission.

T F 2. Shifting of gears is facilitated by means of a clutch.

T F 3. Clutch operation is dependent upon friction.

T F 4. The flywheel and pressure plate will operate independently of each other when the clutch is disengaged.

T F 5. Cushioning devices used on clutches consist in part of a series of coil springs.

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

1. [illegible] ______________________________ [illegible]

2. [illegible] ____________________.

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible] ____________ [illegible] ____________

[illegible] ____________ [illegible] ____________

[illegible] ____________ [illegible] ____________

[illegible] may be classified under one of the four [illegible] below.

[illegible] ______________________ (C) ______________________

[illegible] ______________________ (D) ______________________

[illegible] usually fall under one of the headings listed [illegible]

[illegible] ______________________ (E) ______________________

[illegible] ______________________ (F) ______________________

[illegible] ______________________ (G) ______________________

[illegible] ______________________

<u>Assignment</u>
Sheet No. 15

Covering -
Units 181-184

TRANSMISSIONS AND THEIR SERVICE

The transmission is a box of gears included in the automobile power train to provide separate pre-selected power ratios between the engine and the rear wheels, as well as a device to reverse the direction of the gears to permit the backing of the automobile.

Most transmissions are heavy and internally complex. Although they are not a frequent source of automobile failure, they do require minor repairs. Occasionally, the auto mechanic is called on to make a major transmission overhaul.

In this assignment you will have an opportunity to learn about the various types of transmissions, how they operate, and the principles involved in their maintenance and repair.

<u>Assignment:</u>

1. Read the references listed below.
2. Sketch a planetary gear system indicating the direction each gear rotates in first gear and reverse.
3. Answer the questions below and turn in this assignment by ______________________.

<u>References:</u>

A. Crouse, <u>Automotive Mechanics,</u> pp. 406-447.
B. Stockel, <u>Auto Mechanics Fundamentals,</u> Chapters 10, 11.

<u>Questions:</u>

<u>True-False</u>

<u>Directions:</u> The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. The gear ratio for two gears having the same number of teeth is one to one. (1:1)

T F 2. Torque and gear ratio are the same.

T F 3. As speed increases, the torque in a gear system also increases.

T F 4. The measured torque at the transmission will be the same as the measured torque at each wheel

T F 5. The spur gear teeth are parallel to the center line of of the gear.

T F 6. Gears within the transmission are moved by the use of a shifter fork.

T F 7. A smooth mesh is obtained by having equal speeds of the gears.

T F 8. Gear synchronizing may be accomplished with a pair of stop rings.

T F 9. Torque is converted within the gears of a transmission.

T F 10. The larger the driving gear, the greater the torque multiplication.

T F 11. Direct drive provides a 3 to 1 ratio of torque conversion in a three speed transmission.

T F 12. For quieter operation helical gears are used in transmissions.

T F 13. A transmission is lubricated with a grease fitting.

T F 14. The overdrive permits the main shaft to turn faster than the clutch shaft in high gear.

T F 15. An overdrive will reduce engine speed 60 percent and maintain the same road speed.

T F 16. The type of transmission which uses a servo piston is the E-Stick system.

T F 17. Transmission overhaul procedures are essentially the same for practically all models.

T F 18. A good mechanic can expect to take 5 to 7 hours for transmission overhaul time.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. Transmission gears are one of two types, the ______________ or the ______________.

2. A ______________ unit is provided to select gears without gear grinding.

3. The main use of four speed transmission is to give a wider selection of ______________ ______________.

4. An ______________ ______________ prevents the heavy gear oil from leaking out the ends of a transmission.

5. The two components of an overdrive are the ______________ ______________ and the ______________________________ .

6. The transmission provides a means of varying the ______________ ______________ between the engine and the rear wheels.

7. The crank shaft makes about twelve revolutions for each turn of the rear wheel in ______________ gear.

8. An engine produces 100 pounds foot. The torque exerted at each wheel of a 10 to 1 power train ratio will be ______________ torque.

9. A four speed transmission will have ______________ gears forward.

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. The main parts that make up an overdrive planetary gear system are:

(A) ________________________ (C) ________________________

(B) ________________________

2. The four gear ratios of a three speed taansmission with overdrive are:

(A) ________________________ (C) ________________________

(B) ________________________ (D) ________________________

3. The three drive stages of an overdrive system are:

(A) ________________________ (C) ________________________

(B) ________________________

Assignment
Sheet No. 16.

Covering --
Units 158-189

AUTOMATIC TRANSMISSIONS AND SERVICE

The automatic transmission is operated by fluid coupling. These principles in themselves, are not complicated. However, an understanding of their application requires considerable study. Transmission design is undergoing constant change which requires the mechanic to keep up-to-date. An understanding of the basic principles is absolutely essential before extensive work can be undertaken on any automatic transmissions. This is usually done by a specialist.

In this assignment you will learn the basic principles and some of the methods of application which characterize many types of transmissions.

Assignment:

1. Read the references listed below.
2. Answer the questions below and turn in this assignment by ____________________.

References:

A. Crouse, Automotive Mechanics, pp. 448-501.
B. Stockel, Auto Mechanics Fundamentals, Chapter 12.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. Automatic transmissions use fluid coupling in one form or another for power flow.

T F 2. Oil is used as the coupling fluid to increase efficiency.

T F 3. The driving and driven members of the coupling are attached to the transmission.

T F 4. As the driving and driven members of the coupling approach synchroness speeds the effective oil force is reduced.

T F 5. Extra rotary members are included in some types of transmissions to increase torque.

T F 6. A brake band associated with an automatic transmission is operated by the use of a servo.

T F 7. Releasing the brake band and applying the clutch at the same time in an automatic transmission produces an upshift.

T F 8. "Governor" pressure is a decrease in pressure against the shift valve.

T F 9. An up or down shifting in the planetary system is obtained through a shift valve.

T F 10. A sprag is a one-way clutch.

T F 11. A multiplier coupling multiplies torque to equalize coupling input and output.

T F 12. Hydra-matic transmissions contain only one planetary unit.

T F 13. A torque converter can transmit a torque ratio of 1:1.

T F 14. If torque output is greater than input in a converter, there is torque multiplication.

T F 15. A key to successful transmission overhaul is cleanliness.

T F 16. The two torus members are fastened to the same shaft.

T F 17. Upshifting with the use of a governor is at a fixed point.

T F 18. Transmission oil is a special type of oil.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. Each circuit of a hydra-matic transmission handles one ________________.

2. Torque lost through fluid coupling is due to the effect of ________________.

3. In a torque converter the driving member is known as the ________________ while the driven member is the ________________.

4. The unit that provides braking by the engine through the transmission on steep down grades is the ________________.

5. A transmission may easily be ruined if towed at ________________ speeds.

6. Each of the two halves of a fluid coupling are called a ________________.

7. The two directions of oil flow in a fluid coupling are the ______________ and the ______________ flow.

8. Another name for a converter blade is a ______________.

9. A ______________ ______________ is used to lock the stator.

10. "For every action there is an equal and opposite action" is from ______________ law.

11. The two types of pumps to obtain oil pressure are the __________ and the ______________ in an automatic transmission.

12. Upshifting may be delayed from low to high by the use of a ______________ in the shifter valve.

13. Transmission oil is cooled generally by circulating it through the lower ______________ ______________.

14. Automatic transmissions shift according to ______________ and ______________.

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. The types of couplings to which all hydra-matic transmissions may be classified are:

(A) ______________________ (C) ______________________

(B) ______________________

2. The three members of a planetary gear set are:

(A) ______________________ (C) ______________________

(B) ______________________

3. The five preliminary checks and adjustments to a transmission before a road test is given should be:

(A) ______________________ (D) ______________________

(B) ______________________ (E) ______________________

(C) ______________________

List two sets of primary considerations to be considered when towing a vehicle with an automatic transmission.

(A) ______________________ (B) ________________________

Optional answers:

(C) _____________________ (D) ________________________

Assignment
Sheet No. 17

Covering
Units 190-202

DRIVE MECHANISMS

Essentially, there are two major problems that must be solved in the drive train. They are: flexibility for rear end movement and variability to each wheel on turning curves.

The universal joint and the slip joint combined take care of the flexibility part of the problem. A differential handles the wheel rotation difficulty.

It is the purpose of this assignment to acquaint the student with the operating principles of the drive mechanisms.

Assignment:

1. Read the references listed below.
2. Write a brief report on multi speed axles including the shifting procedures used to change the axle ratios (this information may be obtained from a service manual at any automobile repair shop).
3. Answer the questions below and turn in this assignment by ____________________.

References:

A. Crouse, Automotive Mechanics, pp. 502-516.
B. Stockel, Auto Mechanics Fundamentals, Chapter 13 and 14.

Questions:

True-False

Directions: The following statements are either true or false. If the statement if true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. Road irregularities cause fluxuations in the propeller shaft angle of the drive line.

T F 2. A propeller shaft may be hollow as well as solid.

T F 3. A slip joint is used on a propeller shaft to permit its effective length to change.

T F 4. The rotation of a propeller shaft is in the same direction as the differential.

T F 5. When removing a universal joint the parts are marked for balance in reassembly.

T F 6. The rear wheels revolve at different speeds while an automobile is rounding a curve.

T F 7. Each wheel would be required to skid if it were not for a universal joint.

T F 8. On a straight road the differential pinion does not rotate as both wheels are at the same speed.

T F 9. A convertional differential delivers the same torque to each wheel.

T F 10. A differential with a clutch plate within is a non-slip device.

T F 11. Differential ratio and axle ratio have different meanings.

T F 12. A universal joint is needed for drive line flexibility.

T F 13. The use of a hollow drive tube in the driving mechanism is to promote light weight.

T F 14. Ring and pinion gears are sold as matched sets.

T F 15. Oils in a differential are circulated by the hypoid gear.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. The device that permits torque transfer at various angles is the ____________ ____________.

2. Two types of universal joints in use are ____________________ and ____________________.

3. A ____________ ______________ permits the drive line to adjust for variations in length.

4. A simple universal joint consists of a ____________ and ____________.

5. Bearings used in a spider and yoke design are frequently of the ____________ type.

6. To assure proper part relationship when reassembling a universal joint the two parts should be ____________.

7. Most of the maintenance required on universal joints is limited to ____________.

8. The smaller section of a ring gear tooth is called the ________.

9. The two types of axle housing are the ____________ and the ____________.

[illegible]

[illegible] ____ [illegible]
____ [illegible]

1. [illegible] ____ [illegible]

2. [illegible]
____.

[illegible]

[illegible]

1. [illegible]

   [illegible] ____ [illegible] ____

   [illegible] ____

2. [illegible]

   [illegible] ____ [illegible] ____

   [illegible] ____

3. [illegible]

   [illegible] ____ [illegible] ____

   [illegible] ____

4. [illegible]

   [illegible] ____ [illegible] ____

   [illegible] ____

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

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- [illegible]
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- [illegible]

[illegible]

[illegible]

[illegible]

[illegible] [illegible]

[illegible] [illegible]

[illegible] [illegible]

[illegible] [illegible]

[illegible] [illegible]

[illegible] [illegible]

[illegible] is usually fastened between the frame of [illegible] and the wheel and axle housing.

[illegible] of a spring are of equal length.

[illegible] leaf springs have special inserts between the leaves.

[illegible] is positioned between the spring and axle on [illegible].

[illegible] holds the end of the spring stationary.

[illegible] with rubber bushings require lubrication [illegible] every 1,000 miles.

[illegible] represent "unsprung weight."

[illegible] functions to dampen out spring oscillations.

[illegible] suspension, the wheel spindle [illegible].

Completion

[illegible] in the blank(s) in each statement with the word(s) [illegible] correctly.

[illegible] steel plate in a leaf spring are [illegible] ______________.

[illegible] type of leaf spring used on automobiles is the ______________ spring.

[illegible] that a spring will be compressed in direct [illegible] the ______________ applied.

[illegible] steel plate in a leaf spring is called the ______________________.

[illegible] leaf spring is usually attached to a ______________ on the car frame.

[illegible] kept from separating by means of rebound ______________.

[illegible] bushing used to attach one end of a leaf [illegible] acts to dampen ______________ and ______________.

[illegible] leaf spring is usually attached to a car [illegible] (and ______________.

[illegible] use the ______________ type of front suspension.

10. The wheel assembly is attached to the steering knuckle by means of a (an) ________________.

11. Better body roll control is achieved by means of a (an) ________________ bar providing a form of linkage between the two front lower spring seats.

12. When an automobile attempts to make a curve at high speed, centrifugal force will tend to cause ________________ ________________.

13. Sideward movement of the rear axle housing assembly with respect to the car frame is prevented in rear coil spring suspension system by means of a ________________ bar.

14. Relative forward and backward movement of the rear axle housing is prevented in a rear coil spring suspension system by means of two rear-axle ________________ ________________.

15. Most shock absorbers are based upon ________________ principles.

16. A double-acting telescopic shock absorber consists of three concentric ________________, a (an) ________________, valves, and assembling parts.

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. Four basic types of springs used in automobile suspension are:

(A) ________________ (C) ________________

(B) ________________ (D) ________________

2. The reasons why some leaf springs are covered with a metal sheathing are:

(A) ________________ (B) ________________

3. Three essential components of an air suspension system are:

(A) ________________ (C) ________________

(B) ________________

Assignment
Sheet No. 13

Covering -
Units 209-222

SERVICING STEERING AND SUSPENSION SYSTEMS

With the development of automobiles that operate at high rates of speed, the steering system has become increasingly important. Purchasers of automobiles are usually very critical of the quality referred to as "ease in handling," which is dependent to a large extent upon proper operation of the steering mechanism and suspension system.

The auto mechanic must be familiar with the principles involved in the various types of steering mechanisms and be prepared to diagnose mechanical difficulty and make repairs and adjustments.

In this assignment you will have an opportunity to learn about the various types of steering and suspension systems and how they are repaired and adjusted.

Assignments:

1. Read the references listed below.
2. Write a brief report describing either:
   a. The effects of power steering on the modern automobile or,
   b. The adjustments necessary to have proper alignment in the frontend assembly.
3. Answer the questions below and turn in this assignment by ____________________.

References:

A. Crouse, Automotive Mechanics, pp. 533-571.
B. Stockel, Auto Mechanics Fundamentals, Chapter 17.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. The angular relationship between the front wheels, the front wheel attaching parts, and the car frame is referred to as "front end geometry."

T F 2. When adjusting the wheels, the camber angle should be slightly positive.

T F 3. A backward tilt of the kingpin from the vertical is called negative caster.

T F 4. When both front wheels have positive caster, the car tends to roll out or lean out on turns.

T F 5. Late model vehicles, and particularly heavy-duty trucks, tend toward a negative caster.

T F 6. The movement of the pitman arm is transmitted to the front wheel steering knuckles by the steering linkage.

T F 7. The conventional steering gearbox increases the torque necessary to turn the wheel.'

T F 8. Adjustable tie rods are necessary to compensate for caster angles.

T F 9. The recirculating ball-and-nut type of steering gear is designed to reduce friction to a minimum.

T F 10. Negative caster causes the car to lean in on turns and decreases the effect of centrifugal force.

T F 11. Most automobiles should have a toe-in of only a fraction of an inch.

T F 12. The proper toe-out for both front wheels of an automobile making a sharp curve to the right should be equal.

T F 13. The outside-front wheel should be adjusted so that when going around a curve it will turn through a larger angle with the automobile frame than the inside front wheel.

T F 14. The manufacturer's shop manual should be followed when adjusting or overhauling a steering gear.

T F 15. The driver of a motor vehicle need not sense the "feel" of the road through the steering mechanism.

T F 16. Front wheel shimmy and front wheel tramp are one and the same.

T F 17. The camber angle should be adjusted so that it will approach zero when the vehicle is loaded and rolling along the road.

T F 18. If considerable steering wheel movement is required to set the pitman arm in motion, it indicates linkage connections are worn out or out of adjustment.

T F 19. One of the most common causes of front-wheel tramp is unbalanced wheels.

T F 20. Steering feel is produced by a reaction seal in the hydraulic reaction assembly.

T F 21. The angle of the wheels and automobile path angle are the same when taking a corner.

T F 22. Gear reduction in a steering unit has the same ratio for each vehicle.

T F 23. The tie-rods are generally equal to or longer than the distance between the centers of the two front kingpins.

T F 24. The valve that feeds the oil to the cylinder and pistons of a power-steering system is operated by the turn of the steering wheel.

T F 25. There are many basic differences in the various power steering designs.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. The lower end of the steering shaft has a (an) ______________ type of gear on it.

2. The vast majority of power-steering mechanisms today utilize ______________ pressure.

3. ______________ - arm is another name for steering gear arm.

4. Excessive ______________ of the wheel causes one side of the tire tread to wear more rapidly than the other.

5. The ______________ ______________ furnishes most of the effort required to steer the car in a linkage-type power-steering system.

6. The two general types of power steering are ______________ ______________ and ______________ ______________

7. A steering unit pump generates pressures up to ________ lbs.

8. The type of oil used in power steering units is ______________ ________ ______________ ______________ ______________.

9. ______________ caster will cause the car to lean in on turns.

10. When the rear wheels follow in the tracks of the front wheels, they are said to be ______________.

11. ______________ wear, caused by taking curves at excessively high speeds, may be mistaken for camber wear or toe-in or toe-out wear.

12. A tilting of the steering wheel is made possible through the use of a ______________ ______________.

13. The camber angle is usually about ______________ degree in most automobiles.

14. A sway that is observed when taking a corner may be due to a loose ______________ ______________.

15. Toe-in usually varies between as little as a ______ of an inch to nearly ________ inch.

16. The angle formed between a vertical line and the vertical center line of a front wheel, when looking at the front of an automobile, is referred to as ______________ angle.

17. The ratio between the steering gear worm and the pitman arm have been increased to as much as ______________ to 1.

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. Eight preliminary checks which should be made and corrected before front end alignment is done are:

(A) ________________________

(B) ________________________

(C) ________________________

(D) ________________________

(E) ________________________

(F) ________________________

(G) ________________________

(H) ________________________

2. The angles involved to obtain proper front end alignment include:

(A) ________________________

(B) ________________________

(C) ________________________

(D) ________________________

(E) ________________________

(F) ________________________

(G) ________________________

3. The type of pump design used for power steering will be one of the following:

(A) ________________________

(B) ________________________

(C) ________________________

(D) ________________________

Assignment
Sheet No. 20

Covering
Units 223-235

BRAKES AND BRAKE SERVICE

It is important that an automobile moves, but even more important that it can be stopped. This means good brakes. One"s safety is often dependent upon the effectiveness of the automobile"s brakes. Because of the number of variables influencing braking action, a driver cannot afford to let his brakes get out of top working order. The auto mechanic failing in this responsibility to his customers may be directly responsible for a serious accident.

The assignment will deal with various types of brakes and some of the basic principles underlying their operation. Causes of brake failure are discussed, along with procedures for adjustment and repair.

Assignment:

1. Read the references listed below.
2. Construct two schematic sketches of a hydraulic master cylinder in a brake system.
   A. Using a conventional master cylinder
   B. Using a tandem master cylinder. (Color code each of the split system separately.)
3. Answer the questions below and turn in the assignment by ______________________________.

References:

A. Crouse, Automotive Mechanics, pp. 571-594.
B. Stockel, Auto Mechanics Fundamentals, Chapter 18.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. The hydraulically operated parking brake has largely replaced the mechanically operated type.

T F 2. Static friction between the road and tires is considerably more effective in braking than kinetic friction.

T F 3. Hydraulic wheel cylinders are located in the master brake cylinder.

T F 4. The force applied to a master cylinder is increased from your foot pressure by levers.

T F 5. Varying road conditions will result in varying coefficients of friction between the brake drum and the brake shoe.

T F 6. Brake fluid should be chemically inert.

T F 7. The anchor pin holds the brake shoe securely in place.

T F 8. Air is non-compressible.

T F 9. Mineral oil should never be put into the brake system.

T F 10. Slight traces of grease on brake linings may cause faulty brake action.

T F 11. Power brakes are vacuum assisted.

T F 12. Only the toe end or the heel end of the brake shoe is moved when making a minor adjustment.

T F 13. The use of a pressure tank to fill and bleed the brake system eliminates the need for an assistant.

T F 14. Cast iron is the only material used for brake drums on modern cars.

T F 15. The lines and cylinders in a hydraulic brake system should be flushed with mineral oil.

T F 16. Static friction means friction at rest.

T F 17. If over 25 percent is removed from the brake drum, it would be advisable to replace it.

T F 18. A tandem brake cylinder provides fluid at two wheels for braking.

T F 19. The transmission brake is not usually found on automobiles having a brake shoe emergency brake.

T F 20. An exposed transmission brake is normally dependent upon the action of four brake drums.

T F 21. Brake tubing may be cut properly with a hacksaw.

T F 22. If the left wheel brake lining becomes soaked with brake fluid, the car will tend to pull to the left.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. The basic material used for brake linings is ________________.

2. Brakes make use of a (an) ____________ drag on the brake drums to slow the car down.

3. The parking brake on most automobiles is ____________ operated.

4. Removing the air from hydraulic brake lines is called ____________ the brakes.

5. The only material acceptable for brake lines is double ____________ plated ____________.

6. If the brake fluid drops below the ____________ ____________ air will be drawn in by the hydraulic system.

7. The device that permits brake bleeding is known as a ____________ ____________.

8. ____________ and ____________ are two methods used to hold brake linings to their shoes.

9. One of the best sources for information pertaining to the servicing of a particular kind of automoiile is the applicable ________________.

10. The primary brake shoe is a term given the ____________ brake shoe.

11. Brake linings which are being replaced are fastened to the brake shoes with ____________ or ____________.

12. A device used to prevent skidding is known as an ____________ device.

13. When a brake loses its frictional properties, it is called brake ____________.

14. The brake drum should not be reduced by more than ____________ percent of its original thickness.

15. Brake drums which are too ____________ will tend to overheat and warp.

16. Mineral oil should not be used in a hydraulic brake system because it makes rubber parts __________.

17. Hydraulic brake systems are bled to release any ____________ that may have gotten into the lines.

18. Steel tubing, used in the lines of a hydraulic brake system must be double-____________ to prevent splitting.

19. Brake lining material is frequently interwoven with a fine ________________ and ________________.

20. The piston in the master cylinder is linked to the brake pedals through a ____________ arrangement which provides a considerable ____________ advantage.

21. Light score marks on brake drums can be removed with fine ____________ ____________.

22. Power brake designs may be classified as ____________, ____________, and ____________ types.

Listing

<u>Directions</u>: List the items called for in each of the following. Select your answers carefully.

1. The four means used to operate brakes are:

(A) ______________________ (C) ______________________

(B) ______________________ (D) ______________________

2. The characteristics a brake fluid should possess are:

(A) ____

(B) ____

(C) ____

(D) ____

3. Three types of brakes commonly used on heavy duty vehicles are:

(A) ______________________ (C) ______________________

(B) ______________________

4. The possible reasons why the brake pedal of a hydraulic system might go all the way to the floor boards are:

(A) ____

(B) ____

(C) ____

(D) ____

(E) ____

(F) ____

Assignment
Sheet No. 21

Covering
Units 236-242

WHEELS, TIRES, AND TIRE REPAIR SERVICE

In the early stages of the development of inflated tires, the motorist expected frequent tire repair jobs on the road. He carried several spare tires and a tire repair kit. Much progress has been made in improving the pneumatic tire. Today, tire repair on the road is almost unheard of and the necessity of changing tires en route is rare.

Tires, though greatly improved, still require careful servicing. Tire failure at speeds reached by modern automobiles is extremely hazardous and, in most cases, can be prevented by proper maintenance and care.

In this assignment you will have an opportunity to learn about the various types of tires and how they are constructed, serviced and repaired.

Assignment:

1. Read the references listed below.
2. Illustrate the two types of tire balance, describe the procedure used to overcome these malfunctions.
3. Complete the assignment below and turn in by ______________.

References:

A. Crouse, Automotive Mechanics, pp. 563-566; 595-601.
B. Stockel, Auto Mechanics Fundamentals, Chapter 16.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. Most heavy-duty truck and bus tires are inflated to about 30 pounds.

T F 2. Oil and grease will damage rubber.

T F 3. Both tire beads should be slipped over the rim flange simultaneously when removing a tire from its rim.

T F 4. An innertube should be completely deflated while mounting it and the tire on the rim.

T F 5. Better alignment of the tire, tube, and rim may be achieved by deflating the tire after it has been installed and then reinflate it.

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T F 6. The left front tire wears at the same rate as the left rear tire.

T F 7. Overinflation causes a tire to wear in the center tread.

T F 8. The chief safeguard in servicing tubeless tires is to handle the casing in such a way as to prevent any damage to the sealing ridges.

T F 9. Improper front alignment causes a tire to have a feathered edge.

T F 10. The "drop center" of a tire permits easy, placement on the hub.

T F 11. The tubeless tire has become standard equipment for passenger cars.

T F 12. Wheels must be balanced to give the best performance.

T F 13. The ply rating of a tire is dependent upon the number of fabric layers.

T F 14. Front wheel "tramp" is a term describing high-speed wander.

T F 15. Tire tread design is primarily for looks.

T F 16. Under-inflation is a common cause for sidewall separation in tires.

T F 17. Tire pressure specified by car manufacturers should be adhered to.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. Tire casings are reinforced with layers of ______________ that have been impregnated with rubber.

2. Plies refer to the number of layers of ______________ in a tire casing.

3. The term used to describe the process of heating rubber under pressure is called ______________.

4. The highest number of plies used for tires is ______________.

5. Tires used for passenger cars usually have at least ______________ plies.

6. Care must be exercised when removing a tire from its rim to avoid injury to the tire bead or ______________ ______________.

7. It is recommended that the tires on an automobile be rotated every ______________ miles to equalize tire wear.

8. The process of vulcanizing new tread material to a tire casing is known as ______________.

9. In the procedure for rotating tires, the ______________ ______________ wheel would be next in line as a spare.

10. In the procedure for rotating tires, the right rear wheel would be next used as a (an) ______________ ______________ wheel.

11. The tire that receives the most wear is on the ______________ ______________ wheel.

12. Two types of balance affecting road performance are ______________ and ______________.

13. The grease used for wheel bearings should contain ______________ ______________ material.

14. The type of valve stems used in tubeless tires are ______________

15. The type of nut used to hold the front wheel hub on is a ______________ and it is locked in place with a ______________ ______________.

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. Two basic types of tires are:

(A) ______________ (B) ______________

2. The major functions that tires serve are:

(A) ______________ (B) ______________

3. Four mechanical conditions that cause abnormal tire wear are:

(A) ______________ (C) ______________

(B) ______________ (D) ______________

4. Five parts of tubeless tires are:

(A) ______________ (D) ______________

(B) ______________ (E) ______________

(C) ______________

5. The four ways tire inflation is important are:

(A) ______________ (C) ______________

(B) ______________ (D) ______________

Assignment
Sheet No. 22

Covering -
Units 243-245

AUTOMOTIVE AIR CONDITIONING

The automobile contains numerous examples of items which were once luxuries. These are now rapidly becoming a necessity. The air conditioner is an example of this new changing concept in driving comfort. Essentially this device performs two operations to the air used within the automobile; it filters and removes excess moisture.

In this unit you will have opportunity to review the principles of refrigeration and their application to the air conditioner as used in today's automobile. The process is similar to a household refrigerator.

Assignment:

1. Read the references listed below.
2. A. Study the color coded schematic of the freon cycle on page B-20-12 A of your text.
   B. In a short paper discuss the operation of each component of an air conditioning system.
3. Locate a book on refrigeration in the library, investigate why freon is used as the gas.
4. Answer the questions below and turn in this assignment by ____________________.

References:

A. Crouse, Automotive Mechanics, pp. 602-604.
B. Stockel, Auto Mechanics Fundamentals, Chapter 20.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. An air conditioner removes moisture from the air.

T F 2. An increase in atmospheric pressure will increase the boiling point of a liquid.

T F 3. Freon under pressure has an increased boiling point.

T F 4. A refrigeration system uses gases under low pressure.

T F 5. An air conditioning sight glass indicates the level of freon.

T F 6. Moisture is removed from freon in a receiver.

T F 7. An evaporator is used to dehumidify the air.

T F 8. Freon passing into the evaporator is under high pressure.

T F 9. As a compressor increases the pressure it also raises the temperature of freon.

T F 10. The compressor pulley is running at all times when the automobile engine is running.

T F 11. Refrigeration is dependent upon control of freon pressures.

T F 12. The process of removing heat from an object is cooling.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. The operations performed by air conditioners are to remove ______________ and ______________ from the air.

2. The purpose of the compressor is to ______________ the ______________.

3. It is the purpose of the ______________ to remove dirt and moisture from the system.

4. The device that controls the action in a refrigeration system is called the ____________ ______________.

5. A ____________ ______________ provides a visual means of inspecting the flow of freon.

6. Pressure raised above the normal ______________ pressure will raise the boiling point of a liquid.

7. The pressure range of freon as it enters the line from the compressor is _______ to _______ pounds.

8. Tubes and fins best describe the components of a ______________ and ______ _______.

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. The essential components of an air conditioner system are:

(A) ____________________ (D) ____________________

(B) ____________________ (E) ____________________

(C) ____________________

2. Heat may be transferred from one substance to another by:

(A) ____________________ (C) ____________________

(B) ____________________

3. The action of an expansion valve is controlled by the following three factors:

(A) ____________________ (C) ____________________

(B) ____________________

4. The three characteristics of freon which make its presence hard to verify are:

(A) ____________________ (C) ____________________

(B) ____________________

Assignment
Sheet No. 23

Covering
Units 246-254

JOB MANAGEMENT AND PRICING

The principal reason automobile repair shops are in operation is to provide services for automobile owners. However, these services are continued only if the shop owners realize a reasonable profit on their investment.

Each shop owner strives to offer the greatest amount of services for the least cost to customers and, at the same time, realize a fair return from his investment. In order to accomplish this, management is required to employ sound principles of job management and of pricing services.

In this assignment you will have an opportunity to learn about methods of receiving and routing jobs through the shop and the various methods of pricing services.

Assignment:

1. Read the reference listed below.
2. Ask your employer for copies of business forms which are used in the service department. Fill them in using an imaginary case.
3. When you have completed Items 1 and 2 answer the questions below and hand in with Item 2 on ________________________.

Reference:

Information Sheet No. 1, this manual.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. Customers are usually willing to spend money for car maintenance.

T F 2. It is essential that repair shops have someone on hand that will give the customer courteous attention.

T F 3. A job must receive careful attention from the time it is accepted until it is completed if the customer is to feel that his money is well spent.

T F 4. It is considered good practice to have a mechanic give attention to incoming jobs.

T F 5. In large shops the service salesman meets the customer and discusses the nature of his problem.

T F 6. One of the duties of the head mechanic is to fill in job tickets.

T F 7. The job ticket, or repair order, is a contract between the service shop owner and the car owner.

T F 8. The customer can be forced to pay the entire bill even though work not originally contracted was done.

T F 9. Job tickets in large shops are usually made out in triplicate.

T F 10. The customer can collect compensation for damages to his automobile in a repair shop unless he signed a statement relieving the owner.

T F 11. Job tickets usually do not include a list of repair parts and their prices.

T F 12. If the repair job cannot be completed on schedule, the owner should be notified at the earliest possible time.

T F 13. Carefully kept records of time required to complete jobs are of value in estimating completion dates of similar jobs in the future.

T F 14. The public no longer expects small service jobs at no cost.

T F 15. Profit is usually thought of as the difference between the amount the owner pays the mechanic and that which he receives from the customer.

T F 16. In the past, charges to the customer were established on a time-and-material basis.

T F 17. All jobs done in a general automobile repair shop are based on the flat-rate system.

T F 18. Flat-rate prices are established on the average hourly rate and average time to complete the job.

T F 19. Repair shop owners starting in business frequently make the mistake of selecting an hourly rate which is too small.

T F 20. A low hourly rate for labor charged by some shops is easily offset by profit on repair parts.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. In addition to pleasing customers, careful attention to each job safeguards ________________.

2. In small shops the ________________ gives attention to incoming jobs.

3. To aid in preventing replacement parts of repair jobs from being overlooked and/or not being paid for, a ________________ ________________ is prepared for each job.

4. A job ticket is also known as a ________________ ________________.

5. Upon the completion of a job, the mechanic's copy of the job ticket showing labor time is sent to the ________________ department.

6. Most small shops use a simplified form of job ticket in which one of the two copies is retained by the company and the other goes to the ________________.

7. Incoming jobs are assigned to the various mechanics by the owner or shop ________________.

8. Only when books have been balanced at the end of the ____________ can profit be definitely determined.

9. The system of pricing services now generally accepted, in which a fixed amount is paid for a job regardless of the time required to complete it, is known as the ________________ system.

10. The price paid by the customer per hour is _________ to _________ times the rate paid the mechanic.

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. Two important factors that directly affect customer good will are:

   (A) __________________________ (B) ____________________________

2. Three sources from which printed job tickets may be secured are:

(A) ______________________ (C) ______________________

(B) ______________________

3. The three uses of a job ticket are:

(A) ______________________ (C) ______________________

(B) ______________________

4. Items that are included in total operating costs are:

(A) ______________________ (F) ______________________

(B) ______________________ (G) ______________________

(C) ______________________ (H) ______________________

(D) ______________________ (I) ______________________

(E) ______________________

Information
Sheet No. 1

JOB MANAGEMENT

Owners and operators of small businesses often are not aware of the extent of the responsibilities that they incur. They feel that, if they do the work specified by the customer and pay their bills, they are meeting all their obligations. However, there are other things to be considered as many businessmen have realized after it was too late.

If a businessman fails to provide adequate protection for himself and his customers he can be sued for damages obtained by any person who is injured on his premises. Of course, it is first necessary for the injured party to prove in court that there has been negligence on the part of the owner.

Obviously, every repair shop owner will want to take every possible precaution for the safety of his customers and employees. Not only should he attempt to make his shop completely safe but, in addition, he should take out insurance so that he will be protected financially regardless of what may occur.

Selecting from over 55 types of insurance policies applicable to automotive sales and service, the owner should only take out those policies which he can afford and those necessary to protect him adequately.

PROPERTY HAZARDS

Many of the safeguards that can be taken by the careful shop operator are easily arranged. Others are more complicated and difficult, and will require constant attention on the part of the owner to insure that the safety rules he has made are being observed.

One of the most difficult provisions that can be made for the safety of customers and employees is a clean, oil free floor on which people can walk without danger of slipping or stumbling. Law books are full of cases where damages have been granted to persons who have been injured from falls caused by negligence in the care of floors.

The cement floor of a repair shop requires constant attention, for only a slight spot of grease can easily result in a severe fall if walked on with rubber soles or heels. It is particularly important to make sure there is no grease or litter on the floor surrounding a pit, for a fall at such a point can be extremely serious.

Tools scattered on the floor, a jack handle left protruding from underneath a car, or similar careless and thoughtless handling of equipment can cause serious injury.

Safety precautions should be taken if the shop operates certain kinds of machinery. Many dangers must be guarded against. The gearing and belting on machines must be protected by a suitable guard so that it is impossible for anything to become entangled in the moving parts. Grinding wheels should never be operated without a guard.

It is essential that all tools be inspected frequently to make sure they are safe to use. Always be sure that jacks, horses, and lifts are in perfect working order and that there is no possibility of their failure, with consequent injury to anyone underneath. Never use makeshift blocking instead of a horse or a jack to support a car.

All types of fire-fighting equipment should be inspected frequently to insure that they are in good working order and of the proper type for use against garage type fires.

TYPES OF INSURANCE

To achieve full protection against accidents and other hazards in the operation of your business, be sure that you have all necessary types of insurance. Discuss your insurance needs with a reliable insurance agent, who will advise you regarding the kinds and amounts of insurance that you require.

In general, the types of insurance found adequate to cover hazards in automobile repair shop operation are public liability, workman's compensation casualty, fire, and theft.

Public liability will insure against any accidents that happen to customers when they are on your premises. For instance, if a customer should slip and injure himself while in your shop, the damages awarded him by the court would be taken care of by your public liability insurance. This insurance is an important safeguard, since your action in opening a shop may be construed as an invitation to the public to enter with the assurance of safety. Public liability also covers damage or injury that might be caused by your truck or other equipment used away from the premises.

Workmen's compensation insurance is designed to compensate workmen for any injuries received while on a job. It is required by law in most states when a minumum number of workmen, usually four, are employed. However, it is a protection for you against claims, regardless of the number of your employees and would be advisable to purchas if you have less than the required number of workers.

Casualty insurance covers the risk of damage to such property as buildings, machinery, fixtures, boilers, and plate glass. The value of fire and theft insurance is obvious.

INJURIES

Probably few, even of the largest shops, could maintain a thoroughly equipped emergency room. However, every shop should be prepared to furnish emergency first aid to the injured.

The first-aid kit should be fitted out as recommended by the American Red Cross. It should be replenished immediately after being used, and its contents checked once a month. These supplies must, of course, be kept clean. Cases for first-aid supplies preferably should be made of metal, and be so constructed as to exclude dust.

The effects of an accident may be intensified through lack of immediate and proper care. On the other hand, unskillful handling of a severe injury may do further harm besides causing unnecessary pain. Therefore, the first thing to do in case of a major accident is to get a doctor. Pending his arrival, no first-aid treatment should be given beyond the necessities of the emergency.

Every injury that occurs, no matter how trivial, should be noted in a record book. All cuts, scratches, and bruises should be recorded as soon as they have received attention. Any injury involving lost time requires a more formal report. Such a report usually gives the name of the employer for whom the injured worked and the industry, the name, age, sex and occupation of the worker, cause of injury and designation of the part of the body injured, steps taken to prevent similar injuries and other pertinent data.

As a rule, workman's compensation laws require the reporting of industrial injuries to the appropriate workmen's compensation board. Some of these boards require the reporting all injuries, including those involving only first aid; others, all disabling injuries; still others, only those injuries which exceed the waiting period. Therefore, you should ascertain the requirements of the compensation act applicable to your employees and comply fully with those regulations.

If you carry your compensation insurance with an insurance company, you should, of course, learn the company's requirements for reporting injuries and abide by them.

RECORDING INCOMING JOBS

The success or failure of an automotive repair shop is dependent on many factors. Among the most important and ones that directly affect customer good will are prompt attention to the incoming customer and the careful recording of all work ordered.

To insure that none of the items of repair ordered by the car owner are overlooked and that all work is paid for, it is necessary that a detailed record be kept of the repairs authorized. Most shops use the job ticket or shop order for this purpose and it is the duty of the owner or service manager to make sure that the ticket is filled out in detail.

The repair order or job ticket constitutes an actual contract between you and the car owner and binds you to do a certain amount of work. Care in filling out the job ticket will prevent any misunderstanding later as to the amount of work for which you are contracted.

If you fail to do all of the work agreed upon, the car owner can hold you responsible. On the other hand, if you do more work than was originally contracted for, you cannot force the owner to p pay for the additional labor.

There are many different types of printed job tickets available, some designated especially for the large shops and others for smaller ones. They can be obtained from companies manufacturing business machines, from specialty printers, or from the companies from whom you may be purchasing fuel and lubricants. It is advisable that you study the various forms and select the type best suited to your particular business.

The job ticket used in large shops is usually made out in triplicate. The first copy serves as the customer's invoice, the second goes to the repair shop's accounting department, and the third is given to the mechanic assigned to the job so that he will know what repairs are to be made.

Usually, the job tickets provide places for the name, address, and telephone number of the car owner, the date when the work was received, the time the completed job is promised, and important facts about the car, such as make, motor and license number, and the mileage indicated on the speedometer.

Such information is required in some states as a means of enabling the police to locate stolen vehicles, but it can also be of particular use to you. For instance, the owner's name can be put in your file of persons to whom direct-mail advertising is sent. The mileage reading helps the mechanics to determine what other repairs might be necessary. Furthermore, having a record of the mileage at the time of repair will help you to disprove any claims which the owner may later make to the effect that the car failed after a few miles of driving. Other information contained on the job ticket is of extreme importance for tax, social security, and other purposes.

The major portion of the job order is devoted to listing the various repairs that are to be performed. If the repair shop is operating on a flat-rate price basis, the repair operation number should be noted and the job should be described briefly. There is space provided for writing in the labor charges for each operation and the words "estimates for labor only, material additional" are usually included near this space. This explanation is important as it is impossible in most instances to estimate all the parts that will be required for a particular repair job.

Space is provided for the car owner's signature and a statement similar to the following is usually included: "It is understood and agreed that this company assumes no responsibility for loss or damage occasioned by fire, theft, demonstration, or while road testing, delivering, and/or calling for any vehicle placed with this company for storage, sale, repair, or otherwise."

Unless such conditions are included the car owner can be awarded compensation for damage to his car resulting from fire or other accidents while it is in possesion of the shop.

On two copies of the job ticket space is provided for listing all parts used in repairing the car, and their prices. The list of parts can be obtained from the requisition forms made out by the mechanic who did the job. The total cost of the parts is added to the labor charge on the face of the order to indicate what the customer shall pay.

Whether stamped in by a regular time clock or written down by the shop owner or foreman, work-time information is particularly important where the mechanic is paid on a flat-rate or some other basis involving the actual time required for the repair operation. It may also be of value in determining the relative efficiency of the various mechanics as it consitutes a record of the time they require to do the different jobs.

Upon completion of the work, the third copy of the job order is sent to the accounting department so the mechanic's pay may be calculated.

The form described above, since it is to carry all the information required by large shops, is unduly complicated for use of the shop owner employing only a few men, particularly if they are paid a straight weekly salary. The smaller shops use a simpler form, a single copy of, at most, two copies, to serve the same purposes.

When this simpler type of job order is used, one copy is given to the customer and the other is retained by the shop to supply the information needed by the mechanic assigned the job and by the accounting or bookkeeping department.

ASSIGNING AND CHECKING WORK

The shop foreman or owner, as the case may be, must assign work to the mechanics. Naturally, if there are a large number of employees some will be found to be more skillful than others on certain types of repairing. Therefore, when possible, jobs should be assigned to the mechanics best fitted to do them. In a small shop, assignment of work should not be much of a problem because presumably any mechanic hired would be capable of turning out a good job on all parts of the automobile.

The responsibility of making work assignments involves seeing that repair jobs are completed on schedule.

It is essential that the car be ready for the owner at the time recorded on the job ticket. If the shop fails to live up to its agreement, it will probably lose trade. It is up to the service manager of a large shop or the owner of a small establishment to make careful note of the delivery promise with respect to each car, and to see that all such promises are kept.

It isn't enough to have the delivery time written on the job sheet. A record of the time promised should be kept in plain view. on a blackboard for all the cars under repair. In general, the only information required for such a record in the name of each car owner and the date and time promised.

The owner or service manager must check frequently with the mechanics to make sure that the work on each car is progressing satisfactorily and that it will be completed at the time promised. If for any reason a car cannot be ready on time, the shop operator or service manager should phone the owner and explain the delay.

Keeping a record of this sort has another distinct advantage in that it will help to discourage the person who takes the order from making promises that cannot be kept. In other words, if a shop has only one motor mechanic, the operator should not promise any more work than can be performed by that one mechanic. For example, it requires approximately 6 1/2 hours to do a valve job on an 8-cylinder car. By working fast the mechanic can finish one such job in a day and with luck might start a second. Assuming that no other jobs take precedence, the shop operator should feel safe in promising the owner of the second car that it would be ready for him the following day.

CONTROLLING FOR PROFIT

Too frequently, the shop operator neglects to include all charges when he makes up the customer's bill. It should be remembered that failure to include the price of parts, lubricants, or other materials used on a repair job can change a profitable transaction into a loss. Mechanics should be impressed with the importance of noting either on requisition blanks or in the spaces provided on the job ticket, all parts and materials required for each piece of work.

An accurate record of the time the individual mechanic takes to do various jobs assigned him is important not only because the data needed in fixing charges to the customer, but also because of the growing use of incentive pay methods based on actual work time. Therefore, time clocks, formerly found only in the larger shops, are coming more and more into use.

If a shop operator does not feel justified in going to the expense of purchasing a time clock, he must then write in on each job ticket the time the mechanic starts and finishes the job. Unless the time is checked in each case with the mechanic, this method may result in disagreement between the mechanic and the operator.

FREE SERVICE AND UNPRODUCTIVE TIME

The owner of a repair shop soon finds that he is expected to give many small services on which there is no definite charge. For example, a car with a severe engine miss may be driven up to the shop. A quick diagnosis will disclose that the miss is caused by a shorted spark plug. Obviously, it will only take a minute to clean the spark plug. Since actual time spent in doing the whole job would not exceed five minutes, the shop owner will be inclined to make no charge, particularly if the car owner is a regular customer.

Free service time mounts up and a practice of not charging could result in business failure. On the other hand, the goodwill gained by free service should not be overlooked. The shop owner will have to weigh the value of this goodwill against the time lost on such jobs.

There are many ways to avoid excessive free servicing. In the case of an engine miss, the shop operator could point out to the car owner that, while only one plug was shorted at the moment, the condition which caused that one cylinder to misfire would undoubtedly be found in the other cylinders, as well. He would be justified in saying that a complete tune-up should be done, and possibly new spark plugs to insure satisfactory operation. Be sure, in each instance, to suggest all the work that is required to overcome the trouble.

Unproductive time in a shop can cause considerable loss of profit. Among the factors that can cut deeply into a shop's earning capacity are lost tools, defective or inadequate equipment, lack of intelligent management, and failure to order necessary parts and to have them ready when needed. Another factor is the time spent in selling a small job that could otherwise have been devoted to selling complete one. Such haphazard selling forces the car owner to make repeated trips to the shop for a lot of small jobs when all the work should have been sold and completed on one trip.

COSTS AND QUOTATIONS

In order to operate a successful shop you must be sure that your charge to the customer is sufficient to allow you a profit. Many repair shops have failed because they didn't take into consideration all the expenses that had to be met. Too frequently the dollars left over at the end of a week are looked on as profit even though the rent is unpaid and there are outstanding bills.

It is only when your books have been balanced at the end of your fiscal year that you can determine definitely the extent of your earnings above your salary, but if you fix prices that allow for all cost items, you will lessen the possibility of experiencing a loss.

National averages indicate that profits for successful automotive repair shops approximate 8 percent of net sales. Naturally, there are some automotive repair shops that have profits in excess of the average, many that have profits smaller than average, and still others that are operating at a loss.

Charges for many kinds of auto repair jobs are fairly well standardized, so you will probably have no particular difficulty in establishing your prices. Originally, the procedure was to charge the customer on a time-and-material basis. Owing, however, to pressure on the part of car owners who wanted to know the cost of repairs before they were actually made, repair shops gradually adopted what are known as flat-rate prices for most operations.

Such prices were tried out rather reluctantly by many operators, as they felt it was impossible to foretell accurately how long it would take to do the jobs. However, experience soon indicated that charges could be established which were fair both to the repair shop and the car owner.

FLAT-RATE PRICES

It is true that the time required to do repair jobs of the same kind may vary. But the variation is small and the advantages of being able to quote a price before the work is performed are so great that flat-rate prices are now charged by virtually all shops.

Repair shops owned and operated by car dealers use, for the most part, the prices established by the respective car factories. Independent repair shops, working as they do on all makes of cars, use flat-rate prices established by companies specializing in fixing such rates.

Experience has shown that flat-rate prices can be established for 85 to 90 percent of all the repair operations done on an automobile. For the remaining jobs, such as straightening fenders and repairing wrecks, which cannot be given a flat-rate price, the charge is based on actual time and material.

FIXING THE FLAT-RATE PRICE

A publishing company compiling a manual of flat-rate prices first makes time studies on the repair operation to get an average time for doing that particular work. The average hourly rate that could appropriately be charged by the majority of repair shops is then selected. The prices given in the manuals are based on this average hourly rate and the average time required to do that particular job. Conversion tables are provided so that, if the individual repair shop operates on an hourly rate other than the average rate selected by the publisher, he can revise the published rate.

While the published flat-rate prices figured on averages are convenient guides, it will still be necessary for you to determine the hourly rate you should charge to repair cars in order to obtain the desired profit. Furthermore, you will need to know your hourly rate to figure any time-and- material charges you may quote.

Obviously, a repair shop on the main street of a metropolitan area has a higher overhead and, consequently, has to charge a higher hourly rate than is feasible for a smaller repair shop in some rural section. Repair shop owners starting in business frequently make the mistake of selecting an hourly rate that is too small.

There are two ways to determine the hourly rate for an automotive repair shop.

The first method, used by virtually all car dealers on the recommendation of their respective car factories, is based on the hourly wages paid to the mechanic. To determine the hourly rate by this method the mechanics' hourly wage is multiplied by a factor which ranges from 2 to 2.5. Some car factories advocate the lower factor while others are in favor of the higher one.

As an example, suppose that you are paying your mechanic $1.00 an hour. To obtain the hourly rate on which to base your flat-rate charge to the customer, you have only to multiple $1.00 by 2 or 2.5 The results from this simple method check very closely with those obtained by the second and more complicated accountant's method based on the cost of doing business.

To obtain the hourly rate by the second method, you divide the total of all costs of doing business in a month's time by the number of productive hours during that same period. By " productive hours" is meant the total time actually spent by mechanics working on cars, and would not include the time of a stenographer, bookkeeper, attendants at the gasoline pumps, or the manager.

Suppose that for a shop employing a mechanic and requiring a small amount of nonproductive bookkeeping help, the itemized cost of doing business is as follows:

Rent	$ 100
Depreciation	30
Salary, mechanic	350
Salary, nonproductive	190
Electricity	10
Telephone	5
Mail and advertising	25
Bad debts	10
Unemployment and social security taxes	25
Miscellaneous	55
	$ 800

Most of the items of business cost included above require no explanation. However, it should be pointed out that salaries for everyone in the shop must be included. Remember that you should place yourself on the payroll at a definite salary. Taxes include unemployment taxes, social security taxes, and any municipal or other taxes incurred.

If your are renting your establishment, depreciation would include only the depreciation of equipment. The amount would depend on the length of time before the equipment would normally become obsolete. If you have $ 1,800 worth of equipment and wish to calculate depreciation on the basis of five years, you divide the amount of worth by 60, which gives $30 as the monthly depreciation. If you own the building, instead of a rent item you would have real estate taxes, interest on mortaage and on invested capital, and certain expenses for maintaining your building.

In large shops it is frequently necessary to make different hourly charges for the work done in different departments. For example, if a shop has wheel-aligning, tune-up, car-washing, brake, and engine-overhaul departments, it would probably charge on the basis of approximately $3.50 per hour for wheel aligning and $2.50 per hour for work in the other departments.

The charge can be calculated accurately for each department by using the same procedure as suggested above for the entire shop. The only difference is that each department is assigned a certain portion of the rent and other general expenses. Naturally, only the salaries of those mechanics who work in the department are used when calculating the hourly costs.

There are other reasons for variations in the hourly rate. For example, some specialty shops, because of a high investment in equipment, charge more per hour than do other specialty shops rendering other services.

TIME-AND-MATERIAL CHARGES

The foregoing discussion deals with the problem of fixing charges on an hourly time basis. For such jobs as repairing a wrecked car or straightening a fender, the charge will have to be made on a time-and-material basis. Do not attempt to fix the charges in advance unless you have had years of experience in such estimating and quote prices that are fair to the customer and yet will insure an adequate profit for yourself.

As the term implies, time-and-material charges are based on an hourly rate and the cost of the various parts installed in the car. Determining this charge when the job is completed presents little difficulty if a time record is kept on the repair order or job ticket, or the necessary requisitions are made out by the mechanic who does the work.

Some repairmen make the mistake of using a low hourly rate when calculating the price for such jobs, in the belief that there is sufficient profit in the discount they obtain on the purchase of the repair parts installed. This is a serious error because a great many repairs on modern cars require few parts. For instance, the installation of a detent spring in a transmission may require 5 hours of work but the spring itself will cost only 20 to 25 cents.

Obviously, very little profit can be realized from the parts in such an operation but if the shop is to be successful it must obtain a profit on labor.

TRAINING PLAN AND PROGRESS RECORD
For
AUTO MECHANICS

Employer's Copy

JOB TRAINING: What the Worker Should Be Able to Do	Proficiency Shown	RELATED INFORMATION: What the Worker Should Know
	The Engine	
Perform the tests which are necessary for engine trouble diagnosis. Remove, clean, recondition and replace engine components	☒	The physical principles involved in engine operation and a description of engine components and their relationship to each other
Time in hours _______		
	Fuel System	
Perform tests which are necessary to fuel system trouble diagnosis and make fuel system tune up adjustments. Remove, check, clean, repair and replace the fuel tank, fuel gages, fuel lines, fuel pumps, carburetors and choke and throttle controls	☒	Characteristics of engine fuels, the types and principles of fuel systems, the types and uses of fuel system testing equipment and fuel system trouble diagnosis
Time in hours _______		
	Engine Lubrication	
Diagnose lubrication trouble. Check, clean, repair and replace the component parts of engine lubricating systems	☒	The principles and types of engine lubricating systems and their component parts. Also the composition and properties of engine lubricating oils
Time in hours _______		
	Cooling System	
Inspect, clean, repair and replace component parts of the cooling system	☒	Types of cooling systems; their function and care
Time in hours _______		
	Electrical System	
Check automobile electric system and make necessary repair and replacement of its parts	☒	The theory, function and care of the various parts of automobile electric systems
Time in hours _______		

Clutch

Check, repair and adjust the various types of clutches	☒	Types and functions of clutches, and their opera tion and care

Time in hours ______

Transmission

Overhaul the various types of automobile transmissions	☒	The function, types and operation of transmission

Time in hours ______

Drive Mechanisms

Check, remove, repair, adjust drive train mechanisms	☒	Types and functions of drive mechanisms

Time in hours ______

Front axles and Steering Gear

Overhaul front axles and steering gear and make caster, camber and toe-in adjustments	☒	Types of front wheel susp and steering mechanisms a the principles of front-end geometry

Time in hours ______

Springs and Shock Absorbers

Repair and replace springs and shock absorbers	☒	Types and functions of au mobile springs and shock absorbers

Time in hours ______

Brakes

Repair and adjust brakes	☒	The types and functions o brakes and principles of brake operations

Time in hours ______

Wheels, Tires, and Tire Wear

Remove, repair, and rotate tires	☒	Function and construction of tires; factors which relate to abnormal tire wear

Time in hours ______

General Lubrication

Perform complete lubrication jobs on the various makes and models of cars	☒	Principles and practices of automobile lubrication

Time in hours ______

Job Management

Clean and arrange shop tools and equipment. Check, sort, store and inventory parts and equipment. Meet customers, make sales, and keep records	☒	The problems involved in the operation of auto repair businesses

Time in hours ______

Code for employer's use in marking student's progress:

Performed some operations in area	☒	Performed some operations with reasonable proficiency	☒
Performed most operations in area	☒	Performed most operations satisfactorily	☒

TRAINING PLAN AND PROGRESS RECORD
For
AUTO MECHANICS

Student's Copy

JOB TRAINING: What the Worker Should Be Able to Do	Proficiency Shown	RELATED INFORMATION: What the Worker Should Know
	The Engine	
Perform the tests which are necessary for engine trouble diagnosis. Remove, clean, recondition and replace engine components Time in hours _______	☒	The physical principles involved in engine operation and a description of engine components and their relationship to each other
	Fuel System	
Perform tests which are necessary to fuel system trouble diagnosis and make fuel system tune up adjustments. Remove, check, clean, repair and replace the fuel tank, fuel gages, fuel lines, fuel pumps, carburetors and choke and throttle controls Time in hours _______	☒	Characteristics of engine fuels, the types and principles of fuel systems, the types and uses of fuel system testing equipment and fuel system trouble diagnosis
	Engine Lubrication	
Diagnose lubrication trouble. Check, clean, repair and replace the component parts of engine lubricating systems Time in hours _______	☒	The principles and types of engine lubricating systems and their component parts. Also the composition and properties of engine lubricating oils
	Cooling System	
Inspect, clean, repair and replace component parts of the cooling system Time in hours _______	☒	Types of cooling systems; their function and care
	Electrical System	
Check automobile electric system and make necessary repair and replacement of its parts Time in hours _______	☒	The theory, function and care of the various parts of automobile electric systems

Clutch

Check, repair and adjust the various types of clutches Time in hours ______	☒	Types and functions of clutches, and their operation and care

Transmission

Overhaul the various types of automobile transmissions Time in hours ______	☒	The function, types and operation of transmissions

Drive Mechanisms

Check, remove, repair, adjust drive train mechanisms Time in hours ______	☒	Types and functions of drive mechanisms

Front Axles and Steering Gear

Overhaul front axles and steering gear and make caster, camber and toe-in adustments Time in hours ______	☒	Types of front wheel support and steering mechanisms and the principles of front-end geometry

Springs and Shock Absorbers

Repair and replace springs and shock absorbers Time in hours ______	☒	Types and functions of automobile springs and shock absorbers

Brakes

Repair and adjust brakes Time in hours ______	☒	The types and functions of brakes and principles of brake operations

Wheels, Tires, and Tire Wear

Remove, repair, and rotate tires Time in hours ______	☒	Function and construction of tires; factors which relate to abnormal tire wear

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Perform complete lubrication jobs on the various makes and models of cars	☒	Principles and practices of automobile lubrication

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	Engine Lubrication	
Diagnose lubrication trouble. Check, clean, repair and replace the component parts of engine lubricating systems Time in hours _______	☒	The principles and types of engine lubricating systems and their component parts. Also the composition and properties of engine lubricating oils
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Inspect, clean, repair and replace component parts of the cooling system Time in hours _______	☒	Types of cooling systems; their function and care
	Electrical System	
Check automobile electric system and make necessary repair and replacement of its parts Time in hours _______	☒	The theory, function and care of the various parts of automobile electric systems

Clutch

Check, repair and adjust the various types of clutches Time in hours ______	☒	Types and functions of clutches, and their operation and care

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Overhaul the various types of automobile transmissions Time in hours ______	☒	The function, types and operation of transmissions

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Check, remove, repair, adjust drive train mechanisms Time in hours ______	☒	Types and functions of drive mechanisms

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Brakes

Repair and adjust brakes Time in hours ______	☒	The types and functions of brakes and principles of brake operations

Wheels, Tires, and Tire Wear

Remove, repair, and rotate tires Time in hours ______	☒	Function and construction of tires; factors which relate to abnormal tire wear

General Lubrication

Perform complete lubrication jobs on the various makes and models of cars	☒	Principles and practices of automobile lubrication

Time in hours _______

Job Management

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Time in hours _______

Code for employer's use in marking student's progress:

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Performed most operations in area	☒	Performed most operations satisfactorily	☒

VT002 085

VT 002 085
Meat Cutting, A Course of Study Designed for Cooperative Part-Time Students Employed in Meat Cutting.

Karnes, James B.
Missouri Univ., Columbia. Dept. of Industrial Education
Missouri State Dep of Educ, Jefferson City. Ind Educ Sect

Pub Date - May65
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*STUDY GUIDES, *TRADE AND INDUSTRIAL EDUCATION, *MEAT CUTTERS, HIGH SCHOOLS, POST SECONDARY EDUCATION, JOB ANALYSIS, *COOPERATIVE EDUCATION, INDIVIDUAL INSTRUCTION, *MEAT,

Related occupational information for meat cutting students in high school or post-high school cooperative education programs is presented. It was developed by a committee of teacher coordinators and teacher educators through an analysis of the trade and has been field tested and periodically revised. The 16 assignment sheets, designed for individual instruction, contain informative paragraphs, explanations of the importance of the assignments, references, learning activities, and objective-type questions. Examples of assignment sheet titles are (1) Sanitation in the Meat Department, (2) Preparing Retail Beef Cuts, (3) Preparing Fish and Shellfish, (4) Refrigeration, Curing, and Storage of Meat, and (5) Advertising, Displaying, and Selling Meat. Information sheets are included on retail meat cutters, fresh and frozen fish, and selling meat products. The material is to be used by individual students under the supervision of a qualified coordinator or competent trade teacher for one year or 180 days. The student

should be in grade 11 or grade 12, have proper prerequisites, and be employed in meat cutting in a cooperative education program. Supplementary materials include a list of references, an analysis of the retail meat cutting trade, and a student progress record. Answers to assignment sheet questions are available in VT 002 084. This document is available for $1.50 from Industrial Education, 103 Industrial Education Building, University of Missouri, Columbia, Missouri 65201. (HC)

MEAT CUTTING

A Course of Study

Designed for
Cooperative Part-Time Students
Employed in Meat Cutting

Issued by

Department of Industrial Education
College of Education
University of Missouri
Columbia, Missouri

In Cooperation with

Industrial Education Section
State Department of Education
Jefferson City, Missouri

MEMORANDUM

TO: The ERIC Clearinghouse on Vocational and Technical Education
The Ohio State University
980 Kinnear Road
Columbus, Ohio 43212

FROM: (Person) James B. Karnes (Agency) Univ. of Mo. at Columbia

(Address) 103 Industrial Education Building, Columbia, Mo.

DATE: October 19, 1967

RE: (Author, Title, Publisher, Date) Indus. Ed. Dept., Univ. of Mo. at Columbia MEAT CUTTING, cooperatively with Indus. Educ. Dept. (U. of Mo. at Columbia) and Mo. State Dept. of Ed. (1965)

Supplementary Information on Instructional Material

Provide information below which is not included in the publication. Mark N/A in each blank for which information is not available or not applicable. Mark P when information is included in the publication. See reverse side for further instructions.

(1) Source of Available Copies:
Agency Industrial Education Dept., Univ. of Mo. at Columbia
Address 103 Industrial Education Building
Limitation on Available Copies quantity Price/Unit $1.50
(quantity prices) same
instructor's key $.50

(2) Means Used to Develop Material:
Development Group Development Committee of Teacher-Coord. & Teacher-Educ.
Level of Group state
Method of Design, Testing, and Trial Subject matter specialist and teacher educators based on an analysis of the trade tested in the field over several years and periodically revised.

(3) Utilization of Material:
Appropriate School Setting H.S. and post high school, and area vocational
Type of Program Cooperative education and preparatory programs
Occupational Focus specific job
Geographic Adaptability United States
Uses of Material Study guide for related instruction
Users of Material student

(4) Requirements for Using Material:
Teacher Competency qualified coordinator of competent trade teacher
Student Selection Criteria junior in high school with proper prerequisites
Time Allotment 180 days

Supplemental Media --
Necessary x
Desirable ____ (Check Which)

Describe P

Source (agency) (see attached list)
(address)

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G. United States Department of the Interior, *Basic Fish Cookery*, Test Kitchen Series No. 2, Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C. 20402, 1959, $.25 (1)

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Chronicle Guidance Publications, Inc., *Occupational Brief: Meat Cutter*, 5-58.10, Chronicle Guidance Publications, Inc., Moravia, New York, 1965, $.35.

The following references are publications of the United State Department of the Interior and may be obtained from the Superintendent of Documents, United States Government Printing Office, Washington 25, D. C. 20402.

Test Kitchen Series, Catalog Number I 49.39: (*booklet number*)

1/2 Fish Cookery For One Hundred, 1956, $.30
2/2 Basic Fish Cookery (Reference "G"), 1959, $.25
3/2 How to Cook Oysters, 1953, $.20
4 How to Cook Salmon, 1960, $.20
6 How to Cook Ocean Perch, 1952, $.20
7 How to Cook Shrimp, 1952, $.20

(Continued on the Next Page)

* Subject to educational discount.
** Frequency of use in assignments.

FOREWORD

This course of study, consisting of an analysis of MEAT CUTTING, together with assignment sheets covering the related (occupational) information to be taught by the school, has been prepared for teaching this occupation on an individual basis in a cooperative part-time program.

The original analysis was developed by Mr. Robert C. Ferguson, while Coordinator at Columbia, Missouri, and later revised when the assignment sheets were written by Dr. Hugh L. Oakley, while a Research Assistant in Industrial Education at the University of Missouri. A later revision was made by Dr. Denis J. Kigin, formerly Research Assistant in Industrial Education. The present revision was made by Dr. J. Eldon Yung, Research Assistant in Industrial Education at the University of Missouri.

Special recognition is given to Mr. Bill Stringer, Assistant Professor of Animal Husbandry, and Dr. Donald Naumann, Professor of Animal Husbandry, University of Missouri for their assistance and counsel in preparation of this material.

We wish to acknowledge our indebtedness to Dr. H. H. London, Professor of Industrial Education at the University of Missouri, for the direction and administration of the Curriculum Materials Laboratory in which this material was prepared, and to Dr. James B. Karnes, Assistant Professor of Industrial Education at the University of Missouri, who supervised the preparation of the material and edited the manuscript. Credit is due to Mr. B. W. Robinson, Assistant Commissioner of Education, Mr. Marion Wheeler, Director of Industrial Education, and to other staff members of the State Department of Education for their efforts in the development of the Industrial Education Curriculum Series of which this course of study is a part.

HUBERT WHEELER

Commissioner of Education

May, 1965
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INTRODUCTION

In preparing this course of study, it has been assumed that the attainment of occupational competency in any type of work involves three different, yet closely related, types of learning. They are:

1. Mastery of the practical Job Skills and Procedures performed by the worker in the occupation.

2. Comprehension of the Technical and Related Information basic to an intelligent understanding and practice of the occupation.

3. Development of those Personal-Social Traits which are essential for the successful worker.

The first group of these "learning units" -- the job skills and procedures -- has been arranged in the analysis under the heading of "Job Training." The second group of learning units --the technical and related information -- has been arranged under the heading of "Related Information." The third group -- the personal-social traits -- has been listed under "Personal Qualifications" in the introductory section addressed to the student.

In a cooperative educational program it is necessary for both cooperating agencies -- the school and the employer -- to understand clearly just what each is to be responsible for in the training of the student-worker. Experience has shown that most of the practical job skills and procedures of an occupation can best be learned through supervised work on the job. Experience has shown also that the school can best teach most of the technical and related occupational information needed by young student-workers. This division of responsibility has been made in the arrangement of the course of study; that is, it is expected that the student-worker will master the job skills and procedures through practical work on the job under the immediate supervision of the employer, and that he will receive instruction in related occupational information in the school under the direction of the coordinator.

In the back of this course of study will be found three copies of the TRAINING PLAN AND PROGRESS RECORD FOR MEAT CUTTING, RETAIL. One copy is marked "Student" in the upper right hand corner. On this copy, in the space Time in Hours, the student will keep a talley of the hours he spends on his job performing operations in each area. The next copy marked "Employer," should be given to the employer for recording the student's job performance in each area. The third copy may be used by the coordinator for his record.

Skills and related information are matters for direct instruction, but personal-social traits are acquired only through practicing them during the process of acquiring skills and information in one's daily conduct. Therefore, both the employer and the school, as well as the home, must assume responsibility for developing in the student-worker those habits, attitudes and character traits which are essential for success in his occupation and in life. Both the employer and the school should be constantly on the alert to see that the student-worker places desirable interpretations on his experiences and that he does not practice habits and exhibit character traits detrimental to his success.

Since the coordinator's class will be made up of fifteen or more students, each differing from the other significantly, studying a dozen or more occupations which differ markedly in their requirements, it follows that it will be impossible for him to teach, through the group method, the occupational information which relates to the specific job of each student-worker. In order to be effective, this type of instruction must be individualized. There is, of course, some related information, such as occupational health and safety, workmen's compensation, wage-hour laws, fair labor standards, unemployment compensation, and the like, which is of common interest and concern to all student-workers, and may be effectively taught by the group method. But if the coordinator is to make a real contribution to the in-service vocational education of his students, he must devote a major portion of his classroom instruction to content which deals specifically with the work of each boy and girl enrolled.

With this requirement in mind, and in order to facilitate individual instruction, these assignment sheets have been prepared. Each contains certain record data as to number and range of units covered, introductory paragraphs designed to develop interest, explain the importance of the assignment, and to convey to the student what he is expected to learn, specific assignments including reading, learning activities and a series of new-type questions designed to check his attainment.

Obviously, it is desirable to teach the related information in the school at the time it will be used most advantageously on the job. This means that the two phases of the student-worker's training should parallel each other in a progressive manner. The coordinator will find the assignment sheets well adapted to this end. He can select from day to day the assignment which covers the informational units related to the work being done on the job. With this arrangement, the coordinator will become, during a major portion of his classroom time, a supervising study and helping teacher.

In selecting books for the course, an effort has been made to restrict the number to an adequate coverage of the material, and to select those of recent publication so that current practices can be consistently presented. It is recommended that copies of these books be secured and kept in the coordinator's classroom for ready use by the student.

The key sheets, available in a separate manual, have been prepared to enable the coordinator to score quickly the objective tests which are a part of each assignment sheet. These key sheets give the correct answers to the questions, as well as the reference and the page on which each answer can be found. The key sheets should be kept in the coordinator's possession.

TO THE STUDENT-WORKER

Meat retailing structure is a combination of basic principles of operation. Every business is made up of basic principles. The major principles that confront a meat retailer include keeping his market clean, organizing his many jobs into an efficient pattern, buying effectively, selling effectively, maintaining gross profit, maintaining and using operating records and controlling expenses.

What You Will Do as a Retail Meat-Cutter

In brief, you will display and sell meat and fish (performing the duties of a salesperson); cut meat to size desired for display or desired by the customer, using a knife, saw, and various types of power equipment, and attempting to utilize every portion of the carcass. You will clean fish and poultry; suggest various cuts of meats to customers and indicate the best manner to cook the meat, basing your comments on experience in handling all cuts of meat.

Retail meat-cutting is classified by the United States Employment Service as a skilled occupation, which means you must have a thorough and comprehensive knowledge of the trade, must be able to exercise considerable independent judgement, and possess a high degree of manual dexterity. These qualifications you will acquire with diligent application to learning while on the job and in the classroom.

Requirements for Entry Into Retail Meat Cutting

The meat-cutting occupation is entered through on-the-job training. This may include a three-year apprenticeship program, although it is not generally required. According to U.S.E.S., beginners need two or three years to learn the trade and must receive such training as: buying and grading meats; refrigeration and storage of meats; care and use of equipment; cutting, boning, trimming, and rolling of meats; killing, dressing and drawing poultry; and preparing fish. You will cover all these operations and more in this course.

Have you had any experience in animal dressing or cooking? If so, you will find it helpful in getting started and progressing in this occupation. Should you be called into service after you have received training as a meat-cutter, the Army has three types of jobs in which you might well fit: mess sergeant, meat cutter, or cook. The Navy uses men with such experience as "ship's cooks." Certain civilian occupations are open to trained meat cutters which may interest you later, such as executive chefs or kitchen supervisors in large restaurants, a short-order cook or cook in any eating establishment, or opportunities in the meat-packing industry.

Working Conditions

Working conditions are excellent in the large self-service stores of today. You will work inside the year around with other meat cutters in a well lighted and well ventilated (if not air conditioned) building.

The hours are in keeping with other retail jobs and the wages will be commensurate with wages paid for similar work in the locality which requires substantially the same amount of training.

Whether you can take advantage of the opportunities which lie before you in this field depends upon the skill you obtain in the first few years of your training and experience. Under this part-time program which you are entering, you have the opportunity to master those basic operations and facts upon which you can build with experience to the highest degree of competency. Just how far you wish to go toward this goal depends upon the effort expended toward mastery of the fundamentals. Your future is in your hands.

Personal Qualifications

Honesty - This means giving full value for every cent received; truthfulness in imparting merchandise information; a sense of loyalty to both the employer and the customer.

Tact - This means knowing what to do and say in dealing with others so as not to give offense and thus to win good will for the firm.

Courtesy - This means considerate behavior towards others, respecting their points of view, interests and wants. Though difficult to accomplish in all situations, its many benefits in human and business relations make it well worth constant effort.

Personality - This means those magnetic personal qualities that bring customers back: helpful suggestions made, information gladly given, self-control, emotional stability and reserve tempered with a sense of humor and understanding.

Cleanliness - The clothing and person of the meat cutter must be kept spotlessly clean. Dirty hands and untidy clothing of any food handler repel customers.

Pleasing Appearance - This includes manners and posture, neatness and good habits in personal grooming.

Industry - This is the ability to see things that need to be done and keep busy doing them without supervision. Such as enthusiastic interest is the most salable trait a beginning worker has.

Dependability - This means reporting for work punctually, carrying a fair share of the work load, carrying out an assigned task without supervision and in a commendable manner.

Cooperation - This means a real desire to work harmoniously with others and to be helpful.

Intelligence - The meat cutter must be of average or better general and social intelligence and should have a high school education. He should be able to interpret current market trends and purchase wisely.

Alertness - Manual dexterity and mental awareness of potential dangers are requirements of the meat cutter dealing with razor-sharp equipment.

Health - The meat cutter needs good health to meet legal requirements of food handlers and to insure sanitation. He must have a high degree of stamina, which requires a vigorous constitution, abundant energy, and the ability to stand for long hours. He will frequently lift and carry heavy cuts of meat to and from the refrigerator room. Here he will be exposed to sudden temperature changes as he goes in and out of the refrigerator room, with the possibility, in some instances, of injury to health. Keen eyesight is essential.

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B. Bull, Sleeter, Meat for the Table, McGraw-Hill Book Company, Inc., 330 West 42nd Street, New York 36, New York, 1951, $4.75* (8)

C. American Sheep Producers Council, Lamb Cutting and Merchandising Manual, American Sheep Producers Council, 520 Railway Exchange Building, 909 Seventeenth Street, Denver 12, Colorado, 1957, $3.50 (5)

D. National Association of Retail Grocers, Self-Service Meats, National Association of Retail Grocers, 360 North Michigan Avenue, Chicago 1, Illinois, 1951, $1.50* (5)

E. University of Wisconsin, Retail Meats: Storage Handling Sanitation, Circular Number 583, Extension Service, College of Agriculture, University of Wisconsin, Madison, Wisconsin, 1960, $.05 (1)

F. National Association of Retail Grocers, NARGUS Meat Department System Manual, National Association of Retail Grocers, 360 North Michigan Avenue, Chicago 1, Illinois, 1959. (1)

G. United States Department of the Interior, Basic Fish Cookery, Test Kitchen Series No. 2, Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C. 20402, 1959, $.25 (1)

SUPPLEMENTARY REFERENCES

Chronicle Guidance Publications, Inc., Occupational Brief: Meat Cutter, 5-58.10, Chronicle Guidance Publications, Inc., Moravia, New York, 1965, $.35.

The following references are publications of the United State Department of the Interior and may be obtained from the Superintendent of Documents, United States Government Printing Office, Washington 25, D. C. 20402.

Test Kitchen Series, Catalog Number I 49.39: (booklet number)

1/2 Fish Cookery For One Hundred, 1956, $.30
2/2 Basic Fish Cookery (Reference "G"), 1959, $.25
3/2 How to Cook Oysters, 1953, $.20
4 How to Cook Salmon, 1960, $.20
6 How to Cook Ocean Perch, 1952, $.20
7 How to Cook Shrimp, 1952, $.20

(Continued on the Next Page)

* Subject to educational discount.
** Frequency of use in assignments.

SUPPLEMENTARY REFERENCES (Continued)

8 How to Cook Clams, 1953, $.20
9 How to Cook Halibut, 1956, $.20
10 How to Cook Crabs, 1956, $.20
11 How to Cook Lobsters, 1957, $.20
12 How to Cook Tuna, 1957, $.20
13 How to Cook Scallops, 1959, $.20

Circular Series, Catalog Number:

I 49.2:F 53/8 Tips on Cooking Fish and Shellfish, 1958, $.10

I 49.4:41 Shrimp Tips From New Orleans, 1956, $.25

I 49.4:60 Take A Can Of Salmon, 1960, $.25

ANALYSIS OF MEAT CUTTING, RETAIL

JOB TRAINING: What the Worker Should Be Able to Do	Assign. No.	RELATED INFORMATION: What the Worker Should Know
The Meat Cutting Industry		
	1	1. Historical development of the meat industry
	1	2. Economic importance of the meat industry
	1	3. Organizations that promote meat and meat products
	2	4. Vocational opportunities for meat cutters
	2	5. Training requirements
	2	6. Personal qualifications
	2	7. Trends in the retail meat industry
Sanitation, Inspection and Grading		
8. Recognize signs of meat spoilage	3	8. The various types of meat spoilage, their cause and prevention
9. Check the temperature reading in various areas of the department	3	9. Recommended temperatures for various areas in the department
	3	10. Importance of sanitation in the work area and for the equipment
11. Clean and sanitize floors, ceilings, and walls in the cutting room and cooler	3	11. Materials used for cleaning and sanitizing work areas and equipment
12. Clean and sanitize the racks and counters in the cutting room and cooler		
13. Clean and sanitize the power equipment in the department		
14. Clean and sanitize the hand tools in the department		
15. Maintain a clean uniform	3	15. Importance of good habits of personal cleanliness
16. Wash hands properly before handling meats		
17. Receive meat shipments	3	17. Importance of proper handling and storage procedures for meats

JOB TRAINING: What the Worker Should Be Able to Do	Assign. No.	RELATED INFORMATION: What the Worker Should Know
18. Weigh meat shipments		
19. Place meat shipments in the cooler storage		
20. Handle meat in the cutting room		
21. Care for meats on display		
22. Store meats to be kept over a weekend		
	4	23. Provisions of meat inspection laws
24. Recognize inspected meats	4	24. Meat inspection agencies
25. Recognize and interpret grading stamps	4	25. Government grades of meat and their meaning
	4	26. Job requirements of meat inspectors and graders
	4	27. Cost of meat inspection
	Self-Service Operations	
	5	28. Principles upon which self-service is based
	5	29. Advantages and disadvantages of self-service
	5	30. Organization of equipment and operations in self-service
	5	31. Equipment unique to self-service operations
32. Set up and maintain a self-service display	5	32. Techniques used in making displays
33. Wrap a package using the butcher's wrap	5	33. Techniques of cutting and wrapping meats for self-service
34. Wrap a package using the drugstore wrap		
35. Wrap packages for self-service display	5	35. Characteristics and uses of the various wrapping materials
36. Label packages for self-service display		
37. Re-wrap packages from the self-service display	5	37. When re-wraps are necessary
	5	38. Effects of light on meats in the display area
	5	39. Trends and future of self-service

JOB TRAINING: What the Worker Should Be Able to Do	Assign. No.	RELATED INFORMATION: What the Worker Should Know
	Beef	
40. Identify wholesale and retail beef cuts	6	40. Wholesale and retail beef cuts
	6	41. Classes, grades, and quality of beef
42. Cut hind shank	6	42. Techniques in making retail beef cuts
43. Cut flank steak		
44. Cut flank stew		
45. Cut plate and rib ends		
46. Cut brisket		
47. Cut fore shank		
48. Cut heel of round		
49. Cut round steaks		
50. Cut rump roasts		
51. Cut knuckle soup bone		
52. Cut wedge bone steak		
53. Cut round bone steak		
54. Cut double bone steak		
55. Cut pin-bone steak		
56. Cut porterhouse steaks		
57. Cut T-bone steaks		
58. Cut club steaks		
59. Cut rib roasts and steaks		
60. Cut blade rib roast		
61. Cut chuck, rib or blade roasts and steaks		
62. Cut neck bones		
63. Cut arm pot roasts and steaks		
64. Cut beef liver		
65. Prepare beef brains		
66. Cut beef tongue		
67. Cut beef heart		
	Pork	
68. Identify wholesale and retail pork cuts	7	68. Wholesale and retail pork cuts
	7	69. Grades and quality of pork
70. Cut pork tenderloin	7	70. Techniques of making retail pork cuts
71. Cut sirloin pork roast		
72. Cut Canadian style bacon		
73. Cut loin chops		
74. Cut rib pork chops		
75. Cut loin roasts		

JOB TRAINING: What the Worker Should Be Able to Do	Assign. No.	RELATED INFORMATION: What the Worker Should Know
76. Cut crown pork roast		
77. Cut blade pork steaks		
78. Cut Boston style butt		
79. Cut half ham butt end		
80. Cut half ham shank end		
81. Cut regular bacon		
82. Cut salt pork		
83. Cut spare ribs		
84. Cut fresh picnic shoulder		
85. Cut fresh shoulder hock		
86. Cut arm pork steak		
	7	87. Processes in making lard

Veal

88. Identify wholesale and retail cuts of veal	8	88. Wholesale and retail cuts of veal
	8	89. Classes, grades and quality of veal
90. Cut heel of round pot roast and stew	8	90. Techniques in making retail cuts of veal
91. Cut round steaks, roasts and pot roasts		
92. Cut rump roasts and pot roasts		
93. Cut sirloin chops and roasts		
94. Cut loin chops and roasts		
95. Cut rib chops and roasts		
96. Cut blade steaks and pot roasts		
97. Cut hind shanks		
98. Cut flank stew		
99. Cut breast		
100. Cut fore shank		
101. Cut arm steaks and pot roasts		

Lamb

102. Identify wholesale and retail cuts of lamb	9	102. Wholesale and retail lamb cuts
	9	103. Classes, grades and quality of lamb

JOB TRAINING: What the Worker Should Be Able to Do	Assign. No.	RELATED INFORMATION: What the Worker Should Know
104. Cut leg roasts	9	104. Techniques in making retail lamb cuts
105. Cut leg steaks		
106. Cut sirloin roasts and chops		
107. Cut rib chops		
108. Cut shoulder roasts and chops		
109. Cut breast stew		
110. Cut shank stew		
	Poultry	
	10	111. Grades and classifications of dressed poultry
112. Cut up chickens	10	112. Methods of preparing poultry for display
113. Cut up ducks		
114. Cut up geese		
115. Cut up turkeys		
116. Cut up guineas		
	Fish	
	11	117. Food values derived from fish
	11	118. Species of fish common to the retail market
	11	119. Market forms of fish
120. Dress fish	11	120. Methods of dressing and preparing fish cuts
121. Cut fish steaks		
122. Fillet fish		
123. Test for fresh fish quality	11	123. Quality characteristics of fresh fish
124. Store and display fresh fish	11	124. Procedures for storing and displaying fresh fish
125. Store and display frozen fish	11	125. Procedures for storing and displaying frozen fish
	11	126. Methods used in fish cookery
	11	127. Species of shellfish common to the retail market
	11	128. Market forms of shellfish
	11.	129. Quality characteristics of shellfish
130. Store and display fresh shellfish	11	130. Procedures for storing and displaying fresh shellfish

JOB TRAINING: What the Worker Should Be Able to Do	Assign. No.	RELATED INFORMATION: What the Worker Should Know
131. Store and display frozen shellfish	11	131. Procedures for storing and displaying frozen shellfish
	11	132. Methods used in shellfish cookery

Ground and Ready-to-Serve Meats

	12	133. Historical development of sausages
	12	134. Meat products classified as sausages
135. Cut and grind meats for sausage	12 12	135. Procedures used in making sausages
136. Cut and wrap ready-to-serve meats	12	136. Techniques of cutting and wrapping ready-to-serve meats
137. Set up and maintain a display of ready-to-serve meats	12	137. Precautions to be observed in displaying ready-to-serve meats

Meat Cookery

	13	138. Nutritional values of various meats
	13	139. Basic meat cookery methods
	13	140. Cooking method appropriate for different cuts of meats
	13	141. Techniques used in carving cooked meats

Refrigeration, Curing, and Storage

	14	142. Early methods used to preserve meats
	14	143. Materials and methods used in curing meats
	14	144. Development of refrigeration process for preserving meats
	14	145. Precautions to be followed in freezing meats for home storage
	14	146. Freezer storage life of various meats

JOB TRAINING: What the Worker Should Be Able to Do	Assign. No.	RELATED INFORMATION: What the Worker Should Know
147. Cut meats to be stored in home freezer	14	147. Techniques of cutting meats for home freezer storage
148. Wrap meats for home freezer storage	14	148. Wrapping procedures for home freezer meats
Management and Merchandising		
	15	149. Operations of wholesale suppliers
150. Place orders for meat	15	150. Principles of meat buying
151. Make a cutting test	15	151. Purpose of cutting test
152. Interpret and utilize the results of cutting tests		
153. Compute prices for various retail meats and meat products	15	153. Principles of pricing
154. Process invoices on new shipments	15	154. Importance of current and accurate records
155. Conduct an inventory		
156. Keep books for a retail meat department		
	16	157. Personal characteristics desirable in retail meat salespersons
158. Provide satisfactory special services for customers upon request	16	158. Techniques of personal selling
159. Answer questions and assist customers in making meat selections		
160. Make suggestions for attracting and holding regular customers	16	160. Importance of regular customers

Assignment
Sheet No. 1

Covering
Units 1-3

THE EXPANDING MEAT INDUSTRY

The production, processing and distribution of meat and meat products has become one of the principle industries in America. It has had distinct bearing upon the economic development of modern civilization.

In order to be an efficient and well informed meat cutter, it is well to know through what stages meat passes prior to arriving in the retail store. It is also beneficial to know something of man's eating customs and habits.

In this unit you will have an opportunity to become acquainted with the historical background of the meat industry, the development and growth of the industry, and some of the organizations which promote the continued growth of the industry.

Assignment:

1. Read the references given below.
2. Write a short paragraph (100 words or less) on the relationship of the consumer and the retailer.
3. Answer the questions below and turn in this assignment by ________________.

References:

A. Ziegler, The Meat We Eat, pp. 1-8, 506-513.
B. Bull, Meat for the Table, pp. 1-18.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. The American Indian was largely a meat eater which may have been due to the work associated with obtaining vegetable foods.

T F 2. Most vegetables can be eaten raw without disastrous results, while most meats require cooking for safe eating.

T F 3. Meats were more prominent in the early Greek diet than in the later Greek diet.

T F 4. The diet of the Romans was similar to that of the early Greeks.

T F 5. More people can be fed from an acre of land when the products of the land are fed to livestock and these products, meat, milk or eggs, are then used for human food, rather than when the land products are used directly for human food.

T F 6. Almost 85 per cent of the corn grown annually in the United States is fed to livestock.

T F 7. Henry Ford got his idea for the automobile assembly line from the meat packing industry.

T F 8. "Porkopolis" was a nickname given to the city of Minneapolis when it was an early center of the pork packing industry.

T F 9. Before the development of better transportation, the farmer moved his excess grain to market by feeding it to livestock and then driving the livestock to a slaughter center.

T F 10. The first mechanical refrigeration railroad car for transporting fresh meat was used in the year 1880.

T F 11. The inedible parts of the slaughtered animal have little commercial value.

T F 12. The consumer's present trend is toward the purchase of meats which contain less fat.

T F 13. The fat in a piece of meat adds nothing to the aroma, flavor, or moistness of the meac.

T F 14. Lean meats are primarily protein in nature.

T F 15. The United States ranks third among the countries of the world in the total consumption of meat per individual.

T F 16. The National Livestock and Meat Board was organized in 1922 to combat unfavorable propaganda and to provide information concerning the nutritional value of meat.

T F 17. As a result of the National Cooperative Meat Investigation Project many old cooking methods have been discarded and new ones adopted.

T F 18. Home study courses are available from the American Meat Institute.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. The favorite type of meat in the early Greek diet was ____________.

2. According to Bull, "Eating as an art was really developed by the ______________."

3. Perhaps the greatest change in the eating habits of modern man has been in regard to the ______________ meal.

4. The theory of economics which states that unless an increase in population be checked by prudential restraint, poverty is inevitable, is the ______________ theory.

5. Of the farm land in the United States, pasture crops occupy _________ per cent.

6. Because of the importance of soil conservation there is likely to be a/an _______________ in the amount of pasture land in the United States.

7. The sale of livestock and its products accounts for over _________ per cent of the farmer's total income.

8. In the processing of its finished product, the meat packing industry utilizes what might be called a _______________ line.

9. The term "meat packing" resulted from the practice of shipping meat by packing it in barrels and boxes with a ______________ ______________ or ______________.

10. The Chicago Union Stock Yards were opened on Christmas Day in the year _________.

11. The transportation of livestock to slaughter plants was greatly improved with the construction of ______________ after the Civil War.

12. Two men who founded meat packing companies in Chicago in 1867 and 1875, and who greatly stimulated the industry were ______________ ______________ and ______________ ______________.

13. In addition to being a waterway, Lake Michigan also supplied the early meat packing industry with ______________.

14. In a years' time the average American consumes about eight times as much beef as ______________.

15. In terms of total cash volume of business the meat industry now ranks ______________ among the industries in the United States.

16. The American Meat Packers Association, organized in 1906, is now known as the _______________ ______________ ______________.

17. The American Meat Institute consists of ______________ service departments.

18. The agencies which probably do the greatest amount of work, in terms of finding new facts about meat and disseminating these facts to the public, are the various ______________ ______________ ______________ ______________ and the ______________ ______________ ______ ______________.

Multiple-Choice

Directions: In the space at the left of each statement, write the letter of the item which will provide the correct answer to complete the statement.

_____ 1. It is generally found that as the density of the population increases in a country, the meat consumption per individual will (A) decrease; (B) increase; (C) remain constant; (D) be more affected by other factors.

_____ 2. It is estimated that roughage, i.e., hay and silage, which humans can not eat, produces (A) 40; (B) 50; (C) 80; (D) 95 per cent of our beef products.

_____ 3. A major portion of the crops produced in China and India are used for (A) feeding their livestock; (B) export to other countries; (C) human consumption; (D) feeding their work animals.

_____ 4. In 1850 the center of the pork packing industry was in the city of (A) Chicago; (B) Cincinnati; (C) Detroit; (D) Minneapolis.

_____ 5. In the early days of the meat packing industry, livestock was slaughtered only in the (A) winter; (B) spring; (C) summer; (D) early fall.

_____ 6. The first refrigerated car in which fresh meat could be shipped long distances was designed in 1875 by (A) J. P. Morgan; (B) Philip D. Armour; (C) Gustavus F. Swift; (D) G. H. Hammond.

_____ 7. According to Bull, the price of meat is determined by (A) the farmer; (B) the meat packing industry; (C) the retail butcher; (D) the consumer.

_____ 8. Generally speaking our eating habits are governed in large measure by (A) spendable income; (B) the doctor; (C) both A and B; (D) exclusive of A and B.

_____ 9. Which of the following income groups are the greatest consumers of meat products? (A) low income; (B) middle income; (C) high income; (D) they are all about equal.

_____ 10. Meat contains all the necessary minerals for human body metabolism with the exception of (A) calcium; (B) iron; (C) phosphorus; (D) iodine.

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. The so-called "big four" of the meat packing companies are:

   (A) ____________________ (C) ____________________

   (B) ____________________ (D) ____________________

2. Define what the word "ruminant" refers to.

   (A) ____

3. What were the findings of the Hormel Institute at Austin, Minnesota, concerning the roles of fat and cholesteral in heart disease?

   (A) ____

   ____

4. List some of the findings of the research program promoted by the National Livestock and Meat Board concerning the food value of meat.

   (A) ____

   (B) ____

   (C) ____

   (D) ____

   (E) ____

5. The nine divisions of the National Livestock and Meat Board which coordinate the work of the organization are:

   (A) ____________________ (F) ____________________

   (B) ____________________ (G) ____________________

   (C) ____________________ (H) ____________________

   (D) ____________________ (I) ____________________

   (E) ____________________

Assignment
Sheet No. 2

Covering
Units 4-7

VOCATIONAL OPPORTUNITIES IN MEAT CUTTING

Will I be able to find a job as a meat cutter after I complete my training? Where can I expect to find this type of employment? What can I expect my salary to be? Under what conditions will I be working? What things must I know to be a good meat cutter?

Many of these questions you have probably already answered, but in case you haven't, now is the time to find out. Knowing what this type of work has to offer you and what demands it will make of you will help determine your success and satisfaction in the job. All jobs have unpleasant aspects. This should be expected and you should be willing to adjust to them. There are probably very few people who enjoy every aspect of their job.

Meat cutting has become a skilled trade, having made significant progress since the days of the butcher. Much research has gone into cutting methods, sanitation practices, packaging materials and selling techniques, as well as the development of meat animals. This is a progressive occupation that continues to search for methods and techniques to improve its efficiency.

This is an occupation that contributes to the satisfaction of one of man's basic needs--food. It is also an occupation that will probably not be replaced by automation in the near future. In order for a machine to do the job of the meat cutter, the meat carcasses and wholesale cuts must be uniform in size, and we just don't "grow" animals that way, yet.

In this unit you will have an opportunity to find the answers to your questions about this occupation--the employment opportunities, nature of the work, earnings, training required, personal qualifications and a look into the future.

Assignment:

1. Read the reference listed below.
2. Answer the questions below and turn in this assignment by ______________________.

Reference:

I. Information Sheet No. 1

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. Employment as a retail meat cutter is a steady year-round job.

T F 2. Automation has greatly reduced the need for meat cutters.

T F 3. The self-service department makes no effort to provide personal customer service.

T F 4. The meat cutter should know how to arrange meat packages in a display so they will appeal to the customer.

T F 5. A knowledge of meat cookery is of little value to the self-service meat cutter.

T F 6. The meat cutter is not responsible for the sanitary condition of the meat department.

T F 7. Most of the meat cutter's work is done while standing.

T F 8. The salary for meat cutters has been standardized throughout the country as a result of union action.

T F 9. Meat cutting is a good occupation for those individuals who are unable to do much physical work, because of poor health.

T F 10. Some states require a physical examination for all people who handle food.

T F 11. There are nearly as many women employed as meat cutters as there are men.

T F 12. Meat packers have done little to upgrade the efficiency of their operation.

T F 13. The centralized pre-packaging plant system appears to be applicable only to large multi-unit operations in a community.

T F 14. Store-prepared meats have not been well accepted by the customers.

T F 15. The delicatessen type of service is possible in the small independent stores as well as in the larger chain stores.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. In addition to making cuts from various meat carcasses, the retail meat cutter will also ______________ poultry and fish.

2. When a shipment of meat is received at the store, it should be ______________ and ______________ before it is placed in the cooler.

3. Carcasses and wholesale cuts are usually broken down into retail cuts in the ______________ room.

4. Meat cutters will work at their job about ________ to ________ hours per week.

5. The salary of an apprentice meat cutter will be about ________ to ________ dollars per month.

6. The apprentice training period for meat cutting is from ________ to ________ years.

7. Retail meat cutting can be a rewarding career for the person who enjoys working with his ______________ and being of service to ______________.

8. The employed meat cutter must be of service to both his ______________ and the ______________.

9. In order for the meat cutter to have a job and receive a salary, the results of his work must yield a ______________ for the employer.

10. The meat cutter who desires employment in a meat department that also contains a delicatessen should develop a mastery of meat ______________.

Multiple-Choice

Directions: In the space at the left of each statement, write the letter of the item which will provide the correct answer to complete the statement.

_____ 1. Which one of the following has not been a result of the introduction of self-service? (A) a change in cutting methods; (B) more strict inspection regulations; (C) a change in packaging methods; (D) new job classifications in the meat department.

_____ 2. Meat department supervisors may expect to receive a salary of about (A) $480; (B) 520; (C) $560; (D) $600 per month.

_____ 3. Meat cutting as an occupation is classified as being at the (A) technical; (B) skilled; (C) semi-skilled; (D) unskilled level.

_____ 4. Most of the training for meat cutters is gained through (A) high school courses; (B) trade schools; (C) correspondence schools; (D) on-the-job.

_____ 5. In order to profitably compete in the retail meat business the retailer must (A) provide his customers with extra-services; (B) purchase at the lowest wholesale price available; (C) reduce his operating costs; (D) price all products lower than his competitor.

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. List some common tools and equipment used on the job by the retail meat cutter.

(A) ____________________ (C) ____________________

(B) ____________________

2. List the equipment and materials found in the cutting room.

(A) ____

(B) ____

(C) ____

3. In addition to the duties of cutting, wrapping, and selling, the owner or manager of a meat department will also be responsible for:

(A) ____________________ (C) ____________________

(B) ____________________

4. List some places where meat cutters might expect to find employment.

(A) ____________________ (F) ____________________

(B) ____________________ (G) ____________________

(C) ____________________ (H) ____________________

(D) ____________________ (I) ____________________

(E) ____________________ (J) ____________________

5. List some personal qualities which the meat cutter should possess and practice if he desires to succeed.

(A) ______________________ (E) ______________________

(B) ______________________ (F) ______________________

(C) ______________________ (G) ______________________

(D) ______________________

6. List some advantages of the centralized pre-packaging plant system.

(A) ____

(B) ____

(C) ____

(D) ____

(E) ____

(F) ____

(G) ____

(H) ____

(I) ____

Information
Sheet No. 1

RETAIL MEAT CUTTERS*

Outlook Summary

There will continue to be openings for meat cutters in this large occupation. The demand will be for replacements for those who die, retire, or change occupations. It is also expected that the increase in population, the ever-rising standard of living, and the possiblility of a shorter work week will increase the need for skilled meat cutters. There is also little possibility that automation will replace the meat cutter. With the exception of meat cutters in the packing industry, there is steady year-round work in the occupation.

Nature of the Work

The retail meat cutter is involved with breaking down a meat carcass, or wholesale cut, into various retail cuts. He will also prepare fish and poultry for sale, make sausage, and prepare other special products. This is done by the use of a knife, meat saw, or various types of power equipment.

Meat cutters today do not slaughter the animals or fowls. This is done by butchers or slaughters who are State licensed in packing plants and fish and poultry plants that are subject to sanitary inspection and other regulations.

When the meat is delivered to the retail meat department, the meat cutter weighs and inspects the shipment. He then removes any covering which does not serve as protection during storage before storing the meat on racks or hooks in the refrigerated cooler room.

In recent years, the trend has been toward self-service meat departments. This has resulted in new job classifications for men and women and forced new cutting and wrapping techniques on the meat industry. For the meat cutter this trend has meant a partial release from selling responsibilities.

In the self-service department, processing of the meat into retail cuts is usually done in the cutting room, which will probably be refrigerated. The cutting room contains the cutting blocks or tables, tools and power equipment, and wrapping materials. Here the meat is cut, trimmed, and sometimes boned. Some cuts are rolled, tied, sewed, or skewered; some are cut into small pieces to be ground and made into patties or loaves.

In the more traditional service type of department the meat cutter removed the wholesale cut from the cooler or display case and cut,

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*Adapted by permission from Occupational [illegible] No. 5-58.10, Meat Cutter, Chronicle Guidance Publications, Inc., Moravia, New York, 1965.

ground, or boned, and wrapped as the customer ordered it. In the self-service department this service is still provided but it is not requested by every customer.

In addition to knowing how to make the various retail cuts, the meat cutter also has other responsibilities. He must know how to wrap and effectively display the packages in the self-service display. He must have a knowledge of various meats, their grades and quality, and how they may best be cooked. Customers expect him to be knowledgeable of meat cookery as well as meat cutting. If the meat cutter is the proprietor of his own shop, or if he is a department manager, he must also place orders, compute prices, and maintain other records.

Meat cutters are also responsible for keeping their equipment, counters, cutting areas, and themselves clean and sanitary. The meat cutter handles food eaten by other people and the consequences from selling unwholesome meats should be a major concern. For the meat cutter there is no such thing as being too clean!

Working Conditions

The working conditions for the meat cutter will vary according to the size and the facilities of the establishment. Modern cutting rooms will be air-conditioned and equipped with power equipment, monorail conveyors, and packaging and pricing machines; all of which make the work easier.

The working hours will vary from 40 to 48 hours a week. In areas that are unionized, there are regulations governing the number of hours, rate of pay, vacations, and overtime payments.

The meat cutter must be on his feet most of the time; he will be subjected to cold from time to time; there may be some heavy lifting, and it may be messy. However, the meat cutter soon learns to dress comfortably and he protects his clothing with an apron. There is the hazard of injury from machinery and knives, but with proper precautions, most injuries can be avoided.

Earnings

Like working conditions, earnings of meat cutters vary according to the size and location of the establishment. The meat cutter who owns his own shop, and who establishes a good reputation for quality and service can make a very good living. However, it is becoming increasingly difficult for relatively small retail shops to succeed in competition with the large chain markets.

In general, the earnings for apprentice meat cutters range from about $70 to $90 a week; the average journeymen pay rate is $130 per week. Meat cutters working in supervisory capacities earn as high as $150 and up per week depending on the extent of their responsibility and length of service.

There are very definite wage standards, which vary with localities, for unionized meat cutters. Wages vary more among non-union workers than they do among union workers. Some employers pay annual bonuses; others pay on the commission basis. Local boards usually set the standards.

Where Employed

Meat cutters may find employment in retail meat shops, grocery store meat departments; wholesale supply houses, hotels, restaurants, meat-packing plants, hospitals, schools and other institutions, on ocean liners, and in railroad dining-ca headquarters.

Training and Qualifications

Most meat cutters enter the occupation at the helper or apprentice level and receive on-the-job training. The apprentice training must meet union requirements and is usually for a period of from two to three years.

A high school education is becoming increasingly important in helping individuals secure and maintain employment. It provides a background of general knowledge, understanding, and experiences which most persons would not have otherwise. Employers investigate the high school record and the school's evaluation of the prospective employee. It is difficult, if not impossible, for young people under the usual age of high school graduation to secure a full-time job; the increasing automation of industry is continually resulting in fewer jobs for unskilled workers. Meat cutting is considered to be a skilled occupation and pre-employment training is desirable.

The individual who selects retail meat cutting as a career should like to work with his hands and enjoy being of service to people. The occupation requires good physical health, physical and mental stamina, and manual dexterity. Some states require all workers who handle food to have a periodic medical examination.

The meat cutter who is employed, rather than working for himself, serves both his employer and the customers. He must be efficient in his work habits as the employer must make a profit if the meat cutter is to have a job and receive a salary. In addition, he must provide the type of service to the customer that will make him a steady customer.

Such personal qualities as honesty, neatness, cheerfulness, amiability, and dependability are as important to the meat cutter as they are in any work, especially work which brings the worker in contact with the public. Initiative and imagination are also valuable in a competitive business world.

Meat cutting is almost entirely an occupation for men. Some women are employed in packing plants at light production jobs. In the retail meat department, and especially in the self-service, women may be employed as weighers and wrappers or be responsible for arrangement and stocking of the display case.

Trends

The meat industry is continuing to improve both the quality of its product and the methods of preparing and selling it to the customer at the lowest price possible.

Meat is not manufactured, it grows. Although there is some uniformity from carcass to carcass, no two are probably alike. Breeding practices have done much to develop animals which will yield the highest quality and quantity meat in proportion to the amount of feed provided and in relation to the inedible portions of the animal.

Packers have and are still adjusting their operations to obtain the most efficient operation.

The retailer too has had to meet competition by developing the most efficient operation possible; the same quality meat is available in almost any meat department. His customers must be attracted and held by the service he offers and the prices at which he sells the meat. There is little variation in the wholesale prices so this means that the retail meat department must cut its operating cost in order to sell at a competitive price.

The self-service department has been one means devised to reduce operating costs. The details of this operation are covered more thoroughly in assignment number five.

Another operation that is being tried by some chain stores is the centralized pre-packaging plant. This is possible when the chain has several stores in the community or surrounding area. A centralized plant is built where cuts are made and packaged for all of the stores. Each day the meat cutter at the store determines his needs for the following day and then calls in his order. The meat cutters at the central plant begin work early in the morning and have the orders ready for delivery by the time the retail store is opened for business.

Operating costs are reduced because (1) less floor space is required at the retail store; (2) there is less duplication of equipment; (3) wholesale shipments are received at one location rather than stops at each store; (4) it is easier for one man to order from the wholesaler for several stores than for each store to order separately; (5) pricing is uniform throughout the stores; and (6) profits are more easily controlled and computed.

In addition to reducing operating costs, the system has other advantages. These include (1) a greater control over sanitary conditions in the facilities; (2) better utilization of the meat cutter's time, rather than cutting a dozen chops at a time he can cut any number needed; and (3) the meat cutter's time at the store can be devoted to customer service and promotions.

As the "bugs" are worked out of this system it will probably be adopted by more and more companies that have several stores in a community.

Another service that is being incorporated into more and more meat departments is the preparation of pre-cooked meats. These are prepared in the store and include such items as barbecued ribs, steaks, and chickens. This service has been welcomed by the busy housewife, working people who prefer eating at home but don't have time to cook, and the "last minute" shopper. Being able to purchase meat dishes that are ready to be eaten upon arrival at home has been well received. Some stores have included other prepared foods besides meats. Names, such as Country Kitchen or Southern Kitchen, have been used to advertise this delicatessen type of service. This type of service will undoubtedly grow in the next several years. It can be utilized by the smaller independent store as well as the larger chain operation.

This trend toward store-prepared meats have implications for the meat cutter. In a store that also utilizes the centralized packaging plant, it is conceivable that the meat cutter may spend a great part of his day preparing and cooking these meats. The meat cutter in training, who prepares himself in meat cookery as well as meat cutting will be in demand for such positions.

The retail meat industry is also contemplating the use of vending machines for selling meats. These machines may be coin operated but it is rather doubtful because our coin operated machines have already created problems with coin shortages. It is conceivable that the customer would be provided with a personal key to fit all machines. He could make his selection from any department in the store with his key, the products would be waiting at the check-out counter where he could pay cash or use his key as a credit card. Payment could be made weekly or monthly by check.

Whether or not these innovations will come to pass, only time will tell. Some people say they won't work, but there were skeptics of the automobile, airplane, space travel, and even self-service retail stores. The imagination, initiative, and ingenuity of today's and tomorrow's business men will determine the means by which the customer is provided with the products he desires and at the lowest prices possible.

Assignment
Sheet No. 3

Covering
Units 8-22

SANITATION IN THE MEAT DEPARTMENT

No meat cutter, regardless of his skill, can hope to succeed in his occupation unless he develops and practices good habits of cleanliness! The meat cutter must be aware that this involves both personal habits of cleanliness and work habits which reflect his understanding and concern for cleanliness.

Although health agencies make periodic checks of food preparation areas, sanitation standards should not be met just to satisfy these requirements. Practices which exceed these requirements should be the department's goal.

The degree of sanitation which is practices will also be reflected in sales. Most of the work area is visible to the customer and both your personal and work habits are under observation at all times. You can not afford to lose a customer because of carelessness! Your personal appearance; the packages and their arrangement in the display case; your work habits; and the condition of the tools, equipment, and work surfaces must all reflect good practices by the meat department personnel. Just as any team is only as good as the weakest player, so will be the meat department unless sanitation is practices throughout. The individual meat cutter is the "key" to a sanitary department!

In this unit you will have an opportunity to learn about some of the factors which promote meat spoilage: their causes and prevention. This unit must not be taken lightly because while on the job any negligence on your part could have serious consequences. Ignorance is no excuse!

Assignment:

1. Read the reference listed below.
2. Prepare a list of "do" and "don't" personal habits which should be followed by the retail meat cutter. These should be in terms of promoting sanitation in the meat department. After your list is prepared, check with your employer for additional suggestions.
3. Answer the questions below and turn in this assignment by ____________________.

Reference:

E. University of Wisconsin, Retail Meats: Storage, Handling, and Sanitation, pp. 3-20.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. An effective product control program in the meat department depends upon the sanitation practices of the employees.

T F 2. Molds may be identified by the color, and the dry, fuzzy appearance of the growth.

T F 3. The action of the enzymes during the aging of meat can cause souring of the meat.

T F 4. An increase of only 10 degrees above the freezing temperature will have little effect on the growth of microorganisms in meat.

T F 5. It is more difficult to control the relative humidity in a self-service display case than in a cooler.

T F 6. Sanitizing compounds are the same as cleaning compounds.

T F 7. Sawdust is one of the most sanitary materials which can be used on the floors of cutting rooms and coolers.

T F 8. If the floors and ceilings have been washed with a good cleaning solution it is not necessary to also use a sanitizing compound.

T F 9. When possible, all equipment and tools should be dismantled for proper cleaning and sanitizing.

T F 10. The oil applied to metal surfaces should be removed before bringing meat in contact with that surface.

T F 11. The surface which contacts the meat is the only area on wood equipment that must be sanitized.

T F 12. Washing the hands twice with soap is no more effective in reducing bacteria on the hands than washing them only once.

T F 13. At no time should the meat cutter smoke in the meat department.

T F 14. The practice of not allowing cuts of meat to touch one another in the cooler is done primarily to allow better air circulation.

T F 15. It is recommended that meats be grouped in the cooler according to the date received.

T F 16. Roasts held over the weekend may be rewrapped for sale on Monday.

T F 17. If beef cuts have been prepared on the cutting block, the block should be thoroughly cleaned before other types of meats are prepared on it.

T F 18. Salt pork processed for self service will have a case life of about one week.

T F 19. The higher the degree of acidity in the meat, the more favorable will be the growth of microorganisms.

T F 20. Of the numerous spoilage organisms mentioned, Clostridium botulinum is of least concern to the retail meat cutter.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. Profit in the meat department depends upon the effectiveness of good sanitation practices in controlling losses due to meat _______________ and _______________.

2. A slippery or greasy film on the meat surface may be identified as either _____________ or _______________.

3. If a soft, creamy material gathers on the knife blade when it is drawn over the surface of the meat it can be identified as ________________.

4. When fat becomes rancid, the characteristic white color will change first to ______________, then to ______________ and later becomes _______________.

5. The major advantage in terms of sanitation, of plastic cutting boards over wooden boards, is the fact that they do not _______________ or ______________ as easily as does wood.

6. Cleaned and sanitized cutting boards should be stored in the _______________.

7. Facilities for washing the hands should be placed _______________ the meat department.

8. Meat storage racks for fresh meats should be made of ______________ ______________ and be at least __________ inches off the floor.

9. The most perishable cuts of meat should be stored in the ________________ part of the cooler.

10. The code date to be stamped on a self-service package of ground beef should be __________ day(s) after it is processed and packaged.

11. Most organisms which cause spoilage will be found on the _______________ areas of the meat.

Multiple-Choice

Directions: In the space at the left of each statement write the letter of the item which will provide the correct answer to complete the statement.

_____ 1. Display cases should be defrosted only when (A) the build-up of frost hinders air circulation; (B) the store is closed to customers; (C) there are a few packages on display; (D) the case is fully stocked.

_____ 2. The relative humidity in the cooler and cutting room should be (A) 30%; (B) 50%; (C) 65%; (D) 80%.

_____ 3. A good rule to follow when using cleaning compounds is to (A) use them at full strength; (B) never bring them in contact with the skin; (C) follow the manufacture's directions; (D) use them only on metallic surfaces.

_____ 4. Sodium hypochlorite and quaternary ammonium are types of (A) sanitizing compounds; (B) cleaning compounds; (C) mold; (D) acids in meat.

_____ 5. After cleaning and sanitizing all metal surfaces (except stainless steel) on power equipment, hand tools, trays and work surfaces they should be covered with (A) light machine oil; (B) cheese cloth; (C) Packer's Technical Oil; (D) castor oil.

_____ 6. The water used to rinse and loosen soil and blood from wood equipment should not be over 120 degrees F because hotter water will (A) set the blood; (B) split the wood; (C) be too dangerous for the user; (D) all of the preceding.

_____ 7. When the code date on a cut has expired, the cut should be (A) removed from sale and classified inedible; (B) processed into another type of cut; (C) reduced in price to encourage quick sale; (D) inspected and given a new code date if found to be edible.

_____ 8. After cuts of meat have been placed on backing boards or trays, the meat cutter should allow 15 or 20 minutes to pass before they are wrapped in order to permit (A) excess juices to flow from the meat; (B) shrinkage to take place; (C) a thin crust to form on the cut surface; (D) the meat to bloom.

_____ 9. Which one of the following self-service packaged cuts has the longest case life? (A) fresh poultry; (B) veal patties; (C) pork sausage; (D) variety meats.

Matching

Directions: In the left hand column is a list of cleaning compounds commonly used in the meat department. The right hand column contains statements of uses for these compounds. Match the use statement with the compound by placing the letter of the statement in the blank to the left of the appropriate cleaning compound.

_____ 1. General alkaline

_____ 2. General heavy duty alkaline

_____ 3. General inorganic acid

_____ 4. Heavy duty inorganic acid

_____ 5. Abrasives

A. Removing stains, scale or deposit

B. General cleaning of equipment

C. Remove metallic corrosion, protein, and water hardness film deposits

D. Remove protein-carbohydrate-water hardness deposits with scrub brush

E. Remove water-insoluble soils or films

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. The problem of controlling discoloration and spoilage of meats in the self-services and pre-packaging retail meat department is increasing. List three reasons for this increase.

(A) ____________________

(B) ____________________

(C) ____________________

2. What characteristics are present in meat which makes it highly susceptible to spoilage?

(A) ____________________

(B) ____________________

(C) ____________________

(D) ____________________

(E) ____________________

3. List the types of meat spoilage which may take place without the presence of air.

(A) ______________ (B) ______________ (C) ______________

4. As a means of controlling the growth of microorganisms which cause spoilage, meat should be kept in refrigerated places. List the proper temperatures for the following meat areas.

(A) Cooler ____________________________ degrees F.

(B) Display case ______________________ degrees F.

5. List the desirable qualities of a good cleaning compound. It will:

(A) ____

(B) ____

(C) ____

(D) ____

(E) ____

6. Following each area of the meat department listed below indicate the frequency in which it should be cleaned and sanitized.

(A) Floors in cutting room and cooler ____________________

(B) Meat storage racks in the cooler ____________________

(C) Power equipment ____________________

(D) Hand tools ____________________

(E) Knife racks ____________________

(F) Metal tables, trays, & work areas ____________________

(G) Wood surfaces and equipment ____________________

(H) Display cases ____________________

7. List the personal appearance factors which every meat cutter should be aware of and try to achieve in his work.

(A) ________________________ (D) ________________________

(B) ________________________ (E) ________________________

(C) ________________________ (F) ________________________

Assignment
Sheet No. 4

Covering
Units 23-27

CLASSES, GRADES, AND INSPECTION OF MEAT

An understanding of the various classes and grades of meats and meat products sold in the retail meat department should be gained by the meat cutter. Not that he will be required to qualify as a meat inspector, but it is well for him to be familiar with the system of meat inspection and the significance of the various inspection stamps found on meat. Having this understanding will help in answering customer's questions, checking the correctness of meat shipments and his professional relations with other meat cutters.

What is the purpose of meat inspection and grading? When, where, and by whom is it done? What determines whether or not a beef carcass is graded Prime or Choice? Should the purple stamp mark be removed before the meat is cooked?

In this unit you will have an opportunity to learn the answers to the above questions and others concerned with classes, grades, and inspection of meat. The unit covers beef, pork, lamb, mutton, veal and calf. The classification and grading of poultry is covered in assignment 10; fish is covered in assignment 11.

Assignment:

1. Read the reference listed below.
2. Answer the questions below and turn in this assignment by ______________________ .

Reference:

A. Ziegler, The Meat We Eat, pp. 18-29, 410-434.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. The Meat Inspection Act was passed in the year 1960.

T F 2. Meat inspectors work for the U. S. Government.

T F 3. After the animal has been slaughtered, both the carcass and internal organs must be inspected.

T F 4. About one-third of the meat consumed per year has not been Federally inspected.

T F 5. Most states make no provisions for the inspection of meats and meat products which are slaughtered and sold within their state.

T F 6. Carcasses of animals suffering from pneumonia will be condemned by a Federal meat inspector.

T F 7. The legislation for Federal grading of meat was passed at the same time as legislation for Federal meat inspection.

T F 8. The U. S. Department of Agriculture is responsible for the grading of meat and meat products.

T F 9. In order for a meat product to be given a government grade stamp the meat must also have been inspected by the Federal or other authorized agency.

T F 10. All wholesale cuts from a Choice beef carcass must also be graded Choice.

T F 11. In order to be graded Prime, the beef lean must be well marbled.

T F 12. The chine bones of a Prime beef carcass will be well ossified.

T F 13. Beef carcasses with moderately soft and slightly watery flesh will be graded Choice.

T F 14. Beef carcasses graded Standard will have little marbling in the lean meat.

T F 15. The lean meat of Cutter and Canner grade beef carcasses will range from dark red to brownish black.

T F 16. The break joint on a Prime grade young lamb carcass will have the same appearance as the break joint of the same grade mature lamb.

T F 17. A No. 1 grade barrow or gilt pork carcass will have less fat coverage in proportion to lean than will No. 2 or No. 3 grade carcasses.

T F 18. Both the lean and fat of No. 1, 2, and 3 grade barrow and gilt carcasses will be firm.

T F 19. A Cull grade barrow or gilt carcass will show no marbling in the lean cut.

T F 20. The grades assigned to sow carcasses are the same as those for barrow and gilt.

T F 21. The government grade stamp is placed on the carcass in such a way that the label will appear on all of the principal retail cuts from the carcass.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. The agency of the government which is responsible for carrying out the provisions of the Meat Inspection Act is the United States Department of ________________ .

2. The number which appears on the inspector's stamp identifies the ________________ for which the inspection is made.

3. Meat inspectors are divided into two classes: the ________________ and ________________.

4. The term which refers to the checking of animals before they are slaughtered is ________________ inspection.

5. The government grade stamp on a meat cut is a guarantee to the consumer that the purchase is of the ________________ designated.

6. The fat on a Good grade beef carcass may be somewhat ________________ or slightly ________________ to the touch.

7. The conformation of a Standard grade beef carcass will be ________________ and ________________ .

8. The rounds from a Commercial grade beef carcass may be slightly ________________ and ________________ .

9. On a Utility grade beef carcass the flesh or lean will be ________________, the fat is usually ________________ and the bones ________________ and white.

10. In a Cull grade barrow or gilt carcass the ratio of fat and lean to bone will be ________________ .

11. In addition to a certain number of required years of suitable practical experience or substituted college training, a candidate may only obtain a permanent appointment as a government meat grader by first serving training period commonly called a ________________ period.

12. The letters "HJ", as a part of the grade stamp shown on page 411 identified the ________________ .

13. The ink used in stamping meat is made from a ________________ dye.

Multiple-Choice

Directions: In the space at the left of each statement, write the letter of the item which will provide the correct answer to complete the statement.

______ 1. The establishments which are affected by the provisions of the Meat Inspection Act are (A) all slaughter houses, and retail and wholesale meat departments serving the public; (B) those which prepare meats and meat products for interstate shipment or foreign commerce; (C) only those which desire the service; (D) all those which slaughter, pack, render and prepare meats and meat products

______ 2. The cost of meat inspection is paid indirectly by the customer by means of (A) state sales taxes; (B) Federal sales taxes; (C) state income taxes; (D) Federal income taxes.

______ 3. Which one of the following is not a factor to be considered in assigning a grade to a carcass or cut? (A) breed; (B) finish; (C) quality; (D) conformation.

______ 4. The grading factor which is considered the most important of the three factors is (A) breed; (B) finish; (C) quality; (D) conformation.

______ 5. A significant relationship which exists between the proportion of edible meat to bone in a carcass or cut is attributed to (A) breed; (B) general build; (C) outline of carcass; (D) conformation.

______ 6. Which one of the following beef grades is not assigned to a cow carcass? (A) Cutter; (B) Standard; (C) Choice; (D) Prime.

______ 7. The external fat coverage on a Prime grade lamb carcass will be (A) practically no fat; (B) thick throughout; (C) thin, barely hiding back muscles; (D) thick, practically hiding back muscles.

______ 8. Which one of the following grades are not assigned to mutton carcasses? (A) Cull; (B) Good; (C) Choice; (D) Prime.

______ 9. A Medium grade barrow or gilt carcass will have flesh and fat that can be described as being (A) firm; (B) firm but watery; (C) soft; (D) well marbled.

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. List the purposes of the Meat Inspection Act.

(A) ____________________

(B) ____________________

(C) ____________________

(D) ____________________

2. List the grades assigned to steer and heifer beef carcasses.

(A) ____________
(B) ____________
(C) ____________
(D) ____________
(E) ____________
(F) ____________
(G) ____________
(H) ____________

3. List the grades assigned to lamb and yearling sheep carcasses.

(A) ____________
(B) ____________
(C) ____________
(D) ____________
(E) ____________

4. List the revised grades assigned to veal and calf carcasses.

(A) ____________
(B) ____________
(C) ____________
(D) ____________
(E) ____________
(F) ____________

5. List the grades assigned to barrow, gilt and sow carcasses.

(A) ____________
(B) ____________
(C) ____________
(D) ____________
(E) ____________

Assignment
Sheet No. 5

Covering
Units 28-39

SELF-SERVICE MEAT OPERATIONS

Self-service is a relatively new development in the field of retail meat selling and although it was not the first department in the store to utilize the practice, it has been widely accepted. In fact, it is so wide spread that many in your generation will have known no other system.

The practice of self-service is able to survive only if there is volume sales and this demands heavy customer traffic. Competition in the retail meat business is not in terms of cuts and types of meats, but it is rather competition for customer traffic. This traffic can be gained by providing the customer with well-prepared cuts, attractively packaged and displayed for the convenience of shopping.

Another factor upon which the success of self-service is dependent is efficient operation. A department which is well organized to handle the operations from the time the meat shipment is received until it is sold to the customer demands well-trained personnel who know their responsibilities and work as a team.

In this unit you will have the opportunity to learn about the various phases of a self-service operation and the parts for which the meat cutter is responsible. You will also learn how self-service cuts are prepared, wrapped and displayed.

<u>Assignment</u>:

1. Read the references below.
2. Answer the questions below and turn in this assignment by ______________________ .

<u>References</u>:

C. American Sheep Producers, <u>Lamb Cutting and Merchandising Manual</u>, Ch. 13.
D. NARGUS, <u>Self-Service Meats</u>, pp. 3-59, 109-112.

<u>Questions</u>:

True-False

<u>Directions</u>: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. The idea of self-service meat departments has developed primarily because retail business men feel it is more profitable.

T F 2. Practices found successful for promoting the sale of meat products in one meat department will also be successful in any other meat department.

T F 3. Meat departments have found that the greater the volume of meat handled, the smaller will be the share of overhead to be added to each pound.

T F 4. The floor space needed for cutting and wrapping will be greater for a self-service meat department than for the service type.

T F 5. Self-service meat buyers tend to buy more in terms of the unit price of the cut rather than be concerned with the price per pound.

T F 6. The type of cuts to be wrapped should be the primary concern in arranging the equipment and materials in the self-service wrapping room.

T F 7. Although two medium sized wrapping tables are more desirable than one large wrapping table, one "central" set of tools and equipment is sufficient.

T F 8. Wrapping materials are available only in rolls.

T F 9. Special scales are available for pre-packaged meat work.

T F 10. Attaching a label, which contains the weight and price, to a pre-packaged meat product is done for the convenience of the customer rather than because of any regulations.

T F 11. Wrapping machines are presently adaptable primarily to cuts which are uniform in size and shape.

T F 12. The meat cutter should determine which side of a cut is to be visable to the customer before it is wrapped.

T F 13. If there is a choice the less attractive side of a cut should be visable to the customer.

T F 14. A self-service meat cutter will be most successful if he limits himself to only one method of preparing cuts from a carcass.

T F 15. Customers are usually reluctant to buy brand name meat products from the self-service display.

T F 16. Inventory control is more important in a self-service department than in the service type operation.

T F 17. Because taking inventory in the meat department is complicated, a new meat cutter will generally not be asked to assist.

T F 18. Plain cellophane is not moistureproof nor can it be heat sealed.

T F 19. Fresh meats should be wrapped in a material which will allow oxygen to enter and carbon dioxide to escape from the package.

T F 20. A retailer should stock a wide variety of wrapping paper widths.

T F 21. Both rolls and sheets of wrapping film are sold by the pound.

T F 22. Self-service meat retailing has promoted the development and improvement of backing boards.

T F 23. Backing boards which extend beyond the edge of the meat cut should be trimmed to fit the shape of the cut.

T F 24. Backing boards and trays are interchangeable terms for the same package wrapping accessory.

T F 25. Of the two types of labels used with self-service meat packaging the label which is placed on the outside of the package seems to have more advantages than the label placed inside the package.

T F 26. Since the customer's knowledge about meat cuts is limited, it is not necessary to place the name of the cut on the label.

T F 27. To the customer the price per pound is usually more important than the total price of the packaged cut.

T F 28. The space beneath the display area of a display case is wasted space in most models.

T F 29. One of the major problems created by lighting in the display case is the discoloration of meat.

T F 30. Considerable planning should be given to the placement of each facility within a cutting room.

T F 31. One of the major problems in meat retailing is the fact that most of the operating expenses must be met each week, regardless of the amount of meat sold.

T F 32. All self-service meat departments are required to code date the packages on display.

T F 33. Once the package has been code dated it will not be necessary to remove it from the display until the date has expired.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. The first self-service systems developed in the departments selling ______________ and ______________ products.

2. Some retailers have found that during the last three days of the week they do ________ to ________ per cent of their total weekly volume.

3. Of the total dollar volume of a retail store, it is recommended that the meat department account for at least ________ per cent.

4. Heat-sealed packages should not be stacked immediately because the heat from the fresh seal will ______________ the meat in the package below.

5. The "hub" of the self-service meat department is the ______________ operation.

6. Pre-packaged meats wrapped with a transparent film are heat sealed by using a sealing ______________ or sealing ______________.

7. After a new shipment of carcasses have been weighed and stored in the cooler, the meat cutter should remove from them the parts which will ______________ fastest.

8. A tool which tends to splinter bones and therefore should not be used in the preparation of self-service cuts is the ______________.

9. The brightness of color that develops on the surface of meat cuts after exposure to air for several minutes is referred to as ______________.

10. A general rule to follow in determining the amount of meat supplies to be carried over the weekend is an inventory which costs no more than ________ per cent of the sales volume for the week.

11. Meat inventories may be taken weekly, monthly or quarterly, the most successful practice is on a ______________ basis.

12. Two terms used to describe a wrapping material which allows oxygen to enter the package and carbon dioxide to escape are ______________ or ______________ ______________ wraps.

13. The side of cellophane film which has been treated to preserve the bloom of fresh meat is placed next to the meat when wrapping; this side is referred to as the ______________ side.

14. Sheet wrapping film is generally sold in packages containing ________ sheets.

15. In addition to being clean in color, backing board materials must also be ________________ and ________________.

16. To be of value in sealing meat packages, transparent tape must be resistant to ________________ and have holding-power over a wide range of ________________.

17. It is suggested that an inventory of wrapping materials be taken ________________.

18. A portable self-contained display case is useful for promoting ________________ sales with other departments.

19. The most satisfactory lighting for the self-service display case is a soft ________________ fluorescent light.

20. The display case should be thoroughly cleaned at least once a ________________.

21. The sink should be out of the way, and because of being a focal point for heavy activity should have adequate ________________ for the various activities.

22. In addition to protecting the meat product, packages in the self-service must also ________________ the product.

23. When restocking a display case, the fresh packages should be placed at the ________________ or on the ________________.

24. Two systems may be used to code date packages in the display case: one code is the day the package was ________________ and the other the day the package should be ________________.

Multiple-Choice

Directions: In the space at the left of each statement, write the letter of the item which will provide the correct answer to complete the statement.

_____ 1. Which of the following is not an advantage of a self-service meat department over a service type department? (A) More customers can be handled at one time; (B) It is more flexible; (C) it is easier to operate; (D) It requires more concern about cutting and trimming.

_____ 2. Which of the following is not a factor contributing to the efficient operation of the cooler in a self-service meat department? (A) Walls, floors and equipment should be cleaned once a week; (B) Temperature and humidity should remain constant; (C) Responsibility should be assigned to one person; (D) Germicidal lamps are a necessity; (E) Meats should be arranged in a systematic way.

_____ 3. The elimination of sharp or protruding bones which will tear the wrapping is the responsibility of (A) the meat cutter preparing the cut; (B) the wrapper; (C) the head meat cutter; (D) the person in charge of the display case.

_____ 4. When self-service meat department personnel observe that a particular cut is not selling, they should (A) reduce the price to make it more attractive; (B) change the method of wrapping; (C) change the cutting method; (D) disguise it as a more popular cut.

_____ 5. It is generally agreed that the development of bloom should take place (A) before the cuts are made; (B) after the cuts are prepared but before wrapping; (C) after wrapping but before displaying; (D) while the packaged cuts are in the display case.

_____ 6. While bloom is taking place, the meat should be kept within a temperature range of (A) 20 to 25; (B) 34-38; (C) 42-45; (D) 58-63 degrees F.

_____ 7. In describing Pliofilm (a wrapping material) which one of the following qualities was not covered? (A) The surface to be placed next to the meat; (B) Its dimensional stability; (C) Methods used to seal; (D) Degree to which it is moisture proof.

_____ 8. Which of the following is <u>not</u> an advantage of sheet film wrapping over rolled film wrapping? (A) It speeds-up the wrapping operation; (B) Wrapping material costs are more easily controlled; (C) Less storage space is required; (D) There is less waste.

_____ 9. In addition to giving rigidity to the packaged meat the backing board also has the primary function of (A) hiding the less attractive side of the cut; (B) protecting the cut surface from light and air; (C) providing a surface on which to place the weight and price label; (D) providing a surface on which to heat-seal the film wrapping material.

_____ 10. Retailers generally agree that the self-service meat system has been successful because (A) there is greater profit per cut of meat; (B) it has appealed to customers; (C) it requires less sales personnel; (D) expanded advertising has increased the sales volume.

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. List some reasons why the temperature in the wrapping room should not fluctuate or be above 55 degrees F.

(A) ____________________

(B) ____________________

(C) ____________________

(D) ____________________

(E) ____________________

2. A good wrapping material must meet the following qualifications. It must be:

(A) __________ (B) __________ (C) __________

3. Using the DuPont system of describing the qualities of their cellophane wrapping material, interpret designation "LSAC 450".

(A) "L" ____________________

(B) "S" ____________________

(C) "A" ____________________

(D) "C" ____________________

(E) "450" ____________________

4. Backing boards produced by laimination are so designed that each layer has a specific purpose. After the layers listed below, indicate their function.

(A) First sheet - ____________________

(B) Coating of adhesive - ____________________

(C) Next layer - ____________________

(D) Outer covering - ____________________

5. List the factors which should be considered when choosing the location of the meat display case in the store.

(A) ____________________

(B) ____________________

(C) ____________________

(D) ____________________

(E) ____________________

6. List the equipment and supplies found in a self-service meat department; those which are unique to self-service.

(A) ____________________ (G) ____________________

(B) ____________________ (H) ____________________

(C) ____________________ (I) ____________________

(D) ____________________ (J) ____________________

(E) ____________________ (K) ____________________

(F) ____________________

7. List some things which might be done to increase the sale of slow moving cuts.

(A) ____________________

(B) ____________________

(C) ____________________

(D) ____________________

Assignment
Sheet No. 6

Covering
Units 40-67

PREPARING RETAIL BEEF CUTS

Today's beef cattle usually belong to one of three breeds: the Shorthorn, the Hereford, the Aberdeen Angus. From these breeds of cattle come many classes and grades of beef with which the meat cutter must be familiar if he is to buy wisely and eliminate waste while satisfying the demands of customers.

In this unit you will learn the good points of a high-grade beef carcass, how wholesale cuts are prepared, and the best techniques in cutting beef for the retail trade. In addition you will learn basic preparation of the most popular cuts of beef.

Assignment:

1. Read the references listed below.
2. Read pages 65-86 of Reference A and, in outline form, list the steps involved in dressing the animal from the stunning process through the placing of the carcass in the cooler.

References:

A. Ziegler, The Meat We Eat, pp. 63-92, 330-344.
B. Bull, Meat for the Table, pp. 55-60, 67-93.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. Most of the high-grade beef sold on the market today comes from beef steers which are one and one-half and two and one-half years old.

T F 2. A carcass of beef must be quartered before it can be handled for shipment.

T F 3. Dressed carcasses are not susceptible to foreign odors so other items may be stored in the cooler with the meat.

T F 4. The cuts from a side of beef are standardized across the United States.

T F 5. When three ribs are left on the hind quarter the side has been divided into two nearly equal parts.

T F 6. A right fore quarter is carried on your left shoulder and a left fore quarter is carried on your right shoulder.

T F 7. The style to be used in cutting will determine how the fore quarter is placed on the cutting block.

T F 8. There is no variation in the way the brisket in the fore quarter can be divided into retail cuts.

T F 9. The wholesale cut in the forequarter, known as the chuck, may be divided into retail cuts of both steaks and roasts.

T F 10. The wholesale rib cut will contain five to eight ribs.

T F 11. When placing the hind quarter on the cutting block the inside is placed up.

T F 12. The flank steak is a pear-shaped muscle removed from the outside of the flank.

T F 13. The most satisfactory method of cutting round steaks is to make them as one large slice from the round.

T F 14. Eye and bottom round cuts are of lower quality than the top round cuts.

T F 15. The heel of the round is very suitable as a pot roast.

T F 16. The rump cut is best divided into T-bone and club steaks.

T F 17. Since boning the rump is a simple operation, the beginning meat cutter will need little instruction.

T F 18. The various sirloin cuts get their name from the shape of the bone they contain.

T F 19. Steaks cut from the short loin are the least desirable of the loin cuts.

T F 20. Some people use the terms T-bone and porterhouse steaks interchangeably.

T F 21. The nutritional value of a beef cut will vary with the grade of the carcass.

T F 22. A carcass with good conformation will contain more meat and less bone than one with poor conformation.

T F 23. The fat in a cut of beef adds much to its flavor and tenderness.

T F 24. The quality of a beef carcass is concerned with the lean meat, the fat and the bones.

T F 25. The fat on high-grade beef will be spongy and white.

T F 26. To obtain the advantages of aging, low-grade beef should be aged considerably longer than prime or choice grades.

T F 27. The porterhouse steak is one of the most economical sources of lean meat in the hind quarter.

T F 28. Rib roasts should be cut to contain at least two ribs.

T F 29. Short plate and brisket cuts usually contain only a small smount of bone.

T F 30. The miscellaneous cuts - such as liver, tongue, sweetbreads, and oxtail - are of little nutritional value.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. Yearling steers in the heavy-weight market class will weigh __________ pounds and up.
2. Prime grade cattle should give a dress yield of from __________ to __________ per cent.
3. The penetrating type compression stunner for cattle is to be aimed at the ____________ ____________.
4. When the kidney hangs away from the carcass, the side is known as the ____________ or ____________ side.
5. A quartered beef may also be referred to as being ____________.
6. When a side of beef is quartered, most cutters will leave __________ rib(s) on the hind quarter.
7. When the Chicago or National style of cutting is used the chuck rib and plate are the wholesale cuts found in the ____________ quarter.
8. The sixth rib in the rib cut is not desirable as a part of the standing rib roast because it contains a tip of the ____________ bone.
9. When carrying a hind quarter the shank should be to the ____________.
10. When removing the kidney from the hind quarter, care must be taken so as not to remove the ____________ next to the loin.
11. A one to two inch cut of top round is an excellant cut for ____________ steak.
12. Five or six wafer-thin slices cut from the round and then put together make a ____________ steak.
13. When dividing the loin into the two wholesale cuts the cut is made in front of and close to the ____________ bone.

14. Sirloin steaks are cut from the wholesale loin cut which contains the ______________ bone.

15. The steaks which are cut from the short loin but contain no tenderloin muscle are called ______________ steaks.

16. A high quality cut from a mature beef should be ________________ in color.

17. After being cut, beef will reach its maximum brightness in about __________ hour(s) time.

18. The storage of beef carcasses under less than freezing temperature for a period of one to two weeks for the purpose of improving the flavor is known as _____________ or _____________.

19.

Multiple-Choice

Directions: In the space at the left of each statement, write the letter of the item which will provide the correct answer to complete the statement.

_____ 1. The dressed yield of a heifer carcass will be slightly lower than for a like quality steer carcass mainly because (A) of the smaller bone structure; (B) of the larger bone structure; (C) of the greater amount of internal fat; (D) they are shorter but thicker.

_____ 2. In which section of the country are the methods of cutting beef the most standardized? (A) East; (B) South; (C) Midwest; (D) no difference throughout the country.

_____ 3. In the forequarter, the arm, shank, brisket, and short plate together make up the (A) chuck; (B) loin; (C) rattle; (D) flank.

_____ 4. A retail cut from the rib which has the back bone cut off and the rib sawed at the end of the rib eye muscle is known as a (A) club steak; (B) standing rib roast; (C) rib roll; (D) folded rib roast.

_____ 5. The eye muscle cut from the round is often mistakenly referred to as (A) chip steak; (B) cube steak; (C) New York cut; (D) tenderloin.

_____ 6. One of the disadvantages of using the bottom round muscle as a roast is that it is (A) dry; (B) fatty; (C) small; (D) better suited for chip steaks.

_____ 7. Porterhouse steaks are cut from the (A) round; (B) flank; (C) rump; (D) loin.

_____ 8. The finish of a beef carcass refers to the (A) number of wholesale cuts obtained; (B) quality of the skinning process; (C) the amount and distribution of fat; (D) the percentage of retail cuts obtained.

_____ 9. Which of the following is most descriptive of the bones of young beef? (A) flinty and white; (B) flinty and dark red; (C) porous and white; (D) porous and dark red.

_____ 10. According to Bull, one of the major advantages of using the New York style of cutting is that it (A) produces smaller cuts; (B) produces cuts preferred by commercial eating establishments; (C) reduces the amount of waste; (D) is faster and easier to utilize.

Listing

Directions: List the item called for in each of the following. Select your answers carefully.

1. List the eight grades of slaughter cattle in the correct order from the best to the poorest.

(A) ____________ (D) ____________ (G) ____________

(B) ____________ (E) ____________ (H) ____________

(C) ____________ (F) ____________

2. List the three methods or styles used in cutting beef.

(A) ____________________ (C) ____________________

(B) ____________________

3. List the five wholesale cuts in the hind quarter, excluding the kidney.

(A) ____________________ (D) ____________________

(B) ____________________ (E) ____________________

(C) ____________________

4. What two advantages does Ziegler give for using the National style to remove the round from the rump and loin?

(A) ____

(B) ____

5. List the five classes of beef animals:

(A) ____________ (C) ____________ (E) ____________

(B) ____________ (D) ____________

Assignment
Sheet No. 7

Covering
Units 68-87

PREPARING RETAIL PORK CUTS

Pork is one of the most economical meats the retailer can provide the consumer. Because hogs are bred and raised for the sole purpose of meat, their quality and conformation will generally be uniform and high. In addition, several of the wholesale cuts can either be cured or sold fresh. This means that the retail meat-cutter must become familiar with the types of cuts from both cured and fresh pork if he is to provide his customers with the best service.

In this unit you will have the opportunity to learn the wholesale pork cuts and how they are prepared for retail sales. In addition you will learn some things which will broaden your knowledge about pork.

Assignment:

1. Read the references listed below.
2. Write a one or two page paper concerning the term Trichinosis, what it is, its relationship to pork and the value of this understanding for the retail meat cutter and the customer.
3. Answer the questions below and turn in this assignment by ________________________.

References:

A. Ziegler, The Meat We Eat, pp. 281-306.
B. Bull, Meat for the Table, pp. 94-95, 99-119.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. It is a desirable practice to leave a large portion of the jowl on the shoulder.

T F 2. The Boston style butt is a retail cut made from the shoulder.

T F 3. The Boston butt should have a minimum fat covering of 3/4 inches.

T F 4. Since the bacon from the belly is of little value as a sales commodity it can be sacrificed when separating the loin from the belly.

T F 5. "Short cut" pork loins are regular loins minus the blade bone.

T F 6. Buttons(nipples) on bacon are not an indication of high quality bacon.

T F 7. The percentage of lard rendered from rinded fat is greater than from unrinded fat.

T F 8. Retailers usually buy wholesale cuts of pork rather than the entire pork carcass.

T F 9. Hams are always cured or smoked rather than sold fresh.

T F 10. The butt or heavy half of a ham is less economical than is the shank half.

T F 11. A boneless ham will cost more per pound than a regular or skinned ham.

T F 12. Fresh picnics may be sliced to make pork steaks.

T F 13. The ends of the loin are better suited for roasts than for pork chops.

T F 14. The fat cuts of pork are frequently used to add flavor to other foods.

T F 15. Bacon is one of the cheapest pork cuts.

T F 16. "Hotel style" bacon is sliced thicker than bacon purchased by the housewife.

T F 17. Pork liver usually sells at a higher price per pound than does either beef or veal liver.

T F 18. Pork liver is a better source of iron for the diet than is either beef or veal liver.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. Pork cuts which are cured, rendered into lard, or made into meat products before they are sold to the consumer make-up about ________ to ________ per cent of the carcass.

2. The jowl is frequently cured and smoked and then sold as jowl ________________ .

3. A California Picnic shoulder is sometimes incorrectly referred to as a Cala ________________ .

4. By trimming the spareribs lean, more of the belly is left for the making of ________________ .

5. The killing fat is used by some people for the making of ________________ .

6. When rendering lard the temperature should not be allowed to exceed _________ degrees F.

7. According to Bull, a pound of ham containing the bone will serve about _________ to __________ people.

8. An unskinned ham is generally referred to as a _________________ ham.

9. Picnics are cut from the lower part of the _________________ .

10. Pork chops are cut from the ________________ .

11. If they are to be fried, pork chops should be cut about ___________________ inch thick.

12. When the large muscle along the top of the loin has been rolled, cured, and smoked, it is sold as ____________________ bacon.

13. A pound of bacon is usually sliced to obtain about __________ to __________ slices.

14. The best grades of bacon will contain about ______ per cent fat.

15. Overlapping the slices of bacon so the lean appears more prominent when packaged is referred to as ________________ .

16. The better quality sausage will contain about ________ per cent lean and about _______ per cent fat pork.

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. List the five grades of pork carcasses.

(A) ________________ (C) ________________ (E) ________________

(B) ________________ (D) ________________

2. List five retail cuts from a pork loin.

(A) __________________________ (D) __________________________

(B) __________________________ (E) __________________________

(C) __________________________

3. What type containers are recommended and what types are not recommended to be used for rendering lard?

Recommended	Not recommended
(A) ____________	(A) ____________
(B) ____________	(B) ____________
(C) ____________	

4. What things have the packing industry had to do to lard to make it acceptable as a shortening by the housewife?

(A) ____________________

(B) ____________________

(C) ____________________

(D) ____________________

(E) ____________________

5. Upon what quality is a shortening substance being evaluated when reference is made to its shortening value?

(A) ____________________

____

____

6. To what two factors does Bull credit the low degree of variation in pork tenderness and flavor as compared to other types of meat?

(A) ____________________

(B) ____________________

7. What pork cuts are commonly considered to be the lean cuts?

(A) __________ (D) __________ (F) __________

(B) __________ (E) __________ (G) __________

(C) __________

8. What pork cuts are commonly considered to be the fat cuts?

(A) __________ (B) __________ (C) __________

9. List the variety meats found in the pork carcass.

(A) ____________________

(B) ____________________

(C) ____________________

(D) ____________________

(E) ____________________

(F) ____________________

(G) ____________________

(H) ____________________

(I) ____________________

Assignment
Sheet No. 8

Covering
Units 88-101

PREPARING RETAIL VEAL CUTS

Although veal is an economical meat product it is not too widely utilized because it is more profitable for the livestock producer to retain the animal and fatten it for sale as beef. The retail meat cutter, in order to be of greater service to his customers, should understand the difference between veal, calf, and beef: the cuts available and the general characteristics of the meat. Care must be taken not to confuse veal with calf as there are some definite differences.

In this unit you will have an opportunity to become familiar with the characteristics of veal and the wholesale and retail cuts from the carcass. The differences between veal and calf will also be pointed out.

Assignments:

1. Read the references below.
2. Answer the questions below and turn in this assignment by ______________________ .

References:

A. Ziegler, The Meat We Eat, pp. 351-356.
B. Bull, Meat for the Table, pp. 120-121, 124-141.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. Because of the heavy fat coverage on a veal carcass it is necessary to age it longer than beef.

T F 2. There is no difference between veal and calf, they both refer to the same size animal.

T F 3. The grades assigned to veal and calf carcasses are the same.

T F 4. A veal carcass is usually cut into a fore and hind saddle rather than being quartered.

T F 5. Veal liver is a good retail sale item.

T F 6. The methods of cutting veal sides is very similar to the methods employed in cutting beef sides.

T F 7. The seasoning of mock chicken is done by the retail meat cutter before it is sold to the customer.

T F 8. The seasoning of veal loaf is done by the customer.

T F 9. A veal crown roast is best made from the smaller veal carcass.

T F 10. The loin veal chops correspond to the porterhouse and T-bone steaks of beef.

T F 11. As in beef, the veal tenderloin is usually removed and made into special cuts.

T F 12. The veal cutlet is the most expensive cut in the veal carcass.

T F 13. Most veal calves are of the beef breed variety.

T F 14. The fat on and in a high quality veal carcass will be milky white in color.

T F 15. The bones of a veal carcass can be identified by their white interior.

T F 16. Veal is an easy meat for the cook to prepare because of its natural high flavor and tenderness.

T F 17. Because of its qualities, veal should be cooked long and slow.

T F 18. Chops from lower grade carcasses should be cut thinner than those from the higher grade carcasses.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. A medium weight veal carcass will weigh from __________ to __________ pounds.
2. A medium weight calf carcass will weigh from __________ to __________ pounds.
3. The part of the veal carcass which includes the anterior to the twelfth rib is known as the ______________ saddle.
4. The unsplit posterior portion of a veal carcass is known as the ______________ saddle.
5. The unsplit posterior portion of a veal carcass which includes nine ribs is known as a ______________ saddle.

6. One inch cubes of veal alternated with pieces of pork and secured with a skewer are known as ______________ chicken.

7. The breast is generally considered to be a part of the wholesale ________________ cut.

8. The weight of a four-rib shoulder, which includes the neck, shank, and breast, represents about ________ to ________ per cent of the veal carcass.

9. When one and one-half to two inches of the meat has been removed from the end of a rib chop the process is called _______________.

10. Sirloin veal cutlets are cut from the large or _______________ end of the loin.

11. Another term used for veal round steak is veal _______________ .

12. Veal cutlets to be breaded are normally cut about ______________ inch(es) thick.

13. Most young calves killed for veal are usually of ______________ breeding.

14. The approximate maximum age for killing calves for veal is from _________ to _______ weeks.

15. The veal cuts which are located immediately behind the loin chops and roasts are the ________________ ________________ ______________ ______________ .

16. Steaks are usually cut with a knife and a _____________ .

17. Chops cut from Good to Choice grade carcasses should be cut about ________________ to _____________ inch(es) in thickness.

18. As an edible meat product, the Thymus gland of veal is sold as _____________________ .

Multiple-Choice

Directions: In the space at the left of each statement, write the letter of the item which will provide the correct answer to complete the statement.

______ 1. Which of the following is not a grade of veal carcass? (A) Choice; (B) Standard; (C) Good; (D) Perfect; (E) Cull; (F) Prime.

______ 2. Veal loaf is the combination of ground veal and (A) beef; (B) lamb; (C) pork; (D) seasoning.

______ 3. The wholesale veal rib is divided into retail cuts of either (A) steaks and roasts; (B) stew meat or roasts; (C) chops or steaks; (D) roasts or chops.

______ 4. When slicing veal cutlets from the round the meat cutter should stop when (A) the cutlets are less than three inches across; (B) no bone remains in the cut; (C) the shank knuckle bone is reached; (D) the first vertebrae is reached.

______ 5. The lean meat of a high quality veal carcass can be identified by the following characteristics (A) bright red, watery, soft, and fine-grained; (B) light pink, watery, soft, and fine-grained; (C) dark red, dry, solid, and coarse-grained; (D) cream colored, watery, olid, and coarse-grained.

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. List the wholesale cuts in a side of veal.

(A) ______________________ (C) ______________________

(B) ______________________ (D) ______________________

2. List the retail cuts found in a veal shoulder that includes the neck, shank, and breast.

(A) ______________________ (H) ______________________

(B) ______________________ (I) ______________________

(C) ______________________ (J) ______________________

(D) ______________________ (K) ______________________

(E) ______________________ (L) ______________________

(F) ______________________ (M) ______________________

(G) ______________________

3. List the retail cuts found in the leg or round and rump.

(A) ______________________ (E) ______________________

(B) ______________________ (F) ______________________

(C) ______________________ (G) ______________________

(D) ______________________ (H) ______________________

Assignment
Sheet No. 9

Covering
Units 102-110

PREPARING RETAIL LAMB AND MUTTON

The changing eating habits and tastes of the American public have made it necessary for the successful meat cutter to adjust his business to meet these demands. Since 1940, the consumption of mutton has made up only a small part of the ovine meat diet. The general dislike for the taste of mutton has resulted in lamb being the dominant ovine meat. The public's demand for smaller meat cuts has also reduced the sale of mutton and increased the demand for lamb.

Although lamb and mutton sales may not be a large part of the retail sales, the preparation of cuts should be well understood by the meat cutter. Several of the lamb cuts command a high price and thereby attract a rather exclusive and quality trade. The meat cutter who unde stands the various lamb cuts will be a real asset to his employer.

In this unit you will have an opportunity to gain an understanding of the various lamb and mutton classes and grades, the types of wholesale and retail cuts, and the techniques to be used in preparing these cuts for the retail customer. The emphasis in the unit is on cuts from the lamb carcass but the mutton cuts are very similar. Your employer can probably point out any variations that may exist.

<u>Assignment:</u>

1. Read the references listed below.
2. Answer the questions below and turn in this assignment by ____________________.

<u>References:</u>

A. Ziegler, <u>The Meat We Eat</u>, pp. 357-373.
B. Bull, <u>Meat for the Table</u>, pp. 143, 149-167.
C. American Sheep Producers, <u>Lamb Cutting and Merchandising Manual</u>, Chapters 2-10.

<u>Questions:</u>

True-False

<u>Directions</u>: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. The lean meat of a young lamb will be light pink in color.

T F 2. Sheep which are over one and one-half years old are usually classed as mutton.

T F 3. The buck carcass produces the highest quality mutton.

T F 4. It is not possible to keep even a high grade lamb or mutton carcass for the purpose of aging or ripening.

T F 5. The Saratoga chop is a boneless shoulder cut.

T F 6. The retail cuts from a lamb back consists of either chops or roasts.

T F 7. According to Bull, lamb retail sales will vary considerably from season to season.

T F 8. A high grade loin lamb chop is one of the most expensive cuts of meat provided the customer.

T F 9. The best lamb roasts come from the leg.

T F 10. The American style leg of lamb roast is shorter in length than is the French style.

T F 11. The weight of the lamb carcass will determine the breaking method used to divide it into wholesale cuts.

T F 12. When a lamb saddle is split the resulting pieces are referred to as quarters.

T F 13. Tests have shown that when dividing a leg of lamb the preferred method is to cut straight across rather than at an angle.

T F 14. If the top portion of a divided leg sells better than the lower it is better to sacrifice the lower cut even if it doesn't sell.

T F 15. Calling the lower portion of a divided leg the "shank end," will probably increase its sale appeal.

T F 16. The removal of a sirloin roast or slices from the end of a leg is done primarily to reduce the size of the leg and make it more saleable.

T F 17. The steps to be used in rolling and tying a boneless leg have been standardized and should be followed closely.

T F 18. The loin is generally considered to be the ribless portion of the back.

T F 19. The general practice is to bone the loin and sell it as a boneless roast.

T F 20. It is recommended that the blade bone found in the rack always be removed.

T F 21. To increase the profit from rib chops it is suggested that they be mixed with loin chops.

T F 22. The preferred method of cooking lamb chops is to broil them.

T F 23. It is suggested that the size of a shoulder roast be determined on the basis of the price per package rather than on specified weight.

T F 24. The method used to remove the neck will depend upon the shape and size of the shoulder desired.

T F 25. The size of the breast of lamb will be determined by the type of saddle from which it is taken.

T F 26. Riblets cut from heavy carcasses will always contain a higher proportion of fat than those cut from smaller carcasses.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. Hot house lambs are those born during the months of ____________ through ______________ .
2. The most desirable weight for a lamb carcass is between _______ and ________ pounds.
3. Yearling sheep carcasses will weigh approximately _______ pounds.
4. The higher grade loin chops should be cut about _______ inch(es) thick.
5. A double loin chop cut from an unsplit loin is known as a(an) _________________ chop.
6. Sirloin roasts are difficult to carve because they contain a large amount of ________________ .
7. The process of cutting a lamb carcass into wholesale cuts is referred to as _________________ .
8. To obtain a fore and hind saddle of approximately the same weights, the lamb carcass should be cut to leave ________ rib(s) on the hind.
9. When a packer removes the shanks, breast, and flanks from a lamb carcass the portion remaining is referred to as a _______________ or _________________ carcass.
10. The flavor of a lean, boneless, rolled leg can be improved by adding some ______________ in the roll.

11. In addition to making a roast, the boneless leg can be sliced for ____________ .

12. If properly wrapped and low temperatures maintained lamb can be kept in the food-freezer for as long as _______ months.

13. One of the first things to be done before cutting the rack into retail cuts is to remove the thin parchment-like membrane known as the ____________ .

14. When cutting chops from the rack the recommended procedure is to follow the contour of the ____________ .

15. When preparing the rack as a roast, the meat cutter should always remove the ____________ and ____________ bones.

16. If a Crown Roast of lamb has not been sold the day it was prepared, it should be removed from the display and sliced into ______________ .

17. Two highly perishable parts of the lamb carcass are the ____________ and the ____________, and they should be merchandised as soon as possible.

18. Because of the danger of losing a good customer, it is better to take a ___________ than sell him poor quality meat.

Multiple-Choice

Directions: In the space at the left of each statement, write the letter of the item which will provide the correct answer to complete the statement.

_____ 1. Lamb carcasses are shipped hog-dressed for the following purposes (A) to keep the carcass from absorbing outside odors; (B) to reduce the chances of bruising the meat; (C) to increase the weight and value of the carcass; (D) to preserve bloom and reduce shrinkage.

_____ 2. Sirloin chops are cut from the (A) ribs; (B) leg; (C) shank; (D) flank.

_____ 3. Sirloin roasts are cut from the (A) loin; (B) leg; (C) shank; (D) flank.

_____ 4. When the legs are removed from the carcass the remaining portion is referred to as a (A) trunk; (B) long hind-saddle; (C) triangle; (D) streamlined carcass.

_____ 5. A cleaver should never be used to remove the bone from a sirloin slice because (A) it may splinter the bone; (B) it leaves a ragged meat edge; (C) too much meat is removed with the bone; (D) the small size of the slice makes it a dangerous operation.

______ 6. When cutting chops from the rack it is most important that the meat cutter (A) remove all of the fat from the lean; (B) remove the bone; (C) make each chop uniform in thickness; (D) include one rib in each chop.

______ 7. When rolling a shoulder, or other cut, the good meat cutter strives to make the roll in such a way that (A) there is a good coverage of fat on all outside surfaces; (B) the ends have good eye appeal without being faced; (C) the fat on the inside is not visable; (D) no bones protrude that might tear the wrapping.

______ 8. The shank and breast meat is usually removed before making the shoulder roll because (A) they contain excessive amounts of fat; (B) they can be sold for higher prices; (C) they make the roast too large; (D) they make the roast difficult to carve.

______ 9. When it becomes necessary to slice a shoulder roll, the meat cutter should start from the leaner end because (A) it is easier to slice than the neck end; (B) the lack of fat causes greater shrinkage; (C) it can be sold at a greater profit; (D) the method used for tying makes it necessary.

______ 10. The most common cause of juice seepage from rolled shoulders is (A) excess fat on the inside of the roll; (B) tying the strings too loosely; (C) failure to keep the meat at the proper refrigerated temperature; (D) keeping the meat in the display case for an excessive period of time.

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. List the five grades of spring lamb.

(A) ______________________ (D) ______________________

(B) ______________________ (E) ______________________

(C) ______________________

2. List the retail cuts found in a wholesale lamb shoulder cut that also contains the shank and breast.

(A) ______________________ (I) ______________________

(B) ______________________ (J) ______________________

(C) ______________________ (K) ______________________

(D) ______________________ (L) ______________________

(E) ______________________ (M) ______________________

(F) ______________________ (N) ______________________

(G) ______________________ (O) ______________________

(H) ______________________ (P) ______________________

3. List the four methods or styles of cutting the retail leg of lamb.

(A) ______________________ (C) ______________________

(B) ______________________ (D) ______________________

4. List the variety meats available in the lamb carcass.

(A) ______________________ (D) ______________________

(B) ______________________ (E) ______________________

(C) ______________________ (F) ______________________

5. In reference to the process of breaking a lamb carcass into wholesale and retail cuts, the meat cutter should be aware of the two general observations made by the Lamb Division of the American Sheep Producers Council. These are:

(A) ____

(B) ____

6. When the meat cutter breaks the lamb carcass by removing the shoulders, breasts and foreshanks as one piece, the result is known by different names. These are:

(A) ______________________ (D) ______________________

(B) ______________________ (E) ______________________

(C) ______________________ (F) ______________________

7. List the steps for removing the legs from the lamb carcass.

(A) ______________________________

(B) ______________________________

(C) ______________________________

(D) ______________________________

8. The amount of meat to be left covering the sirloin bone when removing the leg will follow one of three general practices. These are:

(A) ______________________________

(B) ______________________________

____

(C) ______________________________

9. The sirloin slices removed from the end of a leg of lamb are known by various names throughout the country. List the more popular names for these slices.

(A) ______________

(B) ______________

(C) ______________

(D) ______________

(E) ______________

(F) ______________

(G) ______________

(H) ______________

10. List the advantages of a boneless leg as a sales item for the home food-freezer trade.

(A) ______________________________

(B) ______________________________

(C) ______________________________

11. The lamb shoulder yields a variety of retail cuts. List the common types of cuts from a lamb shoulder.

(A) ______________

(B) ______________

(C) ______________

(D) ______________

12. List the various causes for the excessive seepage of juices from a rolled shoulder.

(A) ____________________

(B) ____________________

(C) ____________________

(D) ____________________

Assignment
Sheet No. 10

Covering
Units 111-117

PREPARING POULTRY FOR THE RETAIL MARKET

Poultry is generally considered to include all domestic birds which have been grown for either eating purposes, egg supply or exhibition. The most common of these birds, used for meat purposes, include chickens, turkeys, ducks, geese, and guineas. Of these various types of poultry used for meat consumption, chicken is by far the most popular.

When buying poultry to be used for retail sale the meat cutter must consider four factors which will affect the price and the method used to prepare the cuts. These are: (1) the kind or breed; (2) the class; (3) the grade; and (4) the market style of processing.

In this unit you will have an opportunity to become familiar with the grades and classes of dressed poultry and the various methods used to process the poultry for retail sale.

Assignment:

1. Read the references listed below.
2. Answer the questions below and turn in this assignment by ______________________ .

References:

A. Ziegler, The Meat We Eat, pp. 203-226
D. NARGUS, Self-Service Meats, pp. 103-108.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. Broiler chickens are smaller than fryers.

T F 2. The use of poultry for meat depends to a great extant upon the breed.

T F 3. When the turkey's skin becomes bluish in color it is ready to be taken off feed and processed as a meat product.

T F 4. The most widely used and approved method of bleeding poultry is to cut the throat inside the bird's mouth.

T F 5. The use of the debraining method to kill the bird makes dry picking easier.

T F 6. Dry picking is the most widely used method of removing the feathers from the bird.

T F 7. A blood or feather dressed carcass contains all of the inner organs or entrails.

T F 8. Special sanitized cord is used to truss up the dressed bird.

T F 9. The average family finds the hen turkeys better suited for roasting than tom turkeys.

T F 10. The practice of quartering or halving a large turkey is not recommended under any circumstances.

T F 11. It is very difficult to dry pick waterfowl.

T F 12. The process of dressing guineas is very similar to that used for dressing chickens.

T F 13. The weights of dressed guinea and pheasant carcasses will be very similar.

T F 14. In order to be assigned a U. S. Grade and tagged, a turkey carcass must have an internal temperature of at least 36° F.

T F 15. Turkey carcasses which show bad effects from being frozen can not be graded higher than Grade A.

T F 16. The sale of large tom turkeys to the housewife may be increased by dividing and selling the carcass as individual pieces.

T F 17. Boned and rolled turkey roasts are tied in a manner similar to a boneless cut of beef or pork.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. All poultry products moved in interstate or foreign commerce, or in major consuming areas, have been Federally inspected since the passage of legislation in the year _______ .
2. Chicken fryers will weigh from _________ to __________ pounds.
3. Heavy capons will weigh over _________ pounds.
4. Green ducks and geese are about _______ months old.
5. Chickens should be kept off feed from ________ to ________ hours before killing.

6. An instrument used to sever heads, necks or shanks is known as a ____________ shears.

7. One of the most successful methods used to remove pin feathers, hair, and scale from the carcass is __________ picking.

8. To remove the entrails from a broiler, the meat cutter may make the first cut on either side of the ____________ bone.

9. The greatest sale of tom turkeys for roasting is to the ________ and _____________ trade.

10. Because of the tight feather cover on waterfowl, the recommended process for removing the feathers is to ___________ them.

Multiple-Choice

Directions: In the space at the left of each statement, write the letter of the item which will provide the correct answer to complete the statement.

_____ 1. One of the primary reasons that the prices and demands for poultry remain rather steady throughout the year is (A) the greater number of farmers raising poultry for meat sale; (B) the successful use of freezer storage; (C) improved methods of dressing poultry; (D) the public acceptance of poultry as a meat product.

_____ 2. A poultry carcass with a high blood content may result from (A) the type of feed provided; (B) the withholding of water for a day or longer prior to slaughter; (C) allowing the bird to become over-heated prior to slaughter; (D) the method used to kill the bird.

_____ 3. Hot scalding to remove feathers is not used on birds to be sold because (A) it is a slow, expensive process; (B) the feathers can not be reclaimed for sale as a by-product; (C) it destroys the natural bloom of the carcass; (D) all of the preceding.

_____ 4. The method now used rather universally in large poultry packing plants for removing the feathers from the birds is (A) dry picking; (B) hard scalding; (C) hot scalding; (D) slack scalding.

_____ 5. One of the meatiest birds, in terms of the ratio of meat to bones, used for human consumption is the (A) chicken; (B) turkey; (C) duck; (D) guinea; (E) pheasant.

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. List the various classes of chickens.

(A) ______________________

(B) ______________________

(C) ______________________

(D) ______________________

(E) ______________________

(F) ______________________

(G) ______________________

(H) ______________________

(I) ______________________

(J) ______________________

(K) ______________________

(L) ______________________

(M) ______________________

2. List the various classes of turkeys.

(A) ______________________

(B) ______________________

(C) ______________________

(D) ______________________

(E) ______________________

3. List the various classes of ducks and geese.

(A) ______________________

(B) ______________________

(C) ______________________

(D) ______________________

4. Beginning with the step after rough picking, list the steps in the wax picking process.

(A) ____

(B) ____

(C) ____

(D) ____

(E) ____

5. List the steps to be followed in preparing a full dressed carcass.

(A) ____________________

(B) ____________________

(C) ____________________

(D) ____________________

(E) ____________________

(F) ____________________

(G) ____________________

(H) ____________________

6. List the individual parts of a cut-up chicken in the order of their monetary value.

(A) ____________ (C) ____________ (E) ____________

(B) ____________ (D) ____________ (F) ____________

7. List in order, highest first, the U. S. Standard Grades for chickens and turkeys.

(A) ________ (B) ________ (C) ________ (D) ________

Assignment
Sheet No. 11

Covering
Units 118-133

PREPARING FISH AND SHELLFISH

Fish and shellfish are delicately flavored, have high food value and are adaptable to a variety of cooking methods. They are available fresh, frozen, and in some cases, cured. The fresh products can be displayed attractively in refrigerated cabinets with ice. The frozen products must be displayed and maintained in a frozen condition.

These meats are highly perishable and so need very careful handling from the time they are caught until they are prepared for eating by the customer. The first principle in the fish section is freshness and this calls for frequent inspection and close quality control.

Although the retail meat cutter may have few opportunities to process fish products for sale, he should be familiar with the techniques.

Customers are probably less familiar with cooking methods for fish than they are of other meats. This is probably more true of interior areas than coastal. In either case the retail meat cutter should become as much of an expert on fish cookery as he is of other meats. Being able to answer customer's questions makes sales and repeat sales.

In this unit you will have an opportunity to become familiar with some of the techniques of dressing and cutting fish, the market forms of fish and shellfish, their food values, handling methods, and cooking procedures.

Assignment:

1. Read the references listed below.
2. Answer the questions below and turn in this assignment by ______________________ .

References:

G. U. S. Dept. of Interior, Basic Fish Cookery, pp. 1-25
I. Information Sheet No. 2

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. The proteins found in fish are not easily digested.

T F 2. The mineral content of fish is similar to that of beef.

T F 3. A pound of salmon will contain the same amount of carbohydrates as does a pound of beef or poultry.

T F 4. Salmon is a better source of Vitamin A than is beef.

T F 5. Drawn and whole fish may be cooked with or without the head, tail, and fins being removed.

T F 6. The cut for a fillet is made perpendicular with the backbone.

T F 7. The butterfly fillet is more common in the retail market than is the single fillet.

T F 8. Fish sticks may be made by cutting either parallel or perpendicular to the backbone.

T F 9. Lake trout and catfish are both classified as fat fish.

T F 10. The main market area for yellow perch includes only the states bordering the Great Lakes.

T F 11. Shellfish are classified as lean fish.

T F 12. Fresh fish of most varieties are abundant throughout the year.

T F 13. The gills of fresh fish will be bluish-green in color.

T F 14. If the retail meat department receives a shipment of frozen fish which has thawed during shipment, it should be refrozen immediately.

T F 15. Frozen fish must always be thawed before being placed in the container for cooking.

T F 16. Scaling of fish is more easily done if the fish is wet.

T F 17. When filleting, the rib bones are removed with the fillet.

T F 18. When skinning a fillet, the fillet is placed on the cutting board with the skin side down.

T F 19. Both fat and lean fish are considered suitable for frying.

T F 20. The oxidation of fish can be retarded by sealing the meat from contact with the air.

T F 21. The action of enzymes on fish products can be controlled by sanitary handling practices and low storage temperatures.

T F 22. Finely crushed ice is better for packing fresh fish than large pieces of ice.

T F 23. The ice glazing on some frozen fish products is done by dipping the product into cold water <u>after</u> it has been frozen.

T F 24. Frozen fish are inferior to fresh fish in both flavor and food value.

T F 25. A strong fishy odor is characteristic of top quality frozen fish.

T F 26. The larger the shrimp the higher will be its selling price per pound.

T F 27. The size of the oyster will determine the quality but not the selling price.

T F 28. Lobster meat will have a clear whitish color.

T F 29. Fresh shellfish can be kept at room temperature for several hours without affecting its quality or wholesomeness.

T F 30. Thawing procedures for frozen shellfish are the same as for frozen fish.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. There are approximately __________ varieties of fish sold in the United States, but the average consumer is familiar with only about __________ different species.

2. A pound of canned salmon will contain about _________ calories.

3. By weight, the fat content of fish will vary from __________ to ____________ per cent.

4. Before the whole or round fish can be cooked it must be ______________ and __________________ .

5. Fish steaks may be cut from the larger sizes of ________________ fish.

6. The largest bone in a fish steak will probably be a cross section of the ______________ bone.

7. Fish sticks are cut from either ______________ or _______________ portions of the fish.

8. The market range of round haddock is from __________ to _________ pounds.

9. The main market area for shrimp is the __________ __________ __________ .

10. The average edible serving of fish per person will be about __________ to __________ pound.

11. The preferred method of thawing frozen fish is in an atmosphere ranging from ________ to ________ degrees F.

12. One of the most frequent causes of fish cooking failures is __________ .

13. After fried or deep fat fried fish have been cooked, they should be allowed to drain by placing them on __________ paper.

14. When properly cooked, the flesh of fish will __________ easily when tested with a fork.

15. If the quality and wholesomeness of either fresh or frozen fish is to be maintained it must be kept under constant __________ .

16. The preferred temperature for preserving the wholesomeness of fresh fish is ________ to ________ degrees F.

17. Frozen fish products placed in storage without a moisture-vapor-proof covering will deteriorate because of a gradual loss of __________.

18. If purchased in the shell, the shellfish must be __________ or the meat must be __________ in the shell.

19. Shellfish marketed as cooked meat is ________ per cent edible.

20. When cooked, the shells and meat of shrimp will turn a __________ tint.

21. Shucked oysters will be __________ in color and have a __________ liquid.

22. High quality, wholesome oysters will have a pH factor of ______ .

23. When cooked in the shell, crabs and lobsters will be __________ __________ in color.

24. Thawed frozen scallops and fresh scallops will have a __________ odor.

25. The most common crab specie on the market is the __________ crab.

26. Fresh shellfish should be stored in a temperature near ________ degrees F.

Multiple-Choice

Directions: In the space at the left of each statement, write the letter of the item which will provide the correct answer to complete the statement.

______ 1. The mineral needed by the body and which is found in greater amounts in fish than in beef is (A) iron; (B) copper; (C) magnesium; (D) iodine.

______ 2. An average serving of salmon or mackeral will supply the body with the daily requirement of Vitamin (A) A; (B) B; (C) C; (D) D.

______ 3. Fish marketed with only the entrials removed are known as (A) shucked; (B) dressed; (C) drawn; (D) carcass; fish.

______ 4. Fins should never be removed by cutting or shearing them flush with the skin surface because (A) the root bones are left in the meat; (B) excessive bleeding will occur; (C) the bones are very hard and will dull the blade; (D) it is difficult to do a smooth job.

______ 5. When filleting, the first cut is made from (A) the tail to the head and along the belly; (B) the tail to the head and along the backbone; (C) from the head to the tail and along the belly; (D) from the head to the tail and along the backbone.

______ 6. Which one of the following is not a preferred method of cooking fat fish? (A) planking; (B) steaming; (C) baking; (D) broiling.

______ 7. The result of oxidation can be detected on fish by the appearance of (A) fungus growth; (B) greenish mold growth; (C) yellow discoloration; (D) a shrunken, dried-out surface.

______ 8. The best preservative for fresh fish is (A) salt; (B) ice; (C) sugar; (D) warm water.

______ 9. Top quality frozen round or dressed fish are usually protected from the air by being covered with (A) salt; (B) moisture-vapor-proof wrapping film; (C) a glaze of ice; (D) heavy waxed paper.

______ 10. When the shellfish meat has been removed from the shell and marketed in this form, it is referred to as being (A) drawn; (B) headless; (C) dressed; (D) shucked.

______ 11. The edible portion of shrimp is its (A) tail; (B) legs; (C) claws; (D) head.

______ 12. "Green shrimp" refers to (A) any uncooked shrimp; (B) the color of the shell; (C) the wrapping material used; (D) very small young shrimp.

______ 13. When a live lobster is picked up, the tail will (A) curl over the top of the body; (B) curl under the body; (C) hang down from the body; (D) extend straight up from the body.

______ 14. Soft crabs are (A) king; (B) rock; (C) dungeness; (D) blue; crabs which have lost their hard shell.

______ 15. Scallop meat consists of (A) the legs; (B) the back muscle; (C) the muscle that closes the shell; (D) the muscle of the claw.

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. The best known market forms of fish are:

(A) ______________ (E) ______________

(B) ______________ (F) ______________

(C) ______________ (G) ______________

(D) ______________

2. List the species of fish included in the shellfish group.

(A) __________ (C) __________ (E) __________

(B) __________ (D) __________ (F) __________

3. List the amount of fish required for the following market forms to yield one average serving.

whole-- (A) __________

dressed-- (B) __________

sticks-- (C) __________

fillets-- (D) __________

steaks-- (E) __________

4. List the steps involved after scaling to prepare a dressed fish.

(A) ______________________ (E) ______________________

(B) ______________________ (F) ______________________

(C) ______________________ (G) ______________________

(D) ______________________

5. List the three main causes for the breakdown in quality of fishery products.

(A) ______________________ (C) ______________________

(B) ______________________

6. List two methods used to retard the action of oxidation.

(A) ____

(B) ____

7. The market forms for shellfish include:

(A) ______________ (C) ______________ (E) ______________

(B) ______________ (D) ______________

8. List the four species of crabs on the market and the general areas from which they are obtained.

	<u>Specie</u>	<u>Production area</u>
(A)		
(B)		
(C)		
(D)		

Information
Sheet No. 2

FRESH AND FROZEN FISH*

Fish, being a perishable commodity, should be kept under refrigeration at all times. Only in this way can the quality of fresh or frozen fish be maintained. The three primary causes of breakdown in quality of fishery products are (1) bacterial action, (2) oxidation of the oil or fat in the flesh, and (3) enzymic action in the flesh.

Bacterial action contaminates fishery products when there is poor sanitation in handling and high temperature after the fish have been removed from the water. It is almost entirely arrested when fish are frozen and stored at very low temperatures. It can be considered practically eliminated as long as the fish are kept in this condition.

Oxidation of the oil or fat can cause spoilage of frozen fish even in cold-storage rooms of low temperature. Oxidation is indicated by a yellow discoloration on the surface of the skin or on the flesh in areas exposed to the air. This action is greatly retarded when the fish are properly glazed with a thin coating of ice, or are covered with any of several moisture-vapor-proof wrappings available.

Enzymes responsible for the third type of spoilage are substances in the flesh which build up and tear down the body tissues during the normal life processes. These reactions are common to all forms of animal life and are automatically controlled as long as life is maintained. Although the temperature at which fish are stored has a definite effect on the speed of the digestive reaction of the enzymes after death, the enzymic action cannot be stopped completely during handling and storage. Under good storage conditions, however, the action has no important effect on quality.

Handling and Storing Fresh Fish

Fresh fish should be kept constantly below 40 degrees F., and preferably at 31 or 32 degrees F. to insure maximum storage life. Ice is the best preservative yet devised for keeping fresh fish, since it not only holds the temperature but also keeps the surface of the fish moist and in good condition.

Shipments of fresh fish should be examined immediately upon receipt for signs of spoilage and body damage. They should be packed in ice for delivery, and should be well iced when received. Finely

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*Adapted with permission from Fresh and Frozen Fish Buying Manual, Circular No. 20, United States Department of the Interior, Superintendent of Documents, U. S. Government Printing Office, Washington 25, D.C.

crushed ice is preferable to large pieces, as it does not bruise the fish. Fish packed in orderly arrangement hold their natural shape longer and better. Rough handling should be avoided, since bruises and punctures of the flesh induce and hasten breakdown in quality.

Handling and Storing Frozen Fish

Frozen fish should be kept solidly frozen until ready for use. Do not refreeze fish that have been thawed. Maximum storage life can be obtained by maintaining a temperature of zero degrees F., or below, and by providing adequate moisture-vapor-proof wrapping or glazing. In commercial practice, frozen whole fish, and sometimes dressed fish, are coated with a layer of ice by dipping in cold water after freezing. If fish are placed directly in the refrigerated space without suitable protective treatment, undesirable changes will take place during cold storage: a gradual loss of moisture will occur until the fish are shrunken and dried; this dehydration not only causes an unsightly appearance and alteration in texture, but also results in loss in weight and flavor.

Buying Frozen Fish

Frozen varieties are usually packed during seasons of abundance at reasonable prices, and now are available the year around in practically all sections of the country. Since frozen fish are the equal of fresh fish in appearance, flavor, and food value, the two forms may be used interchangeably.

Frozen fish of good quality have the following characteristics:

1. Flesh: Should be solidly frozen when bought. Virtually all deterioration in quality is prevented when fish is properly held in the frozen state. Unless care is taken, frozen fish thawed and refrozen is poorer in quality. There should be no discoloration, or brownish tinge in the flesh.
2. Odor: Frozen fish should have little or no odor. A strong fishy odor means poor quality.
3. Wrapping: Most frozen fillets and steaks are wrapped either individually or in packages of various weights. The wrapping should be of moisture-vapor-proof material. There should be little or no air space between the fish and the wrapping.
4. Glazing: Whole fish frozen in the round or dressed forms are usually not wrapped, but covered with a glaze of ice to protect them from drying out, or from "freezer burn." This glaze should be on these forms of frozen fish when bought.

Buying Shellfish

Shellfish are marketed in many different forms. Some are marketed alive, and other forms, depending on the variety, include cooked whole in the shell, fresh meat(shucked), headless, and cooked meat.

In shell: Shellfish, such as hard and soft blue crabs, lobsters, clams, and oysters should be alive if bought fresh in the shell. Crabs and lobsters may also be cooked in the shell.

Shucked: Clam, oyster, and scallop meats may be bought free of the shell, commonly known as shucked. In this form the portion is 100 per cent edible.

Headless: Only the tail part of shrimp is commonly marketed. Spiny-lobster tails are also a common market form. About 85 per cent is edible.

Cooked meat: The edible portion is picked from the cooked shellfish, and crab, shrimp, and lobster meat is marketed in this way. Cooked meat is perishable, although packaged in containers, since it is not further processed by heat. It is 100 per cent edible.

Market forms of some of the most important species are described here.

<u>Shrimp</u>: Shrimp is sold in the following forms:

1. Fresh, whole (heads on).
2. Fresh or frozen, headless, but with shells on.
3. Fresh or frozen cooked, generally peeled (shells removed) and cleaned.
4. Frozen, breaded with a coating of crumbs or cornmeal after being peeled and cleaned.

Fresh shrimp have a mild odor, and the meat is firm in texture. The color of the shell may be grayish green, pinkish tan, or light pink. When cooked, the shells turn red, and the meat takes on a similar attractive reddish tint, with possibly some dark-red spots. When shrimp are sold as "green shrimp," this does not refer to the color or species, but is a term used in the trade to describe shrimp that have not been cooked. Shrimp are usually sold on a size basis, with the larger sizes bringing the higher prices.

<u>Clams and Oysters</u> -- Clams and oysters in the shell should be alive--the shells should close tight when tapped gently.

Shucked oysters should be plump and should have a natural creamy color and clear liquid. If in the original package or can, there should be not more than 10 per cent of liquid (by weight). Oysters with an excess amount of liquor should be avoided, as this indicates that they have been improperly handled. Excessive water results in bloating of the oyster meat, and partial loss of flavor and food value. For purchasers who use a chemical test for freshness, the pH should be at least 6.0.

Oysters are sold on a size basis. The price differential between the various sizes does not reflect their quality. The sizes generally adopted by dealers conform to the Government classifications and specifications.

Crabs and Lobsters -- When bought alive, crabs, lobsters, and spiny lobsters should show movement of the legs. The "tail" of live lobsters curls under the body and does not hang down when the lobster is picked up.

Spiny-lobster or rock-lobster tails, forzen, should have meat of clear whitish color. There are several kinds on the market. Those from Florida, Cuba, and the Bahamas have a smooth, brownish-green shell, with white spots; those from South Africa, Australia, and New Zealand have a rough shell with the color varying from dark maroon to brown; those from Southern California and the west coast of Mexico are smooth and yellow green. As is true with other frozen fish and shellfish, frozen lobster tails should be hard-frozen when bought and should have no odor.

Crabs and lobsters, cooked, should be bright red and should have no disagreeable odor. By lifting slightly the lid under the body section of crabs it is possible to smell any strong, disagreeable odor very easily.

Crab meat, cooked, is marketed from four varieties of crabs:

1. Blue crabs: The meat from blue crabs is packed as--
   Lump meat--whole lumps of white meat from the large body muscles that operate the swimming legs.
   Flake meat--small pieces of white meat from the body.
   Flake and lump--a combination of the first two kinds.
   Claw meat--brownish-tinted meat from the claws.

The blue crab is found along the Atlantic and Gulf Coasts and accounts for about three-fourths of all crabs marketed in the United States.

2. Rock crabs: Crab meat from the New England rock crab is marketed in only one grade, and is brownish in color.
3. Dungeness crabs: Crab meat from the Dungeness crabs of the Pacific coast includes that from both the body and the claws. The claw, or leg, meat is reddish; the body meat is white.
4. King crabs: Crab meat from the king crabs of Alaska is taken mostly from the legs, then frozen and packed. The entire leg sections, cooked and frozen, are also marketed.

Soft crabs are Atlantic-coast blue crabs that have shed their old, hard shells. They should be alive when bought fresh. They are also obtainable frozen.

Scallops -- Scallop meats consist of only the muscle that closes the shell of the sea scallop or the bay scallop. The meat of the large sea scallop is white; the meat of the smaller bay scallop is creamy white, light tan, or pinkish. Fresh scallops, and frozen scallops when thawed, should have a sweetish odor. When bought in packages, they should be practically free of liquid.

Handling and Storing Shellfish

When storing fresh shellfish, the temperature should be maintained near 32 degrees F. A few degrees higher can cause a considerable loss in quality in a few hours. Shellfish meats, either fresh or cooked, should not be exposed to bacterial contamination.

Frozen shellfish should receive the same care as that given frozen fish. Thawing methods for frozen shellfish are the same as those for frozen fish.

Assignment
Sheet No. 12

Covering
Units 134-138

PREPARING GROUND AND READY-TO-SERVE MEATS

One of the first responsibilities a new meat cutter may be given in the meat department is to grind or slice meat products, wrap them, and stock the self-service display. Being knowledgeable about the processes, types of sausages, and care of these products will get the new meat cutter off to a good start with his employer.

The ground and ready-to-serve meats are an important part of the profits in the meat department. The extent of this profit will depend in part upon the meat cutters understanding of the products, his observation of customer needs, and suggestions he may make to increase these profits.

In this unit you will have an opportunity to gain some background information on the development of sausages, learn about the various types of sausage products and their composition, and become acquainted with some techniques for preparing and displaying these meat products.

Assignment:

1. Read the references listed below.
2. Answer the questions below and turn in this assignment by ____________________.

References:

A. Ziegler, The Meat We Eat, pp. 307-329.
B. Bull, Meat for the Table, pp. 178-183.
C. American Sheep Producers, Lamb Cutting and Merchandising Manual, Chapter 11.
D. NARGUS, Self-Service Meats, pp. 96-102.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. Cold cuts or luncheon meats are not considered to be sausage.

T F 2. The processing of meats into sausages has been developed within recent years.

T F 3. The Federal government does not permit the use of harmless dyes for the coloring of sausage casings.

T F 4. Casings used for sausages are classified as either natural or artificial.

T F 5. According to Bull, the most popular type of fresh sausage is hamburger.

T F 6. Weiners must be cooked before they are eaten.

T F 7. Dry sausages have very poor keeping qualities.

T F 8. All meat loaves are cooked during the process of manufacture.

T F 9. Summer sausage (Wisconsin style) is predominatily beef which has been cooked but not smoked.

T F 10. Country style, fresh pork sausage is an all-pork product.

T F 11. Natural casings for sausages may be made from the small and large intestines of hogs, sheep, and cattle.

T F 12. When beef and pork are to be combined into a sausage product, they should be ground separately.

T F 13. The terms "frankfurters" and "weiners" refer to the same type of meat product.

T F 14. Scrapple is a combination of various meats, cereals and seasoning.

T F 15. In most cases, dry and semi-dry sausages must be cooked before being eaten.

T F 16. Semi-dry sausages should be stored in a humid place with an even temperature below 50 degrees F.

T F 17. Caserta Peperoni is a fancy sausage originating in Italy.

T F 18. Nearly all salami sausages contain garlic.

T F 19. There are over twenty different varieties of salami on the market.

T F 20. Tripe is made only from the stomachs of cattle.

T F 21. Chitterlings are the cleaned and cooked intestines of swine.

T F 22. Head cheese, liver pudding, and blood pudding are considered to be sausage.

T F 23. Because of the cost of lamb cuts, the meat used for ground lamb should come from those cuts which have not sold and have lost their fresh appearance.

T F 24. Grinding lamb a second time will make it more tender and improve its appearance.

T F 25. Ground lamb sells best when made into one pound packages.

T F 26. Ground lamb for meat loaves will sell best during cool weather.

T F 27. It is not advisable to display two grades of ground lamb because only the cheaper grade will sell.

T F 28. When used alone, the breasts are the best source of meat for ground lamb.

T F 29. The presence of some fat in ground lamb will improve its flavor and greatly reduce shrinkage when cooked.

T F 30. Semi-moisture proof film should be used for wrapping ready-to-serve meats.

T F 31. It is a good practice to wrap ready-to-serve meats in packages containing various numbers of slices.

T F 32. When not on display, packaged luncheon meats should be stored in a dark place or covered with an opaque material.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. The meat industry considers sausage to be any ______________ or ____________________ meat.
2. The Latin word "salsus", from which the term sausage is derived, means ________________ .
3. The German term for sausage is _______________ .
4. Cereal and flour, which are added to sausages, are added for _________________ or holding purposes.
5. Crackers may be added to the sausage mixture in the process of manufacture to hold the mixture together, improve the ________________, and absorb ________________ .
6. When a part of the digestive tract from hogs, cattle or sheep is used as casings for sausages, the casing is classified as __________________ .
7. The type of casing which is not edible and must be removed from the sausage is known as __________________ .
8. The most popular cooked sausage is the ____________________ .

9. Another term sometimes used to designate dry sausages is ________________ sausages.

10. Sausages prepared according to the rules and regulations of the Jewish faith are referred to as _______________ sausages.

11. The consumption of sausage in the United States constitutes about one out of every _________ pounds of meat produced.

12. In the production of luncheon meats the product may or may not be smoked but it will always be ______________ .

13. A 200-pound, dressed hog carcass which is ground into sausage will yield about _____________ pounds of sausage, ___________ pounds of fat and _____________ pounds of bone.

14. Shaved ice is added to the sausage mixture in the silent cutter for the purposes of adding moisture and reducing ______________ .

15. The original wiener was made from a combination of ___________ and pork.

16. The major meat item found in braunschweiger is pork ____________.

17. Cervalet is the name of a semi-dry sausage originating in the country of ______________ .

18. Salami is characterized by its ______________ chop and _________________ flavor.

19. Two methods of promoting lamb patties is to sell them by the pound and at _______________ prices.

20. Ground lamb which is too lean will be ___________ when cooked.

21. Twisting the ends of the film used to wrap luncheon meats, rather than heat-sealing them, is referred to as ___________ -wrapping.

22. The problem of discoloration of luncheon meats can be reduced by the use of _________________ packaging.

Multiple-Choice

Directions: In the space at the left of each statement, write the letter of the item which will provide the correct answer to complete the statement.

______ 1. The original reason for producing sausage was to (A) make a more economical meat product; (B) utilize the unmarketable meat scraps; (C) preserve fresh meat; (D) reduce storage space required for meat cuts.

______ 2. Spices are added to the chopped or ground meat for the purpose of (A) adding flavor; (B) preserving the meat; (C) adding color to the product; (D) counteracting the acids generated by the meats.

______ 3. Which one of the following is <u>not</u> one of the main classes of sausages? (A) fresh; (B) cooked; (C) dry; (D) smoked.

______ 4. The meats most commonly used in the making of weiners are (A) pork and lamb; (B) pork and beef; (C) beef and lamb; (D) beef and veal.

______ 5. Kosher sausages will contain no (A) beef; (B) pork; (C) lamb; (D) fish.

______ 6. The production of sausage products is of such quantity as to provide each person in the United States with approximately (A) 13.5; (B) 21; (C) 28.5; (D) 43.2 pounds.

______ 7. Most of the dry and semi-dry sausages originated in Europe and their names are derived from (A) the method used to wrap them; (B) the family name of the originator; (C) the seasoning which is used most predominately; (D) the town in which they originated.

______ 8. Storing fancy sausages under temperatures which vary greatly will result in (A) loss of flavor and color; (B) sweating and mold formation; (C) a loss of juices and shrinkage; (D) the proper aging of the product.

______ 9. Goteborg sausage was named after the town of Goteborg in (A) Germany; (B) Austria; (C) Italy; (D) Sweden.

______ 10. The principal meat used in salami is (A) beef; (B) veal; (C) pork; (D) mutton.

______ 11. One of the major disadvantages of shingling slices of ready-to serve meat when wrapping is (A) the extra time required; (B) that a larger package is required; (C) that a greater cut surface is exposed to the light; (D) the tendency for the edges to cur.

______ 12. One of the major problems the retail meat cutter encounters with self-service luncheon meat products is (A) keeping the packages at a constant temperature; (B) discoloration of the meat because of exposure to light; (C) breakage of wrapping because of excessive customer handling; (D) providing a variety of products to meat customer demands.

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. List the types of meats commonly used in the making of sausage.

(A) ______________________ (C) ______________________

(B) ______________________ (D) ______________________

2. List the non-meat "binders' used in the manufacture of sausages.

(A) ______________ (C) ______________ (E) ______________

(B) ______________ (D) ______________ (F) ______________

3. In addition to fresh or cured meats, meat loaves may also include:

(A) ______________ (C) ______________ (E) ______________

(B) ______________ (D) ______________ (F) ______________

4. List the types of sausages Ziegler classified as "Domestic Sausages."

(A) ______________________ (E) ______________________

(B) ______________________ (F) ______________________

(C) ______________________ (G) ______________________

(D) ______________________ (H) ______________________

5. List the miscellaneous meat items which may be used as fillers or binders in sausage.

(A) ______________________ (F) ______________________

(B) ______________________ (G) ______________________

(C) ______________________ (H) ______________________

(D) ______________________ (I) ______________________

(E) ______________________ (J) ______________________

6. Equipment used in sausage production includes the following:

(A) ______________________ (D) ______________________

(B) ______________________ (E) ______________________

(C) ______________________ (F) ______________________

Assignment
Sheet No. 13

Covering
Units 139-142

PREPARING AND SERVING MEATS

Not only should the retail meat cutter know how to break down a carcass into retail cuts but he should also be somewhat of an expert on cooking methods for meats.

What is the best way to cook porterhouse steak? Can all grades of the same type cuts be cooked in the same way? At what temperature should the oven be set to roast a ten-pound goose? Will aging a Good grade beef carcass for three weeks improve its tenderness and flavor? What meat cuts are a good source of Vitamin A? These and many other questions will be asked by customers, and they ask the meat cutter because they expect him to know.

The introduction of the delicatessen as a part of the retail grocery store also makes it imperative that the meat cutter understand meat cooking methods. Being able to purchase prepared meats has been well accepted by the busy housewife. This aspect of the retail meat business may grow rapidly in the next few years, but to do so will require individuals who know meat cookery.

The skills of the meat cutter may also be called upon to carve the turkey or roast at the dinner table. At this task he should be as much of an expert as he is at making fresh meat cuts. Developing the "art of carving" can be a real asset to the individual. It is an art at which few people excell and one which makes a favorable impression when skillfully done.

In this unit you will have an opportunity to become familiar with the composition and nutritional values of meat, methods used in meat cookery, and meat carving techniques. This unit is not a thorough coverage of these aspects, but rather it is hoped that the reading will stimulate further study and skill development. The only way you will become proficient in cooking or carving meat is to actually do it. You don't develop the skill by just reading about it!

<u>Assignment</u>:

1. Read the references listed below.
2. Make a chart of the various meat cuts at your work station; the methods used to cook them, the temperatures required, and the length of cooking time when appropriate. Become familiar with the chart and refer to it when needed. (See Reference B, pp. 52-54) It is also suggested that you start a card file of recipes for various meat dishes, sauces, bastings, and stuffings. Become more conscious of meat cooking methods used at home and offer to carve at every opportunity.
3. Answer the questions below and turn in this assignment by ______________________ .

References:

A. Ziegler, *The Meat We Eat*, pp. 248-284, 374-409.
B. Bull, *Meat for the Table*, pp. 213-227.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. The heart is classified as an involuntary, striated muscle.

T F 2. The most tender cuts of meat will contain a great amount of connective tissue.

T F 3. Meats contain all of the essential amino acids needed by the human body.

T F 4. Pork usually contains a lower percentage of protein than does either beef or lamb.

T F 5. The digestibility of animal fats is very low.

T F 6. In the live animal lactic acid changes to glycogen.

T F 7. A fat beef carcass will contain less water than a lean carcass.

T F 8. A high myoglobin content in older beef will result in a dark-colored meat.

T F 9. Aging of meat will reduce its tenderness.

T F 10. The color of the lean and fat of a meat cut is a reliable method to determine the quality of the cut.

T F 11. A high degree of marbling will generally be associated with a highly finished, mature animal.

T F 12. Liver is one of the best sources of Vitamin B_6

T F 13. Meats are the best source of Vitamin C.

T F 14. When cooking meat on a charcoal grill, the individual is employing the broiling method of cooking.

T F 15. The dry heat method of cooking meat is recommended for the more tender cuts.

T F 16. The recommended oven temperature for roasting fresh beef, veal, or lamb is 200 degrees F.

T F 17. Cuts which have not been boned will require less time per pound to cook than boneless cuts.

T F 18. Fresh pork should never be broiled.

T F 19. Refreezing meat should not be done because it will seriously affect the quality of the meat.

T F 20. As long as meat freezing occurs below 10° F., the quality of the meat is not materially affected.

T F 21. The flavor of fat will be more affected by freezer storage than will the lean.

T F 22. When preparing ducks or geese for roasting, it is NOT necessary to rub the outside surface with a fat prior to placing the bird in the pan.

T F 23. When steaming or braising an old bird prior to roasting, the lid of the roaster should be removed.

T F 24. It is recommended that giblets to be used in the stuffing of a bird be pre-cooked.

T F 25. Old birds are better suited for broiling than young birds.

T F 26. The flavor of an old bird is superior to that of a young bird when they have both been stewed.

T F 27. For carving purposes a bird may be placed either on its back or side.

T F 28. After all is said and done it actually makes no difference which way the bird is pointed as you carve the meat.

T F 29. One of the most effective ways for a carver to show his guests that he is using a sharp knife is to sharpen it at the table.

T F 30. The blade of the knife used to carve steaks is shorter than that used to carve roasts or fowl.

T F 31. A steel is used for the purpose of sharpening dull knives.

T F 32. Very little pressure should be applied when steeling a knife blade.

T F 33. A leg of lamb is a recommended cut for the amateur carver to make his debut.

T F 34. If steaks are of sufficient size that carving is required for servings, the carver should remove the bone first.

T F 35. The tenderloin portion of the porterhouse steak should be placed closest to the carver when carving.

T F 36. The position of the leg of lamb on the platter for the purpose of carving will depend upon whether it is a right or left leg.

T F 37. Slices from the thick side of a leg of lamb are made first.

T F 38. The first slices are removed from the leg of lamb for the purpose of making a flat surface on which the roast can rest as the leg is carved.

T F 39. When carving a pork loin roast the ribs are used as a guide for slicing.

T F 40. Steaks may be carved with the grain because their meat fibers are more tender and shorter than those in roasts.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. The breakdown of proteins through the digestive process results in changing them to ________________ acids.

2. The melting point of fats from pork, beef, and lamb will fall in a range from ________ to ________ degrees F.

3. An exceptionally rich source of iron and phosphorus in a carcass is found in the ________________ meats.

4. The color pigment in meat is known as ________________.

5. The bright red color of meat, referred to as "bloom", is the result of myoglobin changing to oxymyoglobin when exposed to ________________.

6. Meat which has turned dark after being cut for some time may often be brightened by removing a ________________ inch slice from the darkened surface.

7. The lower grades of beef and lamb must be aged for a shorter period of time than the higher grades because they generally lack sufficient ________________ ________________.

8. The color of the bone in a meat cut is an indication of the ________________ of the animal.

9. The degree of marbling in a beef cut is a good indication of the ________________ of the cut.

10. A rich source of Vitamin A is ____________ and ____________ liver.

11. The absence of Vitamin B_1 in the diet may cause the nervous disease known as ____________.

12. If meat to be roasted is placed in the pan with the fat side up, a ________________ action will result.

13. The "doneness" of a roast can best be determined by using a meat ____________.

14. A simmer temperature is from ______ to ______ degrees F.

15. A medium-done, broiled, two-inch steak will require ______ to ______ minutes cooking time.

16. The effect of freezer burn can be partially overcome during cooking by adding ____________.

17. When roasting poultry the bird should be turned and basted about every ______ minutes.

18. The three primary bulk ingredients which are used for bird stuffing are ____________ ____________, ____________ ____________, or ____________ ____________.

19. When carving a bird that is positioned on its side, the first portion to be removed is the ____________.

20. The length of the knife blade for carving roasts or fowl should be about ________ to ________ inches.

21. When steeling a blade the stroke is begun with the ____________ of the blade against the ____________ of the steel.

22. When possible, roasts should be carved by cutting ____________ the grain of the meat.

23. The thickness of the slices carved from a rolled rib roast should range from ____________ to ____________ inches.

24. The thickness of the slices carved from a leg of lamb should range from ____________ to ____________ inches.

25. Before carving slices from a center-cut roast ham, it should be divided into ____________ pieces.

Multiple-Choice

Directions: In the space at the left of each statement, write the letter of the item which will provide the correct answer to complete the statement.

_____ 1. Visceral muscles are associated with the organs of (A) the respiratory system; (B) the intestinal tract; (C) skeletal system; (D) circulatory system.

_____ 2. The proteins found in meat that, along with fat, provide aroma and flavor to meat and thereby stimulate the flow of gastric juices are known as (A) nucleoproteins; (B) globulin; (C) albumins; (D) nitrogeneous extractives.

_____ 3. A large portion of the carbohydrates in the animal body is in the (A) pancreas; (B) heart; (C) liver; (D) kidney.

_____ 4. The retail meat cutter should remember that the MOST important aspect of the business is (A) his skill in preparing meat cuts; (B) customer satisfaction; (C) the quality of the meat; (D) competitive prices.

_____ 5. One of the primary reasons given for the tenderness of the tenderloin muscle is the fact that it (A) contains no bone; (B) can be aged more successfully; (C) receives little or no exercise; (D) is one of the larger muscles on the carcass.

_____ 6. The term "gravy cuts" refers to (A) only Choice grade cuts; (B) cuts with a high degree of marbling; (C) soft veal cuts; (D) low grade cuts.

_____ 7. One of the best sources of Vitamin B_1, thiamine, is (A) beef; (B) pork; (C) lamb; (D) fowl.

_____ 8. The vitamin which is essential for normal bone growth and teeth development is (A) Vitamin B_1; (B) Vitamin C; (C) Vitamin D; (D) Vitamin K.

_____ 9. The method of cooking meat which places the meat in direct exposure to the heat source is known as (A) braising; (B) roasting; (C) broiling; (D) basting.

_____ 10. Shrinkage of the meat can be reduced when roasting by (A) using a low temperature; (B) using a high temperature; (C) placing a lid on the roasting pan; (D) placing loose fat or bacon strips over the meat.

_____ 11. Another term commonly used for braising is (A) broiling; (B) panbroiling; (C) basting; (D) pot roasting.

_____ 12. When roasting poultry the bird is placed in the roaster (A) with the breast up; (B) on its side; (C) with the breast down; (D) any of the above may be used.

_____ 13. When carving a bird from the standing position and with the bird on its back, the legs of the bird should point (A) (A) toward; (B) away from; (C) to the left of; (D) to the right of the carver.

_____ 14. Which one of the following is NOT considered an advantage of carving a bird on its side? (A) It eliminates handling the second wing joint and thigh as separate pieces; (B) It makes removal of the drumstick easier; (C) It makes the breast easier to carve.

_____ 15. When used properly, the steel is pointing away from the body at about a (A) 30; (B) 45; (C) 60; (D) 90 degree angle.

_____ 16. Before a standing rib roast is carved, it is recommended that the (A) ribs; (B) cords; (C) backbone; (D) fat be removed.

_____ 17. When carving a standing rib roast, the cut is made (A) from right to left, always; (B) downward, toward the platter; (C) with the grain of the meat and toward the ribs; (D) across the grain of the meat and toward the ribs.

_____ 18. The loin roast of pork is positioned on the carving platter with the ribs (A) to the left of; (B) to the right of; (C) toward; (D) away from the carver.

_____ 19. The method used to carve a roast ham is very similar to that used to carve a (A) crown roast of lamb; (B) leg of lamb; (C) standing rib roast; (D) porterhouse steak.

_____ 20. The method used to carve a lamb crown roast is very similar to that used to carve a (A) standing rib roast; (B) rolled rib roast; (C) porterhouse steak; (D) loin roast of pork.

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. List the glands and organs which are considered variety meats.

(A) ______________ (D) ______________ (G) ______________

(B) ______________ (E) ______________ (H) ______________

(C) ______________ (F) ______________ (I) ______________

2. List the percentages of the following elements found in a lean muscle.

Water (A) __________ per cent Fat (C) __________ per cent

Protein (B) __________ per cent Ash (D) __________ per cent

3. List the minerals commonly found in animal meat.

(A) ____________

(B) ____________

(C) ____________

(D) ____________

(E) ____________

(F) ____________

(G) ____________

(H) ____________

(I) ____________

(J) ____________

(K) ____________

4. In addition to aging, list some materials and methods used to tenderize meat.

Materials

(A) ____________________

(B) ____________________

(C) ____________________

Methods

(D) ____________________

(E) ____________________

5. List the factors which should be considered in judging the quality of a meat cut.

(A) ____________________

(B) ____________________

(C) ____________________

(D) ____________________

6. The two fundamental methods used to cook meat are by the use of

(A) ____________________

(B) ____________________

7. List the materials which may be used to furnish moisture when braising.

(A) ____________________

(B) ____________________

(C) ____________________

(D) ____________________

8. The loss in weight of cooked meat can be attributed to

(A) ____

(B) ____

9. List the method of cooking the following meats and the time required for the cooking.

Meat		Method	Time
Corned beef	(A)		
Beef tenderloin	(B)		
Beef Swiss steak	(C)		
Fresh pork ham	(D)		
Pork chops	(E)		
Bacon	(F)		
Lamb chops (1 in.)	(G)		
Leg of lamb	(H)		
Lamb stew	(I)		
Rolled veal shoulder	(J)		
Veal chops	(K)		

10. The doneness of a roasted bird can be determined by

(A) ____________________

(B) ____________________

(C) ____________________

11. List in order, the parts to be removed and sliced when carving a roast pig.

(A) ____________________ (C) ____________________

(B) ____________________ (D) ____________________

12. List the oven temperature and roasting time for the following birds.

Bird		Oven Temperature (degrees F)	Time (Hours)
4 to 5 lb. chicken	(A)		
14 to 17 lb. turkey	(B)		
5 to 6 lb. duck	(C)		
10 to 12 lb. goose	(D)		
18 to 25 lb. turkey	(E)		

Assignment
Sheet No. 14

Covering
Units 143-149

REFRIGERATION, CURING, AND STORAGE OF MEATS

In the past, one of the major problems confronting the meat industry was keeping meat over a period of time in a condition suitable for its use as a food. In earlier days the principal method used to preserve meat was to pack in salt and/or submerge in a pickling solution various selected portions of the animal carcass.

Modern methods of meat preservation are far more successful than the former, but they do present problems which must be understood by the meat cutter. With the advent of mechanical refrigeration, in addition to the improved methods of canning, drying, salting, pickling, and other methods of curing, the industry has made rapid progress.

In this unit you will have the opportunity to learn the various methods of curing and storing meats; and the precautions which must be taken by the retail meat cutter in order to provide the customer with a quality product and service.

Assignment:

1. Read the references listed below.
2. Using any type of paper of sufficient size, wrap one of your textbooks with a butcher's wrap and another textbook with the apothecary or drug store wrap. Refer to your text or check with your employer for the procedures.
3. Answer the questions below and turn in this assignment by ____________________.

References:

A. Ziegler, The Meat We Eat, pp. 141-202.
B. Bull, Meat for the Table, pp. 168-177, 199-205.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. The early explorers from Europe introduced the dried meat called "jerky" to the Indians in the new world.

T F 2. The dry salting process for preserving meats was first used about 1500 A. D.

T F 3. Getting the curing pickle to the center of the fresh ham as quickly as possible greatly reduces the danger of loss from spoilage when curing hams.

T F 4. One of the advantages of using the artery method of curing hams is the uniform flavor which results.

T F 5. The tenderness of a ham will depend upon the type of curing pickle used.

T F 6. Canadian bacon is made from the sirloin muscle of heavy pork.

T F 7. Dried beef is usually made from the rounds of thin beef animals.

T F 8. A "pH" of 5 indicates the degree of acidity of a substance.

T F 9. Fresh meat with a high pH will have good color and keeping quality.

T F 10. Ingredients used in curing mixtures will slow down the action of bacteria in meat but will not destroy them entirely.

T F 11. Long cured hams generally have more flavor than do quick cured hams.

T F 12. The wood from resinous trees is used in the smoking of meats.

T F 13. The temperature in the smokehouse will determine the length of time required to smoke meat.

T F 14. The outside surface of smoked meat should be trimmed before cooking.

T F 15. The smoke deposits formed on the smokehouse walls are best removed by using a blow torch or similar flame device.

T F 16. The flavor of smoked turkey is very similar to that of a fresh roasted turkey.

T F 17. The keeping quality of cured and smoked turkey is <u>not</u> as good as that of cured and smoked pork.

T F 18. A satisfactory method for storing smoked meats without refrigeration does not appear to be available.

T F 19. The growth of mold on untreated smoked meats can be retarded by hanging the meat in a dry, well ventilated room with a temperature range from 45 to 55 degrees F.

T F 20. The tapeworm larva can be destroyed by thorough cooking or zero freezing.

T F 21. Little or no lamb is cured commercially.

T F 22. During the period from 1955 to 1960 there has been a decrease in the number of locker plants in the United States.

T F 23. Meat juices will freeze solid at 32 degrees F.

T F 24. Meat that has been aged prior to freezing will have a longer storage life than unaged meat.

T F 25. It is recommended that meat to be frozen and stored for some time before being eaten should have the fat trimmed close before freezing.

T F 26. Pork has a longer frozen storage life than beef.

T F 27. Tests have shown that removing the bones from cuts to be frozen and stored will affect the flavor and moistness of the meat.

T F 28. The drug store wrap is the most preferred method to use for meats to be frozen and stored.

T F 29. It is actually considered quite desirable and business-like to use "economy" wrapping paper.

T F 30. Properly prepared and wrapped fresh eggs may be kept at zero temperature for as long as one year.

T F 31. The oxidation of the fats accounts for spoilage of frozen fish just as it does in warm blooded animals.

T F 32. Frozen fish should not be stored with other meats because the odor and fish flavor will be absorbed by the other meats.

T F 33. Very few states have laws regulating the operation of locker plants.

T F 34. Frozen meats must be thawed before they are cooked.

T F 35. Frozen meats thawed slowly in the refrigerator will loose less juices than those thawed at room temperature.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. "Pemmican", a food prepared by the Indians, was a combination of dried ______________, ______________, and ______________ .

2. The practice of preserving meat by salting has been replaced by the process of ________________ the meat.

3. The two primary ingredients of a curing formula are ___________ and ______________ .

4. The addition of sugar to a salt and water brine or pickle makes a _______________ brine or pickle cure.

5. The length of time required to properly cure a ham will depend upon the ______________ of the pickle cure and the _______________ of the ham.

6. One of the best methods used to get the curing pickle to the center of the ham is by _______________ .

7. Beef which has been preserved by the use of salt is known as ________________ beef.

8. The pH of fresh meat will range from _______ to ________ .

9. The pH of fresh meat will depend upon the ______________ content of the muscle at the time of slaughter.

10. The ingredients of the curing pickle for turkey differs from that for pork in the ________________ used.

11. Sliced ham or bacon should not be kept in frozen storage for over ________ month(s).

12. The pork quality which makes it a good curing meat is its _____________ content.

13. The temperature in a commercial meat cooler is usually held at _____ to ________ degrees F.

14. The practice of renting cold storage lockers to customers for the storage of their meats and other items is reported to have been started in the year ________, in the city of ___________ __________________ .

15. The fat will oxidize and become rancid more quickly on a beef carcass that has been ___________ -fed as opposed to being ____________-fed.

16. Boning the cuts of meat to be placed in frozen storage can reduce the space needed by as much as ______ per cent.

17. One of the weaknesses of aluminum foil as a wrapping material is its lack of _______________ .

18. The method of wrapping meats for the freezer which is quick and provides a double thickness of paper over the meat is the _________________ wrap.

19. It is recommended that the storage period for frozen meats not be over ______________ months.

20. Properly wrapped fowl stored at zero temperatures may be kept from _________ to __________ months.

Multiple-Choice

Directions: In the space at the left of each statement, write the letter of the item which will provide the correct answer to complete the statement.

______ 1. Two popular woods used to smoke meat for preservation have been (A) cypress and gum; (B) walnut and gum; (C) walnut and hickory; (D) oak and hickory.

______ 2. The woods used in smoking Virginia Ham (Smightfield) are (A) oak and hickory; (B) hickory and apple; (C) oak and apple; (D) jumper and beechwood.

______ 3. In addition to increasing the salt content of the product, prolonged exposure of meat to the salt action will result in (A) deterioration of the bone; (B) excessive darkening of the meat; (C) excessive shrinkage; (D) softening of the fat.

______ 4. The meat product most applicable for curing in the pressure box process is (A) hams; (B) sausage; (C) bacon; (D) liver.

______ 5. The process used to cure bacon by the use of numerous fine hollow-stemmed needles to inject the curing pickle into the meat is know as (A) injection cure; (B) artery cure; (C) immersion cure.

______ 6. Since most causes for bacterial contamination of meat come from outside sources the best control is (A) purchasing only Government graded and inspected meats; (B) rigid sanitation practices; (C) to never allow customers in the cutting room; (D) to require a health certificate from each employee.

______ 7. Which of the following materials is not recommended for use in smoking meats? (A) cedar wood; (B) maple wood; (C) corn cobs; (D) hickory wood.

______ 8. The greatest shrinkage of smoked hams and bacon will take place (A) during the smoking process; (B) one to two hours after removal from the smoke house; (C) during the first week after removal from the smoke house; (D) during the first month after removal from the smokehouse.

______ 9. The percentage of lean meat which is water will average about (A) 10 to 15; (B) 25 to 30; (C) 60 to 65; (D) 85 to 90 per cent.

______ 10. Which of the following is not a cause of vitamin loss in meats? (A) loss of juices; (B) light; (C) exposure to air; (D) low temperatures.

______ 11. An effective means for reducing "freezer burn" of frozen meats is (A) to use moisture-proof and air-tight wrapping material; (B) to keep the temperature between zero and ten degrees above zero; (C) to freeze the meat slowly rather than quick freezing; (D) to never season the fresh meat prior to freezing.

______ 12. One of the primary advantages of using the apothecary method of wrapping freezer meats is that it (A) requires less paper; (B) results in a good air seal; (C) is quick and easy to make; (D) eliminates juice seepage.

______ 13. The storage life of frozen meats containing salt, in comparison with fresh meats, will be (A) the same; (B) shorter; (C) longer; (D) almost twice as long.

______ 14. It is recommended that the amount of freezer storage space in a home freezer should be about (A) 3 to 5; (B) 7 to 9; (C) 12 to 15; (D) 18 to 20 cubic feet per person.

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. Meat has been preserved by various methods. List the most common methods used.

(A) ______ (C) ______

(B) ______ (D) ______

2. List the functions of sugar as an ingredient in a curing formula.

(A) ______

(B) ______

(C) ______

3. List five of the more common methods of curing meats.

(A) ______ (D) ______

(B) ______ (E) ______

(C) ______

4. In addition to proper sanitation practices, list the factors which promote satisfactory frozen meat results.

(A) ______________________ (D) ______________________

(B) ______________________ (E) ______________________

(C) ______________________ (F) ______________________

5. List two reasons for trimming the fat from meat that is to be frozen and stored for any length of time.

(A) ______________________

(B) ______________________

6. List the qualities required of a good wrapping material to be used for freezer storage.

(A) ______________________

(B) ______________________

(C) ______________________

(D) ______________________

(E) ______________________

(F) ______________________

(G) ______________________

(H) ______________________

(I) ______________________

7. List the general rules to be followed in preparing and wrapping meat cuts for freezer storage.

(A) ______________________

(B) ______________________

(C) ______________________

(D) ______________________

Assignment
Sheet No. 15

Covering
Units 150-157

WHOLESALE PURCHASING, SELLING PRICES AND RECORD KEEPING

The profit to be realized from the retail meat department will depend in great part on the individual's ability to purchase the proper types and grades of meat at the right prices. This purchase is usually made from the wholesale supplier or packer. Larger firms have buyers or agents whose duty it is to select and purchase for the department. In the smaller operation the manager must develop the ability to buy wisely.

After the purchase has been made, it must be processed and priced to meet competition and yield a profit. The department manager must be aware of the factors which effect pricing and the methods he can employ to establish prices.

The keeping of accurate and current records is a must if the department is going to be successful. If efficiently kept the records can serve as a guide for purchasing, processing and pricing the meat products. Without them the manager is only "guessing" when he places an order or decides on a selling price.

An understanding of purchasing, pricing, and record keeping techniques makes the retail meat cutter a greater asset to his employer His understanding and concern may eventually be a deciding factor on his promotion within the department or securing a position with another firm.

In this assignment you will have an opportunity to learn some techniques used in buying, setting selling prices and keeping records. You should not assume that the NARGUS system is the only method available for setting prices and keeping records, but the techniques employed will have application in other systems.

Assignment:

1. Read the references listed below.
2. Complete the cutting test sample problem on page 4-a of Reference F. The method to use in computing the pounds-per-hundred figures will be found on the back of the NARGUS Cutting Test Form. The sales value total should be $63.13 rather than the $63.02 figure shown in the problem.
3. Answer the questions below and turn in this assignment by ____________________.

References:

C. American Sheep Producers, Lamb Cutting and Merchandising Manual, Chapters 16-21.
D. NARGUS, Self-Service Meats, pp. 70-76.
F. NARGUS, Meat Department System Manual, pp. 1-20.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. A retailer's buying problems are usually a result of the sales policies of his packer supplier.

T F 2. The retail meat manager should understand and take into consideration the problems of the packer when making wholesale meat purchases.

T F 3. If at all possible, the retailer should buy from the wholesaler on a standing order basis.

T F 4. The retailer should make his wholesale purchases from the supplier with the lowest prices even though this may mean a frequent change from one company to another.

T F 5. Desirable lamb carcasses are available only a few months out of the year.

T F 6. Retailers have found that it is sometimes cheaper to make up carcasses from saddles when buying lamb.

T F 7. All lambs have 13 ribs.

T F 8. The theory behind handling two grades of meat is to satisfy both the quality trade and the price conscious trade.

T F 9. A retailer may purchase wholesale cuts as well as carcasses from the packer.

T F 10. By using the factor system to compute carcass costs and prices, the retailer has a much closer control over his operation.

T F 11. An efficient retailer should concentrate on his department operation and not be concerned with the operating methods of his wholesale suppliers.

T F 12. The factor system of computing costs is more accurate for figuring small retail cuts than for larger wholesale cuts.

T F 13. There are standardized cutting test figures available which the retailer should use to figure the cost of retail cuts.

T F 14. There are times when a packer will promote the sale of trimmed lamb just to reduce his loss

T F 15. The use of percentages has proven to be a desirable pricing system for meat cuts.

T F 16. When the cost per package is computed and found to be 10¢, the price of all packages should then be raised 10¢.

T F 17. The retail meat department manager will probably spend several hours a day on bookkeeping regardless of the pricing system used.

T F 18. Cutting tests should be made and records kept on both carcasses and wholesale carcass cuts purchased by the meat department.

T F 19. Once a cutting test has been made using a particular cutting method it is not necessary to make additional tests of the same method.

T F 20. It is advisable to have cutting test results from the products of different packer suppliers.

T F 21. Cutting tests on bacon and luncheon meats are not necessary because they will not vary from week to week.

T F 22. There is little advantage to assigning responsibility for invoices to any particular individual in the meat department

T F 23. A NARGUS Operational Summary form or similar form is of value only in a large multiple-unit operation.

Completion

<u>Directions</u>: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. The largest market for lambs is usually during the months of _______________ and _______________.

2. A lamb carcass which has been divided into two equal weight saddles will have __________ rib(s) left on the ____________ saddle.

3. In actual practice, a retailer figuring prices on items will think and figure mainly in terms of price ______________.

4. When the lamb carcass is split to produce a 4-rib yoke, the long hind saddle will account for about ______________ of the total carcass weight.

5. In order for a retailer to have a practical system of figuring prices, he must be able to use figures based upon his own _____________ methods.

6. When computing the price relationship between carcasses and cuts, the retailer should remember that it is the cost of the _____________ that counts, not the cost of the ____________.

7. When utilizing the cost per package method of pricing the retailer needs figures on the dollar cost of operating the department and the number of ______________ ______________.

8. When pulling business away from a competitor, an attempt should be made to pull only the ______________ business.

9. Sales on which very little profit is made is estimated to be about _________ to _________ per cent of the retail meat business.

10. Large volume sales is desired in a self-service department but it is of no value unless it is ______________ volume.

11. Operating costs which do not vary with the volume of meats sold are generally considered to be ______________ costs.

12. Taking an inventory of the meat in the department is usually done in two steps: (1) the meat in the ______________, (2) the meat in the ______________.

13. When taking an inventory it is usually necessary to record only the ______________ of the product.

14. When computing the value of the inventoried products, it should be done in terms of the ______________ cost rather than the ______________ or ______________ cost.

Multiple-Choice

Directions: In the space at the left of each statement, write the letter of the item which will provide the correct answer to complete the statement.

_____ 1. The best way for the retailer to insure the selection of the wholesale purchases he desires is to (A) visit the packers plant and make all selections himself; (B) accept and utilize the carcasses shipped by the packer; (C) place the order far enough in advance that the packer can do a good job of selection; (D) purchase, slaughter and process his own meat animals.

_____ 2. The heaviest marketing of California lambs is made during the month of (A) March; (B) April; (C) May; (D) October.

_____ 3. A 50-50 split lamb foresaddle costing 26¢ per lbs., and a hindsaddle costing 58¢ per lbs., will make up a carcass with a cost of (A) 84¢; (B) 42¢; (C) 32¢; (D) 13¢; per pound.

_____ 4. One of the better pricing methods being used in the meat department is (A) percentages; (B) cost per package; (C) cost per carcass; (D) factors.

_____ 5. When the cost of operating the department for a week is $286.50 and there are 2150 packages sold during the week, the cost per package will be approximately (A) 8; (B) 10; (C) 13; (D) 15 cents.

____ 6. The use of pricing charts is not recommended because (A) (A) no allowance is made for seasons of the year; (B) personnel become confused when reading them; are devised by wholesalers and the markup is too small; (D) no two carcasses ever have the same cutout value.

____ 7. Which one of the following is not a factor in setting the price level of meats in a community? (A) the department's variable operating costs; (B) the stores operating in the area; (C) the price customers are willing to pay.

____ 8. Making the cutting test for a beef carcass by recording the data in terms of the wholesale cuts is advantageous because (A) it is easier to do; (B) there is less loss from shrinkage; (C) the data is easier to compute; (D) data is then available for both wholesale cuts and the whole carcass.

____ 9. When summarizing the weeks business the difference between the sales value as computed on records should not differ from the cash register reading by more than (A) two to four; (B) eight to ten; (C) twelve to fifteen; (D) eighteen to twenty per cent.

____ 10. One of the greatest advantages to keeping accurate, current records (weekly is preferred) of the meat products purchased and sold is that they (A) discourage stealing; (B) make yearly summaries easier to compute; (C) are required for auditing; (D) can be used to detect trouble spots early.

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. List some things a retailer can do to get better service from his packer on wholesale purchases.

(A) ____________________

(B) ____________________

(C) ____________________

(D) ____________________

(E) ____________________

(F) ____________________

(G) ____________________

____

(H) ____________________

2. List some reasons for lamb being a year around profitable meat.

(A) ____

(B) ____

(C) ____

(D) ____

(E) ____

(F) ____

3. Meat products which have the highest mark-up per package are those which:

(A) ____

(B) ____

4. List some pricing policies which have been developed recently.

(A) ____

(B) ____

(C) ____

(D) ____

5. List the values advocated by the NARGUS Meat Department System.

(A) ____

(B) ____

(C) ____

(D) ____

6. Two key features of the NARGUS system are:

(A) ____

(B) ____

7. List the steps for making a cutting test as outlined by the NARGUS system.

(A) ______________________________

(B) ______________________________

(C) ______________________________

(D) ______________________________

(E) ______________________________

(F) ______________________________

(G) ______________________________

(H) ______________________________

(I) ______________________________

8. When the variation between cash register receipts and the computed cash value of the meat products is excessive, the source of trouble might be found by checking:

(A) ______________________________

(B) ______________________________

(C) ______________________________

(D) ______________________________

(E) ______________________________

Assignment
Sheet No. 16

Covering
Units 158-161

ADVERTISING, DISPLAYING, AND SELLING MEAT

Being a skilled meat cutter is only part of the total job of merchandising meat. Before any profit can be realized, the meat must be sold to customers in such a manner that they will return. Salesmanship then is another important responsibility of a meat cutter in a retail meat department.

The successful selling of meat and meat products is a result of effective advertising through the use of outside agencies such as newspapers, radio, television or mail. In the store it involves window display, show cards and case displays. Whatever means are used to advertise, they must be accurate and "attention getting."

The meat cutter must also remember that his personal appearance, habits, and knowledge and skill are advertisements for the meat department. This makes the individual not only a meat cutter but also a "display" and a salesman.

In this unit you will have the opportunity to learn some of the techniques of selling, effective methods of advertising and the building and care of meat displays.

Assignment:

1. Read the references listed below.
2. Answer the questions below and turn in this assignment by ________________.

References:

C. American Sheep Producers Council, Lamb Cutting and Merchandising Manual, Chapters 12 and 14.
D. NARGUS, Self-Service Meats, pp. 60-69, 77-95.
I. Information Sheet No. 3.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. There is little variation from store to store as to the type of meat and cuts of meat which sell most readily.

T F 2. There appears to be no single method of building a display that is superior to all others.

T F 3. Late afternoon or evening shoppers should have as wide a selection of meat cuts as the early morning shoppers.

T F 4. As a general rule, fast moving items should be placed first in the flow of traffic past the display case.

T F 5. Mixing rows of fast and slow moving products throughout the display case has been found to be successful.

T F 6. Uniformity and consistency in packaging meat items can contribute to the building of sales volume.

T F 7. There is little to be gained from the practice of making special cuts at a customer's request, and therefore this practice is not generally recommended for a self-service department.

T F 8. If code dating is used an effort should be made to inform the customer of correct interpretation.

T F 9. Customers of self-service meats are generally more aware of and make their purchase in terms of the total price of a package rather than the cost per pound of the cut.

T F 10. In a self-service meat department the continued and long time sales to a customer is usually more desired than the amount of profit to be made on a particular sale.

T F 11. Self-service has done little to increase the sale of lamb and veal cuts which are slow movers in a service type department.

T F 12. Packaging different kinds of ground beef together in the same package is not recommended.

T F 13. In a service meat department the cuts remaining on a tray after a sale should be rearranged to maintain eye appeal.

T F 14. In a service meat department the wrapping of meat purchases need not be concerned with meeting the eye appeal of the purchaser.

T F 15. It is recommended that every item available in the self-service meat department be on display at all times.

T F 16. Brand name meat products have been found to be no better sellers than those with no brand.

T F 17. There is no advantage to having more than one thermometer in the display case.

T F 18. Cold air usually has a high moisture content.

T F 19. The type of lighting used above the display case can cause the fluctuation of temperatures in the case.

T F 20. Fresh meats should be kept in an atmosphere of relatively high humidity.

T F 21. Smoked and cooked meats should be kept in an atmosphere of relatively low humidity.

T F 22. Lighting of meat display cases is to be considered as an element of good salesmanship.

T F 23. Self-service has done little to change the ways in which meats are sold.

T F 24. Most customers know as much about the quality, care and preparation of meats as does the meat cutter.

T F 25. When a customer is wrong the salesperson should tell them so, even though they insist they are right.

T F 26. A clean appearance is probably more important for the meat cutter in a self-service department than in a service type.

T F 27. Inaccuracy in weighing and pricing packages in a self-service department is not as serious as in a service department.

T F 28. Bad habits are noticed more than are good habits.

T F 29. The meat cutter's selling ability, work habits, and personal cleanliness will probably have little effect on his promotions or raises.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. The manager of a self-service meat department organizes the operation and the personnel for the purpose of _______________ sales.

2. The self-service meat department displays its meat products, the equipment, and the _______________ .

3. Homemakers usually plan their meals around the _______________ dish.

4. Keeping displays simple helps to reduce _______________ and _______________ to the packages.

5. Early morning shoppers are generally looking for meat items such as _______________ or _______________ .

6. Demand items should be placed close to profitable ____________ items.

7. Shoppers who come to the store just before noon or evening meal are usually looking for meat items that are ____________ or ________________ .

8. A porterhouse steak is really just a large __________ steak.

9. The largest display of roast should be made at the __________ of the week.

10. Low temperatures in the display case will retard _________ of bloom and ______________ action.

11. An excessive amount of juices in the display case and its packages is an indication that the temperature in the case is too ____________ .

12. Fluorescent lights which are most popular for lighting the display case are either soft ____________ or a ____________ tint in color.

13. One of the best means to control meat shrinkage due to loss of moisture is with uniform and appropriate ________________ control.

14. There is less personal contact between the customer and the meat cutter in a ________________ type meat department than in a ______________ type department.

15. The proper wind-up to all transactions with customers should be a sincere ______________ .

Multiple-Choice

Directions: In the space at the left of each statement, write the letter of the item which will provide the correct answer to complete the statement.

_____ 1. A good salesman for the self-service meat display is (A) the department manager; (B) the most experienced meat cutter; (C) the most inexperienced meat cutter; (D) each item in the case.

_____ 2. Many customers are of the opinion that the only reason a backing board is used on a package is to (A) absorb the meat juices; (B) hide the less attractive side of the cut; (C) give rigidity to the package; (D) add weight to the package.

_____ 3. Which one of the following is usually not the responsibility of the individual assigned to display case supervision during rush hours? (A) re-wrap damaged packages; (B) answer questions and assist customers in making purchases; (C) relocate items in the display; (D) inform cutters and wrappers of fast and slow moving items.

_____ 4. When a variety of display techniques fail to move an item it is best to (A) reduce the price; (B) disguise it as a popular cut; (C) increase its prestige by raising the price; (D) change the cutting method.

_____ 5. The term "hot spot" as used in the reading refers to (A) items under a spotlight; (B) the warmest temperature area of the display case; (C) the area in the display case from which items seem to sell the quickest; (D) the area in the display case where all of the spicy meat products are displayed.

_____ 6. Apart from wages, one of the highest items of expense in the meat department is (A) wrapping materials; (B) meat shrinkage from loss of moisture; (C) making special cuts for customers; (D) spoilage because of high temperature.

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. List some basic approaches which have been used in display building.

(A) ____________________

(B) ____________________

(C) ____________________

(D) ____________________

2. List some "silent salesman" ideas which can be used to promote sales in the meat department.

(A) ____________________

(B) ____________________

(C) ____________________

(D) ____________________

3. List some causes for poor air circulation and temperature control in the display case.

(A) ____________________

(B) ____________________

(C) ____________________

(D) ____________________

4. Allowing temperatures in the display case to vary several degrees during the day may result in an increase in:

(A) __________ (B) __________ (C) __________

5. The formation of moisture beads on the inside of a transparent film package may be caused by changes in temperature. This may have resulted because the package was:

(A) ____________________

(B) ____________________

(C) ____________________

6. List some reasons for the discoloration of fresh lamb.

(A) ____________________

(B) __________ __________

(C) ____________________

(D) ____________________

7. List the characteristics of a salesperson with whom most customers like to be served. They are:

(A) __________ (E) __________

(B) __________ (F) __________

(C) __________ (G) __________

(D) __________ (H) __________

8. List some factors of personal cleanliness with which the salesperson in the meat department must be aware and practice.

(A) ______________________ (D) ______________________

(B) ______________________ (E) ______________________

(C) ______________________ (F) ______________________

Information
Sheet No. 3

SELLING MEAT PRODUCTS

The growth of self-service meat departments has changed the emphasis in selling meat products in the retail store. In the service type department there is the face-to-face contact with the customer on every sale. Whether or not the customer returns is dependent upon her satisfaction with the salesperson and the product she purchased. With the self-service type of department the return of the customer is more dependent upon her satisfaction with the product she purchases. Most sales are made without the customer or meat cutter seeing each other. This means that the packaged product and the way in which it is displayed must be the "salesman." In the service department the meat cutter can make suggestions for other purchases, but in self-service the package and display must attract the customer's attention.

The less personal selling emphasis of the self-service department does not mean that the meat cutter should be unconcerned with selling techniques. There is still frequent face-to-face contact with customers and there will be some customers who will desire special cuts. This face-to-face contact, although less frequent, is as important in self-service as in service selling.

Whether you are "waiting on" the customer in a self-service or a service type department your mannerisms and techniques should be the same. In addition to being pleasant the salesperson must remember that only wholesome meats or other products are sold to customers. The average customer has a somewhat limited knowledge of meats and depends upon the salesperson to answer questions about the selection, preparation, and care of the purchase.

In addition to selling only wholesome products and assisting with the purchase, the customer likes to be served by a salesperson who is:

1. Courteous
2. Cheerful and pleasant
3. Takes an interest in them and their purchase
4. Uses proper language
5. Has no unfavorable habits
6. Is clean
7. Is willing to wait on them
8. Is patient and considerate

Being courteous means to be just plain nice to customers. Treat them as you would like people to treat you. Make them feel welcome and at ease. The salesperson should avoid arguments with customers; he can only lose, because one of the quickest ways to lose customers is to argue with them.

Customers do not need any particular retailer; there are always others they can go to, but the retailer does need customers.

The successful meat salesperson keeps his feelings to himself even though the customer is discourteous. Quick retorts, rude mannerisms, and facial expressions have no place in meat selling. Lost customers is the price of not being courteous. The salesperson should remember that all people are not alike. Some are sensitive, some are not. Because the salesperson is unable to tell who is sensitive, fussy, peculiar, or unusual, and since he does not have any idea what makes them one way or the other, he should be courteous to all customers. Remember that a sincere "thank you" is an act of courtesy. It is the proper wind-up of all transactions.

Using proper language is an important part of building customer acceptance. This does not mean that the salesperson must be a master of English, rather it means to avoid the use of slang, smart alecky remarks and wise cracks. Some customers don't mind but others do, and since there is no way of telling who objects, be on the safe side and always use proper language. No one objects to proper language.

A clean appearance is a must in selling. This is especially true in the self-service department where the customer must often judge the meat cutter by his appearance since he may never have need or reason to talk to him. No one likes to buy food from a person whose appearance is uninviting and they will hesitate about buying from the self-service display when the people behind the counter are untidy. Customers do not come to the store to evaluate the meat cutter, but anything they see about the person that is not up to standards of cleanliness is quickly reflected in their purchases. The meat cutter may never know why he lost the customer.

Personal cleanliness should include: (1) clean face and hands, (2) clean fingernails, (3) well groomed hair, (4) hair nets for women, and (5) a clean shave for the men. In addition, a spotless apron and uniform, clean shirt, and a tie are as much a part of proper selling as is a wholesome, attractive product.

A cheerful and pleasant attitude is another trait customers like to find in salespeople. They are not one bit interested in how salespeople feel or why. They usually have troubles of their own. Harshly spoken words, short answers, and a sour face make few sales.

Willingness to wait on customers means that they are more important than any job you might be doing. Many self-service departments have installed a buzzer or bell for the customer to sound when they desire personal service. This call should be answered promptly. The job can wait but the customer won't! A grumpy greeting, leaning on the counter, or a sloppy lazy-like posture are not indications of a willingness to wait on the customer. The real salesperson is alert and wide awake, and these characteristics impress customers of his willingness to be of service to them.

Patience with customers also makes sales. The questions they ask or the requests they make are important to them and any indication of irritation or a "don't bother me" attitude on the part of the salesperson must be avoided.

Like all people, customers appreciate being recognized and to have the salesperson show an interest in their purchases and in them as individuals. In a self-service department this personal interest and recognition is more difficult, but a greeting or friendly nod to a steady customer does wonders. If a conscientious effort is made the number of familiar faces will increase. Your recognition of them also impresses the "first time" or "infrequent" customer of the friendliness of the department and may result in them becoming steady customers.

Sales are also made when the customer finds she can place confidence in the department from which she buys her meats. This is as true in the self-service as the service department. At no time should meats be misrepresented, packages inaccurately weighed or priced, or unwholesome products sold to the customer. When a mistake of this type occurs the customer will probably say nothing, but she has lost confidence and will likely take her trade elsewhere.

Like the products that are on display, so is the equipment and personnel of the meat department. The personnel in the self-service department must remember that although their contacts with customers are few they are on constant display while working. Bad habits seem to be more quickly noticed than good habits. The personnel must remember that they and the equipment are in contact with food, and customers are extremely particular about their food. If a salesperson runs his hands through his hair or across his face, uses a handkerchief improperly, spits or smokes while cutting or wrapping meat, don't be surprised if the customer cancels his order or replaces the package in the display case and disappears, never to be seen again making meat purchases in that department.

To do a top selling job the meat department personnel must observe all factors. You can be ever so pleasant and courteous but lax in the matter of clean appearance and the customer forgets how courteous you were. A meat salesperson is any person who waits on customers and the traits outlined in this information sheet apply to all regardless of position or title. It is entirely up to the individual to use or not to use these qualities. Persons who develop and practice these selling qualities will find meat selling more interesting and pleasant, more productive for sales, increased profits and very likely, promotions and raises in pay.

It takes no more time to do a proper meat selling job than it takes to merely "wait on" and "get rid of" customers. Proper selling can become a profitable habit.

TRAINING PLAN AND PROGRESS RECORD
FOR
MEAT CUTTING, RETAIL

Employer's Copy

JOB TRAINING: What the Worker Should be Able to Do	Proficiency Shown	RELATED INFORMATION: What the Worker Should Know
	The Meat Cutting Industry	
	☒	History and organization of the meat cutting industry; vocational opportunities, training requirements, and future
	Sanitation, Inspection and Grading	
Maintain sanitary work area, handle meats in proper manner; and interpret meat inspection and grading stamps Time in hours ________	☒	Types of meat spoilage; their causes and prevention. Inspection and grading criteria for meat
	Self-Service Operations	
Cut, wrap, label, and display self-service meats Time in hours ________	☒	Principles, techniques and future of self-service operations
	Beef	
Cut various beef cuts Time in hours ________	☒	Classes, grades and quality of beef
	Pork	
Cut various pork cuts Time in hours ________	☒	Classes, grades and quality of pork
	Veal	
Cut various veal cuts Time in hours ________	☒	Classes, grades and quality of veal
	Lamb	
Cut various lamb cuts Time in hours ________	☒	Classes, grades and quality of lamb

Poultry

Dress and cut up poultry Time in hours __________	☒	Grades and classification of dressed poultry

Fish

Dress and fillet fish; cut fish steaks; store fish and test for quality Time in hours __________	☒	Principles of fish marketing and fish cookery

Ground and Ready-to Serve Meats

Cut, grind and season meats Time in hours __________	☒	Kind of meats used in ground and in ready-to-serve meats; manufacture of sausage and ready-to-serve meats

Meat Cookery

	☒	Food values of meat; cooking methods; and carving techniques

Refrigeration, Curing, and Storage

Cut, and package meats for home freezer Time in hours __________	☒	Methods of preserving meats

Management and Merchandising

Order, make cutting tests and price meat; keep records; serve customers Time in hours __________	☒	Principles of meat buying, management and merchandising

---

Code for employer's use in marking student's progress

Performed some operations in area	☒	Performed some operations with reasonable proficiency	☒
Performed most operations in area	☒	Performed most operations satisfactorily	☒

TRAINING PLAN AND PROGRESS RECORD
FOR
MEAT CUTTING, RETAIL

Student's Copy

JOB TRAINING: What the Worker Should be Able to Do	Proficiency Shown	RELATED INFORMATION: What the Worker Should Know
	The Meat Cutting Industry	
	☒	History and organization of the meat cutting industry; vocational opportunities, training requirements, and future
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VT 002 086
Building Trades, A Course of Study Designed for Students in
Building Trades Classes.

Prater, Robert L. * and others
Missouri Univ., Columbia. Dept. of Industrial Education
Missouri State Dep of Educ, Jefferson City. Ind Educ Sect
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*STUDY GUIDES, *TRADE AND INDUSTRIAL EDUCATION, *BUILDING TRADES,
GRADE 11, GRADE 12,

This guide is for student use in related instruction classes for the building trades job cluster covering carpentry, masonry, electricity, plumbing, plastering, and painting. It was developed by a committee and research assistants. Of the 46 assignment sheets 24 are on carpentry. Representative titles are (1) Essential Preparation for Building a House, (2) Principles and Methods of Framing for Floors, (3) Principles of Partitions Construction, (4) Special Roof Framing Problems, (5) Interior Trim and Finish, (6) Mixing, Pouring, and Finishing Concrete, (7) Fundamentals of Electrical Work, (8) Layout and Installation of House Sewers and Drains, (9) Applying Plaster, and (10) Application of Paint and Wall Coverings. Each assignment gives introduction, assignment, reference, and questions. Instructors should be vocationally competent, and students should be juniors with proper prerequisites. The suggested time allotment is 180 days. An analysis of the skills and knowledge for each of the major areas and a reference bibliography are included. An instructor's guide (VT 002 087) is available for 50 cents. This document is available for $1.50 from Industrial Education, 103 Industrial Education Building, University of Missouri, Columbia, Missouri 65201. (EM)

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BUILDING TRADES

A Course of Study

Designed for

Students in Building Trades Classes

Issued by

**Department of Industrial Education
College of Education
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In Cooperation with

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MEMORANDUM

TO: The ERIC Clearinghouse on Vocational and Technical Education
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DATE: October 19, 1967

RE: (Author, Title, Publisher, Date) Indus. Ed. Dept., Univ. of Mo. at Columbia BUILDING TRADES, cooperatively with Indus. Educ. Dept. (U. of Mo. at Columbia) and Mo. State Dept. of Ed. (1963)

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(2) Means Used to Develop Material:
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Level of Group State
Method of Design, Testing, and Trial Subject matter specialist and teacher educators. Field tested.

(3) Utilization of Material:
Appropriate School Setting High school, post H.S., area voc.
Type of Program preparatory vocational industrial education programs
Occupational Focus job cluster covering various phases of building trades
Geographic Adaptability United States
Uses of Material Study guide for related instruction on a group bases
Users of Material student guiding class discussion

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BASIC REFERENCES USED IN BUILDING TRADES COURSE OF STUDY

Listed below are the basic references used in the course of study for Building Trades. The alphabetical designation for each reference remains the same throughout this course of study.

A. *Concrete Form Construction*, Delmar Publishers, Inc., Albany, New York, $1.75* Area 1*** (1)**

B. Dalzell, J. Ralph and Townsend, Gilbert, *Masonry Simplified*, Volume 1, American Technical Society, Chicago, 1956, $5.75* Area 2 (2)

C. Dalzell, J. Ralph and Townsend, Gilbert, *Masonry Simplified*, Volume II, American Technical Society, Chicago, 1957 (3) Area 2

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NOTE TO INSTRUCTOR: See Addendum Sheet, next page, for new 1963 revision of *Fundamentals of Carpenty*, Volume II.

F. Graham, Kennard C., *Interior Electrical Wiring, Part 1, Residential* (6th Edition), American Technical Society, Chicago, 1961 $4.75* Area 3 (3)

G. Jarvis, John, *Painting and Decorating Encyclopedia*, Goodheart-Willcox Company, Chicago, 1957, $4.09 Area 6 (3)

H. Matthias, A. J., Smith, Esles, Sr., and Volland, Robert J., *How to Design and Install Plumbing* (4th Edition), American Technical Society, Chicago, 1960, $4.95* Area 4 (7)

J. Mix, Floyd and Ciroui, Ernest H., *Practical Carpenty*, Goodheart-Willcox Company, Chicago 5, Illinois, 1963, $3.75 Area 2 1(14)

K. Portland Cement Association, *Cement Mason's Manual*, 33 West Grand Avenue, Chicago 10, Illinois, 1960, Free Area 2 (1)

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M. U. S. Department of Labor, *Occupational Outlook Handbook*, Government Printing Office, Washington, D. C., 1961 Edition. $4.50 Area 4,3,6,1 (5)

* Subject to school discount
** Frequency of use in assignments
*** Area where used: 1--Carpentry Area; 2--Masonry and Concrete Area; 3--Electrical Construction Area; 4--Plumbing and Pipefitting Area; 5--Plastering Area; 6--Painting and Decorating Area

FOREWORD

This student's manual is designed to serve as a guide in providing related instruction in the Building Trades. It is designed to cover six areas most generally found in Building Trades programs.

A number of individuals were consulted in the perparation of this material. Special credit is due Mr. Roland W. Best, Instructor in Building Trades, Hickman High School, Columbia, Missouri, and Mr. Ray Walsh, Chairman of Practical Arts and Vocational Education, Hickman High School, Columbia, Missouri.

Much credit is due Dr. H. Pat Wardlaw, Assistant Commissioner and Director of Vocational Education; Mr. Merton C. Wheeler, Director of Industrial Education; and other staff members of the Department of Education for their efforts in developing the Industrial Education Curriculum Series of which this study is a part.

We wish to acknowledge our indebtedness to Dr. H. H. London, Professor of Industrial Education, University of Missouri, for the direction and administration of the curriculum materials laboratory in which this material was prepared, and to Mr. James B. Karnes, Instructor in Industrial Education, who supervised the preparation of this manual and edited the manuscript. This manual was prepared by Dr. Robert L. Prater, formerly Research Assistant in Industrial Education, and Mr. Richard E. Ginther, Mr. Donald E. Maurer, and Mr. Robert J. Spinti, all Research Assistants in Industrial Education at the University of Missouri.

HUBERT WHEELER

Commissioner of Education
State Department of Education

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INTRODUCTION

This BUILDING TRADES manual has been designed as an aid in guiding the student's learning. In preparing this material, it has been assumed that job skills and procedures will be learned by the student through the actual construction of a house or some similar building under the direction of a competent instructor. The technical and related information that is necessary to know in order to carry out the construction project is to be given through the use of this manual and whatever other techniques the teacher may indicate is desirable.

The course of study is divided into the following six trade areas: (1) carpentry, (2) masonry and concrete, (3) electrical construction, (4) plumbing and pipefitting, (5) plastering, and (6) painting and decorating. Each of these areas is furnished with a complete analysis of the trade and a series of assignments.

The analysis is a systematic breakdown and listing of the instruction units that a craftsman of that particular trade must know to properly perform his work. The left hand column contains a list of the manipulative skills the student must be able to perform and with which he will become familiar through the practical activities experienced in the construction of the house. The right hand column contains the related information topics. These will be taught through the assignments in this manual. The center column of numbers in the analysis denotes the assignment where that particular element will be covered. Each assignment is also cross-keyed to the analysis indicated by the numbers found under the heading "Covering Units" in the upper right hand corner of each assignment.

Each assignment has an introduction, a reading assignment, and a series of questions covering the readings. The introduction is to tell the student specifically what he is to do and to convey the importance of the material to be covered. The reading assignment is keyed by letter to the Basic Reference List which is found in the front of the student's manual. The questions on the assignment sheets serve two major purposes: (1) to guide the student to the important aspects of the reading assignment, and (2) to form a basis or outline for classroom discussions.

Assignment Sheet No. 1 of the carpentry unit (the first assignment that the student will do) is to introduce the student to the over-all scope of the building trades. This assignment deals, in a generalized manner, with such topics as: what the building trades are; where the workers are employed; training and other requirements; the employment outlook; earnings and working conditions; and where to obtain more detailed information. Each of the six trade areas will have additional information as part of the first assignment for each area, dealing specifically with application to the particular trade being studied. It is hoped that the student will be able to make a firm and knowledgeable occupational choice through the experiences of the classwork and the occupational information in the student assignments.

The instructor will make assignments in addition to those found in the student's manual. He will also supplement them with lectures, discussions, field trips, movies, slides, film strips, outside speakers, etc. The building trades student can look forward to a year of interesting and profitable experiences.

BASIC REFERENCES USED IN BUILDING TRADES COURSE OF STUDY

Listed below are the basic references used in the course of study for Building Trades. The alphabetical designation for each reference remains the same throughout this course of study.

A. *Concrete Form Construction*, Delmar Publishers, Inc., Albany, New York, $1.75* Area 1*** (1)**

B. Dalzell, J. Ralph and Townsend, Gilbert, *Masonry Simplified*, Volume 1, American Technical Society, Chicago, 1956, $5.75* Area 2 (2)

C. Dalzell, J. Ralph and Townsend, Gilbert, *Masonry Simplified*, Volume II, American Technical Society, Chicago, 1957 (3) Area 2

D. Durbahn, Walter E., *Fundamentals of Carpentry*, Volume I, American Technical Society, Chicago, 1961, $4.75* Area 1 (10)

E. Durbahn, Walter E., *Fundamentals of Carpenty*, Volume II, American Technical Society, Chicago, 1956, $4.75* Area 1 (12)

NOTE TO INSTRUCTOR: See Addendum Sheet, next page, for new 1963 revision of *Fundamentals of Carpenty*, Volume II.

F. Graham, Kennard C., *Interior Electrical Wiring, Part 1, Residential* (6th Edition), American Technical Society, Chicago, 1961 $4.75* Area 3 (3)

G. Jarvis, John, *Painting and Decorating Encyclopedia*, Goodheart-Willcox Company, Chicago, 1957, $4.09 Area 6 (3)

H. Matthias, A. J., Smith, Esles, Sr., and Volland, Robert J., *How to Design and Install Plumbing* (4th Edition), American Technical Society, Chicago, 1960, $4.95* Area 4 (7)

J. Mix, Floyd and Ciroui, Ernest H., *Practical Carpenty*, Goodheart-Willcox Company, Chicago 5, Illinois, 1963, $3.75 Area 2 1(14)

K. Portland Cement Association, *Cement Mason's Manual*, 33 West Grand Avenue, Chicago 10, Illinois, 1960, Free Area 2 (1)

L. Portland Cement Association, *Laying Concrete Block*, 33 West Grand Avenue, Chicago 10, Illinois, 1954, Free Area 2 (1)

M. U. S. Department of Labor, *Occupational Outlook Handbook*, Government Printing Office, Washington, D. C., 1961 Edition. $4.50 Area 4,3,6,1 (5)

* Subject to school discount

** Frequency of use in assignments

*** Area where used: 1--Carpentry Area; 2--Masonry and Concrete Area; 3--Electrical Construction Area; 4--Plumbing and Pipe-fitting Area; 5--Plastering Area; 6--Painting and Decorating Area

N. Van Den Branden, Felicien and Knowles, Mark, Plastering Skill and Practice, American Technical Society, Chicago, 1953, $5.95*
Area 5 (2)

ADDENDUM SHEET

Since all assignment sheets are keyed to 1956 revision, Fundamentals of Carpentry, Volume II; when using the 1963 edition of this reference, the assignment sheets should have the following page changes:

Assignment Sheet No. 5, 1963 Ed. pp. (12-33) (47-56)
Questions 1,2,3, and 4 are not answered in 1963 Edition.

Assignment Sheet No. 12, 1963 Edition, pp. (116-123)

Assignment Sheet No. 13, 1963 Edition, pp. (123-129)

Assignment Sheet No. 14, 1963 Edition, pp. (102-111)

Assignment Sheet No. 16, 1963 Edition, pp. (158-165)

Assignment Sheet No. 17, 1963 Edition, pp. (12-14)

Assignment Sheet No. 18, 1963 Edition, pp. (176-189)

Assignment Sheet No. 19, 1963 Edition, pp. (190-228)

Assignment Sheet No. 20, 1963 Edition, pp. (228-247)

Assignment Sheet No. 21, 1963 Edition, pp. (358-379)

Assignment Sheet No. 22, 1963 Edition, pp. (266-297)

Assignment Sheet No. 24, 1963 Edition, pp. (386-404)

ANALYSIS OF CARPENTRY

JOB TRAINING: What the Worker Should Be Able to Do	Assign. No.	RELATED INFORMATION: What the Worker Should Know
Introduction		
	1	1. Types of work done by building tradesmen.
	1	2. Employment opportunities and working conditions
Introduction to Carpentry		
	2	3. Amount and type of training needed by carpenter
	2	4. Effects of technological developments on demand for carpenters
	2	5. Apprenticeship program
	2	6. Carpentry unions
Building Preparations and Preliminaries		
	3	7. Factors to consider in selecting sites and locating homes
	3	8. Types of houses
9. Read local building codes	3	9. Content and purpose of building codes
10. Read local zoning laws	3	10. Types of public services
11. Read a legal contract	3	11. Sources of legal advice
12. Select location of building	5	12. Items to consider in locating a building
13. Lay out building lines	5	13. Significance of building lines
14. Establish grade levels	5	14. Methods and instruments used in staking out buildings
15. Erect batter boards	5	15. Kinds and uses of batter boards
16. Locate and mark excavation lines	5	16. Methods and precautions of excavation work
Concrete and Concrete Forms		
17. Mix concrete	7	17. Standard concrete mixtures and their uses
18. Form and anchor reinforcing steel	7	18. Cement and its uses

JOB TRAINING: What the Worker Should Be Able to Do	Assign. No.	RELATED INFORMATION: What the Worker Should Know
19. Construct straight foundation segments	7	19. Materials used for forms and their relative advantages
20. Plumb, level, and brace forms	7	20. Methods of constructing foundation forms
21. Construct and insert openings, offsets and irregularities	7	21. Details of form construction
22. Set shoring and braces	7	22. Methods of bracing forms
23. Build forms for steps and stairs	7	23. Characteristics and uses of metal forms
24. Insert spreaders and wire ties	7	24. Treatment of forms to decrease warping and swelling
25. Remove forms from concrete	7	25. Precaustions in removing forms
	7	26. Method of calculating board feet
	Blueprint Reading	
	8	27. Types of architectural drawings
	8	28. Purpose of blueprints
29. Calculate distances from drawings	8	29. Principles of drawing to scale
30. Locate walls and openings from drawings	8	30. Types of lines and symbols
31. Assemble milled materials	8	31. Factors to consider when interpreting details
	8	32. Principles to follow in reading and interpreting floor plans
33. Follow specifications in construction	8	33. Purpose of specifications and their interpretation
	Insulating and Dampproofing	
34. Adapt framing to receive insulation	15	34. Types and composition of insulation materials
35. Install building paper	15	35. Uses and comparative values of insulation materials
36. Install various types of insulation	15	36. Procedures for installing insulation
	15	37. Vapor barrier condensation zones
	15	38. Attic ventilator requirements
39. Install weatherstripping	15	39. Types of weatherstripping
	15	40. Method of protecting insulation from dampness

JOB TRAINING: What the Worker Should Be Able to Do	Assign. No.	RELATED INFORMATION: What the Worker Should Know
	Scaffolding	
41. Saw to a line with cross-cut or rip-saw	4	41. Uses and types of hand-saws
42. Drive, set and draw nails	9	42. Sizes and uses of common nails
43. Construct upright outrigger scaffolds	16	43. Types and uses of scaffolds
44. Construct and use suspended scaffolds	16	44. Advantages and limitations of scaffolds
45. Assemble cantilever scaffolds		
46. Assemble permanent scaffold units		
47. Construct and hang bracket scaffold		
48. Construct window bracket scaffold		
49. Construct framed portable (supported) scaffold for high work on interiors	16	49. Details of framed portable scaffolds
50. Construct saw horse, trestle, and miter box	5	50. Types, uses, and construction procedures of horses, vices, benches, ladders, etc.
	17	51. General safety rules and practices
	11	52. Sources of lumber, characteristics and kinds of wood
	11	53. Methods of seasoning lumber
54. Surface stock to thickness	11	54. Classification of lumber
55. Select lumber for specific parts	11	55. Grading of lumber
56. Scale lumber	11	56. Commercial sizes of lumber
	Framing of Floor, Ceiling and Wall	
57. Splice and join joists, beams and girders	10	57. Joints and splices used in framing
58. Trim or pare with chisel	4	58. Types and uses of chisels
59. Cut and place joists, beams and headers	10	59. Methods of assembling joists
	4	60. Care and selection of carpentry tools

JOB TRAINING: What the Worker Should Be Able to Do	Assign. No.	RELATED INFORMATION: What the Worker Should Know
61. Sharpen saws	4	61. Types and sizes of saw files
62. Sharpen tools, such as chisels, planes, bits, etc.	4	62. Care and use of oilstones abrasives, grinding wheels, and files
	4	63. Types and uses of portable power tools
64. Lay out square cuts, bevels, chamfers, tapers and miters	4	64. Types and uses of layout tools
65. Measure and divide spaces with rule, square, scale, etc.	4	65. Types and uses of measuring tools
66. Lay out sills and girders for joists and headers	10	66. Comparison of balloon, braced, and western types of framing
67. Frame around wells and openings in floors and ceilings	12	67. Details of wall framing
68. Frame unsupported corners and landings		
69. Cut studs and build corner studs	12	69. Methods of constructing corner posts
70. Lay off plates for studs	12	70. Purpose and types of plates and studding
71. Double plates; double studs at openings		
72. Frame openings in walls	12	72. Methods of framing wall openings
73. Truss over wide openings		
74. Raise, plumb and brace walls	12	74. Methods of nailing walls
75. Lay out and frame porches		
76. Frame bay windows		
77. Frame dormer windows		
78. Lay out and frame trussed partitions	14	78. Principles of partition construction
79. Adapt framing to receive plumbing, wiring, plastering, tiling, and heating	13	79. Special framing problems related to plastering, plumbing, tiling, heating, and fire hazards
80. Locate and bore holes; set and grout sills	12	80. Importance of properly set sills
81. Lay and level joists	12	81. Methods of assembling joists
82. Brace and bridge joists	12	82. Purpose and methods of bridging between joists
83. Lay and high-joint subflooring	12	83. Methods of laying subflooring

JOB TRAINING: What the Worker Should Be Able to Do	Assign. No.	RELATED INFORMATION: What the Worker Should Know
	Framing of Roofs	
84. Lay off plate and ridge to receive rafters	18	84. Types of rafters and their relations
	18	85. Definition of terms peculiar to roof framing
86. Read and interpret steel square tables	18	86. Interpretation and use of tables and scales on steel squares
87. Lay off and cut common rafters	19	87. Methods of laying off common rafters
88. Lay off and cut jack rafters	19	88. Methods of laying off jack rafters
89. Lay off and cut hip and valley rafters	19	89. Methods of laying off hip and valley rafters
90. Lay off and cut "cripple" jack rafters		
91. Raise and align rafters	18	91. Relationship of span and run, rise, and pitch
92. Frame roof openings		
93. Frame flat roof	18	93. Types and characteristics of roofs
94. Frame lookout or overhang	20	94. Construction of overhang, eaves, and gutters
95. Frame unequal pitch intersections	20	95. Requirements and calculations for different pitches
96. Brace rafters and ceiling joists	20	96. Construction and use of roof trusses and braces
97. Frame gambrel roof		
	Roofing	
98. Cut and nail sheathing and lath	22	98. Kinds of roofing materials and advantages
99. Apply wooden shingles on straight runs	22	99. Relative costs of roofing materials
100. Apply rooled composition roofing	22	100. Procedures of applying roofing
101. Apply valley tin, flashing, and ridge rolls	22	101. Methods of flashing chimneys and dormers
102. Install gutters	22	102. Principles of gutter construction
103. Shingle valleys and curved surfaces	22	103. Techniques of finishing hips, valleys, and ridges
104. Repair wooden shingle roof	22	104. Procedures for calculating roofing areas and costs

JOB TRAINING: What the Worker Should Be Able to Do	Assign. No.	RELATED INFORMATION: What the Worker Should Know
105. Apply processed composition, asbestos, sheet metal, and tile roofing	22	105. Comparison of methods used in applying various roof coverings
106. Trim open cornice	22	106. Kinds of cornices
107. Finish gable cornice	22	107. Cornice construction
108. Cut, fit and nail crown and bed molding	22	108. Types of cornice materials
109. Trim box or closed cornice	22	109. Relative costs of cornices
110. Rake crown molding	22	110. Lay out for raking molding
	Exterior Wall Covering	
111. Apply sheating horizontally	22	111. Comparison of siding materials
112. Apply sheathing diagonally	22	112. Comparison of horizontal and diagonal sheathing
113. Cut and butt siding against outside trim	22	113. Comparison of methods of applying siding
114. Shingle outside wall	22	114. Types of shingles used for siding
115. Apply building paper	22	115. Kinds and uses of building paper
116. Cut and apply asbestos and other types of manufactured wall coverings	22	116. Methods of applying processed siding
117. Cut and nail corner boards	22	117. Practices in the construction of corner boards
118. Apply base and water table	22	118. Purpose and construction of water tables, belts, and courses
	Exterior Door and Window Finish	
119. Determine size of frame from door and window schedule	21	119. Types of door and window frames and their relative advantages
120. Construct simple window frames for double-hung check-rail sash	21	120. Details of window frame construction
121. Cut and apply outside casings, headers, mullions, and brick mold to frames	21	121. Terms peculiar to windows and doors
122. Set window frames	21	122. Methods of setting window frames

JOB TRAINING: What the Worker Should Be Able to Do	Assign. No.	RELATED INFORMATION: What the Worker Should Know
123. Assemble milled door and window frames	21	123. Kinds of milled window frames
124. Flash caps over doors and windows		
125. Construct window screens		
126. Construct door frame with rabbeted jamb	21	126. Details of outside door frame construction
Interior Ceiling and Wall Coverings		
127. Hang shiplap on ceilings	23	127. Characteristics and advantages of the different materials for covering interior walls and ceiling
128. Cut and nail shiplap or lath on interior walls	23	128. Specifications of lumber
129. Cut and apply panel	23	129. Types of plywood panels and methods of joining panels
130. Set grounds for trim on plastered walls		
131. Apply commercial wall boards on ceiling, using ceiling jack	23	131. Application procedures for wall and ceiling materials
132. Cut and nail commercial wall boards		
Finish Flooring		
133. Lay finish flooring with butt joints	23	133. Kinds of finish floors and special floor coverings
134. Lay end-matched flooring	23	134. Methods of nailing flooring
135. Draw and nail crooked pieces of flooring	23	135. Types of jacks for drawing and nailing crooked pieces of flooring
136. Dodge joints systematically on long runs of flooring	23	136. Standard grades and sizes of flooring
137. Lay block flooring	23	137. Effects of moisture on flooring and how to minimize them
138. Lay flooring over building paper	23	138. Methods of insulating floors

JOB TRAINING: What the Worker Should Be Able to Do	Assign. No.	RELATED INFORMATION: What the Worker Should Know
Interior Trim and Finishes		
139. Fit and hang window sash	21	139. Methods of fitting and hanging sash
140. Fit and hang doors	21	140. Methods of fitting and hanging doors
141. Install double-acting door	21	141. Stock sizes and styles of doors and windows
142. Set inside door frames	21	142. Methods of setting door jambs
143. Case door and window openings	21	143. Procedures for installing door and window casings
144. Install inside and outside door locks	21	144. Types of door locks and procedures for installing
145. Fasten with screws and bolts	9	145. Specifications and uses of bolts and screws
146. Countersink screw and bolt heads	9	146. Kinds of finishing hardware
147. Install hardware on windows, doors, and cabinets	9	147. Types, sizes and location of hinges, pulls, and latches
	21	148. Types of casings
149. Fit and install thresholds	21	149. Types of thresholds and methods of installing
	21	150. Types of millwork
151. Finish outside and inside curves	21	151. Methods of milling lumber
152. Cut, fit, and nail baseboards and base shoe	23	152. Types of baseboard and shoe
153. Cut and nail picture mold	23	153. Methods of joining molding
154. Trim interior cornice and ceiling beams	23	154. Types of interior cornice and ceiling beams
155. Apply wainscoting and wainscot cap mold	23	155. Types and details of wainscoting
156. Assemble milled cabinets and built-in fixtures	23	156. Care and precautions in handling millwork
157. Prepare surfaces, for application of stain, fillers, shellac, varnish, lacquer, enamel and paint	23	157. Specifications and kinds of finish for inside wood surfaces
158. Kerf trim for bending around curved surfaces	23	158. Names and stock sizes and shapes of interior molding and trim
159. Miter crown or spring molding	23	159. Methods of mitering molding
160. Cope crown or spring molding	23	160. Methods of coping molding

JOB TRAINING: What the Worker Should Be Able to Do	Assign. No.	RELATED INFORMATION: What the Worker Should Know
161. Set, level and plumb mantles, medicine cabinets, window seats, bookcases, kitchen cabinets and other milled interior fixtures	23	161. Types of milled interior fixtures, their construction details and advantages
	Stairways	
162. Lay out and cut simple, straight run stair stringers	24	162. Procedures for determining the exact relation of tread and riser to run and rise
163. Construct basement stairs	24	163. Types of stairs and definitions of terms peculiar to stair building
164. Lay out and cut routed stringers	24	164. Types of stringers and their uses
165. Assemble milled stairway	24	165. Effects of shrinkage on various types of tread and riser construction
166. Cut and fit skirting board	24	166. Types of tread and riser construction
167. Miter risers into stringer	24	167. Methods of joining steps
168. Return nosing on steps	24	168. Precautions for safety in stairway construction
169. Assemble newel, handrail and balustrade	24	169. Types of platforms and landings, newels, balustrades and handrails
	24	170. Types of standard stairway trim; milled stairways
171. Frame opening and fit disappearing stairway	24	171. Advantages of disappearing attic stairways

Assignment
Sheet No. 1

Covering
Units 1-2

INTRODUCTION TO THE BUILDING TRADES

The largest single group of skilled workers in the nation's labor force is the building tradesmen's group. Their craftsmen are employed mainly in construction, maintenance, repair and alteration of homes and other types of buildings, highways, airports, and other structures.

The prospects for employment in the building trades are very promising for the next decade. Opportunities for employment are expected to rise because of the expected continued expansion in the building industry, retirements, and deaths, and because automation and other technological advances are expected to have limited effects on employment in the building trades.

This assignment is designed to acquaint you with the crafts in which you are expected to study in this program. You will also get acquainted with the wages, working conditions, qualifications needed, and the type and amount of training needed to become a skilled worker in one of the several crafts.

Assignment:

1. Read the references listed below.
2. Be prepared to discuss the study questions listed below.
3. Work out the questions, problems, and projects as assigned by your instructor.

References:

M. U.S. Department of Labor, Occupational Outlook Handbook, 1961, pp. 339-346.
I. Information Sheet No. 1 (this manual).

Questions:

1. What are the three broad classifications of building trades journeymen? Which craftsmen are in each classification?

2. In what type work are building tradesmen employed? Where is the largest group employed?

3. In what trades is the growth for the next decade expected to be more than average?

4. What training is required to become a skilled craftsman? What advantages will a high school education and a certificate in the building trades be to you when you apply for an apprenticeship?

5. Who supervises apprenticeship programs at the local level?

6. From what two sources may an apprentice applicant get information about apprenticeship openings at the local level?

Information
Sheet No. 1

THE BUILDING TRADES PROGRAM

The Meaning of the Building Trades Program

The program in which you are now enrolled is designed to provide you with the background and experience needed to secure employment as an advanced apprentice in one or more of the several building trades crafts, such as carpentry, brick masonry, electricity, etc. The major crafts in the building trades are carpentry, painting, plumbing, bricklaying, electricity (construction), structural iron work, plastering, roofing, cement finishing, heating and air conditioning. However, the crafts emphasized in this course will be carpentry, bricklaying, plumbing, plastering, painting, and electricity. Your trainin will involve on-the-job experience in building a structure, as well as related classroom instruction and home assignments.

The Importance of the Program to You

You are entering the building trades class in a period when skill and know-how are becoming a "must" for those who wish to secure and maintain employment. Through this program you may train for an occupation in which you will be able to learn a livelihood as well as make a contribution to the welfare of your community, state and nation. It will also help you to decide whether or not this is an appropriate occupation for you.

Your high school diploma, along with a certificate of completion from the building trades program, and the endorsement of your instructor, will be a valuable asset when you apply for an apprenticeshi card. This will indicate to the union members that you do possess some of the endurance and drive necessary for becoming a member of their <u>select</u> group.

The Nature of the Building Trades Field

Building trades craftsmen are employed mainly in the construction, maintenance, repair, and alteration of homes and other types of buildings, highways, airports, and other structures.

The work of building trades journeymen may be grouped into three broad classifications--structural, finishing, and mechanical. However, a good craftsman should become familiar with all of these.

Building trades workers concerned mainly with structural work are carpenters, bricklayers, cement finishers, operating engineers, and ornamental-iron workers. Those concerned mainly with finishing work are plasterers, lathers, tile setters, paperhangers, painters, hard-floor layers, glaziers, roofers, and asbestos workers. Those concerned mainly with mechanical work are construction electricians, sheet-metal workers, plumbers, pipefitters, heating and air-conditioning workers and elevator constructors.

Where Building Trades Workers Are Employed

The largest portion of building trades workers are employed by contractors in the contract construction industry. Some are employed as maintenance workers in manufacturing industries. Some work for government agencies, and others are self-employed.

An important consideration for those of you entering the building trades field is that building trades craftsmen are employed in almost every community. However, the industrialized and highly populated states provide the best employment prospect.

Employment Outlook and Wages

Building trades craftsmen make up the largest group of skilled workers in the nation's labor force. In mid-1960 there were about 3 million such craftsmen, which was approximately a third of all skilled workers.

The favorable employment prospects for building trades workers will result primarily from the approximate 50 per cent increase anticipated in the level of construction activity. Another important factor which will affect the growth of employment in the building crafts is that technological changes have limited effects on these workers. Building trades have generally been able to adapt to technological changes and continue to grow.

Building Trades Unions

Most workers in the building trades are union members. This is especially true in large towns and cities. A large proportion of building tradesmen are members of unions affiliated with the American Federation of Labor--Congress of Industrial Organizations (AFL-CIO).

Most local unions have local joint apprenticeship committees and sponsor various apprenticeship programs which should be of interest to you.

Assignment
Sheet No. 2

Covering
Units 3-6

INTRODUCTION TO CARPENTRY

The largest single group of building trades workers are the carpenters. Their work is commonly divided into two broad categories--"rough" carpentry and "finish" carpentry. However, a skilled carpenter should be able to do both types of work.

In building a typical house, the rough carpenters would build forms, erect the sills, girders, floor joists, subflooring, studding, ceiling joists, rafters and sheathing. They would also erect scaffolding and temporary buildings on the construction site. The finish carpenters would do such things as install molding, wood paneling, cabinets, window sash, door frames, doors and hardware.

In this assignment you will have an opportunity to become acquainted with the carpentry trade and to become aware of what is required of you if you wish to become a journeyman carpenter.

Assignment:

1. Read the reference listed below.
2. Be prepared to discuss the study questions listed below.
3. Work out the questions, problems, and projects as assigned by your instructor.

Reference:

M. U. S. Department of Labor, Occupational Outlook Handbook, 1961 edition, pp. 346-349.

Questions:

1. What are the two broad categories into which the carpenter's work is divided? What types of work are done in each category?

2. What are some of the major fields of construction in which carpenters work?

3. What is considered a desirable amount of high school education for an apprentice carpenter? What age is the apprentice generally required to be?

4. How many clock hours of on-the-job training are required to complete the carpentry apprentice program? How many hours of related classroom instruction are required?

5. What per cent of the journeyman's wage does an apprentice usually earn? How many months are usually required before he gets an increase in pay? What is the usual per cent increase?

6. Why do carpenters have greater opportunities, than most other building tradesmen, to become general construction foremen?

7. How have technological developments affected the carpenter? What is the national average hourly wage rate? What were the national <u>minimum</u> and <u>maximum</u> hourly wage rates in 1960?

Assignment
Sheet No. 3

Covering
Units 7-11

ESSENTIAL PREPARATIONS FOR BUILDING A HOUSE

The house which a family builds or buys probably will represent one of their largest investments. If the house is planned with foresight and built with care, it will prove to be a very worthwhile investment.

If you are to be recognized as a good carpenter, you will not only have to be a good craftsman, but you will have to know about building preparations and where to refer individuals for further information about building. By helping the future homeowner you will make friends and build good will in the community.

In this assignment you will have the opportunity to learn about factors which should be considered when selecting a location, complying with building codes and zoning regulations, investing wisely, financing wisely, and cooperating effectively with other individuals.

Assignment:

1. Read the reference listed below.
2. Be prepared to discuss the study questions listed below.
3. Work out the questions, problems, and projects as assigned by your instructor.

Reference:

D. Durbahn, Fundamentals of Carpentry, Vol. I, pp. 221-228.

Questions:

1. What advice should the carpenter be able to give the prospective homeowner?

2. What is generally the largest single item of expense in building a house? Who receives it?

3. What factors should be considered when choosing a location and deciding what type of home to build?

4. What are the purposes of zoning laws and building codes?

5. Who should be contacted to determine the height and adequacy of the sewer? If public sewers are not available, what type of drainage systems may be used as a substitute?

6. What are some of the things which must be checked to insure a clear and unquestionable title to a piece of property you purchase?

7. Why is it necessary to have adequate drawings and specifications when building a home?

8. What precautions should the homeowner take before signing contracts with an architect, carpenter, or other interested parties? Why is the lowest bid not always the best bid?

Assignment
Sheet No. 4

Covering Units
41, 58, 60-65

TOOLS FOR THE CARPENTER

Much of the carpenter's success, and the quality of his work, depends upon his ability to select and care for his tools. In an age when we are constantly bombarded with high-powered advertising, there is urgent need for the tradesman to be able to judge the quality and utility of the tools that he must purchase.

This assignment is designed to acquaint you with the tools used by the carpenter, and to familiarize you with some of the desirable characteristics of high-quality tools.

Assignment:

1. Read the reference listed below.
2. Be prepared to discuss the study questions listed below.
3. Work out the questions, problems, and projects as assigned by your instructor.

Reference:

D. Durbahn, Fundamentals of Carpentry, Vol. I, pp. 7-36, 59-72.

Questions:

1. Why is a carpenter required to own fewer tools today than was required in the past?

2. What type of work should the apprentice's tools be suited for? What two major classifications of tools are suggested for the carpenter's apprentice? Which tools are listed under each classification?

3. What are the major groups of hand tools when classified according to their use? Give three examples from each major group.

4. What are the names of the power tools which must be used in the shop, or must be stationary if on the job? Which one of these is most frequently used?

5. What are two important accessories for the table saw? What use are they to the carpenter?

6. What size blades are available for the electric hand saw? What are two accessories available for the electric hand saw?

7. What are two other names given to the portable jig saw? What are some of the materials which can be cut with the special blades available for this saw?

8. Which power tool may be used to enable carpenters to do butt mortising and lock mortising at production speed?

9. What are the three types of portable sanders? What type work is each best suited for?

Assignment
Sheet No. 5

Covering
Units 12-16

STAKING OUT AND EXCAVATING FOR BUILDINGS

The initial, and possibly the most important step in erecting a structure, is to lay out the foundation. Efficient performance of this task demands that the carpenter possess certain technical knowledge.

Subsequent jobs in erecting the structure will depend upon the "staking out" for its accuracy and stability. Any incorrect placement of footings and foundation walls or piers will affect the strength and stability of the building.

In this assignment you will learn about the procedures, techniques and materials used in foundation layout. Precautions and methods of excavating will also be covered.

Assignment:

1. Read the references listed below.
2. Be prepared to discuss the study questions listed below.
3. Work out the questions, problems, and projects as assigned by your instructor.

References:

D. Durbahn, Fundamentals of Carpentry, Vol. I, pp. 10-19, 32-35
E. Durbahn, Fundamentals of Carpentry, Vol. II, pp. 15-26, 416-467.
J. Mix, Practical Carpentry, pp. 57-62, pp. 10-12.

Questions:

1. What factors should be considered in selecting a home site?

2. What are some of the recent trends in designs and styles for homes?

3. What tools and instruments are needed for laying out a foundation? How are they specified?

4. What major steps must be taken in the process of laying out a foundation?

5. Why is it necessary to determine the size girders to be used and the spacing of girder posts and piers before the foundation is laid out?

6. What are the functions of batter boards? What building lines are established on the batter boards? How are these lines indicated?

7. What methods may be used to square the foundation?

8. What special layout requirements are necessary for excavation work? What precautions are necessary in excavation work?

Assignment
Sheet No. 6

Covering
Unit 50

PROCEDURES FOR CONSTRUCTING CARPENTRY EQUIPMENT

When a carpenter starts out on a job, his mechanical ability is often judged by the type of sawhorse or miter box he builds. Not only is the carpenter's reputation affected by his equipment, but his job efficiency will also depend, to a large extent, upon devices he uses in his work.

In this assignment you will learn some facts about the sawhorse, saw vice, workbench stepladder, miter box, straightedge and other items of equipment frequently constructed by the carpenter.

Assignment:

1. Read the reference listed below.
2. Be prepared to discuss the study questions listed below.
3. Work out the questions, problems, and projects as assigned by your instructor.

Reference:

D. Durbahn, Fundamentals of Carpentry, Vol. I, pp. 36-58.

Questions:

1. How is the size of construction lumber referred to? Can the builder be sure that lumber purchased from the mill is the exact size that is specified?

2. What should determine the length and height of a sawhorse? What material is recommended for building a sawhorse?

3. What numbers on the framing square are used to get the top and bottom cuts on the sawhorse legs? (Page 37 in the reference) How should the sawhorse be tested to see if the legs have been cut at the proper angle?

4. What is the advantage of having a workbench? For what type work is it especially useful?

5. What is the approximate height of a convenient stepladder?

6. What is a miter box used for? What material is recommended for constructing permanent miter boxes?

7. What are door jacks used for? What size material is recommended for their construction?

8. What are the names given to two toolboxes recommended for every carpenter? What is the purpose of each?

Assignment
Sheet No. 7

Covering
Units 17-26

CONCRETE AND CONCRETE FORMS

The modern trend in construction seems to be toward larger and more functional buildings which require the use of concrete for strength and protection against fire.

The quality of the concrete work will, to a large extent, determine the strength of the entire structure.

The design and construction of concrete forms is also important because they must hold and support the semi-liquid concrete until it has hardened. These forms must be located accurately and must be able to withstand heavy pressure.

In this assignment you will have an opportunity to become familiar with the various ingredients for concrete and concrete mixes. You will also learn what materials should be used for concrete forms and how forms should be built.

Assignment:

1. Read the references listed below.
2. Be prepared to discuss the study questions listed below.
3. Work out the questions, problems, and projects as assigned by your instructor.

References:

A. Concrete Form Construction, pp. 15-105.
J. Mix, Practical Carpentry, pp. 15-32.

Questions:

1. What are the major ingredients of concrete? What proportions of each ingredient are recommended for good concrete? In what order are the ingredients specified?

2. What size aggregates are recommended for concrete? What effect does the amount of water have on a concrete mixture?

3. What are the names of the concrete form members needed for a typical concrete wall? What are the functions of each? What materials are used in form construction?

4. What precautions should be taken when building forms?

5. What are the functions of wall ties and spreaders? What types and sizes are found on the market today?

6. How are the quantities of the following materials for forms figured? Studs? Sheathing? Nails?

7. What is the purpose of anchor bolts in foundation walls? How are they installed in the concrete forms?

8. What thickness stock is recommended for construction footing forms? Under what conditions may the earth serve as a footing form? What methodsmay be used to tie the foundation wall to the pier or footing? How are pier and footing forms braced?

9. Under what conditions may a builder use an inside form wall <u>only</u>? What are the disadvantages of using only one foundation wall form? How are wall forms braced?

10. How are openings in concrete walls formed? What methods may be used to provide for easy removal of forms from openings?

11. What are the two general types of concrete steps? What special precautions, if any, must be taken when building each type?

12. What is meant by each of the following terms: Riser? Tread? Pitch board?

13. What size stock is generally used for sidewalk forms? What is the recommended spacing for sidewalk form stakes?

14. What materials should be used for building curved forms?

15. What are the names of forms and centers used for arched openings?

Assignment
Sheet No. 8

Covering
Units 27-33

INTERPRETATION OF BUILDING PLANS AND SPECIFICATIONS

Much of the success of a builder depends upon his ability to read, interpret and follow plans and specifications. The ability to read and interpret plans also will be of value in making estimates of construction costs and thus improve his chances of being a successful bidder.

This chapter is designed to acquaint you with some of the basic fundamentals of blueprint reading, which will enable you to improve your blueprint reading ability when you enter the building industry.

Assignment:

1. Read the reference listed below.
2. Be prepared to discuss the study questions listed below.
3. Work out the questions, problems, and projects as assigned by your instructor.

Reference:

D. Durbahn, Fundamentals of Carpentry, Vol. I, pp. 229-262.

Questions:

1. Why is it so important that the carpenter be able to read and interpret blueprints and specifications?

2. What are some of the things the beginning carpenter should learn to do in order to gain a basic knowledge of how to read blueprints?

3. What are the purposes of a set of drawings, blueprints, and specifications?

4. What is meant by "making a drawing to scale"? What scale is usually used to make house drawings?

5. What four types of drawings are needed for architectural construction? Briefly describe each type.

6. What is the meaning of each of the following: Schedule? Specifications? Symbols?

THE FOLLOWING QUESTIONS PERTAIN TO DRAWINGS AND SPECIFICATIONS OF "A TYPICAL AMERICAN HOME," Reference D, pp. 245-262.

7. What is the pitch of the main roof?

8. How long is the fireplace mantel? How deep is it? What is its height from the finished floor?

9. What are the inside dimensions of the laundry? How many ceiling lights are in the laundry?

10. What material is used for partition walls in the laundry? What type and size basement windows are to be used in the basement?

11. What size joists are to be used for the first floor? What is the recommended spacing?

12. What are the over-all dimensions of the first floor plan? How many windows are to be on the first floor?

13. What are the dimensions for footings and foundation of the north wall? South wall?

14. What is the specified type and grade for the dimension lumber?

15. How is the exterior wall to be finished? What is specified for exterior trim?

~~Assignment~~
Sheet No. 9

Covering Units
42, 145-147

TYPES OF WOOD FASTENERS AND BUILDERS' HARDWARE

It is the carpenter's job to fit and fasten many odd-shaped pieces of wood together or in place. Modern science has made this job easier by contributing many improvements, such as the development of special treatments for nails, water resistant qualities of glue, new inventions in fasteners, and many other progressive aids in this phase of construction.

Wood fastening devices include nails, screws, bolts, timber connectors, dowels, anchors, glues, and other building hardware. An efficient carpenter must know the advantages and limitations of these fastening devices.

This assignment provides you with an opportunity to learn about the types, specifications, and uses of the various wood fastening devices and about the common items of building hardware.

Assignment:

1. Read the reference listed below.
2. Be prepared to discuss the study questions listed below.
3. Work out the questions, problems, and projects as assigned by your instructor.

Reference:

D. Durbahn, Fundamentals of Carpentry, Vol. I, pp. 183-215.

Questions:

1. What are the different fastening devices used today? What three main characteristics of nails should the builder be familiar with?

2. What are the reasons for the special coatings and finishes put on nails? What are the names of these coatings and finishes?

3. What are the different kinds of nails? What is the purpose and function of each kind of nail? How are nail sizes designated?

4. In what ways are wood screws considered superior to nails? How is the diameter of screws designated? What are the three different kinds of wood screws, when classified according to the shapes of their heads?

5. What are the uses of each of the following: Metal screws? Bolts?

6. What are the general categories of anchors used for fastening wood to concrete and masonry? What are the names of anchors that belong in each category?

7. What are the four basic hinge classifications? What other types of hardware may be installed on doors?

8. What general types of glue are available for joining wood? What are the advantages and disadvantages of each?

Assignment
Sheet No. 10

Covering Units
57, 59, 66

PRINCIPLES AND METHODS OF FRAMING FOR FLOORS

No homeowner wants the floors in his house to vibrate every time someone walks across a room. This vibration is annoying, but even more important, it indicates that the floors are unstable. The presence of this type of floor is one of the most obvious signs of poor construction in a home. Of course, it takes more than the use of stronger or larger timbers to avoid this problem. The carpenter has to master many of the principles of joinery, bridging, crowning, and other operations before he can be assured of having a level floor of maximum stability.

The information in this assignment has been selected to give you an opportunity to study the methods, procedures, problems, and common practices involved in modern floor framing.

Assignment:

1. Read the reference listed below.
2. Be prepared to discuss the study questions listed below.
3. Work out the questions, problems, and projects as assigned by your instructor.

Reference:

J. Mix, Practical Carpentry, pp. 57-73.

Questions:

1. What are girders? What percentage of the building weight do they usually support?

2. What factors must be considered in determining girder sizes?

3. What rule may be used in deciding the proper size wood post needed to support girders? Why should girder post footings extend above the basement floor level?

4. What are foundation sills? What are the usual sill sizes? How should they be secured to the foundation wall?

5. What treatment should be given to sills in order to protect them against termites? What other means of termite protection may be used?

6. What is the function of floor joists? What is the usual spacing of joists. What factors must be considered when figuring joist spans?

7. What is the purpose of bridging floor joists? What size stock is recommended for cross bridging? Which end of cross bridging should be nailed first? Why?

Assignment
Sheet No. 11

Covering
Units 52-56

KINDS, PROPERTIES, AND STOCK SIZES OF LUMBER

Lumber is a very important item in all forms of construction work. In fact, the selection and utilization of lumber will be one of the carpenter's greatest responsibilities. There is a great deal of variation in lumber as to kinds, strength, durability, grain, texture, defects, color, beauty, cost, and wearing qualities; the successful carpenter must have a sufficient knowledge of these conditions to make the proper choices. It is just as important for him to know where and when he can use lumber with certain defects without impairing the structure as to be able to select superior pieces for special uses.

This assignment will give you some information about the characteristics, kinds, grades, properties, stock sizes, shapes, and costs of lumber which will help you to become a successful carpenter.

Assignment:

1. Read the reference listed below.
2. Be prepared to discuss the study questions listed below.
3. Work out the questions, problems, and projects as assigned by your instructor.

Reference:

D. Durbahn, Fundamentals of Carpentry, Vol. I, pp. 113-153.

Questions:

1. What is meant by the following terms: Defect? Cross grain? Pith? Warp?

2. What is yard lumber? What is it generally used for?

3. What are the three grades of yard lumber? What are the grades of factory or shop lumber?

4. What three types of measure are used in selling lumber? Give examples of the types of building materials sold by each type of measure.

5. What portion of the house is generally built from softwood? What are the most common species of softwoods that may be found in a lumber yard?

Assignment
Sheet No. 12

Covering Units
67-74, 80-83,
111-112

METHODS OF WALL FRAMING

Any structure depends upon its skeletal framework for strength and support. It is the framing that supports and holds in place all sheathing, siding, roofing, and flooring. Without a strong frame, you can see how difficult it would be to have a stable building. The accuracy of the entire construction job will bear a direct relationshi to the degree of accuracy maintained in the framing. Therefore, errors in the superstructure can "show you up" as a good or bad workman not only during its erection, but also at any time in the later phases of construction or in later years of service.

In this assignment, you will study about the various methods of framing, their uses, as well as the advantages and disadvantages of each.

Assignment:

1. Read the references listed below.
2. Be prepared to discuss the study questions listed below.
3. Work out the questions, problems, and projects as assigned by your instructor.

References:

E. Durbahn, Fundamentals of Carpentry, Vol. II, pp. 78-84.
J. Mix, Practical Carpentry, pp. 51-55, 76-92.

Questions:

1. What are the commonly used house framing methods? What are the distinguishing characteristics and advantages of each method?

2. What are studs? What size stock is generally used for studs? When is it desirable to use a larger size stock other than what is usually used? How should studs be nailed in place?

3. What is a sole plate? What is the recommended method of nailing it in place?

4. What are corner posts? What are the different methods of assembling corner posts? How should corner posts be nailed to the plate or sill? What size nails should be used?

5. What methods may be used to brace wall studs? What are the specific reasons for stud braces?

6. How are openings in walls framed? Distinguish between load-bearing headers and non-bearing headers? Why are trussed headers recommended for wide openings?

7. What are fire stops? What is their function? What are some methods of fire stopping?

8. What are the principal purposes for applying sheathing? What types of materials may be used as sheathing? What are the advantages and disadvantages of each type?

9. What construction methods may be employed to sheath a wall? What are the advantages and disadvantages of each method? What do the tests made by the Forest Products Laboratory indicate as to ridgidity and strength of various wall construction procedures?

Assignment
Sheet No. 13

Covering
Unit 79

SPECIAL FRAMING PROBLEMS RELATIVE TO THE WORK OF OTHER TRADESMEN

There are very few, if any, carpenters who do all of the work that is called for in present day construction. The building trades, like other phases of industry, are in an era of specialization. Electricians, plumbers, stone masons, and many other tradesmen will be your teammates as you work at the job of completing a house that meets the specifications set up by the homeowner.

The success of the related tradesmen depends in part upon your cooperation and your understanding of their duties and responsibilities. It is not necessary for you to master their special skills, but by gaining special information about their problems you will be able to save time, as well as your reputation, and your employer's money.

This assignment considers special framing problems related to plastering, plumbing, tiling, heating, and electrical work.

Assignment:

1. Read the reference listed below.
2. Be prepared to discuss the study questions listed below.
3. Work out the questions, problems, and projects as assigned by your instructor.

Reference:

E. Durbahn, Fundamentals of Carpentry, Vol. II, pp. 84-90.

Questions:

1. Why is the carpenter considered the key man in the construction of wooden frame buildings? What are some of the things he should know concerning the work of other tradesmen?

2. What does the carpenter need to know concerning brickwork, in regard to framing around chimneys?

3. What are probably the most difficult framing problems for the carpenter in regard to making provisions for other tradesmen? Why must the partition wall that houses the soil stack be built of 2 x 8 studs?

4. Why does the carpenter need to have adequate drawings and layouts of the work of such tradesmen as plumbers, heating and ventilating workers, tilesetters, etc?

5. What are plaster grounds? What is their purpose? Why is it so important that they be placed in the correct places? What determines the required thickness for grounds?

6. Why must the concrete base for a tile floor in the bathroom, lavatories, etc., be dropped between the joists? How is it done?

Assignment
Sheet No. 14

Covering
Unit 78

PRINCIPLES OF PARTITION CONSTRUCTION

The erection of the exterior walls of a house is very important, but it takes more than that to make the house livable. For example, the floor space within those walls must be suitably divided by interior partitions, and openings must be made in the partitions to allow for accessibility and circulation. The construction of such walls and openings calls for careful planning and efficient construction.

The carpenter is often called upon to aid the home builder in planning room arrangement and the positioning of door openings. It is important therefore, that the carpenter should be familiar with the principles that guide the placement of rooms in a home as well as the procedures of constructing the partitions that separate the various rooms.

Your goal in completing this assignment should be to learn the principles, procedures, precautions, and special techniques used in partition construction.

Assignment:

1. Read the references listed below.
2. Be prepared to discuss the study questions listed below.
3. Work out the questions, problems, and projects as assigned by your instructor.

References:

E. Durbahn, Fundamentals of Carpentry, Vol. II, pp. 65-73.
J. Mix, Practical Carpentry, pp. 92-96.

Questions:

1. What is meant by a bearing partition? Non-bearing partition?

2. How should a bearing partition be placed in relation to the floor joists beneath it?

3. What type of floor joist assembly and support must be provided for partitions which run parallel to the joists?

4. How are partition posts assembled? Why is it so necessary that partition walls be tied together firmly with solid anchorage?

Assignment
Sheet No. 15

Covering
Units 34-40

THE NATURE OF INSULATION AND ITS INSTALLATION

Years ago your great-grandfather may have stood before an open fireplace absorbing the warmth from the fire while across the room this same warmth was not prevalent. At the same time enough heat went up the chimney to have warmed this other side of the room with enough heat left over to do the family cooking. Today, you may be supplying a furnace with plenty of fuel and sitting in comfort; however, many dollars worth of heat may be seeping through the walls and ceilings.

By modern means of insulation, any homeowner can prevent excessive loss of heat and thus save money on his yearly heating bill. The carpenter is often called upon to give advice about insulation and to install the types of insulation the homeowner selects.

From this assignment, you may learn about the types, composition, comparative values, installation procedures, and the fundamental principles behind the use of insulating materials.

Assignment:

1. Read the references listed below.
2. Be prepared to discuss the study questions listed below.
3. Work out the questions, problems, and projects as assigned by your instructor.

References:

D. Durbahn, Fundamentals of Carpentry, Vol. I, pp. 155-182.
J. Mix, Practical Carpentry, pp. 207-236.

Questions:

1. What is meant by "thermal insulation"? What results are produced by using this material process?

2. What are the various types of building insulation? What are the characteristics of each?

3. What are the comparative values of insulation?

4. Whereare the recommended places to insulate a residential building?

5. What is a vapor barrier? What conditions cause a need for a vapor barrier? What materials are recommended for use as vapor barriers?

6. What type of construction details and techniques may be utilized to control condensation?

7. What materials may be used for acoustics and sound control? What are other methods of controlling and reducing sound in addition to using soundproof materials?

Assignment
Sheet No. 16

Covering
Units 43-49

TYPES AND USES OF SCAFFOLDING

Most of a carpenter's work has to be done above the ground level. Such jobs as putting on siding and roofing as well as the installation of windows demand that he have some sort of elevated platform for himself and his tools. Ladders are often used to help the carpenter reach high places; however, they have the disadvantage of restricting his horizontal movement. Scaffolds are usually constructed on jobs to avoid these and other disadvantages. Of course, there are many types of scaffolds for different jobs, and it is necessary for the carpenter to know the merits of each in order that he may be able to do his job more efficiently. Not only should the types and uses of scaffolding be known, but a competent carpenter must also know the safest methods of constructing them to prevent injury on the job.

The information in this assignment will give you an opportunity to learn something about the types, uses, limitations, and advantages of scaffolding.

Assignment:

1. Read the references listed below.
2. Be prepared to discuss the study questions listed below.
3. Work out the questions, problems, and projects as assigned by your instructor.

References:

E. Durbahn, Fundamentals of Carpentry, Vol. II, pp. 122-128.
J. Mix, Practical Carpentry, pp. 370-377.

Questions:

1. What factors must be considered in determining the type of scaffold you need?
2. What are the principal parts of a carpenter's scaffold? What size stock should each part be made of?
3. How may steel brackets be used in building scaffolds? Why have they become so popular?
4. What are ladder jack scaffolds? Under what conditions can they be used advantageously?
5. What types of supports may be used for roof construction and repairing?

48

Assignment
Sheet No. 17

Covering
Unit 51

SAFETY IN THE BUILDING TRADES

Work in the building trades is generally more dangerous than work in manufacturing, but the risk of injury is lessened considerably when proper work practices are followed. In recent years, the safety record of construction workers in contract construction work has improved as a result of safety programs established by employers and unions.

Not only does an individual who is thoughtless or negligent risk personal injury, but he also increases the possibility of his fellow workers becoming injured. Remember that a good carpenter seldom gets hurt. So don't let constant injury brand you as a poor craftsman. It is always a good practice to follow the old adage that an ounce of prevention is worth a pound of cure. Learning safety rules and practicing them will increase your ounces of prevention.

In this assignment you will have the opportunity of learning general safety rules and practices which are beneficial to carpenters.

Assignment:

1. Read the references listed below.
2. Be prepared to discuss the study questions listed below.
3. Work out the questions, problems, and projects as assigned by your instructor.

References:

D. Durbahn, Fundamentals of Carpentry, Vol. I, pp. 56-57.
E. Durbahn, Fundamentals of Carpentry, Vol. II, pp. 16-18, 129-130.

Questions:

1. What is the basic requirement for reducing accidents to a minimum? What is the major cause of accidents in the building industry?

2. What are the major points to be remembered in regard to work clothes? What type of shoes and shoe-soles are recommended for the builder?

3. What are the other hazards that should be guarded against? What habit should the young carpenter form regarding protruding nails?

4. What is the minimum supply of first aid items that should be included in a carpenter's first aid kit?

5. What are a few "safety conscious" suggestions that should be remembered by builders?

Assignment
Sheet No. 18

Covering Units
84-86; 91-93

PRINCIPLES OF ROOF FRAMING

A good roof must not only look nice and stay in place, but it must also serve its primary purpose of keeping out wind and rain. It must be able to support heavy snow and ice and stand firm against blowing winds and rain. These and other factors go together to make roof framing and design one of the carpenter's most difficult construction problems. When reckoning with these factors, the carpenter must select the proper style of roof as well as the most satisfactory pitch for economy, efficiency, and appearance.

An important part of this assignment is the use and function of the framing square. Therefore, it is necessary for the carpenter to acquaint himself with the fundamental operations performed and the special layouts done with the square in solving construction problems.

This assignment is designed to acquaint you with the various styles and variations in roofs, the terms and relationships of roof members, the requirements and calculations for determining proper pitch, the use of scales and tables found on the framing square, and factors regarding overhand, eaves and gutters.

Assignment:

1. Read the references listed below.
2. Be prepared to discuss the study questions listed below.
3. Work out the questions, problems, and projects as assigned by your instructor.

References:

D. Durbahn, Fundamentals of Carpentry, Vol. I, pp. 73-96.
E. Durbahn, Fundamentals of Carpentry, Vol. II, pp. 134-147.

Questions:

1. What are the names of the various roof styles? Which ones are most commonly used for modern residential buildings?

2. What is meant by the following terms: ridge? rafter plate? rafter? What are the names of the different kinds of rafters?

3. Define the following terms: span? run? rise?

4. What constitutes the total rise of a rafter? What constitutes the total length? What methods may be used to determine the total lengths of rafters?

5. What are the principal parts of the framing square? How may a framing square be tested for accuracy of a right angle?

6. What are the names and uses of the various tables on the framing square? On what part of the square may they be found? How may a square be used to calculate proportions? What are other uses and functions of the framing square?

7. What is meant by each of the following terms: unit runs? unit rise? unit length of rafter? How are these unit measurements applied to rafter cutting?

Assignment
Sheet No. 19

Covering
Units 87-89

PROCEDURES AND PRACTICES OF ROOF FRAMING

To the beginner or casual observer, roof framing seems extremely difficult; however, to the carpenter who thoroughly understands a few principles of geometry and can apply them, the problem of framing a roof becomes less and less difficult.

The roof serves as the backbone of a building and must be able to withstand snow, wind, and rain. For this reason, the job of framing a roof is extremely important and must be done with skill and care. To develop the skill that is needed to do this job properly, the carpenter needs more than practice. He must have a thorough understanding of the principles which form the foundation for the procedures he should follow.

This assignment directs your learning toward the methods of laying off rafters, types and nature of overhang, proper use of roof trusses and braces, and practice in the use of tables and scales found on the steel square.

Assignment:

1. Read the references listed below.
2. Be prepared to discuss the study questions listed below.
3. Work out the questions, problems, and projects as assigned by your instructor.

References:

E. Durbahn, Fundamentals of Carpentry, Vol. II, pp. 147-182.
J. Mix, Practical Carpentry, pp. 99-124.

Questions:

1. What is a roof plan? Of what value is a roof plan to the carpenter?

2. What principal purposes does the ridge serve? What is the difference between the "theoretical length" of the ridge and the "true length" of the ridge?

3. What is the difference between plumb and level lines as used with rafter cutting?

4. What three factors should be considered in determining the size of rafters? What are considered safe spans for the various loads, sizes, and spacings of rafters?

5. What is meant by the following rafter terms: ridge cut? seat cut? tail cut? and overhand?

6. What is meant by roof pitch? What is the relationship between unit rise, unit run and pitch? What unit runs and unit rises are required to make up each of the following pitches: 1/6? 1/4? 1/3? 5/24?

7. How can the unit length of a rafter be determined if pitch is known? How is the total length of the rafter determined?

8. If rafter stock has a crown, how should the crown be placed when the rafter is in position? Why is this important to observe in cutting the rafter?

9. What method is commonly used to find the length of rafters? What is a suggested procedure for laying out common rafters? Why is it necessary to shorten a common rafter at the ridge? How should this be done?

10. What is the relationship between the hip rafters and the common rafters? Why must the unit run for hip rafters be 17 inches instead of 12 inches?

11. What is meant by "backing" hip rafters? What methods may be used to back hip rafters?

12. What two methods are used to frame hip rafters at the plumb cut? How much must the hip rafter be shortened for each method of framing?

13. What are the major differences between a hip rafter and a valley rafter? In what ways are they alike?

14. What are the types of jack rafters? What framing members does each type touch when placed in position in the roof? What is meant by the "common difference" of jack rafters? What procedure may be used to find the common difference in jack rafters?

15. What is the most common spacing for rafters used in ordinary roofs? Why is it better to frame a building so that rafters and ceiling joists are side by side at the plate?

16. What methods can be used to provide support for rafters? At what position on the rafters should collar beams be placed? How may the length of a collar beam be determined, without measuring the length, when the height of the beam above the plate is known?

Assignment
Sheet No. 20

Covering
Units 94-96

SPECIAL ROOF FRAMING PROBLEMS

Many of the more complicated aspects of roof framing do not confront the carpenter now because modern roofs tend to follow more simple designs in contrast with roofs on older homes.

However, a highly skilled carpenter should be familiar with some of the special roof framing problems such as framing dormers, lean-to roofs, gambrel roofs, chimney saddles, and bay-window roofs. The ability to skillfully execute these types of framing problems will make the distinction between the highly skilled craftsman and the less skilled.

In this assignment you will have the opportunity to become familiar with some of the special problems relating to roof framing and the procedure used to solve these problems.

Assignment:

1. Read the references listed below.
2. Be prepared to discuss the study questions listed below.
3. Work out the questions, problems and projects as assigned by your instructor.

References:

E. Durbahn, Fundamentals of Carpentry, Vol. II, pp. 182-214.
J. Mix, Practical Carpentry, pp. 122-124.

Questions:

1. What is the procedure that should be used in laying out rafter spacing on the plate and ridge?

2. On a hip roof how far should the first common rafter be placed away from the corner of the building? Are the hip and jack rafters nailed in place before or after the common rafters? Why is it not necessary to plumb the ridge of a hip roof?

3. What are the different types of shed roofs? What special problems are involved in framing a dormer roof? What problems arise when erecting an intersecting roof?

4. What are the characteristics and construction procedures of a lean-to roof? Gambrel roof? Chimney saddles? Bay window roof?

5. How may the framing square be used to determine the common difference in the lengths of gable-end studs? What figures should be used to get the angle cut used on gable-end studs?

6. What is a layout tee? What size stock should be used for making it? Why is it especially useful for laying out hip, valley, and jack rafters?

7. How is the slope of a roof defined? What slope is required for a flat roof? What method may be used to frame the overhang of flat roofs.

8. Describe the following: transverse beam system of roof framing? longitudinal beam framing?

9. What is a truss roof? What are the advantages of using roof trusses for framing roofs? What are the principal parts of a roof truss?

Assignment
Sheet No. 21

Covering Units
119-126, 139-144,
148-151

TYPES OF WINDOWS AND DOORS, THEIR FRAMING AND INSTALLATION

We would all certainly have to agree that a home or any other building is not complete without windows and doors. Windows allow for natural lighting and ventilation, while doors are necessary for the obvious reasons of gaining entrance and exit. This area of work is especially critical for the carpenter since nothing shows up his skill quite as quickly as a door that drags or one that will not close tight enough to engage the lock. To avoid these and other difficulties, you will have to learn how to construct door and window frames, how to fit, hang, and lock doors and windows, as well as the process of casing openings.

In addition to these skills which you will master, there is much information about doors and windows that you will need to know in connection with the performance of these operations. This assignment is designed to assist you in learning this related information.

Assignment:

1. Read the references listed below.
2. Be prepared to discuss the study questions listed below.
3. Work out the questions, problems, and projects as assigned by your instructor.

References:

E. Durbahn, Fundamentals of Carpentry, Vol. II, pp. 307-326.
J. Mix, Practical Carpentry, pp. 237-282.

Questions:

1. What are door jambs? What are the parts of door jambs? What type of joint is used in building door jambs? What is the usual thickness of door jamb stock? What is the procedure for installing a door jamb?

2. What is a hollow core door? What are some of the unique advantages of a hollow core door? What are the characteristics of other types of doors? What are the popular sizes of exterior and interior stock doors?

3. What three methods are commonly used in hanging doors? What are four types of side hinges?

4. What are the names of the various parts of a door frame? When should the trimming of a door opening take place? What is the procedure to be followed in trimming a door opening?

5. What preliminary precautions should be observed before attempting to fit a door? Approximately how much clearance should be allowed on each side of a well-fitted door? Between the door and the threshold (for exterior doors)? Between door and door stop?

6. What are the two most commonly used types of windows? What are the characteristics of these windows? How do they operate? What are some important facts to remember while installing these windows?

7. What are awning windows? What are the advantages of awning windows?

8. What are gliding windows? How do they operate? What are some important points to remember when installing gliding windows?

9. What are insulating glass units? What useful purposes do they serve? What is one of the recommended procedures for installing insulating glass in picture windows?

10. What precautions should be observed in handling and installing metal framed windows?

Assignment
Sheet No. 22

Covering Units
98-110, 113-118

EXTERIOR TRIM AND FINISH

The personality of a house depends not so much upon the quality of construction as upon the outward appearance it makes. Your face, physical features, dress, and actions reveal your personality. Figuratively, a house relies on all of these except actions to reveal its personality. The shape of the roof, the location and composition of the front door are important features, but the outer covering and the finish really determine the labels of quality, durability and individuality.

As a carpenter, your responsibility is to build the base for certain features that are to be brought out in painted surfaces such as shadow effects, "scalloped" shingles, half-timbered work, and many others. Therefore, you must know the types of finishes available, but more important, you must know how to construct them so that the desired effects are attained.

The information covered in this assignment will increase your knowledge of the types and characteristics of siding materials as well as the construction procedures followed in applying such material.

Assignment:

1. Read the references listed below.
2. Be prepared to discuss the study questions listed below.
3. Work out the questions, problems, and projects as assigned by your instructor.

References:

E. Durbahn, Fundamentals of Carpentry, Vol. II, pp. 215-246, 254-274.
J. Mix, Practical Carpentry, pp. 125-206.

Questions:

1. What are the principal purposes of the exterior finish? What are the principal parts of the exterior finish?

2. What factors must be considered in choosing the wood for exterior finish? What woods are commonly used for exterior finish?

3. What two useful purposes does building paper serve? Of the various types of building paper, which types are commonly used to cover walls?

4. What are the various kinds of materials that may be used as siding on a house? What are the characteristics and merits of each in relation to the other types?

5. What are the various types of wood siding? What are their different characteristics? What are the advantages and disadvantages of each? What construction methods are employed?

6. What are the different styles of corners and corner board construction that may be used with siding? What are battens and where are they used?

7. What unit of measure is used in estimating wood siding? What are the minimum laps for the various widths of siding?

8. What are the characteristics of wood shingles for wall coverings? What are shakes and how do present day "shaved shakes" differ from shakes of years ago? What are the best woods for making shingles? What portion of a shingle is left exposed?

9. What is asbestos cement siding made from? What are the two commonly used types? What are the usual sizes of asbestos shingles?

10. What is a brick veneer wall? Why should brick veneer be used with balloon type framing instead of platform type? What construction procedures are involved in a brick veneer wall?

11. What are water tables? Describe the three types.

12. What is the cornice trim? What are commonly used styles of cornices? What are the merits and characteristics of each? What are rake moldings?

13. What are the principal roofing materials? What are the three major types of asphalt roofing? What are the various weights and shapes of asphalt roofing materials?

14. What is "flashing"? On what parts of the roof is it required? Why is it used? What are two methods of flashing around chimneys?

15. What is a built-up roof? What materials are required for a built-up roof? What are the various procedures employed in applying each different roofing material? What are the characteristics of a wood shingled roof? How is it constructed?

16. What are the commonly used roof tiles made from? What are the two styles of roof tiles?

17. What are the advantages and disadvantages of each of the following types of roofs: galvanized sheet metal? aluminum?

18. What are the various styles, types and shapes of gutters and downspouts? How are these installed? How is the correct size of gutter and downspout determined?

Assignment
Sheet No. 23

Covering Units
127-138, 152-161

INTERIOR TRIM AND FINISH

To be able to build a sturdy, well designed home is very important; however, much of this good work will be overlooked by the owner if the house is not properly finished on the inside. Finishing the interior is very critical since improper selection of floor, wall, and ceiling coverings, molding, wainscoting, etc., can spoil the effect that the rest of the construction processes tried to create

Some carpenters become so proficient at this phase of their work that they specialize in finish work only. As a young carpenter, it will be profitable for you to be well rounded in your trade so that you will be able to perform or supervise work in any of the phases of building.

This assignment is designed to help you become familiar with some of the principles of interior trimming such as the types and structures of doors, window sashes, casings, molding and wainscoting, and the procedures followed in their installation.

Assignment:

1. Read the reference listed below.
2. Be prepared to discuss the study questions listed below.
3. Work out the questions, problems, and projects as assigned by your instructor.

Reference:

J. Mix, Practical Carpentry, pp. 295-309, 319-339

Questions:

1. What are the two principal types of finishes for walls and ceilings?

2. What are four different plaster bases? What are plaster grounds? How are the different plaster bases and grounds applied?

3. What materials are used for a "dry wall" finish? What are its characteristics as to application? What are the advantages and disadvantages of "dry wall" construction?

4. What are the sizes of ceiling tile and planks? What are the three methods that may be used to fasten ceiling tile?

5. What procedure should be followed in laying out ceilings for tiling? What is a "starting strip"? What is a recommended method of fitting tile around fixtures, etc.?

6. Why must the base be clean when preparing a surface to receive tile? Approximately what size adhesive spots should be used for applying tile? Where should they be placed on the tile?

7. What is hardboard? What materials may be used as a base for applying hardboard? When applying tile board in bathrooms, which walls should be covered first?

8. How should studs be braced when ceramic tile is to be installed? What are some acceptable bases for receiving ceramic floor tile? If a concrete base is used for installing ceramic tile, what should be its minimum thickness?

9. What is a baseboard?What is its purpose? What is the difference in a base mold and a shoe mold. What are the corner construction details that may be used in installing baseboard?

10. What are the names of the parts of interior trims around windows and doors?

11. What size stock is used for building kitchen cabinet units? What type joints are used in building kitchen cabinets? What are the construction features of built-in cabinets? What "finish" woods may be used in cabinets?

12. What hardwoods are most commonly used for flooring? What softwoods are sometimes used for finish flooring? What is the difference in methods of cutting quarter-sawed lumber and plain-sawed lumber?

13. What are the sizes and grades of oak flooring? What steps should be followed in determining the amount of flooring needed for a room?

14. How may floors be soundproofed? What purpose does asphalt felt serve when laid between the subfloor and the finish floor?

15. What is the step-by-step procedure for installing asphalt floor tile?

Assignment
Sheet No. 24

Covering
Units 162-171

CALCULATIONS AND PROCEDURES FOR STAIRWAY CONSTRUCTION

Our early forefathers used ladders to move from one floor to another. This is a relatively inexpensive stairway, but as you can imagine, it was not very safe or appealing to the eye. A well designed and safely constructed stairway is a real asset to any home whether it is to be used in the basement, between floors, or for the back porch. Stairwork is a special phase of carpentry, and some of the more elaborate stairways are made up in special shops. However, the regular carpenter will be called upon to build ordinary staircases which are found in most homes so it will be advantageous for you to have a knowledge of stairway layout and the skill necessary to construct them.

This assignment is designed to give you certain information that will enable you to calculate for stairway location and layout, as well as to understand some of the more common construction procedures used in stairwork.

Assignment:

1. Read the references listed below.
2. Be prepared to discuss the study questions listed below.
3. Work out the questions, problems, and projects as assigned by your instructor.

References:

E. Durbahn, Fundamentals of Carpentry, Vol. II, pp. 327-342.
J. Mix, Practical Carpentry, pp. 283-294.

Questions:

1. What are the types of stairs? What are the advantages and disadvantages of each type? What are the safety rules pertaining to stairway building?

2. What is the recommended angle of incline for stairs? What is the recommended height and width for risers and treads?

3. What is headroom? How is it measured?

4. What are stringers? Distinguish between the various types of stringers.

5. What are the basic steps of procedure in laying out the plan for a straight flight of stairs?

6. What procedure should be used to lay out a stair stringer?

7. Why is a four-winder stair safer than a three-winder stair? What is the line of travel? What is considered the average distance (perpendicular) the line of travel should be from the newel post?

8. What is the recommended minimum width for residential stairways?

9. What are the names of stair parts which can be purchased from lumber and millwork dealers?

10. What is the purpose of a disappearing attic stairway? What is the procedure for installing a disappearing stairway?

ANALYSIS OF MASONRY AND CONCRETE

JOB TRAINING: What the Worker Should Be Able to Do	Assign. No.	RELATED INFORMATION: What the Worker Should Know
Introduction to Masonry and Concrete		
	1	1. Nature of work done by cement masons and bricklayers
	1	2. Training requirements
	1	3. Physical and mental requirements.
	1	4. Employment outlook
	1	5. Earnings and working conditions
Footings and Foundations		
6. Conctruct footings	1	6. Importance and purpose of footings and foundations
7. Mix concrete	1	7. Recommended concrete mixers
	1	8. Methods of waterproofing footings and foundations
9. Pour footings and foundations	1	9. Reinforcement for footings
	1	10. Design and types of footings
11. Install reinforcement steel	1	11. Types of reinforcements for footings and foundations
Types, Properties and Uses of Lime and Mortar		
12. Slake lime	2	12. Properties of lime
	2	13. Use and function of lime in construction
	2	14. Function and requirement of mortar
15. Mix mortar	2	15. Types of and properties of mortar
	2	16. Proportions for mortar
	2	17. Precautions in selecting and applying mortar
	2	18. Special purpose mortars

JOB TRAINING: What the Worker Should Be Able to Do	Assign. No.	RELATED INFORMATION: What the Worker Should Know
Mixing, Pouring and Finishing Concrete		
	3	19. Characteristics and requirements of concrete
	3	20. Strength of concrete
21. Set reinforcement rods	3	21. Types of reinforcement for concrete
	3	22. Properties of cement
	3	23. Ingredients for concrete
24. Measure and mix concrete	3	24. Method of designating cement proportions
25. Pour concrete	3	25. Methods of pouring concrete
26. Finish concrete	3	26. Methods of finishing concrete and finishing tools required
27. Cure concrete	3	27. Method of concreting in cold weather
	3	28. Fire protective qualities of concrete
Concrete Block Construction		
	4	29. Kinds of concrete masonry units
	4	30. Shapes and sizes of concrete masonry units
	4	31. Uses of concrete masonry units
	4	32. Wall patterns
	4	33. Construction details
34. Lay concrete block walls	4	34. Methods of laying concrete blocks
35. Partitions and pilasters	4	35. Methods of laying blocks around doors and openings
36. Paint concrete masonry	4	36. Methods of painting concrete masonry
Brick Construction		
	5	37. Kinds of brick
	5	38. Physical characteristics of brick
39. Lay corners	5	39. Brick masonry terms
40. Lay walls	5	40. Types and uses of bricklaying tools
41. Lay pilasters	5	41. Types of bonds
42. Lay brick around openings	5	42. Types of mortar joints

JOB TRAINING: What the Worker Should Be Able to Do	Assign. No.	RELATED INFORMATION: What the Worker Should Know
43. Cut brick	5	43. Types, sizes and function of pilasters
	5	44. Types of mortar finishes

Wall and Partition Construction

45. Lay brick walls and partitions	6	45. Theory of walls and partitions
46. Cut brick and block	6	46. Types and purposes of parapet walls
47. Mix mortar	6	47. Methods of laying brick walls and partitions
48. Lay tile walls and partitions	6	48. Types and grades of structural clay tile
49. Lay pilasters	6	49. Problems encountered in laying out and constructing clay tile walls
50. Tie masonry walls	6	50. Types and uses of wall ties

Fireplace and Chimney Design and Construction

51. Build chimney flue	7	51. Materials for chimney flue
52. Set flue linings	7	52. Types and purposes of flue linings
	7	53. Recommended mortar mix for setting flue linings and building chimneys
54. Build chimney foundations	7	54. Size of chimney foundations
55. Layout and build fireplace	7	55. Types and designs of fireplaces
	7	56. Principal parts of fireplaces
57. Estimate materials for chimneys and fireplaces	7	57. Factors affecting the functioning of chimneys
58. Install modified fireplace	7	58. Types and designs of modified fireplaces
	7	59. Advantages and disadvantages of modified fireplaces

Assignment
Sheet No. 1

Covering
Units 1-11

TYPES AND DESIGNS OF FOOTINGS AND FOUNDATIONS

Footings and foundation walls comprise the first structural work to be done in building homes and other structures. These two parts of the building are of utmost importance to the strength, appearance, usefulness and safety of any structure which requires them.

Without good footings and foundations, a building may develop unsightly cracks, off-level floors, and cause malfunctions of doors, windows, and other moving parts.

This assignment is designed to acquaint you with the types of footings and foundation walls and the methods used in their constructio

Assignment:

1. Read the references listed below.
2. Be prepared to discuss the study questions listed below.
3. Work out the questions, problems, and projects as assigned by your instructor.

References:

C. Dalzell and Townsend, Masonry Simplified, Volume II, pp. 53-135.
M. U. S. Department of Labor, Occupational Outlook Handbook, pp. 356-358, 372-375.

Questions:

1. What is the importance and theory of footings? What kinds of footings are commonly used in building? What are the common footing designs? How are footings made?

2. What concrete mixes are generally recommended for plain concrete footings? What mix is recommended for reinforced footings?

3. What is meant by the dead load? Live load?

4. What four important functions are performed by foundations?

5. What kinds of foundations are recommended by engineers and building codes? Which type is most generally used? What are the advantages and disadvantages of each type? What factors must be considered when designing each type of foundation?

6. What various types of concrete and mortar mixes are recommended for ordinary foundations? What steps of procedure are recommended in building foundations?

7. Why is waterproofing important? What materials and types of waterproofing are available? What factors are important in designing waterproofing systems?

8. What steps of procedure should be followed when waterproofing foundations?

9. What is the nature of the work done by bricklayers? By cement masons? Where are most of the bricklayers employed? The cement masons?

10. What training is required to become a journeyman bricklayer? Cement mason? Where may the training be obtained for each field? What additional qualifications are necessary for each field?

11. How many people are employed in the bricklaying fields? The cement masonry field? How many job openings occur yearly for bricklayers? Cement masons? What is the employment trend for bricklayers? Cement masons?

12. What are the wages generally paid to bricklayers? Cement masons? How do they compare with other skilled building trades workers? Where can you obtain more occupational information about bricklayers and cement masons?

Assignment
Sheet No. 2

Covering
Units 12-18

TYPES, PROPERTIES, AND USES OF LIME AND MORTAR

A good builder, like any skilled tradesman, must have a thorough knowledge of all aspects of his trade. One of the important needs the mason has is a knowledge of the characteristics and properties of cementitious materials which are required in his work.

The functions and requirements of mortar in masonry construction are that it must be of high quality, it must possess sufficient plasticity, it must be of adequate strength, it must provide a cohesive bond for all units, and it must provide a uniform bedding. These and other requirements accentuate the need for a thorough knowledge of high quality cementitious materials.

In this assignment you will have an opportunity to get acquainted with the types, uses, functions and desirable characteristics of lime and mortar.

Assignment:

1. Read the reference listed below.
2. Be prepared to discuss the study questions listed below.
3. Work out the questions, problems, and projects as assigned by your instructor.

Reference:

B. Dalzell and Townsend, Masonry Simplified, Volume I, pp. 1-59.

Questions:

1. What is lime? What are the different classes and types of limestone and lime? How is lime quarried and processed?

2. What are the major physical and chemical characteristics of lime? What is the effect of lime on mortar? What is hydrated lime? How is lime slacked? What are the uses and functions of lime in construction?

3. What is meant by the terms mortar and grout? What are the functions and requirements of mortar?

4. What are the five general types of mortar? On the basis of proportions, how are cement-lime mortars usually classified? What types of cementitious materials are available and what are their characteristics? What desirable properties should aggregates have? Water? Clay? Admixtures? Mortar colors?

5. What are the commonly used proportions of cementitious materials to sand in average mortars? What are the effects of too much sand in mortar? Too little sand? What are the common proportions of the components of cementitious materials? What precautions should be observed in preparing and mixing mortars?

6. What are the properties of mortars? How is each property attained? What precautions should be followed in selecting and applying mortars?

7. In what type construction are special mortars required?

8. What are the types of mortar according to the A.S.A. designation? What mortar mix proportions are required for each type?

Assignment
Sheet No. 3

Covering
Units 19-28

MIXING, POURING AND FINISHING CONCRETE

Concrete is one of the most important materials the builder will work with. It is extremely valuable as a building material and can be adapted to a variety of uses.

Although concrete possesses many outstanding qualities that are needed in building materials, its success depends upon the people who mix and pour it. Selection of quality ingredients, accurate proportioning, careful mixing, and proper pouring are essentials in the making of good concrete.

In this assignment you will have an opportunity to become familiar with concrete ingredients and the recommended procedures for mixing, pouring and curing concrete.

Assignment:

1. Read the references listed below.
2. Be prepared to discuss the study questions listed below.
3. Work out the questions, problems, and projects as assigned by your instructor.

References:

B. Dalzell and Townsend, Masonry Simplified, Volume I, pp. 61-104, 313-354.
K. Portland Cement Association, Cement Mason's Manual, pp. 4-35.

Questions:

1. What is concrete? What are the two principal requirements of hardened concrete? What is the major factor in determining the strength of concrete?

2. What are the different kinds of concrete in terms of the quality and characteristics of the ingredients used?

3. What is meant by the terms "compressive" and "tensile" strength of concrete? What is the purpose of pouring steel rods or bars in concrete? What are two types of steel rods?

4. What are examples of coarse aggregates? Fine aggregates? What determines the proper proportions for mixing concrete?

5. What tools and equipment are needed for measuring concrete? What is needed for mixing concrete? How is concrete poured and finished?

6. What is the purpose of admixtures? What are the major groups into which they may be classified?

7. What is the recommended minimum mixing time for concrete in a mixer? When mixing concrete in a mixer, when should the water be placed in the mixer?

8. What tools are needed for finishing horizontal surfaces? Briefly discuss the purpose and use of each tool.

9. Why should concrete be poured in the forms at a point close to where it is to be in its final position?

10. What is meant by "bleeding"? How can it be avoided?

11. What are the purposes of floating? What are the recommended types of floats?

12. What is troweling? Why should the trowel be held flat against the surface for the first troweling? What method can be used to produce a non-slip surface?

13. How does the finishing procedure for air-entrained concrete differ from the procedure for non-air-entrained concrete? Why should it differ?

14. What is meant by curing concrete? How is it done?

15. What are the names of some of the special surface finishes for concrete? What are some of the causes of surface defects?

16. What factors are to be observed when concreting in cold weather? Hot weather?

17. Why is concrete said to be fireproof? What thickness of concrete is required for fireproofing?

18. What aspects should be considered when designing masonry sidewalks? Driveways? Floors? Steps?

19. What kinds of materials are used to make sidewalks, driveways, floors and steps?

20. What additional design factors are discussed in your Masonry Simplified, Volume I text on pages 332-339?

21. What steps should be followed when constructing concrete sidewalks? Flagstone sidewalks? Driveways? Concrete floors? Concrete base flagstone terraces? Concrete porches? Steps? Rear-entranced platforms?

Assignment
Sheet No. 4

Covering
Units 29-36

BUILDING WITH CONCRETE BLOCK

Concrete masonry units are usually referred to as concrete blocks These concrete units are made by mixing Portland cement with water and such materials as sand, pebbles, crushed stone, cinders, slag, burned shale or clay, or other types of aggregate.

Concrete blocks are extensively used in building stores, garages, farm buildings and residences. They are adapted to easy planning and quick erection.

This assignment is designed to acquaint you with the uses of concrete block and of the method used in laying block.

Assignment:

1. Read the references listed below.
2. Be prepared to discuss the study questions listed below.
3. Work out the questions, problems and projects as assigned by your instructor.

References:

B. Dalzell and Townsend, Masonry Simplified, Volume I, pp. 141-195.
L. Portland Cement Association, Laying Concrete Block, pp. 1-16.

Questions:

1. From what materials are the most commonly used kinds of concrete masonry units made

2. What terms are used to describe the various sizes and shapes of concrete blocks? Explain the difference between the actual size of concrete blocks and the nominal size of concrete blocks. What are some typical uses of concrete masonry?

3. What are the two general groups of wall patterns for block? What are the advantages of each? How thick should horizontal joints be? Vertical joints? In what proportions should mortar be mixed?

4. Why is it a good practice to string out the first course of block without mortar? What factors must be considered when planning window details? Door details? Concrete floor supports? Beam supports? Block wall intersections? Duct details? Cornice details?

5. What is the correct procedure for "laying up" a block wall?

6. What is the procedure for setting door and window frames in place and laying blocks around them?

7. What is meant by "tooling"? What tool is required for tooling? What are control joints and how are they constructed?

8. What type ties should be used for intersecting bearing walls? Intersecting non-bearing walls?

9. What is a cavity wall? How can the cavity be kept clean while the wall is being laid?

10. How are 8" and 12" walls with concrete block backup constructed?

11. How are block walls cleaned and patched? How are block basements waterproofed?

12. How are concrete block chimneys laid? Pilasters?

13. What types of paint are recommended to paint masonry walls? What are the best methods of applying paint to a masonry wall?

Assignment
Sheet No. 5

Covering
Units 37-44

BUILDING WITH BRICKS

The use of brick as a building material was one of the earliest indications that man had risen above the position occupied by his ancestors.

Brick may be used in a variety of ways to create many different wall patterns and designs. However, a high degree of skill is required to lay brick and no other type of masonry offers the same possibilities for the exhibition of skill and perfection.

In this unit you will have an opportunity to become acquainted with the kinds of brick and their application. You will also gain information which should be of value in developing skill in laying brick.

Assignment:

1. Read the reference listed below.
2. Be prepared to discuss the study questions listed below.
3. Work out the questions, problems, and projects as assigned by your instructor.

Reference:

B. Dalzell and Townsend, Masonry Simplified, Volume I, pp. 252-312.

Questions:

1. What is meant by the term "brick masonry"? What materials are used to make brick? What are the names of the various kinds of brick? How are bricks manufactured?

2. Briefly describe each of the following physical characteristics of brick: size, weight, quality, color, and surface finish.

3. What is the meaning of each of the following brick masonry terms: backing, brick veneer, buttering, fat mortar, fire clay, grout, header, jointing, lintel, stretcher, pointing trowel?

4. What is meant by the term "bonding" as used in brick masonry? What are the 11 types of bonds? Be able to identify the various types.

5. What tools are used by bricklayers? What is each used for?

6. Describe the procedures that should be followed in making the following joints: (1) bed, (2) head, (3) cross, (4) closure. Describe the types of joint finishes. How thick should joints be?

7. What supports are provided for a brick veneer wall? What purposes do metal ties serve on brick veneer walls? How close together are they spaced along the wall?

8. What are the major steps in laying an 8" common bond brick wall?

9. What procedure is used to lay brick around window and door openings? How are the frames secured to the walls? How is a 4" brick wall laid on a wood frame?

10. What are pilasters? What size should they be? How are they laid out? How are columns and piers laid up?

11. What are the steps involved in laying a chimney? Bricks around joist bearings?

12. What are the functions, characteristics and properties of mortar used for laying brick?

13. What are the four reasons for wetting bricks prior to laying?

Assignment
Sheet No. 6

Covering
Units 45-50

WALL AND PARTITION CONSTRUCTION

Since the dawn of history, walls have protected man and his belongings from the elements and from his enemies. Today walls play just as an important a role in the life of man. In view of this, it is extremely important that careful consideration be given to the planning and construction of walls and partitions.

In planning and constructing walls and partitions, the builder should be able to select the kinds of walls needed, materials, mortar joints and anchors. He must also make decisions on many other important features.

This assignment is designed to acquaint you with the kinds of masonry walls, their design and some suggestions for their planning and construction.

Assignment:

1. Read the reference listed below.
2. Be prepared to discuss the study questions listed below.
3. Work out the questions, problems and projects as assigned by your instructor.

References:

B. Dalzell and Townsend, Masonry Simplified, Volume I, pp. 196-251.
C. Dalzell and Townsend, Masonry Simplified, Volume II, pp. 315-373.

Questions:

1. What are parapet walls? What is the purpose of wall coping? Corbeling? Chase? Buttress?

2. What are the principle causes of cracks in masonry walls and partitions? What factors affect watertight walls? Strength of walls and partitions?

3. Discuss the important construction details of the following kinds of walls and partitions: (1) solid brick walls, (2) brick partitions, (3) pier and panel walls, (4) rolok-bak and all-rolok walls, (5) cavity walls, (6) tile walls, (7) tile partitions, (8) brick and tile combination walls, (9) glass block, (10) concrete block walls and partitions, (11) brick veneer walls, (12) stucco walls, and (13) stone walls.

4. What design factors must be considered for each of the walls and partitions mentioned in question 3 above?

5. What steps of procedure should be followed when building the walls and partitions mentioned in question 3 above?

6. What is the difference between side construction tile and end construction tile? What is load-bearing wall tile? What are the physical properties of load and nonload-bearing tile? What is common tile? Scored tile? Face tile? Cored-shell tile?

7. What is the method used to designate the dimensions of wall tile? Discuss the sizes, shapes, and uses of the many types of structural clay tile units.

8. What are some typical uses of structural clay tile? In what surface finishes and colors is clay tile available?

9. What aspects of bonding, mortar, joints and pointing are important in clay tile construction?

10. Why is it difficult to plan and lay out walls which are constructed of clay tile? Why should the builder know what manufacturer's tile is available before window and door locations are determined? What items are important considerations in detail planning of walls? Windows? Corners? Flashings? Ties? Lintels? Pilasters? Partition foundations? Nailing strips? Wall draining? Tile beam floors? Parapet walls? Cornices? Fireproofing? Termite shields? Lateral supports? Door bucks?

11. What are the suggested steps in laying tile walls? Veneered and cavity walls? Partitions? Around window and door openings? ~~Reinforced lintels~~? Tile beams?

Assignment
Sheet No. 7

Covering
Units 51-59

CHIMNEY AND FIREPLACE DESIGN AND CONSTRUCTION

A well-built, fire-safe chimney and fireplace are assets to a home and, if well designed, will add a touch of distinction to its appearance.

The location, design and construction of chimneys require careful planning and consideration of many details. These are important factors because they determine the beauty, functionality, safety and durability of the structure.

The purpose of this assignment is to acquaint you with some of the principles of good fireplace and chimney design and construction.

Assignment:

1. Read the reference listed below.
2. Be prepared to discuss the study questions listed below.
3. Work out the questions, problems and projects as assigned by your instructor.

Reference:

C. Dalzell and Townsend, Masonry Simplified, Volume II, pp. 228-314.

Questions:

1. What are the two main purposes of chimneys? Why is draft an essential factor in chimney design? Under what conditions will a chimney have flues? From what materials are chimneys constructed?

2. What theoretical factors must be considered in planning chimney flues? Weather resistance? Insulation? Connections? Soot pockets? Flashing? Spark arrestors? Caps? Hoods? Pots?

3. Discuss the important facets of the different kinds of chimneys noted in your text on pages 246-263.

4. What factors should be considered in designing chimney foundations? Unlined and lined flue sizes? Chimney height? Chimney locations? Chimney walls? Chimney bottoms?

5. What procedures should be followed in constructing chimneys?

6. What are the over-all functions of a fireplace? How do fireplaces heat a room? What are the principle parts of a fireplace and what is the function of each part?

7. What are the main features of plain and modified fireplaces?

8. What important facets must be considered when selecting and designing fireplaces?

9. What steps should be followed when building fireplaces?

10. Explain the method used to estimate the number of bricks required to build chimneys and fireplaces.

ANALYSIS OF ELECTRICAL CONSTRUCTION

JOB TRAINING: What the Worker Should Be Able To Do	Assign. No.	RELATED INFORMATION: What the Worker Should Know
Introduction to Electrical Construction		
	1	1. Nature of the work done by construction electricians
	1	2. Training requirements
	1	3. Physical and mental requirements
	1	4. Employment outlook
	1	5. Earnings and working conditions
	1	6. Sources of occupational information for electricians
Fundamentals of Electricity		
7. Gage wire	1	7. Conductors of electricity and their current carrying capacity
8. Determine direction of electron flow	1	8. Nature and cause of electron flow
9. Wire series and parallel circuits	1	9. Characteristics of series and parallel circuits
	1	10. Meaning and types of phase as applied to electricity
	1	11. Characteristics of direct and alternating current
	1	12. Units of measurement of electricity
13. Measure voltage and amperage	1	13. Types and uses of electrical measuring instruments
14. Solve problems by use of the electrical power equation	1	14. Principles and uses of the electrical power equation
	1	15. The work of the National Safety Council
16. Prevent accidents	1	16. Nature of electric shock
	1	17. Safety precautions relating to electricity

JOB TRAINING: What the Worker Should Be Able To Do	Assign. No.	RELATED INFORMATION: What the Worker Should Know
	Planning	
18. Recognize and sketch standard electrical symbols	1	18. Standard electrical symbols
19. Read electrical and architectural drawings	1	19. Types and uses of architectural drawings
20. Plan fundamental circuits	1	20. Nature and extent of planning services rendered by electricians
	1	21. Services of the Underwriters Laboratories
	1	22. Purposes and provisions of the National Electrical Code
	1	23. The nature and purpose of local inspection
	1	24. Local requirements concerning permits
	1	25. Characteristics of an adequate lighting system
26. Estimate circuit load	1	26. Number and location of appliance receptacles
	Wiring	
27. Select electricians' tools	2	27. Names and uses of electricians' tools
28. Clean, oil, sharpen and adjust tools	2	28. Routine inspection and care of tools
29. Install overhead and underground service entrances	2	29. Characteristics of satisfactory overhead and underground services
30. Install circuit breaker and fuse box	2	30. Types and uses of fuses and circuit breakers
31. Ground system to water pipes and ground rods	2	31. Requirements of a satisfactory ground
	2	32. Names and uses of the parts of the service entrance
33. Mount meter socket and meter	2	33. Types of metering equipment
34. Install service switch		
35. Remove insulation from wire	2	35. Types and uses of insulation
36. Make a pigtail splice	2	36. Kinds of splices and their uses
37. Make a Western Union splice		
38. Make a tee tap splice		

JOB TRAINING: What the Worker Should Be Able To Do	Assign. No.	RELATED INFORMATION: What the Worker Should Know
39. Connect wires with solderless connectors	2	39. Kinds and uses of solderless connectors
40. Insulate connection with tape	2	40. Types and uses of tape
41. Attach wires to terminals		
42. Remove box knockouts	2	42. Types of switch boxes and their uses
43. Mount outlet and switch boxes	2	43. Types of outlet boxes and their uses
44. Secure cable and conduit	2	44. Cable anchoring connector and their uses
	2	45. Anti-short bushings and their uses
46. Install switches	2	46. Types of switches and their uses
47. Mount and wire junction boxes	2	47. Types of junction boxes and their uses
48. Uncoil cable	2	48. Types of cable and their uses
49. Secure cable in place	2	49. Methods of securing cable in place
50. Cut cable to length		
51. Prepare cable for connections		
52. Ground portable motors		
53. Bore holes for cable		
54. Drill holes in masonry and concrete		
55. Cut thin-wall and rigid conduit to length	2	55. Types of conduit and how they are specified and used
56. Bend thin-wall and rigid conduit	2	56. Elbow and sweep specifications
57. Install conduit ells	2	57. Conduit ells and their uses
58. Secure conduit in place	2	58. Methods of fastening conduit and cable to wall
59. Install couplings, bushings and locknuts	2	59. Conduit fittings and their uses
	2	60. Conduit size specifications and wire capacity
61. Ground a conduit wiring system	2	61. Grounding problems involved in conduit wiring
	2	62. Advantages and disadvantages of conduit wiring
63. Ream conduit		
64. Pull-in wires		
65. Install three-wire cable	2	65. Types and sizes of service wiring
	3	66. Types of large appliances in use

JOB TRAINING: What the Worker Should Be Able To Do	Assign. No.	RELATED INFORMATION: What the Worker Should Know
	3	67. Wattage requirements of appliances
	3	68. Off-peak use of electricity and its use
69. Install thermostat	3	69. Types of automatic control equipment
	3	70. Principles of remote-control units
	3	71. Advantages of remote-control units
	3	72. Transformers and their uses
73. Install selector switches	3	73. Types of control and selector switches for remote control wiring and their uses
74. Install relay wire	3	74. Types and gauges of remote control wire
75. Install relays	3	75. The arrangement and use of relays

Estimating

76. Write electrical specifications	3	76. Electrical specifications and their use
	3	77. Ethical practices in bidding
78. Prepare an electrical schedule	3	78. The electrical schedule and its use
	3	79. Circuit arrangement and load estimates
80. Make a material estimate	3	80. Material estimating
81. Make a time and labor estimate	3	81. Time and labor estimating
82. Prepare a bid sheet	3	82. Electrical contracting principles

Assignment
Sheet No. 1

Covering
Units 1-26

FUNDAMENTALS OF ELECTRICAL WORK

One of the fastest growing trades in the construction field in terms of employment opportunities is that of the electrician. Over 130,000 are presently employed and between 3,000 and 3,500 job openings occur annually.

Electricians lay out, assemble, install, and test electrical fixtures, apparatus, and wiring uses in electrical systems. These systems are used to provide heat, light, power, air conditioning, and refrigeration in residences, office buildings, factories, hospitals, schools, and other structures. They also install and connect electrical machinery, equipment and controls.

In this assignment you will learn what qualifications are needed to enter the electrical trade, the nature of the work and working conditions of electricians, safety precautions relating to electricity and the fundamental concepts underlying electrical theory.

Assignment:

1. Read the references listed below.
2. Be prepared to discuss the study questions listed below.
3. Work out the questions, problems, and projects as assigned by your instructor.

References:

F. Graham, Interior Electrical Wiring, pp. 1-21.
M. U. S. Department of Labor, Occupational Outlook Handbook, pp. 361-364.
Information Sheet No. 2, Hazards of Electricity, this manual.

Questions:

1. What is the National Electrical Code? Why were electrical codes developed? What purposes do they serve?

2. What are some preliminary considerations to keep in mind before starting electrical construction work? Who plans the job? Why?

3. What is Ohm's Law? How is it used? Why is it necessary?

4. What is the power equation? How is this formula used?

5. What are the two common types of circuits? How do they differ? How are they used?

6. What is voltage drop? What causes voltage drop? How is the voltage drop of a wire ascertained?

7. What symbols are used to represent electrical fixtures? What purposes do they serve?

8. What two instruments are most commonly used to measure electricity? What is the function of each? How are they used?

9. What training is necessary to become a journeyman electrician? How may this training be obtained?

10. What wages are generally paid electricians? How do their wages compare with other skilled building trade workers? Where can you get more occupational information about the electrical trade?

11. What are the general working conditions for construction electricians?

12. Under what conditions may a person be severly shocked or killed with 120 volt current. Are these conditions prevelant on house construction work?

13. What rules should a workman follow in regard to electrical safety?

Information
Sheet No. 1

HAZARDS OF ELECTRICITY

It is an accepted fact that electricity, if not handled properly, is extremely hazardous. This fact has contributed greatly to the progress that has been made in its control. Through cooperation of manufacturers of electric equipment, governmental bodies, insurance companies and others, the National Electrical Safety Code has been developed. This Code has played an important part in accident-prevention work.

Frequently, construction electricians working with the comparatively low voltage used in house wiring do not have the same respect for it as they do for the high voltage used in delivering current to transformers. They fail to realize that the relationship between the voltage and the resistance of the material serving as ground is the determining factor, and therefore, danger is not determined solely by the voltage. It should be thoroughly understood that the 110 volt current used in lighting circuits is sufficient to kill under many ordinary situations in which the electricians will be working. Potentials of 50 volts or less are capable of killing a person under certain conditions, so extreme caution is necessary.

If the material to which the worker is grounded has low resistance to the flow of electricity, the amperage will be high, resulting in severe electric shock. Electric shock ranges from mild discomfort to actual stoppage of the heart beat and breathing. Serious burns may also result.

The following chart[1] will give some idea of the approximate injury that 60 cycle 120 volts alternating current can cause.

Current	Effect
.0005 or less amperes	No sensation
.0005 to .002 amperes	Threshold of perception
.002 to .010 amperes	Muscular contraction (mild to strong)
.005 to .025 amperes	Painful shock, inability to let go
.025 or more amperes	Violent muscular contraction
.050 to .200 amperes	Ventricular fibrillation (convulsive movement of the heart--fatal)
over .100 amperes	Paralysis of Breathing (apply artificial respiration *immediately*

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[1] U. S. Department of Labor, *Control of Electric Shock Hazards*, Bulletin 216, 1961, p. 6.

The amount of current flowing through the body is governed by the resistance of the body and the insulation of the person from the ground. If a person's skin is dry his resistance may be about 250,000 ohms (a great variation can be expected). If a person is wet from perspiration this may drop to less than 1,000 ohms. Using Ohm's Law with a 120 volt source and 1,000 ohms, the current is .120 amperes, more than enough to kill.

As one can see, the extent of the injury received from electric shock is controlled mainly by the amount of current, the path of the current through the body, and the duration of the shock. The physical and mental condition of the victim may also have a bearing. This fact should never be interpreted to mean that a strong individual should take chances with electricity.

The frequency of the current and the type of current--direct or alternating--are also factors affecting the nature of shock. High frequency current tends to produce heat instead of shock. This is also the case with direct current. Shock hazards may be less, but more severe burns can be expected from direct current accidents. Accident reports indicate minor electric shock has caused serious accidents In these cases, involuntary contraction of the muscles has caused workmen to fall from ladders and scaffolds.

While accidents with electricity are frequently serious, there are fewer safety precautions to be considered than in many other industries. The following rules should be carefully observed by all workmen employed as construction electricians.

1. Assume a circuit is alive until tested and proved dead.

2. Test circuits with proper testing equipment. (110 volt test lamp placed across a 440 volt line will blow up.)

3. Use safety equipment, such as insulated tools, rubber mats and rubber gloves.

4. Main switches should be locked open and a tag attached indicating workmen are working on some part of the circuit before work is started.

5. Before closing a circuit, check carefully to see that workmen are clear of the circuit.

6. Observe the rules of the National Electrical Safety Code.

7. If minor repair of a live circuit cannot be avoided, arrange to have a qualified helper present.

8. Make all parts of a job safe even though they are temporary.

Aside from the hazards of electric shock, the construction electrician is subject to accidents similar to those encountered by other workmen in the building trades. Such as falling from ladders and scaffolds, accidents in manipulation of tools, etc.

Falling is a major cause of industrial accidents. Workmen should avoid improvised steps and ladders. Dependable ladder and scaffolding equipment is available and should be used. Ladders should be of a type designed for the particular purpose. The design of step ladders is an importnat factor in stability. Frequently, improper placing of ladders results in their slipping or the workman trying to reach too far and becoming offbalanced.

Assignment
Sheet No. 2

Covering
Units 27-65

ELECTRICAL WIRING PRACTICES

The major portion of an electricians work deals with installing wires and conduits. Therefore, he must know how to run wire and conduit, how to make connections, and the different methods and materials available for the various aspects of this part of his job.

In this assignment you will have an opportunity to learn about the various methods, materials, and tools available for use in wiring buildings.

Assignment:

1. Read the reference listed below.
2. Be prepared to discuss the study questions listed below.
3. Work out the questions, problems and projects as assigned by your instructor.

Reference:

F. Graham, Interior Electrical Wiring, pp. 22-75, 94-111, 126-151.

Questions:

1. What are the three most commonly used wire splices? What are some other types of connections?

2. What is the proper way to skin wire with a knife? What can happen if it is done improperly?

3. Into what sections or classifications may the electrical wiring system of a residential building be divided? What is the function or purpose of each?

4. How should wire be bent around the screw which fastens it to switches, receptacles, and sockets? Why should it be done this way?

5. What is polarity wiring? Why is it considered important?

6. There are four types of switches which are commonly used for house wiring. List these and explain the operation and function of each.

7. What is nonmetallic sheathed cable?

8. What are seven essential requirements which apply to running nonmetallic sheathed cable.

9. What is armored cable? What are the four recognized types and when should each be used?

10. What is the correct way of designating wire size and number of conductors in flexible armored cable?

11. How is armored cable secured to boxes? What is an antishort bushing?

12. What are the three types of conduit used for general purpose wiring? What are the characteristics and purposes of each?

13. How do conduit ells differ from gas pipe elbows? Why are they made differently? How are ells bent on the job?

14. How are two pieces of conduit fastened together? How is conduit secured to junction boxes?

15. What is the basis for determining the number of wires that may be installed in a conduit?

16. How many bends are permitted in a run of conduit? What might happen if there were more than this number in a run?

17. What are some rules to observe when installing thin-wall conduit in a house?

18. What is fish tape? What is it used for? What is the purpose of a fish tape leader?

19. What could be used to lubricate wires before they are pulled through conduit? Why is this procedure sometimes necessary?

20. What is a hickey? What types of pipe benders are used to bend conduit? What techniques are involved in bending conduit?

21. What types of outlet and junction boxes are available? Where should they be used? Discuss the types of purposes of hangers, covers, and extension rings available for use with outlet boxes.

22. What different fastening devices and anchors are available?

Assignment
Sheet No. 3

Covering
Units 66-82

SPECIAL PROBLEMS FOR ELECTRICIANS

In addition to running wires, conduit, and hooking up lighting circuits, electricians are often called to hook up and/or install various other types of electrical devices.

While these jobs may not be the major part of an electricians work they nevertheless add variety, are challenging, and must be done as skillfully as any other job.

In this assignment you will have an opportunity to learn about some of the special problems which confront electricians and how they can be handled efficiently.

Assignment:

1. Read the reference listed below.
2. Be prepared to discuss the study questions listed below.
3. Work out the questions, problems and projects as assigned by your instructor.

Reference:

F. Graham, Interior Electrical Wiring, pp. 152-173, 190-214, 226-247.

Questions:

1. What considerations must be given in wiring circuits for electrical ranges?

2. Why is it usually necessary to run a three wire 120-240 volt circuit to an electric dryer?

3. What is a thermostat? What determines where it should be placed? How does the operation of a low voltage thermostat differ from that of a line voltage thermostat?

4. Why shouldn't the average electrician or contractor lay out an electric heating system?

5. What are the four basic components of a motor circuit? How is the size of each component determined?

6. What types of automatic control equipment, besides thermostats, are used to control heating systems? What is the purpose of each?

7. What is remote-control wiring? What are its purposes and advantages?

8. What equipment is necessary for remote-control wiring? What is the function of each part?

9. What are the three general methods of arranging remote-control relays? What are the advantages and disadvantages of each method? What procedures are followed when wiring remote-control systems?

10. What are the basic NEC electrical wiring design requirements? How are these requirements used to ascertain the wiring requirements of a house?

11. What is an estimate? What are the essential factors that enter into an estimate? What steps are involved in making an electrical estimate?

ANALYSIS OF PLUMBING AND PIPEFITTING

JOB TRAINING: What the Worker Should Be Able to Do	Assign. No.	RELATED INFORMATION: What the Worker Should Know
Introduction to Plumbing		
	1	1. Recommended amount of high school education for plumbers and pipefitters
	1	2. Methods of learning the trade
	1	3. Apprenticeship requirements
	1	4. Employment outlook
Sewage Disposal Systems		
	2	5. Types of public sewers
	2	6. Municipal sewage treatment
	2	7. Trickling filter sewage plants
	2	8. Septic-tank systems
	2	9. Types and designs of distribution fields
	2	10. Private sewage disposal system
House Sewers and Drains		
11. Sketch drainage system	3	11. Kinds of pipe used for sewers and drains
12. Select sewer pipe and fittings	3	12. Factors to be considered when selecting drainage installation materials
13. Join pipe	3	13. Advantages and disadvantages of the various types of pipes
14. Determine depth of the house drain outlet	3	14. Types of pipe joints
15. Connect house drain to house sewer	3	15. Methods of connecting to the main sewer
16. Connect house sewer to main sewer	3	16. Grades for sewers and drains
	3	17. Classification of drains
18. Install cleanouts and fittings	4	18. Tools and materials needed for house sewer and drain installation
19. Install a grease trap	3	19. Types of traps in the house drain

JOB TRAINING: What the Worker Should Be Able to Do	Assign. No.	RELATED INFORMATION: What the Worker Should Know
20. Lay out and install storm drains	3	20. Trade terms
	3	21. Types and functions of storm drains
	3	22. Types and function of roof leaders
	3	23. Types and methods of inspection and testing

Soil and Waste Pipe Installation

24. Install cast iron soil pipe	5	24. Function of soil pipe
	5	25. Types and sizes of soil pipe
26. Install galvanized soil pipe	5	26. Types of joints
27. Install soil pipe roof terminals	5	27. Types and functions of soil and waste pipe fittings
	5	28. Types of supports and hangers
29. Install cleanouts in soil pipe	5	29. Methods of protecting soil pipe against freezing
30. Connect soil pipe to sewer	5	30. Framing requirements for soil pipe
31. Grade and align soil and waste pipe	5	31. How to determine the size of soil branches and function of waste pipe
32. Install a direct waste line	5	32. Materials used for waste pipe
33. Install an indirect waste line	5	33. How to determine the proper size for waste pipe
	5	34. Fixtures served by waste pipe
	5	35. Tools and equipment needed for waste pipe installation
	5	36. Soil and waste pipe principles
	5	37. Types and methods of inspection and tests

The Water Supply

38. Thread pipe	6	38. Parts and functions of a cold water distribution system

JOB TRAINING: What the Worker Should Be Able to Do	Assign. No.	RELATED INFORMATION: What the Worker Should Know
	6	39. Type of pipe used for cold water distribution system
40. Install fixture risers	6	40. Methods of aligning and grading water pipe
41. Select and install water valves	6	41. Types and functions of water valves
42. Install drip cocks	6	42. Types and function of water pumps
	6	43. Types of water distribution systems for tall buildings
44. Install hot water tank	6	44. Types of hot water storage tanks
	6	45. Methods of sizing storage tanks
46. Install hot water pipe	6	46. Method of determining the work load of a hot-water system
	6	47. Types of water heating devices
48. Connect hot-water pipe to fixtures	6	48. Methods of connecting hot-water tanks
	6	49. Types and function of pressure relief valves
	6	50. Types of hot-water distribution systems

Installation of Plumbing Fixtures

JOB TRAINING: What the Worker Should Be Able to Do	Assign. No.	RELATED INFORMATION: What the Worker Should Know
51. Install traps	7	51. The purpose of traps
	7	52. Sizes and types of traps
	7	53. Permissible traps
	7	54. Objectionable traps
55. Install a relief vent	7	55. The purpose of ventilation
56. Install a waste vent	7	56. Methods of venting plumbing systems
	7	57. Cause of trap seal loss
58. Install a unit vent	7	58. Materials used for vents
	7	59. Vent pipe systems
60. Install loop vents	7	60. Method of ventilating individual plumbing fixtures
61. Install local vents	7	61. Required vent sizes
62. Select and install plumbing fixtures	7	62. Vent pipe principles
	7	63. Plumbing code requirements
	7	64. Roughing in requirements

Assignment
Sheet No. 1

Covering
Units 1-4

AN INTRODUCTION TO THE PLUMBING AND PIPEFITTING TRADE

Employment opportunities for plumbers are expected to continue at a very high rate during the next decade. This is expected to occur because of the high rate of increase in population and because a higher proportion of the population will demand more and better sanitary facilities.

Although plumbing and pipefitting are sometimes considered to be a single trade, most journeymen tend to specialize in either one or the other, especially in large cities. The principal jobs of plumbers deal with water, gas and waste disposal systems, whereas pipefitters install both high and low-pressure pipes that carry hot water, steam and other liquids and gases.

In this assignment you will have an opportunity to become acquainted with the plumbing and pipefitting trade. You will also have an opportunity to get an understanding of the qualifications needed for entry into this occupation as well as the means by which one may get the training needed.

Assignment:

1. Read the references listed below.
2. Be prepared to discuss the study questions listed below.
3. Work out the questions, problems, and projects as assigned by your instructor.

References:

H. Matthias and Smith, How to Design and Install Plumbing, Introduction.
M. U. S. Department of Labor, Occupational Outlook Handbook, pp. 352-356.

Questions:

1. What is the difference in the type of work performed by plumbers and pipefitters?

2. Where are most plumbers and pipefitters employed?

3. What is the recommended number of years of high school education for the plumbing and pipefitting apprentice? What are the recommended high school courses for the apprentice?

4. What is the length of the apprenticeship program? Years? Hours of on-the-job training? Hours of related classroom instruction?

5. What is the nature of the instruction which the apprentice receives in his related classroom instruction?

6. What are the factors which will cause an increase in employment of plumbers and pipefitters?

7. What is the wage range for plumbers? How do they compare with other skilled building trades workers?

8. Breifly describe the history of plumbing from early Roman times until the present.

Assignment
Sheet No. 2

Covering
Units 5-10

TYPES AND FUNCTIONS OF SEWAGE DISPOSAL SYSTEMS

Adequate disposal of sewage is absolutely necessary in today's highly concentrated urban population. Sewage disposal systems are of two general types - public and private. Even though the installation of public sewage systems does not come under the jurisdiction of the plumber, he should be familiar with their general layout and design since he must use them as terminals for the private sewage systems he installs.

This assignment is designed to give you an opportunity to become acquainted with the various types of sewage disposal systems and to acquaint you with the types of knowledge and skills required in this phase of plumbing.

Assignment:

1. Read the reference listed below.
2. Be prepared to discuss the study questions listed below.
3. Work out the questions, problems and projects as assigned by your instructor.

Reference:

H. Matthias, How to Design and Install Plumbing, pp. 1-32.

Questions:

1. Why is it important for the plumber to be familiar with the public sewage disposal system?

2. How many types of public sewers are there? What are their names? How are they classified? What are intercepting and tributary sewers?

3. Who should be in charge of the design and construction of modern sewage disposal plants? Name and briefly explain the operating principles of municipal sewage treatment plants.

4. What type of soil is most suitable for the disposal of waste from a septic tank? Why is it important that the septic system be installed close to the surface of the soil?

5. What is the purpose of a septic tank? What materials are commercially built septic tanks made from? What should determine the size septic tank required?

6. What is the minimum distance that should be allowed between the septic tank and the building? What is the minimum distance the tank should be from the source of water supply?

7. What methods may be used to dispose of the effluent of a septic tank? How is each generally constructed? What factors govern which method should be used to dispose of effluent?

8. What is a distribution box? What purpose does it serve?

~~Assignment~~
Sheet No. 3

Covering Units
11-17, 19-23

LAYOUT AND INSTALLATION OF HOUSE SEWERS AND DRAINS

The layout and installation of the house sewer and drain is one of the most important phases of the plumber's job. Much of the efficiency of the entire drainage installation depends on this part of the plumber's work.

Efficient layout of this portion of the plumbing system requires the selection of proper materials as well as the use of well-made pipe joints.

In this assignment you will have an opportunity to learn some of the basic requirements for installing sewers and drains as well as the materials and tools needed for doing the job.

Assignment:

1. Read the reference listed below.
2. Be prepared to discuss the study questions listed below.
3. Work out the questions, problems and projects as assigned by your instructor.

Reference:

H. Matthias, How to Design and Install Plumbing, pp. 53-106.

Questions:

1. What type of fitting is usually provided for connecting the house sewer to the main sewer? How is the grade of the house sewer determined? What is the usual pitch of a house sewer? How is the size of the house sewer determined?

2. What is the house drain? What are the classifications of drains?

3. How is the size of house drains determined? What is the recommended grade for the house drain?

4. What is the purpose of cleanouts? Where should they be placed in a drainage system? How many are required? How are cast iron and clay house drains installed?

5. What are house drain appliances? Describe the types commonly used today.

6. What is the function of the storm drain? How is its size determined? How are they installed?

7. Describe the function of roof leaders and roof terminals. How is the size of the roof leader determined?

Assignment
Sheet No. 4

Covering
Unit 18

TOOLS AND MATERIALS USED IN HOUSE SEWER AND DRAIN CONSTRUCTION

One of the distinguishing marks of a competent craftsman is his having a thorough knowledge of the tools and materials required to do the most satisfactory job. A thorough knowledge of the tools and materials of the trade enables the plumber to (1) make intelligent estimates of jobs, (2) select the materials most appropriate for a given job, and (3) select materials that will meet code regulations and specifications.

In this assignment you have an opportunity to become acquainted with the tools and materials most often used by the plumber.

Assignment:

1. Read the reference listed below.
2. Be prepared to discuss the study questions listed below.
3. Work out the questions, problems and projects as assigned by your instructor.

Reference:

H. Matthias, How to Design and Install Plumbing, pp. 33-52.

Questions:

1. How is the sewer and drain defined? What kinds of pipe are generally used for sewers and drain?
2. What materials are most commonly used for waste, soil and vent installations?
3. What provisions must be made if clay pipe has to be laid in swampy, unstable soil?
4. What are the names of some of the commonly used clay fittings? What are the purposes of each of these fittings?
5. What are the required lengths for clay pipe? What is the minimum socket taper required by the A.S.T.M.?
6. What are the advantages and disadvantages of cast iron pipe?
7. What fittings are used with cast iron pipe?
8. What are the other kinds of pipe that may be used for sewer and drain installation? What are the advantages and disadvantages of each?
9. What two types of joints are used for joining vitrified clay pipe? Why must these joints be air tight? How may cast-iron pipe be joined to clay pipe?

10. What tools and materials are required to make a vertical calk joint? Horizontal calk joint? Screw thread joint?

11. What tools are needed for cutting cast-iron pipe? What procedure should be followed in making the cut? Describe the special chain-type cast iron cutter.

12. What is the usual composition of the solder used for solder joints on copper pipe? What four steps should be followed in making solder joint on copper pipe? What are the advantages of soldered joints?

13. What are the commonly used wiped joints? What tools and materials are required for wiping joints? What are the steps of procedure for making wiped joints?

Assignment
Sheet No. 5

Covering
Units 24-37

INSTALLATION OF SOIL AND WASTE PIPE

Two of the most important units of the drainage system are the soil and waste pipe installations. Proper installations of these two units requires a knowledge of basic scientific principles, and thorough knowledge of what constitutes good soil and waste pipe practice, as well as a thorough knowledge of rough-in requirements.

The soil pipe is designed to receive the discharge of water closets and other fixtures and convey it to the house drain. On the other hand, waste pipes are designed to convey the discharge of fixtures, other than water closets, to the soil-pipe branch or house drain.

Some of the most important factors in soil and waste pipe installation are: selection of proper size and type of material, proper use of appropriate fittings, location of cleanouts, pitch and proper joints.

In this assignment you will have an opportunity to get acquainted with the problems involved in installing adequate systems of soil and waste pipe.

<u>Assignment</u>:

1. Read the reference listed below.
2. Be prepared to discuss the study questions listed below.
3. Work out the questions, problems and projects as assigned by your instructor.

Reference:

H. Matthias, How to Design and Install Plumbing, pp. 107-146, 197-213.

Questions:

1. What is the function of soil pipe? What material is the soil pipe made from? What type joints are recommended for soil stacks?

2. What are the purposes of "change of direction" units? What are the names of those that are commonly used? Why should a cleanout be installed whenever there is a change in direction?

3. How is the size of the soil pipe determined? What factors, other than pipe size, effect the efficiency of soil pipe?

4. How is the actual installation of the soil pipe started? Where is the soil pipe usually terminated?

5. What is the purpose of roof terminals? What methods may be used to protect them against freezing?

6. What is the soil branch? How is it sized? Why must it be provided with an adequate number of cleanouts? What type of supports and hangers are required? At what grade should soil branch be extended? How is the soil branch installed?

7. What is the function of the waste pipe? What materials are waste pipe made from?

8. What are the common fittings used in the waste pipe system? Where do cleanouts need to be installed?

9. What types of supports and hangers are available for waste pipe? At what location are they mounted for the different kinds of pipe? At what grade is waste pipe installed?

10. What method may be used to determine the size of waste pipe? What is meant by direct waste? Indirect waste? What fixtures belong to each type?

11. What fitting is best to use where the waste pipe joins the soil pipe under the floor? What are the various types of underfloor waste pipe used for domestic buildings?

12. What may be considered to be some of the advantages and disadvantages of the different types of underfloor waste pipe? What provisions must be made for supporting lead pipe?

13. What size vent pipe is used for the laundry tray and sink in the diagram on page 199?

14. What types of tests are given plumbing systems to insure their efficiency and high quality workmanship?

Assignment
Sheet No. 6

Covering
Units 38-50

LAYOUT AND INSTALLATION OF THE WATER DISTRIBUTION SYSTEMS

The proper functioning of plumbing fixtures depend, to a large extent, on an adequate supply of water under adequate pressure. If the pressure is not sufficient, the plumber must be able to select and install pumps so as to raise the pressure to the required level.

In order to provide an adequate supply of hot water, the plumber must be able to determine the required hot water storage tank capacity.

Efficiency in installing both cold and hot water distribution systems requires a thorough knowledge of the proper pipe and fittings available to the plumber.

In this assignment you will have an opportunity to become familiar with the principles and practices regarding the installation of the water distribution systems.

Assignment:

1. Read the reference listed below.
2. Be prepared to discuss the study questions listed below.
3. Work out the questions, problems and projects as assigned by your instructor.

Reference:

H. Matthias, How to Design and Install Plumbing, pp. 215-298.

Questions:

1. What are the two units of the cold water distribution system?

2. At what angle should a riser be connected to the main? At what angle should a branch connect to the main? How are water distribution systems supported?

3. What are the names of the various types of water valves? Which type is best known? What is its chief advantage? What precautions should be observed when installing water distribution systems?

4. What is the function of a pump installed on a water supply system? What are the three types of piston pumps and the operating principles of each? What is the purpose of an air chamber? How does a centrifugal pump operate?

5. What are the two cold water distribution systems used in tall buildings? What are the advantages and disadvantages of each? How does each system operate? How does an air power system operate and where is it used?

6. What are the two types of hot water tanks? What three factors should be considered when determining the proper size for a hot-water tank?

7. What are the advantages and disadvantages of the common water heating devices discussed in your text?

8. What should determine whether the hot water tank will be set in a vertical or horizontal position? How is hot water circulated in the various systems discussed in your text?

9. What is the purpose of temperature-pressure relief valves? Where should they be installed?

10. What is a hot water distribution system? What are the three types in common use today? What are the general construction procedures for each system?

11. What is the house service? What depth is recommended for the installation of the house service? What factors must be considered in determining demand and sizing the water service?

12. What is the function of a corporation stop? Curb stop? Meter stop? Water meter?

13. What are some of the common scientific terms that a plumber should know and what does each mean?

14. How is a municipal water supply purified and disinfected? Briefly describe the direct and indirect pressure distribution systems.

15. What materials, pipe, and fittings are used in water distribution systems?

16. What types of joints are used in water supply systems? What tools are needed to do water supply work?

Assignment
Sheet No. 7

Covering
Units 51-64

SELECTION AND INSTALLATION OF PLUMBING FIXTURES

The type and size of plumbing fixtures should be selected before the plumber begins his work. This decision must be made in order to be able to select the proper size soil, waste, and vent systems. The size and design of the fixtures to be installed must also be known in advance so that rough-in requirements can be known by all mechanics on the job.

Two of the most important requirements for the plumber when setting fixtures are a thorough knowledge of the proper traps to be used for the various fixtures as well as the acceptable ventilation systems.

In this assignment you will have an opportunity to become familiar with the various plumbing fixtures and requirements for proper installation.

Assignment:

1. Read the reference listed below.
2. Be prepared to discuss the study questions listed below.
3. Work out the questions, problems, and projects as assigned by your instructor.

Reference:

H. Matthias, How to Design and Install Plumbing, pp. 147-195, 330-372, 380-386.

Questions:

1. What is the basic function of traps used on plumbing fixtures? Describe the two types of water-sealed traps. What can be done to prevent trap seal loss?

2. What materials are used in the construction of traps? What is the design and shape of permissible traps? What are the recommended size traps for the various fixtures?

3. What is a drum trap? On what fixtures are they generally installed? What sizes are they? What is its major advantage? What other traps are available and when should or shouldn't they be used?

4. What is the importance of ventilating the plumbing system? What causes trap seal loss? How can these causes be prevented?

5. What are the two types of ventilation methods? What is the primary purpose of each method? What materials may be used to construct the vent system? How is the vent system supported and at what grade is it installed?

6. What factors must be considered when sizing vents? What is the main soil and waste vent and how is it sized? What is an individual vent and how is it sized? How are plumbing fixtures individually ventilated?

7. What is a unit vent? What special fitting is needed for a unit vent installation? What is a circuit vent? Relief vent? Wet vent? Looped vent? Local vent? Utility vent?

8. From what material are modern plumbing fixtures made? What are they coated with?

9. What are the two types of water closets? What types of closets are unsanitary? What steps of procedure should be followed in installing a closet bowl?

10. What are the two types of flush devices for water closets? How many different kinds are there of each type? How do they operate? What are the advantages of a flush tank over flush valves? What are the operating principles of high and low tanks? What are frost-proof closets and how do they operate?

11. What are the types of lavatories and basins? What type faucets may be used with the lavatories and basins? What waste connections are required?

12. What are the types of bathtubs? What type of trap is used on bathtubs? What steps of procedure are used in installing bathtubs?

13. What are the two types of shower baths? What is the function of the water mixing valve? How is lead safing installed?

14. What factors must be considered when selecting and installing the different types of sinks?

15. What are the three types of urinals? What precaution must be taken when repairing urinals? What type and size trap should be used on urinals?

16. What factors must be considered in selecting and installing laundry tubs? Drinking fountains?

17. What are rough-in drawings? Who makes them? How does the plumber obtain them? What information do they contain?

ANALYSIS OF PLASTERING

JOB TRAINING: What the Worker Should Be Able to Do	Assign. No.	RELATED INFORMATION: What the Worker Should Know
Introduction to Plastering		
	1	1. Nature of work done by plasterers
	1	2. Training requirements
	1	3. Physical and mental requirements
	1	4. Employment outlook
	1	5. Earnings and working conditions
Lath and Bases		
6. Apply wood lath	1	6. Types of plaster bases
7. Apply metal lath	1	7. Advantages of board (rock) lath
8. Figure house yardage		
9. Break joints	1	9. Purposes of different kinds of metal lath
10. Tie metal lath	1	10. Advantages of metal lath
11. Apply board (rock) lath	1	11. "Floating" system of lath attachment
	1	12. Nails and nailing specifications
	1	13. Commonly used Masonry bases
Tools and Materials of the Plastering Trade		
	1	14. General purpose tools
	1	15. Tools for ornamental work
	1	16. Tools furnished by the contractor
	1	17. Basic plaster ingredients
	1	18. Qualities of lightweight aggregate
	1	19. Types of cementitious materials
Grounds and Corner Beads		
20. Apply wood grounds	1	20. Thickness of grounds
	1	21. Types of tools required
22. Apply metal, screeds, and casings	1	22. Kinds of metal beads, screeds, and casings

JOB TRAINING: What the Worker Should Be Able to Do	Assign. No.	RELATED INFORMATION: What the Worker Should Know
	1	23. Methods of applying grounds straight and true
	1	24. Methods of grounding out doorways and other openings

Reinforcements

	1	25. Tools required
26. Install reinforcements	1	26. Types of reinforcing used
	1	27. How to estimate amount required
	1	28. Why reinforcement is needed

Base-Coating

29. Mix base-coat materials	2	29. Methods of mixing plaster mortar
30. Trowel on scratch coat	2	30. Effect of proper proportioning
31. Trowel on brown coat	2	31. Types of plaster mortar
32. Rod the wall	2	32. Types of plaster finishes
33. Darby plaster	2	33. Advantages of lightweight aggregate materials
34. Mix colors and tint plaster	2	34. Methods of mixing color
	2	35. Drying conditions
	2	36. Causes of cracking
	2	37. How to estimate materials needed
	2	38. Types of plaster

Finish Coating

	2	39. Tools required
40. Mix finish coat plaster	2	40. Proper mixture
41. Apply finish coat	2	41. Methods of mixing
42. Trowel finish coat	2	42. Thickness of finish coat
43. Float finish coat	2	43. Manufacture of materials
	2	44. Suitability of finishes for different jobs
	2	45. Comparison of smooth and sand finishes

Assignment
Sheet No. 1

Covering
Units 1-28

APPLICATION OF THE PLASTERING BASE

The permanency and appearance of the finished work of the plaster depends to a large extent on having a firm sound base on which to apply the plaster. One of the oldest forms of plaster bases is wood lathing. However, many new types of lath are now on the market and have many improved qualities.

In this assignment you are expected to learn what types of plaster bases are available and how to properly apply them, the use of the common plastering tools and equipment, and the nature of the work, entrance requirements and other occupational information related to the plastering trade.

Assignment:

1. Read the references listed below.
2. Be prepared to discuss the study questions listed below.
3. Work out the questions, problems, and projects as assigned by your instructor.

References:

M. U. S. Department of Labor, Occupational Outlook Handbook, pp. 367-370.
N. Van Den Braden, Plastering Skill and Practice, pp. 1-143.

Questions:

1. What was the oldest form of lathing for plaster base? Why is it seldom used today?

2. From what materials is board lathing made? What are some of the major advantages of board lathing?

3. What is considered to be the most popular plaster base in use today? What are its primary advantages?

4. What are the commonly known types of gypsum board lath? How are they applied? What are the commonly known types of insulation board lath? How are they applied?

5. What systems of reinforcements may be used for gypsum board? What material is used as reinforcements?

6. What are the principle advantages of metal lath? What are the four groups of interior metal laths? Why should metal lath used on the interior be of a smaller mesh size than for exterior use?

7. What are corner beads used for? Metal Casings? What three types of corner beads are illustrated in your text?

8. What is a ground? What is its purpose?

9. What are channel irons? How are they sold? What two sizes are most commonly used for plastering?

10. How is metal used to make partitions? What are the three types of wall partitions used to reinforce plaster?

11. What are suspended ceilings? How are they installed?

12. When should exterior metal lath be used? What are the types of exterior metal lath? What are some of the other uses of metal lath?

13. Masonry bases are classified into three classes. What are these classes or groups? What types of masonry materials are included in each group? What are the important characteristics of each group?

14. What is the nature of the work done by plasterers?

15. What training is necessary to become a journeyman plasterer? Where may this training be obtained? What additional requirements are necessary?

16. How many people are employed as plasterers? How many job openings occur each year? What is the employment trend for this trade?

17. What are the wages generally paid to plasterers? How do their wages compare with other skilled building trades workers? Where can you obtain more occupational information about the plastering trade?

18. What are the "tools of the trade" that are used by plasterers? What is each used for?

19. What three ingredients are used to make plaster? What is the purpose of each?

20. What types of aggregates are used to make plaster? What are some of the advantages of each?

21. What are the three main types of cementitious materials that can be used in a plaster mixture? What are the advantages and disadvantages of each.

22. What is an admixture? What three kinds are there? What are the major characteristics of each?

23. How and in what proportions is lime mortar mixed? Gypsum mortar? Keene's cement?

24. What types of finish coats are listed in the text? How and in what proportions are each mixed?

Assignment
Sheet No. 2

Covering
Units 29-45

APPLYING PLASTER

The plasterer must have a knowledge of the tools, plastering materials, and the types of plastering bases in order to do a good job of plastering. However, the most important job of the plasterer is the application of plaster mortar.

In this assignment you will have an opportunity to learn techniques for applying scratch, brown, and finish plaster coats to walls, ceilings, beams and arches lathed with the various plaster bases.

Assignment:

1. Read the reference listed below.
2. Be prepared to discuss the study questions listed below.
3. Work out the questions, problems and projects as assigned by your instructor.

Reference:

N. Van Den Branden, Plastering Skill and Practice, pp. 144-249,

Questions:

1. What two principal tools are used by the plasterer to apply mortar? What is the purpose of each? What techniques are involved in using each of them?

2. What is a darby? What does it do? How is trimming done?

3. What are dots and screeds? How are they used? Why are they used?

4. How does three-coat and two-coat plaster work differ? What are the purposes of the base coat?

5. What steps are involved in applying a finish coat of putty? Sand? Keene's cement? Interior Portland Cement? What are the advantages and disadvantages of each?

6. What techniques are involved in applying color? Texturing surfaces?

7. What materials are imitated in plaster work? What different techniques are utilized to imitate materials?

8. What is a dryout? What causes it? How can it be prevented?

9. What is a sweatout? What causes sweatouts? How can they be prevented?

10. What happens to plaster if it freezes before it sets? How can you tell if the plaster has been frozen? What is oversanding? Overly retarded plaster?

11. What causes plaster to crack? What steps can the plasterer do to avoid this problem?

12. What is meant by soffit? Arris? How is a beam lined? Dotted? Stripped?

13. What is meant by squaring a room? Why is it done? Explain the following methods for squaring a room: (1) right-angle triangle method, (2) square method, (3) center-line method.

14. What techniques are involved in applying the scratch coat to diamond-mesh lathing? Gypsum and insulating board lathing? Wire lathing? Paper-backed lathing? Tarred surfaces? Concrete surfaces?

15. What is browning? What aspects of browning apply in three-coat work? Two-coat work?

16. Discuss the important aspects of scratch and brown coats as they apply to: (1) lime mortar, (2) lightweight aggregates, (3) portland cement, (4) acoustic plaster.

ANALYSIS OF PAINTING AND DECORATING

JOB TRAINING: What the Worker Should Be Able to Do	Assign. No.	RELATED INFORMATION: What the Worker Should Know
Introduction to Painting and Decorating		
	1	1. Nature of work done by painters and paperhangers
	1	2. Training requirements
	1	3. Physical and mental requirements
	1	4. Employment outlook
	1	5. Earnings and working conditions
	1	6. Sources of occupational information for painters
Tools and Equipment		
	1	7. Types of brushes used in the painting and decorating trades
8. Select brush for job	1	8. Points to be observed in selecting brushes
9. Clean and store brushes	1	9. Care of brushes
10. Renovate hardened brushes		
11. Clean paint rollers	1	11. Types of paint rollers
	1	12. Types of air compressors
	1	13. Types of spray guns
14. Spread drop cloths for property protection	1	14. Materials for protecting surfaces while painting
15. Apply masking liquids and tapes		
Color Styling, Harmony, and Selection		
	1	16. Meaning of color styling
	1	17. Effect of color upon exterior architectural defects
	1	18. Selection of color for interior room styling
	1	19. Light reflections of various colors
	1	20. Guide rules for color selection
21. Select exterior finishes	1	21. Types of exterior paints
	1	22. Types of exterior natural finishes
23. Select interior finishes	1	23. Types of interior transparent finishes
	1	24. Types of interior opaque finishes

JOB TRAINING: What the Worker Should Be Able to Do	Assign. No.	RELATED INFORMATION: What the Worker Should Know
Surface Preparation		
25. Measure moisture content with moisture meter	1	25. Effect of moisture upon painted surfaces
	1	26. Purpose of priming
27. Fill nail holes and other blemishes with putty or other preparation	1	27. Surface preparation of new wood
28. Sand wood surfaces preparatory to painting		
29. Seal knots and resin streaks		
30. Apply caulking compound		
31. Apply wall primer and sealer	1	31. Preparation of plastered walls for painting
32. Fill nail holes in wallboard	1	32. Preparation of wallboard and plasterboard walls
33. Apply joint tape and smooth joints		
34. Neutralize alkalinity in concrete surfaces	1	34. Masonry surface preparation
35. Mechanically clean metal surfaces	1	35. Mechanical methods of metal surface preparation
36. Chemically clean metal surfaces	1	36. Chemical methods of metal surface preparation
Paint Application		
37. Mix paint	2	37. Paint mixing techniques
38. Paint windows	2	38. Painting sequence for windows
39. Paint doors	2	39. Painting sequence for doors
40. Paint siding	2	40. Painting house siding
41. Paint inside walls	2	41. Painting inside walls
42. Paint acoustical surfaces	2	42. Painting acoustical surfaces
43. Paint masonry surface	2	43. Painting masonry surface
44. Paint concrete floors	2	44. Painting concrete floors
45. Paint metal surfaces	2	45. Painting metal surfaces
46. Paint wood floors	2	46. Painting wood floors
47. Apply fir plywood sealer	2	47. Painting fir plywood
	2	48. Materials suitable for spraying
49. Clean spraying equipment	2	49. Care of spray painting equipment
50. Paint surfaces with spray gun	2	50. Relationships of distance and stroke speed in spray painting
51. Apply flock finish	2	51. Flock finishing

JOB TRAINING: What the Worker Should Be Able to Do	Assign. No.	RELATED INFORMATION: What the Worker Should Know
	Wall Coverings	
52. Select wall coverings	2	52. Types of wallpaper
	2	53. Measurement standards for wallpaper
	2	54. Fabric and other wall coverings
55. Select tools and equipment for wall-papering	2	55. Tools and equipment necessary for wall-papering
56. Prepare size for application	2	56. Composition of sizing
57. Apply size to wall		
58. Prepare wallpaper paste	2	58. Paste for wallpapering
59. Get material and supplies in readiness for applying wallpaper	2	59. Procedures to follow when applying wallpaper
60. Cut paper to match		
61. Apply paste		
62. Fold and trim paper		
63. Chalk a line for starting course	2	63. Points to be observed to keep paper straight
64. Make butt joints	2	64. Types of seams
65. Make wire edge joints		
66. Make lapped joints		
67. Apply and smooth out paper		
68. Trim around casings, baseboard, etc.		
69. Roll seams		
70. Paper inside and outside corners	2	70. Technique to be observed when hanging wall coverings
71. Hang vertical strips		
72. Hang borders		
73. Hang horizontal strips		
74. Hang wall covering on ceiling		
75. Hang specialty wall coverings	2	75. Unique aspects for hanging specialty wall coverings
	Interior Wood Finishing	
	3	76. Basic steps to achieve a fine finish
77. Identify open and closed grain woods	3	77. Open and closed grain woods

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JOB TRAINING: What the Worker Should Be Able To Do	Assign. No.	RELATED INFORMATION: What the Worker Should Know
78. Bleach wood	3	78. Techniques for bleaching wood
79. Select stain	3	79. Effect of stains upon beauty enhancement
80. Apply stain	3	80. Types and characteristics of stains
81. Apply wood filler	3	81. Types and characteristics of fillers
82. Apply sealer	3	82. Sealers for shellac, varnish, lacquer, and plastic finishes
83. Apply finish coats	3	83. Number of finish coats required for satisfactory finishes
84. Rub and polish the finish	3	84. Rubbing and polishing techniques
	3	85. Varnish defects and their corrections
86. Apply wax	3	86. Finishing waxes
87. Finish hardwood floor	3	87. Floor finishes and procedures
88. Finish softwood floor		
89. Apply lacquer	3	89. Techniques for lacquer finishes
90. Produce spatter finish	3	90. Spatter finishes
91. Apply a stipple finish	3	91. Stippling finishes
92. Produce a design finish	3	92. Design finishes
93. Stripe and line surfaces	3	93. Striping and lining techniques
94. Apply a texture finish	3	94. Texture paints
95. Stencil a surface	3	95. Stenciling techniques

General Cost Estimates

96. Estimate material costs	3	96. Cost estimate techniques
97. Estimate labor costs		
98. Estimate overhead costs		
99. Estimate profit expected		
100. Make out contractor estimate record	3	100. Types of estimate records
101. Make out customer estimate record		

Assignment
Sheet No. 1

Covering
Units 1-36

TOOLS, EQUIPMENT, MATERIAL SELECTION AND SURFACE PREPARATION

An important aspect of the building trades is the painting and decorating field. Approximately 425,000 people are employed in the United States as painters and paperhangers. Though there is somewhat less growth in this field in comparison to the growth of the whole building trade industry, nevertheless 10,000 job openings occur every year. Thus the employment outlook is good in this field.

One of the first steps in learning the painting and decorating trade is to become thoroughly familiar with the tools and equipment and use these items in order to provide reliable service without undue expense and trouble. It is also essential that he learn the proper techniques in preparing all types of surfaces prior to applying the desired finish. He must be well informed on different types and colors of opaque, translucent, and wall covering finishes so that he can expertly advise customers in their choice. The importance of this function of the painter and decorator cannot be overemphasized. If the customer is dissatisfied with the end result, he will not hesitate to complain to you and to his friends. Conversely, a happy customer will gladly pay his bill, compliment you and proudly show off the completed work to his friends and acquaintances.

In this assignment you will learn about employment information dealing with painters and paperhangers, important aspects of tools and equipment, how to prepare surfaces for decorating and factors involved in selecting colors and finishing materials for various surfaces

<u>Assignment</u>:

1. Read the references listed below.
2. Be prepared to discuss the study questions listed below.
3. Work out the questions, problems and projects as assigned by your instructor.

<u>References</u>:

G. Jarvis, <u>Painting and Decorating Encyclopedia</u>, pp. 49-58 73-76, 78-79, 81-93, 158-162, 165-166.
M. U. S. Department of Labor, <u>Occupational Outlook Handbook</u>, pp. 349-352.

<u>Questions</u>:

1. Contrast the nature of the work done by painters with that of paperhangers. Where are most of them employed?

2. What training is necessary to become a journeyman painter or paperhanger? Where may he obtain this training? What additional qualifications are necessary?

3. How many people are employed in the painting and decorating fields? How many job openings occur each year? What is the employment trend for this trade?

4. What are the wages generally paid to painters? Paperhangers? How do they compare with other skilled building trades workers? Where can you obtain more occupational information about the painting and decorating trade?

5. What are the qualities of a good brush? Where are bristles obtained? What are the different types of brushes available and for what purpose is each type used?

6. List the technique for cleaning brushes. What are the solvents used for cleaning brushes? How can hardened brushes be renovated?

7. What are the techniques involved in the correct use of a brush?

8. Discuss the merits of the three types of paint rollers. How are paint rollers cleaned?

9. What units of equipment are necessary to do spray painting? How do the two principal types of compressors work?

10. What are the two types of spray guns? Discuss the operating principles and also the advantages and disadvantages of each type of gun.

11. What materials are drop cloths made from? Discuss the important aspects of masking tapes, blow torches, moisture meters, and electric sanders.

12. What factors are involved in the preparation of interior woodwork prior to applying the finish? Exterior woodwork?

13. What techniques are used to prepare new plaster walls for painting? How are wallboard and plasterboard prepared?

14. When should new masonry be neutralized prior to applying paint? What materials are necessary to do this?

15. Why must metal surfaces be prepared before painting? What methods are used to clean metal? Discuss the various methods and materials used to clean steel, galvanized iron, zinc, copper and aluminum.

16. On what exterior surfaces may house paint be used? Exterior enamels? Natural finishes? Cement paints? Rubber base paints? What types of exterior wood primers are available and where may they be used? Discuss the proper use of the exterior painting chart on page 90 of the <u>Painting and Decorating Encyclcpedia</u>.

17. List the types and uses of transparent and semi-transparent interior finishes. What opaque interior finishes are available and under what conditions should they be used? Discuss the proper use of the interior painting chart on page 91 of the <u>Painting and Decorating Encyclopedia</u>.

18. What is meant by the term "paint styling?" What factors are involved in good paint styling?

19. How may a color scheme be selected to produce desirable eye appeal for house exteriors? What principles of paint styling are involved in selecting an interior room color scheme? How may the reflecting power of paint colors be used effectively?

20. What are the basic paint styling points? Why should current color trends be studied and constantly watched?

Assignment
Sheet No. 2

Covering
Units 37-75

APPLICATION OF PAINT AND WALL COVERINGS

The major portion of the work day of the painter and paperhanger is spent in the application of paint or wall covering material. He must fully understand the techniques and skills involved in order to produce an acceptable finish. Even though the surface is adequately prepared and a wise choice of materials has been made, an inferior and dissatisfactory job will result if the application is not properly carried out.

Different types of paints and wall coverings require, in many instances, slightly different methods of application. Also, different surfaces may require different methods for applying the same type of paint or wall paper.

This assignment is concerned with the procedures and practices that should be observed when applying paint and coverings. You will learn which paints to use on different surfaces, procedures for applying paint, techniques in the operation of spraying equipment, types of wall coverings, the use and care of wall covering tools, and proper hanging techniques for different types of wall covering materials.

<u>Assignment:</u>

1. Read the reference listed below.
2. Be prepared to discuss the study questions listed below.
3. Work out the questions, problems and projects as assigned by your instructor.

<u>Reference:</u>

G. Jarvis, <u>Painting and Decorating Encyclopedia</u>, pp. 95-96, 103-123, 126-131, 167-173, 176-186.

<u>Questions:</u>

1. What different methods are used to mix paint? When is thinning required?

2. List the general brushing techniques discussed in the text. What suggestions are offered for applying exterior oil paint? Flat oil paint? Enamels and varnishes? Shellac? Latex paints? Casein and calcimine? Texture paints?

3. What types of paint rollers are available? What kinds of material are the rollers made of and for what purposes may each be used?

4. What procedure should you use to paint a ceiling? A wall? How should rollers be cleaned?

5. What property protection precautions should be observed when decorating new surfaces? What materials are available for protection?

6. What properties of wood affect the durability of paint? What are the painting characteristics of each of the five classifications of wood as grouped in the text? By what other properties may wood be selected?

7. What suggestions does the author make for painting softwood? Exterior siding and trim?

8. Discuss the procedures to follow for painting windows, doors, and exterior house siding.

9. What procedure should be followed when painting or enameling ceiling? Walls?

10. When applying paint to new plastered walls, what precautions must be observed? List the types of paints that may be used for new plaster walls.

11. Why should masonry surfaces be painted? What paints are suitable for masonry walls and concrete floors?

12. Why is the proper prime coat so important when painting metal surfaces? What suggestions are offered for painting galvanized iron? Copper? Tin? Storage tanks?

13. When should floors be painted rather than varnished? What changes of procedure are necessary when painting open-grained wood floors as contrasted to closed-grained floors?

14. How may checking and grain lifting be prevented when painting fir plywood? Is this technique adaptable to other woods?

15. When may a spray gun be used for painting? Why must painting materials be carefully controlled for viscosity and temperature?

16. What are the techniques for setting the spray gun pattern? For gun stroke? For triggering? Discuss the various trouble shooting aspects of spray painting listed on page 130 of the <u>Painting and Decorating Encyclopedia</u>.

17. What is flock finishing? How may this finish be applied?

18. How should spray equipment be cleaned and maintained? What safety precautions should be followed when spraying?

19. How are wallpapers identified? What are the different types of wallpaper? How is wallpaper measured?

20. What wall coverings are available other than wallpaper?

21. List and explain the use of different tools and equipment utilized by a paperhanger.

22. What is sizing? Why is it applied? What procedure should be followed when applying size? Discuss the various aspects of wallcovering paste.

23. What preliminary steps should be followed when setting up the physical arrangement for paper hanging? Name the items to be checked when inspecting paper.

24. How is paper cut and matched? How is curl removed? What procedure is used to paste, fold and trim paper?

25. What are the three types of seams? Under what conditions is each seam used?

26. What techniques are involved in hanging the first strip? How are the different papers and wall coverings smoothed?

27. How is paper trimmed at doors, windows and baseboards? How is the second strip hung? What precautions must be taken when rolling seams?

28. What techniques are involved in hanging borders? Streamline hanging? Hanging on ceilings?

29. Discuss the other types of wall coverings available and the important hanging aspects for each type.

Assignment
Sheet No. 3

Covering
Units 76-101

INTERIOR FINISHING AND COST ESTIMATION

Finishing the interior walls and woodwork of a home calls for a thorough knowledge of modern materials and step-by-step procedures. The painter and paperhanger must be able to advise his customers so that they may select the finish that will appropriately fit their decor. Closely allied to the choice of an interior finish is the cost for applying the finish. The customer wants a nice and professional appearing job and at a low cost. The painter can competitively bid for jobs and still give a satisfactory finish if he knows the application procedures of modern materials. He can often under-bid and still turn a handsome profit by substituting a modern 2 or 3 coat finish for an older 5 coat finish. The newer finishes often are more enduring than the older ones and also have a greater aesthetic appeal.

In this unit you will study the basic step for achieving a fine finish on interior woodwork, the different types of modern materials that are available, the correct step-by-step procedure for applying the different finishes, special effects that can be selected for interior walls and various aspects of cost estimation.

Assignment:

1. Read the reference listed below.
2. Be prepared to discuss the study questions listed below.
3. Work out the questions, problems and projects as assigned by your instructor.

Reference:

G. Jarvis, Painting and Decorating Encyclopedia, pp. 187-204, 213-217, 221-223, 259-263.

Questions:

1. What are the basic steps involved in achieving a fine finish? Why is it important to know wood classifications? What are some of the closed and open grained woods?

2. Why is sanding required as the first step in finishing? What procedure should be followed in sanding interior woodwork?

3. For what purpose may a tack rag be used? How can a tack rag be made?

4. Why is wood bleached? What bleaches are available and how is each applied? What safety precautions must be followed when bleaching?

5. For what three reasons is wood stained? What are the major classifications of stains? List the advantages and disadvantages for each type?

6. What is paste wood filler composed of? What thinners are used for thinning filler and when would you use each type? How is wood filler applied?

7. Why is sealer applied and what are the three principal types? How are sealers applied?

8. Discuss the advantages and disadvantages of shellac finishes. What is meant by a "four pound cut?" What procedure is followed in applying a shellac finish?

9. What types of varnishes are available and for what purposes would you use each type? What special techniques should be followed when applying varnish?

10. What defects may develop in varnish finishes? How may they be prevented?

11. For what purposes may penetrating stain waxes be used? A plain wax? A colored wax? How is each applied?

12. What are penetrating wood finishes used for? How are they applied?

13. List the various types of floor finishes and discuss the advantages, disadvantages and general procedures for applying each type.

14. Study the step-by-step procedures for the many wood finishes described on pages 201-204 of the Painting and Decorating Encyclopedia. Which ones would be most applicable for interior woodwork?

15. What is a spatter finish? By what different hand methods may spatter finishes be applied? How is multi-color spraying done?

16. What is stippling and how may this finish be applied? For what purpose is the twin roller used?

17. When may texture paints be used advantageously? What different methods may be used to apply texture paints?

18. Explain the different methods used to apply stripes or lines.

19. When are stencils cut by the painter rather than purchased from paint stores? What are the steps of procedure for doing stenciling work?

20. What is the basic unit of measure usually used for estimating materials? How are interior surface areas measured? Exterior areas? Roof areas?

21. What reference book is an important aid to estimating labor costs? What is meant by overhead expenses? How is profit estimated?

22. What are the two kinds of estimates and what is the purpose of each? Why is it important to have a copy of each on file?

23. What precautions should be observed when estimating from blueprints?

24. What are the two methods for figuring wallpaper materials? How may ceilings be estimated?

25. What factors are involved in estimating the time required to do paperhanging?

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Building Trades, Instructor's Guide, For Use with A Course of Study for Students in Building Trades.

Prater, Robert L. * and others
Missouri Univ., Columbia. Dept. of Industrial Education
Missouri State Dep of Educ, Jefferson City. Ind Educ Sect

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This instructor's guide is for teacher use with a companion study guide (VT 002 086). It is divided into the same areas in the same sequence as the student's manual--carpentry, masonry and concrete, electrical construction, plumbing and pipefitting, plastering, and painting and decorating. Key sheets correspond to the 46 assignment sheets in the student manual, and each contains a key to the study questions by reference to a specific text and page, suggested supplementary assignments, suggested visual aids, and other instructional aids. In addition, 11 objective-type tests with answers are included. This document is available for 50 cents from Industrial Education, 103 Industrial Education Building, University of Missouri, Columbia, Missouri 65201. (EM)

BUILDING TRADES

Instructor's Guide

For Use With

A Course of Study for Students in

Building Trades

Issued by

Department of Industrial Education
College of Education
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Jefferson City, Missouri

STUDY GUIDES FROM MISSOURI CURRICULUM MATERIALS LABORATORY

GENERAL

General Related Study Guide -- Student's Manual

General Related Study Guide -- Coordinator's Manual

STUDY GUIDES AND KEYS FOR SPECIFIC OCCUPATIONS

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Auto Mechanics
Cabinetmaking
Carpentry
Chef

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Floristry
Food Service
Food Service Supervisor (Institutional)
Frozen Food Locker Plant Operation
Furniture Retailing

General Mechanics
Grocery Store, Retail
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Management Group Instruction
Management Individual Study
Marketing Group Instruction

Marketing Individual Study
Meat Cutting
Medical Assistant
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Columbia, Missouri

FOREWORD

This instructor's guide has been prepared for the convenience of the Building Trades instructor to provide source material in guiding class discussions outlined by the student's manual, and suggesting evaluation and instructional procedures to be used. For each discussion question provided in the student's manual the reference is given indicating the source of information providing the answer by the letter used to designate the particular text or texts in the assignment sheet.

Although the course of study is keyed to a variety of references, an attempt has been made to keep the number of references at a minimum and still provide adequate coverage. The references were the most recent available at the time of preparation. Additional sources of reference may be found under supplementary assignments which the instructor may find valuable in supplementing the basic material and in assignments for advanced students.

Special credit is due Dr. Robert L. Prater, formerly Research Assistant in Industrial Education, and Mr. Richard E. Ginther, Mr. Donald E. Maurer, and Mr. Robert J. Spinti, all Research Assistants in Industrial Education at the University of Missouri, who prepared assignment sheets and compiled this material.

HUBERT WHEELER

Commissioner of Education
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PAINTING AND DECORATING (AREA 5)

INTRODUCTION

The instructor's guide and student's manual for BUILDING TRADES are designed to provide organized instructional aids to the teacher of building construction classes and are to be used in conjunction with each other. In preparing this material, it has been assumed that job skills and procedures will be learned through actual experience in the construction of a house or some similar building, under the direction of a qualified instructor. The technical and related information is to be given through the use of these two manuals, also under the direction of the instructor.

The student's manual is divided into the following six trade areas: (1) carpentry, (2) masonry and concrete, (3) electrical construction, (4) plumbing and pipefitting, (5) plastering, and (6) painting and decorating. Each of the areas covered in the student's manual has a complete analysis and a series of assignments. Each instruction unit in the analysis is arranged under the assignment in which that particular item is to be covered; the numbers of these assignments are found in the center column in the analysis.

Each assignment is also cross-keyed to the analysis. The numbers found in the upper right corner on the first page of each assignment under the heading "Covering Units--" refer to the instruction units found in the analysis.

Each of the student assignment sheets contains an introduction, a reading assignment, and a series of questions based upon the readings. The purpose of the introduction is to create interest, convey the importance of the assignment to the student, and tell him specifically what he is expected to learn. The reading assignments are keyed to the Basic Reference List found in the front of the student's manual. These texts were chosen because they covered the material adequately and at a desirable reading level.

The questions on the assignment sheets serve two major purposes: (1) to guide the student to the important aspects of the reading assignment, and (2) to form a basis or guide for classroom discussions. These questions, though designed specifically for the foregoing two reasons, may also be utilized as written assignments to emphasize some particular procedure or topic.

The instructor's guide is divided into the same six areas and in the same sequence as the student's manual. Each student manual assignment has a correspondingly numbered and titled key sheet. Each key sheet is divided into sections which are described below:

I. <u>Key To Study Questions</u>:

This section contains the source of the answers to the study questions. The letter denotes the text as it is listed on the assignment sheet and on the basic reference list. The numbers indicate on what page(s) the answer is to be found.

II. Suggested Supplementary Assignments:

Contained in this section are extra readings, discussion questions, written assignments, special projects and problems, etc. These items will be especially helpful where first and second year building trades students are mixed together in the same class. These suggested assignments may then be made to the advanced students only.

However, the instructor may want to occasionally supplement a particular phase of the major assignment by choosing one or more of the supplementary suggestions and have all of the students complete it. These assignments may also be done on either an individual basis, such as for make up work, or as class projects.

III. Suggested List of Visual Aids:

All types of aids are listed--mock-ups, movies, films, posters, film strips, slides, etc. This list is suggestive and is not complete; therefore, the instructor should add to the list. Further, he should carefully choose and use only those aids which best fit his objectives.

IV. Other Instructional Aids:

Essentially this part of the key contains suggestions of speakers and field trips as well as other aids. Again, the instructor should carefully choose those which are appropriate for his particular course. He also should add to this list any item that he finds effective as a teaching aid.

V. Test No. -- Covering Assignments -- and --:

The first four parts of the key described above are found on each key; however, part V is included periodically covering several preceding assignments. These tests are meant only as a guide or model for the instructor to follow when he constructs his own evaluation devices. The individual test item samples are scattered throughout the reading assignments and do not necessarily cover the readings in depth. The instructor will want to make his own tests so that he can test on the principles, procedures, and other technical knowledge that he himself has emphasized in his daily instruction.

The instructor's guide should be used as an aid to make his teaching more effective. It is a guide and not intended to set a formal structure within which a building trades class is to operate. The instructor should feel free to modify, as his experience will allow, by adding or deleting material in both the student's and the instructor's manuals so that they may better fit his particular needs and objectives.

BASIC REFERENCES USED IN BUILDING TRADES COURSE OF STUDY

Listed below are the basic references used in the course of study for Building Trades. The alphabetical designation for each reference remains the same throughout this publication.

A. Concrete Form Construction, Delmar Publishers, Inc., Albany, New York, $1.75* Area 1*** (1)**

B. Dalzell, J. Ralph and Townsend, Gilbert, Masonry Simplified, Volume I, American Technical Society, Chicago, 1958, $5.75* Area 2 (2)

C. Dalzell, J. Ralph and Townsend, Gilbert, Masonry Simplified, Volume II, American Technical Society, Chicago, 1957 Area 2 (3)

D. Durbahn, Walter E., Fundamentals of Carpentry, Volume I, American Technical Society, Chicago, 1961, $4.75* Area 1 (10)

E. Durbahn, Walter E., Fundamentals of Carpentry, Volume II, American Technical Society, Chicago, 1960, $4.95* Area 1 (12)

F. Graham, Kennard C., Interior Electrical Wiring, Part 1, Residential (6th Edition), American Technical Society, Chicago, 1961, $4.75* Area 3 (3)

G. Jarvis, John, Painting and Decorating Encyclopedia, Goodheart-Willcox Company, Chicago, 1957, $4.09. Area 6 (3)

H. Matthias, A. J., Smith, Esles, Sr., and Volland, Robert J., How to Design and Install Plumbing (4th Edition), American Technical Society, Chicago, 1960, $4.95* Area 4 (7)

J. Mix, Floyd and Ciroui, Ernest H., Practical Carpentry, Goodheart-Willcox Company, Chicago 5, Illinois, 1960, $3.75 Area 2, 1(14)

K. Portland Cement Association, Cement Mason's Manual, 33 West Grand Avenue, Chicago 10, Illinois, 1960, Free Area 2 (1)

L. Portland Cement Association, Laying Concrete Block, 33 West Grand Avenue, Chicago 10, Illinois, 1954, Free Area 2 (1)

M. U. S. Department of Labor, Occupational Outlook Handbook, Government Printing Office, Washington, D. C., 1961 edition, $4.50 Area 4,3,6,1(5)

N. Van Den Branden, Felicien and Knowles, Mark, Plastering Skill and Practice, American Technical Society, Chicago, 1959, $5.95* Area 5 (2)

* Subject to school discount
** Frequency of use in assignments
*** Area where used: 1--Carpentry Area; 2--Masonry and Concrete Area; 3--Electrical Construction Area; 4--Plumbing and Pipefitting Area; 5--Plastering Area; 6--Painting and Decorating Area.

Note: For Supplementary References see individual assignments.

KEY--ASSIGNMENT SHEET NO. 1
(CARPENTRY)
INTRODUCTION TO THE BUILDING TRADES

I. Key to Study Questions:

1. M-339-340
2. M-344
3. I-1
4. I-1
5. M-345
6. M-345-346

II. Suggested Supplementary Assignments:

A. Prepare a report on one of the building trades and present it to the class. Be sure to cover such topics as employment opportunities, training and qualifications needed, working conditions, and wages.

III. Suggested List of Visual Aids:

A. Film: CAREERS IN THE BUILDING TRADES--(16mm, 11 min., B & W, sound, $1.00)-Coronet, University of Missouri, Audio-Visual Department, Columbia, Missouri. Bob, a high school boy working on a construction job during the summer, observes all the building tradesmen and discovers that his interests and aptitudes fit him for a vocation in the building trades. When he returns to school, he finds that each of his subjects will contribute to his future work.

B. Film: KNOWLEDGE AND SKILLS--(16mm, 20 min., color, sound, free)--Modern Talking Picture Service, Kansas City 11, Missouri, or St. Louis 11, Missouri. This film brings you a special report on tomorrow's skilled people--the men and women, young and not so young, in the trade and industrial program of our public schools. It is a special report on what we are doing in our schools to provide the skilled and technical workers of the future.

IV. Other Instructional Aids:

A. Speakers:
1. Invite a local building contractor to speak on "The Contractor--Responsibility and Functions of his Job."
2. Invite an official of the local union to speak on "Unions and the Building Trades."
3. Invite a representative of the Bureau of Apprenticeship Training to speak on "The Apprenticeship Program in the Building Trades."

B. Field Trip: Visit a large construction site and observe the various tradesmen at work in their specific job operations.

KEY--ASSIGNMENT SHEET NO. 2
(CARPENTRY)
INTRODUCTION TO CARPENTRY

I. Key to Study Questions:

1. M-346
2. M-347
3. M-347
4. M-347
5. M-347
6. M-347
7. M-348

II. Suggested Supplementary Assignments:

A. Read: Durbahn, Walter E., Fundamentals of Carpentry, Vol. I, American Technical Society, Chicago, Illinois, 1956, pp. 1-6.

   1. Write out the answers to the ten questions on page 6. Be specific with your answers.

III. Suggested List of Visual Aids:

A. Film: THE CARPENTER--(16mm, 50 min., color, $3.00)--United Brotherhood of Carpenters and Joiners, 222 E. Michigan St., Indiaiapolis 4, Indiana. Carpenters are shown in modern saw mills, high-speed plywood mills, and on jobs where wood goes into the construction of everything from dams to kitchen cabinets. The film demonstrates the wide scope of the carpenter's skills.

IV. Other Instructional Aids:

A. Speaker: Invite a local carpenter to speak on the topic, "Working Conditions and Earnings of Carpenters."

B. Field Trip: Visit a large commercial building under construction and observe the various types of work that carpenters do.

KEY--ASSIGNMENT SHEET NO. 3
(CARPENTRY)
ESSENTIAL PREPARATIONS FOR BUILDING A HOUSE

I. Key to Study Questions:

1. D-221
2. D-222
3. D-222
4. D-223
5. D-225
6. D-225
7. D-226
8. D-226-227

II. Suggested Supplementary Assignments:

A. Read: Lair, E. A., Carpentry for the Building Trades, McGraw-Hill Book Company, Inc., New York, 1953, pp. 255-284.

1. Be prepared to lead a class discussion on the various topics such as blueprints, specifications, and contracts.

III. Suggested List of Visual Aids:

A. Film: WHAT IS A CONTRACT?--(16mm, 10 min., B & W, $1.00)--Coronet, University of Missouri, Audio-Visual Department, Columbia, Missouri. Two youngsters take summer jobs to buy the things they have always wanted, only to find themselves jobless and debtors in the middle of the summer. But by contract, their problems are happily solved. Through this story, your students will have a splendid opportunity to study the elements of mutual assent, competent parties, legal bargains, consideration, in both oral and written contracts.

IV. Other Instructional Aids:

A. Obtain copies of blueprints, contracts and specifications from local contractors. Distribute these among the class and then discuss the various major topics and questions.

B. Speaker: Invite a bank manager, broker or architect to talk on " Financing a Home, Legal Requirements, Building Codes and Contracts."

KEY--ASSIGNMENT SHEET NO. 4
(CARPENTRY)
TOOLS FOR THE CARPENTER

I. Key to Study Questions:

1. D-8
2. D-8-9
3. D-9-35
4. D-59-66
5. D-59-62
6. D-67
7. D-68
8. D-69
9. D-69-70

II. Suggested Supplementary Assignments:

A. Prepare a list of carpentry tool manufacturers and write for literature and tool catalogs which describe the purposes, functions and advantages of the various tools.

III. Suggested List of Visual Aids:

A. Charts: Stanley Tools, Division of Stanley Works, "Stanley Instruction Charts," (38--19" x 25")--$6.00 per set. These charts cover all woodworking tools and seven commonly used metal working tools.

B. Write to: Stanley Tools, Division of Stanley Works, Catalog No. 34--(112 pp.)--Free. New Britain, Connecticut. This paper-bound book illustrates a complete line of tools and also a price list insert.

IV. Other Instructional Aids:

A. Speaker: Invite your local hardware dealer or a district representative from one of the tool manufacturing companies to speak on the topic, "Essential Features of Quality Tools."

KEY--ASSIGNMENT SHEET NO. 5
(CARPENTRY)
STAKING OUT AND EXCAVATING FOR BUILDINGS

I. Key to Study Questions:

1. E-416-426
2. E-429-454
3. D-10-19; D-32-35; E-456-467
4. E-18-22
5. J-57-62
6. J-10-12;
7. E-456-467; E-18-22; J-11-12
8. E-22-26

II. Suggested Supplementary Assignments:

A. Select a floor plan from a home builder's magazine and make a sketch of the complete excavation layout required to build the house.

B. Make a list of the materials and tools you would need to make the above building layout.

C. Divide students into small groups and have them stake out a small building near the school.

III. Suggested List of Visual Aids:

A. L. S. Starrett Company, The Starrett Transit Book, Educational Division, Athol, Massachusetts, free, 47 pages. This book contains brief, concise instructions on how to set up and use a transit and level. One section deals with laying out and setting batter boards with the transit and level. (For advanced students.)

IV. Other Instructional Aids:

KEY--ASSIGNMENT SHEET NO. 6
(CARPENTRY)
PROCEDURES FOR CONSTRUCTING CARPENTRY EQUIPMENT

I. <u>Key to Study Questions</u>:

1. D-36
2. D-26
3. D-37-39
4. D-41-42
5. D-44
6. D-47
7. D-48
8. D-48-49, 52, 54

II. <u>Suggested Supplementary Assignments</u>:

A. Utilizing the written assignment for this unit, have students construct one or more of the pieces of equipment described in the assignment, Vol. I, pp. 36-58.

III. <u>Suggested List of Visual Aids</u>:

IV. <u>Other Instructional Aids</u>:

A. Field Trip: Visit different construction sites and observe the various types of carpentry equipment used by the carpenters "on the job." Make note of the ideas that would be of use to the class members.

KEY--ASSIGNMENT SHEET NO. 7
(CARPENTRY)
CONCRETE AND CONCRETE FORMS

I. Key to Study Questions:

1.	J-16-17	6.	A-23	11.	A-73-78
2.	J-16-18	7.	A-30-35	12.	A-79-81
3.	A-14-15	8.	A-39-52	13.	A-90-91
4.	A-16	9.	A-53	14.	A-91
5.	A-18-23	10.	A-65	15.	A-94-98

II. Suggested Supplementary Assignments:

A. Read: Federal Housing Administration, Minimum Property Standards, U. S. Government Printing Office, Washington, D. C., pp. 76, 80-81.

1. Read the requirements for concrete construction in the reference.

2. Be prepared to answer oral questions concerning federal requirements for concrete construction.

B. Make a list of materials required to build sectional forms for a 10 inch thick foundation wall, 50 feet long and 8 feet high.

III. Suggested List of Visual Aids:

IV. Other Instructional Aids:

A. Field Trip: Visit several construction sites, commercial and residential, taking note of the various methods used in the construction of footing and foundation forms.

KEY--ASSIGNMENT SHEET NO. 8
(CARPENTRY)
INTERPRETATION OF BUILDING PLANS AND SPECIFICATIONS

I. Key to Study Questions:

1. D-229
2. D-231
3. D-231
4. D-231-232
5. D-234-236
6. D-237
7. D-251
8. D-251
9. D-254
10. D-254
11. D-254
12. D-256
13. D-258
14. D-259
15. D-260

II. Suggested Supplementary Assignments:

A. Obtain actual construction blueprints and study them in order to become more adept at the interpretation of drawings.

B. Survey magazines and newspapers for house plans of different styles of building architecture.

III. Suggested List of Visual Aids:

A. Using either an opaque or overhead projector, show slides of sample house plans and use this to give direction to class discussion.

IV. Other Instructional Aids:

A. Write to: Eugene Dietzgen Company, The Use and Care of Drawing Instruments, Chicago, Illinois, 1954, (Free). This booklet contains architectural symbols, electrical symbols and plumbing symbols. It also contains information on the use and care of drawing instruments.

V. Test No. 1, Covering Assignments 1-8:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T (F) 1. Batter boards should be located at the exact point where the corners of the building are to meet E-19,22

(T) F 2. The ground around a building should slope away from the building. E-23

(T) F 3. The ability to use a transit may lead the way to advancement for the builder. E-456

T (F) 4. An error in adjustment of the leveling instrument is not very costly when sights are taken over a short distance. E-459

(T) F 5. The 6-8-10 method will prove inaccurate when squaring large buildings E-464

T (F) 6. When staking out irregular shaped buildings, the offsets should be laid out first. E-465-466

(T) F 7. Foundation footings should be poured separately from the walls. J-15

(T) F 8. In specifying a concrete mix, the first number refers to the proportion of Portland cement, the second number the sand and the third the gravel. J-16

T (F) 9. If water supply lines are placed under a floor slab, they do not need to be put in trenches. J-28

T (F) 10. The keyhole saw and the backsaw are similar in shape and are used for about the same purpose D-16

T (F) 11. The fewer teeth a saw has the finer the cut it will make. D-17

(T) F 12. The jack plane is probably the best plane for all-around work. D-20

T (F) 13. Miter boxes should always be made of softwood. D-47

(T) F 14. As the amount of open space around a building decreases, the fire hazard increases. D-223-224

T (F) 15. A lot survey should be made by the homeowner. D-225

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. Each one cubic foot volume sack of Portland cement weighs approximately 94 lbs. J-16

2. Form marks can be removed from foundation wall surfaces by rubbing with a carborundum stone and a mixture of cement and water. J-19

3. Metal or wood sleeves can be inserted in the basement wall form to provide openings for utility connections. J-23

4. Bolts used to anchor sills to foundations should be not more than 12 inches from the corners and on 4 foot centers. J-24

5. It is recommended that metal reinforcement in concrete slabs be placed 1 1/2 inches from the top surface of the slab. J-30

6. The standard framing square has a 24 inch blade and 16 inch tongue. D-12

7. The crosscut saw most widely recommended for rough construction work has eight points per inch. D-17

8. The countersink bit is used to produce a cone-shaped recess at the top of a drilled hole to receive a flathead woodscrew. D-28

9. The 16 ounce hammer is recommended for general all around carpentry work. D-32

10. The term "plan view" and floor plan mean the same. D-234

11. Drawings are simplified by the use of symbols which represent materials as wood, stone, brick and concrete. D-237

Multiple-Choice

Directions: In the space at the left of each statement write the letter of the item which will provide the correct answer to complete the statement.

B 1. The recommended distance between studs when erecting foundation forms is (A) 16 inches; (B) 24 inches; (C) 32 inches; (D) 48 inches. D-28

B 2. The primary use of the band saw is (A) making straight cuts; (B) cutting curved surfaces, (C) ripping, (D) cutting angles. D-61

D 3. The operation of straightening the edge of a board on a jointer is called (A) facing; (B) smoothing; (C) planing; (D) jointing. D-62

C 4. Power planes are available which will finish surfaces up to (A) 1 inch wide; (B) 2 inches wide; (C) 2 1/2 inches wide; (D) 4 inches wide. D-68

A 5. Slots which are formed in footings to lock or tie the footing and foundation wall together are called (A) keyways; (B) grooves; (C) trenches; (D) slides. A-41

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. Four items in which a builder should be able to advise the prospective homeowner are:

(A) securing an architect

(B) choosing a suitable location

(C) drawing up of contracts

(D) handling financial problems D-221

2. The four major types of architectural drawings are:

(A) plans (C) details

(B) elevations (D) sections D-234

3. Three types of portable sanders are:

(A) disc (C) orbital

(B) belt D-69

4. The two most common methods for establishing right angle corners when laying out building lines are:

(A) 6-8-10 method

(B) level-transit and plumb bob E-464; E-20

KEY--ASSIGNMENT SHEET NO. 9
(CARPENTRY)
TYPES OF WOOD FASTENERS AND BUILDERS' HARDWARE

I. Key to Study Questions:

1. D-184
2. D-187
3. D-188-193
4. D-193-194
5. D-196-198
6. D-198
7. D-205-212
8. D-212-214

II. Suggested Supplementary Assignments:

A. Visit local building hardware dealers and obtain literature on various types of fasteners and hardware. Write manufacturers of hardware and request literature on their products. Catalog these into file form.

III. Suggested List of Visual Aids:

A. Film: USING SCREWS AND NAILS--(16mm, 12 min., B & W, $1.50)--University of Missouri, Audio-Visual Department, Columbia, Missouri. Identifies the common types of nails and screws used in woodworking, as well as the function and uses of hammers, nail sets, and screwdrivers.

B. Use an overhead projector to show the various fasteners on the screen. Have the class identify and discuss each type.

IV. Other Instructional Aids:

A. Speaker: Invite a local established hardware store or building supply company manager to speak on "The Kinds, Types and Functions of Materials and Trends in the Area of Building Hardware."

KEY--ASSIGNMENT SHEET NO. 10
(CARPENTRY)
PRINCIPLES AND METHODS OF FRAMING FOR FLOORS

I. Key to Study Questions:

Questions:
1. J-57
2. J-57
3. J-60-61
4. J-62, 65
5. J-64
6. J-64-70
7. J-70, 72

II. Suggested Supplementary Assignments:

A. Read: Durbahn, W. F., Fundamentals of Carpentry, Vol. II, American Technical Society, Chicago, Illinois, 1956, pp. 94-101.

1. Write out the procedure used to frame the sill, locate the joist, and frame joists.

B. Make scaled mock-ups of the various styles of sill construction detail and joist and girder construction detail.

III. Suggested List of Visual Aids:

IV. Other Instructional Aids:

A. Field Trip: Visit a construction site and view the sill and joist construction while they are being framed.

KEY--ASSIGNMENT SHEET NO. 11
(CARPENTRY)
KINDS, PROPERTIES, AND STOCK SIZES OF LUMBER

I. Key to Study Questions:

1. D-113-119
2. D-120
3. D-120-121
4. D-121, 125-127
5. D-127

II. Suggested Supplementary Assignments:

A. Read: Durbahn, W. E., Fundamentals of Carpentry, Vol. I, American Technical Society, Chicago, Illinois, 1956, pp. 102-113.

1. Discuss the growth of wood: (A) hardwood and softwood; (B) heartwood and sapwood; (C) growth rings; (D) spring wood and summer wood; (E) grain and texture; and (F) moisture content.

B. Write to lumber companies and associations requesting literature on and samples of the kinds of lumber used in the building construction industry.

III. Suggested List of Visual Aids:

A. Film: KNOWING WOODS AND THEIR USES--(16mm, 13 min., B & W, $1.50)--University of Missouri, Audio-Visual Department, Columbia, Missouri. Explains the classifications and characteristics of woods so the craftsman can better select and order the woods he needs.

IV. Other Instructional Aids:

A. Speaker: Invite a local lumber dealer to speak on the topic, "Selection, Utilization, and Care of Lumber."

KEY--ASSIGNMENT SHEET NO. 12
(CARPENTRY)
METHODS OF WALL FRAMING

I. Key to Study Questions:

1. J-51-55
2. J-76-77, 81
3. J-78-81
4. J-81-82
5. J-84-85
6. J-85-89
7. J-90-92
8. E-78-81
9. E-81-84

II. Suggested Supplementary Assignments:

A. Make a scale model, sectional mock-ups of the various styles of house framing details as found in the reference for this unit.

B. Make large detailed scale models of corner post constructions, wall partitions, window and door details, and flooring details.

III. Suggested List of Visual Aids:

A. Film: BUILDING FOR SAFETY--(16mm, 14 min., color, free)--Underwriters' Laboratories, Inc., Public Relations Division, 207 E. Ohio Street, Chicago 11, Illinois. Applies science and engineering to the study of fire hazards of building materials. Floors, walls, ceilings, roofs, and doors are tested. Shows testing of floor constructions, roof shingles, glass block walls and building insulation.

IV. Other Instructional Aids:

A. Field Trip: Visit a construction site and observe actual methods and procedures of wall framing.

KEY--ASSIGNMENT SHEET NO. 13
(CARPENTRY)
SPECIAL FRAMING PROBLEMS RELATIVE TO THE WORK OF OTHER TRADESMEN

I. Key to Study Questions:

1. E-87
2. E-87-88
3. E-88-89
4. E-87-90
5. E-84-86
6. E-90

II. Suggested Supplementary Assignments:

A. Read: Durbahn, W. E., *Fundamentals of Carpentry*, Vol. II, American Technical Society, Chicago, Illinois, 1956, pp. 91-93.

   1. Lay out an ellipse using the string method. When might you have occasion to utilize this procedure? Investigate into and determine other practical methods for the layout of an ellipse. What are some other geometric constructions which are applicable to the carpenter's job?

III. Suggested List of Visual Aids:

IV. Other Instructional Aids:

A. Speaker: Invite a local building trades representative to speak on the topic, "The Necessity of Cooperation Between Workers of Various Occupational Areas on a Construction Job."

KEY--ASSIGNMENT SHEET NO. 14
(CARPENTRY)
PRINCIPLES OF PARTITION CONSTRUCTION

I. Key to Study Questions:

1. J-92-96
2. E-66-67
3. E-65-66
4. E-71-73

II. Suggested Supplementary Assignments:

A. Read: Mix, F. M., Practical Carpentry, The Goodheart-Willcox Company, Inc., Chicago, Illinois, 1960, pp. 93-94.

   1. What are some methods of attaching partitions to a wall? Draw sectional views of the various methods.

B. Make a scale model mock-up of various interior wall partition constructions.

III. Suggested List of Visual Aids:

IV. Other Instructional Aids:

A. Speaker: Invite a local architect to speak on the topic, "The Considerations Necessary in the Location, Placement, and Construction of Partitions."

KEY--ASSIGNMENT SHEET NO. 15
(CARPENTRY)
THE NATURE OF INSULATION AND ITS INSTALLATION

I. Key to Study Questions:

1. D-156
2. D-157-175
3. D-175-182
4. J-210
5. J-211-213
6. J-216-222
7. J-227-236

II. Suggested Supplementary Assignments:

A. Read: Mix, F. M., Practical Carpentry, The Goodheart-Willcox Company, Inc., Chicago, Illinois, 1960, pp. 373-378.

  1. What purposes does an attic fan serve? How is air discharged to the outside of the building?

  2. Why is "free circulation" of air required? How is this obtained in the construction of the building?

B. Have members of the class write to the manufacturers of insulation materials to obtain pamphlets, booklets, brochures, and other interesting data.

III. Suggested List of Visual Aids:

A. Obtain samples of thermal and acoustical insulation from local building materials dealers, mount on appropriate panels, and use as visual displays.

IV. Other Instructional Aids:

KEY--ASSIGNMENT SHEET NO. 16
(CARPENTRY)
TYPES AND USES OF SCAFFOLDING

I. Key to Study Questions:

1. E-122
2. E-122-125
3. E-125
4. J-370-372
5. J-372

II. Suggested Supplementary Assignments:

A. In a one-page paper summarize the need for and the importance of erecting safe, dependable scaffolding.

B. Find out what types of steel and other scaffolding are available in your local area.

III. Suggested List of Visual Aids:

A. Film: THE WOODWORKER--(16mm, 10 min., B & W, $1.00)--University of Missouri, Audio-Visual Department, Columbia, Missouri. Shows carpenters erecting scaffold and setting forms for concrete foundations and walls. The building of a house and millworking operations are also portrayed.

IV. Other Instructional Aids:

A. Field Trip: Visit various construction sites and note the different types of scaffolding in use. Notice the various scaffolds in use by the different types of tradesmen.

KEY--ASSIGNMENT SHEET NO. 17
(CARPENTRY)
SAFETY IN THE BUILDING TRADES

I. Key to Study Questions:

1. E-16-17   2. E-17   4. D-56
3. E-17-18   5. D-57

II. Suggested Supplementary Assignments:

A. Read: Manual of Accident Prevention in Construction, The Associated General Contractors of America, Inc., Washington, D. C., 1958, Sections 15-19.

1. Write summaries of the five different sections on safety emphasizing the main facts. Report to the class on this paper.

III. Suggested List of Visual Aids:

A. Film: SAFE USE OF TOOLS--(16mm, 10 min., color, $3.00)--Audio-Visual Extension Service, 115 T.S.M., University of Minnesota, Minneapolis 14, Minnesota. Shows the safe use of tools such as scissors, knives, hammers, saws, files, clamps and other small tools in school and home situations.

IV. Other Instructional Aids:

A. Using the Missouri Revised Statutes, chapters 286-295, look up and discuss the industrial safety provisions.

B. Obtain from local building trades union representative a list of union regulations dealing with safety.

V. Test No. 2, Covering Assignments 9-17:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T (F) 1. An 8d nail is larger than a 10d nail D-189

(T) F 2. When installing wood screws in hardwood, it is necessary to bore pilot holes. D-194

T (F) 3. The standard spacing for joists is 24" O.C. J-64

T (F) 4. Sills are set in place after the joists have been laid. J-62

T (F) 5. Checks that occur in wood are usually caused by a wracking and wrenching of the tree due to high winds. D-114

(T) F 6. The greatest amount of lumber used in construction comes from the softwood classification. D-127

T (F) 7. A sole plate may be referred to as the member used to "tie" the tops of the studs together J-82

(T) F 8. The 2 x 4 is the most common dimension lumber used as studs. J-76

(T) F 9. Grounds serve as a straight edge and guide for the plasterer. E-86

(T) F 10. Rough floors to be used as a base for concrete and tile must be "dropped" between the joists. E-90

(T) F 11. When constructing partition corners, provision must be made to provide a nailing base for interior trim. E-72

T (F) 12. Plates on non-bearing partitions should be doubled for added strength. J-92

(T) F 13. Economy of construction may be achieved by placing bearing partitions directly over one another. J-93

T (F) 14. When flexible insulation is used, it is not necessary to allow "air spaces" in the wall. D-158-159

T (F) 15. Fill insulation may be applied before the inside wall is built up. D-160

(T) F 16. A major purpose of scaffolding is to provide a place to work without unnecessary loss of time. J-370

T (F) 17. Clothing one wears has little effect upon an individual's safety on the job. E-17

(T) F 18. All workers should become safety conscious about themselves, their co-workers, and their jobs. D-57

(T) F 19. Protruding nails should be removed or bent over to prevent injury to workmen. E-18

(T) F 20. The building industry has one of the highest accident rates. E-16

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. The symbol used to designate the term penny is "d". D-189

2. The means of stiffening and distributing loads on floors is called bridging. J-70

3. Any board that varies from being a true or plane surface is warped. D-117

4. Materials such as dowels, moldings, interior trims, and furring strips are sold by the linear foot. D-125-127

5. Another name for the platform method of framing is the western frame. J-51

6. Wall framing to accomodate a soil stack requires the wall to be designed so the stack may be enclosed. E-88

7. If a partition runs parallel to the joist, it should be supported by a double joist. J-92

8. Thermal insulation means the use of materials which possess a hig degree of heat resistance. D-156

9. Ladders should not be used for work stations except in case of emergency or for short periods of time. E-129

10. To protect oneself against electric shock, all electric tools should be grounded. E-131

Multiple-Choice

Directions: In the space at the left of each statement write the letter of the item which will provide the correct answer to complete the statement.

C 1. The kind of nail most frequently used in framing construction is the (A) box nail; (B) casing nail; (C) common nail; (D) cut nail. D-189-190

B 2. How many board feet are in a piece of red oak, 2" x 4" x 9'? (A) 4 bd. ft.; (B) 6 bd. ft.; (C) 8 bd. ft.; (D) 10 bd. ft. D-125

C 3. Most loose fill insulation materials are made from (A) wood fibers; (B) grass fibers; (C) mineral substances; (D) cotton batting. D-159

D 4. The majority of serious accidents in the building industry are caused by (A) nails in boards; (B) protruding wires and bolts; (C) broken tools; (D) falling objects. E-16

A 5. The steps on a general purpose ladder should be uniformly spaced at a distance of (A) 12 inches; (B) 14 inches; (C) 16 inches; (D) 18 inches. E-129

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. Four basic hinge classifications are:

(A) full mortise
(B) half mortise
(C) full surface
(D) half surface D-205

2. Warp may be divided in four general categories, they are:

(A) bow
(B) crook
(C) cup
(D) twist D-117

3. The common classifications of insulation found on the market today are:

(A) flexible blankets
(B) fills
(C) bats
(D) rigid
(E) slabs
(F) reflective D-157

4. Many materials used in construction have insulative qualities. Name three of these materials.

(A) lightweight aggregate block
(B) sprayo-flake
(C) glass block D-174-175

KEY--ASSIGNMENT SHEET NO. 18
(CARPENTRY)
PRINCIPLES OF ROOF FRAMING

I. Key to Study Questions:

1. E-134-136
2. E-136-137
3. E-141-143
4. E-142-146
5. D-74-76
6. D-75-102
7. E-143-147

II. Suggested Supplementary Assignments:

A. Read: Durbahn, W. E., Fundamentals of Carpentry, Vol. I, American Technical Society, Chicago, Illinois, 1956, pp. 99-102.

1. Work out the problems on pages 100, 101 and 102 of the reference.

B. Lay out an octagon on a 16" piece of stock using the eight square scale on the framing square.

III. Suggested List of Visual Aids:

IV. Other Instructional Aids:

A. Obtain: How to Use the Stanley Rafter Square, Stanley Tools, New Britain, Connecticut. (Free)

KEY--ASSIGNMENT SHEET NO. 19
(CARPENTRY)
PROCEDURES AND PRACTICES OF ROOF FRAMING

I. Key to Study Questions:

1. E-147
2. E-147-150
3. J-101
4. J-101
5. J-102-103
6. J-103
7. J-104-105
8. J-105
9. E-151-156
10. E-156-157
11. E-162-163
12. E-164-165
13. E-169-170
14. E-173-182
15. J-108-109
16. J-110-112

II. Suggested Supplementary Assignments:

A. Read: Durbahn, W. E., Fundamentals of Carpentry, Vol. I, American Technical Society, Chicago, Illinois, 1960, pp. 86-90.

1. Using the framing square, lay out miter joints, butt joints, hopper joints, and other appropriate joints applicable to roof framing.

B. Make scaled models of various roof framing construction details.

III. Suggested List of Visual Aids:

IV. Other Instructional Aids:

A. Speaker: Invite a skilled and experienced carpenter who has specialized in roof framing to speak on "Problems and Procedures in the Framing and Construction of Roofs."

KEY--ASSIGNMENT SHEET NO. 20
(CARPENTRY)
SPECIAL ROOF FRAMING PROBLEMS

I. Key to Study Questions:

1. E-182-183
2. E-183-184
3. E-184-186
4. E-188-196
5. E-198-199
6. E-199-200
7. J-122
8. J-123-124
9. J-124

II. Suggested Supplementary Assignments:

A. Read: Durbahn, W. E., Fundamentals of Carpentry, Vol. II, American Technical Society, Chicago, Illinois, 1956, p. 492.

1. Study the varied types of roof trusses and think of an application of where each might be used. What are some construction problems these trusses might present?

III. Suggested List of Visual Aids:

IV. Other Instructional Aids:

A. Field Trip: Visit various commercial buildings and churches observing the various types of roof trusses used and problems concerned in their construction.

KEY--ASSIGNMENT SHEET NO. 21
(CARPENTRY)
TYPES OF WINDOWS AND DOORS, THEIR FRAMING AND INSTALLATION

I. Key to Study Questions:

1. E-307-309
2. E-311-314, J-268-277
3. E-314-317
4. E-310-311
5. E-318-320
6. J-237-246
7. J-247-249
8. J-250-258
9. J-259-264
10. J-265

II. Suggested Supplementary Assignments:

A. Read: Durbahn, W. E., Fundamentals of Carpentry, Vol. I, American Technical Society, Chicago, Illinois, 1956, pp. 205-212.

   1. Identify the four basic hinge classifications. Identify the materials from which hinges are made. List the styles and finishes available on hinges.

   2. Describe the different styles of bolts, holders, catches, handles, etc, used on doors and windows.

B. Make scale model mock-ups of window and door framing details; also, models of the various types of door construction details.

III. Suggested List of Visual Aids:

IV. Other Instructional Aids:

A. Obtain information on types of windows from: Anderson Window Corporation, Bayport, Minnesota, (Free).

B. Builders' hardware catalogs may be used to show the variety of items available for use in interior and exterior door and window installation.

KEY--ASSIGNMENT SHEET NO. 22
(CARPENTRY)
EXTERIOR TRIM AND FINISH

I. Key to Study Questions:

1. E-216
2. E-216-217
3. E-217
4. J-128-132, 136-161
5. J-128-135, E-258-265
6. J-130-132
7. J-133-134
8. E-218-219
9. J-145-147
10. J-159-161
11. J-161-162
12. E-224-229, 265-272
13. J-169-176
14. J-178-190
15. J-187-195
16. J-198-200
17. J-200-201
18. J-202-206

II. Suggested Supplementary Assignments:

A. Have students collect various types and kinds of exterior trim, sidings, etc., and use for class discussion.

B. Make a scaled detailed mock-up of cornice trims and exterior window and door construction details.

III. Suggested List of Visual Aids:

A. Film: SIDING SENSE--(16mm, 14½ min., color, free)--Western Pine Association, 510 Yeon Building, Portland 4, Oregon. This film uses animation to tell the history of the shelter of man. Discusses the requirements of wood exterior siding, beauty, durability, function, and ease of maintenance.

IV. Other Instructional Aids:

A. Obtain samples of various types of roofing materials from local building materials dealers.

B. Obtain samples of various types of sheathing and siding from local building materials dealers.

C. Obtain samples of exterior moldings and trims from local building materials dealers.

KEY--ASSIGNMENT SHEET NO. 23
(CARPENTRY)
INTERIOR TRIM AND FINISH

I. Key to Study Questions:

1. J-295
2. J-295-297
3. J-297-298
4. J-299
5. J-300-302
6. J-302-303
7. J-304-306
8. J-308-309
9. J-319-321
10. J-322-323
11. J-324-328
12. J-329
13. J-329-330
14. J-331-333
15. J-336-337

II. Suggested Supplementary Assignments:

A. Read: Durbahn, W. E., Fundamentals of Carpentry, Vol. II, American Technical Society, Chicago, Illinois, 1956, pp. 275-290, 303-307.

1. What are six common methods for joining interior plywood panels?

2. What designs can be used to install sheetrock panels on the ceiling?

3. What are the various types of interior trims and moldings used in a house?

B. Draw a sectional view of a double hung window. Of a door jamb and frame.

III. Suggested List of Visual Aids:

A. Film: FLOORS WITH A FUTURE--(16mm, 23 min., color, free)--The Bruce Flooring Company, Box 397, Memphis, Tennessee. A floor mechanic shows proper installation techniques for strip hardwood flooring and block hardwood flooring in both conventional and concrete slab construction. Includes a brief sequence of manufacturing and factory finishing of floors, 1957.

IV. Other Instructional Aids:

A. Invite a local floor covering expert to speak to the class on the topic, "Types of Floor Coverings and Their Installation."

B. Invite a local lumber dealer to speak on the topic, "Millwork, Its Manufacture and Variety."

C. Obtain samples of various types of interior moldings, trims, and floor and wall coverings from local building materials dealers.

KEY--ASSIGNMENT SHEET NO. 24
(CARPENTRY)
CALCULATIONS AND PROCEDURES FOR STAIRWAY CONSTRUCTION

I. Key to Study Questions:

1. E-327-330
2. E-330-331
3. E-331
4. E-333
5. E-335-338
6. E-338-340
7. E-340-342
8. J-283
9. J-290-291
10. J-293-294

II. Suggested Supplementary Assignments:

A. Lay out a stringer board for a basement stairs. The total rise is 7' 10", and the total run 11'6".

B. Make scale model mock-ups of the various types of stair construction.

III. Suggested List of Visual Aids:

IV. Other Instructional Aids:

A. Obtain drawings and blueprints of older period style architecture showing details of the many kinds and types of stair constructions.

V. Test No. 3, Covering Assignments 18-24:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

(T) F 1. The simplest type of roof is called the "shed" or "lean-to" roof. E-134

T (F) 2. A "bird's mouth" is the joint formed when the rafter and ridge come into contact. E-137

(T) F 3. The unit span is twice the length of the unit run. E-144

(T) F 4. Collar beams are horizontal members used to strengthen roof rafters. E-197

T (F) 5. The pitch of a roof is changed when the rafters are shortened to allow for a two inch ridge. E-156

T (F) 6. The tail cut is made horizontal to the rafter plate and is a part of the "bird's mouth." J-102

(T) F 7. For ordinary roof sheathing, a 20 inch spacing of rafters is commonly used. J-108

(T) F 8. When framing flat roofs, the overhang may be framed by the use of transverse beam rafters. J-122

T (F) 9. Split rings are an example of a circular truss rafter design. J-124

(T) F 10. The vertical grain wood shingle is a better grade than the flat grain shingle. E-219

T (F) 11. Building paper is used primarily to act as a thermal insulation material. E-217

(T) F 12. The length of life and value of roof covering depends to a great extent upon the way in which it is laid. E-232

(T) F 13. Unless a home is to be completely carpeted, hardwood floors are desirable. J-329

(T) F 14. When laying finish flooring parallel to a wall, an expansion space of at least 1/2 inch should be allowed. J-333

T (F) 15. When applying most gypsum board to interior walls, common nails are used extensively. J-298

(T) F 16. The "center line" approach is the best to follow when applying ceiling tile. J-300

T (F) 17. Window and door frames should be fitted prior to completion of the exterior sheathing. J-237

T (F) 18. A 60 degree angle is a preferred slope for stairway construction. E-330

(T) F 19. Casement windows are usually side hinged and of the outswing type. J-238

(T) F 20. The desired height of staircase risers is 7 inches. E-331

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. A carpenter would be seriously handicapped without a ___ framing ___ square in his tool kit. D-74

2. The primary function of any roof is to ___ shed ___ water. E-134

3. The highest horizontal framing member of a roof is called the ___ ridge ___. E-147

4. Any type of window protruding from a roof may be called a ___ dormer ___. J-119

5. Joints in vertical siding may be covered with strips called __battens____. E-222

6. When shingling against dormers or chimneys, the _flashing___ must be worked in with the shingle courses to prevent leaking behind the courses. E-239-240

7. Except for the length of the pieces, _clapboards___ are the same as common or bevel siding. E-219

8. A board which provides a finish at the junction of a floor and wall is called a _baseboard____. J-321

9. A door jamb is the part of the frame that forms a __lining___ for the opening that receives the door. J-268

10. In an ordinary house a space of about __7__ feet is preferred for headroom. E-331

Multiple-Choice

Directions: In the space at the left of each statement, write the letter of the item which will provide the correct answer to complete the statement.

__C__ 1. The established unit of measurement for the unit run is (A) 1/4 pitch; (B) 6 inches; (C) 12 inches; (D) 24 inches. E-144

__B__ 2. In an equal-pitch hip roof, the hip rafter always meets the ridge at an angle of (A) 30 degrees; (B) 45 degrees; (C) 60 degrees; (D) 90 degrees. E-149

__A__ 3. Pieces of plywood used to assemble roof trusses are called (A) gussets; (B) batters; (C) slabs; (D) strips. J-124

__D__ 4. The core of a veneered door would probably be made up of (A) birch; (B) oak; (C) redwood; (D) pine. E-311

__B__ 5. The parts of a new door which must be sawed off are the (A) rails; (B) stiles; (C) panels; (D) lugs. J-278

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. Basically, there are five roof styles in common use. These five types are:

(A) __shed or flat____ (D) ____gambrel____

(B) __gable____ (E) ____mansard____

(C) __hip____ E-135

2. Rafter spacing is determined by:

(A) stiffness of sheathing

(B) weight of roof

(C) rafter span

(D) snow and wind loads to be carried J-108

3. Factors to be considered when choosing wood for exterior finish are:

(A) decay resistance (C) lumber grade

(B) paint holding quality E-216

4. There are three common methods of hanging doors. They are:

(A) side hinges on edge of door

(B) pivot hinges on top and bottom of door

(C) roll away or sliding track E-314

5. The two most commonly used types of windows are:

(A) casement or hinged (B) double hung J-237

KEY--ASSIGNMENT SHEET NO. 1
(MASONRY AND CONCRETE)
TYPES AND DESIGNS OF FOOTINGS AND FOUNDATIONS

I. Key to Study Questions:

1. C-54-85
2. C-81
3. C-93
4. C-91-96
5. C-96-114
6. C-114-123
7. C-123-128
8. C-129-133
9. M-356, 372-374
10. M-356-357, 374
11. M-358, 374
12. M-358, 375

II. Suggested Supplementary Assignments:

A. Write a paper stressing the importance of footings and their relationship to a structurally sound house.

III. Suggested List of Visual Aids:

A. Film: NATION'S BUILDING STONE--(16mm, B & W, 19 min., $1.00) --University of Michigan, Audio-Visual Education Center, Ann Arbor, Michigan. Quarrying and cutting limestone in preparing building stone; its use in various types of buildings.

IV. Other Instructional Aids:

KEY--ASSIGNMENT SHEET NO. 2
(MASONRY AND CONCRETE)
TYPES, PROPERTIES, AND USES OF LIME AND MORTAR

I. Key to Study Questions:

1. B-2-11
2. B-11-18
3. B-21
4. B-24-32
5. B-32-36
6. B-36-47
7. B-48
8. B-49-56

II. Suggested Supplementary Assignments:

A. Prepare a list of the types and properties of mortar needed in masonry construction.

B. Outline the tools, materials, and steps of procedure for mixing mortar.

III. Suggested List of Visual Aids:

A Film: HOW TO MAKE QUALITY CONCRETE--(16mm, color, sound, 33 min., Free)--University of Missouri, Audio-Visual Department, Columbia, Missouri. This film describes the essential steps in making quality concrete from the design of the mix to the time it comes from the mixer.

IV. Other Instructional Aids:

KEY--ASSIGNMENT SHEET NO. 3
(MASONRY AND CONCRETE)
MIXING, POURING, AND FINISHING CONCRETE

I. Key to Study Questions:

1. B-62-65
2. B-66-67
3. B-62-73
4. B-76-90, K-7-9
5. B-90-101, K-14-20
6. K-6-7
7. K-11
8. K-11-13
9. K-17
10. K-17
11. K-19
12. K-19-20
13. K-20
14. K-20
15. K-25-33
16. B-101-102, K-21-24
17. B-102-103
18. B-314-324
19. B-324-332
20. B-332-339
21. B-339-354

II. Suggested Supplementary Assignments:

A. In a one-page paper, summarize the importance of concrete as it affects our daily lives and our security.

III. Suggested List of Visual Aids:

A. Film: CONCRETE EXAMPLE--(16mm, B & W, sound, 16 min., Free)--University of Missouri, Audio-Visual Department, Columbia, Missouri. Teaches the five simple rules of quality concrete. Features such as air-entrainment, the extensive use of ready mixed concrete, and modern construction methods are included.

IV. Other Instructional Aids:

A. Speaker: Invite mason contractor to speak on the topic, "The Preparation, Mixing, and Pouring of Concrete."

V. Test No. 1, Covering Assignments 1-3:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T (F) 1. Lime is not an important ingredient for mortar which is to be used for laying brick. B-13

(T) F 2. Some limes should be soaked overnight to get the best results from it. B-25

T (F) 3. The consistency of mortar refers to its ability to hold on to water. B-36

(T) F 4. A mortar joint should not be tooled to such an extent that the face is completely sealed. B-47

T (F) 5. The amount of water used in a concrete mix does not have much effect on the strength of the concrete. B-64

(T) F 6. Flat steel reinforcement rods are not satisfactory for reinforcing concrete. B-72

T (F) 7. Cement mixed with sand and water is called concrete. B-73

(T) F 8. Well graded sand ranges in size from very fine up to 1/4 inch. B-82

(T) F 9. The amount of water held by the sand must be considered when figuring the amount of water needed for a concrete mix. B-84

T (F) 10. If a mechanical mixer is to be used, cement should be the first ingredient placed in the mixer. B-87

T (F) 11. The maximum size gravel or stone to use in a concrete mix depends on weather conditions in the area. K-8

(T) F 12. The soil on which concrete is to be poured should be dampened before the concrete is poured. K-16

(T) F 13. Screeding and darbying should be performed before bleeding takes place. K-17

T (F) 14. Less bleeding occurs in non-air-entrained concrete than in air-entrained concrete. K-20

(T) F 15. Scaling can be caused by early cycles of freezing and thawing of newly poured concrete. K-30

T (F) 16. Street walks should be at least 4 feet wide in residential neighborhoods. B-315

(T) F 17. Soft pine boards may be used for expansion joints in sidewalks. B-317

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. When enough water has been added to mortar so that it flows easily, it is called ____grout____. B-21

2. The consistency of a mortar refers to its degree of ____wetness____ B-36

3. A mixture of sand, crushed gravel or stone, and cement is called ____concrete____. B-62

4. The two principal requirements of hardened concrete are ____strength____ and ____durability____. B-63

5. A material other than water, aggregate, and Portland cement that is used as an ingredient of concrete is called an ____admixture____. K-6

6. Regardless of exposure conditions, air-entrained concrete is strongly recommended for all concrete work. K-7

7. A darby is used to float the concrete surface immediately after it has been screeded. K-12

8. Most cement masons prefer a fanning trowel for troweling the concrete slab the last few times. K-13

9. In northern climates where concrete flat surfaces are subject to freezing and thawing, the builder should use air-entrained concrete. K-16

10. If joints are to be cut in concrete slabs with a power saw, they should be cut 4 to 12 hours after the slab has been poured. K-18, 19

11. Watertight paper and polyethylene film may be used as coverings for concrete that is being cured. K-20

12. The occurrence of numerous fine hair cracks in the surface of newly hardened concrete is called crazing. K-31

Multiple-Choice

Directions: In the space at the left of each statement, write the letter of the item which will provide the correct answer to complete the statement.

C 1. Those portions of a building which comprise the first actual structural work are the (A) foundation walls; (B) columns; (C) footings; (D) reinforcement rods. C-54

C 2. One of the most important factors concerning footings is the (A) grade of sand to be used in the concrete mix; (B) size of the aggregates; (C) shapes of their sides and bottoms; (D) size of reinforcement. C-56

D 3. The recommended mix for reinforced concrete footings is (A) 1:2:4; (B) 1:3:5; (C) 1:3:4; (D) 1:2½:3½. C-81

A 4. In reinforced concrete footings, the reinforcing rods should be placed (A) 1½" to 3" from the bottom of the footing; (B) 1" to 2" from the bottom of the footing; (C) 1½" to 3" from the top of the footing; (D) in the center of the footing. C-86

B 5. The recommended concrete mix for ordinary concrete foundations is (A) 1:2:4; (B) 1:2 3/4:4; (C) 1:3:5; (D) 1:1:2. C-114

C 6. If drain tiles are used as a method of waterproofing foundations, gravel or cinders should be backfilled at least (A) 18 inches below the tile; (B) 10 inches above the tile, (C) 18 inches above the tile; (D) 6 inches below the tile. C-133

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. The three admixtures most commonly used by cement masons are:

(A) accelerators

(B) retarders

(C) air-entraining agents

K-6

2. The most common tools used for finishing horizontal concrete surfaces are:

(A) straightedge

(B) hand tamper

(C) darby

(D) bull float

(E) edger

(F) jointer or groover

(G) power join cutter

(H) hand and power floats

(I) hand and power trowels

K-11-13

3. The purposes of floating concrete surfaces are:

(A) to embed large aggregates just beneath the surface

(B) to remove slight imperfections

(C) to consolidate mortar at the surface in preparation for other finishing operations K-19

4. The names of some of the special concrete finishes are:

(A) exposed aggregate

(B) dry-shake color surfaces

(C) geometric design

(D) leaf impression

(E) circle design

(F) swirl design

(G) wavy broom design

(H) keystone finish

K-25-28

KEY--ASSIGNMENT SHEET NO. 4
(MASONRY AND CONCRETE)
BUILDING WITH CONCRETE BLOCK

I. Key to Study Questions:

1. B-142-143, L-2
2. B-143-152, L-2
3. B-153-156, L-3
4. B-156-179, L-4
5. B-179-184, L-4-6
6. B-184-187, L-10
7. L-7-8
8. L-9
9. L-12
10. L-13-14
11. L-15-16
12. B-187-190
13. B-192-193

II. Suggested Supplementary Assignments:

A. Write out an outline of the steps required to lay a block wal without windows or doors.

1. Explain how the sizes of concrete block affect the location of doors and windows? Sketch the construction details of placing a door and window in a block wall.

III. Suggested List of Visual Aids:

A. Film: BUILD WITH CONCRETE MASONRY--(16mm, B & W, sound, 19 min., Free)--University of Missouri, Audio-Visual Department, Columbia, Missouri. Typical examples of concrete masonry farm construction; how masons build with concrete masonry; painting masonry; wall patterns; use of block as a backing.

IV. Other Instructional Aids:

A. Speaker: Invite a local concrete products firm manager to speak on the topic, "Manufacturing of Block, Tile, and Brick."

KEY--ASSIGNMENT SHEET NO. 5
(MASONRY AND CONCRETE)
BUILDING WITH BRICKS

I. Key to Study Questions:

1. B-255-258
2. B-259
3. B-260-261
4. B-263-269
5. B-269-271
6. B-274-279
7. B-281
8. B-291-301
9. B-301-303
10. B-303
11. B-306-308
12. B-272-273
13. B-273

II. Suggested Supplementary Assignments:

A. Write a brief paper on "The Process of Manufacturing Brick."

B. Draw up a series of sketches showing the principal methods of bonding brick.

III. Suggested List of Visual Aids:

A. Film: BRICK AND STONE MASON--(16mm, B & W, sound, 10 min., $1.50)--University of Minnesota, Audio-Visual Extension Service, 115 T.S.M., Minneapolis 14, Minnesota. Features many types of structures using brick and stone: homes, churches, steel mills, round houses, etc. Covers educational requirements, working conditions, and steps in advancement of the masonry trade.

IV. Other Instructional Aids:

KEY--ASSIGNMENT SHEET NO. 6
(MASONRY AND CONCRETE)
WALL AND PARTITION CONSTRUCTION

I. Key to Study Questions:

1. C-317-322
2. C-323-326
3. C-326-353
4. C-353-367
5. C-367-373
6. B-198-204
7. B-204-212
8. B-212-218
9. B-218-219
10. B-219-239
11. B-239-249

II. Suggested Supplementary Assignments:

A. Class Project:

1. Obtain a set of plans for a house and make out a complete bill of materials for all cement and masonry work.

2. Obtain prices for the needed items and compute the cost of all materials.

3. Estimate the amount of man hours required to construct the cement and masonry work and compute the labor costs.

III. Suggested List of Visual Aids:

A. Using an overhead projector, show and discuss photos and sketches of construction details of footings, foundations, walls, chimneys, etc. It would be especially beneficial if the items chosen are directly applicable to the house that the class will construct.

IV. Other Instructional Aids:

KEY--ASSIGNMENT SHEET NO. 7
(MASONRY AND CONCRETE)
CHIMNEY AND FIREPLACE DESIGN AND CONSTRUCTION

I. Key to Study Questions:

1. C-229-237
2. C-238-246
3. C-246-263
4. C-263-270
5. C-270-274
5. C-278-290
7. C-290-295
8. C-295-306
9. C-306-311
10. C-311-312

II. Suggested Supplementary Assignments:

A. In a short paper discuss the effect of weather upon chimneys and the many factors that need to be considered in reducing the effect of weathering.

B. Make a list of the various parts of a fireplace and the function of each.

C. Read: Mix, Floyd, Practical Carpentry, Goodheart-Willcox Co., Chicago, 1960, pp. 355-368.

III. Suggested List of Visual Aids:

IV. Other Instructional Aids:

A. Speaker: Invite a local mason contractor or mason to speak on the topic, "Working with Block, Brick, and Stone."

V. Test No. 2, Covering Assignments 4-7:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

(T) F 1. Concrete masonry permits easy planning and quick erection. B-142

(T) F 2. The three-core block is the one most commonly used. B-143

(T) F 3. A good mortar for the "average" concrete block construction is: one part Portland cement, one part lime and three parts sand. B-156

(T) F 4. Vertical joints for blocks should not be over 3/8 inch thick B-156

(T) F 5. It is possible to carry a heating duct inside a 4 inch partition made of 3 inch blocks and plastered on both sides. B-175

T (F) 6. Units from different tile manufacturers are fairly interchangeable. B-212

T (F) 7. Tile partitions can be used over wood framing or floors. B-213

T (F) 8. Architects prefer end-construction tile over side-construction tile. B-219

(T) F 9. In tile construction the baseboards are nailed directly to the grounds. B-232

T (F) 10. Side-construction tile should be used with metal door bucks B-239

(T) F 11. Fat mortar is sticky and contains little sand. B-260

T (F) 12. In figuring the length of a brick wall, there will be as many mortar joints as brick used. B-291

(T) F 13. Before starting corners, it is best to test the wall length with dry brick. B-293

T (F) 14. Flue linings need not be installed in brick chimneys where gas-fired heating appliances are used. C-235

(T) F 15. Round flues are more efficient than rectangular flues. C-237

T (F) 16. An exterior chimney is more efficient than an interior chimney. C-239

T (F) 17. A flue lining should stop about 2 inches below the top of the chimney cap. C-245

(T) F 18. Chimney locations should be planned when the building is being designed. C-269

T (F) 19. The modified fireplace is more difficult for the mason to build than the conventional type. C-281

T (F) 20. Fireplace lintels should always be steel angles. C-287

(T) F 21. The over-all dimension of the face of the fireplace should be such that whole bricks can be laid up without any cutting being necessary. C-305

T (F) 22. One-half inch joints make stronger masonry work than 1/4 inch joints. C-307-308

(T) F 23. The basic purpose of coping is the same as that of flashing. C-320

(T) F 24. Brick veneer on a frame wall consists of stretcher bonding throughout. C-350

(T) F 25. The concave, "V" and weathered mortar joints are considere the approved types of tooled joints for masonry walls. C-354

(T) F 26. Openings in walls built of masonry units should be planned in order to avoid or eliminate the necessity of cutting the units. C-365

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. In concrete masonry, the horizontal joints are called ___ bed ___ joints. B-156

2. A concrete block wall 20 feet long, using standard blocks 8" x 8" x 16" nominal size and 3/8 inch mortar joints, would contain ___ 15 ___ stretchers. B-157

3. Courses of blocks directly under joists, beams, and slabs should have their ___ cores ___ filled with concrete. B-170

4. The builder can check the designer's dimensions by setting one course around the footing without using ___ mortar ___. B-179-180

5. Two or three courses of ___ bricks ___ are recommended for the top of concrete block bearing partitions so that loads may be evenly distributed. B-184

6. The cells are ___ vertical ___ in end-construction tile. B-198

7. Mortar joints for tile can be from ___ 1/4 ___ inch to ___ 1/2 ___ inch in thickness. B-212

8. Drain holes in the vertical mortar joints of bottom courses are called ___ weep ___ holes. B-226

9. Tile units should be ___ wet ___ before they are laid. B-243

10. The inexperienced mason should not apply mortar for tile bed joints in advance of more than ___ one ___ unit(s). B-247

11. The standard depth of a brick is ___ 2 1/4 ___ inches. B-259

12. In a ___ rowlock ___ course, the bricks lay on edge with only their ends exposed. B-268

13. A mortar joint ___ 1/4 ___ inch thick is generally recommended for ordinary bricklaying. B-279

14. Brick columns may have a load applied after ___ two ___ days. B-306

Multiple-Choice

Directions: In the space at the left of each statement, write the letter of the item which will provide the correct answer to complete the statement.

B 1. If a flue lining is not used, the thickness of a chimney wall should be (A) 4 inches; (B) 8 inches; (C) 6 inches; (D) 12 inches. C-235

C 2. A flue lining should extend above the top of the chimney cap at least (A) 1/2 inch; (B) 1 inch; (C) 2 inches; (D) 8 inches. C-245

A 3. The minimum amount of space that should be left between the outside faces of chimneys and all wooden beams and joints is (A) 2 inches; (B) 3 inches; (C) 1 inch; (D) 6 inches. C-241

D 4. The recommended minimum height that a chimney should extend above a flat roof is (A) 2 feet; (B) 1 foot; (C) 4 feet; (D) 3 feet. C-268

C 5. A fireplace needs about (A) 14; (B) 15; (C) 17; (D) 20 square inches of chimney flue area for each square foot of fireplace opening. C-267

A 6. A practical height for any fireplace if the width of the opening is less than six feet is (A) 30 inches; (B) 36 inches; (C) 27 inches; (D) 24 inches. C-296

B 7. A more watertight wall will result if the joints are (A) flush; (B) thin; (C) thick; (D) recessed. C-324

D 8. The thickness of solid brick walls is in multiples of (A) 2 inches; (B) 3 inches; (C) 5 inches; (D) 4 inches. C-327

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. The two kinds of concrete masonry units are:

(A) regular concrete units (B) lightweight concrete units
B-142-143

2. The common surface finishes of concrete blocks are:

(A) plain finish (C) rough finish

(B) smooth finish B-152-153

3. The kinds of brick most commonly used are:

(A) common brick

(B) face brick

(C) pressed brick

(D) fire brick

(E) glazed brick

(F) imitation brick

B-257-258

4. The tools needed by the bricklayer are:

(A) plumb rule

(B) trowels

(C) brick hammer

(D) brick set

(E) jointer

(F) line

(G) square

(H) mortarboard

B-269-271

5. The most common types of joint finishes are:

(A) flush joints

(B) weather joints

(C) concave tooled joints

(D) "V" tooled joints

B-278

KEY--ASSIGNMENT SHEET NO. 1
(ELECTRICAL CONSTRUCTION)
FUNDAMENTALS OF ELECTRICAL WORK

I. Key to Study Questions:

1. F-1-2
2. F-2-3
3. F-10-13
4. F-13-15
5. F-15-18
6. F-18-19
7. F-4-7
8. F-11-19
9. M-362-363
10. M-364
11. M-364
12. I
13. I

II. Suggested Supplementary Assignments:

Read:

A. Abbott, Arthur L., and Stetka, Frank, National Electrical Code Handbook, Tenth Edition, McGraw-Hill Book Co., New York, N. Y., 1960, pp. 1-32.

B. Mullin, Ray C., Electrical Trades, Blueprint Reading and Sketching, Delmar Publishers, Inc., Albany, N. Y., 1961, pp. 1-30.

C. Simplified Electric Wiring Handbook, Sears, Roebuck and Co., 1960, pp. 1-11.

D. Select a set of house blueprints.

1. Prepare a list of the circuits.
2. Compute the expected consumption of electricity.
3. Ascertain the size of the service equipment needed.
4. Make sketches of all wire runs and show placement of switches, outlets, and lighting fixtures.
5. Make a list of all tools and equipment needed to wire the complete house.

III. Suggested List of Visual Aids:

A. Film: THE ELECTRICIAN--(16mm, B & W, sound, 10 min., $1.50)--University of Minnesota, Audio-Visual Extension Service, Minneapolis, Minnesota. A broad overview of electrical jobs in the home, power plant, telephone, radio and electrical transportation. Also discusses occupation entrance requirements.

IV. Other Instructional Aids:

A. Speaker: Invite a local employment office person to discuss the occupational outlook and requirements of the local labor market area.

KEY--ASSIGNMENT SHEET NO. 2
(ELECTRICAL CONSTRUCTION)
ELECTRICAL WIRING PRACTICES

I. Key to Study Questions:

1. F-24-32
2. F-22-23
3. F-33-54
4. F-56
5. F-55-58
6. F-58-70
7. F-94-95
8. F-95-96
9. F-98-99
10. F-98-99
11. F-100-101
12. F-126-127
13. F-128
14. F-129-131
15. F-137-138
16. F-138
17. F-148-149
18. F-149-150
19. F-150-151
20. F-142-148
21. F-131-134
22. F-134-136

II. Suggested Supplementary Assignments:

Read:

A. Abbott, Arthur L., and Stetka, Frank, National Electrical Code Handbook, Tenth Edition, McGraw-Hill Book Co., New York, N.Y., 1960, pp. 33-350.

B. American Standards Association, National Electrical Code, National Board of Fire Underwriters, 222 West Adams Street, Chicago 6, Illinois, $ .15. Use to look up standards and specifications.

C. Mullin, Ray C., Electrical Trades, Blueprint Reading and Sketching, Delmar Publishers, Inc., Albany, N. Y., 1961, pp. 31-149.

D. Richter, H. P., Wiring Simplified, Park Publishing Co., Minneapolis 8, Minnesota, 1959, pp. 5-127.

E. Simplified Electric Wiring Handbook, Sears, Roebuck and Co., 1960, pp. 12-31, 38-47.

F. Using the house blueprints from Assignment No. 1, make a list of each major portion of the electrical work.

  1. Show when each part of the plan should be done, how long each part will take to complete, and how each part of this plan will dovetail into the over-all construction period for the whole house.
  2. Make out a complete bill of materials for the electrical work.

III. Suggested List of Visual Aids:

A. Film: SERIES AND PARALLEL CIRCUITS--(16mm, B & W, sound, 10 min., $1.00)--University of Missouri, Audio-Visual Department. Columbia, Missouri, Explains the advantages and disadvantages of series, parallel, and series-parallel combination circuits.

IV. Other Instructional Aids:

A. Speaker: Invite the local building inspector to speak on the local code as it applies to the electrical field.

B. Field Trip: Visit the local power generating plant to note the generator unit and how the power gets from the generator to the ultimate consumer.

KEY--ASSIGNMENT SHEET NO. 3
(ELECTRICAL CONSTRUCTION)
SPECIAL PROBLEMS FOR ELECTRICIANS

I. Key to Study Questions:

1. F-152-157
2. F-157
3. F-164-166
4. F-168
5. F-168-173
6. F-190-199
7. F-201-205
8. F-205-208
9. F-208-213
10. F-226-231
11. F-233-247

II. Suggested Supplementary Assignments:

Read:

A. Mullin, Ray C., Electrical Trades, Blueprint Reading and Sketching, Delmar Publishers Inc., Albany, N.Y., 1961, pp. 150-295.

B. Simplified Electric Wiring Handbook, Sears, Roebuck and Co., 1960, pp. 45-63.

C. Utilizing the blueprints and the other problems from assignments 1 and 2, prepare a complete estimate for the electrical work.

   1. Include cost of labor, material, overhead, and expected profit. Enter all data on an estimating form.

   2. Make out a purchase order for wire, fixtures, boxes, and all other necessary materials.

III. Suggested List of Visual Aids:

A. MY POP'S A LINEMAN--(16mm, color, sound, 15 min., $4.50)--University of Minnesota Audio-Visual Extension Service, Minneapolis, Minnesota. The film deals with high voltage safety and depicts a typical workday with several dangerous situations.

IV. Other Instructional Aids:

A. Speaker: Ask a local wholesaler of electrical products to discuss purchasing techniques and procedures, electrical materials, discounts, and other related information.

V. Test No. 1, Covering Assignments 1-3:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T (F) 1. One 25 watt lamp in each room of a house is adequate.
F-1

(T) F 2. The National Electrical Code manual is revised every two years. F-2

(T) F 3. Even though wiring is carefully installed, the materials and devices themselves can be sources of hazard. F-2

T (F) 4. In most places it is not necessary to obtain a wiring permit. F-2

(T) F 5. On smaller jobs, the electrical engineer's services are seldom needed. F-2

(T) F 6. Current will not flow unless the circuit is complete. F-10

(T) F 7. Soldering paste should be non-corrosive F-24

(T) F 8. The neutral wire is connected to the screw shell of the lamp socket. F-55

(T) F 9. The neutral wire should never be run to a switch. F-55

(T) F 10. If the hot conductor is in one conduit and the neutral conductor is in another, induction will take place. F-57-58

(T) F 11. The number of wires permitted by the National Electrical Code is the same for rigid and thin-walled conduit, size for size. F-138

T (F) 12. A two wire 115-230 volt circuit is required for an electric range.

T (F) 13. Armored cable cannot be used to wire a range circuit. F-152

T (F) 14. The home type of electric hot water heater usually has three heating elements. F-158

(T) F 15. Rigid conduit is not used extensively at the present time in dwellings. F-175

(T) F 16. With a remote control, low voltage, wiring system it is possible to turn a light on and off from several different places providing the control switches are hooked up in parallel. F-204

(T) F 17. A current of .05 to .20 amperes is sufficient to kill a grown person. I

T (F) 18. Under ordinary working conditions, there is usually no danger of getting a killing shock from 120 volt current. I

(T) F 19. Most construction electricians work for electrical contractors. M-362

(T) F 20. The electrical apprenticeship program usually requires over 8,000 hours of on-the-job training. M-363

T (F) 21. Approximately 310,000 men are employed as construction electricians. M-363

T (F) 22. The hourly rate for electricians is slightly less than the average of all journeymen in the building trades. M-364

(T) F 23. The injury rate for electricians is lower than that for general construction work. M-364

T (F) 24. An experienced construction electrician cannot easily transfer to another type of electrical work such as a shipbuilding electrician. M-363

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. The unit of electrical pressure is the ____volt______. F-10
2. The unit of electrical current is the ____ampere______. F-10
3. The unit of ____electrical____ ____resistance____ is the ohm. F-10
4. The rate at which electrical energy is delivered and consumed is called ____power____. It is measured in ____watts______. F-13
5. The rule for the power equation states that: Power equals the ____amperes______ flowing in a circuit times the ____volts______ of the circuit. F-14
6. There are two common types of circuits: ____series______ and ____parallel______. F-15
7. Conduit elbows are called ____ells______. F-128
8. The National Electrical Code permits not more than a total of ____four______ 90° bends in a run of conduit. F-138
9. A ____reamer______ is used to remove burrs from the inside of freshly cut pipe. F-140
10. A hacksaw blade used to cut thin-walled conduit should have ____24-32____ teeth per inch. F-140
11. The transformer used in remote-control wiring has a ____24____ volt secondary winding. F-205
12. The National Electrical Code provides that ____three______ watts be provided for each square foot of living quarters in residential occupancies. F-226

Multiple-Choice

Directions: In the space at the left of each statement write the letter of the item which will provide the correct answer to complete the statement.

A 1. If you were asked to install a lighting fixture which could be controlled from five different locations, you would use (A) two 3-way switches and three 4-way switches; (B) two 2-way switches and three 3-way switches; (C) two 4-way switches and three 3-way switches; (D) three 3-way switches and two 4-way switches. F-69

C 2. If a lighting fixture was to be controlled independently from two different locations, you would need (A) 1-way switches; (B) 2-way switches; (C) 3-way switches; (D) 4-way switches. F-61

B 3. A type of electrical wire covered with a spiral of metal is (A) ampex; (B) BX; (C) Romex; (D) Conduit. F-98

D 4. In comparing No. 8 and No. 12 copper wire one would discover that the No. 8 wire has lower (A) weight; (B) cost; (C) strength; (D) resistance. F-19

B 5. If the proper size of wiring is not available, the best practice is to (A) use smaller wire; (B) use the next larger size of wire; (C) install fewer outlets per circuit; (D) use two smaller wires. F-19

C 6. The ground wire should be connected to a (A) gas pipe; (B) steam pipe; (C) water pipe; (D) vent pipe. F-40-41

C 7. The wire which is connected to a terminal should be bent so that it passes around the screw in the direction that the screw is turned when it is tightened becuase (A) the wire acts like a locknut; (B) the screw will be easier to loosen; (C) the wire will not turn off; (D) it will be easier to loosen the screw. F-56

C 8. When skinning a wire, the insulation should be "penciled down" rather than cut square to (A) prevent the braid from fraying; (B) save time; (C) avoid nicking the wire; (D) to make a neater looking splice. F-22

D 9. Ohm's Law is written (A) $E = IR$; (B) $R = \frac{E}{I}$; (C) $I = \frac{E}{R}$; (D) all of the above. F-12

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. The three primary circuit elements are:

(A) volts (B) amperes (C) ohms

F-10

2. Three different kinds of splices are the:

(A) pigtail (B) Western Union (C) tee tap
F-24

3. List three different types of tape used to insulate splices.

(A) rubber tape (C) plastic tape

(B) friction tape F-26

4. List the three general methods of arranging remote-control relays.

(A) outlet-mounted (C) zone-mounted

(B) gang-mounted F-209

5. The main divisions of a complete wiring installation are:

(A) service drop (D) grounding

(B) service wires (E) metering

(C) service switch F-33

6. The three types of conduit used for general purpose wiring are:

(A) rigid conduit

(B) flexible

(C) electrical metallic tubing F-126

7. The three general classes of outlet boxes are:

(A) square (B) octagon (C) rectangular
F-131

8. An estimate of the cost for doing a wiring job is arrived at after considering factors such as:

(A) cost of material (C) overhead cost

(B) cost of labor (D) expected profit
F-233

Matching

Directions: In the left hand column is a list of items. The right hand column contains descriptive phrases or synonymous terms. Match the descriptions to the items by placing the letter of the description in the blank at the left of the appropriate item.

G	1.	BX	F-98
D	2.	Fish tape	F-149
H	3.	Fuse	F-39
K	4.	KW	F-13
I	5.	I	F-10
J	6.	Voltmeter	F-11
M	7.	White wire	F-55
B	8.	4-way switch	F-67
A	9.	Hickey	F-142
C	10.	Acqustat	F-190

A. Used to bend conduit

B. Needed for three or more controlling points

C. Controls temperature of water

D. Flat, narrow steel wire which is used to pull conductors

E. Controls temperature of air

F. Hooked up in parallel with a circuit

G. A term used to identify flexible armored cable

H. Safety device to prevent overloading a circuit

I. Amperes

J. Hooked up in series with a circuit

K. Kilowatt

L. Hot wire

M. Neutral

KEY--ASSIGNMENT SHEET NO. 1
(PLUMBING AND PIPEFITTING)
AN INTRODUCTION TO THE PLUMBING AND PIPEFITTING TRADE

I. Key to Study Questions:

1. M-352-353
2. M-353
3. M-353
4. M-353-354
5. M-354
6. M-354-355
7. M-355
8. H-Introduction

II. Suggested Supplementary Assignments:

A. Prepare a list of all local sources of employment for plumbers and pipefitters. Include the approximate number employed at each plant and company.

III. Suggested List of Visual Aids:

A. Film: PLUMBING--YOUR LIFE'S WORK--(16mm, B & W, sound, 11 min., free)--National Association of Plumbing Contractors, 1016-20th Street, N.W., Washington, D.C. Vocational guidance for a boy wanting to become an apprentice plumber.

IV. Other Instructional Aids:

A. Speaker: Invite a local plumbing contractor to speak on the topic, "Employment Opportunities for Plumbers."

KEY--ASSIGNMENT SHEET NO. 2
(PLUMBING AND PIPEFITTING)
TYPES AND FUNCTIONS OF SEWAGE DISPOSAL SYSTEMS

I. Key to Study Questions:

1. H-1
2. H-1-6
3. H-6-16
4. H-20
5. H-21-25
6. H-26
7. H-26-32
8. H-32

II. Suggested Supplementary Assignments:

A. Read: Federal Housing Administration, Minimum Property Standards, FHA No. 300, Superintendent of Documents, Washington, D. C., pp. 217-230.

B. Make a sketch of a layout for a distribution field for a septic tank. Estimate the material you would need to build the field.

C. Obtain copies of the recommended layout and installation of the septic system from the local county health department.

III. Suggested List of Visual Aids:

A. Film: MODERN PIPE FOR MODERN LIVING--(16mm, color, sound, 27 min., free)--National Association of Plumbing Contractors, 1016-20th Street, N.W., Washington 6, D.C. The manufacture and use of fiber pipe for sewage and septic tank disposal and for drainage and irrigation use.

B. Film: GUARDIAN OF COMMUNITY HEALTH--(16mm, color, sound, 20 min., free)--National Association of Plumbing Contractors, 1016-20th Street, N.W., Washington 6, D.C. Shows sewage and sewage treatment in communities of all sizes.

IV. Other Instructional Aids:

A. Field Trip: Arrange a trip to the local sewage disposal plant.

V. Test No. 1, Covering Assignments 1-2:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T (F) 1. The plumber does not need to be concerned with understanding the public sewage system. H-1

T (F) 2. Sanitary sewers carry both sanitary waste and rain water. H-2

(T) F 3. One of the most common methods by which sewage is treated is the activated sludge process. H-7

(T) F 4. Sandy soil is the most favorable soil for the disposal of waste from a septic system. H-20

T (F) 5. The septic tank should be installed at least five feet below the surface. H-20

(T) F 6. Commercially made tanks may not always meet standards required by state or local agencies. H-25

T (F) 7. The septic tank should be located close to the lot line. H-26

(T) F 8. The distribution field is less expensive to construct than the filter trench. H-30

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. The treatment of sewage has made it necessary to have ___storm___ sewers to take care of rain water. H-2

2. Manholes serve as ___cleanouts___ and make the public sewer accessible for inspection and repair. H-6

3. ___Filter___ ___bed___ ___blocks___ are laid on the floor of a filter to supply ventilation. H-14

4. The ___septic___ ___tank___ is a device used in rural sewage systems to expedite the decomposition of the elements contained in raw sewage. H-21

5. A family of six needs a septic tank of approximately ___50___ cubic feet capacity. H-25

6. For residences serving more than six persons, ___5___ to ___6___ cubic feet of tank content per person is recommended. H-25

7. In most cases there is a lack of free ___oxygen___ in septic tanks. H-26

8. The ___filter___ ___trench___ is the best purification unit to use with clay soil and where a natural drainage terminal is available. H-28

9. There should be ___10___ feet of space between the rows of tile in a distribution field. H-30

10. The distribution field uses the ___earth___ as a means of purifying the discharged effluent. H-30

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. The types of public sewers, classified according to the type of waste they handle, are:

   (A) combination public sewers (C) storm sewers

   (B) sanitary sewers H-1-2

2. Two common methods by which municipal sewage may be treated are:

   (A) activated sludge process (B) sprinkling filter process H-7

3. The three types of rural filtration units are:

   (A) dry well (C) distribution field

   (B) filter trench H-27

KEY--ASSIGNMENT SHEET NO. 3
(PLUMBING AND PIPEFITTING)
LAYOUT AND INSTALLATION OF HOUSE SEWERS AND DRAINS

I. Key to Study Questions:

1. H-54-59
2. H-63-64
3. H-64-69
4. H-70-74
5. H-75-94
6. H-95-100
7. H-103-106

II. Suggested Supplementary Assignments:

A. The instructor should prepare duplicate copies of a set of house blueprints and a lot plan.

   1. Students should make a sketch layout for the house sewer, house drain, and storm drain.

III. Suggested List of Visual Aids:

A. Film: HERE'S HOW WITH CLAY PIPE--(16mm, color, sound, 20 min., free)--National Association of Plumbing Contractors, 1016 20th Street, N.W., Washington 6, D.C. Detailed description of all steps involved in laying trunk and main sewer lines.

B. Film: ONCE AND FOREVER--(16mm, color, sound, 14 min., free)--National Association of Plumbing Contractors, 1016 20th Street, N.W., Washington 6, D.C. Portrays value of installing cast iron soil pipe in residence and in sewer laterals.

IV. Other Instructional Aids:

KEY--ASSIGNMENT SHEET NO. 4
(PLUMBING AND PIPEFITTING)
TOOLS AND MATERIALS USED IN HOUSE SEWER AND DRAIN CONSTRUCTION

I. Key to Study Questions:

1. H-33
2. H-33
3. H-34
4. H-34-35
5. H-35
6. H-35-36
7. H-36-37
8. H-38-42
9. H-43-45
10. H-45-48
11. H-47,52
12. H-49
13. H-49-52

II. Suggested Supplementary Assignments:

A. Utilizing the house blueprints and sketch layout for the suggested advanced assignment of unit 3, make a bill of materials for the house sewer, house drain, and storm drain.

III. Suggested List of Visual Aids:

A. Film: WHITE PIPE--(16mm, color, sound, 35 min., free)--National Association of Plumbing Contractors, 1016 20th Street, N.W., Washington 6, D.C. Illustrates the manufacture use and installation of four transit pipes for the home; building sewer pipe, plumbing, vent pipe, warm air duct and gas vent pipe.

B. Film: LITTLE KNOWN FACTS ABOUT A WELL-KNOWN PRODUCT--(16mm, color, sound, 32 min., free)--National Association of Plumbin Contractors, 1016 20th Street, N.W., Washington 6, D.C. Shows the processing of a malleable iron casting, manufacture of drop forgings, and manufacture of pipe tools.

IV. Other Instructional Aids:

A. Field Trip: Visit a local wholesale plumbing distributor to inspect the various types, sizes, and qualities of traps, pipes, valves, fixtures, etc.

V. Test No. 2, Covering Assignments 3-4:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T (F) 1. The plumber has a wide variety of materials to choose from for drainage construction. H-33

(T) F 2. Fittings used on waste lines should be of long radius. H-33

T (F) 3. Cast iron pipe is recommended for drainage on buildings more than twenty-five stories high. H-35

T (F) 4. The plumber needs more manipulative skill than most other building tradesmen. H-43

T (F) 5. The separation of cast iron soil pipe into two pieces is a sawing process. H-47

(T) F 6. Sweated joints should be made of solder that is approximately 50 per cent tin and 50 per cent lead H-49

T (F) 7. The house sewer should enter the main sewer at a 90 degree angle. H-54-55

(T) F 8. If located back to back, one house sewer may serve two buildings on the same lot. H-61

(T) F 9. A 1/8 bend is classified as a long radius fitting. H-70

(T) F 10. The interior house drain installation is usually begun by calking a Y-fitting into a length of cast iron pipe. H-71

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. Sewers and drains are generally constructed with cast iron soil pipe or vitrified clay pipe. H-33

2. The chief use for galvanized steel pipe is for venting. H-38

3. Waste installations in buildings constructed under federal specifications are usually made with brass pipe. H-41

4. It is necessary to use a pouring rope when making a horizontal calk joint. H-47

5. It is not necessary for a wiped lead joint to be longer than two inches. H-50

6. The part of the drainage system beginning just outside the foundation wall is the house sewer. H-53

7. When a house sewer is installed in soil containing tree roots, cast iron pipe should be used. H-53

8. The usual pitch of a house sewer is not less than 1/4 inch to the foot. H-58

9. The plumber can prevent earth walls from caving in by shoring. H-60

10. The collection line is also referred to as the house drain. H-63

11. The most practical method of determining the size of a house drain is by the ___unit___ system. H-65

12. A 4-inch ___P-trap___ installed not more than two feet under the basement floor makes a desirable floor drain. H-80

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. (A) cement joint on vitrified clay pipe

   (B) mechanical seal joint

   (C) cast iron pipe to vitrified clay pipe

   (D) composition joints

   (E) vertical calk joint

   (F) horizontal calk

   (G) acid-resistant calk joints

   (H) screw thread joint

   (I) sweat or solder joint

   (J) wiped joint

   H-43-49

2. The two things that must be known in order to determine the grade of the house sewer are:

   (A) the depth of the house drain outlet

   (B) depth of the connection in the street

   H-57

KEY--ASSIGNMENT SHEET NO. 5
(PLUMBING AND PIPEFITTING)
INSTALLATION OF SOIL AND WASTE PIPE

I. Key to Study Questions:

1. H-107-109
2. H-110
3. H-111-113
4. H-114
5. H-115-118
6. H-119-124
7. H-125-126
8. H-126-128
9. H-128-130
10. H-131-133
11. H-140-144
12. H-141-146
13. H-199
14. H-209-213

II. Suggested Supplementary Assignments:

A. Read: Federal Housing Administration, Minimum Property Standards, Superintendent of Documents, Washington, D.C., pp. 212-214, Section 1006-1 to 1006-6, FHA No. 300.

1. Be prepared to give a class report on the above sections.

B. Utilizing the house blueprints and sketch layout for the suggested advanced assignments of units 3 and 4, make a layout plan and bill of material for the soil and waste pipe systems.

III. Suggested List of Visual Aids:

A. Film: TOWARD A UNIFORM PLUMBING CODE--(16mm, B & W, sound, 37 min., free)--National Association of Plumbing Contractors, 1016 20th Street, N.W., Washington 6, D.C. Explains fixture-unit system, stack loading, venting and other factors influencing the report of the Uniform Plumbing Code Committee.

B. Film: PENNY WISE--(16mm, color, sound, 18 min., free)--National Association of Plumbing Contractors, 1016 20th Street, N.W., Washington 6, D.C. Shows layout and illustratic of copper stacks and waste systems.

IV. Other Instructional Aids:

KEY--ASSIGNMENT SHEET NO. 6
(PLUMBING AND PIPEFITTING)
LAYOUT AND INSTALLATION OF THE WATER DISTRIBUTION SYSTEMS

I. <u>Key to Study Questions</u>:

1. H-248
2. H-249-250
3. H-251-255
4. H-256-261
5. H-263-271
6. H-274-276
7. H-277-282
8. H-283-289
9. H-289-290
10. H-291-298
11. H-233-245
12. H-245-247
13. H-215-217
14. H-217-219
15. H-221-226
16. H-227-232

II. <u>Suggested Supplementary Assignments</u>:

A. Utilizing the house blueprints, lot plan, and sketch layout for the suggested advanced assignments of units 3 through 5, make layout plans and bills of material for the water distribution systems.

III. <u>Suggested List of Visual Aids</u>:

A. Film: RHYTHM OF INSTALLATION--(16mm, B & W, sound, 15 min., free)--National Association of Plumbing Contractors, 1016 20th Street, N.W., Washington 6, D.C. Installation of hot water heating system and factors such as heat-loss calculations, boiler sizing, water temperatures, etc.

B. Film: SAFE WATER IN THE HOME--(16mm, B & W, sound, 11 min., free)--National Association of Plumbing Contractors, 1016 20th Street, N.W., Washington 6, D.C. Shows several ways in which home water supply can become contaminated.

IV. <u>Other Instructional Aids</u>:

KEY--ASSIGNMENT SHEET NO. 7
(PLUMBING AND PIPEFITTING)
SELECTION AND INSTALLATION OF PLUMBING FIXTURES

I. Key to Study Questions:

1. H-147-151
2. H-151-152
3. H-153-157
4. H-159-167
5. H-169-170
6. H-170-182
7. H-182-195
8. H-330
9. H-331-335
10. H-335-342
11. H-343-347
12. H-347-354
13. H-354-357
14. H-358-365
15. H-365-368
16. H-369-372
17. H-380-386

II. Suggested Supplementary Assignments:

A. Work out the following assignments utilizing the house blueprints and sketch layouts for the suggested advanced assignments for units 3 through 6:

1. Make layout plans and bills of material for the ventilation systems.

2. Compile a list of all plumbing fixtures.

3. Obtain rough-in blueprints for the plumbing fixtures.

III. Suggested List of Visual Aids:

A. Film: DESIGN FOR BETTER LIVING--(16mm, B & W, sound, 35 min., free)--National Association of Plumbing Contractors, 1016 20th Street, N.W., Washington 6, D.C. Traces the history of sanitation and plumbing and then portrays the manufacture of modern plumbing fixtures.

B. Film: BARRIER AGAINST DISEASE--(16mm, color, sound, 15 min., free)--National Association of Plumbing Contractors, 1016 20th Street, N.W., Washington 6, D.C. Explains siphonage, blow-back, and general principles of venting.

IV. Other Instructional Aids:

A. Speaker: Invite a local building inspector to speak on the topic, "Local Plumbing Code Requirements."

V. Test No. 3, Covering Assignments 5-7:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

(T) F 1. Partitions which house soil stack may require 2 x 6 studs or larger. H-108

T (F) 2. The soil pipe is generally installed after partitions are constructed. H-108

(T) F 3. Accessible cleanouts should be installed for every change of direction of the soil pipe. H-110

T (F) 4. The soil branches are generally installed before the main soil pipe is run through the roof. H-114

T (F) 5. A cleanout may be of a smaller diameter than the soil branch which it serves. H-120

(T) F 6. The proper grade for a soil branch is 1/4 inch per foot. H-121

(T) F 7. Acid-resistant pipes are not usually required for domestic or commercial kitchens. H-126

(T) F 8. The problem of what constitutes satisfactory size and grade for waste pipe has been solved by scientific tests. H-130

T (F) 9. The minimum diameter for kitchen sink waste pipe is 1 3/4 inches. H-133

(T) F 10. When copper or brass pipe is used for underfloor work, it should often be assembled above floor. H-143

T (F) 11. Putty is the best material to use for setting closet bowls. H-335

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. That portion of the plumbing system which receives the discharge of water closets is the soil pipe. H-107

2. A tee for ventilation purposes must be left 3 feet above the last floor when installing the soil pipe. H-114

3. That part of the drainage system which conveys the discharge of fixtures other than water closets is the waste pipe. H-125

4. The method used to determine the size of waste pipe is called the unit system. H-132

5. The galvanized underfloor work may either terminate into a soil pipe terminal or a closet bend terminal. H-141-142

6. The device used to prevent the passage of sewer air is called a trap. H-147

7. Improper ventilation may cuase trap seal loss. H-161

8. Vent pipe should be graded lightly so that no water will accumulate in it. H-170

9. The main soil and waste vent is that portion of the soil-pipe stack above the highest installed fixture branch. H-172

10. That portion of the vent pipe system which serves as a terminal for the small vents is the main vent. H-174

11. Two fixture traps that are installed back to back are called unit vents. H-182

12. The factor that determines the type of pipe to be used for water distribution systems is the mineral content of the water. H-221

13. Most cities and water services use heavy cast iron pipe, known as corporation pipe. H-221

14. A water distribution pipe that does not rust or corrode is asbestos-cement pipe. H-223

15. One of the ends of a galvanized iron street ell is threaded on the outside. H-224

16. That part of the plumbing system installed underground between the water main and the house meter is called the house service. H-233

17. A fitting which may be installed on the water main without cutting the pressure off is a corporation stop. H-246

18. The boiling point for water at sea level is 212° F. H-273

19. Where power rates are low, the electric hot water heater provides the cleanest and most trouble-free method of heating water. H-282

20. Temperature pressure relief valves are used on hot water heaters to prevent explosion. H-289

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. Common causes of trap seal loss are:

(A) siphonage

(B) back pressure

(C) evaporation

(D) capillary attraction

(E) wind effect

H-161

2. Some of the most important factors to consider in installing a waste line are:

(A) selection of proper material

(B) conservative use of fittings

(C) adequate support

(D) location of cleanouts

(E) pitch

(F) size

(G) properly made joints H-125

3. The four types of permissible traps are:

(A) p-traps (C) anti-siphon traps

(B) drum traps (D) bell traps H-151-156

4. Ventilation of the plumbing system prevents at least three major difficulties. They are:

(A) trap seal loss (C) material deterioration

(B) retardation of flow H-159

5. The types of plumbing system tests are:

(A) cast iron drain water test

(B) vitrified clay pipe water test

(C) house drain air test

(D) soil, waste and vent pipe water test

(E) soil, waste and vent air test

(F) smoke test H-210-212

6. The parts which the municipal water departments furnish the plumber for the water system are:

(A) corporation cock (C) meter stop

(B) curb cock H-245

7. The three factors which must be considered in determining the size of a hot water storage tank are:

(A) the design of the building

(B) the number of occupants

(C) heating capacity of the supply device H-275

8. According to Matthias, the steps to be followed in setting closet bowls are:

(A) sweep bathroom floor clean

(B) inspect floor flange and insert closet bolts

(C) set bowl in place temporarily to study its appearance

(D) place wax or putty in recess of bowl

(E) wipe bolt holes clean and put bolts in place

(F) set bowls in permanent position

(G) place bolt flange and nuts on each bolt and tighten

H-334-335

9. The advantages of flush tanks over flush valves for residences are:

(A) they produce less noise

(B) require less pressure

(C) require smaller volume of water

(D) served with smaller supply piping H-337-338

KEY--ASSIGNMENT SHEET NO. 1
(PLASTERING)
APPLICATION OF THE PLASTER BASE

I. Key to Study Questions:

1. N-103-106
2. N-107
3. N-107
4. N-107-118
5. N-110-112
6. N-118-124
7. N-125-126
8. N-7
9. N-127-128
10. N-128-132
11. N-132-136
12. N-136-139
13. N-139-143
14. M-367-368
15. M-368-369
16. M-369
17. M-369-370
18. N-19-44
19. N-45-46
20. N-47-55
21. N-55-71
22. N-71-75
23. N-81-86
24. N-86-94

II. Suggested Supplementary Assignments:

A. Read: Van Den Branden, Felicien, and Mark Knowles, Plastering Skill and Practice, American Technical Society, Chicago, 1959, pp. 275-289.

1. Write out the answers for the five questions on page 275.

2. Be prepared to discuss the review questions on pages 288-289.

III. Suggested List of Visual Aids:

IV. Other Instructional Aids:

A. Speaker: Invite a lather to speak to the group about his work in preparing the plaster base.

T (F) 5. The moisture content of the sand used in a plaster mix has no bearing on the amount of water used in the mix. N-49

(T) F 6. Lightweight aggregates are free from foreign matter. N-51

(T) F 7. Both Keene's cement and plaster of Paris are calcined gypsums. N-56

(T) F 8. Quicklime requires extended soaking. N-66

(T) F 9. Quicklime should be added to water. N-67

(T) F 10. Portland cement is used in plaster mixtures that are designed to be water resistant. N-68

T (F) 11. Screeds and grounds are made of the same material. N-148

(T) F 12. Screeds and grounds serve the same purpose. N-148

(T) F 13. The water level is a highly accurate and sensitive instrument. N-156

T (F) 14. Cornices are moldings that are attached where the walls and floor meet. N-157

(T) F 15. The purpose of rodding is to produce plumb walls and level ceilings. N-157

T (F) 16. Atmospheric conditions have little, if any, effect on a plastering job. N-232

(T) F 17. Chip cracking is caused by faulty suction. N-239

(T) F 18. Large cracks in plaster are usually caused by poor construction beneath the lathing and plaster. N-242

T (F) 19. The best interior plaster work is put on in two coats. N-5

T (F) 20. The primary purpose of the scratch coat is to present a smooth unit surface to succeeding coats. N-5-6

T (F) 21. Grounds are used almost exclusively on ceilings. N-7

(T) F 22. Dense plaster is stronger than plasters with less density. N-9

(T) F 23. Much plaster work now consists of only two coats. N-9

T (F) 24. One disadvantage of stucco is that it is greatly affected by climate. N-11

(T) F 25. The careless plasterer is a dangerous worker. N-15

(T) F 26. White clothing is the trademark of the plasterer. N-16

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. The process of producing a plastic or pliable mortar from lime is called ___soaking___ ___lime___. N-65

2. Lime that has been soaked is called ___putty___ because of its plasticity. N-65

3. The two principal tools used by the plasterer to apply mortar are the ___hawk___ and ___trowel___. N-145

4. Grounds are made of ___wood___ ___ ___ or ___metal___. N-143

5. Screeds are made of ___plaster___. N-148

6. Exterior plaster work is called ___stucco___. N-11

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. Plaster is made up of three main ingredients. These are:
   - (A) ___water___
   - (B) ___aggregate___
   - (C) ___cementitious material (or binder)___

   N-45

2. The three main cementing agents used in plaster mortars are:
   - (A) ___gypsum___
   - (B) ___lime___
   - (C) ___Portland cement___

   N-55

3. Admixtures are divided into three kinds. These kinds affect:
   - (A) ___setting time of the plaster___
   - (B) ___the strength of the plaster___
   - (C) ___the color of the plaster___ N-71

4. Three methods which may be used to square a room are:
   - (A) ___right angle method___
   - (B) ___square method___
   - (C) ___center-line method___

   N-167

5. The names given to the coats of plaster in three-coat work are:
   - (A) ___scratch (or base coat)___
   - (B) ___brown coat___
   - (C) ___finish coat___

   N-5

Matching

Directions: In the left hand column is a list of items. The right hand column contains descriptive phrases or synonymous terms. Match the descriptions to the terms by placing the letter of the description in the blank at the left of the appropriate term.

B	1.	Hawk	N-20
G	2.	Trowel	N-21
H	3.	Float	N-23
C	4.	Paddle	N-24
A	5.	Level	N-27
D	6.	Scratcher	N-30
E	7.	Feather edge	N-36
F	8.	Rod	N-36
I	9.	Darby	N-37
K	10.	Finishing boards	N-37

A. A device used to establish a horizontal line

B. Used to hold and carry mortar

C. Used to clean out and finish corners

D. Used to score the first coat of plaster

E. Used to straighten angles (corners)

F. A straightedge

G. Used to apply, spread, shape, and smooth the various plastering mortars

H. A straightening device used by the plasterer to level off the humps and fill in the hollows left by the other tools

I. Used to float freshly rodded brown mortar

J. Used to apply water to the plastered surface

K. Used as a surface on which to mix plaster mortar

KEY--ASSIGNMENT SHEET NO. 1
(PAINTING AND DECORATING)
TOOLS, EQUIPMENT, MATERIAL SELECTION, AND SURFACE PREPARATION

I. Key to Study Questions:

1. M-349-350
2. M-350-351
3. M-350-351
4. M-351-352
5. G-49-54
6. G-54-55
7. G-55-56
8. G-56
9. G-57
10. G-57-58
11. G-73-74
12. G-75-76
13. G-78-79
14. G-81
15. G-82-85
16. G-88-90
17. G-90-93
18. G-158-159
19. G-158-162
20. G-165-166

II. Suggested Supplementary Assignments:

A. Read: Kent, Lonore, Paint Power, Thomsen-Ellis-Hutton Co., Baltimore, Md., 1957, pp. 125-127.

  1. Discuss in detail the aspects of color harmony and paint styling.

B. Select a set of house blueprints and prepare a color scheme for the interior and exterior surfaces.

C. Make a list of all tools and equipment needed to apply the paint and wall coverings for the house in "B" above.

III. Suggested List of Visual Aids:

A. Film: PAINTING AND DECORATING--(16mm, 11 min., sound, B & W, $2.00)-University of Michigan, Audio-Visual Education Center, Ann Arbor, Michigan. Vocational guidance covering exterior and interior work, tools of the trade, requirements, opportunities, ect.

IV. Other Instructional Aids:

A. Speaker: Invite a local interior decorator to speak on "Color Dynamics and Selection."

KEY--ASSIGNMENT SHEET NO. 2
(PAINTING AND DECORATING)
APPLICATION OF PAINT AND WALL COVERINGS

I. Key to Study Questions:

1. G-95-96
2. G-103-106
3. G-106-107
4. G-107-108
5. G-108-109
6. G-109-111
7. G-111-112
8. G-113-114
9. G-115-116
10. G-117-118
11. G-119-120
12. G-121
13. G-122-123
14. G-123
15. G-126-127
16. G-127-130
17. G-129, 131
18. G-131
19. G-167, 169
20. G-169
21. G-170-173
22. G-176-177
23. G-177
24. G-177-179
25. G-179
26. G-179-181
27. G-181-182
28. G-182-183
29. G-183-186

II. Suggested Supplementary Assignments:

A. Read: Kent, Lonore, Paint Power, Thomsen-Ellis-Hutton Co., Baltimore, Md., 1957, pp. 63-97.

1. Discuss the information on painting interior and exterior surfaces as well as the necessary tools, equipment, and safety measures.

B. Utilizing the house blueprints from assignment number 1, make a list of each major painting and paperhanging job, when it should be done, and the approximate time it will take to complete each job. Show how this plan will dovetail into the overall construction period for the whole house

C. Prepare step-by-step procedure lists for each type of finish to be used for the house.

III. Suggested List of Visual Aids:

A. Film: BUILDING A HOUSE--(16mm. B & W, sound, 11 min., $2.00)--University of Michigan, Audio-Visual Education Center, Ann Arbor, Michigan. Step-by-step process in constructing a woodframed home from excavating through the completed home.

IV. Other Instructional Aids:

A. Speaker: Have a local paint dealer speak on new finishes that are available as well as other materials, tools, and equipment handled by local stores.

KEY--ASSIGNMENT SHEET NO. 3
(PAINTING AND DECORATING)
INTERIOR FINISHING AND COST ESTIMATION

I. Key to Study Questions:

1. G-187
2. G-187-188
3. G-188
4. G-188-190
5. G-190-192
6. G-192-193
7. G-193
8. G-193-194
9. G-194-196
10. G-196-197
11. G-197-198
12. G-198
13. G-198-200
14. G-201-204
15. G-213-214
16. G-214-215
17. G-215-216
18. G-215, 217
19. G-221-223
20. G-259-260
21. G-260-261
22. G-261
23. G-261
24. G-261-262
25. G-262-263

II. Suggested Supplementary Assignments:

A. Read: Kent, Lonore, Paint Power, Thomsen-Ellis-Hutton Co., Baltimore, Md., 1957, pp. 100-121, 280-313.

1. Discuss the various aspects for estimating jobs and how to start and operate a contractor painting and decorating business.

B. Utilizing the house plans from assignment sheet number 1, make out a complete estimate for the job.

C. Make out a purchase order for the paint, wall coverings, interior wood finishes, solvents, and all other necessary materials.

III. Suggested List of Visual Aids:

A. Film: WOOD FINISHING--(16mm, B & W, sound, 16 min., $2.00)--University of Missouri, Audio-Visual Department, Columbia, Missouri. Explains the common types of finishing materials used on wood and demonstrates the procedures for each.

IV. Other Instructional Aids:

A. Speaker: Invite a local paint and paperhanger contractor to speak on the local labor market, nature of the work done in the area, union and apprenticeship requirements, and other local occupational information.

V. Test No. 1, Covering Assignments 1-3:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

(T) F 1. A good brush will cost more initially, but longer serviceability will offset the extra cost. G-49

T (F) 2. Hog bristles are not as suitable for painting as other natural bristles as they lack "flag ends." G-49

(T) F 3. A non-bleeder type spray gun cannot pass air until the trigger is pulled. G-57

T (F) 4. An external mix spray gun indicates that the paint is mixed inside the spray gun pot. G-58

(T) F 5. Knots should be sealed with shellac after the prime coat. G-76

(T) F 6. New plaster walls may be painted with casein and emulsion paints without regard to moisture content. G-78

(T) F 7. Emulsion and alkyd enamels usually produce a flat finish. G-92

T (F) 8. Good points of a room should be emphasized by painting them a highly contrasting color. G-166

T (F) 9. Shellac should be thinned with turpentine. G-96

T (F) 10. Paint should be mixed in the paint roller tray. G-107

(T) F 11. A ceiling is usually painted across the shortest dimension of the room. G-107

T (F) 12. In two coat exterior work, one gallon of house-paint primer is thinned with one pint of turpentine. G-112

T (F) 13. A thick prime coat provides good anchorage for the finish coats. G-114

(T) F 14. Latex masonry paint may be applied directly onto new masonry surfaces. G-119

(T) F 15. A phenolic-resin primer-sealer is recommended for the base coat on fir plywood. G-123

(T) F 16. Multi-colored spatter type paints are usually sprayed onto wall surfaces. G-126

T (F) 17. A heavy center spray pattern results from a clogged fluid tip. G-130

(T) F 18. New plaster walls should be neutralized with a zinc sulphate water solution. G-176

(T) F 19. Wallpaper sizing is made from a glue foundation. G-176

(T) F 20. The paperhanger hangs the ceiling first so that glue does not get on the sidewalls. G-177

T (F) 21. The first wallpaper strip should be hung adjacent to a door casing to ensure straightness. G-179

T (F) 22. Wall coverings should be hung continuously around corners if at all possible. G-182

T (F) 23. The first wallpaper strip that is hung on a ceiling is applied in the center of the room. G-183

(T) F 24. A special commercial solvent is used with non-grain-raising stain powder. G-190

T (F) 25. Open grain wood pores are filled with stick shellac. G-192

(T) F 26. Two coats of varnish will produce a good surface if the work has been properly prepared. G-195

(T) F 27. A penetrating stain wax finish is a two-coat finish on closed grain woods. G-197

(T) F 28. Floor seal is a penetrating finishing coat for floors. G-199

(T) F 29. Paneling should be backprimed to prevent moisture absorption. G-204

(T) F 30. Designs may be created on walls with a twin paint roller. G-215

T (F) 31. A fountain pen striping tool feeds paint to a rectangular wick. G-215

T (F) 32. The bristles of a stencil brush are dipped into the paint about 1/4 of an inch. G-222

T (F) 33. A copy of cost estimates is kept in the contractors file as a protective service to the customer. G-261

(T) F 34. Painting and paperhanging are separate skilled building trades though a craftsman may do both types of work. M-349

(T) F 35. Most painters and paperhangers work for contractors on new construction work. M-350

T (F) 36. The recommended length of time for a formal apprenticeship is four years for the painter and paperhanger. M-350

(T) F 37. The employment trend for painters and paperhangers during the 1960's will rise slowly. M-351

T (F) 38. The hourly rate for paperhangers and painters is generally more than the average rate for all building trades journeymen. M-351

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the statement correctly.

1. A nylon fiber brush with exploded tips will outlast a hog bristle brush approximately three times. G-50
2. The three principal types of paint rollers are the fountain, dip, and pressure. G-56
3. A device used to check the moisture content of wood or masonry is called an electronic moisture meter. G-74
4. Wall and plaster board joints should be covered with perforated joint tape. G-79
5. A wash coat used to neutralize alkalinity in new concrete is made of two pounds of zinc sulphate crystals dissolved in one gallon of water. G-81
6. A roof line that seems too high may be "lowered" by painting the roof a dark color. G-160
7. A ceiling of a room is painted before the walls are painted. G-104
8. Emulsion paints may be cleaned from paint rollers by washing them in water. G-108
9. The ideal moisture content of wood when painting should be 12-15 per cent. G-110
10. Masonry surfaces are painted both for decorative and waterproofing purposes. G-119
11. Masonry should season for about 6 months before painting with oil-base paints. G-119
12. American made wallpaper contains 36 square feet in a single roll. G-167
13. Moisture in the paste causes wallpaper to expand. G-176
14. When cutting wallpaper to length, allow at least 2 inches at top and bottom. G-178
15. Wallpaper that is hung horizontally on walls is called streamline. G-183
16. Sanding should be done with the grain. G-187
17. The most frequently used mild wood bleach is oxalic acid. G-188

18. Surplus paste wood filler is removed ___across___ the grain with a coarse cloth. G-192

19. Sealer coats on interior woodwork are applied to prevent stain from ___bleeding___ into the top finish coats. G-193

20. The room temperature when applying varnish should be ___70___ degrees or higher. G-195

21. A "flit" spray gun is used to produce a ___spatter___ painted surface. G-214

22. Two or three different colors may be sprayed at one time from one gun by using a ___multi-color___ spray enamel. G-214

23. Painted stippling may be done with crumpled newspaper, a stippling brush or a ___sponge___. G-214

24. The unit which the estimator bases his prices on is ___100___ square feet. C-259

25. A valuable reference book for estimating is the ___Price Guide___ published by the Painting and Decorating Contractors of America. G-260

26. Wallpaper is estimated by either the square footage method or the ___strip___ method. C-261

Multiple-Choice

Directions: In the space at the left of each statement, write the letter of the item which will provide the correct answer to complete the statement.

__D__ 1. Brushes that are to be stored should be washed with (A) alcohol; (B) linseed oil; (C) gasoline; (D) soap and water. G-55

__D__ 2. Before painting galvanized iron which has been exposed to weather for six months or more (A) wash it with aluminum oxide; (B) scrape or brush until shiny; (C) apply a coat of asphalt; (D) no special preparation is necessary. G-84

__B__ 3. A self-cleaning house paint means that (A) the paint will deteriorate quickly; (B) the chalk and dirt will easily wash away; (C) it isn't necessary to wire brush the surface before repainting; (D) the homeowner can clean the house himself. G-88

__A__ 4. To make a large room seem smaller, paint (A) the walls and ceiling a dark color; (B) the walls light and the ceiling dark; (C) the walls and ceiling a light color; (D) the floor dark and the ceiling and walls a light color. G-159

C 5. A brush should be dipped into the paint (A) 3/4 of the bristle length; (B) at a 60° angle; (C) 1/2 of the bristle length; (D) horizontally. G-103

D 6. New wood such as cedar, redwood, and white pine are usually given (A) an oxide primer and one coat of house paint; (B) a wash coat of linseed oil and two coats of house paint; (C) an emulsion primer and two coats of house paint; (D) a white lead primer and two coats of house paint. G-112

A 7. Below grade concrete floors should be painted with (A) latex-base paints; (B) oil-base paints; (C) casein paints; (D) porch and deck enamel. G-120

D 8. The spray gun pattern should overlap the previous stroke by about (A) 1/8; (B) 1/4; (C) 1/3; (D) 1/2. G-129

C 9. American made wallpaper varies in widths of (A) 12 to 36 inches; (B) 18 to 36 inches; (C) 18 to 48 inches; (D) 24 to 48 inches. G-167

A 10. A paperhanger uses a brush that is about 12 inches long with 2 1/2 inch bristles to (A) smooth the paper to the wall; (B) apply paste; (C) apply size; (D) remove dust from the wall. G-170

B 11. Wallpaper should be trimmed around woodwork and casings (A) after the glue sets; (B) before the glue sets; (C) with a boardknife; (D) with a drawknife. G-181

D 12. If too much pressure is applied when using a seam roller, the (A) glue will curdle; (B) glue will become watery; (C) paper will have air pockets; (D) paper will become shiny. G-182

A 13. A tack rag is made by sprinlking a wet cloth with (A) turpentine and varnish; (B) linseed oil and shellac; (C) benzine and lacquer; (D) lacquer thinner and linseed oil. G-188

B 14. The final "clean-up" wiping when doing paste wood filler work is done (A) across the grain; (B) with the grain; (C) with a linseed oil dampened rag; (D) with a benzine dampened rag. G-192

D 15. Texture paint may be used to (A) decorate floors; (B) paint lawn furniture; (C) stipple walls; (D) create a plaster effect on dry wall. G-215

C 16. The number of painters and paperhangers employed in 1960 was approximately (A) 275,000; (B) 390,000; (C) 425,000; (D) 680,000. M-350

D 17. The number of yearly job openings during the 1960's for painters and paperhangers will be (A) less than 5,000; (B) about 6,000; (C) between 7,000 and 8,000; (D) somewhat over 10,000. M-351

A 18. Painters and paperhangers have an injury rate that is (A) lower than the average contract construction as a whole; (B) higher than the average contract construction as a whole; (C) lower than for all manufacturing industries; (D) about the same as for all manufacturing industries. M-352.

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. The two types of compressors suitable for spraying are:

(A) piston (B) diaphragm

G-57

2. The two principal types of spray guns are:

(A) suction (B) pressure

G-57

3. Four specially prepared materials for masking are:

(A) masking paper (C) masking paste

(B) masking tape (D) liquid masking

G-73

4. In paper hanging, three types of seams or joints are used:

(A) butt (C) lapped

(B) wire edge G-179

5. The principal types of stain as classified by their solvent are:

(A) water (C) spirit or alcohol

(B) oil G-190

6. To properly estimate a job, four main factors must be considered:

(A) labor costs (C) general overhead

(B) material costs (D) profit expected

G-259

Matching

Directions: In the left hand column is a list of terms. The right hand column contains descriptive phrases or synonymous terms. Match the descriptions to the terms by placing the letter of the description in the blank at the left of the appropriate term.

_E_ 1. Wall brush G-51

_G_ 2. Masonry brush G-52

_F_ 3. Stippling brush G-52

_C_ 4. Roof brush G-53

_H_ 5. Stencil brush G-53

_J_ 6. Sash and trim brush G-51

_B_ 7. Calcimine brush G-52

_I_ 8. Wire brush G-53

_A_ 9. Enamel and varnish brush G-52

_D_ 10. Bronzing brush G-53

A. 2 to 3 inches wide and 3 to 3 1/2" long

B. used for water thinned paints

C. for painting shingles

D. for gold enamel

E. 3 to 6 inches wide, 3/4 to 1 inches thick, and 2 to 7 inches long

F. produces a pebble texture on painted surfaces

G. used on rough surfaces

H. a round brush

I. can be used to clean plaster from sub flooring

J. use for cornice work

Matching

Directions: The steps involving an interior finish are listed below in the right hand column. Place the letters of the steps in the correct order in which they are performed in the numbered blanks provided in the left hand column.

1. _C_
2. _F_
3. _D_
4. _A_
5. _E_
6. _G_
7. _B_

A. fill

B. wax

C. sand

D. stain

E. seal

F. bleach

G. top coats

VT002 089

VT 002 089
Painting and Decorating, A Course of Study Designed for Cooperative Part-Time Students Employed by Painters and Decorators.

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Missouri State Dept. of Education, Jefferson City.

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*STUDY GUIDES, *TRADE AND INDUSTRIAL EDUCATION, *PAINTERS, GRADE 11, GRADE 12, *COOPERATIVE EDUCATION,

This study guide is for use by preparatory or cooperative students in painting and decorating courses. It was developed by teacher educators and research assistants with help from a consultant committee. Assignment sheet titles are (1) The Paint Industry, (2) Health and Safety, (3) Tools and Equipment, (4) Surface Preparation, (5) Paint Mixing, (6) Paint Application, (7) Finishing Wood with Shellac, Varnish, and Lacquer, (8) Color Harmony, (9) Color Styling, (10) Special Finishes, (11) Wall Coverings, (12) Estimating, and (13) The Paint Contractor. Each assignment sheet gives an assignment, reference, and objective-type questions. The suggested time allotment is 180 days. The teacher should be a qualified coordinator or trade teacher and students should be at least high school juniors with the proper prerequisites. A job and information analysis and progress records for use by student, teacher, and employer are included. An answer key VT 002 088 is available for 50 cents. This document is available for $1.50 from Industrial Education, 103 Industrial Education Building, University of Missouri, Columbia, Missouri 65201. (EM)

PAINTING AND DECORATING

A Course of Study

Designed for
Cooperative Part-Time Students
Employed by Painters and Decorators

Issued by
Department of Industrial Education
College of Education
University of Missouri
Columbia, Missouri

In Cooperation With
Industrial Education Section
State Department of Education
Jefferson City, Missouri

MEMORANDUM

TO: The ERIC Clearinghouse on Vocational and Technical Education
The Ohio State University
980 Kinnear Road
Columbus, Ohio 43212

FROM: (Person) James B. Karnes (Agency) University of Missouri at Columbia

(Address) 103 Industrial Education Bldg., Columbia, Missouri

DATE: December 6, 1967

RE: (Author, Title, Publisher, Date) Industrial Education Dept.

PAINTING AND DECORATING, cooperatively with Industrial Education Dept. (U. of Mo. at Columbia) and Missouri Dept. of Education.

Supplementary Information on Instructional Material

Provide information below which is not included in the publication. Mark N/A in each blank for which information is not available or not applicable. Mark P when information is included in the publication. See reverse side for further instructions.

(1) Source of Available Copies:
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Limitation on Available Copies quantity Price/Unit $1.50
(quantity prices) same
Teacher's Key $.50

(2) Means Used to Develop Material:
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Level of Group State
Method of Design, Testing, and Trial Analysis of occupation, consultation with specialists, periodic revisions after use in the field.

(3) Utilization of Material:
Appropriate School Setting High school or post high school including area vocational
Type of Program cooperative or preparatory
Occupational Focus Limited job family
Geographic Adaptability United States
Uses of Material Study Guide for related instruction on individual basis
Users of Material student

(4) Requirements for Using Material:
Teacher Competency Qualified coordinator or competent trade teacher
Student Selection Criteria junior in high school with proper prerequisites

Time Allotment 180 days

Supplemental Media --
Necessary x
Desirable ___ (Check Which)

Describe P

Source (agency) See attached list for references
(address)

REFERENCES FOR PAINTING AND DECORATING

A. Brushwell, William, *Painting and Decorating Encyclopedia*, The Goodheart-Willcox Company, Inc., 18250 Harwood, Homewood, Illinois, 1964, $5.45.* (13)

B. National Paint, Varnish and Lacquer Association, *Color....and How To Use It*, National Paint, Varnish and Lacquer Association, Inc., 1500 Rhode Island Avenue, N.W., Washington, D.C., 20005, 1960, $3.00.* (2)*

* Subject to educational discount
** Frequency of use in assignments

FOREWORD

This course of study consisting of an analysis of PAINTING AND DECORATING, together with assignment sheets covering the related (occupational) information to be taught by the school, has been prepared for teaching painting and decorating on an individual basis in a cooperative part-time program.

Credit is due Mr. Carl Putman and Mr. Kim Baugrud, Research Assistants in Industrial Education at the University of Missouri, for preparing the present revision of this course of study.

We wish to acknowledge our indebtedness to Dr. H. H. London, Professor of Industrial Education at the University of Missouri, for the direction and administration of the Curriculum Materials Laboratory in which this material was prepared, and to Mr. James B. Karnes, Instructor in Industrial Education at the University of Missouri, who supervised the preparation of the material and edited the manuscript. Credit is due to Mr. B. W. Robinson, Assistant Commissioner of Education, Mr. Merton Wheeler, Director of Industrial Education, and to other staff members of the State Department of Education for their efforts in the development of the Industrial Education Curriculum Series of which this course of study is a part.

HUBERT WHEELER

Commissioner of Education

May, 1966
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Assignment Sheets:

Information Sheet:

Training Plan and Progress Record

INTRODUCTION

In preparing this course of study, it has been assumed that the attainment of occupational competency in any type of work involves three different, yet closely related, types of learning. They are:

1. Mastery of the practical job skills and procedures performed by the worker in the occupation.
2. Comprehension of the technical and related information basic to an intelligent understanding and practice of the occupation.
3. Development of those personal-social traits which are essential for the successful worker.

The first group of the "learning units"--the job skills and procedures--has been arranged in the analysis under the heading of "Job Training." The second group of learning units--the technical and related information--has been arranged under the heading of "Related Information." The third group--the personal-social traits--has been listed under "Personal Qualifications" in the introductory section addressed to the student.

In a cooperative educational program it is necessary for both cooperating agencies--the school and the employer--to understand clearly just what each is to be responsible for in the training of the student-worker. Experience has shown that most of the practical job skills and procedures of an occupation can best be learned through supervised work on the job. Experience has shown also that the school can best teach most of the technical and related occupational information needed by young student-workers. This division of responsibility has been made in the arrangement of the course of study; that is, it is expected that the student-worker will master the job skills and procedures through practical work on the job under the immediate supervision of the employer, and that he will receive instruction in related occupational information in the school under the direction of the coordinator.

In the back of this course of study will be found three copies of the TRAINING PLAN AND PROGRESS RECORD FOR PAINTING AND DECORATING. One copy is marked "Student" in the upper right hand corner. On this copy, in the space Time in Hours, the student will keep a talley of the hours he spendson his job performing operations in each area. The next copy marked "Employer", should be given to the employer for recording the student's job performance in each area. The third copy may be used by the coordinator for his record.

Skills and related information are matters for direct instruction, but personal-social traits are acquired only through practicing them during the process of acquiring skills and information and in one's daily conduct. Therefore, both the employer and the school, as well as the home, must assume responsibility for developing in the student-worker those habits, attitudes and character traits which are essential for success in his occupation and in life. Both the employer and the school should be constantly on the alert to see that the student-worker places desirable interpretations on his experiences and that he does not practice habits and exhibit character traits detrimental to his success.

Since the coordinator's class will be made up of fifteen or more students, each differing from the other significantly, studying a dozen or more occupations which differ markedly in their requirements, it follows that it will be impossible for him to teach, through the group method, the occupational information which relates to the specific job of each student-worker. In order to be effective, this type of instruction must be individualized. There is, of course, some related information, such as occupational health and safety, workmen's compensation, wage-hour laws, fair labor standards, unemployment compensation, and the like, which is of common interest and concern to all student-workers, and may be effectively taught by the group method. If the coordinator is to make a real contribution to the in-service vocational education of his students, he must devote a major portion of his classroom instruction to content which deals specifically with the work of each boy and girl enrolled.

With this requirement in mind, and in order to facilitate individual instruction, these assignment sheets have been prepared. Each contains certain record data as to number and range of units covered, introductory paragraphs designed to develop interest, explain the importance of the assignment, and to convey to the student what he is expected to learn, specific assignments including reading, learning activities and a series of new-type questions designed to check his attainment.

Obviously, it is desirable to teach the related information in the school at the time it will be used most advantageously on the job. This means that the two phases of the student-worker's training should parallel each other in a progressive manner. The coordinator will find the assignment sheets well adapted to this end. He can select from day to day the assignment which covers the informational units related to the work being done on the job. With this arrangement, the coordinator will become, during a major portion of his classroom time, a supervising study and helping teacher.

In selecting books for the course, an effort,has been made to restrict the number to an adequate coverage of the material, and to select those of recent publication so that current practices can be consistently presented. It is recommended that copies of these books be obtained and kept in the coordinator's classroom for ready use by the student.

The key sheets, available in a separate manual, have been prepared to enable the coordinator to score quickly the objective tests which are a part of each assignment sheet. These key sheets give the correct answers to the questions, as well as the reference and the page on which each answer can be found. The key sheets should be kept in the coordinator's possession.

TO THE STUDENT-WORKER

Definite proof of the use of color for decoration dates back to around 20,000 years ago. Color has been used in the decoration of living quarters and has been extensively used in the adornment of religious surroundings.

Only in comparatively recent times has paint been used because of its protective qualities. Dwellings, business establishments, and industry make extensive use of paint for decoration, property protection, health, and safety.

Opportunities in Painting and Decorating

The painting trade is a large and overcrowded field of work. In 1950 there were approximately 390,000 painters, of which almost one-third were self-employed. Opportunities may be rather limited for the mediocre painter, but as in any trade, the outstanding workers are always in demand.

The COE student will most likely start as a painter-helper in which his duties will consist primarily of:

1. Assisting painter by cleaning, scraping, and sanding surfaces
2. Preparing paint
3. Mixing colors
4. Cleaning brushes
5. Cleaning spray guns

Later, he may advance to an apprentice painter or to a journeyman painter after extended on-the-job training. Once the trade has been mastered, he may go into business on his own.

Most painters are employed in construction, but all industries have maintenance painters.

The work is highly seasonal but with proper planning, many of the seasonal aspects may be eliminated.

Requirements for Entering

The youth who contemplates entering the painting and decorating occupation should have acquired a rather broad general education with emphasis upon industrial arts, art, mathematics, language usage, and chemistry. Some of this information may be acquired through work on the job and through the COE class. Some may best be acquired through special general education courses.

Personal Qualifications

Desirable personality traits are of extreme importance for success in life. They are the factors by which one primarily is judged when meeting people and when attempting to obtain a job. They are vitally important in holding a job. In fact, studies reveal that the chief cause for 90 per cent of the persons being discharged from their jobs is due to a lack of desirable personal-social traits, while only 10 per cent of the discharges are due to a lack of job skills. It should be noted, however, that without job skills it is exceedingly difficult to find employment. Personal-social traits can be improved through conscientious effort. One should know what to improve, how to improve, and why improvement is necessary.

There are a number of personal-social and native traits which the painter and decorator will find important. Some of the more important are the following?

Honesty - Because the painter and decorator is working with a material that can be easily camouflaged and the inadequacy not discovered until sometime later, honesty is of prime importance.

Dexterity - The painter and decorator is called upon to work on small areas requiring him to be nimble with his hands and effective with his tools.

Artistic Ability - The importance of colors and their relation to surroundings requires persons with considerable artistic ability.

Good Vision - A person who is color blind has a definite disadvantage in his effort to become a successful painter and decorator.

Thoroughness - Each task should be done in detail--there is no place for laxity or short-cuts.

Industry - Careful, thoughtful, energetic attack upon each job without loitering or wasting time is important to fulfill committments to customers.

Initiative - The nature of the work of the painter and decorator requires individuals who can see what needs to be done and can go ahead without constant supervision.

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B. National Paint, Varnish and Lacquer Association, Color....and How To Use It, National Paint, Varnish and Lacquer Association, Inc., 1500 Rhode Island Avenue, N.W., Washington, D.C., 20005, 1960, $3.00.* (2)**

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** Frequency of use in assignments

The Paint Industry

JOB TRAINING: What the Worker Should Be Able to Do	Assign. No.	RELATED INFORMATION: What the Worker Should Know
	1	1. The power of paint
	1	2. Paint industry products
	1	3. Economic importance of paint
	1	4. Distribution of paint products
	1	5. History of paint development
	1	6. Acquisition of raw materials
	1	7. Definition of paint
	1	8. Pigments: white, color, extender, metallic, earth
	1	9. Binders or vehicles
	1	10. Thinners
	1	11. Driers
	1	12. Oils
	1	13. Water thinned paints
	1,7	14. Resins: natural, synthetic
	1	15. Rubber derivatives
	1,7	16. Lacquer
	1	17. Stain
	1	18. Driers
	1	19. Roof protectives
	1	20. Wax
	1	21. Sealers
	1,4	22. Removers
	1	23. Bleaches
	1	24. Miscellaneous paint industry products

Health and Safety

JOB TRAINING: What the Worker Should Be Able to Do	Assign. No.	RELATED INFORMATION: What the Worker Should Know
	2	25. Common causes of injuries
26. Inspect scaffolds for hazzards	2	26. Guarding against slipping and falling
27. Clean slippery walkways and remove rubbish		
28. Store tools and materials in proper places	2	28. Prevention of injuries from striking or being struck by objects
	2	29. Causes of over-exertion
	2	30. Safety measures while working with solvents
	2,4	31. Safety in the use of acids and alkalies
	2	32. Electrical hazzards
33. Put out fires with extinguisher	2,4,6	33. Fire hazzards
34. Practice personal sanitation	2	34. Personal hygiene

Tools and Equipment

JOB TRAINING: What the Worker Should Be Able to Do	Assign. No.	RELATED INFORMATION: What the Worker Should Know
	1,3	35. Types of brushes used in the painting and decorating trades
	3	36. How brushes are made
37. Select brush for job	3	37. Points to be observed in selecting brushes
38. Clean and store brushes	3,6	38. Care of brushes
39. Renovate hardened brushes		
40. Clean paint rollers	3,6	40. Types of paint rollers
	3,6	41. Types of air compressors
42. Clean spraying equipment	3,6	42. Types of spray guns
	3	43. Ladder construction
	3	44. Types of ladders
45. Set ladders in proper positions for safe use	3,6	45. Safe use of ladders
46. Inspect ladders for safety	3	46. Care of ladders
47. Select proper materials for scaffold construction	3,6	47. Types of scaffold construction: pole or built up, outrigger, suspended, ladder jack
48. Inspect ropes and lines for securing scaffolds	3	48. Devices for holding and securing scaffolds
49. Tie knots and make hitches for securing scaffolds		
50. Mantle and dismantle steel or aluminum scaffolding	3	50. Steel and aluminum scaffolds
	3	51. Safety rules and regulations for use of metal scaffolds
52. Spread drop cloths for property protection	3,4,5,6	52. Materials for protecting surfaces while painting
53. Apply masking liquids and tapes		

Surface Preparation

JOB TRAINING: What the Worker Should Be Able to Do	Assign. No.	RELATED INFORMATION: What the Worker Should Know
54. Measure moisture content with moisture meter	4,6	54. Effect of moisture upon painted surfaces
	4	55. Painting intervals for different surfaces and types of finishes
	4,7	56. Purpose of priming
57. Prime new wood	4,5,6	57. Surface preparation for new wood
58. Fill nail holes and other blemishes with putty or other preparation		
59. Sand wood surfaces preparatory to painting		
60. Seal knots and resin streaks		

JOB TRAINING: What the Worker Should Be Able to Do	Assign. No.	RELATED INFORMATION: What the Worker Should Know
61. Apply caulking compound where necessary		
62. Remove loose paint	4,6	62. Surface preparation for previously finished surfaces
63. Clean old coating preparatory to painting		
64. Burn off old paint		
65. Remove mildew		
66. Repair holes and cracks	4,6	66. Preparation of plastered walls for painting
67. Apply wall primer and sealer		
68. Fill nail holes in wallboard	4,6	68. Preparation of wallboard and plasterboard walls
69. Apply joint tape and smooth joints		
70. Remove grease and dirt	4,6	70. Painting over wallpaper
71. Remove loose paper		
72. Sand rough surfaces		
	4	73. Masonry surface preparation
74. Neutralize alkalinity in concrete surfaces	4	74. Efflorescence salts
75. Tuck point joints		
76. Clean brick surfaces		
77. Mechanically clean metal surfaces	4,6	77. Mechanical methods of metal surface preparation
78. Chemically clean metal surfaces	4,6	78. Chemical methods of metal surface preparation
79. Apply rust-inhibitive primer	4,6	79. Need for primers on metal surfaces

Paint Mixing

80. Match colors	5	80. Principles of color harmony
81. Stir paint with a paddle	5	81. Effects of paint mixing
	5	82. Procedures for mixing paint
83. Mix paint mechanically	5	83. Devices for paint mixing
84. Interpret charts for ingredient proportions	5	84. Interpretation of mixing formulas
85. Thin for proper consistency	5	85. Solvents used to thin paints
86. Strain and filter paints when needed	5	86. Effects of paint straining
	5	87. Mixtures for applying a second coat
88. Clean mixing equipment		

JOB TRAINING: What the Worker Should Be Able to Do	Assign. No.	RELATED INFORMATION: What the Worker Should Know
	Paint Application	
	6	89. Brushing techniques for various surfaces
90. Paint windows	6	90. Painting sequence for windows
91. Paint doors	6	91. Painting sequence for doors
92. Paint siding	4,6	92. Painting house siding
93. Paint inside walls	4,6	93. Painting inside walls
94. Paint acoustical surfaces	6	94. Painting acoustical surfaces
95. Paint masonry surface	4,5,6	95. Painting masonry surface
	6	96. Painting wallpaper and wall fabrics
97. Apply fir plywood sealer	6	97. Painting fir plywood
	6	98. Application of casein, paint, calcemine, whitewood
99. Clean spray equipment	3,5,6	99. Spray painting equipment controls
100. Paint surfaces with spray gun	6	100. Relationships of distance and stroke speed in spray painting
	6	101. Flock finishing
	Finishing Wood With Shellac, Varnish, Lacquer	
	7	102. Basic steps to achieving a fine finish
103. Identify open and closed grain woods	6,7	103. Open and closed grain woods
104. Bleach woods	7	104. Wood bleaches
105. Stain surfaces with water, oil and/or spirit stains	7	105. Effect of stains upon beauty enhancement
	7	106. Advantages and disadvantages of different types of stains
107. Apply and remove wood filler	7	107. Use of fillers
	7	108. Sealers for shellac, varnish, and lacquer
	7	109. Number of coats for satisfactory finishes
110. Rub and polish shellac, varnish, and/or lacquer finishes	7	110. Rubbing and polishing techniques
111. Identify varnish defects	7	111. Varnish defects
112. Apply paste and liquid wax	7	112. Wax finishing
113. Finish hardwood and softwood floors	7	113. Floor finishing

JOB TRAINING: What the Worker Should Be Able to Do		Assign. No.	RELATED INFORMATION: What the Worker Should Know	
		7	114.	Lacquer finishing
		7	115.	Patching and repairing furniture finishes
116.	Repair marked, spotted, or stained finishes	7	116.	Water marks, spots and stains
		7	117.	Effect of sunlight upon clear finishes
118.	Apply solution for rot, termite and bettle protection	7	118.	Rot, termite, and beetle protection
119.	Produce oil finish	7	119.	Oil finishes
		Color Harmony		
		8	120.	The meaning of color
		8,9	121.	Effect of surface type upon color
		8	122.	Ostwald system of color identification
		8	123.	Munsell system of color identification,hue,value,chro
		8	124.	Types of complementary harmony
		8	125.	Psychological effects of color harmony
		8	126.	Filtration for color harmony
		8,9	127.	Types of color harmony
128.	Mix colors to obtain other colors	5,8,9	128.	Mixing and matching colors
		5,8,9	129.	Use of color in oil
		8,9	130.	Warm and cool colors
		8,9	131.	Use of the color wheel
		Color Styling		
		9	132.	Selection of colors for room styling
133.	Camoflauge architectural defects with color	9	133.	Effect of color upon architectural defects
		8,9	134.	Light reflections of various colors
135.	Select colors which appear pleasing under different lights	8,9	135.	Effects of light upon colors
136.	Select colors to be used for industrial painting	9	136.	Industrial uses of color

Special Finishes

JOB TRAINING: What the Worker Should Be Able to Do	Assign. No.	RELATED INFORMATION: What the Worker Should Know
137. Produce antique glazed finish	10	137. Antique glazing
138. Highlight antique finish	10	138. Antique highlighting
139. Produce spatter finish	10	139. Spatter finishes
140. Stipple with sponge	10	140. Sponge stippling, mottling
141. Stipple with crumpled paper		
	10	142. Texture paints
143. Strip or line surfaces	10	143. Stripping and lining
	1,10	144. Metallic finishes
145. Darken metal using liver of sulphur	10	145. Acid finishes on metal
146. Produce artificial grained surfaces	10	146. Graining
147. Apply metal leaf to surface	10	147. Metal leaf gilding
148. Produce marbleized finish	10	148. Marbleizing
149. Apply wrinkle finish	10	149. Wrinkle finishes
150. Apply crystal and crackle lacquer	10	150. Crystal and crackle finishes
151. Produce a French polish	10	151. French polish
152. Produce a finish with a stencil		

Wall Coverings

JOB TRAINING: What the Worker Should Be Able to Do	Assign. No.	RELATED INFORMATION: What the Worker Should Know
	11	153. Types of wallpaper
	11	154. Measurement standards for wallpaper
	11	155. Fabric and other wall coverings
	3,11	156. Tools and equipment necessary for wall papering
157. Remove loose or scaled paint	11	157. Wall preparation: painted, calciminated, reson or casein paints, textured, sandfinished, papered
	11	158. Need for sizing
159. Prepare size for application	11	159. Composition of sizing
160. Apply size to walls		
161. Prepare wallpaper paste	11	161. Paste for wallpapering
162. Estimate material	11,12	162. Cost estimation
163. Estimate time required to do the job		
164. Get material and supplies in readiness for applying wallpaper	11	164. Procedures to follow when applying wallpaper

JOB TRAINING: What the Worker Should Be Able to Do	Assign. No.	RELATED INFORMATION: What the Worker Should Know
165. Cut paper to match		
166. Apply paste		
167. Fold and trim paper		
168. Make chalk line for starting course	11	168. Points to be observed to keep paper straight
169. Make butt joints	11	169. Types of seams
170. Make wire edge joints		
171. Make lapped joints		
172. Apply and smooth out paper		
173. Trim around casings, baseboard, etc.		
174. Roll seams		
175. Paper around inside and outside corners	11	175. Points to be observed when turning corners
176. Hang borders		
	11	177. Wallpaper care

Estimating

	12	178. Review of mathematics
179. Estimate painting costs from blueprints	12	179. Blueprint reading for the painter
180. List kinds and amounts of materials needed for jobs	12	180. Techniques of estimating materials
	12	181. Techniques of estimating [illegible]or costs
	12	182. Factors in estimating overhead and profit

Paint Store Operation and Contracting

	13	183. The painting contractor
	13	184. Formulation of plans preparatory to becoming a painting contractor
	13	185. Deciding factors in location of the business
	1,3, 13	186. Equipment and tools needed
	13	187. Workers for the industry
	13	188. Manpower utilization
	13	189. Insurance and other protectic
	13	190. Factors pertaining to credit
	13	191. The selling phase of the contracting business
	13	192. Records needed in the operation of the business

Assignment Sheet No. 1 — Covering Units 1-24

THE PAINT INDUSTRY

The products produced by the paint industry are varied and many. So uniformly important are these products that they affect all phases of our daily life. If we stop to analyze their importance, we find we do not eat, sleep, work, or travel without relying upon these products in some way.

As you will see as you progress through your assignments, the painter and decorator needs to be familiar with these products and with the materials necessary for their application or use.

This assignment is designed to give you an overview of the paint industry and provide information on opportunities for painters and decorators.

Assignment:

1. Read the reference listed below.
2. In the block where you live, make a list of the buildings that need painting. If you can, find out when these buildings were painted last. List the types of finishes you would recommend for each building.
3. Select a particular building to be used in subsequent assignments.
4. Answer the questions below and turn in this assignment by ______________________.

Reference:

A. Brushwell, Painting and Decorating Encyclopedia, pp. 9-48.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. Pigment is a powdery solid which is dissolved in a vehicle to make paint.

T F 2. A pigment is essential for an opaque coating.

T F 3. Extender pigments are especially useful because of their covering and hiding abilities.

T F 4. White pigments provide the basis for most shades and tints.

T F 5. White lead is seldom used for interior work.

T F 6. Extender pigments are less costly than other pigments.

T F 7. Colored pigments absorb a portion of the light which falls upon them.

T F 8. Earth colors are found as natural deposits.

T F 9. Precipitation colors are the same as earth colors.

T F 10. Pigments obtained in the fire process are fused in a furnace.

T F 11. Rust is a formation of oxygen and water.

T F 12. Aluminum paint is light fast.

T F 13. Pigments influence only the color of paint.

T F 14. Cost seldom has any bearing on which pigments are used.

T F 15. In general, the finer the pigment is ground, the greater is its hiding power.

T F 16. The function of the binder is to cause the paint film to adhere to the surface.

T F 17. Rosin produces a film that is tough, hard, and glossy.

T F 18. Shellac is soluble in alcohol, turpentine, and lacquer thinner.

T F 19. Paint makers make extensive use of turpentine in the manufacture of paint.

T F 20. Driers continue to act all through the life of the coating.

T F 21. Shellac is a spirit varnish.

T F 22. Short-oil varnishes are recommended for floors.

T F 23. In applying shellac, a few heavy coats are recommended over many thin coats.

T F 24. Wiping stains are best suited for use on close-grained wood.

T F 25. Pigment stains are recommended over dye stains because of their ability to bring out the satin-like quality of woods.

T F 26. Filler is not required on close-grained woods.

T F 27. Semi-gloss enamel contains a higher proportion of pigment than does gloss enamel.

T F 28. Flint paper is made of ground quartz applied to paper with an adhesive.

T F 29. Powdered pumice is used to rub down finishes.

T F 30. Castor oil in its natural state is a non-drying oil.

T F 31. Tung oil is quick drying.

T F 32. An advantage of soybean oil is its excellent color retention

T F 33. Fish oil is easily recognized by its unpleasant odor.

T F 34. Latex paint may be used on exterior masonry.

T F 35. Baked varnish surfaces have a superior hardness.

T F 36. Shellac may be used directly from the can.

T F 37. Lacquer is a fast drying finish.

T F 38. An advantage of oil stain over other types of stain is its non-bleeding qualities.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. The principal ingredients of paint are the ________________ and the ________________.
2. Colored materials used in paint which will dissolve are known as ________________.
3. The covering and hiding power of a pigment is known as the ________________.
4. An anti-corrosive pigment used extensively for iron and steel is ________________.
5. Our most important metallic pigment is ________________.
6. Linseed oil comes from the ______________ ________________.
7. Because of its high moisture resistant qualities, marine finishes use ______________ oil.
8. Paint solvents are used to reduce the ________________ of paint products.
9. Driers are known as ______________.
10. The ratio of oil to resin in varnish is known as the ____________ of the varnish.
11. Varnish containing less than ________ gallons of oil per ________ pounds of resin is known as a short-oil varnish.

12. The principal ingredient in lacquer is ________________.

13. Paste filler is composed mostly of silex, linseed oil and ________________ ________________.

14. Cabinet coated abrasives are sold by the ____________ and range in grits from ________ to ________.

15. Steel wool comes in degrees of fineness from _________, which is very fine, to No. ________,which is very coarse.

16. Paint and varnish removers may be typed as either ____________ or ______________ ________________.

17. The paint finish which gives a high-grade, smooth, finish is ____________________.

18. Inexpensive paints will use ________________ as a binder.

19. A paint that uses no binding vehicle is a ________________ ________________ paint.

20. A good bleach which dissolves in hot water and is expensive is ____________________ ________________.

Multiple-Choice

Directions: In the space at the left of each statement, write the letter of the item which will provide the correct answer to complete the statement.

______ 1. Spirit varnishes are composed of resin and (A) gasoline or naptha; (B) linseed oil or turpentine; (C) alcohol; (D) nitrocellulose or ethyl cellulose.

______ 2. Four pound cut shellac means the proportions are (A) four gallons of shellac to one gallon alcohol; (B) four gallons alcohol to one gallon shellac; (C) one gallon alcohol to four pounds shellac; (D) four gallons alcohol to four pounds shellac.

______ 3. On new work, undercoats are applied (A) after the primer; (B) before the primer; (C) both before and after the primer; (D) need not be applied on new work.

______ 4. To slow the hardening process of plaster of Paris, it is recommended that (A) turpentine; (B) Japan drier; (C) ethyl acetate; (D) vinegar be mixed with it.

______ 5. When water is used with waterproof abrasive paper, the abrasive (A) cuts faster; (B) cuts easier; (C) clogs less; (D) all of these.

______ 6. Extreme care should be taken when using a paint remover as it may (A) burn the skin; (B) destroy clothing; (C) damage other surfaces; (D) all of these.

______ 7. Varnishes are typed as (A) spirit varnishes; (B) oleoresinous varnishes; (C) both of these; (D) none of these.

______ 8. Pigments are ground finest for (A) enamel; (B) white lead; (C) latex; (D) varnish.

______ 9. To stain a surface that has a closed grain, one would use a (A) spirit stain; (B) water stain; (C) wiping or oil stain; (D) varnish stain.

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. Vehicles are composed of a combination of:

(A) ________________ (C) ________________

(B) ________________ (D) ________________

2. The use made of extender pigments:

(A) ________________ (D) ________________

(B) ________________ (E) ________________

(C) ________________ (F) ________________

3. The four main groups of color pigments:

(A) ________________ (C) ________________

(B) ________________ (D) ________________

4. Metals that have value as metallic pigments:

(A) ________________ (D) ________________

(B) ________________ (E) ________________

(C) ________________

5. The advantages of pigmented wiping stains:

(A) ________________ (C) ________________

(B) ________________ (D) ________________

6. The ingredients of putty in general usage:

(A) ______________________ (C) ______________________

(B) ______________________ (D) ______________________

7. The desirable properties of undercoating are:

(A) ______________________ (D) ______________________

(B) ______________________ (E) ______________________

(C) ______________________

8. One of the most importa parts of a repainting job is to remove the following:

(A) ________________ (B) ________________ (C) ________________

Assignment
Sheet No. 2

Covering
Units 25-34

HEALTH AND SAFETY

No matter who the workman is or what he does, the job should be done in the safest manner possible. The development of safe work habits should be a "must" for everyone. The painter is no exception. Although his occupation is not considered as dangerous as some others, he must work with highly inflammable combustible, and poisonous materials. If proper precautions are not taken, he may be in constant danger of falling or having objects to fall upon him. Poison may enter his body through his mouth, his nose, or even through his skin, causing extreme discomfort or possible death.

This is in no way presented to discourage you in your chosen occupation. It is given, however, as a reminder of some of the health and safety precautions that are imperative for a continuously successful career.

You will find, in this assignment, information relative to personal health and safety and the importance of safeguarding the lives of your co-workers. Study the assignment carefully--"The life you save may be your own."

Assignment:

1. Read the reference given below.
2. On page /1 of your reference you will find examples of some knots and hitches frequently found wherever ropes and lines are used. Practice each of these until you are thoroughly familiar with it. Ask your employer to show you any other knots or hitches he considers essential.
3. Answer the questions below and turn in this assignment by ______________________.

Reference:

A. Brushwell, Painting and Decorating Encyclopedia, pp. 229-232.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. About 25 per cent of all painting injuries are the result of falls from elevations.

T F 2. Most falls from elevations occur as a result of inferior ropes or lines.

T F 3. If the inner yarns of a rope are bright, clear, and unspotted, there is an indication that the rope has had excessive wear and should be replaced.

T F 4. For scaffolding, the fibers of a rope should be dry and brittle and difficult to bend with the hand.

T F 5. Three or four broken wires in a foot of wire rope is considered too many for safety.

T F 6. About 50 per cent of painting injuries result from slips and falls on the same level.

T F 7. Uneven walkways and working surfaces are the most frequent causes of slips and falls.

T F 8. About 25 per cent of all painting injuries are caused by painters striking objects or being struck by objects.

T F 9. Over-exertion causes approximately 15 per cent of painting injuries.

T F 10. Care should be taken to open windows with the hands only.

T F 11. Persons with liver, heart or other illnesses are very suceptible to exposure to solvents.

T F 12. Heavy drinkers are not particularly affected by exposure to solvents.

T F 13. Grinding wheels may produce a spark sufficient enough to ignite solvent vapor fumes.

T F 14. If there is no fire or source of ignition within the immediate vicinity of the solvent, one may be guaranteed of safety from fire.

T F 15. When cleaning electric outlets with solvents, use steel wool because of its grounding qualities.

T F 16. About the only safe solvent to use in a place with inadequate ventilization is benzol.

T F 17. Never throw down a solvent-saturated rag; it should be placed in a pocket of the uniform until it can be discarded into a metal container.

T F 18. It is advisable to treat all exterior paint as if it contained lead, unless the label specifically states otherwise.

T F 19. Zinc is non-poisonous.

T F 20. It is advisable to thoroughly flush with solvent when cleaning paint from the skin.

T F 21. The painter should drink as little water and milk as possib possible.

T F 22. Overall pants should not have cuffs.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. The inner fibers of rope used for scaffolding should be inspected by ______________ the rope in several places.

2. Around sandblasting, ______________ rope should be used.

3. Where there is exposure to chemical washing solutions, __________ rope should be used.

4. Liquid solvent may act as skin irritants by removing the ______________ ______________ from the skin and leaving it open to ______________ infections.

5. Solvent vapors are ______________ and ______________ than air.

6. Solvent should be kept in ______________ or cans with __________ openings.

7. When burning off paint containing lead, one should wear a ______________.

8. When acid or alkali comes in contact with the skin, it should be washed with ______________ or a ______________ ______________ solution.

9. Before starting to work, a ______________ ______________ should be applied to the skin.

10. Underclothes should be changed at least ______________ a ______________ and overalls at least ______________ a ______________.

Multiple-Choice

Directions: In the space at the left of each statement, write the letter of the item which will provide the correct answer to complete the statement.

_____ 1. A good workman (A) never spills solvent; (B) may spill solvent but wipes it up immediately; (C) calls an apprentice to clean up solvent he spills; (D) does not use solvent in the first place.

_____ 2. When mixing acid and water; pour (A) the water into the acid (B) the acid into the water; (C) both at the same time; (D) none of these.

_____ 3. Oxalic acid is especially harmful to (A) hands; (B) tools; (C) brushes; (D) nasal passages.

_____ 4. The best possible way to be safe from injury from electricit is to (A) turn off the lights; (B) don't use it; (C) cut it off from its source; (D) wear rubber soled shoes.

_____ 5. When through with wiping cloths, they should be (A) placed in a closed metal container; (B) placed in a pot of water (C) burned; (D) any of these.

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. Four main causes of injury:

(A) _____

(B) _____

(C) _____

(D) _____

2. Causes of injuries resulting from workmen striking or being struck by objects or structures:

(A) _____

(B) _____

(C) _____

(D) _____

3. Signs of excessive exposure to solvent vapor:

(A) _____ (C) _____

(B) _____ (D) _____

4. Forms by which lead poison may be taken into the body:

(A) _____ (C) _____

(B) _____ (D) _____

5. Methods by which lead poison may enter the body:

(A) ______________________________ (C) ______________________________

(B) ______________________________

6. Three essential items for protecting the body when using acids for cleaning, surface preparation, degreasing metal, etc.,

(A) ______________________________ (C) ______________________________

(B) ______________________________

Assignment
Sheet No. 3

Covering
Units 35-52

TOOLS AND EQUIPMENT

In order for the painter or decorator to do good work he must have adequate tools and equipment. He must also know how to select, care for, and use these items in order to provide reliahle service without undue expense and trouble.

Certain items, such as paint applicators, have a direct bearing upon the job. Others, such as scaffolds, may improve the painter's efficiency but have a more indirect relationship. It is important, however, that the painter or decorator be aware of the factors necessar to maintain an adequate supply of tools and equipment along with their relationship to the health and safety of the user.

In this assignment you will become aware of some of the more impor ant considerations to be followed in selecting, caring for, and using various types of paint applicators, ladders, scaffolds and miscellaneou tools and equipment.

Assignment:

1. Read the reference listed below.
2. Select the building in need of paint from Assignment Sheet 1. Prepare a list of all the tools and equipment you would recommend in order to do an adequate paint job.
3. Using No. 8 or 9 wire, make a hook as shown in illustration B-33, page 62 of Reference "A".
4. After completing assignments 1, 2, and 3, answer the questions below and turn in this assignment by __________.

References:

A. Brushwell, Painting and Decorating Encyclopedia, pp. 49-74

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T". If it is false draw a circle around the letter "F".

T F 1. The initial cost of good brushes is greater than brushes of inferior quality.

T F 2. Horse hair makes the best quality brushes for general painti

T F 3. Hog bristles have a flag end.

T F 4. Nylon bristle has about three times the wearing power as hog bristle.

T F 5. Nylon bristle tends to soften in shellac thinned in ethyl alcohol.

T F 6. Nylon bristle cannot be used satisfactorily with water paint

T F 7. The bristle in camel hair brushes comes from North African camels.

T F 8. The bristles in a good brush should all be of the same length

T F 9. Sashtools are used to clean old putty form window frames.

T F 10. A stippling brush does not have a handle like general purpos paint brushes.

T F 11. The chisel shape of a brush helps provide smoother flow and prevent lap marks.

T F 12. Semi-oval brushes should never be used for fine enameling.

T F 13. Before it is used, a new nylon brush should be soaked for at least 12 hours in the thinner of the material in which it will be used.

T F 14. Brushes that have been used in calcimine, whitewash or paste should be stored in water when not in use.

T F 15. It is recommended that after the brush has been dipped in the paint, the surplus be removed by wiping across the edge of the container.

T F 16. Almost all types of protective coatings can be applied faster with spray equipment than with brush or roller.

T F 17. A suction feed spray gun is recommended for spraying heavy paints.

T F 18. A bleeder type spray gun will not pass air until the trigger is pulled.

T F 19. Ladder rungs should be made of red oak, hard maple, or walnut

T F 20. Magnesium and aluminum ladders weigh less than wood ladders of the same size.

T F 21. A trestle ladder is not adjustable to length.

T F 22. Ladders should not be painted.

T F 23. Load carrying capacity for aluminum is less than for steel.

T F 24. The term ridge hook and a roof hook have the same meaning.

T F 25. A steel scaffold is reusable.

T F 26. A canvas drop cloth should not be laundered.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. Solidity in paint brushes is obtained by using more ____________ ____________ than ____________ ____________.
2. Brushes used for the application of paint and stain to large surfaces are flat and range in widths from ____ to _____ inches.
3. A brush which is beveled on both sides is said to have a ________ edge.
4. Calcimine brushes vary in width from _______ to _______ inches.
5. Brushes which have been used for applying shellac or spirit stain should be cleaned in ________________.
6. Brushes used for applying calcimine or casein paint should be cleaned with _________________.
7. A ladder at an angle of ________degrees or more should be lashed at the top.
8. A ladder, with a safety factor of 4, made to support a live load of 200 pounds should not break under loads up to ________pounds.
9. The space from the foot of the ladder to the vertical wall should be ________the length of the ladder.
10. Ropes supporting scaffolds should have a safety factor of at least _________.
11. Sisal rope is about ________per cent as stong as Manila rope.
12. A device used to check the moisture content on the surfaces of wood or masonry is called an ____________ ____________ ____________.
13. The divided end of a hog bristle brush is known as the _________ end.
14. The part of the brush that holds the bristles to the handle is the ______________.
15. Inactive brushes should either be stored in a container of ____________ ____________, or in a _________ _________ ____________ when stored dry.

Multiple-Choice

Directions: In the space at the left of each statement, write the letter of the item which will provide the correct answer to complete the statement.

_____ 1. Brushes should be obtained which have gristles (A) set in chemically inert cement; (B) set in rubber; (C) vulcanized; (D) any of these.

_____ 2. Dusting brushes have (A) soft bristles; (B) stiff bristles; (C) fibre bristles; (D) the same type bristles as regular paint brushes.

_____ 3. A brush clogged with old paint where the butt ends of bristle go into the ferrule is said to be (A) butted; (B) heeled up; (C) fish tailed; (D) gummed.

_____ 4. Brushes that are to be stored should be washed with (A) alcohol; (B) linseed oil; (C) gasoline; (D) soap and water.

_____ 5. When too wide a brush is used on narrow surfaces, it is likel to become (A) beetled; (B) heeled up; (C) fish tailed; (D) gummed.

_____ 6. Lumber used in the construction of scaffolds should be of a strength equal to (A) clear white pine; (B) No. 2 red oak; (C) No. 1 common Douglas fir; (D) No. 1 select maple.

_____ 7. An outrigger scaffold is supported by (A) vertical poles from the ground; (B) ladder jacks; (C) overhead ropes or cables; (D) thrustouts from or through a wall.

_____ 8. Excessive pressure while using a brush will result in a (A) fish tail; (B) plow; (C) heel; (D) comb.

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. Properties possessed by a good brush:

(A) ______________________ (D) ______________________

(B) ______________________ (E) ______________________

(C) ______________________

2. The two principal types of air compressors:

(A) ______________________ (B) ______________________

3. The two principal types of spray guns:

(A) ______________________ (B) ______________________

4. The main advantages of steel scaffolding:

(A)____

(B)____

(C)____

(D)____

5. Four specially prepared materials for masking:

(A)______________________ (C) ______________________

(B)______________________ (D) ______________________

Assignment
Sheet No. 4

Covering
Units 54-79

SURFACE PREPARATION

To produce a successful paint job, the surface must be properly prepared. Different surfaces need different preparations. The painter must study the surface and plan the treatment necessary for proper adhesion of the paint. Improper adhesion, especially of the first coat, will result in scaling, cracking, or other subsequent imperfections.

Although there may be cheaper methods of doing a paint job, the painter should never risk his reputation by haphazard methods. If he must compete against inferior procedures, it is better he lose the job than to risk his good name by producing inferior work.

In this assignment you will become familiar with the proper preparat n of new and old surfaces of walls, wood, concrete, and metal. Also you will learn pertinent facts relating to the proper relation of paints for various surfaces.

Assignment:

1. Read the references listed below.
2. For the building selected in Assignment 3 of Assignment Sheet 2, prepare a schedule of things that should be done to properly prepare the surfaces to be painted. In one column on a piece of paper list the things you would do. In the opposite column list the tools and equipment you would need for each operation.
3. After completing 1 and 2, answer the questions below and turn in this assignment by ____________________.

Reference:

A. Brushwell, Painting and Decorating Encyclopedia, pp. 75-93

Questions:

True-False

Directions: The following statements are either tuue or false. If the statement is true, draw a circle around the letter "T". If it is false, draw a circle around the letter "F".

T F 1. A successful paint job cannot be done without proper surface preparation.

T F 2. When sanding with 2/0 or 3/0 sandpaper, sand with a rotary motion.

T F 3. When filling nail holes with putty, leave the surface slightl convex.

T F 4. Paste filler should be used on maple, gum, and fir.

T F 5. Surfaces should be slightly moistened for good paint adhesion.

T F 6. Nail holes should be filled with putty before applying the prime coat.

T F 7. It is not safe to apply paint over varnish.

T F 8. Chalking of paint is a normal weathering process.

T F 9. Paint burning should be done on days in which there is a strong breeze.

T F 10. Casein and emulsion type paints should never be applied over moist surfaces.

T F 11. Unless the defects are large, paint can adequately hide them without prior preparation.

T F 12. Caulking compound is used to fill cracks around bathtubs where moisture crumbles the plaster.

T F 13. Large cracks should be undercut and deepened until firm plaster is reached.

T F 14. All patched areas should be spot primed before painting.

T F 15. Walls should be patched before they are washed preparatory to painting.

T F 16. Special paints called calcicoaters are used to cover calcimine treated plaster walls.

T F 17. Latex-base paint cannot be satisfactorily applied over wallpaper.

T F 18. Wallpaper cleaner should be used to clean wallpaper before painting.

T F 19. Concrete surfaces are painted for decorative purposes only.

T F 20. No matter how much concrete has cured there is always active alkali on the surface which causes deterioration of paint.

T F 21. Neutralizer is not necessary when painting concrete surfaces with latex-base paint.

T F 22. When rust is painted over without first removing it, the rusting continues.

5

T F 23. Abrasion cleaning of metal is an adequate method of cleaning oil and grease from metal.

T F 24. Weathered galvanized iron holds paint better than new galvanized iron.

T F 25. Rust inhibiting pigments should not be used on articles handled by small children.

T F 26. The oxide surface of aluminum should be removed before painting.

T F 27. Dark colored pigments, in general, have a high oil absorption.

T F 28. Four or five years is considered the normal period that a coating of outside white will remain durable.

T F 29. Repainting at intervals less than three years is usually considered inadvisable.

T F 30. In humid climates, harder types of paint are usually more durable than softer types.

T F 31. In general, present day paints are not as durable as those manufactured fifty years ago.

T F 32. The majority of the outside light colored paints are self-cleaning.

T F 33. House paint cannot be satisfactorily used on anything but wood.

T F 34. House paint should not be used on garden furniture.

T F 35. Natural finishes, in general, are not as durable as good quality house paint.

T F 36. Paint wear is most pronounced on northern exposures.

T F 37. Controlled penetration primers seal the pores and prevent moisture from entering.

T F 38. Shellac may be satisfactorily used as a coating for floors and stair treads and risers.

T F 39. Flat enamels are more mar-resistant than gloss or semi-gloss enamels.

T F 40. Lacquers must be spray applied.

T F 41. Aluminum paint on sheet metal heating ducts tend to reflect out of the duct and cause heat loss.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. A continuous surface is necessary in order to obtain a _______________ paint film.
2. To obtain proper adhesion of paint over varnish an _______________ should be added to the _______________ to soften the varnish.
3. When removing paint, a _______________ should be worn to prevent inhaling dust.
4. Dry mold may be removed by washing with a solution of _______________ _______________.
5. Before oil paint is applied to new plaster, the plaster should be _______________ and _________ ___________.
6. Cracks and crevices in walls should be filled with _______________ _______________ or _______________ _______________ before painting.
7. Alkalinity in concrete may be removed by washing with a solution of _______________ _______________ _______________ dissolved in _______________.
8. Concrete and cinder block surfaces that are too porous to be sealed with paint may be filled by applying a grout coat of _______________.
9. Concrete etching is done by applying a solution of _______________ _______________ and _______________.
10. Fireplace surfaces that do not clean properly may be freshened up by applying a solution of equal parts of _______________ and _______________ _______________ with _______________ _______________ added.
11. If white is painted over dark colors it will usually _______________.
12. In dry climates the _______________ paints are generally more durable.
13. To give concrete floors opaque coatings, _______________ _______________ floor enamels are considered best.
14. Reflectivity of paint is in relation to color or light and _______________.
15. Paint represents ________% of the cost of a job and not over ________% of the total cost of restoration.

Multiple-Choice

Directions: In the space at the left of each statement, write the letter of the item which will provide the correct answer to complete the statement.

_____ 1. Puttying of cracks, nail holes, and other defects should be done (A) after priming; (B) before priming; (C) before sanding; (D) after painting.

_____ 2. The most common reason paint chips or scales is (A) it is too elastic; (B) it becomes hard and brittle; (C) it was applied over moisture; (D) too much stain was in the wood.

_____ 3. The type of paint film defect which is caused by excessive moisture behind the film is (A) blistering; (B) cracking; (C) extra fine cracking; (D) allegatoring.

_____ 4. To paint walls on which the wallpaper and size have been removed (A) no special preparation is necessary; (B) a coat of paste filler should be applied; (C) sized and primer-sealed should be used; (D) they should be washed with muriatic acid .

_____ 5. Brick surfaces which are in poor condition because of excessive salting should be washed with a solution of (A) sulphuric acid and vinegar; (B) vinegar and water; (C) muriatic acid and water; (D) muriatic acid and vinegar.

_____ 6. When mixing acid and water, pour (A) the acid slowly into the water; (B) the acid quickly into the water; (C) the water slowly into the acid; (D) the water rapidly into the acid.

_____ 7. Mildew may be removed with a solution of (A) zinc oxide; (B) copper chloride; (C) phosphoric acid; (D) trisodium phosphate.

_____ 8. Before painting galvanized metal which has been exposed to weather as much as six months (A) wash it with aluminum oxide; (B) scrape or brush until shiny; (C) apply a coat of asphalt; (D) no special preparation is necessary.

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. Four types of paint suitable for masonry surfaces:

(A) ____________________

(B) ____________________

(C) ____________________

(D) ____________________

2. The first coat used for galvanized metal should contain any one of four rustinhibitive primers. They are:

   (A) ______________ (C) ______________

   (B) ______________ (D) ______________

3. The two types of natural finishes may be classified by their method of coating:

   (A) ______________ (B) ______________

4. The type or colors of paint which will provide maximum reflective properties are:

   (A) ______________ (C) ______________

   (B) ______________

5. Primers recommended for use by painters on most metal finishes are:

   (A) ______________ (C) ______________

   (B) ______________ (D) ______________

Assignment
Sheet No. 5

Covering
Units 80-87

PAINT MIXING

The mysteries and secret formulas for mixing paints which the apprentice of days gone by had to learn are now considered technical information. The basic white pigment, drying oils, and thinners are only a portion of what you will be able to learn concerning the formulation of paints for specific uses.

A customer who has received high quality painting service from a paint contractor will be sure that his contractor is a technician of his trade. Today the manufactures have furnished us with the best products their research money could develop. The customer of today deserves and expects to employ a painting contractor who does know all of the technical knowledge necessary to obtain maximum utility from his products.

In this assignment you will learn technical information concerning paint in ready-to-use paste and semi-paste forms, oils, driers, thinners and colors-in-oils. You will also learn how to use formula tables manufactures furnish, which adapt their paints to nearly every specific situation you may need.

<u>Assignment</u>:

1. Read the reference given below.
2. With the knowledge you presently have before reading this assignment, make a three column chart and list in the left hand column the various types of surfaces on a house which are to be painted. These types of surfaces might include an outside porch with a section with a new repaired section stone foundation, outside white walls, colored window trim, painted eve trough with a new repaired section, wood shingle roof with repaired section, and brick chimney. In the middle column list your present method of painting these various areas. After completing No. 3 below, complete the right hand column with the benefit of the technical information obtained in this assignment.
3. After completing 1 and 2 as directed, answer the questions below and turn in this assignment by ________________.

<u>References</u>:

A. Brushwell, <u>Painting and Decorating Encyclopedia</u>, pp. 95-102.

<u>Questions</u>:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. Proper balance within paint between pigments in relationship to other ingredients is necessary to maintain durability.

T F 2. The amount of pigment present in a paint just slightly affects the intensity of its color.

T F 3. A thorough mixing job can most likely be obtained by paddle stirring the bottom and corners of a can.

T F 4. A little stirring and pouring of the paint back and forth between two cans is usually adequate preparation before using.

T F 5. Brushing qualities are hampered by straining newly mixed paints.

T F 6. Medium speed stirring and pausing for the disappearance of bubbles is adequate preparation before applying clear finishes.

T F 7. The manufacturers of paints and varnishes world not feel responsible if the directions on the can label were not followed.

T F 8. Oil must be added to regular paint when used as a first coat due to absorption by the wood.

T F 9. If a thick skin needed to be removed from a stored can of enamel, you most likely would need to thin the enamel.

T F 10. A considerable amount of thinner should be added to oil-based flat finish paints.

T F 11. Porch enamel most likely has had raw linseed oil mixed with its pigments.

T F 12. It is advantageous to prime the back of new siding before it is put in place.

T F 13. Red lead paint is used to test for "bleeding" on stained shingles.

T F 14. Stained interior woodwork which is to be painted will likely show evidence of maple stain bleeding through more so than walnut stain.

T F 15. When a prepared enamel is to be used, a three-coat prime covering should always be used on new wood.

T F 16. While repainting interior plaster to a sharp stipple finish, paint should be mixed at the ratio of 1 1/2 gallons of flatting oil to each 100 pounds of white lead.

T F 17. The prime coat to be used on unpainted wood floors should always contain more oil than is required for for a second coat.

T F 18. Tongue and groove edges of boards on porch floors need not be primed since they are not exposed to the weather.

T F 19. One tube of colors-in-oil for exterior colors is equal to 1/4 pint.

T F 20. For formulas for interior colors, one liquid ounce equals 1/2 pint.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. The two forms in which house paint is now furnished to the painting trade are ____________ and ____________.
2. Paints may be tinted to the desired shade by adding ________________.
3. The kind of paint which usually should not be used immediately after agitating is ________ ________.
4. Pigment irregularities in the finished job can be avoided by __________ the paint.
5. Paint which has been excessively thinned will not ________, ________, or ________ the surface.
6. The proper thinner for shellac is ________ ________ ________ or ________ ________.
7. A special thinner is required for most ______________ type floor enamels.
8. To mix the powdered casein paint, the direction should be from __________ to __________.
9. For exterior use gloss paint is made by mixing white lead with __________ __________.
10. Colors-in-oil are made from two materials: __________ __________ and __________ __________.

Multiple-Choice

Directions: In the space at the left of each statement, write the letter of the item which will provide the correct answer to complete the statement.

_____ 1. While repainting asbestos cement shingles with a flat coat, the number of gallons of lead mixing oil which should be used per 100 pounds of white lead would be (A) 3 1/4; (B) 1; (C) 2 1/2; (D) 4 to 5.

_____ 2. When repainting concrete with an oil base paint, the area per gallon for priming should cover the following number of square feet (A) 200; (B) 300; (C) 400; (D) 500.

_____ 3. The prime coat formula to be used for three-coat work on wallboard should be (A) 25d; (B) 17d; (C) 22d; (D) 14d.

_____ 4. The number of months concrete floors must age before a zinc sulfate solution is not required when painting is (A) 6; (B) 8; (C) 10; (D) 12.

_____ 5. Before painting exterior galvanized steel, surfaces should weather (A) 6 months; (B) 8 months; (C) 10 months; (D) 12 months.

_____ 6. The venetian red content of "Ashes of Rose" is (A) 1 oz.; (B) 3 oz.; (C) 5 Oz.; (D) 6 oz.

_____ 7. The trim color "Seal Brown" contains how much white lead (A) a lot; (B) 1 pint; (C) 3/4 pint; (D) none; (E) painters 1/2 measure.

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. List the Dutch Boy ingredients used in the formula for a black, second coat, exterior metal paint using paste red lead.

(A) ________________________________

(B) ________________________________

(C) ________________________________

(D) ________________________________

(E) ________________________________

(F) ________________________________

Assignment
Sheet No. 6

Covering
Units 89-101

PAINT APPLICATION

Paint application and surface preparation are so closely related that they are almost inseparable. If the surface is properly prepared but the paint is not applied properly, an inferior job will result.

Different types of paints require, in many instances, slightly different methods of application. Even different surfaces may require different methods for applying the same or similar types of surface coverings. Some surfaces may be satisfactorily painted by brush only while others lend themselves more readily to spray painting.

This assignment is concerned with procedures and practices which should be observed when applying paint and related surface coverings. Also included is information pertaining to types of surfaces as they relate to paint application.

Assignment:

1. Read the reference given below.
2. Using the building you chose for Assignment 2 of Assignment Sheet 3, prepare a schedule you would follow for painting. Show what parts you would paint first, second, etc., and indicate all materials you would use in each step.
3. After completing 1 and 2, answer the questions below and turn in this assignment by ________________________.

Reference:

A. Brushwell, Painting and Decorating Encyclopedia, pp. 103-132.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. Spray painting is never as satisfactory as brush painting.

T F 2. The thickness and smoothness of a coat of paint can be governed largely by the amount of paint carried in the brush during application.

T F 3. Brushes with bristles all the same length will carry more paint than those with bristles with varied lengths.

T F 4. When applying house paint, one should daub in spots and immediately spread using long strokes.

T F 5. The oval brush is often preferred for use on small mouldings.

T F 6. When painting a room with a brush, the ceiling should be painted after the walls have been painted.

T F 7. When painting a wall, apply paint evenly with a well-filled brush, first brushing horizontally, then brush with light vertical strokes.

T F 8. Enamel and varnish should be brushed with long even strokes.

T F 9. Shellac should be applied with a soft varnish brush.

T F 10. Shellac should be brushed well, making sure the last brushful of shellac is brushed well into the preceding application.

T F 11. It is considered advisable to use slightly curved strokes when applying casein paint to ceilings.

T F 12. Casein paint should be brushed out more thoroughly than oil paint.

T F 13. Sponge rubber paint rollers prove satisfactory for applying water-base texture paints, but are not satisfactory for applying oil-base paints.

T F 14. When a tray is used with a paint roller, mix only as much paint as needed to sufficiently fill the tray, mixing it as needed.

T F 15. When painting a room with a roller, the ceiling should be painted first.

T F 16. When painting with a roller, use a back and forth motion, changing direction as desired, but lifting the roller when changing direction.

T F 17. A right-handed worker usually starts painting a wall in the upper left-hand corner.

T F 18. When painting a wall with a roller, the first loaded stroke should be upward.

T F 19. The painting characteristics of softwoods depends primarily upon the amount and distribution of summerwood.

T F 20. Paint is more likely to come loose from the summerwood than from the springwood.

T F 21. The best hardwoods for painting are those with pores such as found in walnut.

T F 22. The oils found in cypress and some cedars delay the drying of paints and shorten the life of the coatings.

T F 23. Paints containing zinc oxide are most durable when applied to woods such as eastern white pine, sugar pine, and western white pine.

T F 24. Woods such as ash, chestnut, elm, and hickory require wood filler before being painted or enameled.

T F 25. It is considered good practice to allow wood to weather for a few weeks before being painted.

T F 26. If a paint coating cracks or peels it can be reasonably assumed that the paint was of inferior quality.

T F 27. When painting exterior surfaces it is usually best to paint the highest places first.

T F 28. It is inadvisable to paint shingle roofs.

T F 29. Enamel is more difficult to apply than wall paints.

T F 30. A glue size should be applied to new plaster walls before applying oil paint.

T F 31. Oil-type primers cannot be used satisfactorily under water-thinned paints.

T F 32. The refinishing of acoustical surfaces requires that the pain be thinned to a lower viscosity than normal and applied in a thin coat.

T F 33. Iron and steel surfaces do not require a prime coat.

T F 34. When filling the pores of wood with filler, surplus filler should be removed by wiping with the grain.

T F 35. New porch flooring should be primed on all surfaces before being laid.

T F 36. Calcimine should not be applied over old calcimine.

T F 37. In general, any material that can be applied with a brush can be applied with a spray gun.

T F 38. Heavier coatings can be applied by spray gun when the finishing material is heated.

T F 39. The edges of objects should be sprayed after other surfaces have been sprayed.

T F 40. When cleaning out small holes in fluid tips, one should use a firm object such as a piece of wire or a nail.

T F 41. Spray painting involves hazards from explosion and fire.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. It is advisable to dip the brush into the paint not more than ______________ of the length of the bristles.

2. For applying oil paint to exterior surfaces, a flat brush ______ to ______ inches wide with ________ inch bristles is generally recommended.

3. For painting trim, a flat ________ brush ______to_______ inches wide is recommended.

4. The professional type paint roller is usually ______ inches in length and the type used by amateurs is ______ inches in length.

5. Paints last longer on well seasoned lumber with a moisture content of between ______and______ per cent.

6. Discoloration and oil absorption can be prevented by applying ____________ or spirit ____________ over knots before painting.

7. Blue stain in sapwood is caused by ______________.

8. Copper which comes in contact with wood should be ___________ to prevent staining the paint finish.

9. For painting windows, a _______brush _____or_____ inches wide is needed.

10. When painting from a ladder, one should never go higher than the ____________rung from the top.

11. Painting should not be done in temperatures below ________ degrees F.

12. Surfaces to be enameled or varnished should be wiped only with a specially prepared ____________ rag.

13. Spackled areas should be touched up with ________ or ________ ____________ before applying the second coat of paint.

14. The priming coat applied to ceilings and walls should be sanded to remove the ___________.

15. Enamel should be strained through a very fine mesh screen or a ___________ ____________.

16. Wicker furniture can be painted quickly with a ________ _______.

17. The presence of water, alkali, salts, and hydrated lime on new plaster may cause a chemical reaction with paint called_________

18. Extreme alkaline conditions in new plaster may be neutralized by applying a solution of __________ __________ ______________ dissolved in water.

19. A semi-gloss finish may be obtained on masonry by adding a small amount of _________ _____________ to the paint used for the finish coat.

20. Concrete basement floors should age for _________ ____________ prior to painting.

21. To aid in preventing the fir plywood grain from showing through and hair line checking of paint, it is recommended that a primer-sealer coat of __________________ be applied.

22. When using a spray gun, a pattern six and eight inches wide when the gun is held _________ to _________ inches from the surface is about right for most work.

23. Extension cords for electrically driven air compressors should be No. _______wire up to 25 feet in length and No._______ wire for length 50 feet or over.

Multiple-Choice

Directions: In the space at the left of each statement, write the letter of the item which will provide the correct answer to complete the statement.

_____ 1. Mohair rollers are designed for applying (A) heavy-bodied enamels; (B) varnish; (C) wash coat shellac; (D) light-bodied water paints.

_____ 2. To prevent rollers from drying during short intermissions of non-use, they should be (A) wrapped in brown paper; (B) wrapped in newspaper; (C) wrapped in aluminum foil; (D) wrapped in cheese cloth.

_____ 3. Blistering and peeling of paint is causedby (A) applying too heavy a coat of primer; (B) not applying a primer; (C) too much alkali in the wood; (D) expansion of air and water in the wood.

_____ 4. On new wood, the most important paint coat is the (A) priming coat; (B) sealing coat; (C) second coat; (D) finish coat.

_____ 5. Shingles treated with creosote stain cannot be satisfactorily painted with light-colored paint because (A) the paint won't stick; (B) a chemical reaction will cause the wood to rot; (C) the creosote will bleed through; (D) a chemical reaction will cause injury to the painter.

_____ 6. When applying enamel, start each succeeding strip of painted surface (A) where the last one left off; (B) on bare surface a few inches from last and work into previously painted work; (C) a few inches inside previously painted surface and work out taking in more surface each time; (D) the same as applying house paint.

_____ 7. New dry plaster which is in good condition and is to be coated with water paint, should be first given a coat of (A) glue size; (B) suitable water soluble primer; (C) sealer; (D) thinned material of the same type to be applied later.

_____ 8. A fresh Portland cement paint coating should be kept moist for at least (A) 12 hours; (B) 24 hours; (C) 48 hours; (D) 56 hours.

_____ 9. When spraying with a gun, the spray strokes should (A) overlap about one-half; (B) overlap about one-third; (C) overlap about three-fourths; (D) not overlap but just meet.

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. The principal tools used in applying paint:

(A) ________________ (B) ________________ (C) ________________

2. Possible causes of brush marks in paints, enamels, and varnish:

(A) ____

(B) ____

(C) ____

(D) ____

3. Things to be done to protect occupied property while painting:

(A) ____

(B) ____

(C) ____

(D) ____

(E) ____

Procedure

Directions: The following list contains parts to be painted. Indicate the proper sequence to follow when painting the following areas by placing 1, 2, 3, etc. in the appropriate blank.

A. A Window

____ sash verticals

____ frame and sills

____ mullions

____ sash horizontals

____ frame verticals

B. A Door

____ moulded edges of the panels

____ vertical side boards

____ panels

____ horizontal crossboards

Assignment
Sheet No. 7

Covering
Units 102-119

FINISHING WOOD WITH SHELLAC, VARNISH, AND LACQUER

It must be remembered that the painter and decorator is called upon to suggest, apply, and repair surfaces with finishes other than paint. For this reason he must be familar with the various other transparent and opaque finishes. He must be aware of the characteristics of different words and the preparation necessary preceding the application of a finish.

The painter and decorator may also be called upon to repair finished and unfinished surfaces of woodwork, furniture, floors, etc. Certain relatively simple procedures may be followed to obtain satisfactory results.

In this assignment, you will have an opportunity to increase your knowledge of finishes and finishing materials, other than paint and enamel. Study your assignment well, for it is very difficult to hide mistakes while using shellac, varnish or lacquer.

Assignment:

1. Read the reference listed below.

2. On pages 201-204 of your reference you noticed some step-by step procedures to follow to obtain particular finishes. On 3" x 5" index cards, copy these directions, placing the steps as Step 1, Step 2 etc. Refer to these cards periodically until you become thoroughly famililar with these procedures and keep them handy so you can refer to them when called upon to produce one of these finishes.

3. After completing assignments 1 and 2, answer the questions below and turn in this assignment by ____________________.

Reference:

A. Brushwell, Painting and Decorating Encyclopedia, pp. 187-211

Questions:

True-False

Directions: The following statements are either true of false. If the statement is true, draw a circle around the letter "T". If the statement is false, draw a circle around the letter "F".

T F 1. It is very difficult to tell whether wood is open or close-grained.

T F 2. After wood has once been sanded, it should never be allowed to come in contact with water until the last coat of finish has thoroughly dried.

T F 3. Hydrogen peroxide, which is sold for antiseptic purposes, makes a very good wood bleach.

T F 4. Stain is not a protective finish.

T F 5. The main disadvantage of water stain is its limitations on available colors.

T F 6. Wood must be sanded following the application of water stain.

T F 7. Before water stain is applied, the surface should be moistened with water, allowed to dry and sanded.

T F 8. The same powders used for making water stain may be used in non-grain-raising stains.

T F 9. The primary disadvantage of NGR stains is the slowness of drying.

T F 10. Pigmented type oil stains are actually thinned paints.

T F 11. Pigmented oil stains will not bleed.

T F 12. Pigmented oil stains do not cover up grain pattern as much as NGR stains.

T F 13. Excess pigmented oil stain should be removed by wiping across the grain.

T F 14. The main advantage of oil stain is its ease of application.

T F 15. Spirit stains are used when brush marks and streaks must be avoided.

T F 16. The degree of dilution of wood filler depends upon the size of the pores of the wood to be filled.

T F 17. Naptha is used to thin filler when it is desirable for it to dry slowly.

T F 18. When applying filler, brush with the grain.

T F 19. When removing the surplus filler, wipe across the grain.

T F 20. Oil varnish may be used over oil stain, never over water or spirit stains.

T F 21. Lacquer sealer must always be used before applying lacquer.

T F 22. Not over a six month's supply of shellac should be purchased at one time.

T F 23. Using a type of mixer by which the container can be vibrated is recommended for mixing varnish.

T F 24. All types of varnish may be applied by spraying.

T F 25. An advantage of varnish-stain is, if the varnish is chipped or worn off, the color will remain.

T F 26. Wax finishes are recommended for surfaces exposed to water or heat.

T F 27. Wax should be applied rather heavy; one heavy coat being more desirable than two or three thin coats.

T F 28. The penetrating finishes are very desirable but are difficult to keep from streaking.

T F 29. When applying penetrating wood finishes, both the first and second coats may be applied with either a brush or a cloth.

T F 30. Floor seal, a relatively new product, looks well and wears well but is susceptible to scratching and chipping.

T F 31. Shellac does not darken with age as quickly as varnish.

T F 32. Shellac finished or wax polished floors should not be scrubbed with water.

T F 33. Lacquer is highly volatile and there is always danger of an explosion when spraying.

T F 34. Pitch and asphaltum are mixed to form a water proof seal for masonry and concrete walls before installing wood paneling.

T F 35. Shellac is sometimes applied to the back side of paneling to afford additional moisture protection.

T F 36. Scratches and blemishes in wooden furniture should be repaired with professional materials from a furniture repair kit.

T F 37. Iodine should be diluted to match maple finish by mixing with spirits.

T F 38. The rubbing down of furniture with rottenstone and oil should be executed by using a four inch diameter circular motion with a specially prepared pad.

T F 39. Scratches may be "filled-up" by using shellac.

T F 40. Natural finishes on exterior surfaces are more durable than paint.

T F 41. In general, houses with extensive overhanging roofs will need to be painted more often than those with no or extremely short eaves.

T F 42. Moulding strips should be placed on the lower ends of vertical siding for protection.

T F 43. Oil finishes are recommended in areas of prolonged periods of dampness.

T F 44. Wood sealer finishes do not penetrate the wood as deeply as oils but will impart more glossiness than oil.

T F 45. Spar varnish may be used satisfactorily on galvanized and copper surfaces.

T F 46. The best varnish to use on large areas is one that disintegrates by a very fine crazing, followed by fine crumbling.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. When abrasive paper is used, the direction of sanding is always ____________ the grain.

2. A soft, lintless cloth, especially prepared to pick up dust before applying finishes is called a/an _________ _________.

3. The coloring material used in water stain is usually a/an ________ ________ obtained in powder form.

4. Spirit stains are made by dissolving a dry powder in ____________ or ____________.

5. Filler is used on woods with open pores except when applying what is known as a true ________ ____________ finish.

6. When changing the color of filler to match a particular color of wood, the professional painter usually prefers to mix ___________ oil ____________ to the filler.

7. The number of pounds of shellac gum that has been dissolved in each gallon of alcohol is known as _________.

8. The number of gallons of oil used for each 100 pounds of varnish resin is known as _________ ____________.

9. In obtaining a fine finish, ____________ is the standard abrasiv for rubbing the final coat.

10. When using a powdered abrasive on carvings and moldings use a ____________ ____________ for rubbing.

11. A powdered abrasive used to give a finished surface a near-gloss is ______________________________.

12. Blistering is usually caused by ____________________.

13. A cause of bloom in a varnish finish may be due to rubbing the finish with ______________ and __________ instead of ___________ and ______________.

14. A thin film of ____________________ over the top of varnish will prevent it from skinning over.

15. Wax comes in two principal forms, ______________ and ______________.

16. If shellac remains too long in a metal container it is likely to accumulate salts of __________ which discolors hardwoods containing ______________.

17. To protect a varnished floor and increase its wear, wax should be applied about __________ __________ after the final coat has been applied.

18. A soft cotton floor map, dampened with a mixture of three parts ______________ and one part ______________ __________, is recommended for dry mopping of shellaced floors.

19. Deep blemishes in wood may be repaired with melted ____________ ____________________.

20. The oldest and probably the simplest penetrating finish is ______________ ______________.

Multiple-Choice

Directions: In the space at the left of each statement, write the letter of the item which will provide the correct answer to complete the statement.

_____ 1. To increase the solvent ability of the water so that a stronger oxalic acid bleach will result, it is recommended that (A) the water be chilled; (B) the acid be heated; (C) alcohol be added; (D) distilled water be used.

_____ 2. To neutralize an oxalic acid bleach use (A) a borax solution; (B) kerosene (C) heat; (D) a mixture of linseed oil and turpentine.

_____ 3. When using a hydrogen peroxide bleach, the wood is first coated with (A) hydrogen peroxide; (B) turpentine; (C) sodium hypochlorite; (D) sodium hydroxide.

_____ 4. It is recommended that this first coat of hydrogen peroxide bleach be neutralized with a solution of (A) vinegar and water; (B) gasoline and oil; (C) turpentine and water; (D) sodium bisulphite and naptha.

_____ 5. When applying water stain with a brush, use (A) long straight strokes with the grain; (B) short rotary strokes; (C) strokes with the grain followed by strokes across the grain; (D) do not apply water stain with a brush.

_____ 6. A disadvantage of penetrating oil stain is that it (A) raises the grain; (B) is not light fast; (C) cannot be used on open grained wood; (D) all of these.

_____ 7. Orange shellac is satisfactory for (A) oak; (B) pine; (C) maple; (D) mahogany.

_____ 8. A satisfactory varnish sealer can be made by mixing (A) two parts varnish to one part thinner; (B) two parts thinner to one part varnish; (C) one part shellac to one part varnish; (D) one part varnish to one part thinner.

_____ 9. A satisfactory sealer for lacquer can be made by mixing (A) two parts lacquer to one part thinner; (B) one part lacquer to one part thinner; (C) six parts thinner to one part lacquer; (D) three parts thinner to one part lacquer.

_____10. Four pound cut shellac can be reduced to a three pound cut by adding (A) one pint alcohol to 1/2 gallon shellac; (B) one pint alcohol to one quart shellac; (C) one-half pint alcohol to two quarts shellac; (D) one pint alcohol to one pint shellac.

_____11. When applying varnish, the room temperature should be above (A) 32°F; (B) 60°F (C) 70°F; (D) 95°F.

_____12. The first coat of varnish should be rubbed (A) with pumice and oil; (B) with 6/0 abrasive paper; (C) wet, with rottenstone; (D) with 2/0 abrasive paper.

_____13. The second and succeeding coats of varnish should be rubbed (A) with pumice and oil; (B) with water and 6/0 abrasive paper; (C) with 3/0 abrasive paper; (D) with rottenstone and water.

_____14. Before applying an additional coat of wax, the first coat should be allowed to dry at least (A) 24 hours; (B) 12 hours; (C) 1 hour; (D) 15 minutes.

_____15. Before applying additional finish coats, filler should be allowed to dry (A) 24 hours; (B) 12 hours; (C) 1 hour; (D) 15 minutes.

_____16. The process involved in the inter-action of chemical compound found in paints and varnishes causing them to "set up" in the presence of heat, air, and sunlight to form solids is called (A) distillation; (B) polymerization; (C) pigmentation; (D) demodulation.

_____ 17. Rot or decay in wood is caused by (A) an insect; (B) moist air; (C) fungi; (D) water.

_____ 18. One of the best ways of obtaining protection against rot, termites, and beetles is to give the wood an application of (A) linseed oil; (B) polymerzite; (C) chlorinated phenol; (D) catalytic benzine.

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. The three commonly used bleaches for woods, excluding the commercial bleaches:

(A) ____________ (C) ____________

(B) ____________

2. The advantages of water stain:

(A) ____________ (C) ____________

(B) ____________ (D) ____________

(E) ____________

3. The reasons for applying sealer to wood:

(A) ____________

(B) ____________

(C) ____________

(D) ____________

4. Disadvantages of shellac finishes:

(A) ____________ (C) ____________

(B) ____________

5. The five principal types of varnishes:

(A) ____________ (D) ____________

(B) ____________ (E) ____________

(C) ____________

6. The characteristics of a good finish for hardwood floors:

(A) ______________________________

(B) ______________________________

(C) ______________________________

(D) ______________________________

(E) ______________________________

Assignment
Sheet No. 8

Covering
Units 120-131

COLOR HARMONY

The power of color is reflected in everything we see. Form and proportion are affected by color. Every finished job will appear at its best only if the colors are in harmony with each other in the setting in which they are found.

Skillful choice of color is one of the most important functions of the painter and decorator. In addition to the choice of color, choice of tint or shade may enhance the beauty or ruin the effect of the whole job.

There are several rules which have been found basic to color selection. Although these are not hard and fast, they do act as guides and provide aids upon which the decorator may build a reputation.

You will find in this assignment information concerning color theory, color harmony, and guides for mixing pigments in order to obtain the desired color. Some of the material may seem rather involved but study it carefully; it may be the difference between your remaining a mediocre painter or becoming highly competent.

Assignment:

1. Read the referencesbelow.
2. Prepare a color wheel similar to that shown on page 15 of reference "B", using the colors suggested in the parpgraph below the wheel. Place one inch circles of yellow, red, and blue in triad position on the circumference of a six inch circle and then position the remaining three primary colors in proper order at appropriate distance.

3. Answer the questions below and turn in this assignment by ______________________.

References:

A. Brushwell, Painting and Decorating Encyclopedia, pp. 141-158.
B. National Paint, Varnish and Lacquer Association, Inc., Color...and How to Use It, pp. 7-10, 14-18.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. Purple does not exist in the spectrum of colors found in normal daylight, but is a sensation of the observer.

T F 2. Red paint is red because it selectively absorbs blue and yellow rays.

T F 3. Linseed oil has no effect on the color of the pigment used in paint.

T F 4. Light is reflected away from a surface at an angle equal to the approaching light.

T F 5. Gloss paints have more purity and brilliance when seen with the light striking at an angle other than perpendicular to the surface.

T F 6. Mat surfaces are never seen as pure colors.

T F 7. Every time a light ray passes from one medium to another it is refracted in a new direction.

T F 8. Except for the light absorbed, a pigment will reflect all light received.

T F 9. Mat surfaces are affected more by light than are smooth surfaces.

T F 10. By the Ostwald system of color identification, any color can be identified by a number and two letters.

T F 11. A shade of color is always darker than the color.

T F 12. With no intermediate hue classes being considered the number of principal hue classes is six.

T F 13. The hue notation of a color indicates the degree of lightness or darkness of the color in relation to a neutral gray scale.

T F 14. While thinking in terms of the Munsell color chart and having ten hue values as indicated in Figure G-5, the proper method of indicating the red of strongest saturation in Figure G-7 is R 5/14.

T F 15. The value notation indicates its relation to the five principal and intermediate hues.

T F 16. Lighter value colors are indicated by numbers above five.

T F 17. The degree of departure of a particular hue from a neutral gray of the same value is indicated by the color notation chroma.

T F 18. The color notation H V/C was developed and popularized by Ostwald about 1900.

T F 19. The devise to measure reflectance of the three standard illuminants developed by Munsell is a chart photometer.

T F 20. For some hues it is impossible to have complementary hues.

T F 21. When two complementary colors are placed near each other they tend to dull each other.

T F 22. It is generally advisable to make colors a little too bright than too gray when attempting to produce color harmony.

T F 23. It is impossible to create color harmony with one single col

T F 24. Nearly all natural woods are yellow-orange.

T F 25. People are able to see smaller differences in the high reflective range of illuminations than in the low reflection range.

T F 26. Most colors shift toward green when they are "let up."

T F 27. Whenever complements are mixed together, there is a corresponding increase in light reflection.

T F 28. Mat paints tend to gray as they dry.

T F 29. Latex paints tend to become more yellow as they dry.

T F 30. Colors-in-oil should never be used in large quantities in any paint.

T F 31. The best way to mix colors-in-oil with paint is to put a dab of color in the paint and stir well.

T F 32. It should be kept in mind, especially for large surfaces that the finished paint job will appear lighter than the sample.

T F 33. Wall areas tend to reflect each other causing the colors to seem more pure.

T F 34. Each room should be decorated as a unit, disregarding other rooms, which should also be decorated as units.

T F 35. When talking to the customer, it is not advisable to use fancy names for color.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. Light reflected from a surface is known as _______________ reflection.

2. When white is added to a color, a ______________ of the color results, and when black is added, the result is a _______________ of the color.

3. By the Munsell system of color notation, the three attributes of color become ______________ by which color may be ______________ and ______________.

4. The complement of a color is the color the observer tends to see when ______________ ______________ sets in.

5. Color linked by resemblance and found next to each other on the color wheel are known as ________________ colors.

6. Items found in a room which serve as a basis for a color scheme are known as ______________ ______________.

7. Every color combination is affected by the ________________ ______________ of the observer.

8. It is seldom necessary to use more than __________ pigments to match any color; __________ as a base, __________ to bracket the hue, and __________ to gray the color.

9. The process of squeezing the lightweight, fine particles in a paint mixture to the free surface is known as ________________

10. Bleaching action in mat finishes is partly due to the scattering of ______________ ______________ and partly to a lack of difference in the refraction indexes of the ______________ and the ______________ to which it is exposed.

11. Pigments, finely ground in oil, used for tinting various opaque coatings are known as ________________.

Multiple Choice

Directions: In the space at the left of each statement, write the letter of the item which will provide the correct answer to complete the statement.

_____ 1. When tinting, it is suggested that the color to be added be (A) put in the base color and stirred; (B) thinned befor being added to the base color; (C) mixed with alcohol before being added to the base color; (D) placed in the color and allowed to set for 24 hours.

_____ 2. When making the final decision on color for large areas it is important to remember that the finished job will appear (A) darker than the sample; (B) lighter than the sample; (C) exactly like the sample; (D) less intense than the sampl

_____ 3. It is important to test colors under (A) lighting conditions in which they will be used; (B) actual daylight lighting conditions; (C) daylight fluorescent lighting; (D) incandescent lighting.

Listing

Directions: List the tiems called for in each of the following. Select your answers carefully.

1. The five colors that compose the visible spectrum of color of normal daylight are:

(A) ____________ (D) ____________

(B) ____________ (E) ____________

(C) ____________

2. The five most widely used types of color schemes, based on the color wheel, used to produce color harmony are:

(A) ____________

(B) ____________

(C) ____________

(D) ____________

(E) ____________

3. The two major recognized color systems which bear the names of their creators are:

(A) ____________ (B) ____________

4. The two primary ways of preparing custom or special colors are:

(A) ____________

(B) ____________

5. Three basic rules to follow in mixing colors for matching are:

(A) ____________

(B) ____________

(C) ____________

Assignment
Sheet No. 9

Covering
Units 132-136

COLOR STYLING

One of the most important functions of the painter and decorator is to offer advice on planning color combinations to fit various situations. He must know something of the types of furniture, decorating trends, and other situations that govern color selection. Although primarily concerned with surface decoration, he must also be aware of other factors that enter the decorative process.

The painter and decorator is likely to be called upon to offer suggestions for decorating a room in the style of some particular period or it may be his responsibility to simply carry out suggestions made by someone else. In any event he should be ready to offer wise suggestions when asked.

It is the purpose of this assignment to provide you with information that will help guide your thinking in color styling. Although there are few concrete rules that can be followed, you will become familiar with some of the guides used by the professional painter and decorator.

Assignment:

1. Read the references listed below.
2. Look through a number of catalogues, magazines, newspapers, etc., and select pictures and articles on period and contemporary decoration. Start a notebook in which these pictures and articles are organized in an orderly fashion. Continue this collection, discarding articles and pictures as they become obsolete or trends change.
3. Answer the questions below and turn in this assignment by _______________.
4. Show your coordinator the progress you have made with your notebook.

References:

A. Brushwell, Painting and Decorating Encyclopedia, pp. 158-166.

B. National Paint, Varnish and Lacquer Association, Inc., Color . . . and How to Use It, pp. 26-57.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. When a light colored house and a dark colored house of the same size are the same distance, the light colored house will seem to be the farthest.

T F 2. If the walls and ceiling of a room are painted a light tint, the room will appear to be larger than if it were painted a dark color.

T F 3. The brighter an area is painted the larger it seems.

T F 4. If a chimney is too large in relation to the rest of the house, painting it with a contrasting color will make it look more the proper size.

T F 5. Filament lamps produce light which is rich in red but relatively deficient in blue.

T F 6. Although paint styling has considerable effect upon the safeguarding of health and safety in dwellings, it has little effect upon these items in other buildings.

T F 7. Yard fences and natural surroundings are of minor consideration for exterior house color styling.

T F 8. To properly integrate indoor with outdoor living, proper design would call for repeating an exterior color on the interior of a house.

T F 9. Overly massive protruding type chimneys, in most cases, can be camouflaged by painting them dark brown.

T F 10. For some reason men seem to appreciate working with color schemes more than women do.

T F 11. The do-it-yourself concept has fertile ground in which to grow when it comes to home decorating.

T F 12. Woodwork around doors and windows should contrast with the wall color when in a large room.

T F 13. Ivory would be an appropriate color with which to decorate a large room.

T F 14. End walls can be made to recede in a long narrow room by painting them with a warm color.

T F 15. Good features in a room may be camouflaged by painting a different color.

T F 16. An attractive but rather small fireplace should most likely be painted the same color as the walls.

T F 17. High ceiling should be painted a deep color.

T F 18. The luster and texture of fabrics are of very minor significance in regard to visual interest in a room.

T F 19. In most cases we may decorate a room as we see fit and then consider it adequate for almost any family.

T F 20. Woods of extreme lightness or darkness can be used with any color scheme employing colors of medium values.

T F 21. Color has little effect upon the job efficiency or emotional well being of employees.

T F 22. In offices where too light or too dark a surface would be an eye irritant a good color to use is blue-green.

T F 23. Within a dark office a fine means to promote maximum light reflectancy is to carry the gloss white of the ceiling down onto the upper wall areas.

T F 24. The key to attracting customers and increasing sales is to use colors which harmonize.

T F 25. The side walls within a school classroom could most likely be painted deep yellow.

T F 26. Wall colors within a factory should not contrast with machinery colors.

T F 27. The name of the scheme used to attempt standardization of colors in industrial plants is the Color Code for Safety in Industry.

T F 28. Farmers have a lower accident rate compared to workers in other occupations.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. The one major key element when planning a color scheme for a house is the color of the ________________.

2. Shutters of turquoise color will go well with a ________________ roof.

3. A house with cream as a main body color may have roof colors of ________________, ________________, or ________________.

4. Painting the shutters of the upper story windows the same color as the roof color will ________________ the roof line.

5. Many times it is necessary to paint over the natural colors of building materials in order to achieve ________________.

6. When an architectural defect such as a radiator is painted the same color as the walls this technique is called ______________________.

7. The size of house which would most likely necessitate using color flow would be a ________________ house.

8. While choosing between northeast or southwest rooms, a red color would most likely be used in the ________________ room.

9. In a room that has a ceiling which is too high ________________ lines should be emphasized.

10. A background color which would be excellent for almost any color of wood furniture is ____________.

11. In regard to emotional well-being in industry color has been used to relieve ____________, ____________, and ______________.

12. The best color to be used where jobs require strict visual or mental concentration is ____________.

13. In an office where rust red and turquoise furnishings are to be used one of the best wall colors would be ____________ ____________ ____________, ____________ ____________.

14. Operating rooms are usually styled in green because the surgeon's field of operation is predominantly ____________.

15. While considering hospital color styling the "institution look" can be eased by using ____________ colors.

16. Switches on industrial machines should be painted a/an __________ color.

17. The piping code divides plant piping into categories of color totaling _________ in number.

18. The most common safety color code plan to be used on farms would be the colors ____________ and ____________.

19. A hay fork color of handle would be ____________.

Multiple-Choice

Directions: In the space at the left of each statement, write the letter of the item which will provide the correct answer to complete the statement.

_____ 1. Good features of a piece of furniture may be emphasized by surrounding it with an area of (A) the same color as the surroundings; (B) a different color from the surroundings; (C) the same color as the dominate color found in the piece of furniture; (D) horizontal lines.

_____ 2. A roof that seems too high may be "lowered" by (A) painting the shutters a contrasting color; (B) painting the shutters the same color as the roof; (C) painting the roof a darker color than the body of the house; (D) painting the roof a lighter color than the body of the house.

_____ 3. The colors known as advancing colors are (A) red, orange, and yellow; (B) blue, black, and aqua green; (C) turquoise, jade, and lime; (D) orange, white, and chartreuse.

_____ 4. Warm colors are (A) red, yellow, and orange; (B) blue, black, and Nile green; (C) turquoise, jade, and lime; (D) orange, white, and chartreuse.

_____ 5. Since various departments within a retail store lend themselves to specific color schemes, a department which would be more apt to use light or grayed walls with black, brown, or blue showcases is (A) Millinery; (B) Better Dresses; (C) Lingerie; (D) Jewelry; (E) Furs.

Matching

<u>Directions</u>: In the left hand column is a list of items. The right hand column contains descriptive phrases or synonymous terms. Match the descriptions to the terms by placing the letter of the description in the blank at the left of the appropriate term.

Group I The color of the following items, if painted according to the color code of industry would be:

_____ 1. cutting devices A. red

_____ 2. first aid cabinets B. green

_____ 3. fire extinguishers C. blue

_____ 4. crane hooks D. yellow

_____ 5. pumps and compressors E. orange

Group II Select the color you would most likely use in a room with the following natural light.

_____ 1. cold northern light A. cool blue

_____ 2. a neutral eastern light B. tan

_____ 3. warm southern light C. cool green

_____ 4. light from the west D. neutral gray

Group III The color of the tinted filament bulb which will effect colors, rooms, and other objects in the suggested manner is:

_____ 1. enhances reds

_____ 2. lengthens rooms

_____ 3. goldens copper more

_____ 4. enhances complexions

_____ 5. warms neutral colors

_____ 6. cools down warm colors

_____ 7. restful bedroom color

_____ 8. desirable for light colored woods

A. sun gold

B. sky blue

C. dawn pink

D. spring green

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. Five factors that must be considered when presenting the best color design possible are:

(A) ______________________________

(B) ______________________________

(C) ______________________________

(D) ______________________________

(E) ______________________________

2. Knowing how to "style" with paint is based on the following concept

(A) ______________________________

(B) ______________________________

(C) ______________________________

(D) ______________________________

3. The three main considerations that must be kept in mind when color styling house exteriors are:

(A) ______________________________

(B) ______________________________

____

(C) ______________________________

4. House exteriors may be accented or minimized by consideration of physical features such as:

(A) ______________________________

(B) ______________________________

(C) ______________________________

(D) ______________________________

(E) ______________________________

(F) ______________________________

5. Before advising your customer about a painting situation it is necessary to obtain the following information:

(A) ______________________________

(B) ______________________________

(C) ______________________________

(D) ______________________________

(E) ______________________________

6. Examples of stimulating colors which seem to convey a feeling of warmth are:

(A) ______________ (C) ______________

(B) ______________ (D) ______________

7. The complementary colors used with the following types of artificia light are:

(A) white fluorescent light ______________

(B) mercury vapor light ______________

(C) incandescent light ______________

(D) combination of fluorescent, mercury and incandescent ______________

8. The points which should be kept in mind while helping a merchant plan a color scheme in his retail store are:

(A) ______

(B) ______

(C) ______

(D) ______

(E) ______

(F) ______

(G) ______

9. Two sources upon which to draw while prescribing colors for a church would be:

(A) ______

(B) ______

10. List ten ways in which paint and color styling aid industry:

(A) ______

(B) ______

(C) ______

(D) ______

(E) ______

(F) ______

(G) ______

(H) ______

(I) ______

(J) ______

11. List six types of businesses or buildings in which both safety and color styling are applicable.

(A) ______ (D) ______

(B) ______ (E) ______

(C) ______ (F) ______

Assignment
Sheet No. 10

Covering
Units 137-151

SPECIAL FINISHES

Often times the painter and decorator is called upon to finish surfaces in an unusual or special manner. He may be requested to match or repair an existing finish or to make a wood surface resemble a metal or stone surface.

Although considerable experience is required to produce some of these finishes, it must be remembered that there has to be a beginning.

For this reason, this assignment is provided. You will have an opportunity to become acquainted with various special finishes and how they are produced. Some of them you may have previously done; others may be new to you. No doubt you will be able to add to your store of knowledge by careful study of the following assignment.

Assignment:

1. Read the reference listed below.
2. As you did for Assignment Sheet No. 7, list on 3 x 5 cards the steps to be followed in producing the various special finishes discussed in your readings. Any other special finishes your employer may use should also become a part of your collection.
3. On the reverse side of each card, list the tools required to produce the finish.
4. After completing parts 1, 2, and 3 of your assignment, answer the questions below and turn in this assignment by __________.

Reference:

A. Brushwell, Painting and Decorating Encyclopedia, pp. 213-228.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T". If it is false, draw a circle around the letter "F".

T F 1. A glaze finish may be applied over a stain but not over an enamel finish.

T F 2. Antique glazing is sometimes used over stain to give the effect of greater age than is possible by the stain above.

T F 3. Glaze is applied with a brush and wiped off with a cloth.

T F 4. One must be very careful when applying glaze for it cannot be glazed again without first removing the old glaze.

T F 5. To make the glaze finish durable it should be covered with shellac, varnish, or lacquer.

T F 6. Antique highlighting is done to emphasize the grain of the wood.

T F 7. When producing a spatter finish, a base coat must be applied before the spatter coat.

T F 8. When applying a two or three color spatter coat with a brush, each color should dry before the next color is applied.

T F 9. It is possible to obtain multi-colored enamel in which the different colors exist separately in solution.

T F 10. A stippled or mottled finish may be produced either by putting paint on to a surface or by taking it off of a surface.

T F 11. The only recommended method of striping is by application with a brush.

T F 12. When using masking tape as an aid to striping, the tape must remain in position until the paint is dry.

T F 13. When applying bronze powder and liquid finish, it should be brushed well, first applying the finish and then going over the entire surface to make sure each lap does not show.

T F 14. Gold leaf may be obtained in powder or liquid form.

T F 15. If gold leaf is to be burnished, oil size is most generally used.

T F 16. Silver leaf requires a stronger adhesive than does gold leaf.

T F 17. Before gilding is applied to glass, the glass should be thoroughly washed with kerosene.

T F 18. It is recommended that the highest or top portion of a gilding job be done first.

T F 19. A sharp pair of painters' shears should be used to cut gilding leaf.

T F 20. The better gilding tips are made of copper.

T F 21. Silver and gold leaf are put on in exactly the same manner.

T F 22. Wood must be sealed before gold or silver leaf are applied.

T F 23. No special preparation, other than thorough cleaning, is necessary prior to applying gold leaf to sheet metal.

T F 24. Aluminum leaf is more delicate and must be handled with greater care than gold or silver leaf.

T F 25. Blue chalk lines such as those used in the building trades are recommended for marking lines to follow when stenciling.

T F 26. When graining to resemble oak, the pores are produced after the grain.

T F 27. When graining to produce figured walnut swirl, care must be exercised to get an even distribution of color.

T F 28. One coat is all that is necessary for producing a wrinkle finish.

T F 29. Wrinkle finish can not be satisfactorily applied to wood surfaces.

T F 30. Crackle finishes are produced by applying crystallizing lacquer over French varnish.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. Antique glazing may be applied over stain, provided the stain is sealed with ______________.

2. Glaze may be made by thinning down __________________________.

3. Under lacquer glaze finishes, _____________ colors thinned with ________________ should be used.

4. Antique highlighting is applied to give the appearance of ________

5. When spatter finishing, the __________________ of the paint has considerable bearing upon the size of the spots.

6. When doing mottling or stippling, a _________ of _______________ may be used in place of a sponge.

7. To darken the depressions or low spots found on objects made of brass, copper or bronze, clean with a ______________ __________ solution, dip in a _________ of ______________ solution and polis the high spots with ______________ ______________.

8. The green color that appears on metal as a result of oxidation is called __________________.

9. To apply gold leaf to glass, __________ size, which comes in ______________ form, is used.

10. Before gilding glass, it is washed and when dry, polished with ____________ ____________.

11. Sometimes a bit of yellow color is used in the size to help cover up small imperfections in the gold leaf which are known as ____________.

12. When making stencils, a space of ____________ ____________ should be left all around the design.

13. Oil used to prepare heavy paper for stencils is composed of ______ part ____________ ____________ and ______ part ____________ ____________ ____________.

14. With most wrinkle finishes, the heavier the coat, the ____________ the wrinkles.

15. A crackle finish is obtained by applying a specially prepared ____________ drying finish over a ____________ drying ____________ finish.

16. French polish is produced by using refined ____________ or ____________ ____________ applied with a cloth pad and lubricated with ____________ ____________.

17. After the desired film of French polish has been built up, it is recommended that the surface be polished with the ____________ of the ____________.

Multiple-Choice

Directions: In the space at the left of each statement, write the letter of the item which will provide the correct answer to complete the statement.

_____ 1. Texture paint may be obtained with a (A) latex base; (B) rubberized alkyd base; (C) oil base; (D) all of these.

_____ 2. After darkening metal with acid, the color should be protected with (A) white lead; (B) linseed oil; (C) shellac; (D) lacquer.

_____ 3. Brown color on brass may be simulated by using (A) burnt sienna; (B) burnt umber; (C) Vandyke brown; (D) all of these.

_____ 4. Gilding is the process of obtaining a finish by using (A) metal powder in a binder; (B) metallic paint in oil; (C) thin sheets of metal; (D) a wash coat of stain thinned with shellac.

______ 6. To lay gold leaf on glass, use a (A) camel's hair brush; (B) badger's hair brush; (C) hog's bristle brush; (D) nylon brush.

______ 7. To lay silver leaf on glass, use a (A) camel's hair brush; (B) badger's hair brush; (C) hog's bristle brush; (D) nylon brush.

______ 8. When cutting stencil designs, the knife should be (A) drawn toward the operator; (B) pushed away from the operator; (C) drawn or pushed depending upon the direction of the lines to be cut; (D) scissors are used, not a knife.

______ 9. When graining a surface, the ground or base color should match (A) the darkest color to be imitated; (B) the lightest color to be imitated; (C) the color that covers the greatest area; (D) none of these.

______ 10. Ground color for graining may be a mixture of white lead tinted with the proper color-in-oil and thinned with (A) equal parts of linseed oil and turpentine; (B) three parts naptha to two parts cylinder oil; (C) two parts Japan dryer to one part alcohol; (D) two parts turpentine to one part spar varnish.

Listing

__Directions:__ List the items called for in each of the following. Select your answers carefully.

1. The essentials for doing a good job of striping and lining:

(A) ______________________ (D) ______________________

(B) ______________________ (E) ______________________

(C) ______________________ (F) ______________________

2. Two special items the painter should wear when working with acid:

(A) ______________________ (B) ______________________

3. Four methods of applying metallic paint:

(A) ______________________ (C) ______________________

(B) ______________________ (D) ______________________

4. The two principal kinds of size used for gilding:

(A) ______________________ (B) ______________________

5. The tools used for graining and marbelizing:

(A) ______________________________

(B) ______________________________

(C) ______________________________

(D) ______________________________

(E) ______________________________

(F) ______________________________

(G) ______________________________

(H) ______________________________

(I) ______________________________

Assignment
Sheet No. 11

Covering
Units 153-177

WALL COVERINGS

A knowledge of and skill in selection and application of wall coverings are essential factors inherent in most successful painters and decorators. The painter will find the demand for his services, in addition to painting, less seasonal and in greater demand if he is proficient in other phases of home decoration.

Because of the prevalency of the use of wallpaper and other wall coverings in modern home decoration, the painter and decorator should know what coverings are available, how they are sold, the tools and equipment used in preparation, application and care, and methods of cost estimating.

This assignment, therefore, presents information essential to the individual who is called upon to make suggestions or do the actual work connected with selection, application, and care of wall coverings.

Assignment:

1. Read the reference listed below.
2. After reading the reference carefully, prepare two lists in a similar fashion as the Analysis found in the front of this study guide. In the left-hand column indicate the steps to follow when applying wall paper and in the right-hand column, across from each step, indicate the tools and equipment necessary in its performance. Have your employer check your work for accuracy and make any additions or corrections he thinks necessary.
3. Answer the questions below and turn in this assignment, together with the above lists, by ____________________.

Reference:

A. Brushwell, Painting and Decorating Encyclopedia, pp. 167-186, 258-259

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T". If it is false, draw a circle around the letter "F".

T F 1. When wall paper is printed, a separate roller is required for each color.

T F 2. Duplex paper is wall paper consisting of two separate papers pasted together to create a highly embossed effect.

T F 3. A single roll of wallpaper is sometimes referred to as a bolt.

T F 4. The narrowest domestic wallpaper is purchased in rolls or bolts 18 inches wide.

T F 5. The International Society of Wallpaper Manufacturers has been successful in standardizing the width and length of wallpapers for home decoration.

T F 6. Some expensive wallpaper may be applied to a muslin base so it may be removed and rehung.

T F 7. Silk fabric coverngs are hand-painted after they are hung.

T T 8. Japanese grasscloth is a special cloth made from shredded grass and rice pulp.

T F 9. Linen is difficult to apply because of its shrinking qualities.

T F 10. Shears made of high carbon steel are preferred over those made of forged steel.

T F 11. A pair of 12 inch shears would actually measure 16 1/2 inches from the tip of the blades to the end of the handles.

T F 12. All smoothing rollers should have smooth surfaces that are slightly convex.

T F 13. The brushes found in the paperhanger's tool kit should all be very soft.

T F 14. Paperhanger's knives should have firm blades beveled on one side only.

T F 15. Screw type straightedges made with trimmer tracks are considered safer than those made with clamps.

T F 16. Wood straightedges should be laid on flat sufaces for storing.

T F 17. The uniform of the paperhanger is of little importance.

T F 18. One of the most important requirements for a good job of paperhanging is the proper preparation of the walls.

T F 19. Enameled walls cannot be papered successfully.

T F 20. Wallpaper will not adhere to calcimine.

T F 21. Walls painted with resin or casein paint can not be papered successfully.

T F 22. If old wallpaper has been removed with water or steam the walls should be allowed to dry before any holes or cracks in the walls are repaired.

T F 23. The need for open windows or some other means of air circulation is necessary when hanging wallpaper.

T F 24. An important point to remember in checking the paper with a floral design is that the heavy leaves hang down and the heaviest shading is found at the lower part of the design.

T F 25. Ceilings should be hung first.

T F 26. The apprentice or learner will find the walls easier to hang.

T F 27. When cutting strips of paper to length, care should be exercised to make them the exact length of the surface to be covered in order to avoid waste.

T F 28. The point at which the papering is started determines the pattern arrangement.

T F 29. If possible, papering should be started near a door or window casing or corner in order to use one of these items as a guide to make the paper true.

T F 30. When smoothing out paper after it has been applied, work down the centers first.

T F 31. If too much pressure is used when smoothing, the paper is likely to have air pockets when it drys.

T F 32. The entire sidewall should be hung before the excess paper is trimmed.

T F 33. Spaces over and under windows and doors should be hung as they are approached.

T F 34. When turning inside or outside corners, the strip of paper should not extend more than 1/4 inch onto the next wall.

T F 35. It is recommended that a border be applied in one continuous strip.

T F 36. Varnished or plastic coated paper should always have butt seams.

T F 37. When applying muslin, the materials is usually applied dry to a pasted wall.

T F 38. Seams on oiled fabrics should be pressed down firmly with a seam roller.

T F 39. A low water content paste should be used with Japanese grasscloth.

T F 40. Walls should be lined with paper before burlap is applied.

Completion

<u>Directions</u>: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. Wallpaper may be identified by the ______________ ______________ the color and the design.

2. Papers with a hard finish are known as ______________ papers.

3. The standard measurement for American-made wallpaper is the ______________ which contains ________ square feet.

4. Paperhanger's shears come in lengths of ________ to________ inches.

5. Smoothing brushes are made in widths of ________ to________ inches.

6. The most popular widths for paste brushes are ________ to________ inches.

7. A yardstick is used for measuring but may be used also as a ______________ ______________.

8. Size, used to prepare surfaces for wallpaper, has a foundation of ______________.

9. To make paste harder when drying, add a small amount of ________.

10. Unless paper is allowed to expand before being hung, ______________ and ______________ are likely to result.

11. The vertical starting line should be made with a ______________ ______________ and a ______________ ______________.

12. When paper is put horizontally on walls, it is known as ______________ hanging.

13. A bolt of 18 inch paper contains________ square feet, and a bolt of 30 inch paper contains ________ square feet.

14. Border paper is sold by the ______________ ______________.

15. Paperhanging is paid for at a certain rate per ______________.

Multiple Choice

<u>Directions</u>: In the space at the left of each statement, write the letter of the item which will provide the correct answer to complete the statement.

_____ 1. An elastic size for an enameled surface may be made by adding sugar or syrup to glue size; (B) sal soda to glue size; (C) trisodium phosphate to glue size; (D) any of these.

______ 2. An enameled gloss may be removed by washing the surface with a solution of (A) ammonia and water; (B) kerosene and detergent; (C) liquid wax and naptha; (D) any of these.

______ 3. Glue may absorb water as much as (A) 2; (B) 5; (C) 10; (D) 15 times its own weight.

______ 4. Glue size may be preserved and prevented from souring by adding (A) pulverized borax; (B) carbolic acid; (C) formaldehyde; (D) any of these.

______ 5. Materials added to wheat flour paste to make it more adhesive and elastic also cause it to (A) dry fast; (B) dry slowly; (C) sour more quickly; (D) be difficult to apply.

______ 6. If too much pressure is applied when using a seam roller, the (A) glue will curdle; (B) glue will become watery; (C) paper will have air pockets; (D) paper will become shiny.

______ 7. To press down the seams on heavy embossed papers, use a (A) seam roller; (B) plumb bob; (C) smoothing brush; (D) cloth.

<u>Matching</u>

<u>Directions</u>: In the left hand column is a list of terms. The right hand column contains descriptive phrases or synonymous terms. Match the descriptions to the terms by placing the letter of the description in the blank at the left of the appropriate term.

______ 1. a room seems cramped

______ 2. pencil marks

______ 3. ceiling seems too low

______ 4. ceiling seems too high

______ 5. crayon marks

______ 6. irregular walls and ceiling

______ 7. oily spots

A. art gum

B. vertical climbing pattern

C. naptha

D. all-over pattern

E. horizontal pattern

F. scenic panel

G. Fuller's Earth and cleaning fluid

H. ink eradicator

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. Materials from which wallpapers are made:

(A) ____________________ (D) ____________________

(B) ____________________ (E) ____________________

(C) ____________________ (F) ____________________

2. Types of bristles used for smoothing brushes:

(A) ____________________ (C) ____________________

(B) ____________________ (D) ____________________

3. Reasons for applying size:

(A) ____

(B) ____

(C) ____

4. Information that may be found on the selvedge of wallpaper:

(A) ____________________ (E) ____________________

(B) ____________________ (F) ____________________

(C) ____________________ (G) ____________________

(D) ____________________

5. Types of joints used in paperhanging:

(A) ____________________ (C) ____________________

(B) ____________________

6. Two principle methods of figuring the amounts of paper needed:

(A) ____________________ (B) ____________________

7. Items to be figured when establishing a price per roll for hanging wallpaper:

(A) ____________________ (D) ____________________

(B) ____________________ (E) ____________________

(C) ____________________ (F) ____________________

Assignment
Sheet No. 12

Covering
Units 178-183

ESTIMATING

A very important activity of the painter and decorator is to be able to estimate accurately the amount of material needed, the cost of the material, and the time required to complete a job. He must know all the things which should be considered. In addition to the materials and the actual time involved in application, he must consider overhead time, time involved in surface preparation, profit and other items which may "make or break" his good reputation.

An understanding of arithmetic is essential. If you have forgotten some basic mathematical manipulation, it will be worth your while to go over the material a second time. Your reference provides you with material suitable for review. Bids for painting new construction or on remodeling jobs may require some knowledge of blueprint reading.

You will find, in this assignment, some practical problems regarding estimating. Do your figuring carefully and check all answers. Get in the habit of rechecking your own work before submitting it to your teacher, your employer, or to anyone else.

Assignment:

1. Read the reference listed below
2. Using the building selected in assignment sheet 1, estimate the total cost of restoring the exterior surfaces. Be sure to allow for surface preparation and restoration, cost of materials, depreciation of equipment, wages, profit, and any other items you consider necessary.
3. After you complete assignment 2, submit it to your employer for comments and suggestions.
4. Answer the questions below and turn in the assignment, together with item 2 above, by ______________________.

Reference:

A. Brushwell, Painting and Decorating Encyclopedia, pp. 256-259; 236-242; 249-254.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T". If it is false, draw a circle around the letter "F".

T F 1. In order to ascertain the amount of paint or finishing material needed, it is necessary to know the cubic feet of the surface to be finished.

T F 2. The amount of paint required for the usual width of trim is one gallon per three hundred feet.

T F 3. The term "square" refers to a measure of lineal length often used by estimators in figuring costs.

T F 4. The slant of a roof is of little concern when figuring surface area of a roof.

T F 5. The cost of paint is usually the largest item in a painting contract.

T F 6. Records of past experiences usually serve as guides when determining the cost of an entire job.

T F 7. Various types of surfaces can not be estimated with equal ease or accuracy.

T F 8. General overhead includes all costs that can not be charged directly to a job.

T F 9. The gross payment received for a job represents the contractors profit.

T F 10. Two types of estimates are made by the contractor to show to his prospective customer.

T F 11. The prospective client receives a less detailed estimate than is filed with the contractor.

T F 12. Frequently customer suggested adjustments made during the job would consume the contractors profit.

T F 13. The height of a job can sometimes add extra labor which reduces the contractor's profit if overlooked.

T F 14. The strip method is used to calculate the amount of wall paper needed.

T F 15. The addition of the minuend and subtrahend is the remainder.

T F 16. Five tens is greater than 36 units.

T F 17. Problems in division may be checked by multiplying the two factors.

T F 18. An improper fraction has the larger number below the line.

T F 19. Since two is one half of four, you may multiply the numerator of a fraction by four and the denominator by two without changing its value.

T F 20. 37/32 is a mixed number.

T F 21. Multiplying 5/8 by 1/2 is the same as dividing 5/8 by 2.

T F 22. You may multiply frantions by inverting them and dividing.

T F 23. While adding mixed decimal fractions, the decimal point of each should line up one above the other.

T F 24. Decimal points should usually line up one above the the other while multiplying decimal fractions.

T F 25. The number of decimal places in the sum is always the product of those in the multiplier and the **multiplicand**.

T F 26. When we change a number from .25 to 25, we have actually multiplied the decimal number by 100.

T F 27. The fractional equivalent of .4 is 400/1000.

T F 28. Tablespoon measurement may be converted into gill measurement.

T F 29. Altitude is taken into consideration when figuring the area of a rectangle.

T F 30. All closed curves are circles.

T F 31. All circles are closed curves.

T F 32. Pi is equal to 3.1416.

T F 33. A circle with a radius of four inches has a diameter of 12.

T F 34. To enable figuring the lateral area of a cylinder you should figure the area of the sides of the cylinder.

T F 35. Multiplying two times the radius of a circle by pi will give the circumference.

T F 36. The size of a diameter or radius of a circle is not needed while figuring the lateral area of a round **semetrical** pointed cone.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. The unit of measure on which the estimator usually bases his prices is the ____________.

2. To obtain extreme accuracy for highly competitive estimating on a large job, the rules laid down by ________________ should be used to calculate the area.

3. A valuable reference for many types of estimating is distributed by the ____________ _______ ____________ _____________ _______ ____________.

4. The height of a gable in a one-quarter pitch roof is ___________ the width of the house.

5. The multiplicand and the multiplier can be classified under one term called the ____________ of the product.

6. When a number consists of a whole number and a decimal fraction, it is called a ____________ ____________ ____________.

Short Answer

Directions: Using the plates found on pages 249-254 of reference A, fill in the following blanks with the requested information.

1. What are the overall outside dimensions of the house? ____________

2. What is the lineal dimension of outside wall of the garage? ________________

3. What is the roof pitch of the garage? ________________

4. What are the overall dimensions of the kitchen? ______________

5. What is the width of the stairs to the basement? ______________

6. What is the floor area of the recreation and hobbies area? ________________ square feet

7. What is the floor area of the basement disregarding any inside partitions? ____________ square feet

8. What kind of material is used for the siding of the house? ______________

9. What is the height of the inside walls of the garage? ___________

10. To the nearest foot, what is the height of the following walls?
Basement ________ feet. First floor ________ feet.
Second floor ________ feet.

Estimating

Directions: Fill in the blanks with the information requested.

1. A room 15' x 20' with 8' walls will have how many square feet of wall surface? ______________ square feet.

2. Suppose that one gallon of paint will cover 500 square feet. How much paint would be required for two coats for ceiling and walls of the above room? __________________ gallons.

3. A rectangular building, 20' x 30'; 10' to the rafter plate with a 1/4 pitch roof, (gable ends on the 20' sides) will have how many square feet of surface, disregarding openings? ______________ square feet. How much roof surface? ______________.

4. Figuring a "two coat" job, how much paint will be required to paint the outside walls of the building if one gallon of paint will cover 500 square feet? __________________ gallons.

5. You have been called to estimate the cost of painting a smoke stack that has an outside diameter of 9' and a height of 52'. The walls are perpendicular. What is the area of the outside surface? _________ square feet. How much paint will be required for a one coat job if one gallon will cover 200 square feet? __________ gallons. The paint you need is $4.60 per gallon or $1.75 per quart How much paint would you suggest buying? _________ gallon. Why? ____

____

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. Four main factors which may be considered estimating essentials are:

(A) __________________ (C) __________________

(B) __________________ (D) __________________

2. Items which can be considered as overhead costs are:

(A) __________________ (G) __________________

(B) __________________ (H) __________________

(C) __________________ (I) __________________

(D) __________________ (J) __________________

(E) __________________ (K) __________________

(F) __________________ (L) __________________

3. Percentage of profit can be based somewhat on:

(A) ________________ (C) ________________

(B) ________________ (D) ________________

4. A contractor who can read blueprints and plans can obtain details and plans such as:

(A) ________________ (F) ________________

(B) ________________ (G) ________________

(C) ________________ (H) ________________

(D) ________________ (I) ________________

(E) ________________ (J) ________________

Assignment
Sheet No. 13

Covering
Units 183-192

PAINT STORE OPERATION AND CONTRACTING

No matter how great is the need for paint, people have to be told what to use where. This is the job of the painting contractor. Potentially, everyone working as a painter or decorator could venture on his own and become a contractor.

Before assuming the responsibility of being on your own, there are a number of pitfalls that should be avoided. It is also necessary to investigate all phases of the business to identify these and to become aware of those elements which contribute to future success. Although you are not presently considering going into business at this time, you should begin thinking about the possibility of doing so in the future. Observe the actions of your employer and learn all you can from him.

This assignment will help you identify the areas where pitfalls are abundantly located. As you become more knowledgeable of this phase, the appreciation of what goes into your employer's decisions will become more evident.

Assignment:

1. Read the information sheet provided.
2. Prepare a list of problems you would expect to encounter by going into business as a paint contractor and briefly explain how you would attempt to overcome these problems.
3. Complete the questions below and turn in this assignment by ____________________.

Reference:

C. Information Sheet No. 1.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T". If it is false, draw a circle around the letter "F".

T F 1. The location of a painting contractor's shop is important.

T F 2. Natural light is preferred in the showroom.

T F 3. The shop may have "islands" for display purposes.

T F 4. A large sign should be placed in the front window of the shop for advertising.

T F 5. As much information as possible should be given on your truck advertisement.

T F 6. Going into business for yourself means you have all the responsibilities.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. The life of your business, especially at the start will be ____________ and ____________.
2. Historically, the profession is one of great pride in one's ____________ and ______________.
3. The shop is a reflection of your own __________________.
4. Lighting facilities that are up-to-date will correct for __________ ____________ and ____________ ____________.
5. A good motto to follow in design is _________________.
6. The accessories sold in the shop depend on the type of _________ offered to the people.
7. One of the greatest human factors toward the success of the painting contractor is that of ________________.

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. Formulate a list of points to consider when hiring a future employee: (add from your own experiences)

(A) ____

(B) ____

(C) ____

(D) ____

(E) ____

(F) ____

2. Items which are considered a liability to the business are:

(A) ______________________ (D) ______________________

(B) ______________________ (E) ______________________

(C) ______________________

3. A good businessman requires a knowledge of:

(A) ______________________ (D) ______________________

(B) ______________________ (E) ______________________

(C) ______________________ (F) ______________________

(G) ______________________

PAINT STORE OPERATION AND CONTRACTING

After you have spent some time in the occupation of painting and decorating, you may take it upon yourself to go into business as a painting contractor. Historically the profession is one of great pride-pride not only in one's work, but one's self as well. To uphold the image of leadership in the community requires that type of self pride. Respect is not automatic, it is earned. As a prospective businessman it would be well worth your time to go over many of the details of this new responsibility as possible before you assume your own business. This will save many hours of hardship later on, and possibly help to make your business successful.

Naturally, among the many details you must know about your product and its application are basic knowledges about going into business in general. Good business management requires a thorough knowledge of locating space, financing, and equipping the operation; including insurance, how to hire, to fire, to advertise, to display and to sell. There must be in you a little of the artist, the banker, the salesman, the bookkeeper, the diplomat, the mechanic, and the horse trader. On top of all this you must have confidence in yourself and the personality to overcome any prospective buyer. The factors of personal qualifications form a large part of the assets to which success may be balanced.

Your capital and credit supply will be the life of your operation, especially during the starting years. Choose with careful thoughts both your associates, if any, and the particular "brand names" of products you will be handling. It may be necessary to stand behindyour product and your work. The location of your business is of prime importance. The actual street where the "shop" is located may be determined by several factors. If you plan to sell other supplies as a side line, careful consideration as to the accessability of the shop is needed. Typical questions that should be asked are: How will people get to the shop? Is it on a bus line? Is a car needed, or will people just happen to pass by? Secondly, is the street itself well known, or is it a short passage in some off-section of town and very hard to find? And to what extent are the competitors located in the immediate area or section is also a problem. An equitable balance among these factors determined by the type of service you want to offer the people.

The shop, both inside and out, is a direct reflection of your personality. It should be neat and attractive. Do not have it cluttered with supplies, ladders, etc. Simplicity in design is a good motto to follow. A paint contractor should show good taste, and by all means set a good example. This also holds true for the large sign in front of the shop as well as the writing on your company truck. The sign should be large enough to be easily read, yet, conservative. Avoid the splashy-gaudy line. That is not to say, you should not have a clever idea for the shape or a slogan for advertising purposes. Often a small attractive sign may be placed at the job site advertising who is doing the work and where you or your shop can be located.

In the front portion of the shop an attractive showroom, well-lighted, carefully planned, will be of the utmost necessity to the selling of your product. The latest up-to-date lighting facilities will correct for dark days and color hue. If you are going to sell, you must sell with enthusiasm and feeling. The showroom that transmits such feelings to the buyer as he walks into it is going to sell its product. The first impression is very important for it is lasting. It may mean the difference between a sale or just an inquiry. The shop should reflect good housekeeping practices at all times.

A partition between the display room and the working area or laboratory will convey a personal touch. No mess, tools, paint spots, etc., will distract the effectiveness of the display. Equally important, is the fact that too much material on display will destroy the central idea of the showroom. It would be a good practice to have the front windows, if you have them, clear to permit the person walking or driving by to have a clear view of your showroom. There should be ample space on the remaining three walls and the inclusion of one or more islands for display materials. Let the store "sell itself" rather than be a hindrance to the business.

If you are in business for yourself, you will soon discover that it becomes necessary to attend to all aspects of the business personally. The careful budgeting of your time is then vital. It may seem that there are not enough hours in the day to get accomplished all that you would like. Perhaps it is then advisable to have part-time help with the books, showroom, taking of orders, and selling. Unless oou are anticipating a one-man operation, help of one kind or another will be needed.

The selection of a needed employee is one of the most difficult tasks which a manager is confronted with. Not only must you know how to hire, but hire the person most suitable for the job opening. People are more important than products. If you have developed a good live file of applicants, a vacancy is easy to fill. Once you have the type of qualifications you are desiring, approach the task of future hiring with these points fixed in your mind.

1. Be sure to look for the same qualities in the applicant as previously set up.
2. Give the applicant sufficient opportunity to reveal his true self.
3. Be aware of the first impression.
4. Check on his previous work experiences.
5. Do not fill a position with a candidate if there are reservations in your mind.

If all conditions are favorable, to both parties, chances are that the person hired will be an asset to your firm. The firing of an employee is unpleasant for both parties. For this reason, few people should be hired on a trial basis. As the hiring is your responsibility, so is the responsibility to inspire your people. Your employees look to you for job leadership. The development of a team is not by accident. It does not just happen. Study the people in your organization and select a few that you feel would be good leaders, foremen. Give as many people as possible a sense of sharing in the success of the store. Such items as, incentive pay, promotion, increased responsibility and a "pat on the back" are but a few ways to let your employee know you are happy he is working for you and not a competitor.

Just as you need to watch your people, your merchandise, and your customers, it is necessary to look out for your invested interest. There is little profit in building a successful business and letting it dwindle away through careless bookkeeping, poor collection of bills or even a liability suit. At any given time, you should be able to know what materials are on hand, what is ordered, and how much money is involved. The day to day expenses must be met, sometimes with cash. It is awkward to be caught in a financially embarrasing situation. This situation may be offset by following a few simple rules, yet important ones.

1. Keep careful control over your records.
2. Do not over stock materials unless an apparent demand is forth-coming.
3. Keep current tabs on bills which may become overdue; set a time limit.
4. Pay employees at a prescribed interval.
5. Provide adequate insurance against possible liable lawsuits.

This list is far from complete, and is provided only to stimulate further thoughts of profit, loss, and unnessary drains on the business.

When suddenly you realize it is you who are faced with the responsibility of keeping the store going, you will then know what is meant by the trite phrase, "Happy is the man who has found his work."

TRAINING PLAN AND PROGRESS RECORD
for
PAINTING AND DECORATING

Employer's Copy

JOB TRAINING: What the worker should be able to do	Proficiency Shown	RELATED INFORMATION: What the worker should know

Health and Safety

Inspect tools, materials, equipment, and working area and take proper precautions against hazards Time in hours ____________	☒	Safety practices in the painting and decorating trade

Tools and Equipment

Select and care for the tools and equipment of the trade Time in hours ____________	☒	Tools and equipment necessary for painting and decorating

Surface Preparation

Prepare various types of surfaces preparatory to finishing Time in hours ____________	☒	Types of surfaces and the preparation necessary for each

Paint Mixing

Mix paint for proper color and consistency Time in hours ____________	☒	Principles and techniques of paint mixing

Paint Application

Apply the various types of paint using brush, roller and/or spray Time in hours ____________	☒	Relationship of types of surfaces to paint application

Finishing Wood With Shellac, Varnish, and Lacquer

Apply transparent finishes to wood Time in hours ____________	☒	Characteristics of transparent finishes

Color Harmony

Mix colors to obtain desired color Time in hours ____________	☒	Characteristics of colors and their relationship in harmonious combinations

Color Styling

Select colors which camoflauge or accentuate surfaces appropriate for the immediate environment Time in hours ____________	☒	The relationship of color to the environment

Special Finishes

Produce finishes which represent metal, marble, wood grain, etc. Time in hours ____________	☒	Special finishes and where they are used

Wall Coverings

Prepare surface and apply wall coverings Time in hours ______________	☒	Tools, equipment, and preparation necessary for applying wall coverings

Estimating

Estimate materials necessary and costs for specific jobs Time in hours ______________	☒	Factors involved in cost and materials estimating

---

Code for employer's use in marking student's progress:

Performed some operations in area	☒	Performed some operations with reasonable proficiency	☒
Performed most operations in area	☒	Performed most operations satisfactorily	☒

TRAINING PLAN AND PROGRESS RECORD
for
PAINTING AND DECORATING

Student's Copy

JOB TRAINING: What the worker should be able to do	Proficiency Shown	RELATED INFORMATION: What the worker should know
Health and Safety		
Inspect tools, materials, equipment, and working area and take proper precautions against hazards Time in hours ____________	☒	Safety practices in the painting and decorating trade
Tools and Equipment		
Select and care for the tools and equipment of the trade Time in hours ____________	☒	Tools and equipment necessary for painting and decorating
Surface Preparation		
Prepare various types of surfaces preparatory to finishing Time in hours ____________	☒	Types of surfaces and the preparation necessary for each
Paint Mixing		
Mix paint for proper color and consistency Time in hours ____________	☒	Principles and techniques of paint mixing
Paint Application		
Apply the various types of paint using brush, roller and/or spray Time in hours ____________	☒	Relationship of types of surfaces to paint application
Finishing Wood With Shellac, Varnish, and Lacquer		
Apply transparent finishes to wood Time in hours ____________	☒	Characteristics of transparent finishes
Color Harmony		
Mix colors to obtain desired color Time in hours ____________	☒	Characteristics of colors and their relationship in harmonious combinations

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Estimating

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---

Code for employer's use in marking student's progress:

Performed some operations in area	☒	Performed some operations with reasonable proficiency	▨
Performed most operations in area	☒	Performed most operations satisfactorily	▨

TRAINING PLAN AND PROGRESS RECORD
for
PAINTING AND DECORATING

JOB TRAINING: What the worker should be able to do	Proficiency Shown	RELATED INFORMATION: What the worker should know
	Health and Safety	
Inspect tools, materials, equipment, and working area and take proper precautions against hazards Time in hours ____________	☒	Safety practices in the painting and decorating trade
	Tools and Equipment	
Select and care for the tools and equipment of the trade Time in hours ____________	☒	Tools and equipment necessary for painting and decorating
	Surface Preparation	
Prepare various types of surfaces preparatory to finishing Time in hours ____________	☒	Types of surfaces and the preparation necessary for each
	Paint Mixing	
Mix paint for proper color and consistency Time in hours ____________	☒	Principles and techniques of paint mixing
	Paint Application	
Apply the various types of paint using brush, roller and/or spray Time in hours ____________	☒	Relationship of types of surfaces to paint application
	Finishing Wood With Shellac, Varnish, and Lacquer	
Apply transparent finishes to wood Time in hours ____________	☒	Characteristics of transparent finishes
	Color Harmony	
Mix colors to obtain desired color Time in hours ____________	☒	Characteristics of colors and their relationship in harmonious combinations

Color Styling

Select colors which camoflauge or accentuate surfaces appropriate for the immediate environment

Time in hours ____________

☒

The relationship of color to the environment

Special Finishes

Produce finishes which represent metal, marble, wood grain, etc.

Time in hours ____________

☒

Special finishes and where they are used

Wall Coverings

Prepare surface and apply wall coverings

Time in hours ____________

☒

Tools, equipment, and preparation necessary for applying wall coverings

Estimating

Estimate materials necessary and costs for specific jobs

Time in hours ____________

☒

Factors involved in cost and materials estimating

Code for employer's use in marking student's progress:

Performed some operations in area ☒

Performed some operations with reasonable proficiency ☒

Performed most operations in area ☒

Performed most operations satisfactorily ☒

VT002 097

VT 002 097
Institutional Food Service Supervisor, A Course of Study Designed for Cooperative Part-Time Students Employed in Institutional Food Service.

Karnes, James B., ed.
Missouri Univ., Columbia. Dept. of Industrial Education
Missouri State Dep of Educ, Jefferson City. Ind Educ Sect
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*TRADE AND INDUSTRIAL EDUCATION, *FOOD SERVICE SUPERVISORS, *STUDY GUIDES, *FOOD, *COOPERATIVE EDUCATION, GRADE 11, GRADE 12,

This course of study is designed for use by junior and senior high school students preparing for the occupation of institutional food service supervisor. Local and state subject matter specialists developed, tested, and periodically revised the program. Eighteen assignment sheets, each containing information, assignment, references, and questions, cover (1) The Food Service Supervisor, (2) Nutrition, (3) Function and Source of Food, (4) Menus and Diets, (5) Food Purchasing, (6) Principles of Food Preparation, (7) The Preparation of Food, (8) Serving the Food, (9) Records and Costs, (10) Sanitation, Safety, and Equipment, and (11) Advancement and Career Opportunities. What the worker should be able to do is correlated with what the worker should know in 2-column form. A bibliography of references and progress records for use by teacher, student, and employer are included. The material is to be used by the individual student under teacher supervision for 180 hours. This document is available for $1.50 from Industrial Education, 103 Industrial Education Building, University of Missouri, Columbia, Missouri 65201. (FP)

INSTITUTIONAL FOOD SERVICE SUPERVISOR

A Course of Study

Designed for
Cooperative Part-Time Students
Employed in Institutional Food Service

Issued by

Department of Industrial Education
College of Education
University of Missouri
Columbia, Missouri

In Cooperation with

Industrial Education Section
State Department of Education
Jefferson City, Missouri

MEMORANDUM

TO: The ERIC Clearinghouse on Vocational and Technical Education
The Ohio State University
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Columbus, Ohio 43212

FROM: (Person) James B. Karnes (Agency) University of Mo. at Columbi

(Address) 103 Industrial Education Bldg., Columbia, Mo.

DATE: September 26, 1967

RE: (Author, Title, Publisher, Date) Industrial Education Dept., Univ. of M
at Columbia, FOOD SERVICE SUPERVISOR (INSTITUTIONAL), cooperative
with Industrial Education Dept. (U. of Mo. at Columbia) and
Missouri Dept. of Education

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Necessary x
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REFERENCES FOR INSTITUTIONAL FOOD SERVICE SUPERVISOR

A. American Hospital Association, Hospital Food Service Manual, 840 North Lake Shore Drive, Chicago 11, Illinois, 1954. $6.00 (14)*

B. Peyton, Alice B., Practical Nutrition, J.B. Lippincott Company, East Washington Square, Philadelphia 5, Pennsylvania, 1962. $3.00-paperbound** (12)*

C. American Home Economics Association, Handbook of Food Preparation, 1600 Twentieth Street, N.W., Washington 9,D.C., 1959,50¢ (6)*

D. American Dietetic Association, The, Food Facts Talk Back, 620 North Michigan Avenue, Chicago 11, Illinois, 1957. 50¢ (1)*

* Frequency of use in assignments.
** School discount

FOREWORD

This course of study, consisting of an analysis of INSTITUTIONAL FOOD SERVICE SUPERVISOR together with the assignment sheets covering the related (occupational) information to be taught by the school has been prepared for teaching Institutional Food Service Supervisor on an individual basis in a cooperative part-time program.

The original analysis and assignment sheets were prepared by Dr. Carl R. Bartel, formerly Research Assistant in Industrial Education at the University of Missouri. This revision was prepared by Mr. Nevin E. Andre, Research Assistant in Industrial Education at the University of Missouri.

We acknowledge the assistance of Mr. Ted O. Lloyd, Executive Director, Missouri Hospital Association, Jefferson City, Missouri; Miss Evelyn Carter, formerly Dietary Consultant, Missouri Division of Health, Jefferson City, Missouri; Dr. Margaret W. Mangel, Professor of Home Economics at the University of Missouri; Miss Dorothy L. Vorhies, formerly Director, Department of Nutrition and Dietetics, University Medical Center, Columbia, Missouri.

We wish to acknowledge our indebtedness to Dr. H. H. London, Professor of Industrial Education at the University of Missouri, for the direction and administration of the Curriculum Materials Laboratory in which this material was prepared, and to Mr. James B. Karnes, Instructor in Industrial Education at the University of Missouri, who supervised the preparation of the material and edited the manuscript. Credit is due to Dr. H. Pat Wardlaw, Assistant Commissioner of Education, Mr. Merton Wheeler, Director of Industrial Education, and to other staff members of the State Department of Education for their efforts in the development of the Industrial Education Curriculum Series of which this course of study is a part.

HUBERT WHEELER

Commissioner of Education

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TABLE OF CONTENTS

Assignment Sheets:

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INTRODUCTION

In preparing this course of study, it has been assumed that the attainment of occupational competency in any type of work involves three different, yet closely related, types of learning. They are:

1. Mastery of the practical job skills and procedures performed by the worker in the occupation.
2. Comprehension of the technical and related information basic to an intelligent understanding and practice of the occupation.
3. Development of those personal-social traits which are essential for the successful worker.

The first group of these "learning units"--the job skills and procedures--has been arranged in the analysis under the heading of "Job Training." The second group of learning units--the technical and related information--has been arranged under the heading of "Related Information." And the third group--the personal-social traits--has been listed under"Personal-Social Traits Essential for the Food Service Supervisor"in the introductory section addressed to the student.

In a cooperative educational program it is necessary for both cooperating agencies--the school and the employer--to understand clearly just what each is to be responsible for in the training of the student-worker. Experience has shown that most of the practical job skills and procedures of an occupation can best be learned through supervised work on the job. Experience has shown also that the school can best teach most of the technical and related occupational information needed by young student-workers. This division of responsibility has been made in the arrangement of the course of study; that is, it is expected that the student-worker will master the job sills and procedures through practical work on the job under the immediate supervision of the employer,and that he will receive instruction in related occupational information in the school under the direction of the coordinator.

Skills and related information are matters for direct instruction, but personal-social traits are acquired only through practicing them during the process of acquiring skills and information and in one's daily conduct. Therefore, both the employer and the school, as well as the home, must assume responsibility for developing in the student-worker those habits, attitudes and character traits which are essential for success in his occupation and in life. Both the employer and the school should be constantly on the alert to see that the the student-worker places desirable interpretations on his experiences and that he does not practice habits and exhibit character traits detrimental to his success.

Since the coordinator's class will be made up of fifteen or more students, each differing from the other significantly, studying a dozen or more occupations which differ markedly in their requirements, it follows that it will be impossible for him to teach, through the group method, the occupational information which relates to the specific job of each student-worker. In order to be effective, this type of instruction must be individualized. There is, of course, some related information, such as occupational health and safety, workmen's compensation, wage-hour laws, fair labor standards, unemployment compensation, and the like, which is of common interest and concern to all student-workers, and may be effectively taught by the group method. But if the coordinator is to make a real contribution to the in-service vocational education of his students, he must devote a major portion of his classroom instruction to content which deals specifically with the work of each boy and girl enrolled.

With this requirement in mind, and in order to facilitate individual instruction, these assignment sheets have been prepared. Each contains certain record data as to number and range of units covered, introductory paragraphs designed to develop interest, explain the importance of the assignment, and to convey to the student what he is expected to learn, specific assignments including, reading, learning activities and a series of new-type questions designed to check his attainment.

Obviously, it is desirable to teach the related information in the school at the time it will be used most advantageously on the job. This means that the two phases of the student-worker's training should parallel each other in a progressive manner. The coordinator will find the assignment sheets well adapted to this end. He can select from day to day the assignment which covers the informational units related to the work being done on the job. With this arrangement, the coordinator will become, during a major portion of his classroom time, a supervising study and helping teacher.

In selecting books for the course, an effort has been made to restrict the number to an adequate coverage of the material, and to select those of recent publication so that current practices can be consistently presented. It is recommended that copies of these books be secured and kept in the coordinator's classroom for ready use by the student.

The key sheets available in a separate manual have been prepared to enable the coordinator to score quickly the objective tests which are a part of each assignment sheet. These key sheets give the correct answers to the questions, as well as the reference and the page on which each answer can be found. The key sheets should be kept in the coordinator's possession.

TO THE STUDENT-WORKER

Each year many young people enter the field of health service occupations of which the institutional food service supervisor is one type. The food service supervisor has a very important job and carries a great responsibility with regard to the health services of the institution.

The position of the food service supervisor has become increasingly important in the last several decades. The reason for this rise in importance is the increase in skill, techniques and knowledge required concerning nutritional values and acceptable service which is beyond that expected of the head cook or chef. Another eason is the increased responsibilities of the dietitian making it necessary to delegate some of these, concerning food service, to some one responsible individual.

Personal Qualifications of the Food Service Supervisor

The type of work performed by the food service supervisor demands someone who is dedicated to the job and one who is highly concerned with the health and welfare of all with whom contact is made.

An important asset to this type of work is a sound training in and knowledge of food preparation. As important as this is, it is valueless if the trainee is lacking in the appropriate personal and social traits necessary for this work. Before entering into the occupation, the individual should be aware of what is expected in the way of personal characteristics and have the desire to further develop these traits.

Among the personal-social traits essential for the institutional food service supervisor are the following:

Professional Attitude. Professionalism is revealed by the sincerity with which the food supervisor promotes the welfare of and interest in her vocation.

Intelligence. Average or above intelligence is necessary to successful performance.

Responsibility. The food service supervisor knows the responsibilities of the job and performs her duties to the best of her ability at all times.

Dependability. The food service supervisor is punctual, regular in her work habits and does her work well.

Health. The job of the food supervisor requires one who is healthy and an individual who practices and promotes health habits.

Courtesy and Friendliness. A courteous supervisor is civil and polite in all situations. She also exhibits friendliness and cooperation, and has a genuine interest in the welfare of those with whom she comes in contact.

Precision and Accuracy. The health and welfare of many depend on the precision and accuracy with which the food service supervisor performs her work.

Appearance. It is essential to be suitably dressed, scrupulously clean and generally well groomed in this field of food preparation and service.

REFERENCES FOR INSTITUTIONAL FOOD SERVICE SUPERVISOR

A. American Hospital Association, Hospital Food Service Manual, 840 North Lake Shore Drive, Chicago 11, Illinois, 1954. $6.00 (14)*

B. Peyton, Alice B., Practical Nutrition, J.B. Lippincott Company, East Washington Square, Philadelphia 5, Pennsylvania, 1962. $3.00-paperbound** (I2)*

C. American Home Economics Association, Handbook of Food Preparation, 1600 Twentieth Street, N.W., Washington 9,D.C., 1959,50¢ (6)*

D. American Dietetic Association, The, Food Facts Talk Back, 620 North Michigan Avenue, Chicago 11, Illinois, 1957. 50¢ (1)*

* Frequency of use in assignments.
** School discount

ANALYSIS OF INSTITUTIONAL FOOD SERVICE SUPERVISOR

JOB TRAINING: What the Worker Should Be Able to Do	Assign. No.	RELATED INFORMATION: What the Worker Should Know
The Food Service Supervisor		
1. Carry out duties and responsibilities	1	1. Duties and responsibilities of the food service supervisor
2. Prepare a job description	1	2. Duties and responsibilities of all food service personnel
	1	3. Relationship of the dietary department to others in the institution
4. Cooperate and work with others	1	4. Importance of good relationships with others
5. Be ethical in dealing with people	1	5. Essential ethical and personal qualities
6. Maintain physical fitness and personal appearance	1	6. Personal appearance and health
	1	7. Essential training and experience background
Nutrition		
	2	8. Importance of good nutrition
9. Identify signs of good nutrition	2	9. Signs of good nutrition
10. Select foods wisely	2	10. Selection of food
	2	11. Improving food diets and habits
12. Identify food groups	2	12. Food groups
	3	13. Reasons for food fads
	3	14. Relation between food fads and food costs
15. Secure foods and information from reliable sources	3	15. Fallacies about foods and nutrition
16. Follow accepted procedures only	3	16. Misconception and myths about foods and food preparation
Function and Source of Food		
	4	17. Function and source of carbohydrates
	4	18. Function and source of fats

JOB TRAINING: What the Worker Should be able to Do	Assign. No.	RELATED INFORMATION What the Worker Should Know
	4	19. Function and source of protein
	4	20. Function and source of minerals
	4	21. Function and source of vitamins
	4	22. Function and source of water and cellulose
23. Choose foods that contain necessary food components	4	23. Energy needs
	5	24. Function and source of meat, poultry and fish food groups
	5	25. Function and source of milk, cheese and egg food groups
	5	26. Function and source of vegetable, fruit and salad food groups
	5	27. Function and source of desserts, beverage and appetizer food groups
	5	28. Function and source of sandwich, bread and cereal food groups
29. Select essential food of desired values	5	29. Food values
	Menus and Diets	
	6	30. Nutritional needs during pregnancy
31. Consider nutritional needs in menu planning	6	31. Nutritional needs for various age groups
	6	32. Nutritional adequacy
	6	33. Normal or regular diets
	6	34. Modifications of normal diets
	7	35. Relation of menu planning to cost
36. Follow acceptable planning procedures	7	36. Principles of menu planning
37. Plan weekly menus	7	37. Master menus and basic food patterns
38. Plan full liquid and soft diets		
39. Plan menus suitable for various age groups	7	39. Menu patterns for various age groups
40. Plan acceptable menus	7	40. Food acceptance

JOB TRAINING: What the Worker Should Be Able to Do	Assign. No.	RELATED INFORMATION: What the Worker Should Know
41. Check variety, color, and nutritional adequacy in menu planning		
42. Construct suitable recipes	7	42. Construction of recipes
43. Measure ingredients accurately		
44. Record recipes and menus		
45. Use correct menu terminology	7	45. Terminology in menu planning

Food Purchasing

46. Follow institution's purchasing policies	8	46. Policies and procedures in food purchasing
47. Follow acceptable purchasing procedures		
48. Purchase food products with aid of buying guide	8	48. Buying guides to food products
	8	49. Sources of supply
	8	50. Seasonal purchasing
51. Select and purchase quality food products	8	51. Quality, size, grades and checking of food products
52. Check food products carefully before purchasing		
53. Calculate exact food needs	8	53. Calculation of food needs
54. Write food specifications		
55. Check foods received	8	55. Receiving, storing and preservation of purchased foods
56. Plan the storage and store foods carefully		
57. Control humidity and temperature for storage		

Principles of Food Preparation

58. Maintain a clean kitchen	9	58. Principles of food preparation
59. Assist kitchen personnel		
60. Plan, post and follow work schedule	9	60. Planning and facilities for food preparation
61. Plan for food preparation		
62. Deliver food to work units		

JOB TRAINING: What the Worker Should Be Able to Do	Assign. No.	RELATED INFORMATION What the Worker Should Know
63. Initiate and use standardized recipes	9	63. Use of standardized recipes
64. Maintain recipe file		
65. Check quality of food before serving	9	65. Factors affecting quality and food appeal
66. Measure and weigh food accurately	9	66. Weight and volume measurement of food
67. Determine and measure standard portions		
68. Convert measurements		
	9	69. Cooking temperatures

The Preparation of Food

70. Follow correct timing and temperatures in meat, poultry and fish preparation	10	70. Timing and temperature control in meat, poultry and fish preparation
71. Prepare and cook meats	10	71. Methods of cooking meats
72. Prepare and cook poultry	10	72. Methods of cooking poultry
73. Prepare and cook fish	10	73. Methods of cooking fish
74. Place meats, poultry and fish in storage	10	74. Storage of meats, poultry and fish
75. Freeze meats, poultry and fish		
76. Prepare and use meat, poultry and fish leftovers		
77. Follow correct timing and temperature in milk, cheese and egg preparation	11	77. Timing and temperature control in milk, cheese and egg preparation
78. Prepare milk products	11	78. Methods of cooking and uses of milk
79. Cook with milk		
80. Cook with cheese	11	80. Methods of cooking and uses of cheese
81. Prepare and cook eggs	11	81. Methods of cooking and uses of eggs
82. Place meat, cheese and eggs in storage	11	82. Storage of milk, cheese and eggs
83. Follow correct timing and temperatures in vegetable, fruit and salad preparation	12	83. Timing and temperature control in vegetable, fruit and salad preparation
84. Prepare and cook vegetables	12	84. Methods of cooking and preparing vegetables
85. Prepare and cook fruits	12	85. Methods of cooking and preparing fruits
86. Prepare raw fruits		
87. Prepare salads	12	87. Methods of preparing salads

JOB TRAINING: What the Worker Should Be Able to Do	Assign. No.	RELATED INFORMATION: What the Worker Should Know
88. Place vegetables, fruits and salads in storage	12	88. Storage of vegetables, fruit and salads
89. Prepare and use vegetable, fruit and salad leftovers		
90. Follow correct timing and temperatures in dessert, beverage and appetizer preparation	13	90. Timing and temperature control in dessert, beverage and appetizer preparation
91. Prepare desserts	13	91. Methods of cooking and preparing desserts
92. Prepare beverages	13	92. Methods of preparing beverages
93. Prepare and cook appetizers	13	93. Methods of cooking and preparing appetizers
94. Place desserts, beverages and appetizers in storage	13	94. Storage of desserts, beverages and appetizers
95. Freeze desserts		
96. Prepare and use dessert, beverage and appetizer leftovers		
97. Follow correct timing and temperatures in sandwich, bread and cereal preparation	14	97. Timing and temperature control in sandwiches, bread and cereal preparation
98. Prepare sandwiches	14	98. Methods of sandwich preparation
99. Bake breads	14	99. Methods of baking breads
100. Prepare cooked cereals	14	100. Methods of preparing and cooking cereals
101. Serve ready-to-eat cereals		
102. Place sandwiches, breads and cereals in storage	14	102. Storage of sandwiches, bread and cereals
103. Prepare and use sandwich, bread and cereal leftovers		

Serving the Food

104. Follow desirable and acceptable procedures	15	104. Principles of efficient food service
105. Place and remove serving equipment	15	105. Methods and types of food service
106. Set up a tray		
107. Distribute trays to patients		
108. Serve food to personnel		
109. Display food		
110. Clean up service equipment	15	110. Serving facilities

JOB TRAINING: What the Worker Should Be Able to Do	Assign. No.	RELATED INFORMATION: What the Worker Should Know
111. Keep financial records	15	111. Financial and food serving records
112. Keep serving records		
113. Evaluate food service	15	113. The acceptance of food served
114. Secure evaluative information		
115. Adjust serving to individual preferences		

Records and Costs

	16	116. Accounting and purchasing procedures and policies
117. Make periodic reports	16	117. Periodic dietary and food service record and reports
118. Keep general food service records		
119. Determine costs of recipes	16	119. Portion control and costing of recipes
120. Determine costs of portion served		
121. Order food products	16	121. Purchase orders and receiving records
122. Keep purchase and receiving records		
123. Calculate food to be purchased		
124. Classify foods	16	124. Classification of foods and other expenses
125. Classify other expenses		
126. Maintain inventory records	16	126. Inventory and storeroom control
127. Price foods		
128. Maintain orderly storeroom		

Sanitation, Safety and Equipment

129. Maintain self cleanliness	17	129. Personal health and appearance
130. Dress appropriately for work		
131. Handle food with provided utensils	17	131. Handling food
132. Maintain clean facilities	17	132. Sanitary facilities and cleaning procedures
133. Carry out cleaning procedures on schedule		

JOB TRAINING: What the Worker Should Be Able to Do	Assign No.	RELATED INFORMATION: What the Worker Should Know
134. Maintain washing standards	17	134. Cleaning agents
135. Maintain standards of cleanliness	17	135. Sanitation standards
136. Conduct routine inspection	17	136. Care and safe operation of food service equipment
137. Operate food service equipment safely		
138. Keep equipment records	17	138. Equipment records
139. Follow safety regulations	17	139. Hazards, precautions and general safety procedures
140. Conduct safety campaigns		
<u>Advancement and Career Opportunities</u>		
141. Supervise employees and delegate responsibilities	18	141. Principles of personnel management and supervision
142. Orientate staff members	18	142. Staff relations
143. Acquaint self with nearby food serving institutions	18	143. Opportunities as a food service supervisor
	18	144. Opportunities in the dietary field
	18	145. Other health occupation opportunities
	18	146. Training and experience requirements

Assignment
Sheet No. 1

Covering
Units 1-7

THE FOOD SERVICE SUPERVISOR

There are many facets which need to be considered by the person preparing to become a food service supervisor. You, as a food service supervisor, have the opportunity to associate with many congenial people all of whom, like yourself, have a genuine interest in people and their welfare, and a devotion to the service of humanity. The rewards received are not only monetary, but a feeling of being associated with others in a worthwhile undertaking.

The job of the food service supervisor is one that is considered very important and essential in every institution which provides for quantity food preparation. You must know the responsibilities and duties of your job and the relationship it has to the over-all institution. Your success in this occupation requires that you obtain a high degree of skill in not only operating the food area, but also working with and supervising other employees. To do this you must have the ability to make everyone feel a part of the total organization.

In this assignment you will have the opportunity to learn the duties and responsibilities of the food service supervisor and food service employees, the qualifications considered essential to success and the relationship of this occupation to the total institution.

Assignment:

1. Read the given references listed below.
2. Periodically, throughout your training, rate your progress as a food service supervisor using the "Food Service Supervisor Rating" chart given in Information Sheet No. 1.
3. Answer the questions below and turn in this assignment by ____________________.

References:

A. American Hospital Association, Hospital Food Service Manual, pp. 250-260.
I. Information Sheet No. 1.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. It is essential for the dietitian as well as the food service supervisor to have a basic knowledge and skill in the supervision of workers.

T F 2. Presently, all hospitals have a trained dietitian in charge of the food preparation department.

T F 3. In actual practice, dietitians may serve two or more institutions in a given area.

T F 4. It is essential for a supervisor to delegate certain responsibilities to effect efficient operation.

T F 5. One of the accepted responsibilities of the dietitian is to step in as a "relief" for routine chores and duties.

T F 6. One of the first things to determine when training employees is to decide what you want done and how you want it done.

T F 7. The employee being trained need not follow correct procedures at first because she will have ample time to correct these procedures as she becomes more familiar with her job.

T F 8. Employee training is important both in the large and small hospital, but much more so in the large hospital.

T F 9. One of the steps of procedure in determining the number of workers required is the classifying of workers needed.

T F 10. The administration of general food service is considered the responsibility of the dietitian.

T F 11. The management of therapeutic diets is one of the responsibilities of the supervisor.

T F 12. It is not essential for the food service supervisor to be qualified to assume responsibilities of routine administrative details.

T F 13. One of the responsibilities of the cook may be that of giving instruction to and supervising kitchen helpers.

T F 14. It is desirable for the same person who removes soiled dishes from the eating area to be responsible for returning clean dishes to proper storage area.

T F 15. Duties of a counter worker may be the responsibility of the kitchen helper in some institutions.

T F 16. It is necessary for the dietitian's office to have a record of position and rate of pay for each employee in the department.

T F 17. One advantage of a budget card, in record keeping, is that it gives a continuous listing of individuals successively employed in a particular position.

T F 18. Terms of employment and promotional opportunities are only two of the items which are included in "job specifications."

T F 19. The "work schedule" is designed and used primarily by the dietitian for the control of supervisory staff.

T F 20. Actually, "work schedules" are a means of standardizing work output.

T F 21. College education is not only desirable, but is necessary in order to succeed in the job of food service supervisor.

T F 22. Some experience and training in food preparation will greatly aid one in food service supervisory work.

T F 23. Two personality traits of a food service supervisor are: a genuine interest in people and an interest in the position.

T F 24. Even though good personal appearance is essential for the work which a food service supervisor does, it has little relation to her promotions.

T F 25. It is not necessarily the obligation of the food service supervisor to keep up with current information related to her field.

T F 26. Never should the food service supervisor give out personal information that has come to her attention in the course of her work.

T F 27. The food service supervisor must have the ability to understand individual needs and interpret their attitudes.

T F 28. The total evaluation program of an institution often includes an individual rating of the food service supervisor.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. Dietary consultation programs in recent years have been developed by many ____________ ____________ departments for hospitals and similar institutions.

2. Food service employees should have the ____________ to acquire necessary skills if they do not already have them when employed.

3. In the use of delegated responsibility, each worker must know what ____________ duties are and to ____________ he or she is directly responsible.

4. It is helpful for delegated duties to be put in written form, because written duties are ______________ whereas oral instructions usually ______________ each time they are repeated.

5. The training of employees may be of two major methods; one is by ______________ instruction and the other by ______________ ______________ instruction.

6. Training in a small hospital is usually given as ______________ instruction, whereas it is more frequently given as ______________ instruction in the large hospital.

7. Ideally, the supervisor works under a professionally qualified ______________.

8. The duties of the porter in smaller institutions may be assumed by the ______________ or by an employee from the ______________ or ______________ department.

9. Upon the termination of employment, the employee's personnel record card is placed in the ______________ file.

10. Essential information concerning ______________ of the job and ______________ of the workers are contained in "job specifications."

11. A copy of the "work schedule" should either be ______________ to each employee or ______________ where she can easily see it.

12. Probably the most important purpose of the food service supervisor position is to perform ______________ and ______________ functions delegated by the dietitian.

13. The "watchword" in personal appearance is ______________ ______________.

14. The integrity of the food service supervisor reflects not only on herself but also on her ______________ with whom she works and the ______________ in which she is employed.

15. One of the most important intangible aptitudes of a food service supervisor is the ability to get employees to work ______________, whether under ______________ or not.

16. The service rendered by the food service supervisor must be ______________ and ______________ centered.

17. The greatest value, in rating the food service supervisor as well as other employees, lies in the ______________ to which it has been put after it has been made.

Multiple-Choice

Directions: In the space at the left of each statement, write the letter of the item which will provide the correct answer to complete the statement.

_____ 1. One of the duties not considered that of the dietitian is (A) menu-planning; (B) typing; (C) supervision of departmental sanitation; (D) food purchasing.

_____ 2. One of the duties not considered that of the food service supervisor is (A) employee orientation; (B) efficiency ratings; (C) messenger service; (D) refrigerator inventories.

_____ 3. One of the duties not considered that of the kitchen helper is (A) salad making; (B) testing of recipes; (C) assigned cleaning; (D) pantry work.

_____ 4. One of the duties not considered that of the clerical assistant is (A) issuing supplies; (B) record keeping; (C) periodic inventories; (D) writing requisitions.

_____ 5. One of the duties not considered that of the storekeeper is (A) receiving supplies; (B) storage of supplies; (C) periodic inventories; (D) typing.

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. Qualifications which food service employees should have are:

(A)______________________________

(B)______________________________

(C)______________________________

(D)______________________________

2. The four factors that determine the number of workers in a dietary department are:

(A)_______________ (C)_______________

(B)_______________ (D)_______________

3. Three groups to whom the dietitian often teaches courses are:

(A)_______________ (C)_______________

(B)_______________

4. Information to be provided employees at the time of their employment concerning institutional policies and regulations is:

(A)____

(B)____

(C)____

(D)____

(E)____

(F)____

(G)____

(H)____

5. Records of each employee must be kept in the dietary or personnel office and should include:

(A)____________________

(B)____________________

(C)____________________

(D)____________________

(E)____________________

(F)____________________

(G)____________________

6. Instructions especially concerning diets given to patients, staff, etc., whether written or oral need to be:

(A)____________________

(B)____________________

(C)____________________

(D)____________________

7. The four main items or factors on which a food service supervisor is rated are:

(A)____________________

(B)____________________

(C)____________________

(D)____________________

Information
Sheet No. 1

THE FOOD SERVICE SUPERVISOR

For the individual who is planning to become a food service supervisor, there are many facets to the work which need to be considered.

Some college education is very desirable for this type of work, but is not absolutely essential. One should be familiar with and have had some training and experience in foods and nutrition, and also supervisory work. Any additional knowledge and experience along the lines of the assignments of this course will be very beneficial to the one entering the position of food service supervisor.

Probably the most important purpose of this position is to perform those supervisory and managerial functions which are delegated by the dietitian. The performing of these functions helps to relieve the dietitian of routine administrative duties and allows the dietitian to focus her attention on major administrative functions of the dietary department.

Ethical and Personal Qualities

Certain ethical and personal qualities are essential if one is to be a success at her work. This is especially true for the food service supervisor.

Personality Traits

1. Must have a genuine interest in people and their welfare.
2. Must be able to work harmoniously with others on the institutional staff.
3. Must be willing to work and shoulder the responsibilities of the position.
4. Must be willing to learn and to accept new responsibilities gracefully.
5. Must be sincere in helping others through avenues of her job.
6. Must have a liking and interest for the position of food service supervisor.

Personal Appearance

1. The food service supervisor must maintain a neat appearance at all times.
2. Personal cleanliness should be the "watchwork."
3. Personal appearance is an indication to others of the work performed in the food area.
4. The personal appearance of the food service supervisor very often is a determining factor in future promotions.

Ethical Conduct

1. The food service supervisor should devote herself to the service of humanity.
2. The food service supervisor should show a devotion to those under her direction.
3. It is the responsibility of the food service supervisor to keep pace with new information which is being continually added to the field.
4. The food service supervisor should be interested in and contribute to the welfare of the community.
5. The food service supervisor should be loyal to the institution in which she is employed.
6. The food service supervisor should cooperate fully with all associates to attain the objectives of the institution.
7. The integrity and devotion of each food service supervisor reflects not only on herself, but also on the associates with whom she works and the institution in which she is employed.
8. The food service supervisor should hold in confidence all personal matters which come to her attention except those which are pertinent to the welfare of the individuals whom she serves and, in this case, should be relayed to responsible persons only.
9. The food service supervisor must always exercise good judgment in all her dealings with people.

Relations With Others

Since the food service supervisor is definitely concerned with the over-all preparation and the serving of foods, she must constantly be aware of and encourage friendly relations with both the kitchen and staff personnel, and others for whom the food is prepared. It must be remembered that friendly relations must be maintained with whomever the food service supervisor comes in contact. It has been said that one of the most important aptitudes of a food service supervisor is intangible, this being the ability of making employees work harmoniously whether they are under pressure or not. It is very essential that a pleasant atmosphere exists throughout the institution. To this end the food service supervisor can contribute greatly.

The food service supervisor should constantly bear in mind that the service, which she is rendering, must be patient-, customer-, and staff-centered, and that one must understand individual needs and be able to interpret the attitude of the people with whom she works and serves.

Normal and modified diets are designed for individuals. These individuals need to be considered especially in light of their ability to understand and to follow the various types and kinds of diets prescribed. All instruction to patients, staff, etc., whether written or oral, should be presented in such a way as to hold special interest to the one being instructed. These instructions need to be accurate, factual, brief and to the point, and adaptable to the particular individual.

Rating of the Food Service Supervisor

The work of the food service supervisor is often rated as part of the total evaluation program of the institution. The rating may be performed by either the supervisor, herself, or by those under whom she works. The value of the rating lies in the use to which it is put after it has been made. The food service supervisor should review the ratings made and make an honest effort to improve on those points which were rated low and continue to perform well on those points on which she was rated high.

A typical rating scale is shown below. Study it carefully. Remember each point as you begin your training for food service supervisor and continually evaluate your work on each item as you progress.

Food Service Supervisor Rating*

Items	Excellent	Good	Fair	Unsatisfactory	Remarks
A. Skill					
1. Knows and applies principles of good nutrition and diet therapy					
2. Knows and applies principles of good cookery					
3. Has developed accuracy and reasonable speed and is able to meet deadlines					
4. Is skillful in clerical procedures. (Can chart food orders and order supplies accurately)					
5. Can arrange work for self and others					

Items	Excellent	Good	Fair	Unsatisfactory	Remarks
6. Practices economy in use of material and time					
7. Insists upon principles of good sanitation					
8. Is concerned with safety of patient and personnel					
9. Directs tray setups, cafeteria lines and table service using guides provided					
B. Dependability					
1. Reports on and off duty at scheduled time					
2. Never leaves work area except with supervisor's approval and can always be found in area where needed most					
3. Is conscientious about using sick leave					
4. Completes work even though not under immediate supervision					

Items	Excellent	Good	Fair	Unsatisfactory	Remarks
5. Is careful in checking and receiving supplies and does not issue food or supplies without proper authorization					
6. Follows through on assignments					
C. Personal Qualifications					
1. Is well groomed and in correct uniform					
2. Knows and practices good health habits					
3. Is in good physical and mental health					
4. Is loyal to supervisor and respects authority					
5. Is well mannered (toward patients, visitors, staff and co-workers)					
6. Is co-operative (good team- worker)					
7. Accepts re-assignment and varied tests willingly to achieve maximum production					

Items	Excellent	Good	Fair	Unsatisfactory	Remarks
D. Leadership					
1. Works well with others					
2. Listens to employees' grievances and refers them to proper channels					
3. Accepts constructive criticism and follows through					
4. Instructs each new employee carefully and correctly					
5. Develops employees and helps them to be ready for advancement					
6. Plans work impartially so that the bulk of work is divided fairly among the employees					
7. Has the respect of those supervised					
8. Is able to discipline employees when necessary					
9. Is able to make decisions and adjust to new situations					

Items	Excellent	Good	Fair	Unsatis-factory	Remarks
10. Develops skill in management techniques					
11. Continues to improve by study and self-evaluation					
12. Is industrious and displays initiative					

* Adapted from the publication, <u>Performance Rating Food Service Supervisor</u>, used by permission of the American Dietetic Association.

Assignment
Sheet No. 2

Covering
Units 8-12

NUTRITION FOR GOOD HEALTH

Good food selection is the cornerstone of good nutrition. In fact, nutrition is one of the most important single environmental factors affecting our personal well-being. We, as human beings, are unfortunate in the respect that we do not have any automatic mechanism to guide us in the proper choice of the foods we eat.

Nutrition may be defined as "the science of nourishing the body properly" or may be a term used to refer to the "nutritional status, that is the condition of the body." Another definition which is more comprehensive is "the combination of processes by which the living organism receives and utilizes the materials necessary for the maintenance of its functions and for the growth and renewal of its components." From this the food service supervisor can see that a knowledge and correct use of nutitional principles are essential.

In this assignment you will have the opportunity to learn the importance of nutrition and how it is related to good health.

Assignment:

1. Read the references listed below.
2. Rate your present diet for at least one day. Use the "Food Selection Score Card" (See B p. 16).
3. Answer the questions below and turn in this assignment by ______________________.

References:

B. Peyton, Practical Nutrition, pp. 3-17.
I. Information Sheet No. 2.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. The purpose of food is nourishment for the human body and it has very little effect on a person's morale.

T F 2. Presently much emphasis is placed on the relation of one's weight to his height as a means of judging nutritional status.

T F 3. Nutritional facts as related to health are changing constantly due largely to new discoveries being made.

T F 4. School lunch programs are helping to improve the nutrition of many people.

T F 5. Education concerning nutrition is an accepted function of various health agencies, but very seldom thought of as a function of hospitals.

T F 6. One may often find a nutritional program operating in various kinds of larger industries.

T F 7. Many large companies conduct or sponsor research in nutrition; the public seldom benefits from this since very little of it is made available to them.

T F 8. The Food and Nutrition Board was established to advise the government on matters of food nutrition.

T F 9. According to <u>Food, The Yearbook of Agriculture 1959</u>, about 25 per cent of our nation's households have poor diets.

T F 10. Ascorbic acid-rich fruits are grapefruit and oranges.

T F 11. It is generally accepted that one can work and think better when enjoying good health.

T F 12. Nutrition may be defined as the science of food and its relation to health.

T F 13. The combination of foods with the indicated number of servings (from the "Basic 7 Group") supplies the essential nutrients to meet daily requirements.

T F 14. "A Daily Food Guide" plan is a more recent guide to meal planning than the "Basic 7 Plan."

T F 15. When using the "Daily Food Guide," one should choose at least the minimum number of servings from each broad group.

T F 16. Foods chosen to round out the meals (using the "Four Group Plan") should be from foods not listed in these groups.

T F 17. Each individual should attempt to have some meat, poultry, fish, eggs, or milk at each meal.

T F 18. Communities have developed in certain areas largely due to the settling of people to work the land in order to grow the foods needed.

T F 19. There have been comparatively few discoveries involving minerals and vitamins during the present century.

T F 20. Individuals may survive a week or more without food and with little or no bodily changes occurring.

T F 21. It is true that some individuals who follow poor dietary practices may look healthier than those who follow prescribed diets.

T F 22. Individuals must continually adjust their food habits as they grow older since their nutritional needs are constantly changing.

T F 23. The average life span has increased approximately 20 years since the beginning of this century.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. A person who is in good physical and mental health should have a radiant _______________ ___ and abundant _______________.

2. An effective measure in the improvement of a child's health is the serving of a _______________ _______________, in a school lunch program, to supplement the home diet.

3. Nutritional programs in industry have helped to cut down _______________ and _______________ and generally have increased the output of workers.

4. Guides for various nutrients needed have been set up by a board in the United States called the _______________.

5. In the guide for meal planning, "Basic 7 Food Groups," the foods are divided into groups which are _______________ in food composition and which serve the _______________ function in the body.

6. The "Basic 7" was developed to be used as a guide for the selection of _______________ foods.

7. Sugar, cream, salad dressing, starchy foods and rich desserts should be used sparingly in the diet because they do not always carry added _______________ and _______________.

8. Even though there is an abundant food supply in the U.S., surveys show that diets could be improved, particularly by including more nutrients such as _______________ and _______________.

9. A Daily Food Plan requires a ______________ or a ______________ vegetable at least every other day.

10. As early as the 18th century scientists were aware of the relationship between respiration and the ______________ of food.

11. The human body has many ______________ and ______________ devices which aid it in compensating for poor dietary practices.

12. Poor diets have less effect during ______________, a period of slow growth, than they do during ______________ , a period of rapid growth.

13. At the present time more and more emplasis, as concerned with health, is being placed on ______________ measures and less and less on ______________ measures.

14. Individuals who do not eat properly become less active, their eyes become ______________, their growth is ______________, their life is ______________ and their muscles tend to ______________.

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. The American Dietetic Association lists 13 outward signs of good nutrition; these are:

(A) ______________________________

(B) ______________________________

(C) ______________________________

(D) ______________________________

(E) ______________________________

(F) ______________________________

(G) ______________________________

(H) ______________________________

(I) ______________________________

(J) ______________________________

(K) ______________________________

(L) ______________________________

(M) ______________________________

2. The three international groups who are interested in nutrition are:

(A)______________________________

(B)______________________________

(C)______________________________

3. After the nutritive values are satisfied in the selection of foods from the "Basic 7," it may be necessary to provide for additional caloric requirement. This may be done by:

(A)______________________________

(B)______________________________

4. Nutrients found most frequently below the recommended amounts are:

(A)_______________ (C)_______________

(B)_______________ (D)_______________

5. Diseases rarely seen in this country because people can afford good diets are:

(A)_______________ (D)_______________

(B)_______________ (E)_______________

(C)_______________

6. A food is a substance which meets the following needs of the body:

(A)______________________________

(B)______________________________

(C)______________________________

7. Eight factors which stand in the way of good nutritional practices and food habits are:

(A)_______________ (E)_______________

(B)_______________ (F)_______________

(C)_______________ (G)_______________

(D)_______________ (H)_______________

Information
Sheet No. 2

NUTRITION FOR GOOD HEALTH

Background

All human beings have been and still are greatly concerned with three basic factors: shelter, clothing and food. People in early times obtained their needed nutrition through the gathering of wild native foods as they moved from one place to another. There is evidence that communities, towns and cities have developed due to the settling of people in particular areas for the purpose of cultivating and working land so as to derive the foods needed.

There were many theories developed in these early days as to the values of various food. Some of these have actually been recorded in different chapters of the Bible as well as in other historical writings. During the eighteenth century, when many concepts were changing, scientists began to recognize the relationship of the respiration process to the metabolism of food. Later a great amount of interest developed in the energy or calorie value of foods, especially the carbon-bearing carbohydrates, fats and proteins. During the first half of this century, many discoveries have been made concerning minerals and vitamins and their important role in bodily environment. One of the chief contributions during this period was a caloric requirement chart for different age groups.

Nutrition, a Concern of All

Food does maintain life. A man can live for quite some time without food although profound chemical changes occur within three days without food. Death is an inevitable result of starvation, and even today it is true that many are dying because of starvation.

Good nutritional status is noted when man benefits from the intake of a well-balanced diet. Many of the ailments that befall our population, especially the middle-aged as compared to youth, may be the ultimate toll being paid for poor diets. The human body has many reserves and safety devices, but it cannot stand an indefinite amount of abuse. The poorly nourished individual is a focal point of infection. Often the effects of a poor diet are not evident. It is true that at times individuals, whose diets have been poor, look healthier than those who seem to follow good dietary practices. This may be due to the fact that some can adjust, temporarily, to poor diets and also that all individuals do not have the same needs.

Poor diets definitely have different effects on individuals at varying ages. At an age when growth is slow, such as during childhood, poor dietary practices have less effect than at ages in which spurts of growth take place, such as during adolescence. This indicates that individuals must adjust their food habits as they grow older since nutritional needs and food habits do change with age.

Several factors which tend to stand in the way of improving nutritional practices and the changing of food habits are the following:

1. Food propaganda (fads)
2. Poverty
3. Public that is not informed
4. Prejudices and biases
5. Public unconcern
6. Fraudulent practices
7. Lack of food legislation
8. Food habits of different races

Progress in Nutrition

Public health, scientific research and medical care have brought dramatic changes and progress in the health of the world's people. The increase in longevity is indicative of this improvement. The average life span in 1900 was about 50 years whereas today it is approximately 70 years. The control of preventable diseases has been one of the most important factors in the progress and especially is this true for the young people. Nutrition has played a large part in this. More and more attention is put on preventative measures and less and less on curative. This has brought nutrition to the front as all-important to our civilization.

Individuals who do not eat properly tend eventually to result in the following:

1. Behavior and personality changes
2. Deterioration of the muscles
3. Individual becomes less active
4. Skin becomes dry and grey
5. Growth of individual is usually stunted
6. Eyes and hair usually become dull
7. Shortened life
8. Susceptible to illness
9. A lack of coordination
10. A loss of radiant health

Assignment
Sheet No. 3

Covering
Units 13-16

FOOD MISINFORMATION

There are no magical properties contained in the foods we eat. Superstitious beliefs about foods have been handed down through the ages, and people tend to hold onto these beliefs and to champion them with unreasoning prejudice. Most of the "old wives' tales" concerning certain foods and their so-called special properties are highly fanciful and generally can be shown to be absurd.

Often due to food faddists, sound and competent advice about food has been discredited since the average person seems unable to discriminate between those who know what they are talking about and those who do not. This is especially true during the present century with the great increase in advertising. Food misinformation not only deprives believers of adequate diets, but also encourages the waste of money.

In this assignment you will become acquainted with fallacies about foods and nutrition and will have the opportunity to learn the facts concerning these fallacies.

Assignment:

1. Read the references listed below.
2. Make a list of any prejudices that you have against the eating of certain foods or combinations of foods. Are these prejudices warranted in light of the facts?
3. Make a list of superstitions, prejudices, fads, etc., which you find among other people. Which of these have some basis in fact and which do not?
4. Answer the questions below and turn in this assignment by ____________________.

References:

B. Peyton, Practical Nutrition, pp. 135-143.
D. American Dietetic Association, Food Facts Talk Back, pp. 1-32.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. One reason why food fads and fallacies flourish is that many people want them, like them and blindly follow them.

T F 2. The so-called new "medicine man" often uses the radio and television rather than the newspaper largely because of legal reasons.

T F 3. The problem with food fads is not that they are harmful, but that they are so costly to the individual who believes in them.

T F 4. Taking all factors into consideration, it is just as beneficial to take vegetables in liquid form as it is to eat the raw food.

T F 5. The major claim made for "raw sugar" is the iron content which it has.

T F 6. There are many claims made for blackstrap molasses; one statement which is definitely true is that it has a high laxative quality.

T F 7. It is possible for normal individuals to get an adequate supply of needed vitamins from a balanced diet without taking vitamin concentrates.

T F 8. Many of the reducing drugs are scientifically unsound and potentially dangerous; in fact, there is no known drug which will directly cause weight loss.

T F 9. One acceptable way to aid reducing is by the use of laxatives.

T F 10. Due to the tremendous development in science and medicine there are very few people who believe in the magical properties of food.

T F 11. In early days it was believed that the souls of people resided in certain foods.

T F 12. Besides herbs, flowers and fruits have also been considered to possess various kinds of medicinal powers.

T F 13. The grinding of flour at home as compared to commercial grinding has an advantage in that more food value is retained.

T F 14. The use of rice plus a regular diet is considered by authorities as a cure for high blood pressure.

T F 15. Pinworm is caused by contaminated food and not by the eating of raw potatoes as many believe.

T F 16. Dry cereals do supply body energy but are not considered as more important than cooked cereals.

T F 17. Lemon juice added to sugar tends to lower the caloric value, therefore allowing it to be used in a diabetic diet.

T F 18. It is an accepted fact that the color of the eggshell is related to the nutritive value of the egg.

T F 19. The practice of eating an egg every day can be harmful even to a healthy individual.

T F 20. Even under normal circumstances, it is considered dangerous to eat when taking sulfa drugs.

T F 21. The meat of wild rabbits, which is diseased caused by bacterium tularense, may be rendered harmless by thorough cooking.

T F 22. Gelatin could very easily be used as the sole source of protein in the diet.

T F 23. We do have foods which are specifically designed to build special tissues of the body.'

T F 24. It is not too difficult to obtain an adequate supply of protein from fruits and vegetables.

T F 25. It is true that starvation for a few days has little if any effect on the mental activity of an individual.

T F 26. Generally, proteins and starches should not be eaten together at the same meal.

T F 27. Fats from all foods are digested equally well; that is, fat from one food is not harder to digest than from another.

T F 28. Actually, frozen orange juice is very similar to fresh, as to nutritive value.

T F 29. It is an accepted fact that some foods destroy body tissue.

T F 30. One must be very careful in serving certain fruits and vegetables since some do cause polio.

T F 31. After having opened a can, food should not be left in it as this will be dangerous to those who consume the food.

T F 32. Less milk per day is recommended for adults than for children.

T F 33. It is true that boiled milk is more digestible than raw milk.

T F 34. Foods that can be safely eaten separately can also be eaten in combination without harm.

T F 35. Water is fattening since two-thirds of the total body weight is made up of water.

T F 36. The addition of cream changes the stimulating effect of coffee.

T F 37. Excessive quantities of certain vitamins can be harmful, especially to young children.

T F 38. It is true that fat is the body's way of storing excess foods.

T F 39. The advantage of the three-day prune diet as compared to the banana and skim milk diet is the provision of needed vitamins.

T F 40. There are certain drugs available that do aid a person to lose weight.

T F 41. It is advantageous to use toast in a reducing diet because it has fewer calories than bread.

T F 42. It is as important <u>when</u> you eat foods as <u>what</u> you eat in attempting to lose weight.

T F 43. There is no such thing as fattening or non-fattening foods.

T F 44. We now have scientific proof that certain foods taken during pregnancy will mark the child.

T F 45. Cravings for certain foods indicate a need of these foods.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. The main difference between a food fact, a fad and a fallacy is that a food fact has some ______________ ______________, a food fad is like a fashion and will soon be replaced by some ______________ ______________, a fallacy is one handed down from one ______________ to another.
2. "Live salt," a food quack's product, is a mixture of __________ ______________ with ordinary table salt.
3. Weight reduction is possible only when the food intake is ______________ than the ______________ expended.
4. Whether one food can be substituted for another depends upon the similarity in ______________ ______________.
5. In so-called "de-starched" or "low calorie" potato chips, the ______________ contributes more calories than the ____________ does.

6. Both beef and pork liver compare favorably to protein and calorie content, although beef liver contains more ___________ whereas pork liver contains more _______________.

7. The fertility of soil affects both quality and quantity of food products, although if affects the _______________ more than it does the _______________.

8. Vegetable juices and vegetables themselves are similar in nutritive values; the importance of whole vegetables is that they are a _______________ of _______________ in the diet.

9. Extensive corrosion on the inside of cans of certain canned fruits or vegetables imparts a _______________ taste and usually indicates that they have been packed for a ____________ or more.

10. Carbonated beverages contain ________ to _________ calories per cup.

11. Fat furnishes approximately ______________ times as many calories as proteins.

12. A safe and efficient diet is built around liberal amounts of _______________, _______________, _______________, ____________, and _______________ and limited amounts of _______________ and _______________.

13. The disadvantage of the egg diet is the inadequate provision of _______________.

Multiple-Choice

Directions: In the space at the left of each statement, write the letter of the item which will provide the correct answer to complete the statement.

_____ 1. Profits which a food quack receives from his enterprises are (A) considered average; (B) small; (C) large; (D) enormous.

_____ 2. The American Dietetic Association has recorded approximately (A) 150; (B) 175; (C) 200; (D) 225 baseless food superstitions.

_____ 3. Vitamin preparations (A) cannot; (B) may; (C) often do; (D) seldom do take the place of foods.

_____ 4. Of the following foods, all are high in starch, vary in vitamin and mineral content, but only one contains vitamin C; this is (A) white rice; (B) spaghetti; (C) macaroni; (D) white potatoes.

_____ 5. Properly cooked meat has more nutritive value when prepared (A) rare; (B) medium rare; (C) well done; (D) any of the three methods.

_____ 6. The calorie content of butter as compared to margarine (A) is the same; (B) is higher; (C) is lower; (D) always varies.

_____ 7. Homogenized milk (A) is superior to pasteurized milk; (B) contains no fat; (C) contains more cream than whole milk; (D) is actually whole milk.

_____ 8. Weight for weight, sugar has (A) less; (B) same; (C) more; (D) either less or more caloric value than starch.

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. "Pseudoscientists" or "food quacks" are a group of people who have taken the place of the former "medicine man" and often call themselves:

(A)_____________________ (C)_____________________

(B)_____________________

2. Many current reducing "nostrums" are actually candy and food, the ingredients of which are:

(A)_____________________ (E)_____________________

(B)_____________________ (F)_____________________

(C)_____________________ (G)_____________________

(D)_____________________ (H)_____________________

3. The chemical names for energy producing foods are:

(A)______________ (B) ______________ (C)______________

Assignment
Sheet No. 4

Covering
Units 17-23

FUNCTION AND SOURCE OF FOOD I

The human body's needs can easily be compared with the needs of an automobile engine. As the engine can operate for awhile without fuel, repairs, lubrication, etc., so can the body operate without the necessary and essential foods; but the lack of them will definitely interfere with bodily processes and eventually do permanent damage.

Most of the foods we eat contain a combination of constituents necessary and essential for the nourishment of the human body. Each one of these furnished by food has a specific contribution to make but the use of any one by the body is dependent on a proper balance of all the others. No one is more important than any other. These constituents, specific substances, chemical units, etc., of foods are important to all individuals for health, energy and growth.

In this assignment you will have the opportunity to learn the functions and sources of the food components; carbohydrates, fats, proteins, vitamins, minerals, water and cellulose.

Assignment:

1. Read the references listed below.
2. Calculate the fuel value (calories) which you consume at each meal for a period of time. (See A pp. 4-18; B p. 38)
3. Answer the questions below and turn in this assignment by ________________________.

References:

A. American Hospital Association, Hospital Food Service Manual, pp. 4-18.
B. Peyton, Practical Nutrition, pp. 18-79.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter"F."

T F 1. Carbohydrates furnish a supply of energy more quickly than either proteins or fats.

T F 2. Carbohydrate foods make up a larger percentage of American diets than diets of Europeans.

T F 3. The consumption of sugar in the last three decades has decreased considerably.

T F 4. Sugars depress the appetite and if taken in large amounts are actually detrimental.

T F 5. Beet sugar has a greater sweetening power than cane sugar.

T F 6. The cooking of foods containing starch does very little to aid digestion.

T F 7. Fats give off more heat in the body burning process than either carbohydrates or proteins.

T F 8. Fat is primarily an energy food.

T F 9. The excess consumption of fat may be advantageous or not, depending on the particular individual.

T F 10. It is true that there are some foods which are almost pure fat.

T F 11. All fats are solids at room temperature and need to be heated in order to convert them into liquids.

T F 12. Butter and lard have better keeping qualities and become less rancid than hydrogenated fats.

T F 13. The lower the melting temperature of fats, the more easily they are digested.

T F 14. Lard and most hydrogenated fats have lower smoking temperatures than butter and margarine.

T F 15. Older people who gain weight easily or who have high blood chlorestrol are advised to raise their fat consumption.

T F 16. Margarine is cheaper and contains less food value than butter.

T F 17. A substitute for oils in salad dressings is mineral oil, which is used primarily because it has no caloric value.

T F 18. For all practical purposes, the composition of proteins are the same as fats and carbohydrates.

T F 19. The body can actually manufacture some of the amino acids needed while others have to be furnished by foods.

T F 20. On the average, fruits, vegetables and cereals contribute approximately one-half the daily intake of protein.

T F 21. Timing is very important when supplementing certain protein foods with other protein foods to secure the full value.

T F 22. We have definite proof that diets too low in protein will cause malnutrition.

T F 23. An adult needs approximately three times as much protein per pound of body weight as a growing child.

T F 24. It is commonly accepted that the requirements of protein for one doing muscular work as compared to one who is not, is practically the same.

T F 25. As compared to protein, carbohydrates are a comparatively cheap source of energy.

T F 26. It makes a great difference in protein content whether one uses whole or skim milk.

T F 27. A protein deficiency for a prolonged period of time will cause a loss of weight, strength and appetite.

T F 28. The body stores excess amino acids from protein in the same manner as it stores fats and carbohydrates.

T F 29. One of the factors which may affect the appetite of an individual is being emotionally upset.

T F 30. A calorie is the amount of heat required to raise one gram of water one degree centigrade.

T F 31. It is usually true that foods high in water content are generally low in fuel value.

T F 32. When a person eats the right number of calories to meet his energy needs, his weight does not change.

T F 33. The most important factor which determines the energy requirements of an adult above the basal is the muscular work.

T F 34. Experimentation has shown that purified food nutrients alone are not sufficient to promote good health, but that vitamins are also essential.

T F 35. It is generally conceded that most of the vitamins have been already isolated.

T F 36. Two functions of vitamin A are that it is essential to good health in tissues and necessary for formation and maintenance of tooth enamel.

T F 37. Approximately the same amount of vitamin A is recommended for adolescent boys and girls as for normal adults.

T F 38. A medium sized egg has less vitamin A than one cup of milk.

T F 39. Overdosing with vitamin A may cause serious injury to health.

T F 40. Large amounts of vitamin D are available in a variety of different foods.

T F 41. An overdosage of vitamin D can result in death.

T F 42. It is highly improbable that one will experience a deficiency of vitamin E since it is found in so many of the foods we eat.

T F 43. The need for vitamin C is decreased during the period of adolescence.

T F 44. Citrus fruits are richer in vitamin C, generally, than vegetables.

T F 45. It is recommended that at least one raw food, preferably both a green salad and a fresh fruit, should be taken daily in meeting vitamin C requirements.

T F 46. A food that contains vitamin C very seldom contains any appreciable amount of other vitamins.

T F 47. Water-soluble vitamins cannot be stored, therefore, a sufficient amount must be supplied daily.

T F 48. Pork is a rich source of vitamin B_1.

T F 49. A characteristic of both thiamine and riboflavin is that they aid in releasing the energy of carbohydrates.

T F 50. Minerals, as proteins, help to furnish heat and energy as well as to build bones and teeth.

T F 51. There are indications that calcium aids in extending the life span.

T F 52. As compared to adults, growing children need a higher percentage of calcium.

T F 53. We can assume, if the body has sufficient calcium and protein, that the phosphorus will be adequate.

T F 54. Beans are considered a good, inexpensive source of iron.

T F 55. Sodium and potassium influence all types of muscles in the body.

T F 56. An excess amount of flourine in water tends to increase tooth decay.

T F 57. Due to the acid-base relationship, citrus fruits and milk should not be taken at the same meal.

T F 58. The body can last only three or four days without water, but may go for many weeks without food.

T F 59. Although the intake of water should be from 6 to 8 cups, none of this should be taken with the meal.

T F 60. One disadvantage of cellulose is that it absorbs water which adds to the bulk of digestive residue.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. Carbohydrates and fats are composed of ______________, ______________ and ______________.

2. The germ and outer coating of wheat contain valuable ______________ and ______________ which are removed in making white flour.

3. Not more than _____ to _____ per cent of the daily calories should come from sugar or other sweets.

4. Energy is stored in plants in the form of ______________.

5. Fats should make up at least _____ per cent of the total needed calories.

6. Fat acts as a ______________ in the intestinal tract in the elimination process.

7. As to fat content, one bacon slice equals _____ ______________ of butter, or _____ ______________ of cream cheese.

8. The overheating of fats to be consumed causes irritation to the ______________ of the ______________ and the ______________.

9. Margarine is composed chiefly of ______________ ______________ and must be labeled with the work ____________________.

10. Foods contain many different kinds of proteins, each of which is made up of ______________ ______________.

11. "Complete" or adequate proteins come largely from ______________ sources, whereas "incomplete" proteins come largely from ______________ sources.

12. As a protection against infection, protein is essential to build ______________ and to form antibodies.

13. Factors that have a direct influence on the protein needs of an individual are __________ and __________.

14. The difference between appetite and hunger is that appetite is the ______________ for food while hunger is the ___________ for food.

15. The unit used to measure energy contained in food is the ______________.

16. The Basic 7 Food Plan contains approximately _____ calories, and for an active person it generally varies from _____ to _____ calories.

17. Fat-soluble vitamins may be stored in the body to a greater extent than ______________ vitamins.

18. Skin that is _______ and ________ is an early indication of vitamin A deficiency.

19. A rich source of vitamin A is the ___________ of animals.

20. Green and yellow vegetables are sources of _____________ which is converted into vitamin A by the body.

21. Vitamin _____, that is produced in the skin and in some foods by the rays of the sun, is called _____________.

22. Three factors that influence the thiamine needs are ________ ____________, ______________ and number of ______________ burned daily.

23. It is a good practice to save the water in which vegetables have been cooked since it is often rich in _________________ that are water-soluble.

24. A disease called _______________ results from a deficiency of niacin (B complex group vitamin).

25. Of the various minerals in the body, ____________ is found in largest amounts, most of which is contained in the ______________ and ______________.

26. The most widely distributed mineral in the body is ____________.

27. Hemoglobin is formed by two minerals, _________ and ___________ which combine with protein.

28. The daily requirement of iron for an adult woman is ______ mg. which should be increased to ______ mg. during pregnancy.

29. Iodine is necessary for the normal functioning of the ____________ ______________ which regulates body processes.

30. The chief function of water in the body is its usefulness as a ______________.

Multiple-Choice

Directions: In the space at the left of each statement, write the letter of the item which will provide the correct answer to complete the statement.

_____ 1. The major source of calories for all people is (A) carbohydrates; (B) fats; (C) proteins; (D) vitamins.

_____ 2. Fats are (A) soluble in water; (B) heavier than water; (C) lighter than water; (D) none of the above three.

_____ 3. A food considered protein-rich is (A) egg; (B) cooked cereal; (C) fish; (D) peanut butter.

_____ 4. The vitamin most essential for bone formation along with calcium and phosphorus is (A) A; (B) B; (C) C; (D) D.

_____ 5. The vitamin that has the property necessary for the coagulation of blood is (A) A; (B) K; (C) E; (D) D.

_____ 6. Exposure of milk to sunlight causes great loss of vitamin (A) A; (B) B_2; (C) D; (D) E.

_____ 7. The formation of intercellular substances is a major function of vitamin (A) A; (B) B; (C) C; (D) D.

_____ 8. Vitamin C (A) is easily; (B) is not easily; (C) cannot be; (D) is most easily destroyed as compared to the other vitamins.

_____ 9. A food not considered rich in vitamin C is (A) shrimp; (B) enriched bread; (C) ice cream; (D) milk.

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. Sugars are classified as simple (monosaccharides) and complex (disaccarides). Three classifications under each of these respectively are:

(A)__________________________ (D)__________________________

(B)__________________________ (E)__________________________

(C)__________________________ (F)__________________________

2. Three food groups which yield calories are:

(A)__________ (B)__________ (C)__________

3. Three general uses of vitamins in the body are:

(A)__________

(B)__________

(C)__________

4. Two minerals and one vitamin necessary to prevent rickets respectively are:

(A)__________ (B)__________ (C)__________

5. Cellulose may be found in the following three desirable food sources:

(A)__________ (C)__________

(B)__________

Matching

Directions: In the left hand column is a list of terms. The right hand column contains descriptive phrases or synonymous terms. Match the descriptions to the terms by placing the letter of the descriptions to the terms by placing the letter of the description in the blank at the left of the appropriate term.

Group I

_____	1.	lactose	A.	fatty substance found in blood
_____	2.	sucrose	B.	contained in protein
_____	3.	cellulose	C.	amount of energy necessary to live
_____	4.	cholesterol	D.	prevents scurvy
_____	5.	amino acids	E.	readily soluble sugar
_____	6.	basal metabolimm	F.	One of the first vitamins to be discovered
_____	7.	thiamine	G.	gives rigidity to bones
_____	8.	vitamin A	H.	sugar found in milk
_____	9.	calcium	I.	vitamin necessary for healthy nerves
_____	10.	vitamin C	J.	indigestible

<u>Group II</u>

_____	1.	biotin	A.	rich sources are organ meats
_____	2.	B_{12}	B.	deficiency symptoms of convulsions
_____	3.	folic acid	C.	rich sources are eggs and milk
_____	4.	choline	D.	member of B complex family
_____	5.	pyridoxine (B_6)	E.	deficiency associated with gray hair
_____	6.	pantothenic acid	F.	name means "widespread"
_____	7.	para-aminobenzoic acid	G.	widely distributed in plant and animal tissue

Assignment
Sheet No. 5

Covering
Units 24-29

FUNCTION AND SOURCE OF FOOD II

Why can you feed yourself and others well just by depending on a variety of recommended foods is a question asked by those who are aware of and greatly interested in the function and source of food. What is known today about these various foods is of immeasurable value to our nation's health.

All living things need food, from the tiniest simple-cell spore to man with his highly complex organism. The food man chooses not only supplies his physical but also his emotional needs. The foods we eat can be produced plentifully, kept a long time by various methods and transported great distances. All these factors play a large role in the selection made by the consumer, because it must be remembered that people are not born with certain food likes and dislikes, they are developed. This makes it essential for you, as one engaged in food preparation and service work, to know the function and source of the more common foods.

In this assignment you will have the opportunity to learn the functions and sources of various foods normally consumed in daily diets.

Assignment:

1. Read the reference listed below.
2. Answer the questions below and turn in this assignment by __________________________.

Reference:

B. Peyton, Practical Nutrition, pp. 255-261, 264-267, 271-273, 276-287, 294-300, 302-309, 310-317.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. The sole function of milk in nature is to serve as a food for the young.

T F 2. It has actually been found that milk is relatively high in vitamin C and iron content.

T F 3. The breed of cow is one of the factors which determines the butterfat content of milk while vitamin A content is determined by the feed given the cow.

T F 4. Boiled and raw milk do not have a laxative effect, but boiled milk is more constipating.

T F 5. When on a reducing diet, it is a good practice to cut down on the milk intake since it is considered a fattening food.

T F 6. A cup of fresh whole milk has fewer calories than a cup of ice cream.

T F 7. Cheese that we use in this country is made mostly from raw milk.

T F 8. Eggs not only have a high quality of protein, but also may serve as a meat substitute.

T F 9. Practically all of the minerals and vitamins are found in the yolk of an egg.

T F 10. The size of an egg affects the retail price but does not affect the quality of the egg.

T F 11. Eggs kept in cold storage are desirable for baking purposes rather than table use mainly because of their lower nutritive value.

T F 12. Meat has "satiety" value to which the saying "it sticks to the ribs" may be applied.

T F 13. The consumption of beef in the U.S. is practically equal to all other meats.

T F 14. The fat content of a cut of meat determines the protein content.

T F 15. Liver is not only a good source of some minerals, but also of some vitamins.

T F 16. Even though fish does contain protein it should not be used as a meat substitute.

T F 17. Beef is a meat than is lean, bright red and liberally marbled with fat.

T F 18. Since lamb is a tender meat many of the cuts may be cooked rapidly.

T F 19. Calf liver is more expensive than beef liver mainly because it contains more nutritive values.

T F 20. The liquid in which the fish has been canned should not be used.

T F 21. The cuts of meat that come from the part of an animal receiving the most exercise is the least tender.

T F 22. In using boneless meats, one pound will yield approximately three to four servings.

T F 23. Generally the cheaper grades of meat are just as nutritious as the more expensive.

T F 24. Among the various kinds of cheese, Cheddar cheese is probably the most widely used in this country.

T F 25. Cottage cheese and cream cheese are very similar in nutrient content.

T F 26. All cheese products are a good source of calcium.

T F 27. It has been shown by studies that cheese is much more easily digested than meat.

T F 28. The consumption of cheese, as other foods, varies with different sections and nationalities of this country.

T F 29. Cereal, as a source of calories, is decreasing in this country.

T F 30. Whole-grain bread is a good source of iron.

T F 31. Valuable nutrients are lost in the process of milling flour but all are replaced through the enrichment program (which began and developed during World War II).

T F 32. Enriched flour products are unchanged in flavor when compared to whole-grain products.

T F 33. The keeping qualities of prepared flour mixes have been greatly improved by including a substance which retards rancidity.

T F 34. There is a tendency more and more to add nutrients to breakfast cereals.

T F 35 We have very few quick-cooking variety cereals.

T F 36. It is generally true that cooked cereals are higher in price than ready-to-serve cereals.

T F 37. All commercially made white bread today is enriched.

T F 38. At the present time it is possible to buy a variety of fresh fruits the year around.

T F 39. Fruits may be considered as a rather high energy food.

T F 40. Fresh fruits are very rich in vitamins as well as fat content.

T F 41. Dried peaches, weight for weight, as compared to fresh, have a greater vitamin A content.

T F 42. Fruit is not too easily digested and, therefore, should not have an important place in a patient's diet.

T F 43. Fruit has laxative qualities.

T F 44. Apples not only vary in flavor and firmness, but also in keeping qualities.

T F 45. Bananas should be stored in a cold area such as a refrigerator immediately after purchasing.

T F 46. Fruits to be placed in the refrigerator should be washed thoroughly first.

T F 47. In recent years there has been an increase in use of frozen foods and especially of frozen fruit juices.

T F 48. Due to the concentrated sugar content of dried fruits, they are a wholesome substitute for candy for children.

T F 49. There is no waste in the use of frozen fruit products, which should be considered in computing cost.

T F 50. Fruits and vegetables should be purchased by weight whenever possible.

T F 51. Most of the vegetables contain less than 80 per cent water.

T F 52. Although thin, leafy green vegetables are important for roughage, they contain very little vitamin and mineral values.

T F 53. The nutrient content of vegetables such as beets, celery, corn or onions is small; their contribution to the diet being largely the addition of bulk and flavor.

T F 54. An advantage of green vegetables is that they retain their nutritive content better than other vegetables.

T F 55. "Brand" buying of canned vegetables is one of the best guides to use.

T F 56. One can assume that there is little difference in nutritive value between fresh, frozen and canned vegetables.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. The American Medical Association allows _____ U.S.P. units of _____________ to be added per quart of milk since milk is an ideal food for dispensing it.

2. Adults should have at least _____ cups of milk daily, or its equivalent as evaporated or dried _______ or _______ cheese.

3. The rapidity of digestion and absorption of milk depends on the fineness of the _____________.

4. The composition of an egg is approximately 3/4 water, _______ protein and _______ fat.

5. The color of the yolk is determined principally by the type of ___________ used.

6. Normally grade _____ eggs are used for cooking, while grade ________ eggs are for table use.

7. Meat is not only a valuable source of certain minerals and vitamins, but also a complete source of _____________.

8. It is recommended that ______ ounces of meat should be included in the daily diet.

9. Three factors on which meat is graded are _______________, _____________ and _____________.

10. The U.S. Government grade stamp indicated probably cooking ___________ and _____________.

11. Indications of high-quality pork are greyish pink to rose color and the flesh is ________ and _________-grained.

12. A term used to include heart, liver, etc., (those that are not classed as regular cuts of meat) is __________ ____________.

13. The shrinkage for chickens from live to ready-to-cook weight is approximately ______ per cent.

14. When comparing costs of meat, the lean as well as the amount of ___________, ___________ and ____________ must be taken into consideration.

15. Cheese is actually the __________ of milk which has been separated from the ___________.

16. The cheese lowest in caloric content is _____________ cheese.

17. It is estimated that bread and cereals contribute about ______ per cent of total daily protein and calories.

18. More than ________ per cent of the mineral and _________ per cent of the thiamine is lost in the refined white rice.

19. The reason winter wheat is better for bread making than spring wheat is that it contains a higher _________ content.

20. The nutritive value of breakfast cereals depend upon the degree of ___________ used in preparation and how highly the product is ________________.

21. Fruits are similar to vegetables in that they are an important source of ___________ and _____________.

22. The characteristic flavors of various fruits are due to a number of different organic __________.

23. Of the two types of oranges, the ____________ are juicier while the ___ __________ oranges are seedless.

24. Fruits should be selected for heaviness as compared to size, as this indicates ____________.

25. Dried fruits come in ___________ or _____________ form for jellies and desserts and in ___________ or ____________ form to be cooked like fresh fruits.

26. The _________ of vegetables are high in nutrients; the __________ and __________ are high in energy value; and the shoots and leaves are high in ____________ content.

27. It is generally assumed that the deeper shade of green or yellow in a vegetable, the higher the vitamin ________ value.

28. Large amounts of vitamin C are lost through improper storage and _____________, especially in the case of cabbage.

29. One reason for perforated packages, in which vegetables are packed, is to prevent _____________.

30. Canned vegetables compare favorably with freshly cooked if the canning __________ is used.

31. A disadvantage in the use of dried vegetables for cooking is the loss of ___________ and vitamins, especially vitamin ______.

Multiple-Choice

Directions: In the space at the left of each statement, write the letter of the item which will provide the correct answer to complete the statement.

_____ 1. The content of water in milk is approximately (A) 67; (B) 77; (C) 87; (D) 97 per cent.

_____ 2. Meat obtained from a young calf is (A) veal; (B) lamb; (C) pork; (D) beef.

_____ 3. One and one-half cups of cooked cereal approximates (A) one; (B) one and one-half; (C) two; (D) two and one-half servings.

_____ 4. Fruits are an important source for vitamin (A) A; (B) B; (C) C; (D) D.

_____ 5. Fruit has (A) a high; (B) a low; (C) no; (D) about 50 per cent water content.

_____ 6. Canned orange drink contains (A) more; (B) same; (C) less; (D) no vitamin C as compared to canned citrus fruit juice.

Matching

Directions: In the left hand column is a list of terms. The right hand column contains descriptive phrases or synonymous terms. Match the descriptions to the terms by placing the letter of the description in the blank at the left of the appropriate term.

_____ 1. homogenized milk

_____ 2. vitamin D milk

_____ 3. fluid skim milk

_____ 4. chocolate milk

_____ 5. concentrated milk

_____ 6. cultured milk

_____ 7. evaporated milk

_____ 8. condensed milk

_____ 9. nonfat dry milk

_____ 10. whole milk powder

A. removal of two-thirds of water content

B. removal of one-half of water content

C. contains large amount of sugar

D. buttermilk

E. size of milk fat globules reduced

F. removal of nearly all fat and water

G. subject to rancidity

H. fortified with the antirachitic vitamin

I. contains almost no fat

J. whole or skim milk

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. Three important nutrients contributed by milk are:

(A)____________________ (C)____________________

(B)____________________

2. Eggs are selected on the basis of external and internal quality. External quality is determined by:

(A)____________________ (C)____________________

(B)____________________ (D)____________________

Internal quality is determined by:

(A)____________________ (C)____________________

(B)____

3. In the usual sense of the work, meat includes:

(A)______________ (C)______________ (E)______________

(B)______________ (D)______________

4. Characteristics of good fresh fish are:

(A)____

(B)____

(C)____

5. The general types of cheese are:

(A)____________________ (D)____________________

(B)____________________ (E)____________________

(C)____________________

6. The term "grains" includes:

(A)______________ (C)______________ (E)______________

(B)______________ (D)______________ (F)______________

7. The principal parts of a kernel of grain are:

(A)________________ (B)________________ (C)________________

8. Four different flours produced for special purposes are:

(A)________________________ (C)________________________

(B)________________________ (D)________________________

9. Two main reasons for washing fruits after purchasing are:

(A)____

____

(B)____

____

Assignment
Sheet No. 6

Covering
Units 30-34

ADEQUATE DIETS

An adequate diet is one that is nutritionally adequate; one that provides foods essential for good health. The food supply, especially in this country, is such that everyone should be able to obtain a sufficient variety and amount of food to provide nutrients recommended for good nutrition.

The individual preparing to become a food service supervisor must have a basic knowledge of food values and requirements necessary for various age groups. The supervisor must also know basic food patterns and various modification of these to meet individual and group needs.

In this assignment you will have the opportunity to learn the basic requirements necessary for nutritional adequacy.

Assignment:

1. Read the references listed below.
2. Compare your daily food consumption to the recommended basic food pattern for nutritional adequacy, and discuss the findings with your coordinator. (See A, pp. 19-23.)
3. Answer the questions below and turn in this assignment by ________ ________________.

References:

A. American Hospital Association, Hospital Food Service Manual, pp. 2-3; 19-23; 30-34.
B. Peyton, Practical Nutrition, pp. 95-134.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. One purpose of meal planning is to provide foods essential for good nutrition.

T F 2. For an adequate diet (according to the basic food pattern) an individual should have two servings of vegetables as well as two servings of fruit.

T F 3. Skim milk has the same food value as buttermilk.

T F 4. Two servings of meat or meat alternate are recommended daily (according to the basic food pattern).

T F 5. The outer leaves of cabbage contain less vitamin A than the inner leaves.

T F 6. Cantaloupe and raw pineapple are supplementary sources of ascorbic acid but should not be counted as recommended servings of other fruits.

T F 7. Jellies and rolls are generally considered as additional foods which are used to supplement the basic food pattern for nutritional adequacy.

T F 8. The regular or normal hospital diet is actually the same as a normal diet for adults.

T F 9. Due to the low fiber and connective tissue content, the soft diet is not generally considered adequate.

T F 10. Since protein is important in convalescence, more meat than normally required may be included in the soft diet.

T F 11. It may be assumed that all beverages are allowed in a soft diet.

T F 12. The full liquid, like the regular hospital diet, includes the nutrients required for an adequate diet.

T F 13. Baked custard may be included in a full liquid diet.

T F 14. Orange juice is included in all four standard hospital diets as a breakfast item.

T F 15. Some form of milk product is included in all four standard hospital diets.

T F 16. Studies show that there is a definite relationship between a good diet during pregnancy and good physical condition of the infant at birth.

T F 17. It has generally been found that the pregnant woman is the best fed member of the family.

T F 18. The caloric needs are greatest during the early part of pregnancy.

T F 19. There is a continuous protein need during pregnancy, not only for the mother but also for the growing fetus.

T F 20. Due to the fact that doctors generally prescribe iron salt for expectant mothers, iron-rich foods need not be emphasized in the diet.

T F 21. It is an erroneous belief that increasing the nursing mother's fluid intake will increase the milk supply.

T F 22. Foods high in carbohydrates have been found beneficial in preventing nausea.

T F 23. The caloric requirements of infants is relatively high when compared to the body weight.

T F 24. An advantage of breast feeding is that it provides a safe, suitable milk supply of the right temperature for the baby.

T F 25. Human and cow's milk are both good sources of protein, although human milk contains a greater amount.

T F 26. A baby's formula should be sterilized after it has been put in the bottle and not before.

T F 27. The yolk of an egg is a valuable addition to the baby's diet and is often given when the baby is 3 to 5 months old.

T F 28. Meat, in a baby's diet, is generally started at about the same age as strained vagetables.

T F 29. The recent trend in infant feeding is that of a fixed hourly schedule.

T F 30. The weight of a child may be taken as the reliable factor in judging the nutritional status of the child.

T F 31. Lunches between meals may be desirable for preschool children.

T F 32. Children, one to six, usually prefer their food separate rather than in combination with others.

T F 33. It is generally considered a good practice to use flavored milk to coax a young child to drink milk.

T F 34. The digestion process is affected by over-fatigue and strong emotions.

T F 35. Generally the main difference between the diet of a young school child and the preschool child is that of increasing the quantity.

T F 36. Eating a scanty breakfast is not too detrimental to the school child since he can make up for it easily through the other two meals during the day.

T F 37. During the adolescent period it is perfectly normal for the girl to eat more than her mother.

T F 38. Current fads and styles tend to influence the foods consumed by the adolescent girl.

T F 39. Adolescent boys use up more nutrients than girls, although girls generally do consume more fat and vitamin A.

T F 40. Adolescent girls have a special need for foods rich in protein and iron as well as other nutrients.

T F 41. It is currently recognized that nutrition is a major factor in determining the length of life.

T F 42. The caloric needs and rate of body metabolism both increase for the older age group.

T F 43. It is recommended that the protein intake of an older person continue on the same level as that of a young adult.

T F 44. The vitamin intake of older people should be on the same level or above that taken during the earlier years of life.

T F 45. Limited income and living alone has a great influence on the nutritional habits of older people.

T F 46. It is often desirable to divide the food for a day (for older people) into five light meals rather than three larger ones as this will aid digestion.

T F 47. Older people tend to take liquids in cold form more readily than warm.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. The daily dietary need of both boys and girls 14 years of age is ______ mg. of iron and ________ I.U. of vitamin A.

2. One should have at least ______ servings per day of the "bread and cereal" groups of foods, for nutritional adequacy, (according to the basic food patterns).

3. The recommended amount of milk and milk products for children is from _______ to _______ quart per day (according to the basic food pattern).

4. When a substitution of food is made in the menu of a regular hospital diet, it should be made so as to maintain _____________ value.

5. The soft diet is a modification in ________________ of the normal diet.

6. The basic food pattern for soft diets recommends ______ serving(s) of eggs and _____ serving(s) of fruit.

7. The __________ __________ diet is served postoperatively as a transition diet between the clear liquid and soft diets for patients unable to accommodate solid foods.

8. The __________ __________ diet is intended for short duration and often used postoperatively for 1 to 2 days to supply fluids to the body.

9. Protein needs during pregnancy should come largely from __________ sources.

10. Not only does a quart of milk supply a large calcium percentage but also _______ per cent of daily protein and _______ per cent riboflavin.

11. The lack of iodine during pregnancy may cause cretinism, a disease of retarded ____________ and ____________ development in the young.

12. A nursing mother's diet should include approximately _________ calories above her normal needs.

13. The stomach capacity of a two-week-old baby is _____ ounces or _______ tablespoonsful.

14. An infant at birth has enough of the mineral, __________, to last for several months.

15. Normally, babies are put on simple formulas which include cow's milk, __________ and ______________.

16. A substitute such as ____________ or ____________ milk is sometimes used if the baby is allergic to cow's milk.

17. In the preparation of infant formulas, the cow's milk is diluted with water to reduce the percentage of ____________ and sugar is added to raise the amount of ______________.

18. Orange juice, which is high in vitamin _________, is commonly given as one of the first supplementary foods for infants.

19. A daily food plan for children one to six should include _______ serving(s) of meat and _________ to _______ cups of milk.

20. A "Type A" school lunch, emphasized by the Government is designed to provide from 1/3 to ________ of the growing child's needs.

21. For adolescence, overweight and underweight are both problems, the overweight condition often being due to ______________ problems.

22. Two minerals which are apt to be low in the diet of an older person are __________ and ___________.

23. The recommended weekly allowance for older men and women is __________________ pounds of meat and ______________ pounds of citrus fruits, using the low-cost plan.

24. Foods such as cabbage, beans and fried food should generally be avoided for older people as they might cause ____________ disturbances.

Multiple-Choice

Directions: In the space at the left of each statement, write the letter of the item which will provide the correct answer to complete the sentence.

_______ 1. The following is considered a meat alternate (A) lamb; (B) brains; (C) cheese; (D) turkey.

_______ 2. An individual should have (A) 1; (B) 2; (C)3; (D) 4 servings of butter or margarine per day for nutritional adequacy.

_______ 3. An edentulous diet is (A) same as a regular diet; (B) designed for those who have trouble chewing; (C) one containing no solids; (D) one containing only solids.

_______ 4. A food that should be avoided in a soft diet is (a) milk; (B) egg; (C) grapefruit; (D) corn.

_______ 5. The calcium needs during pregnancy is increased about (A) 50; (B) 40; (C) 30; (D) 20 per cent above that of normal

_______ 6. The first vitamin given to a baby in concentrate form, whether breast or formula fed, is (A) A; (B) B; (C) C; (D) D.

_______ 7. Cereals or fruits are usually the first solid foods given an infant, at about (A) 2-3; (B) 3-4; (C) 4-5; (D) 5-6 months of age.

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. The four standard hospital diets are:

(A)____________________ (C)____________________

(B)____________________ (D)____________________

2. A refusal of food by a young child may be a first sign of an infection; two other factors that may influence a child's appetite are:

(A)____________________ (B)____________________

3. Conditions common to older people that cause a lowered ability to digest, assimilate or eat foods are;

(A)____

(B)____

(C)____

(D)____

(E)____

(F)____

Assignment
Sheet No. 7

Covering
Units 35-45

MENU PLANNING

Meals that are both healthful and attractive do not just happen. Good meals need to be carefully planned. A well-planned menu not only takes into consideration the essential nutrients for various individuals and groups of individuals, but also is concerned with planning that has individual appeal.

Many advantages result from careful menu planning. The successful operation of the food service department is largely dependent on the factor of skillful menu planning in which the food service supervisor plays a major role. Much time and worry is avoided by adequate planning which permits one to take advantage not only of quantity buying, but also special and seasonal buying. It must be remembered that the final stamp of approval or disapproval of menu planning rests with the consumer of foods prepared, whether they be patients, staff members or general public.

In this assignment you will have the opportunity to learn the importance of menu planning, its relation to diets and its relation to the use of basic food patterns or master menus. You will also learn terminology helpful to menu planning.

Assignment:

1. Read the references listed below.
2. Plan or aid in planning a weekly menu for the institution in which you are employed. Discuss the planned menu with your coordinator. (See A pp. 19-29; 35-42.)
3. Answer the questions below and turn in this assignment by ______________________.

References:

A. American Hospital Association; Hospital Food Service Manual, pp. 1-2; 23-29; 35-42.
C. American Home Economics Association; Handbook of Food Preparation, pp. 16-22; 36-49.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter"F."

T F 1. In the process of planning menus, the special needs of the person being served must be carefully considered.

T F 2. If interest and variety are desired, potatoes and noodles should not be served together.

T F 3. The number of food service employees available definitely has an effect on menu planning, whereas the amount of equipment available has very little.

T F 4. In menu planning, a basic menu pattern should be followed.

T F 5. The basic menu pattern generally includes a breakdown of foods to be served for each meal, each day of the week.

T F 6. The week's menu should be planned first, after which the storeroom should be checked for available foods and ordering those foods not on hand.

T F 7. The main course (or meat) is often written in the menu first, after which vegetables and other appropriate foods are added.

T F 8. It is considered good practice to rotate weekly menus in order to have like or similar foods on the same days of each week.

T F 9. The same basic menu could very possibly be served to everyone with modifications of the regular hospital diet for specially prescribed diets.

T F 10. The weekly menu planning sheet generally includes a vertical column containing information concerning the food pattern for the day's menu.

T F 11. When planning meals for children, new foods should be introduced in combination.

T F 12. The weekly menu planning sheet for children is quite different than the one usually used for general hospital use.

T F 13. It is generally true that highly seasoned foods, as well as beverages such as tea and coffee, should be avoided in children's menus.

T F 14. One difference between the basic menu pattern of 10 to 20-month and 20-month to three-year-old children is the inclusion of ice cream in the older children's menu.

T F 15. The menu of a pre-school child should include some foods which require the child to chew.

T F 16. When fish are served to pre-school children, they need not be boneless as in the case of children younger than three years of age.

T F 17. It is considered good practice to serve large enough helpings to children so that they need not ask for seconds.

T F 18. The soft diet is often recommended for the older person who has difficulty in chewing.

T F 19. Serving meals on time and providing for individual differences are two important suggestions which need to be followed when serving older people.

T F 20. Abbreviations should be used whenever possible in the construction or the re-working of recipes.

T F 21. If specific tests or temperatures are written into a recipe, general tests need not be included.

T F 22. The water displacement method may be used when measuring fats or oils used as ingredients in recipes.

T F 23. A one-half teaspoon of powdered foods may be measured accurately enough by using a teaspoon.

T F 24. The difference between processed butter and other butter is that processed butter is made from farm butter and rechurned in fresh milk.

T F 25. A light whipping cream (between 30 and 36 per cent milk fat) is classified as "medium cream."

T F 26. Concentrated milk is classed as evaporated milk.

T F 27. Frozen egg whites generally have ingredients added to improve keeping qualities.

T F 28. Lard is a fat rendered from the fatty tissue of pork and may be light or dark in color.

T F 29. Margarine is actually butter that has been kneaded by machine.

T F 30. Oils that are edible and commonly used in the American home are of vegetable origin.

T F 31. One important difference between durum wheat flour and buckwheat flour is the percentage of gluten-forming proteins.

T F 32. Soy flour is often used for breadmaking, mainly because it has a high protein content.

T F 33. A characteristic of compressed yeast is that the presence of moisture will make it perishable.

T F 34. Soft bread crumbs are generally used in coating foods for frying.

T F 35. Refiner's sirup is the "mother liquor" from which raw cane sugar has crystallized.

T F 36. Of the two sirups, honey contains less water content than maple sirup.

T F 37. The terms "fine granulated" and "extra fine granulated" sugar refer to definite particle size.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. Interest in meals may be stimulated by providing ones that reflect contrasts in flavor, ____________, ____________ and ____________.

2. Of the two meals, dinner and supper, menu planning is often more effective if the ____________ meal is planned first; this is due mainly because it is more ____________ to plan this meal.

3. The weekly planned menu should be posted in the ____________.

4. The weekly menu planning sheet usually contains four horizontal columns which are labeled ____________, ____________ ____________, ____________ ____________ and notes.

5. Meals for children should not only provide daily food essentials but should also satisfy their ____________.

6. The beverage recommended at each meal for children is ________.

7. Foods for children, 10 to 20 months of age, are essentially the same as those included on the ____________ diet.

8. In an effort to stimulate an older person's appetite, ________ is often served as the first course.

9. The constructing of recipes consists of two major parts- a list of ____________ and the method of ____________ the product.

10. When constructing a recipe the yield should be included, giving both the ____________ and ____________ of servings.

11. The basic proportion, for use in menu planning, of tea is ________ cup.

12. The unqualified term "cheese," as used in the United States, means ____________, also called American and American ____________.

13. Frozen blended whole eggs are whole eggs that have been fortified with added ______________.

14. As commonly used, the term "fats" refers to those that are ______________ at room temperature, while the term "oils" refers to those that are ______________ at room temperature.

15. The term ______________ refers to fats that have been rendered in the process of cooking fat meats such as bacon, etc.

16. Unless otherwise stated, the term flour refers to __________ flour.

17. Flour, that may be used for all general cookery purposes, is classed as ______________ or ____________________ flour.

18. A type or class of rice, which is a long, brownish grain and has been hulled but not milled, is called _________ rice.

19. The two forms of tapioca are ____________________ and ________________.

20. A leavening agent produced in a batter or dough by chemical or biological reactions is called ____________ _______________.

21. The unqualified term "sugar" refers to refined sucrose which has been derived from __________ ___________ or ________ _____________.

22. Powdered sugar, which is often used in frosting, usually contains a small amount of ______________ to prevent caking.

Multiple-Choice

Directions: In the space at the left of each statement, write the letter of the item which will provide the correct answer to complete the statement.

_____ 1. The menu planning responsibility is usually delegated (A) to one person; (B) to a small group of kitchen personnel; (C) to two or more administrative staff members; (D) is not delegated.

_____ 2. The following is a description of the "action form" recipe pattern: (A) economical of space; (B) especially food for recipes using many ingredients; (C) not economical of space; (D) none of the above three.

_____ 3. In the construction of recipes, three tablespoons butter plus about seven-eighths cup milk may be substituted for (A) 1 cup honey; (B) 1 cup coffee cream (20 per cent); (C) 1 cup heavy cream (40 per cent); (D) 1 cup butter.

_____ 4. Cultured buttermilk is classed as (A) dry milk; (B) evaporated milk; (C) fermented milk; (D) fresh milk.

_____ 5. Fish that are marketed just as they come from the water are called (A) fillets; (B) dressed; (C) drawn; (D) whole or round.

_____ 6. Flour to which leavening ingredients and salt have been added is (A) whole wheat flour; (B) flour; (C) self-rising flour; (D) enriched flour.

_____ 7. Corn with the hull and germ removed, left whole, or broken into particles is a corn product called (A) corn meal; (B) cornstarch; (C) hominy; (D) corn cereal.

_____ 8. A wheat product which has been prepared from durum wheat and designed for making macaroni is called (A) wheat germ; (B) semolina; (C) farina; (D) cracked wheat.

_____ 9. A chocolate product made from slightly sweetened chocolate and often used in baking is (A) semi-sweet chocolate; (B) cocoa; (C) chocolate; (D) sweet chocolate.

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. Five important factors in menu planning are:

(A)____________________ (D)____________________

(B)____________________ (E)____________________

(C)____________________

2. Advantages of planning menus in advance are:

(A)____

(B)____

(C)____

(D)____

(E)____

(F)____

(G)____

3. The usual procedure in planning and recording menus is to select:

(A)______________________________

(B)______________________________

(C)______________________________

(D)______________________________

(E)______________________________

(F)______________________________

(G)______________________________

(H)______________________________

(I)______________________________

(J)______________________________

(K)______________________________

(L)______________________________

4. In the construction of recipes, the three most used forms of presenting them are:

(A)________________ (C)________________

(B)________________

Matching

Directions: In the left-hand column is a list of terms. The right-hand column contains descriptive phrases or synonymous terms. Match the descriptions to the terms by placing the letter of the description in the blank at the left of the appropriate term.

Group I - Processes

_____	1.	blend	A.	cut into pieces with sharp tool
_____	2.	parboil	B.	to cook in oven or oven type appliance
_____	3.	chop	C.	to sprinkle or coat with flour
_____	4.	whip	D.	brown or cook in small amount of fat
_____	5.	simmer	E.	to destroy microorganisms

_____	6.	bake	F.	free fat from connective tissue at low heat
_____	7.	render	G.	to beat rapidly to produce expansion
_____	8.	fricassee	H.	to moisten foods while cooking
_____	9.	saute	I.	mix two or more ingredients thoroughly
_____	10.	mask	J.	to cook in liquid below boiling point
_____	11.	broil	K.	to boil until partially cooked
_____	12.	dredge	L.	to cook by braising
_____	13.	sterilize	M.	to cover completely with sauce, etc.
_____	14.	baste	N.	to cook by direct heat

Group II - Baking Utensils

_____	1.	sauce pot	A.	large covered cooking utensil with side handles and equipped with jar holder
_____	2.	french fryer	B.	covered or uncovered cooking utensil with bail handle
_____	3.	casserole	C.	round open utensil with flared sides
_____	4.	kettle	D.	consists of two saucepans, each with handle but only one lid
_____	5.	canner	E.	measures a capacity of one-half liquid pint or less
_____	6.	pie pan	F.	a utensil especially designed for baking cake
_____	7.	measuring cup	G.	a covered utensil in which food may be baked or served
_____	8.	double boiler	H.	a covered or uncovered cooking utensil equipped with two side handles
_____	9.	cake pan	I.	uncovered, perforated cooking utensil with meshed insert basket

Assignment
Sheet No. 8

Covering
Units 46-57

FOOD PURCHASING

The purchasing of food products is generally done either by the food service supervisor, the dietitian or a designated purchasing agent. The determination of the placing of responsibility for purchasing depends largely upon the size of the institution as well as the type of institution.

The importance of methods and procedures of purchasing cannot be overstressed. Raw food alone makes up approximately one-fourth of the total outlay for the institution; and, therefore, efficient procedures in purchasing must be followed. The one who is responsible for purchasing must be familiar with writing specifications, grading standards, current prices, marketing procedures, processing procedures, storage of purchased raw food and the keeping of necessary records.

In this assignment you will have the opportunity to learn the many responsibilities involved in purchasing food products and their storage.

Assignment:

1. Read the references listed below.
2. Calculate one week's food requirements (market orders) for the institution in which you are employed. Follow examples given in references. (See C 7-15; A 44-92)
3. Answer the questions below and turn in this assignment by ____________________________.

References:

A. American Hospital Association. Hospital Food Service Manual, pp. 43-132.
B. Peyton, Practical Nutrition, pp. 148-156.
C. American Home Economics Association, Handbook of Food Preparation, pp. 7-15, 55-59.

Questions:

True-False

Directions: The following statements are either true of false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. Yield and price of food must both be considered in purchasing, although price is considered more important.

T F 2. Criteria for determining the best buy should include both the cost per portion and an inspection of quality.

T F 3. Generally the person who prepares food purchase orders is also best qualified to specify the unit of purchase and weight that produce most economical portion serving cost.

T F 4. In calculating the food needs for planned menus, the first step is to prepare a written list of the standard serving portion size for each food.

T F 5. It is generally considered the responsibility of the dietitian to determine the type and quality of food to be used in relation to the menus planned.

T F 6. Direct buying by the individual who is in charge of food service is seldom efficient and economical.

T F 7. More importance should be placed on unit purchase cost than on cost per serving, in making buying decisions.

T F 8. Wholesale suppliers are a good source for food supplies since they carry a variety of food products as well as sort, grade, store and deliver their products.

T F 9. One important factor in determining the frequency of buying is the delivery schedule of the firms.

T F 10. Usually only two purchase orders are made out, one for the dealer and one for the accounting department.

T F 11. In some institutions the checking of foods received is the responsibility of the purchaser.

T F 12. When food products are received, a responsible individual should first sign the receipt after which the delivery should be checked for size, count, weight, quality, etc.

T F 13. The inspection of meats is always done by either federal or state agencies.

T F 14. Meat packers may either use government grading or may use their own system.

T F 15. The term "finish" as used in connection with meats, refers to the general build, shape and contour of the carcass.

T F 16. Processed beef meat products are generally made from USDA Good grade.

T F 17. Almost half of the forequarter of beef is made up into chuck (wholesale) cuts.

T F 18. Commercial grades are very seldom specified for institutional use.

T F 19. The difference in weight is the main basis for distinguishing between veal and calf carcasses.

T F 20. The carcass of lamb is equally divided between hind saddle and fore saddle.

T F 21. The flesh of the best grade of pork is a characteristic dark red in color.

T F 22. Manufactured meat products are generally not graded, and therefore are purchased by brand name only.

T F 23. In specifying poultry products, the terms "dressed" and "ready-to-cook" may be used interchangeably.

T F 24. Federal and/or state inspection is required of all poultry products.

T F 25. Some discoloration is allowed on the breast and legs of chicken for "A" quality.

T F 26. Cuts and tears are permitted for both "A" and "B" quality turkeys.

T F 27. Dressed chicken is usually packed one dozen to a box and, if graded, will indicate weight and quality.

T F 28. Turkeys are packaged like chicken, but may only be purchased as ready-to-cook.

T F 29. On the average, the weight loss of chickens from live to dressed is practically the same as from dressed to ready-to-cook.

T F 30. The shell color of eggs does not have any effect upon the food value of eggs but may have an effect on the price.

T F 31. Although frozen eggs save labor, they are more expensive when compared to equal quantity of fresh eggs.

T F 32. Fresh milk purchased for institutional use should be from an approved dairy and should also be pasteurized.

T F 33. Even though dried milk is economical to use in the preparation of food, one disadvantage is that it is neither graded nor inspected.

T F 34. The American Cheddar cheese is a type of cheese which is largely used on hospital menus.

T F 35. The brand name is often used to indicate the quality of both fresh fruits and vegetables.

T F 36. The recommended standard grade of frozen fruits or vegetables is U.S. Grade AA.

T F 37. It is not only practical but economical to order and purchase canned fruits and vegetables by use of specifications.

T F 38. The use of quality standards for most products is optional.

T F 39. Cheese sold in the retail market seldom includes a quality rating.

T F 40. The quality and weight of eggs are judged together and are so indicated on egg cartons.

T F 41. The grading of fresh fruits and vegetables has been designated primarily for use in the wholesale rather than retail outlets.

T F 42. The cost of meat inspection, whether federal or state, is borne by the packer.

T F 43. The purple shield stamped on a carcass by federal graders must be removed before using the meat.

T F 44. A hardwood floor is the most desirable type for a "dry storage room."

T F 45. Among other items of storage equipment, a worktable should be included in the storeroom.

T F 46. For the storage of dried fruits the humidity should not be more than 45 per cent.

T F 47. Slime and stickiness is formed on meat that has been stored at too low a temperature.

T F 48. Packaged meat should be unwrapped before placing in the refrigerator.

T F 49. Paper wrappings should not be removed from fruit for refrigeration.

T F 50. An indication that bananas have been stored in too cool a temperature is the darkening of the skins.

T F 51. Sweet as well as white potatoes should be stored at a temperature of between 35 to 40 degrees.

T F 52. The development of harmful bacteria in foods is prevented by freezing.

T F 53. There are fewer laws today concerning food processing and sale than during the early part of the nineteenth century.

T F 54. All meat in interstate trade must be federally inspected, whereas meat sold and consumed within a state does not.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. The basic unit on which food orders should be calculated and purchases made is the standard ______________ ______________.

2. Institutional purchasing should be done through competitive bidding, therefore, quotations should be secured from at least _______ desirable suppliers on large orders.

3. In comparing meats to staples, the frequency of buying is greater for _____________ than for ________________.

4. Foods such as milk and bread should be purchased by standing orders, stating the name of firm, unit of purchase, as well as _______________ and_________________________.

5. The hindquarter is _______ per cent while the forequarter is ________ per cent of a beef carcass.

6. The hind saddle of a veal carcass is made up of the __________ and _____________.

7. Cuts of meat made according to buyer specifications are called ____________________ cuts.

8. The two grades of beef, veal and lamb that are most often available in the markets are USDA ___________ and USDA _______________.

9. Fish that have the internal organs and scales as well as head, tail and fins removed are called _____________ fish.

10. The grading of oysters and lobsters is according to __________.

11. The grading of eggs, by the federal government, for quality, is according to ___________ and ______________ appearance.

12. The grading of eggs according to size is based on the __________ per dozen.

13. The two grades of eggs considered most satisfactory for frying are grades ___________ and __________.

14. The three kinds of grades of cream, according to fat content, are ___________, ____________ and ________________ or whipping cream.

15. The classification of cheese intended for use as sandwich spreads are the __________ cheese varieties.

16. Ice cream should contain about ________ per cent butterfat, and should weigh _________ pounds per gallon.

17. Not only must the buyer specify good quality fruits and vegetables, but should also check the ____________ and ___________ or count, as these are important in determining expected number of servings.

18. The term staples refers to foods that are not readily perishable and are kept in __________ __________.

19. U.S. Standards for grades of foods are set up by the U.S. Department of _____________.

20. Large and medium size eggs are commonly found on the market, the difference in weight per dozen is __________ ounces.

21. The food storage area should be located with special relationship to two areas, the ___________ and food ____________ areas.

22. Foods to be stored on the floor level should be placed on racks _______ inches above the floor.

23. Foods, such as cereals and dried vegetables, should be stored in ____________ ___________ ______ with tight-fitting lids.

24. The arrangement of foods in the storeroom should be according to type of ___________.

25. A humidity of from ________ to ________ per cent is recommended for refrigerated storage.

26. The shrinkage of large pieces of meats is about _______ per cent per week, whereas it is _______ per cent for processed meat.

27. Frozen poultry should be stored at a temperature of ________ degrees F. or lower.

28. The Federal Food and Drug Administration approves and issues regulations concerning ____________ additives in foods.

<u>Multiple-Choice</u>

<u>Directions</u>: In the space at the left of each statement, write the letter of the item which will provide the correct answer to complete the statement.

_____ 1. In buying staple foods, the method of buying often considered least efficient is (A) by telephone; (B) through salesman; (C) by mail; (D) by visiting the market.

______ 2. The meat which has the softest fat with lowest melting point is (A) beef; (B) lamb; (C) veal; (D) pork.

______ 3. The grade of beef which is produced more than any other grade is (A) USDA Peime; (B) USDA Choice; (C) USDA Good; (D) USDA Commercial.

______ 4. The grade of veal which has the characteristics of smooth exterior fat and large deposits of fat in the breast and chest is (A) USDA Prime; (B) USDA Choice; (C) USDA Good; (D) other grades.

______ 5. The grade of lamb which has the characteristics of no fat streakings in the inside of the flank muscles, and lean that is dark pink is (A) USDA Prime; (B) USDA Choice; (C) USDA Good; (D) other grades.

______ 6. There are usually (A) 2; (B) 4; (C) 6; (D) 8 fish steaks to the pound.

______ 7. The quality grade of eggs which have the characteristics of reasonably firm whites and yolks free from serious defects is (A) US AA; (B) US A; (C) US B; (D) US C.

______ 8. The grade of butter considered satisfactory for use in institutions is (A) US Grade AA; (B) US Grade A; (C) US Grade B; (D) US Grade C.

______ 9. The box capacity of citrus fruits packed in California is slightly (A) larger; (B) same as; (C) smaller; (D) greatly larger than that in Florida.

______ 10. The temperature in a dry storage room should be (A) 90-100; (B) 80-90; (C) 70-80; (D) 60-70 degrees F.

______ 11. In order to prevent bacterial spoilage of refrigerated foods, the temperature, in general, should be kept at (A) 20-30; (B) 30-40; (C) 40-50; (D) 50-60 degrees F.

______ 12. Bulk or brick ice cream should be kept at (A) 2-6; (B) 6-10; (C) 10-14; (D) 14-18 degrees F. for ease of dipping.

______ 13. In the purchase and use of various dehydrated food products, one must take into consideration the almost complete destruction of vitamin (A) A; (B) B; (C) C; (D) D.

Listing

Directions: List the itmes called for in each of the following. Select your answers carefully.

1. The purpose of systematic planning of food orders is to insure:

(A)____

(B)____

2. The type, kind, amount, etc., of food purchased depends on the following items or factors:

(A)____

(B)____

(C)____

(D)____

(E)____

(F)____

(G)____

(H)____

(I)____

(J)____

(K)____

3. Types of food purchases are usually broken down into four categories, which are:

(A)____________________ (C)____________________

(B)____________________ (D)____________________

4. The quotation sheet used for bids should not only group foods by type of commodity, but also provide space for indicating.

(A)____________________ (C)____________________

(B)____________________ (D)____________________

5. Three factors considered as yardsticks in grading meat are:

(A)______________ (B)______________ (C)______________

6. The term poultry includes:

(A)__________ (C)__________ (E)__________

(B)__________ (D)__________ (F)__________

7. The grading of cheese is based on:

(A)__________ (C)__________ (E)__________

(B)__________ (D)__________ (F)__________

8. The grades of butter depend on the following quality factors:

(A)_______________ (C)_______________

(B)_______________ (D)_______________

9. Three factors that determine the amount of storage space needed for "dry stores" are:

(A)__________ (B)__________ (C)__________

10. The six common ways of preserving food are:

(A)__________ (C)__________ (E)__________

(B)__________ (D)__________ (F)__________

Assignment
Sheet No. 9

Covering
Units 58-69

PRINCIPLES OF FOOD PREPARATION

The manner in which food is prepared has a definite effect upon the success of a meal and its acceptance by those who consume it. A well-organized plan and efficiently arranged facilities make food preparation much more enjoyable to both supervisory and kitchen personnel.

Good food preparation increases the attractiveness of food, conserves nutritive values, increases digestibility, enhances flavor and frees food from injurious organisms and substances. Good food preparation is not possible unless sound principles of food preparation are observed.

In this assignment you will have the opportunity to learn the importance of planning as it applies to food preparation and the various items which must be considered in order that it may be done effectively and efficiently.

Assignment:

1. Read the references listed below.
2. Select one or more recipes and standardize them for use in quantity service (See A: pp. 135-37).
3. Answer the questions below and turn in this assignment by ______________________________.

References:

A. American Hospital Association, Hospital Food Service Manual, pp. 133-138, 193-194, 233-236.
C. American Home Economics Association, Handbook of Food Preparation, pp. 1-6, 22.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. Quality food is not only satisfying to the patient, but also plays a highly important role in restoring his health.

T F 2. The techniques for good food preparation are the same for quantity as for individual or family food preparation.

T F 3. The ideal temperature for bacterial growth is room temperature.

T F 4. In no area in the institution food department is supervision so important as in the kitchen.

T F 5. The scale is used to save time and assure greater accuracy in determining the needed amount of shredded vegetables and other like foods.

T F 6. Standard recipes give complete directions and thus eliminate all guesswork in cooking.

T F 7. It is not necessary to taste all foods before serving.

T F 8. Foods need to be checked routinely for appearance, temperature and acceptability.

T F 9. Garnishing food adds color to the food, which in turn improves the appearance and adds interest.

T F 10. The preparation area should be located between the storage and pre-preparation area.

T F 11. A partition should be placed between the cooking facilities in the kitchen.

T F 12. Cooking facilities should be located in the center of a kitchen to make it more accessible around which employees may work.

T F 13. An aisle space of about six to seven feet should be between the range and the cook's table in the kitchen.

T F 14. As menus become more complex and institutions increase in size, less cooking equipment will be needed.

T F 15. It is desirable to have the baker's work table with bins for flour and sugar near the cook's unit.

T F 16. A refrigerator is a desirable piece of equipment in the salad preparation area.

T F 17. Food served to patients requiring a diabetic diet is regarded as more important than the food to other patients.

T F 18. The elimination of the "special kitchen" to care for the preparation of modified diets has resulted.

T F 19. The abbreviation for teaspoon is "tsp."

T F 20. Cream, 40 per cent, doubles volume when it is whipped.

T F 21. The volume measure of one pound of whole milk and dry whole milk is practically the same.

T F 22. Five to six medium-sized whole bananas weigh one pound.

T F 23. Coarser grinds of coffee weigh somewhat less than fine grinds do for the same volume.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. The foremost concern in food preparation should be the development of a perfect product; the best in ____________, ____________ and ____________.

2. The "watchword" of every kitchen staff member should be ____________ ____________.

3. Consideration in developing skilled workers must be given to ____________ for the job and special attention paid to innate ____________ to work dextrously with the hands.

4. A practice adopted from industry which involves the placing of equipment and supplies in a manner so that there will be few waste motions on the part of the workers is a well-planned ____________ ____________.

5. Standardized recipes are particularly important in the production of ____________ ____________.

6. Duplicate copies of recipes, which are filed according to ____________ of foods, should be kept in a ____________ file.

7. When planning for the preparation of foods a ____________ ____________ ____________ should be prepared and posted a day in advance.

8. Hot foods deteriorate rapidly in ____________, ____________ ____________ and ____________ when held for long periods in hot food units.

9. Prepared cold foods should be ____________ until served.

10. Before serving prepared foods, two qualities that need to be checked, are the correct amount of right ____________ and the proper ____________.

11. The ice cream scoop may be used to measure ____________ and ____________ and also for measuring ingredients of certain ____________ and ____________ fillings.

12. Facilities for the pre-preparation of such foods as meat and vegetables should be located between the ____________ and ____________ areas.

13. The minimum equipment requirements for meat preparation are a ____________ and a ________________.

14. "Lb." is an abbreviation which is used in recipes and stands for the word ____________.

15. One gallon equals _________ quarts, _________ pints, or ____________ peck.

16. Corn flour weighs approximately ________ ounces per cup.

17. In cooking food, a temperature of 75 degrees centigrade is equivalent to _____________ degrees Fahrenheit.

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. Patterns of conformity and uniformity in food preparation should be followed and insured by the use of:

(A)_________________________ (C)___________________________

(B)_________________________ (D)___________________________

2. Kitchen workers must use all possible precaution to safeguard the cleanliness of food and, there fore, should be instructed to:

(A)____

(B)____

(C)____

(D)____

(E)____

(F)____

(G)____

3. Responsibilities of a well-trained supervisor in the kitchen are:

(A)____

(B)____

(C)____

(D)____

(E)____

(F)____

(G)____

4. Tools for measuring and weighing with which kitchen workers should be equipped are:

(A)____

(B)____

(C)____

(D)____

(E)____

5. Standardized recipes should include the following:

(A)____

(B)____

(C)____

(D)____

(E)____

(F)____

6. Items that should be included on a work sheet or schedule are:

(A)____

(B)____

(C)____

(D)____

7. The minimum equipment requirements for cooking in a small institution are:

(A)____________________ (C)____________________

(B)____________________

8. The appearance of and added interest in food on the cafeteria counter is improved by the appropriate use of:

(A)____________________________ (D)____________________________

(B)____________________________ (E)____________________________

(C)____________________________ (F)____________________________

Assignment
Sheet No. 10

Covering
Units 70-76

PREPARATION OF FOOD: MEAT, POULTRY AND FISH

The present day modern methods of feeding, selecting and packaging of meats, poultry and fish have been scientifically studied and mastered by suppliers throughout the world. This factor, along with improved methods of cooking of meats, poultry and fish helps to provide prepared foods of high quality and high nutritive value.

The preparation of meats, poultry and fish necessitates one to know and follow accepted food preparation practices concerning timing and temperature controls and methods of cooking. A knowledge of meat, poultry and fish storage and preservation, both before and after cooking, is also essential.

In this assignment you will have an opportunity to learn accepted procedures and various methods of food preparation as it applies to meats, poultry and fish and methods of caring for and storing these foods.

Assignment:

1. Read the references listed below.
2. In a short paper discuss the various cooking methods that are used for the different cuts of meat.
3. Answer the questions below and turn in this assignment by ____________________.

References:

A. American Hospital Association, Hospital Food Service Manual, pp. 140-155.
B. Peyton, Practical Nutrition, pp. 290-293.
C. American Home Economics Association, Handbook of Food Preparation, pp. 24-31.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. It is recommended that all meats should be cooked at moderate to low temperatures.

T F 2. Roasts should be carved immediately after removing from the oven for best results.

T F 3. Pan or griddle-broiling may be a preferred method over the broiling method for thin cuts of meat.

T F 4. Meat that is coated with flour, or egg and crumbs will require more fat for pan frying than meat that has not been coated.

T F 5. Meat should be brought to room temperature before deep-fat frying.

T F 6. Braising and simmering are methods of cooking generally used for the more tender cuts of meat.

T F 7. Adding water after meat is browned gives more flavor to the vegetables that are cooked with the meat, using the stewing method of cooking.

T F 8. Larger cuts of frozen meats, that need to be defrosted, should not be defrosted in water.

T F 9. "Dressed weight" means that feathers, head and feet are off, and the bird drawn and cleaned ready to cook.

T F 10. In most institutional cooking, it is recommended that the dressing be baked while stuffed in the bird.

T F 11. "Doneness" of a bird, when roasting, may be tested by pressing the fleshy part of the drumstick with the fingers.

T F 12. A "dredging mixture" is a coating used in frying chicken which is generally composed of seasoned flour or crumb mixture.

T F 13. Braising or fricasseeing is one of the better methods to be used for less tender poultry.

T F 14. Fish should be baked in a preheated oven at 350° F. for about 20 to 30 minutes.

T F 15. Fish should be pan-fried rapidly so as to retain the desired flavor.

T F 16. Meats should be broiled about half of the indicated time on one side after which it should be turned and broiling completed.

T F 17. A 7 1/2 pound smoked picnic shoulder should be cooked approximately 1 1/2 to 2 hours.

T F 18. The meat thermometer should be inserted in the center of a roast so that it rests on the bone for the most accurate testing of doneness.

T F 19. A pork loin requires a higher temperature (for a well done) than a veal loin of same weight and same cooking time.

T F 20. If proper thawing and cooking temperatures are followed, very little difference will exist between meat cooked from frozen or thawed state.

T F 21. The safest temperature for thawing meat is the generally accepted refrigerator temperature.

T F 22. Packaged meats received in market paper must be re-wrapped loosely so that a circulation of air will partially dry the surface.

T F 23. Poultry, generally, need not be thawed completely before roasting.

T F 24. Meat after thawing should be cooked immediately and refrozen only under an emergency.

T F 25. Fish, poultry and meat may be preserved and flavor retained in a variety of ways, of which freezing is one of the best.

T F 26. More nutrients are lost in cooking by the dry heat method than by the moist heat method.

T F 27. The protein value of meats is not affected by the average cooking or processing of it.

T F 28. There is less loss of B vitamins in the broiling of meats than in braising or stewing meats.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. Minimum shrinkage is an important consideration in meat cookery; three others are that the finished product should be ____________, ________________ and __________________.

2. To make certain that roasts are neither undercooked nor overcooked, a ____________ _______________ should be used.

3. Meat juices which give it a characteristic flavor are contained in the _____________ of the meat.

4. The rack for broiling tender steaks and chops, which are two inches thick, should be adjusted about _________ inches below the flame.

5. Two general methods of cooking fryers and ______________ and ____________________.

6. In order to prevent birds from becoming too brown during roasting, they should be covered with ______________ dipped in fat or with ______________ ________________.

7. All fresh meat to be stored should be placed in the coldest part of the refrigerator, at a temperature of ________ to ____________ Fahrenheit.

8. Meats to be kept in the freezer should be quickly frozen and kept at ______________ degrees Fahrenheit or colder.

9. Increasing the heat near the end of roasting time for duckling and goose adds ___________________ and _____________ to the skin.

10. Because of its _______________, fish should be wrapped completely or placed in a covered container before refrigerating.

11. The principle of the various preservation methods is to destroy or inhibit the growth of bacteria so that _____________ does not occur.

Multiple-Choice

Directions: In the space at the left of each statement write the letter of the item which will provide the correct answer to complete the statement.

_____ 1. One of the methods of moist heat cooking meat is (A) frying; (B) broiling; (C) braising; (D) roasting.

_____ 2. The total time in minutes for cooking 1" steaks (rare) should be (A) 5-10; (B) 10-15; (C) 15-20; (D) 20-25.

_____ 3. The approximate time necessary for broiling large broilers is (A) 20; (B) 30; (C) 40; (D) 50 minutes.

_____ 4. Fish fillets should be broiled at moderate heat for approximately (A) 2-5; (B) 5-8; (C) 8-11; (D) 11-14 minutes.

_____ 5. In roasting turkey halves or quarters which are five to eight pounds (ready to cook weight) with approximately 1 to 1 1/2 pounds of stuffing at 325°F.: the cooking time should be (A) 3-3 1/2; (B) 3 1/2 - 4; (C) 4 - 4 1/2; (D) 4 1/2 - 5 hours.

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. Four advantages of cooking meat at a low temperature are:

(A)____

(B)____

(C)____

(D)____

2. Four advantages of cooking poultry at low temperatures are:

(A)__________________ (C)__________________

(B)__________________ (D)__________________

3. Cooked fish that is dry and lacks flavor is the result of two factors, which are:

(A)____

(B)____

4. Four reasons for cooking meat are:

(A)__________________ (C)__________________

(B)__________________ (D)__________________

5. Liquid that may be used for braising meat cuts are:

(A)__________________ (D)__________________

(B)__________________ (E)__________________

(C)__________________

Assignment
Sheet No. 11

Covering
Units 77-82

PREPARATION OF FOOD: MILK, CHEESE AND EGGS

The inclusion of milk, cheese, and eggs in food preparation, in combination and individually, is increasing in importance and use. These foods not only help in making meals more attractive and increase acceptance, but are also high in nutritive value and are economical substitutes for other foods normally used in food preparation.

In this assignment you will have the opportunity to learn accepted methods and procedures of food preparation as it applies to milk, cheese and eggs and the storing of these foods.

Assignment:

1. Read the references listed below.
2. In a short paper, discuss the differences between "Evaporated Milk," "Dry Milk Solids" and "Nonfat Dry Milk" and list one or two advantages for each.
3. Answer the questions below and turn in this assignment by ________________________.

References:

A. American Hospital Association, Hospital Food Service Manual, pp. 156-164
B. Peyton, Practical Nutrition, pp. 261-264; 266-267; 274-275.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. Eggs may be used in a variety of ways, such as in combination with other foods, like cheese, ham, or dried beef.

T F 2. The major difference between soft and hard cooking of eggs in the shell, using the cold water method, is the amount of time the eggs are allowed to remain in the water after the fire has been turned off.

T F 3. The liquid used for poaching eggs may be either milk or water.

T F 4. It is considered good practice to cook eggs at relatively high temperatures.

T F 5. A sure indication that separated whites are thoroughly beaten is stiffness and dryness.

T F 6. Fresh whole eggs removed from the shell may be frozen as whole eggs, yolks or whites.

T F 7. Frozen eggs should be placed in warm water to thaw.

T F 8. One fresh egg is equivalent to two-thirds ounce of frozen eggs.

T F 9. By weight, fresh eggs are 50 per cent yolk and 50 per cent whites.

T F 10. Eggs which are either whole or separated may be secured in dehydrated form.

T F 11. It is very important to remember that in whatever way dehydrated eggs are used, they should be cooked at a moderate temperature.

T F 12. The addition of sugar to egg mixtures aids in the prevention of coagulation due to high temperatures.

T F 13. Undercooking mixtures that contain eggs results in toughening of the egg protein.

T F 14. Eggs should be thoroughly washed before putting into storage.

T F 15. Milk is high in nutritive value, the disadvantage of it being that it is hard to digest.

T F 16. Foods that have been prepared with milk generally should be cooked at low temperatures in order to avoid coagulation of protein.

T F 17. At times, flavorings or coloring may be added to milk to make it more acceptable.

T F 18. A reduction of cost may be realized if whole dry milk is used in place of whole fresh milk.

T F 19. Nonfat dry milk is very seldom used in the preparation of foods.

T F 20. In the preparation of baked goods, dry milk is usually mixed with the other dry ingredients first and then water is added.

T F 21. The good flavor of milk can be retained for as long as two weeks if it has been pasteurized and properly cared for.

T F 22. The scum which forms on milk due to cooking cannot be eliminated.

T F 23. Cheese, which is flavorable, is often used in cooking, but has a disadvantage in that it lacks nutrients.

T F 24. Cheese to be used as a topping for foods should be applied near the end of the baking time.

T F 25. A soft white cheese which is mild and may be purchased in small or large curds is called "Camembert" cheese.

T F 26. Processed cheese and cheese foods have higher nutritive value and lower moisture content than cheddar cheese.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. Basting top of eggs when frying may be done with ____________ in pan or by adding small amounts of _____________ and covering pan tightly.
2. The basic causes which make eggs tough and less palatable are long cooking and __________ ___________________.
3. Ten fresh eggs are equivalent to _________ ounces of frozen yolks and __________ ounces of whites.
4. Replacing water in dried-egg powder is called ________________ dried eggs.
5. Hot liquids or mixtures should be added showly to the beaten eggs in order to prevent _______________.
6. Evaporated milk may be used the same as whole fresh milk by adding an equal quantity of _______________.
7. The ___________ and __________ have been removed from whole milk in the preparation of nonfat dry milk.
8. Milk that has been exposed to sunlight for a relatively short time develops "sunlight" flavor with a loss of ___________ and _______________ ______________.
9. A means whereby scorching may be eliminated is the use of a ___________________ ___________________.
10. Cheese is less expensive than and also may be used as a substitute for ___________ in food preparation.
11. In cooking cheese, a layer of _____________ ______________ may be applied to protect the cheese from direct heat.

12. A hard cheese which has a mild to sharp flavor and may be used in baked dishes is the __________ __________ cheese.

13. Semi-hard brick cheese is __________ in color and may be used with crackers or fruit pie or in __________.

14. Cheese should be stored in a refrigerator and may be placed in a special container to protect it from absorbing __________ __________.

15. When including cheese in food preparation, it will blend much more easily with other ingredients if __________ or __________ through a coarse seive.

Multiple-Choice

Directions: In the space at the left of each statement, write the letter of the item which will provide the correct answer to complete the statement.

_____ 1. To increase the volume of eggs and hasten beating, they should be removed from the refrigerator (A) 1/4; (B) 1/2; (C) 3/4; (D) 1 hour before using.

_____ 2. The best temperature for storing eggs and retaining their quality is (A) 15-25; (B) 25-35; (C) 35-45; (D) 45-55 degrees with a humidity of 85 per cent.

_____ 3. Milk that is used in cooking is (A) seldom; (B) always; (C) never; (D) often boiled.

_____ 4. Because cheese contains a great amount of protein and tends to toughen, it should be cooked at (A) very high (B) high; (C) medium; (D) low temperatures.

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. The basic ways of preparing eggs are:

(A)__________ (C)__________ (F)__________

__________ (D)__________ (G)__________

(B)__________ (E)__________

2. Eggs serve in one or more of the following ways, when used as an ingredient of a recipe.

(A)____

(B)____

____

(C)____

(D)____

____

(E)____

(F)____

(G)____

(H)____

3. Three methods of preserving eggs besides refrigeration are:

(A)____________ (B)____________ (C)____________

4. Four precautions or principles well to remember for keeping milk at its best are to keep it:

(A)__________________ (C)__________________

(B)__________________ (D)__________________

5. Milk may be boiled for the following reasons:

(A)__________________ (B)__________________

Assignment
Sheet No. 12

Covering
Units 83-89

PREPARATION OF FOOD: VEGETABLES, FRUITS, AND SALADS

Vegetables, fruits and salads are not only high in nutritive values, but also contribute much to the attractiveness and acceptance appeal of the meal. These foods may be prepared in a variety of ways but great care must be taken so as not to destroy their food value. The storage of these foods, both before and after preparation, also requires special attention of the food service supervisor.

In this assignment you will have the opportunity to learn the various accepted methods of vegetable, fruit and salad preparation and the necessary precautions that need to be observed.

Assignment:

1. Read the references listed below.
2. From your observation of various institutions which do quantity serving, discuss in a one-page paper methods used to increase salad "sales appeal."
3. Answer the questions below and turn in this assignment by ______________________.

References:

A. American Hospital Association, <u>Hospital Food Service Manual</u>, pp. 165-175.
B. Peyton, <u>Practical Nutrition</u>, pp. 316-320; 308-309.
C. American Home Economics Association, <u>Handbook of Food Preparation</u>, pp. 23-24.

Questions:

True-False

<u>Directions</u>: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. Some nutritive values of vegetables are destroyed in the process of cooking.

T F 2. The length of time between cooking and serving vegetables has a definite effect on the retention of minerals and vitamins.

T F 3. Even though leafy vegetables have become wilted, they still retain most of their nutritive value.

T F 4. The washing of vegetables is essential and may be done either before or after paring, scraping or shelling.

T F 5. Care must be taken when paring or scraping various vegetables since valuable nutrients be just beneath the skin.

T F 6. The cooking of vegetables actually improves their flavor and palatability.

T F 7. The use of a pressure cooker helps to retain nutrients in the vegetable but the cooking time is generally longer than other methods.

T F 8. The flavor of vegetables is improved by boiling in a closed kettle.

T F 9. Freshly washed greens require no additional water for boiling and should be cooked quickly for best quality.

T F 10. Eggplant and tomatoes may be either broiled or pan fried.

T F 11. Long soaking of vegetables results in a loss of minerals and vitamins.

T F 12. It makes little difference whether vegetables are placed in the water before or after it starts to boil, on the amount of nutrients they retain.

T F 13. As long as vegetables are kept warm after preparation there is little loss of food value.

T F 14. Vegetables should be removed immediately from the steam kettle when cooking time has expired to prevent further cooking.

T F 15. The overcooking of vegetables causes loss of color.

T F 16. Soda should never be used in the cooking of fresh vegetables.

T F 17. Cooking green vegetables in a minimum amount of water generally aids in color retention but causes loss of nutrients.

T F 18. The pigment of yellow vegetables compared to green is more stable as to acid and heat.

T F 19. The red pigment in red vegetables is soluble in water and is greatly affected by acids and alkali.

T F 20. All vegetables should be cooked only until tender.

T F 21. The cooking of strong-flavored vegetables in a covered container actually makes them more difficult to digest.

T F 22. Cooking rules are generally quite different for cooking frozen vegetables as compared to fresh.

T F 23. Generally the cooking rules for canned vegetables follow those of fresh vegetables.

T F 24. Not only are fruits, in many instances, more attractive when served raw, but their nutritive values are higher than when cooked.

T F 25. Many fruits may be cooked in the same way as vegetables.

T F 26. The cooking of dried fruits should never be done in the same water in which they were soaked.

T F 27. Salads are desirable because they are attractive and contain refreshing flavors, but have the disadvantage of low nutritive value.

T F 28. A salad is at its best when served immediately after preparation.

T F 29. Crispness, color and balance in salad preparation are very important factors to consider.

T F 30. The body of the salad is selected on the basis of the place it occupies on the menu.

T F 31. The main purposes of garnishes are to flavor and to increase palatability of salads.

T F 32. In the preparation of mixed vegetable salads, one should never combine raw and cooked vegetables.

T F 33. Molded salads are often used to add variety to the main course of the meal.

T F 34. For best results head lettuce should be placed in a refrigerator for several hours after washing and before using.

T F 35. Cut celery and carrots are kept fresh in a similar manner.

T F 36. Gelatin salads will have better consistency if they are made a day previous to serving.

T F 37. The dressing for a salad may be combined just before or during the serving of the salad.

T F 38. An excellent method to use of making salads in large quantities is the assembly line method.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. One reason for cooking vegetables is to improve the texture; two other reasons are to soften the __________ and to increase ________________.
2. The selection of uniform size and regualr shape vegetables will cook more ____________.
3. The lack of freshness of green leafy vegetables results in loss of _____________.
4. Vegetables should be covered during storage to keep the loss of _________ _________ to a minimum.
5. The addition of either sugar or salt to corn before cooking will cause the corn to ____________.
6. A vegetable which has been baked in its skin retains practically all of its ____________ content and flavor.
7. Generally, vegetables need not be thawed before cooking, with the exception of _____________________ which needs to be thawed completely.
8. The addition of _________ at the beginning of the cooking process aids fruit to retain its shape.
9. Two general classifications of salads are according to their ______________ on the menu and by the basic _____________.
10. A salad green which is most often used as the base for the salad is ______________.
11. In the preparation of main course salads, materials are often arranged at different levels to avoid a ________ appearance.
12. A salad which is used as a main dish should contain food that is rich in ____________.
13. One essential piece of equipment, especially necessary for quantity salad preparation, is the __________ _____________.
14. The skins of tomatoes are more easily removed if they are first placed in _________ water and then plunged into ______ water.
15. Salad ingredients should not only be planned for nutritive values, but also for _________ , __________, ____________ and texture contrast.

Multiple-Choice

Directions: In the space at the left of each statement, write the letter of the item which will provide the correct answer to complete the statement.

_____ 1. The most common method of cooking vegetables is (A) pan frying; (B) broiling; (C) boiling; (D) baking.

_____ 2. During the cooking time, vegetables should (A) never; (B) seldom; (C) frequently; (D) constantly be stirred.

_____ 3. Generally, green vegetables can be held at serving temperature without loss of color or flavor for about (A) 5-15; (B) 15-25; (C) 25-35; (D) 35-45 minutes.

_____ 4. Pressure in the pressure saucepan should be reduced by placing it under (A) cold water; (B) hot water; (C) warm water; (D) either of above three ways.

_____ 5. Frozen fruits in the carton usually take about (A) 1-2; (B) 2-3; (C) 3-4; (D) 4-5 hours to thaw.

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. Methods commonly used for cooking various vegetables are:

(A)_____________________

(B)_____________________

(C)_____________________

(D)_____________________

(E)_____________________

2. Each of the green, yellow, red and white vegetables contains pigments which are respectively:

(A)_____________________

(B)_____________________

(C)_____________________

(D)_____________________

3. Some fruits when cut discolor quickly; this may be prevented by covering them with:

(A)_____________________

(B)_____________________

(C)_____________________

(D)_____________________

4. All salads consist of four parts which are:

(A)_____________________

(B)_____________________

(C)_____________________

(D)_____________________

5. Three basic salad dressings are:

(A)______________________________ (C)________________________________

(B)______________________________

6. Various kinds of salads which help to balance the food value of the menu are:

(A)________ ____________________ (D)________________________________

(B)______________________________ (E)________________________________

(C)______________________________

Assignment
Sheet No. 13

Covering
Units 90-96

PREPARATION OF FOODS: DESSERTS, BEVERAGES AND APPETIZERS

The ingredients for desserts, beverages and appetizers need to be carefully selected and the foods properly prepared as they can be the most colorful and most appetizing entries on the menu. One probably has no wider choice of methods of preparation as in these foods. The food supervisor will want to especially make use of the many variations which are possible, but should always remember to maintain a well-balanced meal.

In this assignment you will have the opportunity to learn the importance and place which desserts, beverages and appetizers have on the menu and also various methods which may be used in their preparation.

Assignment:

1. Read the references listed below.
2. Select four fruit desserts and explain several variations in the preparation of each. (From your readings or observations.)
3. Answer the questions below and turn in your assignment by ______________________________.

References:

A. American Hospital Association, Hospital Food Service Manual, pp. 139; 180-188.
B. Peyton, Practical Nutrition, pp. 268-270.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. Beverages are not only a source of nourishment, but also provide the fluid needs of the body.

T F 2. Black coffee has very little caloric value.

T F 3. Instant coffee is considered to be more stimulating than standard coffee.

T F 4. Coffee substitutes have a stimulating effect similar to standard coffee.

T F 5. Tea, as such, has no food value.

T F 6. One difference between tea and coffee is that tea has no stimulating effect.

T F 7. The strength of tea depends upon the length of time which it is steeped.

T F 8. Cocoa is only mildly stimulating.

T F 9. Three teaspoons of cocoa and one teaspoon of fat are equal to one square of chocolate.

T F 10. In preparing cocoa, the powder should be mixed with milk and heated for a short time before adding water.

T F 11. Sweetened carbonated beverages contain no nutritive value aside from the added sugar.

T F 12. It is very possible that some carbonated beverages may cause damage to the enamel of the teeth.

T F 13. One reason for using appetizers is to add variety in food preparation.

T F 14. Fruit cocktail, as an appetizer, should be served very sweet in an effort to bring out the individual flavor of the fruits.

T F 15. Fruit juices make excellent appetizers, but should very seldom if ever be used in combination.

T F 16. Tomato juice is high in nutritive value, but is very seldom used as an appetizer.

T F 17. Beef or chicken broth is often added to cream soups to make up an appetizer.

T F 18. Characteristics of a perfect cake are that the crust is golden brown, thin and crisp.

T F 19. Cookies baked in a pan which is too deep will cause them to be burned on top.

T F 20. Flour should be packed slightly when measuring, whereas brown sugar should not.

T F 21. One indication of a good piecrust is one that is rich and flaky.

T F 22. For quantity pastry making, dough should be used as soon as possible after it has been prepared.

T F 23. Fruits are often served in combination for dessert.

T F 24. Sliced apples, pears and peaches have a tendency to discolor, but there is no way to avoid this.

T F 25. Oranges for slicing should be peeled deep enough to remove the white membranes.

T F 26. The red varieties of rhubarb to be used as dessert should be peeled for best results.

T F 27. Raspberries and blackberries should be washed, then placed in a covered container and stored at room temperature until use.

T F 28. Canned fruits should be chilled before serving as a dessert.

T F 29. All dry fruits, used as desserts, need to be soaked before cooking.

T F 30. Frozen fruits are quick-frozen with sugar and, therefore, none should be added before serving.

T F 31. After frozen fruits have been thawed, they may be served with no further preparation.

T F 32. Egg-and-milk desserts are more expensive as compared to other kinds.

T F 33. Of the various desserts, frozen desserts have the most universal acceptance.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. The roasting of coffee beans develops volatile oils which in turn give ________________ and __________________ to coffee.
2. Coffee stimulates, raises blood pressure and tends to prevent fatigue; this is due to a substance in coffee called __________.
3. Coffee which has been ground should be kept in a tightly covered container and stored in a ______________ place.
4. The making of good coffee greatly depends on the use of _________________ utensils.
5. Too great an extraction of tannin from tea results in a _______________ _________________.
6. Chocolate contains a stimulant called _____________________.
7. Some carbonated beverages are undesirable for children because they contain _______________ ________________.
8. Synthetic fruit-flavored soft drinks are essentially ___________ ___________________ solution.

9. Lemon syrup is often added to fruit such as pear and apple slices, used as appetizers, to prevent ______________.

10. In the use of chicken soups as appetizers, the quantity of chicken stock should be ________ quarts to a four- or five-pound fowl.

11. A ___________ dessert is recommended if the meal is light, whereas a ___________ dessert should be served with a heavy meal.

12. If the pan is too small, the cake may ________ while baking; if the pan is too large, the result will be a ____________ cake with a ___________ texture.

13. Butter and shortening to be used as an ingredient in a cake should be warmed to __________ degrees to give it better texture.

14. Pouring a thick liquid such as syrup from a spoon or cup is made easier if the utensils are ____________.

15. Beating a cake mixture too long causes it to have ____________ holes and ______________ texture.

16. Cooky pans should be placed in the oven so as to allow for free ____________ of ______________.

17. Pie dough that is sticky and hard to roll is caused by too ______________ water, whereas dough that is crumbly and hard to roll is caused by too __________ water.

18. In preparing baked piecrusts, a fork is used to prick the pastry thoroughly then chilled before baking to prevent ________________.

19. One reason for not adding sugar at the beginning of cooking dried fruits is that it interferes with the ________________ of ____________ by the fruit.

20. Costs may be reduced in the preparation of egg-and-milk desserts by substituting ____________ ____________ ____________, ____________ ____________ ____________, or ____________ ____________ for fluid milk and ____________ or ____________ ____________ for fresh eggs.

21. One reason why fresh pineapple is not used in gelatin desserts is that it will prevent gelatin ________________.

Multiple-Choice

Directions: In the space at the left of each statement, write the letter of the item which will provide the correct answer to complete the statement.

_____ 1. The type of coffee grind purchased depends largely upon the (A) cost; (B) menu planned; (C) method of preparation; (D) type of service.

_____ 2. "Breakfast cocoa," by government regulations, must contain at least (A) 16; (B) 18; (C) 20; (D) 22 per cent fat.

_____ 3. Unsifted flour measures (A) same as; (B) less than; (C) 1/3 more than; (D) 2/3 more than sifted flour.

_____ 4. Commercially prepared ice cream mixes should contain a minimum of (A) 10; (B) 12; (C) 14; (D) 16 per cent milk fat by weight.

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. The bitter flavor of coffee is due to:

(A)______________________________

(B)______________________________

2. Three different classes of tea are:

(A)__________ (B)__________ (C)__________

3. Desserts are chosen for the following reasons:

(A)______________________________

(B)______________________________

(C)______________________________

4. Two ways to tell if a cake is done are:

(A)______________________________

(B)______________________________

5. A heavy syrup used to glaze apples is made of:

(A)__________ (B)__________ (C)__________

6. Two methods of cooking dried fruits are:

(A)________________________ (B)________________________

7. Three methods of preparing gelatin desserts to make them more appealing are:

(A)________________________ (C)________________________

(B)________________________

Assignment
Sheet No. 14

Covering
Units 97-103

PREPARATION OF FOODS: SANDWICHES, BREADS AND CEREALS

As in other types of food preparation, the selection of ingredients for sandwiches and breads, and the selection of cereals must be done carefully; also the accepted preparation procedures should be followed for good results. Since breads and cereals are quite common and are placed on the menu at least once daily, they should be given special consideration in over-all food preparation. Sandwiches, too, are included on the menu especially for luncheon or supper serving and prove popular if not used excessively.

In this assignment you will have the opportunity to learn the various methods of cooking and preparing sandwiches, breads and cereals and their proper place on the menu.

Assignment:

1. Read the references listed below.
2. Select ten ready-to-eat cereals, state their source and how they are processed from raw material to finished product. (See A, pp. 190-191)
3. In a one-page paper, compare hot cereals to ready-to-eat cereals, indicating advantages and disadvantages of each.
4. Answer the questions below and turn in this assignment by _________________________.

References:

A. American Hospital Association, Hospital Food Service Manual, pp. 175-179; 188-192.
B. Peyton, Practical Nutrition, p. 301.
C. American Home Economics Association, Handbook of Food Preparation, p. 30.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. The cooking of cereals causes them to decrease in bulk.

T F 2. Cereal to be cooked should be placed in a pan of cool water and then brought to a boil with constant stirring.

T F 3. For best results, cereals should be stored in a cool dry place.

T F 4. Whole wheat breads are more susceptible to mold than other breads.

T F 5. Standardized recipes can generally be secured from distributors of yeast and shortening products.

T F 6. Tested or standardized recipes need not be followed for quantity baking of breads.

T F 7. The ingredients of baked goods, handled at room temperature, are highly susceptible to bacterial growth.

T F 8. Cooked cereals which contain disodium phosphate are primarily designed for low-sodium diets.

T F 9. The stirring of cereal while it is cooking will help prevent it from sticking.

T F 10. A coarse grain, loose texture bread, is most desirable for sandwiches.

T F 11. Salad dressings are often used to add color to sandwich fillings.

T F 12. For more efficiency in quantity sandwich making, the assembly line method should be used.

T F 13. Sandwich fillings should always be kept refrigerated when not in use.

T F 14. A high heat should be used to brown both sides of the sandwich, if it is to be made on a grill.

T F 15. A toasted ham and cheese sandwich should be broiled until the cheese puffs.

T F 16. Rolled sandwiches should be prepared just prior to serving.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. Cereals are not only cooked to render starch more easily digested but also to improve the ____________ and soften the ____________________.

2. Cereal grains, while cooking, stick to the utensil and burn easily; this can be avoided with the use of a ________________ ____________________.

3. Warm weather makes the storage of cereals difficult due to insects such as __________________.

4. Standardized recipes for breads generally give measures both of __________ and ____________.

5. Cereal thickens as it cooks, due to __________ and __________ in size.

6. Cereals which have been processed so that they may be cooked in a few minutes are called __________________.

7. The proper term for rolled oats is ____________.

8. By weight, _______ ounce(s) of dry weight cereal to be cooked will yield slightly more than one serving.

9. The acceptable weight for one serving of most ready-to-eat cereal is ________ ounce(s) and for volume from _______ to __________ cup.

10. For sandwich making, the ___________ or __________ loaves are desirable.

11. Butter should not be melted for spreading but rather should be ____________ or ____________.

12. A thin layer of _____________ spread on both slices of bread will prevent moist sandwich filling from soaking the bread.

13. A _____________ should be used for measuring out and placing sandwich filling on the bread.

Multiple-Choice

Directions: In the space at the left of each statement, write the letter of the item which will provide the correct answer to complete the statement.

_____ 1. Bread, to be stored, should be (A) warm; (B) hot; (C) slightly cool; (D) completely cool.

_____ 2. The baking time and oven temperature of corn bread is most nearly the same as (A) muffins; (B) biscuits; (C) yeast bread; (D) cream puffs.

_____ 3. "Old-fashioned" cooking of rolled oats, per pound, in a double boiler, for 20-30 minutes, should be done in (A) 1 1/3; (B) 2 1/3; (C) 3 1/3; (D) 4 1/3 quarts of water.

_____ 4. Salt should be added to the water, in which cereal is to be cooked, (A) before; (B) after; (C) during; (D) before or after the cereal is added.

_____ 5. A pullman loaf of about 2 pounds will provide for approximately (A) 10; (B) 20; (C) 30; (D) 40 slices.

_____ 6. A pound of butter which has been whipped will spread about (A) 100; (B) 80; (C) 60; (D) 40 slices of bread.

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. Different types of cereals absorb varying amounts of water; this depends on:

(A)______________________________

(B)______________________________

(C)______________________________

2. There are five generic types of breakfast cereals that require cooking; they are:

(A)________________ (D)________________

(B)________________ (E)________________

(C)________________

3. There are 15 generic name descriptions for ready-to-eat cereals, which are:

(A)________________ (I)________________

(B)________________ (J)________________

(C)________________ (K)________________

(D)________________ (L)________________

(E)________________ (M)________________

(F)________________ (N)________________

(G)________________ (O)________________

(H)________________

4. Generally, sandwiches may be served in the following ways:

(A)____________________________

(B)____________________________

(C)____________________________

(D)____________________________

5. Three important uses of salad dressing in sandwich fillings are:

(A)________________ (C)________________

(B)________________

6. Tools generally considered necessary for making sandwiches are:

(A)________________ (D)________________

(B)________________ (E)________________

(C)________________

Assignment
Sheet No. 15

Covering
Units 104-115

SERVING THE FOOD

The manner in which a meal is served is of great concern to the patient or customer. Excellent food preparation of high quality accomplishes little if the food service has not also been carried out with extreme care. The ease and efficiency in which serving the food is carried out is dependent on many factors, some of the most important being the method of food distribution and the available physical facilities.

Many institutions have a double problem concerning food service in that they not only serve resident patients and other institutional personnel, but also serve customers who do not dine regularly at the insitution. This problem demands an organization which is well planned as to the physical layout of equipment and the efficient handling of the type of food service in use.

In this assignment you will have an opportunity to become familiar with the various methods and types of organizations concerned with the serving of food.

Assignment:

1. Read the reference listed below.
2. Write a two-page paper on the relative advantages and disadvantages of various types of patient tray service in use. Use examples, for illustration, from experiences in institutional food service you are now having.
3. Answer the questions below and turn in this assignment by ______________________________.

Reference:

A. American Hospital Association, Hospital Food Service Manual, pp. 195-209; 225-231; 237-241.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. Centralized patient tray service refers to the type of service where food is sent in bulk to serving pantries and distributed on small tray carts.

T F 2. Heated lowerators are considered essential in the patient tray service area.

T F 3. The food preparation summary sheet should provide space for indicating both hot and cold foods to be prepared.

T F 4. Diagrams of accepted patient tray set-ups should be posted in the serving units.

T F 5. A napkin is generally not included in the patient tray set-up.

T F 6. It is a recommended and accepted practice to serve a greater quantity of cream on the patient's tray than will be needed for coffee.

T F 7. The plates in which hot foods are placed on a patient's tray should be preheated and covered.

T F 8. Cooperation with the nursing department is essential for efficient patient food service.

T F 9. The only difference between food service for the general patient and isolated patient is that the service articles are sterilized.

T F 10. The cafeteria service in an institution may be of either a pay or non-pay type.

T F 11. The cafeteria serving facilities are often adjacent to the dining room whereas the waitress serving facilities are often in the preparation area.

T F 12. Hot foods should always precede cold foods in cafeteria service.

T F 13. It is improper for the counter worker to offer suggestions to customers in the cafeteria.

T F 14. The waitress should serve the appetizer from the left.

T F 15. The trend for including a snack bar in the planning of institutional service is declining.

T F 16. There is a trend for providing meals as part of the employee's salary.

T F 17. The operation of a pay cafeteria is usually on an all-cash basis.

T F 18. A food requisition sheet for the pay cafeteria should include space for entering the quantity, item, unit cost and total cost of foods.

T F 19. Such foods, as mashed potatoes, should be served with an ice cream scoop to aid in portion control.

T F 20. It is generally assumed that there is a relation between the dietary department layout and quality and cost of food prepared and served.

T F 21. Although employees working in well-equipped dietary units perform tasks more efficiently, they still fatigue as readily as in ill-equipped units.

T F 22. The materials that are used in the construction of walls and floors have an effect on the efficiency of food service.

T F 23. One of the important steps in planning or improving the food service department is the collection and evaluation of structural materials.

T F 24. The preparation of a food service flow chart is essential in the planning or improving of food service.

T F 25. Trays are often transported by subveyor, dumbwaiter, or tray trucks in centralized service.

T F 26. Tray trucks which contain heated ovens are generally kept at a temperature of 130 to 140 degrees F.

T F 27. Tray trucks are usually designed for either hot food delivery or cold food delivery, seldom is a truck designed to handle both.

T F 28. An advantage of centralized tray service as compared to decentralized is that the completed trays are transported a relatively short distance.

T F 29. A greater uniformity of service is obtained by use of the centralized tray service organization.

T F 30. The tray assembly unit, in centralized tray service, should be in close proximity to transportation facilities.

T F 31. An electric plate on the counter, in centralized tray service, is considered an advantage.

T F 32. Pantries for use in decentralized tray service should not be located on floors one directly above the other, as this will reduce efficiency.

T F 33. It is advantageous to have the dining room for the cafeteria so located that guests can return soiled trays to the dishwashing unit.

T F 34. A grill and hot plate are desirable pieces of equipment for cafeteria service.

T F 35. A dispenser for milk, with measuring dial, is considered an important piece of equipment in cafeteria service although it is rather uneconomical to use.

T F 36. Food trucks used for cafeteria service should be of open-type construction.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. In an effort to get the ideal "home-cooked" meal in instutitions, a minimum time lapse must be achieved between ______________ and ______________.

2. Smaller institutions use the ____________ type of patient tray service.

3. The coffee service, cold-food unit and hot-food unit, for patient service, are generally arranged in the following sequence for tray service: _________________ _____________, ___________________ ____________ and, last, the ____________ ______________.

4. The type of institutional service most often used for staff personnel and guests is ______________ service.

5. The principal difference between cafeteria or waitress service concerning facilities is the ______________ of equipment.

6. A good guide for waitresses to follow is that all foods except ______________ should be served and removed from the left.

7. The snack bar supplements the cafeteria and provides food for those who want a _________ __________ or ______________.

8. Control concerning value of meals in a non-pay cafeteria is usually accomplished through a registrar or by use of __________ _______________.

9. A meal census, in a non-pay cafeteria, is obtained from ______________ _____________ or from the signed register.

10. When planning a food department, the first step is to define in writing the _________ and __________ of the service.

11. For a 100-bed hospital, an area of ________ square feet is recommended for the dietary department.

12. The maximum time between patient tray assembly and service, when using unheated trucks for delivery is ____________ minutes.

13. In a decentralized service, the time between the assembly of the tray and service should be from _______ seconds to ______ minutes.

14. The serving area of the cafeteria should be about one-fifth to ________ the size of the dining room.

Multiple-Choice

Directions: In the space at the left of each statement, write the letter of the item which will provide the correct answer to complete the statement.

_____ 1. A food preparation summary sheet usually does not include the following: (A) hot foods; (B) cold foods; (C) coffee service; (D) number of servings.

_____ 2. The suggested arrangement for a breakfast tray for patients, places the creamer in the (A) center; (B) lower left corner; (C) upper right corner; (D) lower right corner of the tray.

_____ 3. The vegetable dish on a dinner tray for patients should be placed in the (A) lower center; (B) upper center; (C) right center; (D) left center of the tray.

_____ 4. The salad plate, on the supper tray for patients, should be placed in the (A) upper right; (B) lower right; (C) upper left; (D) lower left corner of the tray.

_____ 5. For waitress service, foods should be arranged so that they can be picked up in the following order. (A) cold foods, hot foods, hot beverages; (B) hot foods, cold foods, hot beverages; (C) hot beverages, cold foods, hot foods; (D) cold foods, hot beverages, hot foods.

_____ 6. A duty not considered that of a cafeteria-counter worker is (A) make coffee; (B) put away utensils used for serving; (C) replace food as needed; (D) clean tables in dining room.

_____ 7. The bread and butter plate, for dining service, is placed in the (A) lower left; (B) upper left; (C) lower right; (D) upper right of the place setting.

_____ 8. A number 16 scoop is equivalent to a (A) 1-cup; (B) 3/4-cup; (C) 1/2-cup; (D) 1/4-cup size ladle.

_____ 9. Elevators for transporting food trucks in decentralized service should open up, on each floor, (A) adjacent to the serving kitchen; (B) in front of the serving kitchen; (C) in the serving kitchen; (D) as far away from serving kitchen as possible.

_____ 10. Whenever possible, the cafeteria should be adjacent to the (A) kitchen; (B) washing area; (C) receiving area; (D) none of these.

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. The three types of organization concerning patient tray services are:

(A)________________________ (C)________________________

(B)________________________

2. Arrange the following units from A to G in the sequence which they should be located in the dietary department (dishwashing, receiving, pre-preparation, serving, storage, disposal, preparation).

(A)________________________ (E)________________________

(B)________________________ (F)________________________

(C)________________________ (G)________________________

(D)________________________

3. The type of food distribution and service used in an institution will affect the following four items:

(A)________________________ (C)________________________

(B)________________________ (D)________________________

4. Space necessary for a cafeteria may be determined through an analysis of:

(A)____

(B)____

(C)____

(D)____

Assignment
Sheet No. 16

Covering
Units 116-128

COST CONTROL AND FOOD SERVICE RECORDS

A problem which often arises in institutions that serve meals is the conflict that exists between the dietitian department and the accounting office. This conflict is due largely to a misunderstanding and can be resolved if carefully handled.

It is very important for the food service supervisor to have a knowledge of the various kinds of records kept in the dietary department and the relation of these records to the over-all accounting set-up of the institution. Accurate accounting records must be kept for the purpose of determining costs and in controlling these costs so as to aid in a more efficient operation of the institution.

In this assignment you will have an opportunity to become familiar with the accepted accounting procedures used in institutions serving meals and the relation of these procedures to the efficient operation of the institution.

Assignment:

1. Read the reference listed below.
2. For the institution in which you work, calculate or help to calculate the monthly cost of raw food consumed and the raw food cost per meal served per month. Do this for several months and compare results. (See A, pp. 263-264.)
3. Answer the questions below and turn in this assignment by ______________________________.

Reference:

A. American Hospital Association, Hospital Food Service Manual, pp. 261-296.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. Cost accounting is actually a management control device which is of interest and importance both to institutional administrators and dietitians.

T F 2. One of the major purposes of food cost accounting is that it is a method for controlling storeroom stock and minimizes over- and under-buying.

T F 3. Generally speaking, a system of cost accounting adapted to one institution will be applicable to other institutions.

T F 4. A knowledge of the number of meals served is essential to figure raw food costs per meal per month.

T F 5. A cumulative total of meals served from day to day is generally kept on a meal census report.

T F 6. Invoices are considered very important for calculating raw food costs.

T F 7. An inventory of the storeroom taken less than once each year, is sufficient for aiding in calculating raw food costs.

T F 8. There is an indication that detailed cost records cause the administration of the dietary department to operate on an uneconomical basis.

T F 9. As the institution becomes larger, management becomes less dependent on costs as a measure of dietary department efficiency.

T F 10. The dietitian is the one responsible for meal census, daily food report, etc., for her department.

T F 11. The purchase order authorizes the vendor to deliver merchandise according to specifications.

T F 12. Telephoning orders for staples rather than written orders is accepted practice for large institutions.

T F 13. One difference between a purchase order and quotation sheet is that the quotation sheet has more than one vendor's name on it.

T F 14. The procedure which a receiving clerk of staple goods should follow is to sign the delivery slips after which the goods should be checked for quality, omissions, etc.

T F 15. A very important reason for promptness in completing records of purchases is to secure allowed cash discounts.

T F 16. A separate daily expense sheet is used for each day on which deliveries are made.

T F 17. It is highly advisable to have as many purchases as possible issued directly to the kitchen rather than the roundabout way from vendor to storeroom to kitchen.

T F 18. A perpetual inventory card includes space for entering the requisition number.

T F 19. A perpetual inventory record is recommended for both staple and perishable foods.

T F 20. An up-to-date unit price on the perpetual inventory record may be determined in several different ways.

T F 21. The daily cost of food issued from the storeroom may be secured from the amount column of the requisitions.

T F 22. Some institutions classify foods by type of food commodity, for reporting costs.

T F 23. A major limitation of food cost control is the inability to compare quantity and cost of foods to nutritional adequacy.

T F 24. The monthly report of the dietary department contains only two major items, that of raw food costs and adjusted inventories.

T F 25. In case the actual count does not agree with the perpetual inventory, the actual count is written in red on the inventory card.

T F 26. The accounting department is usually responsible for keeping accurate time for each employee, whereas the dietary department is responsible for entering the rate of pay and amount earned for each pay period.

T F 27. The cost of wages of employees who work in several different areas should be prorated to these areas.

T F 28. The maintenance and repair of equipment in the dietary department are generally not included in the operating expense of the department.

T F 29. The total costs of each of the four expense classifications are included in the dietary department monthly cost report.

T F 30. The previous month's costs of each classification of expense is necessary for comparative purposes.

T F 31. It is not essential for dietary personnel to know accounting and statistical terms since the use of these is the responsibility of the accounting office.

T F 32. Comparing meal costs is easily done for hospitals because they all use a uniform meal ticket.

T F 33. The meal count should not include infant formulas.

T F 34. The expenses for special functions as well as those incurred by pay cafeterias should be kept in the same group of accounts and considered as dietary expense.

T F 35. Amounts paid to outside firms for repairs of dietary equipment should be charged to the institution's general maintenance fund.

T F 36. Wages of part-time dietary department workers should not be included in the same expense account as the regular employees.

T F 37. The classification of expenses "other operating expense" refers to items such as paper goods, office supplies and replacement of minor equipment.

T F 38. Stock in the storeroom should be classified into groups of similar items under which the food items should be listed alphabetically.

T F 39. It is considered a good practice to mark the price of each food item as it is placed on the shelf of the storeroom.

Completion

<u>Directions</u>: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. Cost accounting serves as an aid in preventing irregularities in purchasing, ____________, ______________ and dispensing supplies.

2. The cost in the dietary department which is most significant is the cost of ___________ ___________ per meal per month.

3. An accounting of the number of meals served daily should be kept in the ___________ or __________ department.

4. The total raw food purchases must be adjusted to ____________ the cost of items actually ______________ rather than items received.

5. Accounting procedures to be used should be worked out by a person familiar with dietary department organization and with the cooperation of the ____________ office.

6. The meal census form should be designed and set up by ____________________ of meals served.

7. Types of order suggested to use for the food department are ______________ orders for staple foods and __________________ sheets for perishable foods.

8. Usually the original copy of the quotation sheet is placed in the office of the _________________ _________________.

9. In case a question arises concerning the quality of any goods received, the receiving clerk should notify either the ___________ or ____________.

10. The food ledger is arranged alphabetically by _____________ name, whereas the daily expense sheets are filed by __________.

11. The monthly consumption card is filed by name of ____________.

12. An authorization for the storekeeper to issue foods is provided by a written record called a _____________.

13. Such foods as coffee, sugar and cereal are usually placed under the broad heading of __________ for reporting of cost purposes.

14. In large institutions, it is the responsibility of the ____________ office for the preparation of the final monthly report.

15. When taking monthly inventories of stored food products, the unit price is taken from the __________ __ __________ __________ and copied on the inventory sheets.

16. The value of food on hand at the end of the month is the sum of totals of the _____________ inventory and the __________ inventory.

17. A ___________ sheet is set up for each employee's salary deductions and amount paid.

18. The overhead costs are usually allocated by the __________ office at a flat rate determined by cost studies.

19. The monthly dietary department cost report is prepared to show an ___________ of total costs and _________ costs.

20. Utility expenses such as gas and light used in the dietary department are generally charged to the __________ of __________ account or in some cases is subclassified and charged to the dietary department.

21. The first step to take in the arrangement of stock in the storeroom is to make a _________ count and record all _____________ on hand.

Multiple-Choice

Directions: In the space at the left of each statement, write the letter of the item which will provide the correct answer to complete the statement.

_____ 1. A good food cost accounting method is one which provides information desired by management and one which is (A) complex and inexpensive; (B) simple and expensive; (C) complex and expensive; (D) simple and inexpensive.

_____ 2. The following item is not on a purchase order: (A) name of vendor; (B) standard portion for serving; (C) quantity and description of food; (D) terms of payment.

_____ 3. A storekeeper for perishable foods checks goods received against the (A) purchase order; (B) requisition sheet; (C) quotation sheet; (D) vendor's catalog.

_____ 4. The following item is not on a daily expense sheet: (A) name of vendor; (B) date; (C) distribution of purchases; (D) type of delivery.

_____ 5. The food ledger sheet does not contain the following item: (A) name of vendor; (B) distribution of food; (C) amount of invoice; (D) month's total.

_____ 6. The purchase record card does not include (A) percentage of discounts received; (B) amount of invoice; (C) order number; (D) quantity ordered.

_____ 7. The requisitions properly filled out are, at the end of the day, taken to the office of the (A) accounting; (B) supervisors; (C) dietary; (D) storeroom department.

_____ 8. The figure entered in the column marked "food to storeroom" in record of daily cost of raw food per meal served is secured from the (A) purchase order; (B) daily expense sheet; (C) requisition sheet; (D) perpetual inventory.

_____ 9. The figure for "number of meals served today" column in the record of daily cost of raw food per meal served is secured from the (A) storeroom issue sheet; (B) perpetual inventory; (C) daily meal census; (D) none of the above three.

_____ 10. The comparative statement of budget and actual costs does not include the item of (A) total number of meals served; (B) unit cost and expenses; (C) total cost for previous months; (D) total budget and actual costs.

_____ 11. Foodstuff received as donations or grown by the institution should be charged to the dietary department (A) at; (B) above; (C) below; (D) at or below fair market value.

_____ 12. The following is not considered a duty of the storeroom worker: (A) assist with inventories; (B) verify quantities received; (C) deliver commodities to kitchen; (D) purchase needed food commodities.

_____ 13. Hot chocolate powder is included under the following classification - food stores index - (A) condiments, seasonings, spices; (B) fountain and ice cream supplies; (C) beverages, milk products, mineral waters; (D) sugar, syrups, candy.

_____ 14. Sage is included under the following classification - food stores index - (A) condiments, seasonings, spices; (B) fountain and ice cream supplies; (C) beverages, milk products, mineral waters; (D) sugar, syrups, candy.

Listing

Directions: List the items called for in each of the following. Select your answers carefully

1. A suggested cost accounting plan provides information concerning daily food cost per meal and the monthly dietary department costs under which are included four major items; they are:

(A)____________________

(B)____________________

(C)____________________

(D)____________________

2. Staple food invoices are generally recorded in three places:

(A)____________________

(B)____________________

(C)____________________

3. A set of three cards should be maintained for each item stocked, as a perpetual inventory record of storeroom stock:

(A)__________ (C)__________

(B)__________

4. Information necessary to be included on each requisition is:

(A)__________ (D)__________

(B)__________ (E)__________

(C)__________ (F)__________

5. In some institutions a comparison is desired of quantities of food purchased with recommended quantities of food to buy for nutritionally adequate diets which are classified in eleven groups:

(A)______________________________

(B)______________________________

(C)______________________________

(D)______________________________

(E)______________________________

(F)______________________________

(G)______________________________

(H)______________________________

(I)______________________________

(J)______________________________

(K)______________________________

6. The following items are usually recorded on the monthly inventory sheet:

(A)_______________ (E)_______________

(B)_______________ (F)_______________

(C)_______________ (G)_______________

(D)_______________ (H)_______________

7 The count for the meal census usually comes from three sources, which are:

(A)______________________________

(B)______________________________

(C)______________________________

Assignment
Sheet No. 17

Covering
Units 129-140

SANITATION, SAFETY AND CARE OF EQUIPMENT

The role of the food service supervisor, in cooperation with the dietitian, is of ever-increasing importance with reference to the responsibility for the instruction in sanitation and the safe use and care of dietary equipment. The dietary department, as a whole, must be ever mindful of the health and welfare of those whom they serve.

The supervisor should have a thorough understanding and knowledge of accepted equipment installation procedures, selection of quality products and their preparation, safe working procedures, sanitary food handling techniques and other like items of concern to the food service area. The safe and efficient operation of the dietary department depends to a large extent on the skill and supervisory ability of the food service supervisor.

In this assignment you will have the opportunity to become acquainted with and gain an understanding of accepted sanitation policies and procedures, and the selection, care and safe use of food service equipment.

Assignment:

1. Read the references listed below.
2. Use the sanitation check list on A pp. 222-223, or one furnished by the institution, and make a complete check of the dietary (food area) department. Discuss results with the coordinator.
3. Answer the questions below and turn in this assignment by ____________________.

References:

A. American Hospital Association, Hospital Food Service Manual, pp. 210-224; 243-249.
B. Peyton, Practical Nutrition, pp. 144-147.

Questions:

True-False

Directions: The following statements are either true or false. If the statement if true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. The proper cleaning and maintenance of food service equipment will lengthen its life.

T F 2. Often some of the routine inspection is assigned to the maintenance department.

T F 3. One advantage of an equipment inventory is that the amount lost, broken and on hand can easily be determined.

T F 4. It is a good policy to clean a range while still warm as this permits faster cleaning.

T F 5. After cleaning, and not in use, the deep-fat fryer should be covered.

T F 6. Baking soda is effective in removing discoloration on coffee urns.

T F 7. Toasters should be wiped at least once a week with a coarse wet cloth.

T F 8. Dishwashing machines should be thoroughly cleaned after each washing period.

T F 9. We may assume that adequate lighting is important in institutional sanitation.

T F 10. It is best to locate employee washing facilities as far away from the food preparation area as possible.

T F 11. The control of insects and rodents not only should, but must be carried out.

T F 12. Food employees must be instructed that harmful bacteria do exist, although not seen, and that sanitation practices must be developed to eliminate them.

T F 13. Rinse time in machine dishwashing should be a minumum of 20 seconds.

T F 14. The temperature of the water for both manual and machine dishwashing should be about the same.

T F 15. Chlorine is not effective for bactericidal treatment if the utensils are not thoroughly cleaned.

T F 16. A detergent-sanitizer has been found very effective for the job of sanitizing.

T F 17. The posting of safety materials and signs is considered one effective means of gaining employee awareness to safety hazards.

T F 18. It is true that dull knives are more dangerous than sharp ones.

T F 19. Cleaning equipment should not be stored in the kitchen or cafeteria areas.

T F 20. Approximately four square feet per person should be allowed for lockers and rest rooms.

T F 21. Office space for the dietitian is preferably located in the patient area.

T F 22. The most satisfactory flooring for the food preparation area is of the hard surface flooring type.

T F 23. The intensity of lighting recommended for working surfaces in the food area is 50 footcandles.

T F 24. Ease of operation is one important factor in the selection of a particular piece of equipment.

T F 25. Equipment cost is reduced and flexibility gained by purchasing uniform equipment.

T F 26. Very little of the equipment used in the food area is mobile, nor does it have a dual purpose.

T F 27. When considering desirable changes, one important aspect to consider is the relation of working conditions to employee turnover.

T F 28. Food poisoning is not only promptly evident, but the severity has a relation to the amount of the food consumed.

T F 29. Diseases such as diphtheria and tuberculosis may be carried by both food and water.

T F 30. Trichinosis, a serious infection obtained from "pink pork," will be avoided by eating governemnt inspected meat.

T F 31. Prompt refrigeration of foods susceptible to staphylococci is a preventative measure against its development.

T F 32. Epidemics due to bacteria of the salmonella group may be traced to the soil.

T F 33. Generally speaking, bacteria are killed at high temperature and are prevented from multiplying at low temperature.

T F 34. A person can usually tell by tasting whether a food is safe or not.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. The planning of routine care and cleaning of equipment is the responsibility of the ________________.

2. If possible, it is best to have the ____________ of the firm who supplied the equipment give initial instruction to employees using the equipment.

3. One should use warm water and a __________ soap or __________ for removing grease from an electric range.

4. If food particles have hardened on steam kettles, the valves should be closed and filled with ________ _____________ and let stand until particles are softened.

5. Bowls in which egg mixtures or flour batters have been mixed should be soaked in __________ ___________ before washing.

6. When oil is applied on parts of the slicing machine which come in contact with food, it should be of the ________ type.

7. For good sanitary practices _______ __________ are the first step.

8. The most recent answer to the garbage disposal problem is the mechanical _________ _______________.

9. Less than _______ organisms per utensil surface is a minimum requirement for effective dishwashing procedure.

10. Dishes should be washed in water not less than ________F. and for at least ________ seconds in multitank machines.

11. In machine dishwashing, if the hardness of the water is _______ grains per gallon, a softener should be used; if it exceeds 10 grains it should be softened to ________ grains.

12. When a garbage disposal (grinder) is not used, a _____________ area may be required.

13. When possible, the lockers and restrooms for employees should not only be convenient to _______ areas, but also near the ___________ entrance.

14. A glazed tile wall in the kitchen and service area should be at a height of ________ to ________ feet.

15. One disadvantage of using daylight fluorescent lamps is that food assumes an __________ __________ under it.

16. The working heights for equipment should be from ______ to ______ inches.

17. Electrical equipment purchased for institutional use should be approved by the _________ _____________.

18. The responsibility for periodical appraisal of physical facilities and the initiation of changes is considered to be that of the head of the __________ _____________ department.

19. The most frequent cause of food poisoning is ___________ which affects the gastro-intestinal tract.

20. Fruits and vegetables are occasionally infected by ___________ ______________ which produces a serious poisoning known as botulinus.

Multiple-Choice

Directions: In the space at the left of each statement, write the letter of the item which will provide the correct answer to complete the statement.

_____ 1. An equipment record does not contain the following item of information: (A) type of operation; (B) purchase date; (C) maintenance requirements; (D) trade name.

_____ 2. The equipment inventory record contains the following item of information: (A) maintenance procedures; (B) date of purchase; (C) free service period; (D) classification.

_____ 3. After thoroughly cleaning a broiler, one should apply and rub equipment with (A) oil; (B) soap; (C) warm water; (D) detergent to prevent rust.

_____ 4. The urn bag from the coffee urn should be emptied (A) before; (B) after; (C) during; (D) during or after each meal.

_____ 5. Refrigerators should be cleaned at least (A) once each week; (B) twice a week; (C) once each month; (D) twice a month.

_____ 6. Valves for machine dishwashing equipment should withstand (A) 50; (B) 75; (C) 100; (D) 125 pounds of pressure.

_____ 7. If the storage area for cleaning equipment is enclosed, approximately (A) 28; (B) 32; (C) 36; (D) 40 square feet is required.

_____ 8. The bacteria that grow most commonly in egg and milk mixtures are (A) salmonella; (B) trichinosis; (C) botulinus bacillus; (D) staphylococci.

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. When ordering new parts for a piece of equipment the following data need to be indicated:

(A)____________________ (C)____________________

(B)____________________ (D)____________________

2. The minimum space allotted for the office should be ninety square feet to accommodate the following items:

(A)____________________ (C)____________________

(B)____________________ (D)____________________

3. Some factors which determine the amount and type of equipment purchased are:

(A)____

(B)____

(C)____

(D)____

(E)____

Assignment
Sheet No. 18

Covering
Units 141-146

ADVANCEMENT AND CAREER OPPORTUNITIES

The demand for adequately trained food service supervisors in various types of institutions that serve food is great and will continue to increase. This type of work offers opportunity for advancement to those who have the essential personal traits and who are willing to make the necessary preparation to obtain the required skills.

In this assignment you will have the opportunity to learn the requirements and advancement opportunities in the food service supervisor field, as well as in related fields.

Assignment:

1. Read the reference listed below.
2. Answer the questions below and turn in this assignment by ________________________.

Reference:

I. Information Sheet No. 3.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T." If it is false, draw a circle around the letter "F."

T F 1. One of the reasons for the increase in demand for food service supervisors is the transfer of functions formerly performed by the home to manufacturing or service industries.

T F 2. The skill of the supervisor to obtain the cooperation of workers has very little relation to the success and efficient operation of the food service department.

T F 3. The ability to get along with others is not nearly as important for the food supervisor as in other related health occupations.

T F 4. It is important for the supervisor to be competent in areas of work over which supervision is given.

T F 5. The food service supervisor's work is a type of work devoted to the serving and care of others.

T F 6. The demand for food service supervisor is great in institutions where the serving of food is of secondary importance.

T F 7. There is very little demand for food supervisors in nursing homes.

T F 8. The major duties of the food supervisor are similar in the different types of food serving institutions.

T F 9. The food service supervisor should not be expected to adjust menus for individual needs.

T F 10. A college degree in foods and nutrition is considered as a minimum educational requirement for food service supervisors.

T F 11. A trained food service supervisor receives training in supervision and management as well as in foods and nutrition.

T F 12. An adequately trained food supervisor is qualified to take the place of the dietitian in an institution serving food.

T F 13. All institutions must be approved by the American Dietetic Association in order to conduct training programs for food service supervisors.

T F 14. The financial return and prestige depends to a great extent upon a person's education and background.

T F 15. It is considered necessary to have adequate formal college training to advance and succeed in commercial food service work.

T F 16. The hours of work are generally longer in the industrial food service field than in most other types of food serving institutions.

T F 17. Food service supervisors often work their way up through the ranks in the industrial food service field.

T F 18. The food service supervisor in school food service is often asked to teach related classes but seldom required to supervise part-time student help.

T F 19. It is essential that a food supervisor employed in a hospital have both formal training for this type of work as well as some previou experience.

T F 20. The duties for which a hospital food service supervisor should train are those delegated by a trained dietitian.

T F 21. The responsibilities of a supervisor in a nursing home are similar to those performed in a hospital.

T F 22. The rapid growth and demand for food service supervisors is largely due to the excessive number of available dietitians.

T F 23. A knowledge of bookkeeping is considered essential for the dietitian.

T F 24. The salary of a dietitian is usually above that of others having similar educational and experience backgrounds.

T F 25. There is very little demand for specialized nutritionists.

T F 26. One of the responsibilities of a nutritionist is to advise patients in prenatal clinics.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. The food service supervisor is responsible for the ____________ and ____________ of work produced by those working in the kitchen and those who serve foods.

2. Good supervision is the effective use of the ___________ of others to get things done.

3. The surest guarantee for success and advancement in the food service field is good ____________ and __________________ background.

4. The minimum experience that a food service supervisor should have is _________ months to __________ year(s).

5. An adequately trained food service supervisor for hotel work should have training in nutrition as well as in _______________ and ________________.

6. One advantage for factories providing food service to employees is to keep up the workers' ______________.

7. A type of food service which makes it unnecessary for a firm to establish its own food service program is the ______________ food service.

8. A food service supervisor is under the supervision of a ____________ in large hospitals.

9. The food supervisor in hospital service is responsible for instruction to those whom she supervises and also to both ______________ and _________________.

10. An individual planning to obtain a job in a hospital as food service supervisor should obtain formal training as well as a year's internship in a hospital approved by the ____________ ____________ ____________.

11. The dietitian has the over-all responsibility for the ______________ of the food served.

12. A bachelor's degree or above in ____________ ________________ is required to become a dietitian.

13. To become a nutritionist one should have at least ___________ years of college education in the specific phase of ___________ chosen.

Multiple-Choice

Directions: In the space at the left of each statement, write the letter of the item which will provide the correct answer to complete the statement.

_____ 1. Because of a predicted shorter work week, the demand for food service supervisors will (A) decrease; (B) increase; (C) remain the same; (D) reamin the same or decrease.

_____ 2. A responsibility not considered that of the food service supervisor is (A) interviewing employees; (B) assist in menu planning; (C) delegate responsibilities to workers; (D) calculate and make out payroll.

_____ 3. The hours of work in a large institution are usually (A) shorter; (B) longer; (C) same; (D) more irregular than in small institutions.

_____ 4. An institution that serves food and is classified as commercial food service is a (A) bank; (B) department store; (C) secondary school; (D) nursing home.

_____ 5. The value of a trained food service supervisor is probably most recognized in the field of (A) school food service; (B) industrial food service; (C) nursing home food service; (D) none of these.

_____ 6. That which is not a duty of the dietitian is (A) keeping records; (B) making policy decisions; (C) cashiering; (D) instructing.

_____ 7. Following formal training, a dietitian serves an internship for (A) 6; (B) 12; (C) 18; (D) 24 months.

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. A person deciding upon a career as food service supervisor must have a sound knowledge of:

(A)____

(B)____

(C)____

(D)____

(E)____

2. Either of two organizations generally approve institutions that provide for apprenticeship or internship; they are:

(A)____

(B)____

3. Six major areas or institutions in which a food service supervisor may find employment are:

(A)____________________ (D)____________________

(B)____________________ (E)____________________

(C)____________________ (F)____________________

4. Some advantages of working in educational institutions are:

(A)____

(B)____

(C)____

(D)____

(E)____

5. Some of the advantages of food service work in hospitals are:

(A)____

(B)____

(C)____

(D)____

(E)____

6. Dietitians may find employemnt in the following:

(A)__________________ (E)__________________

(B)__________________ (F)__________________

(C)__________________ (G)__________________

(D)__________________ (H)__________________

7. Employment opportunities for nutritionists exist in the following fields:

(A)____

(B)____

(C)____

(D)____

(E)____

(F)____

(G)____

Information
Sheet No. 3

ADVANCEMENT AND CAREER OPPORTUNITIES*

The long-time trend in our economy has been toward the transfer to manufacturing or service industries many of the functions formerly performed in the home. This trend has definitely increased the importance of and created a demand for the food service supervisor.

One must first understand the term "supervisor" as it pertains to food service. A supervisor of food services is one who is responsible for the quantity and quality of work produced by the kitchen and serving personnel as well as their general conduct. The success of the food service department depends largely upon the skill of the supervisor in obtaining cooperation from the workers.

One who is to advance in any type of occupation must have the ability to get along with others. Human relations is all-important for the work of food supervisor, as it is in other related occupations. The effectiveness of an organization depends largely upon the workers' morale, and this in turn is determined by the supervision which they receive. It has often been said that good supervision is the effective use of the ability of others to get things done.

The job of the food supervisor is in many ways like that of a teacher in that the supervisor must know the information and have the skill which she is trying to teach her employees. The supervisor must be competent in the areas of work performed over which she supervises.

Deciding on a Food Service Supervisor Career

Good educational and experience background is the surest guarantee for success and advancement in the food service field. One should have desirable personality traits which are considered necessary when dealing with people. The supervisor must use tact and be courteous, alert and attentive; she must cooperate with workers, receive supervision graciously, etc.

The supervisor must have a sound knowledge of the principles of nutrition, sanitation and service, food preparation, purchase of food, cost and record control, etc. Without this type of knowledge, the supervisor will find herself at a great disadvantage in her relationship with workers and for future advancement possibilities.

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*Adapted from The Outlook for Women as Food-Service Managers and Supervisors, Bulletin 234-2, Womens Bureau, U.S. Department of Labor, 1952; and Job Descriptions and Organizational Analysis for Hospitals and Related Health Services, U.S. Department of Labor, U.S. Employment Service, 1952, pp. 210-212; 236-237.

One must enter this field as a career and not merely as another job, in order to be able to advance and succeed. The work is satisfying and offers interesting contact with people who also have devoted their time to the serving and care of others.

Need and Demand for Food Service Supervisors

There is a great demand for food service supervisors in various types of institutions where the serving of food is primary, as well as in places where the sale of food is of secondary importance. Due to the predicted shorter work week, this demand will undoubtedly continue to increase.

Some of the specific needs are in hospitals, nursing homes, schools, restaurants, commercial and industrial fields, and various other types of institutions that provide for group feeding. The demand for these needs can be met by an adequately trained supervisor.

Work and Responsibilities of a Food Service Supervisor

The work and responsibilities vary some according to the type of institution in which one works. Generally, however, the major duties are quite similar in these institutions. Some of these major duties are:

1. Direct supervision of food service activities
2. Prepare time and work schedules
3. Delegate responsibilities to workers
4. Maintain courteous and prompt service
5. Coordinate activities for efficient operation of the institution
6. Assist in worker activities
7. Conduct on-the-job instruction for employees
8. Maintain clear food area
9. Requisition food products and supplies
10. Check and receive deliveries
11. Take inventories
12. Maintain department records
13. Assist in menu planning
14. Maintain standards for food preparation
15. Adjust menus for individual needs
16. Interview employees

Working Conditions: The food supervisor generally preforms her work in a well-lighted, heated, ventilated and clean environment. The length of the work week varies considerably from one kind of institution to another. In the larger establishments more regular hours are maintained and generally fewer hours per week, whereas in smaller food serving institutions the supervisor may put in longer hours and there is a tendency toward irregular hours.

Education and Experience

Minimum Education: Many food service supervisors have come up through the ranks and may have had very little formal education. It is considered desirable to have some educational training in foods and nutrition as well as management or supervisory training, which may be obtained informally and in adult classes. A high school education with courses in home economics and other related courses is generally thought to be a minimum educational requirement for any kind of food service supervisory work.

Minimum Experience: A broad background of experience is necessary to effectively perform the job of a food supervisor. One should have six months to one year of supervisory training in either a hospital dietary department, cafeteria, dining room, hotel, restaurant, or similar institutions engaged in quantity food service. The greater amount of experience a person has the more probably will be the chance for advancement and success, especially if one lacks the desirable educational training.

The Trained Food Service Supervisor: The trained food service supervisor receives training in schools of home economics by taking a general home economics course or by specializing in foods and nutrition and institutional supervision and management. A course in foods and nutrition (often termed dietetics) includes training in institutional management as well as in the preparation of various types of diets.

Those trained as supervisors cannot take the place of a dietitian but oftentimes a dietitian will directly supervise the food service area. The trained supervisor is one who has completed a home economics course and has served some from of apprenticeship or internship before undertaking supervisory work. Institutions in which internship is done should be approved by the American Dietetic Association or the National Restaurant Association. Some institutions carry on their own training programs for food service supervisors. These generally have not been approved by any particular approving agency. One may also secure training in this line of work through various types of vocational and technical schools.

The greater amount of actual practical experience one can get while attending formal classwork in college, the better prepared she will be to work in her chosen occupation after her training is completed.

Areas of Opportunities

There are a great number of career opportunities open to persons trained as food service supervisor, one of the health occupations. The financial return, as well as prestige and status, depends to a great extent upon the training and experience background as well as the ability of the individual to do the work in the chosen field.

Commercial Food Service Field: There are not enough trained food supervisors to adequately staff the many openings in hotels, restaurants, and like institutions that serve food. These types of jobs require that one have training in nutrition as well as in supervision and management. Often the larger institutions make a distinction between administration and food service, the graduate of home economics and / or business being placed in the administrative positions with responsibilities such as purchasing and accounting.

Restaurants, cafeterias, hotels, department stores, clubs, inns, tearooms, camps, airports, and airlines are some of the possibilities of employment in the commercial food service field. Working conditions naturally vary with each one, depending on many factors, a few of which are size and type of institution.

One who is engaged in commercial food service work will perform the general duties of a supervisor as outlined previously. It is considered essential that one have adequate formal college training to advance and succeed in commercial food service work.

Industrial Food Service: This type of work is connected with factory, bank, utility and like establishments, the food service department being of secondary importance to the main product of the particular company. Industrial feeding has many advantages to management, one of which is to keep up worker morale.

This type of food service is large and is expanding. It has shorter hours of work than most types of food serving institutions. Salaries of top food supervisors compare favorably with those in school and hospital service. The policies, control, etc., is determined by management, which the supervisor is expected to carry out.

The industrial food service supervisor could expect to work in restaurants, cafeterias, canteens, lunchrooms, mobile canteens, etc. Those employed in this type of work are often not formally trained to as great an extent as those in school and hospital programs. They have, instead, worked their way up through-the-ranks.

School Food Service: The value of a trained food service supervisor is probably more recognized in school food service than in most other areas. One may be employed in the lower grades lunch program, the secondary, or on the college level. The duties often vary, especially in colleges.

The supervisor may be requested to teach related classes along with the accepted duties of a supervisor. She may assume home-management duties, supervise part-time student help, provide catering service, etc. The supervisor is often responsible for various methods and types of service being carried on simultaneously, such as cafeteria, dining hall, fountain service, etc.

There are many advantages to working in educational institutions, some of which are a pleasing environment, comparable pay to teachers, comparable rank, working with youth, and a feeling of accomplishment in a growing enterprise.

Concessionaires: This is a type of food service which cuts across all areas found in commercial, industrial and school food service. This service obviates the necessity of a firm to establish and run a food service program. The headquarters is usually located in large cities, out of which the concessionaire caters to various establishments.

Often the management and supervisory staff have come up through-the-ranks. The salary depends largely on the location of the concessionaires as well as the location of the particular institutions being served, and is also dependent on seasonal changes.

Hospitals: The food service supervisor who is employed in a hospital is under the supervision of a dietitian in large hospitals, and very often performs many of the dietitian's duties in the small hospitals. It is considered quite essential for the supervisor in a hospital to have formal training in nutrition and supervisory techniques, and also to have had previous related experience.

Hospital food service work has many advantages, some of which are: work in pleasant surroundings, healthful environment, association with other professional people, variety of services, and the feeling of contributing to the great cause of serving mankind.

The hospital food service supervisor has a very responsible position: as it is her duty to see that food is well cooked, has maximum palatability, and is acceptable by the patients who use this food for recovery from illness, as well as to maintain health. Food must also be prepared for and accepted by staff personnel who often eat at the hospital cafeteria or dining room.

The supervisor also participates in nutrition instruction to both patients and interns. She is responsible for instruction to those whom she supervises. She is generally concerned with the continual improvement of all types of food services.

The supervisor planning to enter hospital work should obtain formal training in food service work in colleges and universities, and should serve a year of internship in a hospital approved by the American Dietetic Association. Training should center around nutrition, food preparation techniques, food personnal supervision, food selection and purchasing, meal planning, and similar duties that are delegated to the supervisor by the trained dietitian.

The salary received for food service supervision is comparable to other occupations of equivalent training and experience.

Nursing Homes: The duties and responsibilities connected with the work of a food supervisor in a nursing home are similar to those experienced in hospitals. One who is planning to enter this work should obtain formal college training in nutrition, supervision and management techniques and in related areas.

Institutions are generally not quite as large as hospitals, but many of the same advantages are present. The greatest joy received in this type of work is the service rendered to humanity and the appreciation received from others for this service.

Dietitian

There exists a great shortage of dietitians in the United States today which accounts, in part, for the rapid growth and demand for food service supervisors. The dietitian enjoys very favorable working conditions and has the opportunity to associate with fellow professional people with like interests.

Types of Work Performed: The dietitian has the over-all responsibility for the quality of food served. She must be up-to-date in the field of nutrition as well as administrative and supervisory techniques. Her special duties include supervising food preparation, formulating menus, determining dietary needs, controlling costs, keeping records, instructing, conferring with physicians, making policy decisions, and generally supervising through the food service supervisor.

Knowledge Required: The dietitian must have a thorough knowledge of the organization and operation of the dietary department. She must also have a knowledge of practices of dietetics, nutritional requirements, special diet requirements, physiology and digestion processes, bacteriology principles and new developments in the dietetic field. The dietitian must be very familiar with and have ability to apply principles of personnel administration. A knowledge of mathematics and bookkeeping is also essential.

Employment Opportunities: A large percentage of dietitians are found in hospitals, as well as in the following fields of work:

1. Teaching fields
2. School lunch programs
3. Commercial food service
4. Industrial food service
5. Public health nutrition
6. Consulting work
7. Writing and research

Training and Experience Requirements: A bachelor's degree or advanced degree in home economics from an accredited college or university, with a major in foods, nutrition and/ or institutional management, is required. This field of study should be supplemented by courses in chemistry, food preparation, meal planning, management, diets, diseases, and methods of teaching.

Following the formal training, the dietitian serves an internship of a year in a hospital or other institution offering dietetic internship approved by the American Dietetic Association.

The salary which a dietitian receives is comparable to that of other professional people of similar training and experience.

Nutritionist

Well-trained nutritionists, especially with graduate training in certain phases of human nutrition, are in demand. The food service supervisor desiring to become a nutritionist must secure the required formal education as well as the necessary experience.

The nutritionist may find employment in the following fields:

1. Nutrition clinic
2. State and local public health departments
3. Federal government services
4. Red Cross
5. International work
6. Nutrition instructor
7. Nutritionist in industry

Some of the duties which a nutritionist performs are:

1. Assist the training of nurses and student nurses
2. Advise patients in prenatal clinics
3. Plan school nutrition projects
4. Aid in health meetings
5. Consultation work
6. Research and experimentation
7. Teaching responsibility both in general college courses as well as in medical and dental schools

Training and Experience: One should have at least four years of college education in the particular phase of nutrition chosen. The college or university must be selected with care, one that enjoys the respect of the employing institutions. The course generally consists of training in the sciences and nutrition and their practical application, and training in educational methods as applied to nutrition. One should also, and in many cases is required to, have practical experience in related work so as to provide a better background for the work.

Employer's Copy

TRAINING PLAN AND PROGRESS RECORD
for
INSTITUTIONAL FOOD SERVICE SUPERVISOR

JOB TRAINING: What the Worker Should Be Able to Do	Proficiency Shown	RELATED INFORMATION: What the Worker Should Know
The Food Service Supervisor		
Carry out duties and responsibilities; cooperate with others Time in hours ________	☒	Duties and responsibilities; relationship to other departments; personal requirements; training and experience
Nutrition		
Select foods wisely; identify food groups; obtain foods and information from reliable sources Time in hours ________	☒	Importance of good nutrition; selection of foods; improving diet and habits; food misconceptions
Function and Source of Food		
Choose foods containing necessary food components; select essential food of desired values Time in hours ________	☒	Function and source of fats, proteins, minerals, vitamins, water and cellulose; function and source of the food groups
Menus and Diets		
Follow accepted menu planning procedures; plan diets; plan menus for acceptance; construct and file recipes; use correct menu terminology Time in hours ________	☒	Nutritional needs; nutritional adequacy; normal and modified diets; planning menus, basic food patterns; food acceptance
Food Purchasing		
Select and purchase quality products; calculate food needs; write specifications; check and receive products Time in hours ________	☒	Buying guides; sources of supplies; quality, size and grades; calculating food needs; receiving, storing and preserving foods

Principles of Food Preparation

Maintain efficient kitchen; plan for food preparation; check food quality; determine and follow measurements	☒	Principles of food preparation; standard preparation procedures; weights and measures

Time in hours _________

The Preparation of Food

Follow correct timing and temperature; store, freeze and preserve foods; prepare and use leftovers	☒	Times and temperatures in cooking foods; methods of cooking and uses of foods; storage of foods

Time in hours _________

Serving the Food

Place and remove serving equipment; set up trays; serve and display food; keep records; evaluate food service; adjust for individual preferences	☒	Principles of food service; methods and types of food service; records; acceptance of foods

Time in hours _________

Records and Costs

Make reports; keep records; determine costs; order food products; classify foods and expenses; maintain inventory records; price foods	☒	Accounting procedures and policies; records and reports; purchase orders; classification of foods and expenses; inventory

Time in hours _________

Sanitation, Safety and Equipment

Maintain sanitary standards; inspect and operate equipment; keep sanitary and safety records	☒	Personal health and appearance; handling food; sanitary standards; care and use of equipment; safety procedures

Time in hours _________

Advancement and Career Opportunities

Delegate responsibilities; orientate staff; become familiar with institution serving food ☒ Career opportunities; opportunities in health occupations; training and experience requirements

Time in hours _________

Code for employer's use in marking student's progress

Performed some operations in area ☒

Performed some operations with reasonable proficiency ☒

Performed most operations in area ☒

Performed most operations satisfactorily ☒

Student's copy

TRAINING PLAN AND PROGRESS RECORD for INSTITUTIONAL FOOD SERVICE SUPERVISOR

JOB TRAINING: What the Worker Should Be Able to Do	Proficiency Shown	RELATED INFORMATION: What the Worker Should Know
	The Food Service Supervisor	
Carry out duties and responsibilities; cooperate with others Time in hours ______	☒	Duties and responsibilities; relationship to other departments; personal requirements; training and experience
	Nutrition	
Select foods wisely; identify food groups; obtain foods and information from reliable sources Time in hours ______	☒	Importance of good nutrition; selection of foods; improving diet and habits; food misconceptions
	Function and Source of Food	
Choose foods containing necessary food components; select essential food of desired values Time in hours ______	☒	Function and source of fats, proteins, minerals, vitamins, water and cellulose; function and source of the food groups
	Menus and Diets	
Follow accepted menu planning procedures; plan diets; plan menus for acceptance; construct and file recipes; use correct menu terminology Time in hours ______	☒	Nutritional needs; nutritional adequacy; normal and modified diets; planning menus, basic food patterns; food acceptance
	Food Purchasing	
Select and purchase quality products; calculate food needs; write specifications; check and receive products Time in hours ______	☒	Buying guides; sources of supplies; quality, size and grades; calculating food needs; receiving, storing, and preserving foods

Principles of Food Preparation

Maintain efficient kitchen; plan for food preparation; check food quality; determine and follow measurements	☒	Principles of food preparation; standard preparation procedures; weights and measures

Time in hours ________

The Preparation of Food

Follow correct timing and temperature; store; freeze and preserve foods; prepare and use leftovers	☒	Times and temperatures in cooking foods; methods of cooking and uses of foods; storage of foods

Time in hours ________

Serving the Food

Place and remove serving equipment; set up trays; serve and display food; keep records; evaluate food service; adjust for individual preferences	☒	Principles of food service; methods and types of food service; records; acceptance of foods

Time in hours ________

Records and Costs

Make reports; keep records; determine costs; order food products; classify foods and expenses; maintain inventory records; price foods	☒	Accounting procedures and policies; records and reports; purchase orders; classification of foods and expenses; inventory

Time in hours ________

Sanitation, Safety and Equipment

Maintain sanitary standards; inspect and operate equipment; keep sanitary and safety records	☒	Personal health and appearance; handling food; sanitary standards; care and use of equipment; safety procedures

Time in hours ________

Advancement and Career Opportunities

Delegate responsibilities; orientate staff; become familiar with institution serving food ☒

Career opportunities; opportunities in health occupations; training and experience requirements

Time in hours ________

Code for employer's use in marking student's progress

Performed some operations in area	☒	Performed some operations with reasonable proficiency	☒
Performed most operations in area	☒	Performed most operations satisfactorily	☒

TRAINING PLAN AND PROGRESS RECORD
for
INSTITUTIONAL FOOD SERVICE SUPERVISOR

JOB TRAINING: What the Worker Should Be Able to Do	Proficiency Shown	RELATED INFORMATION: What the Worker Should Know
	The Food Service Supervisor	
Carry out duties and responsibilities; cooperate with others Time in hours ________	☒	Duties and responsibilities; relationship to other departments; personal requirements; training and experience
	Nutrition	
Select foods wisely; identify food groups; obtain foods and information from reliable sources Time in hours ________	☒	Importance of good nutrition; selection of foods; improving diet and habits; food misconceptions
	Function and Source of Food	
Choose foods containing necessary food components; select essential food of desired values Time in hours ________	☒	Function and source of fats, proteins, minerals, vitamins, water and cellulose; function and source of the food groups
	Menus and Diets	
Follow accepted menu planning procedures; plan diets; plan menus for acceptance; construct and file recipes; use correct menu terminology Time in hours ________	☒	Nutritional needs; nutritional adequacy; normal and modified diets; planning menus, basic food patterns; food acceptance
	Food Purchasing	
Select and purchase quality products; calculate food needs; write specifications; check and receive products Time in hours ________	☒	Buying guides; sources of supplies; quality, size and grades; calculating food needs; receiving, storing, and preserving foods

Principles of Food Preparation

Maintain efficient kitchen; plan for food preparation; check food quality; determine and follow measurements	☒	Principles of food preparation; standard preparation procedures; weights and measures

Time in hours __________

The Preparation of Food

Follow correct timing and temperature; store, freeze and preserve foods; prepare and use leftovers	☒	Times and temperatures in cooking foods; methods of cooking and uses of foods; storage of foods

Time in hours __________

Serving the Food

Place and remove serving equipment; set up trays; serve and display food; keep records; evaluate food service; adjust for individual preferences	☒	Principles of food service; methods and types of food service; records; acceptance of foods

Time in hours __________

Records and Costs

Make reports; keep records; determine costs; order food products; classify foods and expenses; maintain inventory records; price foods	☒	Accounting procedures and policies records and reports; purchase orders; classification of foods and expenses; inventory

Time in hours __________

Sanitation, Safety and Equipment

Maintain sanitary standards; inspect and operate equipment; keep sanitary and safety records	☒	Personal health and appearance; handling food; sanitary standards; care and use of equipment; safety procedures

Time in hours __________

Advancement and Career Opportunities

Delegate responsibilities; orientate staff; become familiar with institution serving food ☒ Career opportunities; opportunities in health occupations; training and experience requirements

Time in hours ________

Code for employer's use in marking student's progress

Performed some operations in area	☒	Performed some operations with reasonable proficiency	☒
Performed most operations in area	☒	Performed most operations satisfactorily	☒

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Automotive Body Repairman, Suggested Guide for a Training Course.

Roney, Maurice W.
Office of Education, Washington, D.C.
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*CURRICULUM GUIDES, *TRADE AND INDUSTRIAL EDUCATION, *AUTO BODY REPAIRMEN, *MOTOR VEHICLES, POST SECONDARY EDUCATION, PROGRAM PLANNING,
MDTA Programs,

This curriculum guide is for administrator and teacher use in planning and developing a post-high school course to prepare persons for employment as auto body repairmen. It was developed by the Oklahoma State University under contractual arrangements with the U.S. Office of Education Division of Vocational and Technical Education. Some of the nine instructional units are (1) Automotive Metals, (2) Frame Straightening, (3) Refinishing Processes, and (4) Glass Removal and Replacement. Each unit gives the classroom and shop time allocation, objectives, unit outline, suggested shop exercises, and study references. The time allocations serve to indicate the relative emphasis to be placed on each area and may be changed to adapt the course to local conditions and to the background of the trainees. The course is designed for 245 hours of classroom and 1,515 hours of shop work. The teacher must have experience in automotive body repair, and the student should have manual dexterity and an appreciation of quality workmanship. The U.S. Employment Service General Aptitude Test Battery for automotive body repairmen is suggested as an aid in trainee selection. Suggestions for teaching the course, a list of references and films, and suggested machines, tools, equipment, supplies, and training facilities are included. (HC)

A Suggested
Guide for a
Training Course

AUTOMOTIVE BODY REPAIRMAN

U.S. Department of Health, Education, and Welfare

Office of Education

AUTOMOTIVE BODY REPAIRMAN

(D.O.T. Occupational Code 807.381)

Suggested Guide for a Training Course.

U.S. Department of Health, Education, and Welfare
John W. Gardner, Secretary

Office of Education
Harold Howe II, Commissioner

Manpower Development and Training Program

FOREWORD

The automotive body repairman is one of the more highly skilled and better paid mechanics in the automotive field. The demand for body repairmen far exceeds the present supply due to the ever-increasing number of automobiles and their use in our mobile society. The major portion of the automotive body repair business is conducted by small shops; therefore, the opportunities for eventual self-employment in this field are very good.

The purpose of this guide is to assist administrators and teachers in organizing courses and developing course content in preparing workers for employment in this occupation.

The guide was prepared for the Division of Vocational and Technical Education under contractual agreements with the Oklahoma State University. Recognition is given to Maurice W. Roney, Director, School of Industrial Education, Oklahoma State University, for supervising the development of content; to L. Carl Love, Oregon State College, for his assistance as consultant during the preparation of this guide; and to Dennis N. Chapman, Head, Automotive Department, Oklahoma State Technical Institute, as well as selected teachers in vocational schools and auto body specialists who contributed to the development of technical content.

This guide contains nine major units covering 1,760 hours of instruction in the classroom and laboratory-shop. The sequence of units and the hours assigned to each unit are flexible; therefore, both the time and content may be adjusted to better meet local needs.

A suggested list of machines, tools, equipment, supplies, textbooks, films, and a floor plan of the training facility have been included to assist school administrators and teachers in organizing the course. The assistance of local advisory groups should be sought for guidance in selecting equipment which will best serve the local conditions. Modifications of the suggested shop layout should follow advisory committee recommendations.

Walter M. Arnold
Assistant Commissioner for
Vocational and Technical Education

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TRAINING COURSE FOR AUTOMOTIVE BODY REPAIRMAN

Purpose of the Guide

This training guide has been prepared to assist in planning and developing a course of training for workers who will be employed to repair or replace parts of the automobile body and chassis. The guide has been organized in a manner to be of maximum value to school administration personnel who may not themselves be specialists in the occupation. Sufficient detail has been included, however, to provide an outline of instruction for the instructor who will be responsible for the operation of the training program.

The suggestions outlined in the training guide are not meant to delineate instruction in every detail. Supplemental material can be found in the suggested textbooks, references, and films. Further, the suggested course outline may require modification to meet special needs. The sequence of presentation as well as the final selection of topics for special emphasis should be determined by the instructor and will vary, depending on the needs and background of the trainee group.

Although this guide has been developed primarily for use in the Manpower Development and Training program, it includes instructional material that can be useful in planning similar programs for secondary school vocational students. Some of the related material included in the course outline has been added to assist the trainee to progress beyond the entry level job.

Job Description

The work of the automotive body repairman consists of those jobs which require a knowledge of automotive construction and a relatively high degree of manual dexterity. In the larger shops, repairmen are generally assigned to special phases of the work. However, in the small shops, one person may be required to do satisfactory work on several jobs ranging from complete body rebuilding to frame straightening. Since there is so much diversity in requirements, the good repairman should have a broad background of training, even though he may, at some point, be required to specialize.

Any one or all of the specializations described below may be performed by the automotive body repairman, depending on the size of the shop.

1. Estimating - examines automobiles driven into garage by customers and determines need and cost of repairs; attempts to sell needed repair service to customers, estimating and quoting costs of repairs.
2. Metal working - straightens or replaces damaged body areas by hammering, jacking, picking, filing, buffing, filling with lead or synthetic material, shrinking, welding, using metal screws and various cutting methods.
3. Sanding - prepares all of the original finish for repainting in addition to sanding and resanding surfaces coated with primer.
4. Painting - masks areas to be free of over-spray. Sprays required coats of metal primer and surfacer to extablish adequate base and finish coats. May control drying lights or baking ovens.
5. Upholstering - repairs or replaces upholstery and fabric tops of automobiles and trucks, following written or verbal orders. Removes old upholstery, rebuilds springs and padding, and may sew patches over small holes in upholstery. Cuts covering material to size, stretches covering over roof, and replaces gutters and molding.
6. Aligning frame - checks frame alignment and makes adjustments as necessary by straightening members or replacing old members by welding and riveting.

7. Installing front end parts - estimates when parts are damaged beyond repair and installs new front end parts or assemblies.
8. Installing glass - removes old glass, checks glass channel and guide, replaces or repairs faulty window mechanisms, installs new glass, seals and waterproofs windows and windshield.

The automotive body repairman is employed in practically every community, large and small. The Occupational Outlook Handbook, 1966-67 Edition, states that approximately 90,000 auto body repairmen were employed in early 1965. This handbook also states that trained men are not available to fill the existing positions. This condition has existed for a number of years, primarily because a great deal of experience is necessary in order to become a skilled body repairman. Poor workmanship is exposed to view in automotive body repair, therefore, only top quality work is acceptable.

Earnings depend upon the workers skill and efficiency since they are generally paid on a commission basis. This commission may range from 40% to 60% of the customer's cost. Workers in various locations can expect from $2.50 to $4.30 per hour while some yearly earnings reach $10,000. Well-trained and experienced workers may fill better paying positions as shop foremen, insurance claims adjusters, or may go into business for themselves.

The opportunities are expected to increase as the number of vehicles grows. A leading automotive magazine showed 81,557,060 privately owned vehicles in the U.S. in 1963, a gain of 4.6% over 1962.

Length of Course and Course Units

The training program, as outlined, covers a period of 44 weeks and includes a total of 1,760 hours of class instruction and laboratory-shop practice. The training is intended to progress at a rate of 8 hours per day, 5 days per week.

Major Divisions of Instruction

Unit	Title	Suggested class hours	Suggested laboratory hours
I.	Orientation to Automotive Body Repair	10	20
II.	Automotive Metals	20	20
III.	Body Panel and Fender Straightening	50	480
IV.	Welding and Leading	30	240
V.	Frame Straightening	25	155
VI.	Front End Repair and Alignment	10	40
VII.	Refinishing Processes	50	350
VIII.	Removing and Replacing Upholstery and Trim	20	60
IX.	Glass Removal and Replacement	30	150
	Sub-total	245	1515
			245
		Total	1760

The allocation of hours to each unit of instruction serves to indicate the relative emphasis to be placed on these areas. Since this program represents a typical situation, changes in the distribution of time may be necessary to adapt this program to local conditions and to the background of the group in training. The instructor should use his own discretion in applying the stated ratio of classroom time to actual shop practice.

Qualifications of Trainees

Although no reliable method has been found to identify persons who will be successful in this field, there are certain qualities and abilities an individual should possess. Manual dexterity and an appreciation of quality workmanship are of great significance if the trainee is to succeed. The work of an automotive body repairman must frequently be done in an environment which at times is contaminated with dust and paint spray. Persons who are allergic to paint fumes associated with this type of work should not be admitted to the training program.

An aid in the selection of trainees, the U.S. Employment Service General Aptitude Test Battery B-593 for Automotive Body Repairman, should be utilized.

Teacher Qualifications

The instructor for this program must have experience in automotive body repair, and preferably, should have business experience as manager of an automotive body repair shop.

If the person selected for this teaching assignment has no teaching experience, he should be given certain fundamental principles of lesson planning and presentation.

Suggestions for the Organization of Instruction

The program in this training guide is intended to develop a marketable skill and, at the same time, to provide the trainee with a background that will permit him, at some appropriate time, to specialize in one of the many areas of work found in the automotive body repair industry.

Laboratory experiences, as well as classroom instruction, should be carefully selected by the instructor to furnish work experiences of the many tasks that challenge the trainee after he becomes employed in the trade. It is advisable to inform local automotive body shops of the nature of the program and to arrange for visits to local industries to observe work of special related interest.

It should be noted that this training guide is designed for a class of twenty persons, while the optimum trainee-teacher ratio in the laboratory-shop would be about 10:1. A great deal of individual instruction and close supervision is required to teach the skills of such a divergent field, expecially during the early part of the program.

Course Unit I

RELATED INSTRUCTION

Training Time — Classroom, 10 hours; shop, 20 hours

Objectives

To orient the trainee to the automotive body repair trade
To provide a basic understanding of automobile body and chassis construction
To familiarize trainees with the tools of the trade, including, nomenclature, use, maintenance and safety

Unit Outline

A. The automotive body repairman
   1. Primary duties (skills)
   2. Opportunities (locally and nationwide)
   3. Pride in workmanship
   4. Wages
B. Types of body construction
   1. Manufacturer (model, make)
   2. Materials
      a. Types
      b. Shapes
      c. Size or gauge
      d. Characteristics
C. Types of chassis - frames
   1. Ladder
   2. X Frame
   3. Offset
   4. Offset with X members
   5. Unitized
D. Hand tools
   1. Nomenclature
   2. Uses
   3. Care and maintenance
   4. Safety
E. Power tools and special equipment
   1. Nomenclature
   2. Uses
   3. Care and maintenance
   4. Safety
F. Parts manual
   1. How to use
   2. Estimating
   3. Ordering
G. Safety in the shop
   1. Rules and regulations
   2. Good housekeeping

Suggested Shop Exercises

1. Demonstrate and practice the proper use and maintenance of hand and power tools, and special equipment.
2. Practice use of the parts manual in ordering specific parts and making cost estimates.

References

Motor Service's Automotive Encyclopedia.
Crouse, William Harry. Automotive Chassis and Body: Construction, Operation and Maintenance.

Course Unit II

AUTOMOTIVE METALS

Training Time — Classroom, 20 hours; shop, 20 hours

Objectives

To develop skills in analyzing damage patterns and provide practice in shrinking body and fender sections.

Unit Outline

A. Types of metals
   1. Properties
   2. Uses
B. Physical metallurgy
   1. Weldability
   2. Hardening
   3. Annealing
C. Strength of automobile body members
   1. Door panels
   2. Fenders
   3. Hood
   4. Trunk
   5. Cowl
   6. Floor Panel
D. Damage pattern
   1. Analyzing procedures
   2. Corrective measures
      a. Repair
      b. Replace
E. Shrinking procedures

Suggested Shop Exercises

1. Make an analysis of damage patterns
2. Practice shrinking body and fender sections

References

Athanson, William J. Automobile Body Repair and Paint Guide.

Venk, Ernest, Edward D. Spicer, and Ewart J. Davies. Automotive Collision Work.

Course Unit III

BODY PANEL AND FENDER STRAIGHTENING

Training Time — Classroom, 50 hours; shop, 480 hours

Objectives

To develop skills in the straightening of body panels and fenders.

Unit Outline

A. Analyzing damaged areas
   1. Impact area
   2. Type of damage

B. Roughing-out sequence

C. Tools required
   1. For raising low spots
   2. For removing deep bends
   3. For flattening high spots

D. Files and buffing equipment
   1. Proper use
   2. Care and maintenance

E. Estimating damage
   1. Flat rate manual
   2. Time and materials cost

Suggested Shop Exercises

1. Roughing-out and straightening body damages utilizing dollies and hammers (manual and air).
2. Exercises in metal finishing procedures using files and buffer.
3. Submit job estimates on each assignment.

References

Sargent, Robert L. Automobile Sheet Metal Repair.
Toboldt, William K. Automotive Body Repairing and Repainting.
Vale, John W. Modern Auto Body and Fender Repair.

Course Unit IV

WELDING AND LEADING

Training Time — Classroom, 30 hours; shop, 240 hours

Objectives

To develop selected skills in oxyacetylene and arc welding, and leading.

Unit Outline

A. Principles of welding and brazing
B. Oxyacetylene procedures
   1. Use and care of equipment
   2. Proper flame adjustment
   3. Welding techniques
   4. Cutting techniques
   5. Safety practices
C. Arc welding equipment
   1. Operation of arc welding machine
   2. Use and care of equipment
   3. Welding techniques
   4. Safety practices
D. Brazing
   1. Advantages and disadvantages
   2. Brazing techniques
E. Leading (soldering)
   1. Principles
   2. Types of filler
   3. Preparation of body for leading
   4. Leading procedures
   5. Leading finishing
      a. Grinding
      b. Filing
      c. Sanding
F. Safety procedures
G. Safety equipment

Suggested Shop Exercises

1. Practice oxyacetylene welding, and brazing of body and chassis metals
2. Practice metal arc welding of frame and cross member sections
3. Practice cutting of body and chassis metals using oxyacetylene equipment
4. Use filling materials to repair auto bodies
5. Practice grinding, filing and sanding filled body sections

References

Sargent, Robert L. Automobile Sheet Metal Repair.
Toboldt, William K. Automotive Body Repairing and Repainting.
Vale, John W. Modern Auto Body and Fender Repair.

Course Unit V

FRAME STRAIGHTENING

Training Time — Classroom, 25 hours; shop, 155 hours

Objectives

To develop skills in the straightening of automotive frames and bumpers.

Unit Outline

A. Frame testing and checking equipment
  1. Steel rule
  2. Tram gauge
  3. Self-centering gauge
  4. Principles of body-frame correction machine
B. Replacement versus repair
  1. When
  2. Why
C. Bumper straightening and arm alignment
  1. Tools required (hand and power)
  2. Procedures
D. Estimating
  1. Flat rate manual
  2. Time and material cost

Suggested Shop Exercises

1. Exercises in frame and arm alignment, bumper straightening
2. Remove and replace cross members
3. Demonstrations showing frame replacement
4. Exercises for holding and applying pressure to frame members
5. Submit job estimate for each assignment

References

Crouse, William Harry. Automotive Chassis and Body: Construction, Operation, and Maintenance

Venk, Ernest, Edward D. Spicer, and Ewart J. Davies. Automotive Collision Work.

Course Unit VI

FRONT END REPAIR AND ALIGNMENT

Training Time — Classroom, 10 hours; shop, 40 hours

Objectives

To develop skills in the installation and alignment of front end parts.

Unit Outline

A. Front end section alignment
   1. Tools and equipment
   2. Checking alignment procedure
   3. Straightening sequence

B. Steering mechanism
   1. Operating principle
   2. Assembly
   3. Nomenclature

C. Estimating
   1. Front end section repair and alignment
   2. Steering assembly repair

Suggested Shop Practices

1. Check front section alignment and use necessary tools and equipment to align
2. Repair and assemble steering assembly
3. Submit job estimates on front end section and steering assembly repair

References

Crouse, William Harry. Automotive Chassis and Body: Construction, Operation, and Maintenance.

Venk, Ernest, Edward Spicer, and Ewart J. Davies. Automotive Collision Work.

Course Unit VII

REFINISHING PROCESSES

Training Time Classroom, 50 hours; shop, 350 hours

Objectives

To develop selected skills in refinishing automotive body panels and fenders.

Unit Outline

A. Types of Paint
  1. Lacquer base
    a. Advantages
    b. Disadvantages
    c. Precautions when using
  2. Synthetic base
    a. Advantages
    b. Disadvantages
    c. Precautions when using
B. Prepainting procedures
  1. Remove all rusty surfaces
  2. Patch all holes or breaks
  3. Fill and smooth all indentations
  4. Sand all flaking and chipped paint areas
  5. Apply primer coat properly
  6. Properly mask areas not to be painted
C. Operating techniques of paint sprayers
  1. Nomenclature
  2. Spray adjustment
  3. Proper spraying techniques
  4. Disassembly and cleaning
  5. Maintenance and care of spraying equipment
D. Drying
  1. Bake dry process
  2. Air dry process
E. Rubbing, polishing, and waxing
  1. Materials
  2. Procedures
F. Job estimating
  1. Flat rate manual
  2. Time and materials cost
G. Safety
  1. Ventilation
  2. Flammable material
  3. Personnel protective equipment
    a. Gloves
    b. Mask
    c. Goggles

Suggested Shop Exercises

1. Prepare body surfaces using files, grinders, and sanders (hand and power equipment)
2. Practice proper and efficient masking procedures
3. Practice painting portions of auto body and spot painting, using the sprayer
4. Disassemble, clean, and reassemble spray equipment
5. Use rubbing compound, wax, and polish, by hand, and with buffing equipment
6. Practice refinish shop job estimating

References

Athanson, William J. Automobile Body Repair and Paint Guide.
Toboldt, William K. Automotive Body Repairing and Repainting.
Vale, John W. Modern Auto Body and Fender Repair.
Venk, Ernest, Edward D. Spicer, and Ewart J. Davies. Automotive Collision Work.

Course Unit VIII

REMOVING AND REPLACING UPHOLSTERY AND TRIM

Training Time — Classroom, 20 hours; shop, 60 hours

Objectives

To develop skills in removing and replacing upholstery and trim.

Unit Outline

- A. Seat construction
  - 1. Adjustment assembly
  - 2. Springs
  - 3. Padding material
  - 4. Upholstery and trim material
  - 5. Buttoning
- B. Interior head lining
  - 1. Proper care
  - 2. Removal techniques
  - 3. Replacement techniques
- C. Door and quarter panel
  - 1. Door operating assembly
  - 2. Nomenclature
  - 3. Removal and replacement
- D. Moulding and trim
  - 1. Construction
  - 2. Installation
- E. Estimating
  - 1. Flat rate manual
  - 2. Time and material cost

Suggested Shop Exercises

1. Remove and adjust seats
2. Remove and replace head lining
3. Remove and install new interior panels
4. Remove and replace moulding and trim
5. Recover front and back seats and arm rests
6. Submit job estimates for each job

References

Motor Service's Automotive Encyclopedia.

Venk, Ernest, Edward D. Spicer, and Ewart J. Davies. Automotive Collision Work.

Course Unit IX

GLASS REMOVAL AND REPLACEMENT

Training Time — Classroom, 30 hours; shop, 150 hours

Objectives

To develop skills in the removal and replacement of automotive glass.

Unit Outline

A. Types of automotive glass
  1. Safety
  2. Laminated
  3. Tinted
B. Window regulators
  1. Nomenclature
  2. Assembly operation
C. Glass removal and installation
  1. Wind shield and rear window
  2. Door windows
D. Job estimating
  1. Flat rate manual
  2. Time and materials cost

Suggested Shop Exercises

1. Make trial orders for glass replacement
2. Exercises in repairing window regulators
3. Assignments of removing glass without damage
4. Install glass and glass channels
5. Submit job estimate with each assignment

References

Athanson, William J. Automobile Body Repair and Paint Guide.
Venk, Ernest, Edward D. Spicer, and Ewart J. Davies. Automotive Collision Work.

TEACHING THE COURSE

Planning the Lesson

The best guide or lesson plan is, of course, one that has been prepared by the individual instructor, based on personal experiences and manner of teaching. Although instructors differ in their ways of organizing and coordinating important parts of their presentations, they agree that the purpose of a lesson is to present effective and meaningful classroom instruction.

Written plans may be brief, but the good instructor will know before the class starts:

1. The goals or objectives of the lesson - the kind of learning desired
2. The outline and suggested time schedule for the lesson, including:
   a. An interest approach - a way to introduce the lesson, to capture the interest of the trainees and to direct their attention to the lesson's goals or objectives
   b. Activities which will involve the trainees in discovering new facts and principles, solving realistic problems, or practicing skills
   c. A way to summarize the lesson - to help trainees arrive at some valid conclusions and/or to evaluate the extent to which lesson goals have been achieved
3. The subject matter content - the facts and principles or main ideas to be brought out in the lesson
4. The teaching materials and references to be used

Training Facility Considerations

The intent of this section of the training guide is to describe typical training facilities. It is recognized, however, that flexibility is required in order to meet local requirements. Shop layouts and equipment lists illustrate the minimum rather than optimum programs. The training facility floor plan, see Appendix E, represents what can be done with a minimum size physical plant. However, if existing buildings are utilized, the vehicle stalls may not be accessible from the outside. In this case, the building should be wide enough to permit locating a center driveway 25 feet wide. If the working stalls are located at a 45 degree angle, the aisle width could be reduced to 16 feet.

A separate classroom is recommended for this training program. This will permit trainees to concentrate much better than would be possible in the environment of the working area where many distractions may exist. Also, this classroom will permit shelf space in a convenient location for a reference library, encouraging greater use of reference materials.

The parts and tool room, as shown, would be stocked with a few common parts and speciality tools which may be used to give trainees experience in writing requisitions. A service counter, opening to the parts and tool room, should be available to control and access to tools.

Items necessary for personal comfort would include lighting, heating, cleanliness, and control of contaminated air. Optimum lighting conditions would require illumination of 50 foot candles at 30 inches above floor level. Radiant heating in the floor is recommended for geographical areas of severe cold. However, any environment control system capable of maintaining 68°F (plus or minus 4°F) for the cold season, and a summer temperature control which provides good ventilation will suffice. An air filter system for the general working area to trap spray and dust particles is recommended, especially during cold weather when all doors and windows are closed. The welding booths should be connected to the exhaust system by a hood with a 6" x 14" intake opening. The hood should be located within 12 inches of the welding zone. In addition to this, the spray booth should have its own exhaust system. It is advisable to consult local regulations before construction of the spray booth. A system of floor drains or gutters (not shown) would be conducive to good housekeeping.

In maintaining the policy of indicating a minimum facility, no space has been designated for an air compressor or a parts cleaning tank. It would be highly desirable to have available extra room for these two pieces of equipment although it is not mandatory. The parts cleaning tank should have at least a 100 gallon capacity, and should be provided with a circulating pump and filter.

Since specific items of equipment have been chosen to represent a typical training situation, instructors responsible for particular programs may wish to adapt this training guide to meet the needs of local conditions and the background of their trainees.

In the list of equipment, see Appendixes A, B, and C, prices have been included for the purpose of indicating approximate quality of each item; and, again, considerable flexibility must be recommended. More detailed specifications will be needed should this list be used for writing purchase orders.

Criteria for Judging Trainee Readiness for Employment

The criteria which serve as guides for determining whether the trainee is ready for employment as an automotive body repairman may be more rigorous than in some other occupations. However, some understanding and insight into how to provide various services are of such importance that every attempt be made to evaluate trainee progress.

The use of various evaluative devices is necessary for the instructor and the trainee to accumulate objective information about the growth of the trainee. The following personal qualities and characteristics should be developed or strengthened during the training program.

A. Personal qualities:

1. Courtesy, friendliness, and tact in dealing with supervisors, fellow workers, and the general public
2. Acceptable appearance - good grooming, cleanliness and neatness in dress, sensible choice of clothing
3. Good personal habits in speech, mannerisms, neatness and method of work
4. Acceptable attitudes - calmness in disorganized situations, cooperativeness, willingness to work with others
5. Understanding the role of the Automotive Body Repairman

B. Activities showing knowledge, understanding, and skills:

1. Demonstrates knowledge of automotive body repair work
2. Understands and conforms to instructions or directions
3. Demonstrates ability to work with minimum immediate supervision
4. Demonstrates the ability to keep repair facilities clean and orderly
5. Demonstrates the ability to properly use and maintain tools used in automotive body work
6. Demonstrates the ability to develop and follow a work plan or schedule
7. Demonstrates understanding of basic safety precautions

SUGGESTED LIST OF TEXTBOOKS AND REFERENCES

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Venk, Ernest, Edward D. Spicer, and Ewart J. Davies. Automotive Collision Work. 3rd ed. Chicago: American Technical Society, 1964.

SUGGESTED LIST OF FILMS

Title	Subject Matter
FIRE - CAUSE AND ALARM 16 mm, sound, 12 minutes Bell Telephone System Offices	Shop Safety
HOW METALS BEHAVE 16 mm, sound, 30 minutes American Society for Metals Mr. T. C. DeMond Metals Park, Ohio	Basic Theory
MAKING THE MOST OF THE SPRAY PAINTING METHOD 16 mm, sound, 45 minutes DeVilbiss Co. 300 Phillips Avenue Toledo, Ohio	Basic Paint
NEW WELDING PROCEDURES 16 mm, sound, 20 minutes Eutectic Welding Alloys Corp, 40-40 172nd Street Flushing 58 New York, New York	Basic Practices
OXY-ACETYLENE FLAME MASTER OF METALS 16 mm, sound, 19 minutes Bureau of Mines Graphic Services 4800 Forbes Avenue Pittsburgh 13, Pennsylvania	Basic Practices
STORY OF ARC WELDING, A 16 mm, sound, 24 minutes Bureau of Mines Graphic Services 4800 Forbes Avenue Pittsburgh 13, Pennsylvania	Basic Practices
WORLD OF HENRY FORD 16 mm, sound, 35 minutes Ford Motor Co. Ford Film Library Dearborn, Michigan	History & Introduction

Appendix A. SUGGEST LIST OF MACHINES

Quantity	Description	Total cost estimated
1	Compressor, air, 15 h.p.	2,075.00
1	Shear, metal cutting, bench model	250.00
6	Welding and cutting units, gas, portable	1,050.00
4	Machines, arc welding, 250 amp capacity	1,100.00
1	Drill press, ½" chuck capacity	450.00

Appendix B. SUGGESTED LIST OF TOOLS

Quantity	Description	Total cost estimated
20	Hammers, double faced dinging	62.00
20	Hammers, pecking	60.50
20	Hammers, long body finishing	71.00
20	Hammer, finishing for fender bends	57.00
20	Dolly assortments, 6 pieces	420.00
20	Hammers, sledge, 3 lbs	95.00
20	File, assortments and file holders, 8 pieces	442.00
20	Plier assortments, 8 pieces	490.00
20	Screw driver sets, standard tip, 5 pieces	185.00
20	Screw driver sets, phillips head, 5 pieces	157.00
20	Punch and chisel sets, 12 pieces	165.00
20	Snips, combination pattern sheet metal, 13½" length	140.00
20	Snips, aviation, sets(1 right hand, 1 left hand)	75.00
20	Wrench sets, combination, box and open end, 15 wrenches	820.00
20	Wrench, socket, ½ square drive, 25 piece set	825.00
1 pr.	Cutters, bolt, with 24 inch handle	10.50
12	Clamps, "C", 6 inch opening	72.00
1	Punch and drift set, 6 pieces	6.00
6	Chisels, cold, 1 inch wide blade	6.00

Quantity	Description	Total cost estimated
2 sets	Drills, twist, high speed, with metal index	60.00
6	Hammers, 2-ball peen, 2-sledge, 2-soft face	14.00
2	Bars, pry	10.00
10	Frames, hack saw, adjustable to 12 inches	30.00
8	Saws, hole, 3/4 inch to 3 inch diameter	38.00
1	Saw, saber	50.00
1	Cutter, panel, pneumatic, complete with one set of 3 chisels	250.00
2	Soldering irons, 200 watt	25.00
2	Soldering guns, 250 watt	24.00
2	Rules, steel	2.00
2	Tapes, steel, 25 ft. long	10.00
1	Tap and die set, $\frac{1}{4}$" to $\frac{1}{2}$" size, in N.C. and N.F. and 4 x 36 to 12 x 24 size in machine screw thread	38.00
1	Insert tool, head lining	2.25
1	Aiming machine, head light	15.00
2	Socket sets, $\frac{1}{4}$" drive, 19 pieces	42.00
1	Wrench set, metric, 3/8" drive, to 27 mm	35.00
2	Drills, portable, electric, $\frac{1}{4}$" capacity	65.00
1	Drill, portable, electric, $\frac{1}{2}$" capacity	50.00
6	Sanders, body, 9" disk, electric	590.00
2	Sanders, block type, electric or air	180.00
2	Buffer-polishers	180.00

Quantity	Description	Total cost estimated
3 doz.	Files, assortment	49.00
1	Flaring tool, 3/15 to 4/8" O.D. tubing	15.00
6	Wrenches, adjustable 4" to 16"	28.00
2	Wrenches, pipe, 14" length	9.00
24	Clamps, body	250.00
36	Pliers, vise grip	90.00
6	Spoons, pry	20.00
6	Spoons, bumping	15.00
6	Spoons, body	15.00
6	Spoons, general	24.00
6	Spoons, rough service	24.00
6	Spoons, combination	24.00
2	Pry rods	15.00
2	Gauge, tram, length 114"	50.00
6	Gauge, self-centering	200.00

Appendix C. SUGGESTED LIST OF EQUIPMENT

Quantity	Description	Total cost estimated
20	Lighters, torch, with one flint	7.00
20	Goggles, welding	60.00
20	Cabinets, tool, mounted on heavy duty rollers	600.00
1	Desk, 5 drawer	120.00
20	Chairs, tablet arm	240.00
10	Lockers, personnel, steel, double compartments 72" x 24" x 18"	400.00
1	Projector, motion picture, 16 mm sound	220.00
1	Projector, still, for slides	135.00
1	Projector, overhead	120.00
1	Screen for showing pictures, 6' x 6'	36.00
2	Jack, body, complete with pump and ram, 10 ton capacity	338.00
2	Jacks, body, complete with pump and ram, 2 ton capacity	404.00
1	Jacks, frame, 10 ton capacity	650.00
3	Jacks, floor, hydraulic, 2 ton capacity	525.00
24	Stands, floor, automotive	420.00
6	Rick racks, for holding body panels 24" x 48"	140.00
6	Benches, for metal work, metal top, 30" x 72"	540.00
7	Air pressure regulators, with moisture traps, 0-100 lb gage	350.00
1	Table, demonstration, 30 x 62" top	60.00

Quantity	Description	Total cost estimated
7	Hoses, air, 3/8" I.D., 50 foot length	120.00
2	Racks, paper	60.00
1	Press, hydraulic, 5 ton capacity	250.00
12	Creepers, low profile	120.00
4	Vises, 4" jaw, 6" opening, swivel base	170.00
4	Extinguishers, fire	190.00
1	Hoist, chain, 2 ton capacity	367.00
1	Light, drying, complete set with 8 heating elements	150.00
8	Hoses, water, 5/8 I.D., 25 feet long	64.00
3	Pans, drain, 3 gallon capacity	12.00
3	Containers, waste, with lids	15.00
12	Covers, fender, with rubber backs	72.00
6	Covers, seat, spread	36.00
6	Guns, spray, siphon cup type	360.00
1	Gun, spray, hot spray type	86.00
6	Brushes, wire, 12" length	3.60
6	Brushes, striping	4.80
9	Brushes, paint, assorted sizes	22.00
12	Paddles, solder	12.00
1	Trimmer, sanding disc	17.50
4 doz	Brushes, flux	6.00
12	Lights, extension, moulded rubber handle	36.00
12	Plates, tension, solder-on type	48.00

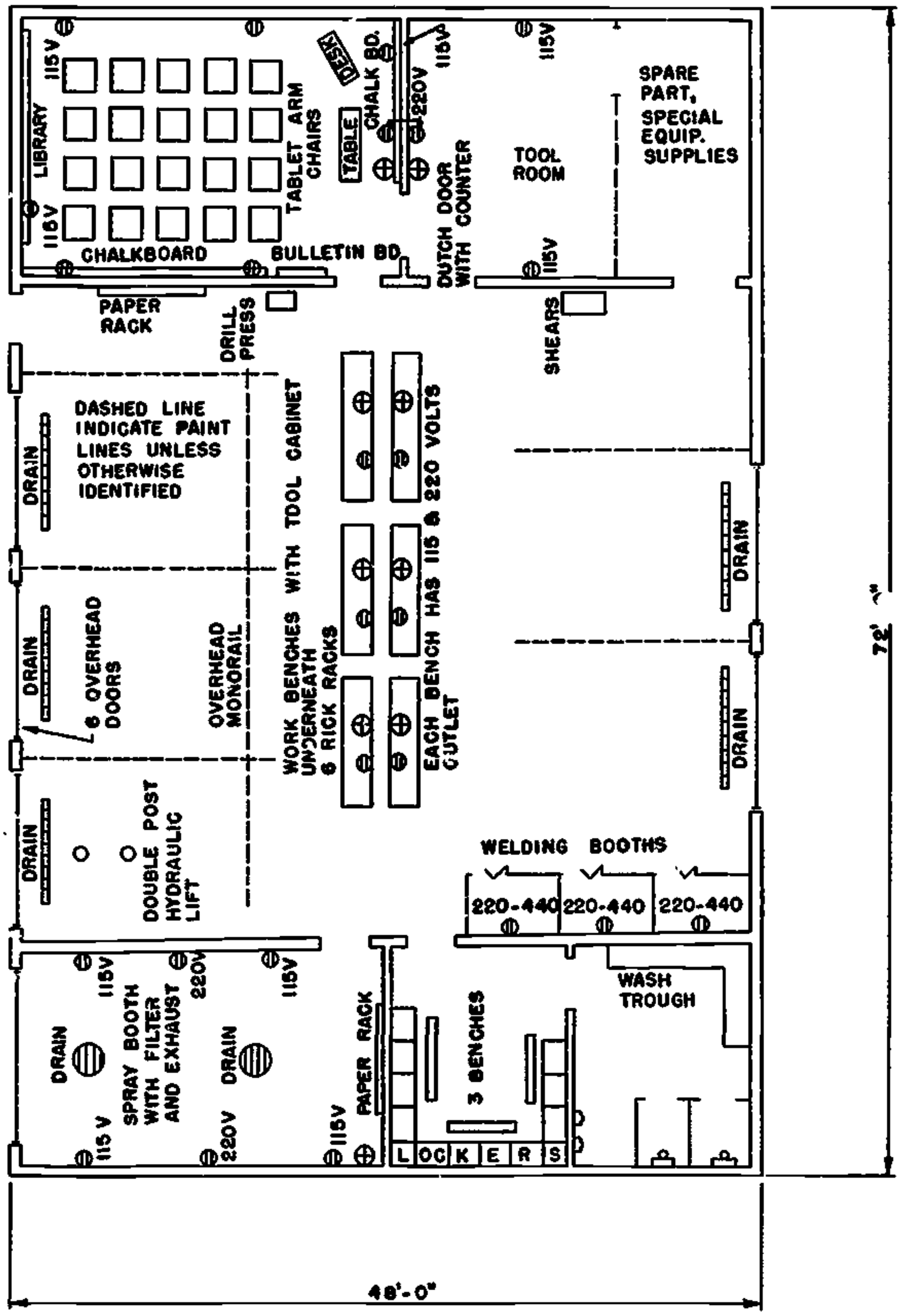
Appendix D. SUGGESTED LIST OF EXPENDABLE SUPPLIES

Quantity	Description	Total cost estimated
20 gal	Stripping material, (paint remover)	110.00
20 gal	Primer	120.00
55 gal	Paint thinner, enamel	88.00
5 doz	Masking tape, ½", 1", 1½"	60.00
55 gal	Paint thinner, lacquer	54.00
3 gross	Sanding discs, 24, 36, and 50 grit	95.00
200 lbs	Body solder, 50-50 (60-40 optional)	160.00
12 jars	Solder flux	14.00
144	Tack rags	36.00
144	Steel wool, pads	15.00
24	Solder paddle lubricant	12.50
6 cyl	Oxygen	24.00
6 cyl	Acetylene	24.00
500 lbs	Welding rods and electrodes	150.00
100 lbs	Brazing rods	130.00
1500 sheets	Sand paper, 80, 200, 400 grit	150.00
200	Shop towels (wiping rags optional)	20.50
2 qts	Jack fluid, hydraulic	1.20
12	Buffer pads, wool	36.00
1 assortment	Machine bolts and nuts, ¼" through 5/8", ½" to 2½" length	60.00
1 assortment	Machine screws, 6 x 32 through 10 x 24, ½" to 1" length	20.00

Quantity	Description	Total cost estimated
10 gross	Sheet metal and selftapping screws	15.00
20 lbs	Steel washers	7.50
500	Lock washers	5.00
20 gross	Hack saw blades	60.00
20	Practice fenders (used)	60.00
20	Practice panels (used)	60.00
4	Practice paint boards, paper covered	120.00
50	Sheet metal, 12" x 18", practice, 20-22 gauge	25.00
2	Stretchers, sheet metal strip	18.00
1	Cutaway section, roof rail	12.00
1	Cutaway section, rocker panel	12.00
6	Lock mechanisms, door	24.00
4	Lock mechanisms, trunk	12.00
1	Cutaway section, floor pan and drain	14.00
4	Window regulators, side	8.00
3	Window regulators, vent	6.00
1	Window regulators, rear, station wagon	8.00
24	Moulding clips, assortment	6.00
10 gal	Synthetic filler material	60.00
5 gal	Glass sealer with dispenser	20.00

APPENDIX E

SUGGESTED TRAINNG FACILITY



⊖ ELECTRIC OUTLET

⊕ LINE PRESSURE ETC.

✳ EXPLOSIVE PROOF SWITCHES AND LIGHTS SHOULD BE INSTALLED WHERE REQUIRED

DISCRIMINATION PROHIBITED - Title VI of the Civil Rights Act of 1964 states: "No person in the United States shall, on the ground of race, color, or national origin, be excluded from participation in, be denied the benefits of, or be subject to discrimination under any program or activity receiving Federal financial assistance." Therefore, the Vocational Education program, like every program or activity receiving financial assistance from the Department of Health, Education, and Welfare, must be operated in compliance with this law.

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*OCCUPATIONAL HOME ECONOMICS, HOME MANAGEMENT, FAMILY LIFE, PROGRAM DEVELOPMENT, *CURRICULUM GUIDES, TEACHING GUIDES, PUBLIC HOUSING, *MANAGEMENT AIDES,
MDTA Programs,

Resource material is provided for use in developing a training program for management aides, persons who assist housing managers of local housing authorities in orienting residents to living in a new environment. The program objective is to prepare trainees to establish working relationships with people of varying backgrounds, interpret regulations and provide information regarding community services, instruct tenants in the best methods of home management, and assist the manager in keeping records, preparing reports, and handling problems. Units are Achieving Effective Working Relationships with People, Assisting Tenants with Family Living Problems and Housing Project Life, and Additional Tasks of the Management Aide. Each unit consists of suggested training time, objectives, course unit outline, and references. The student should be a high school graduate with a background in home economics, experience in wage earning and homemaking, and sufficient maturity to deal with a variety of problems. The teacher should have home economics training, experience in teaching adults, and ability to adapt materials and methods to the level of the group. Suggested training time is 360 hours. Suggestions for planning lessons and learning experience, evaluating achievement, securing teaching facilities, and judging trainee readiness for employment are included. This document is available as FS5.287--87001 for 20 cents from Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402. (MS)

OE-87001

A SUGGESTED TRAINING PROGRAM

Management Aide in Low-Rent Public Housing Projects

U. S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE, Office of Education

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
OFFICE OF EDUCATION

OE - 87001

MANPOWER DEVELOPMENT AND TRAINING PROGRAM

Management Aide in Low-Rent Public Housing Projects

A SUGGESTED TRAINING PROGRAM

U. S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
Office of Education . Division of Vocational and Technical Education

Developed and first published pursuant to a contract with the U.S. Office of Education by McGraw-Hill, Inc.

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FOREWORD

THE MAJOR ROLE of home economics training in vocational education has been to assist youth and adults to prepare for the responsibilities and activities of homemaking and the achievement of family well-being. Although this role will continue to be a responsibility of home economics education, many socioeconomic changes affecting women and families require that home economists now assume, to a greater extent than in the past, the responsibility of providing training for wage earning. An increasing number of women find it necessary to spend part of their lives in some wage-earning occupation. In addition, many employed homemakers and community agencies find it necessary to secure assistance in the care of family members or in the provision of other services that contribute to more satisfactory family life.

A series of work conferences held in 1963, under the direction of the Professional Services Section of the Manpower Development and Training Program, U. S. Office of Education, brought together national leaders in adult education in home economics, who, in cooperation with workers in other branches of vocational education and several national organizations and agencies, selected nine service occupations for which to prepare training materials. These occupations, based on home economics knowledge and skills, provide a service to families within an institutional or community setting or within the home. Suggested resource material from which to develop a training program that meets the needs of a particular group of trainees have been prepared for each of the nine occupations. The job analyses and job descriptions used in the suggested training programs were prepared for inclusion in the revised edition of the Dictionary of Occupational Titles, issued by the U. S. Department of Labor.

This guide for the Management Aide in Low-Rent Public Housing Projects provides resource material from which a local training program can be developed. It is recognized that the experience and education of trainees will vary, as will the aims and needs of the local Housing Authority that will employ and supervise the trained Management Aide. A suggested schedule for training is included, but the program should be adapted to each group of trainees. This publication will be useful for the development of training programs that will enable women to acquire competencies having a valid wage value and needed in serving families.

Walter M. Arnold
Assistant Commissioner for
Vocational and Technical Education

CONTENTS

TRAINING PROGRAM FOR THE MANAGEMENT AIDE IN LOW-RENT PUBLIC HOUSING PROJECTS

Developing Course Plans

The following suggestions are for training persons who are to be employed to assist housing managers in low-rent public housing projects. Nationally, this job has been given a variety of descriptive titles. In this training guide the title Management Aide in Low-Rent Public Housing Projects is used.

Teachers must adjust and adapt the suggestions in this guide to the needs of the particular group they are teaching because the duties expected of the Management Aide may differ from community to community, and the trainees will vary in education, experience, and ability. In addition to having first-hand information concerning job requirements, the teacher must secure as much information as possible about trainees. The specific objectives, teaching methods, and time allotted to each aspect of the training can then be adjusted to the local situation and to the trainees.

Job Functions

The Management Aide assists housing managers of local housing authorities in orienting residents in housing projects to living in a new environment and to making effective use of the resources, facilities, and services provided in the project and in the community for achieving a satisfying family life.

Program Objectives

To prepare trainees:

1. To establish working relationships with people of varying socioeconomic backgrounds, cultural and racial heritages, and age groups; and to orient them to living in a housing project;
2. To interpret regulations;
3. To show location of project facilities; to demonstrate the use of kitchen, bathroom, and laundry equipment;
4. To provide information to tenants regarding community health services, child welfare services, churches, schools, adult education centers, and recreation centers;
5. To assist the manager of the local housing authority in handling special managerial and human relations problems; keeping records; preparing reports; and referring individuals or families requiring special counseling or other services to the management staff;
6. To instruct tenants in the best methods of planning homemakers' work schedules; selecting, buying, storing, and preparing food; selecting, buying, and caring for clothing; managing money; caring for children; and observing sanitary housekeeping practices.

It is suggested that the teacher review the "Criteria for Judging Trainee Readiness for Employment" prior to developing plans for teaching this course. The criteria will be useful throughout the course in setting up specific objectives, providing learning experiences, and making periodic evaluations.

Teacher Qualifications

A person qualified to teach is a competent homemaker who has had home economics training. She should also have had experience teaching adults, and should be able after inservice training to adapt teaching materials and methods to the level of the group. She should be emotionally mature, in good health, and should have sufficient understanding of human relations to help trainees relate themselves to the tenants and staff of a housing project.

Background of Trainee

A trainee should be a high-school graduate, preferably with two or more years of home economics study in high school or junior college. She should be experienced as a homemaker and wage earner, and should have some experience working with groups on a voluntary or paid basis. The trainee should be able to help people help themselves, and should be well-adjusted, even-tempered, and possessed of much patience. She should have sufficient maturity to work effectively with the housing management staff, the different groups represented in the housing project, and the representatives of community agencies and organizations.

Length of Course and Course Units

A course of 360 hours is suggested for training. The following suggested time for each of the three units may be used as a guide for planning the course to meet trainee and community needs.

Course Unit	Title	Hours
I	Achieving Effective Working Relationships with People	90
II	Assisting Tenants with Family Living Problems and Housing Project Life	192
III	Additional Tasks of the Management Aide	78
	Total	360

COURSE UNIT I

ACHIEVING EFFECTIVE WORKING RELATIONSHIPS WITH PEOPLE

Suggested Training Time 90 Hours

Objectives

To help trainees achieve effective working relationships with people by developing an understanding of basic human needs. Particular attention is focused on the differences among various ethnic, cultural, age, and socioeconomic groups. The unit also provides training in skills needed for communicating effectively with people.

Course Unit Outline

A. Some important understandings basic to working effectively with people

1. Basic needs and desires of individuals
   a. Love and affection
   b. Security
   c. Recognition for achievement
   d. Self-confidence and self-respect
   e. To be liked and to be with others
2. Some evidence of emotional maturity—achieving basic needs
   a. Ability to face facts
   b. Acceptance of others at their present growth level
   c. Acceptance of criticism—avoidance of blaming or taking out feelings on others
   d. Ability to face difficulties
   e. Acceptance of disappointments
3. Self-understanding as a prerequisite for sympathetic understanding of and effective work with people
4. Some possible characteristics of people from varied ethnic, cultural, age, and socioeconomic groups
   a. Aspiration level is often low—individuals have seldom experienced success
   b. May care about education, but dislike school
   c. Not particularly interested in the community
   d. Traditional festivals may be important to older people, but are rejected by youth, resulting in possible conflicts
   e. Dress may differ from generally accepted standards
   f. The man may have nebulous position in family or may be autocratic head of family
   g. Food customs may differ from those of the American middle class
5. Many facts must be recognized and accepted, including
   a. Patterns of behavior and family practices differ
   b. Differences in behavior, within socially acceptable limits, result in uniqueness of individual personalities
   c. Basic human needs and the way they are met influence the quality of relationships within the family and the attitudes of the individual in the community
   d. Ways to meet basic human needs can be learned at any age

B. Some methods of communicating with tenants

1. Illiterate tenants
   a. Friendly conversation

    - (1) Choose the right time and place
    - (2) Begin with an expression of interest, a question, or reference to some successful achievement
  - b. Individual or group discussions
  - c. Demonstrations to show "how"
  - d. Exhibits of how to use housing facilities
- 2. Functionally literate tenants
  - a. Illustrated talks
  - b. Simple direction sheets
  - c. Group discussions
  - d. Role playing
- 3. Important skills for effective communication—friendly manner, distinct speech, clearly stated ideas, simple vocabulary, presentation of only a few directions at one time, repetition to insure understanding

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COURSE UNIT II

ASSISTING TENANTS WITH FAMILY LIVING PROBLEMS AND HOUSING PROJECT LIFE

Suggested Training Time 192 Hours

Objectives

To develop the trainee's skills in and knowledge of ways to assist homemakers orient themselves to housing project living—regulations, problems concerning household schedules, food, clothing, money-management, care of children, sanitation, repair and replacement of equipment, prevention of accidents, and simple home decoration.

Course Unit Outline

- A. Helping families become oriented to living in a housing project
  - 1. Interpretation of regulations
  - 2. Location of project facilities for family living—laundry, play area for toddlers, and community center
  - 3. Use and care of equipment in kitchen, bathroom, laundry, and refuse-disposal areas
- B. The household work schedule for the full-time homemaker and the woman who is both a homemaker and a wage earner

1. Household routines essential for family well-being
2. Division of responsibilities within the family
3. Sequence of work and job tasks to save time and energy
4. Ways to determine the priority of home activities for family well-being or satisfaction

C. Family problems concerning food

1. Spending the food dollar wisely—procedures for controlling the food budget
2. Ways of preparing food in the time available
3. Methods of storing food
4. Use of food in promoting happy relations with family and friends

D. Problems concerning clothing the family

1. Family clothing plan
2. Ways of renovating and methods of care
3. Purchasing—thrift shops, rummage sales, and clothing stores
4. Good grooming

E. Money management plan

1. Essential weekly and monthly expenditures
2. Family planning for use of income
3. Ways to stay within planned expenditures
4. Savings—one use of money
5. Credit—guides for use

F. Care of children

1. Need for good food, adequate rest, healthy play, and cleanliness
2. Normal behavior of children of different age groups
3. Types of facilities provided for children of different ages within the housing project
4. Plans for care and safety of children whose mother works
5. Protecting children from hazards—stairwells, broken playground equipment, open windows, matches, poisons (cleaning fluids), and medicines
6. Health protection by immunization

G. Sanitary housekeeping

1. Cleaning
   a. Stoves and refrigerators
   b. Suitable methods and materials for each room and type of surface
   c. Frequent laundering to avoid accumulating soiled linens and clothing
2. Pest Control—preventive practices, extermination service provided by the housing management
3. Garbage and trash—proper handling in the apartment; use of project facilities for disposal; care of family garbage containers

H. Repair and replacement of equipment

1. Tenant responsibilities in using any project-owned equipment
2. Procedures for reporting needed repairs—leaking faucets, broken windows, clogged plumbing, or suspected gas leaks
3. Tenant responsibility for complying with housing management requirement regarding repairs and installations

I. Prevention of accidents

1. Proper use of equipment—stoves, laundry, lighting, gas heaters
2. Use of improvised stepladders
3. Storage of toys and small household equipment
4. Removal of slippery spots on floor caused by water, grease, or excess floor wax
5. Care of yard adjacent to home unit

J. Simple home decoration

1. Project regulations concerning decorating, hanging pictures, structural changes
2. Use of community center rooms or a model apartment to demonstrate inexpensive ways to make an apartment livable and attractive

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COURSE UNIT III

ADDITIONAL TASKS OF THE MANAGEMENT AIDE

Suggested Training Time 78 Hours

Objectives

To develop an understanding of the Management Aide's role in a low-rent public housing project; to emphasize knowledge and skills important in dealing effectively with tenants.

Course Unit Outline

A. Serving as an information clearinghouse to tenants about available services and their location in the community
   1. Community health services
   2. Family and child-welfare services
   3. Schools and churches
   4. Adult education centers
   5. Recreation centers

B. Serving as an assistant to the manager of the local housing authority
   1. Work of the housing authority
   2. Organization of the staff
   3. Work of all staff members
   4. Work of the Management Aide
   5. When to refer individuals or families to the management staff
   6. How to keep records and prepare reports

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TEACHING THE COURSE

Planning the Learning Experiences

The objectives of a training program are achieved by learning experiences designed to help the trainees develop those behaviors and abilities designated in the objectives. Each experience should serve a definite function and should not be introduced because it is traditional or "modern" or because it is satisfying to the teacher.

A good teacher constantly reminds herself that "covering" the topics outlined for a course does not automatically result in learning. She knows that effective learning experiences should be planned by visualizing what the trainee must be able to do on the job. The job analysis will be an important guide, because the class experiences must be realistic and based on work situations for which the training is being given. Each trainee needs opportunity to apply her understandings and abilities to the different kinds of problems she may face.

A variety of learning experiences will be needed to develop the kinds of abilities required in home and community service occupations. Creativity is a key in providing meaningful experiences for a particular group. The successful teacher will see new ways to synthesize, adapt, and revise experiences to fit the unique characteristics of the group and fulfill the requirements of the job.

These are some planned experiences to be considered:

A. Experiences that will add to and enrich the background of trainees

1. Bringing employers to class to give information on nature of the job
2. Using persons from special fields such as mental health, geriatrics, nutrition or dietetics, child development, medicine, public health, and housing to extend basic knowledge and answer questions
3. Providing reading material appropriate to age and reading ability
4. Using movies, filmstrips, charts, tape recordings, or other audiovisual materials to present specific information (it will be necessary for teachers to preview films, filmstrips, and tapes for appropriateness of and familiarization with the content)

B. Experiences which help develop insight and desirable attitudes

1. Playing out roles of people who might be involved in a work situation
2. Visiting with prospective employers who are to benefit from services to be given by trainees
3. Comparing methods of doing a task by making simple time and motion studies
4. Reacting to situations illustrated in movies, cartoons, or short dramas
5. Making planned trips to representative places of employment

C. Experiences in analyzing work situations and solving problems

1. Considering a specific employment problem or work situation. The situation presented must be realistic. (If actual cases are studied, anonymity should be maintained.) The teacher should ask questions which lead trainees to recognize the problem, to decide what additional information might be needed, and to suggest and evaluate solutions.
2. Developing step-by-step work schedules for some aspects of the job
3. Working out typical problems in a laboratory situation

D. Experiences to develop specific skills and abilities

1. Watching demonstration of a technique, with follow-up practice in class, laboratory, in own home, or in a situation provided by cooperating employer(s)
2. Observing and participating in specific activities in places similar to those where trainee will be employed
3. Experimenting with different arrangement or placement of equipment and supplies, or different techniques for completing a job
4. Acting out situations such as interviewing a prospective employer, repeating directions given, or getting help from a supervisor

E. Some teaching methods which help trainees draw conclusions and summarize important ideas

1. Circle discussion—each member tells of something she observed on a field trip or in a film that would be useful to an employee
2. Buzz group—a small group of trainees applies a principle to new situations
3. Summarizing panel—2 to 5 members of the class review important ideas presented in a class session
4. Summary sheets—brief summaries of major ideas. important facts, or steps in a work process, prepared by the teacher for distribution to trainees at the end of a lesson

Evaluating Achievement

Major functions of evaluation in a program designed to prepare individuals for wage-earning:

1. Assessing basic abilities of persons desiring to enroll in the training program as a basis for selection
2. Determining needs and backgrounds of trainees as one basis of setting up specific goals for the course
3. Measuring the extent to which trainees achieve the goals

Evaluation made for these purposes also will give the teacher a basis for developing learning experiences, modifying course plans, and selecting appropriate references and teaching materials. The needs, backgrounds, and abilities of potential trainees can be assessed by teachers in informal interviews with each person. Personal data sheets and more formal measurement of reading ability and aptitudes for the job may be supplied by vocational counselors or employment service offices.

An integral part of planning a course is selecting some means for checking the progress of each trainee. The desired understandings, attitudes, and abilities are described in the objectives. Course plans must include:

1. Ways of observing each trainee's progress toward achieving objectives
2. Methods of recording observations so progress may be assessed

A teacher can obtain some clues to progress from the trainee's participation in class and from individual conferences. An "anecdotal record," which is a factual report of what the trainee says or does, needs to be written at frequent intervals. Evaluation of the anecdotes should not be attempted until a number of observations has been recorded and at a time when the teacher's feelings and emotions are least likely to influence her judgment.

A rating scale may be used to indicate the level or quality of trainee accomplishment. Three levels are commonly used such as "very good," "acceptable," "not acceptable." (An experienced teacher may use one with 5 to 7 levels, but those used by trainees should be less complex.) The accomplishments being evaluated should be stated specifically and the meaning of the different levels on the scale should be indicated clearly so that all persons using the scale have a common understanding of the meaning of each rating. A check-off type of list can be used by both teacher and trainee to record completion of learning activity or achievement of some measurable skill. Rating scales, sometimes called "score cards," may also be developed to rate a completed task.

Evidence of trainee accomplishments should be compiled throughout the training course. Since observations are more valid if made in realistic situations, much of the evaluation will usually take place in laboratory and practice sessions.

Planning the Lesson

The best guide or lesson plan is, of course, one that has been prepared by the individual teacher, based on personal experience and manner of teaching. Although teachers differ in their ways of organizing and coordinating important parts of their presentations, they agree that the purpose of a lesson is effective and meaningful classroom instruction.

Written plans may be very brief, but the good teacher will know before the class starts:

1. The goals or objectives of the lesson—the kind of learning desired
2. The outline and suggested time schedule for the lesson, including
   a. An interest approach—a way to introduce the lesson, to capture the interest of the trainees and to direct their attention to the lesson's goals or objectives
   b. Activities which will involve the trainees in discovering new facts and principles, solving realistic problems, or practicing skills
   c. A way to summarize the lesson—to help trainees arrive at some valid conclusions and /or to evaluate the extent to which lesson goals have been achieved
   d. Assignments of additional study or practice
3. The subject matter content—the facts and principles or main ideas to be brought out in the lesson
4. The teaching materials and references to be used

Teaching Facilities

In addition to home economics departments, there are various types of public and private facilities which, if available locally, could be used to enhance the effectiveness of this course. Trainees, for example, could profit from visits to housing facilities to observe techniques used in tenant orientation, home management, housekeeping, and similar course-related activities.

Because all of the suggested facilities will not be available in every community, it remains for the teacher to modify or supplement the following suggestions:

1. Rooms in housing projects, public schools, recreation centers, YWCA's, libraries
   Rooms in any of these institutions may provide space and facilities for class meetings and group discussions. Of particular interest are rooms which contain bulletin boards, chalkboards, and are suitable for the use of audiovisual aids.
2. Facilities within housing projects
   Through visits to furnished apartments in low-rent public housing projects, trainees can observe typical facilities and decor. The teacher can point out examples of how inexpensive furniture obtained from thrift shops, Good Will Industries, the Salvation Army, or similar sources may be used to advantage. Apartments may also be used for demonstrating and practicing good housekeeping techniques, the use and care of house-

hold equipment (stove, refrigerator and bathroom fixtures), and home safety measures. Visits to project laundry, playground, and refuse-disposal areas will familiarize trainees with other typical project facilities.

3. Local appliance stores and utility companies

   These stores and firms usually employ trained specialists who give demonstrations in the use and care of common household appliances, not all of which may be available for class practice sessions or demonstrations. Much can be learned about the use, operation, and care of these appliances through a well-planned visit to these facilities.

4. Schools and child-care centers

   A visit to a kindergarten, nursery, or primary grade offers trainees an excellent opportunity to observe children and their activities. Particular attention can be focused on techniques used in obtaining the cooperation of children.

5. Local stores

   Field trips to local stores can help trainees learn more about desirable shopping techniques, general price levels, characteristics of various products, and methods of selection of clothing, food, and furnishings.

6. Other community resources

   Visits to other community resources—community health centers, child-welfare centers, adult education centers, recreation centers—can acquaint trainees with some resources outside the housing project which may be available to project residents.

Criteria for Judging Trainee Readiness for Employment

The criteria which serve as guides in determining whether the trainee is ready for employment as a Management Aide will be more intangible than in some other occupations. However, some understanding of human frailties and needs, and some insight into how to establish effective working relationships with people, are of such importance that every attempt should be made to evaluate trainee progress.

The use of various evaluative devices is necessary for the teacher and the trainee to accumulate objective information about the growth of the trainee. The following kinds of competencies are important to develop or strengthen during the training program.

A. Personal qualities
   1. Courtesy, friendliness, and tact in dealing with housing project residents and staff members
   2. Acceptable appearance—good grooming, neatness in dress, sensible choice of clothing
   3. Good personal habits—speech, mannerisms, cleanliness, methods of work, punctuality
   4. Mature judgment in a variety of situations
   5. Acceptable attitudes—interest in people, ability to relate easily to different kinds of people, cooperativeness, patience
   6. Understanding of own role and that of others

B. Activities showing knowledge, understanding, and skills
   1. Works effectively under supervision—understands and carries out instructions given by the management staff
   2. Demonstrates ability to understand and interpret housing project regulations—explains tenant and management responsibilities
   3. Demonstrates procedures for preparing reports and keeping records
   4. Exhibits knowledge of people to contact and action to take in an emergency

5. Demonstrates some recommended methods for obtaining and giving information
6. Demonstrates ability to instruct people of varied abilities and backgrounds
7. Demonstrates an understanding of basic needs and desires of individuals and differences among various groups—cultural, age, socioeconomic
8. Demonstrates ability to establish working relationships with all kinds of people
9. Demonstrates ways to help homemaker with household routines, efficient scheduling, and methods of work
10. Demonstrates knowledge of family shopping—preparation of a shopping list, selection of items, problems related to weights and measures, money and change, other shopping practices
11. Demonstrates ability to help families with money-management problems
12. Demonstrates some understanding of elementary techniques for working with children—their needs, typical problems, the care of infants
13. Demonstrates some techniques and methods of keeping home clean, sanitary, orderly
14. Demonstrates care and use of common household appliances and equipment—washing machine, dryer, stove, refrigerator, etc.
15. Demonstrates understanding of safety in the home—basic precautions, dangerous areas
16. Demonstrates some inexpensive ways to make an apartment livable and attractive
17. Demonstrates proper use and care of project facilities and equipment—laundry room, refuse-disposal areas, playgrounds, recreation rooms, etc.

This is one of a series of nine training guides for Home and Community Service Occupations.

A. Community-Focused Occupations Which Use Home Economics Knowledge and Skills
   1. Child Day-Care Center Worker
   2. Management Aide in Low-Rent Public Housing Projects
   3. The Visiting Homemaker
   4. Hotel and Motel Housekeeping Aide
   5. The Supervised Food Service Worker

B. Home-Focused Occupations Which Use Home Economics Knowledge and Skills
   1. Clothing Maintenance Specialist
   2. Companion to an Elderly Person
   3. Family Dinner Service Specialist
   4. The Homemaker's Assistant

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Electronic Business Data Processing Peripheral Equipment
Occupations, Suggested Curricula.

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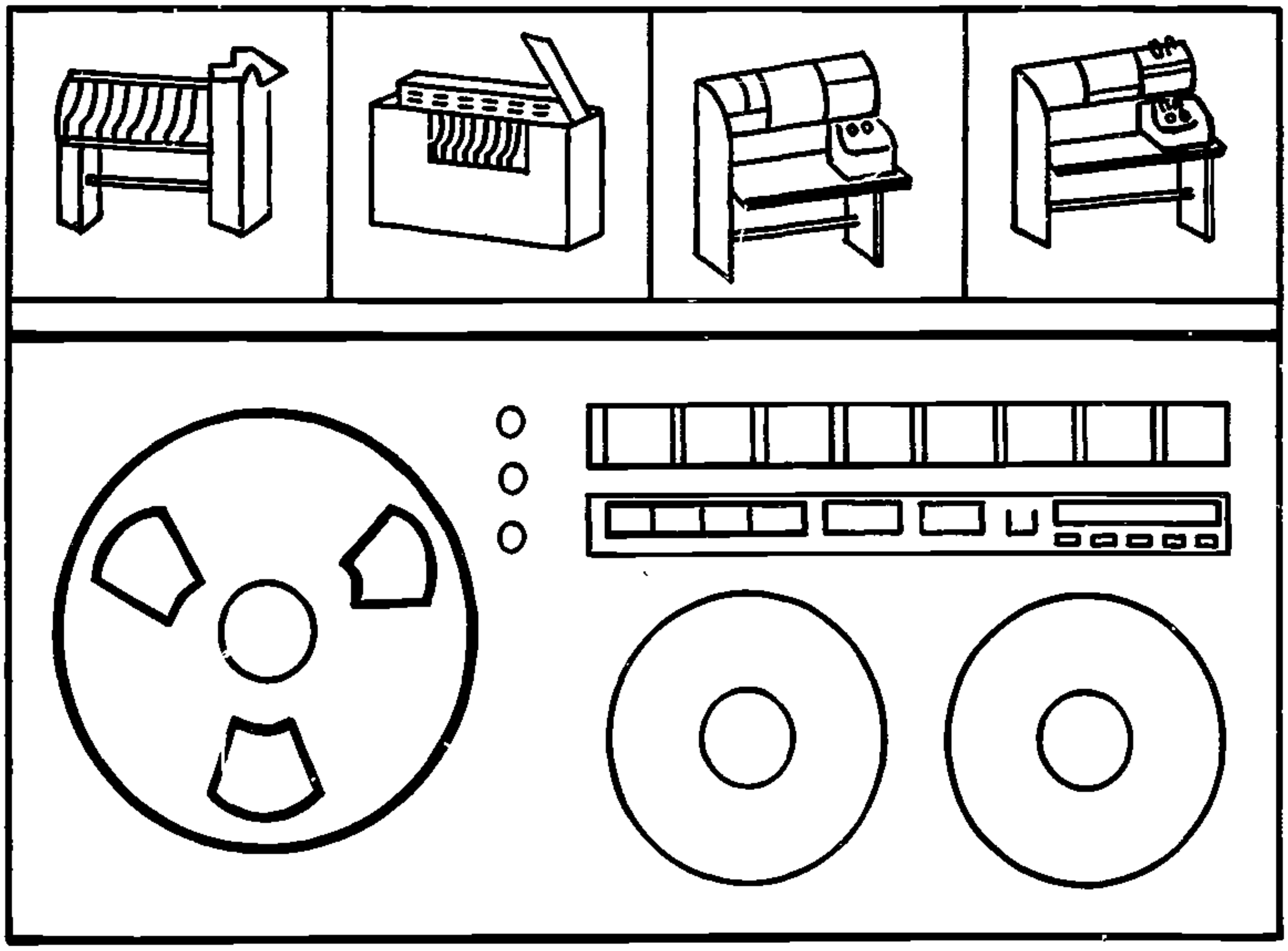
Vocational curriculums are suggested for eight electronic business data processing occupations as a guide to training unemployed and underemployed persons. The course outlines and other material were prepared by staff members of the Information and Training Services Division of McGraw-Hill, Inc. Consultants included data processing training specialists from industry, administrators in city and state business education departments, and faculty memebers in high schools, colleges, and vocational training institutions. Curriculums are suggested for the occupations--(1) Tape Librarian, (2) Key-Punch Operator, (3) Clerical Supervisor, (4) Coding Clerk, (5) Machine-Records Unit Supervisor, (6) Statistical Clerk, (7) Tabulating Machine Operator, and (8) Console Operator. Subjects for each occupational course of study are drawn from General Office Education Units, subjects common to two or more occupations, and Specialized Occupation Units, both listed. Program lengths vary from 13 to twenty-two 30-hour weeks. Hours required, unit description, topic outlines for each unit, texts, and other teaching aids are shown for each course of study. Job descriptions and prerequisites for training and employment are given for each occupation. Trainees enrolled in the programs are expected to have completed approximately 10½ years of formal education and to have a working knowledge of English and elementary arithmetic. Instructors should be qualified in business data processing. Suggested standards of achievement and an extensive bibliography of texts and references, periodicals, directories, films and filmstrips, and other instructional aids are included. This document is available for 70 cents from Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402. (PS)

OE-86010

MANPOWER DEVELOPMENT AND TRAINING PROGRAM

ELECTRONIC BUSINESS DATA PROCESSING PERIPHERAL EQUIPMENT OCCUPATIONS

suggested curricula



U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
Office of Education

OE-86010

MANPOWER DEVELOPMENT AND TRAINING PROGRAM

ELECTRONIC BUSINESS DATA PROCESSING PERIPHERAL EQUIPMENT OCCUPATIONS

Suggested Curricula

U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
Office of Education ● Division of Vocational and Technical Education

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FOREWORD

THE MANPOWER DEVELOPMENT AND TRAINING ACT OF 1962 established a large-scale training effort to solve the problem of hard-core unemployment. The nationwide program of vocational training proposes to provide marketable job skills for unemployed and underemployed persons, including industrial and business workers whose skills have been rendered obsolete by automation, farm workers no longer needed in an era of mechanized agriculture, and youths who left school without acquiring a marketable job skill. The Nation needs to reduce the number of people dependent on unemployment compensation or public welfare and to increase its reservoir of skilled manpower. The Manpower Development and Training Act of 1962 was designed to meet these objectives.

Training programs are administered by the State Boards for Vocational Education under an agreement with the Secretary of the Department of Health, Education, and Welfare. Applicants for training are screened and referred to the schools by the State Employment Service offices which are affiliated with the United States Employment Service.

The training courses to be offered in any particular community or State are determined by surveys made by the State Employment Service of the job offerings in that locality, and with approval of the teaching content by the State Department of Education. A prime objective of the program is to be reasonably certain that each trainee will be readily absorbed into the labor force when his course is completed. In many areas there are chronic shortages of such workers as key punch operators and computer console operators. Trainees with skills in data processing, peripheral equipment operation, and allied occupations greatly improve their chances for gainful employment.

This publication has been prepared to suggest vocational curricula in certain electronic business data processing occupations. The outlines and other materials are designed to aid administrators, supervisors, and teachers in the promotion and development of these vocational courses. It should be recognized that the material contained herein is for "suggested" curricula, which should, in most instances, be adapted to meet local needs and training facilities.

The course outlines and other materials were prepared by staff members of the Information and Training Services Division of McGraw-Hill, Inc., under a contractual arrangement with the U. S. Office of Education. Consultants to McGraw-Hill included data processing training specialists from industry; administrators in city and State business education departments; and faculty members in high school, college, and university business education departments and vocational training institutions. All the materials were discussed and reviewed by the consultants, by the McGraw-Hill staff, and by the U. S. Office of Education. Many varied suggestions and criticisms were received. The curricula necessarily could not reflect all the suggested approaches, philosophies, and ideas, but each one was carefully considered and, wherever possible, was incorporated into the final document. Since the resulting materials represent many opinions, no approval or endorsement by any one institution, agency, or person should be inferred.

WALTER M. ARNOLD
Assistant Commissioner for
Vocational and Technical Education

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ELECTRONIC BUSINESS DATA PROCESSING
PERIPHERAL EQUIPMENT OCCUPATIONS

INTRODUCTION

TECHNOLOGICAL AND ECONOMIC DEVELOPMENTS mean changing manpower needs in the United States in the coming years. Expanded training efforts are required to assure that the rapidly growing work force will be trained to meet shifting needs.

To be fully effective, training programs require surveys of manpower resources, community skill requirement studies, training program development, aptitude testing, counseling, trainee selection, referral to training programs, job development, referral to jobs, and follow-up. Training must be directed toward specific employment needs in the area where job openings exist.

One expanding area of employment is the cluster of jobs centered around electronic business data processing. In order to handle the growing volume of business data which must be processed, skilled people are required to operate data processing equipment.

These suggested curricula provide a guide to training unemployed and underemployed persons as qualified workers in several business data processing occupations.

It is envisioned that technical changes in data processing equipment and systems will necessitate periodic review of suggested curricula with a view to deleting units, changing or adding subject content, and even eliminating certain occupations because of technological change.

The "About the Curricula" section of this guide contains information about the design and objectives of the program. Also included are suggestions for making use of the unit outlines and programs for administrative and teaching purposes. Some of these suggestions will be found under "Administrative Options."

The design of the curricula is sufficiently flexible to give local administrators and instructors wide latitude in planning and conducting courses which meet the needs of selected trainees. Local facilities and training needs will, to a large extent, determine how the suggested plans discussed in "About the Curricula" are to be adapted for use in particular programs for effective utilization of instruction time, reduction of schedule planning time, and optimum use of available training facilities.

Appendix A provides suggestions for evaluating trainee achievement. Achievement is matched with selected occupational competencies. Job descriptions from the revised edition of the Dictionary of Occupational Titles and suggested position and training prerequisites are provided for each of eight data processing occupations.

Each subject unit includes a list of suggested texts, references, and other teaching aids. Additional teaching materials that may be helpful to the teacher are listed in Appendix B. These lists include the more commonly used materials in the subject fields. As with the specific course content, the choice of teaching materials rests with local school administrators and instructors. Local business firms may provide additional useful teaching materials and resource persons.

The Sample Suggested Lesson Plan in Appendix B is included to assist the instructors in the preparation of guides for individual lessons. It is not intended as an example to be rigidly followed, but is offered as an illustration of one way to develop an outline topic.

Qualified business data processing instructors may be found in commercial and Government data processing installations, in vocational training schools, and in colleges, universities, and secondary schools.

The basic program goals are the accelerated development of skills used in specific business data processing occupations and the increase in trainee understanding of basic concepts and fundamental principles applicable to business and data processing. In view of the training goals, the teacher should provide useful and rewarding equipment operation experiences for the trainee throughout the program.

CURRICULA OUTLINES

General Office Education Units

Unit Title	Code	Hours
Business Mathematics I	BM-I	30
Business Mathematics II	BM-II	30
Elements of Fiscal Recordkeeping	FA	60
Payroll Records	PR	30
Language Skills	LS	30
Business Communications	BC	30
Personal Development	PD	30
Business Principles and Organization I	BPO-I	30
Business Principles and Organization II	BPO-II	30
Fundamentals of Typing	FT	60
Production Typing	PT	60
Office Calculators	OC	30
Introduction to Business Data Processing	BDP	60
Electro-Mechanical Accounting Machines	EAM	30
Elementary Descriptive Statistics	EDS	60
Principles of Supervision	OS	30
Psychology for Supervisors	PS	30
Classification and Coding	CLC	60
Introduction to Computers	IC	30

Specialized Occupation Units

Elementary Library Systems	ELS	60
Key-Punch Equipment Operation	KP	60
Data Processing Mathematics	DPM	30
Introduction to Programming	IP	30
Tabulating Machine Operation	TM	45
Tabulating Machine Wiring	TMW	45
Control Console Operation	CO	60
Data Processing Systems	DPS	90

CURRICULA SYNOPSES

Each peripheral business data processing occupational training program is shown below with its suggested length in weeks. A week consists of 5 6-hour days totaling 30 hours. Variations in the length of the training day may be made on the basis of trainee caliber and administrative judgment.

Occupation	Length of Program in Weeks
Tape Librarian	13
Key-Punch Operator	15
Supervisor, Clerical	22
Coding Clerk	13
Supervisor, Machine-Records Unit	22
Statistical Clerk	15
Tabulating Machine Operator	15
Console Operator	15

Daily Training Schedules

Since many of the occupational training programs have identical subject units for certain periods of time, trainees may be grouped in order to conserve teaching time, space, and facilities. Suggested daily training schedules are shown in the following tables. The tables show the hours of the day, the subject unit suggested for each hour, and the occupations for which the scheduling is appropriate. The codes used for subject units are to be found in the Curricula Outlines section.

First Period—6 weeks

Occupational Training Group	Suggested subject unit, by hour of the training day					
	1	2	3	4	5	6
Tape Librarian	BDP	BDP	PD	BPO-I	FT	FT
Key-Punch Operator	BDP	BDP	PD	BPO-I	FT	FT
Clerical Supervisor	BDP	BDP	PD	BPO-I	OS	BM-I
Coding Clerk	BDP	BDP	LS	BPO-I	PD	BM-I
Machine Records Unit Supervisor	BDP	BDP	PD	BPO-I	OS	BM-I
Statistical Clerk	BDP	BDP	LS	BPO-I	PD	BM-I
Tabulating Machine Operator	BDP	BDP	LS	BPO-I	PD	BM-I
Console Operator	BDP	BDP	LS	BPO-I	PD	BM-I

Second Period—6 weeks

Occupational Training Group	Suggested subject unit, by hour of the training day					
	1	2	3	4	5	6
Tape Librarian	PT	PT	LS	BC	ELS	ELS
Key-Punch Operator	PT	PT	LS	BC	BPO-II	OC
Clerical Supervisor	BM-II	FA	FA	BC	FT	FT
Coding Clerk	BM-II	FA	FA	CLC	CLC	IC
Machine Records Unit Supervisor	BM-II	FA	FA	BC	BPO-II	IC
Statistical Clerk	BM-II	FA	FA	PR	BPO-II	OC
Tabulating Machine Operator	BM-II	FA	FA	PR	BPO-II	OC
Console Operator	BM-II	FA	FA	BC	BPO-II	IC

Third Period—1 week

During the third period, lasting one week, all occupational training groups will be given the subject, Electro-Mechanical Accounting Machines. Tape Librarian and Coding Clerk groups will have completed their programs of study at the end of the third period.

Fourth Period—2 to 6 Weeks

Occupational Training Group	Period Length (weeks)	Suggested subject unit, by hour of the training day					
		1	2	3	4	5	6
Key-Punch Operator	2	KP	KP	KP	KP	KP	KP
Statistical Clerk	2	EDS	EDS	EDS	EDS	EDS	EDS
Tabulating Machine Operator	2	TM	TM	TM	TMW	TMW	TMW
Console Operator	2	CO	CO	CO	CO	CO	CO
Clerical Supervisor	6	PT	PT	PS	PR	BPO-II	IC
Machine Records Unit Supervisor	6	IP	DPM	PS	DPS	DPS	DPS

Fifth Period—2 Weeks

Occupational Training Group	Suggested subject unit, by hour of the training day					
	1	2	3	4	5	6
Clerical Supervisor	OC	CLC	CLC	EDS	EDS	EDS
Machine Records Unit Supervisor	OC	CLC	CLC	EDS	EDS	EDS

ABOUT THE CURRICULA

These suggested curricula differ from those offered in most educational institutions in that major emphasis is placed upon skill and knowledge development for specific peripheral business data processing occupations described in the revised edition of the Dictionary of Occupational Titles.

The curricula objectives provide a framework of suggested studies qualifying trainees to hold certain jobs in the business data processing field. The suggested framework is sufficiently flexible to permit adaptation of the program at local levels according to community needs and availability of facilities, equipment, and teaching time.

The course of study for each of the eight occupations has been planned to provide the specific skills needed for employment, and to give each trainee a background in general office work. Subjects for each occupational course of study are drawn from two groupings—General Office Education Units and Specialized Occupation Units. The General Office Education Units section is comprised of those subjects common to two or more occupations. The subject content of these units will serve to orient the trainee to office work and provide certain prerequisite skills for particular occupational studies. They can also be used to refresh the trainee with information or skills previously acquired but forgotten through disuse.

Several of the General Office Education Units were included in Clerical and Record Keeping Occupations and Stenographic-Secretarial Occupations, two suggested curricula previously developed by the U. S. Office of Education under the Manpower Development and Training Act. The subject units were reviewed and changed to fit the needs of the Electronic Business Data Processing Peripheral Equipment Occupations. Suggested curricula changes reflect a desire to accelerate the training time.

The Specialized Occupation Unit outlines, texts and other teaching aids are germane to the specific occupation under which they are grouped. Job descriptions and prerequisites for training and employment are shown for each occupation. To the extent possible, the subject content of the Specialized Occupation Units has been generalized to allow adaptation by the teachers to suit the business data processing equipment available at the training location.

The subjects suggested for each occupational program were developed to correspond to job descriptions detailed in the revised edition of the Dictionary of Occupational Titles. Since these job descriptions are general in nature, having been compiled from many sources in different locations, it is envisioned that programs may have to be adjusted to local conditions.

Since some of the special occupational skills learned in the program will become obsolete, programs are sufficiently broad to permit adaptation to changes of data processing equipment and the demand for certain job skills. Each program is planned to strike a balance between general knowledge and acquisition of skills. Skill in operating equipment is a necessity for obtaining employment. An understanding of fundamental principles of data processing provides the flexibility needed for working with varied makes of equipment and for future changes in equipment and nature of business data processing procedures.

The suggested curricula do not attempt to provide detailed subject units to the extent usually found in a teacher's manual. The unit outlines may not in all cases present topics for coverage in chronological order. Because of such factors as trainee group knowledge, extent of review required, and individual methods of presentation, the sequence of topics is left to the discretion of the individual teacher. In addition, local program administrators and teachers are encouraged to develop detailed lesson plans and obtain appropriate teaching aids. Helpful supplemental materials are to be found in the suggested texts, references, films, and other instructional materials lists.

Introduction to Business Data Processing is scheduled early in the course to provide an overview of the field and to help motivate the trainees. This introductory unit presents topics which are expanded and applied in later units. The Language Skills Unit provided for six of the eight occupations should help build essential background for improved communication skills needed in office work and for study purposes. The unit builds vocabulary, improves spelling, and reviews basic English grammar. Most trainees will also take the Business Communications Unit which should provide for further improvement.

When possible, subjects of like character should be massed in order to simulate conditions of office work. Local availability of teachers and facilities will determine the feasibility of this method. One method of unit grouping is shown in the Curricula Synopses section.

Many of the trainees will have had no office or data processing experience prior to this training program. However, trainees enrolled in the program are expected to have completed approximately $10\frac{1}{2}$ years of formal education and to have a working knowledge of English and elementary arithmetic. Several of the units allow for a review of these important basic subjects, but the need for depth of review in each course unit must be assessed by the local instructor.

In the skill development subjects, lectures and discussions should be kept to the minimum required for understanding procedures and operating instructions. As much time as possible should be devoted to actual trainee practice with the available equipment.

In the social area subjects a variety of methods should be used. Role playing, case analysis, group discussion, lectures and motion pictures—all can be used effectively. Varied presentation can serve to heighten interest, participation, and learning. Although a special unit has not been included in the curricula for developing proper study habits, teachers and administrators should stress this area. Many booklets and pamphlets are available for helping trainees with this important know-how.

Periodic progress checks should be made throughout each unit to evaluate trainee progress toward meeting the Suggested Standards of Achievement. In addition, these checks serve as a guide for reviewing material that may not have been fully learned.

The teacher should consider using resources of the community for assistance with training. Guest speakers from business and industry can assist with special topics and, in addition, can help trainees relate their activities to local business needs and standards.

The greatest challenge for teachers may lie in building the morale of the trainees. Motivation and morale building should be a part of every class and practice period. It is suggested that teachers make an effort early in the program toward establishing a teaching climate which will heighten and maintain the trainee's interest. The success of the program can be judged only by the number of trainees who will remain gainfully employed in careers which would otherwise not have been available to them.

Administrative Options

The Curricula Synopses section of the Introduction shows typical programs for each of the occupations. These programs are based on 6-hour days of instruction. It is recognized that variations in this scheduling may have to be made to suit local conditions. To facilitate administration of the programs and hold the required number of teachers and teaching hours to a minimum, subjects have been grouped to enable one teacher to handle combined groups of trainees at the same time. The number of trainees that may meet in a combined session should be compatible with good teaching practice in terms of span of control, instructional methods and equipment availability.

The curricula for the eight occupations have been planned to develop the abilities needed for employment. Before starting the specialized occupational units the trainee should have skills and knowledge equivalent to that gained from those general office education units suggested as pertinent to his occupation. In order to plan an appropriate program, the trainee's previously acquired abilities and educational background should be evaluated against the Standards of Achievement listed for the required basic units. If the trainee already has acceptable skills in some areas, the instructor or administrator may delete units from the trainee's program and substitute units which would have been given at another time. In this way, subject units can be rearranged to form a more appropriate and meaningful sequence for certain trainees, and the time needed for the development of employable skills can be shortened.

For example, a Key-Punch Operator trainee may present a high-school transcript showing completion of courses in typing and bookkeeping. If the trainee's skill in one of these subjects compares favorably with the Suggested Standards of Achievement listed for Fundamentals of Typing, this particular course may be deleted from his program. The training period could thus be shortened for those trainees presenting this type of achievement, and the trainee could be considered employable at an earlier date. Careful screening of the trainee should disclose the nature and extent of his background. Such pertinent information should be made available to the local program administrator.

Due to this possibility of certain courses being deleted from a trainee's program, some topics have been repeated in certain units. This repetition of topics serves two purposes: to expose trainees to areas of subject content that they may have missed and, in other instances, the topic can be used for refresher purposes.

Supervisory Training Information

In view of the requirements for the Clerical Supervisor and Machine Records Unit Supervisor occupations, trainees selected for these supervisory programs should have exhibited considerable potential to the group responsible for selection. Some trainees for supervisory positions may have comparatively more education and experience than some other trainees. However, the suggested programs for these occupations outlined in the Curricula Synopses section of the Introduction assume little prior experience or education in the clerical field except in the Language Skills area. As in the other occupational programs, a trainee who enters with certain demonstrable skills and knowledge may have unnecessary subject units deleted from his program of study.

Clerical supervisors may become responsible for any of several clerical activities such as bookkeeping, filing or typing. Local employment opportunities as listed on the MDT-1, may determine the trainee's specific area of concentration. Since the areas of specialty cannot be foreseen, the curricula provide a general office education to equip the supervisory trainee with basic skills in several areas. These skills can be augmented by on the job training.

Three courses, Classification and Coding, Elementary Descriptive Statistics, and Office Calculators, have been shortened in order to accelerate the supervisory programs. Using the outlines for the three courses, instructors may delete topics or reduce time allotted to some topics to effect this reduction in class time. Emphasis should be placed on application of the subject content.

GENERAL OFFICE EDUCATION UNITS

BUSINESS MATHEMATICS I

Hours Required

Class: 1 hour daily Total: 30 hours

Description

Basic principles of business mathematics with emphasis on the four fundamental operations—addition, subtraction, multiplication, and division—are applied to business situations. The trainee is introduced to the use of simple calculators or adding machines for checking work. Importance of accuracy is stressed. Numerous exercises in applying percentages, discounts, and other mathematical operations should be provided for improving commercial number-handling skills.

Topic Outline

I. Addition Skills
II. Subtraction Skills
III. Multiplication Skills
IV. Division Skills
V. Fractions
VI. Percentage
VII. Sundry Applications

TOPIC I. ADDITION SKILLS

A. Improving skills
   1. Adding whole numbers
   2. Increasing speed
   3. Checking accuracy

B. Types of addition
   1. Horizontal
   2. Horizontal-vertical

C. Addition of decimals

TOPIC II. SUBTRACTION SKILLS

A. Improving skills
   1. Subtracting whole numbers
   2. Checking accuracy

B. Horizontal subtraction

C. Subtraction of decimals

D. Bank reconciliation

E. Making change

TOPIC III. MULTIPLICATION SKILLS

A. Improving skills
   1. Multiplying whole numbers
   2. Checking multiplication accuracy

B. Multiplying decimal numbers (the product of two decimal numbers)

C. Shortcuts in multiplication

D. Horizontal multiplication

E. Extensions

F. Checking multiplication by machine

TOPIC IV. DIVISION SKILLS

A. Improving skills
   1. Division of whole numbers
   2. Checking division accuracy

B. Dividing decimal numbers

C. Shortcuts in division

D. Computing averages

TOPIC V. FRACTIONS

A. Improving skills in using fractions
   1. Changing fractions to equivalent fractions
   2. Addition
   3. Subtraction
   4. Multiplication
   5. Division

B. Aliquot parts

TOPIC VI. PERCENTAGE

A. Improving skills in using percentage
   1. Percentage value in equivalent forms
   2. Decimal numbers and fractions as percentage values
   3. The percentage formula

B. Computing depreciation charges

TOPIC VII. SUNDRY APPLICATIONS

A. Public utility cost computation

B. Linear, scale, area, and cubic computation
   1. Measuring
   2. Computing

Texts and Other Teaching Materials

From the following suggested texts and materials (or other equivalent commercially available materials), select trainee and teacher materials for use in this unit. Additional references are listed in Appendix B.

Beighey, Clyde and Borchardt, Gordon C. Modern Business Mathematics. 3d ed. New York: McGraw-Hill Book Co., Inc., 1960.
Tests; Teacher's Key.

Briggs, Milton. Mathematics Skill Builder. 2d ed. Cincinnati, Ohio: South-Western Publishing Co., 1960.
Teacher's Manual.

Cutler, Ann and McShare, Rudolph. Tractenberg's Speed System of Mathematics. New York: Doubleday and Co., 1961.

Fisher, Ray W.; Wahl, Frederick D.; and Spencer, Blake W. Arithmetic Review. 2d ed. New York: Pitman Publishing Corp., 1960.

Huffman, Harry. Programmed Business Mathematics, Parts I, II, and III. New York: McGraw-Hill Book Co., Inc., 1962.

_______, Twiss, Ruth M. and Whale, Leslie J. Arithmetic for Business and Consumer Use. 2d ed. New York: McGraw-Hill Book Co., Inc., 1962.
Workbook; Teacher's Manual and Key.

McNelly, A. E. and Adams, L. J. Business Arithmetic. 4th ed. Englewood Cliffs, N. J.: Prentice-Hall, Inc., 1958.
Workbook and Tests.

Piper, Edwin B.; Gruber, Joseph; and Curry, Preston E. Applied Business Arithmetic. Complete. 8th ed. Cincinnati, Ohio: South-Western Publishing Co., 1964.
Problems and Drills Manual; Teacher's Manual; Tests 1-8; Teacher's Key.

_______, Gruber, Joseph and Curry, Preston E., Applied Business Arithmetic. Abridged. 8th ed. Cincinnati, Ohio: South-Western Publishing Co., 1964.
Problems and Drills Manual; Teacher's Manual; Tests 1-6; Teacher's Key.

Rosenberg, R. Robert. Business Mathematics - Exercises, Problems, and Tests, 2d ed. New York: McGraw-Hill Book Co., Inc., 1959.

_______, and Lewis, Harry. Business Mathematics—Principles and Practice. Complete. 6th ed. New York: McGraw-Hill Book Co., Inc., 1958.

_______, College Business Mathematics. 3d ed. New York: McGraw-Hill Book Co., Inc., 1961.
Principles and Problems, Teacher's Manual.

BUSINESS MATHEMATICS II

Hours Required

Class: 1 hour daily — Total: 30 hours

Description

Basic and specialized principles of business mathematics are applied to payrolls, retailing, financing, insurance, and taxation. The work in the unit should concentrate on practical applications in several fields.

Topic Outline

I. Payrolls
II. Retailing
III. Financing
IV. Insurance
V. Taxation

TOPIC I. PAYROLLS

A. Mathematical preparation
  1. Time payment (hourly wage system)
  2. Straight piecework wage systems
  3. Bonus pay systems
  4. Currency memorandum
  5. Use of withholding tax tables—national and local

TOPIC II. RETAILING

A. Discount computations (trade and cash)
  1. Series of discounts
  2. Single tax rate equivalent to a series of discount rates
  3. Cash discount and net price
  4. Trade discount and net price

B. Sales computation
  1. Consumer discounts
  2. Discount rates
  3. Markup and markdown
  4. Sales and excise taxes

TOPIC III. FINANCING

A. Interest
  1. Monthly rates
  2. Daily periods
  3. Exact interest
  4. Bankers' 60-day method
  5. Time lapses between two dates
  6. Tables
    (a) Interest
    (b) Time
  7. Compound interest

B. Installment buying and selling
  1. Installment charges
  2. Rate of interest on installment purchases
  3. Automobile installment purchases
  4. Interest rates charged by small-loan agencies

TOPIC IV. INSURANCE

A. Fire and theft

B. Automobile

C. Life

TOPIC V. TAXATION

A. Property taxes

B. Federal and State income taxes

C. Social Security
  1. Primary benefits
  2. Family benefits (on retirement and death of insured)

Texts and Other Teaching Materials

Texts and other teaching materials under Business Mathematics I are applicable to this unit.

The teacher may also wish to give consideration to the use of the following suggested texts and materials. Additional references will be found in Appendix B.

Hadley Editorial Staff and Thistlethwaite, Robert L. Payroll Accounting, 5th ed. New York: McGraw-Hill Book Co., Inc., 1962.
_________, Payroll Record Keeping, 6th ed. New York: McGraw-Hill Book Co., Inc., 1959.
Huffman, Harry and Margulies, Stuart. Programmed Business Mathematics: Concepts, Skills, and Applications, Part II. New York: McGraw-Hill Book Co., Inc., 1962.
Nanassy, Louis C. Standard Payroll Project, 2nd ed. New York: Pitman Publishing Corp., 1962.
Pendery, John A. Clerical Payroll Procedures, 3d ed. Cincinnati, Ohio: South-Western Publishing Co., 1959.
Van Voorhis, Robert H., Palmer, Charles E., and Archer, Fred C. College Accounting, Theory, and Practice, Part I. New York: McGraw-Hill Book Co., Inc., 1963.
    Problems and Working Paper for Part I
    Practice Set I
Federal Tax Office-Special Kit: Enlarged form 1040, Handbook, Blank Forms, etc., for Federal Income Taxes.

ELEMENTS OF FISCAL RECORDKEEPING

Hours Required

Class: 1 hour daily, Laboratory: 1 hour daily   Total: 60 hours

Description

The introductory topics of this course unit include general aspects of recordkeeping for business use, including cash, banking, payroll, social security, and tax records. The third and fourth topics of the unit are devoted to an introduction to elementary bookkeeping, including vouchers, checks, invoices, sales, stock record, and purchase order forms. The final topics emphasize the basic elements of bookkeeping, including business transactions, journalizing, posting, preparing financial statements, and cash transactions. Supervised laboratory sessions include skill development through problem solving and the use of practice sets. Since automated recordkeeping is covered in depth in other units, teachers should use this topic for meaningful association.

Topic Outline

I. Purpose and Use of Records
II. Types of Records
III. Common Business Record Forms
IV. Introduction to Bookkeeping

V. Bookkeeping Fundamentals
VI. Accounts
VII. Business Transactions
VIII. Journalizing and Posting
IX. Trial Balance
X. Work Sheets and Financial Reports
XI. Closing Ledgers

TOPIC I. PURPOSE AND USE OF RECORDS

A. Why records are kept

B. Organizing records for
  1. Ease of access
  2. Ease of interpretation
  3. Legibility

C. Business and records

D. Automated recordkeeping

TOPIC II. TYPES OF RECORDS

A. Cash records

B. Banking records

C. Payroll records

D. Social Security records

E. Tax records

F. Daybook and general journal

G. Time records

TOPIC III. COMMON BUSINESS RECORD FORMS

A. Purchase orders, sales invoices, and receipts

B. Stock records and requisitions

TOPIC IV. INTRODUCTION TO BOOKKEEPING

A. Cash
  1. Receiving
  2. Paying
  3. Forms: vouchers, checks, etc.
  4. Banking

B. Credit
  1. Sales
  2. Purchases

C. Financial records and statements

TOPIC V. BOOKKEEPING FUNDAMENTALS

A. Assets and liabilities

B. Proprietorship

C. Bookkeeping equation

D. Balance sheets

TOPIC VI. ACCOUNTS

A. "T" accounts

B. Recording changes

TOPIC VII. BUSINESS TRANSACTIONS

A. Opening transactions

B. Changes in assets

C. Changes in liabilities

D. Changes in proprietorship

TOPIC VIII. JOURNALIZING AND POSTING

TOPIC IX. TRIAL BALANCE

A. Preparation

B. Locating errors

TOPIC X. WORK SHEETS AND FINANCIAL REPORTS

A. Preparation of work sheets

B. Preparation of financial reports

TOPIC XI. CLOSING LEDGERS

A. Closing entries

B. Balancing the accounts

Texts and Other Teaching Materials

From the following suggested texts and materials (or other equivalent commerically available materials), select trainee and teacher materials for use in this unit. Additional references are listed in Appendix B.

Baron, Harold and Steinfeld, Solomon C. Clerical Record Keeping. Cincinnati, Ohio: South-Western Publishing Co., 1959.
Working Papers & Supplementary Problems, Units 1-6 and Units 7-10; also, Teacher's Manual.

Barron, Allan E. and Taylor, James R. Clerical Office Training. Englewood Cliffs, N. J.: Prentice-Hall, Inc., 1963.

Breidenbaugh, Vachel E.; Lins, Angeline G.; and Elwell, Fayette H. Bookkeeping Principles. New York: Pitman Publishing Corp., 1958.

Carlson, Paul A. Drills and Problems in Bookkeeping & Accounting. Cincinnati, Ohio: South-Western Publishing Co., 1959.
Solutions Manual.

_______, Forkner, Hamden L. and Boynton, Lewis D., 20th-Century Bookkeeping & Accounting. 22d ed. First-Year Course. Cincinnati, Ohio: South-Western Publishing Co., 1962.
Working papers and Study Guides; Bradford Wholesale Grocery Set, business papers and blanks; Clayton Retail Hardware Set, business papers and blanks; Insurance Broker Set (partnership); Service Station Set, 2d ed. (sole proprietorship); also, Teacher's Manual, overhead projector transparencies.

Clerical Practice and Record Keeping. 2d ed. Baltimore, Md.: H. M. Rowe Co.

Freeman, M. Herbert; Hanna, J. Marshall; and Kahn, Gilbert. Gregg Bookkeeping and Accounting. 3d ed. New York: McGraw-Hill Book Co., Inc., 1963.
Practice Sets; Workbooks; Objective Tests; Teacher's Manual and Key; Correlated Series of Six Filmstrips.

Heiges, P. Myer; Schneider, Arnold E.; and Huffman, Harry. General Record Keeping, 4th ed. New York: McGraw-Hill Book Co., Inc., 1959.
Workbook for 4th edition; Working Papers for the Magic Star Practice Set; Teacher's Manual and Key, 4th edition; Tests; Teacher's Key for Tests.

Kirk, John G.; Crawford, Maurice L.; and Quay, Mark H. General Clerical Procedures. 3d ed. Englewood Cliffs, N. J.: Prentice-Hall, Inc., 1959.
Workbook I; Chapter Tests.

Olson, Milton C.; Zelliott, Ernest A.; and Leidner, Walter E. Introductory Bookkeeping. 3d ed. Englewood Cliffs, N. J.: Prentice-Hall, Inc., 1961.
Workbook I, '61; Progress Tests.

Perry, Enos C.; Frakes, John C.; and Zabornik, Joseph J. Clerical Record Keeping. New York: Pitman Publishing Corp., 1957.
In addition, the teacher may wish to secure record forms from local business firms and reproduce them for classroom use.

Wolpert, Saul. Bookkeeping and Accounting: Introductory Course 7th ed. Englewood Cliffs, N.J.: Prentice-Hall, Inc., 1960.

Van Voorhis, Robert H.; Palmer, Charles E., and Archer, Fred C. College Accounting, Theory and Practice, Part I. New York: McGraw-Hill Book Co., Inc., 1963.
Problems and Working Papers for Part I; Practice Set I.

PAYROLL RECORDS

Hours Required

Class: 1 hour daily — Total: 30 hours

Description

This unit includes analysis of payroll legislation, intensive practical application of accounting principles to payroll procedures, and coverage of how data processing equipment is used in payroll operations. The unit should include sessions for skill development in which the trainee works with practice sets and uses realistic "write-it-once" forms.

Topic Outline

I. Payroll Accounting
II. Payroll Procedures
III. Payroll and Tax Reports
IV. Other Payroll Deductions

TOPIC I. PAYROLL ACCOUNTING

TOPIC II. PAYROLL PROCEDURES

A. Time cards

B. Payrolls (hourly, weekly, biweekly, monthly)

C. Year-end procedures

D. Pegboard, keysort, accounting machine payroll applications

TOPIC III. PAYROLL AND TAX REPORTS

A. Federal taxes
  1. Old-age tax (F. I. C. A.) and benefits
  2. Unemployment insurance
  3. Income (withholding) tax

B. State taxes

TOPIC IV. OTHER POSSIBLE PAYROLL DEDUCTIONS

A. Saving plans including Credit Unions

B. Insurance plans

C. Other deductions
  1. Garnishments
  2. Union dues

Texts and Other Teaching Materials

From the following suggested texts and materials (or other equivalent commercially available materials), select trainee and teacher materials for use in this unit. Additional references are listed in Appendix B.

Felter, Emma and Reynolds, Marie. Basic Clerical Practice, 2d ed. New York: McGraw-Hill Book Co., Inc., 1959.

________, Payroll Accounting. 5th ed. New York: McGraw-Hill Book Co., Inc., 1962.

Hadley Editorial Staff and Thistlethwaite, Robert L. Payroll Record Keeping, 6th ed. New York: McGraw-Hill Book Co., Inc., 1959.

Enveloped Booklets; Business Papers and Reports; Teacher's Key.

Huffman, Harry. Programmed Business Mathematics, Part II. New York: McGraw-Hill Book Co., Inc., 1962.

Nanassy, Louis C. Standard Payroll Project. 2d ed. New York: Pitman Publishing Corp., 1962.
Pendery, John A. Clerical Payroll Procedures, 3d ed. Cincinnati, Ohio: South-Western Publishing Co., 1959.
Teacher's Manual. 3d ed.
Van Voorhis, Robert H.; Palmer, Charles E.; and Archer, Fred C. College Accounting, Theory and Practice, Part I. New York: McGraw-Hill Book Co., Inc., 1963.
Problems and Working Papers for Part I Practice Set I.

It is suggested that the teacher obtain payroll forms from local business firms and reproduce them for classroom use.

LANGUAGE SKILLS

Hours Required

Class: 1 hour daily

Total: 30 hours

Description

This unit is designed to build vocabulary, develop spelling ability, and provide opportunity to apply principles of English grammar. Emphasis should be placed on proper use of word forms and good sentence construction. Trainees should be encouraged to do outside reading and develop an interest in data processing terminology and other new words.

Topic Outline

I. Importance of Spelling and Vocabulary Development
II. Pretest
III. Spelling by Sound and Meaning
IV. Spelling Rules
V. Word Forms
VI. Sentence Structure
VII. Capitalization and Punctuation

TOPIC I. IMPORTANCE OF SPELLING AND VOCABULARY DEVELOPMENT

A. Word meanings and usage

B. General vocabulary

C. Business vocabulary

D. Accounting, personnel, and management vocabulary

E. Banking and insurance vocabulary

F. Data processing vocabulary

TOPIC II. PRETEST

A. Determination of vocabulary level, spelling ability, and grammatical knowledge

TOPIC III. SPELLING BY SOUND AND MEANING

A. Spotting errors

B. Attacking errors

C. Use of dictionary

TOPIC IV. SPELLING RULES

A. Rule errors

B. Carelessness and demon errors

C. Correcting rule errors and other difficulties

D. Abbreviations

TOPIC V. WORD FORMS

A. Nouns

B. Pronouns

C. Verbs

D. Adjectives

E. Adverbs

F. Prepositions

G. Conjunctions

TOPIC VI. SENTENCE STRUCTURE

A. Simple sentences and phrases

B. Clauses in compound and complex sentences

C. Effective sentences and paragraphs

TOPIC VII. CAPITALIZATION AND PUNCTUATION

A. Proper nouns

B. Special uses of capitalization

C. Punctuation
   1. Period, question mark, and exclamation mark
   2. Comma, semicolon, and colon
   3. Apostrophe and hyphen
   4. Quotation mark and italics
   5. Parentheses and dashes

Texts and Other Teaching Materials

From the following suggested texts and materials (or other equivalent commercially available materials), select trainee and teacher materials for use in this unit. Additional references are listed in Appendix B.

Anderson, Ruth; Straub, Lura Lynn; and Gibson, E. Dana. Word Finder. Englewood Cliffs, N. J.: Prentice-Hall, Inc., 1960.

Crank, Doris; Crank, Floyd; and Connelly, Mary. Words: Spelling, Pronunciation, Definition, and Application, 5th ed. New York: McGraw-Hill Book Co., Inc., 1962.
Instructor's Guide.

Doris, Lillian and Miller, Besse. Complete Secretary's Handbook. 2d ed. Englewood Cliffs, N. J.: Prentice-Hall, 1960.

Gavin, Ruth E. and Hutchinson, E. Lillian. Reference Manual for Stenographers and Typists, 3d ed. New York: McGraw-Hill Book Co., Inc. 1961.

Gilmartin, John G. Word Study, 5th ed. Englewood Cliffs, N. J.: Prentice-Hall, Inc., 1955.

Himstreet, William C.; Porter, Leonard J.; and Maxwell, Gerald W. Business English in Communications. Englewood Cliffs, N. J.: Prentice-Hall, Inc., 1964.
Activities Book: Text Book.

Hodges, John C. and Connolly, Francis X. Harbrace College Handbook, 5th ed. New York: Harcourt, Brace, and World., Inc., 1962.

Hutchinson, Lois. Standard Handbook for Secretaries. 7th ed. New York: McGraw-Hill Book Co., Inc., 1960.

Kierzek, John M. and Gibson, Walker. Macmillan Handbook of English, 4th ed. New York: The Macmillan Co., 1960.

Johnson, H. Webster. How to Use the Business Library. 3d ed. Cincinnati, Ohio: South-Western Publishing Co., 1963.

Larson, Greta. Business English Essentials. 2d ed. New York: McGraw-Hill Book Co., Inc., 1959.

Larson, Lenna A. and Koebele, Apollonia M. Reference Manual for Office Employees, 4th ed. Cincinnati, Ohio: South-Western Publishing Co., 1960.

Leslie, Louis A. 20,000 Words—Spelled, Divided, and Accented. 4th ed. New York: McGraw-Hill Book Co., Inc., 1959.

Malsbary, Dean R. Spelling and Word Power. Englewood Cliffs, N. J.: Prentice-Hall, Inc., 1958.
Tests and Practice (Workbook).

Mayo, Lucy G. Communications Handbook for Secretaries. New York: McGraw-Hill Book Co., Inc., 1958.
Workbooks I and II; Teacher's Manual and Key.

Menning, J. H. and C. W. Wilkinson. Communication Through Letters and Reports. 3d ed. Homewood, Ill.: Richard D. Irwin, Inc., 1963.

Monro, Kate M. and Wittenburg, Mary Alice. Modern Business English. 3d ed. New York: McGraw-Hill Book Co., Inc., 1962.

Nanassy, Louis C. and Selden, William. Business Dictionary. Englewood Cliffs, N. J.: Prentice-Hall, Inc., 1960.

Norman, Lewis, ed. The New Roget's Thesaurus of the English Language in Dictionary Form. Garden City, N. Y.: Garden City Books, 1961.

Parkhurst, Charles C. Business Communications for Better Human Relations. Englewood Cliffs, N. J.: Prentice-Hall, Inc., 1961.

_______, Practical Problems in English for Business. 3d ed. New York: Pitman Publishing Corp., 1962.

Shachter, Norman. English the Easy Way. 2d ed. Cincinnati, Ohio: South-Western Publishing Co., 1960.
Tests and Final Examinations; Teacher's Manual.

Shaw, Harry. Spell It Right. New York: Barnes & Noble, Inc., 1961.

Shurter, R. L. Written Communication in Business. New York: McGraw-Hill Book Co., Inc., 1957.

Silverthorn, J. E. Word Division Manual. Cincinnati, Ohio: South-Western Publishing Co., 1958.

Stewart, Marie M.; Hutchinson, E. Lillian; Lanham, Frank W.; and Zimmer, Kenneth. Business English and Communication. 2d ed. New York: McGraw-Hill Book Co., Inc., 1961.
Workbook; Objective Tests.

Taintor, Sarah August and Monro, Kate M. The Secretary's Handbook; A Manual of Correct Usage. 8th ed. New York: The Macmillan Co., 1958.

Walters, R. G. and Lamb, Marion M. Word Studies. 5th ed. Cincinnati, Ohio: South-Western Publishing Co., 1963.
Workbook; Spelling tests, including Final Examination; Teacher's Manual.

Watkins, Floyd C. and Martin, Edwin T. Practical English Handbook. Boston: Houghton Mifflin Co., 1961.

Wykoff, George S. and Shaw, Harry. Harper Handbook of College Composition. 3d ed. New York: Harper & Bros., 1962.

A standard dictionary is also suggested, such as The American College Dictionary (New York: Random House) or Webster's New Collegiate Dictionary (Springfield, Mass.: G. and C. Merriam Co.)

BUSINESS COMMUNICATIONS

Hours Required

Class: 1 hour daily — Total: 30 hours

Description

This unit emphasizes the importance of effective business communication and the need for careful planning and consideration of the reader before beginning to write. The types of business communications covered include letters, postal cards, memoranda, reports, telegrams, and other communications; attention is given also to effective oral communication. Finding and using sources of information on correct English usage are also included. Practice exercises in report writing should be provided frequently.

Topic Outline

- I. Communicating in Business
- II. Fundamentals of Effective Written Communication
- III. Types of Business Correspondence
- IV. Good English in Oral Communications

TOPIC I. COMMUNICATING IN BUSINESS

- A. The importance of written and oral communication in business
- B. The communicating process
  - 1. Some basic semantic principles
  - 2. Brief review of English grammar (as needed)
  - 3. Sources of information on English, special forms of address, etc.
    - a. English handbooks and secretarial handbook
    - b. Dictionaries
    - c. Thesaurus

TOPIC II. FUNDAMENTALS OF EFFECTIVE WRITTEN COMMUNICATION

- A. Goals of business writing; planning the communication
- B. Basic qualities of business letters and reports
- C. Mechanics of the letter
  - 1. Essential parts; other parts
  - 2. Layout, form, most used styles
  - 3. Addressing the envelope
- D. Avoidance of business jargon, stock phrases, etc.

TOPIC III. TYPES OF BUSINESS CORRESPONDENCE

- A. Specific types of business letters
  - 1. Neutral and good-news messages
    - a. Inquiries, orders, answers and acknowledgments, remittances
    - b. Public relations, industrial relations, personnel
  - 2. Persuasive messages
  - 3. Messages of regret or refusal
  - 4. Application letters
- B. Memoranda and reports
  - 1. Simple reports (practice exercises in writing)
  - 2. Complex reports (practice in organization and writing)
- C. Telegrams

TOPIC IV. GOOD ENGLISH IN ORAL COMMUNICATIONS

- A. In an interview
- B. Communicating with people

Texts and Other Teaching Materials

Texts and other teaching materials under Language Skills are applicable to this unit. The teacher may also wish to give consideration to the use of the following suggested texts and materials. Additional references will be found in Appendix B.

Brown, Leland. Communicating Facts and Ideas in Business. Englewood Cliffs, N. J.: Prentice-Hall, Inc., 1961.

Ingram, Karl Culton. Talk That Gets Results—Communication: Key to Success and Harmony with Others. New York: McGraw-Hill Book Co., Inc., 1957.

Schutte, William M. and Steinberg, Erwin R. Communication in Business and Industry. New York: Holt, Rinehart, and Winston, Inc., 1960.

PERSONAL DEVELOPMENT

Hours Required

Class: 1 hour daily Total: 30 hours

Description

The first three topics in this unit are designed to help the trainee establish personal standards of conduct and appearance that conform to general office expectancies. Emphasis is placed on office customs and etiquette and on expected conduct with superiors. Guided group discussion and guest speakers from the business community are suggested to motivate trainees and encourage them to accept general business standards as their own.

Topics IV through VIII are designed to guide the trainee in the establishment of effective human relations in an office situation. The nature and importance of personality and behavior are stressed. The trainee should receive individual guidance in self-appraisal and self-improvement.

Topic Outline

I. Office Etiquette
II. Employee-Employer Relationships
III. Business Customs
IV. The Nature and Importance of Personality
V. Roles of Motives and Emotions
VI. The Role of Intelligence
VII. Personal Efficiency
VIII. Social Efficiency: Human Relations, Teamwork

TOPIC I. OFFICE ETIQUETTE

A. Behavior
  1. Acceptable office behavior
  2. Mannerisms
  3. Speech
  4. Attitude

B. Appearance
  1. Grooming
  2. Wardrobe
  3. Health and posture

C. Good public relations
  1. Customers and callers
  2. Introductions
  3. Telephone etiquette

TOPIC II. EMPLOYEE-EMPLOYER RELATIONSHIPS

A. Seeking a job

B. Orientation on a new job

C. Progress on the job

D. Punctuality, attendance, break periods

E. Performance during office-business emergencies

F. Mutual respect and courtesy

TOPIC III. BUSINESS CUSTOMS

A. In the office

B. While traveling

C. Meetings
  1. Appropriate participation
  2. Parliamentary procedures
  3. Speaking in public

TOPIC IV. THE NATURE AND IMPORTANCE OF PERSONALITY

TOPIC V. ROLES OF MOTIVES AND EMOTIONS

A. Importance and nature of motives

B. Emotional stability
  1. Place of emotions in one's life
  2. Meaning and attainment of emotional maturity

TOPIC VI. THE ROLE OF INTELLIGENCE

A. Understanding ourselves and others

B. Intelligent behavior

C. Problem-solving and decision making

TOPIV VII. PERSONAL EFFICIENCY

A. Methods for self-appraisal

B. Self-development and self-improvement
  1. Improving appearance, voice and speech, manners, etc.
  2. Improving concentration, memory, reading, learning, confidence

C. Procedures for improvement
  1. Improving communication skills
  2. Broadening interests
  3. Developing or changing habits

TOPIC VIII. SOCIAL EFFICIENCY: HUMAN RELATIONS, TEAMWORK

A. Good human relations with co-workers

B. Good human relations with superiors and subordinates

C. Healthful adjustment to groups

Texts and Other Teaching Materials

From the following suggested texts and materials (or other equivalent commerically available materials), select trainee and teacher materials for use in this unit. Additional references are listed in Appendix B.

Agnew, Peter L. and Meehan, James R. Clerical Office Practice. 3d ed. Cincinnati, Ohio: South-Western Publishing Co., 1961.

Archer, Fred C.; Brecker, Raymond F.; and Frakes, John C. General Office Practice. 2d ed. New York: McGraw-Hill Book Co., Inc., 1963.

Barron, Allan E. and Taylor, James R. Clerical Office Training. Englewood Cliffs, N. J.: Prentice-Hall, Inc., 1963.

Beamer, Esther K.; Marshall, Hanna J.; and Popham, Estelle L., Effective Secretarial Practices. 4th ed. Cincinnati, Ohio: South-Western Publishing Co., 1962.
Workbook; Instructor's Manual

Becker, Esther R. and Lawrence, Richard L. Success and Satisfaction in Your Office Job. New York: Harper & Bros., 1954.

Carney, Marie L. Etiquette in Business. New York: McGraw-Hill Book Co., Inc., 1948.
Filmstrips: Set I (1-6), Set II (7-11).

Coleman, James C. Personal Dynamics and Effective Behavior. Chicago: Scott, Foresman & Co., 1960.

Famularo, Joseph J. Supervisors in Action. New York: McGraw-Hill Book Co., Inc., 1961.

Friedman, Sherwood and Grossman, Jack. Secretarial Practice. New York: Pitman Publishing Corp., 1960.

Gregg, John Robert; Fries, Albert C.; Rowe, Margaret; and Travis, Dorothy. Applied Secretarial Practice, 5th ed. New York: McGraw-Hill Book Co., Inc., 1962.

Keily, Helen J. and Walters, R. G. How to Find and Apply for a Job. 2d ed. Cincinnati, Ohio: South-Western Publishing Co., 1960.

Laird, Donald A. and Eleanor C., Practical Business Psychology. 3d ed. New York: McGraw-Hill Book Co., Inc., 1961.

MacGibbon, Elizabeth Gregg. Fitting Yourself for Business. 4th ed. New York: McGraw-Hill Book Co., Inc., 1961.

Mayo, Lucy Graves. Communications Handbook for Secretaries. New York: McGraw-Hill Book Co., Inc., 1958.

McLean, Beth Bailey and Paris, Jeanne. The Young Woman in Business. Ames, Iowa: Iowa State University Press, 1962.

Newton, Roy and Green, Helen. How to Improve Your Personality, 3d ed. New York: McGraw-Hill Book Co., Inc., 1963.

Ruch, Floyd L. Psychology and Life: A Study of the Thinking, Feeling, and Doing of People. 5th ed. Complete or Abridged. Chicago: Scott, Foresman and Co., 1959.
Booklet of Test Items; Instructor's Manual.

Russon, Allien. Business Behavior, 3d ed. Cincinnati, Ohio: South-Western Publishing Co., 1964.

Sferra, Adam; Wright, Mary E.; and Rice, Louis A. Personality and Human Relations, 2d ed. New York: McGraw-Hill Book Co., Inc., 1961.

Shidle, Norman G. Getting Along with Others in Business. New York: B. C. Forbes, 1947.

Stickney, Rufus and Blanche G.; Flood, Kathleen; Horton, Helen J.; and Weil, Harriet S. Office and Secretarial Training, 4th ed. Englewood Cliffs, N. J.: Prentice-Hall, Inc., 1959.

Wilson, Everett B. and Wright, Sylvia B. Getting Along with People in Business. New York: Funk and Wagnalls Co., 1950.

BUSINESS PRINCIPLES AND ORGANIZATION I

Hours Required

Class: 1 hour daily Total: 30 hours

Description

This unit provides an introduction to the study of the organization of businesses. Strong emphasis is placed on the principles of economics, governmental activity and the importance of and principles of good management. The trainee should also be given an indication of some of the principal governmental legislation affecting business enterprise.

Topic Outline

I. Business Enterprise
II. Principles of Economics
III. Government and Business
IV. Principles of Management

TOPIC I. BUSINESS ENTERPRISE

A. The nature of business in the American economy
  1. Scope of business enterprises
  2. Opportunities in business

B. Single proprietorship
  1. Legal structure
  2. Nature of businesses of this type
  3. Earmarks of efficiency

C. Partnership
  1. Legal structure
  2. Nature of businesses of this type
  3. Earmarks of efficiency

D. Corporation
  1. Legal structure
  2. Nature of businesses of this type
  3. Earmarks of efficiency

E. Cooperatives

TOPIC II. PRINCIPLES OF ECONOMICS

A. Money and banking systems

B. Economic cycles

C. Role of Government in the economy
  1. Profit objectives
  2. Business cycles

TOPIC III. GOVERNMENT AND BUSINESS

A. Key areas of governmental legislation and taxation

B. Encouragement of business activity

TOPIC IV. PRINCIPLES OF MANAGEMENT

A. Overall responsibilities of management

B. Organization of management

C. Patterns of operation
  1. Planning
  2. Organizing
  3. Directing
  4. Integrating
  5. Controlling

D. Key executives responsible for management functions

Texts and Other Teaching Materials

From the following suggested texts and materials (or other equivalent commercially available materials), select trainee and teacher materials for use in this unit. Additional references are listed in Appendix B.

Aberle, J. W.; Sielaff, T. J.; and Mayer, F. L. General Business for Today and Tomorrow. Englewood Cliffs, N. J.: Prentice-Hall, Inc., 1959.

Crabbe, Ernest H.; Enterline, Herman G.; and DeBrum, S. Joseph. General Business. 8th ed. Cincinnati, Ohio: South-Western Publishing Co., 1961.
  Workbook, 1st semester; Workbook 2d semester; Tests 1-7 and Examination; Tests 8-14 and Examination; Manual and Key.

Hurley, Morris L. Business Administration. 2d ed. Englewood Cliffs, N. J.: Prentice-Hall, Inc., 1960.

Keith, Lyman A. and Gubellini, Carlo E. Business Management. New York: McGraw-Hill Book Co., Inc., 1958.
Instructor's Manual.

Littlefield, C. L. and Peterson, R. L. Modern Office Management. Englewood Cliffs, N. J.: Prentice-Hall, Inc., 1956.

Polishock, W. M. Today's General Business. Boston: Ginn and Co., 1959.
Workbook: Tests and Manual.

Price, Ray G.; Musselman, Vernon; and Weeks, Edwin E. General Business for Everyday Living. 2d ed. New York: McGraw-Hill Book Co., Inc., 1960.
Workbooks; Tests; Correlated Filmstrips; Teacher's Manual.

Shilt, Bernard A. and Wilson, W. Harmon. Business Principles and Management. 4th ed. Cincinnati, Ohio: South-Western Publishing Co., 1961.

Tonne, Herbert A.; Simon, Sydney L.; and McGill, E. C. Business Principles, Organization, and Management. 2d ed. New York: McGraw-Hill Book Co., Inc., 1963.

BUSINESS PRINCIPLES AND ORGANIZATION II

Hours Required

Class: 1 hour daily Total: 30 hours

Description

In this unit emphasis is placed upon financial management, production management, marketing and merchandising, and personnel and human relations in terms of providing the trainee with a deeper awareness and understanding of the complexity of business management and decision-making at upper levels of management which may affect him in his day-to-day activities.

Topic Outline

I. Financial Management
II. Production Management
III. Marketing and Merchandising
IV. Personnel and Human Relations

TOPIC I. FINANCIAL MANAGEMENT

A. Executives and responsibilities

B. Financial decisions

C. Internal financial management
  1. Financial accounting
  2. Determination of profits
  3. Determination and control of costs
  4. Budgets and budgetary control
  5. Taxes and their impact on business
  6. Risks and insurance

D. The role of business data processing in decision making

TOPIC II. PRODUCTION MANAGEMENT

A. Responsibilities of executives and departments
  1. Skills and knowledges needed
  2. Nature of job responsibilities

B. Planning production and scheduling

C. Factors of production

D. Problems of production

E. Control of production and measuring its effectiveness

TOPIC III. MARKETING AND MERCHANDISING

A. The role of marketing in the American economy

B. The extent of the marketing activity—numbers of people and nature of the enterprises

C. Distribution activities
   1. Organization
   2. Implementation

D. Marketing activities
   1. Buying
   2. Pricing
   3. Selling

E. Merchandising activities
   1. Structure
   2. Promotion and advertising
   3. Display and selling
   4. Delivery and shipping

F. The efficiency of marketing and merchandising in the American economy

TOPIC IV. PERSONNEL AND HUMAN RELATIONS

A. Responsibilities of executives and department supervisors

B. Identification of need for workers

C. Recruitment, selection, and training of employees

D. Determination of wage scales, Social Security, and workmen's protection

E. Employer-employee relations

Texts and Other Teaching Materials

All texts and materials listed under Business Principles and Organization I are applicable to this unit.

FUNDAMENTALS OF TYPING

Hours Required

Class: 2 hours daily   Total: 60 hours

Description

This unit is designed to introduce the trainee to touch control of the keyboard and correct operation of all manipulative parts of the typewriter. Supervised skill development sessions are an integral part of the course. Concentration should be on good techniques as well as on the development of speed and accuracy through exercises. (The demonstration of proper techniques by the teacher is vital.) The course also includes a brief orientation to the basic patterns of arranging correspondence, manuscripts, tables, and some business forms.

Topic Outline

I. Machine Fundamentals
II. Typewriting Procedures and Techniques
III. Development of Concepts of Standards
IV. Basic Skill Development
V. Brief Introduction to Application of Typewriting Skill
VI. Auxiliary Knowledges and Skills

TOPIC I. MACHINE FUNDAMENTALS

- A. Knowledge of parts used by the beginning typist
  - 1. Identification (as and when needed)
  - 2. Function and use
- B. Manual and electric typewriters (if both are used)
  - 1. Similarities
  - 2. Differences

TOPIC II. TYPEWRITING PROCEDURES AND TECHNIQUES

- A. Proper position
  - 1. Hand position
  - 2. Arm position
  - 3. Overall posture; relationship of chair and table to correct posture
- B. Paper insertion and removal
- C. Key stroking—manual, electric
- D. Operation of additional service parts—tabulator, backspacer, margin release, variable spacer, etc.

TOPIC III. DEVELOPMENT OF CONCEPTS OF STANDARDS

- A. In speed
- B. In accuracy
  - 1. How to proofread (for content, not typing errors alone)
  - 2. How to correct
    - a. Erasing
    - b. Spreading and crowding
- C. In neatness and attractiveness of typewritten product
  - 1. General
  - 2. Layout—arrangements, spacing, etc.
  - 3. Corrections
  - 4. Mailability
- D. In acceptability of the mechanics of English
  - 1. Language usage
  - 2. Spelling
  - 3. Punctuation, capitalization, etc.

TOPIC IV. BASIC SKILL DEVELOPMENT

- A. Keyboard mastery and an understanding of the principles of touch typewriting
- B. Composing at the typewriter
- C. Areas for improvement
  - 1. Increased accuracy through control, proper techniques
  - 2. Increased speed through proper machine manipulation as well as stroking
  - 3. Product quality

TOPIC V. BRIEF INTRODUCTION TO APPLICATION OF TYPEWRITING SKILL

- A. Simple letters and envelopes
- B. Memos
- C. Simple manuscript typing, including reports
- D. Simple tabulation and centering
- E. Simple business forms and records

TOPIC VI. AUXILIARY KNOWLEDGES AND SKILLS

- A. Proper care of machine
  - 1. Use of dust cover
  - 2. Cleaning type
  - 3. Proper techniques when erasing
  - 4. Changing ribbons
- B. Use of carbon paper
- C. Correct interpretation of edited copy, simple rough drafts

Texts and Other Teaching Materials

From the suggested texts and materials listed below (or other equivalent commercially available material), select trainee and teacher materials for use in this unit. Additional references are listed in Appendix B.

Altholz, Gertrude. Modern Typewriting Practice. 3d ed. New York: Pitman Publishing Corp., 1962.

Blackstone, Bruce I. Technique, Speed, and Accuracy Typing. Englewood Cliffs, N. J.; Prentice-Hall, Inc., 1956.

Connelly, Mary and Porter, Leonard J. Typing Speed Builders. Englewood Cliffs, N. J.: Prentice-Hall, Inc., 1962.

Grubbs, Robert L. and White, James L. Sustained Timed Writings. 2d ed. New York: McGraw-Hill Book Co., Inc., 1963.

Leslie, Louis A. and Pepe, Philip S. Typing Simplified. 2d ed. New York: American Book Co., 1960.

Lessenberry, D. D.; Crawford, T. James; and Erickson, Lawrence W. 20th Century Typewriting—Elementary Course. 8th ed. Cincinnati, Ohio: South-Western Publishing Co., 1962.
Workbook; Teacher's Manual; Tests; Records and Tapes.

Lloyd, Alan C.; Rowe, John L.; and Winger, Fred E. Typing Power Drills. New York: McGraw-Hill Book Co., Inc., 1956.

Mount, Dick and Hansen, Kenneth J. Progressive Typewriting Speed Practice. 2d ed. New York: McGraw-Hill Book Co., Inc., 1961.

Nelson, Roger H. Accelerated Typing. Salt Lake City, Utah: Business Education Publishers, Inc., 1959.

Oliverio, Mary Ellen and Palmer, Harold O. Graded Time Writings. Englewood Cliffs, N. J.: Prentice-Hall, Inc., 1959.

Reigner, Charles G. and Rygiel, Walter S. Rowe Typing. 4th ed. Baltimore, Md.: H. M. Rowe Co., 1958.

Rowe, John L. and Etier, Faborn. Typewriting Drills for Speed and Accuracy. 2d ed. New York: McGraw-Hill Book Co., Inc., 1959.

________, Lloyd, Alan C., and Winger, Fred E. Gregg Typing—191 Series, Book One, General Typing; and Gregg Typing—191 Series, Book Two Office Production Typing. New York: McGraw-Hill Book Co., Inc., 1962.

Tidwell, M. Fred and Stuart, Esta Ross. Tidwell-Stuart Typing—One Year Course. Englewood Cliffs, N. J.: Prentice-Hall, Inc., 1964.
Workbook; Teacher's Manual.

Wanous, S. J. and Wanous, E. W. Basic Typewriting Drills. 3d ed. Cincinnati, Ohio: South-Western Publishing Co., 1958.

PRODUCTION TYPING

Hours Required

Class: 2 hours daily — Total: 60 hours

Description

This unit provides further supervised speed and accuracy development integrated with basic production of correspondence, business forms, manuscripts, and tabulated material. Emphasis is placed upon following accurately whatever directions are given and using judgment when detailed instructions are lacking. The goal is to help the trainee become a thinking typist, rather than a mechanical copyist. Numerous opportunities should be provided for trainees to evaluate the quality and quantity of their own work. It is recommended that, to the extent practicable, some use be made of forms and stationery from the business community.

Topic Outline

I. Review of Fundamentals
II. Further Development of Concepts of Standards
III. Further Skill Development
IV. Advanced Applications of Typing Skill
V. Auxiliary Knowledges and Skills

TOPIC I. REVIEW OF FUNDAMENTALS

A. Keyboard—touch control

B. Posture

C. Techniques in stroking, shifting, operation of service parts, etc.

D. Machine parts—function and proper operation

E. Care of machine

TOPIC II. FURTHER DEVELOPMENT OF CONCEPTS OF STANDARDS

A. Speed: usable piece of work in reasonable length of time

B. Accuracy; responsibility for correctness of typing, English mechanics, verification of content (dates, quantities, and other facts)

C. Appearance of the typewritten product according to business standards

TOPIC III. FURTHER SKILL DEVELOPMENT

A. Keyboard mastery, including the number and symbol keys

B. More refined control of other manipulative parts

C. Learning to use judgment for letter placement, tabular arrangement, centering, etc.

D. Increased speed, accuracy, and overall product quality

TOPIC IV. ADVANCED APPLICATIONS OF TYPING SKILL

A. Letters and memos, including displayed material, special lines, two pages, etc.

B. Manuscripts and reports

C. Tabulations, including column headings, ruling, etc.

D. Various kinds of business forms and office records

E. Complicated rough drafts

F. Offset masters, stencils, spirit masters

G. Chain feeding of envelopes

TOPIC V. AUXILIARY KNOWLEDGES AND SKILLS (as required)

A. Following written and oral instructions if given; working with a minimum of direction when detailed instructions are not given.

B. Knowing appropriate supplies to use—paper, carbon sets, eraser, stencils, etc.

C. Caring for machine—keeping type clean, using ribbon of suitable intensity, etc.

Texts and Other Teaching Materials

Most of the texts and other teaching materials under Fundamentals of Typing are applicable to this unit.

The teacher may also wish to give consideration to the use of the following suggested texts and materials. Additional references are listed in Appendix B.

Agnew, Peter L. Typewriting Office Practice. 3d ed. Cincinnati, Ohio: South-Western Publishing Co., 1960.

Anderson, Ruth I., and Porter, Leonard J. 130 Basic Typing Jobs. Englewood Cliffs, N. J.: Prentice-Hall, Inc., 1960.

Bell, Mary L. Speed Typing. 3d ed. Cincinnati, Ohio: South-Western Publishing Co., 1959.

Fries, Albert C. Timed Writings about Careers. Cincinnati, Ohio: South-Western Publishing Co., 1963.

_______, Nanassy, Louis C. Business Timed Writings. Englewood Cliffs, N. J.: Prentice-Hall, Inc., 1960.

Frisch, Vern A. and Sivinski, Joan. Applied Office Typewriting. 2d ed. New York: McGraw-Hill Book Co., Inc., 1961.
Enveloped kit

Hossfield, George L. and Nelson, Julius. Faster Typing. Baltimore, Md.: H. M. Rowe Co., 1958.

Liquori, F. Basic Typing Operations. Cincinnati, Ohio: South-Western Publishing Co., 1964. (available summer).

Lloyd, Alan C.; Rowe, John L.; and Winger, Fred. Typing Skill Drives. New York: McGraw-Hill Book Co., Inc., 1960.
Teaching tapes for Typing Skill Drives.

MacClain, Lenore Fenton, and Dame, J. Frank. Typewriting Techniques and Short Cuts. 3d ed. Cincinnati, Ohio: South-Western Publishing Co., 1961.

Mount, Dick and Hansen, Kenneth J. Progressive Typewriting Speed Practice. 2d ed. New York: McGraw-Hill Book Co., Inc., 1961.

Rowe, John L.; Lloyd, Alan C.; and Winger, Fred. Gregg Typing/191 Series, Book Two—Office Production Typing. New York: McGraw-Hill Book Co., Inc., 1963.
Learning Guides and Working Papers for Book Two—Office Production Typing, Parts 1-6
Learning Guides and Working Papers for Book Two—Office Production Typing, Parts 7-12.

OFFICE CALCULATORS

Hours Required

Class: 1 hour daily — Total: 30 hours

Description

The objective of this unit is development of moderate skill in the use of the 10-key and full-key adding machines, and rotary and printing calculators. Considerable emphasis is given to skill development in 10-key machines, operating them by touch. Application is made to business

business documents. When possible, work materials for this unit can be those used in Fundamentals of Accounting.

Topic Outline

I. 10-key Adding Machines and Printing Calculators
II. Full-key Adding Machines
III. Rotary Calculators
IV. Practical Applications

TOPIC I. 10-KEY ADDING MACHINES AND PRINTING CALCULATORS

A. Adding by touch
B. Subtraction
C. Multiplication
D. Decimals and fractions
E. Division on the printing calculator

TOPIC II. FULL-KEY ADDING MACHINES

A. Addition
B. Subtraction
C. Multiplication
D. Decimals and fractions
E. Division

TOPIC III. ROTARY CALCULATORS

A. Addition
B. Multiplication
C. Decimals
D. Subtraction
E. Division

TOPIC IV. PRACTICAL APPLICATIONS

A. Checks
B. Invoices
C. Stock records
D. Sales reports
E. Basic accounting records

Texts and Other Teaching Materials

From the following suggested texts and materials (or other equivalent commercially available material), select trainee and teacher materials for use in this unit. Additional references are listed in Appendix B.

Agnew, Peter L. Machine Office Practice. Cincinnati, Ohio: South-Western Publishing Co., 1959.

________, and Cornelia, Nicholas J., Office Machine Course. 3rd ed. Cincinnati: South-Western Publishing Co., 1962.
Practice Materials; Solutions Manual.

________, and Pasewark, William R. Full-Keyboard Adding Listing Machine Course. 3d ed. Cincinnati, Ohio: South-Western Publishing Co., 1963.

________, Ten-Key Adding Listing Machine and Printing Calculator Course. 3d ed. Cincinnati, Ohio: South-Western Publishing Co., 1963.
Teacher's Manual.

Fasnacht, Harold D. and Bauernfeind, Harry B. How to Use Business Machines. 2d ed. New York: McGraw-Hill Book Co., Inc., 1962.

Gibson, E. Dana. Adding Machine Systems. Dubuque, Iowa: Wm. C. Brown Co., 1960.

Johnson, Mina M. and Pactor, Paul. Ten-Key Adding Machine Course. New York: Pitman Publishing Corp., 1956.

Keelon, John K. Tested Problems for Calculators and Listing Machines. Englewood Cliffs, N.J.: Prentice-Hall, Inc., 1959.

Meehan, James R., How to Use the Calculator and the Comptometer. 4th ed. New York: McGraw-Hill Book Co., Inc., 1959.

_______, and Kahn, Gilbert. How to Use Adding Machines. New York: McGraw-Hill Book Co., Inc., 1962.
Instructor's Guide.

Walker, Arthur L.; Reach, J. Kenneth; and Hanna, J. Marshall. How to Use Adding and Calculating Machines. 2d ed. New York: McGraw-Hill Book Co., Inc., 1960.

INTRODUCTION TO BUSINESS DATA PROCESSING

Hours Required

Class: 2 hours daily Total: 60 hours

Description

This orientation unit is designed to promote understanding of the need for and importance of data in different types of businesses and in other fields. It introduces the trainee to the basic data processing cycle and the current systems, methods, and equipment used for rapid handling of large quantities of business data. Basic office filing procedures are also explained and practiced. The application of the basic cycle to manual, mechanical, electro-mechanical, and electronic systems used for various business purposes is explained and demonstrated. Computer fundamentals should be explained but not treated in depth as in the "Introduction to Computers" course unit. Stress is placed on the importance of the peripheral data processing functions and the use of associated equipment. Trainees should be given the opportunity to see demonstrations of equipment in operation in the school facility and local business data processing installations.

Topic Outline

I. Importance and Uses of Data
II. Evolution and Growth of Data Processing Systems
III. Applications of Data Processing
IV. Basic Data Processing Cycle
V. Input-Output Data Representation
VI. Introduction to Systems and Equipment
VII. Introduction to Computers
VIII. Peripheral Business Data Processing Occupations

TOPIC I. IMPORTANCE AND USES OF DATA

A. History of record-keeping

B. Sources and types of data

C. Needs for data

D. Decisions based on data

E. Growing complexity of data

TOPIC II. EVOLUTION AND GROWTH OF DATA PROCESSING SYSTEMS

A. Definition of terms: data, data processing, technology, automation, etc.

B. Evolution of data processing systems
  1. Early one-man businesses—simple bookkeeping

2. Expansion of business and increasing need for data
3. Early mechanization of the recordkeeping process
4. Development of office machines
5. Development of punched card systems
6. Integrated data processing
7. Electronic data processing systems
8. Future of data processing

C. Data processing in the business organization

D. Filing techniques
   1. Alphabetic files
   2. Numeric files
   3. Subject files
   4. Other types of files—chronological, geographical, etc.
   5. Indexing and filing rules
   6. Filing procedures and materials
   7. Filing correspondence, printed material, department records
   8. Establishing and maintaining filing systems
   9. Filing practice

TOPIC III. APPLICATIONS OF DATA PROCESSING

A. Engineering

B. Science

C. Statistics

D. Military

E. Financial and banking

F. Business and industry
   1. Accounting
   2. Payroll
   3. Reports
   4. Inventory and material control
   5. Production scheduling
   6. Labor distribution
   7. Sales analysis
   8. Market forecasting
   9. Management forecasting

TOPIC IV. BASIC DATA PROCESSING CYCLE

A. Collection of data (original documents—checks, time cards, etc.)

B. Input preparation and entry (preparing ledger pages, punching cards, etc.)

C. Processing
   1. Classifying (by location, production lot, etc.)
   2. Sorting (by code, account number, etc.)
   3. Calculating (total volume, averages, deductions, etc.)
   4. Summarizing (new or reconstructed data)

D. Storage (machine memory, library, paper files)

E. Output (punched cards, magnetic tape, document, statement)

TOPIC V. INPUT-OUTPUT DATA REPRESENTATION

A. Recording media
   1. Punched cards
   2. Punched paper tape
   3. Magnetic tape
   4. Magnetic ink characters
   5. Printed forms
   6. Cathode-ray tube
   7. Other media

B. Coding systems—man-machine communication

TOPIC VI. INTRODUCTION TO SYSTEMS AND EQUIPMENT

A. Flowcharting

B. Manual

C. Machine
   1. Typewriter
   2. Reproducing machines
   3. Calculator
   4. Accounting machine
   5. Key sort

D. Electro-mechanical machine functions and types
    1. Key-punch
    2. Verifier
    3. Reproducer
    4. Collator
    5. Sorter
    6. Interpreter
    7. Calculator
    8. Tabulator
    9. Media converter—tape to card, card to tape

E. Electronic

TOPIC VII. INTRODUCTION TO COMPUTERS

A. Computer applications

B. Components and functions of a computer system

C. Number systems (binary, octal, decimal)

D. Computer characteristics

E. Console and inquiry
    1. Console function
    2. Inquiry function

F. Programming
    1. The programming function
    2. Preparing a problem for processing
    3. Coding and programming fundamentals

TOPIC VIII. PERIPHERAL BUSINESS DATA PROCESSING OCCUPATIONS

A. Job functions and associated equipment
    1. Tape librarian
    2. Coding clerk
    3. Key-punch operator
    4. Tabulating machine operator
    5. Console operator
    6. Supervisor, machine records unit
    7. Supervisor, clerical
    8. Statistical clerk
    9. Possible future occupation—peripheral equipment operator

B. Importance of peripheral business data processing occupations

Texts and Other Teaching Materials

From the following suggested texts and materials (or other equivalent commercially available materials), select trainee and teacher materials for use in this unit. Additional references are listed in Appendix B.

Canning, Richard G. Electronic Data Processing for Business and Industry. New York: John Wiley and Sons, Inc., 1956.

________, Installing Electronic Data Processing Systems. New York: John Wiley and Sons, Inc., 1956.

Chapin, Ned. An Introduction to Automatic Computers. 2d ed. Princeton, N. J.: Van Nostrand Co., 1963.

Gotli. ., C. C. and Hume, J. N. P. High-speed Data Processing. New York: McGraw-Hill Book Co., Inc., 1958.

Gregory, Robert H. and Van Horn, Richard L. Automatic Data-Processing Systems. 2d ed. Belmont, Calif.: Wadsworth Publishing Co., 1963.

Freeman, M. Herbert; Hanna, J. Marshall; and Kahn, Gilbert. Gregg Bookkeeping and Accounting. 3d ed. New York: McGraw-Hill Book Co., Inc., 1963. (Contains special section on business data processing.)

Hein, Leonard W. An Introduction to Electronic Data Processing for Business. Princeton, N. J.: D. Van Nostrand Co., 1961.

Johnson, Lloyd E.; Wadsworth, William E.; and Burger, John. Business Automation Fundamentals. San Francisco, Calif.: Automation Institute Publishing Co., 1961.

Kahn, Gilbert; Yerian, Theodore; and Stewart, Jeffry R. Progressive Filing. New York: McGraw-Hill Book Co., Inc., 1961.
Workbook, Practice Materials, Practice Instruction Manual, and other materials.

Kometsky, G. and Kirchner, P. Electronic Computers and Management Control. New York: McGraw-Hill Book Co., Inc., 1956.

Laurie, Edward J. Computers and How They Work. Cincinnati, Ohio: South-Western Publishing Co., 1963.

Leven, Howard S. Office Work and Automation. New York: John Wiley and Sons, Inc., 1956.

Martin, E. Wainright. Electronic Data Processing: An Introduction. Homewood, Ill.: Richard D. Irwin, 1961.

McCracken, D. D.; Weiss, H.; and Lee, T. Programming Business Computers. New York: John Wiley and Sons, Inc., 1959.

McGill, Donald A. C. Punched Cards: Data Processing for Profit Improvement. New York: McGraw-Hill Book Co., Inc., 1962.

Nett, Roger W. and Hetzler, Stanley A. An Introduction to Electric Data Processing. Glencoe, Ill.: Free Press, 1959.

Oakford, Robert V. Introduction to Electronic Data Processing Equipment. New York: McGraw-Hill Book Co., Inc., 1962.

Pfeiffer, John. The Thinking Machine. Philadelphia: J. B. Lippincott Co., 1962.

Wanous, S. J. and Wanous, E. W. Automation Office Practice. Cincinnati, Ohio: South-Western Publishing Co., 1964.
Teachers' Manual. Office Practice Set.

Weeks, Bertha, How to File and Index. New York: The Ronald Press Co., 1956.

ELECTRO-MECHANICAL ACCOUNTING MACHINES

Hours Required

Class: 2 hours daily, Laboratory: 4 hours daily Total: 30 hours

Description

This unit provides an orientation to the principles of electro-mechanical accounting machines as part of an independent system and as support of the computer. Trainees are given an opportunity to study application of the equipment to problems in accounting. They should see each piece of equipment in operation as the functions, features, and operating procedures are explained.

Topic Outline

I. The Punched Card
II. Machine Functions
III. Machine Components
IV. Key Punch and Verifier
V. Interpreter
VI. Sorter
VII. Reproducer

VIII. Collator
IX. Accounting Machine—Tabulator
X. Calculator
XI. Basic Housekeeping Procedures
XII. Equipment Used as Computer Support
XIII. Accounting Applications

TOPIC I. THE PUNCHED CARD

A. The source document

B. Card format

C. Card code

D. Card field

E. Card control functions

F. Card movement in the machines

TOPIC II. MACHINE FUNCTIONS

A. Recording

B. Classifying

C. Calculating

D. Reporting

TOPIC III. MACHINE COMPONENTS

A. Feeding

B. Reading

C. Control panels
  1. Types
  2. Wiring

D. Checking

TOPIC IV. KEY PUNCH AND VERIFIER

A. Functions

B. Features

C. Numeric and alphabetic punching

D. The control card

E. Duplicating

F. Verification

TOPIC V. INTERPRETER

A. Functions

B. Features

C. The column split

D. Interpreting

E. The selector

F. Interpreting with selection

TOPIC VI. SORTER

A. Functions

B. Features

C. Operating procedures

D. Numerical and alphabetic sorting

E. Block sorting

TOPIC VII. REPRODUCER

A. Functions

B. Features

C. Operating procedures

D. Reproducing

E. Gang punching

F. Verifying

TOPIC VIII. COLLATOR

A. Functions

B. Features

C. Operating procedures

D. Sequence checking

E. Selection

F. Merging

G. Matching

TOPIC IX. ACCOUNTING MACHINE—TABULATOR

A. Functions

B. Features

C. Control Panel
  1. Detail printing

2. Program control
3. Addition and subtraction
4. Group printing and group indication
5. Selective printing
6. Summary punching

TOPIC X. CALCULATOR

A. Functions

B. Features

C. Control panel
   1. Add
   2. Subtract
   3. Multiply
   4. Divide

TOPIC XI. BASIC HOUSEKEEPING PROCEDURES (Procedures differ with each equipment manufacturer)

TOPIC XII. EQUIPMENT USED AS COMPUTER SUPPORT

A. Data preparation

B. Input function

C. Output function

TOPIC XIII. ACCOUNTING APPLICATIONS

A. Accounts receivable
   1. Functions and objectives
   2. Source documents
   3. Statements and reports
   4. Cards and files
   5. Data processing flow charts

B. Accounts payable
   1. Functions and objectives
   2. Source documents
   3. Checks and reports
   4. Cards and files
   5. Data processing flow charts

C. Payroll
   1. Functions and objectives
   2. Source documents
   3. Statements, checks, reports
   4. Cards and files
   5. Data processing flow charts

Texts and Other Teaching Materials

From the following suggested texts and materials (or other equivalent commercially available material), select trainee and teacher materials for use in this unit. Additional references are listed in Appendix B.

Freeman, M. Herbert; Hanna, J. Marshall; and Kahn, Gilbert. Gregg Bookkeeping and Accounting. 3d ed. New York: McGraw-Hill Book Co., Inc., 1963. (Contains special section on business data processing.)
   Practice Sets; Workbooks; Objective Tests; Teacher's Manual and Key; Correlated Series of Six Filmstrips.

IBM Personal Study Program. Punched Card Data Processing Principles. Form #320-1443, 1444, 1445, 1446, 1447, 1448, 1449. 1961.

Irwin, Wayne C. Digital Computer Principles. Princeton, N. J.: D. Van Nostrand Co., 1961.

Johnson, Eldred A. Accounting Systems in Modern Business. New York: McGraw-Hill Book Co., Inc., 1959.

Johnson, Lloyd E.; Wadsworth, William E.; and Burger, John. Business Automation Fundamentals. San Francisco, Calif.: Automation Institute Publishing Co., 1961.

Laurie, Edward J. Computers and How They Work. Cincinnati, Ohio: South-Western Publishing Co., 1963.

McGill, Donald A. C. Punched Cards - Data Processing for Profit Improvement. New York: McGraw-Hill Book Co., Inc., 1962.

Nelson, Oscar S. and Woods, Richard S. Accounting Systems and Data Processing. Cincinnati, Ohio: South-Western Publishing Co., 1961.

Oakford, Robert V., Introduction to Electronic Data Processing Equipment. New York: McGraw-Hill Book Co., Inc., 1962.

Randall, Clarence B.; Weimer, Sally W.; Greenfield, Maynard S. Systems and Procedures for Automated Accounting. Cincinnati, Ohio: South-Western Publishing Co., 1962.

Salman, Lawrence, IBM Machine Operation and Wiring. Belmont, Calif.: Wadsworth Publishing Co., Inc., 1962.

VanNess, Robert G. Principles of Punched Card Data Processing. Elmhurst, Ill.: Business Press, Inc., 1962.

ELEMENTARY DESCRIPTIVE STATISTICS

Hours Required

Class: 1 hour daily, Laboratory: 1 hour daily — Total: 60 hours

Description

Designed to provide certain trainees (statistical clerks and supervisors) with basic knowledge and skills required in business applications of elementary descriptive statistics. This course also serves to broaden understanding of routine compilation of data. Statistical theory discussion should be concurrent with the development of proficiency through practice exercises in the laboratory sessions.

Topic Outline

I. The Field of Statistics
II. Organization and Interpretation of Data
III. Graphical Presentation
IV. Measures of Central Tendency
V. Measures of Variability
VI. Frequency Distribution Classifications
VII. Basic Sampling Concepts
VIII. Statistical Reports
IX. Using the Computer for Statistical Analysis (Demonstration)

TOPIC I. THE FIELD OF STATISTICS

A. Statistics defined

B. Origin and history of statistics

C. Growth of statistics in business and industry

D. Sources of statistical data

E. Uses of statistical data

F. Pitfalls in statistics
   1. Bias
   2. Improper sampling
   3. Noncomparative data
   4. Improper assumptions

G. Some modern descriptive statistical methods

TOPIC II. ORGANIZATION AND INTERPRETATION OF DATA

A. Definitions, notations, and symbols

B. Basic rules of computation

C. Class intervals

D. Frequency Distribution
   1. Basic concepts
   2. Grouping
   3. Graphic presentation

E. Tabular presentation
   1. Elements of a table
   2. Rules for construction of a table

TOPIC III. GRAPHICAL PRESENTATION

A. Types of graphs

B. Histograms

C. Pictograms

D. Frequency polygons

E. Cumulative distributions and ogives

TOPIC IV. MEASURES OF CENTRAL TENDENCY

A. The arithmetic mean
   1. Ungrouped data
   2. Grouped data

B. The median
   1. Ungrouped data
   2. Grouped data

C. The mode

D. The weighted arithmetic mean

E. The geometric mean

F. Quartiles, deciles, and percentiles

TOPIC V. MEASURES OF VARIABILITY

A. The range

B. The average deviation

C. The standard deviation
   1. Ungrouped data
   2. Grouped data

TOPIC VI. FREQUENCY DISTRIBUTION CLASSIFICATIONS

A. Normal distribution

B. Skew

C. Other types of frequency distribution (optional)

D. Transformation of data

TOPIC VII. BASIC SAMPLING CONCEPTS

A. Random sampling

B. Stratified sampling

C. Proportional sampling

D. Size of sample

TOPIC VIII. STATISTICAL REPORTS

A. Need for statistical reports in business

B. Types of reports

C. Preparation and processing of reports

TOPIC IX. USING THE COMPUTER FOR STATISTICAL ANALYSIS (DEMONSTRATION)

Texts and Other Teaching Materials

From the following suggested texts and materials (or other equivalent commercially available materials), select trainee and teacher materials for use in this unit. Additional references are listed in Appendix B.

Croxton, F. E. and Cowden, D. J. Applied General Statistics. Englewood Cliffs, N. J.: Prentice-Hall, Inc., 1955.

Freund, John E. and Williams, Frank J. Modern Business Statistics. Englewood Cliffs, N. J.: Prentice-Hall, Inc., 1958.

Johnson, Palmer O. and Jackson, Robert W. B. Introduction to Statistical Methods. Englewood Cliffs, N. J.: Prentice-Hall, Inc., 1953.

Lewis, Edward E. Methods of Statistical Analysis in Economics and Business. Boston: Houghton Mifflin Co., 1953.

McCarthy, Philip J. Introduction to Statistical Reasoning. New York: McGraw-Hill Book Co., Inc., 1957.

Mode, E. B. Elements of Statistics. Englewood Cliffs, N. J.: Prentice-Hall, Inc., 1951.

Mood, Alexander M. and Graybill, Franklin A. Introduction to the Theory of Statistics. New York: McGraw-Hill Book Co., Inc., 1963.

Mosteller, F.; Rourke, R. E. K.; Thomas, G. B., Jr. Probability and Statistics. Reading, Mass.: Addison Wesley Publishing Co., 1961.

Paden, Donald W. and Lindquist, E. F. Statistics for Economics and Business. 2d ed. New York: McGraw-Hill Book Co., Inc., 1956.
Workbook.

Riggleman, John R. and Frisbee, Ira N. Business Statistics, 3d ed. New York: McGraw-Hill Book Co., Inc., 1951.

Sprowls, R. Clay. Elementary Statistics. New York: McGraw-Hill Book Co., Inc., 1955.

Tuttle, Alva M. Elementary Business and Economic Statistics. New York: McGraw-Hill Book Co., Inc., 1957.
Laboratory Manual.

Walker, Helen M. and Lev, Joseph. Elementary Statistical Methods. New York: Henry Holt & Co., 1958.

Wallis, W. A. and Roberts, H. V. Statistics: A New Approach. Glencoe, Ill.: The Free Press, 1956.

Waugh, A. E. Elements of Statistical Method. 3d ed. New York: McGraw-Hill Book Co., Inc., 1952.
Statistical Tables and Problems

Wolf, Frank L. Elements of Probability and Statistics. New York: McGraw-Hill Book Co., Inc., 1962.

PRINCIPLES OF SUPERVISION

Hours Required

Class: 1 hour daily — Total: 30 hours

Description

In this unit the trainee should gain an understanding of good supervisory principles and practices in the office. Attention in the unit is centered on the responsibilities of supervision and developing good relationships with office employees. Core activities should include the techniques of face-to-face communication, assigning employees, delegating authority and responsibility, and the orientation and training of new employees. The teacher should take every opportunity to use role playing techniques to develop trainee skills and case discussions to widen understanding. Cases, role plays, discussions, and problems should focus on office work situations.

Topic Outline

I. The Function of Management
II. The Supervisory Job: General Responsibilities
III. Communicating with Employees
IV. Interviewing
V. Evaluating Employees
VI. Other Factors Affecting Supervision

TOPIC I. THE FUNCTION OF MANAGEMENT

- A. Major responsibilities in planning and controlling
- B. Nature of office supervision
- C. Supervisory authority and responsibility
  - 1. Authority and responsibility defined
  - 2. Final accountability for actions
  - 3. Relationship with superiors

TOPIC II. THE SUPERVISORY JOB: GENERAL RESPONSIBILITIES

- A. Participating in the selection and placement of office employees
  - 1. Cooperating with personnel department
  - 2. Interviewing prospective employees
  - 3. Evaluating abilities of prospective employees
- B. Indoctrinating and training employees
  - 1. Newly hired employees
  - 2. How to determine training needs
  - 3. How to train
- C. Organizing the work of the section
- D. Obtaining quality work from others
- E. Developing the employee's capacities and interests effectively
- F. Reviewing and evaluating the work performance of employees
- G. Utilizing effective human relations to achieve teamwork and harmony
- H. Improving work methods
- I. Increasing the value of employees
- J. Participation in the formation of objectives
  - 1. Departmental
  - 2. Sectional
  - 3. Personal
- K. Keeping personnel records

TOPIC III. COMMUNICATING WITH EMPLOYEES

- A. Communicating changes in work methods
- B. Communicating changes in policies and procedures
- C. Communicating orders

TOPIC IV. INTERVIEWING

- A. Some interviewing techniques
- B. Interviewing technique practice (role play)

TOPIC V. EVALUATING EMPLOYEES

- A. Appraising employees and prospective employees
- B. Disciplining employees
- C. Rewarding employees

TOPIC VI. OTHER FACTORS AFFECTING SUPERVISION

- A. Union contracts
- B. Problem employees
- C. Accepting supervisory responsibilities

Texts and Other Teaching Materials

From the following suggested texts and materials (or other equivalent commercially available materials), select trainee and teacher material for use in this unit. Additional references are listed in Appendix B.

Brown, Milon. Effective Supervision. New York: The Macmillan Co., 1956.

Cooper, Alfred M. How to Supervise People. 4th ed. New York: McGraw-Hill Book Co., Inc., 1958.

Dorcus, Roy M. and Jones, Margaret Hubbard. Handbook of Employee Selection. New York: McGraw-Hill Book Co., Inc., 1950.

Famularo, Joseph J. Supervisors in Action—Developing Your Skills in Managing People. New York: McGraw-Hill Book Co., Inc., 1961.

Halsey, George D. Supervising People. New York: Harper & Bros., 1953.

Kay, Brian R. and Palmer, Stuart. The Challenge of Supervision. New York: McGraw-Hill Book Co., Inc., 1961.

Laird, Donald A. and Eleanor C. Practical Business Psychology. 3d ed. New York: McGraw-Hill Book Co., Inc., 1961.

________, Sizing up People. New York: McGraw-Hill Book Co., Inc., 1951.

________, The Techniques of Delegating. New York: McGraw-Hill Book Co., Inc., 1951.

Nichols, Ralph G. and Stevens, Leonard A. Are You Listening? New York: McGraw-Hill Book Co., Inc., 1957.

Neuner, John J. W. Office Management. 4th ed. Cincinnati, Ohio: South-Western Publishing Co., 1959.

Newton, Roy and Green, Helen. How to Improve Your Personality. 3d ed. New York: McGraw-Hill Book Co., Inc., 1963.

Sferra, Adam; Wright, Mary Elizabeth; and Rice, Louis A. Personality and Human Relations. 2d ed. New York: McGraw-Hill Book Co., Inc., 1961.

Terry, George R. Office Management and Control. 3d ed. Homewood, Ill.: Richard D. Irwin, Inc., 1958.

PSYCHOLOGY FOR SUPERVISORS

Hours Required

Class: 1 hour daily — Total: 30 hours

Description

This unit is designed for those who will supervise others in an office environment. It is an introduction to the understanding of interpersonal relationships, personality, morale, personal efficiency, and leadership as they relate to office work climate and productivity. Trainee participation should be maximized by the employment of case studies, discussion, and role-playing, as they pertain to office situations.

Topic Outline

I. Human Relations and Morale
II. Personality and Emotional Health
III. Improving Personal Efficiency
IV. Personal Leadership

TOPIC I. HUMAN RELATIONS AND MORALE

- A. Human relationships
  - 1. Dimensions of human relations
    - a. Psychological
    - b. Social
  - 2. In personal situations
  - 3. In business situations
- B. Human relations' influence on morale
  - 1. Effect of morale in the work situation
  - 2. Enhancement of morale
  - 3. Deterioration of morale and hostilities
  - 4. Value of praise
- C. Specific human relations situations
  - 1. At time of interview
  - 2. In meeting and working with new people
  - 3. In sustaining good work relationships
  - 4. In handling "problem" situations

TOPIC II. PERSONALITY AND EMOTIONAL HEALTH

- A. The mature personality
  - 1. Key characteristics
  - 2. Development
- B. The mature personality in business life
  - 1. Responding to new demands and environment
  - 2. Assuming responsibility for handling problems

TOPIC III. IMPROVING PERSONAL EFFICIENCY

- A. Identification of job responsibilities
  - 1. Planning appropriate work schedules
  - 2. Organizing work
  - 3. Following through on plans
- B. Maintenance of physical efficiency
  - 1. Planning for adequate rest and recreation
  - 2. Understanding other physical needs of people

TOPIC IV. PERSONAL LEADERSHIP

- A. Levels of leadership responsibility
- B. Development of leadership skills
  - 1. In small group situations
  - 2. In large group situations
  - 3. In supervisory positions
- C. Rewards of good leadership

Texts and Other Teaching Materials

From the following suggested texts and materials (or other equivalent commercially available material), select trainee and teacher materials for use in this unit. Additional references are listed in Appendix B.

Becker, Esther. Success and Satisfaction in Your Office Job. New York: Harper and Bros., 1954.

Davis, Keith. Human Relations in Business. New York: McGraw-Hill Book Co., Inc., 1957.

Gardner, Burleigh and Moore, David. Human Relations in Industry. Homewood, Ill.: Richard D. Irwin Publishing Co., 1955.

Laird, Donald A. and Eleanor C. Practical Business Psychology. 3d ed. New York: McGraw-Hill Book Co., Inc., 1961.
Tests.

________, The Techniques of Delegating. New York: McGraw-Hill Book Co., Inc., 1957.

Lawshe, C. H., Jr. The Psychology of Industrial Relations. New York: McGraw-Hill Book Co., Inc., 1953.
Six filmstrips, three records, correlated with this text.

Russon, Allien. Business Behavior. Cincinnati, Ohio: South-Western Publishing Co., 1964.

CLASSIFICATION AND CODING

Hours Required

Class: 1 hour daily, Laboratory: 1 hour daily　　Total: 60 hours

Description

Emphasis in this unit is on coding skill development. The trainee learns various types of coding systems and should develop a basic understanding of programming and data processing system material preparation. Since some of this material would have been covered in the unit, Introduction to Business Data Processing, instructors should use minimum time for refreshing trainee and concentrate on practice experiences.

Topic Outline

I. Fundamentals of Program Preparation
II. Coding Systems and Coding Practice
III. Flow Charts and Block Diagrams
IV. Elements of Data Processing Systems
V. Types of Computers
VI. Number Systems
VII. Computer Words and Practice Coding
VIII. Computer Address System
IX. Fundamentals of Coding Digital Computers

TOPIC I. FUNDAMENTALS OF PROGRAM PREPARATION

A. Definition and analysis

B. Elements of program design

C. Coding

D. Testing

TOPIC II. CODING SYSTEMS AND CODING PRACTICE

A. Classification codes
    1. Alphabetic
    2. Numeric
    3. Alpha-numeric
    4. Mnemonic

B. Machine language and communication codes
    1. Punched tape (5, 6, 7, 8 channel codes)
    2. Punched card (80 col., 90 col.)
    3. Magnetic tape (5, 6, 7, 8 channel codes)
    4. Character recognition

C. Coding sheet forms

TOPIC III. FLOW CHARTS AND BLOCK DIAGRAMS

A. Types

B. Symbols

C. Organization

TOPIC IV. ELEMENTS OF DATA PROCESSING SYSTEMS

A. Input-Output

B. Storage

C. Processing

D. Control

TOPIC V. TYPES OF COMPUTERS

A. Analog

B. Digital

C. General purpose

D. Special purpose

TOPIC VI. NUMBER SYSTEMS

A. Binary

B. Octal

C. Binary arithmetic

D. Conversion of bases

TOPIC VII. COMPUTER WORDS AND PRACTICE CODING

A. Data words

B. Instruction words

TOPIC VIII. COMPUTER ADDRESS SYSTEM

A. Concept of address system

B. Types of systems

TOPIC IX. FUNDAMENTALS OF CODING DIGITAL COMPUTERS

A. Input-output commands

B. Arithmetic operations

C. Decision-making

D. Editing

E. Loops and indexing

Texts and Other Teaching Materials

From the following suggested texts and materials (or other equivalent commercially available materials), select trainee and teacher materials for use in this unit. Additional references are listed in Appendix B.

Chapin, Ned. Programming Computers for Business Applications. New York: McGraw-Hill Book Co., Inc., 1961.

Evans, G. W. and Perry, C. L. Programming and Coding for Automatic Digital Computers. New York: McGraw-Hill Book Co., Inc., 1961.

Galler, Bernard A. The Language of Computers. New York: McGraw-Hill Book Co., Inc., 1962.

Gotlieb, C. C. and Hume, J. N. P. High-speed Data Processing. New York: McGraw-Hill Book Co., Inc., 1958.

Gregory, Robert H. and Van Horn, Richard L. Automatic Data-Processing Systems. 2d ed. Belmont, Calif.: Wadsworth Publishing Co., 1963.

Hein, Leonard W. An Introduction to Electronic Data Processing for Business. Princeton, N. J.: D. Van Nostrand Co., 1961.

Jeenel, Joachim. Programming for Digital Computers. New York: McGraw-Hill Book Co., Inc., 1959.

Johnson, Lloyd E.; Wadsworth, William E.; and Burger, John. Business Automation Fundamentals. San Francisco, Calif.: Automation Institute Publishing Co., 1961.

Laurie, Edward J. Computers and How They Work. Cincinnati, Ohio. South-Western Publishing Co., 1963.

McCormick, E. M. Digital Computer Primer. New York: McGraw-Hill Book Co., Inc., 1959.

McCracken, D. D.; Weiss, H.; and Lee, T. Programming Business Computers. New York: John Wiley and Sons, Inc., 1959.

Nathan, Robert and Hanes, Elizabeth. Computer Programming Handbook. Englewood Cliffs, N. J.: Prentice-Hall, Inc., 1962.

Nelson, Oscar S. and Woods, Richard S. Accounting Systems and Data Processing. Cincinnati, Ohio: South-Western Publishing Co., 1961.

Oakford, Robert V. Introduction to Electronic Data Processing Equipment. New York: McGraw-Hill Book Co., Inc., 1962.

Sherman, Philip M. Programming and Coding Digital Computers. New York: John Wiley and Sons, Inc., 1963.

Siegel, Paul. Understanding Digital Computers. New York: John Wiley and Sons, Inc., 1961.

Wanous, S. J. and Wanous, E. W. Automation Office Practice. Cincinnati, Ohio: South-Western Publishing Co., 1964.

Teachers' Manual. Office Practice Set.

Williams, Samuel B. Digital Computing Systems. New York: McGraw-Hill Book Co., Inc., 1959.

In addition, references, equipment manuals, and instructional aids are available from local representatives of most data processing equipment manufacturers. The following examples are appropriate for use with this unit.

IBM Form Number	Title
F22-6517	Introduction to IBM Data Processing Systems
F20-8093	Coding Methods
J22-6690	Binary Coded Decimal Code for 1401-1410-7040-7044
A24-3067	1407-1460 System Operators Reference Manual
A24-3068	Misc. Input/Output Instructions for 1401-1460
A24-3069	Tape Input/Output Instructions
A24-3070	Disc Storage Input/Output Instructions
G24-1477	1401 Data Flow
J22-6690	Standard BCD Interchange Code
C24-1480	1401 Symbolic Programming System
C24-1486	1401 Autocoder with 1311 Storage Drives
J24-1434	Autocoder for the 1401
F28-8053	COBOL
C24-1464	FARGO
J24-0215	Report Program Generator
C24-1494	1401 System Programmer's Guide
F28-8074	FORTRAN

Burroughs Corp. Form Number	System	Title or Description
200-20002-D	B 200	Student Workbook—Sales Training
200-21001-D	B 200	Reference Manual
200-21006-D	B 200	Instruction List—Card
MSSG	B 200	Revisions & Additions to B200 Reference Manual
MSSG	B 200	B200 Assembler-Compiler
CHIDO	B 250	Financial Programming Hints

INTRODUCTION TO COMPUTERS

Hours Required

Class: 1 hour daily Total: 30 hours

Description

This unit provides trainees, whose job functions will be closely involved with computer operation, with greater in-depth knowledge of the computer than was given in the orientation unit, "Introduction to Business Data Processing." The teacher should treat certain topics in this unit as "refresher" material. Other topics such as computer characteristics, functions, processing, and programming should be given greater attention and emphasis.

Topic Outline

I. Computer Applications
II. Computer Characteristics
III. Components and Functions of a Computer System
IV. Input-Output Media
V. Central Processing Unit
VI. Internal Processing
VII. Console and Inquiry
VIII. Programming

TOPIC I. COMPUTER APPLICATIONS

A. Commercial and financial

B. Scientific

C. Process control

D. Numerical control

E. Planning and simulation

F. Communications

TOPIC II. COMPUTER CHARACTERISTICS

A. Analog and digital

B. Serial and parallel

C. Buffered and unbuffered

D. Sequential and random

E. Numeric and alphanumeric

F. Variable and fixed

TOPIC III. COMPONENTS AND FUNCTIONS OF A COMPUTER SYSTEM

A. Input-Output

B. Storage

C. Logic

D. Arithmetic

E. Control

TOPIC IV. INPUT-OUTPUT MEDIA

A. Card devices

B. Magnetic tape unit

C. Paper tape devices

D. Magnetic character sensing

E. Optical reader

F. Printers

G. Random access devices

H. Console

TOPIC V. CENTRAL PROCESSING UNIT

A. Storage unit or memory
  1. Purpose
  2. Types of storage
  3. Data representation in storage

B. Arithmetic

- C. Logic
- D. Control

TOPIC VI. INTERNAL PROCESSING

- A. Loading the stored program
- B. Accessing
- C. Registers
- D. Data flow

TOPIC VII. CONSOLE AND INQUIRY

- A. Console function
- B. Inquiry function

TOPIC VIII. PROGRAMMING

- A. Program preparation steps
- B. Types of instruction
- C. Coding
- D. Flow charting and block diagraming
- E. Number systems
- F. Address systems
- G. Computer word format
- H. Housekeeping
- I. Running
- J. Error correction

Texts and Other Teaching Materials

From the following suggested texts and materials (or other equivalent commercially available material), select trainee and teacher materials for use in this unit. Additional references are listed in Appendix B.

Bell, W. D. A Management Guide to Electronic Computers. New York: McGraw-Hill Book Co., Inc., 1957.

Canning, Richard G. Electronic Data Processing for Business and Industry. New York: John Wiley and Sons, Inc., 1956.

Chapin, Ned. An Introduction to Automatic Computers. Princeton, N. J.: D. Van Nostrand Co., 1963.

Fahnestock, James D. Computers and How They Work. New York: Ziff-Davis Publishing Co., 1960.

Gotlieb, C. C. and Hume, J. N. P. High-speed Data Processing. New York: McGraw-Hill Book Co., Inc., 1958.

Grabbe Eugene M., ed. Automation in Business and Industry. New York: John Wiley and Sons, Inc., 1957.

Irwin, Wayne C. Digital Computer Principles. Princeton, N. J.: D. Van Nostrand Co., 1961.

Hein, Leonard W. An Introduction to Electronic Data Processing for Business. Princeton, N. J.: D. Van Nostrand Co., 1961.

Jeenel, Joachim. Programming for Digital Computers. New York: McGraw-Hill Book Co., Inc., 1959.

Johnson, Eldred A. Accounting Systems in Modern Business. New York: McGraw-Hill Book Co., Inc., 1959.

Laurie, Edward J. Computers and How They Work. Cincinnati, Ohio: South-Western Publishing Co., 1963.

Ledley, Robert S. Programming and Utilizing Digital Computers. New York: McGraw-Hill Book Co., Inc., 1962.

Leeds, Herbert D. and Weinberg, Gerald M. Computer Programming Fundamentals. New York: McGraw-Hill Book Co., Inc., 1961.

Livesley, R. K. An Introduction to Automatic Digital Computers. New York: Cambridge University Press, 1962.

Martin, E. Wainright. Electronic Data Processing. Homewood, Ill.: Richard D. Irwin, Inc., 1961.

McCormick, E. M. Digital Computer Primer. New York: McGraw-Hill Book Co., Inc., 1959.

McCracken, D. D.; Weiss, H.; and Lee, T. *Programming Business Computers*. New York: John Wiley and Sons, Inc., 1959.

Murphy, John S. *Basics of Digital Computers*. New York: John F. Rider Publisher, Inc., 1958.

Nett, Roger W. and Hetzler, Stanley A. *An Introduction to Electric Data Processing*. Glencoe, Ill.: Free Press, 1959.

Oakford, Robert V. *Introduction to Electronic Data Processing Equipment.* New York: McGraw-Hill Book Co., Inc., 1962.

Pfeiffer, John. *The Thinking Machine*. Philadelphia: J. B. Lippincott Co., 1962.

Postley, John A. *Computers and People.* New York: McGraw-Hill Book Co., Inc., 1960.

Richards, R. K. *Digital Computer Components and Circuits.* Princeton, N. J.: D. Van Nostrand Co., 1957.

Sherman, Philip M. *Programming and Coding Digital Computers.* New York: John Wiley and Sons, Inc., 1963.

Siegel, Paul. *Understanding Digital Computers.* New York: John Wiley and Sons, Inc., 1961.

Williams, Samuel B. *Digital Computing Systems.* New York: McGraw-Hill Book Co., Inc., 1959.

SPECIALIZED OCCUPATION UNITS

CODING CLERK

Job Description D. O. T. No. 1-36.05

Converts items of information obtained from reports and records to codes for processing on automatic machines, using predetermined coding system. Records codes onto form for subsequent transfer to punchcards. May be designated according to trade name of computer system.

Prerequisites

For Occupation

Work situations involve repetitive activities performed according to set procedures. The coding clerk must work to established standards of accuracy in assigning codes. Since coding is performed according to a predetermined, standardized system, a preference for activities of a routine, concrete, organized nature is preferred. Clerical perception is required in converting data to codes, recognizing omissions, and correcting errors in data used.

For Occupational Course of Study

The occupational unit for this trainee is included under the General Office Education Units. Appropriate units for this trainee are listed below.

The local instructor may check the trainee's previously acquired abilities against the Standards of Achievement for the General Office Education Units in order to plan the curriculum for the trainee.

Appropriate General Office Education Units	Hours
Business Mathematics I	30
Business Mathematics II	30
Elements of Fiscal Recordkeeping	60
Language Skills	30
Personal Development	30
Business Principles and Organization I	30
Introduction to Business Data Processing	60
Classification and Coding	60
Introduction to Computers	30
Electro-Mechanical Accounting Machines	30

STATISTICAL CLERK

Job Description

D. O. T. No. 1-36.01

Compiles regular and special reports for the use of management and as a basis for statistical studies, using the regular bookkeeping and accounting records as a source of information. Makes up reports showing information such as amount and type of material ordered, used, and rejected; volume and class of daily sales; number and kind of accumulative pending sales, and average working time and wage rate of company employees. May check material used as a source of information. May operate an adding machine and a calculating machine.

Prerequisites

For Occupation

The statistical clerk works under specific instructions, carrying out set procedures and adhering to established standards of accuracy. The trainee should have a preference for activities of a routine, concrete, organized nature.

Clerical perception is required to perceive pertinent detail in written and tabular material, to proofread words and numbers, and to avoid perceptual errors in arithmetic computation. Form perception is needed to make visual discriminations and comparisons in graphic material. Good visual acuity is required for working with figures, tables, graphs, and written reports.

Numerical aptitude is required to perform arithmetic operations quickly and accurately. Verbal ability is required to understand instructions and to present information clearly.

Since the statistical clerk may operate an adding machine or a calculating machine, motor coordination and finger and manual dexterity are needed.

For Occupational Course of Study

The occupational unit for this trainee is included under the General Office Education Units. Appropriate units for this trainee are listed below.

The local instructor may check the trainee's previously acquired abilities against the Standards of Achievement for the General Office Education Units in order to plan the curriculum for the trainee.

Appropriate General Office Education Units	Hours
Business Mathematics I	30
Business Mathematics II	30
Elements of Fiscal Recordkeeping	60
Payroll Records	30
Language Skills	30
Personal Development	30
Business Principles and Organization I	30
Business Principles and Organization II	30
Office Calculators	30
Introduction to Business Data Processing	60
Electro-Mechanical Accounting Machines	30
Elementary Descriptive Statistics	60

TAPE LIBRARIAN

Job Description — D. O. T. No. 1-20.04

Maintains library of reels of magnetic or punched paper tape used for automatic data processing purposes. Classifies and catalogs reels of tape in accordance with such factors as content of data and type of routine. Assigns code conforming with standardized system. Prepares records for file reference. Stores reels according to classification and catalog designation. Issues reels and maintains charge-out records. Inspects returned reels to determine if tape needs replacing due to wear or damage.

Prerequisites

For Occupation

The activities require performance according to specific procedures. Therefore, the tape librarian should have a preference for activities of a routine, concrete, organized nature.

The work is light, requiring frequent lifting and placing reels of tape (20 pounds reel weight lifted occasionally). Reaching and handling are required to store, issue, and wind reels.

Other requirements are verbal ability to deal with subject matter and clerical ability to perceive pertinent details involved in assigning catalog numbers and classifying reels of tape.

For Occupational Course of Study

As a prerequisite for entering the occupational course the trainee should have skills and knowledge equivalent to that gained from the General Office Education Units suggested as pertinent to this occupation.

The local instructor may check the trainee's previously acquired abilities against the Standards of Achievement for the General Office Education Units in order to plan the curriculum for the trainee.

Appropriate General Office Education Units	Hours
Language Skills	30
Business Communications	30
Personal Development	30
Business Principles and Organization I	30
Fundamentals of Typing	60
Production Typing	60
Introduction to Business Data Processing	60
Electro-Mechanical Accounting Machines	30

Specialized Occupation Unit which follows:	
Elementary Library Systems	60

ELEMENTARY LIBRARY SYSTEMS

Hours Required

Class: 1 hour daily, Laboratory: 1 hour daily Total: 60 hours

Description

This unit serves to acquaint trainees with procedures and methods used in maintaining a tape library. Elementary systems for identification and control of stored materials are detailed. Each class of library materials is discussed in terms of the factors which affect its receipt, storage, and issue. Emphasis is on developing skill in originating and maintaining basic tape library records.

Topic Outline

I. The Library in the Organization
II. Factors in Organizing Storage of Library Materials
III. Storing Tapes, Cards, and Materials
IV. Record Systems
V. Classification Systems
VI. The Program Library
VII. Simulation of Setting up a Library

TOPIC I. THE LIBRARY IN THE ORGANIZATION

A. Library services

B. The job of the librarian

C. Advances in library technology

D. Integrating the library with the total data processing system

E. Data processing materials

TOPIC II. FACTORS IN ORGANIZING STORAGE OF LIBRARY MATERIALS

A. Size and types of storage space—racks, cabinets, containers

B. Types of supplies needed—tapes, reels, etc.

C. Receipt, storage, and issue of materials

TOPIC III. STORING TAPES, CARDS, AND MATERIALS

A. Factors in handling magnetic tape
   1. Properties, size, data representation
   2. Temperature and humidity conditions
   3. Tape reconditioning
   4. Cycling tapes in the library
   5. Protective handling
   6. Packing and shipping
   7. Checking for damage
   8. Cleaning
   9. Testing

B. Punched paper tape

C. Cards

D. Other materials

E. Practice in handling stored materials

TOPIC IV. RECORD SYSTEMS

A. Purpose of and need for accurate record systems

B. Types of systems

C. Record formats

D. Records for file references

E. Records for issue and receipt

F. Scratch dates

G. Practice in library clerical activity

TOPIC V. CLASSIFICATION SYSTEMS

A. Purposes of classification

B. Classification systems

C. Process of classification
  1. By content of data
  2. By type of routine

D. Classification of varied types of materials
  1. Magnetic tapes
  2. Punched paper tape
  3. Punched cards
  4. Other materials

E. Labeling Magnetic tapes
  1. Label formats
  2. Types of information needed on labels
  3. External labels
  4. Internal labels

F. Practice in classifying and labeling

TOPIC VI. THE PROGRAM LIBRARY

A. Classification and control of materials
  1. Program card decks
  2. Program master tapes
  3. Utility programs
  4. Subroutines
  5. Control panels
  6. Printer carriage control tapes

TOPIC VII. SIMULATION OF SETTING UP A LIBRARY

(Practice on all library activities)

Texts and Other Teaching Materials

From the following suggested texts and materials (or other equivalent commercially available material), select trainee and teacher materials for use in this unit. Additional references are listed in Appendix B.

Gotlieb, C. C. and Hume, J. N. P. High-Speed Data Processing. New York: McGraw-Hill Book Co., Inc., 1958.

McCracken, Daniel D. Digital Computer Programming. New York: John Wiley and Sons, Inc., 1957.

Nathan, Robert and Hanes, Elizabeth. Computer Programming Handbook. Englewood Cliffs, N. J.: Prentice-Hall, Inc., 1962.

Randall, C. B.; Weimer, S. W.; and Greenfield, M. S. Systems and Procedures for Automated Accounting. Cincinnati, Ohio: South-Western Publishing Co., 1962.

In addition, references, equipment manuals, and instructional aids are available from local representatives of most data processing equipment manufacturers. The following examples are appropriate for use with this unit.

IBM Form Number	Title
F20-6088	Planning for an IBM System
F22-6517	Introduction to IBM System
520-1715	Care and Handling of Magnetic Tape
520-1598	Testing and Care of IBM Cards

Burroughs Corp.

Form Number	System	Title or Description
200-21005-D	B 200	Magnetic Tape Sort Generator I—Preliminary Information
703-20001-D	P 703	Amount and Account Number Encoder—Brochure
20008-D		Survey of Modern Programming Techniques—Reprint
200-21003-D	B 200	A Brief Description of Report Generator I

KEY-PUNCH OPERATOR

Job Description

D. O. T. No. 1-25.62

Records accounting and statistical data on tabulating cards by punching a series of holes in the cards in a specified sequence, using a punch machine similar in operation and action to a typewriter. Places card on base of machine by hand or automatically by pressing a lever, and positions carriage for perforating operation. Following written information on records, punches corresponding numbers or symbols on the machine keyboard, thereby transcribing the written information into perforations on the tabulating cards. May operate a tabulating machine, a sorting machine, or a verifying machine.

Prerequisites

For Occupation

The worker must adhere to established standards of accuracy when recording data. Good visual acuity is required to type data rapidly and continuously.

Clerical perception is required to detect errors in recorded data. Recording of data on cards for machine tabulation requires an adjustment to a routine, concrete, organized type of activity.

For Occupational Course of Study

As a prerequisite for entering the occupational course the trainee should have skills and knowledge equivalent to that gained from the General Office Education Units suggested as pertinent to this occupation.

In order to learn key-punch operation, the trainee must have a typing speed of approximately 40 wpm at the time of entry into the specialized course. Reaching, handling, motor coordination, and finger and manual dexterity are involved in operating the keyboard and inserting material into and removing material from the machine.

The local instructor may check the trainee's previously acquired abilities against the Standards of Achievement for the General Office Education Units in order to plan the curriculum for the trainee.

Appropriate General Office Education Units	Hours
Language Skills	30
Business Communications	30
Personal Development	30
Business Principles and Organization I	30
Business Principles and Organization II	30
Fundamentals of Typing	60
Production Typing	60
Office Calculators	30
Introduction to Business Data Processing	60
Electro-Mechanical Accounting Machines	30
Specialized Occupation Unit which follows:	
Key-Punch Equipment Operation	60

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KEY-PUNCH EQUIPMENT OPERATION

Hours Required

Class: 2 hours daily, Laboratory: 4 hours daily — Total: 60 hours

Description

This unit is designed to familiarize trainees with the function and operation of key-punch and verifying machines. Emphasis on practice exercises is required to develop speed and accuracy in standard operating procedures to meet employable proficiency standards.

Topic Outline

I. The Unit Record
II. Basic Key-Punch Machine Features and Functions
III. Operating Procedure Practice
IV. Additional Features of the Key-Punch Machine
V. Operating Procedure Practice—Entire Keyboard
VI. Program Control Unit
VII. Program Card and Programming
VIII. Program Control Exercises
IX. Verifying Procedures and Practice

TOPIC I. THE UNIT RECORD

A. Source document
B. Card format
C. Card code
D. Card field
E. Control punches

TOPIC II. BASIC KEY-PUNCH MACHINE FEATURES AND FUNCTIONS

A. Main line switch
B. Hopper
C. Stacker
D. Punching Stations
E. Keyboards
   1. Numeric
   2. Combination (Numeric-alphabetic)
F. Feeding mechanism
G. Reading station
H. Backspace key
I. Column indicator
J. Pressure roll release lever
K. Program unit

TOPIC III. OPERATING PROCEDURE PRACTICE

A. Practice keyboard exercises
B. Simple feeding operations

TOPIC IV. ADDITIONAL FEATURES OF THE KEY-PUNCH MACHINE

A. Auxiliary duplication device
B. Self-checking numbers device
C. Alternate programming
D. Card insertion device
E. Interspersed master card gang punching
F. Card correction feature

TOPIC V. OPERATING PROCEDURE PRACTICE—ENTIRE KEYBOARD

Practice exercises using all key-punch features

TOPIC VI. PROGRAM CONTROL UNIT

A. Function of the program unit

B. Program card codes

TOPIC VII. PROGRAM CARD AND PROGRAMMING

A. Field definition

B. Numeric or alphabetic shift

C. Automatic shift

D. Automatic skipping

E. Duplication

F. Zero print

G. Print suppression

TOPIC VIII. PROGRAM CONTROL EXERCISES

Practice exercises using all program control elements

TOPIC IX. VERIFYING PROCEDURES AND PRACTICE

A. The need for verifying

B. Visual verification procedures—listing, printing, proofreading

C. Visual verification practice

D. Verifier features and functions
   1. Verifying station
   2. Keyboard
   3. Error light
   4. Operating procedures

E. Practice in verifier use

Texts and Other Teaching Materials

From the following suggested texts and materials (or other equivalent commercially available materials), select trainee and teacher materials for use in this unit. Additional references are listed in Appendix B.

McGill, Donald A. C. Punched Cards—Data Processing for Profit Improvement. New York: McGraw-Hill Book Co., Inc., 1962.

Van Ness, Robert G. Principles of Punched Card Data Processing. Elmhurst, Ill.: The Business Press, 1963.

TABULATING MACHINE OPERATOR

Job Description D. O. T. No. 1-25.64

Operates a machine that automatically analyzes, makes calculations, and translates or divides information represented by holes punched in groups of tabulating cards, and prints the translated data on form sheets, reports, special cards, or accounting records. Sets or adjusts machine to add, subtract, multiply, and make other calculations. Places cards to be tabulated in feed magazine and starts machine. May file cards after they are tabulated. May sort punched cards, punch information on cards, or verify punched cards.

Prerequisites

For Occupation

The tabulating machine operator trainee should show a preference for working with machines, processes, and techniques, and for activities that are routine and concrete. Motor coordination and finger and manual dexterity are required to wire control panels and operate machines, and use the typewriter.

Other requirements are good vision and clerical perception for error detection in printing and format, and form perception for operating the machine and following wiring diagram details. Some mechanical ability is advantageous.

For Occupational Course of Study

As a prerequisite for entering the occupational course the trainee should have skills and knowledge equivalent to that gained from the General Office Education Units suggested as pertinent to this occupation.

The local instructor may check the trainee's previously acquired abilities against the Standards of Achievement for the General Office Education Units in order to plan the curriculum for the trainee.

Appropriate General Office Education Units	Hours
Business Mathematics I	30
Business Mathematics II	30
Elements of Fiscal Recordkeeping	60
Payroll Records	30
Language Skills	30
Personal Development	30
Business Principles and Organization I	30
Business Principles and Organization II	30
Office Calculators	30
Introduction to Business Data Processing	60
Electro-Mechanical Accounting Machines	30

Specialized Occupation Units which follow:

Tabulating Machine Operation	45
Tabulating Machine Wiring	45

TABULATING MACHINE OPERATION

Hours Required

Class: 1 hour daily, Laboratory: 2 hours daily Total: 45 hours

Description

This unit is designed to acquaint trainees with the functions and features of tabulating machines. Extensive practice in operating procedures is required to assure development of proficiency. Since features vary in different models, it is essential that the instructor concentrate on those features common to most tabulating equipment and show or relate some of the differences which are found.

Topic Outline

I. Functions
II. Operating Features
III. Tape-Controlled Carriage
IV. Form control
V. Operating Procedure Practice

TOPIC I. FUNCTIONS

A. Detail printing (listing)
B. Group printing
C. Addition and subtraction
D. Accumulating
E. Program control
F. Summary punching

TOPIC II. OPERATING FEATURES

A. Control panel
B. Signal lights
C. Hopper
D. Stacker
E. Print unit
F. Reading stations
G. Operating keys and switches
H. Hammerlock levers
I. Hammersplit levers

TOPIC III. TAPE CONTROLLED CARRIAGE

A. Carriage controls
B. Control tape
C. Form thickness adjustment
D. Form stops
E. Pressure release lever
F. Platen shift wheel

TOPIC IV. FORM CONTROL

A. Carriage skips
B. Head control
C. Form to form skipping
D. Overflow skipping
E. Program skipping

TOPIC V. OPERATING PROCEDURE PRACTICE

A. Card handling
B. Operating the machine
C. Operating the carriage
D. Exercises in all machine functions (detail printing, etc.)

Texts and Other Teaching Materials

From the following suggested text and material (or other equivalent commercially available material), select trainee and teacher materials for use in this unit. Additional references are listed in Appendix B.

Wanous, S. J. and Wanous, E. W. Automation Office Practice. Cincinnati, Ohio: South-Western Publishing Co., 1964.
Teachers' Manual. Office Practice set.

TABULATING MACHINE WIRING

Hours Required

Class: 1 hour daily, Laboratory: 2 hours daily Total: 45 hours

Description

This unit serves to acquaint trainees with control panel wiring principles and procedures. Practice in wiring and in wiring control board replacement for the various applications is essential for the development of proficiency.

Topic Outline

I. Principles of Control Panel Wiring
II. Wiring Fundamentals
III. Wiring Practice

TOPIC I. PRINCIPLES OF CONTROL PANEL WIRING

A. Function of control panel

B. Applications

C. Report formats

TOPIC II. WIRING FUNDAMENTALS

A. Printing
  1. Normal printing
  2. Transfer printing
  3. Character emitting
  4. Zero printing

B. Selection
  1. Pilot selector
  2. Co-selector

C. Program control

D. Addition

E. Subtraction

F. Storage units

G. Summary punching

TOPIC III. WIRING PRACTICE

Texts and Other Teaching Materials

From the following suggested texts and materials (or other equivalent commercially available material), select trainee and teacher materials for use in this unit. Additional references are listed in Appendix B.

Data Processing Wiring Guide. Detroit Mich.: American Data Processing, Inc., 1962.
Solmon, Lawrence J. IBM Machine Operation and Wiring. Belmont, Calif.: Wadsworth Publishing Co., 1962.

A sufficient number of wiring panels should be provided so that certain phases of this course can be taught using the battery plan of instruction.

CONSOLE OPERATOR

Job Description D. O. T. No. 1-25.17

Monitors and controls an electronic computer that automatically processes data to solve mathematical, engineering, or technical problems or to maintain business records, by operating a central control unit known as a console. Studies program instruction sheet to determine equipment set-up and operating instructions. Mounts reels of tape in designated magnetic tape units which extract input data or record output data. Switches auxiliary equipment, such as automatic typewriter and peripheral machines into circuit, to close loop and effect feedback of data. Manipulates up to 100 or more control switches on console panel to start and operate electronic computer that reads and processes data. Observes continuously as many as 200 lights on control panel and magnetic tape units and action of automatic typewriter to monitor system and determines point of equipment failure. Tears printed sheets from typewriter at designated points to be used for verification. Reports machine malfunctioning to supervisor. Manipulates controls in accordance with standard procedures to rearrange sequence of program steps in order to correct computational errors or to continue operations when individual units of system malfunction. Confers with technical personnel in event errors require change of instructions or sequence of operations. Rewinds and removes tape at completion of processing. Maintains operating records, such as machine performance and production reports.

Prerequisites

For Occupation

Work activities require an adjustment to situations that are scientific and technical in nature, as well as to situations that are related to machines, processes, and techniques, and involve business contact with others. Work is routine, concrete, and organized when following program instructions.

The console operator is required to make proper decisions under emergency conditions resulting from error situations. In such instances the worker is faced with alternatives of repeating runs or salvaging all or part of faulty runs. The worker's actions affect decisions as to costly down-time for maintenance. The console operator also makes decisions in terms of factual data contained in program instructions and on a judgmental basis when altering program instructions in emergency situations. Dealing with people in conference situations is sometimes involved in the work of the console operator.

Clerical perception is needed to recognize pertinent details in program instructions, and to maintain accurate records of machine performance and production.

Motor coordination, finger dexterity, and manual dexterity are needed to learn to mount reels of tape on spindles of magnetic tape units and manipulate switches controlling auxiliary equipment.

Reaching and handling are involved in positioning reels. The work requires unrestricted use of hands and fingers to set any of 100 or more 2- to 5-position switches on the control panel or to manipulate appropriate output selector buttons and switches.

Talking and hearing are involved in exchanging information continuously concerning equipment characteristics and requirements.

Color vision is involved in monitoring as many as 200 indicator lights which show normal machine functioning or error situations.

The work is considered light, requiring frequent lifting of reels of instruction or data tape (maximum reel of 20 pounds lifted occasionally) onto appropriate magnetic tape units.

For Occupational Course of Study

Certain aptitudes are required for successful training. Verbal ability is needed to comprehend the meaning of programming instructions and machine logic as applied to a specific technical or business problem, and to learn to present clearly suggestions and ideas to programmers and other technical personnel which may affect their decisions concerning techniques for solving a problem.

As a prerequisite for entering the occupational course the trainee should have skills and knowledge equivalent to that gained from the General Office Education Units suggested as pertinent to this occupation.

The local instructor may check the trainee's previously acquired abilities against the Standards of Achievement for the General Office Education Units in order to plan the curriculum for the trainee.

Appropriate General Office Education Units	Hours
Business Mathematics I	30
Business Mathematics II	30
Elements of Fiscal Recordkeeping	60
Language Skills	30
Business Communications	30
Personal Development	30
Business Principles and Organization I	30
Business Principles and Organization II	30
Introduction to Business Data Processing	60
Electro-Mechanical Accounting Machines	30
Introduction to Computers	30
Specialized Occupation Unit which follows:	
Control Console Operation	60

CONTROL CONSOLE OPERATION

Hours Required

Class: 3 hours daily, Laboratory: 3 hours daily Total: 60 hours

Description

The purpose of this unit is to train the individual in the fundamentals of console operation. Lecture on the basic aspects of operation will be supplemented by laboratory sessions familiarizing the individual with specific equipment. Machine practice will provide actual experience in set-up procedures, manipulation and use of console control, control of peripheral devices, and use of operating aids.

Topic Outline

I. The Control Console in the System
II. Description and Use of the Control Console Features
III. Program Initiation and Operation
IV. Programming and Coding
V. Operating Aids and Procedures
VI. Control Console Practice

TOPIC I. THE CONTROL CONSOLE IN THE SYSTEM

TOPIC II. DESCRIPTION AND USE OF THE CONTROL CONSOLE FEATURES

Since equipment and training will vary at each training location, the description of the specific console is left to the discretion of the teacher. He should cover the location and function of:

A. Lights, switches, and keys
  1. Power source
  2. Power control lights and switches
  3. Emergency lights and switches
  4. Start keys
  5. Alarm control lights and keys
  6. Peripheral equipment control lights and keys
  7. Logic display

B. Register control lights and keys
  1. Register, select, and reset control
  2. Register display lights
  3. Register entry keys
  4. Instruction set-up and execution procedures

C. Memory accessing lights and keys
  1. Memory display lights
  2. Memory entry keys
  3. Procedures for writing to and reading from memory

D. Console typewriter operation

E. Special features

TOPIC III. PROGRAM INITIATION AND OPERATION

A. Program library organization

B. Loading programs from magnetic tape, punch cards, paper tape, or random access devices

C. Automatic program loading routines

D. Error stop procedures

E. Restart procedures

TOPIC IV. PROGRAMMING AND CODING

A. Steps in program preparation

B. Programming fundamentals
   1. Number systems
   2. Word format
   3. Computer address systems
   4. Instruction formats
   5. Flow charting

C. Coding fundamentals
   1. Classification codes
   2. Machine language and communication codes
   3. Coding sheet forms

TOPIC V. OPERATING AIDS AND PROCEDURES

A. Program testing
   1. Error stop information
   2. Debugging aids

B. Operation run books
   1. Organization
   2. Contents
   3. Operating procedures

C. Other operation records
   1. Machine logs
   2. External reel labels
   3. Schedules

D. Utility and assembly programs

E. Executive routing concept

F. Data library organization

G. Housekeeping procedures
   1. Documentation
   2. Tape handling and tape library procedures
   3. Storage of card decks, tapes, and other materials
   4. Neatness and organization

H. Procedures for reporting machine malfunctioning

TOPIC VI. CONTROL CONSOLE PRACTICE

Console practice, or laboratory sessions, which account for 50 percent of the course hours should be closely integrated with the lecture material. When local conditions permit, the first 3 hours of each day should be devoted to lecture and the last 3 hours to console practice. Console exercise should be designed to provide practice related to the preceding lecture material. Console practice should include the following areas:

A. Manipulation of all keys, switches, and lights

B. Data entry to memory

C. Data retrieval from memory

D. Register setting

E. Register display

F. Program loading

G. Running of assembly and utility routines

H. Program running

I. Error correction

J. Use of run books, operating procedures and data library facilities

K. Operation of related peripheral equipment (Magnetic tapes, card and paper-tape printer, console typewriter, on-line printer)

Later practice sessions should build on the knowledge of basic procedures to develop sound judgment in new situations, ability to distinguish machine malfunction from data or program errors, knowledge of restart procedures, and practice in interpreting operating manuals independently to obtain information on procedures.

Texts and Other Teaching Materials

A variety of useful reference manuals and teaching materials can be obtained from local representatives of data processing equipment manufacturers.

RCA 301 Console Operator's Manual and RCA 501 Console Operator's Manual are available at all RCA EDP Branch Sales Offices.

A catalog on console operation texts is available for consultation at any IBM office, although they cannot be distributed generally.

SUPERVISOR, CLERICAL

Job Description **D. O. T. No.***

Supervises a group of workers engaged chiefly in one general type of clerical function, as bookkeeping, typing, and filing: Determines procedures of work. Issues written and verbal orders or instructions. Assigns duties to workers and checks their work for exactness and neatness. Makes up composite reports based on individual reports of subordinates. Maintains harmony among workers. Adjusts errors and complaints. May perform essentially the same duties as the other workers, as a regularly assigned duty, or assist subordinates in performing only the more difficult and complicated duties. May keep time reports and other personnel records of quantity and quality of work performed, and may employ, train, and discharge workers. Must be proficient in the particular type of clerical work in which he functions. Designated according to the group of workers he supervises, as chief cashier; filing supervisor; head bookkeeper.

Prerequisites

For Occupation

The work of the clerical supervisor involves an ability to reason and make judgments. The work situation involves directing, controlling, and planning an entire activity, and directing the activities of others.

Verbal ability is needed to understand and present information or ideas clearly.

Clerical perception is required to perceive pertinent detail in verbal or tabular material—to observe differences in copy, to proofread words and numbers, and to avoid perceptual errors in arithmetic computation.

For Occupational Course of Study

The occupational units for this trainee are included under the General Office Education Units. Appropriate units for this trainee are listed below.

The local instructor may check the trainee's previously acquired abilities against the Standards of Achievement for the General Office Education Units in order to plan the curriculum for the trainee.

Appropriate General Office Education Units	Hours
Business Mathematics I	30
Business Mathematics II	30
Elements of Fiscal Recordkeeping	60
Payroll Records	30
Personal Development	30
Business Communications	30
Business Principles and Organization I	30
Business Principles and Organization II	30

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*Classifications are made and code numbers are assigned according to the type of work supervised.

Appropriate General Office Education Units (cont'd)	Hours
Fundamentals of Typing	60
Production Typing	60
Office Calculators	10
Introduction to Business Data Processing	60
Electro-Mechanical Accounting Machines	30
Elementary Descriptive Statistics	30
Principles of Supervision	30
Psychology for Supervisors	30
Classification and Coding	20
Introduction to Computers	30

SUPERVISOR, MACHINE-RECORDS UNIT

Job Description

D. O. T. No. 1-25.67

Supervises workers engaged in keeping records and tabulating reports, using punch cards and special office machines: Sets up machines for new operations. Directs care and cleaning of machines, sometimes making mechanical adjustments and minor repairs in an emergency. Performs other duties as described under Supervisor. May assist administrative officials in planning new accounting methods and designing cards and forms for new clerical processes. May be designated according to trade name of machines used in office, as IBM supervisor.

Prerequisites

For Occupation

The work of the machine-records unit supervisor involves an ability to reason and make judgments. The work situation involves directing, controlling, and planning an entire activity, and directing the activities of others. Ability to deal with people is important.

Verbal ability is required to understand instructions and to present information clearly. Numerical aptitude is required to perform arithmetic operations quickly and accurately. Good visual acuity is required for working with numbers and written material.

Clerical perception is required to perceive pertinent detail in verbal or tabular material—to observe differences in copy, to proofread words and numbers, and to avoid perceptual errors in arithmetic computation.

Mechanical aptitude is advantageous. Comprehension of data processing systems in detail is a vital need in making procedural explanations to subordinates on the job.

For Occupational Course of Study

As a prerequisite for entering the occupational course the trainee should have skills and knowledge equivalent to that gained from the General Office Education Units suggested as pertinent for this occupation.

The local instructor may check the trainee's previously acquired abilities against the Standards of Achievement for the General Office Education Units in order to plan the curriculum for the trainee.

Appropriate General Office Education Units	Hours
Business Mathematics I	30
Business Mathematics II	30
Elements of Fiscal Recordkeeping	60
Business Communications	30
Personal Development	30
Business Principles and Organization I	30
Business Principles and Organization II	30
Office Calculators	10
Introduction to Business Data Processing	60
Electro-Mechanical Accounting Machines	30
Elementary Descriptive Statistics	30

Appropriate General Office Education Units (cont'd)	Hours
Principles of Supervision	30
Psychology for Supervisors	30
Classification and Coding	20
Introduction to Computers	30
Specialized Occupation Units which follow:	
Data Processing Mathematics	30
Introduction to Programming	30
Data Processing Systems	90

DATA PROCESSING MATHEMATICS

Hours Required

Class: 1 hour, 3 days/week, Laboratory: 1 hour, 2 days/week Total: 30 hours

Description

This unit provides trainees with a practical foundation in numerical concepts needed for understanding accounting and machine processes as related supervision of machine-records units. Desk calculators may be used. A background in basic mathematics is necessary for starting this course.

Topic Outline

I. Notation
II. Number Systems
III. Number Systems with an Arbitrary Base
IV. Basic Algebra
V. Linear Equations
VI. Fixed and Floating Point Numbers
VII. Elements of Boolean Algebra
VIII. Methods of Numerical Computation
IX. Use of the Computer for Numerical Computation

TOPIC I. NOTATION

A. Concepts of notation
B. Arithmetic progression and series
C. Subscripts
D. Functional notations
E. Exponents
F. Infinite sum
G. Factorials

TOPIC II. NUMBER SYSTEMS

A. Concepts of number systems
B. Base 10 number systems
C. Rational numbers
D. Irrational numbers
E. Powers and roots
F. Logarithms
G. Properties of fractions

TOPIC III. NUMBER SYSTEMS WITH AN ARBITRARY BASE

A. Binary
B. Octal
C. Conversion

TOPIC IV. BASIC ALGEBRA

A. Algebraic expressions
B. Algebraic fractions
C. Factoring
D. Polynomials

TOPIC V. LINEAR EQUATIONS

A. Equations with one unknown
B. Equations with more than one unknown
C. Determinants

TOPIC VI. FIXED AND FLOATING POINT NUMBERS

- A. Fixed point
  - 1. Scaling
  - 2. Advantages
- B. Floating point
  - 1. Mantissa
  - 2. Exponent
  - 3. Advantages

TOPIC VII. ELEMENTS OF BOOLEAN ALGEBRA (Briefly, as needed)

- A. Connectives
- B. Truth tables
- C. Machine implementation of arithmetic operations
- D. Simplification of Boolean algebraic expressions

TOPIC VIII. METHODS OF NUMERICAL COMPUTATION

- A. Computation with powers of 10
- B. Computation with logarithms
- C. Number systems with bases other than 10

TOPIC IX. USE OF THE COMPUTER FOR NUMERICAL COMPUTATION

Texts and Other Teaching Materials

From the following suggested texts and materials (or other equivalent commercially available material), select trainee and teacher materials for use in this unit. Additional references are listed in Appendix B.

Adler, Irving. Thinking Machines: A Layman's Introduction to Logic, Boolean Algebra, and Computers. New York: John Day Co., 1961.

Apostle, H. G. A Survey of Basic Mathematics. Boston: Little, Brown, and Co., 1960.

Ayres, W. L.; Fry, Cleota G.; and Jonah, H. F. S. General College Mathematics. 2d ed. New York: McGraw-Hill Book Co., Inc., 1960.

Crowder, Norman A. The Arithmetic of Computers. Garden City, N. Y.: Doubleday and Co., 1960.

Helton, Floyd F. Introducing Mathematics. 2d ed. New York: John Wiley and Sons, Inc., 1958.

Hohn, Franz E. Applied Boolean Algebra, An Elementary Introduction. New York: The Macmillan Co., 1960.

Moore, J. T. Fundamental Principles of Mathematics. New York: Holt, Rinehart, and Winston, Inc., 1960.

Oakford, Robert V. Introduction to Electronic Data Processing Equipment. New York: McGraw-Hill Book Co., Inc., 1962.

Richards, R. K. Arithmetic Operations in Digital Computers. New York: D. Van Nostrand Co., Inc., 1955.

Richardson, M. Fundamentals of Mathematics. New York: The Macmillan Co., 1958.

Siegel, Paul. Understanding Digital Computers. New York: John Wiley and Sons, Inc., 1961.

Stibitz, George R. and Larrivee, Jules A. Mathematics and Computers. New York: McGraw-Hill Book Co., 1957.

Titchmarsh, E. C. Mathematics for the General Reader. Garden City, N. Y.: Doubleday Publishing Co., 1959.

Wade, Thomas L. and Taylor, Howard E. Fundamental Mathematics. 2d ed. New York: McGraw-Hill Book Co., Inc., 1961.

Young, Frederick H. Digital Computers and Related Mathematics. Boston: Ginn and Co., 1961.

INTRODUCTION TO PROGRAMMING

Hours Required

Class: 1 hour daily, Laboratory: 1 hour daily Total: 30 hours

Description

This unit is designed to provide help in understanding the fundamentals of programming for the person who is involved in supervising the day-to-day application of business data processing problems using computers. While stressing fundamentals, the unit also introduces some higher level concepts with which trainees should be acquainted.

Topic Outline

I. Review of Computer Fundamentals
II. Programming Fundamentals
III. Coding Fundamentals
IV. Steps in Program Preparation
V. Instructions to the Machine
VI. Introduction to Symbolic Programming
VII. Subroutines
VIII. Some Programming Systems
IX. Program Testing and Modification
X. Integrating Programming Fundamentals with Accounting Methods

TOPIC I. REVIEW OF COMPUTER FUNDAMENTALS

A. Computer characteristics

B. Components and functions

C. Applications

TOPIC II. PROGRAMMING FUNDAMENTALS

A. Number systems
  1. Decimal, binary, octal
  2. Arithmetic
  3. Conversion

B. Word format
  1. Data words
  2. Instruction words
  3. Fixed and variable word lengths

C. Computer address systems

D. Flow charting

E. Looping and address modification

TOPIC III. CODING FUNDAMENTALS

A. Classification codes
  1. Alphabetic
  2. Numeric
  3. Alpha-numeric
  4. Mnemonic

B. Machine Language and communication codes
  1. Punched tape (5, 6, 7, 8 channel codes)
  2. Punched card (80 col, 90 col.)
  3. Magnetic tape (5, 6, 7, 8 channel codes)
  4. Character recognition

C. Coding sheet forms

TOPIC IV. STEPS IN PROGRAM PREPARATION

A. Definition and analysis

B. Elements of program design

- C. Coding
- D. Running
- E. Error correction

TOPIC V. INSTRUCTIONS TO THE MACHINE

- A. Instruction formats
- B. Input-output
- C. Arithmetic
- D. Logic control
- E. Error indicators
- F. Rearrangement of data

TOPIC VI. INTRODUCTION TO SYMBOLIC PROGRAMMING

- A. Use of symbolic labels
- B. Operation statements
- C. Address arithmetic
- D. Assembly operation

TOPIC VII. SUBROUTINES

- A. The use of subroutines
- B. Library concept
- C. Open subroutine
- D. Closed subroutine

TOPIC VIII. SOME PROGRAMMING SYSTEMS

- A. Macro-instructional
- B. Assembling and compiling systems
- C. Utility
- D. High-level language

TOPIC IX. PROGRAM TESTING AND MODIFICATION

- A. The test deck
- B. Test results and duplication of errors
- C. Kinds of errors
- D. Error correction

TOPIC X. INTEGRATING PROGRAMMING FUNDAMENTALS WITH ACCOUNTING METHODS

Practice case studies

Texts and Other Teaching Materials

From the following suggested texts and materials (or other equivalent commercially available material), select trainee and teacher materials for use in this unit. Additional references are listed in Appendix B.

Chapin, Ned. Programming Computers for Business Applications. New York: McGraw-Hill Book Co., Inc., 1961.

Evans, G. W. and Perry, C. L. Programming and Coding for Automatic Digital Computers. New York: McGraw-Hill Book Co., Inc., 1961.

Fahnestock, James D. Computers and How They Work. New York: Ziff-Davis Publishing Co., 1960.

Galler, Bernard A. The Language of Computers. New York: McGraw-Hill Book Co., Inc., 1962.

Gotlieb, C. C. and Hume, J. N. P. High-speed Data Processing. New York: McGraw-Hill Book Co., Inc., 1958.

Gregory, Robert H. and Van Horn, Richard L. Automatic Data-Processing Systems. 2d ed. Belmont, Calif.: Wadsworth Publishing Co., 1963.

Hein, Leonard W. An Introduction to Electronic Data Processing for Business. Princeton, N. J.: D. Van Nostrand Co., 1961.

Irwin, Wayne C. Digital Computer Principles. Princeton, N. J.: D. Van Nostrand Co., 1961.

Jeenel, Joachim. Programming for Digital Computers. New York: McGraw-Hill Book Co., Inc., 1959.

Laurie, Edward J. Computers and How They Work. Cincinnati, Ohio: South-Western Publishing Co., 1963.

Ledley, Robert S. Programming and Utilizing Digital Computers. New York: McGraw-Hill Book Co., Inc., 1962.

Leeds, Herbert D. and Weinberg, Gerald M. Computer Programming Fundamentals. New York: McGraw-Hill Book Co., Inc., 1961.

Livesley, R. K. An Introduction to Automatic Digital Computers. New York: Cambridge University Press, 1962

McCormick, E. M. Digital Computer Primer. New York: McGraw-Hill Book Co., Inc., 1959.

McCracken, D. D.; Weiss, H.; and Lee, T. Programming Business Computers. New York: John Wiley and Sons, Inc., 1959.

Murphy, John S. Basics of Digital Computers. New York: John F. Rider Publisher, Inc., 1958.

Nathan, Robert and Hanes, Elizabeth. Computer Programming Handbook. Englewood Cliffs, N. J.: Prentice-Hall, Inc., 1962.

Nelson, Oscar S. and Woods, Richard S. Accounting Systems and Data Processing. Cincinnati, Ohio: South-Western Publishing Co., 1961.

Oakford, Robert V. Introduction to Electronic Data Processing Equipment. New York: McGraw-Hill Book Co., Inc., 1962.

Postley, John A. Computers and People. New York: McGraw-Hill Book Co., Inc., 1960.

Richards, R. K. Arithmetic Operations in Digital Computers. New York: D. Van Nostrand Co., Inc., 1955.

________, Digital Computer Components and Circuits. Princeton, N. J.: D. Van Nostrand Co., 1957.

Sherman, Philip M. Programming and Coding Digital Computers. New York: John Wiley and Sons, Inc., 1963.

Siegel, Paul. Understanding Digital Computers. New York: John Wiley and Sons, Inc., 1961.

Stibitz, George R. and Larrivee, Jules A. Mathematics and Computers. New York: McGraw-Hill Book Co., 1956.

Williams, Samuel B. Digital Computing Systems. New York: McGraw-Hill Book Co., Inc., 1959.

DATA PROCESSING SYSTEMS

Hours Required

Class: 1 hour daily, Laboratory: 2 hours daily Total: 90 hours

Description

This unit is designed to provide the supervisory trainee with an understanding of concepts and procedures in business data processing systems. Applications for basic business accounting operations should be given in detail, and case studies used to illustrate the different applications.

Topic Outline

I. Brief Review of Data Processing
II. Systems Concepts in Business
III. Charts, Forms, and Records
IV. Accounts Receivable Applications
V. Accounts Payable Applications
VI. Payroll Applications
VII. Inventory Control Applications

TOPIC I. BRIEF REVIEW OF DATA PROCESSING

A. Importance and use of data

B. Evolution and growth of data processing

C. Specific applications of business data processing

D. Basic data processing cycle

TOPIC II. SYSTEMS CONCEPTS IN BUSINESS

A. The systems approach

B. Types of systems

C. Parts of a system

D. The business as a system

E. Systems survey, design, and implementation

TOPIC III. CHARTS, FORMS, AND RECORDS

A. Types of systems charts
  1. Organization charts
  2. Work and schedule charts
  3. Statistical tables and graphical charts

B. Flow charts
  1. Types
  2. Applications

C. Record and report layouts

D. Specifications for magnetic encoded checks

E. Forms design requirements
  1. Elements of a form
  2. Forms numbering and classification systems
  3. Steps in forms design
  4. Specification writing

TOPIC IV. ACCOUNTS RECEIVABLE APPLICATIONS

A. Objectives and importance of accounts receivable

B. Making entries—effects on general ledger, journal, and sales records

C. Controls

D. Handling methods
   1. Open item
   2. Balance forward

E. Applications for electromechanical data processing machines
   1. Open item
   2. Balance forward

F. Applications for computing machines
   1. Open item
   2. Balance forward

G. Case studies

TOPIC V. ACCOUNTS PAYABLE APPLICATIONS

A. Objectives and importance of accounts payable

B. Functions of accounts payable department

C. Effect on general ledger and journal

D. Establishing liability accounts
   1. Purchases requisition
   2. Purchasing department functions
   3. Purchase order preparation

E. Validating liability accounts
   1. Internal expenses
   2. Outside charges
   3. Receiving reports
   4. Debit memos

F. Posting liabilities
   1. Ledgers and journals
   2. Discounts

G. Writing checks

H. Applying distributions
   1. Allocating expenses
   2. Analyzing records

I. Accounting controls

J. Applications for electromechanical data processing machines

K. Applications for computing machines

L. Case studies

TOPIC VI. PAYROLL APPLICATIONS

A. Objectives and importance of payroll applications

B. Organization for payroll control

C. Effects on balance sheets and income statements

D. Payroll source data
   1. Attendance documents
   2. Production documents
   3. Deduction documents
   4. Computative data
   5. Classification data
   6. Identification data

E. Controls

F. Types of payroll
   1. Hourly
   2. Salary
   3. Incentive

G. Payroll calculation (practice exercises)

H. Overtime

I. Tax and deduction computation

J. Payroll register

K. Checks and earnings statements

L. Tax reports

M. Payroll cost analysis and distribution

N. Procedure study requirements

O. Applications for electromechanical data processing machines

P. Applications for computing machines

Q. Case studies

TOPIC VII. INVENTORY CONTROL APPLICATIONS

A. Objectives and importance of inventory control

B. Organization for inventory control
   1. Establishing controls
   2. Procedural approaches

C. Applications for electromechanical data processing machines

D. Applications for computing machines

E. Case Studies

Texts and Other Teaching Materials

From the following suggested texts and materials (or other equivalent commercially available material), select trainee and teacher materials for use in this unit. Additional references are listed in Appendix B.

Bell, W. D. A Management Guide to Electronic Computers. New York: McGraw-Hill Book Co., Inc., 1957.

Canning, Richard G. Electronic Data Processing for Business and Industry. New York: John Wiley and Sons, Inc., 1956.

_______, Installing Electronic Data Processing Systems. New York: John Wiley and Sons, Inc., 1956.

Chapin, Ned. An Introduction to Automatic Computers. Princeton, N. J.: D. Van Nostrand Co., 1957.

_______, Programming Computers for Business Applications. New York: McGraw-Hill Book Co., Inc., 1961.

Churchman, C. W.; Ackoff, R. L.; and Arnoff, E. L. Introduction to Operations Research. New York: John Wiley and Sons, Inc., 1957.

Gregory, Robert H. and Van Horn, Richard L. Automatic Data-Processing Systems. Belmont, Calif.: Wadsworth Publishing Co., 1960.

Hein, Leonard W. An Introduction to Electronic Data Processing for Business. Princeton, N. J.: D. Van Nostrand Co., 1961.

Irwin, Wayne C. Digital Computer Principles. Princeton, N. J.: D. Van Nostrand Co., 1961.

Johnson, Eldred A. Accounting Systems in Modern Business. New York: McGraw-Hill Book Co., Inc., 1959.

Kometsky, G. and Kirchner, P. Electronic Computers and Management Control. New York: McGraw-Hill Book Co., Inc., 1956.

Laden, H. N. and Gildersleeve, J. R. System Design for Computer Applications. New York: John Wiley and Sons, Inc., 1963.

Laurie, Edward J. Computers and How They Work. Cincinnati, Ohio: South-Western Publishing Co., 1963.

Levin, Howard S. Office Work and Automation. New York: John Wiley and Sons, Inc., 1956.

Martin, E. Wainright. Electronic Data Processing. Homewood, Ill. Richard D. Irwin, Inc., 1961.

McCracken, D. D.; Weiss, H.; and Lee, T. Programming Business Computers. New York: John Wiley and Sons, Inc., 1959.

McGill, Donald A. C. Punched Cards Data Processing for Profit Improvement. New York: McGraw-Hill Book Co., Inc., 1962.

Nelson, Oscar S. and Woods, Richard S. Accounting Systems and Data Processing. Cincinnati, Ohio: South-Western Publishing Co., 1961.

Neuschel, Richard F. Management by System. 2d ed. New York: McGraw-Hill Book Co., Inc., 1960.

Optner, Stanford L. Systems Analysis for Business Management. Englewood Cliffs, N. J.: Prentice-Hall, Inc., 1960.

Randall, C. B.; Weimer, S. W.; and Greenfield, M. S. Systems and Procedures for Automated Accounting. Cincinnati, Ohio: South-Western Publishing Co., 1962.

Laboratory Problems, Cards and Forms Design Kit, Teachers' Manual.

Wanous, S. J. and Wanous, E. W. Automation Office Practice. Cincinnati, Ohio: South-Western Publishing Co., 1964.

Teachers' Manual. Office Practice Set.

APPENDIX A—SUGGESTED STANDARDS OF ACHIEVEMENT

Acceptable vocational competencies in a job classification will vary according to local labor and employer standards. The following suggested standards reflect professional opinion concerning generally accepted achievement levels in the subject areas.

Standards of performance are divided into two areas: those subjects in which objective skill measurement is fairly well standardized, and those subjects in which reliance must be placed on the teacher's business knowledge and previous teaching experience. These latter subjects are primarily concerned with acquisition of knowledge, development of attitudes, and demonstration of acceptable behavior.

The suggested standards should not be considered rigidly minimal. Rather, they should be looked upon as guides in evaluating trainee achievements and class goals.

Evaluation of each trainee by the teacher should include the use of selected class tests, workbook grading, and final tests. In addition, the teacher should note trainee interest, contributions, and motivation.

GENERAL OFFICE EDUCATION UNITS

BUSINESS MATHEMATICS I

Accurately (95% or better) perform calculations of percentages, averages, measurements, and simple money statements involving proficiency in conversion and use of fractions and decimals

BUSINESS MATHEMATICS II

a. Accurate (95% or better) calculation of simple payrolls, discounts and prices, interest rates, and interest yields
b. Accurate (95% or better) calculation of deferred payments and charges, discount and discount rates on notes and drafts
c. Knowledge of the simpler types of insurance and tax computations

ELEMENTS OF FISCAL RECORDKEEPING

a. Knowledge of basic bookkeeping, including simple entries in double entry system
b. Knowledge of the nature and application of common business records
c. Average degree of proficiency in completion of common and simple records
d. Demonstrated ability to handle cash transactions accurately (no errors)
e. Knowledge of double-entry bookkeeping. Simple journal and ledger entries
f. Knowledge of source records required for posting

PAYROLL RECORDS

a. Understand payroll accounting procedures
b. Compute payroll deductions and make required reports
c. Make accurate payroll calculation from source data (100% accuracy)

LANGUAGE SKILLS

a. Correct spelling of the more commonly used business English words
b. Know meaning, use, and spelling of general business terms and most frequently used data processing terms
c. Knowledge of rules of punctuation, capitalization, and abbreviations
d. Ability to construct sentences and use phrases and clauses correctly
e. Test level of achievement. Course unit content knowledge (approximately 90%)

BUSINESS COMMUNICATIONS

a. Knowledge and understanding of the fundamental principles of effective communication
b. Adequate mastery of the mechanics of English
c. Preparation of simple letters from rough notes
d. Handling of appointments, schedules, and acknowledgments
e. Use of source material for information
f.. Ability to compose letters and reports

PERSONAL DEVELOPMENT

a. Knowledge of basic office customs
b. Acceptable appearance and clear, distinct speech
c. Demonstration of good personal habits and application of common sense to routine office work
d. Understanding of self—personality, motives, emotions—and demonstrated willingness to strive for self-improvement
e. Ability to adjust to group work situations: human relations, teamwork
f. Ability to work independently, organize work, and recognize superior-subordinate relationships

BUSINESS PRINCIPLES AND ORGANIZATION I

Knowledge of fundamentals of course unit in regard to types of business organizations and managerial structure and functions (85 to 90% grades on tests of factual material in course content)

BUSINESS PRINCIPLES AND ORGANIZATION II

a. Knowledge of basic techniques and importance of management of finance, personnel, and production
b. Basic understanding of simpler business and government relationships
c. Appreciation of personal relationships in office of superiors, subordinates, and co-workers

FUNDAMENTALS OF TYPING

a. Keyboard mastery; understanding of principles and techniques of touch typing
b. Concept of neatness and attractiveness of typwritten product; knowledge of how to proofread copy and correct errors
c. Ability to make applications of typing skill to basic letter forms, simple tabulations, simple manuscript typing, simple office forms
d. Clean typewriters; change ribbons
e. Type straight copy, average difficulty, 3 minutes—approximately 35 to 50 wpm (gross)—3 errors or fewer

PRODUCTION TYPING

a. Keyboard mastery, including number and symbol keys, and correct operation of service parts
b. Knowledge, skill, and judgment to produce neat, attractive typewritten "jobs" of some complexity with a minimum of direction and with a sense of responsibility for the correctness of the items from all standpoints
c. Ability to produce mailable business letters of approximately 120 words in 5 minutes; manuscript copy, double-spaced, with headings, from plain copy, 200 words in 10 minutes; tabulated material, 4 columns, with headings, from plain copy (10 items per column) in 5 minutes
d. Knowledge of typing common business documents, including fill-in typing on printed forms
e. Ability to type "masters" for reproduction
f. Appropriate care of the machine: cleaning, changing ribbon, etc.
g. Type straight copy, average difficulty, 5 minutes—approximately 45 wpm or more (gross)—3 errors or fewer

OFFICE CALCULATORS

a. Tabulation of 50 handwritten checks in 1 minute or less; No errors
b. Listing from columnar figures 80-to 100-keys-per-minute rate
c. Knowledge and use of reciprocal tables with full-key adding machine
d. Identify basic calculators and know uses in clerical activities
e. Proficiency in touch system with 10-key and full-key adding machines as per (a) and (b)
f. Ability to add, multiply, subtract, and divide on adding machines and calculators

INTRODUCTION TO BUSINESS DATA PROCESSING

a. Knowledge of special vocabulary of data processing
b. Understanding of what data processing is and of its importance to business
c. Understanding of the steps in a data processing cycle
d. Basic knowledge of functions of data processing equipment
e. Knowledge of the functions of a data processing department and of peripheral data processing occupations

ELECTRO-MECHANICAL ACCOUNTING MACHINES

a. Knowledge of basic functions, features, and operating procedures of each piece of equipment
b. Knowledge of basic housekeeping procedures for each piece of equipment
c. Theoretical understanding of the accounting applications of electro-mechanical accounting machines

ELEMENTARY DESCRIPTIVE STATISTICS

a. Understanding of elementary statistics and its uses
b. Knowledge of statistical measurement
c. Knowledge of graphical presentation
d. Understanding of basic sampling concepts
e. Ability to organize and interpret statistical data
f. Knowledge of the use of statistics as a means of communicating business information

PRINCIPLES OF SUPERVISION

a. Understanding of management functions
b. Understanding of the nature of supervisory responsibilities
c. Knowledge of effective use of authority
d. Knowledge of performance evaluation techniques

PSYCHOLOGY FOR SUPERVISORS

Basic understanding of human relations, morale and productivity as affected by work climate

CLASSIFICATION AND CODING

a. Knowledge of various coding systems
b. Ability to read flow charts
c. High degree of skill in coding
d. Knowledge of various machines and systems which can be used in handling data processing problems, and of how to communicate with these machines through various coding systems

INTRODUCTION TO COMPUTERS

a. Knowledge of electronic data processing vocabulary
b. Understanding of the general principles of a computer system
c. Knowledge of computer elements and their purposes
d. Basic knowledge of programming fundamentals

SPECIALIZED OCCUPATION UNITS

ELEMENTARY LIBRARY SYSTEMS

a. Understanding of the organization and function of a data processing library
b. Knowledge of basic recordkeeping systems
c. Knowledge of the classification of data processing materials
d. Knowledge of handling and preservation of data processing materials
e. Knowledge of receipt, storage, and issue procedures

KEY-PUNCH EQUIPMENT OPERATION

a. Knowledge of all operative parts of the key-punch machine
b. Ability to prepare program cards
c. Ability to produce a minimum of 5000 correct key strokes per hour

TABULATING MACHINE OPERATION

a. Mastery of all operating features of the machine
b. Competency in all machine functions
c. Ability to list all steps in the flow of data from the raw source to report with a complete description of the activity performed at each step

TABULATING MACHINE WIRING

Ability to apply control panel wiring principles and procedures pertaining to all functions of tabulating machines

CONTROL CONSOLE OPERATION

a. Display full knowledge of proper tape and card handling and housekeeping procedures
b. Recognize and use the records of a tape library
c. Understand data flow through machine register operation and basic programming concepts and instructions
d. Display thorough understanding of run manual and operating records maintenance
e. Identify the features of a control console and perform basic practice exercises accurately, displaying knowledge of programming runs and tests and error correction
f. Using a run book, set up and monitor the processing of a programming application without supervision
g. Demonstrate understanding of utility and assembly routines, and be able to use their respective operation manuals correctly and independently
h. Identify any unusual console conditions selected by the instructor and take appropriate actions

DATA PROCESSING MATHEMATICS

a. High degree of understanding of number systems
b. Ability to handle various basic mathematical computations necessary for understanding and using data processing equipment
c. Ability to understand application of these numerical concepts to computer programming problems

INTRODUCTION TO PROGRAMMING

a. Knowledge of computer fundamentals
b. Basic understanding of programming techniques for business applications
c. Knowledge of flow charting

DATA PROCESSING SYSTEMS

a. Understanding of the function of data processing systems in business
b. Basic understanding of data processing equipment
c. Knowledge of charts and forms used in business data processing
d. Knowledge of business systems, procedures, and desired outputs

APPENDIX B—TYPICAL MATERIALS FOR INSTRUCTIONAL PURPOSES

SAMPLE SUGGESTED LESSON PLAN

A good unit of instruction provides various kinds of learning activities that should be coordinated with each other for maximum effect, and an effective teacher's guide can aid in such coordination. Among helpful learning activities are demonstrations, lectures, directed study, supervised practice, and examinations. Many approaches are thus made to the problems in the unit, and the trainee takes a basic step in learning as he solves problems through these approaches. A typical teacher's guide may suggest topics for presentation by using various teaching techniques—lecture, audiovisual presentation, individual or group activities or discussion, formal or informal review, and oral or written examination. Each separate activity should contribute its part to the mastery of the content of the unit.

The sample suggested lesson plan of a teacher's guide presented here is illustrative of suggested methods of unitizing material for class presentation under the appropriate subtopic or topic of a typical course outline. The individual teacher may expand or contract the detail contained in his own personal guide as his particular experience dictates. Rigorous adherence to the format is neither recommended nor intended. It is a helpful instructional aid when new or infrequently occurring subject content is to be presented.

CODING AND CLASSIFICATION

Lesson X—Flow Charts, Part I, "Types of Charts"
Review: 5 minutes
Lecture and demonstration: 35 minutes
Discussion and preview: 10 minutes
Materials: Coding sheets, Example flow charts, flow chart symbol sheets

Topic Outline

I. Review of preceding lesson
    A. Codes
    B. Coding sheet forms
    C. Cover any material not covered in prior session plan

II. Flow chart fundamentals
    A. The flow chart defined
    B. Uses of flow charts
    C. Flow charts in manual systems
    D. Flow charts in automatic data processing systems
    E. The flow chart as a means of communication
    F. Elements of a flow chart
    G. The flow charting process
    H. How the coder uses flow charts

III. Types of flow charts
    A. Process
        1. Uses
        2. Examples
            a. Block diagrams: inventory application
            b. Flow charts using symbols: payroll application
    B. Detail
        1. Uses

- B. Detail (cont'd)
  - 2. Examples
    - a. Block diagrams: Social Security computation
    - b. Flow charts using symbols: payroll application
- C. Relationship of detail charting to process charting

IV. Examples of flow charts and flow chart development

V. Discussion and questions

VI. Preview of next lession: Flow Charts, Part II, "Symbols and Organization"

Reading assignment for Lesson XI: Hein, An Introduction to Electronic Data Processing for Business, pages 110 to 129.

References

Gregory, Robert H. and Van Horn, Richard L. Automatic Data Processing Systems. (Belmont, Calif.: Wadsworth Publishing Co., Inc., 1960. p. 463-499.

Hein, Leonard W. An Introduction to Electronic Data Processing for Business, Princeton, N.J.: D. Van Nostrand Co., 1961. p. 90-110.

Leeds, Herbert D. and Weinberg, Gerald M. Computer Programming Fundamentals. New York: McGraw-Hill Book Co., Inc., 1961. p. 69-99.

McCracken, Daniel D.; Weiss, H.; and Lee, T. Programming Business Computers. New York: John Wiley and Sons, Inc. 1959. p. 26-43.

INSTRUCTIONAL MATERIALS

The following instructional materials have not been previously listed in the course units. They are included here to assist the teacher in finding appropriate and useful supplementary materials. Although this list is by no means exhaustive, it will serve as a convenient initial source of many helpful materials.

For the further convenience of the teacher who may wish to find materials appropriate to a particular subject area quickly, many of the items have been assigned codes which indicate the subject area(s) for which any particular item appears most appropriate. The codes do not specificially refer to titles of units as they appear in the curricula.

Code	Subject Area
A	Accounting and Recordkeeping
BDP	Business Data Processing
BP&O	Business Principles and Organization
C	Computers
CO	Console Operation
C&P	Coding and Programming
CTO	Card-Tape Converter Operation
DPS	Data Processing Systems
E	English

Code	Subject Area
EAM	Electro-Mechanical Accounting Machines
HSP	High-Speed Printer
I	Instructor's reference (advanced texts, additional source lists, and similar materials)
KP	Key Punch Operation
M&S	Mathematics and Statistics
MT	Machine Tabulating
OC	Office Calculators
OS	Principles of Supervision
PD	Personal Development
PS	Psychology for Supervisors
TL	Tape Library
T	Typing
W	Wiring

NOTE: The addresses of publishers, producers, and additional sources of materials may be found in APPENDIX C.

TEXTS AND REFERENCES

(OC, A, M&S) Agnew, P.L. *Machine Office Practice*. Cincinnati, Ohio: South-Western Publishing Co., 1959.

(M&S) Allendoerfer, C.B. and Oakley, C.O. *Principles of Mathematics*. New York: McGraw-Hill Book Co., Inc., 1955.

(I) Alt, Franz L. and Rulunoff, M., eds. *Advances in Computers*, 4 vols. New York: Academic Press, 1960-63.

(OS, I) Archer, Fred C.; Brecker, Raymond F.; and Frakes, John C. *General Office Practice, 2d ed.* New York: McGraw-Hill Book Co., Inc., 1963.

(E) Aurner, Robert R. and Burtness, Paul S. *Effective English for Business, 5th ed.* Cincinnati, Ohio: South-Western Publishing Co., 1962. Study Projects (Workbook); Tests 1-3 and Final Examination, Teacher's Manual.

(I) Bartee, Thomas C. *Digital Computer Fundamentals*. New York: McGraw-Hill Book Co., Inc., 1960.

(I) ________; Lebow, Irwin; and Reed, Irving S. *Theory and Design of Digital Machines*. New York: McGraw-Hill Book Co., Inc., 1962.

(I) Bellows, R. *Psychology of Personnel in Business and Industry, 3d ed.* Englewood Cliffs, N.J.: Prentice-Hall, Inc., 1961.

(T) Bendixen, E.T. and Ricksen, H.B. *Production Typing, 2d ed.* Cincinnati, Ohio: South-Western Publishing Co., 1958. Laboratory Material; Instructor's Manual.

(BDP, BP&O) Bethel, Lawrence L.; Atwater, Franklin S.; Smith, George H.E.; and Stackman, Harvey A., Jr. Industrial Organization and Management. New York: McGraw-Hill Book Co., Inc., 1962.

(OS) Bittel, L.R. What Every Supervisor Should Know. New York: McGraw-Hill Book Co., Inc., 1959.

(I) Bowman, Edward H. and Fetter, Robert B. Analysis for Production Management. Homewood, Ill.: Richard D. Irwin, Inc. 1957.

(A) Boynton, L.D. Methods of Teaching Bookkeeping and Accounting. 2d ed. Cincinnati, Ohio: South-Western Publishing Co. Available summer 1964.

(I) Brown, L. Communicating Facts and Ideas in Business. Englewood Cliffs, N.J.: Prentice-Hall, Inc., 1961.

(PS) Calhoon, R.P. and Kirkpatrick, C.A. Influencing Employee Behavior. New York: McGraw-Hill Book Co., Inc., 1956.

(I, C&P) Colman, Harry L. and Smallwood, Clarence P. Computer Language: An Autoinstructional Introduction to Fortran. New York: McGraw-Hill Book Co., Inc., 1962.

(E) Cox, H.L. Coping with Correspondence. New York: Sterling Publishing Co., Inc., 1962.

(I, W) Data Processing Wiring Guide. Detroit, Mich.: American Data Processing, Inc.

(I) Delta Pi Epsilon, Bibliography of Teaching Materials in Business Education. New York: New York University Press.

(I) Delta Pi Epsilon, The Business Teacher Learns from Cases. Cincinnati, Ohio: South-Western Publishing Co., 1957.

(A) Dictionary of Bookkeeping and Accounting Terminology, rev. ed. Cincinnati, Ohio: South-Western Publishing Co., 1962.

(I) Douglas, L.V.; Blanford, J.T.; and Anderson, R.L. Teaching Business Subjects. Englewood Cliffs, N.J.: Prentice-Hall, Inc., 1958.

(M&S) Dutton, W.H. and Adams, L.J. Arithmetic for Teachers. Englewood Cliffs, N.J.: Prentice-Hall, Inc., 1961.

(I) Flores, Ivan. Computer Logic: The Functional Design of Digital Computers. Englewood Cliffs, N.J.: Prentice-Hall, Inc., 1960.

(I, M&S) Fowler, F.P. and Sandberg, E.W. Basic Mathematics for Administration. New York: John Wiley and Sons, Inc., 1962.

(M&S) Franzblaw, Abraham N. A Primer of Statistics for Non-Statisticians. New York: Harcourt, Brace & World, 1958.

(I) Green, H. Activities Handbook for Business Teachers. New York: McGraw-Hill Book Co., Inc., 1958.

(E) Gruber, E. Grammar and Spelling Made Simple. New York: Arco Publishing Co., Inc., 1955.

(I) Hardaway, M. and Maier, T.B. Tests and Measurements in Business Education. 2d ed. Cincinnati, Ohio: South-Western Publishing Co., 1952.

(I) Harms, H. Methods in Vocational Business Education. Cincinnati, Ohio: South-Western Publishing Co., 1949.

(OS) Hegarty, E. How to Build Job Enthusiasm. New York: McGraw-Hill Book Co., Inc., 1960.

(I, EAM, BDP) How to Increase the Effective Capacity of IBM Punched Cards. Detroit, Mich.: American Data Processing, Inc.

(I) Huffman, H., ed. and others. The Clerical Program in Business Education—The American Business Education Yearbook. New York: New York University Press, 1959.

(BDP, C) Jaski, Tom. Electronics in Business Machines. New York: A. S. Barnes and Co., 1963.

(A) Johnson, Eldred A. Accounting Systems in Modern Business. New York: McGraw-Hill Book Co., Inc., 1959.

(I, BDP, TL) Kahn, Gilbert; Yerian, Theodore; and Steward, Jeffrey R. Progressive Filing and Records Management. New York: McGraw-Hill Co., 1962.

(M&S) Kanzer, E.M. and Schaaf, W.L. Essentials of Business Arithmetic. Boston: D.C. Heath & Co., 1960.

(I) Lamb, M.M. Your First Year of Teaching Typewriting. 2d ed. Cincinnati, Ohio: South-Western Publishing Co., 1959.

(E) Larson, G. Business English Essentials. 2d ed. New York: McGraw-Hill Book Co., Inc., 1959. Workbook.

(BP&O) Lawrence, N.R. Secretary's Business Review. Englewood Cliffs, N.J.: Prentice-Hall, Inc., 1959.

(A, BDP) Lazzaro, Victor, ed. Systems and Procedures: A Handbook for Business and Industry. Englewood Cliffs, N.J.: Prentice-Hall, Inc., 1959.

(C&P, C, I) Leeson, Daniel N. and Dimitry, Donald L. Basic Programming Concepts and the IBM 1620 Computer. New York: Holt, Rinehart and Winston, Inc., 1962.

(PD, PS) MacGibbon, E.G. Fitting Yourself for Business, 4th ed. New York: McGraw-Hill Book Co., Inc., 1961.

(PD) ________. Manners in Business, rev. ed. New York: The Macmillan Co., 1954.

(M&S) McCollough, Celeste and Van Atta, Loche. A Programmed Introduction to Statistical Concepts. New York: McGraw-Hill Book Co., Inc., 1963.

(M&S) McMackin, F.J.; Marsh, J.A.; and Baten, C.E. Arithmetic of Better Business. Boston: Ginn & Co., 1959. Diagnostic Tests.

(BP&O) McNaughton, W.L. Introduction to Business Enterprise. New York: John Wiley & Sons, Inc., 1960.

(PS) Maier, Norman R.F. Principles of Human Relations. New York: John Wiley & Sons, Inc., 1958.

(M&S) Mallory, V.S. and others. Commercial Arithmetic. Syracuse, N.Y.: L.W. Singer Co., Inc., 1956.

(OC, A) Meehan, J.R. and Kahn, G. How to Use Full Keyboard Adding Machines. New York: McGraw-Hill Book Co., Inc., 1955. Workbook.

(OC) ________ How to Use Ten-Key Adding Machines. New York: McGraw-Hill Book Co., Inc., 1955. Workbook.

(E) Modern English Spelling. 2d ed. A Programmed Textbook. New York: TMI Grolier, 1961.

(I) Monroe, Alfred J. Digital Processes for Sampled Data Systems. New York: John Wiley and Sons, Inc., 1962.

(PD) Morgan, Clifford T. and Deese, James. How to Study. New York: McGraw-Hill Book Co., Inc., 1957.

(I) Nanassy, L.C., ed. Business Education Index. Delta Pi Epsilon and Gregg. Annual issues since 1940.

(I) National Office Management Association. Manual of Practical Office Short Cuts, Vol. I. New York: McGraw-Hill Book Co., Inc., 1947.

(I) ________, Practical Office Time Savers, Vol. II. New York: McGraw-Hill Book Co., Inc., 1957.

(OS, PS) Niles, H.E.; Niles, M.C.; and Stephens, J.C. The Office Supervisor: His Relations to Persons and to Work. 3d ed. New York: John Wiley & Sons, Inc., 1959.

(OS, PS) Parker, W.E. and Kleemeier, R.W. Human Relations in Supervision. New York: McGraw-Hill Book Co., Inc., 1951.

(A) Perry, E.C.; Frakes, J.C.; and Zabornik, J. F. Clerical Bookeeping. New York: Pitman Publishing Corp., 1957.

(A, PD) Polishook, W.M.; Beighey, C.; and Wheland, H. E. Elements of General Business. rev. ed. Boston: Ginn & Co., 1955. Workbook; Tests; Manual.

(PD) Post, E. Etiquette, 9th ed. New York: Funk & Wagnalls Co., 1955.

(EAM, BDP, I) Punched Card Applications Handbook. Detroit, Mich.: American Data Processing, Inc.

(E) Punctuation, Modern English Series, 2d ed. A Programmed Textbook. New York: TMI-Grolier, 1961.

(T) Reynolds, H. and Skimin, E. Office Practice Typewriting. New York: McGraw-Hill Book Co., Inc., 1954.

(M&S) Rosenberg, R.R. Business Mathematics. 2d ed. New York: McGraw-Hill Book Co., Inc., 1959. Exercises; Problems; Tests.

(I) Russon, A.R. and Wanous, S.J. Philosophy and Psychology of Teaching Typewriting. Cincinnati, Ohio: South-Western Publishing Co., 1960.

(W, CO, BDP) Salmon, Lawrence. IBM Machine Operation and Wiring. Belmont, Calif.: Wadsworth Publishing Co., 1962.

(E) Schaffer, V. and Shaw, H. McGraw-Hill Handbook of English. 2d ed. New York: McGraw-Hill Book Co., Inc., 1960. Correlated Filmstrip Series.

(BDP, C) Schmidt, R.N. and Meyers, W.E. Electronic Business Data Processing. New York: Holt, Rinehart and Winston, Inc., 1963.

(I) Scott, Norman R. Analog and Digital Computer Technology. New York: McGraw-Hill Book Co., Inc., 1960.

(T) Scott, W.E.; Hamilton W.J.; and Hertzfeld, A. Modern Basic Typewriting. New York: Pitman Publishing Corp., 1954.

(E) Sheppard, M. Plain Letters—The Secret of Successful Business Writing. New York: Simon and Schuster, Inc., 1960.

(I, C) Smith, Charles V.L. Electronic Digital Computers. New York: McGraw-Hill Book Co., Inc., 1959.

(PD) Sparling, A.E. Practice in Office Work. New York: McGraw-Hill Book Co., Inc., 1949. Workbook.

(BP&O, A) Spengler, E.H. and Klein, J. *Introduction to Business. 4th ed.* New York: McGraw-Hill Book Co., Inc., 1955. Workbook.

(OS) Spriegel, W.R.; Schulz, E.; and Spriegel, W.B. *Elements of Supervision. 2d ed.* New York: John Wiley & Sons, Inc., 1957.

(PD) Staton, Thomas F. *How to Study*. Montgomery, Ala.: How to Study.

(M&S, C) Stibitz, George R. and Larrivee, Jules A. *Mathematics and Computers*. New York: McGraw-Hill Book Co., Inc., 1956.

(T, PD) Strony, M.S. and Greenaway, M.E. *The Secretary at Work. 2d ed.* New York: McGraw-Hill Book Co., Inc., 1958. Records; Filmstrip Series, Workbook.

(I) Tonne, H.A. *Principles of Business Education. 2d ed.* New York: McGraw-Hill Book Co., Inc., 1954.

(I) Tonne, H.A.; Popham, E.: and Freeman, M.H. *Methods of Teaching Business Subjects. 2d ed.* New York: McGraw-Hill Book Co., Inc., 1957.

(I, BDP) *Total Systems.* Detroit, Mich.: American Data Processing, Inc.,

(T) *Typing Homework Series*. Self-Study Workbook. 30 assignments. Huntington, N.Y.: Educational Developmental Laboratories.

(C, C&P, BDP) Van Handel, Paul, ed. *Electronic Computers: Fundamentals, Systems and Applications.* Englewood Cliffs, N.J.: Prentice-Hall, Inc., 1961.

(EAM, C&P, TL) Van Ness, Robert J. *Principles of Punched Card Data Processing*. Elmhurst, Ill.: Business Press, 1962.

(PD) Vanderbilt, A. *Complete Book at Etiquette. rev. ed.* New York: Doubleday & Co., 1958.

(I) Von Neumann, John. *The Computer and The Brain.* New Haven, Conn.: Yale University Press, 1958.

(E) *Webster's Third New International Dictionary of the English Language.* Springfield, Mass.: G. & C. Merriam Co., 1961.

PERIODICALS, GUIDES, AND DIRECTORIES

It is suggested that the teacher become acquainted with some of the following materials. Their contents are both specific and general, and may be applicable to several areas of business education.

Administrative Management. Geyer-McAllister, Inc., 212 5th Avenue, New York, N.Y. 10010

American Business. 4660 Ravenswood Ave., Chicago, Ill. 60640

American Business Education. University of Connecticut, Storrs, Conn. 06268

Audio-Visual Aids for Data Processing Systems and Automation. 1963, Data Processing Management Association. Park Ridge, Ill. 60068

Automation. A Penton Publication, Penton Building, Cleveland, Ohio. 44013

Balance Sheet. South-Western Publishing Co., 5101 Madison Rd., Cincinnati, Ohio. 45227

Business Automation. OA Business Publications, Inc., 288 Park Avenue West, Elmhurst, Ill. 60126

Business Education World. McGraw-Hill Book Co., Inc., 330 W. 42nd St., New York, N.Y. 10036

Business Management. Management Magazines, Inc., 22 West Putnam Ave., Greenwich, Conn. 06830

Business Newsmagazine. The Alsen Publishing Co., 1445 N. Fifth St., Milwaukee, Wis. 53212

Business Screen. Business Screen Magazine, Inc., 7064 Sheridan Rd., Chicago, Ill. 60626

Business Week. McGraw-Hill Publishing Co., Inc., 330 W. 42nd St., New York, N.Y. 10036

Canadian Controls and Instrumentation. A Maclean-Hunter Publication, 481 University Ave., Toronto 2, Ontario, Canada.

Check List of All Available Teaching Aids. Prentice-Hall, Inc., Englewood Cliffs, N.J. 07632

Communications of the A.C.M. Association for Computing Machinery, 211 E. 43rd St., New York, N.Y. 10017

Computer Applications Services. American Data Processing, Inc., 2200 Book Tower, Detroit, Mich. 48226

Computers and Automation. Berkeley Enterprises, Inc., 815 Washington St., New Somerville, Mass. 02143

Computers & Data Processing. 217 Broadway, New York, N.Y. 10007

Control Engineering. McGraw-Hill Publishing Co., 330 W. 42nd St., New York, N.Y. 10036

Data Processing for Education. American Data Processing, Inc., 2200 Book Tower, Detroit, Mich. 48226

Data Processing for Management. American Data Processing, Inc., 2200 Book Tower, Detroit, Mich. 48226

Data Processing Yearbook. American Data Processing, Inc., 2200 Book Tower, Detroit, Mich. 48226

Data Systems Engineering. E.H. Nelson Publishing Co., Inc., 510 Madison Ave., New York, N.Y. 10022

Datamation. F.D. Thompson Publications, Inc., 141 E. 44th St., New York, N.Y. 10017

Directory of Films about Property, Casualty and Surety Insurance. Insurance Information Institute, 110 William St., New York, N.Y. 10038.

Directory of 2660 16mm Film Libraries. Department of Health, Education and Welfare, Washington, D.C. 20202

Educators Guide to Free Films. Educators Progress Service, Dept. AVG. Randolph, Wis. 53956

Educators Guide to Free Slidefilms. Educators Progress Service, Dept. AVG, Randolph, Wis. 53956

Employment Outlook of Electronic Computer Operating Personnel and for Programmers. (BLS Bulletin 1300-34) U.S. Government Printing Office, Washington, D.C. 20402

Financial Executive. Financial Executives Institute, 50 W. 44th St., New York, N.Y. 10036

Instrument and Apparatus News. Instruments Publishing Co., 845 Ridge Ave., Pittsburgh, Pa. 15212

Instruments and Control Systems. Instruments Publishing Co., 845 Ridge Ave., Pittsburgh, Pa. 15212

Instruments and Control Systems Buyers' Guide. Instruments Publishing Co., 845 Ridge Ave., Pittsburgh, Pa. 15212

International Business Automation. OA Business Publications, Inc., 288 Park Avenue West, Elmhurst, Ill. 60126

ISA Journal. Instrument Society of America, Penn-Sheraton Hotel, 530 William Penn Place, Pittsburgh, Pa. 15219

Journal of Accountancy. American Institute of Certified Public Accountants, 666 Fifth Ave., New York, N.Y. 10019

Journal of College Placement. College Placement Council, Inc., 35 E. Elizabeth Ave., Bethlehem, Pa. 18018

Jounral of Data Management. Data Management Association, 524 Busse Highway, Park Ridge, Ill. 60068

Journal of the American Society of Training Directors. American Society of Training Directors, 2020 University Ave., Madison, Wis. 53705

Modern Office Procedures. Industrial Publishing Corp., 812 Huron Road, Cleveland, Ohio. 44115

Nations Business. U.S. Chamber of Commerce, 1615 H St., NW., Washington, D.C. 20006

The New UNIVAC Educational Package. The Educational Marketing Department, UNIVAC Division, Sperry Rand Corp., 2121 Wisconsin Ave., NW., Washington, D.C. 20007

Occupations in Electronic Data-Processing Systems. U.S. Department of Labor, 1959. U.S. Government Printing Office, Washington, D.C. 20402

Office. Office Publications, 60 E. 42nd St., New York, N.Y. 10017

Personal Market Place. Merchandiser Publishing Co., Inc., 419 Park Ave. S., New York, N.Y. 10016

Pitmanite. Pitman Publishing Corp., 2 W. 45th St., New York, N.Y. 10036

Reproduction Methods for Business and Industry - RM. Gellert-Wolfman Publishing Co., 33 W. 60th St., New York, N.Y. 10023

Scientific American. Scientific American Inc., 415 Madison Ave., New York, N.Y. 10017

Systems. United Business Publications, Inc., 200 Madison Ave., New York, N.Y. 10016

The National Public Accountant. National Society of Public Accountants, 919 18th St., NW., Washington, D.C. 20006

Today's Secretary. McGraw-Hill Book Co., Inc., 330 W. 42nd St., New York, N.Y. 10036

Typewriting News. South-Western Publishing Co., 5101 Madison Rd., Cincinnati, Ohio. 45227

The Typing Teacher. 4006 Carlisle Ave., Baltimore, Md. 21216

Visual Aids for Business and Economic Education, rev. 1961. (Monograph 92). South-Western Publishing Co., 5101 Madison Rd., Cincinnati, Ohio. 45227

FILMS AND FILMSTRIPS

Abbreviations Used in Descriptions

BW - Black & White
Col - Color
FS - Filmstrip
Min. - running time in minutes

MP - Motion Picture
Si - Silent
So - Sound

(OC, A) Accounting and Calculating Machines. MP-So-BW-12 min. Teaching Aids Exchange.

(A) Accounting Cycle Direct Ledger Entry, The. FS-Si. Business Education Films.

(A) Accounting Series. 11 FS-Si-BW. McGraw-Hill Book Co., Inc.

(PD, PS) As Others See Us. MP-So-BW-10 min. British Information Service.

(C, BDP) Automatic Computers. MP-So-Col-16 min. International Business Machines.

(BDP, C) Automation. A CBS NEWS "See It Now" Production. MP-So-BW-84 min. McGraw-Hill Book Co., Inc.

(BDP) Automation of B.J. Blurch, Inc., The. MP-So-Col-16 min. DPMA International Headquarters.

(A) Banks and Credit. MP-So-BW-10 min. Coronet Instructional Films.

(C&P, M&S, C) Base and Place. MP-So-BW-30 min. University of Colorado.

(T) Basic Typing - Machine Operation. MP-So-BW-30 min. United World.

(BDP, EAM) Beauty of It, The. FS-So-Col-30 min. Burroughs Corporation.

(T) Better Typing at Your Fingertips. MP-So-Col-30 min. Modern Talking Picture Service.

(A, M&S) Bookkeeping and Accounting. MP-So-BW-11 min. Carl F. Mahnke Productions.

(A) Bookkeeping and Accounting Errors. FS-Si-BW. Business Education Films.

(A) Bookkeeping and You. MP-So-Col/BW-11 min. Coronet Instructional Films.

(A) Bookkeeping Cycle, The. FS-Si. Society for Visual Education, Inc.

(A) Bookkeeping Series. 6 FS-Col. McGraw-Hill Book Co., Inc.

(E) Build Your Vocabulary. MP-So-Col/BW-10 min. Coronet Instructional Films.

(T) Building Typing Skills. MP-So-Col/BW-11 min. Coronet Instructional Films.

(A, E) Business Education Series. 6 FS-Col. McGraw-Hill Book Co., Inc.

(PD, PS) Business Etiquette Series. 11 FS-BW. McGraw-Hill Book Co., Inc.

(C&P, M&S) By the Numbers. MP-So-Col-16 min. International Business Machines.

(BDP) Careers in Business Data Processing. MP-So-Col-16 min. U. of Southern California.

(BDP, EAM) Cards That Count, The. MP-So-Col-15 min. International Business Machines.

(BDP, C)	Census '60. MP-So-BW-13 min. Univac Division of Sperry Rand.
(C&P)	COBOL. FS-So-Col-20 min. Burroughs Corporation.
(M&S)	Collection of Data. FS-So-Col-22 min. City College of New York.
(C&P, CO)	Computer Programming. MP-So-BW-26 min. System Development Corporation.
(EAM)	Control Input for ADP. FS-So-Col-27 min. Burroughs Corporation.
(A)	Controlling Accounts. FS-Si. Business Education Films.
(EAM, BDP)	Costs That Make Sense. MP-So-Col-15 min. International Business Machines.
(EAM, BDP)	Data for Diagnosis. FS-Col-So-22 min. Burroughs Corporation.
(BDP)	Data Processing for Hospitals. MP-So-Col-16 min. International Business Machines.
(BDP)	Data Processing for the Wholesale Drug Industry. FS-So-Col. International Business Machines.
(C, BDP)	1620 Data Processing System. FS-So-Col. International Business Machines.
(C)	Disks That Are a Cylinder. MP-So-Col-10 min. International Business Machines.
(BDP)	Distribution Accounting. FS-So-Col. International Business Machines.
(T)	Do You Know Your Typewriter? FS-Si. Society for Visual Education.
(M&S)	Donald in Mathmagic Land. MP-So-Col-28 min. University of Michigan.
(C)	Educated Computer, The. FS-So-Col. International Business Machines.
(T, E)	Eight Parts of a Business Letter. MP-So-Col/BW-11 min. Business Education Films.
(T)	Electric Typing Time. MP-So-Col-20 min. International Business Machines.
(BDP)	Electronic Bank Bookkeeping on the Job. MP-So-Col-12 min. Burroughs Corporation.
(C&P, M&S)	Electronic Computers and Applied Mathematics. MP-So-Col/BW-23 min. Colburn Film Distributors, Inc.
(C)	Electronic Computers Improve Management Control. MP-So-Col-15 min. University of California.

(BDP) F-2000 Computer. MP-So-Col-17½ min. Burroughs Corporation.

(BDP) Filing Procedures in Business. MP-So-Col/BW-11 min. Coronet Instructional Films.

(BPD) Fire and Casualty Agency Accounting. FS-So-Col. International Business Machines.

(C&P, BDP) Flow Process Chart, The. MP-So-Col-15 min. City College of New York.

(BDP, C&P) Flow Process Chart and How To Use It. MP-So-Col-15 min. University of Michigan.

(E) Fundamentals of English Series. 6 FS-Si-Col. McGraw-Hill Book Co., Inc.

(M&S) General Mathematics - Business Mathematics Course. 25 FS-Si-BW. (Teacher Manual) Educational Developmental Laboratories.

(E) Grammar: Verbs and Ways We Use Them. MP-So-Col/BW-11 min. Coronet Instructional Films.

(T) Gregg Typewriting Series. Set I and Set II. FS-So-12 min. per filmstrip. McGraw-Hill Book Co., Inc.

(BDP) Hospital Accounting. FS-So-Col. International Business Machines.

(A) How To Balance Accounts. FS-Si. Business Education Films.

(PD, PS) How To Be Well Groomed. MP-So-Col/BW-10 min. Coronet Instructional Films.

(PD, PS) How To Keep a Job. MP-11 min. Coronet Instructional Films.

(OS, PS) Human Relations in Supervision. 24 FS-So-6 min. per filmstrip. McGraw-Hill Book Co., Inc.

(BDP, HSP) IBM 1404 Printer, The. MP-So-BW-8 min. International Business Machines.

(BDP, C) IBM 1410 Data Processing Systems. FS-So-Col. International Business Machines.

(BDP, C) IBM 1428 Alphameric Optical Reader, The. MP-So-Col-11 min. International Business Machines.

(C, BDP) Information Machine, The. MP-So-Col-10 min. International Business Machines.

(BDP) Integrated Data Processing. MP-So-Col-35 min. Business Education Films.

(M&S, A) Interest—60 Day 6% Method—Parts I and II. FS-Si. Business Education Films.

(A) Introduction to Accounting. PS-Si. Business Education Films.

(C, BDP) Introduction to Digital Computers. MP-So-Col-25 min. Univac Division of Sperry Rand.

(BDP, C) Introduction to Feedback. MP-So-Col-11½ min. International Business Machines.

(A) Journal—First Lesson, The. MP-Si. Business Education Films.

(T) Know Your Typewriter. MP-So-Col/BW-11 min. Coronet Instructional Films.

(E) Look It Up! (Dictionary Habits). MP-So-Col/BW-11 min. Coronet Instructional Films.

(EAM, BDP) Magic Window—Principles of Punched Card Accounting, The. FS-So-Col. International Business Machines.

(BDP) Man-Machine Charts. MP-BW-22 min. State University of Iowa.

(PD) Manner of Speaking, A. MP-So-BW/Col-28 min. Indiana Bell Telephone Company.

(A, M&S) Meaning of Percentages. MP-So-Bw-10 min. Business Education Films.

(BC) Message to No One, A. MP-So-Col-25 min. Champion Paper and Fiber Co., Hamilton, Ohio

(BDP) Methods Analysis. MP-So-BW-10 min. McGraw-Hill Book Co., Inc.

(OC) Modern Business Machines. MP-So-20 min. Teaching Aids Exchange.

(C) Moon Is Born, A. MP-So-Col-4 min. International Business Machines.

(EAM, BDP) Next Step, The. MP-So-Col-15 min. International Business Machines.

(OR, PD) Office Courtesy—Meeting the Public. MP-So-Col/BW-12 min. Encyclopaedia Britannica Films, Inc.

(PD, PS) Office Etiquette. MP-So-15 min. Encyclopaedia Britannica Films, Inc.

(OS) Office Supervisor's Problems. Six 8 min. films with Discussion Leader's Manual. MP-So-Col/BW. McGraw-Hill Book Co., Inc.

(OS, PS) Office Supervisor's Problems Series, The. 6 MP-So-Col. McGraw-Hill Book Co., Inc.

(OR, PD) Office Teamwork. MP-So-Col/BW-12 min. Encyclopaedia Britannica Films, Inc.

(C) 1418 Optical Character Reader. FS-Col. International Business Machines.

(A) Pay to the Order of. MP-So-10 min. Public Relations Council, American Bankers Association.

(A, M&S) Percents and Percentage Series. FS-So-Col/BW. Society for Visual Education, Inc.

(PD) Personal Qualities to Job Success. MP-So-11 min. Coronet Instructional Films.

(PD) Polish Up Your Personality. FS-Si. Society for Visual Education, Inc.

(A) Posting—One Journal, One Ledger. FS-Si. Business Education Films.

(C, BDP) Principles of Electronic Data Processing. FS-So-Col. International Business Machines.

(BDP) Process Charts. MP-So-BW-16 min. State University of Iowa.

(C) Program for Progress. MP-So-Col-16 min. Burroughs Corporation.

(C&P) Programming Languages. MP-So-Col-5 min. System Development Corporation.

(BDP) Public Utilities Accounting. FS-So-Col-14 min. Univac Division of Sperry Rand.

(BDP) Question Tree, The. MP-So-Col-13 min. International Business Machines.

(BDP, EAM) Retail Accounts Receivable. FS-So-Col. International Business Machines.

(BDP) Serving Through Better Systems. FS-So-Col-17 min. Burroughs Corporation.

(T) Shortcuts in Typing. MP-So-30 min. Educators Progress Service.

(BP&O) Sound Business. FS-So-BW. Continental Illinois National Bank and Trust Co.

(OS, PS) Supervisory Problems in the Office. 12 FS-So-8-11 min. per filmstrip. McGraw-Hill Book Co., Inc.

(BDP) Systems Analysis. FS-So-Col-13 min. Standard Register Company.

(BDP) Technology and You. MP-So-Col-13 min. University of Michigan.

(OC, M&S) Ten-Key Touch Training Course. 25 FS-Si-BW. (Operators and instructor manuals) Educational Developmental Laboratories.

(BDP, C) Then and Now. MP-So-Col-12 min. Univac Division of Sperry Rand.

(BDP, C)	Thinking Machine, The. MP-So-BW-54 min. Association Films.
(C, BDP)	"Thinking" Machines. MP-So-C-20 min. University of California.
(M&S)	This Business of Numbers. FS-So-Col-20 min. Remington Rand Corporation.
(M&S, C&P)	This Business of Numbers. FS-So-Col-20 min. Univac Division of Sperry Rand.
(T)	Tips on Typing. MP-So-21 min. Underwood Corporation.
(T)	Tricks of the Trade for Typists. MP-Si-15 min. Teaching Aids Exchange.
(EAM, BDP)	Truck Route to Better Records. MP-So-BW-17 min. Univac Division of Sperry Rand.
(T)	Typing-Keyboard Introduction Course. 2d. ed. 10 FS-Si-BW. (Student and teacher manuals) Educational Development Laboratories.
(T)	Typing-Skill Development Course. 25 FS-Si-BW. (Student and teacher manuals) Educational Development Laboratories.
(C, BDP)	UNA and the UNIVAC. FS-So-Col-16 min. Univac Division of Sperry Rand.
(BP&O)	What Is a Corporation? MP-So-Col/BW-11 min. Coronet Instructional Films.
(BDP)	What Is EDP? MP-So-Col-13 min. International Business Machines.
(E)	Why Punctuate? MP-So-11 min. McGraw-Hill Book Co., Inc.
(E)	Writing Better Business Letters. MP-So-Col/BW-10 min. Coronet Instructional Films.
(PD, PS)	You're on the Team. MP-15 min. Eastman Kodak Company.

ADDITIONAL INSTRUCTIONAL MATERIALS

(BDP, I, C)	Audio-Visual Aids. Data Processing Management Association. (Annual Catalog of Films in Data Processing.)
(E, BDP, I)	Automation Dictionary (A Booklet) Philadelphia: Minneapolis-Honeywell Regulator Co., Industrial Division.
(A)	Bookkeeping Procedure Visualized. (21 1/2" × 27 1/2" chart, B/W) National Blank Book Co.

(A) Bookkeeping Transparencies (8" × 10") for overhead projector. (Cincinnati: South-Western Publishing Co.) 1962.

(A) Bookkeeping Wall Charts. (48" × 52", 3 colors) George F. Cram Company, Inc.

(BDP) Careers in Data Processing. (A Booklet) Project on Information Processing. NSTA, Montclair State College, Upper Montclair, N.J.

(T) Cartoons. (8 1/4" × 10", for typing) National Association of Secondary School Principals.

(T) Cartoons. (8 1/2" × 11") Ohio Typewriter Service.

(A) Cartoons. (8" × 10", B/W for Bookkeeping) Special Teaching Aids.

(T) Case of the New, New Ribbon, The, (30" × 40" Poster, Col.) Poster Visual Aids.

(M&S) Facts for Math. (Teachers Ref.) Automobile Manufacturers Association.

(BDP) Filing Simplified. (17" × 22", Col.) Smead Manufacturing Co.

(T) Good Posture Charts. (11" × 17", Col.) Adjusto Equipment Co.

(T) Gregg Typing Picture-Posters—Letter Style Series. New York: McGraw-Hill Book Co., Inc.

(T) Gregg Typing Records—Keyboard Series. Boxes 1-4 inclusive. New York: McGraw-Hill Book Co., Inc.

(T) Keyboard Wall Chart. Education Research Committee.

(T) Keyboard Wall Chart. Royal Typewriter Co.

(T) Office Experience—Typewriters. (Demo. Kit, 40 mins.) Underwood Corporation.

(A) Social Security Charts. (Kit: 32" × 44" charts, teacher pamphlets) Bureau of Internal Revenue.

(PD) The Successful Secretary. (A Booklet) New York: Royal McBee Corp.

(T) Typewriter Keyboard Chart. (21 3/8" × 13") E. D. Crim Publications.

(T) Typewriter Keyboard Test. R.C. Allen Business Machines, Inc.

(T) Typewriter Kit No. 1. (Posters, Col.) Educational Supplies and Services.

(T) Typewriting Posture Posters. American Book Co.

(T) Typewriting Rhythm Records—Progressive Speed Series. New York: McGraw-Hill Book Co., Inc.

(T) Typing Cartoons. (8 1/2" x 11", Red and Black) Poster Visual Aids.

(T) Typing Habits, Ugh! (8" x 10") Poster Visual Aids.

(T) Typingo. (Typing game) Russell W. Kraning.

(T) What Every Typist Should Know About Copies in Office Work. (Speed and Accuracy Tests) Ditto, Inc.

(A) Vu-Graph Bookkeeping Visual Aid Kit, The. (8 1/2" x 11" transparencies) Charles Beseler Co.

MATERIALS FROM DATA PROCESSING EQUIPMENT MANUFACTURERS

A variety of useful teaching materials may be obtained from local representatives of data processing equipment manufacturers. Some representative examples of available materials are listed in the Texts and Other Teaching Materials sections of the Elementary Library Systems and Classification and Coding units.

APPENDIX C — SOURCES OF EDUCATIONAL MATERIALS

Materials listed in this guide are obtainable from the following sources. Some of these sources may not have been referred to elsewhere, but all provide teaching materials of varying kinds.

Academic Press Inc., 111 Fifth Ave., New York, N.Y. 10003

Addison-Wesley Publishing Co., Inc., Reading, Mass. 01867

R. C. Allen Business Machines, Inc., 678 Front Ave., NW, Grand Rapids, Mich. 49404

Allyn and Bacon Inc., 150 Tremont St., Boston, Mass. 02111

American Bankers Association, 12 E. 36th St., New York, N.Y. 10016

American Book Company, 55 Fifth Ave., New York, N.Y. 10003

American Data Processing, Inc., 2200 Book Tower, Detroit, Mich. 48226

American Economic Foundation, 51 E. 42nd St., New York, N.Y. 10017

Arco Publishing Co., Inc., 480 Lexington Ave., New York, N.Y. 10017

Association Films, 347 Madison Ave., New York, N.Y. 10017

Automation Institute Publishing Co., 821 Market St., San Francisco, Calif. 94103

Automobile Manufacturers Association, 320 New Center Bldg., Detroit, Mich. 48202

Bailey Films, 6509 De Longpre Ave., Hollywood, Calif. 90028

A. S. Barnes and Co., 11 E. 36th St., New York, N.Y. 10016

Barnes & Noble Inc., 105 Fifth Ave., New York, N.Y. 10003

Charles Beseler & Company, 219 S. 18th St., East Orange, N.J. 07018

British Information Service, 30 Rockefeller Plaza, New York, N.Y. 10022

William C. Brown Co., Publishers, 135 S. Locust St., Dubuque, Iowa. 52002

Bureau of Internal Revenue, Department of the Treasury, Washington, D.C. 20220

Burroughs Corporation, 219 Park Ave. S., New York, N.Y. 10003

Business Education Films, 4607 16th Ave., Brooklyn, N.Y. 11204

Business Press, 288 Park Ave. W., Elmhurst, Ill. 60126

Business Teachers Guide, P.O. Box 114, Conway, N.H. 03818

Cambridge University Press, 32 E. 57th St., New York, N.Y. 10022

Carter's Ink Company, 80 Varick St., New York, N.Y. 10013

Castle Films, R.C.A. Building, 30 Rockefeller Plaza, New York, N.Y. 10020

Champion Paper and Fiber Co., Hamilton, Ohio. 45013

City College of New York, 17 Lexington Ave., New York, N.Y. 10010

Continental Illinois National Bank and Trust Co., 231 LaSalle St., Chicago, Ill. 60690

Coronet Instructional Films, 65 E. South Water St., Chicago, Ill. 60601

George F. Cram Company, 730 E. Washington St., Indianapolis, Ind. 46207

E. D. Crim Publications, 4271 Leimert Blvd., Los Angeles, Calif. 90008

Dartnell Corp., 4660 Ravenswood Ave,, Chicago, Ill. 60640

Data Processing Management Association, 524 Busse Hiway, Park Ridge, Ill. 60068

Department of Public Instruction, Commonwealth of Pennsylvania, Harrisburg, Pa. 17126

Ditto Inc., Harrison at Oakley Blvd., Chicago, Ill. 60612

Doubleday & Co., Inc., 575 Madison Ave., New York, N.Y. 10022

Education Research Committee, 777 14th St., NW., Washington, D.C. 20005

Educational Developmental Laboratories, Inc., Huntington, L.I., N.Y. 11744

Educational Supplies and Services, 1650 N. Serrano Ave., Los Angeles, Calif. 90027

Educators Progress Service, Randolph, Wis. 53956

Encyclopaedia Britannica Films, Inc., 1150 Wilmette Ave., Wilmette, Ill. 60091

The Free Press, Glencoe, Ill. 60022

Funk & Wagnalls Co., 360 Lexington Ave., New York, N.Y. 10017

Garden City Books, Garden City, L.I., N.Y. 11535

Ginn & Company, Statler Office Bldg., Boston, Mass. 02117

Globe Book Company, 175 Fifth Ave., New York, N.Y. 10010

Grolier Co., 575 Lexington Ave., New York, N.Y. 10022

Grosset & Dunlap, 1107 Broadway, New York, N.Y. 10010

Harcourt, Brace and World, 757 Third Ave., New York, N.Y. 10017

Harper & Bros. See Harper & Row.

Harper & Row, Publishers, 49 E. 33rd St., New York, N.Y. 10016

D. C. Heath & Company, 285 Columbus Ave., Boston, Mass. 02116

Henry Holt and Co. See Holt, Rinehart and Winston, Inc.,

Holt, Rinehart and Winston, Inc., 383 Madison Ave., New York, N.Y. 10017

Horder's Inc., 231 S. Jefferson St., Chicago, Ill. 60606

Houghton Mifflin Co., 2 Park Street, Boston, Mass. 02108

Indiana Bell Telephone Co., 240 N. Meridian St., Indianapolis, Ind. 46204

International Business Machines Corp., 590 Madison Ave., New York, N.Y. 10022

Richard D. Irwin, Inc., 1818 Ridge Rd., Homewood, Ill. 60430

Karwood Comapny, P.O. Box 133, Milwaukee, Wis. 53213

R. W. Kraning, Indiana University, Gary Center, Gary, Ind. 46408

J. B. Kppincott Co., E. Washington Square, Philadelphia, Pa. 19105

Lyons and Carhahan, 2500 Prairie Ave., Chicago, Ill. 60616

Carl F. Mahnke Productions, 215 E. 3rd St., Des Moines, Iowa. 50309

McGraw-Hill Book Co., Inc., 330 W. 42nd St., New York, N.Y. 10036

David McKay Co., Inc., 119 W. 40th St., New York, N.Y. 10018

Macmillan Company, 60 Fifth Ave., New York, N.Y. 10011

G. & C. Merriam Co., 47 Federal St., Springfield, Mass. 01105

Minneapolis-Honeywell Regulator Co., Wayne and Windrim Aves., Philadelphia, Pa. 19144

Modern Talking Picture Service, 3 E. 54th St., New York, N.Y. 10022

Monroe Calculating Machines Co., Educational Dept., Orange, N.J. 07051

Moore Business Forms, 210 Post St., San Francisco, Calif. 94108

National Association of Secondary School Principals, 1201 16th St., NW., Washington, D.C. 20006

National Blank Book Company, Holyoke, Mass. 01040

National Foreman's Institute Inc., Bureau of Business Practice, 100 Garfield Ave., New London, Conn. 06320

National Secretaries Association, 18 E. 60th St., New York, N.Y. 10022

Nation's Business, 1615 H St., NW., Washington, D.C. 20006

New York University Press, Press Building, 32 Washington Place, New York, N.Y. 10003

Ohio Typewriter Service, 3759 N. Berkeley, Cincinnati, Ohio. 45236

Oxford Filing Supply Co., Inc., Clinton Rd., Garden City, L.I., N.Y. 11535

Pitman Publishing Corp., 2 W. 45th St., New York, N.Y. 10036

Poster Visual Aids, 58 Union St., Milford, N.H. 03055

Prentice-Hall Inc., Englewood Cliffs, N.J. 07632

Remington Rand, Division of Sperry Rand Corp., 315 4th Ave., New York, N.Y. 10010

Republic Book Company, 115 E. 53rd St., New York, N.Y. 10022

John F. Rider, 116 W. 14th St., New York, N.Y. 10011

The Ronald Press Co., 15 E. 26th St., New York, N.Y. 10010

H. M. Rowe Company, 624 North Gilmor St., Baltimore, Md. 21217

Royal Typewriter Company, 2 Park Ave., New York, N.Y. 10016

Scott, Foresman, and Co., 433 E. Erie St., Chicago, Ill. 60611

Simon & Schuster, Inc., 630 Fifth Ave., New York, N.Y. 10020

L. W. Singer Co., Inc., 249-259 W. Erie Boulevard, Syracuse, N.Y. 13202

Smead Manufacturing Company, 309-311 2nd Ave., Hastings, Minn. 55033

Smith-Corona-Marchant Inc., 410 Park Ave., New York, N.Y. 10022

Society for Visual Education Inc., 1345 W. Diversey Parkway, Chicago, Ill. 60614

Sound Education, Box 414, Port Huron, Mich. 48061

Soundscriber Corp., 140 Munson St., New Haven, Conn. 06711

South-Western Publishing Co., Inc., 5101 Madison Rd., Cincinnati, Ohio. 45227

Special Teaching Aids, 3408 N. Potomac Street, Arlington, Va. 22213

Sperry-Rand Corporation, 1290 Avenue of the Americas, New York, N.Y. 10019

Standard Packaging Corp., Advertising Mgr., 200 E. 43nd St., New York, N.Y. 10017

Standard Register Company, 250 Park Ave., New York, N.Y. 10017

State University of Iowa, Ames, Iowa. 50012

Stenotype Company, 417 S. Dearborn St., Chicago, Ill. 60605

Sterling Publishing Company, 419 Park Ave., S., New York, N.Y. 10016

Superintendent of Documents, Government Printing Office, Washington, D.C. 20402

System Development Corporation, 350 Fifth Ave., New York, N.Y. 10001

Teaching Aids Exchange, 307 South B St., San Mateo, Calif. 94401

The Typing Teacher, 4006 Carlisle Ave., Baltimore, Md. 21216

Underwood Corporation, 1 Park Ave., New York, N.Y. 10016

United Business Schools Association, 1518 K St., NW., Washington, D.C. 20005

United World Films, Inc., 1445 Park Ave., New York, N.Y. 10029

University of California, Berkeley, Calif. 94720

University of Colorado, Boulder, Colo. 80302

University of Michigan, Ann Arbor, Mich. 48103

University of Southern California, Los Angeles, Calif. 90007

University Publishing Company, 1126 Que St., Lincoln, Nebr. 68501

D. Van Nostrand Co., Inc., 120 Alexander St., Princeton, N.J. 08541

Victor Adding Machine Co., Business Education Dept., Chicago, Ill. 60618

Wadsworth Publishing Co., 10 Davis Drive, Belmont, Calif. 94002

John Wiley & Sons, 440 Fourth Ave., New York, N.Y. 10016

Yale University Press, 206 Elm St., New Haven, Conn. 06711

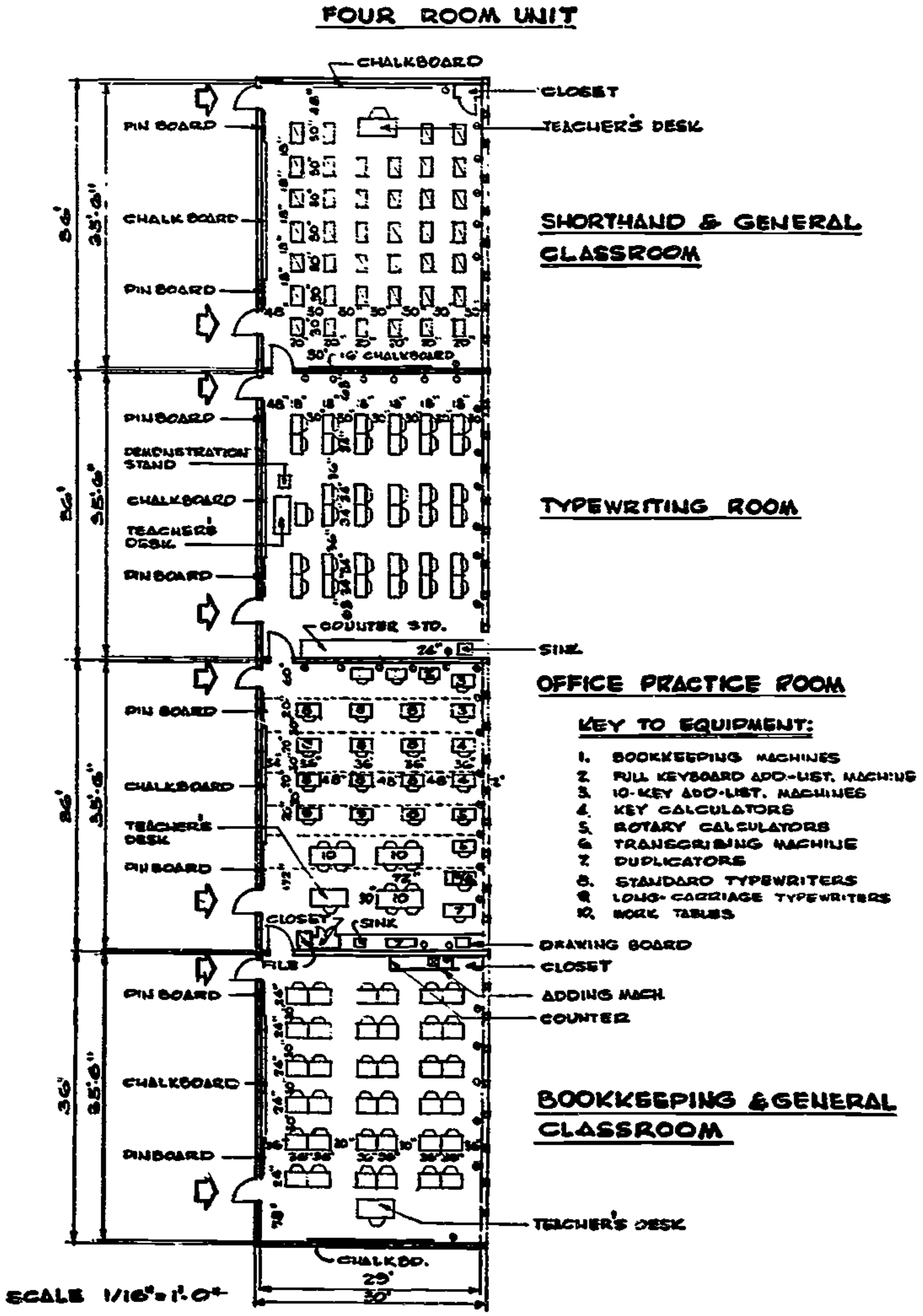
Ziff-Davis. Now A. S. Barnes.

APPENDIX D — PHYSICAL FACILITIES LAYOUTS

TYPICAL FACILITIES LAYOUTS

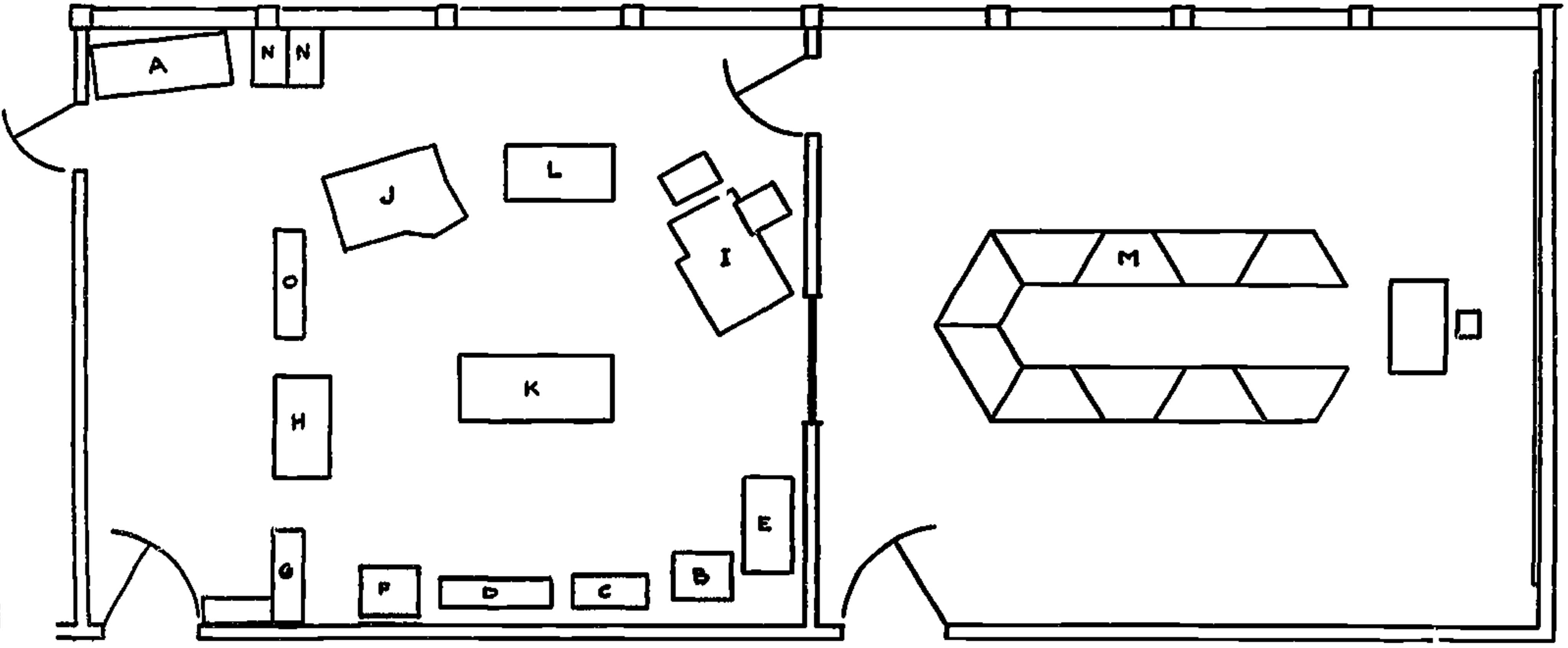
Requirements for physical facilities cannot be estimated in advance for any particular location. These requirements will be affected by trainee populations, available instructional time and present facility adequacy.

Two layouts are shown. One is reprinted by permission of the California State Department of Education from Bulletin No. 68. It is suggestive of a four-room layout of business education facilities. Should the number of trainees be greater or smaller, than these layouts can accommodate, then necessary adjustments are indicated.



Courtesy of Bureau of Business Education, California State Department of Education and South-Western Publishing Co., Inc.

DATA PROCESSING
LABORATORY LAYOUT



A. WIRING POSITION
B. VERIFIER
C. COLLATOR
D. SORTER
E. REPRODUCING PUNCH
F. CARD PUNCH
G. STORAGE CABINET
H. CARD FILES
I. ACCOUNTING MACHINE
J. COMPUTER
K. CONFERENCE TABLE
L. CARD READ AND PUNCH UNIT
M. STUDENT DESKS
N. CARD FILES
O. MASTER STORAGE LOCKER

NOTE: AIR CONDITIONING IS REQUIRED FOR THE LABORATORY

U.S. GOVERNMENT PRINTING OFFICE : 1964 O—741-710

VT002 454

VT 002 454 ED (See August 1968 RIE)

Planning for the Year, the Unit, the Daily Lesson.

Simpson, Elizabeth Jane
Pub Date - 65
EDRS PRICE MF-$0.50 HC-$2.60 63p.

*CURRICULUM PLANNING, *HOME ECONOMICS EDUCATION, *TEACHING GUIDES, HIGH SCHOOLS, LESSON PLANS, CURRICULUM, EDUCATIONAL OBJECTIVES, *CONCEPT TEACHING, EVALUATION, INSTRUCTIONAL AIDS, LEARNING EXPERIENCE, RESOURCE UNITS,

In developing teaching plans, (1) scope, the major areas of content, and (2) sequence, the order in which content will be developed, must be considered. Major areas of content for a proposed curriculum plan include "roles of women" core, education for homemaking and family life, education for employment involving home economics knowledges and skills, preprofessional education, and commonalities in vocational education. Essentials of any teaching plan are discussed--objectives, content to be taught including the development of concepts and generalizations, learning experiences, teaching aids, and evaluation techniques. The following instructional materials are included--(1) a lesson using the series of structured questions for developing generalizations, (2) a vocabulary study for developing the ability to think, (3) a resource unit on personal and family relationships, (4) bulletin board ideas, (5) a bibliography, and (6) two units making use of the structured set of questions--Exploring Values That Influence Choices in the Area of Home Furnishings and Communicating Non-Verbally. A scope and sequence chart of a home economics program is given. This article is published in the "Illinois Teacher of Home Economics," volume 9, number 5, 1965. (MS)

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OF HOME ECONOMICS

CURRICULUM DEVELOPMENT IN HOME ECONOMICS EDUCATION

HOME ECONOMICS EDUCATION · UNIVERSITY OF ILLINOIS

A publication of the Division of Home Economics Education, Department of Vocational and Technical Education, College of Education, University of Illinois, Urbana, Illinois 61801

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PLANNING FOR THE YEAR, THE UNIT, THE DAILY LESSON

Elizabeth Jane Simpson, Professor and Chairman
Division of Home Economics Education
College of Education
University of Illinois

Developing teaching plans is one of the major responsibilities of the teacher. As knowledge of the teaching-learning process develops, as new and more refined teaching aids become available, and as knowledge in the subject fields expands, the tasks of planning for teaching become increasingly complex. There are more choices open to the teacher, more factors to take into account as she plans for the year, the course or unit, and the day.

There will be no attempt in this article to consider all facets of planning for teaching. However, attention will be given some basic guides to action in developing teaching plans.

Scope and Sequence in the Home Economics Program

Scope refers to the major areas of content included in the program. Following are some questions that one might ask in determining the scope of the home economics program:[1]

1. How frequently will the learning be needed?
    - 1.1 The universality of the need at different socio-economic levels?
    - 1.2 The universality of the need in different life-cycle periods?
    - 1.3 The universality of the need in different vocations?
    - 1.4 The universality of the need in different geographical areas?
    - 1.5 How frequently will the learning be needed as a basis for acquiring more knowledge?
2. What are the chances that outcomes will be adequately learned apart from direct instruction in school?
    - 2.1 The difficulty of learning?
    - 2.2 The seriousness of error?

---

[1] As given in "Improved Teaching Through Improved Essay Tests" by Janet Tracy and Letitia Walsh, Illinois Teacher of Home Economics, Vol. III, No. 5, University of Illinois, Urbana, Illinois, p. 208.

3. What is the cruciality of the situations in which it will be used?

    3.1 How far must the learning be developed to meet the present need?
    3.2 What level of mastery might meet foreseeable future needs?
    3.3 What level of over-learning might provide insurance against unforeseeable demands?

4. How far are students capable of extending any given learning?

    4.1 What are the natural limitations of ability?
    4.2 What are the temporary deficiencies due to a lack of maturity?
    4.3 What are the limitations in perceptual background?
    4.4 What deeply emotionalized attitudes might impede learning?

5. What learning experiences can be provided?

    5.1 Which will enrich students' conceptualization?
    5.2 Which are feasible in terms of semantics involved?
    5.3 Which are helpful to students in clarifying and handling their own and others' values?
    5.4 Which promise to provide the most economical and effective practice in thinking?

6. If <u>X</u> is taught, what is to be de-emphasized or omitted?

In determining the sequence, or the order in which content will be developed, the following questions may help guide choices:[1]

1. What is a logical development of content in this field?

    1.1 Logical development of concepts?
    1.2 Sequence of difficulty of concepts?
    1.3 Sequence of difficulty of skills?
    1.4 Sequence of difficulty of projects, considering both number of kind of skills and new understandings called for?
    1.5 Relationship of one content area to another, to provide for smooth transition?

2. What is the usual state of "readiness" for learning at each level?[2]

    2.1 Characteristics of students at each level?

        Maturation levels?
        Needs and interests?

---

[1] Developed by Elizabeth Simpson.

[2] Unless one is critical and cautious, his answers to the questions in Item 2 may be heavily loaded with opinions rather than facts.

        Developmental tasks?
        Experiences?
        Eye-hand and eye-eye coordination?

    2.2 Typical student problems at each level?
    2.3 Likelihood that students will have the prerequisite knowledge?

3. What students are likely to be enrolled in homemaking classes at each level?

    3.1 All levels of ability represented in earlier years?
    3.2 A larger proportion of slow learners in later years?
    3.3 Fast learners in special sections?

4. How may provision for new and interesting challenges be made each year?

    4.1 By teaching a few areas thoroughly each year rather than trying to cover entire scope of field?
    4.2 By deliberately "saving" some new and interesting material and not "taking the cream of" during the first years?

5. How much repetition in an area is justified?

    5.1 Only the repetition that is needed for mastery?
    5.2 Repetition provided in new contexts so pupils do not feel that this is "old stuff"?

6. How may facilities be used most effectively with respect to sequential development?

7. How may teacher's time and energy be most effectively employed with regard to sequence?

Following is an example of a "scope and sequence" chart developed by the author as an extension of her schema for a proposed curriculum in home economics at the secondary level.[1] Preceding the chart, a diagram of the schema and a brief outline of major areas of content for each aspect are presented.

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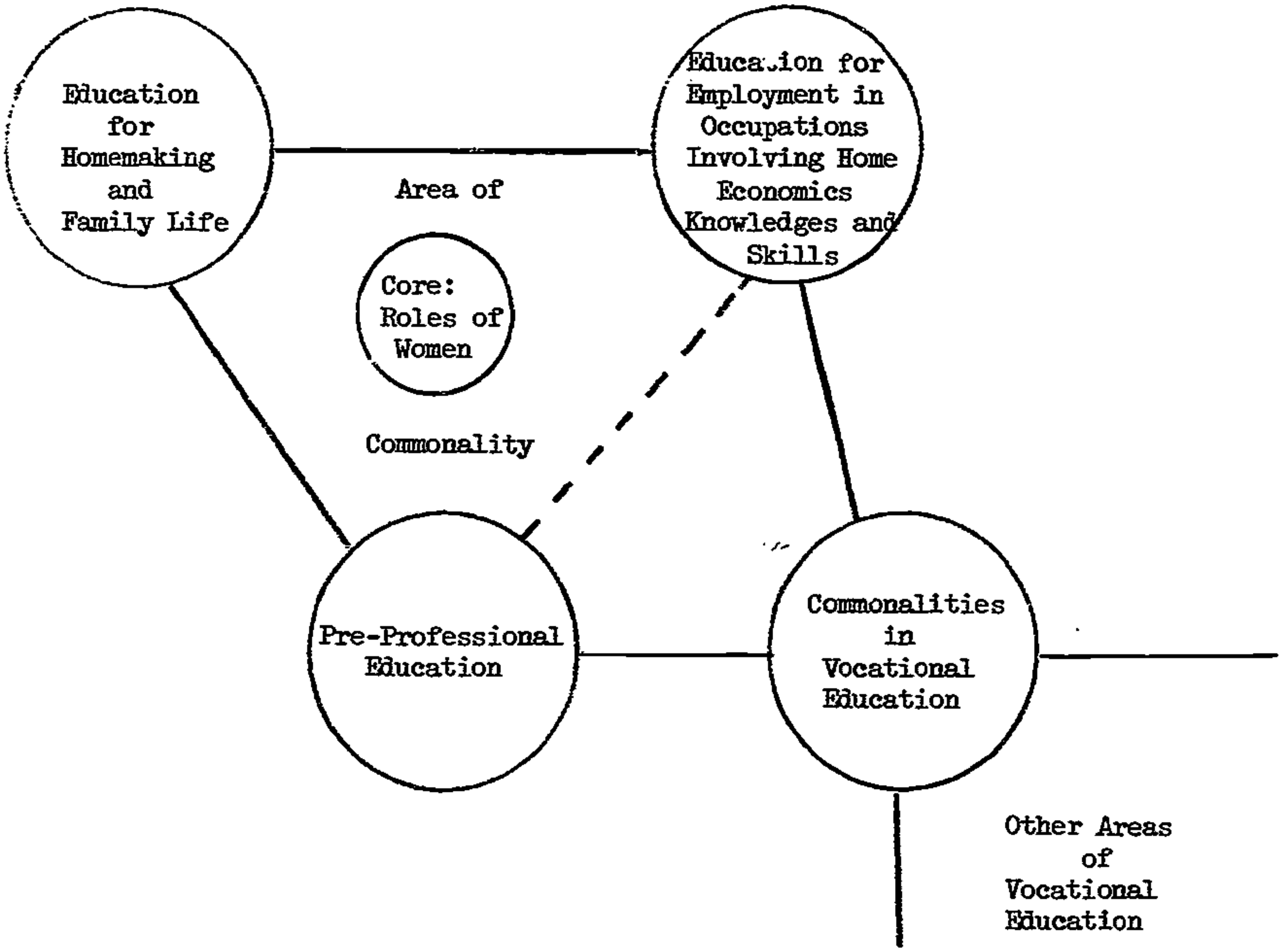
[1] Simpson, Elizabeth Jane, "Projections in Home Economics Education," American Vocational Journal, Vol. 40, No. 8, November, 1965, pp. 41-43.



Schema for Proposed Curriculum
in Home Economics
at Secondary Level

<u>Outline of Major Areas of Content for Each Aspect of Proposed Curriculum Plan</u>

I. "Roles of Women" Core

- A. Roles of the girl; roles of the mature woman
- B. Concept of "maturity"--what it means to be a mature woman
- C. Understanding self and others
- D. Personal development--evaluation of own development, goals to work toward, resources
- E. Relationships with others--basic human needs; communication, verbal and nonverbal; sensitivity to others' needs
- F. Preparation for marriage and/or job or career
- G. Understanding and caring for children
- H. Nutrition and food selection
- I. Personal clothing--art aspects; consumer buying
- J. A place to live
- K. Management of personal resources

L. Use of leisure
M. Personal standards and values
N. Continuing education in "womanhood"

II. Education for Homemaking and Family Life

A. Meaning of "home" and "family"
B. The family as a social institution
C. Relationship of family to other social institutions
D. Cultural influences on family life
E. Responsibilities of the family
F. Developmental stages in family life
G. Parenthood
H. Management of the home, including family finances
I. Housing the family, and furnishing the home
J. Food for the family
K. Clothing the family
L. Caring for sick and aging in the family
M. Continuing education in family life

III. Education for Employment in Occupations Involving Home Economics Knowledges and Skills

A. Home economics-related occupations requiring varying levels of training or education
B. Personal traits and habits that make for employability
C. Knowledges and skills needed for certain occupations related to: child care and guidance, food and nutrition, home management and care of the home, home furnishings, clothing and textiles, care of sick and aging

IV. Pre-professional Education

A. Professional opportunities in home economics
B. Meaning of "profession," "professional commitment"
C. Independent studies in depth--problems related to some phase of home economics

V. Commonalities in Vocational Education

See: Van Camp, Donna M., "Commonalities in Vocational Education," *Illinois Teacher of Home Economics*, Vol. VIII, No. 1, pp. 23-32.

Proposed Curriculum in Home Economics at Secondary
Level Areas of Emphasis, Grades 7-12

Grade	Roles of Women	Homemaking	Employment	Pre-professional
7th	x		x	
8th	x		x	
9th	x			
10th	x		x	
11th	x	x	x	x
12th	x	x	x	x

Scope and Sequence Chart: Home Economics Program at Secondary Level, Based on Proposed Curriculum Schema

Grade	Areas of Study		
7th	Understanding Personal Development Physical Emotional Social	Personal Attractiveness Personal hygiene Grooming Manners	Developing Traits for Employability, Friendships
8th	Understanding Personal Development Concept of "femininity" Feminine responsibilities	Understanding Others Friends of same sex Boys Parents and other adults Older persons	Occupations Related to Home Economics Requiring varying levels of preparation
9th	Understanding Self Present roles Basic human needs (self)	Understanding Others--Family and Friends Basic needs (others) Communication, verbal and nonverbal	Personal Standards of Conduct
10th	Looking Forward to Marriage and/or a Job or Career Orientation to world of work	Becoming a Mature Woman Concept of "maturity" Evaluation of own maturity Sensitivity to others' needs Improving communication skills	Understanding and Caring for Children (Self-understanding through understanding children)
11th	EDUCATION FOR HOMEMAKING AND FAMILY LIFE Students: 11th and 12th grade students looking toward marriage. Basic course--for boys and girls (team teaching by man and woman teachers)	Meaning of Home and Family Family Roles	Family as a Social Institution Relationship to other social institutions Cultural influences on family life
12th	Students: 12th graders who have had basic course. May be elected after basic course	Family Financial Management	Housing the Family and Furnishing the Home

Areas of Study

Nutrition and Food Selection	Helping Keep Surroundings Attractive, Safe, Sanitary	Managing Personal Resources Time, energy, money, abilities	Helping Care for Children Guiding children's play
Selecting and Caring for Personal Clothing	Use of Personal Leisure (Analysis of TV programs, movies)	Communications in Social Situations As hostess, guest, entertaining at home	
Becoming an Attractive Woman Grooming (new aspects) Clothing selection (art aspects)	Consumer Buying of Clothing Wardrobe planning Quality features (not covered, grade 8) Ethical shopping practices	Personal Nutrition Problems in nutrition Preparing a quick, nutritious meal	Use of Personal Leisure Concepts of leisure Values related to use of leisure
Planning and Preparing Simple Meals Principles of cookery (basics only)	Personal Clothing (may be omitted) Minimum essentials of construction		
Responsibilities of the Family To its members To society	Developmental Stages of Family Life	Beginning a New Family Husband-wife relationships	Managing a Home Becoming a Parent
Providing for Family Food Needs	Providing for Family Clothing Needs	Meeting Needs of Sick and Aging in the Family	Continuing Education in Family Life

Grade	Areas of Study			
11th 12th	EDUCATION FOR EMPLOYMENT Students: those for whom high school is terminal and those preparing for further vocational education in voc.-tech. school or other specialized training program	<u>Preparation for Employment</u> (Commonalities in Voc. Ed.)	Cooperative Work Experience-Study Program to Prepare for Employment in Occupations Requiring Home Economics Knowledges and Skills and/or Classroom Program to Develop Knowledges and Skills for Employment in One or More Areas or a Combination of These	Group and individual conferences on problems related to job and to management of personal resources. Special units on: 1. Living Away from Home Living arrangements Finding a place to live Relationships at work and away from the job 2. Continued Development for Employability
11th or 12th	PRE-PROFESSIONAL EDUCATION Students: college-bound, particularly those interested in home economics professions	<u>Professions Related to Home Economics</u> <u>Meaning of</u> Profession Professional person Professional commitment	<u>Independent studies in depth</u>--problem related to some phase of home economics	

The example given provides for a total home economics education program which takes into account the home and family living aspect of the program, the occupationally-oriented aspect, and a pre-professional aspect. That the occupational program was not outlined in greater detail was not due to a lack of concern and commitment to the program on the part of the author--but, rather, to the newness of the program and the fact that basic content for this aspect is in the early stages of development.

In the example given, both horizontal and vertical sequence have been considered. Questions regarding sequence which were presented previously were taken into account. Obviously, if all facets of the program were carried out, the services of several teachers would be required; such a program would be possible only in a larger school unit. In the smaller one-teacher department, choices would be made. For example, the teacher might decide to use the outlines for the ninth and eleventh grades with their emphasis on the vitally important areas of management and relationships, and provide for a pre-professional course, with emphasis on individual study, for college-bound girls aiming at careers in home economics or related professions.

Essentials of Any Teaching Plan

Any teaching plan has five major parts, as was pointed out in the first issue of the current series of the Illinois Teacher. These are:

- Objectives--or, if you prefer, goals, aims, purposes, outcomes
- Content--what is to be taught, the subject matter--stated in the form of facts, principles, generalizations or "levels of generalizations," depending on how you were taught and prefer thinking of them
- Learning experiences--the activities and procedures employed to help students progress toward the objectives
- Teaching aids and facilities--the tools used to aid students in progressing toward the objectives
- Means of evaluation--methods employed to help ascertain student progress toward objectives and the effectiveness of the teaching

General procedures in curriculum development were outlined in the Illinois Teacher, Vol. IX, No. 1, pp. 8-9. At this point, it might be helpful to review this section.

Educational Objectives

The following references will be helpful to the teacher in analyzing the behavioral aspects of educational objectives:

Bloom, B. S., editor, Taxonomy of Educational Objectives, Handbook I, Cognitive Domain, New York: David McKay Co., 1956.

Krathwohl, D. R., Bloom, B. S., and Masai, B. B., A Taxonomy of Educational Objectives, Handbook II, Affective Domain, New York: David McKay Co., 1964.

A classification system for educational objectives in the psychomotor domain is being developed under a grant from the U.S. Office of Education.

The following overview of considerations in developing educational objectives in home economics has been prepared by Professor Mary Mather, Division of Home Economics Education, University of Illinois. She has used this guide in working with teacher groups concerned with problems of curriculum development.

Considerations in Developing Educational Objectives

What should a student study? How can I help a student learn? How can I tell when a student has achieved this learning? These are three questions frequently raised by teachers. Well-stated educational objectives can help determine the answers.

An EDUCATIONAL OBJECTIVE is a statement of intent, of hoped for behavior (desired learning, proposed change), on the part of the learner which may result from instruction.

LEARNING is a change in capability which is inferred from a difference in an individual's performance from one time to a later time.

Therefore, it follows that:

1. we must have some type of data in terms of the individual performing in some way in order to infer that learning has taken place, and
2. in order to collect data from which learning is to be judged, statements of hoped for learning (educational objectives) must be specific enough and clear enough that we know what we are looking for;
3. the degree of specificity (how detailed to make the objectives) should be at the level of generality of behavior that one is seeking to help the student to acquire. Identify a performance which can be valued in and of itself as being effective in the student's life. Each objective should express a purpose which

makes sense within the larger purpose of the person's life goals, and this purpose should be distinguishable from others. For example, "ability to combine colors for pleasing combinations in one's home" is more specific than "can use color effectively";

4. since PERFORMANCE seems to be the key, a description of hoped for behavior must contain a good "strong" verb, a verb referring to observable human action.

Well-stated educational objectives guide the BEHAVIOR OF THE TEACHER. They help her COMMUNICATE to herself and to her students (as well as to other teachers sharing her materials and responsibilities).

1. Objectives tell teachers what the intent of instruction is so that: (a) appropriate experiences can be provided to give opportunities for learners to move toward the desired objective, and (b) appropriate evaluation materials can be devised to measure growth toward, and achievement of, the objective (the desired learning).

2. Objectives communicate to students where they should be going. Unless students know what the objectives are they are likely to resort to memorization and mechanical completion of exercise rather than carry out relevant sorts of learning activities. There should be less of the students' trying to guess what the teacher wants, and less surprise on the part of students when they are evaluated on one premise (one the teacher had in mind) when they had studied and learned on another set of assumptions.

Classification of Educational Objectives

Educational objectives are thought of in three major groups:

- those dealing with knowledge and intellectual skills and abilities, i.e., the COGNITIVE domain;

- those dealing with interests, attitudes and values, the motivators of much of human behavior, i.e., the AFFECTIVE domain; and

- those dealing with manipulative skills and abilities, i.e., the PSYCHOMOTOR domain.

All of the above contribute to an ACTION PATTERN on the part of the learner, our old friend PERFORMANCE.

Although there is much relationship among the three classifications, it is useful to be able to identify the domain in which you are primarily teaching and evaluating at any one time.

Each family or class of objectives can be further organized and classified to indicate various levels or steps in learning in the cognitive, affective or psychomotor areas, each step building on the previous one. Just as it is useful to be able to identify in which domain you are endeavoring to achieve changed behavior, it is useful to be able to identify at which level you are working. Thus we are aided in our teaching and evaluating by being

SPECIFIC PRECISE REALISTIC

when stating objectives.

Content

"Content" refers to student learnings, what is taught. It includes facts, principles, and generalizations. Emphasis was given this aspect of curriculum development in home economics in an article by Professor Hazel Spitze in the *Illinois Teacher of Home Economics*, Vol. IX, No. 2.[1]

The following statement on "Teaching for the Development of Concepts and Generalizations" has been prepared to serve as a guide for teachers as they seek to gain skill in using the "concept approach" in teaching. It involves consideration of both content and methodology. As given here, the statement will appear in the Illinois home economics curriculum guide to be published during 1966. The statement is presented by permission of the Illinois State Department of Education.

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[1] Spitze, Hazel Taylor, "The Structure of Home Economics as a Basis for Curriculum Decisions," *Illinois Teacher of Home Economics*, Vol. IX, No. 2, 1965-66, pp. 62-96.

TEACHING FOR THE DEVELOPMENT OF CONCEPTS AND GENERALIZATIONS*

Why teach for the development of concepts and generalizations?

- The transfer of learnings from the classroom to the home and community, and to employment situations, is more likely to result when students have been guided to draw warranted conclusions in the form of generalizations.
- In a rapidly changing world, the specifics may change; the concepts and generalizations have more enduring value and meaning.
- Teachers and students have more understanding of the material when they have learned to generalize. Generalizations help a person connect, explain, and identify facts and predict what may happen next.
- The ability to generalize is a technique used in everyday living. Quality of living may be improved through development of ability to draw sound generalizations.
- The ability to generalize soundly, once developed, is a time and effort saver. Instead of many isolated facts, a person may have one "big idea" to remember.
- One of the purposes of education is preparation for the future. Meaningful organization of the subject matter of a field is facilitated through understanding the concepts and related generalizations and how they are developed.[1]

What is a concept?

One author said, in effect, that they come in different kinds of packages. They may be in the form of ideas, rules, generalizations, principles or laws, theories, problems, or areas of living.[2]

A concept may be embodied in a word or phrase and this has sometimes been called the concept in its purest form. It is this word or phrase idea of a concept that many people find most useful.

There are several definitions of concepts that may be helpful. One frequently used in connection with the development of curriculum materials in home economics is:

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*Prepared by Elizabeth J. Simpson.

[1] Adapted from a statement prepared by Lila Jean Eichelberger, Home Economics Teacher, Champaign High School.

[2] Dressel, Paul L., "The Roles of Concepts in Planning the Home Economics Curriculum," Home Economics Seminar, Progress Report, 1961, p. 13.

> Concepts are abstractions which are used to organize the world of objects and events into a smaller number of categories. These, in turn, can be organized into hierarchies.[1]

Burton, Kimball, and Wing, in Education for Effective Thinking, say:[2]

> Some writers make very heavy going in defining a concept. This is probably necessary in technical fields and for advanced thinking. Simple definitions can be made which tell us what we need to know:
>
>> A concept is a defined idea of meaning fixed by and as extensive as, the term used to designate it.
>>
>> A concept is the amount of meaning a person has for any thing, person or process.
>>
>> A concept is a suggested meaning which has been detached from the many specific situations giving rise to it and provided with a name.
>>
>> A concept is a logical construct capable of interpersonal use.
>>
>> A concept is a word or other symbol which stands for the common property of a number of objects or situations.
>>
>> Concepts are established meanings on which we can rely with assurance.

Concepts grow and develop through experience, by reflection upon experience, by abstracting from experience and interrelating various phases of experience.

Let us consider the concept of HAPPINESS. We have the notion of a "pleasurable state," satisfaction, good feelings associated with the word.

In understanding the concept, it might help to consider what it means in terms of childhood experiences. Charles Schultz in Happiness is a Warm Puppy[3] defined happiness as a pile of leaves for jumping in, a string of paper clips--if you are a little girl, and, from the puppy's point of view, a piece of fudge caught on the first bounce. One might add his own notions:

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[1] From Work Material for Regional Conference, Department of Health, Education, and Welfare, Office of Education, Division of Votec. Education, Home Economics Education Branch, February 1962.

[2] Burton, William H., Kimball, Roland B., and Wing, Richard L., Education for Effective Thinking, Appleton-Century-Crofts, Inc., New York, 1960, p. 154.

[3] Schultz, Charles, Happiness is a Warm Puppy, Determined Productions, Inc., San Francisco, Calif., 1962.

Happiness is a Ruth Welcome recording to dine by in the evening.
Happiness is renewing old friendships.
Happiness is an orange flower in a bud vase.

The happiness concept is enhanced through experience. One soon begins to realize that values are involved in his concept of happiness.

One might generalize that, "What gives one happiness is affected by the values that he holds." This simple generalization adds further meaning to the notion of happiness. <u>One might think of the pure concept as having generalizations that cluster about it</u>. Some people find this way of looking at concepts and generalizations helpful.

<u>What is a concept?--another look at the question</u>

Presented earlier was the simple definition of a concept: "A concept is the amount of meaning a person has for any thing, person, or process." Within this definition there is another term that may need defining. That term is <u>meaning</u>.

> Meaning is the total significance of any thing, person, process, or situation built up by an individual as he has experiences with it. Meaning is the grouping of ideas, knowledges, beliefs, feelings, and impressions of any and all kinds attached to the item.[1]

<u>How do concepts develop? What are the principles governing their development?</u>

Following are the principles of concept development as brought out by Professor William Burton[2] in his work with home economics educators:

1. Concepts grow out of experience in pursuit of a problem or purpose of some sort. The school, therefore, must provide many and varied experiences.

   For example, one might consider the concept of resources. A purpose in the area of management is to help students gain increased understanding of the resources that may be employed in achieving individual, family, and institutional goals. Many learning experiences at all levels may be provided to help students recognize the technological resources having to do with things; social resources having to do with things and people, as a church, a loan company; and the personal resources

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[1] Burton, Kimball, and Wing, Op. Cit., p. 160.

[2] The principles as stated are based on materials appearing in Burton, William, Kimball, Roland B., and Wing, Richard L., <u>Education for Effective Thinking</u>, New York: Appleton-Century-Crofts, 1960; and Lee, J. Murray and Lee, Doris H., <u>The Child and His Curriculum</u>, 3rd Ed., New York: Appleton-Century-Crofts, 1960.

that have to do with feelings, attitudes, beliefs, emotions, sentiments, and so forth.

2. Opportunities for observation, handling, experimentation, and discovery are necessary.

   For example, the concept of safe food. The meaning of safe food is enhanced through observing sanitary procedures in preparing and storing food, through such experiences as touching unwashed food to an agar plate and watching the development of bacterial growth, through comparing the results of different methods of storing food, through reading....

3. Concepts may be derived from vicarious experiences instead of direct experience.

   For example, the meanings attached to the term personal values may be developed through case situations, through the use of films, through role playing, as well as through one's personal experiences.

4. Concepts may be clarified and extended through reflection, analysis, and discrimination.

   One teacher reported as follows: "Through the years, my concept of communications has grown and developed. At first, I thought of communicating as talking with or corresponding with someone. Then, somewhere in a counseling course we discussed non-verbal communications; and I learned that how I sat, stood, held my hands and arms, smiled or failed to smile communicated something to observers. Still later, doing research on teen magazines I became more and more aware of the power of the mass media of communication. So the whole idea of communications took on more and more meaning as I experienced, reflected on experience, analyzed, and abstracted from these experiences with communication."

5. Concepts are not achieved quickly at a given time. They are never fixed or final. Levels are to be discerned. The process goes on continuously.

   The meaning of this should be apparent, with the possible exception of the idea that "levels are to be discerned." Some concepts in the word or phrase form are quite broad and cover others that are more limited. For example, the concept of "family roles" covers the more limited concepts of "mother role," "father role," "grandparent role," "dual role of women," and so forth. Perhaps Burton was speaking of the concept in the form of the generalization when he said that levels are to be discerned. A discussion of "levels of generalizations" is included in this section of the guide.

6. Concepts are achieved ordinarily through an active, dynamic process, not through a formal or so-called "logical" process (except with very well-informed, mature learners).

However, one may "set the stage" in the classroom for the development of concepts in a more orderly manner than might occur by chance. This is one of the purposes served by the teacher--to help the student to organize and to perceive organization.

7. Concepts gradually evolve, are refined, and change. They evolve from questioning previous concepts.

   Thus, a student who has been taught about color harmony in terms of specific color combinations with names, as "monochromatic," "adjacent," "triad," may develop the notion that no other combinations are harmonious. When he thinks about the idea of color harmony the meaning he attaches is that of certain "accepted" combinations. Later, he is pleased by other combinations. He questions whether his first notions about color harmony were entirely correct. Perhaps he reads in the area of "color" and finds a statement something like this: Any colors may be combined harmoniously provided they are pleasing in respect to value and intensity. His concept of color harmony has been changed and refined as a result of questioning a previously held concept.

8. Concepts to be developed should be carefully selected and then presented through many and varied learning experiences.

   Since we do not have time to teach everything and must make some selections from all that we *might* teach, an important curriculum question that occurs is "if X is included, what must be omitted?" Space does not permit going into all the factors that should be considered in selecting content, but perhaps one could be given. There are certain concepts that have relevance to more than one area of home economics. Perhaps these coordinating concepts should have high priority. Examples might be: Management of time, roles of family members, home safety.

9. Accidental discoveries sometimes produce concepts.

   Perhaps what is needed is a more serendipitous approach on the part of both teacher and student!

What guides may be used in determining what concepts are to be taught?

The following statements may serve as guides in this process. However, it is important to realize that the author was doubtlessly thinking of the concept in forms other than that of the pure concept as expressed in a word or phrase.

1. A useful concept must be accurate, for otherwise it will lead to faulty generalizations and inaccurate thinking.

2. A useful concept must be recent, or of recently demonstrated work, else it may be outmoded when today's learner comes to apply it in tomorrow's world.

3. A useful concept must be permanent--must be built to last. 'Some ideas, some values, some knowledge, some skills, some attitudes are of worth, because of their continuing relevancy to human existence and problems.

4. A useful concept must release the learner's creative instincts, for tomorrow's world will require, above all else, the ability to apply the imagination. And in today's curriculum, those experiences which may tend to narrow the individual's perspective will need to be...eliminated in favor of those which support creativity.[1]

<u>What is a generalization? What is the relationship between concepts and generalizations?</u>

- A "generalization" is a complete thought which expresses an underlying truth, has an element of universality, and usually indicates relationships.[2]

- Any full generalization or principle is a concept. Some limited generalizations may not be concepts, i.e., child-made generalizations. Concepts are bigger, broader, more "fuzzy" and will "cover more ground" than generalizations.[3]

One might consider the concept of "basic human needs." This is a big, broad, "fuzzy" idea. It covers a great deal, including the more limited concepts of "basic mental needs." It also covers a number of generalizations, for example, "A knowledge of basic needs contributes to self-understanding; and families, school, church, community, and peer groups contribute to meeting physical, mental, and social-emotional needs."

In the chapter, "What a Lovely Generalization" in <u>Thurber Country</u>,[4] James Thurber illustrated humorously and well some of the "do nots" in respect to generalizations. This is fun reading for the teacher struggling with the task of helping students draw sound generalizations.

<u>How may one test a generalization for soundness?</u>

The following tests may be used by the teacher developing curriculum materials and as a guide for students in testing their conclusions:

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[1] By Harold D. Drummond of the University of New Mexico, as given in <u>News Letter</u>, Champaign, Illinois, Community Schools, Vol. 21, No. 36, May 27, 1963, p. 4.

[2] Work material for Regional Conference, Op. Cit.

[3] From presentation by William Burton at Pacific Regional Conference, March 1962.

[4] Thurber, James, <u>Thurber Country</u>, Simon and Schuster: New York, 1962.

1. Is it supported by research or accepted theory?

2. What are the assumptions that underlie this conclusion? Are these sound?

3. Is it applicable to other situations? That is, does it have the "element of universality" mentioned in the definition?

Another question that one might ask has to do with the relationship word selected. Most generalizations will show relationships between or among ideas. For example: "Human relationships are enhanced through the understanding of behavior and its causes." *Enhanced* is the relationship word. "A clear concept of the material to be transmitted facilitates communication." *Facilitates* is the relationship word. "Development results from a continuous interaction of the individual and his environment." *Results* is the relationship word. *Enhances* and *facilitates* are soft relationship words; they denote causation and are quite correctly used in the examples given. *Results* is a stronger, more forceful relationship word and was properly used in the example. It is apparent that the choice of the relationship term is quite important in determining whether the statement can be supported.

What are the "levels of generalizations"?[1]

1. The *first level* is likely to be either a description, definition, analogy, identification, or classification. Statements are simple and may relate to personal experience.

2. The *second level* shows relationships among ideas. They may make comparisons and include more ideas than on the first level. This is the *principle* level.

3. The *third level* usually explains, justifies, interprets, or predicts. Generalizations at this level may be more remote in time or space. They often suggest a direction for behavior.

What are some examples of generalizations at each level?

Concept: Communications

First-level generalization. "Communication includes those processes by which individuals influence one another. Communication takes various forms, both verbal and nonverbal."

Second-level generalization. "A clear concept of the material to be transmitted facilitates communication. Communication with others influences an individual's personality."

Third-level generalization. "Ability to communicate grows with communication experiences. Relationships with others are enhanced through development of the ability to communicate."

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[1] Work material for Regional Conference, Op. Cit.

Concept: Proteins

First level. Definitions of protein, classification of protein food.

Second level. Principles of preparing protein-rich foods--cheese, eggs, meat, etc.

Third level. Generalizations that apply to protein cookery in general.

It is not necessary always to identify the level of generalization nor force a generalization at each level for every concept considered. But, the idea of levels is helpful. It is quite apparent that understanding terms and classification systems and being able to describe and offer analogies is essential to an understanding of principles and generalizations making use of these ideas. Hence, there is some order in the generalizations that cluster about a concept. And the task of identifying the generalizations is made easier when this order is recognized and understood.

How may teachers help students develop generalizations?

- A generalization is an outcome of teaching. Students should formulate generalizations in their own words. They are not given to the student nor verbalized for him. A student arrives at a generalization inductively and uses it deductively.

- Understanding the concepts included in a generalization is basic to understanding the generalization. Understanding concepts contributes to ability to see relationships between and among them, hence to the ability to develop second- and third-level generalizations. Thus, is the importance of the first-level generalization emphasized.

- To formulate a generalization, the learner must be able to perceive at least two ideas simultaneously with clarity and meaning, put the ideas together, compare and contrast them, and formulate conclusions.[1]

- Comprehension of a generalization is increased as learners use them in different ways and in new situations.[2]

- Student ability to test the soundness of a generalization may be developed through providing repeated opportunities for such activity in the classroom.

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[1] "Curriculum Planning and Teaching: The Concept Approach," Working papers, National Home Economics Curriculum Development Workshop, University of Missouri, June 1964, p. 4.

[2] Ibid., p. 4.

- Identification of the levels of generalizations clustering about a concept serves to guide planning in respect to organization and sequence in teaching.

- Understanding of individual characteristics of learners is basic to determination of ways of developing concepts and generalizations with them.

In guiding students to develop generalizations, the following list of structured questions has proven helpful:

A Guide to Developing Conclusions in the Form of Principles and Generalizations

Films, minute dramas, case situations, and role playing may be used in order to help students think, examine ideas, and develop understandings. When they are used for these purposes, they serve to stimulate thinking; they may raise questions rather than answer them. They present ideas which may be examined and used as a basis for helping students to clarify their beliefs and draw their own conclusions.

When the above methods have been used for the purposes suggested, the following kinds of questions in the sequence given have been helpful in guiding discussions:

1. Questions for which the answer will be found in the situation.

2. Questions calling for an examination of similar ideas in other situations.

3. Questions asking the student to draw inferences, to begin to see cause and effect relationships, to begin to express their own opinions or ideas in regard to situations.

4. Questions that ask students to formulate a generalization of their own, based on an examination of data from the film, case situation, or drama; from many sources in life situations; and from the opinion of authorities. As a teacher carries on a class discussion, she may want the class to study the many generalizations made by individual students and help them to arrive at generalizations which have a higher degree of agreement within the group.

5. Questions that ask students to examine these ideas as they apply to their present day life; questions that ask what authorities say about certain problems.

6. Questions that ask students to illustrate the meaning of their generalizations. In general, these questions call for students to begin to see how thinking and planning can get some of these ideas into everyday practice.

Adapted from: TEACHING MATERIALS FOR USE IN THE TEACHING OF CHILD DEVELOPMENT AND RELATED ART IN HOMEMAKING EDUCATION IN TENNESSEE, University of Tennessee, Department of Home Economics Education, Knoxville, Tennessee, in cooperation with the State Department of Education, Vocational Education, Nashville, Tennessee.

Following is an example of a lesson using this series of structured questions. Actually, it could serve as a lesson plan. The teacher who developed the plan used it, with variations, in several class situations. In parentheses, she has indicated how the lesson developed with one group. She reported that the series of questions, only slightly revised, were useful regardless of the specific role-playing situation selected by the class.

Example of a Lesson Using the Series of Structured Questions for Developing Generalizations

UNIT: DEVELOPING LOVE AND UNDERSTANDING WITHIN THE FAMILY UNIT

TOPIC: UNDERSTANDING OLDER MEMBERS OF THE FAMILY

OBJECTIVES:

1. Increased understanding of and appreciation and respect for aging members of the family--and aging people in general.
2. Increased understanding of how we may help aging people meet their basic human needs.
3. Increased understanding of how we may live in peace and harmony with aging members of the family.
4. Increased understanding of self.

ACTIVITIES AND PROCEDURES	CONTENT
1. Show pictures of hands of aging person "Can you describe the person who belongs with these hands? Tell me something about the person."	Obviously these are the hands of an aging person because they are wrinkled and the skin is that of an older person. They look like hands that have been very busy--the hands of a person who has known hard work.
2. "Think about the older people you know. Tell us a little about them--without using names." Discuss older people students know--relationship to student, their interests and needs.	

ACTIVITIES AND PROCEDURES	CONTENT
3. "Sometimes it is necessary for three generations of a family to live together--at least for a time. What are some of the problems that sometimes arise in these situations?"	Possible problems Conflicts between needs of aging for peace and quiet and needs of younger people for activity and noise. Difficulties in communication due to different times, different experiences. Lack of understanding of basic needs and how they may be best satisfied at different stages in life cycle. Etc.
4. "Suppose that we role-play one of these problem situations and see if we can gain increased understanding of the older people involved and of ourselves in relation to them." "Which problem seems to you to be the one that most frequently arises in the three-generation family?"	
Class selects problem. (The problem that students choose might have been anticipated--that of the conflicting needs of older people and younger family members. The needs of the older family members are for peace, quiet, and serenity; the needs of younger members are for activity and noise.)	
5. "Who would be involved in this problem situation? Describe those persons involved."	
6. "Where would the action take place? Describe the setting and exactly what has led up to this problem."	
7. "Secure volunteers for the various roles. Ask them to 'get in character.'"	
8. Ask that half of the class observers identify with the older person and try to feel as she feels and half identify with the younger person and try to ascertain what she is feeling.	

ACTIVITIES AND PROCEDURES	CONTENT
9. Role-play the problem situation. (In one class, the action took place in the kitchen. The adolescent daughter was entertaining two girl friends who were dancing to her Beatle records. The grandmother who was the only adult at home entered the kitchen and asked her granddaughter to be quieter, saying, "Young people didn't do this sort of thing when I was young," etc.)	
10. Discussion	
A. "What happened in this situation?" Student gives brief summary of situation that was role-played.	
B. "Do people you know ever behave the way the granddaughter did? Tell us about it."	
"Do older people you know act the way that this grandmother did?" Discuss.	
C. "Why did they behave as they did? The granddaughter? What feelings did she have? What needs did she express?"	Needs--independence, activity, to be like peers, to be popular.
"The grandmother? What feelings did she express?"	Needs--peace and quiet, a feeling of belonging.
D. "What do authorities say about situations like this?"	
Read in Smart and Smart, Living in Families, pp. 95-96; 394-396.	
E. "Now, considering what we have seen in our role-playing situation, what we have experienced in our own contacts with older people, and what we have read, what conclusions might be drawn regarding older members of the family?"	

"Their needs?"	No matter what age a person is, he has certain basic needs, both physical and psychological. The psychological needs are needs for affection, recognition, security, new experience, achievement and feelings of adequacy, dependence and independence, and a satisfying philosophy of life.
"How may we help them meet their needs?"	We may help aging people meet their needs through showing respect for them, planning some time with them, considering their desires, remembering to show appreciation, and keeping the lines of communication open.
"How may we live happily with older people?"	Keeping the lines of communication open among the three generations is one way in which good relationships are promoted. Through practicing empathy we may gain increased understanding of aging members of our family or neighborhood.
"What are the results for ourselves when we begin to increase our understanding of other people and the reasons why they behave as they do?"	As we gain understanding of others, we increase our understanding of self.

F. "Let's review these conclusions that we have drawn." (Read each from board.) "How may we apply them in our own relationships with older people and others?"

Discuss the application of each. Students illustrate how they might apply each generalization in rather specific ways to own life.

MEANS OF EVALUATION: Pencil and paper test requiring the application of the generalizations to problem situations.

Observation of pupils in family situations--on home visits, for example.

Anecdotal records of pupils' relationships with others--particularly older people.

What are some other guides to helping students develop generalizations?

The following statement[1] with only minor revisions was presented in the working papers of the national Home Economics Education Curriculum workshop held at the University of Missouri, June 1964. Some of the suggestions given were included in the structured question guide:

> In helping learners state generalizations and develop concepts, perception should be trained continually and use made of such questions as, 'What do you see in this situation?' Ability to abstract should be developed with questions such as, 'What do you see here that is similar or dissimilar to another situation?' Generalizations should be used in answering the question, 'From what you know about this, what do you think will happen in this new situation just presented to you?' Other questions that may help learners to state generalizations are ones that:
>
> 1. Call for an example of similar ideas in other situations.
> 2. Ask learners to draw inferences, to see cause and effect relationships.
> 3. Bring out dissimilarities of main ideas.
> 4. Ask learners to illustrate meanings of the conclusions as they apply to their own life.
> 5. Ask learners to state the relationship between two concepts.
> 6. Ask what authorities say about certain problems.
> 7. Ask what research evidence regarding the problem is available.
> 8. Ask learners how they can prove an observation.

What is the place of vocabulary study in the development of generalizations?

In the development of generalizations, the first level, as has been stated, is "likely to be either a description, definition, analogy, identification, or classification." The importance of a study of word meanings in developing first-level generalizations is obvious.

Second- and third-level generalizations show relationships among ideas which have been developed at the first level. That is, they are built on the first-level generalizations.

Hence, vocabulary study serves to help prepare students for stating generalizations at these levels.

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[1] Adapted from "Curriculum Planning and Teaching: The Concept Approach," Op. Cit., p. 5.

The following section on vocabulary study includes many suggestions which have been found helpful by a group of Illinois teachers working over a two-year period in the general area of "teaching for development of the ability to think."

Vocabulary Study

We use language as a tool in thinking. "If students are to think clearly in any area of subject matter, they must understand the terms that are used. Therefore, vocabulary study should be a part of each unit that is taught."[1]

The following are some suggestions for teaching for increased understanding of word meanings:

Define or have students look up meanings of new terms.

Have a place on the chalkboard set aside for terms and their definitions.

Plan with students for a special place in each student notebook for new words and phrases and their meanings.

Where appropriate, use the bulletin board to illustrate the meaning of new terms.

Include on pre-tests, terminology important to the development of understandings within a unit of study. Provide for special study of terms most frequently misunderstood. Evaluate progress in development of understanding of terms with end-test.

Use crossword puzzles, developed by teacher or student, as one means of providing for vocabulary study.

Have each student list all of the words that she does not understand in a reading assignment. Summarize the list and use it as a guide in determining which words to include in vocabulary study assignments.

Have students make sentences using new terms as one way of determining whether they understand word meanings.

Kinds of terms that need defining include:

New terms encountered in a unit of study--for example, such terms as family life cycle, developmental tasks.

Value terms, such as good, bad, attractive, interesting. Students need to know how these terms are being used by others if they are to communicate effectively.

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[1] Lemmon, Louise and Simpson, Elizabeth, Teaching Process of Thinking in Homemaking Education, Department of Home Economics, NEA, Washington, D.C., p. 4.

Terms with depth of meaning. These are the kinds of words which have emotional significance for individuals. Meanings for individuals may vary according to experiences, attitudes, values and beliefs held. Such terms as the following are included: *home, family, democracy, security, parent*.

Students may have difficulty with:

Synonyms--for example, colors next to each other on the color wheel may be referred to as neighboring, adjacent, or analogous. Different references may use different terms. Students may need help in recognizing that the terms mean the same thing.

In defining words, the dictionary may give synonyms which are only approximate in meaning. A student may need guidance in using the synonyms in appropriate ways.

Homonyms; a homonym is a word having the same pronunciation as another, but differing from it in origin, meaning, and often, in spelling. Examples in the field of home economics include:

baste, as in "baste the seam"
baste, as in "baste the roast"

whip, as in "whip the cream"
whip, as in "whip the raw edge of the seam"

cube, as in "cube the cheese"
cube, as in "ice cube"

fold, as in "fold in the dry ingredients"
fold, as in "fold the towels"

pear, as in "eat the pear"
pair, as in "pair of shoes"
pare, as in "pare the pear"

Words which may be ambiguous in meaning--as value words and certain words which denote quantity, such as *some, many, much, several*.

Ways of clarifying meanings

In helping students to understand word meanings, the following means of defining may be used:[1]

1. *By genus and differentia*. For example, "An orange is a citrus fruit, botanically a berry, that is nearly globose in form and orange in color."
2. *Comparison*. "Like a grapefruit, only, as a usual thing, smaller and orange rather than yellow."
3. *Synonym*. "Ascorbic acid for vitamin C."
4. *Pointing*. "That is an orange."

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[1] Burton, William H., Kimball, Roland, Wing, Richard L., *Education for Effective Thinking*, Appleton-Century-Crofts, Inc., 1960, p. 184.

5. Example. "A mandarin is one of a group of Chinese oranges."
6. By direct observation or demonstration--quartering and eating an orange.

A closing note

The teacher will doubtless find new and creative ways of helping students to develop concepts and generalizations. The foregoing suggestions may serve as a beginning in this important undertaking!

Learning Experiences

Thus far, we have considered educational objectives and content as aspects of curriculum development. A third major part of any curriculum plan is learning experiences. In their selection, the following guides may be helpful:

- Learning experiences should contribute toward the achievement of the objectives. They should be appropriate to the objectives.

  Let us consider what this means. An educational objective has two aspects, a behavioral aspect and a content aspect. For example, in the objective, "Knowledge of criteria for the evaluation of family television programs," knowledge is the behavioral aspect and criteria for the evaluation of family television programs is the content aspect. Using the taxonomy of educational objectives, cognitive domain, this objective would be classified as 1.24 Knowledge of criteria.[1] This analysis aids in determining what learning experiences may be most meaningful in working toward the objective. Since, in this case, it is knowledge which concerns us, we know that recall is involved. The learning experience, then, may be one which helps the student develop awareness of criteria for evaluating family television programs and recall these when the situation calls for this knowledge.

  Now, on a higher level, an appropriate objective would be, "Ability to evaluate family television programs." Ability to evaluate is the behavioral aspect; family television programs is the content aspect. The objective would be categorized as 6.20 Judgments in terms of external criteria.[2] At this level, one is concerned with "evaluation of material with reference to selected or remembered criteria."[3] The learning experience should be such that the student is afforded the opportunity of applying her knowledge about the criteria as she actually has the experience of evaluating family television programs. Developing ability calls for performance opportunity--in this case, guided performance which is then discussed as the student is helped with the application involved in the situation, all of which should lead toward development of the judgment called for at this advanced level.

- Learning experiences should lead to the development of significant content.

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[1] Bloom, op. cit., p. 203.

[2] Ibid., p. 207.

[3] Ibid., p. 207.

Students should have opportunities to arrive at their own conclusions. They will need help in understanding the bases for sound conclusions. Such questions as the following may be helpful: Is there evidence in research or accepted theory for the conclusion? Does one's own direct experience or observation tend to support the conclusion? Is it a conclusion that is generally applicable in situations similar to the one where it was developed?

- Learning experiences should be suited to the needs and concerns of students.

  Professor Hazel Spitze dealt with this point in some detail in the *Illinois Teacher*, No. 3 of this volume.

- Learning experiences should provide for continuity and sequential development.

  The discussion of "levels of generalization" in the section of this article on developing concepts and generalizations is relevant here.

- Learning experiences should provide for variety with respect to media and senses employed.

  Thus, provision may be made for individual differences in ways of learning and for greater student interest.

- Resources should be available for carrying out the learning experiences.

  However, one should not easily be daunted by a lack of resources. Frequently these can be obtained with some effort--or one may improvise resource materials that will serve the purpose.

- Learning experiences should provide for student development in ability to think and allow for development of problem-solving ability.

- Learning experiences should contribute to interest in and desire for more learning.

Helpful in planning learning experiences is the reference, *Techniques for Effective Teaching*, a publication of the Department of Home Economics, National Education Association. It is available for 75¢ from the Department of Home Economics, NEA, 1201 Sixteenth Street, NW, Washington, D.C.

Teaching Aids and Facilities

A fourth major factor in planning for teaching is that of teaching aids and facilities. A whole new array of teaching (or, if you prefer, *learning*) tools is available to teacher and student. Teaching machines, films, recordings, educational television--these are among the aids that offer promise for more effective teaching and learning. Lee A. DuBridge, President of the California Institute of Technology, states that:

> We are only beginning to learn how to use these tools effectively. They are too often regarded as devices to replace the teacher--a wholly false conception. A hammer and saw do not replace the carpenter; a typewriter does not replace a secretary. A new tool is a new opportunity for doing a better job, provided only we learn how to use it.[1]

The primary consideration in selecting teaching aids is the contribution they may make toward the attainment of the objectives. Certainly, a teacher who is well-informed regarding the various aids available and who is able to use them effectively will be equipped to select better those that are suited to the objective and the related content and learning experiences.

Professor Mary Mather dealt with the problems of selecting and using teaching aids in her article, "A Look at Resources for Teaching Home Economics," in the Illinois Teacher, Vol. VI, No. 9. Since copies of this publication are still available, a detailed discussion of teaching aids will not be included here.

However, a few comments regarding instructional areas may be appropriate. Certainly it is a truism that "Instructional areas should be planned in terms of the curriculum rather than the curriculum adjusted to fit the space and equipment provided in the instructional areas." Realistically, one has to think--at least to some extent--of the space and equipment available as curriculum plans are developed. But, very real danger lies in making too many concessions to outmoded facilities or (worse yet) using them as an excuse for retaining what is no longer appropriate in the content of the program.

Provocative reading for the teacher taking a long and serious look at teaching aids is Marshall McLuhan's "Understanding Media: The Extensions of Man."[2] It opens new avenues of thought concerning the nature of some of the newer media that we are employing in the teaching-learning situation.

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[1] DuBridge, Lee A., "The Teaching Profession--Forty Years of Change," The Changing Face of Teaching, Addresses and Discussions of a Teaching Career Month Symposium, Sponsored by the National Education Association, Washington, D.C., April 8, 1965, p. 34.

[2] McLuhan, Marshall, "Understanding Media: The Extensions of Man," McGraw-Hill Book Co., New York, 1964, 364 pp.

Facilities for today's home economics program were discussed in the Illinois Teacher, Vol. VIII, No. 2.[1] Volume VIII of the publication is being reprinted and copies will be available soon again.

Means of Evaluation

Determining the means of evaluation to be employed is a fifth major task in developing curriculum plans. The seven basic steps[2] involved are:

1. Formulation of a statement of objectives.

2. Classification of objectives in [illegible] major types. (Invaluable tools at this stage are the classification systems for educational objectives developed by Bloom, Krathwohl and others.[3])

3. Defining of each objective in terms of behavior.

4. Suggesting of possible situations in which these behavior patterns may be exhibited.

5. Selection and trial of promising methods for obtaining evidence regarding each objective.

6. Selection on the basis of this preliminary trial the more promising appraisal methods for further development and improvement.

7. Devising of means for interpreting and using the results of the various instruments of evaluation.

Some means of collecting evidences of student progress toward objectives are:

anecdotal records
check lists
conferences with parents and students; notes from parents
diagnostic charts
diaries or "logs" (student records)
discussion
essay-type examinations

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[1] Barrow, Joseph and Elizabeth Simpson, "The Setting for the Home Economics Program at the Secondary Level," Illinois Teacher of Home Economics, Vol. VIII, No. 2, pp. 74-86.

[2] Tyler, Ralph W., Ch. 12, "Evaluation Must be Continual and Flexible; It Must Evaluate," General Education in the American High School, University of Chicago, Chicago, Illinois, 1942, pp. 290-308.

[3] Bloom, op. cit.; Krathwohl, op. cit.

informal conversations
observations of behavior
performance tests
personal interviews
problem situation tests--oral or written
questionnaires
rating scales
score cards
short-answer tests--multiple choice; true-false; completion

Looking at the Five Parts of the Curriculum Plan as an Integrated Whole

Experienced curriculum planners will find it impossible to think of one aspect of the curriculum plan without thinking of the others. In considering educational objectives, one is forced to think of the related content (suggested in the content aspect of the objective), the learning experiences for achievement of the objective, which are implied in the behavioral aspect. Looking at these factors leads naturally to a consideration of the teaching aids and evaluation. All of these considerations are rooted in the bases upon which curriculum decisions are made--such factors as the conditions of society and of families within the society, student needs, the local situation, and the structure of the field of study. In turn, these considerations are related to the curriculum planner's philosophy of home economics education, of home economics, of education, and of life itself.

Thus, curriculum planning is seen as a complex and demanding task. The complexity and challenge add to the fascination to be found in the task--and to the reward of seeing the plans work out in classroom operations.

Examples of Plans for the Home Economics Program

An example of an over-all plan for a home economics program has been given. Following is an example of a unit plan developed by graduate students (Peggy Carroll, Elda Kaufman, Betty McGhee, and Joy Plattner) at the University of Illinois in a class taught by Professor Hazel Spitze. Following the unit plans are examples of lesson plans.

The examples are presented for whatever interest they may have for the busy teacher engaged in her own tasks of planning for the year, the unit, and the day.

Personal and Family Relationships, Example of a Resource Unit

I. To increase understanding of myself

Content (as Generalizations)	Activities to Encourage Learning
1. Understanding self contributes to understanding and accepting others.	Students fill out questionnaire "All About Yourself," Illinois Teacher, Vol. II, No. 2.
	Take interest inventory to determine students' questions or problems related to this area.
	Teacher-student planning of objectives for unit.
	View Understanding Myself, McGraw-Hill Guidance Filmstrips, 330 W. 42nd St., N.Y. 36, N.Y.
2. Fulfillment of physical and psychological needs leads to individual development and satisfaction.	Bulletin Board - Use "pipe cleaner girl" as central figure. Students bring pictures to show how different needs are met; arrange pictures radiating from central figure. Use as basis for discussion.
	Observe a younger child (in elementary grades or at home or while babysitting). Did you see evidences of children's needs being fulfilled or ignored? How does this relate to your family life?
	Read a short story, magazine or a newspaper article, or a book about adults, young people, or children. Which of the basic needs are involved in the actions of the main character?
	Study the ads in popular magazines; find as many as you can whose appeal is to the needs we've discussed. Bring them to class for discussion and analysis.
3. Individuals face certain tasks in development which must be accomplished in order to progress to the next level of development.	Define the concept of "developmental task"; the term itself does not have to be used. One might refer to the tasks as "responsibilities for growing up."

Identify the developmental tasks of a:
baby
toddler
teen-ager
parent
grandparent

Roleplay several situations depicting teen-agers working at their developmental tasks, some of the hurdles which they encounter.

View filmstrip Learning to be Independent, Church Screen Productions.

4. Individuals differ because of heredity and environment.

Students take pretest on heredity and environment.

List the many ways you differ from a classmate of yours. From thinking about your parents and grandparents, which of the above traits might you have inherited?

View and discuss: Heredity and Family Environment, McGraw-Hill (film).

Heredity and Environment, National Repository of Tapes for Teaching, Kent State University, Kent, Ohio. (Send blank tape--tape recording.)

Discuss how certain adults have capitalized on physical characteristics or have overcome physical handicaps.

Stump, Al J., Champions Against Odds. (Macrae Smith Co., Philadelphia, Pa.) pamphlet.

A Desk for Billie, NEA, Washington, D.C.--film concerning environmental handicaps.

5. An understanding of how our bodies grow and change helps us accept our physical development.

Question box for anonymous questions about growing up physically.

Invite a doctor or nurse (possible Red Cross) to discuss physical changes.

	View and discuss film Farewell to Childhood, International Film Bureau, 6 N. Michigan Ave., Chicago 2.
6. Being able to recognize our feelings and control our actions contributes to personal satisfaction and acceptance by others.	Observe in elementary grades; describe any situation involving emotional control or lack of it. Buzz sessions - "Experiences in the family develop emotional control." Write down 3 things that have happened to you lately which aroused your emotions. Were the emotions destructive or constructive? How did you handle the situation? How did you feel when it was all over? Roleplay situations involving problems brought about by emotional immaturity--follow by class discussion: draw conclusions. Films: Control Your Emotions--Coronet Act Your Age--Coronet Toward Emotional Maturity--McGraw-Hill He Acts His Age--McGraw-Hill
7. Recognizing problems is the first step in solving them.	Use case studies from About You (Science Research Associates) to explain use of defense mechanisms. List defense mechanisms commonly used at school. Roleplay situations that illustrate each. Discuss situations in which these mechanisms are harmful. Develop and present a skit showing a teen-ager faced with a difficult situation; divide the class into small groups. Let each group make the decision. Compare results of various groups. Weigh the advantages and disadvantages of each decision. Facing Reality, McGraw-Hill (film).

Summarize unit by forming generalizations which would help a newcomer to our class better understand herself.

Class evaluate their progress toward objectives set up at the beginning of the unit.

II. To improve relationships with others

Content as Generalizations	Activities to Encourage Learning
1. Friends help satisfy basic psychological needs for security, a sense of worth, and mutually agreeable interactions with others.	Checklist to determine students' problems or concerns about family and friends. Teacher-student planning of objectives for the unit. Bulletin Board - "Why Bother With Friends?" Girl's puzzled face in center, question marks surrounding her. Through class discussion, remove the question marks and answer her question.
2. Making and keeping friends is easier if one develops certain attitudes such as: interest in other people, friendliness, cheerfulness.	Students fill out Dr. Laird's check-list, "Traits Which Make Us Liked by Others" (Guide for Teaching Personal and Family Relationships, pp. 35-36). Write a paragraph about a person who fits the following description: a) "You just can't help but love her." b) "She hasn't a friend in the world." Look through and select a story from Reader's Digest's "Most Unforgettable Character" which illustrates qualities which make a person likeable. Use students' selections as a basis for class discussion. Discussion: Is it better to have just one or two close friends or many friends? Discuss the advantages of each. Produce skit, "The Ins and Outs" (National Association for Mental Health, 10 Columbus Circle, N.Y. 19)

Film: Making Friends (Encyclopedia Britannica Films, Inc., 1150 Wilmette Ave., Wilmette, Illinois)

Filmstrips:
- As Others See You, McGraw-Hill
- Making People Like You, Church Screen Productions
- Polish Up Your Personality, Church Screen Productions

3. Manners are based upon consideration of others, kindness and respect.

Discuss the reasons and bases for manners. Maybe students could write their own "rulebook."

Roleplay specific situations such as introductions, eating out, accepting or refusing a date. Compare role-playing with similar situations in the following films.

Films:
- Mind Your Manners, Coronet
- Social Courtesy, Coronet

Filmstrips:
- Developing Social Maturity, McGraw-Hill
- Why Have Manners, Eye Gate House, Inc.
- Table Manners, Eye Gate House, Inc., 2716 Forty First Ave., L.I.C., N.Y.

Collect current articles and cartoons on etiquette from newspapers and magazines. Post them on the bulletin board for reference when writing advice for the etiquette questions that come from hypothetical situations.

4. Understanding family members contributes to the improvement of family relationships.

Panel Discussion - "What Parents and Teen-Agers Expect of Each Other." Invite two parents to participate along with two students.

Students select a committee of class members to prepare a "Declaration of Rights and Responsibilities for Today's Teen-Agers."

Consider ways of developing parent-youth code for our own community. Begin work on such a code.

Skit, "High Pressure Area" (Mental Health Material Center, Inc., 1790 Broadway, N.Y. 19) as a basis for class discussion of parent-teenager relations.

Films:
  You and Your Family, Associated Films, 291 Broadway, N.Y. 17)
  Family Life, Coronet
  Parents Are People Too, McGraw-Hill
  A Date With Your Family, International Films

Filmstrips:
  Your Job as Big Brother or Sister, Chas. A. Bennett Co., Inc.

Conduct a class poll to determine those who are youngest in family. Ask each one to discuss position of youngest as he sees it. Compare agreements and disagreements. Do the same for oldest, middle, and only child. Discuss different ways people feel about their place in their own families.

Film:
  Sibling Relations and Personality, McGraw-Hill

5. Development of special interests by a family promotes personal satisfactions and enriches family living.

Tape Recording: *Family Recreation* describes some ideas for family recreation and the value of doing things together.

Plan, carry out, and evaluate an activity which your family will enjoy together.

Film: *Family Outing* ($1.25 rental from University of Utah). Discuss purposes family vacation serves.

By "Brainstorming" determine a list of things teen-agers could do to make more leisure time for all members of the family.

Discuss advantages and disadvantages of commercial, out-of-the-home entertainment and compare with family entertainment in the home. Plan an evening of entertainment for the family.

6. If responsibilities are accepted, privileges are more likely to be granted.

<u>Skits</u> about family life: (State Director of Home Economics Education, Carson City, Nevada)
"Always the Garbage"
"Mother and Dad Are People Too"
"Bob Disobeys Orders"
"Please Pick Up Your Own Clothes"
Discuss situation, reasons for conflict, ways to solve problems.

Film: <u>Sharing Work at Home</u>, Coronet. Follow with discussion. Plan ways you could make better use of time, money, energy, for greater satisfaction.

Girls answer roll call by naming a family responsibility. Arrange them in chart form as follows:

Responsibility	Father	Mother	Student
1. Wash Dishes			X
2. Make beds	X	X	X

7. Conflict exists in families because of the differences among family members.

Roleplay:
  a) family making decisions as to where to go on vacation
  b) family deciding on how responsibilities will be shared now that Mother has gone back to work.

Film: <u>Age of Turmoil</u> (U. of Utah, $3.25). Discusses causes of conflict.

Write a paper showing how you differ from a brother or sister in functions performed at home, at school, or at work; in your needs and desires; in expressions of emotions. Have these differences led to any conflict you are aware of in your family?

8. There are many patterns for family life; it is the responsibility of each family to develop a pattern which meets its needs.

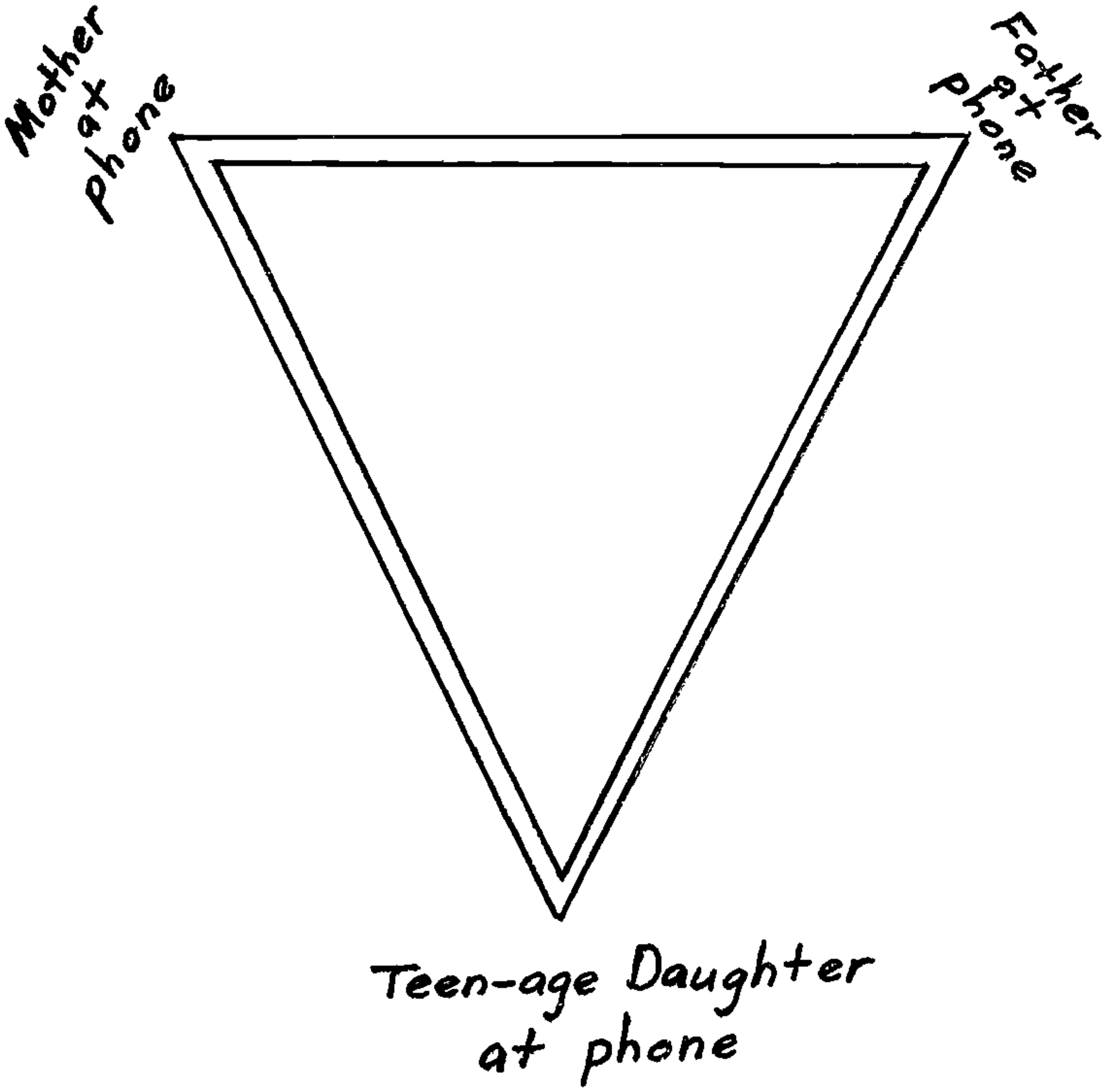
Discuss in buzz groups ways your families differ; each group summarize and report differences. Make list on board. Develop generalizations regarding differences.

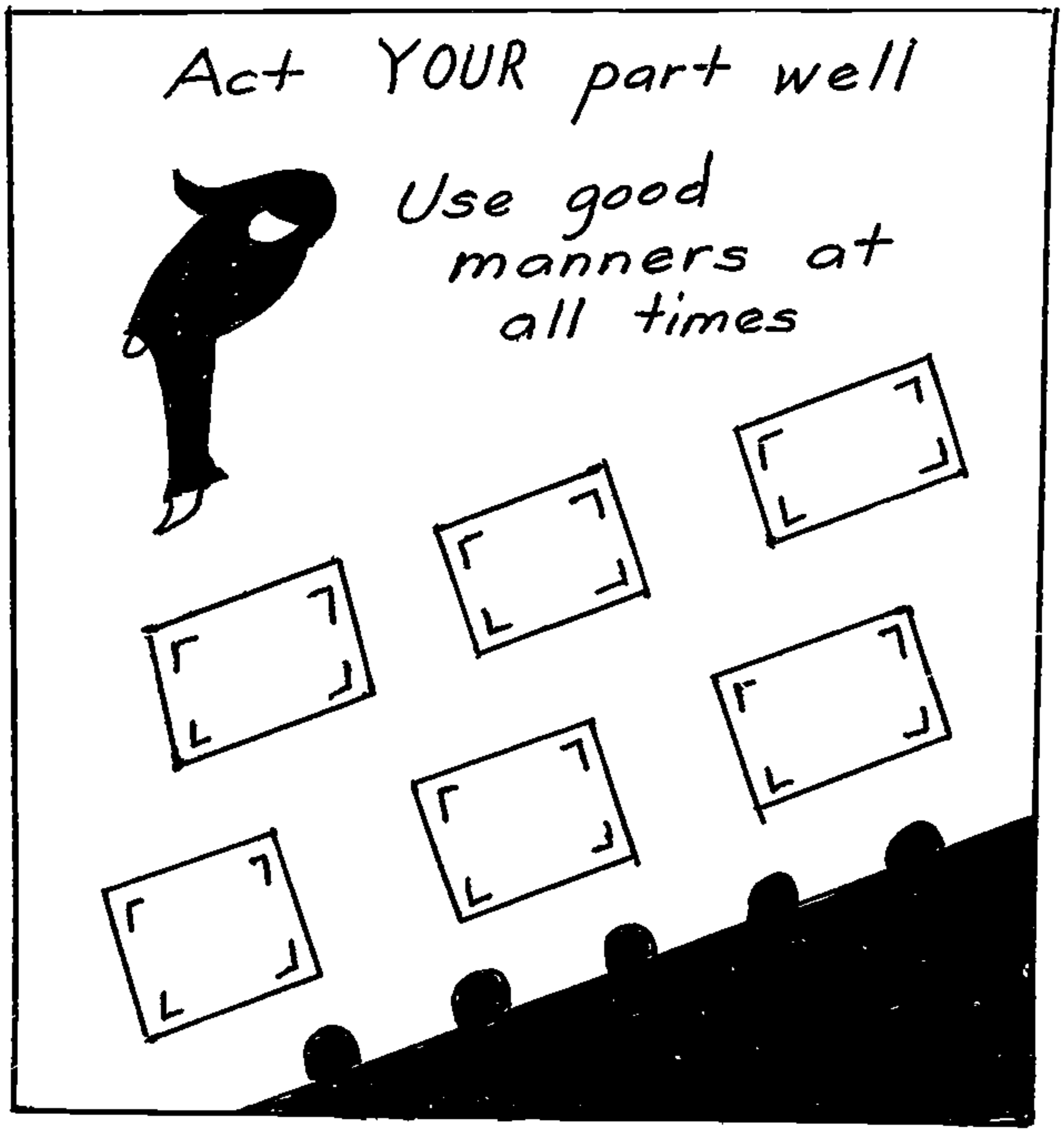
Summarize unit by developing generalizations regarding you and your relationships with others.

Students evaluate growth towards objectives set up at beginning of unit.

BULLETIN BOARD IDEAS

Keep Family Lines of Communication Open





- Use six pictures from books or magazines that illustrate good manners and the occasions where good manners should be practiced.

- Use black sketches for the actor and the theater audience.

- Keep it simple.

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Guide to Good Manners, Mary Beery, Chicago: Science Research Associates.

How to Live With Parents, Life Adjustment Pamphlet, Chicago: Science Research Associates.

How You Grow, Bernice Naugarten, Chicago: Science Research Associates.

Making and Keeping Friends, William Menninger, Chicago: Science Research Associates.

Life With Brothers and Sisters, Chicago: Science Research Associates.

Understanding Yourself, William Menninger, Chicago: Science Research Associates.

Where Are Your Manners?, Barbara Hertz, Chicago: Science Research Associates.

Films

Date With Your Family - 10 minutes - Instructional Films. Some relationships within a family are described to show how consideration and kindness can help in developing understanding among family members.

Developing Friendships - 10 minutes - Coronet. Shows how one teenager learned to be a friend and to make friends among others of different backgrounds and personalities.

Dining Together - 11 minutes - Instructional Films. Shows the manners and conduct of two boys at a family Thanksgiving dinner at which guests are present. The pleasure in knowing how to behave correctly is emphasized.

Good Table Manners - 11 minutes - Coronet. Good table manners depend primarily upon attitude. Here this important factor is developed by showing that table manners are matters of courtesy, consideration for others and common sense.

Family Life - 11 minutes - Coronet. Explains how the Miller family manages to have the time and money "to have fun." They plan cooperatively their schedules, responsibilities, privileges, and finances in order to gain the happiness a family should have.

Family Teamwork - 17 minutes - Firth Films. Illustrates the teamwork in the Garman family of five who specialize in raising prize milk goats. Bill, about twelve, and teenage Barbara help with the housework and feed and milk the goats. The parents provide for the family's needs and help the children get their goats ready to show at the 4-H exhibit. Ends by showing the group at a pleasant evening meal followed by an evening of recreation centered in the home.

Friendship Begins at Home - 15 minutes - Coronet. This film presents a boy who learns to appreciate his family. It is directed to the adolescent, illustrating the importance of friendship in the home and the fun of doing things with the family group.

Fun of Making Friends - 11 minutes - Coronet. Introduces Joey first as a social outcast because he does not consider the feelings of his classmates. But, eager for personality development, he has a heart to heart talk with his mother and the next day puts into practice new rules of conduct that bring gratifying results.

Making Friends - 11 minutes - Encyclopedia Britannica. Three high school students learn how to work out their problems in making and keeping friends.

Mind Your Manners - 10 minutes - Coronet. Shows a high school boy and his sister discovering the correct ways to act when with friends, at home, at school and on a date.

The Family - 18 minutes - Herbert Kerkow Production. Presents a day in the life of an American family, with its needs, disagreements, and solutions. The grandmother is very much a part of the family and each member has rights and responsibilities. Shows the importance of a feeling of belonging to a family and that problems may be met by cooperation.

You and Your Friends - 7 minutes - Associated Films. A film showing a teenage party. Friendly cooperation is contrasted with self-centered bad manners. The audience is asked to evaluate different types of behavior and is encouraged to select and remember those qualities needed by one to be a friend and to have a friend.

Other Films

As Others See You - 35 frames - McGraw-Hill
How Can I Understand Other People - 41 frames - McGraw-Hill
Is Your Home Fun - 50 frames - Pilgram
Making Friends - 32 frames - Jim Handy Organization
Making Friends Is Easy - 45 frames - McGraw-Hill
Parents are People Too - 41 frames - McGraw-Hill
Personal Relationships - 38 frames - McGraw-Hill
You and Your Family - 32 frames - Jim Handy Organization

Suggestions for General Reading
(Concerning Family Life)

Alcott, Louisa, Little Women
Austen, Jane, Pride and Prejudice, New York: Rinehart
Austen, Jane, Sense and Sensibility, New York: Dutton
Benson, Sally, Meet Me in St. Louis, New York: Random House
Bell, Margaret, Ride Out the Storm
Buck, P. S., The Good Earth, New York: Grosset and Dunlap
Cronic, A. J., The Green Years, Boston: Little, Brown
Daly, Maureen, Seventeenth Summer, New York: Dodd, Mead
Davis, Clyde B., The Newcomer, New York: Lippincott
Day, Clarence, Life with Father, New York: Knopf

Day, Clarence, *Life with Mother,* New York: Knopf
Durell, Ann, *My Heart's in the Highlands,* New York: Doubleday
Fisher, D. C., *The Bent Twig,* New York: Holt
Forbes, Kathryn, *Mama's Bank Account,* New York: Harcourt, Brace
Fox, Genevieve, *Bonnie, Island Girl,* Boston: Little, Brown
Freedman, Benedict, and Freedman, Nancy, *Mrs. Mike,* New York: Coward-McCann
Gilbreth, F. B., Jr. and Carey, E. G., *Cheaper by the Dozen,* New York: Crowell
Hilton, James, *Random Harvest,* Boston: Little, Brown
Holiday, Philip Harking, *Knockout*
Kesinger, Grace Gelvin, *More Than Glamour,* Nelson
Lewis, Sinclair, *Kingsblood Royal,* New York: Random House
Llewellyn, Richard, *How Green Was My Valley,* New York: Macmillian
Morrow, H. W., *Demon Daughter,* New York: Morrow
Rolvaag, O. E., *Giants in the Earth,* New York: Harper
Saroyan, William, *The Human Comedy,* New York: Harcourt, Brace
Seller, Naomi, *Cross My Heart,* New York: Doubleday
Tarkington, Booth, *Alice Adams,* New York: Doubleday, Page
Tarkington, Booth, *Seventeen,* New York: Grosett and Dunlap
Taylor, Rosemary, *Chicken Every Sunday,* New York: McGraw-Hill

EXAMPLES OF LESSON PLANS MAKING USE OF THE STRUCTURED SET OF QUESTIONS WHICH MAY SERVE AS A GUIDE IN DEVELOPING GENERALIZATIONS WITH STUDENTS

(Please refer to page 246)

EXAMPLE I:

The following lesson plan, developed by Elizabeth Simpson, makes use of minute dramas written by Ann Montgomery Gerteis, formerly research assistant in the Division of Home Economics Education, University of Illinois, and now a full-time homemaker and mother.

EXPLORING VALUES THAT INFLUENCE CHOICES IN THE AREA OF HOME FURNISHINGS

Unit: The Home and Its Furnishing

Lesson Plan

Objectives:

1. Understanding of certain values that affect choices in the area of home furnishings.

2. Some understanding of the sources of these values.

3. Increased understanding of and respect for other peoples' values and ways of expressing them.

4. Increased understanding of own values.

Activities and Procedures:

1. Introduction: "Previously we discussed some of the factors to be considered in planning home furnishings. We mentioned the makeup of the family with respect to (1) number in family, (2) ages, (3) sex of family members, (4) interests, and (5) activities. We discussed the income of the family as a factor to be considered. The art principles and their application have also been discussed as considerations in making home furnishing decisions."

   "Now, there is another very important consideration that we haven't even mentioned. All of us prize certain things or ideas in life. What we prize enters into our choices in all areas of living--whether we are selecting a dress, or a house, or deciding how to discipline a child."

   "Let's look at a typical family situation and see what the mother prizes that will enter into her decisions about home furnishings."

2. Students present Minute Drama I (see page 277)

3. Discussion:

		Discussion guide	Content
(Guide,) pt.1	A.	"What did the mother prize?"	sentiment her relationship with her husband
(Guide,) pt.2	B.	"These things that we prize are also called our values. Have you known people who held values similar to those of the mother? Tell us about them."	
(Guide,) pt.3	C.	"Why do you think that the perfume bottle seemed so important to the mother? Let's speculate about this a little."	Perhaps the husband gave it to her for some special occasion--and, therefore, it has a sentimental attachment for her. The perfume bottle itself is not a value, but it is an expression of a value.
	D.	"Let's explore this matter of values in relation to home furnishing a bit more. Suppose we act out some other situations in which values are involved."	

4. Students present Minute Dramas II-VIII (see pages 277-279)

5. Discussion questions for each:
(Guide,) pt.1 A. "What is the value presented here?" (list on board)
(Guide,) pt.2 B. "Do people you know hold similar values?"

6. Discuss: "Have we omitted from our minute dramas or discussion any values that influence choices in the area of home furnishings?"
(Guide,) pt.2
Aesthetics-Beauty
Relationships

7. "Where do these values come from? How do we get to be people who value beauty, or privacy, or comfort so much that our choices are influenced by these things that we prize?"
(Guide,) pt.3
Our experiences in the family and elsewhere. Values held by those who are models for us--parents, teachers, peers.

8. "Let's now take a more personal view of values related to the home. Let's suppose that you are out of high school and are going to a strange town to work or to go to school. What do you think that you would look for first of all in a room or apartment for yourself?" Discuss:

(Guide,) A. "What values would serve to guide you?"
pt.3 B. "How would these values influence your choices?"
C. "What are the possible sources of these values?"

Discuss--The same value may have a different degree of importance for another class member. Why? How does this affect decisions made in home furnishings?

9. "Suppose we summarize what we have learned up to this point about values in relation to home furnishings." (Write conclusions on board.)

(Guide,) A. What we prize (value) in life enters into our choices of
pt.4 home furnishings.
B. Many people hold the same values, but differences may be found in the relative importance they place on the values and the ways in which they express them.
C. People differ with respect to values because they have different backgrounds of experience; have had different people to imitate and with whom to identify; and have different needs and interests.
D. We gain increased understanding of other people as we gain an appreciation of what they prize (value).

10. "Now, let us look at what authorities in the area of home furnishings say about this matter of values."

(Guide,) Read Craig and Rush, Homes with Character, p. 3 (for example)
pt.5

11. "Do the conclusions that we drew still seem to be sound?" (Discuss)

12. "How may we apply these conclusions to our own lives?" (Discuss each.)

(Guide,)
pt. 6

Means of Evaluation:

Pencil-and-paper test on values that influence choices in area of home furnishings--perhaps, using case situations and having students to identify values held by different persons and discuss the possible influence of these values on choices.

Students' comments regarding their own and others' values and the influence of these on choices in area of home furnishings.

Minute Dramas for the Study of Values in Home Furnishings
by Ann M. Gerteis

Minute Drama I.

Scene: Mother is in the living room cleaning while the daughter cleans a bedroom.

Daughter: (As she runs into the living room) Mom, let us throw this old perfume bottle away. There isn't a thing in it. It's just a dust collector. I'm tired of cleaning it every week. I could see some purpose in keeping it if it were pretty. But, in my opinion, the shape is awful and it hasn't any purpose!

Mother: I wouldn't begin to let you throw that bottle out. Why, your father gave me perfume in it before we were married. It is quite dear to me. I always thought it was rather beautiful. (With a dreamy look in her eyes) I guess you'll just have to put up with my sentimentality.
(Value: Sentiment)

Minute Drama II.

Scene: Mr. Davis is in the living room resting and reading the paper after a hard day's work.

Wife: Dear, this may be the last evening you will be sitting in that old chair. Remember you said I could get some new furnishings? Well, I picked out a lovely chair down at Toble's for you dear. I'll be glad to get rid of that old one. Now, I'll move the couch here and--

Husband: (Interrupts) What did I hear--get rid of this chair? What is life coming to? A man can't even have a comfortable chair in his own home. We have had this chair for years, dear. I just can't see getting another one when this one is so comfortable.
(Value: Comfort)

Minute Drama III.

Scene: A neighbor is visiting in the kitchen.

Neighbor: Oh, I see you have put the washer and dryer in here. I can't understand why you put them in the kitchen. I always thought a person was supposed to do laundering in the basement.

Sue: I thought about putting them in the basement--but with the baby, I have to wash every other day. It is so much more convenient to have the washer and dryer in the kitchen.
(Value: Convenience)

Minute Drama IV.

Scene: Mother and daughter are having a discussion in the bedroom of daughter's new home.

Mother: I just can't see spending all that money for decorating this guest bedroom. My gracious, it's pretty, and I'll bet it is comfortable. But, all that expense for a guest room seems a bit foolish to me. Looks like you would have wanted to spend that money on your own room.

Daughter: Jack and I love having company. You can never tell when one of our friends or family is going to drop in. We enjoy having people, so we want to make their stay as happy and comfortable as possible. Just like when you and Dad drop in--we want to make you feel welcome.
(Value: Hospitality)

Minute Drama V.

Scene: Mrs. Brown is showing her new drapery material to her friend.

Friend: Ruth, I guess I like the fabric. In fact, it is quite nice. The beige color is pretty. It goes with everything. And I understand that it will wear and wear. I read an article in one of the magazines explaining that the fabric will not be hard to clean. But, I still keep thinking of that lovely, lovely piece of silk material I saw downtown at Larson's. It would be just perfect for your room. Oh, the material really had that expensive feel about it! Ruth, I'll bet you could take this material back and get the fabric at Larson's. Why don't you do that? I know you would rather have the silk.

Ruth: Jane, the expensive fabric would be nice. But, I'm very happy with what I bought. I would rather have this manmade fabric at a lower price than the silk. We need to spend the money on something else. I'm just trying to be economical.
(Value: Economy)

Minute Drama VI.

Scene: Aunt Jane is being shown the house for the first time.

Aunt Jane: Linda and Joan have separate rooms. Looks to me like it would be better if they shared a room. If the girls shared a room, there would be only one room to furnish.

Mrs. Liston: I know it would be easier. However, you must understand that both Joan and Linda like to be alone sometimes. We think this is important. They need the privacy that comes from having their own rooms.
(Value: Privacy)

Minute Drama VII.

Scene: It is moving day. John is in the den while his wife is upstairs.

John: Margaret, Margaret where did you put my rock collection? Yes, yes my rock collection. I want it in the den. This house won't seem like home without it.

Margaret: John, I think it is in the box in the basement. Yes, in the basement by the washing machine. It has a green cord around it. It is marked "rock collection." I'll be glad for you to get it in the den too. Having your hobbies around us will make this new house seem like home.
(Value: Special Interests)

Minute Drama VIII.

Scene: Helen and Mary are talking by the stairway of Mary's new home.

Helen: Mary, you know if you would just take down this rail, the appearance of the stairway would be much more pleasing.

Mary: Helen, I think you are right but it would be very unsafe without the rail. I certainly want my home to be safe for my family.
(Value: Safety)

EXAMPLE II:

COMMUNICATING NON-VERBALLY

Unit: Relationships at home, at school, and at work.

(Note: This has been taught as a demonstration lesson with junior high school girls as the students. Slides were used to illustrate the various aspects of non-verbal communication. We have had the color slides converted to 2" by 3" photographs. The photographs follow the lesson plan in the sequence in which they were used in the lesson. The quality is somewhat poor since the process used in duplicating the Illinois Teacher results in another conversion--from color to black and white. Nevertheless, we hope that the idea may be conveyed. Perhaps a teacher will wish to prepare her own slides or drawings using her own students as subjects. This lesson plan also makes use of the article "We Speak--In Silence," which appeared in the Illinois Teacher, Vol. IX, No. 4.

Objectives:

1. Increased understanding of ways of communicating with others at home, at school, and at work.

2. Some understanding of the concept of non-verbal communication.

3. Some appreciation of the role of non-verbal communication in human relationships.

ACTIVITIES AND PROCEDURES	CONTENT
1. Our topic for this lesson is: Communicating Non-verbally.	
2. Perhaps we should first make sure we understand the meaning of the term, communication.	Communication is the act of exchanging thoughts, opinions, and feelings. It means making common to both parties involved the knowledge or quality conveyed, to impart what is known or felt to another.
3. What are some of the ways in which we communicate with others?	Talking, writing letters, giving someone something we want her (him) to read; these are the verbal means of communication.
4. Let us look at some of the ways in which people communicate without words.	
a. Here we have a young woman who is going to a job interview.	
Guide Ques. 1 What feelings is she communicating through her posture?	Slide 1, Dejection, lack of confidence Slide 2, Pleasant anticipation, self-confidence
Ques. 1 Have you noticed people who conveyed certain feelings through the way they stood or walked? Tell us about them.	
5. Ques. 1 Here is a young lady who is showing how some students sit in class. What does her posture say to you?	Slide 3, Disinterested or very tired
Here she is again, but this time her posture says to us that she is eager and interested.	Slide 4, Alert and interested
Ques. 2 Have you noticed that your posture may reflect how you feel in a particular class? Did you notice any examples of posture communicating feelings in your afternoon classes?	
6. The next three slides show a teacher standing before her class.	Slide 5, Sense of authority Slide 6, "Closed up," feeling, distance, aloofness

Activities and Procedures	Content
Ques. 1 What does she seem to be communicating in each case?	Slide 7, Permissiveness
Ques. 3 We are not in complete agreement about what is communicated. Why do you suppose this is true?	We may perceive things differently because of our different experiences, interests, needs, and values.
7. Ques. 1 Here are two pictures of a pleasant couple enjoying each other's company. Then, along comes someone they dislike. What happens?	Slides 8-10, It looks as if the man and woman withdraw and wrap themselves up protectively when the third person joins them.
Ques. 3 Let us suppose that the third person opened the door when she came into the room and let in a blast of cold air. Could we then conclude that the man and woman were necessarily rejecting the woman who joined them?	The context in which communication occurs is a factor in interpreting its meaning.
8. Thus far, we have seen that people may communicate through posture and gestures. This next slide shows how touch may communicate a feeling--perhaps, in this case, reassurance and encouragement.	Slide 11, Encouragement, reassurance
9. Ques. 3 Do dress and makeup tell anything about us?	Slide 12
Of course, communication is a two-way process. We are communicating something of ourselves through our dress and makeup but in receiving impressions, we are also involved in the communication process. And how we "see" these two young women is a reflection of us. As we said earlier..........................	We may perceive things differently because of our different experiences, interests, needs, and values.
10. Another way in which we communicate is through the use we make of time.	Slide 13

Activities and Procedures	Content
Ques. 2 Can you think of any examples you have seen of ways in which people communicated through their use of time?	
11. The use we make of space also conveys meanings. These two slides show North American conversational distance. We are comfortable talking when people are about as far apart as those in the two pictures.	Slides 14 and 15
But, the South American is uncomfortable at that distance. He wants to get closer.	Slide 16
Ques. 3 What feelings are conveyed to the North American when people get very, very close to talk?	They are either very fond of each other, or angry with each other!
12. This last picture shows a charming young teacher with her husband. Through her interested expression and expressions of warm concern she conveys love and support.	Slide 17
13. Let us take a thinking minute. What general conclusions can we Ques. 4 draw from our slides, from our personal observations of people communicating non-verbally, and from our discussions this evening?	People communicate with each other both verbally and non-verbally. We communicate with others by means of posture, gestures, touch, dress and makeup, and use of time and space. How we perceive what is communicated is a function of our experiences, needs, interests, and values. Context is a factor in interpreting the meaning of what is communicated.
Ques. 4 What difference does non-verbal communication make in our relationships with others?	The way in which we communicate non-verbally affects our relationships with others.
14. Our textbooks did not have anything on non-verbal communication, so I wrote something on the subject and had it duplicated for	

Activities and Procedures | Content

you. I did have a source of
some authority for what I
wrote: Hall's little book,
Lead. <u>The Silent Language</u>.
to
Ques. Suppose you read this for tomorrow
5 and we will check our conclusions
and see whether they still seem
sound. For tomorrow, also consider how we might get these
ideas we have developed here
Lead. into our own living.
to
Ques. What difference will it make
6 in your relationships with
your family and friends now
that you have these understandings about non-verbal communications?

MEANS OF EVALUATION: Pencil-and-paper test calling for application of generalizations to problem situations.

Informal comments of students regarding their applications of understandings about non-verbal communication to personal situations.

Slide 1--
dejection, lack of
confidence

Slide 2--
pleasant anticipation,
self-confidence

(posed by Mildred Griggs)

Slide 3--
disinterested,
or very tired

Slide 4--
alert and interested

(posed by Nancy Carlson)

Slide 5--
sense of authority

Slide 6--
"closed up" feeling,
distance, aloofness

Slide 7--
Permissiveness

(posed by Ruth Whitmarsh
Midjaas)

Slides 8-10
They were enjoying each other's company; then they were joined by someone they dislike!

(posed by Alice and Ben Cox and Elizabeth Simpson)

Slide 11--
encouragement and reassurance

(posed by Eva Moore and Mildred Griggs)

Slide 12--
dress as a factor in
non-verbal communication

(posed by Alice Brunner
and Alice Cox)

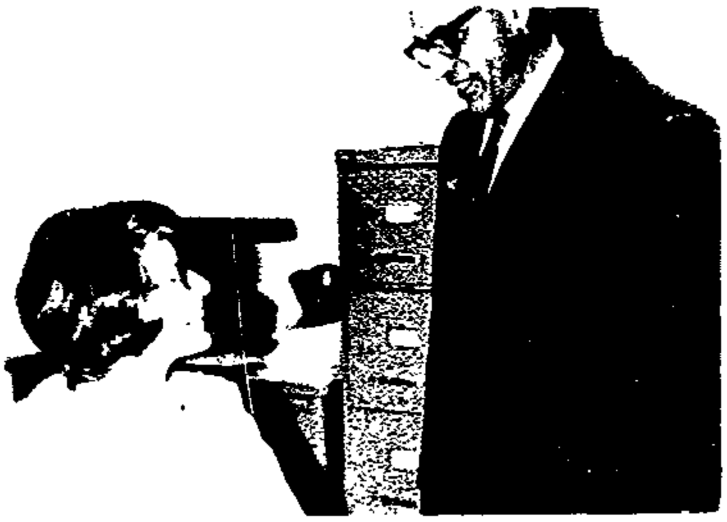
Slide 13--
Eva Moore checks her
watch--use of time is
a way in which one
communicates non-verbally

Slide 14--
comfortable conversational
distance for the North
American

(posed by Professor Lloyd
Phipps and Cindy Turley,
secretary and student)

Slide 15--
comfortable conversational distance for the North American

(posed by Professor Simpson and Ruth W. Midjaas)



Slide 16--
in some cultures, people like to get very close when they talk

(posed by Professor Phipps and Miss Turley)

Slide 17--
expression of affection and support

(posed by Frances and Limuel Dokes)

VT002 531

VT 002 531
Vocational Technical Educational and Development Project, Washington State University. Programed Instruction for Vocational Agriculture Teachers.

Long, Gilbert
Washington State Univ., Pullman. Coll. of Education
Washington State Board for Vocat. Educ., Olympia

Pub Date - 66
MF AVAILABLE IN VT-ERIC SET 213p.

*PROGRAMED UNITS, *VOCATIONAL AGRICULTURE, *PLANT NUTRITION, *LAND JUDGING, YOUTH CLUBS, FEEDS, *ANIMAL SCIENCE, GRADE 9, GRADE 10,

Programed instruction materials in seven agricultural subject areas for ninth and 10th grade vocational agriculture students were developed by a teacher educator in consultation with subject matter specialists. The material was tested in 10 schools, revised, and pilot tested in 16 schools. Each of the seven units includes a statement of purpose, a pretest, a posttest, the program frames, information panel, and an answer sheet. The units are (1) animal nutrition, (2) feed characteristics, (3) vitamins, (4) minerals, (5) plant nutrition, (6) land judging, and (7) Future Farmers of America. The material is intended as a supplemental instructional aid. It was designed for use in one-half hour blocks of time for a total of 12 to 16 hours. Teachers using the material should be familiar with the proper utilization of programed materials. (JM)

AGRICULTURAL
EDUCATION

PROGRAMED INSTRUCTION FOR VOCATIONAL AGRICULTURE TEACHERS

COLLEGE OF EDUCATION
WASHINGTON STATE UNIVERSITY
PULLMAN, WASHINGTON

GILBERT A. LO

IN COOPERATION WITH
THE STATE BOARD FOR VOCATIONAL EDUCATION
OLYMPIA, WASHINGTON

1966

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VOCATIONAL TECHNICAL EDUCATIONAL

AND DEVELOPMENT PROJECT

WASHINGTON STATE UNIVERSITY

Programed Instruction
for
Vocational Agriculture Teachers

Gilbert A. Long
Agricultural Education
Washington State University

MEMORANDUM

TO: The ERIC Clearinghouse on Vocational and Technical Education
The Ohio State University
980 Kinnear Road
Columbus, Ohio 43212

FROM: (Person) Gilbert A. Long (Agency) Washington State University

(Address) Pullman, Washington 99163

DATE: February 15, 1968

RE: (Author, Title, Publisher, Date) Gilbert A. Long, Programed Instruction For Vocational Agriculture Teachers, Washington State University, 1966

Supplementary Information on Instructional Material

Provide information below which is not included in the publication. Mark N/A in each blank for which information is not available or not applicable. Mark P when information is included in the publication. See reverse side for further instructions.

(1) Source of Available Copies: ERIC Only (We will service individual orders for a limited time.
Agency Agricultural Education, Washington State University, Pullman, Wn.
Address Pullman, Washington 99163
Limitation on Available Copies 15 Price/Unit Free
(quantity prices)

(2) Means Used to Develop Material:
Development Group Gilbert A. Long, member of Wn State Research and Development
Level of Group Assistant Professor, Agricultural Education
Method of Design, Testing, and Trial Designed by subject matter specialist-teacher trainer with advice of college subject matter specialist, tested on 10 vocational agriculture teachers' students, revised, pilot tested with 16 schools.

(3) Utilization of Material:
Appropriate School Setting Secondary school vocational agriculture students
Type of Program High school vocational agriculture
Occupational Focus Production agriculture and ag related occupations
Geographic Adaptability No established limits
Uses of Material Student activity to complement lesson presentations
Users of Material Secondary students, junior college students.

(4) Requirements for Using Material:
Teacher Competency familiarity with proper utilization of programed instruction.
Student Selection Criteria Land judging - sophomore minimum feed characteristics - freshmen, vitamins and minerals - sophomore minimum
Time Allotment By 1/2 hour maximums, a total of 12-16 class hours

Supplemental Media -- Transparency Masters for Vocational Agriculture and Transparency Master Supplement
Necessary ______) (Check Which)
Desirable ______)

Describe

Source (agency) Agricultural Education, Washington State University
(address) Pullman, Washington 99163

(5) The author's experience with this programed instruction indicates the necessity of limiting student exposure to from 20-40 frames per class session. Good students should be allowed to read only--they need not take time to write each answer. This material's impact or demand for it, will not be clear until some way to make it available in quantity is identified.

PREFACE

This group of seven programs is the initial phase of a PROGRAMED INSTRUCTION DEVELOPMENT PROGRAM conducted under the auspices of the Vocational Technical Education Research and Development Project at Washington State University in cooperation with the State Board for Vocational Education.

The purpose of this developmental program is to; 1) develop a supply of up-to-date programed instructional materials 2) establish channels for the early development and adoption of instructional materials, including programed instruction and visual transparency masters to be used in logical systems of instruction. It is the further intent of the project to demonstrate the feasibility of utilizing programed instructional units in vocational agriculture.

The author will coordinate a sixteen-hour workshop on the principles, construction and specific usefulness of programed instruction in the vocational agriculture curriculum. This workshop is to be held July 25-29, 1966, as part of the Washington State Vocational Agriculture Teachers' Conference. This workshop group of approximately thirty teachers will identify felt needs for curriculum development and will begin to prepare instructional units for these areas. The author will edit and pilot test this material following the conference.

The group of programs herein are designed to complement present vocational agriculture curriculum. This material has gone through one pilot test and refinement. The vocational teachers within the "Workshop" will cooperate in a final pilot test. Pre-tests, post-tests, and answer sheets will be returned to the author for scoring, evaluation of the success in meeting stated objectives and for final editing of the programed material.

The foregoing procedure is intended to introduce programmed instructional materials to the vocational agriculture teachers in a useable form, develop basic programed instruction development skills and to identify and orient cooperating pilot testing schools for the programed instructional materials included herein.

INTRODUCTION

Programed instruction will not replace the vocational agriculture teacher, nor will it substitute by itself for a logically developed system of instruction. A system of instruction will employ the best instructional materials available, including texts, references, visuals, models, specimens and programed instructional materials.

Programed instruction does have a good future, according to the literature. Some of the merits claimed are that programs may be effective for use with the slow learner and programs may be used as a supplement for the gifted child. The same program may be effective for different grades at different ages. More specific to the programs included herein is the fact that knowledge can be gained by the student via programed material.

A textbook is written to provide a student with an avenue from start to finish in his study of a new subject. A "programed text" is written more specifically to a level of reading ability and is more explicit about the steps along the road. Each step is a numbered "unit" called a "frame," and care is taken to make sure that each step follows logically from the steps that have preceded it.

Some part of most frames is purposely left incomplete so that the student can supply the missing words from the knowledge he has recently acquired. These missing words are the "answers" which the student is asked to write down.

With this description of programed texts in mind, programed instruction advocates claim the following characteristics to be true:

1. Students move at their own speed.

2. Active participation on the part of the student is required. At least part of the frame requires a student response.

3. The subject matter is divided into small units called frames and small steps in learning result as the program moves from the simple to the complex. This is done in a careful sequence.

4. The student is provided immediate feedback reinforcement because the student is right a high per cent of the time. He is regarded or reinforced.

5. Revisions are based on student responses.

6. Programs are more carefully aimed at a particular ability level of student based on experimentation, not on opinion. This programed unit is designed for use by pilot schools as a part of the evaluation for final editing.

Your cooperation in supplying answer sheets, pre-tests, post-tests and written comments to the author will be appreciated.

TABLE OF CONTENTS

ANIMAL NUTRITION

PURPOSE

This is a programmed instruction unit titled "Animal Nutrition." This program is designed to introduce high school vocational agriculture students to a study of "Livestock Nutrition." This unit should be followed by "Feed Characteristics," "Vitamins," and "Minerals" programs in that order.

This program includes the following knowledges:

1. Chemical composition of plants and animals.
2. The animal nutritional requirements for maintenance, growth, fattening, production and reproduction.
3. Chemical composition of carbohydrates.
4. Feeds that supply carbohydrates.
5. Importance of proteins.
6. Amino Acids.
7. Protein concentrates.
8. Importance of fats as an energy feed.
9. Function of minerals.
10. Function of vitamins.
11. What a feed ration is and what a balanced ration is.
12. Importance of nutrition to fertility of livestock.
13. Some examples of practical "rules of thumb" for feeding different classes of livestock.
14. Economics of feed substitution within balanced rations.
15. The Pearson Square Method of finding the proportion or percentage of two (or more) feeds which, when mixed together, will furnish a desired per cent protein.

Name ________________________

PRE-TEST

NUTRITION

UNDERLINE THE CORRECT ANSWER.

1. Animals require nutrients to sustain life with no loss or gain of weight. This is called

   a. growth
   b. fattening
   c. maintenance
   d. production

2. __________ are the chief sources of heat and energy for animals.

   a. Minerals
   b. Carbohydrates
   c. Proteins
   d. Fats

3. The nutrients to provide milk and wool are called the requirement for

   a. reproduction
   b. fattening
   c. growth
   d. production

4. __________ include starches, sugars, and cellulose.

   a. Carbohydrates
   b. Fats
   c. Proteins
   d. Minerals

5. Feeds that are high in __________ include corn, oats, barley, and wheat middlings.

   a. protein
   b. fats
   c. carbohydrates
   d. minerals

6. The kind and quality of __________ are fully as important as the amounts.

   a. fats
   b. proteins
   c. minerals
   d. carbohydrates

7. __________ are the high energy compounds of feeds.

   a. Proteins
   b. Minerals
   c. Calcium
   d. Carbohydrates

Name ____________________

8. __________ are essential minerals for feeding livestock. (choose two)

a. Gold
b. Platinum
c. Sodium
d. Manganese
e. Silver

9. Fats supply __________ times as much heat energy as do carbohydrates.

a. 2.25
b. 2.50
c. 2.75
d. 2.00

10. __________ requirements vary according to what is created for "sale" by the animal (milk, wool, meat, eggs, etc.).

a. Maintenance
b. Production
c. Reproduction
d. Growth

11. A(n) __________ is the amount of feed nutrients in the proper proportion for a 24-hour period.

a. ration
b. balanced ration
c. adequate supply
d. increment

12. __________ are common protein supplement feeds. (Choose two.)

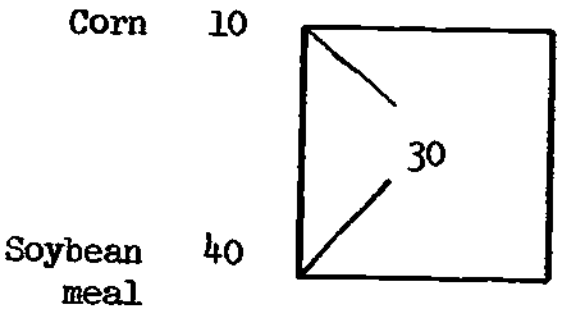
a. Barley
b. Oats
c. Cottonseed meal
d. Bone meal
e. Soybean oil meal
f. Corn

13. To reduce gain of bred sows or gilts, feed more __________ and less __________.

a. roughage
b. vitamins
c. protein
d. grain
e. minerals

Name ______________________________

14.



__________ parts of corn

(Fill in the blanks)

__________ parts of soybean oil meal

a. 10 parts corn
b. 70 parts corn
c. 10 parts soybean oil meal
d. 20 parts soybean oil meal

(underline two)

INFORMATION PANEL

This is a programed instruction unit for "animal nutrition." You will find it relatively easy to answer the questions in each "frame." This method of instruction will aid you to master the objectives listed if you apply yourself to the material.

You are provided with a program and a combination answer sheet and mask to cover the answers.

1. Place the mask (answer sheet) over the answer in a way that exposes one question (frame) at a time.
2. Write your answer on the answer sheet.
3. Move the answer sheet down to expose the next frame and answer to the previous frame.
4. Should your answer be wrong, write the correct answer above or along side--do not erase your incorrect answer.

Animal Nutrition

If you have not read the information panel, do so now, then proceed to frame 1.

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Nutrition, Continued

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60. ____

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water carbohydrates (organic matter) ash	1. Plants and animals are composed of (1) water, (2) organic matter, and (3) mineral matter or ash. Organic matter is composed of carbon united with hydrogen and oxygen and, in some cases, nitrogen and other chemical elements. Mineral matter is neither animal nor vegetable; it is an inorganic homogeneous substance. Plants and animals are composed of ________________, ________________, and ________________.
3/4	2. Carbohydrates make up about <u>three-fourths</u> of all the dry matter in plants, and they are the chief source of energy and heat for animals. Carbohydrates are composed of carbon, hydrogen, and oxygen. Carbohydrates form about ________________ of all dry matter in plants.
(1) water (2) carbohydrates (3) mineral matter or ash	3. Plants and animals are composed of (1) ________________, (2) ________________, and (3) ________________.
carbohydrates	4. Animal nutritional requirements are most conveniently spoken of as requirements for <u>maintenance</u>, <u>growth</u>, <u>fattening</u>, <u>production</u>, and <u>reproduction</u>. ________________ are the chief source of heat and energy for animals.
maintain	5. To sustain life with no loss or gain of weight requires sufficient feed to m________________ the animal

growth	6. In addition to a maintenance ration, an animal requires additional feed to put on weight and increase in muscle and bone. This is called a ________ requirement.
fattening	7. Increased fat deposition is obtained by satisfying a requirement for ________.
production	8. The nutrients to provide milk and wool are called the requirements for ________.
reproduction	9. The required feed nutrients needed for an animal to produce young are called requirements for ________.
maintenance growth production fattening reproduction	10. The nutrient requirements are classified by the functions of ________, ________, ________, ________, and ________.

no	11. A nutrient is any compound or group of compounds having similar chemical composition that aids in the support of life. Is beet pulp a nutrient?
nutrient	12. A compound or group of compounds having similar chemical composition that aids in the support of life is called a ______________.
carbohydrates proteins fats minerals vitamins	13. The different groups of nutrients are carbohydrates, proteins, fats, minerals, and vitamins. Copy these.
carbohydrates	14. Carbohydrates are the starches, cellulose, and sugars. ______________ make up 3/4 of all dry matter of plants.
carbohydrates	15. Feeds high in carbohydrates are the grains and their by-products such as corn, oats, barley, wheat middlings, and wheat bran, and the fiber portions of roughages. These grains and their by-products are high in ______________.

carbohydrates fats minerals vitamins proteins	16. The different groups of nutrients are ____________, ____________, ____________, ____________, and ____________.
protein	17. Proteins are compounds made up of amino acids. Proteins are particularly important nutrients needed for growth. Compounds made up of amino acids and important for growth are ____________. The kind and quality of protein is fully as important as the amount.
protein	18. The common protein supplements are soybean meal, cottonseed meal, linseed meal, tankage, meat and bone scraps, fishmeal and dried skimmilk. All common feeds contain some ____________ but not to the extent that those listed here do.
amino acids	19. Protein are very complex substances, made up of 24 or more different amino acids. In the digestion of food the proteins are split into these amino acids which are absorbed from the digestive system and enter the blood streams. ____________ ____________ are the component parts of protein.
fats	20. Fats in the forms of esters of fatty acids and glycerol are the high-energy compounds of feeds. They are also the carriers of many of the vitamins present in feeds. ____________ are the high-energy compounds of feeds.

blood stream	21. Minerals are the major elements of bones and teeth and a vital part of main tissues, organs, and the body's enzyme system, as well as the soft tissues and the fluids of the body. The amino acids are absorbed by the animal body through the ______________ ______________.
minerals	22. Calcium, phosphorus, sodium, chlorine, potassium, sulfur, magnesium, iron, iodine, copper, cobalt, zinc, manganese, molybdenum, florine, and arsenic are ______________ that are essential for, or affect in some way, livestock feeding.
proteins	23. ______________ are made up of amino acids and are furnished in adequate supplemental forms in soybean meal and fishmeal.
amino acids	24. Proteins are made up of ______________ ______________ and are particularly important to meet the growth requirements.
protein growth maintenance reproduction	25. Young animals require ______________ to meet ______________ requirements. Mature cattle need nutrients to maintain the same weight. This is a ______________ requirement. Bred cattle require an additional ______________ requirement.

growth maintenance production	26. A fattening ration must satisfy g______________, ______________, and ______________ requirements.
carbohydrates	27. C______________ includes starches, sugars, and cellulose.
fats	28. ______________ supply 2.25 times as much energy as carbohydrates. Fats aid in absorption from food of Vitamin A and may help in the absorption of calcium.
organic	29. Vitamins are trace organic nutrients. Essential vitamins to livestock feeding are: A, D, E, K, Thiamin or B_1, niacin or nicotinic acid, B_{12}, and C or ascorbic acid, choline pyridoxin, biotin, and folic acid. Vitamins are trace ______________ nutrients.
green forage crops	30. One of the most important facts in livestock production is that all green forage crops are rich in most of the vitamins required by farm animals. The only exception seems to be Vitamin D and Vitamin B_{12}. Vitamin D and Vitamin B_{12} are not supplied by _____ _____.

Vitamins	31. Water and oxygen provided inadequately, or inconveniently, may affect the performance of livestock. ____________ are trace organic nutrients and must be considered in the balancing of rations.
maintenance growth fattening production reproduction	32. The nutrient requirements are classified by functions as ____________, ____________, ____________, ____________, and ____________.
proteins minerals carbohydrates fats vitamins	33. The different groups of nutrients are ____________, ____________, ____________, ____________, and ____________.
oxygen water	34. ____________ and ____________ are essential for successful performance of livestock but are not expensive to provide in most cases.
maintenance	35. The body can be kept at a constant weight and temperature when carrying on only such activities as digestion, heartbeat, and breathing by providing a ____________ ration. The energy-producing nutrients (carbohydrates and fats) along with small amounts of protein, minerals, and vitamins fulfill this requirement.

proteins minerals vitamins water	36. Animals need proteins, minerals, vitamins, and water for growth, so feeds that are relatively high in these nutrients should be fed. A young growing animal suffers sooner and much more seriously from nutritive deficiencies than does a mature animal. Animals need ______________, ______________, ______________, and ______________ for growth. Proteins are most commonly limiting in a growth ration.
carbohydrates fats	37. Carbohydrates and fats are required for fattening. Little or no protein is necessary, but any extra protein in the ration that is not used otherwise can be used by the body for fattening. Proteins are generally more expensive, however, than carbohydrates and fats. ______________ and ______________ are more economical for fattening purposes than the protein feeds. The purpose of fattening is to cause "marbling" in the lean meat (deposition of fat in the lean meat) and a covering of fat over the carcass.
false	38. The nutrients that are needed for production vary according to the type of production. Milk is high in calcium, protein, and phosphorus, and feeds for milk cows should be high in these elements. All production requirements are the same. True or false?
	39. Eggs are rich in protein, fats, minerals, vitamins, and water. Feeds high in these nutrients need to be fed to laying hens.
calcium phosphorus	40. Milk production requires feeds high in the minerals ______________ and ______________.

nutrition	41. The fertility of breeding stock is dependent on adequate nutrition levels. Small and weak litters of swine and poor hatchability in poultry result from inadequate rations. Flushing of swine and sheep are two examples of the importance of adequate ______________ to fertility of breeding stock.
vitamins	42. Breeding herds or flocks should be provided a liberal supply of protein, minerals, and vitamins. Liberal supplies of proteins, minerals and ______________ are necessary to maintain high fertility.
24	43. A ration is the amount of feed allowed an animal during a 24-hour day. If a ration contains all the nutrients in proportion and amounts necessary for proper nourishment, the ration is said to be balanced. A ration is the amount of feed allowed an animal during a _______-hour period.
balanced	44. A good ration in addition to containing nutrients in the proper amounts should (1) be as economical as possible, (2) not be harmful to the animal, (3) should be palatable, and (4) be in the proper proportion. A ration that agrees with the above requirements is said to be a b______________ ration.
2 3 1	45. The following are some practical "rules of thumb" for feeding livestock. For beef cattle maintenance, feed approximately 2 lbs. of air dry roughage for every 100 lbs. of liveweight. If silage is used, then substitute 3 lbs. of silage for 1 lb. of air dry roughage. Protein and mineral supplements may have to be added to the hay or silage rations. A rule of thumb ration of roughage for beef cattle would be _______ lbs. per 100 lbs. of liveweight. If silage is used, substitute _______ lbs. of silage for each _______ lbs. of air dry roughage.

1 2	46. For beef cattle fattening, feed approximately 3/4 to 1 lb. of air dry roughage and 2 lbs. of concentrate per 100 lbs. liveweight to cattle on full feed. The ratio of roughage to concentrate is _______ to _______.
	47. For dairy cattle feed 2 lbs. of air dry roughage per 100 lbs. of liveweight and concentrate as follows: Jersey and Guernsey, feed 1 lb. concentrate for every 3 lbs. milk produced. Holstein, Brown Swiss, and Ayrshires, feed 1 lb. concentrate for every 4 lbs. of milk produced.
1 3	48. Jersey and Guernsey cattle require a ratio of concentrate to milk of _______ to _______.
1 4	49. Holstein, Brown Swiss, and Ayrshire cattle require a ratio of grain to milk of _______ to _______.
3	50. For sheep maintenance, feed 3 lbs. roughage per 100 lbs. liveweight and supplement with proteins and minerals if needed. Ratio of roughage to 100 lbs. liveweight is _______ lbs. per 100 lbs. liveweight.

1 1/2 2 100	51. For sheep fattening feed 1 1/2 lbs. roughage and 2 lbs. of concentrate per 100 lbs. liveweight. Ratio ________ to ________ to ________.
	52. For bred sows and gilts. If self feeding, provide enough ground roughage to furnish 12-15% fiber. Approximately 1/3 roughage, such as ground legume hay or corn cobs; 1/3 oats; and 1/3 corn supplemented (barley may be substituted for corn) with protein, minerals, and vitamins will be satisfactory. Control the gain in weight by changing the proportion of roughage to concentrate. More concentrate results in more gain and vice versa.
concentrate barley	53. To reduce gain, reduce ________________ and increase ________________ proportionately.
12 15	54. If self feeding sows and gilts, feed enough roughage to provide ________ to ________% of fiber.
roughage oats corn or barley	55. Bred sows and gilts should be fed 1/3 ________________, 1/3 ________________, and 1/3 ________________ with proper supplements.

56. The Pearson Square Method of balancing rations is used to simplify and systematize the procedure.

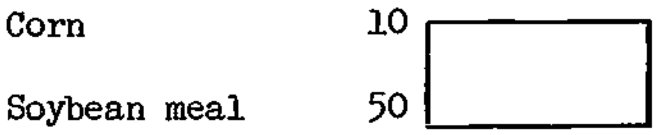
To find the proportion or percentages of two feeds which, when mixed together, will furnish the desired percent of protein (or any other nutrient), use the square as follows:

Calculate the amount of corn (10% crude protein) and soybean oil meal (50% crude protein) that will be needed to furnish 10 lbs. of a mixture containing 20% crude protein.

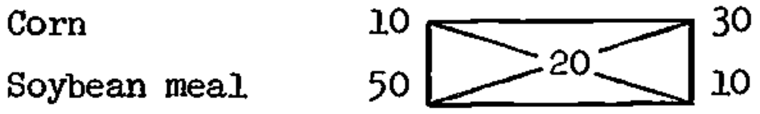
1. Draw a square with line connecting opposite corners.

2. In the center of the square, enter the crude protein percentage desired in the mixture.

3. At the left-hand corners of the square, write the materials mixed together and their crude-protein content.



4. Subtract along the diagonals, the smaller from the larger, and place the difference at the opposite end of the diagonals. Thus 20 minus 10 is 10, and 50 minus 20 is 30.



The 30 then becomes the parts of corn required in the ration and the 10, the parts of soybean meal.

Corn	10		30
		20	
Soybean meal	50		10
			40 total parts

5. To find the percentage of each feed in the desired mixture, divide the parts of <u>each</u> by the <u>total</u> parts.

Corn $30 \div 40 \times 100 = 75\%$

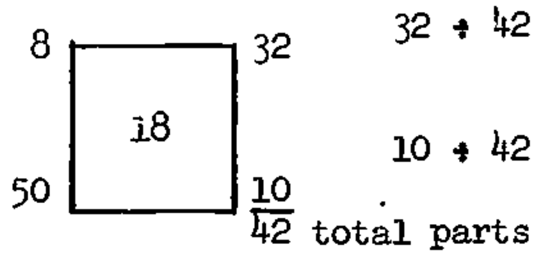
Soybean meal $10 \div 40 \times 100 = 25\%$

6. Since we want 10 lbs. of the mixture, mix (1 lb. x 75%) 7.5 lbs. of corn with (10 lbs. x 25%) 2.5 lbs. of soybean meal.

57. Calculate, using the Pearson Square, the amount of barley (8% crude protein) and soybean oil meal (50% crude protein) that will be needed to furnish 100 lbs. of a mixture containing 18% crude protein.

Barley

Soybean oil meal



32 ÷ 42 = 76 parts or 76% barley

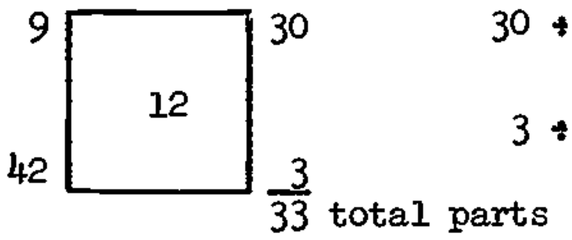
10 ÷ 42 = 24 parts or 24% soybean oil meal

The 100 lb. mixture should be made up of 76 lbs. of barley and 24 lbs. of soybean oil meal.

58. Calculate, using the Pearson Square, the amount of barley (9% protein) and cottonseed cake (42% crude protein) that will be needed to furnish 100 lbs. of a mixture containing 12% crude protein.

Barley

Cottonseed cake



30 ÷ 33 = 90.9 parts or 90.9% barley

3 ÷ 33 = 9.1 parts or 9.1% cottonseed cake

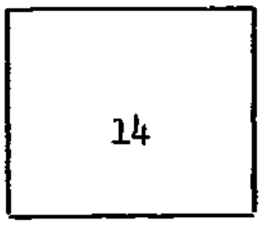
The 100 lb. mixture should be made up of 90.9 lbs. of barley and 9.1 lbs. of cottonseed cake.

59. Suppose you plan to use 20% wheat at 10.5% protein, 40% barley at 9% protein and 40% mill run at 13% protein. You will supplement this grain ration with a 38% protein supplement. You require a 14% mix. Solve using the Pearson Square for 100 lbs. of feed.

Wheat = .105 x 20 = 2.10 Barley = .09 x 40 = 3.60 Mill run = .13 x 40 = 5.20

2.1 + 3.6 + 5.2 = 10.9% protein in the mixture of wheat, barley, and mill run at the percentages given.

mix 10.9 24.0



supplement 38.0 3.1

27.1 total parts

24 ÷ 27.1 = 88.6 parts or 88.6% "mix"

3.1 ÷ 27.1 = 11.4 parts or 11.4% protein supplement

The 100 lb. mixture should be made up of 88.6 lbs. of mixed grain and 11.4 lbs. of cottonseed cake.

Sufficient nutrients in a 24-hour period in proportion to requirements of the animal.	60. The key to profitable livestock feeding is to feed a balanced ration. Define such a ration.

Name ________________________

POST-TEST

NUTRITION

UNDERLINE THE CORRECT ANSWER.

1. Animals require nutrients to sustain life with no loss or gain of weight. This is called

   a. growth
   b. fattening
   c. maintenance
   d. production

2. __________ are the chief sources of heat and energy for animals.

   a. Minerals
   b. Carbohydrates
   c. Proteins
   d. Fats

3. The nutrients to provide milk and wool are called the requirement for

   a. reproduction
   b. fattening
   c. growth
   d. production

4. __________ include starches, sugars, and cellulose.

   a. Carbohydrates
   b. Fats
   c. Proteins
   d. Minerals

5. Feeds that are high in __________ include corn, oats, barley, and wheat middlings.

   a. protein
   b. fats
   c. carbohydrates
   d. minerals

6. The kind and quality of __________ are fully as important as the amounts.

   a. fats
   b. proteins
   c. minerals
   d. carbohydrates

7. __________ are the high energy compounds of feeds.

   a. Proteins
   b. Minerals
   c. Calcium
   d. Carbohydrates

Name ____________________

8. __________ are essential minerals for feeding livestock. (choose two)

a. Gold
b. Platinum
c. Sodium
d. Manganese
e. Silver

9. Fats supply __________ times as much heat energy as do carbohydrates.

a. 2.25
b. 2.50
c. 2.75
d. 2.00

10. __________ requirements vary according to what is created for "sale" by the animal (milk, wool, meat, eggs, etc.).

a. Maintenance
b. Production
c. Reproduction
d. Growth

11. A(n) __________ is the amount of feed nutrients in the proper proportion for a 24-hour period.

a. ration
b. balanced ration
c. adequate supply
d. increment

12. __________ are common protein supplement feeds. (Choose two.)

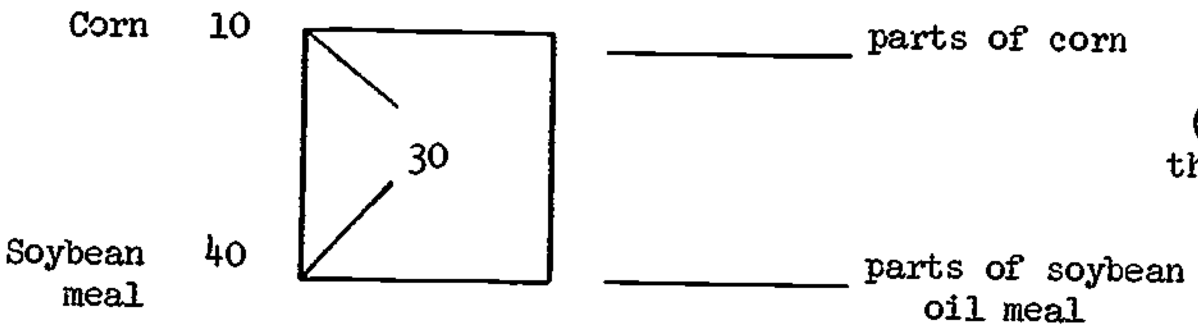
a. Barley
b. Oats
c. Cottonseed meal
d. Bone meal
e. Soybean oil meal
f. Corn

13. To reduce gain of bred sows or gilts, feed more __________ and less __________.

a. roughage
b. vitamins
c. protein
d. grain
e. minerals

Name ______________________________

14.



(Fill in the blanks)

a. 10 parts corn
b. 70 parts corn
c. 10 parts soybean oil meal
d. 20 parts soybean oil meal

(underline two)

FEED CHARACTERISTICS

PURPOSE

This programmed instruction unit titled "Feed Characteristics" is designed to provide an introduction to "Livestock Nutrition." This instrument includes the following knowledges:

1. Classification of feeds into:
    a. total digestible nutrients
    b. net energy
    c. concentrates
    d. protein supplements (animal and plant)
    e. roughages
    f. legumes and non-legumes forage quality.
2. Energy value as a measure of feeding value.
3. Maintenance and production-feed requirements.
4. The importance of forage testing as an economic tool for efficient feeding of livestock.
5. The method of matching forage-test information with grain requirements for dairy cattle.

Name______________________________

PRE-TEST

FEED CHARACTERISTICS

Underline the correct answer(s).

1. Livestock feeds are generally classified according to the amount of ____________ they provide.

   a. nutrients not fat
   b. total digestible nutrients
   c. net energy available
   d. availability
   e. color

2. Feeds that contain relatively large amounts of ______________ are called roughages.

   a. protein
   b. lignin
   c. fiber
   d. minerals
   e. ash

3. Feeds that contain relatively small amounts of ______________ are called concentrates.

   a. protein
   b. carbohydrates
   c. minerals
   d. fiber

4. ______________ are feeds that have a comparatively high digestibility.

   a. Concentrates
   b. Roughages
   c. Protein
   d. Total digestible nutrients

5. ______________ are feeds that have a comparatively low digestibility.

   a. Concentrates
   b. Carbohydrates
   c. Roughages
   d. Protein

6. Protein supplements contain ______________ or more per cent protein.

   a. 10
   b. 15
   c. 20
   d. 30
   e. 40

7. Tankage is classified as a

   a. concentrate
   b. protein supplement
   c. low fiber food
   d. feed additive

8. Protein supplements originate from ______________ or ______________.

   a. animal
   b. fibrous
   c. plant
   d. cereal

9. Fish meal is a

   a. plant derivitive protein supplement
   b. animal derivitive protein supplement
   c. little used protein supplement
   d. unpalatable feed

10. The ______________ derivitive proteins are the best quality proteins of the common protein supplements.

   a. plant
   b. mineral
   c. vegetable
   d. animal
   e. enzyme

11. The small grains are

   a. roughages
   b. concentrates
   c. low energy feeds
   d. protein supplements

12. Feeds ______________ depending upon such things as variety, soil fertility, where grown, methods of harvesting, stage of maturity, and length of time in storage.

   a. vary
   b. do not vary
   c. vary but do so in no particular order

13. The ______________ determines to some extent the quality of the feed.

   a. manufacturing process
   b. distribution methods
   c. price
   d. quantity

14. _______________ losses occur through chewing, digesting, assimilation of feed, and losses through undigested material in the feeds.

   a. Protein
   b. Energy
   c. Mineral
   d. Time
   e. Amino acid

15. It is _______________ to have the farmer obtain a chemical analysis of his home grown feeds.

   a. of little importance
   b. important
   c. of no economic value
   d. a and c

16. Net energy values of feed are commonly expressed as _______________.

   a. calories
   b. pounds
   c. therms
   d. ounces

17. The _______________ represents the amount of energy available for productive purposes, such as growth.

   a. total digestible energy
   b. energy value
   c. real income value
   d. net energy value

18. For purposes of balancing rations we must know _______________ and _______________.

   a. the nutrient content of the feed
   b. the nutrient requirements of the animal
   c. the type of feeding system used
   d. the preferences of the owner
   e. the cost of the feeds.

19. _______________ is only partially digestible (75-85%).

   a. Digestible protein
   b. A mineral
   c. A carbohydrate
   d. Crude protein

20. Net energy requirements are broken down into requirements for _______________ and _______________.

   a. growth
   b. maintenance
   c. production
   d. therms

21. Net energy values of feed for __________ are generally higher than net energy values of feed for maintenance.

a. reproduction
b. production
c. neither a nor b

22. Livestock require about __________ times as much energy as protein.

a. 3
b. 4
c. 5
d. 7
e. 12

23. NEp stands for

a. net energy potential
b. net energy for production
c. net energy power
d. net energy

24. The value of a feed __________ as digestibility decreases and crude fiber increases.

a. increases
b. decreases
c. stays the same

25. Ruminant stomached animals are fed __________ protein feeds because the higher quality animal derivitive proteins are unnecessary and, generally, more expensive.

26. The single most important step in forage testing is __________.

a. accurate size samples
b. a proportional sample
c. a large sample
d. none of the above

27. Home grown grain is __________ adequate when feeding 13 per cent protein hay.

a. probably
b. probably not
c. never

28. Roughages are divided into __________ and non __________. (Fill in

the blanks.) __________ are higher in protein than __________.

INFORMATION PANEL

This is a programed instruction unit for "Feed Characteristics." You will find it relatively easy to answer the questions in each "frame." This method of instruction will aid you to master the objectives listed if you apply yourself to the material.

You are provided with a program and a combination answer sheet and mask to cover the answers.

1. Place the mask (answer sheet) over the answer in a way that exposes one question (frame) at a time.
2. Write your answer on the answer sheet.
3. Move the answer sheet down to expose the next frame and answer to the previous frame.
4. Should your answer be wrong, write the correct answer above or along side--do not erase your incorrect answer.

Feed
Characteristics

If you have not read the information panel, do so now, then proceed to frame 1.

Name ______________________

1. ---
2. ______________
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28. ---
29. ______________
30. ---
31. ---
32. ---
33. F ______________
    g ______________
34. ______________
35. ---
36. ______________
37. ---
38. ---
39. d ______________
    i ______________
    f ______________
    p ______________
40. ______________
41. f ______________
    p ______________
42. ______________
43. ______________
44. ---
45. ______________
46. ---
47. ---
48. ---
49. ---
50. ______________
    ____
51. ---
52. ______________
53. ---

Feed Characteristics, Continued

Name ______________________

54. ______________

55. ______________

56. ______________

57. ___1. ___2. ___3. ___4.

___5. ___6. ___7.

58. ______________

59. ______________

60. See frames 48, 49.

--	1. Livestock feeds are generally classified according to the amount of total digestible nutrients they provide, or according to the amount of specific nutrients they furnish in the ration.
Roughages	2. Feeds that contain relatively large amounts of fiber or non-digestible material are called roughages. ____________ contain large amounts of fiber.
fiber	3. Concentrates are feeds that have a comparatively high digestibility, and are high energy goods. They are relatively low in ____________. They include all grains and many by-products of grains and animals, such as wheat middlings, tankage, and soybean oil meal.
grains	4. Concentrates include all ____________ such as wheat, corn, oats, and barley.
concentrate	5. Tankage is a protein supplement as is soybean oil meal because it has 20 per cent or more protein. Oats is a ____________.

concentrates	6. Protein concentrates may be classified as a subdivision of concentrates. They contain 20 or more per cent protein. ______________ have a comparatively high digestibility.
20	7. Protein concentrates contain ______________ or more per cent protein.
Animal	8. Protein concentrates are derived from either animal or vegetable substances. Proteins derived from animal or animal by-products are high quality protein feeds valuable for poultry and swine. They are more expensive than plant proteins. ______________ proteins are high quality proteins.
vegetable or plant animal	9. Vegetable or plant proteins are found in the by-products of plants. Soybean oil meal, linseed oil meal, cottonseed meal, and peanut oil meal are ______________ protein concentrates. Tankage, meat scraps and fish meal are ______________ protein concentrates.
animal	10. The ruminant-stomached livestock are fed vegetable proteins because ______________ proteins are more expensive and are not essential feed stuffs for ruminant animals. They synthesize their own protein "quality proteins" whereas swine and poultry cannot.

protein	11. Cottonseed oil meal, soybean oil meal, and linseed oil meal have in excess of 20 per cent protein and are classified as ______________ supplements.
grains or high energy feeds	12. The grains are the best source of energy for the common feed stuffs and they have the best fattening value. Corn and oats are examples of ______________.
non-legume	13. Roughages are divided into legume and non-legume. Legumes are plants that have the ability to use nitrogen which they take from the air. Legumes are higher in protein than are ______________ roughages.
Grains	14. Grains and roughages vary considerably in nutrient values depending upon variety, stage of maturity, soil fertility where grown, methods of harvesting, and length of time in storage. ______________ and roughages vary considerably in nutrient value.
--	15. The manufacturing process determines to some extent the values of feeds. Therefore, average composition of various feeds is often used when planning livestock rations. This is true regarding grains, but forage testing is done chemically and will be discussed later in this program.

important	16. It is (important, unimportant) for the farmer feeding home grown feeds to have a chemical analysis made of his feed because of the variability of these feeds.
--	17. The energy value of a feed is a very good criteria of its feeding value. Energy losses occur through undigested material in the feeds, energy losses in the urea, energy lost (in small amounts) in the combustible gases, and energy lost in the various processes of chewing, digesting, and assimilating food.
less than	18. The animal can be likened to an automobile. There is (less than, nearly perfect) efficiency in utilization of the "fuel."
energy	19. An additional energy loss is through the heat increment produced in the body following and because of the consumption of the food. These losses are higher in feeds that are high in fiber. Fiber content has an effect on ____________ losses.
net energy	20. The net energy value of a feed is the amount of energy left after deducting the losses previously mentioned. The ____________ ____________ value represents the real value of the feed for productive purposes such as growth, production of body fat, milk or wool or performance of work.

therm	21. The net energy values of feeds are commonly expressed as therms in this country. A therm (unit for measuring heat) is the amount of heat required to raise the temperature of 1,000 lbs. of water about 4° Fahrenheit. The unit for measuring heat is the ______________.
1,000	22. In human nutrition the calorie is used as the unit for measuring heat. One therm is 1,000 Calories or 1,000,000 small calories. A therm is the amount of heat required to raise the temperature of ______________ lbs. of water about 4° Fahrenheit.
--	23. Net energy values and total digestible nutrients (T.D.N.) values are available information for balancing rations. Net energy values are generally the most useful. T.D.N. values are most accurate for some particular purposes.
T.D.N. Net energy	24. Two of the categories of information, other than protein, available for ration balancing are ______________ and ______________ values.
--	25. For purposes of balancing rations, we must know (1) the nutrient requirement of the animal, and (2) the nutrient content of the feed. Crude protein and energy are the measurements that we use primarily for the nutrient content of the feed (T.D.N.).

--

26. Net energy is measured as NEm or net energy for maintenance, and NEp or net energy for production. For example:

	Crude Protein	TDN	NE	
			m	p
Alfalfa	15	50	34	24

The net energy value of alfalfa for maintenance is higher than the energy value for production. This is characteristically true as the maintenance ration must be satisfied before the production requirement is met.

---

net energy
maintenance
net energy
production
production
maintenance
energy
T.D.N.

27. NEm stands for ______________.

NEp stands for ______________.

Net energy is calculated in terms of ______________ requirements and ______________ requirements.

______________ is a more sensitive indicator of feeding values than is ______________.

--

28. Maintenance feed requirements furnish the nutrients to provide neither gain nor loss of weight, plus normal nutritional health.

The production requirement is the requirement for wool and milk or fat above the maintenance requirement.

---

seven

29. Livestock require about seven times as much energy as protein in their diets. There is a considerably greater difference between the net energy value of a high grade concentrate and that of a dry roughage than there is between the percentages of total digestible nutrients furnished by the same feed.

Livestock require ______________ times as much energy as protein.

--

30. Dent corn of Grade No. 1 supplies 81.9 therms of net energy per 100 lbs. while timothy hay, all analysis, furnishes but 37.3 therms, or only 46 per cent as much. However, timothy hay has about 60 per cent as much digestible nutrients as does corn. It has 49.1 per cent total digestible nutrients, in comparison with 81.9 per cent of No. 1 dent corn.

<table>
<tr><td>--</td><td>31.
<table>
<tr><th></th><th></th><th>Net Energy
Therms</th><th>TDN
%</th></tr>
<tr><td>Dent Corn</td><td>Grade No. 1</td><td>81.9</td><td>81.9</td></tr>
<tr><td>Timothy Hay</td><td>All Analyses</td><td>37.3</td><td>49.1</td></tr>
</table>
37.3 is 36% of 81.9
49.1 is 60% of 81.9</td></tr>
<tr><td>--</td><td>32. The net energy figures are more meaningful than the TDN (total digestible nutrients) figures in most cases when balancing feed rations.</td></tr>
<tr><td>Forages
grains</td><td>33. The nutrient requirements of dairy cattle are satisfied largely by forages and grains.

F__________ make up 60-80 per cent of the total nutrients and g__________ the other 20-40 per cent of the nutrients for dairy cattle.</td></tr>
<tr><td>low</td><td>34. The protein in the grain mixture should complement the protein supplied by the forage. The grain, of course, is the primary energy feed.

A high protein hay would require a __________ protein grain.</td></tr>
<tr><td>--</td><td>35. A poor quality hay may require a high protein grain costing as much as $15 more per ton. Washington forage tests have resulted in a range of 2.8-14.9% protein for grass hay and 10.6-24% for legume hay.</td></tr>
</table>

errors	36. These quality differences demonstrate differences in harvesting, climate, soils, and variety of seed. Using average values of forages when balancing the protein level in grain mixtures leads to large (advantages, errors).
--	37. Visual estimates of forage quality, as are used for Federal grading of hay, are often in error. Errors as much as 5 per cent in crude protein and 9 per cent TDN (total digestible nutrients) are made by trained individuals.
--	38. The case for forage testing is based upon the relation between the chemical composition of a forage and its feeding value for animals. As a plant matures, its digestibility decreases and its protein content declines. Chemically these changes are reflected by an increase in crude fiber (and lignin) and by a decrease in crude protein. This is the basis of forage testing. Hays that are weathered also show an increase in fiber and a decrease in protein since soluble nutrients are washed out by rain and leaves are lost during harvest.
declines increases fiber protein	39. As a plant matures its digestibility d______________. As a plant matures, crude fiber content i______________. Weathered hay shows an increase in f______________ and a decrease in p______________. Weathered hay loses Vitamin A in large amounts, but does not lose a like amount of energy unless the hay molds.
less	40. As digestibility of a feed declines and its crude fiber content increases, the value of this particular feed becomes ______________.

fiber protein	41. Forage testing tests for the amount of crude f__________, and, therefore, crude p__________.
15	42. Hay varies with the way in which it is grown, cured, and stored. Soils, climate, and variety of plant also affect quality of hay. There are often differences in quality within the same field due to weather changes during harvest. A representative sample is, therefore, important (15% approximately). To sample a 5 ton of hay one should take at least (5, 12, 15) core samples from different bales.
1	43. The purpose of forage testing is to __________. (Choose One.) (1) Establish an accurate feed value for roughage. (2) Establish an accurate feed value for the concentrate fed. (3) Determine how much an animal requires to produce at a certain level.
--	44. The single most important step in forage testing is sampling. Fifteen cores (drill samples) should be taken from one lot of forage. Samples from one bale vary as much as 1.8 per cent protein. Bales in a truckload vary as much as 6.5 per cent protein.
15	45. __________ core samples should be taken from each lot of forage. Samples should be taken each time a change in feed is noticed; for example, change from first cutting to second cutting.

46. We said that we try to balance protein content of our forage by the grain we purchase or mix. In general, we expect our hay to follow the following averages:

Remember a forage test is the only accurate method - the table below is here for use as an example only.

47.

	Average Crude Protein (moisture free)
Alfalfa	16%
Brome Grass	7%
Ladino Clover	18%
Red Clover	9%
Oat Forage	7%
Orchard Grass	8%
Timothy	5%
Corn Silage	5%
Pea Vines	13%

48 and 49. The following tables will tell you what per cent of protein grain to feed with your forage.

% Crude Protein in Forage	% Crude Protein Needed in Grain Mix
2.0 - 3.3	20
3.4 - 4.5	19
4.6 - 5.6	18
5.7 - 6.8	17
6.9 - 7.9	16
8.0 - 9.1	15
9.2 -10.2	14
10.3 -11.4	13
11.5 -12.5	12
12.6 -13.7	11
13.8 +	10

50. What per cent protein grain would you feed if your forage tested 8.3% on a dry matter basis? (See above table.)

And if the forage tested 13.2%

15%
11%

--	51. Many cases where high quality forage is fed require only 10-12% crude protein in the grain mix (as per table). When this occurs economical grain mix may be fed which does not include a protein supplement. Such mixtures as steamed rolled barley, barley-oats, or barley-mill run combinations which contain 1% steamed bone-meal* and 1% iodized or trace mineralized salt are good feeds. *or dicalcium phosphate
does not	52. A high quality forage (does, does not) require a grain mix containing a protein supplement.
--	53. How can we establish how much grain and hay to feed each cow? We need to know what her individual nutrient requirements are. This is determined by her production. Tables are available to conveniently arrive at the correct amounts. (E.M. 2040, Rev., October, 1965, Washington State Cooperation Extension Bulletin).
forage	54. The basis for an economical feeding system for dairy cows is ______________ testing.
are not	55. High quality alfalfa hay requires a mixture of home grown grains plus 1% steamed bonemeal and 1% salt, iodized or trace mineralized. Protein supplements (are, are not) necessary with this kind of forage.

$675.00	56. Through forage testing it was found that a dairy farmer needed 10% protein grain rather than the 13% protein grain he had been feeding. This resulted in a saving of $5 per ton of grain. Over a 10 month period, feeding 60 cows at an average of 15 lbs. per animal, the farmer saved ________________.
2,3,5,-A 1,4,6,7,-P	57. Label the plant derived protein supplements with a P, the animal derived protein supplements with an A. ________1. Soybean oil meal ________2. Tankage ________3. Meat scraps ________4. Cottonseed oil meal ________5. Fish meal ________6. Linseed oil meal ________7. Peanut oil meal
animal	58. (Plant proteins or Animal proteins) are higher quality proteins and are more expensive.
concentrate	59. Barley, wheat and middlings are (protein supplements, concentrates).
See frames 48-49	60. Suppose a forage test indicated a 16% crude protein hay. What per cent protein grain is necessary?

Name____________________________

POST-TEST

FEED CHARACTERISTICS

Underline the correct answer(s).

1. Livestock feeds are generally classified according to the amount of ____________ they provide.

   a. nutrients not fat
   b. total digestible nutrients
   c. net energy available
   d. availability
   e. color

2. Feeds that contain relatively large amounts of ____________ are called roughages.

   a. protein
   b. lignin
   c. fiber
   d. minerals
   e. ash

3. Feeds that contain relatively small amounts of ____________ are called concentrates.

   a. protein
   b. carbohydrates
   c. minerals
   d. fiber

4. ____________ are feeds that have a comparatively high digestibility.

   a. Concentrates
   b. Roughages
   c. Protein
   d. Total digestible nutrients

5. ____________ are feeds that have a comparatively low digestibility.

   a. Concentrates
   b. Carbohydrates
   c. Roughages
   d. Protein

6. Protein supplements contain ____________ or more per cent protein.

   a. 10
   b. 15
   c. 20
   d. 30
   e. 40

7. Tankage is classified as a

   a. concentrate
   b. protein supplement
   c. low fiber food
   d. feed additive

8. Protein supplements originate from ______________ or ______________.

   a. animal
   b. fibrous
   c. plant
   d. cereal

9. Fish meal is a

   a. plant derivitive protein supplement
   b. animal derivitive protein supplement
   c. little used protein supplement
   d. unpalatable feed

10. The ______________ derivitive proteins are the best quality proteins of the common protein supplements.

    a. plant
    b. mineral
    c. vegetable
    d. animal
    e. enzyme

11. The small grains are

    a. roughages
    b. concentrates
    c. low energy feeds
    d. protein supplements

12. Feeds ______________ depending upon such things as variety, soil fertility, where grown, methods of harvesting, stage of maturity, and length of time in storage.

    a. vary
    b. do not vary
    c. vary but do so in no particular order

13. The ______________ determines to some extent the quality of the feed.

    a. manufacturing process
    b. distribution methods
    c. price
    d. quantity

14. _______________ losses occur through chewing, digesting, assimilation of feed, and losses through undigested material in the feeds.

a. Protein
b. Energy
c. Mineral
d. Time
e. Amino acid

15. It is _______________ to have the farmer obtain a chemical analysis of his home grown feeds.

a. of little importance
b. important
c. of no economic value
d. a and c

16. Net energy values of feed are commonly expressed as _______________.

a. calories
b. pounds
c. therms
d. ounces

17. The _______________ represents the amount of energy available for productive purposes, such as growth.

a. total digestible energy
b. energy value
c. real income value
d. net energy value

18. For purposes of balancing rations we must know _______________ and _______________.

a. the nutrient content of the feed
b. the nutrient requirements of the animal
c. the type of feeding system used
d. the preferences of the owner
e. the cost of the feeds.

19. _______________ is only partially digestible (75-85%).

a. Digestible protein
b. A mineral
c. A carbohydrate
d. Crude protein

20. Net energy requirements are broken down into requirements for _______________ and _______________.

a. growth
b. maintenance
c. production
d. therms

21. Net energy values of feed for ______________ are generally higher than net energy values of feed for maintenance.

   a. reproduction
   b. production
   c. neither a nor b

22. Livestock require about ______________ times as much energy as protein.

   a. 3
   b. 4
   c. 5
   d. 7
   e. 12

23. NEp stands for

   a. net energy potential
   b. net energy for production
   c. net energy power
   d. net energy

24. The value of a feed ______________ as digestibility decreases and crude fiber increases.

   a. increases
   b. decreases
   c. stays the same

25. Ruminant stomached animals are fed ______________ protein feeds because the higher quality animal derivitive proteins are unnecessary and, generally, more expensive.

26. The single most important step in forage testing is ______________.

   a. accurate size samples
   b. a proportional sample
   c. a large sample
   d. none of the above

27. Home grown grain is ______________ adequate when feeding 13 per cent protein hay.

   a. probably
   b. probably not
   c. never

28. Roughages are divided into ______________ and non ______________. (Fill in the blanks.) ______________ are higher in protein than ______________.

VITAMINS

PURPOSE

This is the "Vitamins" programmed instruction booklet. It is the third program in the animal nutrition series of programs.

This program includes the knowledges listed below:

1. The importance of vitamins to animal nutrition.
2. What vitamins are.
3. Which vitamins are essential to animal nutrition.
4. How are the individual vitamins provided to livestock.
5. What anti-vitamins are.
6. Symptoms of vitamin deficiency.
7. Which vitamins are commonly deficient within particular classes of livestock.
8. The importance of vitamins to reproduction.

Name ______________________________

PRE-TEST

VITAMINS

Underline the correct answer(s).

1. The chemical make-up and functions of vitamins are ______________.

   a. Similar to each other
   b. similar but distinct
   c. different from each other

2. Vitamin ______________ is required by all animals and must be present in the feeds.

   a. A
   b. B
   c. C
   d. D
   e. B_{12}

3. Research in vitamins is ______________.

   a. extensive
   b. limited
   c. questionable
   d. economical

4. So called "cottonseed meal poisoning" is really a deficiency of vitamin ___________.

   a. A
   b. B_{12}
   c. C
   d. D
   e. F

5. Severe losses of vitamin ______________ occur through oxidation during hay making or long storage periods.

   a. A
   b. B_{12}
   c. D
   d. E
   e. B_2

6. Adequate vitamin D is necessary for the proper assimilation and use of the minerals ______________ and ______________.

   a. phosphorous
   b. Manganese
   c. Calcium
   d. magnesium
   e. iron
   f. zinc

7. Poultry need more vitamin ____________ in their rations than do other farm stock, especially for egg production.

a. A
b. B
c. C
d. D
e. E

8. Deficiency of vitamin ____________ causes rickets.

a. A
b. B
c. B_2
d. D
e. B_{12}

9. Swine need ____________ because they do not synthesize it in their digestive tracts as sheep, beef, and dairy cattle do.

a. Vitamin A
b. Vitamin B-complex
c. Vitamin C
d. Vitamin D

10. All green forages are ____________ sources of vitamins.

a. poor
b. moderate
c. rich
d. inadequate

11. A deficiency of vitamin ____________ accompanied by loosening of the teeth is evidence of scurvy.

a. A
b. B_2
c. C
d. D
e. b_{12}

12. An ____________ prevents the actions of vitamins or kills the vitamins.

a. exovitamin
b. antivitamin
c. killer vitamin
d. antidote

13. Vitamin ____________ is necessary for reproduction in poultry, rats, and perhaps some other animals.

a. A
b. E
d. C
d. D

Name ______________________________

14. Vitamin ______________ seems to cause "white muscle disease."

a. A
b. E
c. C
d. D

15. Slow healing wounds are symptomatic of a deficiency of vitamin ______________.

a. A
b. B_{12}
c. C
d. D

INFORMATION PANEL

This is a programed instruction unit for "Vitamins." You will find it relatively easy to answer the questions in each "frame." This method of instruction will aid you to master the objectives listed if you apply yourself to the material.

You are provided with a program and a combination answer sheet and mask to cover the answers.

1. Place the mask (answer sheet) over the answer in a way that exposes one question (frame) at a time.

2. Write your answer on the answer sheet.

3. Move the answer sheet down to expose the next frame and answer to the previous frame.

4. Should your answer be wrong, write the correct answer above or along side--do not erase your incorrect answer.

Vitamins

If you have not read the information panel, do so now, then proceed to frame 1.

Name ____________________

1. __________
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21. __________
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22. __________
23. R__________
24. __________
25. __________
26. __________
27. __________
28. __________
29. __________
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_____ _____
30. __________
31. __________
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32. __________
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33. R__________
34. __________
35. __________
36. __________
37. __________

vitamins	1. Much of our modern efficiency in feeding livestock, particularly swine and poultry, can be attributed to the rapid succession of discoveries concerning vitamins. Research concerning ______________ has increased the efficiency of animal production and has made possible the prevention of serious diseases.
--	2. Previous to 1911 vitamins were unknown. The vitamins that are known are not related chemically to each other, as are proteins, fats or the carbohydrates. The function of the vitamins are also entirely different from each other.
vitamins	3. The ______________ are grouped together because each vitamin is organic in nature and because in many cases it is a nutritive essential required only in an exceedingly small amount.
Vitamins	4. Some vitamins are needed by only a few species of animals. Others are required by all species, but there is no need for a supply in the feed. That is because an adequate supply is synthesized, either in the body tissues or by bacteria in the digestive tract. ______________ are grouped together because they are organic in nature.
Vitamin A Carotene	5. Vitamin A is required by all animals and can be made only from carotene contained in plants. Animals must, therefore, receive in their food an adequate supply of ______________ or ______________.

Carotene	6. The knowledge concerning the different amounts of each vitamin in various feeds is limited compared with our knowledge of the ordinary nutrients. Vitamin A is found in the form of _______________ in many plants. Animals cannot synthesize this vitamin.
A	7. All green <u>forage</u> crops are rich in most of the vitamins required by farm animals. Animals are not able to produce Vitamin _______________. It must be in their feed.
Forage	8. Green _______________ crops are a rich source of vitamins. These crops provide vitamins (and minerals) in proportion to the leafiness of the plant.
	9. The exception to the preceeding statement is lack of Vitamin D and Vitamin B_{12}. These two vitamins, D and B_{12}, are not plentiful in green forage crops.
	10. Swine and poultry on good pasture do not seem to need Vitamin B_{12} even though pasture is not a good provider of Vitamin B_{12}. Vitamin D is supplied by sunlight.

D D, B_{12}	11. Hay and other dry forage cured in the sun supply vitamin ______________. Pasture is not a good source of vitamins ______________ and ______________.
Forages vitamins and minerals	12. <u>Green forages</u> supply undiscovered vitamins as indicated by the fact that sows on dry lot fed a seemingly balanced diet are unable to reproduce--until supplied with green ______________. Legumes have more leaves than grasses and are richer in ______________ and ______________.
D	13. A study of vitamins is not complete without some mention of the antivitamins. Antivitamins are substances that prevent the action of the vitamin or even destroy it. The sun supplies vitamin ______________ to animals directly and indirectly through hay.
Antivitamin	14. Paralysis for foxes raised for fur is caused by an ______________ in certain raw fish that destroys the vitamin thismin. Bracken fern poisoning of cattle also seems to be caused by an antivitamin.
	15. Vitamin ______________ must be included in an animals' feed as carotene. This vitamin is essential for maintenance of mature animals and in greater amounts for growth, reproduction, and lactation.

carotene	16. The so-called "cottonseed-meal poisoning," produced when cattle are fed for lengthy periods on such a ration as cottonseed meal and cottonseed hulls, is due primarily to the lack of Vitamin A. Vitamin A is found in plants as ______________.
Vitamin A	17. Severe losses of vitamin A occur through oxidation during hay making or long storage periods. Hay stored a year or longer has little or no vitamin A feed value. "Cottonseed-meal poisoning" is caused primarily by a shortage of ______________. Rain on drying hay results in severe losses of vitamin A. Energy losses occur if molding occurs.
Antivitamins A	18. The cereal grains with the exception of corn are very low in vitamin A. ______________ are substances that prevent the action of vitamins or even destroy them. Severe losses of vitamin ______________ occur during the hay making process due to the drying action of the sun (oxidation.)
A	19. Adequate vitamin D is necessary for the proper assimilation and use of Calcium and Phosphorous and the development of good bones and teeth. Vitamin D is needed especially during growth. Much less Vitamin D is necessary for maintenance of mature animals. The cereal grains, with corn the one exception, are low in vitamin ______________.
Calcium Phosphorous	20. Poultry need more vitamin D in their rations than do other farm stock, especially for egg production. Vitamin D is necessary for the proper assimilation of the minerals ______________ and ______________.

Poultry D	21. ____________ need more vitamin D than do other livestock. The assimilation of calcium and phosphorous is tied to adequate amounts of vitamin ____________.
growth	22. Deficiency of vitamin D causes rickets. Less severe deficiencies retard growth and produce a weak skeleton. Vitamin D is needed especially during ____________.
rickets	23. A deficiency of vitamin D in mature fowls causes thin-shelled eggs, decreased egg production, and lowered hatchability. Deficiency of vitamin D causes r____________.
A	24. When dairy cows, beef cattle, or sheep receive ordinary rations that include satisfactory roughage, no attention need generally be given to the B-complex vitamins because of the synthesis of these vitamins in the rumen. The cereal grains are low in vitamin ____________ except for corn.
vitamin D	25. Swine need the B-complex vitamins in their feed because there is little synthesis of them in their digestive tracts. Their requirements are met by pasture during the growing season and good well-cured legume hay when not on pasture. Thin shelled eggs may be caused by a deficiency of ____________

Snythesize or produce	26. Sheep, beef, and dairy cattle ______________ the B-complex vitamins in the rumen.
swine	27. Forms of yeast such as brewers dried yeast are sometimes used as a B-complex vitamin supplement. ________________ do not synthesize B-complex vitamins in their digestive tracts and, for this reason, must receive adequate B-complex vitamins in their feed.
Riboflavin	28. Riboflavin or Vitamin B_2 is required in large amounts for poultry. Milk and dairy by-products such as dried skim milk, dried butter milk, and dried whey are especially rich in riboflavin. They are valuable poultry feeds. ________________ is vitamin B_2.
Yeasts Riboflavin Milk products	29. ________________ are sometimes used as B-complex vitamin supplements. Vitamin B_2, ________________, is supplied in good amounts by ________________ ________________.
rich	30. Niacin or nicotinic acid is a B-complex vitamin that is necessary for all animals. Ruminants synthesize their own supply. Humans, dogs, swine, and poultry require a supply in their food. Milk and dairy products are a ________________ source of riboflavin.

Ruminants humans dogs, swine, or poultry	31. Dried yeast, rice polish, rice bran, wheat bran peanut oil meal, and green forage and pasture crops are rich in the vitamin niacin. Good quality hay supplies a fair amount, while corn, grain, oats, rye, and dairy by-products have a rather low content. ______________ synthesize their own supply of niacin; ______________ do not.
rich Ruminants humans, dogs, swine, or poultry	32. Vitamin E is necessary for <u>Reproduction</u> in poultry, rats, and perhaps some other animals. "Stiff lamb disease," can be prevented or cured by vitamin E. A deficiency of vitamin E seems to be the cause of "white muscle disease" also. Green forage is ______________ in niacin. ______________ synthesize their own supply of niacin, ______________ do not.
reproduction	33. A lack of vitamin in poultry feeds causes the disease encephalomalacia, or "crazy chick disease." A prolonged lack causes lowered hatchability of eggs and sterility of males. Vitamin E is necessary for r ______ ________ in poultry.
E	34. Deficiency of vitamin ______________ seems to cause "white muscle disease." "Stiff lamb disease" can be cured by this vitamin. Crazy chick disease is caused by a deficiency of this vitamin.
Vitamin C	35. Only human beings, monkeys, and guinea pigs lack the ability to synthesize ascorbic acid (vitamin C). Sailors in our early history suffered from a deficiency of ______________ ______________.

vitamin C	36. A deficiency of vitamin C (ascorbic acid) in man, monkeys, or guinea pigs causes scurvy. The symptoms are loosening of the teeth, inflammation of the gums, hemorrhages, brittleness of the bones, slow healing of wounds, and loss of vigor. Slow healing of wounds is a symptom of a deficiency of ________________.
scurvy	37. A deficiency of vitamin C evidenced by loosening of the teeth is a sign of _______________.

Name ____________________

POST-TEST

VITAMINS

Underline the correct answer(s).

1. The chemical make-up and functions of vitamins are ____________.

   a. Similar to each other
   b. similar but distinct
   c. different from each other

2. Vitamin ____________ is required by all animals and must be present in the feeds.

   a. A
   b. B
   c. C
   d. D
   e. B_{12}

3. Research in vitamins is ____________.

   a. extensive
   b. limited
   c. questionable
   d. economical

4. So called "cottonseed meal poisoning" is really a deficiency of vitamin _________.

   a. A
   b. B_{12}
   c. C
   d. D
   e. F

5. Severe losses of vitamin ____________ occur through oxidation during hay making or long storage periods.

   a. A
   b. B_{12}
   c. D
   d. E
   e. B_2

6. Adequate vitamin D is necessary for the proper assimilation and use of the minerals ____________ and ____________.

   a. phosphorous
   b. Manganese
   c. Calcium
   d. magnesium
   e. iron
   f. zinc

Name ______________________________

7. Poultry need more vitamin _______________ in their rations than do other farm stock, especially for egg production.

   a. A
   b. B
   c. C
   d. D
   e. E

8. Deficiency of vitamin _______________ causes rickets.

   a. A
   b. B
   c. B_2
   d. D
   e. B_{12}

9. Swine need _______________ because they do not synthesize it in their digestive tracts as sheep, beef, and dairy cattle do.

   a. Vitamin A
   b. Vitamin B-complex
   c. Vitamin C
   d. Vitamin D

10. All green forages are _______________ sources of vitamins.

   a. poor
   b. moderate
   c. rich
   d. inadequate

11. A deficiency of vitamin _______________ accompanied by loosening of the teeth is evidence of scurvy.

   a. A
   b. B_2
   c. C
   d. D
   e. b_{12}

12. An _______________ prevents the actions of vitamins or kills the vitamins.

   a. exovitamin
   b. antivitamin
   c. killer vitamin
   d. antidote

13. Vitamin _______________ is necessary for reproduction in poultry, rats, and perhaps some other animals.

   a. A
   b. E
   d. C
   d. D

Name ______________________________

14. Vitamin _______________ seems to cause "white muscle disease."

a. A
b. E
c. C
d. D

15. Slow healing wounds are symptomatic of a deficiency of vitamin _______________.

a. A
b. B_{12}
c. C
d. D

MINERALS

PURPOSE

This is a programmed instruction unit titled "Minerals." This program is the fourth of the animal nutrition series.

This program is designed for high school students who have successfully completed the first three units in the animal nutrition series.

"Minerals" includes the knowledges listed below:

1. Importance of minerals for animal growth and reproduction.
2. Which minerals are required.
3. Which body functions minerals perform in the body.
4. Adequate mineral nutrition-what it depends upon.
5. Symptoms of mineral deficiencies.
6. Classification of minerals as major or minor elements.
7. Knowledge of information tables available to balance a ration for minerals based upon the minerals supplied by particular feeds.
8. Salt deficiency symptoms.
9. Symptoms of deficiency for the major and minor elements.
10. Specific mineral information for common feeds for different classes of livestock.

Name ______________________________

PRE-TEST

MINERALS

Underline correct answer(s).

1. A ration containing an abundance of protein, carbohydrates, and fat, without minerals will generally result in the death of an animal ______________ than if no food at all is given.

   a. at the same time
   b. sooner
   c. later

2. ______________ minerals are known to be required by animals.

   a. 7
   b. 9
   c. 11
   d. 13
   e. 15

3. Extra minerals fed as "insurance" ______________ as economical supplement to feed.

   a. are
   b. are not

4. Mineral deficiencies are important only if deficiency symptoms can be observed.

   a. True
   b. False

5. Block salt ______________ be depended upon as a lone supply of salt for average to high producing dairy cattle.

   a. should
   b. should not

6. Animals with a craving for salt based upon a lengthy deficiency may eat enough to ______________.

   a. require none for a period of time
   b. catch up on their requirements
   c. injure themselves

7. Alfalfa is classed as ______________ in phosphorus.

   a. poor
   b. moderate
   c. rich

Name ____________________

8. Plenty of ____________ will help prevent rickets.

   a. sunlight
   b. alfalfa hay
   c. protein
   d. milk

9. The important function of ____________ in sheep nutrition is to promote synthesis of Vitamin B_{12} in the rumen.

   a. manganese
   b. iron
   c. cobalt
   d. zinc

10. ____________ cannot get enough block salt to satisfy their requirements.

    a. Swine
    b. Cattle
    c. Sheep

11. "Shot gun" mixtures of minerals ____________ an economical feed supplement for livestock.

    a. are
    b. are not

12. Thumps are an indication of ____________.

    a. too much milk
    b. anemia
    c. too much iron

13. The Pacific Northwest is a(n) ____________ deficient area.

    a. iron
    b. iodine
    c. calcium
    d. phosphorus

14. ____________ is a good source of calcium.

    a. Ground limestone
    b. Bonemeal
    c. Meat scraps
    d. Tankage
    e. Sodium chloride
    f. Dicalcium Phosphate

15. Plenty of ____________ will help prevent rickets and cure it in its early stages.

    a. iron
    b. salt
    c. bleached hay
    d. sunshine

Name ______________________

16. Mineral deficiencies ______________ economic losses even though deficiency symptoms are not visibly apparent.

  a. can cause
  b. cannot cause

17. Anemia in animals results from a deficiency of ______________.

  a. salt
  b. iron
  c. cobalt

18. ______________ is necessary for the formation of thyroxine, a hormone of the thyroid gland.

  a. Iron
  b. Salt
  c. Cobalt
  d. Manganese
  e. Iodine

19. Slipped tendons in growing chickens result from ______________ deficiency.

  a. mangesium
  b. iron
  c. manganese
  d. cobalt

20. Match the following materials with the minerals they provide.

  a. Oystershell ________calcium
  b. Iron sulfate ________salt
  c. Sodium chloride ________iron

21. ______________ ______________ or ______________ ______________ are good sources of calcium and phosphorus.

  a. Oystershell
  b. Dicalcium phosphate
  c. Steamed bone meal
  d. Iron sulfate
  e. Vitamin A

22. The function(s) or phosphorus in the animal is (are) ______________. Choose correct answer(s).

  a. bone formation
  b. regulating body processes
  c. necessary for usage of carbohydrate by animal
  d. necessary for usage of fat by animal
  e. necessary for usage of protein by animal

Name ______________________________

23. ________________ animals have the greatest need for minerals such as calcium and phosphorus.

a. Young
b. Mature
c. Aged

24. Label the following with

A. Major element
B. Minor element
C. Not essential for livestock

________1. Calcium
________2. Gold
________3. Selenium
________4. Cobalt
________5. Platinum
________6. Uranium
________7. Phosphorus
________8. Magnesium
________9. Copper
________10. Potassium

________11. Manganese
________12. Iodine
________13. Chlorine
________14. Sulfur
________15. Zinc
________16. Sodium
________17. Iron
________18. Lead
________19. Tin
________20. Aluminum

25. Studies at WSU indicate adequate amounts of most minerals with the exception of ________________, in the State of Washington.

a. Zinc
b. Copper
c. Selenium
d. Sulfur
e. Calcium

INFORMATION PANEL

This is a programed instruction unit for "Minerals." You will find it relatively easy to answer the questions in each "frame." This method of instruction will aid you to master the objectives listed if you apply yourself to the material.

You are provided with a program and a combination answer sheet and mask to cover the answers.

1. Place the mask (answer sheet) over the answer in a way that exposes one question (frame) at a time.

2. Write your answer on the answer sheet.

3. Move the answer sheet down to expose the next frame and answer to the previous frame.

4. Should your answer be wrong, write the correct answer above or along side--do not erase your incorrect answer.

If you have not read the information panel, do so now, then proceed to frame 1.

Name ______________________

1. ______________
2. ______________
3. ______________
4. ______________

______ and ______

______ and/or ______

5. --
6. ______________
7. ______________
8. c______________

p______________

p______________

s______________

s______________

c______________

m______________

____

9. ______________

____

____

____

____

____

____

____

____

10. ______________
11. ______________
12. --
13. --
14. ______________
15. ______________
16. ______________
17. ______________
18. --
19. ______________
20. ______________
21. ______________

____

22. ______________

____

23. ______________
24. ______ ______
25. ______________
26. ______________
27. ______________

____

____

28. ______________

Review

A. ______________

____

B. ______________

____

C. ______________

____

29. c______________

p______________

30. ______________
31. ______________
32. ______________

Minerals
Continued

Name ______________________

33. ______________

____

34. ______________

35. ______________

36. ______________

37. ______________

38. ______________

39. M_____________

40. ______________

41. ______________

42. _______ _______

43. _______ _______

44. ______________

45. ______________

____

46. ______________

____

____

____

47. ______________

48. L_____________

____

____

49. ______________

50. ______________

51. --

Minerals	1. A ration containing an abundance of protein, carbohydrates, and fat without minerals will generally result in the death of an animal sooner than if no food at all is given. __________ are necessary for many body processes including growth and reproduction.
15	2. Fifteen separate and distinct mineral elements are known to be required by animals. Some of the important functions they perform in the body are: (1) they contribute to the body structure, particularly the bones and teeth, (2) they aid in muscular activities, in the reproduction processes, and in lactation and egg production, and (3) they promote digestion of food, repair the body tissues in maintenance, formation of new tissue in growth, and liberation of energy for muscular work and activity and the production of heat. __________ minerals are known to be required by animals.
minerals	3. Adequate mineral nutrition is dependent on: (1) a sufficient intake of each required element, (2) presence of the elements in forms biologically available to animals, (3) a suitable balance between each of the elements, and (4) adequate supply and balance of other nutrient factors. Sufficient energy and vitamins in balance with other nutrients are necessary to insure adequate absorption of available __________.
3 2 and 3 1 and 4	4. We must know the type of ration and the form in which the mineral is fed based upon item _____ listed in frame 3 above. Fertilizer elements added to a deficient soil might result in a deficiency of a mineral element previously adequate in the feed ration and probably adequately supplied now. This condition could be explained by ________ and ________, listed in frame 3. Irrigation may wash away soluble minerals such as calcium. Calcium might become deficient because of _______ and/or _______ listed in frame 3.
	5. When supplementing rations, only those minerals that are deficient need be added. As necessary as minerals are, an oversupply can reduce performance or in some cases even be toxic. As an example, cobalt is most essential yet when as little as 12 ppm (.1 gram/day) is fed, digestion of roughage is reduced. Consequently, cattle feeders cannot operate on the theory that if a small amount of mineral is good three times this level would be better. Indiscriminate use of minerals may be expensive in cost and in reducing performance.

False	6. Mineral deficiencies may be so slight as to be hardly noticeable or acute enough to cause death. Correct feeding practices must include feeding of the minerals that the animal needs. Nothing is gained in adding a mineral to a ration in which enough of that mineral is already included. Extra minerals fed as "insurance" are an economical supplement to feed. True or False.
False	7. Mineral deficiencies that are not severe enough to result in visible symptoms may represent an economic loss because of reduced growth and inefficient feed utilization. Therefore, mineral deficiencies may result in an economic loss before they are serious enough to cause visible symptoms. Mineral deficiencies are important only if deficiency symptoms can be observed. True or False
Calcium Phosphorus Potassium Sodium Sulfur Chlorine Magnesium False	8. The essential elements are usually classified as either major or minor. The essential major elements are calcium, phosphorus, potassium, sodium, sulfur, chlorine, and magnesium. The essential major elements are: C______, P_________, P_______, S_______, S_______, C_______, and M_______. Mineral supplements should be added to rations according to the theory "if a little is good, a lot is better." True or False.
Iron Zinc Copper Iodine Manganese Cobalt Selenium Molybdenum Fluorine	9. The minor or trace elements usually considered as essential are iron, zinc, copper, iodine, manganese, cobalt, selenum, molybdenum, and fluorine. Write these names on your answer sheet. You should become familiar with them. In addition to these elements known to be required, an animal's body may contain 20 to 30 additional different elements in trace amounts. Some of them may one day prove to be essential.
Cannot	10. Studies at WSU indicate that animals studied at 20 locations throughout Washington state were being fed rations containing an adequate amount of most minerals with the exception of copper on the West side and in the Basin. Certain by-product feeds are exceptionally low in one or more minerals, and a deficiency proportional to the amount of the by-product fed might occur. Also, when rapid gains are expected the stress is likely to increase the requirements over that normally needed for many of the minerals. General recommendations of mineral supplements for all rations (can) or (cannot) be made with assurance, for a state-wide area.

Feed lot operations. No May cause imbalance and thereby cause a deficiency.	11. Mineral deficiency will be more likely with a (Feed lot operation) or (cow and calf operation.) Extra minerals fed liberally as "insurance" are an economical supplement to a ration. True or False. Why or why not?

12. In order to supply the correct amount of minerals, it is necessary first to know the mineral composition of the feeds. Knowing this, one can add the correct minerals and amounts as needed. Some of the commonly used cattle feeds of Washington have the following approximate mineral compositions:

	Calcium	Phosphorus	Salt		Copper	Iodine	Cobalt
	%	%	(Sodium) %	(Chlorine) %	Mg/lb		
Alfalfa	1.50	0.25	.13	.37	2-4	b	b
Barley	0.06	0.35	.06	.15	1-2a	b	b
Beet Pulp	0.62	0.09	.18	.17	5	b	b
Corn silage (dry matter basis)	0.33	0.23	.01	.05	0.6	b	b

a. Estimated
b. Not present, in amounts too small to be detected or contents not known.

If you were feeding a ration composed as follows:

Alfalfa	20%
Beet pulp	30%
Barley	50%

It would contain approximately 0.52 per cent calcium, 0.25 per cent phosphorus, 0.3 per cent salt and 1.4 mg copper per pound. Such a ration is inadequate in iodine, copper, and salt. It will be readily observed that adequate calcium is present. There is enough phosphorus--if it is all available. In this case phosphorus supplementation would be good insurance.

13. A general statement about possible mineral deficiencies* in the State of Washington is that salt and iodine (iodized salt) should be added to rations. There is also a possibility of copper deficiencies. Other minerals should be fed as needed in a form that is most available to cattle.

*beef cattle.

Sodium and chlorine or salt	14. Sodium and chlorine combined as sodium chloride is common <u>salt</u>. The symptoms of a salt deficiency are, an intense craving for salt, rapid weight loss, lusterless eyes, and in the case of dairy cattle, diminished milk production. A rapid weight loss is symptomatic of a ________________ deficiency in cattle.
Salt	15. Calves and sheep require 1/4 to 1/2 ounce of salt per day, while high producing cows may require as much as 3 ounces. Salt may be included in the swine ration (1/2 to 1 per cent) but generally it is advisable to supply animals free choice also. Block salt should not be depended upon as the lone supply of salt for average to high producing dairy cattle. Lusterless eyes, rapid loss of weight and diminished milk production are symptoms of ______________ deficiency.
Kill or make sick	16. Animals that have not had salt for some time should not be given free access to it because they may eat enough to cause digestive disturbances or even death. They should be given small quantities daily until the craving has largely disappeared. Animals with a craving for salt based upon a lengthy deficiency may eat enough to ______________ if given free access to large amounts of it.
regulating body process	17. Phosphorus also is found primarily in the bones and teeth. About 80 per cent of it is used for structural pruposes. Like calcium, it is important in bone formation, but this is not its most important function since it is vitally concerned in regulating various body processes. Protein, fat, and carbohydrates cannot be used by the animal in the absence of phosphorus. This compound serves at least 14 different function in the body. Phosphorus is primarily important for (bone formation) (Regulating body processes).
	18. Potassium has received renewed interest in the last few years. Deficiency symptoms may range from barely noticeable to acute. Slightly reduced feed intake or performance may go unnoticed. A minor stiffness, especially in the front joints that could be mistaken for disease, weather, or effects of age, may actually be due to insufficient potassium intake. One possible reason for a higher incidence of these problems is that rations have been changed to include more feedstuffs with lower potassium content. Most cereal and animal products are, at best, only martinal in potassium content and these ingredients comprise the major part of today's rations for rapidly growing and fattening cattle.

is not	19. One example of comparative availability of minerals is that of calcium. It has been shown that the calcium contained in milk is much more readily available for absorption than is the calcium in other foods. But, even if the calcium available for absorption is high, unless there is a proper ratio of calcium and phosphorus and Vitamin D, the absorption cannot be fulfilled and the calcium will pass through the body and be excreted. Adequate supply of a mineral (is) or (is not) a guarantee of adequate absorption by the animal.
phosphorus	20. Symptoms of a phosphorus deficiency are stiffness and soreness of the joints, listlessness and lack of appetite, and even a depraved appetite causing the animal to eat dirt or chew bones or wood. Thus rate of growth and production are affected. Lack of ______________ can affect rate of growth and production.
moderate poor	21. Feeds are classed as phosphorus poor, moderate, or rich. Most legume hays are moderate in phosphorus while the grass hays are poor. If the dry matter of the feed contains less than .2 per cent, it is classed as phosphorus poor; between .2 per cent and .5 per cent, as moderate amount; and more than .5 per cent, as phosphorus rich. Alfalfa is ______________ in phosphorus. Grass hay is ______________ in phosphorus.
moderate poor	22. The cereal grains are moderate in phosphorus while beet pulp, silage, and early green pastures are poor. The cereal grains are ______________ in phosphorus while beet pulp, silage, and early green pastures are ______________.
rich	23. Wheat bran, cotton seed meal, skimmilk and linseed meal are rich in phosphorus. Wheat bran, cotton seed meal, skimmilk and linseed meal are ______________ in phosphorus.

TABLE 1

PHOSPHORUS

Poor	Moderate	Rich
Dry -.2%	Dry .2 - .5%	Dry .5%+
Grass Hay	Legume Hay	Wheat Bran
Beet Pulp	Cereal Grains	Cottonseed meal
Silage		Skimmilk
Early Green Pasture		Linseed oil meal

TABLE 2

CALCIUM

Poor	Moderate	Rich
Cereal Grains	Bluegrass Pasture	Alfalfa Hay
Legume Feeds	Linseed Oil Meal	Red Clover Hay
Grass Hay*	Cottonseed Oil Meal	Ladino Clover Hay
	Soybean Oil Meal	Tankage
	Dried Beet Pulp	Meat Scraps
	Corn Silage	Fish Meal
	Fodder	Milk Products

*Grown on acid soils

	24. Rations poor in phosphorus should be supplemented with steamed bonemeal, dicalcium phosphate, or defluorinated rock phosphate. Dicalcium phosphate is generally preferred but any one of the three materials will supply phosphorus in a satisfactory form, especially if it doesn't contain fluorine. It becomes a matter of convenience to make available steamed bonemeal and salt in two containers. One container to contain salt, the other to contain 2/3 salt and 1/3 dicalcium phosphate or steamed bonemeal. ________________ is the supplement generally preferred as a source of phosphorus.
calcium	25. Calcium deficiencies result in weakening of the bones, lameness and even fractures. Less serious symptoms include slow growth, poor condition or unsatisfactory milk production. Bones are composed largely of phosphorus and ______________.
gypsum (calcium sulphate), lime	26. An excess of calcium will often decrease absorption of zinc and manganese. What plant fertilizer additive adds calcium to the soil? Calcium is the major mineral in the body. About 99 per cent of this mineral is found in the bones and teeth while the remaining 1 per cent is in the soft tissue. Since calcium is used largely for structural purposes it is needed in greater amounts for younger animals than for feed lot cattle. Calcium has other functions in the body such as blood clotting.
rich poor moderate	27. Calcium Poor feeds include cereal grains, and their by products, legume seeds and all grass hay grown on acid soils. Calcium in moderate amounts is supplied by bluegrass pasture, linseed meal, cottonseed meal, soybean meal, all grass hay grown on non-acid soils, dried beet pulp, and corn silage and fodder. Calcium rich feeds include alfalfa hay, red clover hay, ladino clover hay, tankage, meat scraps, fish meal, and milk products. Alfalfa hay and tankage are calcium ________ feeds. The cereal grains are ________ in calcium and ________ in phosphorus.
limestone, ground oyster shell, steamed bonemeal, dicalcium phosphate	28. Calcium supplements include good grade limestone, dicalcium phosphate, ground oystershell, or steamed bonemeal. Vitamin D, furnished by direct sun rays enables an animal to make better use of the calcium avaialable to it. ________________ is a good calcium supplement.

Practice Review Use Tables 1 and 2

A. Grass hay grown on acid soil is ______________ in calcium and ______________ in phosphorus.

B. Cottonseed meal is ______________ in phosphorus and ______________ in calcium.

C. Ladino hay is a calcium ______________ feed and a ______________ source of phosphorus.

calcium phosphorus	29. Fattening hogs require no additional calcium or phosphorus if fed enough tankage, fishmeal, or milk by products to balance the protein needs of the ration. Soybean meal used as a protein supplement requires additional finely ground limestone or bonemeal fed free choice. Fattening hogs require no additional C______________ or P______________ if fed enough tankage, fishmeal, or milk by products to balance the protein needs of the ration.
milk	30. (Beef Cattle) More calcium and phosphorus is needed by young calves than by older cattle. Nursing calves or calves getting skimmilk need no extra calcium. Should the soil of their pasture be deficient in phosphorus, dicalcium phosphate should be made available. Phosphorus is more of a problem than calcium and dicalcium phosphate has a good balance of calcium and phosphorus. ______________ is an adequate source of calcium for young calves.
anemia	31. Anemia in animals results from a deficiency of iron. It is recognizable by paleness of the skin and especially membranes of the mouth. Thumps in suckling pigs is also an indication of anemia. The problem usually is limited to pigs kept on concrete or wooden floors with no access to soil and calves, lambs or colts kept too long on milk as their only feed. Milk is deficient in iron. A deficiency of iron results in ______________.
iodine	32. Iodine is necessary for the formation of thyroxine which is a hormone of the thyroid gland. When a deficiency of iodine exists, the gland enlarges in an effort to provide more thyroxine. ______________ is necessary for the formation of thyroxine.
iodized salt iodine	33. Iodized salt with stabilized iodine added is a good way to provide iodine. Iodine deficiency in sheep results in the birth of weak, dead or woolless young. Stabilized ______________ is a good way to provide ______________.

stabilized	34. Iodine deficient areas occur locally throughout the Northwest, the Great Lake Region, Indiana, Ohio, Pennsylvania, Illinois, the Dakotas', Nebraska, Utah, Nevada, Colorado, Idaho and Montana. _______________ iodine is necessary to prevent weathering of iodized salt blocks.
copper	35. Copper deficiency may exist as a primary deficiency or in combination with cobalt and possibly iron deficiencies. Copper deficiency seems to be associated with anemia. Anemia is recognizable by paleness of the skin and expecially the membranes of the mouth. _______________ deficiency may exist as a primary deficiency or in combination with cobalt and possible iron deficiencies.
copper	36. Animals suffering from inadequate copper intake appear to be unable to absorb iron at a normal rate, and a defect in hemoglobin synthesis exists. Symptoms of copper deficiency in young lambs are muscular incoordination with partial paralysis of the hindquarters. A defect in hemoglobin symthesis may result from a _______________ deficiency preventing absorption of adequate iron.
Vitamin B_{12}	37. The important function of cobalt in sheep nutrition is to promote synthesis of Vitamin B_{12} in the rumen. Cobalt deficiency causes a loss of appetite, lack of thrift, weakness, anemia and a decrease in fertility and in milk and wool production. Cobalt functions in the rumen to promote synthesis of _______________.
sulfur	38. Sulfur is essential in livestock diets. It functions in the synthesis of sulfur containing amino acids in the rumen and certain other sulfur compounds of the body. Mature grass and grass hays are sometimes low in sulfur and may not furnish adequate amounts for optimum animal performance. _______________ functions in the synthesis of some amino acids in the rumen.

manganese	39. The symptoms of manganese deficiency are poor hatchability of the eggs in the laying flock and slipped tendons in growing chickens. Rations containing wheat or wheat products or a small amount of manganese sulfate will generally prevent the trouble. A deficiency in M_____________ does affect hatchability of eggs and causes slipped tendons in growing chickens.
salt	40. Tankage, milk by products or fishmeal fed to boars in large enough amounts to balance their protein needs satisfies the mineral needs except for salt. _____________ is the only mineral not adequately supplied to boars when protein requirements are satisfied with tankage, milk by products or fishmeal.
sunshine	41. Calves in confinement sometimes get rickets. Feeding a well-balanced ration made up of grain and sun-cured legume hay, and access to sunlight will prevent rickets and cure it in its early stages. Plenty of _____________ will help prevent rickets.
Dicalcium phosphate	42. Cows nursing calves on early spring pasture may need calcium added to their ration. Dicalcium phosphate is a good form to use. Good legume hay fed at the rate of 6 or 7 pounds daily with other roughage should provide enough calcium but phosphorus may be lacking. _____________ _____________ is a good source of phosphorus.
ground limestone or dicalcium phosphate	43. Bulls fed mixed hay and grain during winter need no mineral supplement other than salt. If no legume hay is fed, calcium should be supplied by ground limestone, free choice or dicalcium phosphate. Bulls on pasture and grain, or bulls on grass hay should be supplied with _____________ _____________.

will not	44. Neither calcium or phosphorus are necessary supplements when stocker and feeder cattle are fed a balanced ration of grain and good legume hay. Feeder and stocker cattle on a balanced ration for nutrients other than minerals not including legume hay (will, will not) be adequately supplied with calcium and phosphorus.
pasture legume hay	45. Supplementary minerals are not necessary for young dairy cattle on pasture or legume hay except for salt. It is good practice to keep dicalcium phosphate available to them, however. High producing cows in the early stages of lactation may need additional calcium and phosphorus. Supplementary minerals are not necessary for young dairy cattle on ______________ or ______________ except for salt.
ground limestone steamed bonemeal or dicalcium phosphate phosphorus phosphorus	46. Producing dairy cattle not receiving legume hay should be furnished ground limestone or steamed bonemeal. These may be mixed with the grain at the rate of 1 to 2 pounds for each 100 pounds of grain mixture, or for cows on pasture a mixture consisting of equal parts bonemeal or dicalcium phosphate, limestone, and salt may be supplied in feeders to which the cattle have free access. Dairy cattle not on legume hay should receive ____________. or _________. Dairy cattle fed grass hays are generally deficient in _________. This can be remedied usually by feeding supplements high in ___________.
loose	47. Salt should be available at all times. Swine cannot eat enough block salt to get all that they need, so loose salt should be fed in the ration or free choice. Brood sows and pigs not running on pasture should be self-fed sun-cured legume hay to provide calcium and Vitamins A and D. This is especially true during the winter when pastures are not available. Salt should be provided for swine in the _________ form.
Legume, Iron, Copp Copper NOTE: Iron injection or solution painted on the udder or iron sulfate (iron + copper) or ferrous sulfate fed to the litter.	48. L__________hay is needed to provide calcium and Vitamins A and D for brood sows and pigs not on pastures. It is impossible to give a lactating sow the feeds that will enable her to furnish enough iron and copper in her milk to prevent anemia in her pigs. For this reason young pigs kept on concrete or wooden floors should have ___________ and ___________ provided.

manganese	49. Poor hatchability of the eggs in a laying flock and slipped tendons in growing chickens result from manganese deficiency. Wheat and wheat products or 4 or 5 ounces per ton of manganese sulfate will generally prevent the trouble. Slipped tendons in growing chickens result from____________ deficiency. Manganese deficiencies are common only in the poultry industry.
no	50. Now that you are aware of mineral deficiencies to be concerned about, answer this question again. Should extra minerals be fed as "insurance" to maximize profits?
	51. With the increasing useage of irrigation in the United States mineral supplements will become more necessary. Some of the important minerals are soluble and will become deficient because of irrigation. Commercial fertilization has the effect of adding minerals to the soil. In some cases this could bring about a poor balance of minerals. In other cases the fertilizer elements will compensate for losses through irrigation.

Name ______________________________

POST-TEST

MINERALS

Underline correct answer(s).

1. A ration containing an abundance of protein, carbohydrates, and fat, without minerals will generally result in the death of an animal ________________ than if no food at all is given.

   a. at the same time
   b. sooner
   c. later

2. ________________ minerals are known to be required by animals.

   a. 7
   b. 9
   c. 11
   d. 13
   e. 15

3. Extra minerals fed as "insurance" ________________ as economical supplement to feed.

   a. are
   b. are not

4. Mineral deficiencies are important only if deficiency symptoms can be observed.

   a. True
   b. False

5. Block salt ________________ be depended upon as a lone supply of salt for average to high producing dairy cattle.

   a. should
   b. should not

6. Animals with a craving for salt based upon a lengthy deficiency may eat enough to ________________.

   a. require none for a period of time
   b. catch up on their requirements
   c. injure themselves

7. Alfalfa is classed as ________________ in phosphorus.

   a. poor
   b. moderate
   c. rich

Name ______________________________

8. Plenty of ______________ will help prevent rickets.

   a. sunlight
   b. alfalfa hay
   c. protein
   d. milk

9. The important function of ______________ in sheep nutrition is to promote synthesis of Vitamin B_{12} in the rumen.

   a. manganese
   b. iron
   c. cobalt
   d. zinc

10. ______________ cannot get enough block salt to satisfy their requirements.

    a. Swine
    b. Cattle
    c. Sheep

11. "Shot gun" mixtures of minerals ______________ an economical feed supplement for livestock.

    a. are
    b. are not

12. Thumps are an indication of ______________.

    a. too much milk
    b. anemia
    c. too much iron

13. The Pacific Northwest is a(n) ______________ deficient area.

    a. iron
    b. iodine
    c. calcium
    d. phosphorus

14. ______________ is a good source of calcium.

    a. Ground limestone
    b. Bonemeal
    c. Meat scraps
    d. Tankage
    e. Sodium chloride
    f. Dicalcium Phosphate

15. Plenty of ______________ will help prevent rickets and cure if in its early stages.

    a. iron
    b. salt
    c. bleached hay
    d. sunshine

Name ______________________

16. Mineral deficiencies ______________ economic losses even though deficiency symptoms are not visibly apparent.

- a. can cause
- b. cannot cause

17. Anemia in animals results from a deficiency of ______________.

- a. salt
- b. iron
- c. cobalt

18. ______________ is necessary for the formation of thyroxine, a hormone of the thyroid gland.

- a. Iron
- b. Salt
- c. Cobalt
- d. Manganese
- e. Iodine

19. Slipped tendons in growing chickens result from ______________ deficiency.

- a. mangesium
- b. iron
- c. manganese
- d. cobalt

20. Match the following materials with the minerals they provide.

a. Oystershell	_______calcium
b. Iron sulfate	_______salt
c. Sodium chloride	_______iron

21. ______________ ______________ or ______________ ______________ are good sources of calcium and phosphorus.

- a. Oystershell
- b. Dicalcium phosphate
- c. Steamed bone meal
- d. Iron sulfate
- e. Vitamin A

22. The function(s) or phosphorus in the animal is (are) ______________. Choose correct answer(s).

- a. bone formation
- b. regulating body processes
- c. necessary for usage of carbohydrate by animal
- d. necessary for usage of fat by animal
- e. necessary for usage of protein by animal

Name ______________________________

23. ________________ animals have the greatest need for minerals such as calcium and phosphorus.

a. Young
b. Mature
c. Aged

24. Label the following with

A. Major element
B. Minor element
C. Not essential for livestock

________ 1. Calcium
________ 2. Gold
________ 3. Selenium
________ 4. Cobalt
________ 5. Platinum
________ 6. Uranium
________ 7. Phosphorus
________ 8. Magnesium
________ 9. Copper
________ 10. Potassium

________ 11. Manganese
________ 12. Iodine
________ 13. Chlorine
________ 14. Sulfur
________ 15. Zinc
________ 16. Sodium
________ 17. Iron
________ 18. Lead
________ 19. Tin
________ 20. Aluminum

25. Studies at WSU indicate adequate amounts of most minerals with the exception of ________________, in the State of Washington.

a. Zinc
b. Copper
c. Selenium
d. Sulfur
e. Calcium

PLANT NUTRITION

PURPOSE

This is a "Plant Nutrition" programmed instruction unit designed to provide an introduction to "Soil Fertility" or "Plant Nutrition." This program includes the following knowledges:

1. Chemical elements necessary for plant growth, grouped by:
    a. Sources of air, water and soil.
    b. Major and minor elements.
    c. Primary plant foods.
    d. Secondary plant foods.
2. Functions of nitrogen, phosphorus, and potash for growth and maturity of plants and resistance to disease.
3. The soil amendment to correct acid soil conditions.
4. The function of the "carrier" material in commercial fertilizers.
5. The soil type and its affect on fertilizer utilization by crops.
6. The importance of chemical soil tests to establish fertilizer needs.
7. The importance of field testing the rates of fertilizers recommended by the chemical soil test results.
8. The plant processes; photosynthesis, transpiration and respiration.
9. The physical texture and structure and chemical fertility of soils as these two factors limit or promote plant growth.
10. Barnyard manure as a source of nutrients to the soil.
11. Green manure crops.
12. Commercial fertilizer labeling.
13. The purposes of crop rotation.
14. The nitrogen cycle.
15. The solubility of nitrogen.
16. The carbon-nitrogen ratio.

PRE-TEST Name________________

PLANT NUTRITION

Underline the Correct Answer

1. Water and air furnish three elements for plant growth. They are

   a. Manganese
   b. Phosphoric acid
   c. carbon
   d. oxygen
   e. copper
   f. zinc
   g. hydrogen

2. ______________ is taken from the air by certain groups of bacteria. It is available to plants through these bacteria.

   a. Oxygen
   b. Nitrogen
   c. Carbon
   d. Calcium
   e. Phosphorous

3. Which three are known as primary plant foods?

   a. carbon
   b. zinc
   c. nitrogen
   d. phosphoric acid
   e. iron
   f. potash

4. The "rarer elements" include _______, _______, _______, molybdenum, copper, manganese.

   a. zinc
   b. magnesium
   c. boron
   d. iron
   e. nitrogen

5. ______________ functions to increase growth and slow up maturity.

   a. Phosphorous
   b. Calcium
   c. Nitrogen
   d. Oxygen

6. ______________ hastens maturity of crops.

   a. Nitrogen
   b. Sulphur
   c. Potash
   d. Phosphoric acid

Name ____________________________

7. ______________ appears to aid plants in resisting certain diseases.

   a. Phosphorous
   b. Gypsum
   c. Nitrogen
   d. Potash
   e. Phosphoric acid

8. The term ______________ is used to indicate the material in which the plant nutrient is found (commercial fertilizers).

   a. dryer
   b. carrier
   c. host
   d. conveyer

9. Lime does not furnish nitrogen, phophoric acid or potash and is therefore classified as a

   a. carrier
   b. "helper"
   c. fertilizer
   d. amendment

10. Soil acidity is measured as

   a. tilth
   b. friability
   c. sourness
   d. sweetness
   e. pH

11. ______________ is the process resulting in production of carbohydrates.

   a. Transpiration
   b. Photosynthesis
   c. Respiration
   d. Transportation

12. ______________ is the process of absorption of water by root hairs, movement up through the stems, to the leaves. The remainder of the water is lost by evaporation through the stomata.

   a. Perspiration
   b. Photosynthesis
   c. Respiration
   d. Transportation

13. ______________ is a destructive process by which food is destroyed, with a consequent release of energy, intake of oxygen, and outgo of carbon dioxide and water.

   a. Respiration
   b. Exhalation
   c. Transpiration
   d. Photosynthesis

Name ____________________

14. Barnyard manure is valuable for its nutrient elements and for its

a. phosphoric acid
b. calcium
c. organic matter
d. nitrogen

15. 12-15-7 stands for a commercial fertilizer mixture of 12% ______, 15% ______, and 7% ______.

a. sulfur
b. phosphoric acid
c. potash
d. nitrogen
e. calcium
f. sulfur

(Fill in the blanks with the correct letter)

16. One approach to ____________ includes a cash crop, a cultivated crop, and a legume or hay crop.

a. nitrification
b. crop rotation
c. nutrition
d. a carbon cycle

17. ____________ in the soil is soluble and easily lost to drainage.

a. Phosphoric acid
b. Sulfur
c. Potash
d. Nitrogen

18. Crop residues, commercial fertilizers, and ammonium and nitrate salts by precipitation are forms of

a. phopshorous
b. potash
c. nitrogen
d. calcium

19. ____________ is most readily available and in larger amounts for microorganisms and plant growth.

a. N, nitrogen
b. NH_4, ammonium
c. NO_2, nitrite
d. NO_3, nitrate

20. The relationship between nitrogen and carbon is called the

a. nitrogen-carbon ratio
b. carbon-nitrogen ratio
c. potash cycle
d. carbon-nitrogen equivalent

INFORMATION PANEL

This is a programed instruction unit for "Plant Nutrition." You will find it relatively easy to answer the questions in each "frame." This method of instruction will aid you to master the objectives listed if you apply yourself to the material.

You are provided with a program and a combination answer sheet and mask to cover the answers.

1. Place the mask (answer sheet) over the answer in a way that exposes one question (frame) at a time.
2. Write your answer on the answer sheet.
3. Move the answer sheet down to expose the next frame and answer to the previous frame.
4. Should your answer be wrong, write the correct answer above or along side--do not erase your incorrect anser.

Plant Nutrition

If you have not read the information panel, do so now, then proceed to frame 1.

Name ______________________________

1. ______________
____
____

2. c______________
h______________
o______________

3. ______________

4. ______________

5. ______________
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7. ______________
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8. ______________
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10. ______________
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11. ______________
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12. ______________

13. _______ _______

14. _______ _______

15. ______________
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16. ______________
____
____

17. c______________

18. ______________

19. ______________
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20. ______________

21. ______________

22. --

23. R______________

24. ______________
____

25. ______________
____

26. --

27. o_______m_______
____

28. g______________

29. ______________
____

30. --

Plant Nutrition
Continued

Name ____________________

31. ____________
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32. ____________
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33. --

34. --

35. ____________
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36. ______ ______

37. --

38. ____________

39. ____________
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40. --

41. ____________

42. ____________
____

43. ____________

44. ____________

45. ____________

46. ____________

47. ____________

48. --

49. --

50. ______:______

51. --

52. f______t______

53. --

REVIEW

____
____
____

______ iron
______ copper
______ calcium
______ boron
______ zinc
______ sulfur
______ molybdenum
______ magnesium
______ manganese

carbon hydrogen oxygen	1. Fourteen elements have been recognized as being necessary for plant growth. Three from air and water are carbon, hydrogen, and oxygen. These elements account for over 90 per cent of the total weight of the plant. The three elements furnished by air and water are ____________, ____________, and ____________.
oxygen hydrogen oxygen	2. The atmosphere provides c____________, h____________ and o____________ to plants.
nitrogen	3. Nitrogen is taken from the air by certain groups of bacteria. The nitrogen assimilated by these organisms undergoes a change before it is used by higher plants. Certain groups of bacteria remove ____________ from the air.
nitrogen	4. The bacteria taking nitrogen from the air may be associated with most, if not all, leguminous plants are nitrogen-fixing plants. Non-legumes do not fix ____________.
oxygen hydrogen carbon	5. The nitrogen which is taken from the air by bacteria is combined in the soil to make soluble compounds before it can ordinarily be used by higher plants. Therefore, it is ordinarily stated that 7 elements come from the soil, and 3 from air and water. The three from air and water (other than nitrogen) are ____________, ____________, and ____________.

nitrogen phosphoric acid potash	6. Twelve elements are provided by the soil. Nitrogen, phosphoric acid, and potash are known as "primary plant foods" and are needed by plants in relatively large amounts and have long been recognized as those most likely to be deficient in soils. Copy them in the answer space.
calcium sulfur magnesium	7. Calcium, sulfur, and magnesium are secondary plant foods. These secondary plant foods are usually needed in relatively large amounts. Copy in the answer space.
nitrogen phosphoric acid potash calcium sulfur magnesium	8. ____________, ____________ and ____________ are "primary plant foods. ____________, ____________ and ____________ are "secondary plant foods."
iron manganese copper zinc boron molybdenum	9. Iron, manganese, copper, zinc, boron, and molybdenum are usually called the "rarer elements" or "minor plant foods." They are needed in minute amount but are essential. Copy them in the answer space.
iron manganese copper zinc boron molybdenum	10. Continuing research is studying some eleven other mineral elements. However, ____________, ____________, ____________, ____________, ____________, and ____________ are the "rarer elements" proven to be essential to plant growth.

growth maturity	11. Nitrogen functions to increase growth and defer maturity. It produces a good leaf and stem development and gives to the plant that luxurious dark-green color which is so desirable in growing crops. Nitrogen increases ____________ and defers ____________.
nitrogen	12. No matter how much phosphoric acid and potash there may be in the soil, the crops can use only quantities in proportion to the growth of the plants, and the growth of the plants will be in proportion to the ____________ in the soil.
phosphoric acid	13. Phosphoric acid hastens maturity of crops and aids in transferring substances from the stalk, leaves, and other growing parts to the seed, making the grains plump and full. ____________ ____________ increases the proportion of grain to straw and also stimulates root development in young plants.
phosphoric acid	14. ____________ ____________ hastens the maturity of crops. <u>Potash</u> appears to aid the plants resisting certain diseases. An insufficiency of potash results in the early ripening or dying of the stems and leaves of plants while the seeds or fruit are still immature.
potash carbon hydrogen oxygen	15. ____________ appears to aid plants in resisting certain diseases. ____________, ____________, and ____________ are elements furnished by air and water. They make up 90 per cent of the plant weight.

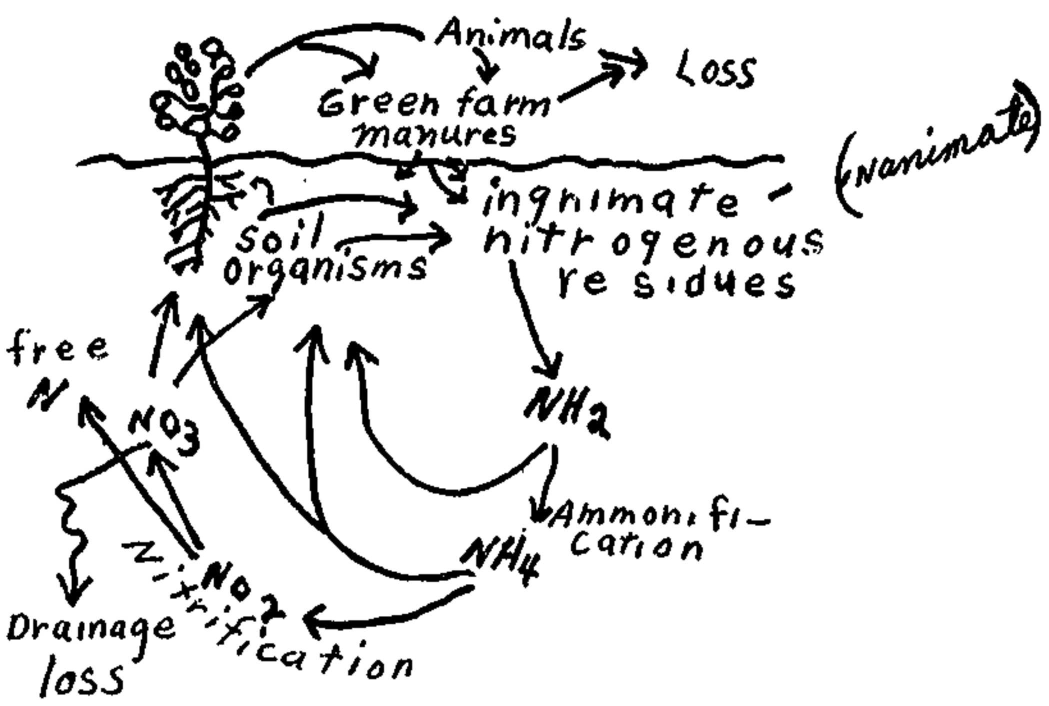
nitrogen potash phosphoric acid	16. The term "carrier" is used to indicate the material in which the plant nutrient is found. For instance, sodium nitrate, superphosphate, and potassium sulfate are carriers of the "primary plant foods," ____________, ____________, and ____________.
carrier	17. The term c____________ is used to indicate the material in which the plant nutrient is found. Chemical soil tests have been developed to determine which fertilizer elements are less than adequate in a particular soil.
less	18. Soil type has a marked effect on the results of fertilizer applied to soils having the same chemical test result. Clay soils are usually richer in plant nutrients than sandy soils. Sandy soils leach badly compared to clay soils, therefore, losing nutrients more quickly than clay soils. Certain chemical forms of a fertilizer elements are more quickly available and are more soluble than other forms. A sandy loam is ____________ rich in plant nutrients than a silty clay loam.
clay sandy	19. Chemical soils tests are important to a fertilization program. A <u>field trial</u> based upon the chemical tests results can definitely establish the rate of fertilizer application by applying the amounts of fertilizer indicated by the chemical test to growing crops and by measuring the differences in crop yield. ____________ soils do not leach as badly as do ______ soils, and, therefore, do not lose nutrients as quickly.
amendment	20. Lime is called a soil "amendment" rather than a fertilizer, as it does not carry nitrogen, phosphoric acid or potash. The acidity of the soil determines the kinds of crops that can be grown on a soil. Lime is a soil ____________.

photosynthesis	21. Some knowledge of plant processes are important to the growth and nutrition of crops. Photosynthesis is the process by which green plants combine carbon dioxide and water in the presence of sunlight, to form carbohydrates. ______________ results in formation of carbohydrates.
--	22. Plants need a certain amount of water in carrying on their physiological processes. However, only a small percentage of the water that is absorbed by the root hairs and passes upward to the leaves is used in these processes. The remainder evaporates through the stomata as water vapor. This process is called <u>transpiration</u>.
Respiration	23. Respiration unlike photosynthesis, which is limited to certain cells in the leaves, takes place in every living cell. Respiration is a destructive process by which food is destroyed with a consequent release of energy intake of oxygen and outgo of carbon dioxide and water. R______________ results in release of carbon dioxide and water.
Transpiration Respiration	24. ______________ is the process of absorption of water by the root hairs, and movement up through the stems, to the leaves. ______________ is the process involving release of energy, intake of oxygen and outgo of carbon dioxide and water.
Physical texture chemical fertility	25. Two soil characteristics equally important as limitations to plant growth are the <u>physical texture</u> and structure of the soil and the <u>chemical fertility</u> of the soil. ______________ and ______________ are important soil characteristics to plant growth.

	26. Barnyard manure is valuable for its nutrient elements and for its organic matter content so beneficial to the physical structure of the soil. Manure is not a well-balanced fertilizer. It is low in phosphoric acid and relatively high in nitrogen and potash. Addition of phosphorous to manure adds much to its value.
organic matter phosphoric acid	27. Barnyard manure is valuable for its nutrient elements and for its o__________ m__________ content. Manure is low in __________.
green manure crop	28. A green manure crop is one used for turning into the soil, whether planted for that purpose or not. For supplying organic matter to the soil, the g__________ __________ __________ that will produce the most growth in the time available should be chosen.
(1) (2)	29. Fertilizers are made up of two major groups (1) Manures or organic amendments, and (2) Commercial fertilizers. Group I included barnyard manures, green manures, crop residues and wastes that are plowed under for enrichment of the soil. Group II includes fertilizers produced commercially and sold singly or in combination. A compost of leaves is [(1), or (2)]. Calcium nitrate is group __________.
	30. The mixed fertilizers are commonly referred to by a series of numbers such as 0 - 10 - 10, 5 - 10 - 20, etc. The first number stands for the percentage of nitrogen; the second number, available phosphoric acid; and the third number, the water soluble potash. 10 - 20 - 30 stands for 10 lbs. of nitrogen, 20 lbs. of phosphate, and 30 lbs. of potash.

15 40 10	31. 10 - 40 - 15 stands for ______________ lbs. potash, ______________ lbs. phosphoric acid, and ____________ lbs. nitrogen.
nitrogen phosphorus potash	32. 20 - 10 - 5 stands for 20 lbs. ______________, 10 lbs. ______________, and 5 lbs. ______________.
	33. A crop rotation is any plan that is followed whereby one crop follows another. Usually one thinks of a well-planned program when referring to a crop rotation.
	34. Some advantages of crop rotation are: 1. Maintains fertility of the soil. The same crop grown successively uses more of one nutrient than of the others. 2. Disease, weeds and insects are more easily controlled. 3. Labor is distributed to better advantage. 4. Legumes aid in maintaining soil fertility through nitrogen fixation. 5. Erosion control is promoted through preservation of organic matter by proper rotation. 6. Diversification spreads the financial risk. The farmer with a variety of crops has hedged against losses.
	35. Can you think of any suggestions why any of the above might be true? List them.

crop rotation	36. A fundamental approach to _______ _______ includes cash crop, cultivated crop, legume or hay crop (poorer quality soils would require more than one year in this last category).
--	37. Nitrogen in the soil is soluble and easily lost to drainage. Nitrogen has a rapid effect on plant growth. Such a potent nutrient element should not only be conserved but also regulated. Some of the intake and outgo of nitrogen can be controlled by man; some is beyond man's control.
soluble	38. Nitrogen is _______________ and easily lost to drainage.
20 12 15	39. The nitrogen income of arable soils is derived from such materials as crop residues, green manures, farm manures, commercial fertilizers, and ammonium and nitrate salts brought down by precipitation. In addition, there is fixation of atmospheric nitrogen. 12 - 20 - 15 stands for ________ lbs of phosphorous ________ lbs of nitrogen ________ lbs of potassium
	40. The outgo of nitrogen is due to crop removal, to drainage, to erosion, to loss in a gaseous condition, both elemental and ammonia, and to unavailable forms of nitrogen.

nitrogen	41. ______________ has a rapid effect on plant growth.
crop residue, green manures, commercial fertilizer, ammonium and nitrate salts by percipitation crop removal, drainage, erosion, gaseous losses, unavailable forms	42. One form of nitrogen income in ______________. One form of nitrogen outgo is ______________.
	43. Much of the nitrogen added to the soil undergoes many transformations before it is removed. NH_4 (ammonium) changes to NO_2 (nitrate). This nitrate form is either appropriated by microorganisms and higher plants, or is removed in drainage or volatilization. And so the cycle goes on and on.
	44. Study the nitrogen cycle. 

income outgo	46. Crop residue is considered nitrogen (outgo, income). Drainage is considered nitrogen (outgo, income).
low	47. A close relationship exists between the organic matter and nitrogen contents of soils. This ratio of carbon to nitrogen in the organic matter of the furrow slice ranges from 8:1 to 15:1. This ratio controls the available nitrogen, total organic matter, and rate of organic decay. The relationship is called the carbon-nitrogen ratio. Green manure crops have a (low or high) ratio of carbon to nitrogen.
	48. Competition for available nitrogen results when residues having a high C:N ratio are added to the soil (straw at 90:1 carbon to nitrogen ratio for example). When a high carbon residue is added to a soil having a narrow C:N ratio, the demand for nitrate nitrogen becomes so great by the micro-organisms rapidly decomposing the organic matter that little nitrate nitrogen is available for higher plants. This slows growth of plants.
a	49. A practical example would be the plowing under of wheat straw and planting a crop. Unless the nitrogen content is high the new crop will lack optimum nitrogen for growth. Commercial fertilizer in correct amounts will hasten decomposition of organic matter and release the nitrate nitrogen for the new crop. Moisture often limits the amount of fertilizer useable as a maximum amount. Farmers currently (A. add commercial nitrogen or B. burn stubble) to keep the C:N ratio low for a new growing crop.
30:1	50. 30 parts carbon to 1 part nitrogen is a ratio of ________: ________ carbon to nitrogen.

	51. Western Washington soils react to phosphorous fertilizer by "fixing" about 70 per cent of it into forms not available to plants. Eastern Washington soils do not lose this much nutrient value. More important to the farmer is whether additions of fertilizers result in a profitable increase in production.
field trials	52. The amounts of fertilizer providing the best economic return can best be determined by chemical tests followed by f__________ t__________.
	53. Farming is applied science. This program illustrates this. A farmer needs to make use of chemical test, resource people, and the scientific method in his farming enterprise.
	Review The primary plant foods are _______, _______ _______, and _________. Choose the secondary plant foods by placing the letter "S" in front of them and the "rarer elements" by putting an "R" in front of them. ________ iron ________ copper ________ calcium ________ boron ________ zinc ________ sulfur ________ molybdenum ________ magnesium ________ manganese

PRE-TEST Name______________________

PLANT NUTRITION

Underline the Correct Answer

1. Water and air furnish <u>three</u> elements for plant growth. They are

   a. Manganese
   b. Phosphoric acid
   c. carbon
   d. oxygen
   e. copper
   f. zinc
   g. hydrogen

2. ______________ is taken from the air by certain groups of bacteria. It is available to plants through these bacteria.

   a. Oxygen
   b. Nitrogen
   c. Carbon
   d. Calcium
   e. Phosphorous

3. Which three are known as primary plant foods?

   a. carbon
   b. zinc
   c. nitrogen
   d. phosphoric acid
   e. iron
   f. potash

4. The "rarer elements" include ________, ________, ________, molybdenum, copper, manganese.

   a. zinc
   b. magnesium
   c. boron
   d. iron
   e. nitrogen

5. ______________ functions to increase growth and slow up maturity.

   a. Phosphorous
   b. Calcium
   c. Nitrogen
   d. Oxygen

6. ______________ hastens maturity of crops.

   a. Nitrogen
   b. Sulphur
   c. Potash
   d. Phosphoric acid

Name ____________________________

7. ______________ appears to aid plants in resisting certain diseases.

   a. Phosphorous
   b. Gypsum
   c. Nitrogen
   d. Potash
   e. Phosphoric acid

8. The term ______________ is used to indicate the material in which the plant nutrient is found (commercial fertilizers).

   a. dryer
   b. carrier
   c. host
   d. conveyer

9. Lime does not furnish nitrogen, phophoric acid or potash and is therefore classified as a

   a. carrier
   b. "helper"
   c. fertilizer
   d. amendment

10. Soil acidity is measured as

   a. tilth
   b. friability
   c. sourness
   d. sweetness
   e. pH

11. ______________ is the process resulting in production of carbohydrates.

   a. Transpiration
   b. Photosynthesis
   c. Respiration
   d. Transportation

12. ______________ is the process of absorption of water by root hairs, movement up through the stems, to the leaves. The remainder of the water is lost by evaporation through the stomata.

   a. Perspiration
   b. Photosynthesis
   c. Respiration
   d. Transportation

13. ______________ is a destructive process by which food is destroyed, with a consequent release of energy, intake of oxygen, and outgo of carbon dioxide and water.

   a. Respiration
   b. Exhalation
   c. Transpiration
   d. Photosynthesis

Name ____________________

14. Barnyard manure is valuable for its nutrient elements and for its

a. phosphoric acid
b. calcium
c. organic matter
d. nitrogen

15. 12-15-7 stands for a commercial fertilizer mixture of 12% _______, 15%_______, and 7%_______.

a. sulfur
b. phosphoric acid
c. potash
d. nitrogen
e. calcium
f. sulfur

(Fill in the blanks with the correct letter)

16. One approach to _____________ includes a cash crop, a cultivated crop, and a legume or hay crop.

a. nitrification
b. crop rotation
c. nutrition
d. a carbon cycle

17. _____________ in the soil is soluble and easily lost to drainage.

a. Phosphoric acid
b. Sulfur
c. Potash
d. Nitrogen

18. Crop residues, commercial fertilizers, and ammonium and nitrate salts by precipitation are forms of

a. phopshorous
b. potash
c. nitrogen
d. calcium

19. _____________ is most readily available and in larger amounts for microorganisms and plant growth.

a. N, nitrogen
b. NH_4, ammonium
c. NO_2, nitrite
d. NO_3, nitrate

20. The relationship between nitrogen and carbon is called the

a. nitrogen-carbon ratio
b. carbon-nitrogen ratio
c. potash cycle
d. carbon-nitrogen equivalent

LAND

LAND JUDGING

This program is "Land Judging." It is to follow "Plant Nutrition." "Land Judging" is designed to introduce the subject of soil management. This program includes the following knowledges:

1. Why land is classified.
2. How land is classified.
3. What the classifications are.
4. What pH is and its affect on plant growth.
5. What the seven factors of classification are.

PRE-TEST Name________________________

LAND

Underline the correct answer(s).

1. Land classes suitable for cultivation are _______, _______, _______, and _______.

   a. I
   b. II
   c. III
   d. IV
   e. VI
   f. VII
   g. VIII

2. Land classes not suitable for cultivation are _______, _______, and _______.

   a. I
   b. II
   c. III
   d. IV
   e. VI
   f. VII
   g. VIII

3. Land slope is defined as the number of feet fall per _______.

   a. 10 feet
   b. 100 feet
   c. 25 feet
   d. 1,000 feet

4. Soil depth is the effective depth that roots and _______ can penetrate the soil.

   a. moisture
   b. a drill
   c. a shallow rooted plant
   d. a post hole digger

5. Soil permeability refers to the rate of movement of _______ and _______ through the soil.

   a. roots
   b. moisture
   c. air
   d. fertilizer

6. Soils that feel "sticky" when moist are _______ textured soils.

   a. loam
   b. silt
   c. medium
   d. fine
   e. coarse

Name ____________________

7. "Silty" or "Loamy" textured soils are ____________.

a. fine
b. medium
c. coarse
d. heavy

8. ____________ is the major influence for rate of water run-off.

a. Slope
b. Soil drainage
c. Permeability
d. Flexibility

9. Soil ____________ refers to how rapidly the land drains after snow melt or heavy rains.

a. length of life
b. drainage
c. permeability
d. slope

10. Moderate erosion is a loss of topsoil between ____________ per cent.

a. 10-20
b. 15-30
c. 25-75
d. 30-60

11. The acidity, or alkalinity (sweetness) of a soil are measured in terms of ____________.

a. pH
b. bH
c. sourness
d. cation exchange

12. Land that can be used regularly for crops in a good rotation but needs intensive treatment and is subject to serve limitations in use for crop land is land class ____________.

a. I
b. III
c. IV
d. VI

13. Land that is very deep is greater than ____________ deep.

a. 30"
b. 40"
c. 50"
d. 60"

Name ____________________

14. The individual parts of soil are called soil _____________.

    a. conglomerates
    b. clumps
    c. particles
    d. pieces

15. A common example of a soil profile having limiting permeability is one having a heavy layer of _____________ in the subsoil.

    a. sand
    b. minerals
    c. clay
    d. nutrients

INFORMATION PANEL

This is a programed instruction unit for "Land Judging." You will find it relatively easy to answer the questions in each "frame." This method of instruction will aid you to master the objectives listed if you apply yourself to the material.

You are provided with a program and a combination answer sheet and mask to cover the answers.

1. Place the mask (answer sheet) over the answer in a way that exposes one question (frame) at a time.
2. Write your answer on the answer sheet.
3. Move the answer sheet down to expose the next frame and answer to the previous frame.
4. Should your answer be wrong, write the correct answer above or along side--do not erase your incorrect answer.

Land

If you have not read the information panel, do so now, then proceed to frame 1.

Name ______________________

1. --

2. c ______________

3. c ______________

4. ______________

5. c ______________

6. ______________ s

7. d ______________

8. ____________ or ____________

9. ____________ ____________

10. ________________________

____

____

____

____

11. ______________

12. ____________ or ____________ s

13. ______________

14. ______________

15. ______________

16. ______________

17. ____________ to ____________

18. ____________ to ____________

19. ____________ to ____________

____

20. ____________ to ____________

____

____________ to ____________

____________ to ____________

______ ______---______ or ______

21. ______________

22. ________________________

23. ______________

24. ____________ ____________

25. ________________________

26. ____________ ____________

27. ________________________

28. s ________ ________ t ________

29. ______________

____

____

30. ____________ ____

____

____

31. ______________

Land
Continued

Name ______________________

32. __________ and __________

33. c __________

34. __________

35. f __________

36. __________

37. __________

38. m __________

39. __________

40. __________

41. __________

____

____

42. __________ - __________

__________ - __________

__________ - __________

43. ______ ______ ______

44. __________

45. ______, ______, and ______

REVIEW

a. ______ b. ______ to ______

c. __________ __________

d. ______ ______ to ______

e. ______ f. ______ and

______ g. ______

______, and ______.

h. __________, __________

and ______________.

46. s __________ p __________

47. ________________

48. __________ and __________

49. ____________

50. ____________

51. ____________

52. ____________

53. ____________

54. ____________

55. ____________

56. ____________

57. __________ __________

58. ____________ __________

59. __________ __________

60. __________, __________

and ______________.

61. ____________

Land
Continued

Name ____________________

62. ______________

63. ______________

64. ______________

65. ______________

66. ______________

__________ __________

____

67. ______________

68. ______________

69. ______________

70. ______________

71. ______________

72. ______________

73. ____________ ________

74. ______, ______ ______,

and ____________.

75. a. ____________

b. ____________

c. ____________

76. ______________

77. ________________________

____

____

____

____

____

78. ______________

79. ______________

80. __________, s__________,

s__________, __________

81. __________, __________,

__________, __________,

__________, __________,

82. ______________________

____

____

____

____

____

83. __________ __________

__________ __________

84. m__________ __________, to

__________ __________ to

__________ to ______ ______

Land
Continued

Name ____________________

85. ____________________
____
____
__________ __________
____
____

86. __________ __________

87. __________ __________

88. __________, __________
____

89. ____________________

90. ____________________

91. ____________________

92. ____________________

93. ____________________

94. ____________________

95. __________, __________,
and __________.

96. _ __________

97. __________ and __________

98. ____________________

99. __________ to __________
__________ and __________.

100. __________ to __________

101. ____________________

102. ____________________

103. __________ to __________,
__________, or __________.

104. ____________________
____
____

105. ____________________
____

106. ____________________

107. ____________________

108. ____________________

109. ____________________

110. __________ and __________

111. ____________________

112. ____________________

113. ____________________

114. ____________________

115. ____________________

Land
Continued

Name ______________________

116. ______________________

117. ______________________

118. ______________________

119. ______________________

120. ________, ________, ________

121. ______________________

122. ______________________

123. ______________________

124. ______________________

125. ______ ______________

126. ______________________

127. ______________________

128. ______________________

129. ______________________

130. ______________________

131. ______________________

132. ______________________

133. --

134. ______________________

135. --

136. --

137. ______________________

138. ______________________

--	1. Before you start the program, you should read the instruction sheet. If you have not already done so, read the instruction sheet now. If you read it, proceed to frame 2.
capability	2. For the most hazard free land usage we classify our soils into "ability to produce" groups, or land capability classes. These eight capability classes are divided according to their c______________.
classify	3. Just as a doctor checks pulse and temperature of a patient before classifying the sickness, so do we learn to check the seven symptoms of our land before attempting to c___________ it.
seven	4. We look for _______________ factors or symptoms before classifying the land and recommending certain crop usage for it.
classifying or classification	5. The reason for c______________ of land is to make the best use of the land. We wish to gain the biggest return from our investment without permanent loss of the soil or its fertility.

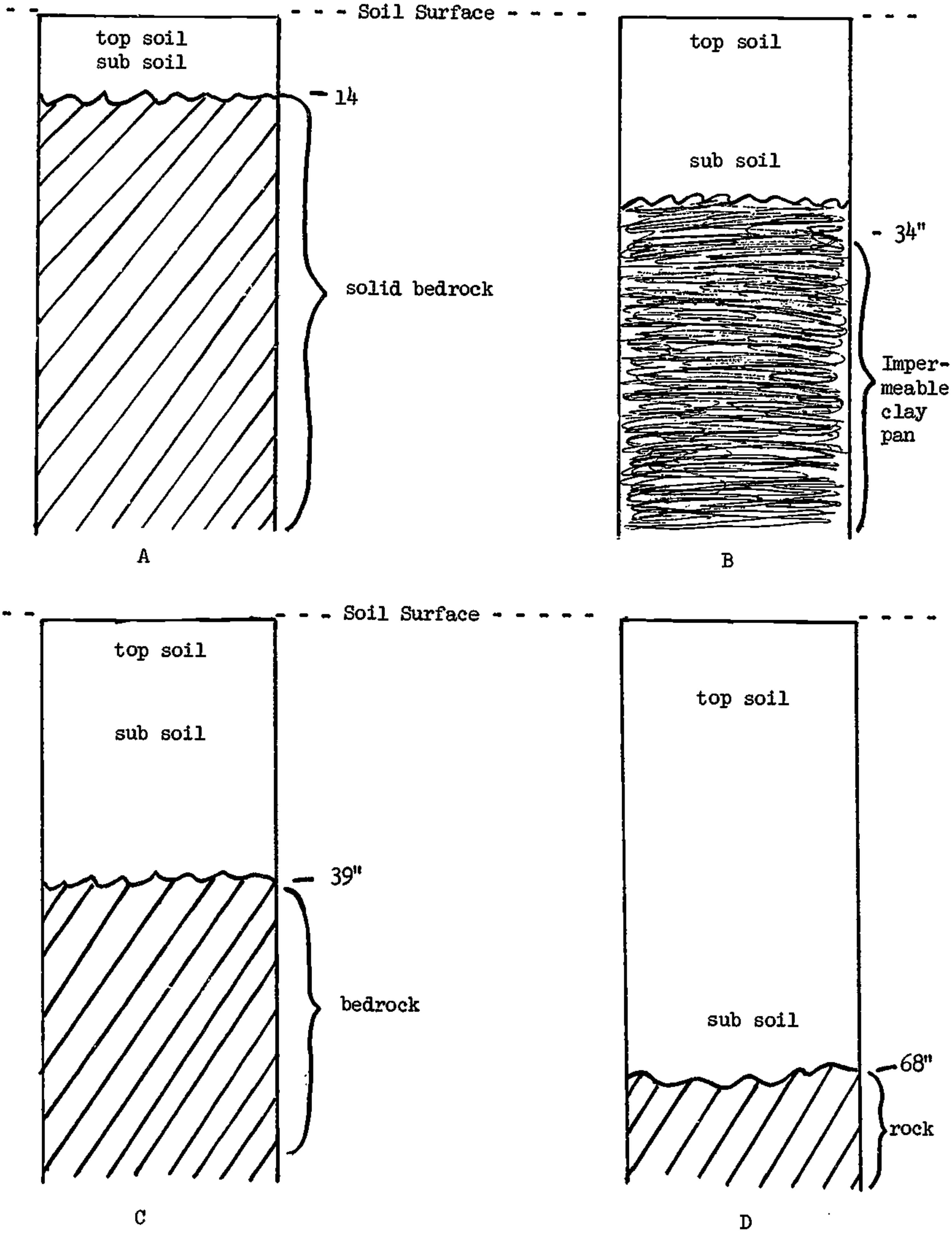
factors or symptoms	6. Efficient classification of the land will require a detailed knowledge of the seven ____________s.
depth	7. Soil depth is the first factor we will consider in detail. Soil d______ is determined by the depth of penetration of roots and moisture.
moisture or root	8. Soil depth may be measured by either ____________ or ____________ penetration.
soil depth	9. We classify soils as very shallow, shallow, moderately deep, deep or very deep. These are divisions or categories of ____________ ____________.
--	10. Soil depths are separated by inches as follows: 0-10" - very shallow 10-19" - shallow 20-35" - moderately deep 36-59" - deep 60" or more - very deep Copy the soil depths.

deep	11. Deep soils are from 36-60 inches deep. Alfalfa roots found at 53 inches depth is an indication of a ____________ soil.
moisture or roots	12. Very deep soils can be identified by evidence of ________ or _________s at 60 inches or deeper.
10	13. Very shallow soils are less than 10 inches deep. Shallow soils are from ____________ to 19 inches deep.
36	14. Moderately deep soils are from 20 to 36 inches deep. Deep soils are from ____________ to 60 inches deep.
60	15. Very deep soils are ____________ inches or deeper.

10	16. Very shallow soils are less than _______ inches deep.
20 36	17. Moderately deep soils are _______ to _______ inches deep.
10 20	18. Shallow soils are from _______ to _______ inches deep.
36 60 60	19. Deep soils are from _______ to _______ inches deep. Very deep soils are _______ inches deep or more.
0-10 Shallow 20-36 36-60 Very deep -- 60 or over	20. If you answer the following questions correctly, move on to question 21. Otherwise, turn back to question 11 for a review. Very shallow --- ___to___" _________ --- 10 to 20" Moderately deep --- ___to___" Deep --- ___to___" ______ ______ --- ___or___"

SOIL PROFILES

Diagrams of vertical profiles showing depths of soils



shallow	Refer to information panel, page 5, to answer frames 21-24. 21. The depth of soil profile "A" would be classified as ________________.
moderately deep	22. The depth of soil profile "B" would be classified as __ ________________.
deep	23. The classification would ________________ for soil profile "C".
very deep	24. Soil profile "D" would be classified as ________ ________.
moderately deep	25. Failure to find evidence of moisture or roots deeper than 22 inches would indicate ________________ soil depth.

Soil surface texture is classified according to the proportion of sand, silt, and clay that make up the soil mass.

The size of individual particles of soil influences the ability of the soil to absorb and store water and air.

After looking at and feeling the soil, we can then classify the surface texture as:

Fine - "clayey" soils that feel stick or slick to the touch.

Medium - "silty" soils that feel smooth or "floury" to the touch.

Coarse - "very sandy" soils that feel gritty or abrasive to the touch.

surface texture	If you have not read information panel on soil surface texture, do so now. 26. Soil ________ ________ refers to the composition of the important top six inches of soil -- the root zone.
by looking at it and feeling it	27. Texture of clothing is sometimes referred to as "coarse." We speak of soils as fine, medium, or coarse textured. We are referring to a six-inch layer. How would you decide whether a soil were fine, medium, or coarse?
soil surface texture	28. Perhaps a series of different sized sieves would work to determine s________ ________ t________.
fine, medium, or coarse	29. Sieves are used in the laboratory, but are awkward for field use. Field men learn to determine soil surface texture by moistening it and rubbing it between the thumb and forefinger. In this way they can determine if the soil surface texture is ________, ________, ________.
sand, silt, clay	30. Soils are composed of ________, ________, and ________, the individual parts being called particles.

particle	31. ________ size determines ability of the soil to hold air and water.
air water	32. Particle size influences the ability of the soil to absorb and store ________ and ________.
coarse	33. Sandy soils feel abrasive and "gritty" to the touch. Sandy soils have a c________ texture.
coarse	34. Coarse soils are predominately sand with some silt and clay. Desert soils are usually ________ in texture due to large proportions of sand.
fine	35. Soils having enough clay to feel "slick" and "sticky" have a f________ texture.

sticky or slick	36. Fine textured soils feel ________ to the touch.
gritty	37. Coarse textured soil feels ________ to the touch.
medium	38. Soils with a large quantity of silt that feel smooth and floury are classified as having a m________ texture.
silt	39. Medium textured soils are composed predominantly of ________. They feel smooth and "floury" to the touch.
smooth or floury	40. Medium textured soils feel ________ to the touch

a-fine b-coarse c-medium	41. a. __________ textured soils feel sticky. b. __________ textured soils feel gritty. c. __________ textured soils feel smooth and floury.
fine - sticky. medium - smooth or floury. coarse - gritty.	42. List the classifications of soil surface texture and indicate how they feel.
soil surface texture	43. The purpose of this classification is to accurately field test a soil as to its __________ __________ __________.
particles	44. The individual parts of these soils are called soil ________, the size of which determines the ability of the soil to hold air and water.
sand, silt, clay	45. Soil is composed of carying proportions of __________, __________, and __________.

10	REVIEW A. Very shallow soils are 0 to _________ inches deep.
10-20	B. Shallow soils are _________ to _________ inches deep.
Moderately deep	C. _________ _________ soils are 20 to 36 inches deep.
deep 35 to 60	D. _________ soils are _________ to _________ inches deep.
60	E. Very deep soils are greater than _________ inches deep.

roots moisture	F. Soil depth is the effective depth that __________ and __________ can penetrate.
	Fine soils characterized by a sticky feeling when moist are chemically fertile but are often a problem physically. They are either too hard for adequate moisture penetration or too moist and sticky to disc and cultivate for seedbed preparation. Soil surface texture is an important consideration in land classification for hazard free land usage.
sand silt, clay	G. Soil is composed of varying proportions of __________, __________, and __________.
fine medium coarse	H. Depending upon the proportions of sand, silt, and clay, we speak of soils in the three textural categories __________, __________, and __________.
	The next section of this program will consider the effects of fine, medium, and coarse textured soils on the movement of air and water through the entire profile (depth) of the soil.

Soil permeability refers to the rate of movement of air and water through the subsoil. Soils may be placed into relative permeability classes through studies of structure, texture, cracking, density and other features. Structure refers to the arrangement of soil particles into granules, clods, columns, or crumbs. We classify permeability as:

Limiting - soils which have dense, heavy clay or clay pan subsoils. Soils under this classification feel sticky and plactic, have the appearance of putty, press out thin between the fingers without crumbling when wet.

Adequate - granular clay loam or silt loam subsoils. Soils with strata cracks usually running perpendicular to the surface. This type of soil is ideal for most agricultural purposes since the water, air, and plant roots can penetrate easily. Yet the soil column is firm and stable.

Excessive - sandy, coarse subsoils through which water and air move freely.

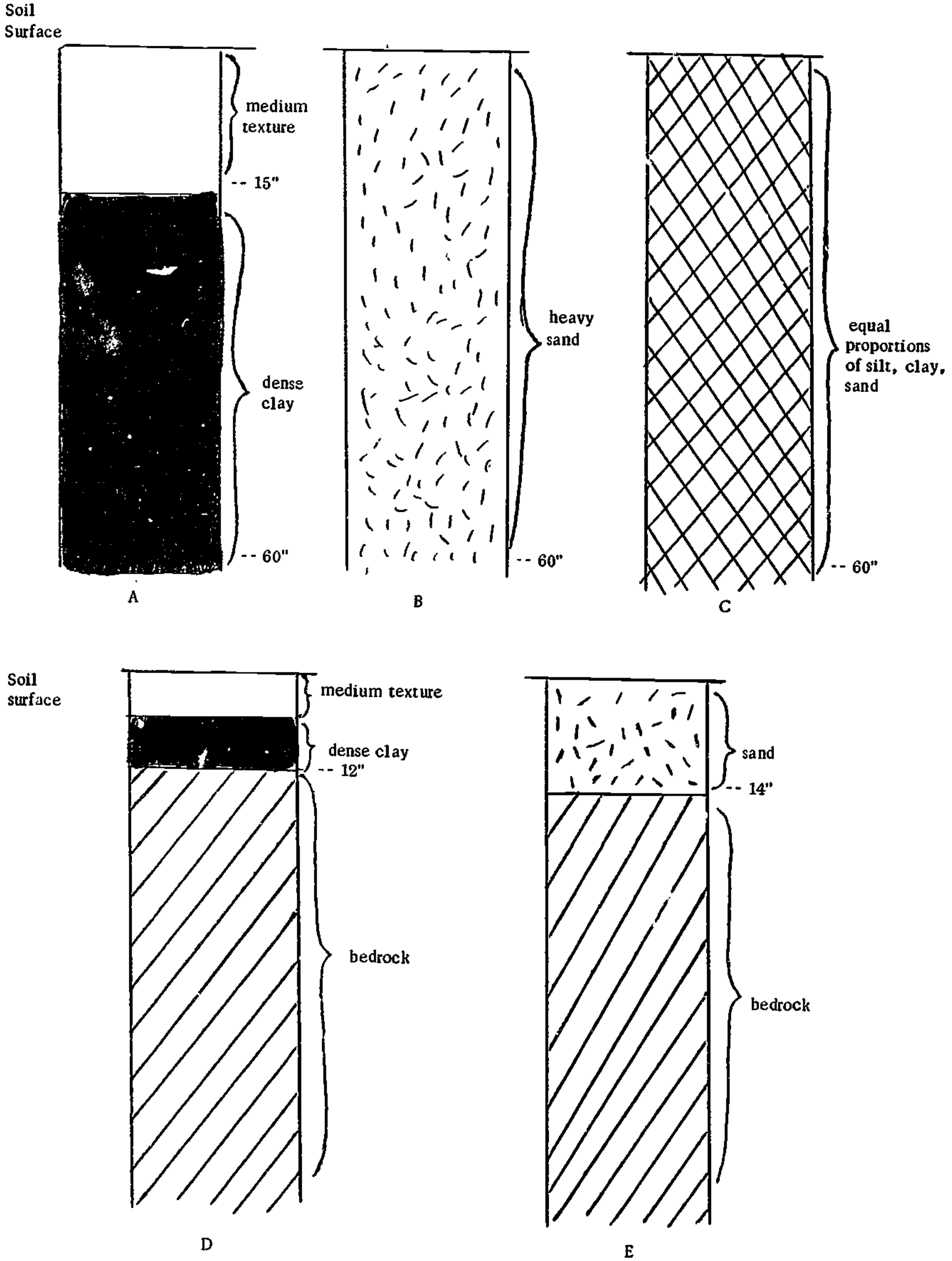
soil permeability	46. Soil depth, you will recall, was important as it affects the amount of moisture available to crops. Soil permeability refers to the rate of movement of air and water through the subsoil. How well excess moisture drains through the soil profile is a function of s________ p________.
permeability	47. Soils may be placed into relative ________ classes through studies of structure, texture, cracking, density, and other features.
moisture air	48. Structure of the soil profile is determined by the "clumping" of individual particles. This affects the movement of ________ and ________ through the entire soil profile. For our system of classification, we will divide soil permeability into limiting, adequate, or excessive.
limiting	49. Soils that have dense clays in their subsoil would limit movement of water through the profile. We would classify their permeability as ________.
clay	50. A common example of a soil profile having limiting permeability is one having a heavy layer of ________ in the subsoil.

adequate	51. A medium texture soil throughout the profile would result in _______________ permeability.
smooth or floury	52. A soil profile having adequate permeability would feel _______________ to the touch throughout the profile.
excessive	53. A deep sandy soil would have excessive drainage of water through the profile. The permeability of this soil would be _________.
sand	54. A soil having excessive permebility would consist largely of _______________.
surface texture	55. Permeability pertains to the effective depth of a soil and not to the surface six inches as does soil __________ __________.

permeability	56. A dense subsoil of a putty-like consistency would be classified as having limiting __________ that would limit water movement through the soil. Obviously a narrow horizontal band of soil of a particular texture can result in a limiting permeability.
excessive permeability	57. A soil that is excessively drained because of a sandy, coarse subsoil has __________ __________.
limiting permeability	58. Very slow movement of air and moisture through the soil indicates __________ __________.
adequate permeability	59. A satisfactory movement of air and moisture through the soil is called __________ __________.
a-limiting b-adequate c-excessive	60. The three classifications of permeability are __________, __________, and __________.

SOIL PROFILES

Diagrams of vertical profiles showing permeability.



limiting	Refer to information panel, page 16, to answer frames 61-65. 61. Profile "A" demonstrates __________ permeability.
excessive	62. Profile "B" is an example of __________ permeability.
adequate	63. Profile "C" is an example of __________ permeability.
limiting	64. "D" profile demonstrates __________ permeability.
excessive	65. "E" profile demonstrates __________ permeability.

light medium dark dark	66. Soil color is a rather subtle clue to the history of a particular soil. Soil color is divided into three divisions: light, medium dark, and dark. Write the three color divisions in the answer box.
high	67. Dark soil is nearly black and is usually (high or low) in inherent fertility.
dark	68. Soil with a high inherent fertility level is usually classified as having a ______________ color.
medium	69. Medium dark soil has a moderate level of inherent fertility. Dark gray to light brown soils indicate a ______________ dark color.
medium	70. Medium dark soil has a (high, medium, low) level of inherent fertility.

light	71. A low or very low inherent fertility is indicated by a ____________ color.
low	72. Light gray to palw brown surface soils usually have a ____________ inherent fertility level.
soil fertility	73. Soil color is not always a reliable clue to inherent fertility. Soil color may or may not indicate inherent ____________ ____________.
dark medium dark light	74. Soil color is divided into three divisions. They are ____________, ____________ ____________, and ____________.
a-medium b-low c-high	75. List the probable inherent fertility level indicated by each of the following soil colors: a. medium dark - ____________ b. light - ____________ c. dark - ____________

Slope. Slope is very important because it influences the rate at which water runs over the soil. This runoff is one of the causes of erosion. Slope also influences the way in which the land can be farmed. Slope is expressed by the number of feet of fall in each 100 linear feet. Slope ranges vary widely in different areas. For instance, land with 8 to 12 feet fall per 100 linear feet might be considered steep or very steep in some climates and soil conditions. It might be considered only moderately sloping under other conditions of less intensive climatic conditions. It is necessary, therefore, that for purposes of judging contests, slope ranges applicable to the contest area be used. The following will give an idea of the manner in which slope ranges are expressed:

(2% means 2 feet fall per 100 linear feet of distance)

Nearly level

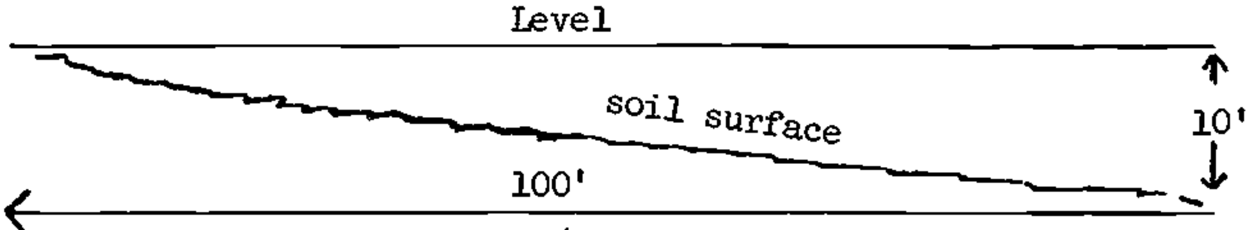
Gently sloping

Moderately sloping

Strongly sloping

Steep

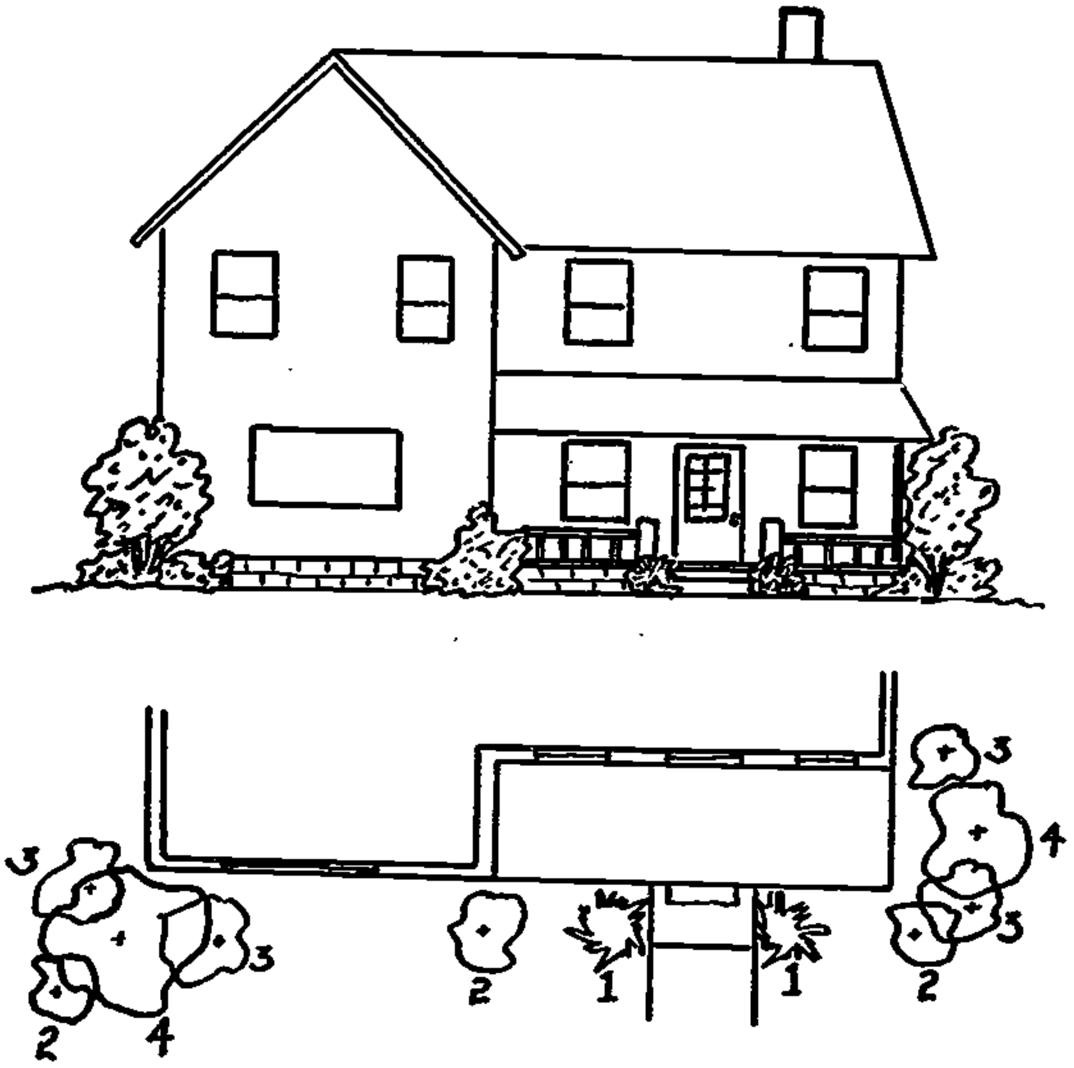
Very steep



10% slope

slope	If you have not read the information panel on soil slope, do so now. 76. Slope is important as it directly influences water run off and erosion. ________ is expressed as the number of feet of fall per 100 linear feet of "run."
nearly level gently sloping moderately sloping strongly sloping steep very steep	77. Slope ranges are expressed as nearly level, gently sloping, moderately sloping, strongly sloping, steep, and very steep. Write the slope ranges in the answer box.
2	78. Two per cent fall means ________ feet fall per 100 linear feet.
slope	79. Erosion is partially caused by water runoff, which is due to per cent of ________. The slope of the land is the major influence on erosion.
level, sloping, sloping, steep	80. Slope is divided into six categories. They are nearly ________, gently s________, moderately s________, strongly sloping, steep, and very ________.

Figure 36. This is a suggested solution to the exercise in Figure 36.



Suggested Planting

1. Compace Taxus Media (3')
2. Cranberry Cotoneaster (4')
3. Dwarf Spreading Yew (2')
4. Doublefile Biburnum (8' - 10')

Figure 35. This is a student exercise in the selection of appropriate plants for corner and porch plantings for tall houses. Have the student list the name and height of the plants.

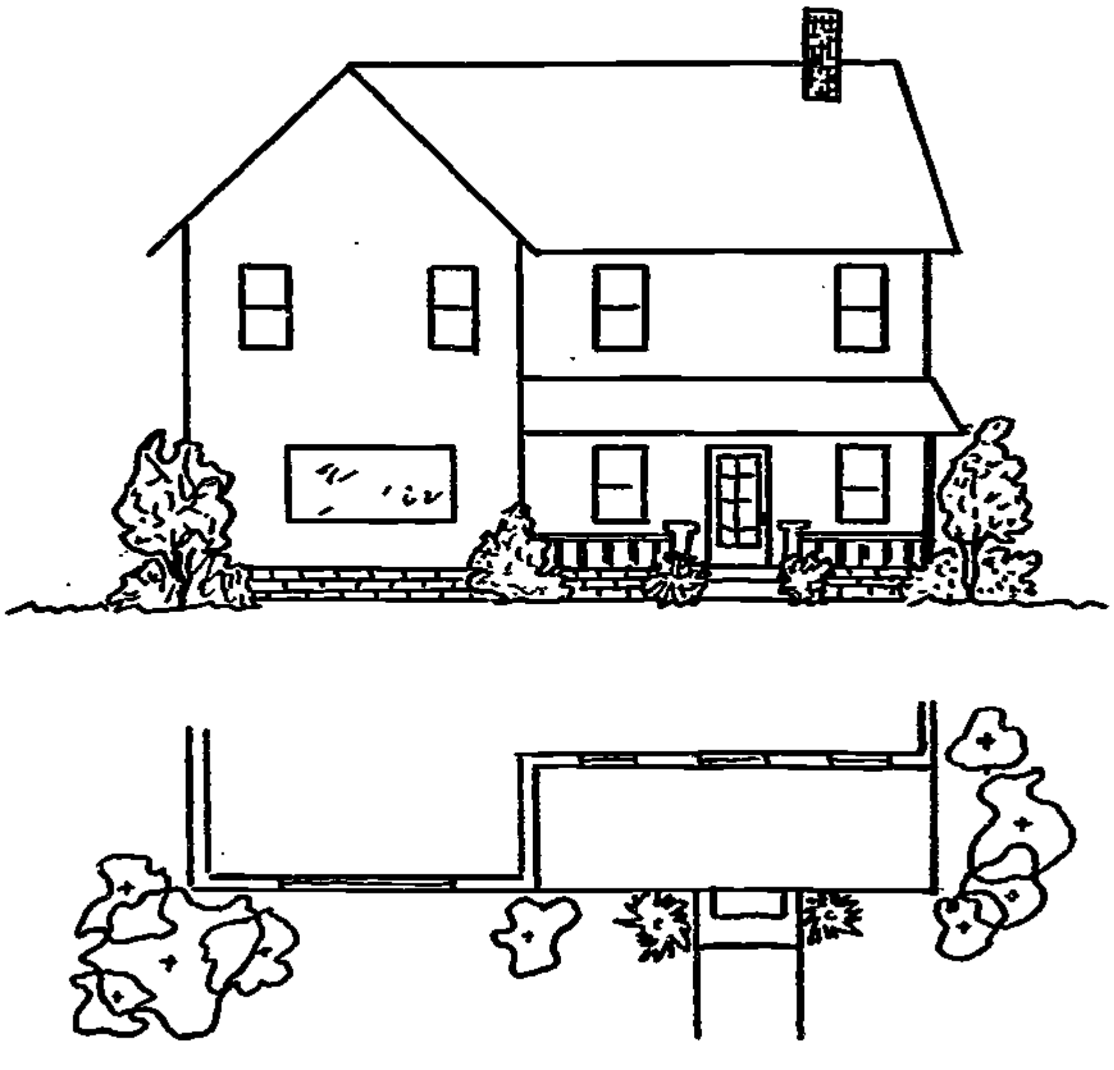


Figure 37. Suggested corner and porch plantings for a tall house with the porch in the center of the house. In this student exercise in selection of appropriate plants, have the students list the name and height of the plants.

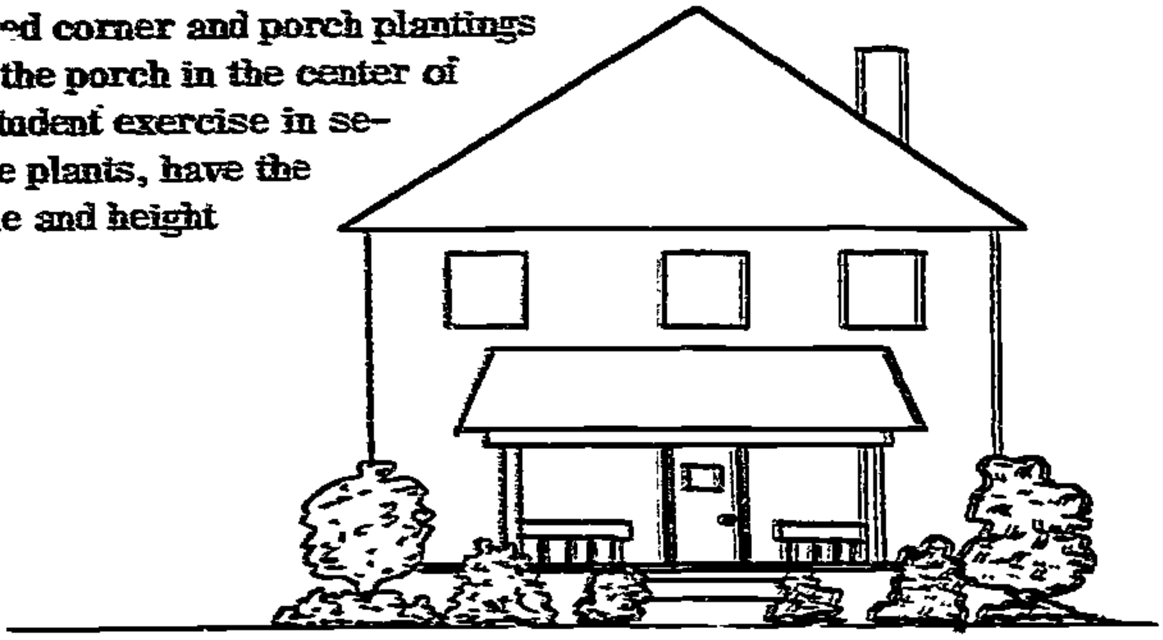
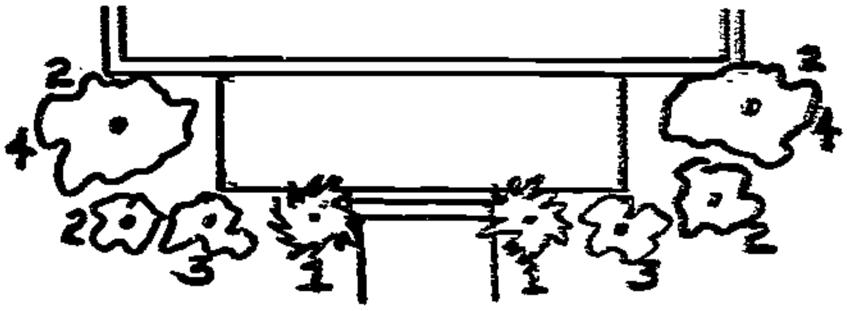
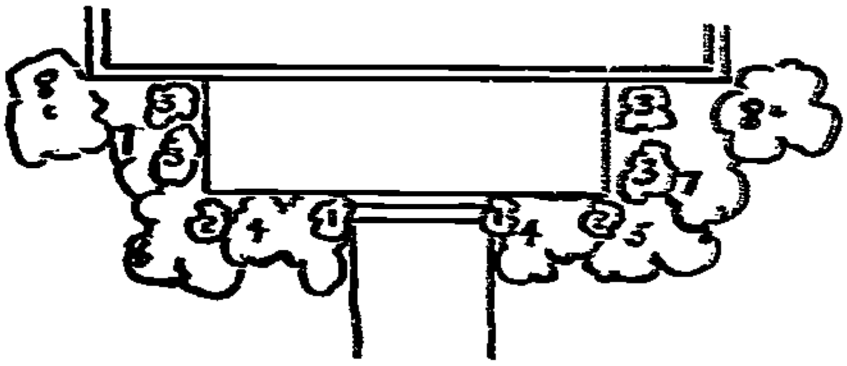


Figure 38. Suggested solution to the student exercise in Figure 37.



Suggested Planting for a Low Cost Budget

1. Compact Taxus Media
2. Glossy Wintercreeper
3. Koreanspice Viburnum



Suggested Planting for a High Priced Budget

1. Roundleaf Japanese Holly
2. Double Mockorange
3. Alpine Currant
4. Glossy Abelia
5. Common Flowering Quince
6. Cranberry Cotoneaster
7. Spirea Froebeli
8. Doublefile Viburnum

CHAPTER VI

Planting Ornamental Shrubs and Shade Trees.

Problem: What procedures should be followed in transplanting shrubs and trees?

Items to Consider:

1. Time to plant.
2. What size of hole to dig.
3. How to place plant in hole.
4. Use of a mulch.
5. Handling of balled plants.
6. Supporting of trees.
7. Protecting young plants from weather, insects, etc.

Basic Information:

1. Time to plant.

Ornamentals can be transplanted in the fall or spring. In the fall, soil is warm, moisture is usually sufficient, and plants grow better. Plants can become established before hot, dry weather. In the spring, there is more soil moisture, but the soil is cold. The best time to transplant bare root plants is the latter part of September or the early part of October, after the leaves have fallen.

Hard-to-transplant ornamentals should be planted in the spring to assure the longest possible period for the establishment of new roots.

2. Size of hole to dig.

The hole should be big enough so that the roots don't need to be wound around the ball of soil. There is also danger that the roots may girdle themselves with these wound roots. The hole for balled or container plants should be one to two feet wider than the ball, to permit sufficient backfill with good planting soil. Bare root plants should have room for the roots to spread out full-length.

3. Placing plant in hole.

In transplanting the ornamental, keep the soil level, the same on the plant as it was in the nursery. Put loose soil in the bottom of the hole. Manure or peat moss may be used in heavy soil. Don't plant on a moist day because the clay soil becomes packed which destroys air movement. Don't stamp the soil too firmly. Leave a saucer of earth around the edge of the hole. This retains the water to allow it to soak around the plant. Plant first and then let water hose run slowly for about one to two hours. The water also helps to remove any air pockets around the roots.

4. Using a mulch.

Manure, peat moss, etc. can be used on top to conserve moisture after transplanting. Fertilizer can be added to a mulch of corn cobs, straw, sawdust for bacteria growth.

In spring, wait until soil is warm before mulching, usually about May. Mulch can be applied anytime in the fall.

5. Handling of balled plants.

Dig hole about two feet wider than ball of plant. Set top of ball slightly above ground level to compensate for its weight. Take out balling nails and lay burlap back and cover edge with soil. It will eventually rot.

When removing plants from containers, wet down to prevent soil from crumbling. Always take plants out of metal containers, and it is recommended that plants be taken out of paper containers, even though the paper will eventually rot. Roots grow out to the side as well as down. Roots will be required to grow too deep if whole can or container is not removed. See Figure 39.

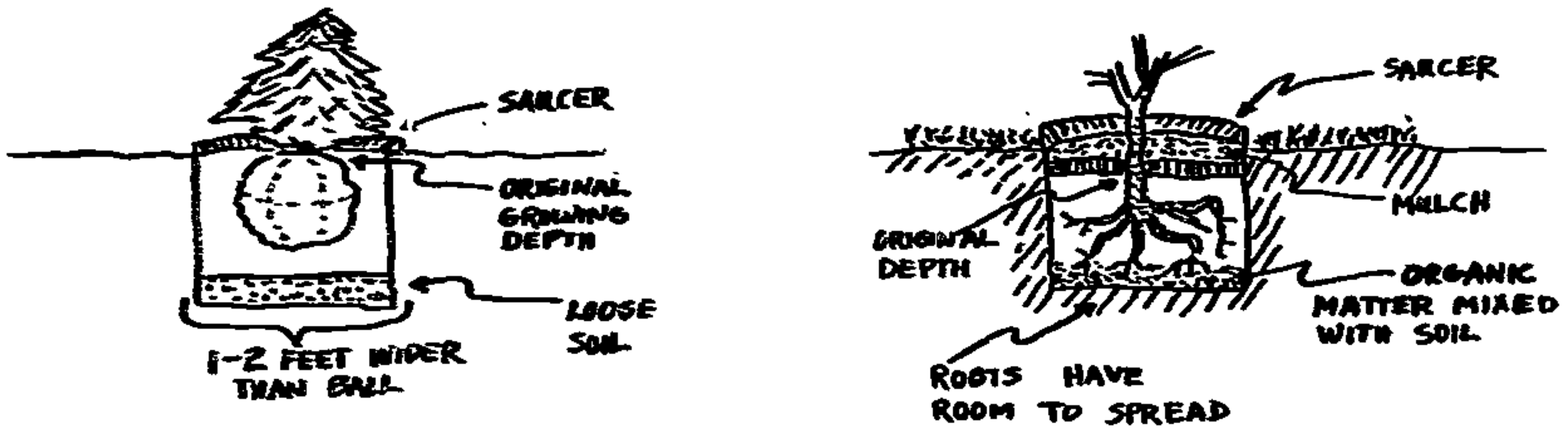
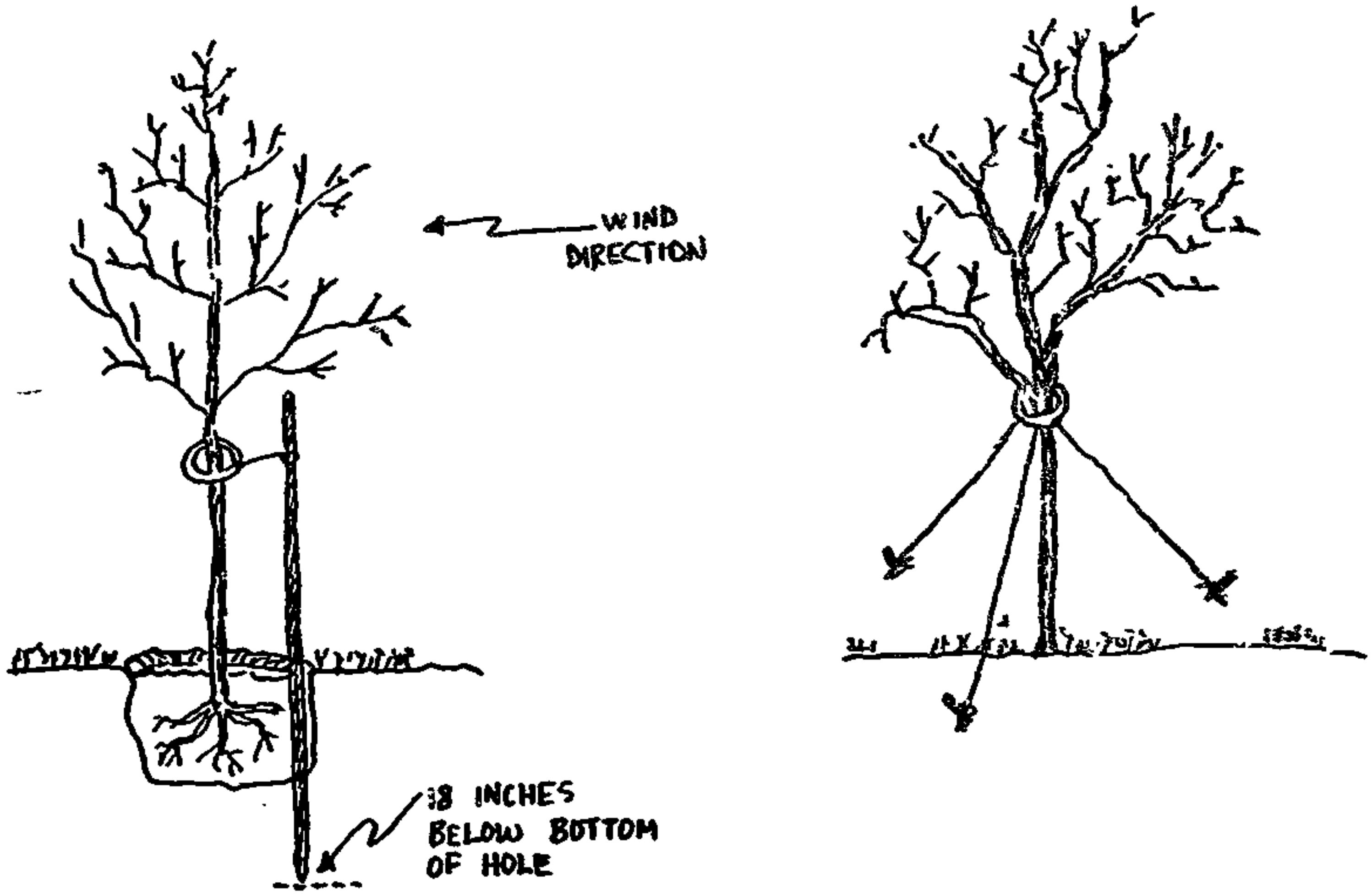


Figure 39. Proper placement of balled and bare-root plants in the ground.

6. Supporting trees after planting.

Put the supporting stake(s) on side of prevailing winds. Set stakes before planting to avoid damaging the roots. Set stake 18 inches deeper than the bottom of the hole, using a 2" x 2" x 8' stake. Any tree or shrub over two inches in diameter needs two to three stakes. Any plant over five inches in diameter needs guy wires. See Figure 40.

Figure 40. Proper method of supporting trees after planting.



7. Protecting young plants from weather, insects, etc.

Regular tree wrap prevents most of these troubles. Leave wrap on for at least two years. Regular tree wrapping is best to use, but burlap in strips is satisfactory. Start wrapping where branches come out.

QUIZ --- PLANTING ORNAMENTAL SHRUBS AND TREES

Completion:

1. Ornamentals can be transplanted in the fall or spring.

2. The best time to transplant bare root plants is latter part of September or early October.

3. The hole should be big enough so that the roots don't need to be wound around ball of soil.

4. The hole for balled plants should be two feet wider than the ball.

5. In transplanting the ornamental, the plant should be set same depth as it was in the nursery.

Essay:

6. Why should a saucer of earth be left around the edge of the hole? (To retain water - to allow it to soak around plant.)

7. Describe the correct procedure for handling the burlap on a balled plant. (Not necessary to remove burlap. Take out balling nails and lay burlap back. Cover edge with soil. It will eventually rot.)

8. Why should container plants be wet down before removing containers? (To prevent soil from crumbling.)

9. Describe the correct procedure for supporting a 2 1/2" diameter tree. (Use three stakes. Set 2" x 2" x 8' stakes 18 inches beyond bottom of hole.)

10. Why should newly transplanted trees be wrapped? (Wrapping trunk prevents insect and weather damage.)

CHAPTER VII

Fertilizing Ornamentals.

Problem: What fertilization practices should be followed in caring for ornamentals?

Items to Consider:

1. Need for shrub and tree fertilization.
2. Type of soil.
3. Time of year to fertilize.
4. Types and amounts of fertilizer to use.
5. Where to put fertilizer.

Basic Information:

1. Need for shrub and tree fertilization.

A deficiency of certain plan nutrients in the soil will cause reduced growth, reduced flowering and fruiting of some ornamentals, more susceptibility to diseases, reduced winter hardiness and off-colored foliage in flowering shrubs.

2. Type of soil.

For an accurate measure of plant nutrient deficiencies, soil should be tested at an approved soil laboratory. Most soils on home grounds are usually deficient in proper levels of mineral elements necessary for maximum plant growth.

3. Time of year to fertilize.

It is easy to damage plants when they are making new roots. If shrub is planted in fall, fertilize in the spring; if planted in spring, fertilize in the fall. Fertilize in April or September or October.

4. Types and amounts of fertilizer to use.

a. Trees.

For trees up to six inches in diameter, use three pounds per inch, of 10-6-4, 10-10-10, 12-12-12. For trees above six inches in diameter, use four to five pounds per inch of diameter. Fertilize annually.

b. Evergreens.

Narrowleaf evergreens require one-half to one pound per plant of 10-6-4, 8-8-4, or 4-12-4 fertilizer or similar analyses in the fall or early spring.

Broadleaf evergreens need applications of a special brand of broadleaf evergreen fertilizers, or 6-10-4, or 4-12-4 in which an organic nitrogen carrier is used to supply one-fourth or one-third of the nitrogen. Rate of application is the same as for narrowleaf evergreens.

c. Deciduous Shrubs.

For specimen plants, use one to two pounds per plant of 10-6-4, 15-10-5, 6-10-4, or 4-12-4.

5. Where to put fertilizer.

When fertilizing trees, it is best to put fertilizer in holes punched in the soil. Holes may be drilled 15 to 18 inches deep with an auger, or if soil is moist, an iron bar can be used to punch the holes. Use 20 holes per inch of tree trunk diameter.

Start holes a little beyond the edge of the branches because more roots are away from the trunk. Punch holes up to within a few feet of the trunk. See Figure 41.

Fertilizer for shrubs can be applied in the same manner. However, since phosphorus is relatively slow moving, it may be added at planting time. Do not use an excessive amount of fertilizer around plant roots as serious injury or death of the plant may occur.

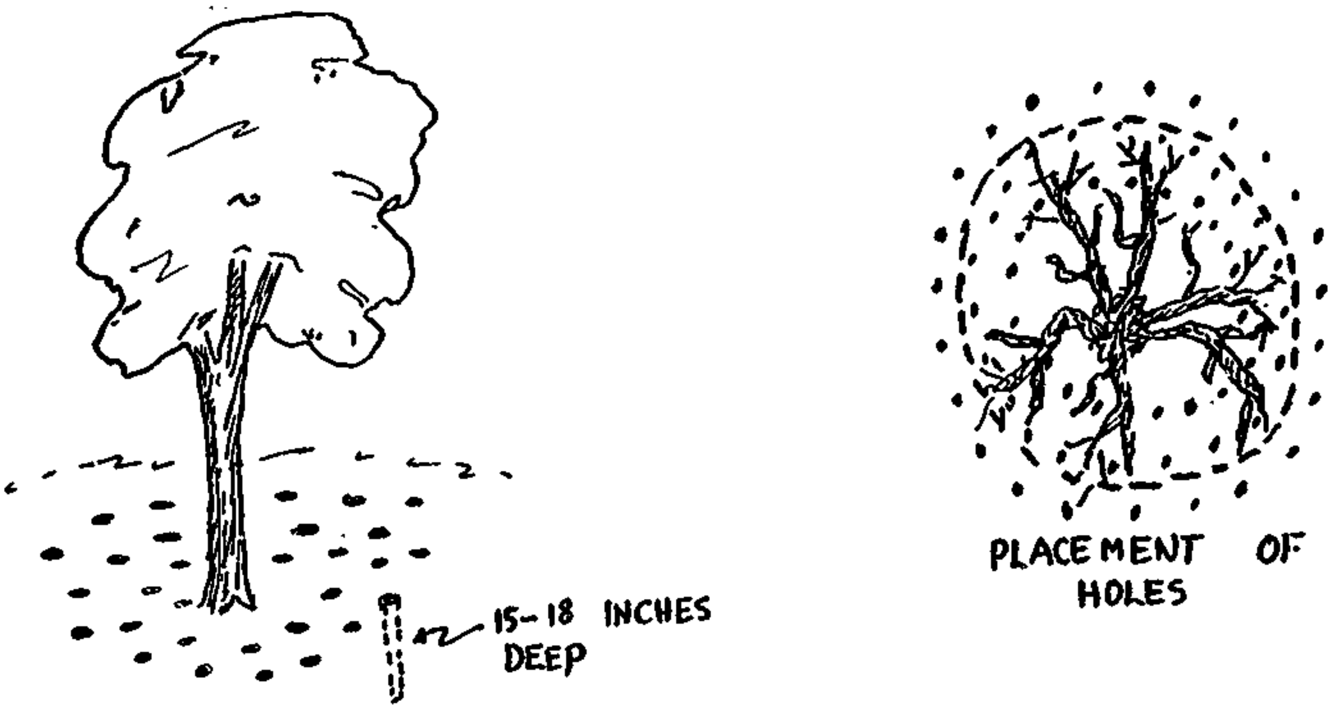


Figure 41. Placement of holes for application of fertilizer.

QUIZ --- FERTILIZING ORNAMENTALS

Multiple Choice:

1. Reduced flowering and fruiting of some ornamentals is caused by:

   *a. deficiency of certain plant nutrients in the soil.
   b. hot weather.
   c. too much watering.
   d. improper planting procedure.

2. The best time of year to fertilize is:

   a. usually in the spring.
   b. usually in the fall.
   c. when the plants are making new roots.
   *d. in the spring if shrub is planted in the fall; fall, if shrub is planted in the spring.

3. For trees up to six inches in diameter, fertilize as follows:

   a. 1 lb. 10-10-10 per inch of diameter.
   b. 2 lbs. 10-6-4 per inch of diameter.
   *c. 3 lbs. 12-12-12 per inch of diameter.
   d. 5 lbs. 12-12-12 per inch of diameter.

4. Broadleaf evergreens need applications of

   a. 10-10-10
   b. 12-12-12
   c. 10-6-4
   *d. 4-12-4

5. When fertilizing trees, it is best to put fertilizer

   a. on top of the ground as to benefit the grass.
   *b. in holes punched in the soil.
   c. on in the spring.
   d. on in the liquid form.

CHAPTER VIII

Pruning of Ornamental Shrubs and Shade Trees.

Problem: What procedures should be followed in pruning ornamentals?

Items to Consider:

1. Why prune ornamentals.
2. When to prune.
3. How to prune.
4. What equipment to use.
5. What special procedures to follow for different kinds of shrubs.

Basic Information:

1. Why prune ornamentals.

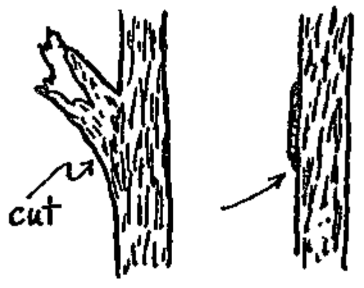
   a. To remove dead, diseased, criss-crossed, injured, or broken wood.
   b. To produce and preserve the desired shape and appearance of the plants.
   c. To keep them vigorous and to improve chance of survival at transplanting time.
   d. To improve flowering or fruiting.
   e. To retain maximum color on colored twig plants.

2. When to prune ornamentals.

Pruning can usually be done at any time of the year. Worst time to prune is the spring when new growth is starting. This weakens the plants, and they may die in the winter. Best time to prune evergreens is at Christman when they are dormant. Cuttings may then be used for decorations. Shrubs and trees may also be pruned in winter while they are dormant. Hedges may be pruned in the summer.

3. How to prune.

Primary rule: Don't leave stubs. Make cuts flush with the adjoining branch. Cuts of terminal shoots should be made just above a bud. Cut branches, don't break them off.



4. What equipment to use.

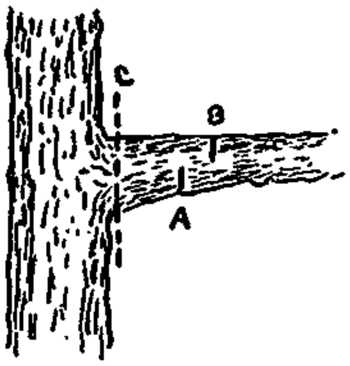
Adequate for most pruning jobs would be hand pruning shears, lopping shears, hedge shears, and a pruning saw. All equipment should be kept sharp, as proper pruning and ideal wound healing are dependent on the use of correct tools that are sharp.

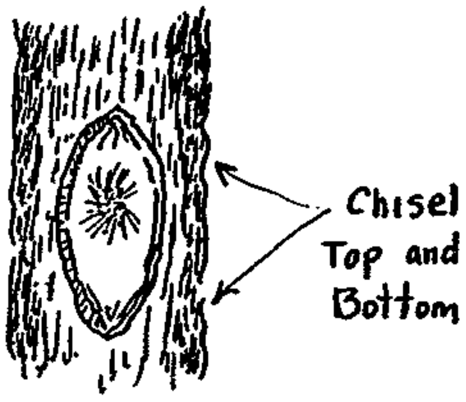
5. What special procedures to follow for different kinds of shrubs.

a. Shade trees.

Prune shade trees only when the tree branches or limbs are damaged, when they interfere with traffic on a walk or drive, or when they cause damage to or interfere with the operation of a building chimney, eaves spouting, etc.

The tree top may be thinned out to open internal branches to light. Do not cut the central leader unless absolutely necessary. Cut any large branches (size requiring a saw) by making three cuts according to diagram below. Treat all wounds one inch or more in diameter with regular tree paint. Do not use house paint. Filling a cavity in a tree does not keep rotting from continuing. It is necessary to get all of the rot out of the cavity. Shape cavity by chiseling it to a point at the top and at the bottom.





b. Flowering trees and shrubs.

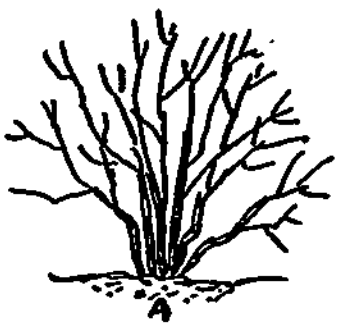
Follow recommendations indicated under shade trees. Old, hard wood won't grow new branches, so flowering trees need carefully planned, regularly scheduled pruning.

1) Forsythia Deutzia, Spirea, Lilacs, and most other early flowering plants bloom from buds formed on last summer's twigs. Prune from one to two weeks after bloom; when plants are through flowering.

2) Hydrangea, Rose of Sharon, Rugosa Rose and such plants produce flowers on new spring growth. Such plants may be pruned during the late fall after stem growth has ceased.

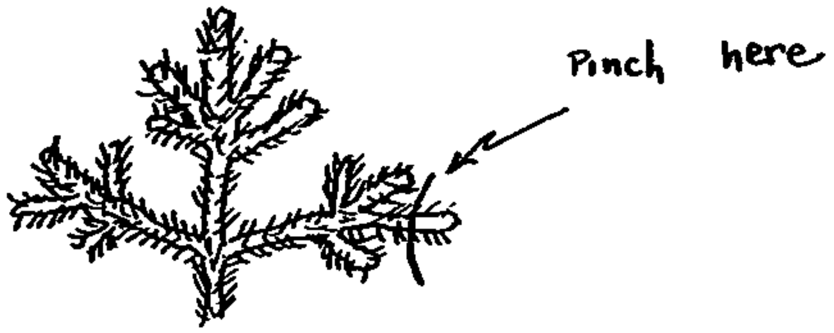
3) Shrubs that have showy colored stems, such as Red and Yellow Dogwood, Kerria and some low-growing shrub roses, produce their most brilliant color on new wood. About one-third of the older wood should be removed every year to retain maximum coloration.

Caution: Don't simply trim back tops on shrubs. Thin out plant by cutting older branches back to ground. Spirea can be cut back to four to six inches of the ground when old and bulky. Mockorange and lilacs can also be cut back the same. Don't cut viburnams clear to the ground.



c. Narrowleaf evergreens.

Narrowleafed evergreens produce new growth in the spring, so pruning should be done either before the new growth starts or after it is nearly complete, in the fall. Evergreens are usually plucked by hand, not sheared, in order to retain natural beauty. Spruces, pines, and firs are pruned by pinching off part of the candle growth (shoots) about half way in June. Pruning must be done every spring in order to have dense, compact plants.



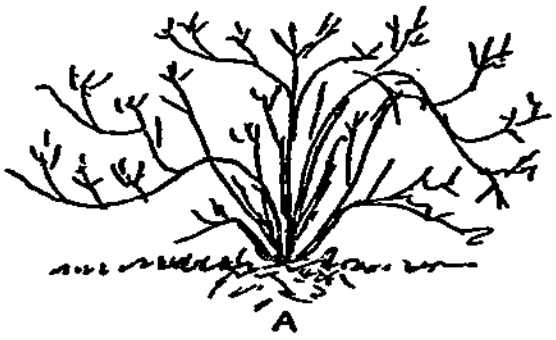
Caution: Cut leader or terminal branch only to stop growth of plant, or to get a spreading of the branches. Do not prune branches at base of tree. This results in an artificial unattractive form.

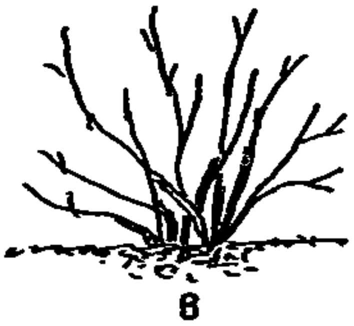

A


B

d. Broadleaf evergreens.

Usually necessary to prune out just the deadwood, broken, diseased or insect infested branches. Straggly, misshapened plants may be cut back one-third to one-half of the terminal growth to a point where there is branching or budding of at least one green shoot or active bud. Rhododendrons may even be cut down to within several inches of the soil, although it may take several years before good height and flowers are attained.





e. Vines and ground covers.

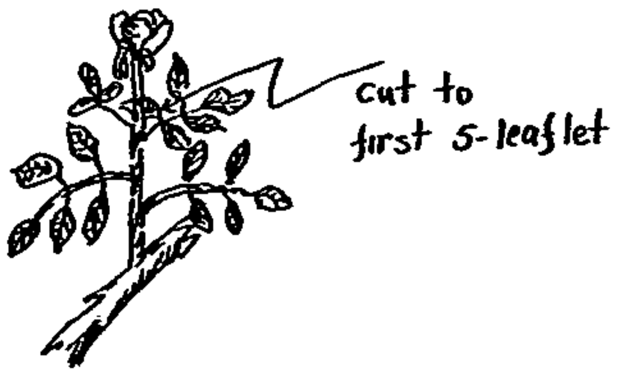
Prune vines to control direction of growth, in order to keep them out of windows, etc. Regrowth starts from buds just below the cut. Vines do not generally renew themselves from shoots at the base.

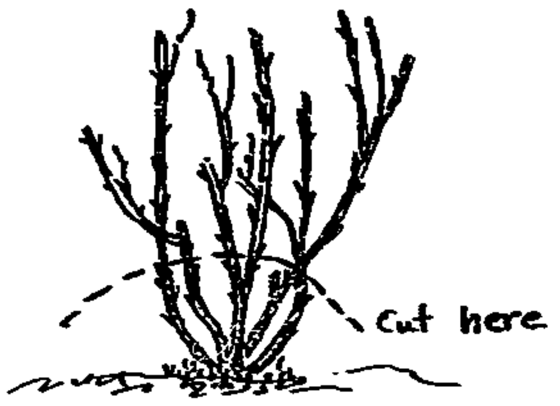
Ground covers may need winter brown tips clipped in the spring after growth has begun. Usually, little pruning is necessary on many of the evergreen ground covers with the exception of some of the Euonumus, English Ivy, Spruge, and Creeping Mahonia.

f. Roses.

Prune roses in March, except climbers, which should be pruned after flowering. "Pencil" size shoots should be cut out. In summer, cut off old flowers. Cut to first 5-leaflet, because bud will grow long and sturdy, producing a bigger flower. If cut back to 3-leaflet, it may get a blind bud.

Remove dead, broken, and disease or insect infested branches, plus criss-crossed or misshapen canes. Cut remaining canes back to 18-24 inches in height.

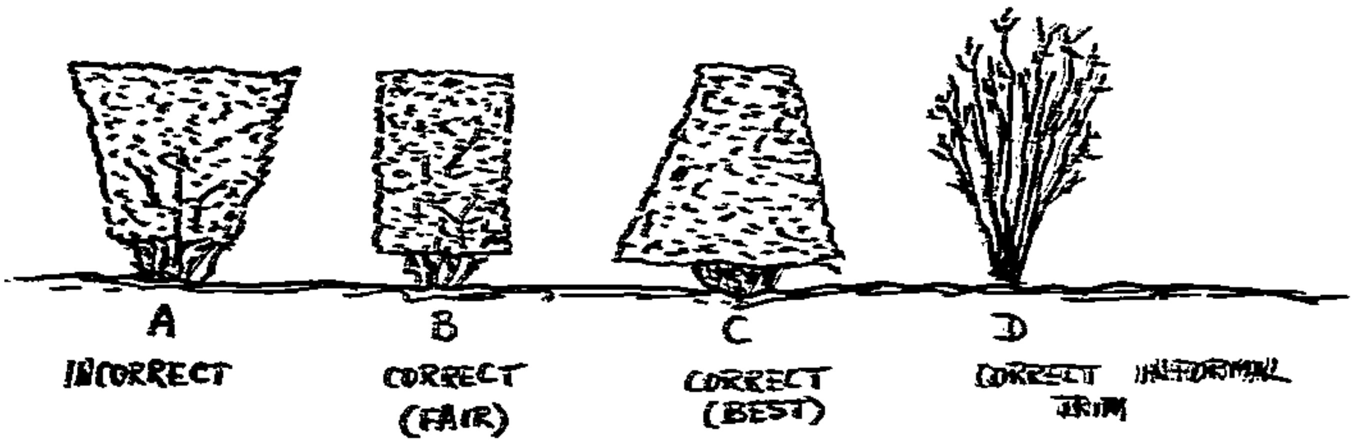




g. Hedges.

Prune prior to growth in spring and again in summer to remove feathery new growth. Caution: Late-summer pruning of hedges is unsafe, as this practice creates a new growth of wood that seldom becomes hardened sufficiently to withstand severe winter weather.

Prune annually to retain size and shape. Prune hedge so that bottom is wider than the top. This prevents lower branches from dying due to loss of sunlight. Prune according to diagram below.



QUIZ: PRUNING ORNAMENTAL SHRUBS AND SHADE TREES

1. Ornamentals are pruned in order to produce and preserve the desired shape and appearance of the plant.

2. Ornamentals can usually be pruned at any time of the year.

3. The primary rule in pruning is: don't leave stubs.

4. In pruning shade trees, do not cut the central leader unless absolutely necessary.

5. Forsythia, Deutzia, Spirea, Lilacs and most other early flowering plants bloom from buds formed on last summer's twigs.

6. In pruning flowering shrubs, thin out the plant by cutting older branches back
A to the ground.

7. The usual procedure in pruning spruces, pines and firs is to pinch off part of the candle growth (one-half) in June.

8. Vines are pruned to control direction of growth.

9. Prune roses in March, except climbers, which should be pruned after flowering.

10. A hedge should be pruned so that the bottom is wider than the top.

Name____________________

UNIT TEST ON LANDSCAPING PRINCIPLES

Write "T" in the blank if the statement is true; "F" if the statement is false.

__T__ 1. Mass, color, line or texture must be equalized on each side of a real or imaginary point to satisfy one's visual sense of balance.

__T__ 2. Symmetrical balance means that plant arrangement on one side of an axis is the exact duplicate of the other side.

__T__ 3. A large tree on one side of the property can be used to balance several small trees on the other side.

__F__ 4. A medium-sized tree on one side of the property will not balance a group of shrubs on the other side.

__T__ 5. Simplicity is destroyed when too many different kinds of plants are used in the design.

__T__ 6. It is usually best to group three of one kind of plant rather than have a single plant.

__T__ 7. Objects such as plantings, fences, screens, etc., in the design should be wider than they are tall.

__T__ 8. If scale is kept constant throughout the design, the design will have proportion.

__F__ 9. Plantings in the front of the house should be higher in the center than on the corners.

__F__ 10. The front door of the house should not be accented by plantings.

Complete the statements with the appropriate word or phrase.

11. Landscaping is the art of arranging and fitting together of __land__, __plants__, and __structures__ for human use and enjoyment.

12. The __front__ __entrance__ is the focal point or center of interest around which public area plantings are grouped.

13. In designing corner plantings for low houses, for a pleasing transition between dominant vertical and horizontal lines, use __irregular__ shrubs with __horizontal__ __branching__ type of growth along with low spreading evergreens.

14. Hardiness of a plant refers to its ability to stand cold temperatures.

15. Proper selection of a plant in terms of habit, growth rate, and ultimate size will reduce much heavy pruning.

16. Fast-growing trees may be short lived.

17. Hardwood trees are usually long lived.

18. The living area should be located so that it is easily reached from the family room or living area of the house and the kitchen

19. The Thornless Honeylocust is replacing the American Elm as a popular shade tree.

20. The open-grassed area in the private lawn should be at least 50 feet by 80 feet to provide room for badminton, croquet, etc.

In the blank at the left of the statement place the letter of the word or phrase that best fits the statement.

c 21. Achieved through repetition of landscape materials.

j 22. Achieved by repeating a few well-arranged forms, colors, or textures in various areas.

h 23. Means the size of units, such as open space, buildings, or plantings.

i 24. A pleasing relationship of one part of the design to another part and to the whole design.

d 25. Achieved by the use of contrast in size, texture, and color of plants.

a 26. Achieved by placing a dark green evergreen plant against a white house.

d 27. Achieved when colors of the various plantings blend with one another and with their surroundings.

m 28. Achieved by planting a large tree on one side of the property and several small trees on the other side.

l 29. Achieved by using a formal design rather than an informal design.

h, i 30. Achieved by placing small to medium sized trees in a design for a low ranch type house.

a. contrast
b. balance
c. simplicity
d. harmony or rythm
e. unity or completeness
f. focal point
g. sequence
h. scale
i. proportion
j. repetition
k. texture
l. symmetrical balance
m. asymmetrical balance
n. condensation

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*STUDY GUIDES, *TRADE AND INDUSTRIAL EDUCATION, *CARPENTERS, *CABINETMAKING, GRADE 11, GRADE 12, *COOPERATIVE EDUCATION,

This study guide is to direct the individual study of high school juniors and seniors in cooperative education programs in carpentry and cabinet and mill work. It was developed by a statewide committee of trade and industrial education coordinators and designed by subject matter specialists and teacher educators. The 123 job sheets are grouped into units titled (1) Maintain Hand Tools and Equipment, (2) Maintain Machine Tools and Equipment, (3) Size and Square to Dimensions, (4) Make Joints with Hand and Machine Tools, (5) Miscellaneous Construction, (6) Gluing and Clamping, (7) Metal Fastenings, (8) Wood Turning, (9) Surface Decoration, (10) Upholstery, (11) Wood Finishing, and (12) Millwork Projects. Each job sheet is indexed to an occupational analysis and progression record and provides the job title, related study references, and study questions designed to give the student definite direction in his reference reading. Eleven drawing problems are included. The material is to be used by individual students under teacher supervision for 2 years or 360 hours. This mimeographed document is available for $2.00 from Trade and Industrial Education, State Department of Education, P.O. Box 2847, University, Alabama 35486. (HC)

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CARPENTRY

CABINET AND MILL WORK

D. O. Series
Progression Chart No. 76

Prepared by

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Division of Vocational Education
Montgomery, Alabama

Issued by
Department of Trade and Industrial Education
University of Alabama
University, Alabama

Revised June, 1963

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DATE: October 13, 1967

RE: (Author, Title, Publisher, Date) Carpentry - Cabinet and Mill Work

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The following study guide is used as a means of guiding and checking the progress of the student.

The correct way to use this study guide is for the student to observe or help do a job in the shop. At the next related study period the student looks up that job in the study guide and studies the references given for that job and answers the questions (in writing) asked about that job.

The following symbols will be used by the student to indicate accomplishment on the job:

JOB PERFORMANCE

⊡ A dot in center of square indicates that the student observed a job being done.

⧄ A diagonal line in square indicates that the student did the job under instruction.

⊠ Two diagonal lines in square indicates that the student completed the job under supervision without instruction.

■ A square filled in solid indicates that the student has reached a satisfactory level of accomplishment. On the date this job accomplishment level has been attained, the student turns to the occupational anaylsis sheet in the front index section and places this date in the "Job Performance" column opposite this job.

REFERENCE READING IN THE RELATED CLASS

The student places a date such as 4/20/53 (in the "date read" column opposite a specific related reference) on a job sheet, to indicate completion of that reference study. When all of the references for a job have been studied and all of the questions have been answered, the student turns to the occupational analysis sheet in the front index section and places the date of this completion in the "Reference Reading" column opposite the job studied.

A quick check of satisfactory attainment in jobs performed and references read can be made by looking through the occupational analysis sheets.

In each instance the job numbers on the occupational analysis index and progression record sheet correspond with the numbers of the pages in the study guide on which the job references and questions appear. For example: Job No. 6 will be found on page 6, with references and questions pertaining to that job.

The questions on a job sheet are to be used as a guide for the student's reading and not as test questions. It gives the student something definite to look for in the reference reading. It points out the more important things that should be found in the reference.

The essay type of answers that are required for most questions have a very definite value as they will help the student to form the habit of giving clear-cut, definite answers or explanations about the jobs.

Only a few references and a few questions have been listed on each job sheet to teach the student how to study the literature pertaining to their occupation. If the student learns how to study according to this plan, a much wider field of study is then open to him. After learning how to study, it is the responsibility of the coordinator to supplement the student's related study with additional material depending on the ability of the student to assimilate it.

An examination may be taken on any job at any time the student feels capable of taking it.

TRADE ANALYSIS AND PROGRESSION RECORD

Carpentry - Cabinet and Mill Work

Job No.	Type Job	Job Performance	Reference Reading
	UNIT #1 - MAINTAIN HAND TOOLS AND EQUIPMENT		
1.	History of Woodworking Tools and Machinery	Inf.	
2.	Build a Carpenter's Shop Bench		
3.	Equip Bench with Woodworking Vises		
4.	Joint, Set and File Hand Saws		
5.	Sharpen a Plane Iron or Bit		
6.	Sharpen Gouges, Carving and Turning Tools		
7.	Sharpen and Adjust a Cabinet Scraper		
8.	Sharpen and Adjust a Hand Scraper		
9.	Sharpen Boring Tools		
10.	Clean a Rasp or File		
	UNIT #2 - MAINTAIN MACHINE TOOLS AND EQUIPMENT		
11.	Joint, Gum, Set and File a Circular Saw		
12.	Braze, Set and File Band Saws		
13.	Sharpen Jointer and Planer Knives (Using the Modern Grinding Machine)		
14.	Sharpen Shaper Knives, Router Bits and Hollow Chisels		
	UNIT #3 - SIZE AND SQUARE TO DIMENSIONS		
15.	Size and Square Boards with Hand Tools		
16.	Joint Boards for Gluing with Hand Tools		
17.	Size and Square a Table Top with Hand Tools		

TRADE ANALYSIS AND PROGRESSION RECORD

Carpentry - Cabinet and Mill Work

Job No.	Type Job	Job Performance	Reference Reading
18.	Size and Square a Table Top with		
	Machine Tools		
19.	Size and Square Table Legs with		
	Hand Tools		
20.	Size and Square Table Legs with		
	Machine Tools		
21.	Taper Table Legs with Hand and		
	Machine Tools		
	UNIT #4 - MAKE JOINTS WITH HAND AND		
	MACHINE TOOLS		
	(A) Grooved Joints		
22.	Make a Rabbet Joint		
23.	Make a Groove		
24.	Make a Dado Joint		
25.	Make a Gain or Stopped Dado Joint		
26.	Make a Dado and Rabbet Joint with		
	Hand Tools		
27.	Make Grooved Joints with Machine		
	Tools		
	(B) Dowel Joints		
28.	Make a Doweled Butt Joint		
29.	Make a Draw-bolt Joint		
30.	Dowel Boards Together Edge to Edge		
	with Hand Tools		

TRADE ANALYSIS AND PROGRESSION RECORD

Carpentry - Cabinet and Mill Work

Job No.	Type Job	Job Performance	Reference Reading
31.	Dowel Legs to a Turned Column		
32.	Bore Dowel Holes with Machine Tools		
	(C) Lap or Half Joints		
33.	Make an End-lap Joint with Hand Tools		
34.	Make a Cross-lap Joint with Hand Tools		
35.	Make a Dovetail-lap Joint with Hand		
	Tools		
36.	Make Lap Joints with Circular Saw		
	(D) Mortise-and-Tenon Joints		
37.	Lay out a Blind Mortise-and-Tenon Joint		
38.	Make a Blind Mortise-and-Tenon Joint		
39.	Make Special Mortise-and-Tenon Joints		
	(Haunched and Barefaced)		
40.	Make a (a) Through Mortise-and-Tenon		
	joint		
	(b) Slip Joint		
	(c) Keyed Mortise-and-Tenon Joint		
41.	Make a Mortise on a Mortising Machine		
42.	Cut Tenons on a Circular Saw		
	(E) Miter Joints		
43.	Cut Miter Joints with Hand and Machine		
	Tools		
44.	Glue Mitered Frames		
45.	Reinforce Mitered Joints (Slip Feather)		
46.	Reinforce Mitered Joints (Spline and Dowel)		

TRADE ANALYSIS AND PROGRESSION RECORD

Carpentry - Cabinet and Mill Work

Job No.	Type Job	Job Performance	Reference Reading
47.	Cope Moldings		
	(F) Dovetail Joints		
48.	Make a Through and a Half-lap Multiple		
	Dovetail Joint		
	UNIT #5 - MISCELLANEOUS CONSTRUCTION		
49.	Make a Drawer		
50.	Make Drawer Rails and Guides		
51.	Make a Panel Structure		
52.	Make a Rule Joint		
53.	Make Supports for Table Leaves		
	UNIT #6 - GLUING AND CLAMPING		
54.	Properties and Uses of Glue	Inf.	
55.	General Directions for Gluing	Inf.	
56.	Glue Two or More Boards Edge to Edge		
57.	Glue Bookshelves		
58.	Glue a Cabinet		
59.	Glue a Drawer and a Chair		
60.	Glue Doweled Joints and Segments		
	UNIT #7 - METAL FASTENINGS		
61.	Use Nails as Fastenings		
62.	Use Screws for Wood Fastenings		
63.	Use Bolts for Wood Fastenings		
64.	Hinge a Door		
65.	Put on Cabinet Locks		
66.	Put on Catches and Door Bolts		

TRADE ANALYSIS AND PROGRESSION REOCRD

Carpentry - Cabinet and Mill Work

Job No.	Type Job	Job Performance	Reference Reading
67.	Install Casters, Chair Tips, Drawer Pulls		
	and Knobs		
68.	Fasten a Table Top to a Frame		
	UNIT #8 - WOOD TURNING		
69.	Use Turning Lathe Safely		
70.	Center and Clamp Stock in Lathe		
71.	Turn a Plain Cylinder		
72.	Make a Shoulder Cut		
73.	Make a Taper Cut		
74.	Make a Concave Cut		
75.	Make a Convex Cut		
76.	Turn Legs with Square Parts		
77.	Turn Duplicate Parts		
78.	Do Split Turning		
79.	Fasten Stock to a Faceplate or Screw		
	Chuck		
80.	Turn a Disk		
81.	Do Chuck Turning (Outside Chucking)		
82.	Do Chuck Turning (1) Plug Chucking		
	(2) Inside Chucking		
	(3) Gluing to Waste Stock		
83.	Use a Spindle Sander in a Lathe		
84.	Use a Disk Sander in a Lathe		
85.	Finish and Polish Turned Work in the		
	Lathe		

TRADE ANALYSIS AND PROGRESSION RECORD

Carpentry - Cabinet and Mill Work

Job No.	Type Job	Job Performance	Reference Reading
	UNIT #9 - SURFACE DECORATION		
86.	General Suggestions for Surface		
	Decoration		
	(A) Inlaying		
87.	Inlay Lines and Bands		
88.	Inlay Insets		
89.	Cut Sıraigth Reeds		
90.	Cut Spiral Reed		
91.	Carve a Single Spiral on a Turned		
	Cylinder		
92.	Carve a Double Spiral on a Turned		
	Cylinder		
93.	Lay Out Tapered Spirals		
	(B) Simple Carving		
94.	Cut Beads, Chamfers and Hollows		
95.	Carve Borders		
	(C) Moldings		
96.	Make Moldings		
97.	Shape the Edges of Table Tops		
98.	Do Simple Veneering		
99.	Make Diamond Match		
100.	Decorate by Overlays, Frets or Veining		
	UNIT #10 - UPHOLSTERY		
101.	History of Upholstery	Inf.	
102.	Make a Plain Pad Seat		

TRADE ANALYSIS AND PROGRESSION RECORD

Carpentry - Cabinet and Mill Work

Job No.	Type Job	Job Performance	Reference Reading
103.	Make a Pad Seat with a Roll Edge		
104.	Upholster a Slip Seat		
105.	Weave a Fiber Seat		
106.	Weave a Cane Seat		
107.	Apply Cane Webbing		
	UNIT #11 - WOOD FINISHING		
108.	Prepare the Surface for Finishing		
109.	Stains	Inf.	
110.	Apply Stains		
111.	Apply Wood Filler		
112.	Apply Shellac		
113.	Apply Wax		
114.	Apply Linseed Oil		
115.	Apply Lacquer		
116.	Apply Varnish		
117.	Prime Furniture and Interior Woodwork		
118.	Fill and Apply Finish Coats of Paint		
	UNIT #13 - MILLWORK PROJECTS		
119.	Lay Out the Miter Between a Straight and		
	a Curved Molding		
119A	Information Sheet - Lay Out the Miter		
	Between Straight and a Curved Molding		
120.	Lay Out Decorations on a Panel		
120A	Information Sheet - Lay Out Decorations		
	on a Panel		

TRADE ANALYSIS AND PROGRESSION RECORD

Carpentry - Cabinet and Mill Work

Job No.	Type Job	Job Performance	Reference Reading
121.	Lay Out Miter Angles		
121A	Information Sheet - Lay Out Miter Angles		
122.	Characteristics of Lumber	Inf.	
123.	Manufactured Lumber	Inf.	
	DRAWING PROBLEMS		
1.	Bisecting an Acute Angle		
2.	Bisecting an Obtuse Angle		
3.	Trisecting a Right Angle		
4.	Laying Out an Ellipse		
5.	Laying Out an Ellipse		
6.	Laying Out Miter Angles		
7.	Laying Out Miter Angles		
8.	Laying Out a Miter Between a Straight		
	and a Curved Molding		
9.	Dividing a Line into a Given Number		
	of Parts		
10.	Laying Out a Polygon on a Line		
11.	Laying Out a Polygon in a Circle		

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Carpentry - Cabinet and Mill Work

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7.	Sharpen and Adjust a Cabinet Scraper		
8.	Sharpen and Adjust a Hand Scraper		
9.	Sharpen Boring Tools		
10.	Clean a Rasp or File		
	UNIT #2 - MAINTAIN MACHINE TOOLS AND EQUIPMENT		
11.	Joint, Gum, Set and File a Circular Saw		
12.	Braze, Set and File Band Saws		
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Carpentry - Cabinet and Mill Work

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22.	Make a Rabbet Joint		
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Carpentry - Cabinet and Mill Work

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NAME____________________________OCCUPATION___________________AGENCY__________

STUDENT'S DAILY RECORD

Date	List the Job Numbers Performed the Previous afternoon	List the References Read in the Related Class by Symbols and Pages	List the Number of the Job Studied Today

Job 1

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
History of Woodworking Tools and Machinery	Inf.	PWH pp 1-14	

1. When were the first woodworking tools made?
2. Of what were they made and where have they been found?
3. Compare woodworking tools of the early and late stone age.
4. In what part of the world were metals first used?
5. What kind of metal was first used for making tools?
6. Explain how bronze and bronze tools were first made?
7. During what period in history were most of our carpenter tools invented?
8. What restriction prevented the use of iron tools during the early days of the Romans?
9. Who were the first people to learn to set saws?
10. Who invented the chisel and the claw hammer?
11. When were the first trade unions formed?
12. Name the three classifications of workmen set up by the guilds during the Middle Ages.
13. Under what conditions did apprentices serve their trade in the early days?
14. When did the development of machinery begin?
15. When were the first attempts at woodworking machinery made?
16. By whom were these first machines used?
17. Who was Samuel Bentham and for what was he noted?

Job 2

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Build a Carpenter's Shop Bench		PWH pp 15-19, 183-185 226-247, 266-271, 287-302	

1. Turn to Fig. 1, p 15, PWH, and make a drawing of the carpenter's bench giving the length, height and width that you think a bench of this kind should have.

2. Make a complete list of the materials that you would need if you were to build this bench.

3. What do the black dots across the end and on the side of the bench indicate?

4. What kind of joints should be used in building the frame of this bench? See PWH, pp 226-247

5. Explain to your instructor how you would proceed to glue and to fasten these joints together. See PWH, pp 287-302

6. Explain how you would proceed to make the top of this bench.

7. What tool should be used to remove surplus glue?

8. Why is it sometimes necessary to chamfer the furthest end of the table top?

9. In which direction should a table top made of cross-grained wood such as birch or mahogany be planed?

10. How is a table top tested for squareness or levelness?

11. When the surface is true over-all, what tools can be used to remove the plane marks?

12. Why is it necessary to plane from both sides towards the center in squaring the table top?

13. How many drawers does this bench have?

Job 3

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Equip Bench with Woodworking Vises		PWH pp 15-19 fig. 6	

1. What is a vise?
2. What are vises used for?
3. Name and describe the different kinds of vises.
4. What is the difference in the"continuous-screw" type vise and the "quick-acting" type vise?
5. What kind is found in your shop?
6. What do we mean by an adjustable dog in reference to vises?
7. How is the adjustable dog on a vise used? See PWH, Fig. 6
8. Of what use is a tail vise?
9. Tell how a bench stop may be used instead of a tail vise.
10. What is the difference in a bench stop and a bench hook?

Job 4

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Joint, Set and File Hand Saws		PWH pp 139-143	

1. What three operations does the sharpening of saws require?

2. What is jointing a saw and why is it necessary?

3. Explain the process of jointing a saw.

4. What determines when a saw is jointed enough?

5. After the jointing or striking of the saw is done, what is done next?

6. How is the file held while sizing the teeth?

7. Explain the process of setting a saw.

8. Why is it necessary to set saws?

9. Are all saws set the same amount? Why?

10. How do we determine how much to set a saw?

11. Explain the process of filing: (a) a ripsaw, (b) a crosscut saw.

NOTE: The information given in this lesson will be of great help to you in learning to keep your saws in good shape, but you will never learn to sharpen saws until you actually do the operations. A good plan is to practice on an old saw, following the instructions given in this lesson.

Job 5

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Sharpen a Plane Iron or Bit		PWH pp 143-145	

1. Why is it sometimes necessary to grind plane bits rather than whet them on the oilstone?
2. What kind of a grinder is best for grinding plane bits? Why?
3. How does burning a bit injure the bit?
4. How can we tell when the bit is burned?
5. Why should dry emery wheels not be used to sharpen plane bits?
6. What should be the length of the bevel on the bit?
7. What makes the best cooling liquid for oilstones?
8. Describe the process of whetting the plane bit on the oilstone
9. How can we tell when the edge of the bit is square across?
10. How can we tell when the plane bit is sharp?
11. What other tools are sharpened the same way as the plane bit?

Job 6

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Sharpen Gouges, Carving and Turning Tools		PWH pp 36-39, 145, 150-153	

1. Describe a gouge.

2. What is the difference between an outside and an inside gouge?

3. Why do some gouges have bent shanks?

4. What are turning tools used for?

5. Explain the sharpening of inside bevel gouges.

6. Describe a "slip stone".

7. How long should the bevel on a gouge be?

8. Describe the sharpening of an outside bevel gouge.

9. Explain why the entire length of the "slip stone" should be in contact with the inside of the outside bevel gouge.

10. What is a skew chisel?

NOTE: For further study of the use of these tools, see PWH p 335

Job 6

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Sharpen Gouges, Carving and Turning Tools		PWH pp 36-39, 145, 150-153	

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6. Describe a "slip stone".

7. How long should the bevel on a gouge be?

8. Describe the sharpening of an outside bevel gouge.

9. Explain why the entire length of the "slip stone" should be in contact with the inside of the outside bevel gouge.

10. What is a skew chisel?

NOTE: For further study of the use of these tools, see PWH p 335

Job 7

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Sharpen and Adjust a Cabinet Scraper		PWH pp 34-35, 146-147	

1. What is the difference in the "cabinet scraper" and the "hand scraper"?

2. What is a molding scraper?

3. For what kind of work are scrapers used?

4. Do scrapers produce a finer or a coarser finish than the plane

5. Why should all scraping be done before the surface is sanded?

6. How is the cabinet scraper ground?

7. Why is grinding necessary each time the blade is sharpened?

8. What is a burnisher and for what is it used?

9. Describe the process of turning the edge on the cabinet scraper.

10. Explain how the scraper blade is adjusted.

NOTE: Practice is necessary in order to learn to turn the blade of the cabinet scraper. We would suggest to the learner that he practice at leisure time when he can take time to observe what he does. Experimenting is the best way to learn such jobs as turning the scraper, filing the saw and many other things.

Job 8

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Sharpen and Adjust a Hand Scraper		PWH pp 34-35, 147-149	

1. Draw an enlarged end view of the edge of a hand scraper that has just been sharpened and turned.

2. What are the advantages of the hand scraper over the cabinet scraper?

3. What is drawfiling?

4. What kind of a file is used in drawfiling a hand scraper?

5. What is a bur, when used relative to filing tools?

6. How may burs be removed?

7. At what angle to the scraper blade should the file be held when drawfiling?

8. Does a hand scraper need drawfiling each time it is sharpened? Why?

9. Explain the complete process of sharpening a hand scraper.

10. Correct the following statement: "In learning the art of sharpening scraper blades, information is required but practice is desired."

Job 9

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Sharpen Boring Tools		PWH pp 38-43, 149	

1. Name the dirrerent parts of an auger bit.

2. How are auger bits sharpened?

3. Complete the following statements:
   (a) The size of the auger bit is indicated in ____________.
   (b) Dowel bits are ____________ long.
   (c) Car bits and ship augers are ______________ long.
   (d) __________________ bits can be adjusted to bore holes of various sizes.

4. A forestner bit cuts with a _________________ and is used for boring holes in ______________ because they do not _________ the wood.

5. (a) Gimlets are used for boring _______ holes in _________ for inserting small ____________.
   (b) The size of gimlets is indicated by ___________ and the size ranges from _________ to _________.

6. (a) The twist bit is very much like the _______ ________.
   (b) It ranges in size from ______ to_______ and the size is indicated in __________ which is stamped on the ___________.
   (c) It has a square _________ for fitting into the__________ of the brace, and is not intended to be used for boring in ____________.

7. (a) Twist drills are used for drilling in ________ but can be used for drilling in ____________.
   (b) Drills that are made for drilling in ________ have round shanks.

8. (a) A ___________ is used for making small holes in wood for screws and nails and should not be used in _______ wood or too close to the edge because of the danger of ______.

9. (a) The ____________ is used for enlarging the end of holes for _____________ screws. There are _______ kinds of them, one of which can be ____________ and one that cannot be ____________.

Continued....

Job 9 (Continued)

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Sharpen Boring Tools		PWH pp 38-43, 149	

10. (a) There are ____________ kinds of braces. The __________ can be used in close places where a __________ ________ cannot be made.

(b) The __________ _________ is a steel rod with a ______ on one end of it and is used for _________ __________.

(c) They are made in lengths from _________ to ________ inches.

Job 10

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Clean a Rasp or File		PWH pp 46-48, 152-153	

1. The carpenter uses files for ________ ________ such as ________, ________ ____, and ________, while he uses the rasp to ________ and ________ the edges of ______.

2. Files are classified according to their shape and we have the ________, ________, ______________, ________ and ____________ as the most common ones.

3. (a) To clean the rasp or file we use ________ and ________.
   (b) The ________ ________ also ________ the ________ ________ that has filled the ________ between the ____________.

4. Another way to clean the file is to ________ it in ______ for an ________ and then ________ it with a ______ ____. The water ________ the ________ that is between the teeth and ________ it until it can be removed by ______.

5. Rasps cut faster than ________ and leave the surface ________. For this reason, they should be used ________ the file is used if a ________ ________ is desired. When measuring the length of rasps or files, the ________ should not be included.

6. If one edge of a file or rasp is ________, this edge is called a ________ ________ because it will not ________ if accidentally rubbed against a surface.

Job 11

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Joint, Gum, Set and File a Circular Saw		PWH pp 153-158	

1. The purpose of jointing a circular saw is to make all ______ the same __________. In jointing the saw, it is necessary the the longer teeth only be jointed down to the same height as the ________ _________.

2. The grinding out of the gullets with a special grinding wheel is called ___________ the saw. If the saw is not __________ occasionally it _____________ with sawdust.

3. The grinding wheel for gumming a circular saw should be about ______________ inch thick and ____ inches in diameter.

4. The devise that holds the saw while gumming is called the ____________. The front of the teeth should be in line with a tangent to a circle drawn _______________ the distance between the _________ of the saw and the edge. The angle of the teeth is called the ___________.

5. A saw has to be set because ____________________________

   ____

   ____

   ____

6. A _________ _______ ________ _________ file is best for filing a circular saw.

7. Gullets made with square edge files are liable to cause the saw to ____________.

8. In filing circular saws, we file the tooth that is bent ____ ______ the filer and then turn the saw and file the other teeth.

Job 12

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Braze, Set and File Band Saws		PWH pp 159-162	

1. What is scarfing a band saw?

2. Explain the process of scarfing a band saw.

3. Why should a band saw always have an even number of teeth?

4. For what is a brazing clamp used?

5. What is a flux and for what is it used?

6. What are brazing tongs?

7. Explain the complete process of brazing a band saw using the brazing tongs.

8. Explain the process of brazing a band saw using the electric brazer.

9. What is the result if a joint cools too quickly?

10. How can the hardening of a joint be prevented?

11. Name two ways that a band saw may be set.

12. What is meant be the term "set and pawl movement"?

13. Explain the use of fitting wheels in setting or filing a band saw.

14. Explain the filing of band saws by completing the following sentences.
    (a) Band saws may be filed by either ________ or ________.
    (b) Band saw teeth are filed in the same shape as the teeth of a ______________ ______.

Job 13

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Sharpen Jointer and Planer Knives (Using the Modern Grinding Machine)		PWH pp 162-167	

1. See Fig 56, PWH. What is a cutterhead?
2. Explain the use of the three-pronged knife adjusting gauge.
3. What is the first step in grinding jointer and planer knives with the knife grinding attachment?
4. Should each knife be done as in step number one on p 162, PWH?
5. After the knives have all been gauged or set with the micrometer, what is the next thing to be done?
6. For what is a saddle used?
7. Why is it important that the cutter head be locked in position before grinding the knives?
8. Why is it important that all knives be ground at each setting of the grinder before the grinder is reset?
9. Why is it necessary to joint the blades after they have been ground?
10. How can it be determined when knives are jointed enough?
11. Explain briefly the process of jointing the jointer blades, giving the principal things to observe in the operation.
12. What is the cause of the heel and what is the remedy?

Job 14

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Sharpen Shaper Knives, Router Bits and Hollow Chisels		PWH pp 168-170	

1. What kind of knives and bits are sharpened like plane irons and flat chisels?

2. With what are knives with curved edges ground?

3. How are three-lip shaper cutters sharpened?

4. To what shape are milled shaper cutters sharpened?

5. Why are router bits sharpened on the inside?

6. Explain the process of sharpening hollow chisels.

7. How can particles of steel be removed from the grinding wheel and the oil stone?

8. How can oil and dirt be removed from the grinder and the oil stone?

9. List an important safety precaution to be taken while dressing the emery wheel.

10. How can rust be removed from tools and machines?

Job 15

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Size and Square Boards with Hand Tools		PWH pp 173-179, 24	

1. In sizing and squaring boards, what selection should the carpenter make before he begins the sizing?

2. What is meant by the "working face" and the "working edge"?

3. Why should boards not be clamped tightly in the vise while being sized?

4. In planing boards with the hand plane, what observation should be made of the grain in the board? Why?

5. Explain how the edge and the side of the board can be tested for squareness.

6. Why should boards not be cut to the exact length or the finish length before the sizing is done?

7. Explain how to gauge the width of a board with the marking gauge. See Fig. 23,p 24, PWH.

8. What should be used to gauge a wide board? Give two methods. See Fig. 24, p 24, PWH.

9. Fill in the blank spaces in the following sentences with the correct word.
   (a) To size the edge of a long board I would use a ________ plane.
   (b) To size the side or surface I would use a ____________ plane.
   (c) To square the end I would use a ____________ plane.

10. How can splitting be prevented when planing across the end of a board?

Job 16

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Joint Boards for Gluing With Hand Tools		PWH pp 179-180 PWH p 293 Art. 225	

1. What consideration should be given to the grain of boards that are to be glued together?

2. Why is it necessary to select the better side of the boards?

3. Is the face of the boards usually planed before or after the gluing is done? Give a reason for this.

4. What is the reason for placing two boards together in the vise to joint the edges?

5. How can the ends of long boards be held together for jointing?

6. What is the reason for placing the better sides on the outside when jointing two boards together?

7. Why is it important that the boards fit tightly together at the ends before the clamps are put on?

8. How can allowance be made for the shrinking near the ends of the boards?

9. Explain the process of gluing and clamping boards. See Art. 225

10. What kind of a plane should be used in jointing boards? See PWH, p 32.

Job 17

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Size and Square a Table Top with Hand Tools		PWH pp 15-55, 180-183	

1. Explain the process of planing a table top.
2. Why is it good practice to chamfer the edge furtherest from the carpenter?
3. Why is it better to run the plane across the grain in cross-grained woods?
4. How can the surface be tested to determine when it is true?
5. After the surface is true, what is the next step in dressing the table top?
6. On what kind of wood should a cabinet scraper be used?
7. In squaring a line across the end of the table top, along which edge should the framing square be placed?
8. About how much should be cut off in squaring the first end?
9. In planing across the end, what kind of a plane would you use and in what direction would you run your plane to avoid splintering the edges?
10. How would you determine where to saw the second end?
11. For what could a panel gauge be used on this job?

Job 18

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Size and Square a Table Top with Machine Tools		PWH pp 79-91, 183-185	

1. How long should the boards for a table top be cut at first?

2. Name three different kinds of motor driven saws that can be used to cut the boards for this table top.

3. What is meant by a board being in "wind"?

4. What can be done to straighten a board that is in "wind"?

5. What does the grain have to do with the way in which we feed a board to the planer?

6. Which machine should be used to plane the warp or wind out of a board, the planer or the jointer?

7. What must be done to the edges of the boards to be used to make a table top?

8. How are the boards sized to an even thickness?

9. Since the grain runs in opposite directions on the sides, what must be done with the boards when sizing them on the jointer?

10. What must be taken into consideration when we place the boards together for matching and marking?

11. Explain the process of applying the glue.

12. What machine is used to size the table top after the glue is set?

13. If the top is more than 20 inches wide, how would you dress the top.

14. Explain the process of trimming the ends of the top with the band saw and the jig.

Continued....

Job 18 (Continued)

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Size and Square a Table Top with Machine Tools		PWH pp 79-91 183-185	

15. Of what advantage is the jig?

16. Explain the process of planing the ends on the jointer.

17. From which edge of the top should the end by planed? Why?

18. Why should the end planing be stopped 1/2 inch from the unfinished edge when planing the ends of the top?

Job 19

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Size and Square Table Legs with Hand Tools		PWH pp 24, 15-55, 185-187, 178	

1. If the finished table legs are to be 2¼" square when finished, what size material would you select for the legs?

2. How much should be allowed for rough length?

3. How should the leg be tested for squareness? See Fig. 30, page 183

4. How should the leg be tested for "wind" or warp?

5. What should the marking gauge be set on for marking these legs?

6. Which hand plane should be used in sizing and squaring the other two sides of the legs?

7. Give a reason for using a miter box for cutting the legs to exact length.

8. Why is it important that the legs be centered carefully before they are placed in the turning lathe?

Job 20

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Size and Square Table Legs with Machine Tools		PWH pp 187-191	

1. At what angle to the jointer table should the fence be for planing the second side of the table leg square to the first side?

2. Why is 1/32 inch allowance made in sawing the legs in this case?

3. For what is a push stick used?

4. How much cut can the carpenter take in planing these legs smooth on the jointer?

5. What other machine can be used instead of the jointer and saw to bring the legs to the finish size?

6. Explain the process of cutting the legs to length.

7. What is a stop rod?

8. Should all the legs be cut at one operation or one by one? Why?

9. What kind of machine saw should be used?

Job 21

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Taper Table Legs with Hand and Machine Tools		PWH pp 185-187, 84	

1. Explain how the tapered part of the table leg is laid off.

2. At what point is the pencil line squared around the leg?

3. Why are the taper lines made on oposite sides of the leg?

4. Give two ways in which the taper could be cut with hand tools.

5. After the first two sides have been tapered, how are the other two sides tapered?

6. Explain the first step in tapering table legs with the circular saw.

7. Explain the jig and tell how it works in tapering legs for tables.

8. At what distance from the top of the legs, for this job, does the taper begin?

9. Why are different notches in the jig used in tapering the second two sides of the leg?

10. Remember that so far the legs are sawed and the sides have not been finished. With what tools can they be finished?

11. Explain how the leg is placed on the jointer relative to the beginning of the taper.

12. List three good safety rules for this job.

Job 22

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Make a Rabbet Joint		PWH pp 195-197	

1. What is a rabbet?
2. What hand tools are used to make rabbets?
3. Explain the setting of the rabbet plane.
4. What is the spur and what is its use?
5. What are the two gauges on the rabbet plane for?
6. How should the rabbet plane be held on the board while rabbeting? Why?
7. In case the board is thin or narrow and the gauges cannot be used, what can be done to govern the width and depth of the rabbet?
8. Explain the process of rabbeting across the end of a narrow board.
9. What tools are used in rabbeting across the grain of narrow boards?
10. Explain two ways in which straight saw cuts can be made across a board.
11. With what tool can the final smoothing and depth cutting be done?

Job 23

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Make a Groove		PWH pp 32-33, 58, 91, 101 106, 197-198	

1. What is a groove?
2. How does a groove differ from a rabbet?
3. Name some of the uses of grooves.
4. Name two hand tools with which grooves are made.
5. Name all the machines with which grooves can be made.
6. How are groove and rabbet joints used in furniture and cabinet work? Give examples.
7. Why are grooves used in jointing wood together?
8. What is a barefaced tongue joint?
9. How are barefaced tongue joints used in cabinets and tables?
10. Are grooves used in making barefaced tongue joints?

Job 24

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Make a Dado Joint		PWH pp 32-33, 65, 66 198-199, 203-208	

HAND TOOLS

1. What is a dado?

2. Name three or more places where dado joints are used.

3. What procedure is used in laying out a dado

4. Give another way to lay out a dado. What advantage has one way over the other?

5. Which side of the line is cut?

6. Explain one method of sawing a straight line in the cutting of a dado.

7. How is waste stock removed between the kerfs?

8. What can be done if the dado is too tight? Too loose?

MACHINE TOOLS

9. A dado head consists of what items?

10. What width dadoes can be cut with a dado head?

11. After a dado head is on the arbor and the saw table is in place, what should be done before beginning the cutting of dadoes for production?

12. List a safety rule to be observed in operating a dado machine.

13. See Fig. 15, p 65, PWH. What is the diameter and thickness of the collar?

Job 25

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Make a Gain or Stopped Dado Joint		PWH pp 67-70, 199-200 204-206	

HAND TOOLS

1. How does a gain joint differ from a plain dado joint?

2. What is the advantage of a gain joint over a plain dado joint?

3. How much stop is left on the front of a stopped dado joint? See Fig. 20 p 200 PWH.

4. How long would the dado be in a standard 1" X 8" board, laid out according to measurement in Fig. 20 p 200.

5. How is the chisel held in cutting out the gain?

6. Why strike light blows with a mallet in beginning the chiselin of gain joint?

7. What tool, or tools, are used to finish the gain?

8. On what piece of furniture would this joint be used?

Machine Tools

9. What machines may be used in cutting grooves, rabbets, and dadoes?

10. The ends of stopped dadoes cut on a circular saw must be finished in what way?

11. What is the greatest danger in operating a circular saw?

12. Why is there no danger of a kickback when cutting dadoes on a circular saw?

Job 26

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Make a Dado and Rabbet Joint with Hand Tools		PWH pp 195-198, 200-201	

1. Where is the dado and rabbet joint used?

2. What is the first step in making this joint?

3. What is the second step in making this joint?

4. The depth of the rabbet is usually what part of the thickness of the stock?

5. The width of the rabbet is equal to what?

6. Tell how to cut the dado?

7. In what two ways can rabbets be cut?

8. Why try the fit of the rabbet in the dado before reaching the depth line?

9. Is it a good idea to drive the joint together? Why?

Job 27

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Make Grooved Joints with Machine Tools		PWH pp 57, 67-70, 105 202-206	

1. After laying off a rabbet to be cut 1 inch wide and ½ inch deep, on a circular saw, what is the first machine adjustment to be made?

2. Why is width of the rabbet (1 inch) measured from the ripping fence to a way point away from the fence instead of a saw point nearer to the fence?

3. Why must special caution be exercised in making the cut in Question #2

4. In cutting the depth of the rabbet (½ inch), how is the stock held? Is there a "kickback" hazard involved?

5. Can rabbets along the grain and rabbets across the grain be cut with the same "set-up" of the saw?

6. Can rabbets be cut by using a dado head? If so, what would be the advantage of cutting with a dado head?

7. Can rabbets be planed on a jointer?

8. Can rabbets be cut on a shaper or a router?

9. Is a shaper to be considered a comparatively safe or dangerous machine to operate? If safe, Why? If dangerous, what are some safety rules to follow?

10. Grooves and dadoes on straight work are usually cut on which machine?

11. Cutting grooves on the shaper and router, (a) how is straight work guided, (b) curved work?

12. How are dadoes cut on a shaper?

13. How are dadoes cut on a router?

14. Ends of stopped grooves and dadoes cut on a circular saw or shaper must be squared. How?

Job 28

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Make a Doweled Butt Joint		PWH pp 207-209 PWH Fig.38, 40	

1. Where are dowels used extensively?
2. For what type joint is a dowel joint a substitute? Why?
3. The patternmaker uses dowels in what patterns?
4. What are dowels?
5. For what reason are dowels grooved?
6. Why is it a good idea to countersink dowel holes slightly?
7. After squaring stock to dimensions for a butt joint, how are the first lines drawn?
8. What determines the place of the auger holes?
9. What diameter should the dowel be?
10. What device is used to bore all holes to the same depth?
11. How long should dowels be cut?
12. What undesirable effect results from dowels that are too short?
13. How are the dowels put into the joint?

Job 29

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Make a Draw-bolt Joint		PWH pp 209-210 PWH Fig. 43, 45	

1. This is not strictly a dowel joint, why is it described under this heading?

2. In what kind of construction is this joint used?

3. What advantage over other joints is the draw-bolt joint?

4. The horizontal member or rail is joined to the vertical member with one or two dowels. Are the dowels glued into the member? Why?

5. How can you be sure the bolt will fit the hole in both members

6. Why should the hole be longer than the bolt?

7. How is the nut put on the bolt?

8. Why should a washer be put under the head of the bolt?

9. If surfaces to be joined are not at right angles to the sides, how should the holes be bored for dowels?

10. At what angle to the miter joint are the dowels in Fig. 44

Job 30

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Dowel Boards Together Edge to Edge with Hand Tools		PWH pp 207-211, 179-180	

1. What is the first operation when boards for a table top are to be glued together?
2. How are the boards marked in order that they will be joined in the order of layout?
3. How are they jointed to fit?
4. Why is it of the utmost importance that the edges of both boards make a good joint at both ends?
5. Is it required to do this job as carefully as if no dowels were to be used? Why?
6. When all the joints fit, the edges are all gauged. How?
7. Clamp all the boards together side by side and square lines all around them. What determines the location for holes for dowels?
8. What can be done that helps center the auger bit quickly and accurately?
9. Why are no dowel holes bored in the two outside edges?
10. A doweling jig is of what practical use?

Job 31

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Dowel Legs to a Turned Column		PWH pp 211-213 Fig. 49, 51 PWH pp 207, Art. 178 Steps 2, 4-7 PWH p. 299, Art. 231 Step 6	

1. On what are the legs sanded? Why
2. How are legs held steady while obtaining desired curvature?
3. What tool is used in testing squareness of legs?
4. When is the test made?
5. How are the center lines gauged? See Art. 175, Step 2.
6. If lines are gauged and dowels set a little off center, how will it affect the joints? Why?
7. How are marks obtained on the column at the points where the legs are to join it?
8. How are vertical lines obtained at the points where the legs are to join the column?
9. How are positions of dowels found?
10. When the underside of the column is flat, how may the horizontal gauge lines be gauged?
11. How are holes for dowels bored?
12. How can the legs be glued to the column?

Job 32

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Bore Dowel Holes with Machine Tools		PWH pp 213-214	

1. Holes for dowels can be bored on what machines?
2. What limitation has a router for boring dowel holes?
3. When boring holes in the edges of boards for a table top, what extra device should be used?
4. What purpose does the auxiliary fence serve?
5. How can holes be bored in a miter joint?
6. Can holes be bored in surfaces at other angles than 45°? How?
7. How may holes be bored in a turned column?
8. Suggest two safety rules that apply here.

Job 33

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Make an End Lap Joint with Hand Tools		PWH pp 214-216	

1. Why is the joint called lap or halving joint?

2. Who uses this joint?

3. In beginning this joint, what is marked first?

4. In a joint 3/4" thick, 2" wide, you would lay out the width (2") on each piece and square lines all around. Why?

5. How is the marking gauge set to mark the edges of the pieces?

6. A line is now gauged around the end of each piece from the face of both pieces. Why emphasize face?

7. In sawing the shoulder cut across the grain, what two methods can be used to guide the saw?

8. What saw may be used to make the cheek or side cut?

9. What method is suggested in the reference reading for making the cheek cut?

10. What advantage is there in clamping the piece diagonally?

11. When the pieces are fitted together, if their upper and lower surfaces are not flush, or the side of one does not fit accurately against the shoulder of the other, what can be done?

12. When is the end-lap joint with rabbet used?

13. Why plane the rabbet in a piece of wood long enough for the whole frame?

14. How does layout for this joint differ from layout of an ordinary end lap joint?

15. See Fig. 57 p. 216, PWH. What are the two dimensions of the rabbet?

Job 34

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Make a Cross-lap Joint with Hand Tools		PWH pp 217-220 PWH Fig. 58	

1. (a) How much is the cross-lap joint used in cabinetmaking?
   (b) Where is it used?

2. (a) Are members of a cross-lap joint generally of the same width and thickness?
   (b) Do they cross at right angles?
   (c) Cross-lap joints may be made at different angles and the parts may be of different dimensions?

3. If the joint is to be in the center and both pieces are the same length, how can you test the accuracy of the lines squared across the center?

4. How are depth lines gauged?

5. Is it better to make shoulder cuts too large or too small? Why?

6. Why should a few extra saw cuts be made between the shoulder cuts? How?

7. How is the cut finished?

8. Why chisel from both edges toward center in finishing the cut?

9. Can cross-lap joints be made on the edges of the stock?

10. Where are middle-lap joints used?

11. How is the joint made?

Job 35

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Make a Dovetail-lap Joint with Hand Tools		PWH pp 223-225 Fig. 76	

1. This joint is a modification of what joint?

2. Why is it used especially where there is pull or tension strain?

3. Where is it used?

4. How is this joint laid out?

5. How is the angle obtained?

6. How is the angle transferred to the work?

7. How is the first cut made?

8. How is the cheek cut made on this piece?

9. Having now cut the dovetail on one member, how is it cut in the other?

10. When a dovetail lap joint is made on the end of a leg as in Fig. 76, PWH, how is the recess in the leg cut?

11. Do all dovetail joints have two sides slanting?

Job 36

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Make Lap Joints with Circular Saw		PWH pp 225, 62-63	

1. When a number of lap joints are to be to the same dimensions, how is the stock prepared?
2. How is the machine set for the shoulder cut?
3. What saw is recommended for making the cheek cuts?
4. What are some reasons for using jigs for making the cuts?
5. Name safety rules to remember on this job.
6. What cutter can be used on a circular saw in cutting cross lap joints?
7. (a) Tell how to cut a cross-lap joint with a dado head.
   (b) How is the remaining part cut out?
8. How may the operation be performed without use of the ripping fence?
9. What is the purpose of the ripping fence?
10. What is the purpose of the universal gauge?

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Lay Out a Blind Mortise-and-Tenon Joint		PWH pp 227-229	

1. How important is the mortise-and-tenon joint in cabinet construction?

2. Name some variations of this joint.

3. Why is the blind type of mortise-and tenon joint used in most cabinet work?

4. What are three principal operations in making mortise-and-tenon joints

5. What is first to be done in laying out?

6. (a) After determining the length of the tenon, what is done at the shoulder?
   (b) Next, mark the total width of the tenon member where?

7. What is the usual thickness of the tenon?

8. The gauge lines for the thickness of the tenon are marked from (a) what and (b) where and (c) how far?

9. How is the mortise gauge set to gauge the mortise if the mortise member is thicker than the tenon member?

10. Is the tenon usually made full width of the member in cabinet work?

11. If the mortise is near the end of a piece, how much should be taken from the width of the tenon and why?

12. Where there are several mortise-and-tenon joints with the same dimensions, how must they be laid out in order to produce accurate work?

13. When four legs are required, as in a table, what is a convenient way of marking?

14. If an ordinary gauge is used instead of a mortise gauge how can the gauge lines be marked?

Job 38

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Make a Blind Mortise-and-Tenon Joint		PWH pp 229-238	

1. How can mortise be made? (Two ways)

2. What width chisel is used in cutting a mortise?

3. How is a mortise chiseled?

4. How is a bored mortise made?

5. How is the tenon clamped for making cheek cuts? Why this position?

6. How far down the gauge line on the tenon is to be sawed, and what saw should be used?

7. How is the cut completed?

8. How is the piece of wood held when sawing the shoulder cut?

9. How are shoulder cuts made?

10. Fit parts of the joint together, and make necessary adjustments How much pressure should be necessary to bring the members of the joint together?

11. Tenon members of equal length must measure how?

12. How is a blind mortise and tenon joint sometimes strengthened?

13. What are such joints called?

Job 39

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Make Special Mortise-and-Tenon Joints (Haunched and Barefaced)		PWH pp 238-239	

1. Where is this joint used?
2. What is the usual width of the mortise?
3. What variation is made in the layout of this joint and the blind mortise-and-tenon joint?
4. Where and why are taper-haunch joints used?
5. When is a double tenon used?
6. How is the double tenon made?
7. When is it better to use barefaced mortise-and-tenon instead of a regular tenon joint?
8. To strengthen the joint in such cases, how is the tenon made?
9. What limit is there to the use of this joint?
10. What is the purpose of the haunch?

Job 40

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Make a: (a) Through Mortise-and-Tenon Joint, (b) Slip Joint, (c) Keyed Mortise-and-Tenon Joint		PWH pp 240-242	

1. What is the difference in laying out a through mortise-and-tenon joint and a blind mortise-and-tenon joint?

2. Why is the mortise on a through mortise-and-tenon joint easier to chisel than on a blind mortise-and-tenon joint?

3. In what ways are tenons finished on a through mortise-and-tenon joint?

4. What is a wedged mortise-and-tenon joint?

5. What change is made in the mortise on a wedged mortise-and-tenon joint?

6. What is a slip joint?

7. What difference is there in the cutting of the mortise on a slip joint?

8. Is the slip joint a strong joint? Where is it used?

9. The keyed mortise-and-tenon joint differs from the other mortise-and-tenon joints in what way?

10. What is the keyed joint?

11. (a) What is the mortise for in the projecting end of the tenon on a keyed mortise-and-tenon joint?
    (b) How is this mortise cut?
    (c) How is the key fitted? Draw a key.

Job 41

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Make a Mortise on a Mortising Machine		PWH pp 95, 242-243	

1. Two chisels and two bits are shown on p 95. List them.

2. To what is the edge of the chisel set parallel?

3. (a) In what sizes are hollow chisels made?
   (b) What is the largest size for ordinary use?

4. Clamp the piece to be mortised on the table. Press down the foot pedal and bring the bit down near the top of the wood without starting the machine. Why?

5. What adjustment is needed regarding the lengthwise movement of the table?

6. Why is it necessary to lay off only one piece when several pieces are to be mortised alike?

7. Start the machine. How should the first cut be made? Why?

8. How is the last cut made? Why?

9. How are pieces managed that will not lie flat on the table?

10. When mortises are to be cut in turned stock, what is of the utmost importance?

11. Can this method of holding the stock be used when legs are to be doweled to a turned column?

Job 42

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Cut Tenons on a Circular Saw		PWH pp 243-247	

1. When a number of tenons have to be cut to the same dimensions, how are the pieces prepared?

2. Why lay out only one piece?

3. What is the first cut and how is the machine set for making the cut?

4. Study Fig. 121, 122, 125, and list two advantages of this manner of tenon cutting.

5. If the stock is not exactly the same thickness, how can the tenon be cut accurately?

6. How is it possible to make both cheek cuts in one operation?

7. Can the mortise member of a slip joint be cut on the above set up? (Fig. 124)

8. Can a dado head be used to cut a mortise on a slip joint?

9. Can tenons be cut with a dado head? How is the ripping fence set?

10. What may cause tenons to be too thick or too thin?

11. List two safety rules for above operations.

Job 43

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Cut Miter Joints with Hand and Machine Tools		PWH pp 247-251	

1. Where are miter joints used?

2. Is a miter joint strong or weak? Why?

3. What are three principal operations in making a miter joint?

4. Most moldings are cut at what angle?

5. Determine the angle cut of a polygon of ten sides?

6. Having determined the miter cut, what is the next step?

7. If molding for a picture frame is to be cut, how is the length found?

8. What is used when cutting miters by hand?

9. What advantage has an iron miter box over a wooden one?

10. If joints should not fit exactly, what can be done?

11. How can a joint be resawed to fit?

12. How can miters be cut on a circular saw?

13. What variety of pieces can be accurately mitered on the jig?

Job 44

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Glue Mitered Frames		PWH pp 251-256	

1. What is the best way to glue mitered frames?
2. What is a starved joint?
3. How are mitered ends "sized" to prevent starved joints?
4. How can joints be prevented from sticking to the bench?
5. When the frame is in the four clamps, how can the four miter joints be brought into line?
6. How can small frames be clamped?
7. How can hand screws and triangular blocks be used to clamp frames?
8. How are triangular blocks glued to frames so that they can be removed?
9. When may the above method of gluing (Question 7) be particularly useful?
10. How may hand screws be used for clamping and avoiding gluing triangular blocks on the frame?

Job 45

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Reinforce Mitered Joints (Slip Feather)		PWH pp 256-259	

1. (a) Why should miter joints always be reinforced?
   (b) Why use miter joints if they are weak?

2. Name the most common methods of reinforcement.

3. What are nails used in picture frames called? Why are they used instead of ordinary nails?

4. Why is picture frame reinforcement not satisfactory for use in school or home workshop?

5. What is a slip feather? How is the frame prepared for the slip feather?

6. How is the slip feather glued in place?

7. How is the joint finished? What is the name of this joint?

8. How is the veneer concealed in wide moldings?

Job 46

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Reinforce Mitered Joints (Spline and Dowel)		PWH pp 257-259	

1. What are splines?

2. How may bevels be made?

3. How is a cut made in a bevel to receive the spline?

4. In a spline miter joint, the grain of the spline must run in which direction to the joint?

5. When a miter joint is reinforced with dowels, how are the holes laid out?

6. How are the above holes bored? What tools are used?

7. After dowels are glued into the members, how is the joint clamped?

8. If it does not matter that the ends of the dowels show on the outside edge of the frame, how is it easier to reinforce the joint?

9. How can through dowels be concealed?

Job 47.

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Cope Moldings		PWH pp 259-261, 554-556	

1. In how many directions does wood shrink? It shrinks most in which direction?

2. Which shrinks more, (a) summer wood or spring wood, (b) heavy wood or light wood?

3. Why do miter joints often open up in the inside part of the joint?

4. How are moldings cut to overcome open joints?

5. Explain "coped".

6. How are moldings coped to fit at 90° angles?

7. What line is followed in sawing the coping?

8. Can the same method be used in coping moldings at other angles?

9. Which will warp worse, a board sawed through the center of a log, or one sliced off the side of the log? Why?

10. In drying, will the edges of a board bend toward, or away from, the heart of the timber?

11. Can molds that are undercut be coped?

Job 48

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Make a Through and a Half-lap Multiple Dovetail Joint		PWH pp 263-266	

1. What factors recommend this type joint to cabinetmaking?

2. Why is this joint used only in the better class of work?

3. What other name is applied to this joint?

4. How is the strongest through joint made? Why is it usually not made this way?

5. After stock is squared and a line squared around each member, what is the next step?

6. How are pins laid off from the equal spaced points?

7. How is the angle of dovetail arrived?

8. How is the angle transferred to the work?

9. What saw is used in cutting dovetails?

10. Chisel away waste from both sides. Why?

11. How are the dovetails marked?

12. What may happen if the parts of the joint are forced together?

13. The half-lap multiple dovetail joint differs from the through multiple dovetail joint in what way?

14. The above joint is used on what construction?

15. How are lengths of tails gauged on both members?

16. If one member is thicker than the other, on which member would the tails be made?

17. When should the groove for the drawer bottom be plowed? Why?

Job 49

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Make a Drawer		PWH pp 266-269, 298-299 Fig.170, 172, 173	

1. Drawers are made according to what?

2. What is the first step in all drawer construction?

3. The front should fit how? Why?

4. How is the simplest kind of drawer made?

5. What improvement on this joint is shown in Fig. 170, B?

6. How is the bottom of a drawer put in?

7. What material is preferred for drawer bottoms? Why?

8. How do the back and bottom fit together? How are they fastened?

9. What two points are to be borne in mine in gluing a drawer?

10. How is the endwood concealed in the drawer shown in Fig. 172

11. On the better furniture, how are front and sides of a drawer joined? See Fig. 173.

Job 50

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Make Drawer Rails and Guides		PWH pp 269-271	

1. The weight of a drawer is supported on what?
2. How is the movement of the drawer controlled?
3. The rails usually consist of what members?
4. What purpose is served by a ¼ inch plywood panel generally framed in between these rails?
5. How are frames joined to the sides of the cabinet?
6. How may drawer guides be made? What are the limitations to these guides?
7. What method will serve in all cases?
8. What holds the center guide?
9. What is a test of a well-fitted drawer?
10. How is the drawer stopped at the right point?

Job 51

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Make a Panel Structure		PWH pp 271-273	

1. In what work is panel construction used?

2. What is the object in panel construction?

3. The best type frames are joined with what type joint?

4. What other joints are used?

5. What steps are taken in preparing the frame?

6. Of what are panels made?

7. On what machines can raised panels be made?

8. What size should a panel be?

9. Frames for panels may be molded on the edges around the panel. What is this called and on what machine is it done?

10. If a shaper is not available, how can the frame be molded?

Job 52

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Make a Rule Joint		PWH 273-275	

1. Where is the rule joint used?
2. Why is the rule joint used?
3. How is the marking gauge set and lines drawn in laying out?
4. If "backflaps" are not obtainable, what can be substituted?
5. How are the radii cuts laid off?
6. What is the first cut to make?
7. How can the curves be shaped?
8. How is the joint kept from rubbing and scarring the finish?
9. Where are grooves cut for the knuckles of the hinges?
10. When using the hinge hasp, how can showing of the gains when the leaves are folded be avoided?
11. If cutters of the right shape and size are available, what machine can be used to cut rule joints?

Job 53

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Make Supports for Table Leaves		PWH pp 275-279	

1. What is one of the oldest and most common type of extension tables?

2. How are leaves supported on various tables?

3. What is the finger joint?

4. Into how many parts are the members of the finger joint divided?

5. How are lines gauged on the face of the members of the finger joint?

6. At what angle are cuts made through the thickness of the members of the finger joint?

7. (a) At what angle are the pieces placed to bore the hole in the finger joint?
   (b) How is it advisable to bore the hole for the pin?
   (c) What is used for a pin?

8. Why is the movable part of the finger joint beveled on the rear side?

9. What objection is there to a continuous hinge?

10. (a) A slide support for a hinged table leaf is composed of what?
    (b) How are the three boards fitted?

11. How is a pivoted rail support made?

Job 54

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Properties and Uses of Glue	INF.	PWH pp 287-290	

1. Is gluing regarded as an important phase of the woodworkers art? Why?

2. Name several kinds of glue used commercially?

3. Of what is animal glue made?

4. How is animal glue prepared for use?

5. (a) What is the effect of overheating animal glue?
   (b) What is the right temperature at which to heat glue?

6. Of what is casein glue made and how is it prepared?

7. What is one advantage of casein glue? One disadvantage?

8. Of what is resin glue made?

9. What is one advantage of resin glue? One disadvantage?

10. (a) Is vegetable glue suitable for shopwork?
    (b) Where is it used?

11. (a) Of what is blood-albumin glue made?
    (b) What is its use?

12. (a) Which of the glues are not suitable for shopwork?
    (b) Which are waterproof?

Job 55

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
General Directions for Gluing		PWH pp 291-292	

1. Why must the work be done quickly when using animal glue?
2. How are finished surfaces protected from being scratched by the clamps or hand screws?
3. What tools should be convenient to hand before gluing is started?
4. Why clamp the pieces together without glue?
5. Why close all doors and windows before applying animal glue?
6. What is the objection to the glue being cooled?
7. Glue is applied and pieces clamped as quickly as possible. What next?
8. Is it usually best to do the job alone or to have helpers?
9. Is speed as important when using casein and resin glue as when using animal glue? Why?
10. Is temperature important with casein glue? With resin glue?
11. What is used to clean off casein and resin glue?

Job 56

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Glue Two or More Boards Edge to Edge		PWH pp 293-295, 180	

1. Why is a slight opening desirable in the center when gluing boards edge to edge?

2. Before glue is applied, how is this joint tested?

3. How is glue applied to the edges of the boards?

4. Which clamp is tightened first in doing this job?

5. How is test for flatness made? If boards bulge in center, how can this be corrected?

6. Glue will not hold what kind of wood?

7. When large table tops consisting of several boards are to glued, what is done to make them level?

8. Need particular care be taken to protect outside edges of boards glued together to form tops? Why?

9. When the gluing process is completed, can the work be moved before the glue dries?

Job 57

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Glue Bookshelves		PWH pp 295-296	

1. What surfaces are finished and sandpapered before gluing bookshelves?
2. How are the joints marked on this job?
3. After the joints are marked, what is done before applying glue?
4. How many blocks and clamps are needed for each shelf?
5. How are sides and shelves fitted together?
6. How are clamps applied on the bookcase?
7. How are the bookshelves tested for squareness?
8. If shelves are not square with the sides, how can this defect be easily remedied?
9. How is surplus glue removed?

Job 58

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Glue a Cabinet		PWH pp 296-299	

1. What useful purpose is served by the clamp blocks?
2. Should mortise-and-tenon joints be clamped without glue? Why?
3. How may glue be applied to mortises?
4. How are finished surfaces protected from scars when clamping?
5. Why should no glue be applied to panels or the grooves into which they fit?
6. How are angles that are not square corrected?
7. How is unevenness corrected?
8. Where two sides of a cabinet are alike, why are they clamped with inside faces together?
9. Why is it easier to finish the sides with plane, scraper and sandpaper before gluing the cabinet?
10. By what two means may tests for squareness be applied?
11. If a cabinet is difficult to square, how may it be brought into line?

Job 59

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Glue a Drawer and a Chair		PWH pp 298-299	

1. What is done before glue is applied to a drawer?
2. Which part of a drawer is glued first?
3. How are blocks prevented from sticking to the sides of the drawer?
4. How can a stick be used to square the drawer?
5. How can a drawer be made to fit on a level surface while the glue is drying?
6. How is the bottom of the drawer fastened?
7. What parts are glued first in making a chair?
8. After cleaning and sanding, how is glue applied to a chair and how are finished surfaces protected?
9. How are joints in a chair checked for accuracy and adjusted?
10. How are joints of the chair strengthened?

Job 60

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Glue Doweled Joints and Segments		PWH pp 299-302	

1. Why are dowels pointed?
2. Cut a small V groove along the side of each dowel. Why?
3. How are dowels set into the joint?
4. How is straight work clamped?
5. How are segments or curved pieces clamped?
6. What kind of rope is it advisable to use to clamp segment or curved work? Why?
7. What special clamps are recommended for curved work?
8. How can legs be glued to a turned column?
9. What slows the work in gluing legs to a turned column?
10. How can irregular shapes be glued?

Job 61

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Use Nails as Fastenings		PWH pp 304-307	

1. Beside glue, what are three fasteners of wood?

2. Where are nails used?

3. What are nails made of?

4. What are the most common nails used in the woodworking industry?

5. (a) In what lengths are common nails made?
   (b) How are the lengths indicated?

6. (a) How long is a two penny nail?
   (b) An eight penny nail?
   (c) A sixteen penny nail?

7. Why were nails more expensive in colonial times than in modern times?

8. How are box nails treated to make them hold better?

9. Casing nails have two advantages over common nails for putting up interior trim. What are they?

10. The one pound packages of brads bear two marks. (a) What are they? (b) The higher the number the thicker, or the thinner, the brad?

11. How should cut nails always be driven?

12. In what lengths are carpet tacks made?

13. How should a nail be clinched? Why?

14. When a nail has a tendency to follow the grain of the wood, what will help to drive it in a straight line?

15. What can be done to make it easier to drive nails into hardwood without bending them?

Job 62

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Use Screws for Wood Fastenings		PWE p 308	

1. What three superiorities have screws over nails as fasteners of wood?

2. Of what materials are screws made?

3. What are the most common screws?

4. Screws are made in what lengths and gauges?

5. The higher the number the thicker, or thinner, the screw? Is it the same, or opposite for nails?

6. How many screws in a package? How many screws in a gross?

7. In places where screws might rust, what kinds of screws are used?

8. What are some good, and bad, features of the Philips head screw?

9. How can brass screws be driven with less danger of twisting off?

10. What happens if a screwdriver is too thin or has rounded edges?

11. How may screws be held in endwood?

12. What diameter size holes should be bored for a screw, gauge Number 9, in hardwood?

Job 63

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Use Bolts for Wood Fastenings		PWH pp 311-312	

1. Where are bolts used?

2. How do bolts differ from screws?

3. How are threads cut on bolts? (Two ways)

4. What bolts are most commonly used by the woodworker?

5. In what sizes are stove bolts made?

6. (a) Iron bolts are of what sizes?
   (b) Are carriage bolts made of the same sizes?

7. Why are carriage bolts especially useful for wood?

8. What are the two parts of expansion bolts?

9. How is the masonry prepared for expansion bolts?

10. (a) What is the use of toggle bolts?
    (b) Can they be easily removed from the work?

11. When great pressure is not required, what kind of nut is sometimes used? How is this convenient?

Job 64

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Hinge a Door		PWH pp 312-320	

1. It is customary to place hinges on a panel door at what points

2. When hinging the lid of a box or chest, at what points are the hinges placed?

3. (a) In fitting a door, which edge is planed first?
   (b) What is the next operation?

4. If it is a large panel door, what is the first operation in hinging it?

5. After the hinge edge is planed and the top squared, what is done next?

6. How is the door held in the frame while marking the position for hinges?

7. Where are marks for the hinges made, on the door, on the frame, or on both?

8. What is the difference in marking cabinet doors and in marking larger doors for hinges?

9. How is the gain for the hinge chiseled?

10. Besides a chisel what tools may be used to cut hinge gains?

11. What is wrong if: (a) There is a crack between the edge of the door and the frame? (b) The edge of the door and frame come too close together so that the door springs back when an attempt is made to close it?

12. If gains for hinges are too deep, how can this be remedied?

13. For what is a butt gauge used?

Job 65

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Put on Cabinet Locks		PWH pp 320 - 323	

1. Where are cabinet locks used?

2. What are the principal parts of a lock?

3. How does the "strike" add to the security of the door?

4. What are the two kinds of cabinet locks?

5. Locks for desks, boxes, chests, and pianos are constructed to withstand what kind of pull?

6. (a) If a mortise lock is used, where should the mortise be located?
   (b) Why not toward the front edge?

7. What saw is used in finishing the keyhole?

8. What is the difference in procedure in fastening a rim lock and a mortise lock?

9. How can the strikes for chest, desk, or box locks be easily located?

10. How can the strikes for drawer or door locks be located?

11. Which of the escutcheons, or key plates, would be harder to install? Why?

Job 66

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Put on Catches and Door Bolts		PWH pp 323-326	

1. Where are catches and door bolts used?
2. How are elbow catches installed?
3. Where are door bolts used?
4. Is it necessary, ordinarily, to cut the door or frame to install door bolts? Why?
5. What is the neatest type of door bolt?
6. Ball catches are made in what sized?
7. How are ball catches attached to doors?
8. How is a table catch put on a tilt-top table?
9. What is a common use for a cupboard catch?
10. Could a cupboard catch be used on a tilt-top table, or a table catch on a cabinet door? Why?

Job 67

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Install Casters, Chair Tips, Drawer Pulls and Knobs		PWH pp 326-328	

1. Why are casters used on furniture?

2. The wheels of casters are made of what materials?

3. The enlargement on the end of the stem of a caster serves what purpose?

4. Why put brass sockets on legs of furniture?

5. What are glides and for what are they a substitute?

6. How can glides be fastened to the legs of furniture?

7. How do chair tips differ from glides?

8. How are chair tips attached?

9. How are drawer pulls and knobs attached to furniture?

10. On a chest of drawers, how are pulls placed?

Job 68

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Fasten a Table Top to a Frame		PWH pp 328-331	

1. Provision for what characteristic of wood must be made in fastening a table top?

2. When holes are bored at an angle as at Fig. 53 A, why are they bored from the top?

3. How is the top fastened as at Fig. 53 B?

4. (a) What size cleats are used at Fig. 53 C?
   (b) How are holes bored in the cleats?

5. Where and how are the cleats Fig. 53 C., fastened?

6. How is the top fastened to the frame as shown at Fig. 53 D?

7. What advantage has method D. above over A, B. or C?

8. What modification of the wooden block fastener is shown at Fig. 53 E?

9. Which of the five above mentioned methods of fastening a table top to the frame presupposes the use of machines?

Job 69

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Use Turning Lathe Safely		PWH pp 335-346	

1. What are the principal parts of a modern lathe?

2. What is the "swing of the lathe"?

3. As the dead centers do not revolve, how is burning through friction prevented?

4. What are steady rests?

5. For what are dividers and calipers used?

6. What danger is involved in turning cracked or poorly glued stock?

7. (a) Why is it not safe to run stock at high speed before it is rounded off?
   (b) How should stock over 6 inches in diameter be run after rounding?

8. How close to the work shall the tool rest be clamped?

9. What particular danger is loose clothing around a lathe?

10. Considering the cutting method and the scraping method of woodturning:
    (a) Which is faster?
    (b) Which is safer?
    (c) Which is more accurate?
    (d) Which requires the more sanding?
    (e) Which is the more quickly learned?

Job 69

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Use Turning Lathe Safely		PWH pp 335-346	

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Job 70

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Center and Clamp Stock in Lathe		PWH pp 346-349	

1. What is included in spindle turning?

2. How is the center on the end found on square or rectangular stock?

3. How is the center found on irregular stock?

4. If the lumber is hard, why is it well to make a saw cut on the diagonals of one end of the stock and bore a small hole in the center of both ends?

5. Why is the live center removed from the lathe and driven into the wood?

6. Why should a hammer not be used to drive the live center into the wood?

7. (a) Why is oil put on the dead center end of the stock?
   (b) Why is soap or wax to be preferred?

8. Why should the cone center not enter the end wood more than 3/16 inch?

9. (a) How far is the tool rest set from the edge of the wood?
   (b) How far above centers?

10. Why should the wood be revolved before turning the power on?

11. What safety rule is always applicable here before power is turned on?

Job 71

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Turn a Plain Cylinder		PWH pp 349-352	

1. What danger is there in running the lathe fast before the stock is rounded?

2. What tool is used for the first cut? Why roll the tool toward the right?

3. (a) Where is cutting started?
   (b) In which direction is the gouge moved?
   (c) Why not begin the cuts at the ends of the stock?

4. What danger is there in taking too long a cut in rounding off the corners?

5. When the work is cylindrical and a little larger than needed, what readjustment is needed on the lathe?

6. How are calipers and the parting tool used to reduce the cylinder nearer to correct diameter?

7. (a) Using the scraping method, how is the cylinder smoothed?
   (b) How is the chisel held and the lathe run?

8. How is the cylinder cut to length?

9. Using the cutting method to smooth the cylinder, what tool is used and how is it held?

10. What is an easy way to smooth a long straight or tapered cylinder? How is the lathe run?

Job 72

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Make a Shoulder Cut		PWH pp 352-354, 335-339	

1. Given a cylinder in the lathe, how are the cuts shown in Fig. 32, PWH, laid off?

2. Using the scraping method, how are initial cuts made?

3. How is waste between the initial cuts removed?

4. Using the cutting method, how are shoulder cuts made?

5. With what tools is waste removed using the cutting method?

6. (a) What is the original length of the cylinder (Fig 31)?
   (b) What is the finished length?

7. What are the maximum and minimum diameters (Fig. 31)?

8. (a) What was the most primitive lathe? (Fig. 1, p 335)
   (b) What was the next step in the development of the lathe? (Fig. 2 p 336)

9. Why was the worker with the bow lathe or the pole lathe able to cut only half the time?

10. Until about what time was the treadle lathe used?

11. How many workers were required to operate the great wheel lathe?
    How large was the great wheel?

Job 73

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Make a Taper Cut		PWH pp 350-355	

1. What is the rough length and finished length of the stock. Fig. 34

2. How is the cylinder marked for the initial cuts? Fig. 32

3. Using the scraping method, how are initial cuts made?

4. What tool is used to turn the ends to finished dimensions?

5 (a) With what tool are the tapers roughed out?
  (b) Smoothed?

6. How can flatness of tapers be tested?

7. (a) Using the cutting method, with what tool is the work rough cut?
  (b) Smoothed?

8. Using the scraping method:
  (a) How are ends squared
  (b) How is the stock cut to length?

9. Using the cutting method:
  (a) How are ends squared?
  (b) How is the stock cut to length?

10. See Fig. 34
  (a) What is the diameter of the finished ends?
  (b) What is the straight length of the taper?

Job 74

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Make a Concave Cut		PWH pp 355-357	

1. What length and diameter cylinder is required for work shown in Fig. 35, PWH?

2. In laying out for the work (Fig. 35, PWH), how many lines are drawn around the cylinder for each concave cut? For the whole job?

3. How are lay off lines marked on the cylinder?

4. Using the scraping method; how are the first cuts made, and how is the cut measured?

5. What tool is used for making the concave cuts?

6. How is the chisel held (Fig. 36) and the cuts begun?

7. (a) What shape must the finished cuts be?
   (b) How are they tested?

8. (a) Using the cutting method, with what tool are the cuts made?
   (b) How is the gouge used?

9. How are the cuts made?

10. How is the curvature tested?

Job 75

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Make a Convex Cut		PWH pp 357-359	

1. (a) What is the length and the diameter of the cylinder specified? (Fig. 39 A)
   (b) What is the finished length and the finished diameter of the work? (Fig. 39 B)

2. Using the scraping method, cylinder A:
   (a) What tools are V cuts made with?
   (b) What tools are used to round corners?

3. Cylinder B (Fig. 39):
   (a) The first cut is made with what tool?
   (b) The corners are rounded with what tools?

4. (a) What special tools may be had for cutting beads?
   (b) What size beads will they cut?

5. Are beading tools scraping or cutting chisels?

6. Using the cutting method A:
   (a) With what tool are V cuts made?
   (b) What tool is used to round corners, and how is it used?

7. In cutting the openings between the beads on cylinder B:
   (a) What tool is used?
   (b) How deep are the cuts?

8. Cylinder B:
   (a) How wide are the end beads on the end?
   (b) How wide are the beads in the center?
   (c) How wide are the cuts between the beads?

Job 76

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Turn Legs with Square Parts		PWH pp 359-360	

1. Beginners have what difficulty in turning legs that have square or rectangular parts?

2. The stock can be cut to exact length before being placed in the lathe. Why?

3. Why is it better to plane the legs to finish dimensions before turning?

4. Why is it better to place the legs side by side and lay out the rectangular parts?

5. (a) Why is it necessary to center each leg very carefully in the lathe?
   (b) How is centering checked before beginning the cutting?

6. Using the scraping method:
   (a) How are the first two cuts made?
   (b) How is room made for rounding the parts with a gouge?
   (c) Why leave a narrow flat piece on each side?

7. Using the cutting method:
   (a) What tool is used to nick the edges as the first cut?
   (b) What tool is used to round the edges?
   (c) What tool is used to square the ends of the squared parts?

Job 77

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Turn Duplicate Parts		PWH pp 360-361, 344-345	

1. Why is turning duplicate parts one of the most difficult things for a beginner to do?

2. What is the first thing to do on this job?

3. How is the stock prepared?

4. How is the measuring stick used to transfer the design to the stock?

5. (a) How are calipers set for the first diameter?
   (b) How are the calipers used at each setting?
   (c) After largest diameters are cut, what procedure is followed?

6. After all diameters are cut, what is the next step?

7. (a) How can the greatest accuracy be obtained in turning the cylinder to shape?
   (b) Is it easier to use a template solid or cut into smaller parts?

8. What are safety rules 1 and 3 ?

Job 78

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Do split turning		PWH pp 362-363	

1. What are split turnings?
2. When did this method of decoration originate?
3. How is split work turned?
4. What is the manner of preparing the stock?
5. How can the members be extra securely fastened together?
6. From what point is the design laid out and with what allowance for waste?
7. How are the ends cut off?
8. Suggest an easy way in which the turned pieces can be separated?
9. How are quarter turnings prepared for turning?
10. What is the best way to prepare a three-quarter stock for turning?

Job 79

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Fasten Stock to a Faceplate or Screw Chuck		PWH pp 363-364, 344-345	

1. In faceplate work the stock is entirely supported on what?
2. What is of the greatest importance in mounting stock in the lathe?
3. How is stock prepared?
4. How can the faceplate be accurately centered on the stock?
5. If the wood is hard, how can screws be safely inserted?
6. If screws twist off, what must be done in most cases?
7. (a) Why is it best to turn the faceplate slowly to the spindle?
   (b) What safety precaution applies here?
8. Why is sandpaper used on screw chucks?
9. What is required of wood to be fastened to a faceplate or screw chuck?
10. What are safety rules 5 and 6?

Job 80

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Turn a Disk		PWH pp 363-367	

1. When stock is screwed to the faceplate, about what size screws are recommended?

2. (a) At what height should the T rest be set?
   (b) How near the stock?

3. At what speed is the lathe started? Why?

4. (a) What operation is first in cutting the disk?
   (b) Is the cut made through the entire thickness of the disk?
   (c) Why?

5. How is "facing off" done?

6. How is the diameter of the disk marked?

7. How is the thin piece of material left on the rear edge removed?

8. What tool is used, instead of the square-nose chisel, in cutting convex and concave shapes?

9. How can a hole to fit a turned tenon be cut on the lathe?

Job 81

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Do Chuck Turning (Outside Chucking)		PWH pp 367-369	

1. What is a chuck?

2. (a) Where does the woodturner secure chucks?
   (b) When are chucks required?

3. To make the base for the lamp illustrated in Fig. 55, when the stock is reduced to the thickness and diameter required,
   (a) What is the overall thickness and diameter of the cylinder A, Fig. 55?
   (b) 1. Why is the 1/16 inch deep recess cut?
       2. How near the edge does the recess extend? (With your pencil change the 4 inches to 3 inches on Fig. 55)

4. What kind of wood and what dimensions are specified for the chuck?

5. (a) How deep a recess is cut in the chuck?
   (b) What can be done if the recess is a trifle large?
   (c) How much is the base driven into the chuck?

6. Is there danger of the base coming loose from the chuck?

7. Is the hole for the wire bored in the base before or after chucking?

8. How is the hole made to fit the tenon for the upright part of the lamp?

9. Why is the above process called outside chucking?

10. What would be the most economical standard stock size lumber from which to cut a 1-1/2" thick by 6" diameter chuck?

Job 82

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Do Chuck Turning 1 Plug Chucking 2 Inside Chucking 3 Gluing to Waste Stock		PWH pp 368-369	

1. Plug chucking means what?

2. How are the two members of a plug chuck made?

3. How can the box (Fig. 57) be turned on the end of the cylinder?

4. (a) How is the recess in the bottom of the cup cut?
    (b) What is this procedure called and why?

5. How is the lid turned?

6. (a) What is the length of the cylinder, not counting the tenon, at the beginning of the operation?
    (b) What is the outside diameter of the box?
    (c) Estimate the height of the box without lid?

7. (a) When turning objects which cannot be screwed to a faceplate or screw chuck without marring a finished surface, how can the objects be turned?
    (b) What is this called?
    (c) How is it done?

8. When the turning has been completed, on an object that is "glued to waste stock", how may the object be removed from the waste stock?

Job 83

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Use a Spindle Sander in a Lathe		PWH pp 370, 115, 345	

1. If a sanding machine is not available, what can be substitued to sand concave surfaces?

2. (a) What allowance is made in turning a spindle to be used in sanding?
   (b) Why?

3. How is sandpaper measured for the cylinder?

4. How is sandpaper fastened to the cylinder?

5. What other methods of fastening sandpaper to the cylinder are described in the paragraph on p 115 and shown in Fig. 119 and 120?

6. (a) What preliminaries preceed the actual sanding?
   (b) What safety rule (Art. 256) is observed in removing the tool rest?

7. How are curves sanded and why move stock rapidly back and forth?

8. (a) How is work steadied when sanding endwood of a leg to be doweled to a turned column?
   (b) Why must the work be moved from side to side?
   (c) Why must the work be held steady and perfectly flat while sanding?

Job 84

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Use a Disk Sander in a Lathe		PWH pp 370-371, 344-345	

1. (a) What surfaces are sanded on a disk sander?
   (b) Why is the disk sander not recommended for flat surfaces?

2. (a) In cutting the disk for a disk sander, what dimensions are recommended?
   (b) What kind of wood is preferred?

3. How is the faceplate centered on the disk so as to prevent vibration?

4. If the disk is larger than a sheet of sandpaper, how is the sandpaper glued on?

5. How is the glued sanpaper held in place until dry?

6. (a) What should take the place of the tool rest when the sanding wheel is used?
   (b) How thick should it be?

7. (a) What is suggested as a safe speed for the lathe with different diameter stock (Art. 256 Step 4)?
   (b) The power should not be turned on the lathe while the faceplate is only part way on the spindle of the lathe. Why?

8. What would be the maximum diameter disk sander that could be used on a lathe with a 10" swing?

Job 85

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Finish and Polish Turned Work in the Lathe		PWH pp 371-373	

1. Which is easier, to finish and polish work in a lathe or to polish flat surfaces of a piece of furniture?

2. What is required of the surface of wood if a good polish is to be built up?

3. (a) Begin sanding with what size sandpaper?
   (b) Will rings on the unfinished work show through the polish?

4. (a) How are beads sanded?
   (b) After sanding with No. 1/2 sandpaper, what size, or grade sandpaper is used?

5. Between sanding with No. 2 and No. 3 sandpaper, what is suggested as a good plan of treating the work?

6. (a) What is the first finish material applied to the wood, and how long should it dry?
   (b) How is excess stain removed?

7. How is the stained surface treated?

8. How is the shellacked surface treated?

9. How is the lathe run and the rag used?

10. If shellac should pile up forming rings or ridges, how may it be smoothed?

Job 86

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
General Suggestions for Surface Decoration	Inf.	PWH pp 376-377	

1. What are the most common ways of enriching or decorating a wood surface?

2. What mistakes in decoration are beginners apt to make?

3. In general, what may be said of the kind, type, or amount of surface decoration?

4. Where may the beginner find guidance in decoration?

5. For furniture of soft or inexpensive wood, as chairs, tables, kitchen cabinets:
   (a) What decoration is appropriate?
   (b) What decoration should not be employed?

6. Where is inlaying, veneering, carving, and reeding best employed?

7. Inlaying should be done on what woods?

8. (a) What is the purpose of veneers?
   (b) Why are insets rarely used with matched veneers?

9. (a) Should carving and inlaying be on the same piece of furniture?
   (b) When is spiral reeding and straight reeding appropriate on the same turned piece?

10. When using moldings, is it better that they be made too small or too large (in case there is an error)?

Job 87

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Inlay Lines and Bands		PWH pp 377-381	

1. What is inlaying?

2. How is material for inlay made commercially?

3. (a) Where are lines or bands generally used?
   (b) Where are insets used?

4. How is the beautiful shading accomplished on insets?

5. How is a tool made for cutting grooves for inlay?

6. How should the inlay fit into the groove?

7. When the inlay lines have been cut to length and mitered, how are they put into place?

8. After inlay lines are glued in, how is the work treated?

9. What machine can be used to cut grooves for line inlay?

Job 88

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Inlay Insets		PWH pp 381-382	

1. (a) Insets sold by manufacturers of marquetry are of what thickness?
   (b) How are edges of the insets protected?

2. How is veneer removed from the inset?

3. (a) How is the inset placed on the surface to mark its position?
   (b) If the inset is elliptical, for example, and the inlay is to be in the center of a tray or table, how is the position marked?
   (c) If the inset is not symmetrical, how can it be accurately located on the tray or table?

4. (a) If the inset is diamond shape, what tool may be used to cut the outline?
   (b) If the inset is circular or elliptical, what tool may be used?

5. How is wood within the outline removed?

6. (a) Which side of the inset is glued down?
   (b) How is the inset held in place while drying?

7. Why not glue an inset in place with the papered side down?

Job 89

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Cut Straight Reeds		PWH pp 383-386	

1. (a) What is a reed as applied to a turned column?
   (b) What name is applied to it in architecture?

2. (a) Is a reed difficult to carve by hand?
   (b) Is the time and patience needed for its execution worth while?

3. (a) What is the first step in the process of reeding?
   (b) What size is a box for reeding made?

4. How is the piece to be reeded fastened in the box?

5. How is the column laid off with the desired number of reeds?

6. (a) How is the column marked for reeding?
   (b) If there is much difference in the diameters of the parts to be reeded, what may be necessary?

7. What tool cut is made first and what tool can be used?

8. When the V cuts are completed on the column, what are the finishing steps?

9. (a) What machine may be used to cut reeds and flutes?
   (b) How is stock in the lathe held to position when fluting with the machine?

Job 90

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Cut Spiral Reed		PWH pp 386-387	

1. How are the extremities of the spiral located?

2. What determines the pitch of the spiral?

3. How are lines drawn from one extremity of the spiral to the other in laying out the spirals?

4. How are the spirals cut and smoothed?

5. (a) Is it easier to shape spiral reeds, or straight reeds?
   (b) Why?

Job 91

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Carve a Single Sprial on a Turned Cylinder		PWH pp 387-390	

1. (a) When the cylinder is turned to the right diameter, what is first to determine?
   (b) What is the customary length of each turn?

2. What are the first layout lines?

3. Each major part is divided into how many parts? (Fig. 16 A)

4. How are longitudinal lines marked and drawn?

5. How are spiral guide lines drawn?

6. How are spiral lines begun and ended? Why?

7. With what tool, and how, is the first cutting operation made? (Fig. 17)

8. How is the spiral shaped from the saw cut? (Fig. 18)

9. (a) What is the cylindrical diameter of A, Fig. 16?
   (b) What is the length of each turn of the spiral at A, Fig. 16?

Job 92

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Carve a Double Spiral on a Turned Cylinder		PWH pp 387-391	

1. When a double spiral is to be carved, what change is made in the procedure for a single spiral, Art. 281, Step 1-4?

2. (a) How much does a spiral rise in one round of the cylinder, Fig. 16, A?
   (b) How much is one round in Fig. 16, B?

3. The second spiral is laid out like the first but begins where?

4. (a) How many rounds of the cylinder does a spiral make at A, Fig. 16?
   (b) How many rounds of the cylinder does each spiral make at B, Fig. 16?

5. How may the hollow double spiral at the right Fig. 21, be laid out?

6. Sawing on hollow spirals should be done where in relation to the spiral lines?

7. What should be remembered about shaping the ends of spirals?

8. What tools are used to work out hollows in hollow spirals?

Job 93

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Lay Out Tapered Spirals		PWH pp 391, 388	

1. How are four equally spaced lines drawn the length of a tapered cylinder? (Art. 281, Step 4)

2. How are major divisions laid out on the cylinder?

3. How are the small division lines spaced (Fig. 16)?

4. (a) What are the larger and smaller diameters of the tapered cylinder in Fig. 16, C?
   (b) How wide apart are the smaller division lines at:
      1. Larger end?
      2. Smaller end?

5. The major divisions of the cylinder are divided into what number of parts?

6. Is the taper cylinder C, Fig. 16, laid off for a single or a double spiral?

7. (a) Spiral turning is of what origin?
   (b) When was spiral turning introduced in Europe, and by whom?

Job 94

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Cut Beads, Chamfers, and Hollows		PWH pp 391-393	

1. What good reason is there for wood carving?

2. (a) What is the easiest way for the beginner to learn the art of wood carving?
   (b) Why is this the easiest way?

3. Is simple wood carving difficult or comparatively easy?

4. (a) In selecting a carved ornament for a piece of cabinet-making, the student should consult what?
   (b) Why?

5. Beginners in carving need few tools. Suggest tools they may need.

6. What is a scratch stock?

7. How may stopped chamfers be cut with hand tools?

8. How may stopped chamfers be cut with machine?

9. (a) What are hollows?
   (b) What determines the width of the hollow?

10. Can chamfers and hollows be made with a scratch stock?

Job 95

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Carve Borders		PWH pp 392-396	

1. What tool is used in making the carvings shown in Fig. 28 at a, b, c, and d?

2. (a) How is the border at a (Fig. 28) cut with the gouge?
   (b) What further embellishment is given this border and with what tool?

3. (a) Border b is a variation of a (Fig. 28) in only what way?
   (b) How are each two adjoining bands cut in b?

4. (a) Are borders c and d (Fig. 28) cut in the same manner as b?
   (b) What difference is there in the cutting?

5. How is the strapwork shown at b, Fig 29, carved?

6. (a) What practice is common in strapwork (Fig. 30)?
   (b) What is the usual procedure in cutting the outline of the bands?
   (c) What machine is a very useful tool for cutting away the background?

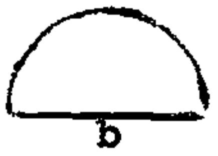
7. How is it recommended that the acanthus leaves illustrated in Fig. 31, be carved?

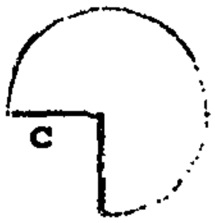
Job 96

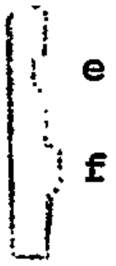
TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Make Moldings		PWH pp 396-398	

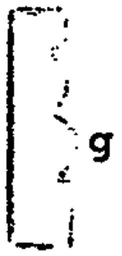
1. (a) What justifies the extra work of putting molding on cabinetwork and interior woodwork?
   (b) What is there about molding that attracts the eye?
   (c) Molding is used to accentuate certain parts of a piece of furniture such as what parts?

2. Identify the types of molding a to g.









3. What kind of moldings are "cyma" moldings (Fig. 32)?

4. With what tools and machines can moldings be cut?

5. When moldings are worked out roughly on a circular saw, Fig. 33, how is the molding laid out?

6. (a) What is the difference in the cutting of flat and curved surfaces of the molding on the circular saw Fig. 33?
   (b) How are the curved surfaces of the molding shaped?

7. (a) Final smoothing is done with what?
   (b) How long should these pieces of wood be?

Job 97

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Shape the Edges of Table Tops		PWH pp 398-399	

1. Why are tops of cabinets or tables shaped or molded?

2. (a) How deep and wide is the rabbet cut (Fig. 34) in D in preparing to shape the table edge as at A, B. and C?
   (b) How may the rabbet cut be made?

3. (a) How is the edge shaped?
   (b) Why is a piece of thin stock clamped on the edge of the rabbet?

4. How can a round top be rabbeted on the circular saw?

5. (a) If the table top has straight sides and ends, how are the edges, as A and B. Fig. 36, rounded?
   (b) If the table is circular, how is the edge rounded?

6. (a) How is the rabbeted edge smoothed?
   (b) How is the rounded edge smoothed?

7. How is the beaded edge made, as D, Fig. 36?

Job 98

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Do Simple Veneering		PWH pp 399-401	

1. (a) What does it mean to veneer a surface?
   (b) Why is this done?

2. (a) How much is strength of wood affected by being built up of several layers glued together at right angles to each other, as compared to when it is in one solid piece?
   (b) What is said of plywood with several laminations put together with modern water-proof glue?

3. What names are applied to the plies of a five ply board?

4. What is veneer, its thickness, and how obtained?

5. Why could highly figured woods not be used if cut into solid boards?

6. (a) How should the core for a table top be glued?
   (b) What are "cross-bands" and how are they glued to the core (Fig. 37)?

7. Why is plain grain used for "back veneer" on the table top and better grade of veneer used for "face veneer"?

Job 99

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Make Diamond Match		PWH pp 401-405	

1. To make the diamond match, what kind of veneer is selected and how is it cut?

2. How may veneer be cut at an angle of 45 degrees?

3. (a) Place the piece of veneer, cut as in above question on the table how?
   (b) How is the second piece cut (Fig. 41)?

4. How is the veneer held while sawed edges are planed to fit together perfectly?

5. (a) How are veneer pins or brads driven and why?
   (b) Why is tape applied to the jointed edges?

6. Why is tape applied on the face side only?

7. Why are lines squared over the edges of the table before gluing the veneer on it?

8. How is the work glued up?

9. If the edges of the table top are to be veneered, how may this be done?

Job 100

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Decorate by Overlays, Frets, or veining		PWH pp 405-407	

1. Why are overlays, frets , or veining used as decoration?

2. (a) What are overlays?
   (b) They should be made of what?
   (c) How are they generally stained?

3. (a) What are frets and where are they used?
   (b) How are they often stained?
   (c) Why should glue be applied very sparingly to the back of the fret?

4. (a) What are grills?
   (b) How are they made?
   (c) Are grills made of other material than plywood?

5. (a) Why is veining used (Fig. 50)?
   (b) What is "two toning"?

Job 101

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
History of Upholstery		PWH pp 410-417	

1. The art of upholstery dates back how far?

2. (a) When did upholstery reach a high degree of development in France?
   (b) In the same period, what was used instead of upholstery in England?

3. (a) What act of the French government was a great factor in development of upholstery in England?
   (b) Why did this so greatly affect England?

4. What trades are closely related to cabinetmaking and in some measure dependent upon it?

5. (a) What is tow made from?
   (b) What is muslin?
   (c) What is wadding or cotton felt?

6. (a) Of what does imitation or artificial leather consist?
   (b) For what purposes is it used, other than upholstery?

7. (a) What is moss and where is it abundant?
   (b) How is it processed for use?

8. (a) Hair used in the upholstery trade comes from what animals?
   (b) Most of it comes from what states or countries?

Job 102

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Make a Plain Pad Seat		PWH pp 417-419	

1. What is a pad seat (Fig. 16)?

2. (a) If a pad is to cover the entire board except for a 1 inch margin along the edge, how is work laid out?
   (b) What is the next step?
   (c) How is the stuffing held in place?
   (d) What is done with the second half of the stuffing?

3. (a) What goes over the stuffing and how is it fastened?
   (b) How is the tacking done?

4. (a) What goes between the muslin and the covering?
   (b) What procedure is used in tacking the covering?

5. (a) What finishing touch is now given the seat?
   (b) How far apart are tacks spaced?

6. How is gimp mitered in the corners?

7. What is gimp?

Job 103

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Make a Pad Seat with a Roll Edge		PWH pp 419-422	

1. (a) What is the difference between the pad seat with roll edge and the plain pad seat?
   (b) Why is the roll put on the edge?

2. (a) How is the roll formed (Fig. 18)?
   (b) How does cutting the burlap straight help?

3. (a) What is burlap, where is it obtained?
   (b) Name some uses for burlap.
   (c) In what size piece is burlap generally made?

4. The roll formed, what process in next?

5. What is used between the muslin and the covering material?

6. How should the corners be folded or pleated on the footstool, (Fig. 19)?

7. How may the effect of a rolled edge be produced with molding, (Fig 20)?

Job 104

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Upholster a Slip Seat		PWH pp 422-426	

1. (a) How does a slip seat fit?
   (b) How is it supported when in place?

2. (a) The frame is made of what size material?
   (b) What kind of joint is preferred for joining these pieces? Why?

3. In joining the frame, how much allowance is made for thickness of upholstery material?

4. After being glued, how is the frame prepared for the webbing?

5. (a) How many strips of webbing are used on a chair-seat frame?
   (b) How is webbing put on the frame?

6. (a) Why are pieces of webbing crossing each other interlaced?
   (b) From what is webbing made, how wide and long?

7. How is burlap placed over the webbing?

8. (a) How thick a layer of tow is applied between the two layers of burlap (Fig. 23)?
   (b) How is the top layer of burlap cut and tacked?

9. (a) How is the stuffing sewed (Fig. 24)?
   (b) How are the stitches made?

10. (a) What may be used instead of webbing?
    (b) How then, can the seat be sewed?

11. (a) How is the edge of the seat formed?
    (b) How is the burlap folded for tacking?

12. (a) In what manner is the edge of the seat sewed?
    (b) Why use a curved needle?

Continued.....

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Upholster a Slip Seat		PWH pp 422-426	

13. (a) What is next spread over the seat (Fig. 28)?
    (b) What covers the moss or hair and how may it be temporarily fastened?

14. (a) If the seat is to be covered with thin material, what is done to prevent the hair from sticking through the covering fabric?
    (b) How is the covering tacked?

15. Why is a piece of black cambric tacked to the underside of the frame?

Job 105

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Weave a Fiber Seat		PWH pp 426-429	

1. For how long have woven seats for chairs, stools, and settees been popular in this country?

2. (a) What did New Englanders use for weaving "rush seats" or "flag seats"?
   (b) How was it used?

3. What particular skill was required in the weaving of rush seats?

4. (a) Why is "art fiber" a good material for seat weaving?
   (b) What diameter fiber is suitable for weaving a fiber seat?

5. (a) How much should the legs extend above the rails?
   (b) In case of a slip seat, what should be done (Fig. 30,32)?

6. The rails should set back what distance from the corners of the posts (Fig. 31)?

7. Tell how the first complete round of weaving a fiber seat is made on a square seat (Fig. 31)?

8. (a) How tightly are the strands of fiber pulled?
   (b) How is a new length of fiber joined to the old?

9. What can be done to make the seat more solid?

10. (a) When the seat is wider at the front than at the rear how is extra width filled?
    (b) How much width must be filled on the front to make it the width of the rear?

11. What is recommended for waterproofing the seat?

Job 106

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Weave a Cane Seat		PWH pp 429-431	

1. What is cane made from and where does it grow?

2. (a) How is cane graded?
   (b) What are the grades?

3. How are holes for a cane seat laid out on the frame?

4. In Fig. 33, there are four holes more in the front rail than in the rear rail. How is this difficulty overcome in weaving the seat?

5. (a) When a strand is used up, how is the end fastened?
   (b) The end of the new strand?

6. (a) In what direction are the first strands run?
   (b) The second?
   (c) The third?

7. How is the fourth strand installed (Fig. 34)?

8. What is required, after putting in four strands, to complete the weaving (Fig. 35)?

9. What finish is usually put on the woven seat?

Job 107

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Apply Cane Webbing		PWH pp 431-432	

1. To what is the name "cane webbing" applied?
2. In what widths is cane webbing manufactured and how is it sold?
3. How does cane webbing compare with hand weaving in ease of application?
4. (a) In Fig. 36, how deep and how wide is the groove in the chair seat?
    (b) How far away from the inner edge of the rails is the groove?
    (c) How can the grooves be cut?
5. How large are the cane sheets cut and why this size?
6. How long should the cane soak in water before being applied?
7. (a) What size is the board prepared for placing over the cane?
    (b) How is the board applied on the seat (Fig. 36)?
8. (a) How is the cane driven into the grooves?
    (b) What is the next step?
    (c) Why are splines driven just halfway?
9. Beside making the cane pliable, what good is derived from soaking the cane?

Job 108

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Prepare the Surface for Finishing		PWH pp 450-452, 435-447	

1. (a) What is wood finishing?
   (b) It was formerly a part of the cabinetmaker's trade, why is it not now?

2. (a) What are the two types of finishes?
   (b) What are the three divisions of transparent finish?

3. Why are finishes applied to furniture, cabinets, homes, barns, roofs, etc?

4. Why is it of utmost importance to give a piece of work a thorough inspection when all the toolwork has been completed?

5. (a) See that every trace of glue is removed from around the joints. Why?
   (b) How can spots of glue be removed?

6. (a) Inspect the surfaces thoroughly for any dent or bruise. How may a dent in the wood often be removed?
   (b) A quicker way of taking out dents is to use steam. How is this done?

7. Look for any marks left by the cabinet scraper or any scratche caused by sanding across the grain. Why?

8. See that there are no spots of oil or grease on the surface. How should such spots be removed?

9. How should holes, cracks or other defects be treated?

10. (a) What grade of sandpaper is used for final sanding?
    (b) What is the coarsest and finest sandpaper?

11. Imperfections in the surface are not covered by the finish. What happens?

Job 109

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Stains	Inf.	PWH pp 453-454	

1. (a) What is the purpose of staining?
   (b) Oftentimes certain species of wood are stained for what purpose?

2. (a) How are stains classified?
   (b) Name three common classifications.

3. Water Stains:
   (a) Are made how?
   (b) Have what advantages?
   (c) Have what disadvantage?
   (d) Should be applied how?

4. Spirit stains:
   (a) Are made how?
   (b) Have what advantage?
   (c) Have what disadvantages?

5. Oil stains:
   (a) Are made how?
   (b) Have what advantages?
   (c) Have what disadvantages?

6. Why are acid stains or stains due to chemical action very seldom used commercially at the present time?

7. (a) What is turpentine?
   (b) Asphalt?
   (c) Naptha?

Job 110

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Apply Stains		PWH p 454	

1. In applying stain, what kind of brush is used and how is it used?

2. Why stain all inside surfaces before staining outside surfaces?

3. Stain all removable parts, as drawers or doors, separately. Why?

4. How are laps prevented?

5. When it is not practical to brush the entire length of a surface, how is brushing done to prevent laps?

6. Why should regular stain be applied to sapwood parts and allowed to dry before the general staining?

7. (a) How may endwood be prevented from getting too dark?
   (b) Why does staining endwood while it is wet lighten the color?

8. What is done to the stained surface after it is thoroughly dry?

9. (a) If waste or rags used in wiping oil stain, or other oily surfaces, are piled in a pan and left over night, what may happen?
   (b) How is the danger of fire avoided?

Job 111

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Apply Wood Filler		PWH pp 454-457	

1. Why is wood filler used?

2. (a) Of what does wood filler consist?
   (b) What is silex?
   (c) What is japan?
   (d) What is the natural color of filler?

3. What thins wood filler?

4. Is filler applied before or after stain?

5. (a) How is filler mixed on the job for using?
   (b) How does the grain of the wood influence the consistency of the filler?

6. How is filler applied to the wood?

7. (a) How is it known when to begin wiping off the filler?
   (b) How is the wiping done?

8. What position is urged for surfaces when being filled? Why?

9. (a) How many coats of filler are usually required and how long is allowed for drying?
   (b) How are close-grained woods, such as maple or birch, treated?

10. What is the "wash coat"?

Job 112

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Apply Shellac		PWH pp 457-461	

1. (a) How is shellac produced?
   (b) How long do lac bugs remain on a twig?

2. (a) What dissolves shellac?
   (b) What is meant by a label on a can of shellac which reads: "4 lb. cut shellac"?
   (c) What is the natural color of shellac?

3. How is the first coat of shellac prepared?

4. (a) Why is shellac difficult to brush on evenly?
   (b) Where does the brushing start on a piece of furniture?
   (c) How are runs picked up?
   (d) How are brush strokes always made?

5. (a) How long is allowed for drying of a coat of shellac, and with what is it rubbed?
   (b) Why is steel wool preferable?

6. How is shellac finish applied?

7. A common mistake is to use shellac too thick and to keep brushing it over the work several times. What is the result?

Information: Shellac dries quickly and, therefore, does not require as much of a dust free room as some finishes, as varnish, yet shellac is easily applied and is durable and beautiful when kept dry.

Job 113

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Apply Wax		PWH pp 461-462	

1. (a) Of what substance is wax chiefly composed?
   (b) What is the best and hardest kind of wax, and where is it produced?

2. In what form are most waxes manufactured?

3. (a) Before a surface is ready for waxing, what must be done?
   (b) What is the result if the surface is not filled and given a sealing coat?

4. (a) How is wax applied, either paste or liquid?
   (b) What is likely to happen if you put too much on at a time

5. (a) How long a time is allowed for the wax to dry before polishing?
   (b) How is the polishing done?

6. How long an interval is allowed before applying a second coat?

7. (a) Is a wax finish easy to apply?
   (b) Is it durable?
   (c) How does a liquid spilled on a waxed surface affect the finish?
   (d) In most cases, how can dull spots be removed?

Job 114

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Apply Linseed Oil		PWH pp 462-463	

1. (a) How is linseed oil produced?
   (b) Which dries faster, raw or boiled linseed oil?
   (c) Which, raw or boiled oil, is used principally on inside work?

2. (a) When putting an oil finish on a piece of furniture, what is applied over the filler?
   (b) How long is allowed for filler to dry for best results?
   (c) Is the linseed oil applied a little at a time, like wax, or plentifully?

3. (a) How much and with what is the oiled surface rubbed?
   (b) Why must the surface be wiped dry?

4. (a) How many coats of oil are necessary?
   (b) How long is allowed between coats?

5. What are some characteristics of a linseed oil finish?

6. There is a fire hazard in oil finishing. What is it?

Job 115

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Apply Lacquer		PWH pp 463-471	

1. (a) Name some chemicals of which lacquer is composed.
   (b) What are some good characteristics of lacquer?
   (c) Why is it that lacquer cannot be used over oil stain, varnish, or paint without using a sealing coat?

2. (a) How is the best way to apply lacquer?
   (b) Can it be applied by hand?

3. (a) When should lacquer be thinned, when being applied by hand?
   (b) What is used as thinner for lacquer?

4. Give some points for brushing on lacquer.

5. (a) Is it necessary to sand between coats of lacquer?
   (b) How many coats are applied?
   (c) How long is allowed for the last coat to dry?

6. (a) What is used for rubbing down a lacquered surface?
   (b) When gloss is removed, with what is the rubbing continued?
   (c) When only should rubbing oil be used?

Caution: Be careful of fire when using lacquer, especially if sprayed. Lacquer dust is very inflammable.

Job 116

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Apply Varnish		PWH pp 471-472	

1. (a) Of what does varnish consist?
   (b) What are copal gums? Where are they found?

2. What are qualities of a good rubbing varnish suitable for cabinetwork?

3. (a) What are some advantages of varnish as a finish?
   (b) Some disadvantages?

4. What steps are taken to avoid dust when applying varnish?

5. (a) At what temperature should varnishing be done?
   (b) How much is the varnish thinned? Why?
   (c) How can the varnish be made to flow more freely?

6. How are finish strokes made on a coat of varnish?

7. (a) How long is allowed between coats of varnish for drying?
   (b) Why is it necessary to sand in between coats?

8. (a) How is dust that would be produced by rubbing with ordinary sandpaper avoided?
   (b) Why are 2 hours allowed between rubbing a varnish coat and applying the next coat, if water is used in rubbing?

9. How can a varnish remover be made?

Job 117

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Prime Furniture and Interior Woodwork		PWH pp 472-474, 450	

1. Painting may be divided into the following operations: (name 5).

2. (a) In what condition must the surface of a piece of furniture be before finish of any kind is applied?
   (b) What is applied to softwood before the priming coat? Why?
   (c) What is applied to pitchy woods before the priming coat? Why?
   (d) What is applied to porous woods, such as oak, chestnut, and ash, before the priming coat?
   (e) Do hard, close-grain woods, such as birch or maple, need preparation beyond smoothing and sanding before applying the priming coat?

3. (a) What are the chief ingredients of inside paints?
   (b) What is generally added to a priming coat? Why?

4. (a) If it is desired to mix the primer from raw materials, what two ingredients are mixed first?
   (b) Upon what does the amount of each ingredient depend?
   (c) If the finish color is to be white, what then?

5. Zinc white and white lead are both metallic compounds derived respectively from zinc and lead. Why is zinc white recommended in preference to white lead?

6. (a) How long is the primer allowed to dry?
   (b) How much is the primer sanded?
   (c) What size sandpaper is used?

Job 118

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Fill and apply Finish Coats of Paint		PWH pp 452, 474-476	

1. After the priming coat is applied to a surface, how are imperfections affected?

2. (a) How are imperfections on the surface of furniture filled following the priming coat?
   (b) What good points does this type putty have?

3. What is whiting?

4. (a) How is the second coat of paint prepared?
   (b) The second coat is allowed to dry for how long before sanding?

5. (a) Is there any ocher used in the third undercoat of paint?
   (b) How long is the third coat allowed to dry before sanding and how is it sanded?

6. If it is desired to use ready mixed paints and undercoats, what results may be expected?

7. The finish coat generally consists of enamel.
   (a) What is enamel?
   (b) For what reason is paint used as undercoat for enamel?

8. (a) The first finish coat, or last undercoat, should consist of what and be allowed to dry how long?
   (b) How is the surface treated to receive the last coat?

9. Of what does the last coat consist and what restrictions should be observed in its application?

10. It is best to let the work stand how long before rubbing it down with pumice stone and water?

Job 119

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Lay Out the Miter Between a Straight and a Curved Molding		Inf. Sheet # 119A Draw. Prob. 8	

In building mantels for a twelve apartment building the specification called for a straight mold along the underside of the shelf and the innerside of the pilasters, meeting at the corner with a quarter circle of mold of the same cross section, the molding fitting flat against the ground. Radius of the inside curve of the corner molding is 6".

1. Could the straight molding be cut at a 45° angle and the curved molding fitted to this angle? If not, why not?
2. (a) Can a curved miter be easily determined for joining a curved molding to a straight molding as called for on this job? (Draw. Prob. 8 and Inf. Sheet # 119A.)
   (b) What materials will the workman need in laying out the miter on a drawing, such as Fig. 8 of the information sheet?
3. How can a short piece of molding be used to determine the several points of the profile as they occur respectively in the straight and the curved moldings?
4. In this case, where would the steel point of the compass be placed in drawing the profile lines of the curved molding? Why?
5. When profile lines of both moldings are drawn so that they intersect, how does this help to determine the miter angle?
6. How can the miter angle be transferred from the drawing to the molding?
7. Will it be necessary to lay off an additional miter line for the other end of the circular molding? Why?

Lay Out the Miter Between a Straight and a Curved Molding

Information Sheet No. 119A

When straight molding is intersected with a curved molding of the same size and contour, the miter is not a straight line. The miter line is found by projecting lines from the several points of both the straight and curved moldings so that the respective lines intersect, as shown in Draw. Prob. 8. In order to find the miter between the two moldings, draw a line through the points of intersection of the straight and curved lines, as Xby in Draw. Prob. 8. (ab and bc represent the projected line from the center of the straight and curved moldings.) A template of the curved miter Xby can be made of heavy paper or metal for marking the miter on the straight back of the actual molding.

Job 120

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Lay Out Decorations on a Panel		PWH p 21 Inf. Sheet #120A Draw. Prob. 9, 10, 11	

1. The shopman wanted to put a cherry molding around a panel. He had one piece of cherry lumber 2-5/8 inches wide from which to cut the four pieces of molding. Show by a drawing how he used a rule to divide 2-5/8 inches into four equal parts.

2. The panel was further decorated with an octagon 5 inches in diameter in its center and a 2 inch hexagon near each corner. draw a pattern for the octagon.

3. Draw a pattern for the hexagon.

4. The panel was further decorated with a plywood ring 1-1/2 inches wide fitted around the octagon with its inner edge 1 inch minimum away from the octagon.
   (a) What is the diameter of the hole in the ring?
   (b) What is the outside diameter of the ring?

5. What is the outside circumference of the ring?

6. Find the area of the ring.

7. The ring is cut from a 10 inch square of plywood. What is the area of the waste on the square corners?

8. The octagon can be cut from a 5 inch disk. The shopman cuts the 5 inch disk from the 7 inch disk cut from the ring. How much waste is there in this operation?

9. If 40.3096 square inches of the 10 inch square plywood is waste, what is the percentage of waste? (To one decimal place.)

Lay Out Decorations on a Panel Information Sheet #120A

Drawing Problem #9 - shows a way to divide a distance into a given number of parts. The ruler is simply skewed across the width until the number of equal divisions coincides with the width to be marked.

Drawing Problem #10 - shows the method for constructing a polygon on a given line. This polygon of six sides is called a hexagon, but this method can be used to lay out polygons of more sides or of less number of sides. Draw the line EF equal to the length of one side of the polygon to be constructed, and with EF as a radius and F as center draw a quadrant (one fourth of a circle). Divide the quadrant into six equal parts and draw from E through 2. From the midpoint of EF draw a perpendicular, and where this line, G2, intersects E2 will be the center of a circle containing the hexagon. (On other polygons the perpendicular will not cut E2 at the point 2.) Draw the circle and step off with dividers around the circle the length EF and join these points with straight lines.

Drawing Problem #11 - shows how to draw a hexagon in a circle. Draw the circle with diameter AB, and divide the diameter into six equal parts. With A and B as centers and AB as Radius, draw arcs which intersect at C. From C draw a line through point 2 meeting the circle at D. Draw line AD which is the length of one side of the hexagon. With dividers step off the length of AD around the circle and join these points.

This method can be used to draw a polygon of fewer sides or of more sides than a hexagon.

Job 121

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Lay Out Miter Angles		Draw. Prob. 1,2,6,7 Inf. Sheet 121A	

1. (a) Draw a right angle and bisect it.
   (b) This is the miter cut on a figure of how many sides? (Draw. Prob. 6)

2. (a) Draw a 60° angle. (Draw. Prob. 3)
   (b) Bisect the 60° angle.

3. (a) The 30° angle obtained by bisecting a 60° angle is the miter angle on a figure of how many sides? (Draw. Prob. 7)
   (b) What figures on a steel square can be used to obtain the same angle?

4. (a) What is the miter cut in degrees for a hexagon?
   (b) What figures on the square are used to lay out the miter cut for a hexagon?

5. (a) What is the size in degrees of the angle EOC, Draw. Prob. 7?
   (b) What is the number of the degrees in the other two angles of the triangle EOC?

6. The angle DOE, (45°), Draw. Prob. 7, is the miter cut angle for a square. What is the size of the other two angles?

7. (a) When lines are drawn from the points of a nine sided figure (a nonagon) to its center, the figure is divided into 9 triangles. What is each angle at the center?
   (b) What is each of the other angles?

8. (a) What is the miter cut for a decagon (10 sides)?
   (b) What is the miter cut for a figure of 12 sides?

9. To obtain miter cut for a figure of 16 sides use 12" and 2-13/32" on the square. What is the number of degrees for the miter cut?

10. Use 12" and 2-1/8" on a square to obtain miter cut for a figure of 18 sides. What is the miter cut in degrees?

Continued....

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Lay Out Miter Angles		Draw. Prob. 1, 2, 6, 7 Inf. Sheet 121A	

11. Use 12" and 1-19/32" on a square to obtain miter cut for a figure of 20 sides. What is the miter cut in degrees?

12. What tool is especially useful in transferring angles from the layout onto the work?

Lay Out Miter Angles Information Sheet No. 121A

A circle is a curved line, every part of which is equidistant from a point called the center. Around this point is an angle of 360°. Lines drawn from the center to the circle are radii and equal, and the opening between the lines at the center of the circle is the angle. A line drawn connecting the ends of the radii at the circumference of the circle forms a triangle with the radii. The sum of the three angles of a triangle is 180°. Therefore, if the angle at the center is known, the other angles may be found by subtracting the central angle from 180° and dividing the remainder by two. Thus, if the central angle is 65°, 180°- 65° = 115° sum of two angles. 115° ÷ 2 = 57-1/2° each angle.

An angle may be bisected (Draw. Prob. 1 and 2) with any convenient radius. Set one leg of the dividers at O and strike arcs at A and B on the lines OX and OY. With A and B as centers, draw arcs cutting at P. Draw PO, the bisector of the angle XOY.

A right angle may be trisected to obtain 30° angles as shown in Draw. Prob. 3. Angle XOZ is a right angle. With O as a center, draw a quadrant cutting at A and B. With A as center and AO as radius, draw the arc cutting at D. With B as center, and the same radius, draw an arc cutting at C. AOC, COD, and DOB are 30° angles.

Job 122

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Characteristics of Lumber	Inf.	PWH pp 505-566	

1. (a) Name three conifers, or naked seed, trees.
   (b) Name some broad-leaved, or two-seeded, trees.

2. (a) List five needs that man looks directly to plants for supply.
   (b) List four needs that are indirectly supplied by plants.

3. What is now being done to eliminate waste and conserve the supply of lumber?

4. Will wood float in water if thoroughly saturated with water? Why?

5. What power to reproduce themselves do most broad-leaved trees possess that all conifers, except redwood, lack?

6. What is the difference between plain-sawed and quarter-sawed lumber?

7. (a) What should be the moisture content for furniture material?
   (b) For outdoor material?

8. How long does it take to kiln dry 1 inch boards?

9. (a) In what three ways does wood shrink?
   (b) In what way does it shrink the least?
   (c) In what way does it shrink the most?
   (d) How does the difference in shrinkage affect boards sawed from the side of a green log?

10. A lumber dealer divides all species of wood into two general classes, ____________ and ____________.

Job 123

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Manufactured Lumber		PWH pp 566-586	

1. In general, where are softwoods, or conifers, used, and where are hardwoods, or broad-leaved trees, used?

2. Name a half-dozen types of manufactured lumber for the building and furniture trades.

3. Of what does plywood usually consist? (Reference to number of plies and direction of grain.)

4. (a) What are some uses of plywood in the better class furniture?
   (b) Why is plywood used?

5. What are desirable qualities of lumber for cabinetwork?

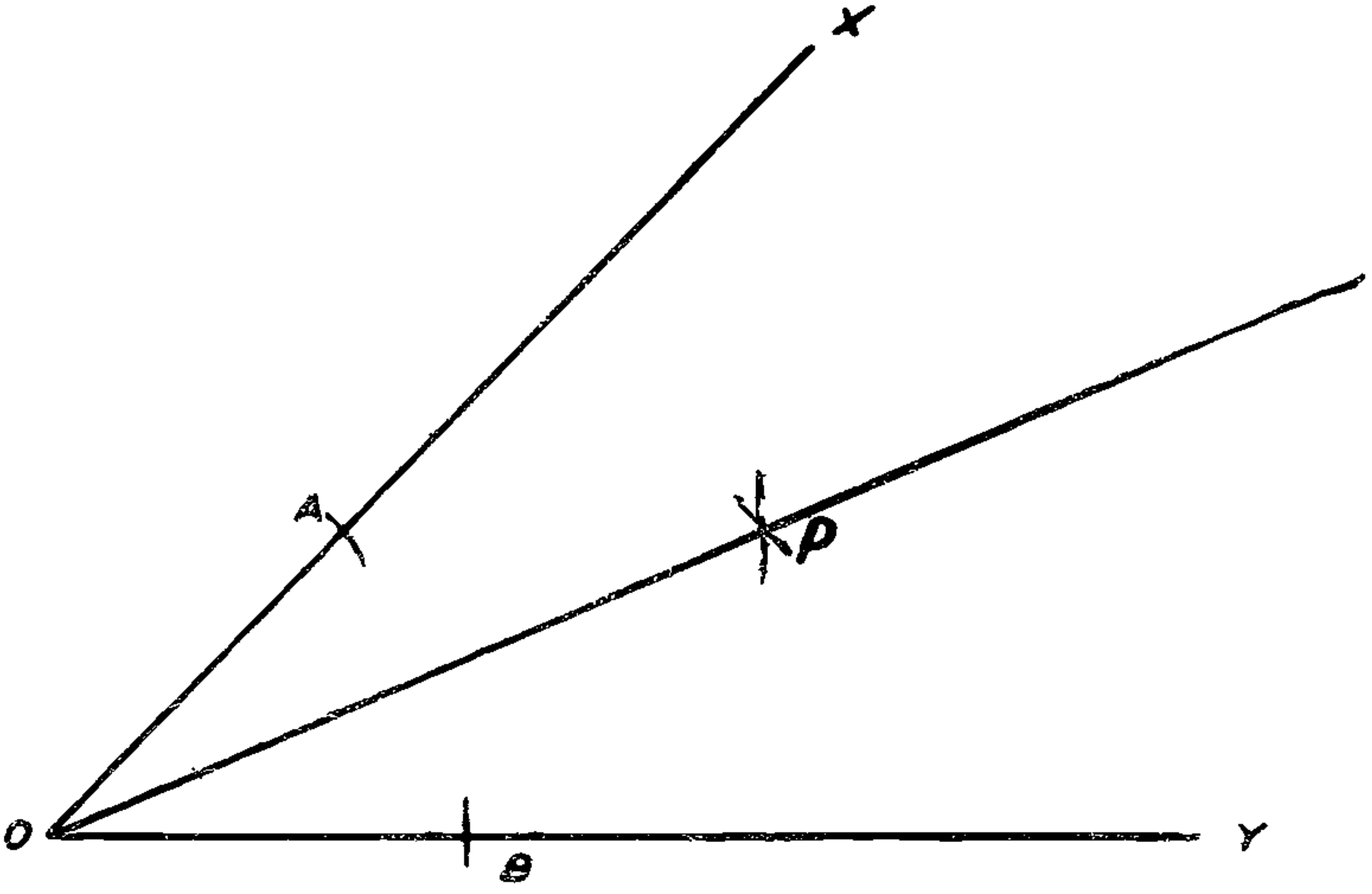
6. Which is more important, grain or color, in furniture construction?

7. Cabinet woods having beautiful grain are ____________________, ____________________, ____________________, ____________________.

8. (a) Woods that shrink and warp but little and are suitable for cabinetwork are ______________, ______________, __________.
   (b) Woods that warp considerably are ____________, ______________, and ______________.

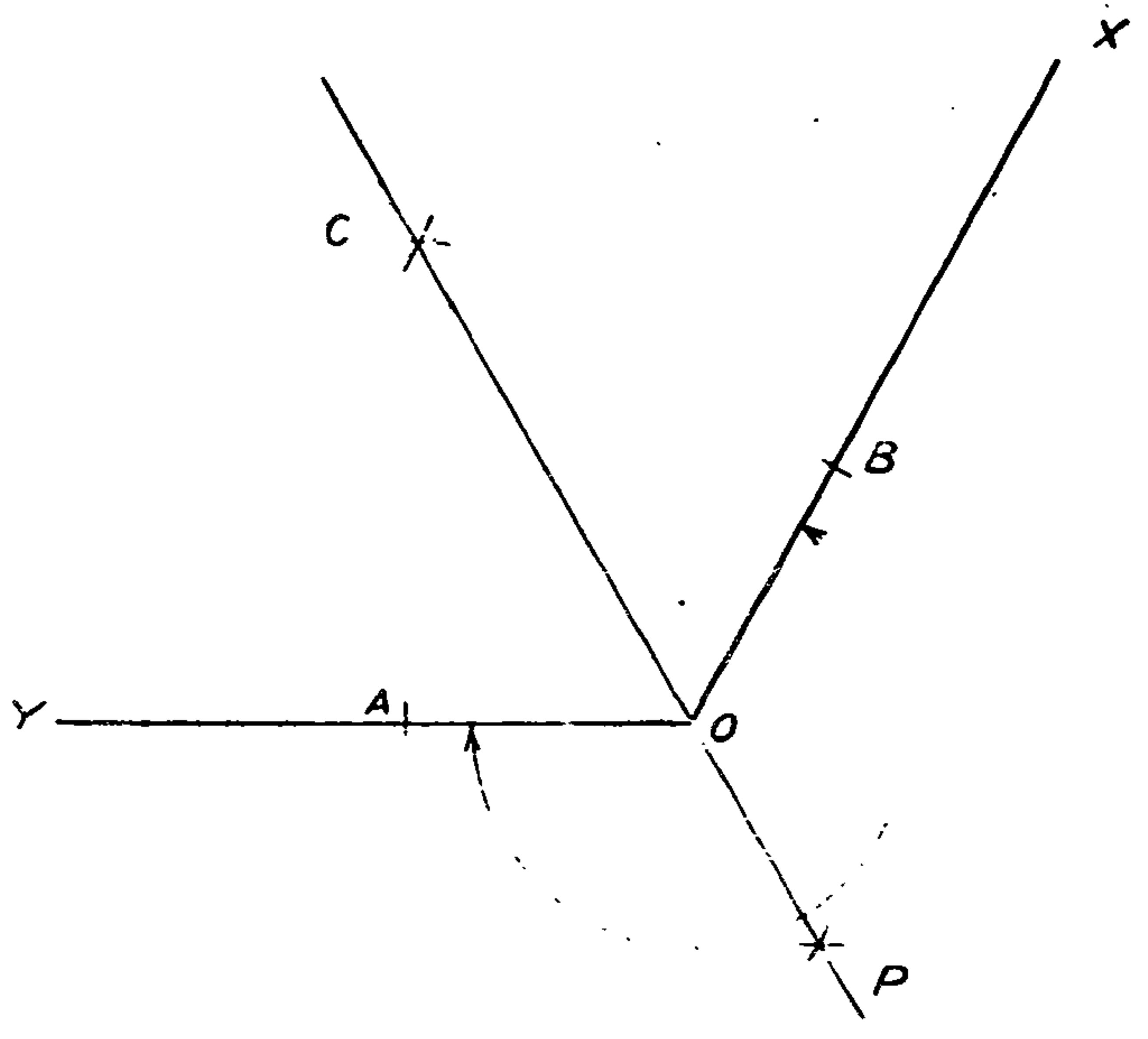
9. (a) Why are elm and cypress unsuitable for cabinetwork?
   (b) What woods are most suitably hard for cabinetwork?

10. Grain or figure, hardness, ease of working are desirable qualities of cabinet wood. What are some different qualities to be desired for building purposes?



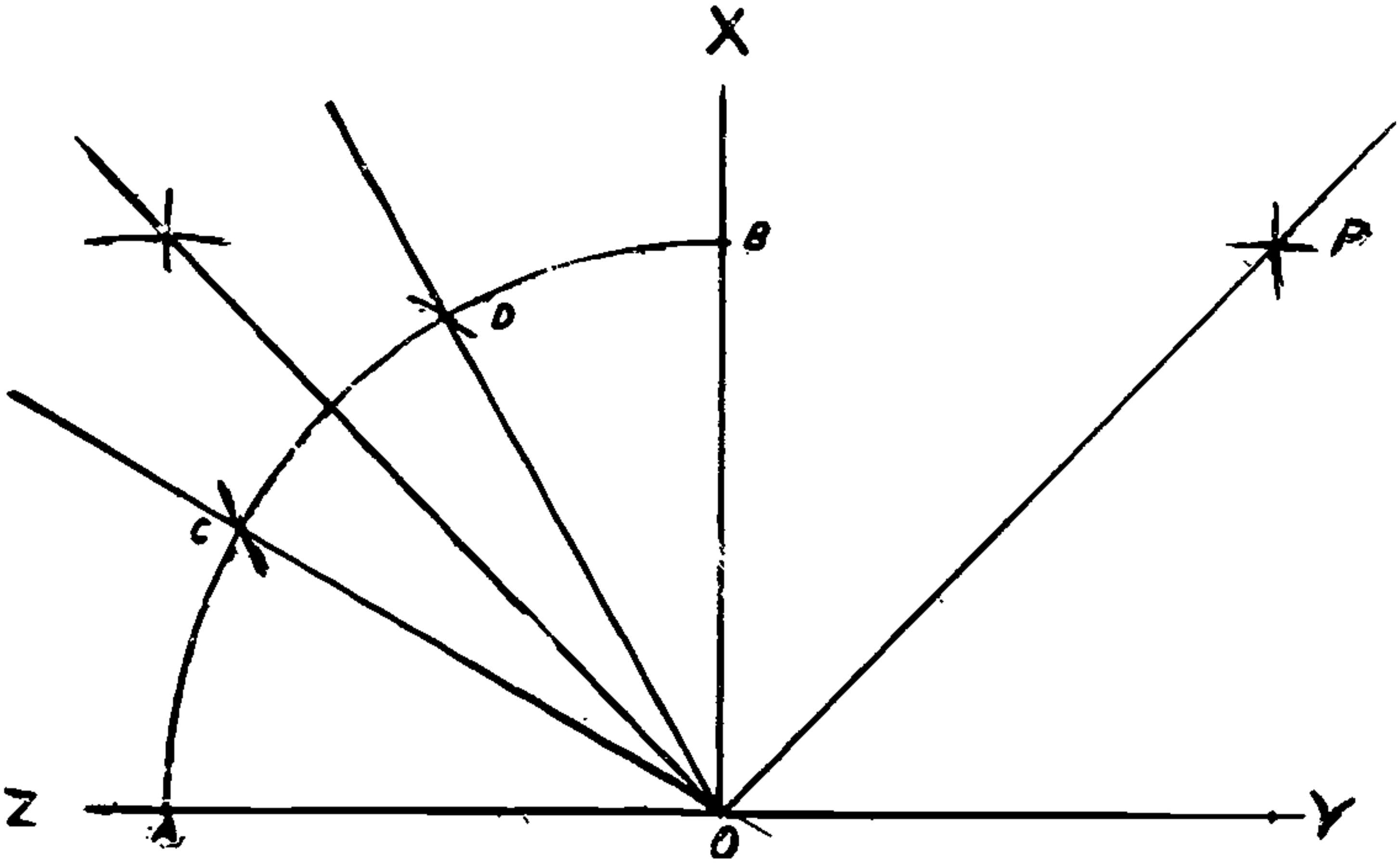
BISECTING AN ACUTE ANGLE

PROBLEM 1



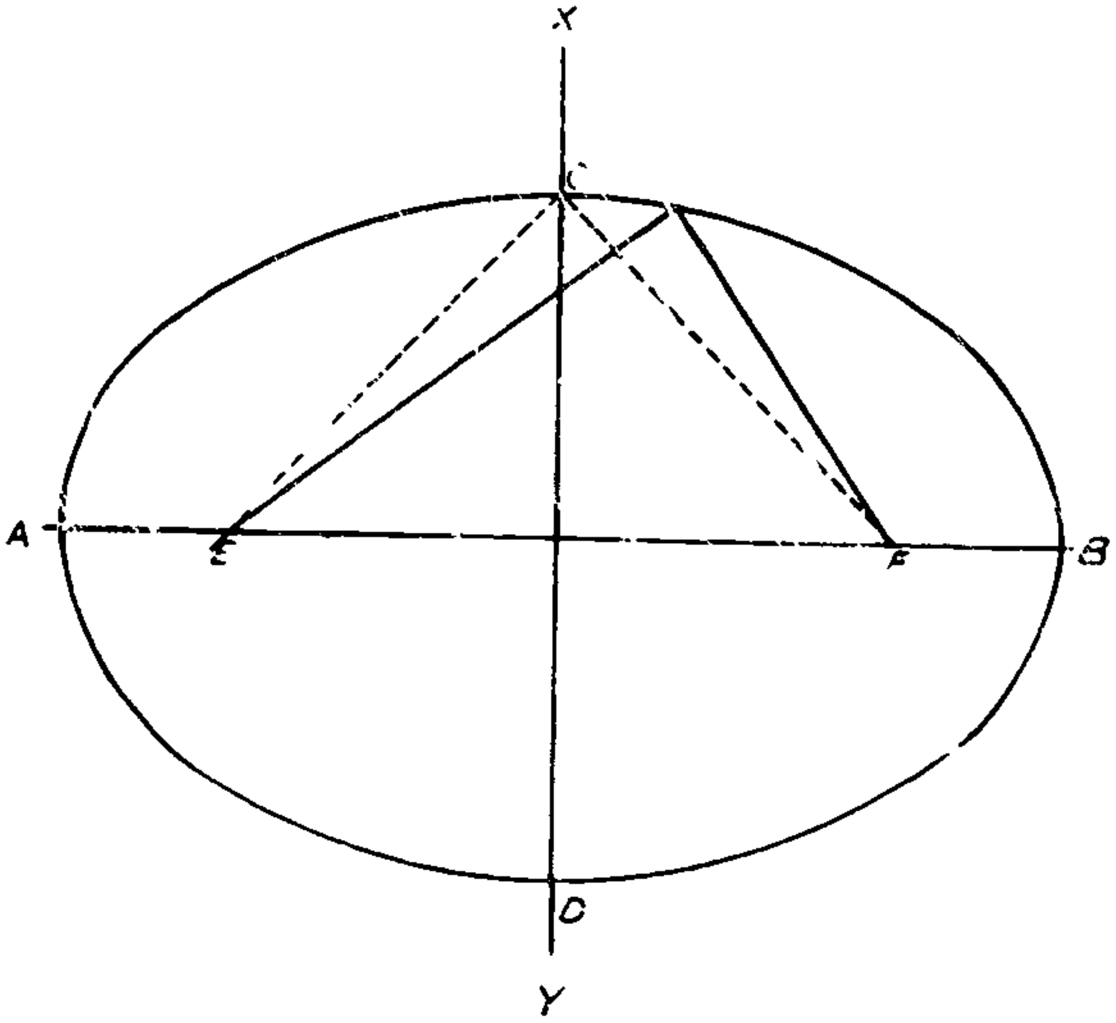
BISECTING AN OBTUSE ANGLE

PROBLEM 2



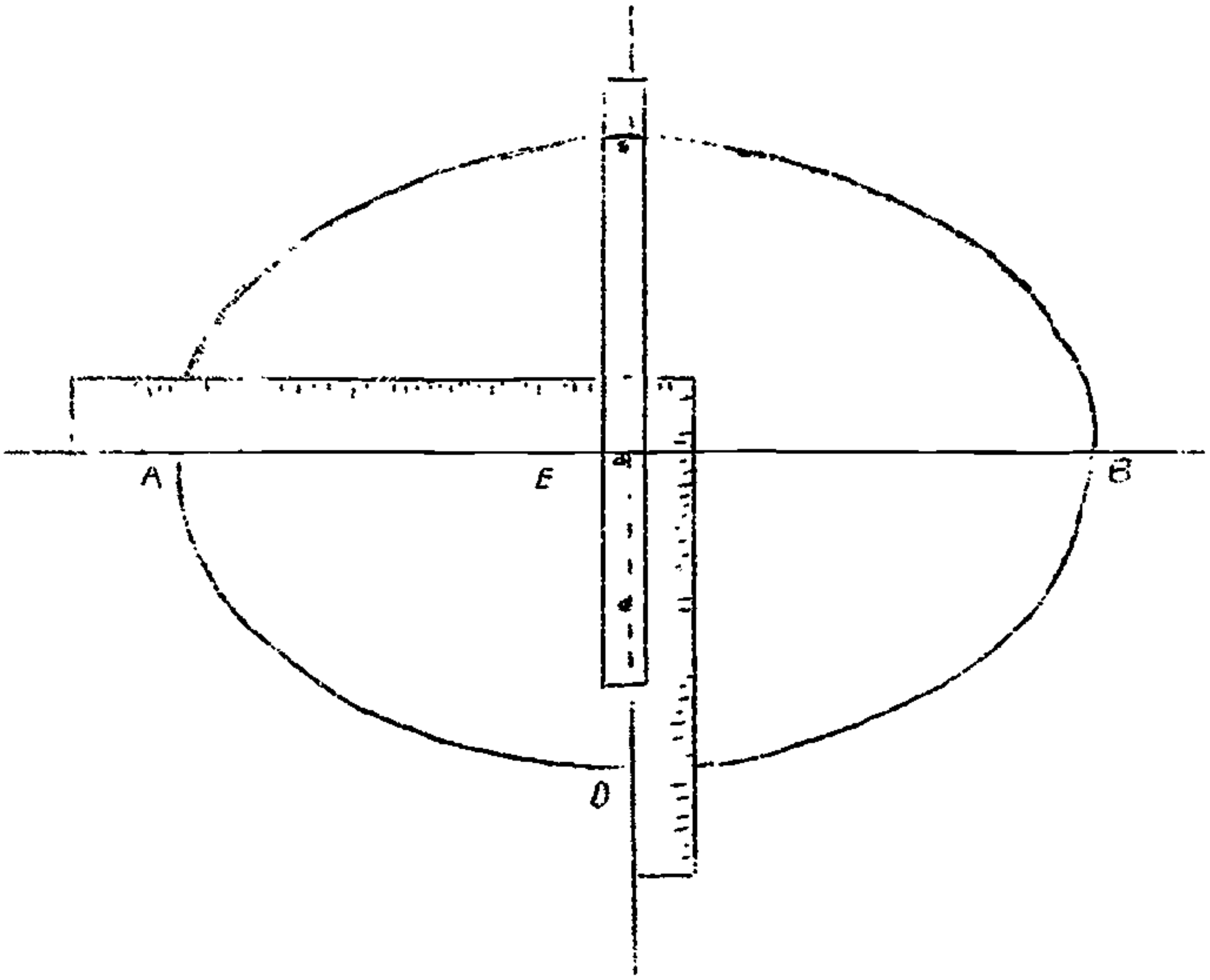
TRISECTING A RIGHT ANGLE

PROBLEM 3



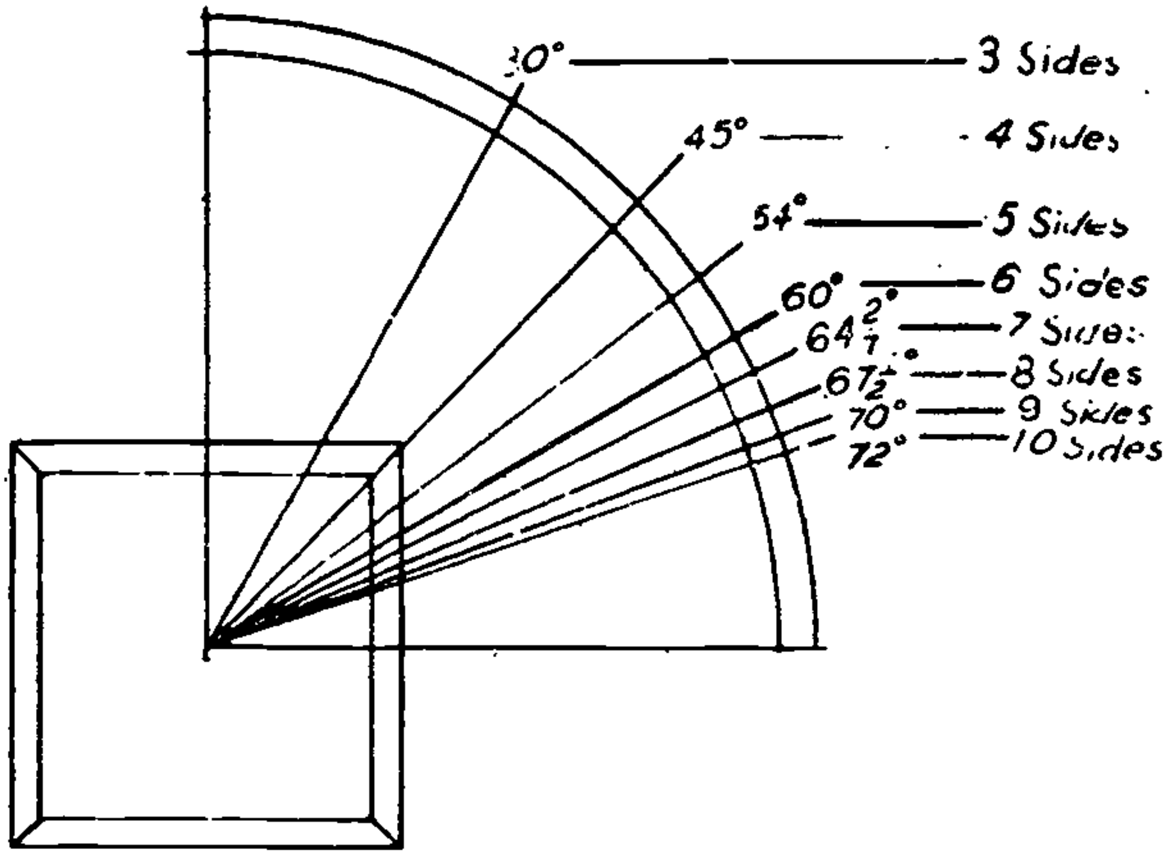
LAYING OUT AN ELLIPSE

PROBLEM 4



LAYING OUT AN ELLIPSE

PROBLEM 5

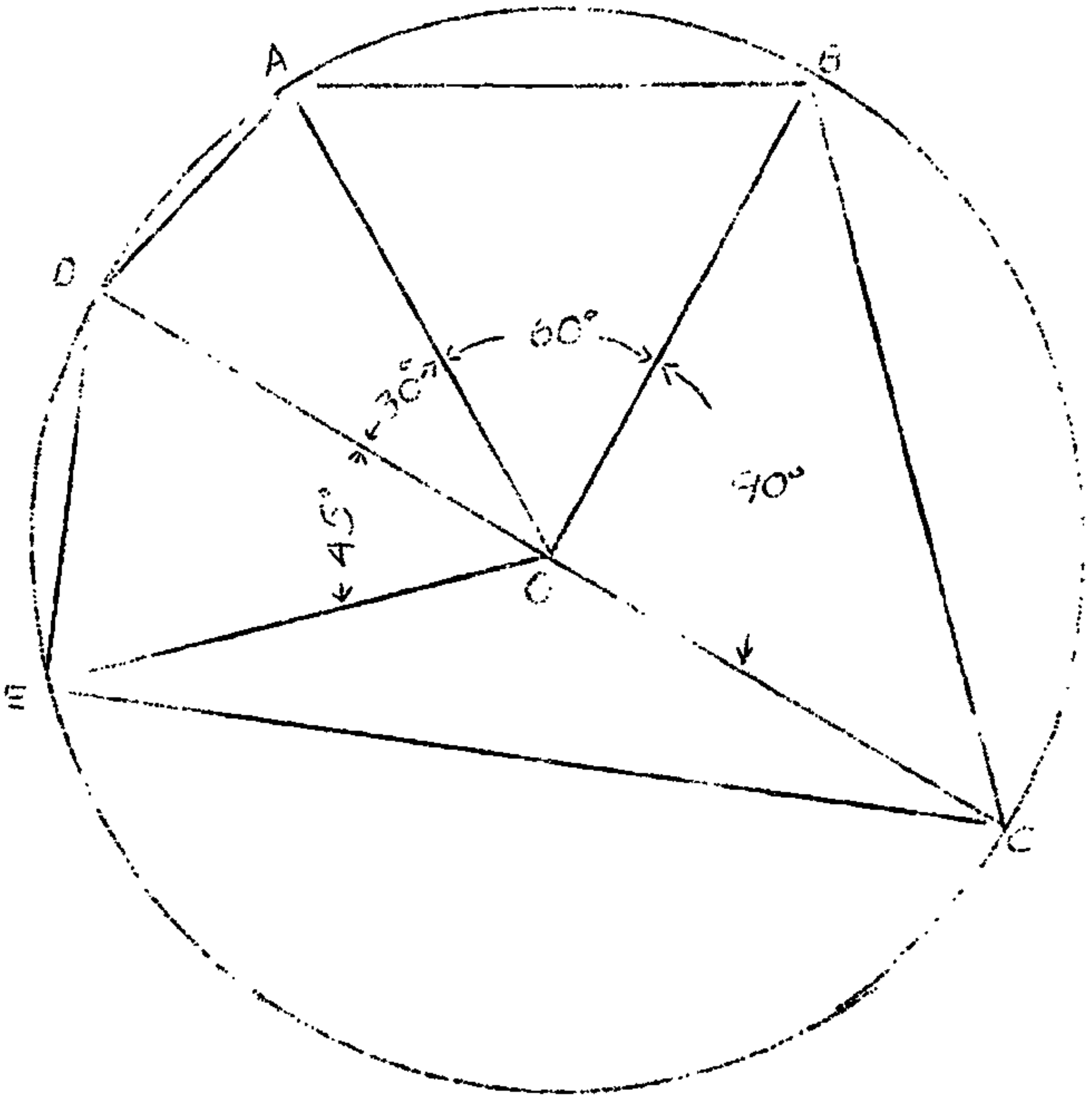


LAYING OUT MITER ANGLES

MITER CUTS FOR POLYGONS USING A STEEL SQUARE.

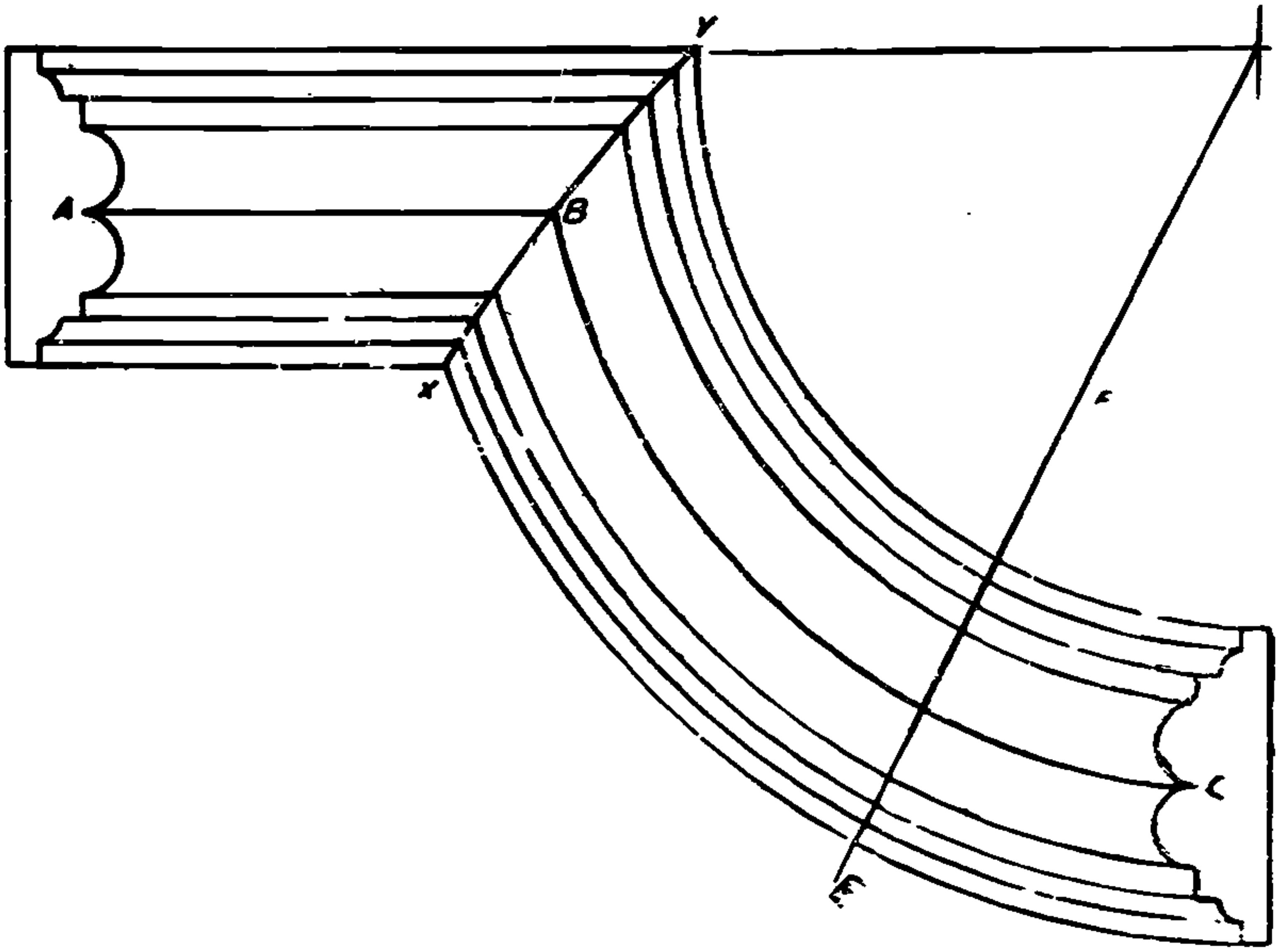
3 SIDES — 12' & $20\frac{1}{8}$"
4 SIDES — 12' & 12"
5 SIDES — 12" & $8\frac{25}{32}$"
6 SIDES — 12" & $6\frac{15}{16}$"
7 SIDES — 12" & $5\frac{25}{32}$"
8 SIDES — 12" & $4\frac{11}{32}$"
9 SIDES — 12" & $4\frac{3}{8}$"
10 SIDES — 12" & $3\frac{7}{8}$"
12 SIDES — 12" & $3\frac{7}{32}$"
14 SIDES — 12" & $2\frac{3}{4}$'

PROBLEM 6



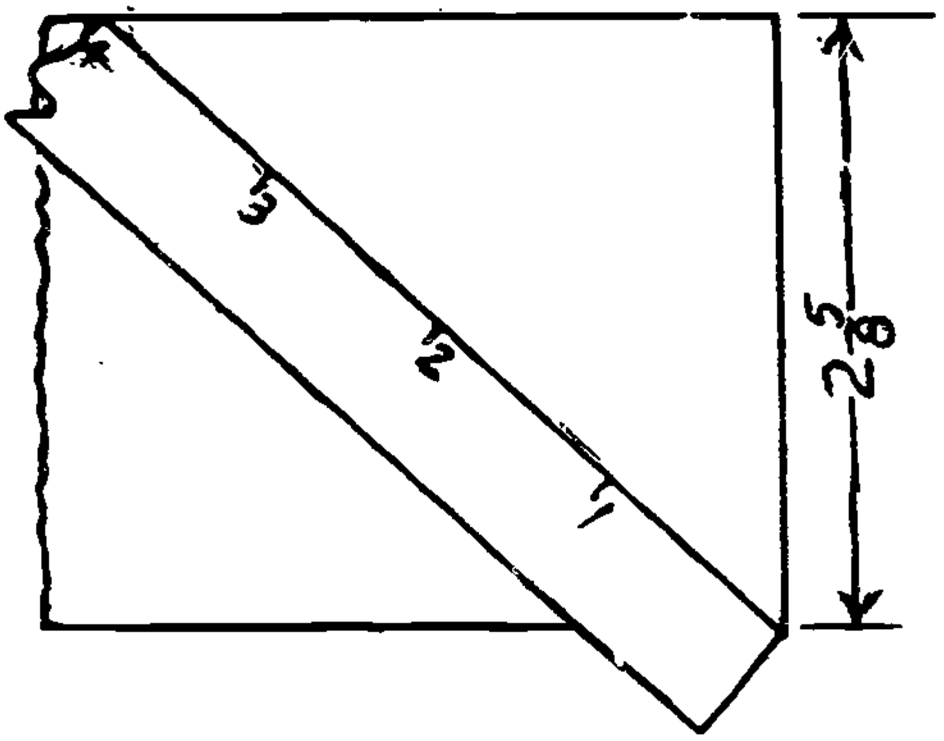
LAYING OUT MITER ANGLES

PROBLEM 7



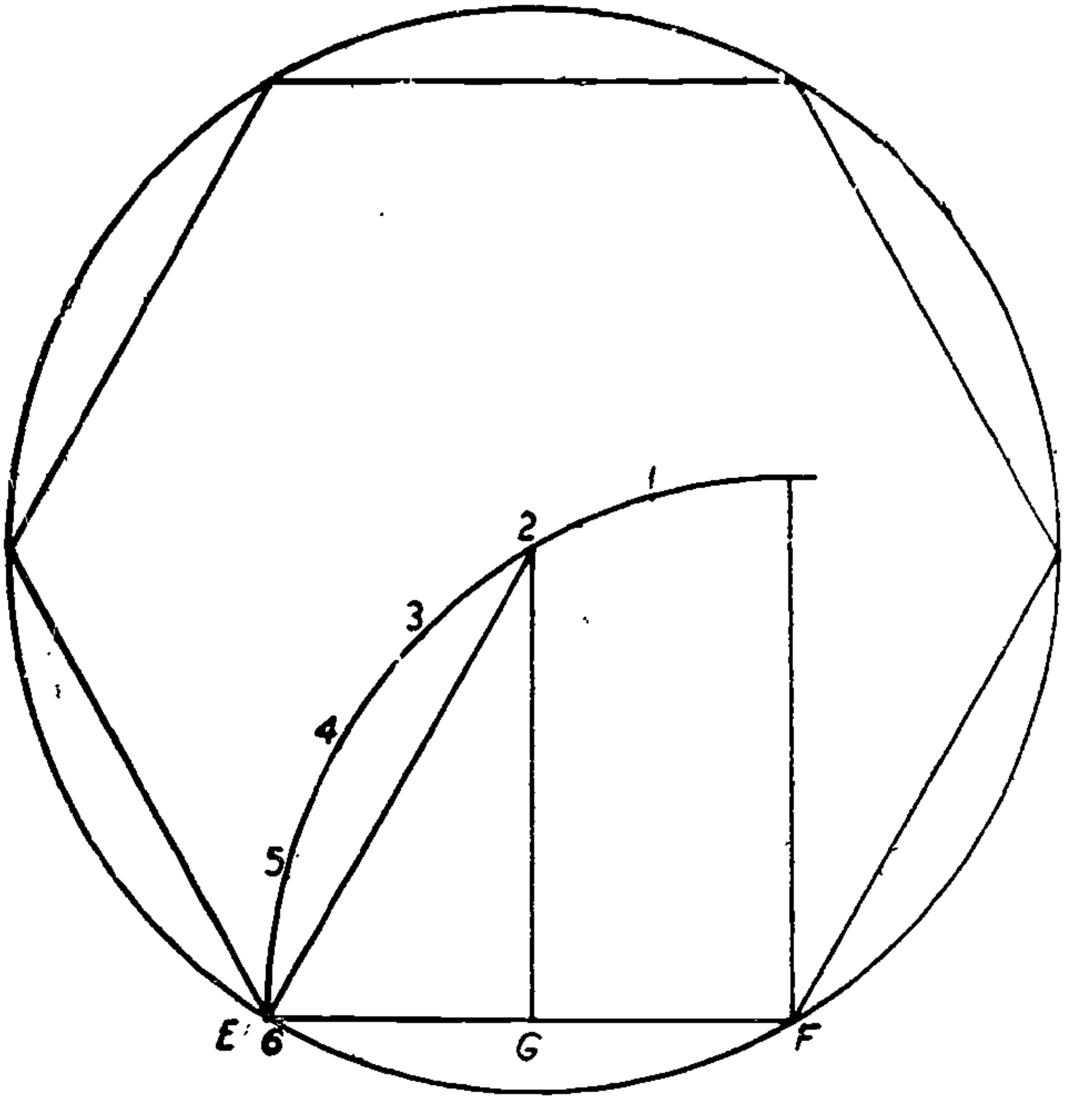
LAYING OUT MITER BETWEEN A STRAIGHT AND CURVED MOLDING

PROBLEM 8



DIVIDING A LINE INTO A GIVEN NUMBER OF PARTS

PROBLEM 9



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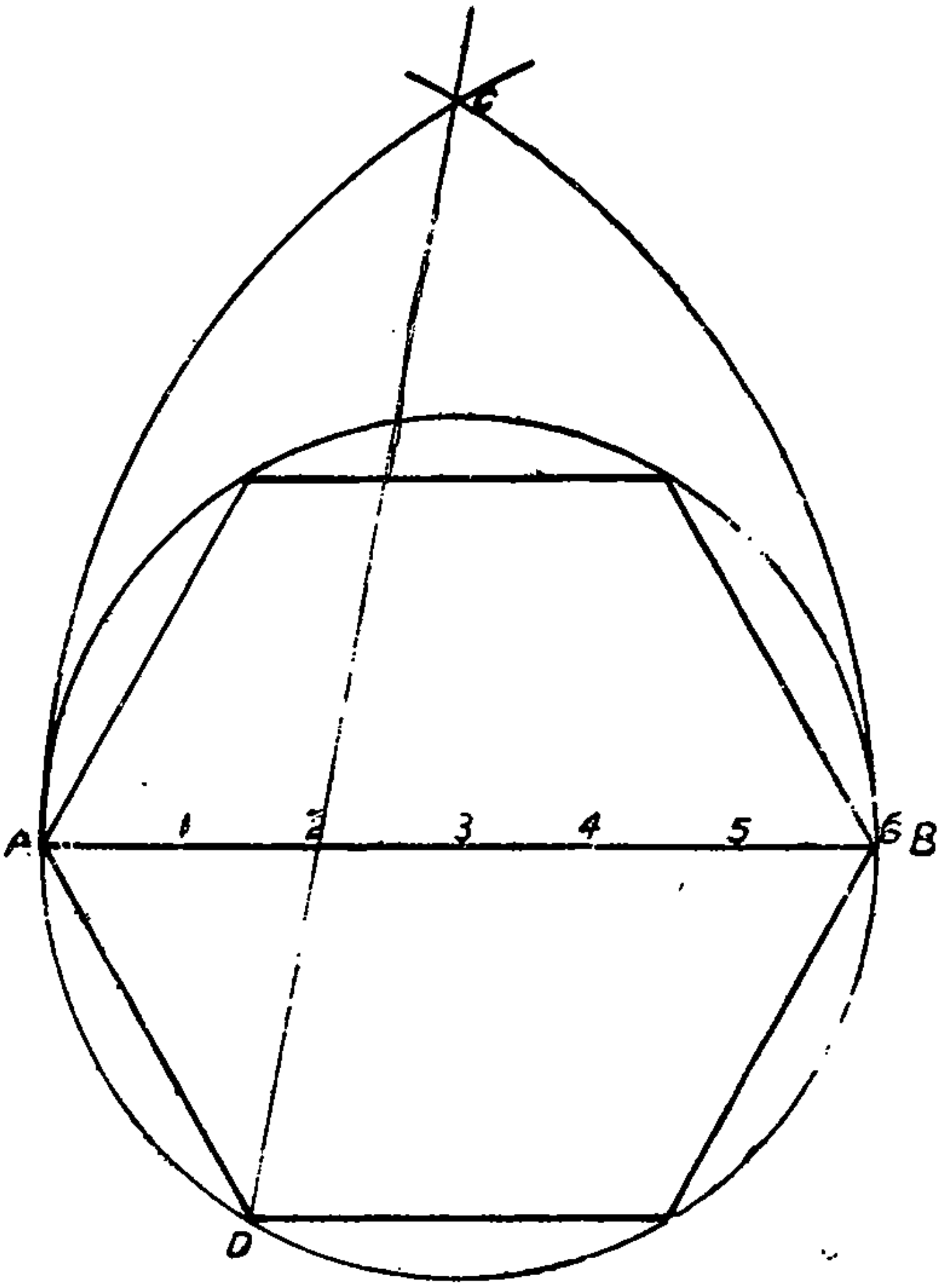
LAYING OUT A POLYGON ON A LINE

PROBLEM 10



LAYING OUT A POLYGON IN A CIRCLE

PROBLEM 11

VT002 990

VT 002 990
Auto Mechanics, Part 4, Workbook.

California State Dept of Ed, Sacramento. Bur of Ind Ed
Pub Date - 66
MF AVAILABLE IN VT-ERIC SET 111p.

*STUDY GUIDES, *TRADE AND INDUSTRIAL EDUCATION, *AUTO MECHANICS (OCCUPATION), AUTO MECHANICS, *MOTOR VEHICLES, ADULT VOCATIONAL EDUCATION, *APPRENTICESHIPS,

The technical information in this study guide is for use in related technical classroom instruction in the auto mechanics apprentice training program. The material was planned under the direction of the State Educational Advisory Committee for the Automotive Trades and written by trade instructors. The units are (1) Fuel Systems, (2) Carburetion, (3) Crankcase Vents and Manifolds, (4) Basic Electricity, (5) Batteries, (6) Automotive Lighting Systems, (7) Ignition Systems, (8) Starters and Starting Motors, (9) Generators, (10) Generator Controls, (11) Automotive Accessories, and (12) Engine Tune-Up. Units are divided into study topics, each of which contains an assignment from reference material, an introduction, a section of related information, and check-up questions for student self evaluation. Photographic and line-drawing illustrations are included in the related information. Space for checking completed topics is provided in the study guide index. The study of this 144-hour course by indentured apprentices on a group or individual basis is to be directed by a qualified journeyman of the trade. Recommended supplementary instructional materials for the apprentice are listed. Testbooks and final examinations are available to the instructor. Auto Mechanics, Part I, (VT 002 761) is also available. This document is available for $2.10 from Bureau of Industrial Education, California State Department of Education, 721 Capitol Mall, Sacramento, California 95814. (HC)

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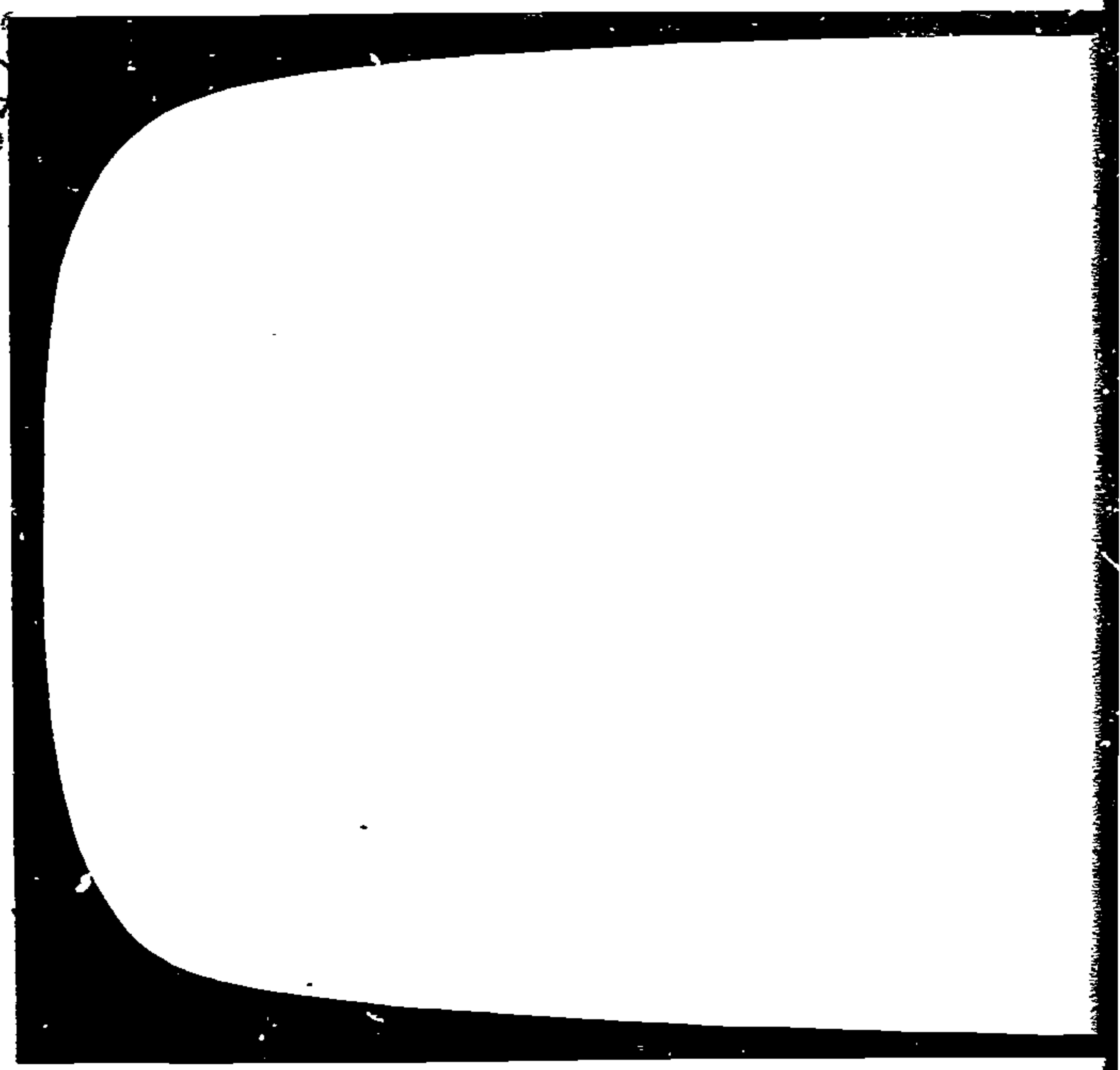
PART 4



California
State
Department
Of Education

MAX RAFFERTY
SUPERINTENDENT OF
PUBLIC INSTRUCTION

Sacramento
1966

VT 02990

WORKBOOK

Related Training Record

A column labeled "Assignment Date" has been provided at the right-hand side of each page in the Contents. Whenever your instructor assigns a topic, he should write this date in the appropriate blank. When you have completed the topic satisfactorily, your instructor should place his initials next to the assignment date. If this procedure has been followed, and you should transfer from one school to another, you will have an accurate record of the work you have completed. It should never be necessary for you to duplicate work on topics already studied or to skip topics not previously assigned.

In order to provide other school records needed, be sure to fill in below your name, home address, and telephone number. Then ask your instructor to fill in the official date of your enrollment in his class and to sign his name.

NAME ____

ADDRESS ______________________________________

________________________ PHONE ________________

DATE ENROLLED __________________________________

INSTRUCTOR(S) __________________________________

____

PART 4

AUTO MECHANICS

WORKBOOK

PREPARED UNDER THE DIRECTION OF
THE BUREAU OF INDUSTRIAL EDUCATION

MEMORANDUM

TO: The ERIC Clearinghouse on Vocational and Technical Education
The Ohio State University
980 Kinnear Road
Columbus, Ohio 43212

FROM: (Person) Wallace Theilmann (Agency) California State Dept. of Ed.

(Address) 721 Capitol Mall, Sacramento, California 95814

DATE: July 25, 1967

RE: (Author, Title, Publisher, Date) AUTO MECHANICS, Part 4, workbook, 1966 ed.

Prepared under the direction of the Bureau of Industrial Education,

California State Department of Education

Supplementary Information on Instructional Material

Provide information below which is not included in the publication. Mark N/A in each blank for which information is not available or not applicable. Mark P when information is included in the publication. See reverse side for further instructions.

(1) Source of Available Copies:
Agency California State Department of Education
Address 721 Capitol Mall, Sacramento, California 95814
Limitation on Available Copies N/A Price/Unit workbook - $2.00
(quantity prices) SAME

(2) Means Used to Develop Material:
Development Group State Educational Advisory Committees
Level of Group Top representatives from management and labor groups
Method of Design, Testing, and Trial Course consists of a workbook for the apprentice and testbooks and final examinations for the instructor's use.

(3) Utilization of Material:
Appropriate School Setting Junior College or Technical Institute
Type of Program Apprenticeship
Occupational Focus Related technical phase of the apprenticeship training program.
Geographic Adaptability N/A
Uses of Material Classroom instruction (individual and class front)
Users of Material Indentured apprentices

(4) Requirements for Using Material:
Teacher Competency Qualified journeyman from the trade
Student Selection Criteria Indentured apprentice

Time Allotment 144 hours minimum

Supplemental Media --
Necessary XXX
Desirable ____ (Check Which)

Describe Reference books are listed in the back of each workbook.

Source (agency)
(address)

Foreword

The apprenticeship programs offered in California are important phases of the total educational program for which the state is so well known. They are also unique phases of the total program, for they offer each participant opportunity to profit from paralleled and closely related learning experiences. One of these is to learn by actually working at one's chosen vocation under the direction and supervision of men who are both trained and experienced in the vocation. The other is to learn by attending classes in which all instruction is directed toward helping one to acquire the information and understanding he needs to perform on the job intelligently and with increasing proficiency and success.

The California State Department of Education has the responsibility for developing and making available the instructional materials that are used in the related training classes. It meets this responsibility primarily through the Bureau of Industrial Education.

Every effort is being made to produce instructional materials that are appropriate and adequate. These materials should be helpful to instructors in conducting their classes and to students in doing the required learning.

Max Rafferty

Superintendent of Public Instruction

Preface

The Bureau of Industrial Education has responsibility for making available the related instructional materials required for use in the training programs offered by the various trade groups in the state. The Bureau meets this responsibility by working cooperatively with employer-employee groups representing each of these trades in determining what materials are needed and in developing these materials.

This edition of Auto Mechanics, Part 4, was planned under the direction of the State Educational Advisory Committee for the Automotive Trades. The membership of this committee included the following representatives of employers and employees:

Representing the Employers	Representing the Employees
Amos Crowl, San Francisco	L. J. Costa, San Mateo
Roy J. Harper, Los Angeles	Mack O. Keister, Fresno
Paul Stockburger, Fresno	R. N. Fleming, San Diego

Educational Consultant: Lee D. Bodkin, Bureau of Industrial Education

Joseph W. Menconi, Auto Mechanics Instructor, John A. O'Connell Vocational High School and Technical Institute, San Francisco, wrote the material for this edition. Wallace Theilmann, Supervisor of Instructional Materials, Bureau of Industrial Education, California State Department of Education, coordinated the project activities. Thanks and appreciation are extended to Toshiro Sugimoto, Instructor, Los Angeles City Schools, for his able assistance as a consultant on this revision.

J. GRAHAM SULLIVAN
Chief
Division of Instruction

RICHARD S. NELSON
Chief, Bureau of
Industrial Education

Assignment Date

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Topic

UNIT K AUTOMOTIVE ACCESSORIES

Topic

UNIT L ENGINE TUNE-UP

Topic

Instructions for Checkup Questions

Checkup questions will be found at the end of each topic in the workbook. Answer the questions for each topic as soon as you have finished studying the assignment. Remember that although you are not graded on the checkup questions, your ability to answer them shows how well you understand the information and the assignments in the topic preceding them.

The checkup questions in this book are completion items. These are sentences in which certain key words are omitted. A numbered blank will be found in the right-hand margin corresponding to each of the missing words. Write the required word in the blank with the correct number.

Other types of questions may be found throughout the book. When this is the case, directions will be given for their use.

unit A | FUEL SYSTEMS

TOPIC 1—AUTOMOTIVE ENGINE FUELS

Assignment *

1. Automotive Encyclopedia, pp. 20-1 to 20-7.
2. Crouse, Automotive Mechanics, pp. 165-71.

Introduction

The improvements made in internal combustion engines during the last decade have to a great extent been made possible by the improvement of fuels. These improvements have permitted the use of increased compression ratios, which raises the developed horsepower per cubic inch of piston displacement.

A good knowledge of the various types of automotive fuels and the behavior of each under operating conditions is essential to the understanding of internal combustion engines.

Checkup

Automotive fuels are ___1___ compounds.

1. ____________

The combustion of gasoline is the rapid ___2___ of the ___3___ and ___4___ constituting the fuel.

2. ____________
3. ____________
4. ____________

One of the most important qualities of modern fuel is its ability to burn without causing ___5___, or ___6___.

5. ____________
6. ____________

Vapor lock is caused by gasoline ___7___ in the fuel ___8___, fuel ___9___, or ___10___.

7. ____________
8. ____________
9. ____________
10. ____________

Liquid petroleum gas, as a dry gas, creates less ___11___ than other fuels and does not cause ___12___ of engine oil.

11. ____________
12. ____________

Fuels with a high cetane rating have a slightly lower ___13___ ___14___ than the same quantity of a low-grade fuel.

13. ____________
14. ____________

Increasing sulfur content from 0.25 to 1.25 percent increases ___15___ and ___16___ 135 percent.

15. ____________
16. ____________

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* For publication information, see the list of instructional materials in the back of this book.

Water in gasoline will ___17___ zinc die castings of which ___18___ ___19___ and ___20___ are made.

17. __________
18. __________
19. __________
20. __________

For economy or maximum miles per gallon, fuel must have a high ___21___ ___22___.

21. __________
22. __________

The speed of flame travel is called the "___23___ of flame ___24___."

23. __________
24. __________

The temperature rise of air or of a gas due to compression is called "___25___ of compression."

25. __________

Preignition is referred to as ___26___ knocking, since it can occur almost any time after the ___27___-___28___ charge is admitted.

26. __________
27. __________
28. __________

Amounts of harmful chemicals and ___29___-forming substances in gasoline must be held to the minimum.

29. __________

The combustion of one lb. of octane yields 1.42 lb. of ___30___.

30. __________

TOPIC 2—FUEL TANKS

Introduction

The servicing of fuel tanks consists principally of draining them and repairing leaks. Even though tanks require only a minimum of attention, the mechanic must still have knowledge of their construction, and it is extremely important that he be aware of the precautions that must be taken while servicing them.

Related Information

Construction of fuel tanks. Automobile fuel tanks are made of terneplate, which ranges in thickness from approximately 0.015 to 0.050 inch, and which is joined by welded seams. Fittings, such as the drain valve, filler neck and fuel-line connections, are soldered to the tank. The tank contains a number of baffles, or metal plates, which are attached to the inner surface of the tank and are parallel to the ends. These baffles have openings through which the gasoline can pass, and their main purpose is to prevent a sudden surging of the gasoline from one end of the tank to the other when the car rounds a corner.

The tank is usually secured to the car by means of two metal bands that are lined with padding material to prevent them from wearing into the tank. The tank end of the fuel line is usually located about 1/4 inch from the bottom of the tank. This clearance is designed to prevent water and dirt from entering the line. There is often a small sump in the bottom of the tank in which water and dirt can collect. When the fuel line is attached near the top of the tank, another piece of steel tubing is run from the inside of the fuel-line fitting to the bottom of the tank. If this tubing develops an air leak below the point where it is attached at the upper end, the fuel pump will draw air after the fuel level in the tank drops below the level of the leak. This trouble does not occur very often, but if this possibility is not taken into consideration, the leak may be difficult to locate.

The filler neck on some passenger cars is not long enough to reach to the outside of the car, and it is welded or otherwise securely attached to the inside of the car body. The tank is usually attached to the filler neck by means of a neoprene sleeve, so that the tank may be removed and replaced easily.

In order for gasoline to be drawn from the fuel tank, the tank must be vented in some way so that normal atmospheric pressure is maintained at all times on the surface of the fuel. This is necessary because the fuel pump works on the differential of pressure principle. An air vent is sometimes soldered into the top of the tank, but frequently the tank is vented through the filler cap. Should a vent become clogged, a vacuum can be created in the tank which will prevent fuel from being drawn into the fuel pump line. Since a clogged vent can affect engine performance much the same as when the car is running out of gas, the fuel pump is often suspected of failure.

Cleaning, testing, and repairing. Dirt, pieces of rubber hose, leaves, or other foreign matter sometimes get into the tank. The most practical way of cleaning the tank is to remove it and turn it upside down. However, water and small particles of dirt may be drained out through the drain opening in the bottom of the tank, if any, and tanks should therefore be drained at least once a year as a matter of good preventive maintenance. A fuel-tank filler cap lock offers excellent protection for the fuel system, for such a cap will prevent anyone from putting rocks, dirt, or other foreign matter into the filler neck.

Leaks may occur in the seam welds or soldered joints because of vibration, strain, or faulty construction. Occasionally, leaks in the tank may be caused by sharp objects that are kicked up on the road by the wheels of the vehicle and thrown against the tank.

Since a fuel tank always offers a chance of explosion, it should be cleaned thoroughly before any attempt is made to make any repairs. The usual procedure, after first removing the float mechanism, is to fill the tank with a solution containing an alkaline cleaner and then flush it out with steam. This procedure is absolutely necessary as a safety precaution to prevent possible explosion of gasoline fumes that may otherwise remain in the tank. While the tank is being flushed, all the fittings should be kept open to drain the sediment and prevent the building up of steam pressure high enough to weaken or damage the tank.

Fuel tanks are tested for leaks by either the wet method or the air-pressure method. The following steps are followed in the wet method:

1. Plug all openings tightly except the filler neck.
2. Dry the entire outer surface thoroughly with compressed air or a clean rag.
3. Place the tank on a bench on top of blocks so that the underside can be easily seen with the aid of an electric light.
4. Fill the tank with water.
5. Insert the end of an air hose into the filler neck and cover the rest of the opening with the palm of the hand.
6. Apply air pressure against the water in the tank by opening the air valve for a short time.
7. Examine the entire tank for moist spots, which will occur if water is forced through at any point. Draw a ring around each spot.

The following steps are followed in the air-pressure method:

1. Plug all openings except the fuel outlet connection.
2. Attach the loose end of the air-supply hose to the fuel outlet connection by a short threaded tube.
3. Submerge the fuel tank in a tank of clean water, or cover the tank with soapy water.
4. Turn on the air pressure (not more than four pounds per square inch).
5. Draw a ring around each spot on the fuel tank where bubbles appear, indicating leaks.

It is extremely important for the mechanic to remember that a torch should never be used to solder a gasoline tank. A soldering iron, preferably electric, is considered the most satisfactory means of repairing a leak in a fuel tank.

No matter how thoroughly drained a tank is thought to be or how long it has been since last used, enough fuel may still remain in the tank to produce a combustible mixture. Therefore, whenever a fuel tank is being soldered, extreme care must be taken to prevent any open flame from coming into contact with the tank or with the fumes that might still be present in the tank.

Checkup

The fuel tank contains baffles to prevent __1__.

1. ________

To avoid picking up __2__ and __3__, the tank end of the fuel line is located __4__ from the bottom of the tank.

2. ________
3. ________
4. ________

The fuel tank is vented in order to maintain __5__ __6__ upon the fuel.

5. ________
6. ________

A clogged tank vent will produce the same effect as a(n) __7__ tank or a faulty __8__ __9__.

7. ________
8. ________
9. ________

If an air leak is developed in the "pickup" tube, the fuel pump will draw __10__, instead of __11__, as the fuel level in the tank __12__.

10. ________
11. ________
12. ________

For easy tank removal, some tank filler necks are attached with __13__ sleeves.

13. ________

To prevent explosion, a fuel tank must be thoroughly __14__ and flushed out with __15__.

14. ________
15. ________

When a tank is tested with air pressure, the pressure should not exceed __16__.

16. ________

TOPIC 3—MECHANICAL FUEL PUMPS

Assignment

1. Automotive Encyclopedia, pp. 26-1 to 26-4.
2. Crouse, Automotive Mechanics, pp. 130-31.

Introduction

Early-model cars were provided with various types of fuel feed systems, making use of such devices as mechanically-driven pumps, or tanks that supplied fuel by means of gravity or a vacuum system. Many of the advantages of each of these early types of gasoline feed systems are combined in the mechanically-operated diaphragm pump, which has the added advantage of providing fuel at the pressure required to keep the carburetor properly supplied under all conditions of engine load and speed.

Most modern automobiles are equipped with mechanically operated diaphragm fuel pumps, a few with combination mechanical and vacuum fuel pumps. The repair of these pumps is not difficult; however, it is seldom done because it is generally cheaper to replace than to repair a pump. However, to determine when a pump is in need of replacement or repair, how to diagnose problems of low volume, high or low pressure, and the like, a mechanic must understand the principles of pump operation.

Checkup

The mechanically operated pump provides ___1___ under constant ___2___.

1. __________
2. __________

The vacuum pump operates the windshield wipers when engine vacuum is ___3___.

3. __________

The function of the air dome on the outlet side of the pump casting is to ___4___ ___5___.

4. __________
5. __________

A fuel pump is tested for ___6___, ___7___, and ___8___.

6. __________
7. __________
8. __________

A fuel pump should not be replaced before proper __9__ are made. 9. __________

Excessive pressures can be caused by __10__ diaphragm flexing. 10. __________

Fuel pump pressure is determined by the diaphragm __11__ __12__. 11. __________
12. __________

A ruptured vacuum diaphragm can cause excessive __13__ consumption. 13. __________

The fuel pump delivers fuel to the carburetor when the pump __14__ moves the diaphragm. 14. __________

TOPIC 4—ELECTRIC FUEL PUMPS

Assignment	1. Automotive Encyclopedia, pp. 26-4 to 26-6. 2. Crouse, Automotive Mechanics, pp. 131-32.

Introduction

The electric pump has one definite advantage over the mechanical pump in that, unlike the mechanical pump, it may be mounted at any convenient location on the vehicle. All the pump requires for its operation is an electric current; it needs no mechanical link to the engine. When it is mounted in a cool place away from the heat of the engine, the possibility of vapor lock is greatly reduced. Although electric fuel pumps are not standard equipment on passenger cars at present, many of these pumps are sold as replacements for mechanical pumps. Electric fuel pumps are standard equipment on many trucks.

Reference books provide very little information concerning electric fuel pumps, but specifications and service instructions may be obtained from the manufacturers. Since electric pumps require occasional maintenance, every mechanic should understand the principles upon which these pumps operate and have some knowledge of the service procedures involved in cleaning and adjusting them.

Related Information

Operation. The electric fuel pump operates independently of any mechanical linkage with the engine. Its principle of operation is similar to that of the diaphragm-type mechanical pump, except that some electric fuel pumps use a bellows instead of a diaphragm, and the motive power which produces the vacuum is an electromagnet (or an electric motor) rather than the engine. The return or pressure stroke is produced by spring action. Back pressure in the carburetor builds up pressure in the bellows (or diaphragm) and prevents further pumping by holding the electrical circuit open.

Construction. Figure 1 shows a cross section of a typical electric fuel pump. The binding post is connected to the ignition switch. When the switch is turned on, current passes through the binding post to contact the arm through the coil, and it completes the circuit by passing through the contact points to

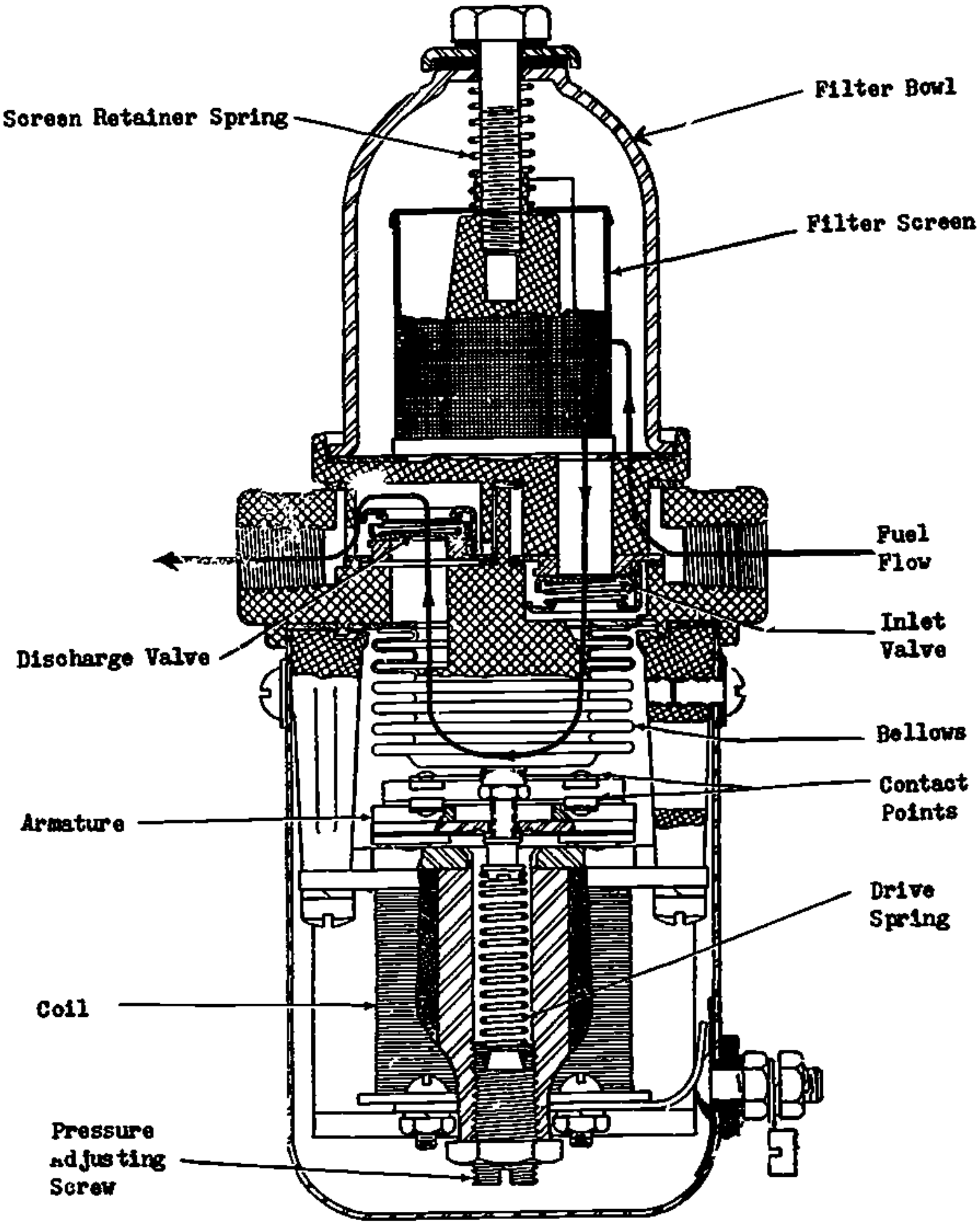


Fig. 1. Cross section of a typical electric fuel pump

ground. As the coil is energized, electromagnetism pulls the armature down, which expands the bellows and opens the points. As the bellows are pulled down, a partial vacuum is created above the bellows that causes fuel to be drawn from the supply tank, through the inlet valve, and into the chamber above the bellows. When the points are pulled apart, the current stops flowing, and the magnetic pull on the armature is broken. The drive spring then pushes the bellows up, creating a pressure on the fuel, which causes the inlet valve to close and forces the fuel through the outlet valve to the carburetor. When the spring returns the bellows, the contact points are again closed, and the cycle is started all over again. When the carburetor is not in need of additional fuel from the pump, a pressure is built up above the bellows, which holds the contact points open and stops the operation of the pump. The bellows type fuel pump develops a pressure of between 2 and 5 pounds per square inch.

Maintenance. Electric fuel pumps give very little trouble, although they need periodic cleaning and adjusting. Dirt and water coming from the fuel supply tank are filtered out by the bowl screen. To clean this screen, the fuel bowl retainer screw must first be removed, then the bowl, the spring, and the screen. A new gasket should be installed to guard against any air leaks around the lip of the bowl. When the pump pressure is to be adjusted, the cover should be removed and a battery connected to the contact arm. The locknut is loosened, and if a higher pressure is desired, the adjustment screw is turned clockwise. If the pressure is too high, the adjustment screw is turned counterclockwise.

Parts replacement. Practically all the parts in these pumps are replaceable. Factory specifications relative to clearances and adjustments should be followed closely when any major work is done on the pump.

Checkup

The electric fuel pump is usually supplied with current through the ___1___ ___2___.
1. __________
2. __________

The flexible part of the pump, which develops the suction, is called the ___3___ or ___4___.
3. __________
4. __________

The pump coil is energized when the contact points are ___5___.
5. __________

When the contact points are closed, the bellows begin to move ___6___.
6. __________

When the bellows are moved down, the ___7___ valve is open.
7. __________

The valves are returned to their seats by ___8___.
8. __________

The bellows are moved down until the contact points ___9___.
9. __________

The bellows are moved upward by a(n) ___10___.
10. __________

As it enters the pump, the fuel is filtered through a(n) ___11___.
11. __________

The bellows are drawn downward by the force of ___12___.
12. __________

When the bowl is cleaned, a new ___13___ should be installed.
13. __________

The screen of the Autopulse pump is held in place by a(n) 14 . 14. __________

Pressure is increased in the Autopulse pump by turning the adjustment screw 15 . 15. __________

The adjustment screw is held in place by a(n) 16 . 16. __________

When the carburetor is not in need of fuel, the bellows and the contact points are held 17 . 17. __________

The pusher type pump has an advantage since it has no 18 . 18. __________

Electric fuel pumps are less subject to 18 19 than mechanical types. 19. __________

TOPIC 5—FUEL FILTERS

Assignment : Automotive Encyclopedia, pp. 26-10 to 26-11.

Introduction

Every automobile is equipped with some kind of fuel filter, either as part of the fuel pump or carburetor, or installed as a separate unit in the fuel line. Many designs of fuel filters have been developed during the past several years, but all of them perform the same function--to remove impurities from the gasoline before it is delivered into the carburetor jets. Much carburetor repair is necessary simply because a filter has not done its job, which can be avoided if filters are kept operating efficiently.

Related Information

Types of Filters

Ceramic filter. The ceramic-type of filter, shown in Fig. 2, is one of the filters in wide use. The fuel is strained through a ceramic filter element (a porous clay product) that filters out microscopic particles of dirt. The ceramic element is held in position by a coil spring. For cleaning, the ceramic element is washed in acetone or a good carburetor cleaning solvent and blown out with air.

Under normal fuel pump pressure, the filter will permit a flow of approximately 50 gallons of gasoline an hour, much more than the 10 gallons or less most automobiles consume even at excessively high speeds.

Fiberite filter. Another filtering element is made of a series of fiber discs. This type of filter, shown in Fig. 3, strains out lint, dust, dirt, and water. The discs are not affected by water or acids found in the fuel, or by any of the various types of blended alcohol and aromatic fuels. The manufacturers recommend that this filter element be replaced periodically rather than cleaned.

Disc-type fuel filter. The disc-type fuel filter was popular several years ago. It consists of a series of laminated metal discs and spacers with openings

Fig. 2. Typical ceramic fuel filter

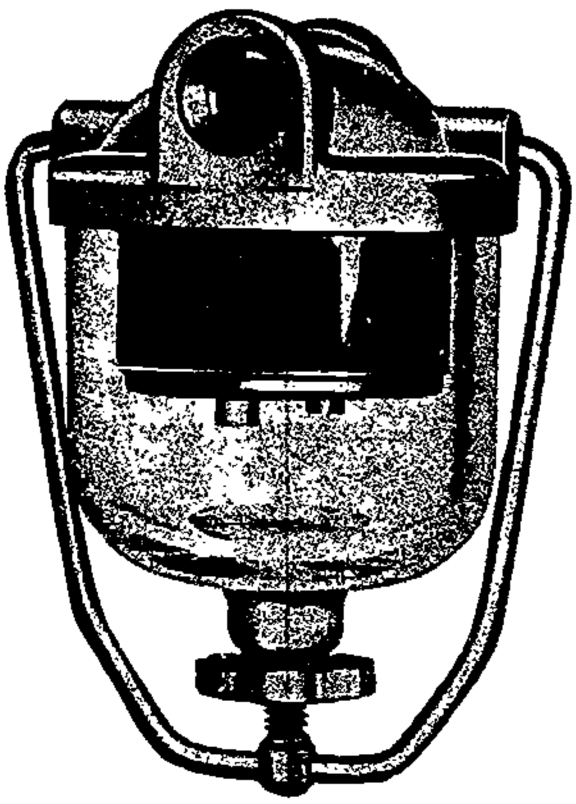


Fig. 3. Fiberite filter

Fig. 4. Replaceable filter element

approximately .002 inch in width, which is several times finer than openings in 120-mesh wire screen. This filter strains out all foreign matter such as water and dirt. The fuel is forced into the glass bowl and between the laminations to the inside of the filtering unit. In the process of cleaning this unit, the bowl is removed and the stack of discs is unscrewed. As these discs are unscrewed, they separate somewhat to permit cleaning. The filter should be swished back and forth in clean solvent and then allowed to dry. The bowl gasket should be replaced to prevent leakage. The disc-type filter is no longer manufactured. A composition element is supplied to replace the laminated discs when they become worn.

Screen filter. The average mechanic is familiar with the screen-type filter that has been in use for many years. Such filters are sometimes inefficient because the screen does not always seat correctly. A filter of this type may have a very fine mesh screen, but if the dirt is allowed to pass between the screen and the seat, the filtering action is poor. Screen filters are often used on the intake side of the fuel pump. Whenever the bowl is removed for cleaning, the bowl gasket must be replaced, because if a leak were present, even though the fuel would not leak out, air would be taken in, reducing the fuel capacity of the pump.

Other Filters

Other locations of filters. Filter units that are not a part of the fuel pump or carburetor are usually installed next to the carburetor so that the fuel is filtered just before entering, thereby assuring the passage of clean fuel to the carburetor. Many makes of cars are equipped with line filters. These filters are inserted in the line between the pump and carburetor. They are capable of very fine particle filtration. These filters are not serviced, but replaced according to the recommendations of the manufacturers.

Air domes. The mechanic will find that many types of filters do not become completely filled with gasoline. Fuel filters are often designed to accommodate an air pocket that acts as a cushion to damp fuel pulsations caused by the fuel pump. These pockets are called "air domes."

Checkup

Ceramic fuel filters use a(n) __1__ clay element through which the fuel is strained. 1. ________

About __2__ of fuel an hour can pass through the ceramic filter. 2. ________

The filter element in the ceramic filter is held in position by a(n) __3__ __4__.
3. ________
4. ________

When a Fiberite filter element becomes dirty, it should be __5__. 5. ________

The discs of a disc filter are spaced about __6__ apart. 6. ________

The fuel is filtered through most elements from the __7__ to the __8__.
7. ________
8. ________

Disc, screen, and ceramic-type filters should be washed in __9__ or other good carburetor cleaning __10__.
9. ________
10. ________

Whenever a bowl-type filter is cleaned, the bowl __11__ should be replaced. 11. ________

If the filter bowl on the suction side of a fuel pump leaks, the pump's __12__ __13__ is reduced.
12. ________
13. ________

Filters should be located as near the __14__ as possible. 14. ________

Some filters do not become completely filled with fuel because of a(n) __15__ __16__.
15. ________
16. ________

Screen filters sometimes do not filter fuel efficiently because the screen is not properly __17__. 17. __________

Fuel filter bowls should be cleaned as often as __18__ a year. 18. __________

unit B | CARBURETION

TOPIC 1—BASIC PRINCIPLES OF CARBURETION

Assignment

1. Automotive Encyclopedia, pp. 21-1 and 21-3.
2. Crouse, Automotive Mechanics, pp. 132-36.

Introduction

It is necessary to gain a thorough understanding of the basic principles of operation that apply to all carburetors before attempting to understand the construction, operation, and characteristics of any particular brand or type. Although one carburetor may look considerably different than another, the fact is that all carburetors work on the same fundamental principles, regardless of variations in design.

Checkup

The purpose of the carburetor is to supply the engine with a(n) ____ 1 ____ - ____ 2 ____ mixture in the ____ 3 ____ proportions.

Fuel is atomized for quicker ____ 4 ____ .

The air-fuel ratio best for full power is ____ 5 ____ to ____ 6 ____ .

The purpose of the venturi is to create ____ 7 ____ by increasing air ____ 8 ____ .

Gasoline is pushed out the nozzle by ____ 9 ____ pressure.

Carburetors operate on the ____ 10 ____ of air ____ 11 ____ principle.

High temperatures will cause rapid ____ 12 ____ .

Final evaporation takes place in the ____ 13 ____ .

Fuel is sprayed into the venturi from the end of the fuel ____ 14 ____ .

1. ____________
2. ____________
3. ____________
4. ____________
5. ____________
6. ____________
7. ____________
8. ____________
9. ____________
10. ____________
11. ____________
12. ____________
13. ____________
14. ____________

The various fractions contained in commercial gasoline vaporize at temperatures of ____15____ to ____16____.

15. __________
16. __________

Evaporation of a liquid is increased by ____17____ ____18____ pressure above the liquid.

17. __________
18. __________

Air flow through the air horn is controlled by a(n) ____19____ valve.

19. __________

To increase the amount of fuel surface exposed to evaporation, the fuel is ____20____.

20. __________

TOPIC 2—BASIC CARBURETOR CIRCUITS

Assignment

1. Automotive Encyclopedia, pp. 21-2 to 21-11.
2. Crouse, Automotive Mechanics, pp. 136-44.

Introduction

A carburetor controls the flow of air and gasoline into the combustion chamber of an automobile engine by means of three distinct processes:

1. Measuring--The carburetor is a measuring device designed to deliver the correct amount of gasoline and air mixture to the engine. This amount varies with speed, altitude, temperature, kinds of fuel, acceleration, and the type of manifold used on the engine. The parts that perform this function are the throttle valve, jets, metering rods, air valves, and metering valves.

2. Atomizing--The carburetor acts as an "atomizer" to break up the gasoline into extremely fine particles so that combustion will be as complete as possible. The venturis are mainly responsible for this. Carburetors may have from one to four venturis for each throat.

3. Blending--The carburetor correctly blends and mixes air and fuel for burning in the cylinders. The most important part of this function is the maintenance of a proper ratio of air to fuel under all circumstances and conditions. The parts of the carburetor that do the blending are the low-speed jet, intermediate jet, power jet, accelerator pump, air bleeds, air horn, venturi, float bowl vents, and manifolds.

Checkup

The accelerating pump supplies fuel to eliminate the "__1__ __2__" when the throttle is suddenly opened.

1. __________
2. __________

A high float level will cause too much fuel to flow from the main __3__.

3. __________

The six basic carburetor circuits are the ___4___, ___5___ ___6___ or ___7___ - ___8___, ___9___ or ___10___ - ___11___, ___12___, and ___13___ or ___14___ system.

4. ________
5. ________
6. ________
7. ________
8. ________
9. ________
10. ________
11. ________
12. ________
13. ________
14. ________

The pump circuit employs a(n) ___15___ and ___16___ valve.

15. ________
16. ________

The idle system takes gasoline from the ___17___ jet through the ___18___ jet and discharges it ___19___ the throttle valve.

17. ________
18. ________
19. ________

The high speed circuit takes in fuel through the ___20___ jet and discharges it from the main ___21___ with the throttle ___22___ to ___23___ opened.

20. ________
21. ________
22. ________
23. ________

When the choke valve is closed, only a small amount of ___24___ can get past it, developing a high ___25___ in the air horn. This causes a heavy discharge from the ___26___ nozzle.

24. ________
25. ________
26. ________

Metering rods or power jets can be ___27___ or ___28___ operated.

27. ________
28. ________

TOPIC 3–CARBURETOR CONSTRUCTION AND DESIGN

Introduction

Carburetor design keeps changing as time goes by, but the most recent changes have been primarily in appearance, rather than in function--the interior function of the modern carburetor is much the same as it has been for several years. The six circuits are there (refined in some instances, relocated in others), but the basic function remains the same. Carburetors vary by make and model, but the mechanic has only to understand the basic carburetor components, their design, and the reason for each to be able to troubleshoot and repair this part of the automobile fuel system.

Related Information

Construction

Carburetors are usually made up of three main parts: the air horn, main body, and throttle body.

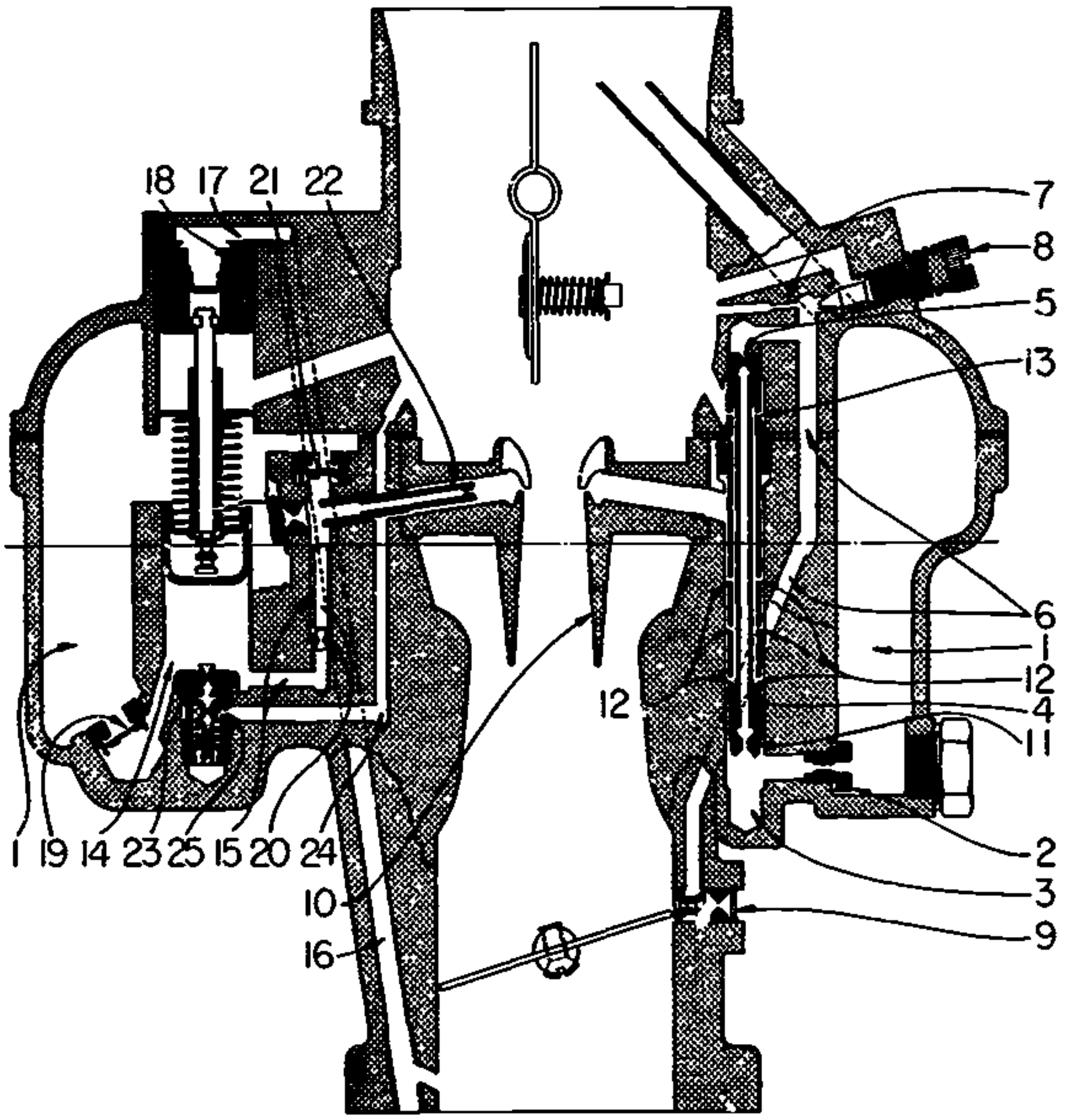
The air horn. The air horn is usually made of die-cast pot metal or aluminum. Some earlier models were made of cast iron, but these are no longer used for passenger cars.

The air horn is also the cover for the main body. Some air horns are quite simple, containing a choke valve and necessary mountings for manual or automatic choke operation; others are more complicated. They may contain the choke and its controls, the floats, needle and seat assemblies, power or metering rod assemblies, accelerating pump and linkage, bowl vents, and antipercolators. One early model had the secondary venturi located in the air horn. All air horns do not contain all of the components listed. No set rule exists for what should go into the makeup of the air horn--one popular single-barrel carburetor, for example, has the idle crossover, main nozzle, and secondary venturi in the air horn.

Main body. Some large commercial vehicle and boat engines have carburetors with cast iron main bodies, but most modern passenger car carburetors are of die-cast pot metal or aluminum.

Die-casting is a process wherein two dies of the required shape or form are used. One part of the die has the outer shape, and the other die controls the inner shape. Molten metal is forced between the dies. As soon as the metal is cool enough to set, the dies are opened and the part extracted. The dies can be used over and over again to turn out parts that are exactly alike. Die-casting practically eliminates most machining processes. The necessary passages are drilled. Any holes drilled from the outside in are plugged with metal plugs.

The main body can contain any number of the following items: the main (or primary) venturi, needle and seat assemblies, the float assembly, carburetor bowl and main jets, main nozzle and air bleeds, and idle jet and passages. Vacuum passages to operate power valves, metering rods, and chokes are drilled into the main body. Some automatic choke assemblies, mounted onto the main body, operate the choke valve through linkage. Economizers or power jets, located in the bottom of the float bowl chamber, often are operated by a piston and spring assembly mounted in the cover or air horn.



1. **Float Chamber**
2. **Main Jet**
3. **Main Metering Well**
4. **Idling Tube**
5. **Idling Jet Calibration**
6. **Idling Channel**
7. **Permanent Bleed**
8. **Idling Adjustment Needle**
9. **Plug**
10. **Secondary Venturi**
11. **Main Discharge Nozzle**
12. **Metering Holes**
13. **Bleed Opening**
14. **Pump Cylinder**
15. **Fuel Channels**
16. **Vacuum Channel**
17. **Vacuum Channel**
18. **Vacuum Piston**
19. **Check Valve**
20. **Ball and Weight**
21. **Upper Check Valve**
22. **Accelerating Jet**
23. **Power Jet Valve**
24. **Fuel Channel**
25. **Power Jet Valve Calibration**

Fig. 5. Zenith downdraft carburetor

The primary venturi is usually cast as part of the main body; while other venturis are separate pieces connected to the cover or suspended into the main body. The purpose of the venturi is to increase air velocity. Several venturis used together can improve the "spray" or break-up of fuel. However, the maximum number of venturis that can be used to advantage is four. Most carburetors have two venturis, but many others use three. Four venturis are used mostly on updraft carburetors.

Throttle body. Throttle bodies, which are of either aluminum or cast iron, often have grooves cut on the lower side. Some grooves are made small to equalize vacuum for choke and power valve control. The larger grooves are designed to pass exhaust gases from the heat riser crossover to heat the carburetor base. (However, excessive heat on the carburetor must be avoided to prevent vapor lock.) Sometimes fiber blocks are used under the carburetors as heat insulators. Throttle bodies for two- and four-barrel carburetors are usually cast separately, although on some four-barrel carburetors in use today, the main body and the throttle body are cast together.

The throttle body contains the throttle valves and their operating shafts and levers. Idle passages are extended through the throttle body to the idle discharge ports on either side of the closed throttle valves. The idle mixture screws are located in the throttle body. The fast idle, lockout, and unloader are located on the throttle shaft. In cars with a throttle-controlled starting switch, the switch is mounted on the throttle body. (This type of starting device has an advantage over other types of starters. When the driver engages the starter, he must depress the accelerator pedal sufficiently to allow the automatic choke to close and to open the throttle. With the throttle open, the engine is assured of getting a mixture rich enough for easier starting.)

An automatic throttle opener consisting of a spring-loaded vacuum diaphragm is used on some models. When the engine is not running, the spring pushes a plunger which opens the throttle a specific amount. When the engine is running, the engine vacuum returns the plunger to an "off" position.

On engines that drive automatic transmissions, dashpots are used to prevent the throttle from closing too quickly and the engine from stalling. These are referred to as slow-closing throttles.

Float Systems

Bowls. The float bowl contains a small amount of gasoline which flows into the engine because of the pressure differential between the surface of the gasoline and the nozzle tip. The gasoline must be maintained at a specific level at all times. For best results, the level should be 1/64 to 1/32 inch below the tip, and this level is controlled by a float which opens and closes a needle valve. At driving speeds the float keeps the needle off its seat just enough to keep a steady stream of fuel running into the bowl.

Proper fuel level is set at the factory by the use of sight gauges or by drilling holes in the sides of the bowl. These holes are closed with plugs which can be removed to check fuel level while the engine is running. Some floats can be adjusted while the engine is running; others can be adjusted only by removing the cover and float assembly.

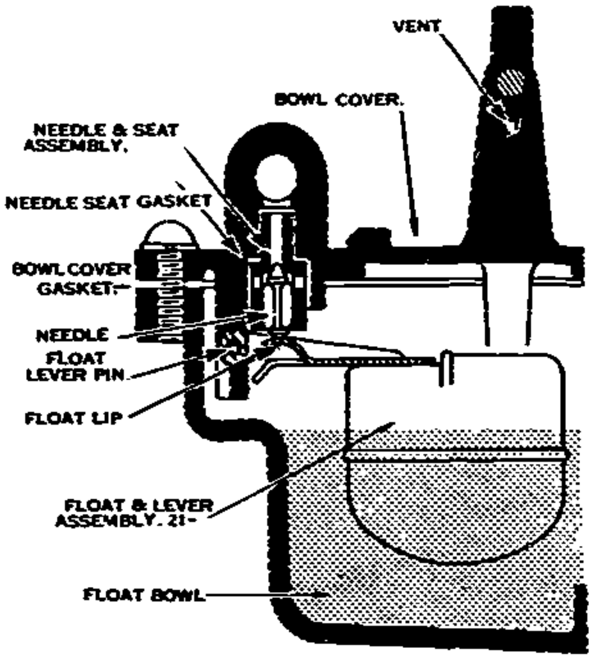


Fig. 6. A float circuit system

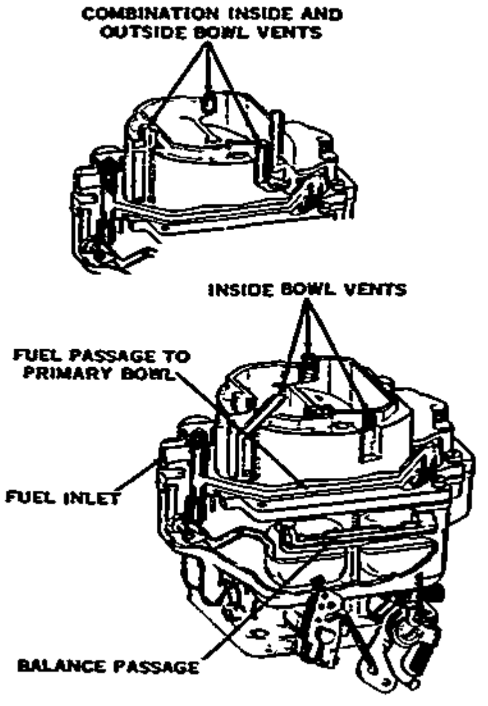


Fig. 7. An example of a two-float system

Early floats were made of cork, the pores of which were sealed with shellac to prevent the cork from becoming fuel-logged. It is quite obvious that if the float changes weight, the fuel level will change. Modern floats are hollow "cans" formed to fit the shape of the bowl. The floats are made of very thin brass and must be handled carefully to avoid punctures. When a float springs a leak, the air is replaced by fuel, which results in carburetor flooding. No amount of adjusting will correct the conditions caused by a punctured float. The bowl also contains the main metering jet, the idle and power jets, and the accelerating pump well.

Bowl location. The location of the bowl in relation to the nozzle affects both the performance and economy of an engine. When the bowl is set to one side of the barrel (eccentric), certain effects are noticed. On many carburetors the bowl is on the front, or radiator, side of the barrel. When the car is traveling on a level surface, the fuel level remains constant; but when the car climbs an incline, the liquid level in the bowl changes--the front of the level drops, and the rear level rises. This causes fuel to spill out of the nozzle, creating an extra rich condition. When a car is climbing, additional gasoline is necessary to run the engine and a certain balance is achieved by the additional fuel. When the car is going downhill, the opposite effect is obtained--the front level rises and the main nozzle is starved. Since the car is going downhill, less power is needed, and a leaner mixture is satisfactory.

This phenomenon was more noticeable in early aircraft carburetors. An aircraft not only climbs but also banks sharply to the right and the left. This led to the development of the "aerotype" carburetor which has a float bowl surrounding the barrel (concentric). The reason for this design can be demonstrated if a glass, partially filled with water, is tilted to one side. If tilted far enough, the water will spill out over the lower edge of the glass. No matter how it is tilted, however, the depth of the liquid at the center remains practically the same. Today we have single-, double-, and four-barrel carburetors employing this "concentric" principle. One model has the bowl in the center and the "throat" on the outside.

Needles and seats. Most needle valve seats are made of brass with calibrated holes to match fuel pump pressure and engine needs. The materials from which needles are constructed vary. Early needles were made of nonmagnetic steel alloys. A needle that accidentally becomes magnetized will hold any iron particles present in the fuel between it and the seat, and may cause flooding. A nonmagnetic needle therefore has certain advantages in this respect. During World War II, when metal was scarce, many carburetors were equipped with plastic needles. However, plastic needles proved to be inferior to metal types, so they are no longer used. These plastic needles are not to be confused with the metal needles that have a plastic tip. These needles are said to have the advantage of being soft enough to "surround" small particles, so they seat properly. In most cases a needle needs weight to be pulled from its seat. Sometimes float lips are clipped onto the needle to open it; other needles are spring-loaded for smoother operation.

Needle and seat assemblies come in matched sets and should never be interchanged. The sharper the needle angle and the narrower the seat, the better the seal; but this also results in a wedging action which can cause the needle to stick closed, thereby starving the engine. The flatter the needle angle and the broader the seat, the poorer the seal, but also the less reason for the needle to stick. Valve assemblies are therefore generally bevelled somewhere between these two extremes, for both sticking and leaking must be avoided.

Bowl vents. The bowl vent has the job of maintaining the required pressure on the fuel in the bowl. Unless a pressure differential is maintained between different parts of the carburetor, the fuel will not flow. A simple experiment will prove this: fill a glass about three-fourths full of water. Place a straw in the glass. Now as you draw on the straw, you create low pressure in the straw, and water is pushed up the straw by atmospheric pressure exerted on the surface of the water. Next, leave the straw in the water and pour some heated paraffin over the water and wait for the wax to cool. The atmospheric pressure will then be sealed off the surface of the water. Then when you draw on the straw, you will observe that no water is forced into the straw. This is because there is no atmospheric pressure on the surface of the water.

Some carburetors have bowl vents extending into the air horn; others, bowl atmospheric vents which upset the balance of pressure, for the advantages are always lost when there is an opening in the bowl to atmospheric pressure. Some models use metal washers on the metering rods to seal out the air; others use metal covers with gaskets over metering rods and accelerating pump assemblies.

To service a carburetor, it is necessary to know which type of venting system is employed and to understand the functioning of the system.

- The atmospheric vent. An atmospheric vent consists of a hole drilled in the bowl cover which allows air to enter the chamber. A certain amount of dust and dirt can also enter through this vent. The main disadvantage of this type of vent, however, is demonstrated when the air cleaner is plugged or restricted. The pressure in the carburetor throat then decreases below normal, but the pressure in the fuel bowl remains the same. This condition forces an excessive amount of fuel from the main nozzle, causing gas mileage to drop rapidly. Also at high altitudes, where the air is less dense, the atmospheric vent causes an unbalanced effect, resulting in a richer mixture.

- The balanced vent. The balanced vent opens into the carburetor throat, usually above the choke valve. This compensates for any air cleaner clogging. When the air cleaner of an externally vented carburetor becomes restricted (usually due to dirt), it acts like a partially closed choke. With the balanced vent, the air pressure is decreased on the fuel in the bowl as the air pressure is decreased in the carburetor throat. This tends to maintain a balance between bowl pressure and manifold pressure. This balance is also maintained at high altitudes--as the air becomes less dense and the pressure drops, the fuel-air ratio remains fairly constant. Carburetors with balanced vents are often operable at altitudes up to 10,000 or 15,000 feet with little change in fuel-air ratio.

Idle Systems

The idle system usually consists of two passages (one feeding and the other discharging), a metered jet, air bleeds, and two discharge ports (one above and one below the closed throttle). On the one below the closed throttle, a needle valve and screw control the amount of mixture for idling. On one model, an idle air control screw is used for idle speed control. The throttle valves are completely closed, and air for idle speed is introduced below the throttle valves through a separate passage controlled by a large screw.

In many cases the idle jet is screwed into a passage fed by the main jet. The main nozzle is not working while the idle system is working, and the idle system stops working when the main metering starts working, so they do not interfere with each other. In some cases the air bleeds of the idle system become part of the main metering system.

The air-fuel mixture at idle is controlled, in most cases, by the size of the jet and its air bleeds. The idle screw allows more mixture, but it does not make the mixture leaner or richer. The only way to change the air-fuel ratio is by changing the jet size. For example, suppose a car is running poorly and the engine seems to "hunt" (speed up and slow down) at 25 mph. This indicates that the idle, or low-speed, system is dropping out before the main metering system takes over. The idle screw can be turned out, but this may not help. The next step is to increase the idle jet size by about 0.002 inch. This will supply the additional fuel needed for a smooth transfer. Other factors, such as low float level, pump pressure, or vent problems can give the same symptoms, but these should have been checked out and corrected, or eliminated as a source of trouble.

Two types of carburetors have a different type of idle system. In these, the fuel is taken from one side of the throat over a "bridge" to the other side, and then down. The main nozzle is located in the center of the bridge. The theory behind this system is that there will be a continuous flow of fuel across the bridge, thereby minimizing or eliminating a "flat spot" when changing from low-speed system to main metering system at 25 to 28 mph.

Single-barrel carburetors have one idle system, dual-barrel carburetors and four-barrel or multiple carburetors have two idle systems. An idle compensator is used on cars equipped with air conditioning. This compensates by admitting more air when the engine compartment heats the air and causes it to become less dense.

Antipercolators

When an engine is running, fuel is constantly flowing through the carburetor and is therefore relatively cool. When the engine is stopped, the heat from the engine (or the sun) causes the fuel in the bowl to boil. Depending on carburetor design, a "percolating" action then develops as gasoline is forced up the nozzle and into the manifold, causing hard starting when the engine is hot.

Several different methods are used to offset this: one of the simplest and least noticeable is the one in which the main air bleed is used as an antipercolator. The main discharge tube is designed so that if any vapor bubbles are formed in the hot gasoline, the vapors pass around the outside of the tube, instead of passing through the center of the tube. These bubbles collect and condense in the dome-shaped high-speed bleed, thereby eliminating percolation troubles.

In another method, valves open to vent the bowl or main discharge nozzle when the throttle is closed. When an antipercolator vents the main nozzle, care must be taken that the valve is closed during throttle operation. Air entering through the antipercolator will cause lean mixtures, resulting in loss of power and economy. The antipercolator valves can be open only when the throttle is closed.

Bowl vent valves are used on some models as antipercolators. The carburetors with this system are usually of the balanced-vent type and the bowl vent valve is similar in operation to the nozzle type of antipercolator. The only difference is that instead of making the mixture leaner, this system can make the mixture richer. The balanced vent cannot work when the bowl is vented directly to the atmosphere by the open antipercolator valve.

Main Metering Systems

The main metering system consists principally of a nozzle, a main jet, and air bleeds. It is closely related to the power system, which is a means of enriching the mixture for power and acceleration.

Main jet. The main jet is located in the bottom of the bowl. A passage supplying the main nozzle usually supplies the low-speed jet also. When the main nozzle is in operation, the idle jet air bleeds become part of the main metering

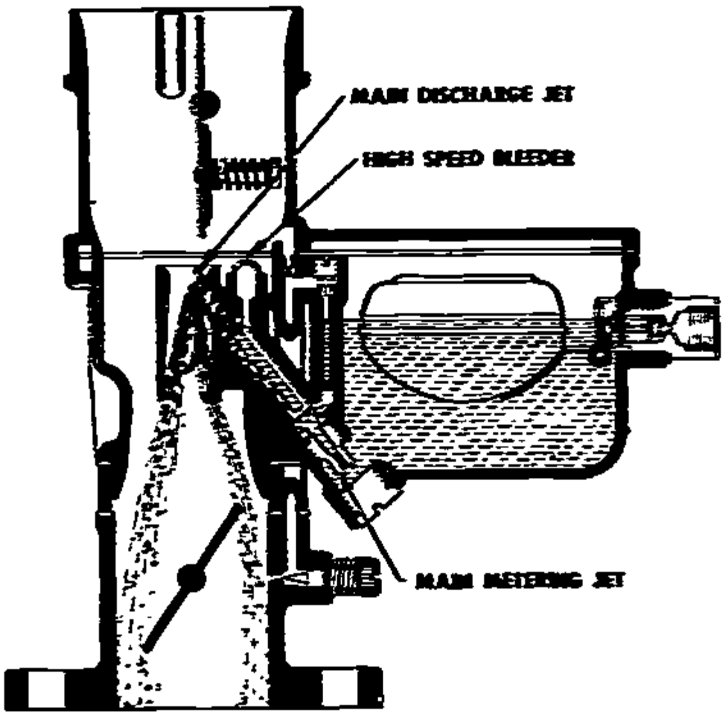


Fig. 8. A main metering system

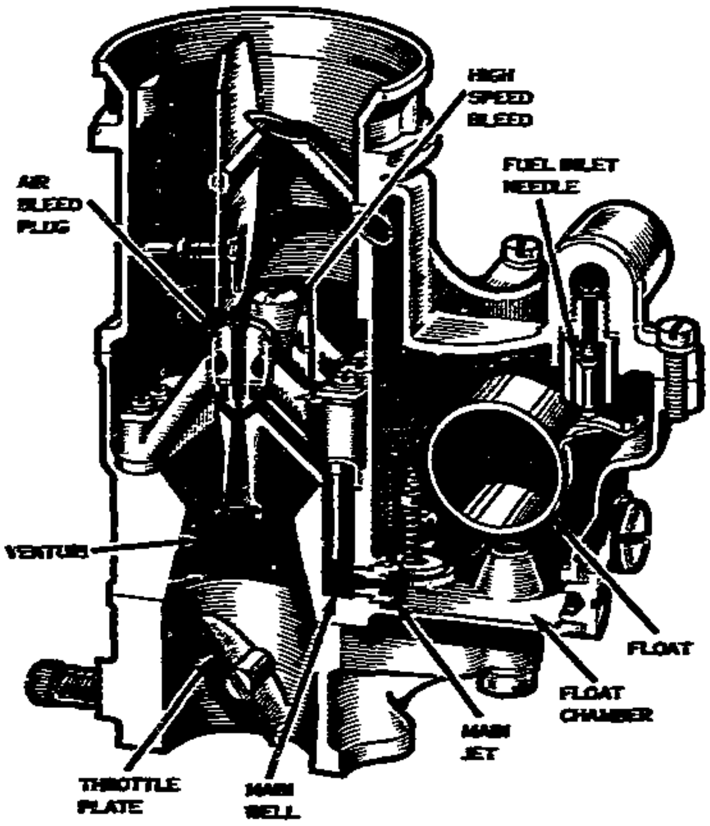


Fig. 9. A cutaway of a main metering system

system. Main jets are stamped with numbers indicating their sizes. For example, a jet marked 0.059 is fifty-nine thousandths of an inch in diameter. Jets in two or three sizes are available for most carburetors.

Main nozzles. Most main nozzles angle up from the bottom of the bowl and extend into the carburetor throat. These nozzles are surrounded by the secondary (smallest) venturi. In another type a passage or well connects to a "bridge" or crossover called a nozzle bar. The nozzle bar, also containing the idle passage, discharges fuel at the center directly into the air stream. The nozzle bar contains the necessary air bleeds. Theoretically, this provides for a smoother transition from low-speed metering to main metering. Gasoline flows through the bar at all engine speeds.

Another design of this type has a nozzle which extends up and over to the center of the carburetor throat, but does not extend to the other side. A "cluster," containing a secondary venturi, nozzles, idle jets, air bleeds, and pump discharge passages and jets, is formed.

Still another version, the concentric-bowl type, employs an inverted U passage, discharging fuel below the bowl. The bowl is in the center of the air stream or "throat."

Power System

The power system is part of, and works with, the main metering system. The main objective of the power system is to enrich the mixture for acceleration and maximum power. A common method of doing this is by a spring-loaded valve operated by a vacuum through a diaphragm or a piston and spring.

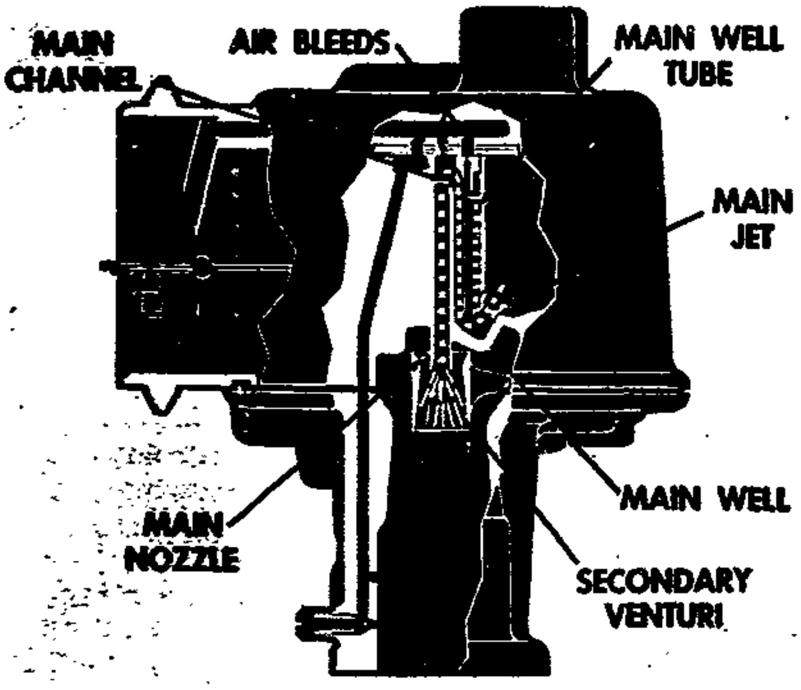


Fig. 10. A main metering system

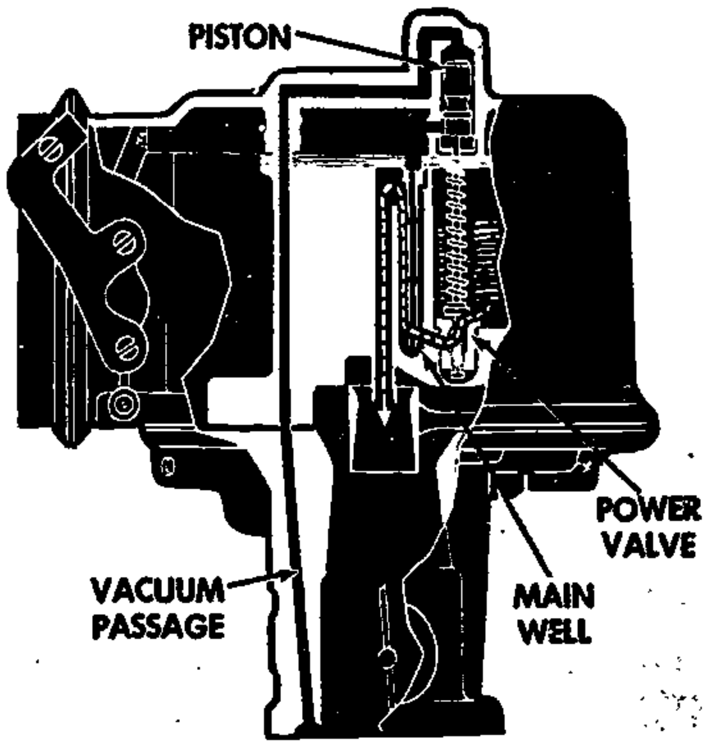


Fig. 11. A power system

In one early version of a power system, the pump discharge check valve was used as an "economizer"--actually a power valve. When the plunger reached the end of its stroke, the discharge valve was held open and additional fuel was discharged into the main stream through the pump discharge nozzle.

In most of the power systems used today, a passage to the main well bypasses the main jet and supplies additional fuel to the main nozzle.

Metering rods. The metering rod works in the main jet, changing the hole size to meet different engine demands. The metering rod is tapered, and as the size of the taper in the hole is changed, the main jet supplies the required amount of fuel.

Main metering rods are operated either mechanically or in combination with engine vacuum. During part-throttle operation, the metering rod is controlled by engine vacuum. When the throttle is opened suddenly for acceleration and at high speeds, the vacuum drops. This causes the metering rod to rise and, in effect, to increase the metering jet hole size. On some models, in addition to the vacuum control, a mechanical means of operating the metering rod is provided. The vacuum control is provided by a piston and a spring. The spring is calibrated to operate with the vacuum piston to give the proper fuel-air ratio for part-throttle operation.

Adjustment of metering rods on earlier models was rather complicated. Almost every model had a different setting. The adjustments were quite similar mechanically, but different gauges were used for different models. This made servicing difficult unless the mechanic had the proper metering rod gauges.

On most carburetors in use today, the metering rod adjustment is done without gauges. In most cases, the rods are pushed down as far as the vacuum power piston or diaphragm allows, and the lip of the mechanical lever is set so it just touches the operating bar. Other adjustments may be necessary first, like throttle opening, but these are usually explained in detail in most manuals.

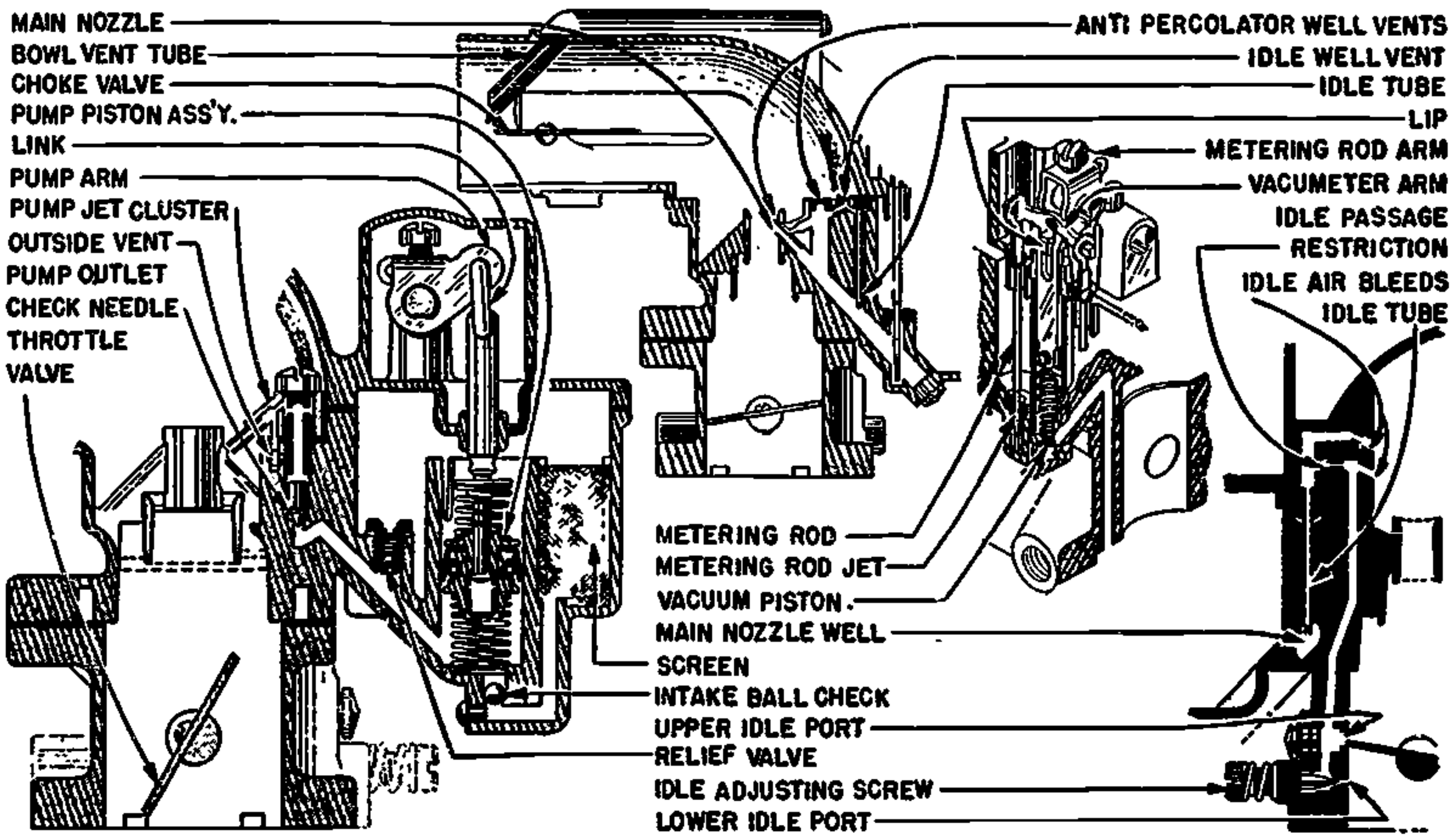


Fig. 12. A dual-type carburetor

Other power systems. Most other power systems are operated by vacuum only in conjunction with a piston and spring, or a diaphragm and spring. These work independently of the main jet. Under power conditions, the vacuum drops and the spring pushes a rod that opens a valve. The valve allows additional fuel to bypass the main jet and flow through the main nozzle.

The piston (or diaphragm) and spring can be located either in the cover or main body. One model uses an "economizer" valve located below the bowl between the throttle body and the main body. Regardless of type or location, their function is the same.

Vacuum operated power or economizer valves cannot be adjusted. The piston or diaphragm size is matched with the spring at the factory. The piston must work freely, and the spring should be replaced if it is worn or has lost tension.

Pump or Accelerating Systems

The accelerating pump can be of the piston or diaphragm type. Both types employ an intake and a discharge check valve. Since a liquid is not compressible, a means of maintaining throttle flexibility must be provided. If the throttle linkage were connected solidly to the pump, the throttle could not be opened quickly. The speed would be controlled by how quickly the fuel could flow through the discharge jet restriction. Some means must therefore be used to allow the throttle to move freely and independently of the pump.

One method is to use an inverted cup on the plunger or piston. Air is trapped in the cup, and when the throttle is opened, the air is suddenly compressed. The compressed air then pushes the fuel out of the discharge nozzle in a steady stream. The disadvantage of this system is that when the air in the cup is lost through leakage, the throttle becomes stiff because the pump now acts as a dashpot.

The most common method used is to spring-load the plunger. When the throttle is opened suddenly, the spring is compressed and operates the pump. This method is used with the diaphragm type of pump also. Another spring is used to return the plunger or diaphragm.

Some pump plungers are equipped with relief ball checks to prevent high pressure from developing in the pump circuit when the engine is not running. This prevents gasoline from being forced into the manifold and causing hard

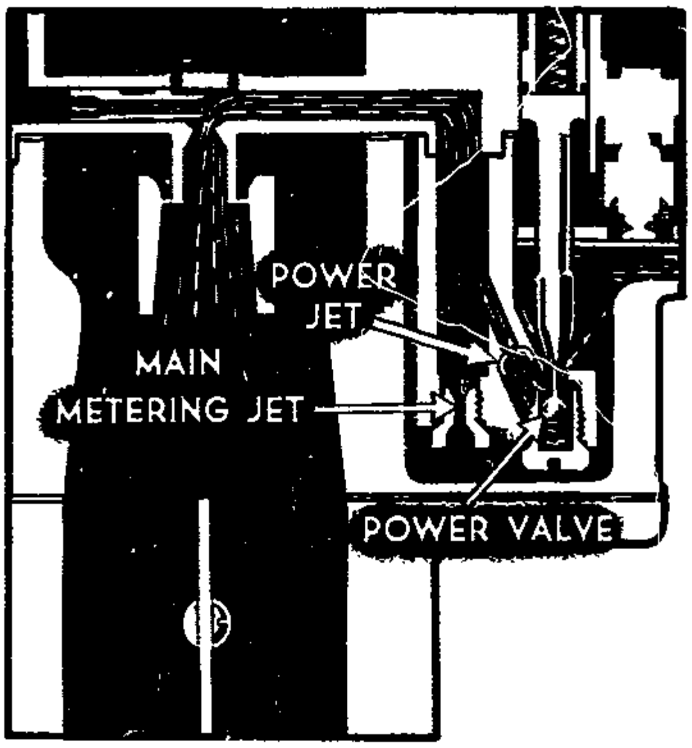


Fig. 13. A power system

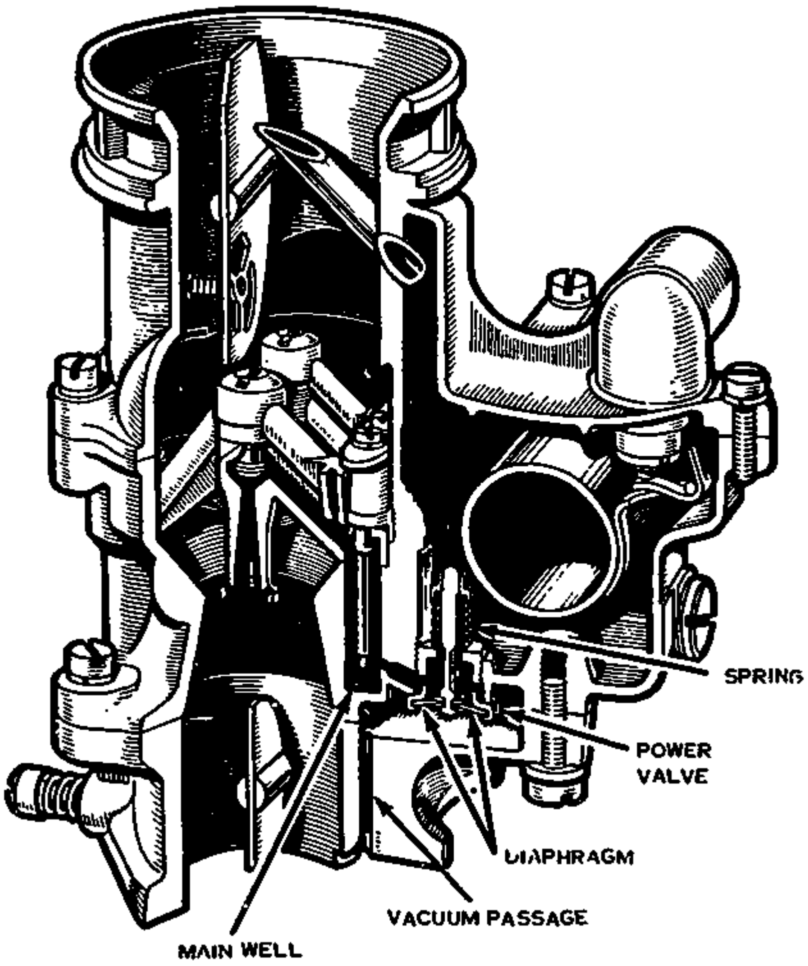


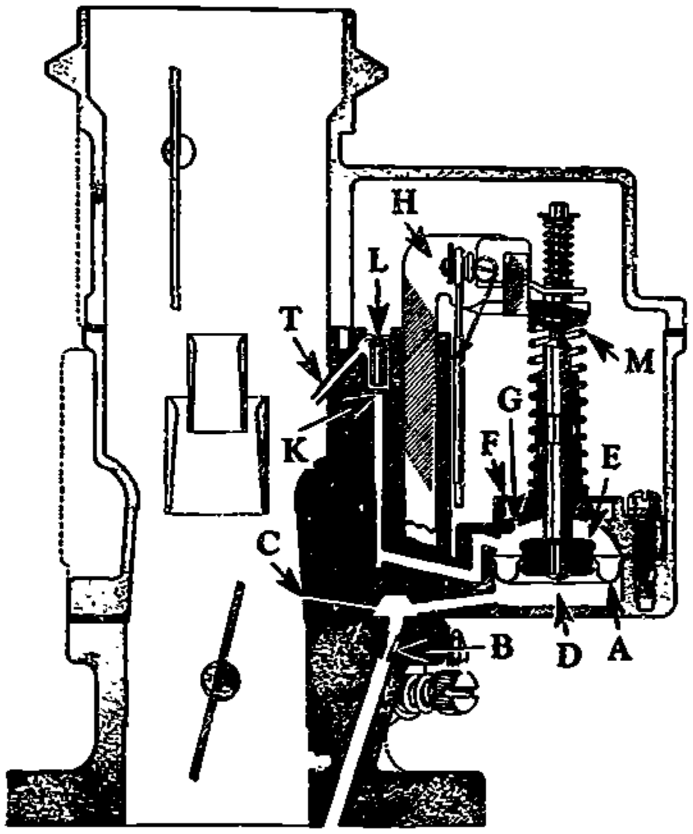
Fig. 14. A power enrichment system

starting when the engine is hot. In other words, the ball check acts as an antipercolator for the pump system and the pump intake valve.

The piston of most pump plungers has a leather cup, but some have a synthetic rubber cup. Leather has been used for many years and has given little trouble. As long as the leather is not allowed to dry out and harden, it will have a long, useful life.

Diaphragm-type pumps have a synthetic rubber diaphragm with a piece of metal on each side of the rubber. The diaphragm assembly is riveted together in the center. One side forms the seat for the return spring and the other side the seat for the operating lever.

Some pumps have two intake check valves; others have one. All have a discharge check valve. Most intake valves are of the ball type, and discharge valves are of the needle or spring-loaded ball type. Some disc-type valves were used on earlier models. In some pumps, the plunger is used as an intake valve. The fuel level is higher than the top of the plunger at all times. When the plunger is on the return stroke, vacuum created below the plunger allows fuel to pass by the cup and fill the space below. Ball discharge valves are kept closed by a spring, and needle types are kept closed by their weight, or by a vent in the cross passage. This is necessary to prevent fuel from flowing because of the differential of pressure between the pump well and the discharge nozzle.



Fuel enters pump circuit through restricted opening in diaphragm housing (G) and is discharged through a pump jet in the carburetor wall (T) on the side of the secondary venturi.

Fig. 15. A pump circuit

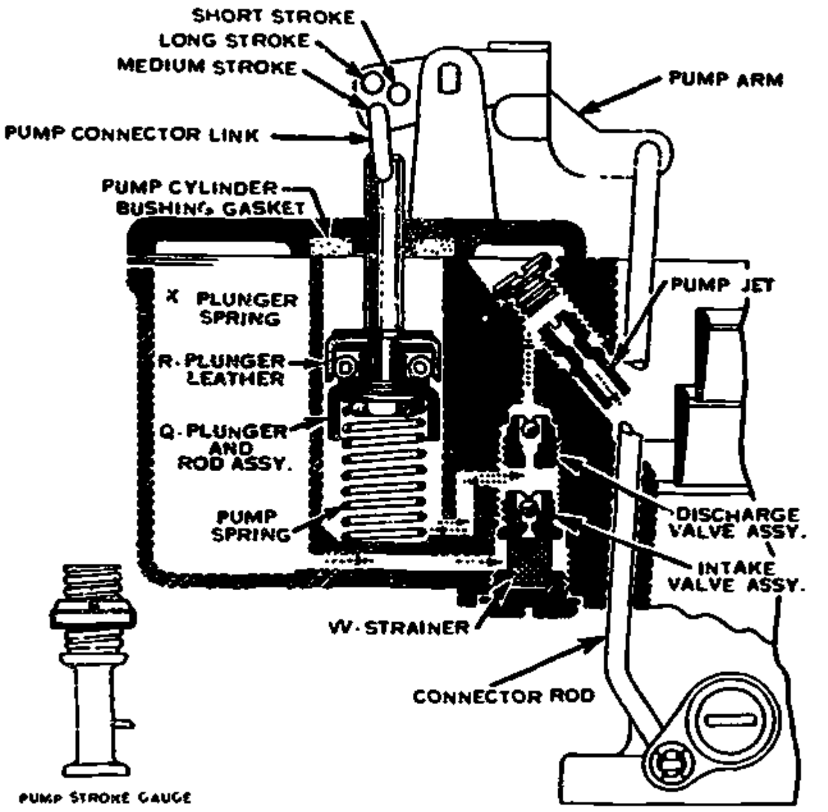
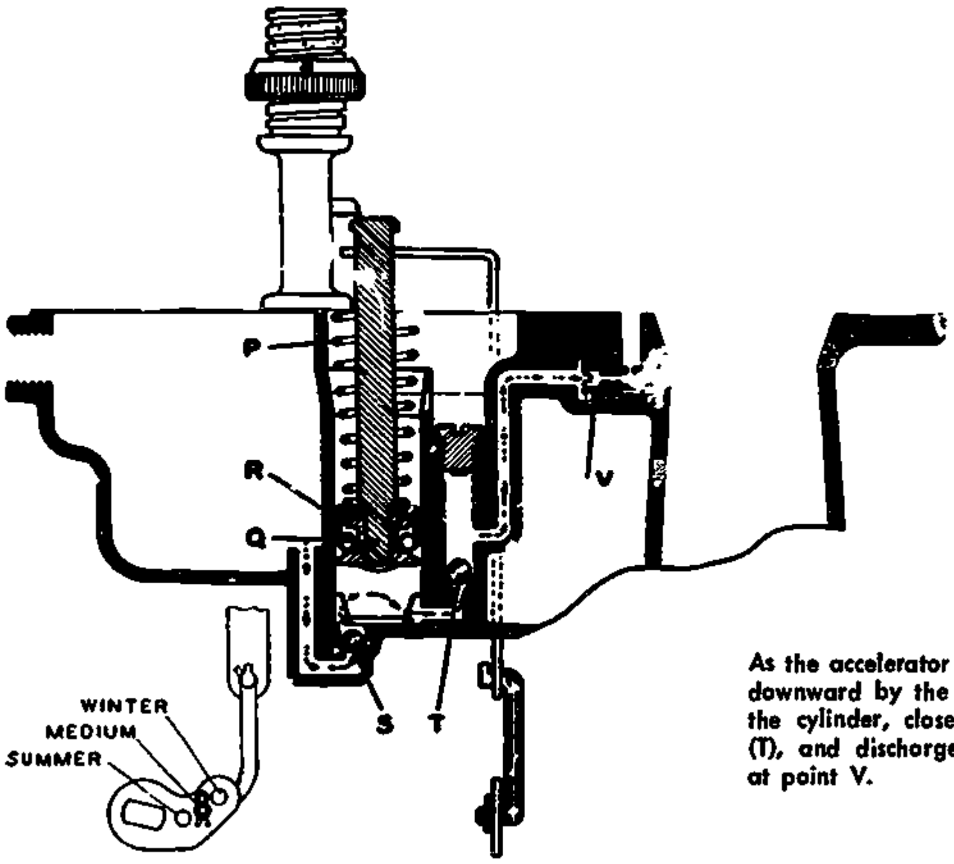


Fig. 16. A pump circuit



As the accelerator pedal is depressed, the pump piston is forced downward by the pump spring. This forces the gasoline out of the cylinder, closes the inlet valve (S), opens the outlet valve (T), and discharges gasoline into the throat of the carburetor at point V.

Fig. 17. An acceleration circuit

The discharge nozzle discharges into the barrel just above the main venturi. Most discharge nozzles are removable for service. Two- and four-barrel carburetors have one pump and two discharge nozzles. The pump and discharge nozzles are located only in the primary side of four-barrel carburetors. The only adjustment is the stroke adjustment. Some carburetors have two or three holes on the throttle lever to connect to the plunger by a link. Since each hole gives a different length pump stroke, the stroke for most economical operation can be selected. Other carburetors are provided with connecting link adjustment. The pump stroke is adjusted to specifications by bending the connecting link. The length of the pump stroke has a definite effect on gas mileage. An overlong pump stroke can decrease mileage considerably. The accelerating pump is responsible in large part for the difference between city and highway driving mileage. The pump is at the end of its stroke when the throttle is opened for a speed of approximately 55 mph.

Checkup

Most carburetor changes in recent years have been in __1__ rather than in design. 1. ________

When gasoline is forced up the nozzle and into the manifold because of heat when the engine is not running, the action is called __2__. 2. ________

Four-barrel and multiple carburetors use ___3___ idle systems.
3. ________

Float lips are often clipped onto the needle in a float system in order that the needle will ___4___ properly.
4. ________

On some carburetor models, the pump stroke is adjusted by ___5___ the ___6___ ___7___.
5. ________
6. ________
7. ________

The location of the bowl in relation to the ___8___ has a decided effect on engine performance and ___9___.
8. ________
9. ________

In all carburetors, some means must be used to allow the ___10___ to move independently of the pump.
10. ________

In some pumps the plunger is used as a(n) ___11___ valve.
11. ________

For best results, fuel level must be maintained 1/64" to 1/32" ___12___ the ___13___ tip.
12. ________
13. ________

Antipercolator valves are ___14___ when the throttle is closed and ___15___ when the throttle is open.
14. ________
15. ________

Needle and seat assemblies are supplied in ___16___ sets and should not be ___17___.
16. ________
17. ________

Two types of bowl vents are designed, called ___18___ and ___19___.
18. ________
19. ________

Most power systems work by ___20___.
20. ________

The level of gasoline in the center of a(n) ___21___ bowl remains constant regardless of carburetor angle.
21. ________

The metering rod in a carburetor is ___22___ and the amount of fuel delivered by the main jet is determined by the ___23___ of the rod.
22. ________
23. ________

Most main nozzles extend into the carburetor ___24___ or are surrounded by the ___25___ venturi.
24. ________
25. ________

The advantages of a(n) ___26___ vent are lost when an opening is available to the atmosphere.
26. ________

Idle mixture is controlled in most cases by the size of the ___27___ and its ___28___ ___29___.
27. ________
28. ________
29. ________

The primary venturi is usually cast as part of the ___30___ body.
30. ________

When fiber blocks are installed under carburetors, they act as __31__ against __32__.

31. __________
32. __________

The balanced vent compensates to some degree for __33__ __34__ restriction.

33. __________
34. __________

TOPIC 4—CHOKE SYSTEMS

Assignment

1. Automotive Encyclopedia, pp. 22-1 to 22-5.
2. Crouse, Automotive Mechanics, pp. 145-49.

Introduction

A combustible fuel-air mixture richer than that needed for normal operation is essential in starting a cold engine. Nearly all carburetors are equipped with chokes to reduce the air supply and thus permit the mixture to become enriched. The chokes on some carburetors are operated manually, those on others by automatic control. The automatic chokes must be kept in good working condition and proper adjustment to secure proper mixture for starting and running.

One European make of carburetor has no choke, but is equipped with a special jet that feeds extra gasoline into the mixture to secure enrichment. This jet, called the "starter jet," is sometimes equipped to be controlled manually, and sometimes to be controlled automatically.

Related Information

Automatic control of chokes is accomplished by employing a mechanism that is controlled by temperature. When the engine is cold, the choke is closed to enrich the fuel-air mixture; as the engine warms up, the choke opens. The conventional thermostatic spring and vacuum piston type of automatic choke is slowly being replaced by a system utilizing only the thermostatic spring, which both opens and closes the choke valve. Since no pistons are used in this new system, one of the major problems encountered in servicing the conventional type of automatic choke is thus eliminated.

Fast idle. The fast idle has a function much more important than just keeping a cold engine from stalling. This function is to provide the lubrication needed to secure efficient engine operation--minimum wear and maximum performance. When an engine is left idle for any period of time the oil drains off the cylinder walls and piston rings. If the engine is started and idled slowly, the amount of oil thrown off the crankshaft and connecting rods will not be sufficient to oil the cylinder walls adequately to prevent excessive piston ring wear and ring blowby. The idle speed should therefore be sufficiently great for sufficient oil to be thrown onto the cylinder walls to provide the required lubrication and ring sealing. The fast idle speed required for this purpose is approximately that of the engine when the car is traveling 25 mph.

Many drivers pump the accelerator pedal several times before they attempt to start the motor. In doing so they cause additional fuel to be thrown into the carburetor by the accelerator pump. This fuel is not needed if the engine is equipped with an automatic control that is working properly. But if the control is not working properly they may get satisfactory starting and then be unable to understand why the motor stalls frequently until it is warmed up. When a customer reports that the engine in his car starts well, but then stalls and must be restarted several times, a mechanic should inquire whether the customer pumps the gas pedal before he starts the motor. If this is the case, the mechanic then has reason to believe that the automatic choke needs to be serviced.

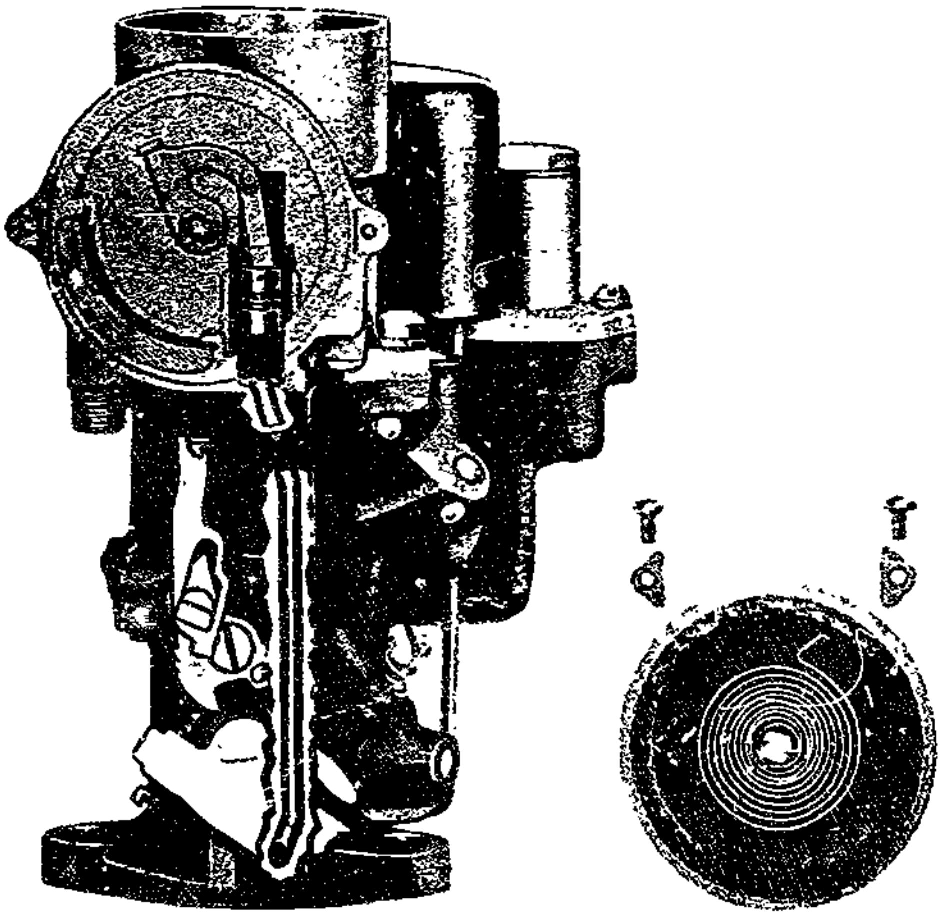


Fig. 18. A climate control circuit

Checkup

Choking devices are used to provide a(n) __1__ mixture for starting and a somewhat __2__ mixture for __3__.

Chokes are either __4__ or __5__ in operation.

1. ________
2. ________
3. ________
4. ________
5. ________

The thermostatic spring depends on engine ___6___ for expansion.

6. ___________

On the Carter climate control, the spring ___7___ the choke and the ___8___ piston ___9___ the choke.

7. ___________
8. ___________
9. ___________

Heat is obtained from the exhaust ___10___ to operate ___11___ springs.

10. ___________
11. ___________

The Sisson choke employs a(n) ___12___ to close the choke and a(n) ___13___ ___14___ to open it.

12. ___________
13. ___________
14. ___________

Some choke valves are set off-___15___ to allow air velocity to open the choke ___16___.

15. ___________
16. ___________

The fast idle is to keep the engine from ___17___ and to lubricate the ___18___ ___19___.

17. ___________
18. ___________
19. ___________

The thermostatic spring is made up of two metals with different ___20___ rates.

20. ___________

The same result as choking can be achieved by adding more ___21___ instead of restricting the ___22___.

21. ___________

TOPIC 5—AIR FILTERS AND CLEANERS

Assignment

1. Automotive Encyclopedia, pp. 24-1 to 24-3.
2. Crouse, Automotive Mechanics, pp. 132, 334-35.

Introduction

The proper functioning of a carburetor requires that the air cleaner must be clean, so that the air intake of the carburetor is sufficient to permit the proper fuel mixture. Therefore, when a carburetor is serviced, the air filter or cleaner should always be examined and cleaned or replaced, depending upon its type and its condition.

The air cleaner on a carburetor acts as the "nostrils" of the gasoline engine. It filters every bit of air that enters the carburetor, keeping out dust, lint, soot, and other foreign particles. A dirty filter element restricts the flow of air to the carburetor and this in turn causes the engine to run poorly. Furthermore, restricted air flow into an externally vented carburetor causes the air-fuel mixture to be even richer, which reduces the engine's efficiency. However, a clean air filter will not reduce engine efficiency because the carburetor has been calibrated with the cleaner installed. On all factory-equipped air cleaner installations, the added restriction of the air cleaner is compensated for in the carburetor jets so that the maximum performance is maintained.

Because the air cleaner works during every mile that a car, truck, or tractor is driven, an accumulation of some dirt is expected in normal use and is compensated for in its design and that of the carburetor.

Related Information

Fuel economy. Air cleaners are designed with a minimum of air resistance, and they can safely be used on any car for which they are recommended by the manufacturer without risk of impairing gasoline economy or engine performance. It is true that removing a restricted cleaner or a portion of it will increase the mileage, but this increase in mileage is obtained only at a sacrifice of other performance characteristics, such as acceleration and power, and carries with it the danger of increased engine wear. Increasing very low gasoline mileage by removing a part (or all) of the air cleaner is a dangerous practice, since it can damage an engine. The same increase in mileage could probably be obtained with the air cleaner installed correctly if the carburetor and engine were in good condition and properly adjusted. The gasoline mileage will be correct for a particular car when the air cleaner specified for that carburetor and engine is used.

If still greater fuel economy is desired, the solution is not to be found in the removal of engine safety devices, such as air cleaners. The correct approach is to make the necessary adjustment in air-fuel ratio and reduction in the size of carburetor jets. This will improve gasoline economy without endangering performance of the engine.

Oil-bath air cleaners. Some impairment of the function of an oil-bath type air cleaner can be caused by a too-high oil level. A high oil level in an oil-bath air cleaner may be due to servicing with too much oil or to the presence of water that could enter when the car is washed. Too high an oil level may cause either pull-over or splash-over. Of these two conditions, pull-over is probably the most dangerous, since it can result in gumming of the carburetor and also pulling of road dirt, mixed with the oil, into the carburetor. Danger of pull-over in warm climates can be minimized by the use of SAE 50 oil in the oil reservoir. Splash-over results in decreased cleaner efficiency due to loss of reservoir oil.

Air restriction can be caused by an overfilled oil reservoir in oil-bath types of cleaners; by a dirty or inadequately cleaned mesh element; by a jarred part in the cleaner; or by a dent in the original shape which restricts the passage of air. Any air restriction lowers gasoline mileage.

Oil-wetted air cleaners. The filter unit in an oil-wetted type air cleaner that is not serviced regularly may dry out. This drying can result in a loosening of the accumulated dirt that was originally trapped in the element, which can be sucked into the carburetor and engine.

Air leakage. Any air cleaner that stays unusually clean between servicing times should be examined thoroughly for air leakage. Air leakage might occur at the air cleaner neck or at the cleaner cover, as a result of a bent or warped condition, or possibly a broken or dried-up cover gasket.

Crankcase ventilation air cleaners. The inlet to the crankcase is protected by a somewhat smaller, but equally important, air cleaner. Its purpose is to remove dirt particles from air entering the crankcase. Crankcase ventilation air cleaners are supplied in two general types--oil-wetted mesh and oil bath.

The location of crankcase ventilation air cleaners varies on different makes of vehicles: some are placed on the oil filler tube; some on the tappet cover plate; and others on the overhead valve cover plate.

Service of crankcase breather air cleaners is performed in the same manner as service of carburetor air cleaners. The filter mesh (the more common

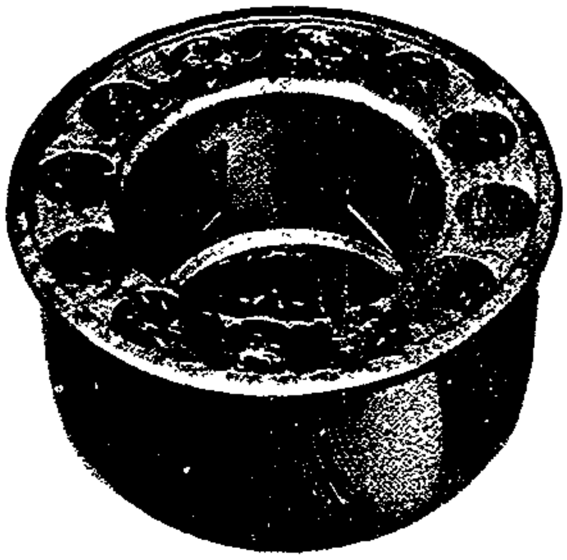


Fig. 19. Crankcase breather type filter

type) must be washed out in cleaning fluid, dried, and reoiled. In oil-bath types, the oil must be renewed and the mesh element washed out.

Checkup

The purpose of the air cleaner is to reduce the amount of __1__ and __2__.

1. ________
2. ________

The air cleaner also acts as a(n) __3__ arrestor.

3. ________

On the oil-bath type, the dirt is trapped in the oil because of the __4__ of the __5__ flow.

4. ________
5. ________

A highly efficient air cleaner is the __6__ element type.

6. ________

One of the least efficient types of air cleaner is the __7__ __8__ type.

7. ________
8. ________

The oil-bath type cleaner normally uses a(n) SAE __9__ oil, but a warm climate calls for SAE __10__ oil.

9. ________
10. ________

Small air cleaners are used on __11__ ventilation systems.

11. ________

As much as __12__ of air passes through an air cleaner every thousand miles.

12. ________

TOPIC 6—SUPERCHARGERS

Assignment : Automotive Encyclopedia, pp. 9-4 and 26-6 to 26-9.

Introduction

Superchargers are not used to any great extent on American passenger cars. There are several reasons for this, mainly the high initial purchase cost and the inefficiency with which they operate at low speeds. They are, however, used on some cars, and this makes it necessary for a mechanic to understand how superchargers function and to learn how to service them.

Checkup

Superchargers increase overall __ 1 __.
1. ________

Rootes-type blowers run at __ 2 __ to __ 3 __ times engine speed.
2. ________
3. ________

On a diesel engine only __ 4 __ is blown into the cylinders.
4. ________

The increase in horsepower of a supercharged engine is not proportional to the __ 5 __ consumed.
5. ________

The turbo-charger has the advantage of using __ 6 __ __ 7 __ for its source of power.
6. ________
7. ________

The supercharger is needed for __ 8 __ speed driving but not for __ 9 __ speed driving.
8. ________
9. ________

Superchargers are used extensively on __ 10 __ cars, and to a limited extent on __ 11 __ cars and trucks.
10. ________
11. ________

There are two general types of superchargers: the __ 12 __ type and the __ 13 __ type.
12. ________
13. ________

A centrifugal type supercharger can easily attain a speed of _14_.

Superchargers can be installed either between the _15_ and the _16_ or at the _17_ _18_ of the carburetor.

14. ________
15. ________
16. ________
17. ________
18. ________

unit C | CRANKCASE VENTS AND MANIFOLDS

TOPIC 1—CRANKCASE SMOG DEVICES

Assignment

1. Crouse, Automotive Mechanics, pp. 185-86.
2. Handbook for Installation and Inspection Stations: Motor Vehicle Pollution Control (Crankcase Devices), California Highway Patrol, pp. 1-36.

Introduction

Crankcase smog devices have been used on commercial and military vehicles for 25 years or more. Also, enclosed engines, such as those used for bus air conditioning as early as 1940, are installed in baggage compartments; and the crankcases of these engines are ventilated through crankcase smog control devices to prevent objectional odors from seeping into the passenger compartments and to remove water vapors from cold-running engines.

All new cars sold in California must be equipped with crankcase smog control devices. In addition, California law makes it mandatory that such devices be installed on other American-made cars manufactured since 1955 and which are registered in areas organized as pollution control districts. This extended use of crankcase smog control devices has presented many new problems and it is increasingly important for every mechanic to know how these devices function, how to install and service them, and how they relate to other engine units.

Related Information

Crankcase smog control systems are actually closed crankcase ventilation systems. In these systems the road draft tube on the crankcase is sealed shut or eliminated, and a tube is installed through which the gas vapors are drawn from the crankcase into the intake manifold, either directly or indirectly through the carburetor or air cleaner. From the intake manifold, the vapors go into the cylinders, where they are burned and many of the objectionable hydrocarbons thus eliminated. These closed crankcase systems are called "smog control devices," for their function is to reduce smog-producing elements.

Types of devices. The type of device connected below the carburetor has a spring-loaded valve with a metered hole that controls the air flow. When the vacuum is high (idling), the valve is seated, allowing air to enter through the metered hole only; but as engine speed increases, the valve is lifted off its seat and air passes around the valve as well as through the metered hole.

Another type is connected to both the intake manifold and the air cleaner through a diaphragm valve. At idle and low engine speed, the air passes through the valve body by means of a small tube connected below the carburetor. At speeds above idle, the valve is opened, and air flows through to the air cleaner.

The simplest type of all consists of a hose leading from the crankcase to the clean air side of the air cleaner, thus avoiding clogging the air cleaner. This is quite similar to devices sold to take care of excessive blowby of fumes caused by worn or stuck rings. Neither of these devices operates through a valve.

Deposits. All these smog control devices have one fault in common, though each may have different effects on engine operation: crankcase vapors contain fumes that leave deposits along paths they travel and therefore carbon accumulation occurs inside the hoses, valves, connections, and tubes. As this accumulation builds, the efficiency is reduced, and since the devices are calibrated to work with the carburetor, the function of the carburetor is disturbed to a point where rough engine idling, misfiring, loss of power at all speeds, or blowing of oil from the breather cap and seals results.

If the devices are connected through the air filter, the vapor from the crankcase will soon clog the carburetor air cleaner filter element. If the devices are connected to the carburetor below the air cleaner, the vapor will be pulled directly through the carburetor throat. Clogging of the air filter is thus avoided, but "dirty" air is drawn through the air bleeds and clogs them. Detergents and other cleaning agents in most modern gasolines keep fuel passages relatively clean, but there is no means of preventing buildup in the air bleeds, which can have a detrimental effect on gasoline economy. For example, in a 0.010-inch air bleed hole with a 0.002-inch deposit, the air flow will be reduced to less than half. The carburetor must be cleaned frequently to keep the air bleeds open.

Failure of a smog control device to function has the same effect as a plugged road draft tube--excessive crankcase pressures are built up and oil is thrown out the breather cap, past the rear main seal, and through any other openings. Care must therefore be taken to make sure that smog control devices are examined at regular intervals and given the service required. Factory recommendations should be followed in servicing those on new engines; those on older engines--especially those with excessive blowby--should be serviced at relatively short intervals. Cars used for slow or intermittent driving tend to accumulate more engine carbon than those driven at high speed for prolonged periods. The smog control devices on cars that are used for slow or intermittent driving will therefore plug up faster than those on cars driven fast for prolonged periods and must therefore be serviced at shorter intervals. The intervals may vary from 6,000 to 12,000 miles, with servicing of the devices ranging from cleaning to complete replacement.

Checkup

Crankcase ventilating systems are designed to remove 1 and 2 vapors.

1. ________
2. ________

Positive crankcase ventilation has been in use for more than 3 .

3. ________

The worst problem of smog control devices is 4 accumulation and 5 .

4. ________
5. ________

Crankcase vapors can be drawn into the engine 6 or 7 the carburetor or 8 ways.

6. ________
7. ________
8. ________

Stopped-up smog control devices can cause 9 to be thrown out of the 10 cap because of excessive crankcase 11 .

9. ________
10. ________
11. ________

In one type of valve, air goes through the center of the valve at 12 speeds and around and through the valve at 13 speeds.

12. ________
13. ________

An air bleed can be restricted more than 14 by 15 deposits.

14. ________
15. ________

Engine damage can result from a(n) 16 or inoperative crankcase ventilation system.

16. ________

A license to operate an official smog control device installation and inspection station will be issued only to stations meeting 17 18 .

17. ________
18. ________

Many crankcase devices designed to control blowby gases have been certified by the Motor Vehicle 19 20 21 .

19. ________
20. ________
21. ________

One of the basic characteristics of the tube-to-air cleaner type device is that it tends to 22 the air-fuel mixture.

22. ________

Combination systems that use a fixed orifice to control the flow to the intake manifold can provide 23 emission control under 24 engine speeds.

23. ________
24. ________

In order for the road draft tube to work effectively, the vehicle must be traveling at a speed of 25 or better.

25. ________

Any indication of a faulty engine, or an engine that tends to run rough, should be called to the attention of the car owner 26 a smog control device is installed.

26. ________

TOPIC 2—ENGINE MANIFOLDS

Assignment

1. Automotive Encyclopedia, pp. 23-1 to 23-6.
2. Crouse, Automotive Mechanics, pp. 90, 149-52.

Introduction

The intake manifold conducts the air-fuel mixture from the carburetor to the cylinders, and the exhaust manifold, usually made of a gray cast iron alloy, conducts the burned gases from the cylinders to the exhaust pipe. The exhaust manifold is internally streamlined to prevent the build-up of back pressure, for such pressure impairs cylinder scavenging. The exhaust manifold must be large enough to permit rapid expansion of the gases discharged into it from the cylinder and to permit rapid discharge of the gases into the exhaust pipe before excessive heat or pressure can build. This is also one of the provisions made to secure quiet motor operation.

The manifolds seldom cause trouble, but the mechanic should know why they are designed as they are and be prepared to identify and correct any conditions that may cause them to function improperly.

Checkup

Because of ___1___ temperatures and ___2___ from the exhaust, the manifold heat valve shaft is mounted on ___3___ steel bushings.

1. ________
2. ________
3. ________

Intake manifolds serving dual carburetors are designed so a(n) ___4___ number of cylinders is supplied by each carburetor ___5___, as required by the firing order.

4. ________
5. ________

It is important that a minimum of heat reaches the carburetor to avoid ___6___ ___7___ and ___8___.

6. ________
7. ________
8. ________

A groove is cut in the ___9___ of the carburetor where it is ___10___ to the manifold to equalize ___11___ in sections of the ___12___ manifold.

9. ________
10. ________
11. ________
12. ________

The usual arrangement of manifold parts is to "_13_" as many as possible.

13. ________

One of the important factors affecting distribution is that the heavy particles of the _14_ _15_ have greater _16_ than the lighter particles.

14. ________
15. ________
16. ________

The difficulty in designing intake manifolds is to provide each cylinder with the same _17_ and _18_ of fuel.

17. ________
18. ________

unit D | BASIC ELECTRICITY

TOPIC 1—NATURE OF ELECTRICITY

Assignment

1. Automotive Encyclopedia, pp. 30-1 to 30-5.
2. Fundamentals of Electricity and Magnetism (Section A, Delco-Remy Training Chart Manual), pp. 1-5 and 22-23.

Introduction

The basic principles of magnetism, electricity, and electronics must be understood before anyone can understand the functioning of automotive electrical equipment and systems. The increased use of a-c generators (alternators) and various transistorized units in the d-c systems--with every promise of many further developments along the same lines--makes it apparent that a mechanic must not only know electrical circuits, but that he must be continually studying to learn about the new improvements introduced and how they are serviced.

The molecular structure of matter, the makeup of atoms, the phenomena of magnetism, and the movement of electrons through solids are all subjects directly related to the study of harnessing electricity for useful work. In this study, the electron theory is of prime importance. The movement of electrons makes current flow possible, and current flow is electricity in motion--electricity at work. Electron flow is from negative to positive, which is directly opposite to an idea arbitrarily adopted over a century ago, called the current theory, which held that current flow was from positive to negative. Electric current is electron flow, free electrons moving along a given path, always from a negative source to a positive terminal.

Checkup

The accepted theory is that electricity is a flow of __1__.

Electric current is caused by the __2__ of electrons from one __3__ to __4__.

1. __________
2. __________
3. __________
4. __________

Similarly electrified bodies __5__ each other, while oppositely electrified bodies __6__ each other.

5. ________
6. ________

Ohms law is expressed by the formula __7__ over __8__.

7. ________
8. ________

One ohm is the amount of __9__ needed to limit the current rate to one __10__ when a pressure of one __11__ is applied.

9. ________
10. ________
11. ________

Two basic circuits are the __12__ and the __13__.

12. ________
13. ________

For electricity to flow, a circuit must be __14__.

14. ________

A good conductor is a material containing a substantial number of __15__ electrons.

15. ________

To create a flow of electrons through a circuit, it is necessary to have an electrical __16__.

16. ________

The unit used to measure electrical power is the __17__.

17. ________

In a series circuit the total resistance is the __18__ of the __19__ resistances.

18. ________
19. ________

The decrease in voltage as current passes through a resistor is known as the __20__ __21__.

20. ________
21. ________

Visualizing the existence of open spaces in all materials helps in understanding __22__ flow in seemingly __23__ material.

22. ________
23. ________

The electrical unit for measuring work is called the __24__.

24. ________

TOPIC 2—MAGNETS AND MAGNETISM

Assignment

1. Automotive Encyclopedia, pp. 30-5 to 30-10.
2. Fundamentals of Electricity and Magnetism, (Section A Delco-Remy Training Chart Manual), pp. 6-21.

Introduction

Magnetism is used to operate many electrical units of an automobile. Charging circuits, ignition components, and starting motors all work on magnetic principles. The mechanic who understands these principles and knows how to employ them has little trouble in locating improper functioning in any of these units or in servicing them.

When studying this subject it will be found that reference is made to both the right and left hand rule of determining the direction of current flow. To avoid confusion between these two rules, it should be kept in mind that the right hand rule is based on the current theory; that is, that current travels from positive to negative. The left hand rule is based on the electron theory; that is, electrons travel from negative to positive (see Topic D-1). Both rules will provide the same answer if properly applied. Some authors use the word current to mean electron flow; however, whenever the word current is used, it is usually referring to the current theory. Electron flow is usually described as such.

Checkup

Like poles ___1___ and unlike poles ___2___ each other.

Soft iron loses nearly all of its ___3___ ___4___ when it is removed from the magnetic ___5___.

There is always a magnetic ;field around a conductor carrying an electric ___6___.

The right hand rule is used with the ___7___ theory, and the left hand rule is used with the ___8___ theory.

1. __________
2. __________
3. __________
4. __________
5. __________
6. __________
7. __________
8. __________

The right hand rule is used to determine the ___9___ of coils.

9. __________

A solenoid is an ___10___ core magnet.

10. __________

The strength of a magnetic field surrounding a wire is in direct ___11___ to the number of ___12___ and the strength of the ___13___.

11. __________
12. __________
13. __________

The strength of a magnet is often discussed in terms of ___14___ turns.

14. __________

The kind of iron used in the core of electromagnets and the ___15___ of lines of force created have a pronounced effect on the total ___16___ ___17___ obtained.

15. __________
16. __________
17. __________

When the only function of a solenoid is the closing of switch controls, it is called a(n) ___18___ switch.

18. __________

The force of attraction of a magnet is inversely proportional to the ___19___ of the ___20___ fromthe magnet.

19. __________
20. __________

TOPIC 3—CIRCUITS, SYMBOLS, AND CONDUCTORS

Assignment

1. Automotive Encyclopedia, pp. 36-4 to 36-10 and 36-25.
2. Fundamentals of Electricity and Magnetism (Section A, Delco-Remy Training Chart Manual), p. 22.

Introduction

The mechanic must be qualified to replace original wiring or to install new wiring for added accessories. In many instances to do the work he must read the manufacturer's drawing or blueprint, a skill that requires interpretation of the symbols used and knowledge of electrical circuits and conductors.

Checkup

A circuit is a(n) __1__ path for the __2__ of electricity.

1. __________
2. __________

If the wire is too small in diameter, the resistance will be too __3__ for proper operation of the particular electrical unit.

3. __________

Circuit __4__ and fuses protect the circuit from __5__ in cases of __6__ and __7__.

4. __________
5. __________
6. __________
7. __________

High tension cable should be designed to withstand the effects of __8__, __9__, __10__, __11__, __12__, and __13__.

8. __________
9. __________
10. __________
11. __________
12. __________
13. __________

A circuit which offers only one path for electricity to follow is called a(n) __14__ __15__.

14. __________
15. __________

A circuit which offers more than one path for electricity to follow is considered a(n) __16__ __17__.

16. __________
17. __________

A circuit that comprises both single and multiple paths for current flow is called a __18__ - __19__ __20__.

18. __________
19. __________
20. __________

Resistor ignition cable is made up of __21__ and __22__ thread, treated with __23__.

21. __________
22. __________
23. __________

When a five-foot piece of 14-gauge wire, carrying a 75 cp lamp load, is lengthened to 15 feet, the circular mil area of the new conductor needs to be more than __24__ the original.

24. __________

unit E | BATTERIES

TOPIC 1—BATTERY CONSTRUCTION

Assignment

1. Automotive Encyclopedia, pp. 36-13 to 36-16.
2. Crouse, Automotive Mechanics, pp. 200-04.
3. Storage Batteries (Section B, Delco-Remy Training Chart Manual), pp. 1-7.

Introduction

One main function of the battery is to supply current for the operation of the starter and the ignition system to get the engine running. The resulting loss of charge is compensated for by the generator, which recharges the battery during engine operation. Another function of the battery is to supply current to the other electrical circuits during the periods when the generator is not charging. To understand why the battery functions as it does, the mechanic must be familiar with its construction.

Checkup

Wooden sheets, ___1___ ___2___ matted into sheets, and porous ___3___ sheets are used as separator material in batteries.

1. ____________
2. ____________
3. ____________

Negative plate groups normally contain ___4___ more ___5___ than the corresponding ___6___ groups.

4. ____________
5. ____________
6. ____________

Charged negative plates contain ___7___ lead which is ___8___ in color.

7. ____________
8. ____________

Charged positive plates contain ___9___ ___10___, which has a ___11___ color.

9. ____________
10. ____________
11. ____________

The electrolyte for lead acid batteries is made up of ___12___ and ___13___ ___14___.

12. ____________
13. ____________
14. ____________

Cells are connected in __15__ to obtain the battery __16__ desired.

15. ________
16. ________

The basic reason for adopting 12-volt electrical systems for passenger cars was to improve __17__ performance and provide greater __18__ __19__ on high-compression eight-cylinder engines.

17. ________
18. ________
19. ________

The lead acid storage battery is a(n) __20__ device for converting __21__ energy to __22__ energy.

20. ________
21. ________
22. ________

Battery cases are usually made of hard __23__ or __24__ composition.

23. ________
24. ________

The greater the number of plates, or plate __25__, the greater the __26__ of the cell.

25. ________
26. ________

TOPIC 2—PRINCIPLES OF BATTERY OPERATION

Assignment

1. Automotive Encyclopedia, pp. 36-16 to 36-19.
2. Crouse, Automotive Mechanics, p. 204.
3. Storage Batteries (Section B, Delco-Remy Training Chart Manual), pp. 8-13.

Introduction

Once the apprentice mechanic has studied the various components of a battery, he should learn the function of each component and how it contributes to the function of the battery as a whole.

Checkup

Cell voltage depends primarily upon the ___1___ between plate ___2___.

1. ___________
2. ___________

While a battery is discharging, the ___3___ acid is used up and replaced by ___4___.

3. ___________
4. ___________

The sulfate radical ___5___ with the lead at both ___6___ to form lead ___7___.

5. ___________
6. ___________
7. ___________

Water in the battery is used up when ___8___ occurs.

8. ___________

A fully charged battery is not likely to freeze because the amount of ___9___ in the electrolyte is at a minimum.

9. ___________

Charging drives the ___10___ out of the ___11___.

10. ___________
11. ___________

After the battery is quick-charged, the ___12___ ___13___ reading may be erroneously low because of the ___14___ in the electrolyte.

12. ___________
13. ___________
14. ___________

The percent of sulfuric acid remaining in the ___15___ determines approximately how much ___16___ is available.

15. ___________
16. ___________

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To compensate for the effect of temperature on a specific gravity reading, 17 gravity points must be 18 to the gravity reading for every 19 of electrolyte temperature above 20 F.

17. ________
18. ________
19. ________
20. ________

Separators are damaged by 21 .

21. ________

Any 22 in the water detrimentally affect the life and performance of a battery.

22. ________

TOPIC 3—BATTERY SERVICE

Assignment

1. Automotive Encyclopedia, pp. 36-19 to 36-26.
2. Crouse, Automotive Mechanics, pp. 356-62.
3. Storage Batteries (Section B, Delco-Remy Training Chart Manual), pp. 14-20.

Introduction

After the mechanic learns how a battery is made and how it functions, his next step is to learn how to determine its condition, and service it when required. The exterior condition of a battery can be checked by visual inspection, but the interior condition can be checked only by the use of proper testing equipment.

Checkup

The usual methods used in converting alternating to direct current are ___1___ - ___2___, ___3___ ___4___ rectifiers, and ___5___ - ___6___ rectifiers.

1. ________
2. ________
3. ________
4. ________
5. ________
6. ________

High charging rates can be used, providing the temperature of the electrolyte does not exceed ___7___ F and charging does not cause excessive ___8___ and loss of electrolyte.

7. ________
8. ________

Behavior during charge can indicate many important ___9___ of a storage battery.

9. ________

Batteries are tested to determine the ___10___ condition of the electrolyte and the ___11___, or ability to deliver ___12___.

10. ________
11. ________
12. ________

The light load test, claimed to be simpler and more conclusive than the hydrometer test, is accomplished with a(n) ___13___.

13. ________

When water is added, the battery should be operated for
a sufficient time to thoroughly __14__ the water with the 14. ________
electrolyte __15__ a sample is taken with a hydrometer. 15. ________

The voltage regulator protects the battery from serious
overcharging and __16__. 16. ________

Any condition in a battery which affects its voltage will
cause a serious deviation from normal __17__ 17. ________
characteristics.

Some batteries used in hot climates have a specific
gravity of __18__ when fully charged. 18. ________

It is always advisable to use __19__ or other water that is 19. ________
relatively free from __20__ when filling a battery. 20. ________

Battery __21__ and terminals should be tested for 21. ________
voltage __22__. 22. ________

The gases that form in the battery during charging
are very __23__. 23. ________

With a high rate charger, batteries can be charged
in approximately __24__. 24. ________

The electrical potential of a battery while idle is
commonly called the __25__ __26__ voltage. 25. ________
26. ________

A battery subjected to severe __27__ will soon be ruined. 27. ________

Visual inspection of the battery will disclose __28__ 28. ________
damage to the case or cell covers.

Sulfuric acid is very __29__ and will destroy most things 29. ________
with which it comes in contact.

The basic instruments required for battery testing are 30. ________
the __30__, __31__, and __32__. 31. ________
32. ________

Specific gravity readings should be used cautiously
unless the __33__ fully-charged specific gravity of the 33. ________
battery is known.

During battery quick-charging the __34__ of the electrolyte 34. ________
should be checked and the charging stopped if the
electrolyte becomes __35__. 35. ________

Acid must always be poured __36__ into the battery water. 36. ________

Insufficient watering can cause permanent changes in
battery __37__. 37. ________

When more complete battery testing is contemplated, the 38 rate 39 tester may be added.

38. ______
39. ______

Continued operation in either hot or cold climates usually requires a tailored adjustment of the 40 .

40. ______

unit F | AUTOMOTIVE LIGHTING SYSTEMS

TOPIC 1—LIGHTING SYSTEM DEVELOPMENT

Assignment ⁞ Optics and Wheels, General Motors, pp. 3-31.

Introduction

The science of optics, which deals with the nature and properties of light, has made a great contribution to the continuous development of the automobile, making it not only more dependable,but safer. A study of the developments in optics and light will show how this knowledge has been applied to the night-driving problem. The modern headlight system was developed cooperatively by the automotive industry, lamp manufacturers, safety groups, and state motor vehicle agencies.

Checkup

Until recent times the source of all light, other than that from the sun, was ___1___. 1. __________

Since 1929 all bulbs have been made so accurately that the ___2___ is at the focus when the bulb is put into the socket. 2. __________

The intensity of light varies ___3___ with the ___4___ of the distance.
3. __________
4. __________

A triangular-shaped wedge of glass is called a(n) ___5___. 5. __________

Flutes and prisms are used to ___6___ the light beam. 6. __________

Only a portion of the night-lighting problem can be solved by ___7___ on the car. 7. __________

Tail lights have a section that will ___8___ the light from the ___9___ of an overtaking car.
8. __________
9. __________

The sealed reflector maintains lighting ____10____ as the car grows older.

10. ____________

The first horseless carriage either had no lights at all or adapted ____11____ ____12____ from horse-drawn carriages.

11. ____________
12. ____________

The standard of measurement for light is the ____13____.

13. ____________

Fog droplets act as many-sided ____14____ which reflect the light back in ____15____ direction.

14. ____________
15. ____________

The first filaments used in electric lights were ____16____ and easily broken, making them ____17____ for automotive use.

16. ____________
17. ____________

Acetylene was easily ____18____ for vehicle ____19____.

18. ____________
19. ____________

One of the first laws of light is that it travels in a(n) ____20____ ____21____.

20. ____________
21. ____________

Reflectors can increase the light from a low candlepower filament by as much as ____22____ times.

22. ____________

The starter requires a battery and generator, thus making the ____23____ ____24____ system possible.

23. ____________
24. ____________

TOPIC 2—ALIGNMENT AND TROUBLESHOOTING

Assignment ⋮ Automotive Encyclopedia. pp. 36-1 to 36-6.

Introduction

No matter how well the mechanic has mastered the theory of automotive lighting and individual lighting systems, the real test of his knowledge will be in his ability to locate and correct any electrical difficulties that he encounters in those lighting systems.

Checkup

A circuit breaker is designed to ____1____ and ____2____ a circuit when a short circuit occurs.

1. __________
2. __________

Light ____3____ are used to reduce voltage loss.

3. __________

The "second wire" is the ____4____ of the car body and ____5____.

4. __________
5. __________

Sealed beam head lamps do not need to be ____6____.

6. __________

A voltage drop test made between the ____7____ and each individual lamp will pinpoint excessive ____8____.

7. __________
8. __________

Short life or frequent burning out of headlamps results from excessive ____9____.

9. __________

Voltage loss (or drop) can be minimized by using a wire of sufficient ____10____ to carry the current ____11____.

10. __________
11. __________

The wiring in lighting circuits should be inspected periodically for ____12____ and ____13____ connections, and ____14____ insulation.

12. __________
13. __________
14. __________

Dim lights in older cars are often traced to poor connections to the __15__ or __16__.

15. __________
16. __________

Draw a simple automobile wiring system, naming various lights and switches.

TOPIC 3—LEGAL REQUIREMENTS FOR LIGHTING

Assignment : Vehicle Code, State of California, 1965, pp. 294-318.

Introduction

The mechanic must be prepared to maintain and repair original lighting equipment and to install new lighting equipment on vehicles if necessary. He also must know the legal requirements pertaining to lighting for motor vehicles. These requirements are not the same for every state, but at present an electrical lighting code for motor-driven vehicles that operate on the highways is being developed that will be recommended for adoption as a nationwide code.

Checkup

Headlights are required to be on when there is not sufficient light to render clearly discernible any person or vehicle at a distance of ___1___.

1. __________

No spotlight shall be equipped with any lamp source exceeding ___2___ watts.

2. __________

Fog lamps should be mounted at a height of not less than ___3___ nor more than ___4___ from the road.

3. __________
4. __________

Every vehicle shall be equipped with ___5___ or more tail lamps capable of exhibiting ___6___ light plainly visible at a distance of ___7___ to the rear.

5. __________
6. __________
7. __________

During darkness, every motor vehicle other than a(n) ___8___ shall be equipped with at least ___9___ lighted headlamps with at least one on each side of the ___10___ of the vehicle.

8. __________
9. __________
10. __________

The stop lamp on every new vehicle must be visible from a distance of ___11___ to the rear both during normal ___12___ and at night.

11. __________
12. __________

Flashing lights are permitted on vehicles for indicating a left or right ____13____, as warning lights on certain disabled or parked vehicles, and for use on authorized ____14____ vehicles.

13. ____________
14. ____________

No vehicle shall be equipped with any lights not ____15____ or ____16____ by the code.

15. ____________
16. ____________

Whenever any motor vehicle is parked or standing upon a highway, any headlamp that is lighted shall be ____17____ or on the lower ____18____.

17. ____________
18. ____________

unit G | IGNITION SYSTEM

TOPIC 1—CONSTRUCTION AND OPERATION

Assignment

1. Automotive Encyclopedia, pp. 35-1 to 35-9.
2. Better Ignition, Delco-Remy Service Manual, pp. 1-10.
3. Crouse, Automotive Mechanics, pp. 233-36 and 239-44.
4. The Ignition Circuit (Section D, Delco-Remy Training Chart Manual), pp. 1-7 and 10-16.

Introduction

The ignition system is the most vital of the automotive electrical systems. It is the only system that operates continuously while the engine is running and is mechanically controlled. This system must be capable of a high degree of proficiency in spark quality and synchronization.

Checkup

The ignition circuit has the job of producing and delivering 1 2 3 to each spark plug in turn at correctly 4 intervals.

1. ________
2. ________
3. ________
4. ________

The current of the vibrating coil flowing through the 5 winding creates a magnetic field, which attracts the 6 carrying one of the sets of contact 7 .

5. ________
6. ________
7. ________

Full vacuum control is possible because the speed of the 8 through the carburetor air horn is directly related to engine 9 .

8. ________
9. ________

The condenser is made up of two thin 10 plates separated by a(n) 11 .

10. ________
11. ________

Coil characteristics must be balanced with 12 - 13 of time, so that at top engine speed the ignition coil will still build up sufficiently for good 14 .

12. ________
13. ________
14. ________

A coil is supplied with 6 or 12 volts and produces a voltage 15 to 16 times greater.

15. ______
16. ______

"Build-up" on positive points happens when the 17 builds up too fast in the 18 coil due to coil design or circuit 19 .

17. ______
18. ______
19. ______

The highest voltage requirements exist at 20 engine speed with very 21 acceleration.

20. ______
21. ______

The condenser is connected directly across the distributor 22 23 .

22. ______
23. ______

The ignition coil has 24 circuits in it.

24. ______

One of the distributor functions is to 25 and 26 the circuit between the 27 and the ignition 28 .

25. ______
26. ______
27. ______
28. ______

Negative voltage at the center electrode results in 29 and more consistent sparking voltage than is obtained when the center electrode is 30 .

29. ______
30. ______

Engine speed, compression, carburetor mixture ratios, spark plug temperature, and width and shape of plug gap all affect the 31 required to produce the spark.

31. ______

Resistors are bypassed while the engine is being cranked to compensate for 32 33 .

32. ______
33. ______

Resistors are built into rotors to suppress high frequency 34 in the 35 circuit.

34. ______
35. ______

The purpose of the ignition condenser is to reduce 36 at the 37 38 .

36. ______
37. ______
38. ______

The difference in voltage on the two sides of the condenser dielectric creates the 39 action which brings the voltage and current to a(n) 40 stop.

39. ______
40. ______

With special cam and breaker lever combinations, it is possible to obtain 41 to 42 usable cam angle on an 8-cylinder distributor.

41. ______
42. ______

Too close a contact point opening results in a slow rate of 43 .

43. ______

In an 8-cylinder engine, 12,000 sparks are produced every mile traveled; at 90 mph, the ignition is delivering these surges at the rate of 44 per second.

44. ______

The voltage usually needed to establish spark across the spark plug gap is from ___45___ to ___46___.

45. __________
46. __________

Spark is advanced to allow for the ___47___ time of the fuel mixture.

47. __________

The vacuum advance supplies the additional spark advance needed to compensate for slower-burning ___48___ mixtures at part-throttle operation.

48. __________

The quick collapse of the magnetic field induces as much as ___49___ in the primary coil and ___50___ in the secondary coil.

49. __________
50. __________

TOPIC 2—TRANSISTORIZED SYSTEM

Assignment

1. Crouse, Automotive Mechanics, pp. 234-37.
2. Introduction to Transistor Operation and Applications (Section W, Delco-Remy Training Chart Manual), Charts 1-6.

Introduction

Transistorized ignition systems are arousing considerable interest, and they are being used more widely as time goes by. A number of manufacturers have developed a variety of complete systems and conversion kits. Some of the major car manufacturers are offering transistorized ignition systems as extra cost options. As the cost of these systems is brought down and the components are improved, transistorized systems will probably become standard equipment on most passenger cars.

Related Information

Conventional ignition systems require frequent adjustment and repair, particularly at the weakest link--the contact points. High-compression engines require a high ignition output, hence the change from the 6-volt to the 12-volt system. One reason this change in voltage was necessary was that the current-carrying capacity of ignition points is limited to approximately 3 to 5 amperes. Since the current could not be increased, it was necessary to increase the voltage.

The industry as a whole was rather reluctant to change. The main advantage of a 12-volt system is in ignition and engine starting, but the disadvantages are many: shorter lamp bulb life, higher rate of battery self-discharge, insulation problems due to higher voltages, and the like. If transistorized systems had been introduced earlier, probably the 6-volt system would not have been abandoned, because the transistorized system is designed primarily to increase the life of contact points or eliminate them entirely.

Conversion kit systems. The change to a transistorized system is made in several ways. The simplest and least costly way is to use conversion kits now on the market. The ignition points are retained, but the condenser is removed. The contact points are used as a trigger to open and close the transistor primary circuit, which operates the secondary circuit. Some coils operate with currents as high as 15 amperes.

In transistorized systems, the points carry approximately 1/10 of the 3- or 4-ampere current of a conventional system. This reduction in amperage gives the points greater life and reliability.

An additional advantage of this type of transistorized system is that voltage output is not greatly affected by dwell time. However, this does not eliminate point problems due to fiber block wear and cam lobe wear, which can change overall timing and vary cylinder-to-cylinder firing.

Magnetic control systems. A second type of transistorized system is magnetically controlled. One method uses a distributor much like the standard distributor except that the points are replaced by a magnetic pulse generator. The pulse generator is similar to a low-voltage magneto, the pulses being used to trigger the transistor primary circuit with the help of an amplifier unit.

One manufacturer supplies a magnetic pulse generator mounted on an adapter plate to replace the points and condenser. A pulse amplifier transistor and other electronic components are mounted on a printed circuit and sealed.

Capacitor discharge systems. A third type of transistorized system, the capacitor discharge system, has conventional breaker points which are used to trigger the transistors. A means is provided to charge the capacitor, and the capacitor can be discharged either directly to the spark plugs or to the primary circuit of the coil. This system is a bit more complicated and more costly than the other transistorized systems, and at the present time is used primarily for experimentation.

Detailed information on each type of system is available from the manufacturers. Service data manuals carry service information on the units in most common use.

Checkup

The primary purpose of transistorized systems is to improve point __1__ or __2__ points entirely.

1. __________
2. __________

Contact point current-carrying ability is limited to __3__ to __4__ amperes.

3. __________
4. __________

Transistorized systems using contact points are still subject to problems due to fiber block and cam lobe __5__.

5. __________

Transistors are __6__ devices which act as electrical __7__.

6. __________
7. __________

The small current in the emitter-__8__ circuit controls a much larger current in the emitter-__9__ circuit.

8. __________
9. __________

The emitter- 10 circuit is used in place of a set of 11 12 .

10. ________
11. ________
12. ________

The emitter- 13 circuit can be controlled by 14 or 15 means.

13. ________
14. ________
15. ________

Resistors are placed on the 16 of ignition units so that heat can be 17 more readily.

16. ________
17. ________

The transistor is turned 18 with the ignition switch and 19 by the voltage generated by the magnetic pulse.

18. ________
19. ________

Since the transistor is capable of carrying more current than the contact points, more 20 voltage is available at 21 engine speeds.

20. ________
21. ________

With a transistor ignition system, the points carry 22 of the current of those in a conventional ignition system.

22. ________

TOPIC 3—MAINTENANCE AND TESTING

Assignment

1. Automotive Encyclopedia, pp. 35-31 to 35-32.
2. Better Ignition, Delco-Remy Service Manual, pp. 10-16.
3. Crouse, Automotive Mechanics, pp. 384-89.
4. The Ignition System (Section D, Delco-Remy Training Chart Manual), pp. 8, 9, and 20-23.
5. Introduction to Transistor Operation and Application (Section W, Delco-Remy Training Chart Manual), Charts 7-10.

Introduction

The ignition system must be tested regularly because of its intricate mechanical operation. Regular, methodical inspections by the mechanic will ensure better, more reliable performance of the vehicle and, in the end, will save the car owner time and money.

Checkup

All the wiring switches and connections should be ___ 1 ___ inspected and checked for ___ 2 ___ or ___ 3 ___ connections.

1. ________
2. ________
3. ________

A low-capacity condenser can cause ___ 4 ___ starting.

4. ________

Clogged engine breather pipes and piston blowby create crankcase ___ 5 ___ which may force ___ 6 ___ up into the distributor.

5. ________
6. ________

Misfiring will occur when the voltage required to fire a plug ___ 7 ___ the voltage available from the ___ 8 ___ ___ 9 ___.

7. ________
8. ________
9. ________

As high as a ___ 10 ___ leakage can occur outside a spark plug under adverse conditions if the plug is left ___ 11 ___.

10. ________
11. ________

Contact point work is simplified by a one-piece __12__ of the circuit breaker level and __13__ support.

12. ________
13. ________

Emery cloth must __14__ be used to clean __15__ points.

14. ________
15. ________

A good condenser tester should be able to test the condenser for __16__ or __17__ and to measure the __18__ and __19__ of the insulation.

16. ________
17. ________
18. ________
19. ________

Contact points which have been used often will make contact over an even __20__ area than can be expected with new points.

20. ________

If points need cleaning or replacement, the distributor should be __21__.

21. ________

Ignition coil primary windings can be checked by connecting a(n) __22__ across the two ignition coil __23__ terminals.

22. ________
23. ________

Used points are best checked with a dial indicator or __24__ meter.

24. ________

A cam lubricator impregnated with a(n) __25__ __26__ lengthens the life of cams and rubbing blocks.

25. ________
26. ________

If worn, distributor housing bushings will allow excessive side __27__ and __28__.

27. ________
28. ________

Low point pressure will cause the contact points to __29__ and __30__.

29. ________
30. ________

Increasing the cam angle decreases the __31__ __32__ opening.

31. ________
32. ________

The operation of the centrifugal advance mechanism can be checked through the full distributor speed range on a(n) __33__.

33. ________

It must be remembered that loose or corroded connections cause __34__, which will impair ignition performance.

34. ________

TOPIC 4—SPARK PLUGS

Assignment : Automotive Encyclopedia, pp. 17-2 and 35-18 to 35-22.

Introduction

Efficient ignition of an engine depends upon proper performance of the spark plugs. Spark plugs may look alike, but their performance characteristics vary. Considering the fact that ignition systems are designed to be used with certain types of spark plugs, the best performance can be obtained only by using those plugs engineered to meet specific engine and driving conditions.

Checkup

For tightening a spark plug, a(n) ____1____ wrench should be used.

1. __________

If the engine is operated for long periods of low speed at part-throttle opening, ____2____ plugs will tend to foul.

2. __________

The spark plug gap size is dependent upon the ____3____ ratio, characteristics of the ____4____ chamber, and the characteristics of the ____5____ system.

3. __________
4. __________
5. __________

An advantage of the wider spark plug gap is that it can hold more fuel ____6____ than a narrow gap, and consequently there is better opportunity to ____7____ it.

6. __________
7. __________

Spark plug life can be materially extended by frequent ____8____ and ____9____.

8. __________
9. __________

Systems with high capacity are subject to more rapid ____10____ wear than systems with low capacity.

10. __________

The center wire temperature ranges from a low of ____11____ at 10 mph to a high of ____12____ at 80 mph.

11. __________
12. __________

The material from which the insulator is made and its shape will affect spark plug __13__. 13. ____________

Engine designers select spark plugs which will give good performance for __14__ driving conditions. 14. ____________

Before installing a spark plug, it is important to make certain that the __15__, __16__, and insulator are clean. 15. ____________
16. ____________

Partly fouled plugs do not allow __17__ to build up enough to jump the gap. 17. ____________

A plug with a heat range too high for operating conditions will cause __18__. 18. ____________

unit H

STARTERS AND STARTING MOTORS

TOPIC 1—CONSTRUCTION AND OPERATION

Assignment

1. Automotive Encyclopedia, pp. 33-24 to 34-4.
2. Cranking Motors and Series-Parallel Switches (Section C, Delco-Remy Training Chart Manual), pp. 2-7.
3. Crouse, Automotive Mechanics, pp. 205-14.

Introduction

Many types of internal combustion engines--and all those used on modern automobiles--are equipped with electric starters, sometimes referred to as cranking motors. The dependability and efficiency of the present-day "self starter" has progressed to the point where there is no other way to start the car. The old-time crank is no more, and the advent of the automatic transmission has made it virtually impossible to start a car unless the starter is functioning properly. It has become imperative, therefore, that this unit work properly every time it is needed.

Checkup

A starting motor operates on the principle that a current-carrying conductor tends to move from a(n) __1__ magnetic field to a(n) __2__ magnetic field.

1. __________
2. __________

A shunt-connected coil is used for the purpose of __3__ the top __4__ speed of a starting motor.

3. __________
4. __________

The natural magnetic strength of the magnetic poles is aided by the __5__ winding.

5. __________

An assist spring pushes the commutator end of the armature against a(n) __6__ washer, which acts as a(n) __7__ to slow down the __8__ speed of the armature when the clutch is disengaged.

6. __________
7. __________
8. __________

Two field windings are connected in ___ 9 ___ to each other and in ___ 10 ___ with the armature to produce a high cranking torque.

9. __________
10. __________

When the armature loops rotate and reverse the ___ 11 ___, flow is reversed by the ___ 12 ___.

11. __________
12. __________

Motor brushes are usually located back of the static neutral point to prevent excessive ___ 13 ___ and to obtain more ___ 14 ___ operation.

13. __________
14. __________

With no load, the speed of a series-wound motor will continue to ___ 15 ___ to such an extent that ___ 16 ___ force will destroy the ___ 17 ___.

15. __________
16. __________
17. __________

In all starting motors, the adjacent pole shoes must be of ___ 18 ___ polarity.

18. __________

Wave-wound armatures have only ___ 19 ___ paths for current flow; lap-wound armatures have as many paths as there are ___ 20 ___.

19. __________
20. __________

TOPIC 2—STARTER DRIVES AND CONTROLS

Assignment

1. Automotive Encyclopedia, pp. 34-8 to 34-15.
2. Cranking Motors and Series-Parallel Switches, (Section C, Delco-Remy Training Chart Manual), pp. 8-14, 16, and 20-22.
3. Crouse, Automotive Mechanics, pp. 211-14.

Introduction

Several different methods are used to engage and disengage the starting motor pinion and the engine starting gear. Generally, sufficient torque cannot be developed by a starting motor without some means of gear reduction. Gear reduction mechanisms are of several different designs, but the purpose is always the same--to couple the starting motor to the engine in such a way that the engine will turn over with sufficient speed to start. Once the engine has started, the coupling must automatically remove itself from the engine and this, too, is a vitally important function of the starter unit.

Checkup

The Bendix drive depends on ___1___ to provide meshing of the ___2___ ___3___ with the engine flywheel ring gear.

1. __________
2. __________
3. __________

The Dyer drive is designed to make it impossible to start another cranking cycle without completely ___4___ the shift lever.

4. __________

For heavy duty cranking, a ___5___ clutch type Bendix drive is used.

5. __________

The series-parallel system provides ___6___ voltage for cranking and ___7___ voltage afterwards.

6. __________
7. __________

The armature is protected from excessive speed by the overrunning ___8___ when the pinion remains enmeshed and the engine ___9___.

8. __________
9. __________

Magnetic ___10___ are used with some Bendix-drive starting motors to ___11___ the motor switch.

10. ____________
11. ____________

During the cranking interval, lights and other accessories are supplied by ___12___ batteries in the series-parallel system.

12. ____________

Series-paralled circuits can be of the ___13___ or the ___14___ type.

13. ____________
14. ____________

The solenoid switch on a starting motor ___15___ the pinion in mesh with the flywheel before the motor is supplied with ___16___.

15. ____________
16. ____________

TOPIC 3—TROUBLESHOOTING STARTERS

Assignment

1. Automotive Encyclopedia, pp. 34-4 to 34-8.
2. Cranking Motors and Series-Parallel Switches (Section C, Delco-Remy Training Chart Manual), pp. 15, 17, 18-19 and 23-24.
3. Crouse, Automotive Mechanics, pp. 363-70.

Introduction

Any mechanic must have a thorough understanding of troubleshooting, a vital factor in the servicing of starting motors. Many mechanics are inclined to be parts changers rather than good repairmen, because they lack a sound knowledge of automotive theory and the ability to read and understand manufacturers' charts.

Checkup

Because of the high current draw of starting motors under load, ___ 1 ___ must be of adequate size and connections clean and ___ 2 ___ to prevent excessive voltage drop.

1. __________
2. __________

To determine how fast a starting motor will run and the current draw at a given voltage, the ___ 3 ___ - ___ 4 ___ test is used.

3. __________
4. __________

If the commutator is out of round, worn, or has high ___ 5 ___, it should be turned in a lathe.

5. __________

A quick check for starter trouble can be made by turning on the ___ 6 ___ and ___ 7 ___ the starting motor.

6. __________
7. __________

The overrunning clutch type drive should not be cleaned by any high ___ 8 ___ or grease- ___ 9 ___ methods.

8. __________
9. __________

If the starting motor fails to operate and draws no ___ 10 ___, this is an indication of a(n) ___ 11 ___ circuit.

10. __________
11. __________

Stall torque is the torque developed with the ____12____ stalled, or not rotating.

12. __________

Burned commutator bars usually indicate a(n) ____13____ -circuited armature.

13. __________

Grounded fields can be tested either with a test lamp or a(n) ____14____.

14. __________

The brush spring tension should never be ____15____ specified limits.

15. __________

Voltage drop is checked with a(n) ____16____.

16. __________

Voltage drop across the battery terminal of the starter relay and the other lead to the battery is limited to ____17____ for a 6-volt system and ____18____ for a 12-volt system.

17. __________

18. __________

unit I | GENERATORS

TOPIC 1—A-C GENERATORS

Assignment

1. A.C. Charging Circuits (Section H, Delco-Remy Training Chart Manual), pp. 2-9.
2. Automotive Encyclopedia, pp. 31-1 to 31-4.
3. Crouse, Automotive Mechanics, pp. 217-20.
4. "Delcotron" Generator and the Charging Circuit (Section M, Delco-Remy Training Chart Manual), Charts 1-17.

Introduction

Both alternating and direct current generators operate on the same principle. The direct current generator changes alternating current to direct current by means of a rotating switch. Alternating current can also be changed to direct current by electronic means.

Alternators have been used for many years on vehicles that have high current requirements. Since the necessary rectifiers were both bulky and expensive, alternators were not used on passenger cars until recently. The heavy current demands of most modern passenger cars and the development of solid state diodes have made the use of alternators on such vehicles both practical and possible at reasonable cost.

Checkup

In an alternator, the magnetic field is __1__, and the voltage is generated in the __2__ coils.
1. __________
2. __________

Magnesium-copper sulfide rectifier plates are limited to a maximum voltage of __3__.
3. __________

Direct current is supplied to the rotor coils through brushes and __4__ __5__.
4. __________
5. __________

The voltage or electrical pressure at a particular point with respect to another point is called __6__ __7__.
6. __________
7. __________

Diodes with a negative case have __8__ polarity leads, 8. ________
while positive case diodes have __9__ polarity leads. 9. ________

To provide voltage control at high speed, many
alternators have a __10__ field winding. 10. ________

A generator constructed with three separate windings
in the stator is referred to as "three __11__." 11. ________

As alternating current cannot be used to charge a battery,
it is necessary to change the __12__ current to __13__ 12. ________
current by means of a __14__. 13. ________
14. ________

The field windings on the rotor are energized by current 15. ________
from the __15__ by __16__ and __17__ __18__. 16. ________
17. ________
18. ________

The number of cycles per second in alternating current
is called the __19__. 19. ________

The composition of a diode is such that it will allow
current to travel through itself in __20__ direction(s). 20. ________

TOPIC 2—D-C GENERATORS

Assignment

1. Automotive Encyclopedia, pp. 31-10 to 31-21.
2. Crouse, Automotive Mechanics, pp. 215-17.
3. Generators (Section E, Delco-Remy Training Chart Manual), pp. 1-10, 15-18, and 21-23.

Introduction

The rising popularity of the alternator would seem to indicate that the automotive direct current generator is becoming obsolete. However, millions of d-c generators are in service today, and these will need service for the next five or ten years. In addition, the low cost of the d-c generator will tend to keep it popular on lower priced vehicles and on vehicles that have low current requirements.

Checkup

How much may the drive ratio of an automotive generator vary? 1. ________

What are the two types of shunt generator circuits? 2. ________
____

Name four other types of generator circuits. 3. ________
4. ________
5. ________
6. ________

The generator field frame forms the return ___ 7 ___ circuit for the lines of ___ 8 ___ from the south or the north pole.
7. ________
8. ________

An "interpole" is used to ___ 9 ___ commutator ___ 10 ___ .
9. ________
10. ________

Bucking field coils are used to obtain ___ 11 ___ generator output at ___ 12 ___ speeds.
11. ________
12. ________

Polarity is the ___ 13 ___ of current flow from the ___ 14 ___ to the external circuits.
13. ________
14. ________

Cleanliness and proper 14 are vital to the life of any generator.

14. ______

If current is allowed to flow through the field coil of a generator in the wrong direction, the generator will become 15 16 .

15. ______
16. ______

Generator circuits should be tested for 17 , 18 , 19 , and 20 .

17. ______
18. ______
19. ______
20. ______

Short circuits in the armature may be detected on a 21 .

21. ______

Lack of understanding of generator polarity and its relationship to the vehicle battery has been responsible for many unnecessary electrical failures in the 22 - 23 24 , 25 , and 26 .

22. ______
23. ______
24. ______
25. ______
26. ______

To conduct a generator output test, some means must be provided for 27 the generator.

27. ______

An open-circuited armature is easily identified by visual inspection of the 28 29 .

28. ______
29. ______

Generator output test voltage should be in excess of 30 on a 6-volt system and 31 on a 12-volt system.

30. ______
31. ______

Rectifiers used on an alternator can be tested by means of a 12-volt battery and a(n) 32 lamp.

32. ______

Generators should be tested at the specified rotation speed to produce the required 33 and 34 .

33. ______
34. ______

A short-circuited field coil has 35 effect on generator 36 .

35. ______
36. ______

Brushes worn to 37 - 38 their original length should be replaced.

37. ______
38. ______

Where brush adjustment is provided, it is necessary to first locate the mechanical 39 40 .

39. ______
40. ______

Wrong spring tension results in 41 and short 42 life.

41. ______
42. ______

Heel or toe seating of a brush changes the 43 position and will result in excessive 44 .

43. ______
44. ______

Each generator operating condition requires a brush with a different 45 .

45. ______

Generator operation is based on the principle of ___15___ ___16___.

15. ____________
16. ____________

The commutator changes ___17___ current to ___18___ current.

17. ____________
18. ____________

Voltage will be at maximum when the armature coil passes through a magnetic field of ___19___ density.

19. ____________

The strength of the voltage induced in a rotating coil is proportional to the strength of the ___20___ ___21___, the speed of ___22___ movement through the magnetic field, and the number of ___23___ ___24___.

20. ____________
21. ____________
22. ____________
23. ____________
24. ____________

Residual magnetism in the pole shoes is used to induce the initial ___25___ in the ___26___.

25. ____________
26. ____________

Iron loss is reduced by using ___27___ armature cores.

27. ____________

The effect of the magnetic field created by the armature upon the magnetic field created by the field coils is known as ___28___ ___29___.

28. ____________
29. ____________

With varying speeds and loads, the ideal commutating point is constantly ___30___.

30. ____________

The residual magnetic field of the pole is ___31___ by current flowing through the field coils.

31. ____________

The physical strength of a generator must be great enough to withstand the electrical ___32___ it is designed to produce.

32. ____________

Generators with more than two field poles have one ___33___ point for each ___34___.

33. ____________
34. ____________

A generator is capable of supplying current in either direction, depending on the ___35___ of the ___36___.

35. ____________
36. ____________

TOPIC 3—GENERATOR TESTING

Assignment

1. Automotive Encyclopedia, pp. 32-1 to 32-9 and 31-6 to 31-8.
2. Crouse, Automotive Mechanics, pp. 371-79.
3. "Delcotron" Generator and the Charging Circuit (Section M), Charts 30-32.
4. Generators (Section E, Delco-Remy Training Chart Manual), pp. 24-36.

Introduction

Generators usually give trouble-free service for many thousands of miles. Even when troubles do develop, they are generally minor in nature caused by dirty connections, worn or sticking brushes, and the like. The mechanic should make the proper tests to determine the cause of such troubles. Repairs will vary from changing a faulty part to changing the whole unit.

Checkup

A short circuit is any ___1___ connection that permits the current to ___2___ part of the electrical unit.

1. __________
2. __________

The test procedure to be used is determined by the ___3___ of generator being checked.

3. __________

It is important to avoid grounding the alternator field circuit to prevent damage to the ___4___ ___5___.

4. __________
5. __________

An armature with a grounded circuit can be checked with a(n) ___6___ ___7___.

6. __________
7. __________

Mica insulators higher than the commutator bars will cause rapid ___8___ wear, ___9___ brushes, and ___10___.

8. __________
9. __________
10. __________

Stator windings should be tested for ___11___, ___12___, and ___13___.

11. __________
12. __________
13. __________

When replacing worn brushes, the brush holder rails must be polished to allow __46__ movement of the brush. 46. ________

unit J | GENERATOR CONTROLS

TOPIC 1—CONSTRUCTION AND OPERATION

Assignment

1. Automotive Encyclopedia, pp. 33-1 to 33-4, 33-7, 33-8 to 33-9, 33-13, 33-14, and 33-15.
2. Crouse, Automotive Mechanics, pp. 221, 224-26.
3. Generators (Section E, Delco-Remy Training Chart Manual), pp. 10-14 and 18-20.
4. Standard Duty Generator Regulator (Section F, Delco-Remy Training Chart Manual), pp. 1-13.

Introduction

The voltage regulator is often regarded as a "mystery box," but actually the box contains only simple relays and resistors. A mechanic must understand how and why each part works. When the function of each part is thoroughly understood, it can be seen that the operation of a voltage regulator is quite simple.

Checkup

Third-brush generators used on some farm tractors are provided with only a __1__ __2__.

1. __________
2. __________

In Auto-Lite regulators, the effect of heat on the resistance and operating characteristics of regulator windings is compensated for on some units by a nickel-__3__ __4__ __5__.

3. __________
4. __________
5. __________

The purpose of the cutout relay is to prevent the battery from __6__ through the __7__ when the engine is __8__ or turning at slow speed.

6. __________
7. __________
8. __________

The regulator controls the voltage and the current by automatically cutting additional __9__ in or out of the __10__ circuit.

9. __________
10. __________

The vibrating contact __11__ used in generator regulation have a very definite __12__.

11. __________
12. __________

"A" circuit generators have the field coils connected between the 13 14 .

13. ________
14. ________

The regulator points are part of the 15 circuit.

15. ________

The current regulator has a(n) 16 winding of 17 wire, as it carries the entire 18 of the generator.

16. ________
17. ________
18. ________

Either the 19 regulator or the 20 regulator operates at any one time; they never operate simultaneously.

19. ________
20. ________

The necessary temperature correction is provided by means of a(n) 21 hinge on the 22 of the relay or regulator of some models.

21. ________
22. ________

Surges of induced field voltage due to changes in field strength are partially dissipated by the two 23 which reduce 24 at the contact points.

23. ________
24. ________

Some regulators are designed for use with systems having the negative terminal of the 25 grounded, while others are designed for use with 26 grounded systems.

25. ________
26. ________

The voltage regulator has a(n) 27 shunt winding of many turns of 28 wire.

27. ________
28. ________

The cutout relay has 29 windings which are assembled on a(n) 30 core.

29. ________
30. ________

TOPIC 2—TRANSISTORS AND REGULATORS

Assignment

1. A.C. Charging Circuits (Section H, Delco-Remy Training Chart Manual), pp. 10-28.
2. Introduction to Transistor Operation and Applications (Section W, Delco-Remy Training Chart Manual), Charts 11 and 12.

Introduction

With the development of diodes and transistors, it is now possible to eliminate some moving parts from the automotive electrical system, thereby producing a more reliable and trouble-free operation. Of course, voltage and current control by vacuum tubes has been used for many years in other than automotive applications, but the ability of transistors to withstand the vibration and road shocks of automotive applications now makes possible an all-electronic automotive generator output control. Understanding how transistors work and their function in a circuit is essential to proper service.

Checkup

The emitter-collector current to the fields is stopped by making the voltage potential at the __1__ more positive than the voltage potential of the __2__.

1. ________
2. ________

A material is considered a conductor when the __3__ have freedom of __4__.

3. ________
4. ________

Transistorized regulators contain a(n) __5__ transistor working with a(n) __6__ voltage regulator unit.

5. ________
6. ________

Because transistors generate a considerable amount of heat during operation, it is necessary to provide some means of __7__.

7. ________

If the voltage contacts opened without a diode in the circuit, the sudden interruption of field 8 would cause a high voltage to be induced in the 9 10 , causing a failure of the 11 .

8. __________
9. __________
10. __________
11. __________

The transistor regulator contains no moving parts; it limits the generator 12 through the 13 of two transistors working together.

12. __________
13. __________

The transistor regulator performs one function only--to 14 the generator 15 current.

14. __________
15. __________

The generator field windings are connected to the 16 through the field relay by the 17 switch.

16. __________
17. __________

The transistorized regulator with its 18 contact point current and 19 generator field current, reduces 20 at the contacts and gives better generator performance.

18. __________
19. __________
20. __________

The resistor connected across the emitter and base of the transistor acts to 21 emitter-to-collector current 22 when the voltage regulator contacts are 23 .

21. __________
22. __________
23. __________

The element antimony has 24 electrons in its outer ring.

24. __________

The combination of 25 and 26 is known as "P" type or positive material.

25. __________
26. __________

The unusual operating characteristics of the transistor results from the physical arrangement of the 27 , 28 , and 29 .

27. __________
28. __________
29. __________

A circuit arrangement with the negative post of the battery connected to the "N" material and the positive post of the battery connected to the "P" material is known as a(n) 30 - 31 connection.

30. __________
31. __________

The addition of a(n) 32 section of "P" type material to a(n) 33 forms a complete transistor.

32. __________
33. __________

When a number of germanium atoms are combined together in 34 form, the result is called " 35 36 ".

34. __________
35. __________
36. __________

TOPIC 3—TESTING PROCEDURES

Assignment

1. Automotive Encyclopedia, pp. 31-8 to 31-10, 33-3 to 33-5, 33-6 to 33-7 and 33-9 to 33-22.
2. Crouse, Automotive Mechanics, pp. 371-79.
3. Introduction to Transistor Operation and Application (Section W, Delco-Remy Training Chart Manual), Charts 13-16.
4. Standard Duty Generator Regulator (Section F, Delco-Remy Training Chart Manual), pp. 15-29.

Introduction

Many regulators which need only a few minor adjustments to keep them in operation are discarded and replaced with new ones. The chief reason for this is the mechanic's lack of knowledge pertaining to the proper adjustment of regulators; hence, the customer is forced to buy a new piece of equipment instead of paying only for the adjustment that was needed. Usually only a few minutes of testing a regulator can pinpoint the cause of trouble, and a few more minutes of work will correct it.

Checkup

The fixed 1/4 ohm resistance method and the variable resistance method are used to set ___1___.

1. __________

The regulator cover should be ___2___ and the generator should be ___3___ when adjustments are checked.

2. __________
3. __________

The mechanic should never attempt to use a regulator of the wrong ___4___.

4. __________

Most Auto-Lite two-charge regulators have a fuse mounted on the base and connected in the generator ___5___ circuit; this provides protection against excessive ___6___ ___7___.

5. __________
6. __________
7. __________

The regulator must be at ___8___ temperature when checks are conducted and adjustments made.
8. ________

The air gap is the space between the regulator ___9___ and the winding ___10___.
9. ________
10. ________

A wide air gap will ___11___ the difference between operating levels under high and low ambient temperatures.
11. ________

Cutout points are soft and should not be cleaned with a(n) ___12___ ___13___.
12. ________
13. ________

The cutout relay requires three checks and adjustments: ___14___ gap, point ___15___, and ___16___ required to close the contact.
14. ________
15. ________
16. ________

Transistors and diodes may be checked with a(n) ___17___.
17. ________

To check the voltage setting of the transistor regulator, the ammeter is inserted ___18___ the battery terminal and battery wire. The voltmeter is connected from the regulator ___19___ terminal to ___20___.
18. ________
19. ________
20. ________

To check the current regulator setting, the ___21___ ___22___ must be prevented from operating.
21. ________
22. ________

Excessive resistance in the charging system between the regulator and the battery causes the ___23___ ___24___ to operate and reduce the ___25___ output.
23. ________
24. ________
25. ________

When high operating temperatures are normal, as in tropical climates, the voltage regulator must be ___26___ to ___27___ for the effect of heat on the ___28___.
26. ________
27. ________
28. ________

The upper and lower contacts of both voltage and current regulators are made of ___29___ metals.
29. ________

The opening amperage of the cutout relay is the amount of ___30___ current discharged from the battery to the generator that is required to open the points.
30. ________

unit K | AUTOMOTIVE ACCESSORIES

TOPIC 1—HORNS AND WARNING DEVICES

Assignment

1. Automotive Encyclopedia, pp. 36-10 to 36-12.
2. State of California Vehicle Code, Horns and Warning Devices, pp. 334-35.

Introduction

Although an automobile horn seldom gives trouble, the mechanic should understand its construction and operation so that when trouble does arise, he can determine whether repair is feasible and, if so, make the necessary repairs or adjustments. It must be remembered that although the automobile horn is used for other purposes, it is essentially a safety device and should always be operative.

Checkup

All mounting ____1____ and electrical ____2____ for a horn should be tight.
1. ____________
2. ____________

To test whether a horn is inoperative, connect a(n) ____3____ wire from the ____4____ to the horn.
3. ____________
4. ____________

Most modern horns consist of a diaphragm which is vibrated by means of a(n) ____5____.
5. ____________

The horn must be capable of emitting a sound audible under normal conditions from a distance of not less than ____6____.
6. ____________

A relay is used to eliminate ____7____ ____8____ in the circuit from the horn to the battery.
7. ____________
8. ____________

Because of the relatively heavy current required to operate a horn, the wire used for horn circuits should be ____9____ or larger.
9. ____________

No vehicle shall be equipped nor should any person use upon a vehicle any __10__ except as authorized by the Department of Motor Vehicles. 10. ________

The adjustment of the armature gap is critical and must be done in accordance with the __11__ for that particular make and model of horn. 11. ________

Some types of horns have a resistance connected in __12__ with the magnetic winding, or a condenser across the contact points to reduce __13__.

12. ________
13. ________

There are only three checks and adjustments necessary to repairing a horn relay: the __14__ gap, the __15__ __16__ opening, and the __17__ __18__.

14. ________
15. ________
16. ________
17. ________
18. ________

The approximate range of armature gap on an electric horn is __19__ to __20__.

19. ________
20. ________

TOPIC 2—INSTRUMENTS AND GAUGES

Assignment

1. Automotive Encyclopedia, pp. 26-9 to 26-10 and 36-27 to 36-31.
2. Crouse, Automotive Mechanics, pp. 128-29, 183-85, 196-97, and 245-47.

Introduction

The mechanic usually does not have to service automotive instruments and gauges beyond the point of checking their working order and making whatever minor corrections are necessary. An automobile instrument seldom needs repair, but the mechanic should know how each one works before making tests to locate possible troubles.

The current tendency of manufacturers to use "idiot lights" rather than gauges will probably continue, but mostly on economy models. The fuel gauges and speedometers now in use will probably remain unchanged for many years.

Gauges are often replaced unnecessarily by mechanics who fail to realize that a gauge may only show the effect of an automotive trouble, not always the cause of it. The mechanic should always look for the cause of the effect he sees before replacing any gauge. Since dashboards are generally difficult to work behind, much discomfort can be avoided and time saved by a mechanic who can rely on his knowledge instead of guesswork.

Checkup

Electric fuel, oil, and temperature indicating devices are of two types: __1__ and __2__.
1. __________
2. __________

Two types of fuel gauges now being used are the __3__ coil and __4__.
3. __________
4. __________

The speed-indicating portion of the speedometer operates on the __5__ principle.
5. __________

When both speed and mileage readings are too high or too low, 6 size and transmission speedometer 7 should be checked for correct size.

6. ________
7. ________

The tank unit of the balancing coil type fuel gauge contains a(n) 8 contact that slides back and forth on a(n) 9 as the float moves up and down in the fuel tank.

8. ________
9. ________

The thermostatic gauge has a pair of 10 blades, each with a(n) 11 coil.

10. ________
11. ________

More or less bending is imposed upon the tank thermostatic blade by a(n) 12 .

12. ________

While speedometers of different manufacturers differ in detail, they are all designed to register the same 13 at a given number of 14 .

13. ________
14. ________

Speedometer cables should be lubricated every 15 .

15. ________

The pressure-expansion indicator uses a hollow 16 tube that is 17 on one end and 18 on the other.

16. ________
17. ________
18. ________

The temperature indicator bulb, usually placed in the 19 20 of the engine, is filled with a(n) 21 that 22 at a fairly low temperature.

19. ________
20. ________
21. ________
22. ________

The ammeter is connected between the 23 and the 24 .

23. ________
24. ________

unit L | ENGINE TUNE-UP

TOPIC 1—TUNE-UP PROCEDURES

Assignment

1. Automotive Encyclopedia, pp. 18-1 to 18-4. Review pp. 32-3 and 32-4, 35-31 and 35-32, 34-6 to 34-8, and 36-19 to 36-21.
2. Crouse, Automotive Mechanics, pp. 248-57. Review pp. 356-58, 363-65, 371-78, and 384-87.

Introduction

In the early 1930s, the owner of a car was not very particular about performance, provided his motor would start and keep running. The mechanic had few factory specifications to guide him. Spark plugs were set with a thin dime, distributor points with a calling card, and valves more or less at the mechanic's option.

As time passed, the car buyer demanded more speed, faster acceleration, a quiet-running engine, smooth idle, quiet valves, and with all this, better gas mileage.

In response to this demand, automotive engineering has produced remarkable economy and performance in modern motor cars. After exhaustive tests, the best settings for valves, plugs, and spark gap were established by the car manufacturers. Compression was increased, coils and condensers were carefully chosen and balanced, and great improvements were made in carburetion and in ignition timing.

To restore all of these things to their original factory condition is the only way original factory performance and economy can be attained for the customer. To do this, the mechanic should have complete factory specifications, so that he knows what equipment to use for testing and what adjustments to make.

The auto mechanic must know how to use test equipment and to interpret the results. The test equipment illustrated in the instructional material is representative, since all makes are basically the same. Most manufacturers furnish an instruction manual with their tune-up equipment, so it is a simple matter for the mechanic to apply his general knowledge of testing and repair procedures.

Related Information

The following is a typical example of recommended procedures in the use of test equipment for trouble diagnosis:

The combustion tester. The engine exhaust is composed of several gases--carbon dioxide (CO_2), carbon monoxide (CO), oxygen (O_2), hydrogen (H_2), and nitrogen (N_2). The proportion of these gases in the exhaust varies, depending upon the fuel-air ratio of the fuel mixture supplied to the combustion chambers by the carburetor.

This relationship is definite; consequently, an instrument which will respond to changes in the proportion of certain of the gases can be used to indicate the fuel-air ratio of the fuel mixture. A rich mixture--one containing more fuel and less air than normal--results in an increase in hydrogen and a decrease in carbon dioxide. A lean mixture is the reverse of this proportion.

Hydrogen has a thermal conductivity about six times greater than that of air, while carbon dioxide has approximately one-half that of air. It is upon this difference in thermal conductivity of the two gases and their varying proportions in the exhaust that the operation of this testing instrument is based.

A greater proportion of the volume of hydrogen gas readily carries the heat away from the cells or resistors of the testing instrument. This cools, and therefore lessens, the resistance of the resistor and causes the needle to indicate a rich mixture. The movement of the needle is in direct proportion to the increase of hydrogen gas. A greater proportion of carbon dioxide gas and a decrease of hydrogen gas around the cells or resistors will carry off heat less readily, and the instrument will indicate a leaner mixture.

There is one exception: If the mixture is leaned to a point where detonation occurs, high proportions of hydrogen are liberated, causing the needle to swing to the rich side or reverse itself. This condition, however, is usually encountered only under laboratory conditions.

Checkup

A test report lists, step by step, the ___1___ to follow and the ___2___ to be made.

1. ________
2. ________

The purpose of cylinder compression and leakage testers is to determine whether or not the cylinder can hold ___3___ or whether there is excessive leakage past the ___4___, ___5___, or ___6___ ___7___.

3. ________
4. ________
5. ________
6. ________
7. ________

The last step in an engine tune-up is usually the final adjustment of the ___8___.

8. ________

The fuel pump test measures ___9___ developed, the ___10___ of fuel delivered in a given time, and the amount of ___11___ developed.

9. ________
10. ________
11. ________

A device that enables the user to look around corners when making engine checks is called a(n) __12__.

12. ________

A balance test is made by running an engine on only __13__ __14__ at a time.

13. ________
14. ________

A rather complete analysis of engine operation can be made without taking the car out of the shop by using a(n) __15__.

15. ________

When using the cylinder leakage tester, the cause of leakage can often be ascertained by listening to the __16__, __17__, or __18__ __19__ __20__.

16. ________
17. ________
18. ________
19. ________
20. ________

A complete diagnosis of the electrical system requires the testing of the __21__, __22__, __23__, __24__ and __25__ __26__.

21. ________
22. ________
23. ________
24. ________
25. ________
26. ________

A timing light makes a moving flywheel or pulley appear to stand still due to __27__ effect.

27. ________

An engine tune-up is a procedure for checking the various operating characteristics of an engine and its __28__ for any necessary correction.

28. ________

Instructional Materials

The first listing of each publisher includes the address from which publications may be purchased. List prices are given where known. School prices may be obtained in some cases through the instructor.

BOOKS RECOMMENDED FOR EACH APPRENTICE

Auto Mechanics, Part 4 (Workbook and Testbook). Sacramento: California State Department of Education, 1966. See price list.

Better Ignition. Delco-Remy Service Manual. Anderson, Ind.: Delco-Remy Division of General Motors Corporation, n.d.

Crouse, William H., Automotive Mechanics 5th ed. New York: McGraw-Hill Book Co., Inc., 1965. (201 Tamal Vista Drive, Corte Madera, Calif.)

Delco-Remy Training Chart Manuals, Sections:

A - Fundamentals of Electricity and Magnetism.
B - Storage Batteries.
C - Cranking Motors and Series-Parallel Switches.
D - The Ignition Circuit.
E - Generators.
F - Standard Duty Generator Regulator.
H - A. C. Charging Circuits.
M - "Delcotron" Generator and the Charging Circuit.
W - Introduction to Transistor Operation and Applications.

Handbook for Installation and Inspection Stations: Motor Vehicle Pollution Control (Crankcase Devices). Sacramento: California Highway Patrol, 1965. (2490 - 1st Avenue -- May also be secured from any Highway Patrol area office)

Motor Service's Automotive Encyclopedia. Chicago: The Goodheart-Willcox Co., Inc., 1962. (1322 So. Wabash) $8.95

Optics and Wheels. Detroit: General Motors Public Relations Staff, n.d.

Vehicle Code. Sacramento: State Department of Motor Vehicles, 1965. (2570 - 24th Street -- May be purchased from any DMV field office) $1.00

VT003 006

VT 003 006
Maize Dwarf Mosaic of Corn.

Illinois Univ., Urbana. Vocational Agriculture Service
VAS-4049
Pub Date - Dec65
MF AVAILABLE IN VT-ERIC SET 7p.

*TEXTBOOKS, *REFERENCE BOOKS, *VOCATIONAL AGRICULTURE, *PLANT PATHOLOGY, *CORN (FIELD CROP),

The purpose of this document is to provide textual and reference material for high school vocational agriculture and adult farmer students on maize dwarf mosaic of corn, a new disease which is potentially very serious in the Corn Belt. The material was developed by a teacher educator after being designed by subject matter specialists, teacher-educators, supervisors, and teachers. The sections of the document answer the questions--(1) How Much Damage Does the Disease Cause, (2) Where Does the Disease Occur, (3) What Are the Symptoms, (4) How Does it Spread, and (5) How Can I Control It. It is appropriate for use by teachers with competence in general agriculture with students of average ability with interest and an occupational objective in production agriculture. Time required is 1 to 2 hours. This document is available for 10 cents from Vocational Agriculture Service, 434 Mumford Hall, University of Illinois, Urbana, Illinois 61801. (JM)

MAIZE DWARF MOSAIC OF CORN.

1. How Much Damage Does the Disease Cause?
2. Where Does the Disease Occur?
3. What Are the Symptoms?
4. How Does It Spread?
5. How Can I Control It?

Maize dwarf mosaic is a new virus disease of corn, first reported in southern Ohio and Arkansas in 1962. It is closely related to corn stunt, another virus disease of corn found in the Southern states.

Dwarf mosaic and corn stunt both attack corn of all ages from the very young to matured plants. Disease symptoms may show up as early as seven days after the plant is infected with dwarf mosaic. Corn stunt symptoms, however, may not show up for six weeks after the disease hits.

The ranges of these two diseases are believed to overlap. It is possible for both to be found in the same field, or even on the same plant.

This corn virus complex is potentially the most serious disease or diseases ever to invade the Corn Belt. Already, corn growers in some areas have had to give up growing corn until corn varieties with good disease resistance are developed.

Fig. 1. A matured corn plant showing symptoms of maize dwarf mosaic.

1. HOW MUCH DAMAGE DOES THE DISEASE CAUSE?

Losses due to maize dwarf mosaic are staggering. In Ohio, the loss from the disease in 1964 was estimated at 5 million bushels. Yields in hard-hit fields fell from 100-150 bushels per acre to 5 bushels or less. An overall loss of 10 percent was reported for more than 15,000 acres in the Scioto, Ohio, Muskegon, and Miami River valleys. The loss in Scioto County was 20 to 30 percent of the total corn crop.

Other states that reported major losses included Tennessee, Kentucky, Arkansas, and Missouri. A number of fields in each of these states have been abandoned as far as corn production is concerned.

In Missouri, losses of 90 to 95 percent were reported in 1964 in severely affected fields in several counties--especially Jefferson, where an estimated 40 to 85 percent of all corn plants in the county were infected. In Arkansas, corn yielded 3 to 30 bushels per acre where maize dwarf mosaic was severe. In Tennessee, 500 to 700 acres near Memphis suffered a 50 percent loss. In the south-central counties, the loss was estimated at 40 percent, with losses of 100 percent in certain fields. The overall loss in Tennessee, involving some 10,000 acres, was 20 percent or roughly 100,000 bushels.

Several states have found greater losses on the late-planted corn than on the early. In Missouri, many late-planted fields were a complete loss, while in Tennessee a 30 percent loss and 50 to 70 percent infection were reported.

In extreme southern Illinois about 400 acres of corn was affected and reduced in yield by 70 percent or more in 1964. Another 400 acres had losses between 5 and 50 percent. Very light or trace infections were found on another 1,200 acres. In one late-planted field grown for silage, the yield was reduced from an expected normal 8 tons to about 2 tons.

2. WHERE DOES THE DISEASE OCCUR?

In 1964, maize dwarf mosaic was reported in California, Iowa, Illinois, Missouri, Arkansas, Tennessee, Kentucky, Indiana, Ohio, West Virginia, Virginia, North and South Carolina, and possibly Kansas and Nebraska (Fig. 2). Corn stunt was reported in Florida, Georgia, Alabama, Arkansas, Mississippi, and Louisiana. The two were believed to be "mixed together" in the latter southern states as well as in southern Missouri, Arkansas, and possibly Tennessee and South Carolina. Other states may well have had one or both diseases in 1964, but they were not adequately surveyed.

In many of the states, maize dwarf mosaic has been found only in bottomland soils close to major rivers and other bodies of water. In Ohio, Tennessee, Kentucky, Indiana, Iowa, Arkansas, Missouri, and North Carolina, however, the disease was also found in upland soils many miles from a major river--particularly late in the season.

Fig. 2. This map shows the known locations of the corn virus disease complex in 1965. Additional areas may be discovered and present locations may change.

3. WHAT ARE THE SYMPTOMS?

The first symptoms of maize dwarf mosaic are indistinct light and dark green mottlings between the veins or as elongate, pale green blotches (flecks) and interrupted stripes on the younger leaves. The blotches and stripes often merge and turn yellow, giving affected plants a pronounced yellowish cast (Fig. 3).

Diseased plants are often stunted or dwarfed from a bunching of the upper internodes. The degree of stunting and the development of later symptoms apparently depend on a number of factors, such as the age and maturity of the plant when first infected, the corn hybrid or inbred, strain of virus involved, temperature, and soil fertility.

In the field, the dark green mottling or blotches frequently disappear, especially during hot weather. Diseased plants remain dwarfed or stunted with yellowish tops. On some hybrids, brilliant reddish-purple streaks and blotches begin to develop in the leaves, particularly the upper ones, about tasseling time (Fig. 4). Certain leaves appear to be largely reddish purple. In some fields, especially in cooler areas, mosaic, yellowing, and purple-reddening of the leaves all appear

MEMORANDUM

TO: The ERIC Clearinghouse on Vocational and Technical Education
The Ohio State University
980 Kinnear Road
Columbus, Ohio 43212

FROM: (Person) J. W. Matthews (Agency) Vocational Agriculture Service

(Address) 434 Mumford Hall, Urbana, Illinois 61801

DATE: August 1, 1967

RE: (Author, Title, Publisher, Date) Maize Dwarf Mosaic of Corn. VAS 4049. Urbana, Illinois: Vocational Agriculture Service, University of Illinois. 8 p., 1965.

Supplementary Information on Instructional Material

Provide information below which is not included in the publication. Mark N/A in each blank for which information is not available or not applicable. Mark P when information is included in the publication. See reverse side for further instructions.

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Level of Group State: R. L. Courson, Asst. Prof. of Vocational Agriculture
Method of Design, Testing, and Trial Designed by subject-matter specialists, teacher educators, supervisors and advisory committee of teachers

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Fig. 3. University of Illinois extension plant pathologist, M. C. Shurtleff, examines ears of corn infected by maize dwarf mosaic. M.D.M. last summer reduced the yield 70 percent or more in the field near McClure in Alexander County.

at the same time--even on the same plant.

Excessive tillering and development of multiple ear shoots are other common symptoms. Early-affected plants produce only nubbin ears that are often partly or totally barren. Many of these plants die prematurely (Fig. 5).

Fig. 5. Early-infested corn plants produce nubbins with scattered kernels.

It is suspected that corn plants infected after tasseling, produce a normal yield and are normal in height. The appearance of large, reddish-purple streaks and blotches on the upper leaves is the only indication of disease.

Fig. 4. Diseased plants may develop streaks or color changes in the upper leaves about tasseling time.

Positive identification of the disease cannot be made by field symptoms alone. Symptoms closely resembling these may be caused by other viruses, herbicides in the soil, mechanical or insect damage to roots or stalks, lack of one or more essential nutrients (e.g., zinc, magnesium, potassium), drought combined with hot, dry winds, and possibly other factors.

Because similar symptoms may be produced by a variety of causes, it is necessary, for positive identification, to transmit the virus by sap transfer from infected plants to other corn, sorghum, or Johnsongrass plants to show infectivity. Other laboratory techniques, such as electron microscope and serology (the science dealing with the reactions, preparation, use, etc., of serums), are also used to identify the virus. When seen under an electron microscope at 5,000 to 20,000 magnification, maize dwarf mosaic appears as flexuous virus-like rods (Fig. 6).

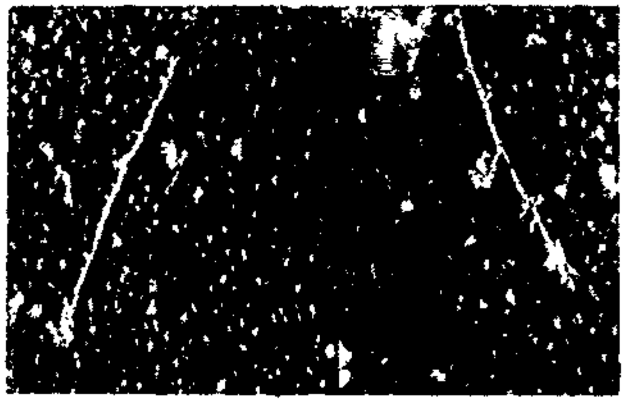

Fig. 6. With the electron microscope, flexuous, virus-like rods could be seen in some of the mounts prepared from experimentally infected plants.

The findings reported from these tests provide the first positive experimental proof that the new corn disease in southern Illinois is infectious. They also indicate without any doubt that a flexuous elongate virus is associated with the disease.

It has not been proved, however, that this virus is the sole cause of the disease in the field. To finally determine the primary cause, or causes, of the field disease, the typical disease must be experimentally induced with known cultures or samples of the causal agent(s), and then the agent(s) must be isolated from the experimentally diseased plant and identified. Figure 7 shows the areas where maize dwarf mosaic virus has been diagnosed by tests in 1965.

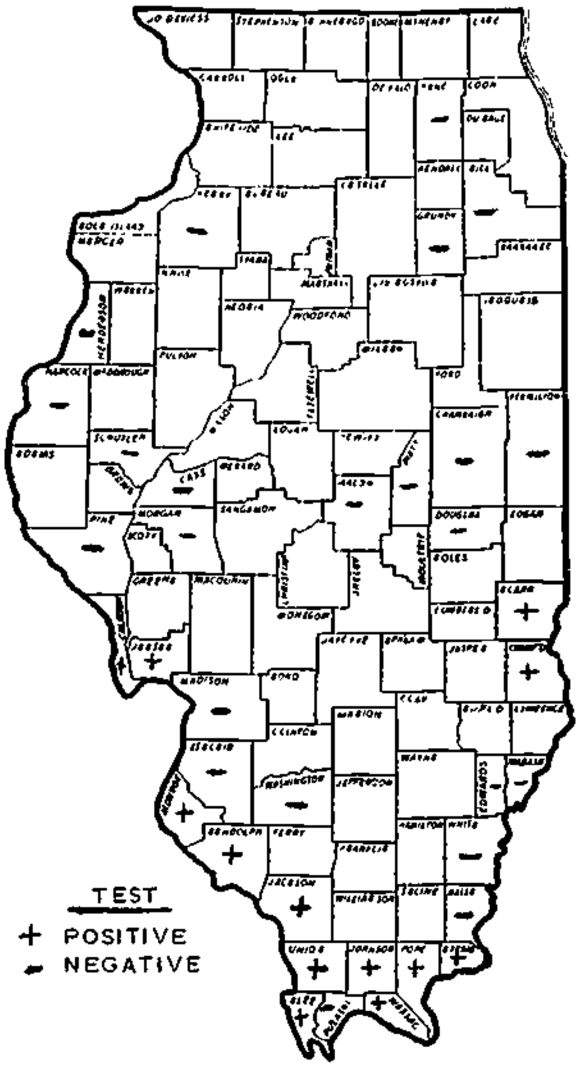

Fig. 7. Map showing the areas of maize dwarf mosaic virus in Illinois in 1965 as diagnosed by tests.

4. HOW DOES IT SPREAD?

Since maize dwarf mosaic is so near like corn stunt, it was believed that the two were transmitted alike. It was known that the corn stunt virus was transmitted by specific leafhoppers, so researchers worked along this line. They soon found, however, that the dwarf mosaic virus could be easily transmitted mechanically from one plant to another by using sap from infected plants (Figs. 8 and 9). Aphids were then found to be carriers of the virus from infected corn plants to healthy corn, sorghum, Johnsongrass, and other grass hosts. It has been found that aphids may acquire the virus while feeding for as short a period as 20 seconds.

Fig. 8. H. H. Thornberry, U. of Ill. plant pathologist, demonstrates laboratory technique for transferring M.D.M. virus from infected plants, in the foreground, to healthy corn.

Fig. 9. Carborundum, in the shaker in Fig. 8 when applied to the corn leaves insures inoculation.

The most efficient aphid carriers, for transmitting the virus in the Corn Belt are probably those that migrate considerable distances and move restlessly about from plant to plant within a field (e.g., green-peach aphid). They may not necessarily be those that find corn or sorghum a suitable host on which to feed and multiply regularly (e.g., corn leaf aphid).

Johnsongrass, a prevalent weed along river valleys where dwarf mosaic is most serious, is probably the most important overwintering host of the virus. Several aphids also feed on Johnsongrass in the spring and summer.

To date the virus has been transmitted to all types of corn (field or dent, sweet, and popcorn), teosinte, sorghum, Sudangrass, sorghum x Sudangrass hybrids, sugarcane, large crabgrass, barnyardgrass, downy brome or cheat, Japanese chess, bristlegrass, foxtails, and cubgrass. At present, transmission to goosegrass, foxtail millet, lovegrass, and certain millets is questionable.

None of the small grains (wheat, oats, barley, and rye), or such common grasses as Kentucky and other bluegrasses, smooth bromegrass, orchardgrass, fescues, wild rye, ryegrasses, quackgrass, bullgrass, and reed canarygrass are known to become infected. To date the maize dwarf mosaic virus seems to be restricted to members of the grass family.

The host range of the virus differs somewhat among investigators, possibly because of the strain of the virus or technique that is used, age of the grass plant, temperature, and presently unknown factors.

5. HOW CAN I CONTROL IT?

At present the development of resistant corn hybrids and varieties appears to offer the best and most lasting method of control. No corn breeder can say with certainty, however, how long it will be before commercially acceptable, highly resistant single- and double-cross hybrids will be available to farmers. It is not known yet how many virus strains are involved and whether a hybrid that is highly resistant in Ohio or Kentucky will also be highly resistant in Iowa, Illinois, or Missouri. Some corn lines that are rated "resistant" in field plots may actually have been missed by migrating aphids.

Environmental factors affect aphid population and movement. Present sprays have not been very effective. If you grow corn where the virus has cut yields severely, continue planting hybrids that seem to do best for you or possibly change your rotation or grow another crop.

Corn breeders are optimistic, however, that suitable replacements for the more susceptible commercial lines will be developed. Resistance to the virus(es) now appears dominant to susceptibility, and inheritance studies so far have shown that relatively few genes are involved. On the basis of extensive 1964 field tests in Ohio, Indiana, Kentucky, Tennessee, Mississippi, and Louisiana, the possibility of having commercial corn hybrids and varieties with good resistance seems bright now compared with just a year ago. A considerable number of inbreds and crosses in common use by commercial, experiment station, and USDA sources have shown a high degree of field resistance to the maize dwarf mosaic virus. Many exotic strains of corn developed in Mexico and other Central American countries have also shown excellent field resistance.

Extensive field plantings, using all available corn germ plasm (standard lines, hybrids, synthetics, and interspecifics) that appear promising, are planned in practically all states where the new disease has appeared. A "spectrum test" of 20 selected corn inbreds and other strains susceptible and resistant to both maize dwarf mosaic and stunt are being made in at least 13 breeding nurseries and field plantings in 1965. Plants will also be experimentally inoculated in infested fields and in greenhouses under controlled conditions.

Until resistant corn varieties become available, the most immediately effective control measure is a vigorous Johnsongrass eradication program. Other perennial and winter annual grasses known to harbor the virus should also be controlled in the vicinity of corn, sorghum, Sudangrass, and sorghum x Sudangrass hybrids.

Controlling Johnsongrass. Johnsongrass first appears as a few scattered clumps along roadsides, railroads, or fences, on waste land, or in fields. If not controlled, a clump may become a solid stand in a few years. The easiest way to keep Johnsongrass from spreading is to eliminate clumps or small patches promptly. Two materials are recommended for this purpose:

Use Atlacide at the rate of one cupful per clump or 6 pounds per square rod in patches. Be sure to treat far enough from the plants for the chemical to kill the rhizomes under the soil surface. Atlacide may be used in dry form or mixed with water and used as a spray.

Use dalapon at the rate of 1 pound in 5 gallons of water. Treat when the grass is between 1 and 2 feet high. Apply a second treatment about three weeks later to kill any new growth. Dalapon acts through the leaves, so wet the foliage thoroughly with the spray. A knapsack or small compression-type sprayer is satisfactory for treating small patches.

In solid stands in pastures, fencerows, levees, railroad right-of-ways, and other non-crop lands, mow 2 or 3 times during the summer, then spray with dalapon when the grass is growing actively. Use 8 pounds of dalapon in 30 to 40 gallons of water per acre. If the area cannot be mowed, apply dalapon when the grass is 2 to 3 feet tall, using the amounts as mentioned above. A second and third application may be necessary to kill all of the roots and rhizomes.

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Capitalism, Socialism, and Communism.

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*TEXTBOOKS, *REFERENCE BOOKS, *VOCATIONAL AGRICULTURE, *COMMUNISM, GOVERNMENTAL STRUCTURE, *CAPITALISM,

The purpose of this document is to provide high school vocational agriculture and adult farmer students with textual or reference material on forms of economic and governmental systems. Development by a teacher-educator included consultation with subject matter specialists, teacher educators, supervisors, and teachers. Sections are (1) Communism is Socialism, (2) How Do Industrialized Economies Operate, (3) What is Capitalism, (4) Can Personal Freedoms Be Maintained Under Socialism or Communism, and (5) Comparison of Capitalism and Socialism-Communism. Vocational agriculture teachers may use the material with students of average ability with interest and occupational goals in agriculture. Time required is 1 to 3 hours. This document is available for 15 cents from Vocational Agriculture Service, 434 Mumford Hall, University of Illinois, Urbana, Illinois 61801. (JM)

CAPITALISM, SOCIALISM, AND COMMUNISM

1. Communism Is Socialism.
2. How Do Industrialized Economies Operate?
3. What Is Capitalism?
4. Can Personal Freedoms Be Maintained Under Socialism or Communism?
5. Comparison of Capitalism and Socialism-Communism

The terms capitalism, socialism, and communism have varying meanings. In this unit we will use them to designate different types of economic organization of a society or a nation. A comparison is made at the end of this unit of such items as ownership, profits, freedom of enterprise, and economic incentives under these different systems.

In our time the communistic form of economic organization is often closely associated with dictatorial governments and with atheistic philosophical views. However, neither communism nor any other form of economic organization is necessarily tied to any particular religious belief or to any certain form of government.

Forms of government

Essentially there are two basic types of government in the world today: (1) popular governments and (2) dictatorial governments.

Popular government is one that is responsive to popular opinion, where the people have easy access to essential information, and where they are free to express in public their support for or opposition to the government. The United States, England, France, West Germany, Canada, and Japan are examples of such governments. We say that these countries have "democratic" (spelled with a small "d") governments, but some dictatorial governments also use the word democratic to describe their governments. Thus the official name of the dictatorial government that rules the eastern (communist) part of Germany is the "German Democratic Republic."

There is one unfailing test to show whether a government is dictatorial or popular. This test is the nature and extent of the opposition to the ruling group or individual. In any country where the people are really free, there is always open, organized, aggressive opposition to the group or party in power. Such opposition is always absent under dictatorial governments.

The evidences of open, organized, aggressive opposition to the group in power are opposition newspapers and other publications and one or more opposition organizations with well-known leaders who wish and work to take over power from those in control.

Religion and economic systems

Our generation has come to associate communism with atheism, probably because the Russian communistic leaders have opposed religious organizations. Communism, however, is not always antireligious. In fact, many communistic communities have been organized and operated on religious bases. One of the best known of these societies was that founded by Robert Owen at New Harmony, Indiana, in 1825. Others were those at West Roxbury, Massachusetts, at Bishop Hill in northern Illinois, and the Amana Society at Amana, Iowa. The Amana Society continued its communistic form until about 1932.

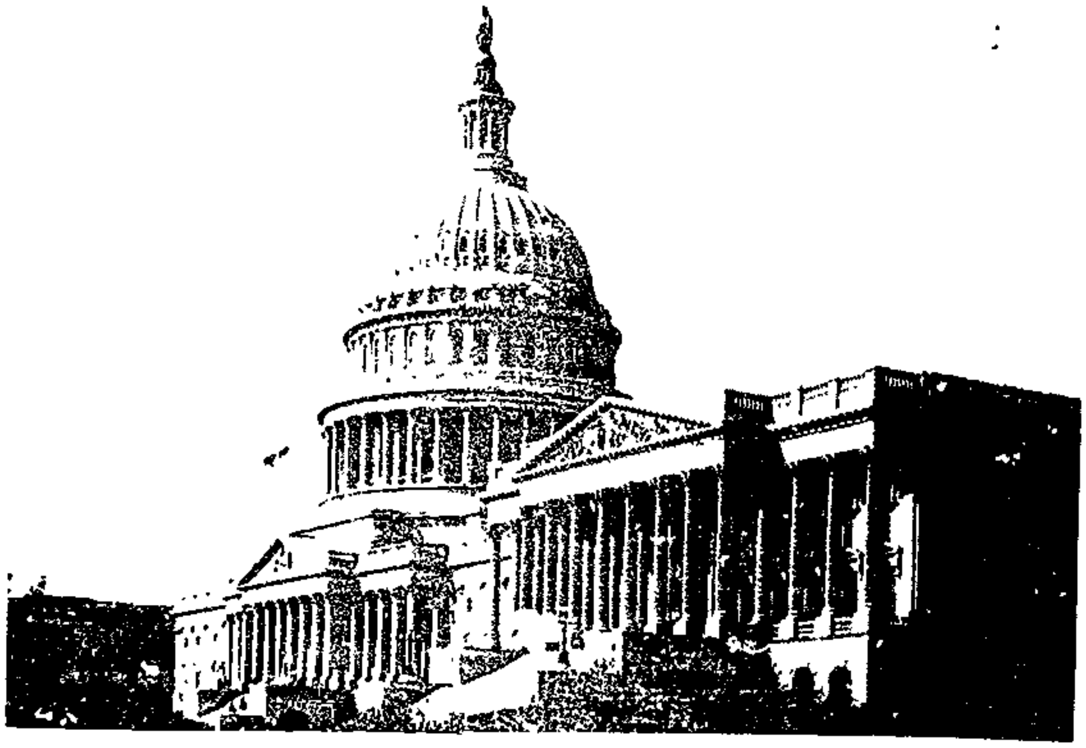

Fig. 1. The United States Capitol Building in Washington, D.C.

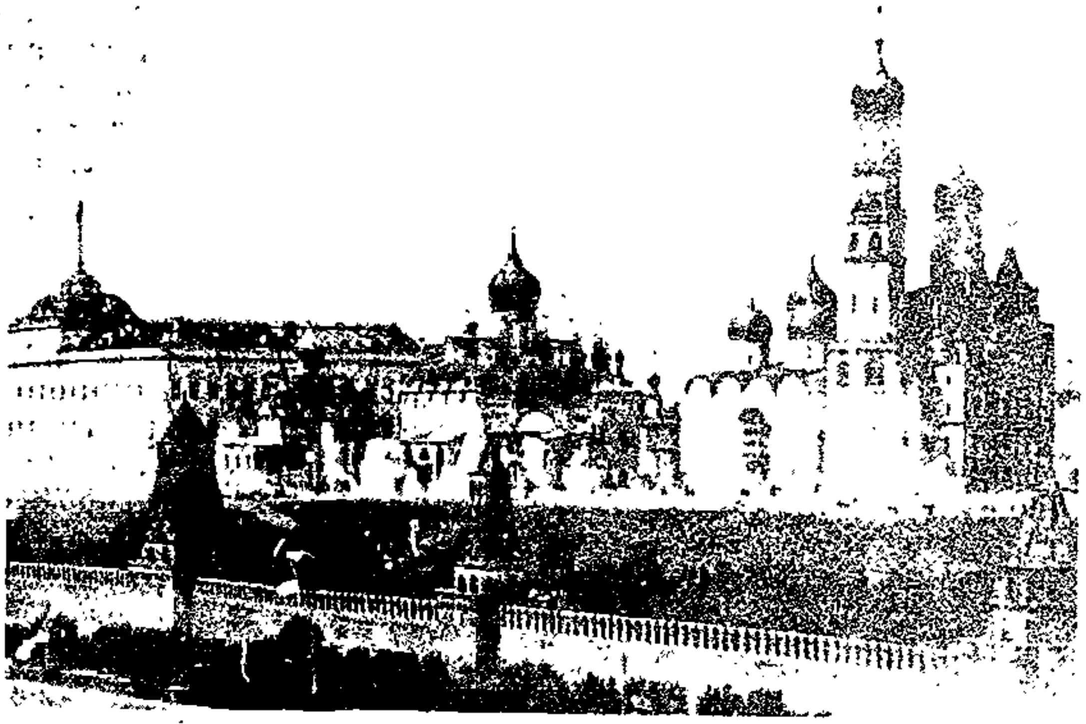

Fig. 2. The Kremlin, seat of Russian Government, in Moscow.

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1. COMMUNISM IS SOCIALISM

Many Americans seem to believe that there are important differences between socialism and communism. Communism and socialism, however, are primarily two different names for the same thing. This fact is made clear by a study of reliable dictionaries and encyclopedias and of statements by the leaders of the socialist-communist movement.

Most dictionaries give essentially the same definition for socialism as for communism. Each is defined as a social or economic system in which the government owns and runs most of the "means of production." It owns the land, mines, factories, stores, transportation, newspapers, radio, television, hospitals, service agencies, and apartment houses. There is only one major employer and one landlord--the government. Families and individuals may be allowed to own a few personal things such as clothes, books, bicycles, and perhaps some furniture.

Karl Marx (1818-1883) was the founder of modern socialism-communism. He was a German writer on economic subjects. He used the words socialism and communism interchangeably. The Encyclopedia Britannica describes Marx as a "socialist and philosopher." The Encyclopedia of the Social Sciences describes him as a "social philosopher, revolutionary leader, and founder of the chief current in modern socialism." Other major reference works use similar descriptions.

Communistic parties in all modern countries base their programs on the writings of Karl Marx (and his fellow worker, Friedrich Engels), especially the Communist Manifesto, published in 1848. The Manifesto advocated the following measures:

1. Abolition of all private property in land.
2. A progressive income tax.
3. Abolition of all rights of inheritance.
4. Government ownership of all banks and credit agencies.
5. Government ownership of all transportation and communication.
6. Operation of all productive enterprises by the government.
7. Compulsory labor, with the establishment of armies of laborers for industry and especially for agriculture.
8. The combining of agriculture with industry to eliminate differences between town and country.
9. Free education and abolition of child labor in factories.

These recommendations provide important questions for discussion. For example, to what extent have these measures been adopted in the United States? What are some good and bad results? What advantages and disadvantages would arise from the adoption of others?

Marx claimed that the productive wealth of nations had become concentrated in fewer and fewer hands, leaving a growing class of people, the proletariat, with nothing to sell but their labor. He believed that the workers would and should organize, seize all productive property, and use it for the common good.

The doctrines of Marx and Engels are being followed in Russia, China, Cuba and, to varying degrees in the United States and many other countries.

Khrushchev himself has made some statements about the relationship between socialism and communism. According to the Russian leader, the present system in Russia is socialist, but the eventual goal is communism. It is significant to note that the name of "Russia" today is the Union of Soviet Socialistic Republics, while the name of the organized group in control is the Russian Communist party.

2. HOW DO INDUSTRIALIZED ECONOMIES OPERATE?

The creation and operation of a modern industrialized economy requires three distinct, though closely related, processes:

1. The creation of capital.
2. The management of the productive processes.
3. The allocation of the products of the economy among the people.

We shall see how these processes are carried out in the socialistic-communistic system and in what we call the capitalistic system.

The creation of capital

By the creation of capital we mean the production of products or goods that are used in the production of other goods and services. These products include simple tools like hammers and knives and highly complex tools like tractors, ships, airplanes, machine tools, steel mills, electric power plants, irrigation systems, automated factories, business buildings, and electronic computers.

In every form of economic organization all capital goods must be the result of production in excess of consumption. In our capitalistic system the formation of capital (the accumulation of goods for further production) is largely the result of individual enterprise. The motivating force is the hope for profit.

In order that capital may be accumulated, the workers must produce more than they receive for consumption. This means that in primitive economies the laborers must work for low wages. They must work for low wages regardless of whether the society is capitalistic or socialistic-communistic. This is because the productivity of primitive economies is low, and the people can not consume more than their economy produces. Further, if they wish to accumulate machinery and equipment (capital) they must consume less than they produce, or they must borrow from more highly developed nations. Our people did both in the early years. Now we help others by lending our capital.

In the socialistic-communistic system the government, called the state in most discussions, decides what capital goods are to be produced and forces the people to produce them. Force can be exerted by withholding food and other necessities of life and by inflicting physical punishment upon the worker or members of his family.

In our capitalistic economy the people, through their spending patterns, largely determine what capital goods will be produced. By this spending they determine whether the nation's capital formation will be used for more drive-in theaters, more shopping centers, or more gasoline refineries.

Even in our economy the state decides upon the creation of certain capital items. Such items generally include streets and highways, sanitary systems, many water and irrigation systems, some hospitals, some electric power-producing and distributing systems, public recreational facilities, and most schools and colleges. (Some of our best hospitals, schools, and colleges, however, are privately owned and operated.) The workers are forced to contribute to the production of these capital items through taxes, inflation, or charges for use of the facilities.

Capital formation requires two steps, (1) saving and (2) investment. In our capitalistic system different people often perform these two functions. Some people save--put some of their income into savings accounts, government bonds, and retirement funds. Other people borrow from the savings institutions to invest--build factories, motels, bowling alleys, restaurants, and apartment houses, open mines, or drill oil wells.

The management of productive processes

In our capitalistic system the management for our industries is selected on a competitive basis. Each firm competes with others to get the best management for top and subordinate positions. The poor managers are weeded out when their divisions or their companies fall behind or fail.

A big chain-store company keeps careful records on the performance of each department manager and each store manager. The top producers get the promotions; the nonproducers get the axe.

When a whole company has poor management, the stockholders throw out the chief executives or take a big loss when the company fails. For example, of more than 70 automobile companies in the United States in 1924, less than half a dozen are still operating today.

In the socialistic-communistic system, management is selected largely on the basis of politics. This system is much like that we use in selecting persons for postmasters and many other federal and state jobs. It gets some good managers, but it is not very effective in eliminating poor management.

In our capitalistic system the management of industry is guided by the continuous voting of the people. They vote with their money. They vote every time they spend a dime for a coke, a dollar for a lunch, ten dollars for a motel room, a hundred dollars for a suit, a thousand dollars for a boat, ten thousand for a new barn, 100 thousand for an apartment house, or a million for an airplane.

In the socialist-communist system the management receives much less guidance from the people and much more from the central government. In many cases the people cannot vote for what they want because none of it is available in the markets.

Allocation of the products among the people

In our capitalistic system the allocation, or division, of products and services among the people is determined by (1) the amount of buying power that they can command and (2) their personal preferences for the unlimited variety of goods and services that are available to them.

The amount of buying power available to each person is determined in part by competitive conditions and in part by law and contractual arrangements. The incomes of individual farmers and independent business and professional men are determined in highly competitive situations where individuals or small groups of individuals are the competitive units. The incomes of large union labor groups are also determined largely by competitive conditions, but the competitive unit is a larger group, such as the employees of a specific factory or the workers in a trade.

Here we should note that union contracts in effect tell an employer how much he must pay and the worker how little he must take. Unions do not guarantee any worker a job, although contracts with employers usually indicate some order of seniority for workers. This order establishes a system of rationing jobs when employment opportunities are fewer than the number of qualified workers who would like to work at the established wage rates.

This may be said about the level of wages: They can never be more than the productivity of the economy. Thus increased productivity is always essential to higher real wages. By real wages we mean purchasing power.

In addition to wages, we use two other devices to allocate products of the economy among the people. These devices are (1) rationing and (2) taxes and public aid.

Rationing is always necessary whenever the price of any commodity is kept below its balance point, or market value. If the government does not ration the item, then the producer or distributor must do it. Rationing may be on a simple first-come, first-served basis, or on some basis of need, merit or influence.

During World War II shoes, gasoline, tires, and many foods were rationed. Most raw materials were rationed to manufacturers in accord with the importance of their product to our military effort. A few items are still rationed today; for example, natural gas for heating homes is rationed in some areas. The privilege of attending college may be rationed on the basis of merit--scholarship. Students with low grades are not admitted.

In socialist-communist countries prices of some things are often kept below market value. For this reason it is necessary to ration many items, including housing. Usually a long wait is necessary before housing can be secured. The privilege of attending high school and college is more carefully rationed in socialist-communist countries than in the United States. Good scholars can attend college with little or no expense. In the United States the size of father's checking account, rather than the student's scholarship, sometimes is the factor that determines whether or not the good student goes to college. Some families do not value education highly. Some farm families, for example, may prefer to spend their money for a new automobile, tractor, or furniture, or more land than for education. The proportion of farm boys and girls attending college in our country is well below the average for the nation.

Public aid is used extensively in the United States and other capitalistic countries to allocate food and other essentials to individuals and families that cannot take care of themselves. Unfortunately public aid is also given to many who could provide for themselves if they wished to do so, or were forced to do so. We do not have much information about public aid in communistic systems.

3. WHAT IS CAPITALISM?

The word capitalism has many connotations, some of them unfavorable. According to a huge dictionary published 50 years ago, capitalism is "a system which favors the concentration of wealth in the hands of a few." This definition or description was devised and publicized by Marx. Most of us in America could not support that kind of capitalism.

An equally heavy, but newer, dictionary defines capitalism as "an economic system in which...the ownership of land and natural wealth, the production, distribution and exchange of goods, the employment and reward for labor,... are entrusted to and (carried on) by private enterprise and control under competitive conditions." According to this definition, the two key characteristics of our form of economic organization are (1) private ownership and (2) competitive conditions. This definition is much more appropriate for us in America than the one given by Marx a century ago. Incidentally, this same dictionary says that "usually socialism denotes the doctrines developed by...Karl Marx...." This supports our earlier observation that socialism is identical with communism.

Curiously enough, the New International Encyclopedia, published in 1917, does not have an article on capitalism, although it has long discussions of both socialism and communism. Among other things it says that "communism, in its broadest sense, is the economic basis of socialism."

The concept of capitalism is much newer than the idea of socialism-communism. Karl Marx is given credit for "discovering capitalism." His most famous book is called "Das Kapital." Most of the other economists of his time did not even mention capitalism. They accepted it, but did not have a name for it.

The famous German economist, Werner Sombart, who lived until 1941, was the first to recognize capitalism as fundamental to the modern system of economic thought. His chief work, Der Moderne Kapitalismus, was first published in 1902.

We may note some of the essential characteristics of modern capitalism:

1. The capitalistic process is evolutionary; it is always changing; it can never remain static. It is the only known economic system that has led to the highest levels of living for the masses of people.

2. The capitalistic system inflicts at least temporary hardship on some people. They lose out in the competitive struggle and are forced to find other employment. Farmers, coal miners, and railroad workers are examples of entire groups who find that opportunities for employment are diminishing.

Many persons assert that there is little or no competition in our present business world. Most of them apparently have had little or no experience in the management or ownership of any business. We do have literally millions of persons who have worked in the business world of modern America and who can testify to the reality of competition there. Just talk to a few businessmen in your own home town--or someone who has a managerial position in a large corporation.

3. The capitalist society has a class structure (as do most known societies). Marx alleged that there were only two classes--the wealthy owners and the poor working people, the "haves" and the "have-nots," but we have many "classes." We have managers of businesses, farmers, skilled workers, common laborers, the clerical ("white collar") group, and the professional class. These are, of course, not distinct classes, but rather broad areas that have no distinct border lines. Supporters of capitalism ascribe individual success in this society to superior ability, strenuous effort, and strong moral standards. Opponents of capitalism assert that exceptional economic achievement under capitalism is the result of "luck" or the absence of moral standards, or both!

4. A fourth characteristic of the capitalistic system is that it runs by spurts--sometimes fast, sometimes slow. Thus we have alternating periods of boom and recession. The recession periods bring extensive unemployment and also political unrest. Recessions and depressions are fertile breeding grounds for political revolution. The depressions after World War I brought on the destruction of popular governments and the rise of dictators in Germany (Hitler), Italy (Mussolini), and several other countries. Even here in the United States we experienced a considerable revolution led by Franklin D. Roosevelt.

In our society the government owns considerable property and operates a number of major enterprises. Among these are roads and streets, parks, public lands in the Rocky Mountain states, dams, reservoirs, and much electric power generating and distribution equipment. Among the government operated enterprises are the postal system, the social security system, and most of our schools and colleges.

It is argued that since the government has managed these properties and enterprises efficiently and satisfactorily, it could own most of our other property and operate most of our other enterprises with equal success and satisfaction. There is one big fallacy, however, in this line of argument. It overlooks the fact that private enterprise provides essential competition for the government institutions. The government must meet the competition provided by the private sector of the economy. Thus, state universities must meet the competition provided by private schools, such as Harvard, Yale, Princeton, Northwestern, and the University of Chicago. The state schools must meet competition in paying staff members but, more important, they must meet competition in excellence of teaching.

Employment by a public agency is reasonably pleasant and remunerative under present conditions. Employment by the state, however, might be very unpleasant, or unobtainable, if there were no private employers.

We should say a word about laissez faire, a French expression meaning let it be, do not interfere. It is a policy supported by some economists in the past and also at the present time. Many people confuse laissez faire with competition. They argue that we do not have laissez faire in business; therefore, we should not expect to maintain competition in agriculture. The first part of this argument is right, but not in the sense that is commonly meant. Certainly we do not blindly follow the doctrine of laissez faire in our economy. We intervene especially to maintain or create competition. By contrast, laissez faire would permit big business to become highly monopolistic.

If there is any one characteristic that is special to our (the U.S.) form of capitalism, it is intense competition. We have extensive laws to promote and maintain competition. This fact is illustrated by the court trials and the conviction of the executives of some large corporations for conspiring to avoid competition.

To be sure, our competition is not perfect. We have some laws to promote and maintain monopolies. Outstanding among them are laws that exempt labor unions from antitrust laws. In this respect West Germany is ahead of the United States. We see the results in the fact that the U. S. dollar is weak while the mark is strong. The Germans have been gaining gold while we have been losing it.

4. CAN PERSONAL FREEDOMS BE MAINTAINED UNDER SOCIALISM OR COMMUNISM?

One important question for us to consider is whether a popular or free government can be maintained where that government owns most of the means of production and hires and fires most of the people. In the United States today many people prefer working for the government to working in private industry or going into business for themselves. Most employees of federal, state, and local governments enjoy reasonably good pay, often more than they could earn in private employment. Goldbrickers seldom get fired. Wage increases come almost automatically. Disability and retirement benefits are acceptable, and if any good worker becomes dissatisfied he can usually get acceptable employment in private business.

However, if the government controlled all jobs--was practically the only employer, the individual would have no choice of employer. The best jobs would go to political favorites and to those who would support the "party line." Persons who criticized the administration or its policies would be penalized by being denied promotions, by being demoted, or by being assigned to some American equivalent of Siberia.

There are some of these practices in our own country, and probably in every country that has popular government and private enterprise. For example, there are hundreds of jobs in the federal government that are filled to pay political debts and to build political organizations. Similar practices prevail in most state and city governments.

Another example is the collection of so-called voluntary contributions from city, state, and federal employees to build political campaign funds.

A third example is provided by many of our labor unions. They virtually control the employment opportunities of their members. Workers who oppose the union may find themselves subject to personal harassment and be denied employment.

Union members, like government workers, are often asked to make "voluntary" contributions to so-called educational programs which are in reality political campaigns. Failure to make such contributions results in social and economic pressures on the members who would be independent.

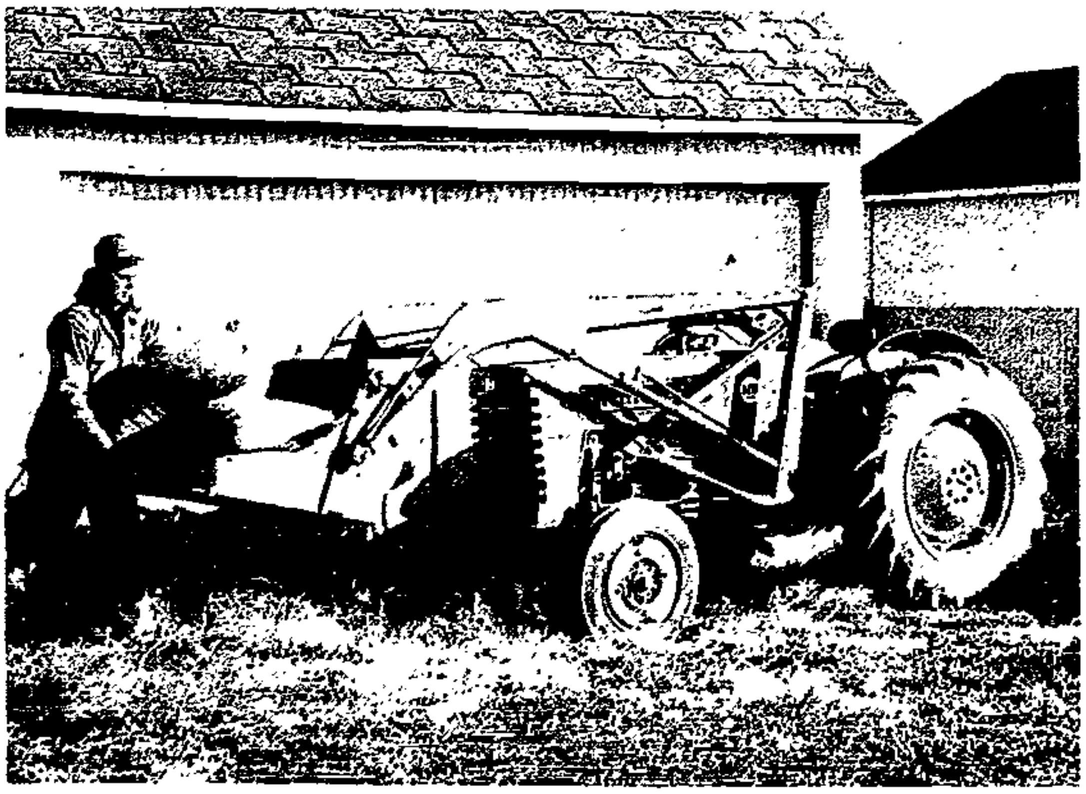

Fig. 3. American farmer at work on his farm.

In a private enterprise system, employment in government service is always protected by the existence of alternative employment in private industry. The alternative of private employment is the essential force that makes and keeps government employment bearable.

Recall the quotation, "Power corrupts. Absolute power corrupts absolutely."

While it is theoretically possible to have popular government that is also socialist-communist, no such government has ever existed for any substantial period of time. In the absence of specific examples to the contrary, and in view of the nature of people, it seems unlikely that we can expect to see personal freedoms maintained under any socialist-communist economic system.

5. COMPARISON OF CAPITALISM AND SOCIALISM-COMMUNISM

All known economic systems are mixtures of capitalism (private enterprise) and socialism-communism (public enterprise). There seem to be some important advantages from such a mixture. For example, a good system of public schools seem to be necessary for the achievement of a high standard of living for a nation. And no socialist-communist country has been able to operate without some private enterprise.

While a mixture of private and public enterprise seems to be desirable, the nature of the mixture is very important. Some essential services apparently can be provided advantageously by public agencies, but extensive government control of production and employment--especially schools, newspapers, radio, and television--leads to inefficient production and loss of personal freedom.

An economic system can be compared with the making of concrete. Strong and useful concrete can be made with the right mixture of high quality cement, sand, gravel, and water. But poor quality ingredients, or improper proportions of them produces only a worthless mess. The following paragraphs provide some comparisons between capitalism and socialism-communism.

Fig. 4. Russian women at work on a farm.

Ownership of property

Capitalism. Most property is owned by individuals or groups (corporations). The owners have great freedom in the use of their property. They can use it for personal enjoyment or for producing things for sale, so long as such use does not interfere materially with the rights of other people. Private property can be sold or given away. Owners usually must pay taxes based on the value of the property, for the maintenance of public services. Taxes also may be levied upon property when it is transferred from one party to another. Private property rights are granted by society as a whole and are limited by the whole society.

Socialism-Communism. Property generally belongs to the people collectively. The public owns the land, mines, factories, transportation, stores, hotels, restaurants, theaters, newspapers, radios, and television. The public also owns the houses, apartments, and automobiles. These properties are managed by government employees who are directed by a highly centralized authority. Individuals and families may be permitted to own personal items such as clothing, furniture, and bicycles.

Freedom of enterprise

Capitalism. Each person has the privilege of choosing his occupation or business. He can work for himself, or choose a private or public employer. It is believed that when each person is free to choose his occupation he is likely to make his best contribution to group welfare. Freedom of enterprise does not guarantee that each individual will be successful in his chosen vocation. Governmental units, representing the public, intervene to prohibit activities judged to be against the public interest.

Socialism-Communism. Practically all individuals must work for the government or a government agency. Each person is expected to work in a job provided by the government, though he may have some choice of jobs. While socialist-communist countries usually permit some small private enterprises, no one, except possibly a favored few political leaders, is permitted to earn substantial profits. Freedom of enterprise is often expressed in graft--or the sale of influence.

Economic incentives

Capitalism. Individuals base most of their activities on a desire from some kind of economic gain such as wages or profits. The desire for power and prestige, and the satisfaction from helping others, also serve to motivate individuals to produce useful goods and services. The desire for economic gain guides individuals into occupations and activities where they can make a large contribution to the satisfaction of the wants of many people.

Socialism-Communism. There is very little opportunity for personal profit, or to become the owner of such attractive things as automobiles, homes, and farms. According to traditional socialist-communist theory each individual would be paid largely according to his needs. Thus wages and salaries would be about the same for everyone. In practice, however, public officials and the managers of enterprises, (who usually double as political leaders) receive much higher incomes than do most of the people.

The price system

Capitalism. Most of the economic activity is guided by an impersonal price system. It directs the production and use of goods and services, except those provided by public agencies. Individuals consider prices when they decide what and how much to buy. They are guided in a large part by wages and salaries (the price of their labor) in the choice of their occupation and employer. Prices also guide the use of land and capital (buildings and equipment) into the most desired uses. Prices keep production and consumption in balance without need for rationing.

Socialism-Communism. Prices are relatively unimportant in guiding production and consumption. Major decisions are made by public officials, who usually are political leaders. The central governing group decides what and how much to produce. Prices provide some guide to consumers in their purchases, but most major items--such as housing --are allotted by government officials. Wage differentials (prices) apparently are essential to encourage leadership and the assumption of responsibility. The lack of a free pricing system prevents the development of efficient agricultural and industrial enterprises.

Competition

Capitalism. In the American form of capitalism competition works to reward the efficient and to penalize the inefficient. Competition among firms encourages the reduction of costs of production, the improvement of quality and the development of new products for consumers and industry. In most industries competitive conditions are maintained by government rules, and court action if necessary. Some monopolies are permitted and even encouraged, for example the supplying of water, electricity, gas, and telephone service. Charges by monopolies are controlled by the government, not to insure a profit to the owners, but to protect the public. Competition among individuals for the better jobs leads to constant improvement of individual performances.

Socialism-Communism. There is relatively little direct competition among farms, factories, and other economic units in the socialist-communist systems. Effective competition is impossible without free prices and free markets. There is little incentive to reduce costs, improve quality or to develop new products for consumers. Factories, railroads, etc., operate largely as monopolies. Prices and charges are regulated primarily for the benefit of the government. This benefit may be monetary or political. There is considerable competition among ambitious individuals. This competition begins in school. Students who show exceptional abilities are given advanced training. Later, those who exhibit technical ability and/or political leadership are given the better jobs. Those who incur the displeasure of the leaders are demoted or punished.

Political and economic freedom

Capitalism. Experience over many centuries has shown that a high degree of political and economic freedom can be achieved and maintained under our form of capitalism, which is characterized by the private ownership and competitive operation of land, factories, and other productive property. Each individual can go into a business for himself, or get a job with any one of many private businesses or public agencies. He can freely and publicly support or criticize his private employer or the public officials. He can participate in the selection of nominees for public office, and usually can choose between at least two contenders for any public office. He can himself become a candidate for public office without or with the support of the ruling group.

Socialism-Communism. Marx and other leaders long claimed that people were oppressed under capitalism and that they would gain freedom under socialism-communism. It hasn't worked out that way. Everywhere that the communists have taken over the people have lost, rather than gained freedom. They have lost the privileges of owning property, going into business for themselves, or working for an employer of their own choice. They have lost the freedom to criticize their employer and government officials. Most of the people have no voice in the selection of candidates for public offices. They can vote, but only for the man selected by the party leaders. The lack of freedom and opportunity is clearly shown by the stringent measures, including the building of the infamous wall in Berlin, taken to prevent the people from leaving the socialist-communist countries.

This unit was prepared by L. H. Simerl, Department of Agricultural Economics, University of Illinois.

VT003 013

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Safety in the Agricultural Mechanics Shops.

Illinois Univ., Urbana. Vocational Agriculture Service
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*TEXTBOOKS, REFERENCE BOOKS, *VOCATIONAL AGRICULTURE, *SAFETY,
*EQUIPMENT, *FARM SHOPS, AGRICULTURAL ENGINEERING,

The purpose of this document is to provide reference and textual materials for high school vocational agriculture and adult farmer students on the safe operation of shop equipment. Development by a teacher educator included consultation with subject matter specialists, teacher-educators, supervisors, and teachers. The document concerns general safety rules, and hand tool, electrical, tractor and machinery, and sheet metal safety. Safety instructions are included for portable electric circular saws, tilting arbor and radial arm saws, jig saws, band saws, jointers, electric sanders, routers, planers, drills, grinders, power hacksaws, arc welders, gas welders, inert gas welders, spot welders, and gas forges. The material is appropriate for use by vocational agriculture teachers with students of average ability with interest and occupational goals in agriculture. Time required is for 2 to 8 hours. This document is available for 30 cents from Vocational Agriculture Service, University of Illinois, 434 Mumford Hall, Urbana, Illinois 61801. (JM)

ED020442

SAFETY IN THE AGRICULTURAL MECHANICS SHOPS

1. What Are General Rules for Safety in the Agricultural Mechanics Shop?
2. What Are Safety Instructions for the Use of Hand Tools?
3. What Are Safety Regulations When Working with Electricity?
4. What Are Safety Instructions for Tractor and Machinery Repair?
5. What Are Safety Instructions for Soldering and Sheet Metal Work?

Safety Instructions for Operating

6. Portable Electric Circular Saws
7. Circular Saws (Tilting Arbor and Radial Arm)
8. Reciprocating and Portable Jig Saws
9. Band Saws
10. Jointers
11. Electric Sanders
12. Routers and Planers
13. Drill Press and Portable Electric Drills
14. Power Grinders
15. Power Hack Saws
16. Arc Welders
17. Oxy-Acetylene Welders
18. Inert Gas Shielded Welders
19. Spot Welders
20. Gas Forges

One of the most valuable habits you can acquire in your shop training is the formation of a positive safety attitude. A positive safety attitude means the habit of not only being safety conscious but also familiar with recommended safety procedures in using tools and operating equipment. It is not difficult to be constantly aware of the importance of safety when you know how vital it is to you to cultivate proper attitudes toward safe work habits.

VT003013

The danger of the absence of a positive attitude toward safety becomes immediately apparent when you consider the consequences of neglect in any one area. In the field of traffic safety, evidence shows that where traffic law enforcement decreases, accidents increase. In another case, a factory foreman became lax in enforcing the requirements for wearing safety goggles, and in one month's time, eye injuries increased five percent. No doubt each of you can easily recall recent accidents in your community that were due to carelessness, neglect, or an improper safety attitude. Industrial shops are not the only place where a positive safety attitude is important. It is important in agricultural mechanics shops. Therefore, the safety recommendations found here have been established for three very good reasons:

1. To protect you and your co-workers from bodily harm.
2. To minimize damages to the facilities, machinery, and tools.
3. To provide you with experience in safety concepts that apply to occupational fields.

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1. WHAT ARE GENERAL RULES FOR SAFETY IN THE AGRICULTURAL MECHANICS SHOP?

Safety is of first importance in any shop. Safety involves many things. It means having tools and equipment in good operating condition with proper guards in place at all times. It means that students who use the shop must be properly trained in safe operating procedures. Most of all, it means the use of common sense and good judgment by students who are alert and who really believe in safety.

Statistics show that 85 percent of school and industrial plant accidents are due to human factors against which mechanical devices cannot guard. Thus, guards and other safety devices afford only about 15 percent protection against accidents. Most accidents result from someone's thoughtlessness, carelessness, or lack of consideration for others.

Safety depends upon YOU; YOU must believe in it; YOU must learn and practice safe rules of conduct in the shop; YOU must sell others on the idea of safe operation at all times.

Proper dress in the shop

Wear appropriate clothing in the shop. Avoid loose fitting or ragged clothing. When working with power equipment, remove your tie, roll your sleeves above the elbows, and tuck your shirt in your trousers.

For welding, clothing should be free from accumulated oil, dirt, and grease. Fire resistant gauntlet gloves are recommended for the hands and wrists. Woolen clothing is preferable to cotton because it is not as readily ignited. Keep sleeves and collars buttoned. Cuffs should be turned down and pockets should be eliminated. Low shoes with unprotected tops permit slag or sparks to lodge in them.

Keep hair cut to avoid hazards when working in the shop.

Wear safety goggles while working in the shop. Safety goggles protect the eyes from injuries caused by small particles, splashed acids, etc.

Proper work habits in the shop

Avoid HURRY. Plan your work so you will have plenty of time to finish before clean-up time. A hasty operator cannot be a careful operator.

Keep busy during the entire period in the shop. Plan your work so you are busy during the shop period. Do not bother other students or work on another student's project unless you have been so assigned by your instructor.

Refrain from loud talking or shouting. The shop is a teaching laboratory and unnecessary noise is distracting. Talk in a low tone and avoid shouting.

Do not leave the shop without the instructor's permission. The instructor is responsible for all members of the class during the time they are assigned to him. Do not leave the class without first checking with your instructor.

Do not talk to another student while he is operating power equipment. Operating a machine is a full time job. If necessary to talk, signal him and wait until he has turned off the machine.

Do not start or stop machines unless you are the operator. The operator of a machine must be in full control at all times. Some operations require a helper, but the helper should not start or stop the machine or control its operation in any way. All stationary power tools should have a working safety zone. It may have lines plainly marked encircling the power tool. During the operation of the power tool, only the operator or the operator and his assistant should be within the safety zone.

Do not engage in horseplay, scuffling, or pushing while in the shop. Any student who, by his actions in the shop, becomes a hazard to the safety of himself or his fellow students, should not be permitted to operate equipment. In extreme cases he may not be permitted to continue as a member of the class.

Clean the shop before leaving it. When the warning bell rings, all tools should be returned to their proper storage place and work areas cleaned up before the class is dismissed. Spilled oil or grease should be cleaned up promptly as it may cause others to slip and fall. Accumulations of dirt, sawdust, and trash create a fire hazard as well as an accident hazard.

Report all defective equipment to your instructor. Turn off any motor or appliance

MEMORANDUM

TO: The ERIC Clearinghouse on Vocational and Technical Education
The Ohio State University
980 Kinnear Road
Columbus, Ohio 43212

FROM: (Person) J. W. Matthews (Agency) Vocational Agriculture Service

(Address) 434 Mumford Hall, Urbana, Illinois 61801

DATE: August 1, 1967

RE: (Author, Title, Publisher, Date) Safety in the Agricultural Mechanics Shops, VAS 3022. Urbana, Illinois: Vocational Agriculture Service, University of Illinois. 24 p., 1967.

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that does not seem to be operating properly. Turn off the motor if it seems to be heating above normal operating temperature. Equipment must be kept in good condition to be safe. Cutting tools must be kept sharp, handles tight, and guards in place on grinders, saws, and other power tools. Equipment that is not in good operating condition should be labeled "OUT OF ORDER" and not used until it is repaired.

THINK. Most accidents are caused by thoughtlessness. When in doubt about the correct safety procedure, ask your instructor.

Proper fire protection in the shop.

Know the location of fire extinguishers. Learn the types of fire extinguishers that are available in the shop and the correct type to use on each class of fires.

Know the location of the fire blanket. The fire blanket should be available to the welding area for emergency use to extinguish clothing fire.

Always check the area for flammable material before lighting torches or turning on welders.

Store paint, lacquer, and other flammable material in metal cabinets.

Use only safe solvents for cleaning. Gasoline should never be used for cleaning purposes because of the danger of fire or explosion.

Proper first-aid in the shop

Report all injuries, including minor cuts, to your instructor. Infections can develop wherever the skin has been broken or cut. Use first-aid materials and if in any doubt, consult a doctor or nurse. No student who has had an accident which caused the flow of blood should leave the shop alone.

Know the location of the first-aid cabinet. The standard items of first-aid supplies should be kept in a first-aid cabinet in the shop.

Welding or cutting on containers

Never do any welding or cutting on containers that have held a flammable substance until they have been thoroughly cleaned and safe-guarded.* An empty gasoline container may be just as dangerous as a full one because gasoline vapor usually remains in the container after gasoline or other flammable material has been removed.

First wash the tank several times and flush it with live steam until all possibility of gasoline vapor has been removed. Washing with a strong solution of caustic soda or similar chemical will remove heavy oils.

Fill the tank with water or carbon dioxide before welding or cutting on it.

Water drives out any remaining vapor. However, before starting to weld, drain the water to a point just below the spot to be welded. Also be sure there is a vent or opening above the water to provide for the release of heated air from inside the container (Fig. 1).

Carbon dioxide may be forced into the container where it is not practical to fill it with water (Fig. 2). Periodic examination of the gas contents of the container should be made to make sure the concentration of carbon dioxide (80% of air space inside container) is great enough to prevent an explosive mixture.

Dry ice is sometimes used by placing a sufficient amount in the container to provide

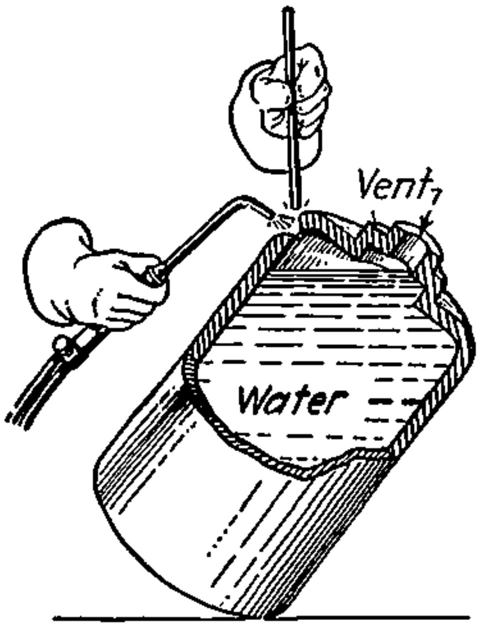

Fig. 1. Containers which have held flammable materials should be filled with water before welding or cutting. Make sure that the space above the water level is vented.

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*Detailed procedures for safe-guarding containers for welding may be found in the booklet "Safe Practices for Welding and Cutting Containers That Have Held Combustibles." American Welding Society, 33 W. 39th St., N. Y.

protection. The dry ice produces carbon dioxide which occupies the air space in the container. In using dry ice, be sure to use enough dry ice to replace 80% or more of the air space with the carbon dioxide.

PRECAUTION! - The use of carbon tetrachloride in place of carbon dioxide is not recommended as carbon tetrachloride gives off a poisonous vapor when heated.

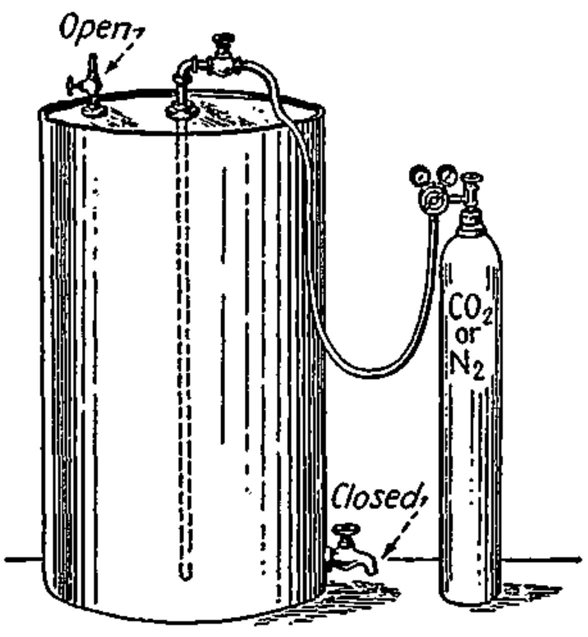


Fig. 2. Suitable concentrations of nitrogen or carbon dioxide may be used to supplement thorough cleaning to safeguard containers.

2. WHAT ARE SAFETY INSTRUCTIONS FOR THE USE OF HAND TOOLS?

Although most serious accidents involve power equipment, many minor accidents occur with common hand tools. Following are some suggested practices that will help to eliminate shop accidents with hand tools.

Proper use of hand tools

Keep all edge tools sharp. Dull tools are dangerous because excessive pressure is necessary to make them cut and this frequently causes tools to slip and injure the operator.

Avoid cutting toward yourself or others around you, when using an edge tool. There is always a possibility of the tool slipping and injuring you or others. It is necessary to pull a draw knife or a spokeshave toward you, but, since you use both hands with these tools, they are relatively safe.

Use wrenches of the proper kind and size for the job. Wrenches with worn or spread jaws are hazardous. Do not use a pipe to extend the handle of a wrench. Wrenches that fit improperly increase the chance of slipping and injuring your knuckles. Do not strike wrenches with hammers.

Do not handle tools carelessly. Avoid dropping tools or placing them where they can fall or be easily knocked over.

Provide handles for all files. This reduces the possibility of an injury from the sharp tang.

Use tools correctly. Do not use a tool for a purpose other than for which it was designed. Use the right tool for the job. The wrong tool may damage materials, injure workers, or both.

Do not use pliers in place of a wrench.

Do not use a wrench as a hammer. The wrench may break or chip.

Do not use a screwdriver as a chisel, punch, or pry bar. Hammering on a screwdriver may damage it.

Do not use a machinists or ball pein hammer for carpentry work.

Do not use carpenter's hammers to strike punches or cold chisels.

Do not use punches or chisels with mushroomed heads. Dress the heads of mushroomed cold chisels and punches on the grinder in order to prevent particles from breaking off and endangering the user or other persons.

Store tools properly so that sharp edges are guarded.

Keep handles secure and in good repair. Be sure all tool handles are securely attached before using them. Loose hammer heads or weak handles endanger other workers as well as yourself. Check for cracked or loose handles on all axes, hatchets, and hammers before using them.

Adjust the jaws of adjustable wrenches. Take time to properly adjust the jaws and keep the face of the wrench forward in the direction the handle is to turn. Adjustable wrenches often slip or break when used improperly.

Keep tool handles free from dirt, oil, and grease. Dirty, greasy tools are dangerous because it is impossible to grip them properly. Clean tools make a worker more efficient.

Drive nails correctly. Hold the nail between the thumb and forefinger. Keep the remaining fingers closed and away from the nail.

Do not carry edged or pointed tools in your pocket. Serious injuries can be caused by chisels, scribers, wing dividers, etc. in this way.

Hold work steadily. Be certain that work to be cut, sheared, chiseled, or filed is steady and secure to prevent tools from slipping.

Use screw drivers of the proper size. Don't use one with a blade too thick, too thin, too wide, or too narrow, as it may slip and cause injury. Keep the tip in good condition, not worn or rounded. Use screw drivers of proper design. Do not hold work in your hand when using a screwdriver. If possible, use both hands on a screwdriver and keep it pointed away from your body. Puncture injuries caused by screwdrivers are rather common and often quite serious.

Mount vises securely. A loose vise is dangerous. If a machinist's vise has a swivel base, be sure it is locked. Do not strike the vise handle with a hammer. Do not use a pipe as an extension of the handle. Normal leverage will hold the work securely in place. Do not hammer on the beam. It is not an anvil and is not intended for this use. Keep vise jaws clean at all times.

3. WHAT ARE SAFETY RECOMMENDATIONS WHILE WORKING WITH ELECTRICITY?

Students are surrounded in the agricultural mechanics shop by various types of electrical equipment, tools, and appliances. In order to work safely under these conditions, it is important to understand the possible dangers that may result from unsafe and improper operation of electrical equipment.

Recommendations for safety with electricity

Check all wiring, outlets, and service fixtures in the shop regularly for safety. This should include wire size, outlets, fuses, switch boxes, etc. All wiring should comply with the National Electrical Code.

Locate and check the master switch. Be sure you know where this switch is located and how to shut it off in an emergency.

Check all electrical tools for damaged cords, faulty plugs, or loose connections. All cords should contain a grounding conductor.

Check all extension cords for exposed wires, faulty plugs, poor insulation, and poor connections. Avoid overloading extension cords. Avoid handling electrical cords and switches with wet hands. Do not place extension cords in doorways or lay them on radiators or steam pipes. Wipe them to remove grease before putting them away. Do not disconnect power tools, appliances, or extension cords by pulling on the cord. This may cause loose connections or broken conductors.

Use grounding plugs on all power tools. Be sure that all receptacles in the shop are the grounding type and properly installed.

Use care in damp places. Do not operate electrical equipment adjacent to water or damp places unless special precautions have been taken. When working with electrical equipment in damp places, it is best to wear rubber-soled shoes.

Keep proper size fuses on hand. Do not use pennies or other objects as a substitute for fuses. This may result in overheated conductors and appliances or in a fire.

Unplug heating appliances. Never leave heating appliances connected when not in use. Overheating or fire may result.

Use proper cleaning solvents. Do not use gasoline or flammable solvents to clean electric motors or appliances.

Check motor temperature. Turn off motors and appliances that are smoking, have a peculiar smell, or are operating above normal temperature.

Check circuits carefully. Use an insulated circuit tester to check circuits. Do not use bare fingers to see if a circuit is energized.

Use a fuse puller to remove cartridge fuses.

Lock a control switch open if you are working on a circuit. If it is not locked open, someone may close the switch and energize the circuit.

Use proper extinguisher on electrical fires. Do not use water-type extinguishers as they can result in a fatal shock.

Observe the following precautions when completing electrical wiring, electric motors, and controls exercises.

a. First make a wiring diagram on paper and have it checked.
b. Solder wire splices and tape them unless insulated solderless connectors are used.
c. Properly connect and tighten screws on wires connected to electrical fixtures. Do not tighten screws so hard that fixtures are broken or threads are stripped.
d. Use correct wiring methods and procedures and follow the rules of the National Electrical Code.
e. Have instructor check the work before connecting up to current.
f. Have instructor check connections before turning on an electric motor.
g. Be sure the neutral conductors are not switched in controls exercises.

4. WHAT ARE SAFETY INSTRUCTIONS FOR TRACTOR AND MACHINERY REPAIR?

The repair of tractors and farm machinery in the farm mechanics shop demands serious consideration of safety. In working with present day complex farm machines, it is necessary that the student be alert and safety conscious in order that he avoid accidents.

Safety instructions for farm equipment

Use hoists and jacks correctly. Never allow any part of your body to be under a machine while it is suspended by hoists or resting on jacks. After raising the machine, make it safe and secure by use of solid supports placed under the machine.

Use proper sizes and types of wrenches. Wrenches which do not fit or are used improperly may slip and cause injury.

Use small parts containers. Provide containers for bolts, screws, and disassembled parts. Bolts and parts left scattered on the floor become lost or may cause others to trip over them.

Cover protruding parts. Exposed shafts, axles, and sheet metal may cause injury to others.

Provide ventilation. Make provisions for removing exhaust gases when engines are operated in the shop. Carbon monoxide from tractor exhaust fumes may be fatal if inhaled in sufficient quantities.

Avoid burns. Never remove the radiator cap while the engine is overheated. Steam pressures from the radiator may explode and cause burns on face, hands, and arms. Keep parts of body away from hot manifolds to prevent burns.

Clean up grease and oil from the floor promptly or cover it with an absorbent. Grease spilled on floors may cause falls.

Stop equipment before adjusting it. Do not adjust tractors or machines while they are running. This is important. Fingers, hands, arms, and legs may be injured or lost because of failure to observe this recommendation.

Do not use your mouth in siphoning gasoline. Gasoline contains many additives, some of which are harmful.

Prevent gasoline fires. Wipe up spilled

gasoline promptly. Sparks may ignite the gasoline causing serious fires and burns. Welding of farm machinery should never be done in the vicinity of fuel storage. Never add fuel to a tractor while it is running as sparks from the engine may ignite escaping gasoline fumes. Never use gasoline to wash parts. Various types of commercial solvents are now available which are less flammable and easier on the hands. Do not leave open pans of cleaning fluid in the shop. Never pour gasoline or dirty cleaning fluid down the drain.

Avoid lifting heavy machinery parts. Back injuries are often the result of improper lifting of heavy objects. Use an overhead hoist when available.

Warn others before you move any levers or trip any parts that might cause pinching or crushing.

Wear gloves when removing tight and rusted nuts to avoid injury to knuckles.

5. WHAT ARE SAFETY INSTRUCTIONS FOR SOLDERING AND SHEET METAL WORK?

By engaging in unsafe practices while soldering or working with sheet metal you risk injury to yourself and others. Safety instructions should be strictly followed while soldering and working with sheet metal.

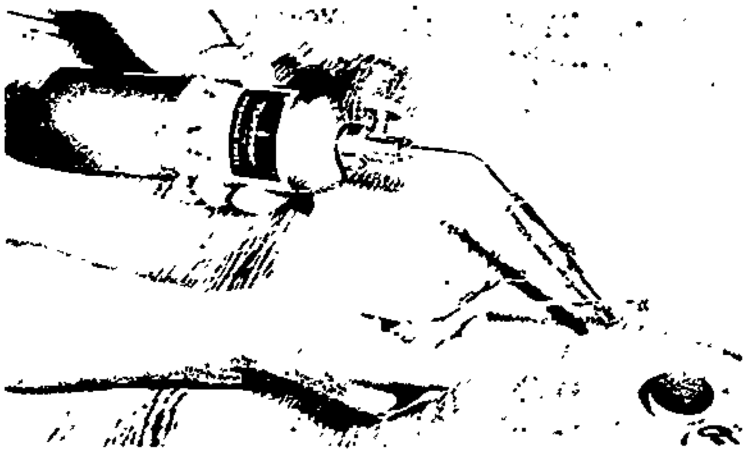
Safety instructions for soldering

Be careful with soldering acid. This acid will ruin your clothes, burn your skin or injure the eyes. If you get acid on your skin, wash it off as quickly as possible. In case of any burns, report at once to your instructor for first aid treatment.

Avoid breathing fumes. Fumes from soldering fluxes and from tinning a soldering iron are harmful when breathed in quantity and should be avoided.

Use care with molten solder. Avoid dropping molten solder on cold, damp surfaces. Molten solder spatters and the small droplets of metal may cause burns. Molten solder can cause steam pockets when it comes in contact with moisture. These pockets can explode and cause burns. Position yourself so molten solder will not fall on you. Be careful that the hot metal does not burn you. Burned fingers are almost the sure sign of a beginner at soldering. Just because the solder has cooled enough to solidify does not mean that the metal is cool enough to handle with the bare hands.

Be careful of fires and explosions from propane torches, blow torches, and gas firepots. Do not light a soldering torch near combustible materials. Stand to one side when lighting gas burners or torches. If gas does not light immediately, turn off valves before investigating the reason for the failure.



Never throw empty propane cylinders in an incinerator.

Handle electric soldering irons carefully. Inspect the plugs and cords regularly. When soldering with welding equipment, refer to safety regulations recommended for operating arc and oxy-acetylene welders. Never solder a container until it has been "safe-guarded". For methods of "safe-guarding" containers see footnote bottom of page 3.

Use shears carefully. Make sure metal squaring shears are equipped with guards. Never put the fingers under the blade and never reach behind the shear blade to hold small pieces. Do not permit sheet metal to slip through your hands. Cuts from metal are usually from a slicing motion. Snip off sharp points left from pattern cutting. Watch for slivers on edges of cut metal. When beginners cut sheet metal with snips they often leave sharp needlelike slivers on the edges.

Use correct procedures. When in doubt about the correct safety procedures ask your instructor.

6. SAFETY INSTRUCTIONS FOR OPERATING PORTABLE ELECTRIC CIRCULAR SAWS

In carpentry work, one of the most useful power tools is the portable saw. Most hand-cutting operations can now be performed with the portable electric saw. This tool becomes dangerous when improperly used. The operator should be properly trained in handling the saw and procedures in making the various cuts. Suggestions for safe use of the portable electric saw follow:

1. Keep a sharp blade on the saw at all times.

Dull blades may pinch in the work and cause a kick back. Do not use a blade after you sense it is dull, needs setting, or has come in contact with metal.

2. Check to see if safety devices are functioning properly before using the saw.

Safety guards are provided in front and over the bottom of the blade, and usually are constructed to return to position after sawing. Some saws have a kickproof clutch. This relieves motor strain and protects the operator from possible kickback of the saw.

3. Check regularly for cracked blades.

Considering the damage that might result from a cracked blade, it is best to replace it at once.

4. Before starting the cut, be sure the extension cord is away from the saw, and that it will allow freedom of movement throughout the length of the cut. The third wire in the extension cord is for grounding and should be connected.

5. Never use a portable saw unless you are well balanced and have good footing.

Keep from standing on scraps or rubbish and do not lean over or reach to extreme positions while sawing.

6. Be sure the blade is clear of the work before the saw is turned on or off.

7. Keep both hands on the saw unless a protractor or other aid to guide the saw is used.

Never hold a small piece with one hand and the saw with the other. Clamp small pieces to a saw horse or table; hold larger pieces down with your knee so that both hands may be used to control the saw. Never reach around to catch a board to prevent it from falling.

8. Hold the saw until it stops turning before you lay it down after a cut.

9. Disconnect the saw when making any adjustments that require your fingers to be near the blade.

Two adjustments are incorporated in the body of the saw. One lock knob provides for (1) depth of cut adjustment and (2) another lock knob allows for angular adjustment. A third adjustment is provided through use of a rip guard. This device must be installed when needed.

10. When starting a pocket or interior cut, the telescoping blade guard should be pushed up out of the way.

7. SAFETY INSTRUCTIONS FOR OPERATING CIRCULAR SAWS
(Tilting Arbor and Radial Arm)

One of the most common pieces of equipment in the agricultural mechanics shop is the table saw. There is no safety device in the shop that is disregarded more than the saw guard. Quite often serious accidents result from careless use of the circular saw. Listed below are some recommendations for proper operation of the circular saws:

1. Be sure that the saw is located in a position so that the electric power cord from the saw to the electric outlet will not be in the way while operating the saw. Encircle the saw with "safety zone" lines.

Painted lines enclosing an area around the saw should indicate a safety zone. Only the operator should be within the zone area when the saw is being operated except in cases where the instructor has assigned a student to assist the operator.

2. Check the power cord and plug for damage.

3. Check the saw table before using to see that it is clean.

A clean table permits holding the material to be cut in a solid flat position against the guide fence. Do not place tools, accessories, or attachments on the saw table as they can mar the surface.

4. Make sure the saw is grounded.

Use the grounding wire in the power cord for grounding the saw.

5. Do not use dull or damaged blades or cutters of any type on the saw.

A dull tool is a dangerous tool and when driven at high speed is even more dangerous.

6. Do not wear gloves, long loose sleeves, neckties, or rings. Keep shirts in trousers.

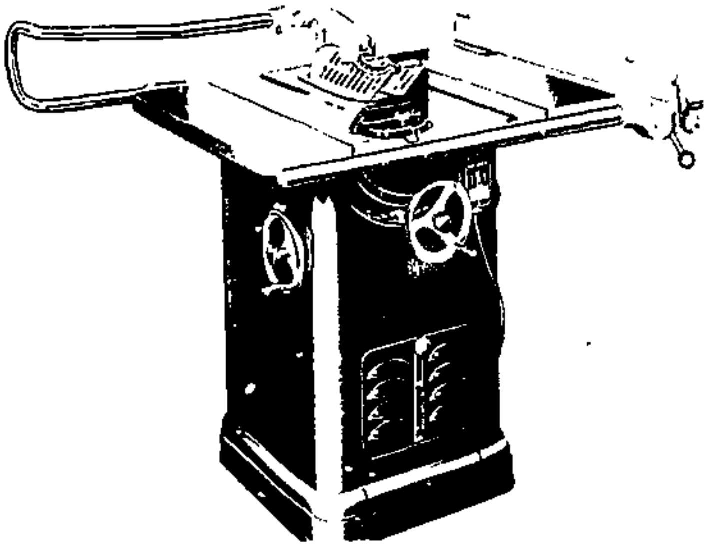
They may get caught in the moving parts of the machine and cause injury.

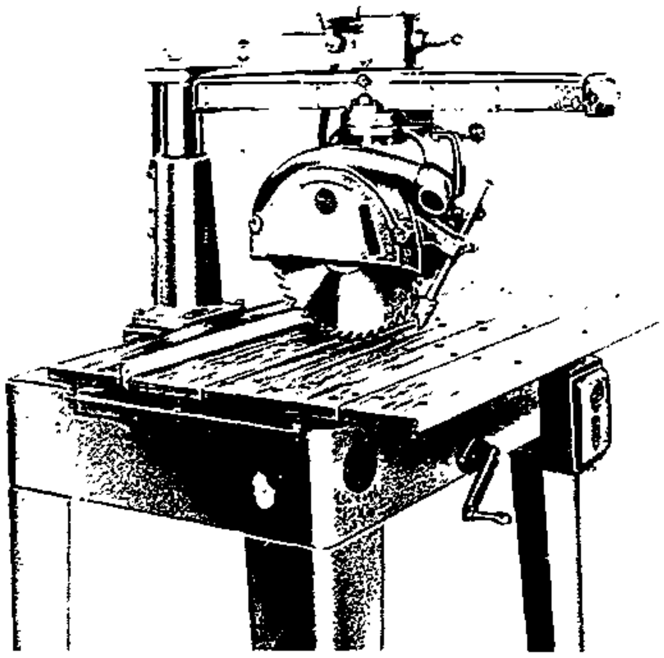
7. Keep the guard down over the saw blade for all normal sawing operations. Always use the guard when ripping or cross-cutting. It is usually necessary to remove the guard on a table saw when rabbetting, dadoing, or resawing. In these cases, compensate by being extra careful and replace the guard immediately when the operation has been completed.

8. Do not saw freehand or try to follow a line with a table saw.

Use the rip fence for ripping and the miter gauge for cross-cutting.

9. Adjust the blade height of the table saw so that it clears the work by no more than 1/4 inch.





This makes for smoother cuts as well as safer operation.

10. When ripping, use a push stick to push the end of the piece through the saw.

11. Never allow your fingers to go beyond a line even with the edge of the guard unless both hands are on the miter gauge, or unless a push stick is being used.

12. Do not use the fence as a stop to gauge the length of pieces being cross-cut.

A clearance block may be clamped to the fence near the edge of the table for gauging the length of pieces being cross-cut.

13. Never clear away scraps close to the blade with your fingers while the saw is running.

If necessary to remove scraps, use a stick at least 2 feet long.

14. When helping someone rip a long board, do not push or pull on the board being ripped.

Merely support the board and allow the operator to control the cut at all times.

15. Always stand with your face slightly to one side of the direct line of the saw blade.

16. Disconnect the power before working around the blade with your fingers.

17. Make no adjustments until the saw has come to a complete stop and never attempt to stop the blade from coasting with a piece of scrap lumber.

Additional recommendations for radial arm saw

18. Do not position yourself directly in front of the saw blade. Be sure the floor is clean of debris and that fellow workers are not within the safety zone area. Be sure all clamping and adjusting handles are tight before the power is turned on.

19. Get the feel of the saw before operating it.

To do this grasp the saw handle and pull the saw out to its full travel on the radial arm. Do this several times and find the most convenient foot position that will enable you to bend your arm naturally without strain on your body. This will help maintain your foot position on the floor and at the same time permit watching the operation of the saw.

20. Before ripping, adjust the front of the guard to not more than 1/8 inch above the work to be ripped.

21. Before ripping, adjust antikickback device so that the fingers are at about 60° angle when in contact with board to be ripped.

22. Before ripping, check the direction of rotation of the blade and push the board in from the proper side.

Remember, in ripsawing operations, the saw rotates up and toward the operator and the material to be cut is pushed into the saw.

23. In cross-cutting, pull the saw from the rear side of the table toward you and through the board.

In crosscutting operations, the saw blade should rotate down and away from the operator and the saw blade should be pulled slowly into the material or it will climb up on the material, stall the saw, or throw it out of adjustment.

24. Return the saw to the rear side of the table when you have finished cross-cutting.

8. SAFETY INSTRUCTIONS FOR OPERATING RECIPROCATING AND PORTABLE JIG SAWS

The sabre saw, sometimes called a bayonet saw, is essentially a portable electric jig saw. Reciprocating saws are more versatile than the sabre saw and the blade action is usually different. Both saws have a broad range of work capacity. Although they are not considered as dangerous tools, certain safety precautions should be observed in operating them.

1. Check electrically operated saws to see that they are adequately grounded and all electric connections are safe.

2. Do not use electric saws or any electric tools while standing on wet ground.

3. Make sure the electric cord cannot become fouled during operation of the tool.

4. Make sure the work to be cut is solidly supported.

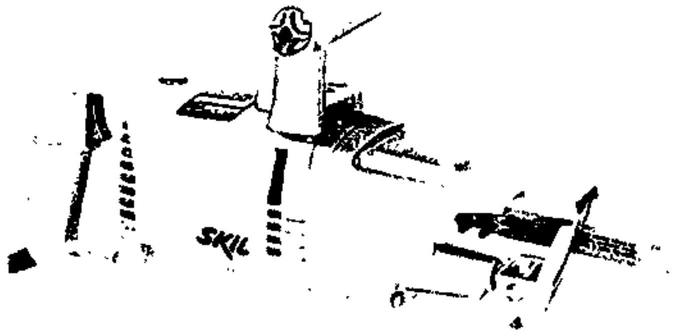
5. Select the proper blade for the type of work to be done.

Sabre blades are of three types: woodcutting, metal cutting, and knife blade. Reciprocating saw blades are made in a variety of sizes and shapes.

6. Make sure the blade is locked securely before starting to work.

In changing blades follow the instructions found in the Operator's Manual which usually comes with each electric saw.

7. Rest the shoe firmly against the work when operating the saw. Otherwise the blade



may catch and the saw will move instead of the blade.

8. Move the saw forward rapidly enough to keep the blade cutting.

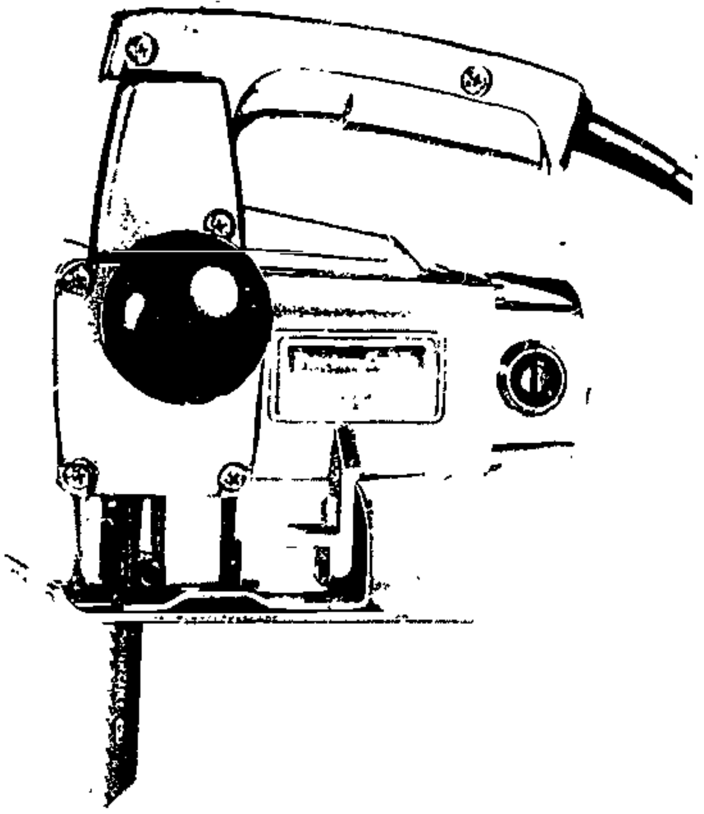
Do not force the saw. Use the hand knob for safer control of the saw. Follow the line of cut accurately.

9. Check the saw for loose parts and screws.

This will help to insure better work and safer operation.

10. Clean the saw periodically.

Air inlet and outlet passages should be kept clean to insure a cool running motor.



Accumulated dust should be blown out of the motor frame with an air jet.

11. Always disconnect the cord when repairing or adjusting the saw and when changing blades.

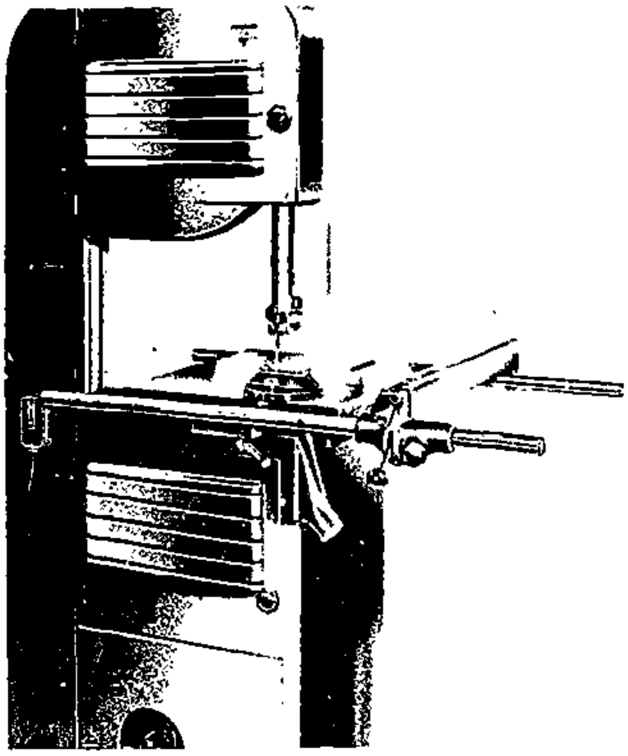
9. SAFETY INSTRUCTIONS FOR OPERATING BAND SAWS

Although the band saw is considered less dangerous than other types of power saws, certain precautions must be observed in its operation. No student should attempt to operate the band saw without permission from the instructor.

1. Before turning on the saw, check to see that no fellow workers are within the saw "safety zone" area.

Painted lines enclosing an area around the saw should indicate the safety zone area. When the saw is being operated, only the operator should be within the zone area, except in cases where the instructor has assigned a student to assist the operator.

2. Loose clothing, aprons, and ties are considered hazardous when operating the band saw.



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3. Check the saw for free movement and trueness of blade before turning on the power.

This may be done by turning the saw a few revolutions by hand to track or align the blade on the wheels. Realign and reset adjustments if necessary.

4. When operating the saw, be alert to possible dangers and loss of fingers.

Keep both hands on the same side of the saw blade while pushing work through the band saw. Do not allow fingers to come closer than two inches to the saw blade when cutting. Keep fingers away from a direct line with the blade. Use a push stick. Do not reach back of the blade to pull stock through.

5. Keep the saw blade clean, sharp, and properly set.

Running the saw with a dull blade may cause it to break. It also causes undue pressure on guide wheels. Operating the saw caked with dust and gums frequently causes breakage. Insufficient set causes the blade to burn the wood.

6. Keep the saw guide down within one-half inch of the stock being cut.

7. Keep the blade fully guarded at all times.

8. Avoid backing the saw blade out of a long curved cut.

If necessary to back saw blade out of a cut, turn off power and wait until machine stops before freeing the blade from the cut.

9. Be alert for such saw troubles as twisted, dirty or dull blades, or any other saw problems.

When saw trouble is apparent, quickly turn off the power and call the instructor.

10. Do not saw cylindrical stock on the band saw. Use the band saw for straight cuts only. Sawing cylindrical cuts tends to twist the blade and may cause it to fly off. Round stock tends to spin.

10. SAFETY INSTRUCTIONS FOR OPERATING JOINTERS

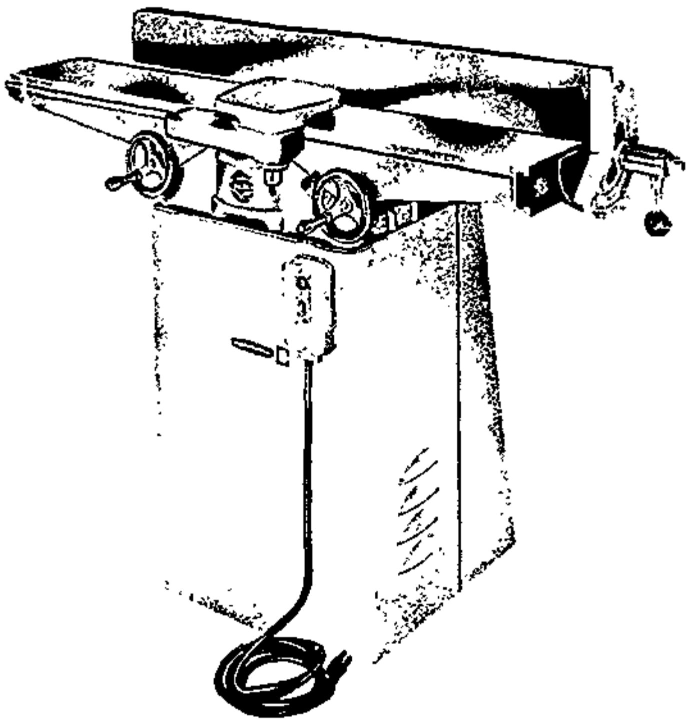
Jointers usually come equipped with guards that automatically cover the jointer head. Nevertheless, many accidents occur with this piece of equipment. The fact that the blades are usually covered may be the reason people become careless in its operation. Some recommendations for safe use of the jointer follow:

1. Keep the guard over the blades and in good working condition at all times. Adjust only when the machine is not in motion.

There are various styles of guards for jointers. Make sure you understand the correct position for the guard and how it works.

2. Keep the jointer blades sharp.

When the cutting blades become dull, both the efficiency and safety factors are lessened. The machine also becomes more difficult to operate. Always disconnect the power when checking or removing blades.



3. Check the blades for proper depth before operating the jointer.

Make sure the power is off before examining the blades. After setting or adjusting depth of blade, it is well to check the position of the rear table.

4. Make no cuts deeper than 1/16 inch without the instructor's permission.

Light cuts are safer than heavy cuts and are easier on the jointer.

5. Avoid jointing short pieces.

Due to the danger involved in handling small pieces, no attempt should be made to joint pieces less than 12 inches in length.

6. Use a hand plane on narrow pieces.

Secure the instructor's permission before jointing narrow pieces. A push stick should be used on any piece less than 2 inches wide.

7. Use an assistant when jointing the edge or face of long pieces.

Make sure only the operator and the assistant are in the safety zone area while operating the jointer.

8. Examine the stock carefully for knots, splits, paint, or nails before running it over the jointer. If any are found, do not run the stock through the jointer as they will damage the cutter.

9. Do not run the flat side of a piece of stock over the jointer without special permission from your instructor.

Remember, the jointer is designed for straightening and smoothing the EDGES of boards. It is not made for planing the flat sides or the ends of boards. Using it for these purposes is extremely dangerous and a frequent cause of jointer accidents.

10. Do not place your hands above the cutter. Feed the work through by using fingertips not the flat of the hand.

11. Do not run end grain over a jointer.

12. Be sure the fence is clamped in place.

13. The stock should be run through with the grain, not against it.

11. SAFETY INSTRUCTIONS FOR OPERATING ELECTRIC SANDERS

Although the sander is not found in many agricultural mechanics shops, some shops have access to their use. They are not considered a dangerous tool, however, there are certain recommendations and care which must be observed in their use in order to avoid accidents.

Disk sanders

1. Sand only on the downstroke side of the disk.

2. Do not hold small pieces in your hand.

Small pieces have a tendency to rotate and may pull your fingers against the revolving disk. Sand small pieces by hand or, if a large number are to be sanded, devise a jig to hold them securely.

3. Always stop the sander to clean, make adjustments, or repair it.

4. Never leave the sander after turning it off until it has come to a complete stop.

5. Never touch a moving sanding disk.

6. Wear a dust mask when sanding masonry.

To sand masonry, install a #24 or #36 grit carbide disk.

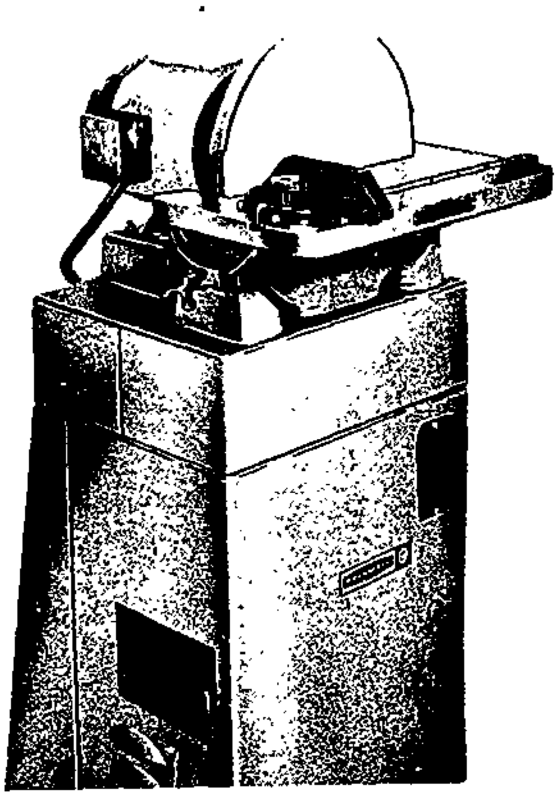
Belt sanders

1. Check sander belt before starting motor.

Make sure the cord is disconnected. If belt needs replacing, select proper abrasive and belt size. Follow replacement instructions.

2. Fasten the item to be sanded firmly.

The sander exerts tremendous pulling force. The material to be sanded should be fastened accordingly.



3. Make sure the belt is tracking.

To do this, start the motor before the sander is placed on the surface and observe the motion of the sander belt. Make adjustments if necessary.

4. Check the dust collector.

Make sure the opening to the bag is clean. In some types of sanding dust, there is danger of spontaneous combustion if dust is left in the dust collector.

5. Never stop or start a portable sander that is resting on the work.

6. To stop the portable sander, lift it from the work and turn off the switch. This results in less strain on the motor. Never lay the sander down until it has stopped running.

Finishing sanders

(Finishing sanders may be identified as either orbital or oscillating type)

1. Check the power cord for loose connections.

2. Check the sander for loose screws or parts.

3. Make sure the cord is long enough for the job.

In finishing walls, cabinets, etc., an extension cord is usually necessary to provide enough length to cover the area. The extension cord should be heavy enough to supply adequate current for the sander.

4. Hold the sander firmly while operating it.

5. Always disconnect the sander from the power before changing the abrasive sheets.

Select the proper size abrasive sheet for replacement. Check for proper operation of the machine after changing the abrasive sheet by allowing the sander to operate a short time before applying it to the work.

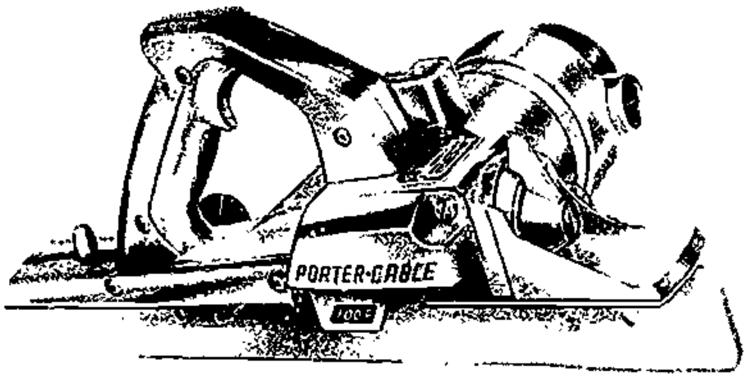
6. Always start the sander off the work and apply it evenly.

The normal weight of the machine is sufficient for proper sanding. Do not put additional pressure on the machine.

7. When sanding is completed, lift sander off the work before stopping the motor.

12. SAFETY INSTRUCTIONS FOR OPERATING ELECTRIC ROUTERS AND PLANERS

The router is one of the most versatile portable power tools to be found in woodworking shops. Neither the router or electric planer are commonly found in the agricultural mechanics shop. For students having access to these tools, the following regulations should be followed for safe use:



Electric router

1. Make sure you are familiar with the router and how it operates.

If you have not previously operated a router or planer, ask for a demonstration of its use and adjustments. Make sure you are familiar with all moving parts.

2. Carefully check the router before turning on the power.

Make sure you are using the proper bit and that it is properly fitted into the collet of the router and firmly tightened. Run the motor briefly before applying to the stock.

3. Examine the attachment cord.

Are all connections tight? Is the ground attached properly? Is the cord long enough to allow for work to be done?

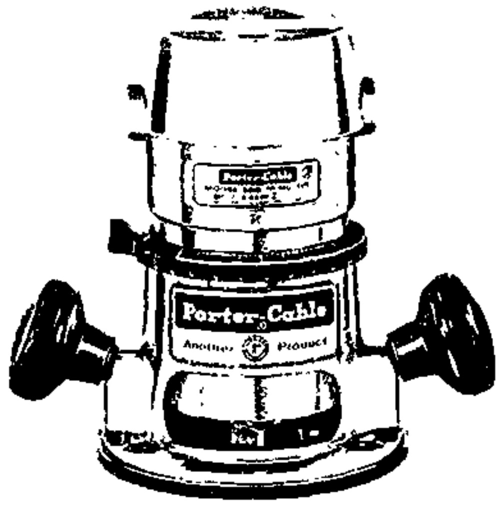
4. Adjust the router for depth.

For this adjustment follow instructions in the Operator's Manual which accompanies the tool. Make a sample cut on scrap lumber after each adjustment.

5. Always make sure the stock is securely fastened before starting work.

6. Keep a firm grip on the router while operating it.

Since the cutter rotates clockwise, more efficient cutting will be obtained if the router is moved from left to right as you stand facing the work.



7. Keep the router free from dirt, oil, and cuttings.

Always use a brush to clean away cuttings even though the power is turned off.

Additional safety instructions for electric planers

8. Make sure the electric cord cannot become fouled and is properly grounded.

Do not run the planer over the power cord.

9. Hold the plane correctly while operating it.

The four fingers of the left hand should be wrapped underneath the motor and against the vertical fence. Keep left thumb firmly on top of front shoe.

10. When a cut is finished, turn off power but do not lay the planer down until cutter stops rotating.

13. SAFETY INSTRUCTIONS FOR OPERATING DRILL PRESSES AND PORTABLE ELECTRIC DRILLS

The drill press ranks second only to the electric grinder in the number in agricultural mechanics shops. Although the drill press and portable electric drill are not considered particularly hazardous, there are many careless practices that need to be eliminated to avoid accidents when operating the drill press. Following are some precautions to be observed when operating these tools:

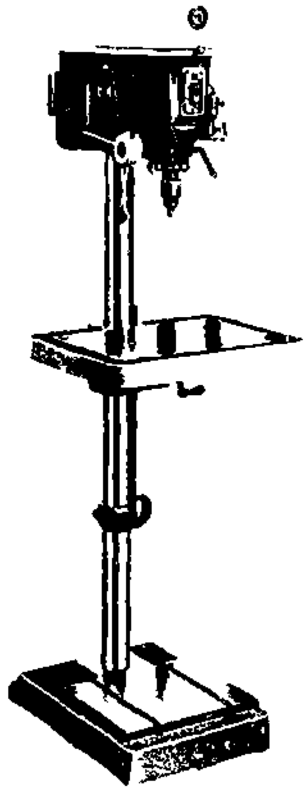
Drill presses

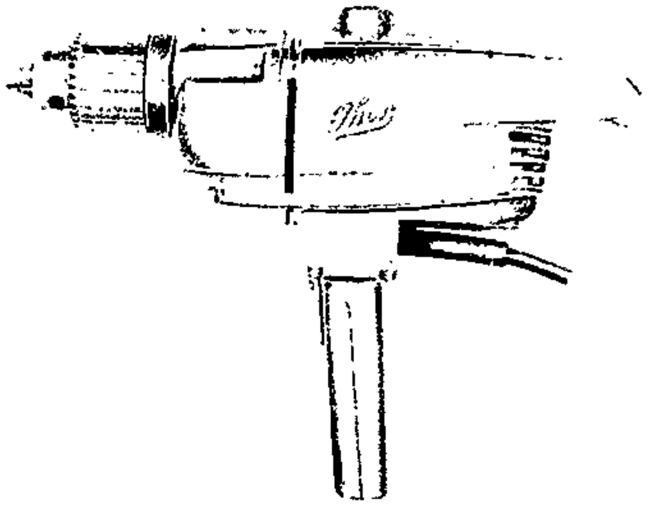
1. Use drills that are properly sharpened.

2. Check the drill to see that it is straight and has no nicks or burrs. A bent drill is difficult to control. To check for bent drills, start the drill motor and observe the drill point for trueness.

3. Never operate the drill with a loose chuck. Tighten the drill in the chuck firmly with a chuck wrench.

4. Avoid wearing loose clothing when operating the drill press.





5. Check to see that the chuck key is removed before starting the drill press.

6. Keep floor around the machine free from scrap material, oil, and grease.

A working zone with well marked lines should encircle the drill.

7. Select the drilling speed that is suitable for the work being done.

8. Wear goggles or other eye protection when drilling metal or wood.

9. Be sure the main power switch is "off" when setting up or making adjustments on the drill press.

10. Relieve the pressure on the drill just before it breaks through a piece of metal to prevent "seizing."

11. Do not hold small work by hand for drilling on the drill press.

Be sure you have at least 12 inches of leverage (distance from hole being drilled to your hand) before holding work to be drilled. Clamp smaller pieces to the table or use a drill press vise, wrench, or pliers to hold them securely while drilling.

12. Remove chips and shavings with a brush, not your hand.

Portable drills

13. Be sure that the portable electric drill is properly grounded through the third wire in the attachment cord.

14. Have a firm grip on a portable electric drill when drilling holes in metal.

Portable drills of 1/2 inch capacity and larger may throw the operator off balance and cause an accident if the bit catches while drilling.

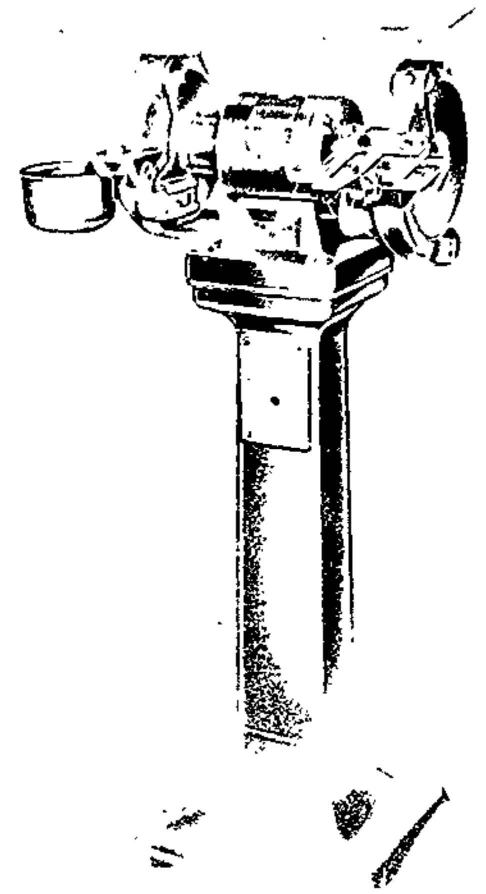
15. Keep the connecting cord for the portable drill clear of the bit or chuck to prevent wrapping when operating the portable drill.

16. Never lock the switch in "on" position when a portable drill is held in the hands.

The switch lock should be used only when the portable drill is fastened in a stand.

14. SAFETY INSTRUCTIONS FOR OPERATING POWER GRINDERS

Grinders are the most common pieces of power equipment in the agricultural mechanics shops. Despite the fact that the grinder is simple to operate and appears harmless to many people, accidents are relatively frequent in its use (or misuse). Following are some of the safe practices to be followed in grinder operation:



Stationary grinders

1. Wear a face shield or goggles for all grinding operations.

Goggles and shields should be shatterproof.

2. Check and if necessary adjust tool rests before starting grinder.

Tool rests should be rigid, slightly above the center of the grinding wheel, and not more than 1/8 inch away from the face of the wheel.

3. Check the wheel for flaws and cracks.

After a new grinding wheel has been installed, stand to one side and let grinder run for a full minute. Do this if you are unfamiliar with the grinder, or if a piece of metal has been jammed into it, even though the wheel is not new. A defective wheel will usually break and fly to pieces during the first minute.

4. Grind only on the face of the wheel. Side pressure may cause the wheel to break and will put strain on the wheel bearings.

5. Do not grind until the wheel has come up to full speed after the grinder is turned on, and stop grinding before the grinder is turned off.

6. Do not make adjustments of the rests or other grinder parts until the wheel has come to a full stop.

7. Keep fingers away from the wheel. Use pliers to hold small objects against the wheel.

8. Do not touch your face or eyes after grinding until your hands have been thoroughly cleaned to remove abrasive dust.

9. A dull wheel causes unnecessary heating. Keep grinding wheels dressed and trued. This requires a special tool. Do not use grinding wheels that are "out-of-round".

10. Do not apply pressure on the work great enough to slow the speed of the grinder.

11. Turn off machine and correct any vibration as soon as it is noticed.

Portable grinders

1. Before you start the portable grinder, see that other workers are out of range or are wearing suitable eye protection.

2. Do not lay the portable grinder down until it comes to a complete stop.

3. Use a portable grinder only when you are in a balanced, comfortable position and you have good footing.

4. Hold the portable grinder firmly with both hands at all times.

5. Be careful to avoid entanglement with the attachment cord.

6. Check the grinder regularly for damaged parts or cracked or glazed grinding wheel.

15. SAFETY INSTRUCTIONS FOR OPERATING POWER HACK SAWS

A power hack saw is a great time and labor saver in a shop where much metal work is done. It will cut faster and more accurately than can usually be done by hand. In operating a power hack saw, the following safety precautions should be observed.

1. Before using the saw, carefully read the operator's manual which comes with it. Run the saw at the speed recommended by the manufacturer.

2. Clamp the work securely in the saw vise. Clamp the work so that the blade will not have to cut straight across thin sections. Clamp angle iron with the corner up.

3. Use the right blade for the job.

4. Insert blade so that the teeth will point in the direction of cutting. Check with the blade manufacturer for the correct tension to put on a blade. Use a torque wrench to tighten the blade.

5. Use a file to start the blade on very sharp edges.

6. Be sure the blade is up and out of contact before starting the saw.

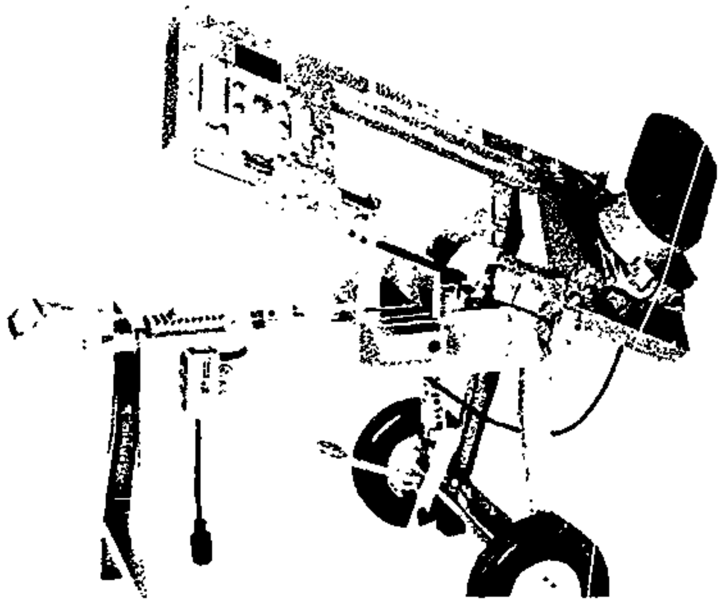
After the blade is in motion, let it down gently on the work, holding up on the handle slightly to reduce the pressure while the blade is starting its cut.

7. Do not push down on the saw to add pressure to the blade while cutting.

Use a suitable cutting pressure on the blade, just enough to keep it cutting. Reduce the pressure when cutting thin metal. Curly chips indicate correct pressure. Fine dust means the pressure is too light. Thick chips mean the pressure is too heavy.

8. Always stop the saw before adjusting it.

9. Wear safety glasses. Keep your hands away from your eyes after working around a power hack saw.



SPECIAL FOR THE BAND HACK SAW

1. Wear safety glasses and keep hands away from eyes.

Small pieces of metal rubbed into the eyes causes pain and serious injury to the eye.

2. If saw teeth wear off unusually fast, reduce speed.

3. Clean blade brushes frequently in kerosene.

4. Keep saw blade and moving parts properly lubricated.

5. Keep hands a reasonable distance from the blade when cutting.

6. Keep the adjustable blade guide as close as possible to the material.

7. Always keep the blade at proper tension when cutting.

8. Follow general safety rules applying to all power equipment.

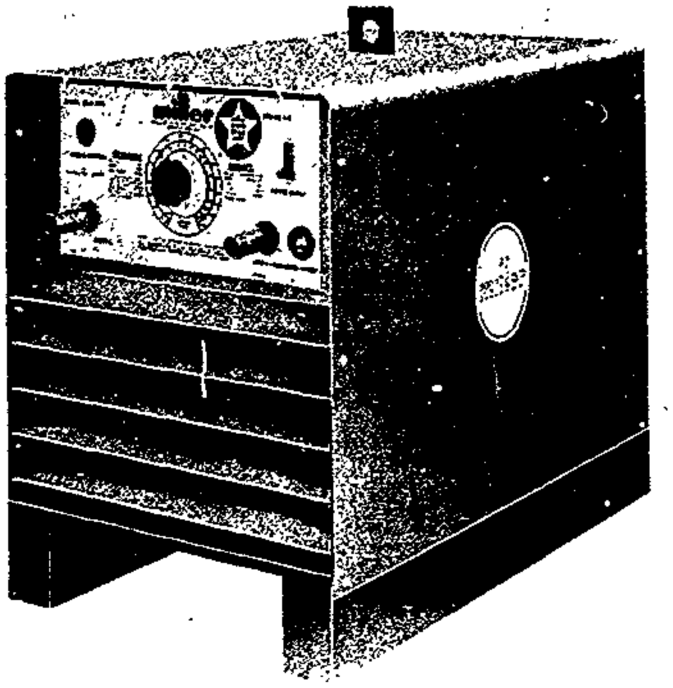
16. SAFETY INSTRUCTIONS FOR OPERATING ARC WELDERS

Hazards which most frequently affect the health of the welding operator are burns, injurious light rays, and injurious fumes. These can best be avoided by following these safety practices while welding.

1. Wear a welding helmet and leather gloves at all times when arc welding.

Protection from hot metal, hot electrodes, particles of spatter and slag, or the metal being welded is necessary at all times when welding.

2. Wear high top shoes to protect feet and ankles from burns caused by weld spatter. Avoid wearing clothing with turned up cuffs.



Keep your collar and pockets buttoned. Avoid wearing ragged clothing.

3. Inspect welding cables for broken insulation and frayed conductors. Check the electrode holder and ground clamps for good connections before beginning to weld.

Loose connections and grounds may prove dangerous. Provide a dry wooden platform to work on or wear rubber sole shoes where there are damp floors.

4. Clear all combustible materials away from the welding area before beginning to weld.

Flying sparks from the spatter will readily ignite combustible material.

5. Turn on exhaust fan before beginning to weld.

Welding fumes soon spread to all parts of the shop and may be injurious when inhaled. Always take special precaution from fumes when welding or cutting metals containing zinc.

6. Do not strike the arc before covering the face and eyes with the protective shield or helmet.

Rays given off by the "arc" are very intense, especially when one is close to the arc. Irritation and eye burn will result if eyes are not covered.

7. Do not endanger your fellow workers by welding without a welding screen enclosing your area. Warn persons standing nearby to cover their eyes when you are ready to strike an arc.

8. Do not weld barrels, tanks, or other containers which has held combustible material until they have been cleaned and "safe-guarded."

For methods of "safe-guarding" containers see footnote bottom of page 3.

9. Be alert for fires at all times.

10. Do not "chip" when your eyes or those of others near you are unprotected.

11. Do not leave hot metals where others may pick them up or step on them.

12. Guard against saturation of clothing by moisture or perspiration as this increases shock hazard.

13. Disconnect the welder when working on it.

14. Always unplug the welder and put equipment away when through welding.

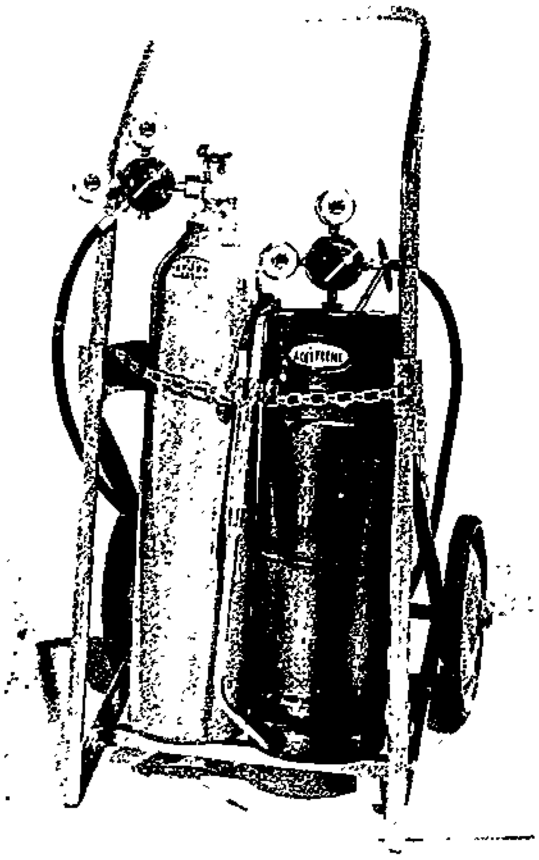
15. In case of eye or skin burns, secure first aid treatment. Report all burns to the instructor immediately.

17. SAFETY INSTRUCTIONS FOR OPERATING OXY-ACETYLENE WELDERS

Oxy-acetylene welding is not considered to be a hazardous operation. Most injuries and fires are caused by negligence. However, there are some hazards connected with welding which can affect the health of the operator if not properly guarded against.

1. Fasten oxygen and acetylene cylinders securely in an upright position.

Chain cylinders to a cart, bench, wall, or post to keep them from being accidentally tipped over.



2. Keep oil and grease away from oxygen cylinders and equipment.

Oil and grease may catch fire or explode spontaneously in the presence of oxygen.

3. Test equipment connections periodically with clean paint brush and soapy water to be sure there are no leaks of oxygen or acetylene. Test hoses by immersing them in a pail of water and watching for bubbles.

Test equipment immediately after making any new connections.

4. Check operating pressures carefully and follow recommendations.

5. Clear the area of all combustible materials before lighting the torch. This may avoid an explosion or serious fire.

6. Cover eyes with proper goggles or colored face shield and put on leather gauntlet gloves before lighting torch. Wear clothes suitable for work being done.

7. Do not stand too close to the regulator when opening the cylinder valve.

A defect in the cylinder valve may cause the gas to blow out, shattering the glass and blowing it into your face. Make it a practice to stand to one side of the regulator, never in front, when opening the cylinder valve. Open valve slowly. If the gas in the tank, which is under high pressure is permitted to come against the regulator suddenly, it is apt to cause damage to the equipment.

8. Do not open blowpipe valves more than one-half turn when lighting torch.

9. Never use a match to light a torch.

Using matches bring the fingers too close to the tip and the sudden ignition may cause burns. Always use a spark igniter.

10. When igniting a torch, keep the tip facing downward and away from you.

Lighting the torch while it is facing upward or outward may result in burning someone.

11. Make no attempt to relight a torch from the hot metal when welding in an enclosed box, tank, drum, or other small container.

There may be just enough unburned gas in the confined space to cause an explosion.

12. Be sure that your fellow workers are in the clear before relighting a torch.

13. Do not walk with a lighted torch or lay down a lighted torch.

Get in position before lighting and remove all obstacles between you and shut off controls.

14. If a flashback should occur, turn off torch immediately, close cylinder valves, and notify your instructor.

A flashback occurs when the flame disappears and burns back inside your equipment. There is a hissing, squealing sound, smoke may come out the torch tip, and the handle may get hot. If the torch is not turned off promptly, fire may get to the hoses or the cylinders. Do not relight after a flashback until the equipment has been inspected closely, and perhaps repaired.

15. Never open acetylene cylinder valve more than 1 to 1 1/2 turns and leave the T-

handle wrench in position at all times while welding.

In case of fire, you want to be able to turn off the acetylene cylinder promptly.

16. Never do any welding on containers that have held flammable substances until it has been "safe-guarded."

For methods of "safe-guarding" containers see footnote bottom of page 3.

17. When welding or cutting zinc or galvanized metals, make special effort to avoid breathing the fumes as they may be injurious. Zinc fumes cause an illness called zinc fume fever.

18. Be sure that cylinders are turned off and all valves closed before leaving the welder.

19. Never leave hot metal where others may be burned by it. Cool it in water or mark it "HOT" with chalk.

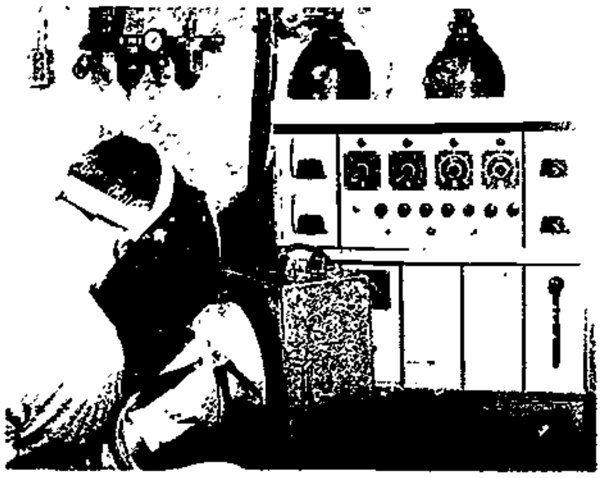
20. Be alert for fires at all times and use the proper fire extinguisher or a fire blanket if necessary.

18. SAFETY INSTRUCTIONS FOR OPERATING INERT GAS SHIELDED WELDERS

The safety practices for inert gas-shielded arc welding are specific for this type of welding. In general the same safe practices that apply to other arc welding would also apply to inert gas-shielded arc welding. You should review the potential shock, burn, and fire hazards that are included in the SAFETY INSTRUCTIONS FOR ARC WELDERS before using the shielded-arc welder. You should also read the manual provided with the welder to make sure you are familiar with the equipment.

1. Store argon cylinders in a cool dry storage area. Do not drop or abuse cylinders in any way. Argon is an inert gas so the cylinders are not potential fire hazards. However, they should be protected from arc burns, high temperatures, and mechanical damage. Do not move cylinders unless the valve protection cap, where provided is in place and tight. Never strike an arc on a cylinder of compressed gas. Be sure cylinders are securely fastened so they do not fall. Do not use a wrench or hammer to open cylinder valves. Notify the supplier of defective valves. Do not force connections that do not fit. Check all connections to regulators, adapters, and valves with soapy water to detect leaks.

Be sure argon cylinders are never grounded. Cylinders, fittings and supports should be insulated with wood or rubber from structures, fixtures or electrical conduit. Keep cylinders away from work tables and welding fixtures. Check to see how the work is grounded so ground connections do not touch the cylinder.



2. Hang the welding torch or electrode holder on a hook when it is not in use. Do not hang it on the flow meter, regulator, or cylinder valve. Do not lay the torch on the work or work table. Hang it in a safe place so the electrode is not touching metal which may be grounded.

3. Make sure all electrical connections are tight, clean, and dry. There is danger of water leaking from a water cooled unit. If the floor is damp, a wooden platform or rubber mat may be used to insulate the operator from the damp floor.

4. Be sure you are properly dressed for welding. Thin cotton clothing may be inadequate for protection from the ultraviolet rays. Protect your hands from the arc rays by wearing gloves. It may be necessary to remove the tips of the glove fingers to permit manipulation of the electrodes but the rest of the glove should be worn.

5. Protect your eyes and face. Never look directly at the arc without protection for the eyes. Use a welder's helmet with the proper shade of glass. Shades 10 and 12 are recommended for carbon arc and shielded-arc welding. Do not chip or grind without safety goggles.

6. Handle all hot metal with tongs or pliers. Aluminum does not change color when it gets hot and there is great danger of burning the hands on aluminum because it is such a good conductor of heat. Mark metals "Hot" that have been welded.

7. Start the exhaust fans before beginning to weld. Fumes given off from the welding process may not be injurious but certain metals do give off harmful fumes. It is best to weld galvanized metal out of doors. Inhalation of zinc oxide causes an illness called zinc fume fever. Drinking milk has been recommended to relieve the toxic effect.

8. Maintain good housekeeping within the welding area. Tools and scrap metal on the floor create a tripping hazard. Pick up tools and scrap metal. Grease on the floor makes a slipping hazard. Cover grease with sand to remove this hazard.

9. Clear the welding area of possible fire hazards before starting to weld. Remove straw, shavings, rags, paper and other combustible materials. At least one fire extinguisher and one fire blanket should be located near the welding area. In case of clothing fire, immediately strip off the burning article. If a blanket is available wrap yourself in it and lay on the floor. If no blanket is available, roll on the floor and fold your arms across your face.

10. In case of eye or skin burns, secure first aid treatment at once. Report burns to the instructor immediately. Do not wait until the next day as eye burn may cause serious trouble if not treated as soon as detected. A supply of tannic acid and burn ointment should always be available in the first aid kit.

11. Do not change a tungsten electrode before it has cooled or while the welder switch is in the "on" position.

12. Clean aluminum with alcohol or acetone prior to welding. Be sure the surfaces cleaned are thoroughly dry and the area properly ventilated before welding. Carbon tetrachloride, trichlorethylene, or other chlorinated hydrocarbons should not be used for cleaning aluminum prior to welding.

13. Do not weld on closed containers without first "safe-guarding" the container. (See p. 3.

14. Use the correct size welding cable. Continuous overloading of welding cables will deteriorate the insulation and damage the cable, creating both a shock and fire hazard.

15. Do not use defective welding cable. If any of the connections are hot, this usually indicates a poor electrical connection.

16. Protect the hose and welding cable from being run over. Avoid having them tangled or kinked. Keep them so they are not a tripping hazard. Protect them from flying sparks, hot metal or open flame. Protect them from oil and grease which will cause the rubber to deteriorate.

17. When welding is to be stopped for a period of time, release the pressure adjusting screws on the regulators.

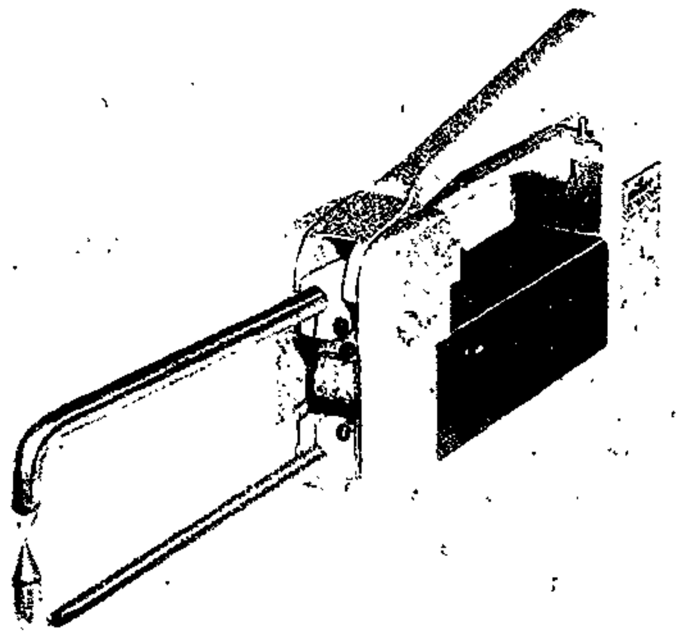
18. Use paints that are nonreflective in the welding area. A flat finish paint is suitable.

19. SAFETY INSTRUCTIONS FOR OPERATING SPOT WELDERS

Spot welding is a method of joining two pieces of metal together with electric heat and mechanical pressure.

The heat is developed by the resistance of the metal to high-amperage, low-voltage current which passes through a limited area. This is where a resistance weld is made. Some safety suggestions for operating the spot welder follow:

1. Before attempting to make power-line connections, change tips, or make repairs, be



sure the unit is completely disconnected from the power line.

2. Always avoid contact between any part of the human body and any current-carrying part of the spot welder.

3. Be sure the welder is connected to the proper voltage and securely grounded. A grounding wire is provided in the power cord for grounding the welder in case of internal insulation breakdown. Do not cut off the grounding terminal on the cord plug.

4. The spot welder should be operated from a separately fused circuit. The capacity of the welder is affected by the line voltage. If the circuit is overloaded, the performance will be reduced. Extension cords should not be used because of the voltage drop they are apt to cause.

5. Wear a face shield when operating a spot welding machine. This protects your eyes and face from hot molten particles.

6. Be sure the tongs are properly aligned and pressure correctly adjusted before turning on the welder. Check the alignment before the power is turned on. If the tips are misaligned, the work to be welded will move out of place. There is no advantage in having excessive tong pressure. The metal to be welded should be in close contact before applying pressure on the tongs.

7. Never apply current to the tong tips without having metal between them.

The points will burn together and the welder may be damaged.

8. Keep tong tips dressed.

As the welder is used, the diameter of the tong tips will increase in size. This increased diameter will require more current and a longer time setting.

For galvanized and stainless steels, the tips must be clean and properly dressed or the weld will cause excessive splatter.

9. Be sure there is water flowing through water cooled welders before using them.

If water is not flowing to cool the tips, they will be burned.

10. Start the exhaust fan before welding galvanized metal.

The fumes given off from welding zinc coated material may cause zinc fume fever.

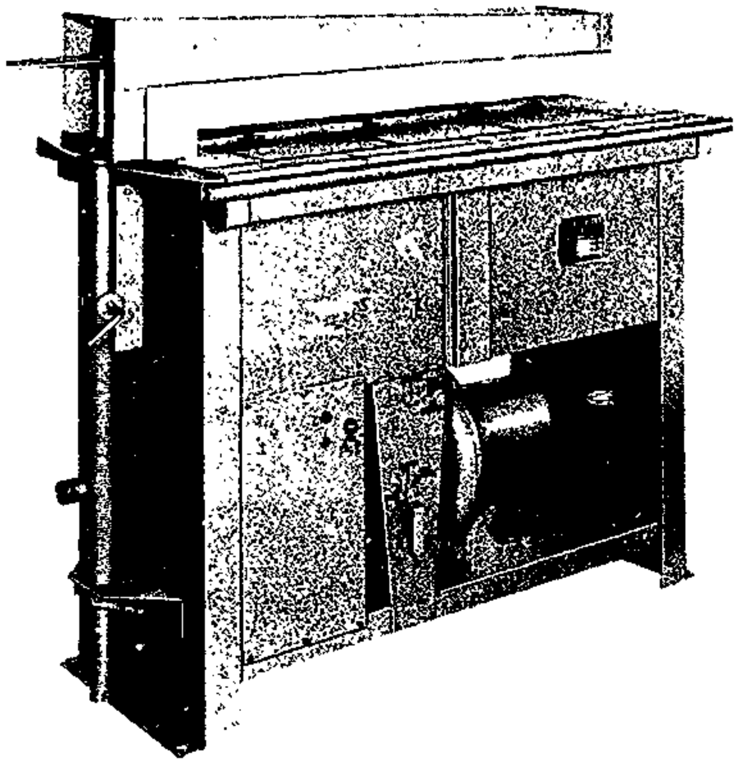
20. SAFETY INSTRUCTIONS FOR OPERATING GAS FORGES

Any piece of shop equipment that uses flame has potential fire and burn hazards. While there are a limited number of gas forges in agricultural mechanics shops, if you have one, it is important that care be used to prevent burns and fires.

1. Wear a safety face shield when working with a forge. A face shield provides more protection than goggles.

2. Be sure you have materials at hand before trying to light the forge. Crumple or twist paper, light it and insert it in the forge. Do not try to light the forge with a match.

3. Turn on the gas. The air supply should be regulated until the flame is blue. If the air and gas are turned on separately, turn on the gas first, then the air. Shut off the gas first, then the air. Do not rely on an electric valve to shut off the flow of gas completely. When the forge is not in use, use a gate valve ahead of the electric valve to shut off the gas securely.



4. Do not leave hot stock lying around the shop. Someone may step on or pick up a piece of metal that is still hot. Pieces should be marked "HOT."

5. Be sure the handles are securely fastened in all hammers used in forging.

6. Do not strike the face of the anvil with a hammer. When you do this, you are striking hardened steel against hardened steel and chips are liable to break off and fly.

7. Be sure you cut metal on the cutting block of the anvil. Be careful when cutting stock or rivets that no one else is in line with or close to the parts being cut off.

8. Keep forge tools well dressed, sharpened, and free of mushroomed heads.

9. Use tongs that fit the stock.

10. When using the forge to heat a lead or solder pot, be sure that no moisture is introduced into the molten metal. The water will turn to steam and explode the molten metal.

11. Wear gauntlet gloves to protect your hands from the heat of the forge.

The illustrations of power tools and equipment were furnished by:
Johnson Gas Appliance Co., Cedar Rapids, Iowa
Linde Company, Division of Union Carbide Corp., New York, N. Y.
Miller Electric Mfg. Co., Appleton, Wisconsin
Rockwell Manufacturing Co., Power Tool Division, Pittsburgh, Pa.
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Turner Corporation, Sycamore, Illinois
Wells Mfg. Co., Three Rivers, Michigan

Student tests, pertaining to this unit, are available from Vocational Agriculture Service.

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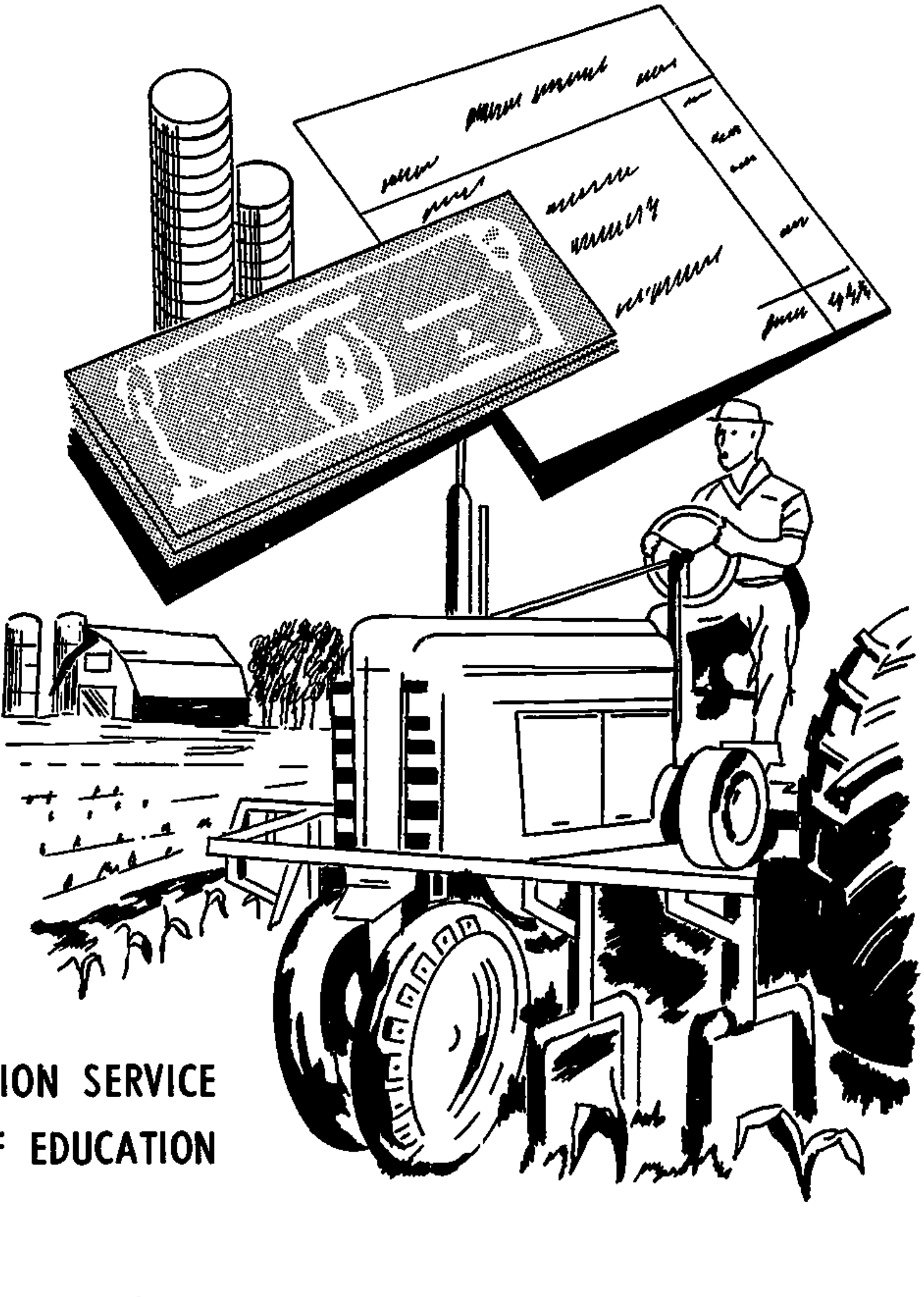
*CURRICULUM GUIDES, *CURRICULUM, *VOCATIONAL AGRICULTURE, ANIMAL SCIENCE, PLANT SCIENCE, AGRICULTURAL ENGINEERING, HIGH SCHOOLS, FARM MANAGEMENT, SUPERVISED FARM PRACTICE, LEADERSHIP TRAINING, CURRICULUM DEVELOPMENT, GUIDELINES,

The purpose of this guide is to assist vocational agriculture teachers in developing an agricultural production curriculum. It was developed by a committee of supervisors, teacher educators, and teachers and tested in local schools. It provides guidelines for curriculum development as related to program areas, basic assumptions, subject matter selection, sequence, and vocational objectives. Procedures for recording data on the curriculum sheets are outlined. Major subject areas include plant science, animal science, agricultural mechanics, and farm business management. Each major area is divided into teaching units, and each unit includes time allotment, vocational objectives, major competencies to be attained, and a subject matter outline. Sections on supervised occupational experiences and leadership training are included. The guide is appropriate for high school programs with farming and farm-related occupational focus in the Midwestern United States. This document is available for $2.00 from Ohio Vocational Agriculture, Instructional Materials Service, The Ohio State University, 2120 Fyffe Road, Columbus, Ohio 43210. (JM)

AGRICULTURAL PRODUCTION

CURRICULUM GUIDE



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THE OHIO STATE UNIVERSITY

COLUMBUS, OHIO
1967

AGRICULTURAL PRODUCTION

CURRICULUM GUIDE,

OHIO STATE BOARD OF EDUCATION

1967

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State Department of Education
Division of Vocational Education
Agricultural Education Service
State Office Building
Columbus, Ohio

Dr. Harold Bowers
Assistant Superintendent in Charge of Public Instruction

Dr. Byrl Shoemaker
Director of Vocational Education

Mr. James Dougan
Supervisor, Vocational Agriculture Service

in cooperation with
The Ohio State University
Department of Agricultural Education

MEMORANDUM

TO: The ERIC Clearinghouse on Vocational and Technical Education
The Ohio State University
980 Kinnear Road
Columbus, Ohio 43212

FROM: (Person) Harlan E. Ridenour (Agency) Agricultural Education Curriculum Material Service
(Address) Room 201, 2120 Fyffe Road, Columbus, Ohio 43210

DATE: 24 July 1967

RE: (Author, Title, Publisher, Date) Vocational Agriculture Service, Ohio, Dept. of Education and Agricultural Education Dept., Ohio State University. Agricultural Production Curriculum Guide, Agricultural Educatio;n Curriculum Materials Service, 1967.

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Level of Group State
Method of Design, Testing, and Trial Committee work with teachers and staff and Trial of Curriculum in local schools.

(3) Utilization of Material:
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Type of Program Production Agriculture
Occupational Focus Farming and related occupations
Geographic Adaptability Mid West
Uses of Material Teacher in Curriculum planning
Users of Material Teachers or state staff

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Source (agency) ____
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FOREWORD

Today's teacher of vocational agriculture is faced with ever expanding problems of what to teach and whom he should serve. The American farm has expanded into a well-organized, highly efficient business. Agriculture production is based predominantly on sound scientific technology and operated on sound principles of business. The farmer of today is a well-educated individual who is constantly seeking information upon which to base the many decisions he is required to make in conducting this business.

The teacher of vocational agriculture has a responsibility for the agricultural education of those who are or will be engaged in production agriculture, for those who will be engaged in the agriculturally related businesses supporting production agriculture, and for those who plan to become professional agricultural workers. The agricultural education needs of these groups are varied and complex and pose a challenging problem to the teacher in planning a curriculum to meet the needs of agriculture in the local community.

It is the belief of the Supervisory Staff, Teacher Education Staff, and Advisory Committees of Teachers that each teacher of vocational agriculture in Ohio should have planned and written a complete curriculum for his program of vocational agriculture. This curriculum guide has been prepared to assist teachers in developing the curriculum for their departments of vocational agriculture.

James E. Dougan, Supervisor
Agricultural Education Service
Department of Education

Ralph E. Bender, Chairman
Department of Agricultural Education
The Ohio State University

ACKNOWLEDGMENTS

The curriculum guide has been developed through the efforts of many people over a long period of time. Some of the groups and individuals who have assisted are as follows:

A production agriculture committee composed of teachers of vocational agriculture and combined staff members worked in 1965 and 1966 in giving recommendations for curriculum development. The committee was comprised of the following individuals:

Teachers: D. C. Barrett, Homer Burt, Jack Devitt, Clarence Fridline, Henry Horstman, Horace Hummell, Roger Roediger, Odell Miller, Jack Nowels, and John Watkins.

Staff: John T. Starling, Harlan E. Ridenour, and Gilbert S. Guiler.

In addition to the above committee work, individual teachers have worked with the development of specific areas of the curriculum guide. They are as follows: Plant Science and Soils, Clarence Fridline; Animal Science, Henry Horstman; Agricultural Mechanics, Martin Rehmert; and Farm Business Management, Bennie White.

The combined Supervisory and Teacher Education Staff has given leadership to the development of this production agriculture curriculum guide. Specific staff members who have contributed to the writing and editing of the information in the guide are as follows: Dr. John T. Starling, Dr. R. J. Woodin, Dr. G. S. Guiler, and Dr. H. E. Ridenour, who coordinated the work and did final editing.

Ohio Vocational Agriculture
Curriculum Materials Service

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CURRICULUM DEVELOPMENT

PROGRAM AREAS

Agriculture is comprised of the group of related courses or units of subject matter which are organized for carrying on learning experiences concerned with developing knowledge, understanding, appreciations, and skills involved in preparation for upgrading in occupations requiring knowledge and skills in agricultural subjects.

The program areas in agriculture are as follows:

01.00	Agricultural Production
02.00	Agricultural Supplies
03.00	Agricultural Mechanics
04.00	
05.00	Ornamental Horticulture
06.00	Agricultural Resources
07.00	Forestry

The functions for the above program areas and the services related thereto are emphasized in the instruction designed to promote opportunities for students to prepare for or improve their competencies in an agricultural occupation or cluster of related occupations. An agricultural occupation or cluster of occupations may include one or any combination of these functions.

Supervised occupational experience programs are an integral part of the teaching program in each of the program areas of vocational education in agriculture. Occupational experience provides an opportunity for the student to apply the knowledge, skills, and abilities gained in the classroom to real-life situations similar to those he will be experiencing in the world of work. The classroom teaching and occupational experience program should be coordinated to supplement each other. The student should be assisted in recognizing the competencies required for success in his chosen occupation, or cluster of related occupations, gain an understanding and appreciation of the fundamental principles, concepts, and laws related to his needed competencies, and be assisted in making practical applications of his knowledge.

The Future Farmers of America and related leadership training are highly significant integral activities which aid agricultural education in making contributions to the guidance and total general educational development of pupils. The Future Farmers of America and related leadership training permeates every aspect of the instructional program in agriculture.

CURRICULUM GUIDE SERIES

A series of curriculum guides has been prepared for each of the above program areas. These publications are intended to serve as guides in their respective program areas. They are for use by teachers of vocational agriculture in planning local programs of instruction, identifying curriculum materials needs, and identifying facilities and equipment requirements. School administrators, boards of education, and advisory committees may use the curriculum guides as a basis for decision-making in determining needs for program offerings and in evaluating existing programs.

Emphasis should be placed on the fact that this publication is only a guide. It is in no way intended to be "the" curriculum for vocational agriculture in Ohio. It should be used as a guide in planning local programs to meet local student and community needs. Time would not permit the inclusion of all the teaching units presented in this guide. Thus, the teacher has the responsibility of including in the local program those units or parts of units that best meet the needs of local conditions.

PLANNING THE CURRICULUM IN AGRICULTURAL PRODUCTION

In preparing a curriculum for agricultural production in the vocational agriculture program, certain assumptions are made as to the type of students enrolled, the type of school in which the program will be offered, and the opportunities for occupational experience. The curricula which follows has been designed with the following assumptions in mind:

1. The vocational agriculture program, comprising of several courses would ordinarily be a part of a comprehensive high school enrolling at least 30 students, and employing one or more teachers depending upon the total enrollment.

2. This curriculum is planned for a four-year period. The courses for the first two years basically consist of plant and animal science, with appropriate units in agricultural mechanics, while the third and fourth years are devoted to agricultural mechanics and farm management, respectively.

3. This curriculum is planned for a daily time schedule of seven to ten 45-minute periods per week.

4. It is assumed that most of the occupational experience of the students will be secured on their parents home farms or on neighboring farms.

5. It is assumed that a part of the teaching will include supervised instruction in relation to the student's occupational work experience program.

6. Most students are preparing for and will enter an agricultural occupation upon graduation. Some may be expected to continue this education through post-high school technical education, and some through a four-year college program.

7. The first two courses consisting of plant and animal science with appropriate units in agricultural mechanics will also provide a basis for those students whose agricultural occupational objective is other than farming who, in their third and fourth year, may be enrolled in one of the other agricultural programs.

8. This curriculum guide has been prepared for a broad application. It contains more material than could be covered in a four-year period. This requires making a selection of those areas of instruction and teaching units or parts thereof that best meet the agricultural education requirements of the students served.

DETERMINING WHAT TO TEACH IN AGRICULTURAL PRODUCTION

What we teach in vocational agriculture determines to a large extent the success of our total program. When we teach carefully selected, appropriate and useful information, our students are eager and receptive. When we make mistakes in what we select for teaching, our students become uninterested, unenthusiastic, and waste their own time as well as that of their teacher.

What we teach in vocational agriculture should depend upon the following seven points:

1. Our approach to learning helps determine what we teach.--In vocational education, we believe that people learn best by doing, and by doing as soon as possible in relation to the unit taught. We believe in the teaching of principles, but also in the opportunity for practice in using these principles as soon as possible.

2. The particular occupation or cluster of occupations for which training is provided determines what should be taught.--Job analysis is a process which helps to determine which learnings are important to perform a given job. In this process an analysis is made of the time which a person spends in various aspects of his

work and of the new learnings he must possess in order to succeed. Using this approach, we teach the vocational agriculture student those abilities he will need, leaving out much of the related information which might be only "nice to know."

3. Student situations provide an important clue as to what to teach.--In agriculture the previous experience of the student, his age level, his preparation in other courses, and his mental and emotional maturity all help us to decide what to teach. This means that what we teach in a particular first-year course may vary considerably from what we might teach in another course which includes a different group of students.

4. Teaching should recognize the organized knowledge of the discipline.--In the biological sciences there has been much scientific investigation and, therefore, we can teach more efficiently by moving from the simple to the more complex. This provides a basis for teaching the basic principles of cell growth, of genetics, of cell division, and similar understandings. It should be kept in mind, however, that this may not be the most interesting approach from the standpoint of the student so, therefore, the organized knowledge of the discipline must be related to the student's own frame of reference.

5. A teacher's objective determines what he selects for teaching.--Most vocational educators are committed to the approach of developing in the student those abilities, skills, attitudes, and ideals which they believe the student should possess to be successful in his first occupation. Decision-making becomes a key ability in this psychological approach; therefore, the students are taught to solve problems rather than to memorize facts.

6. The continuing educational effort which is expected of the student determines what is taught.--Teachers of vocational agriculture need to recognize the fact that some of their students will complete their education at the end of high school, that others will have an opportunity to participate in young and adult farmer programs or two-year technical programs, while still others may take baccalaureate degrees in agriculture at agricultural colleges.

7. Finally, teacher judgment is the major determinant of what is taught.--Teacher judgment becomes sharper with additional years of experience.

AGRICULTURAL PRODUCTION (Program Area)

Agricultural production includes subject matter and learning activities which are concerned with the principles, concepts, and processes involved in the planning related to and the economic use of facilities, land, machinery, chemicals, finance, and labor in the production of plant and animal products. In practice, activities include classroom instruction, laboratory experiences, and supervised occupational experiences in and out of school, including farms and other agriculturally related establishments.

AREAS OF INSTRUCTION

The program areas are divided into logical areas of instruction. Each area of instruction should prepare students for entry into and advancement in an occupation or cluster of related occupations.

The areas of instruction for agricultural production are as follows:

Animal Science	(The production of livestock products)
Plant Science	(The production of crop products)
Agricultural Mechanics	(The selection, operation, repair, adjustment, and the economic use of agriculture machinery. Farm Construction.)
Farm Business Management	(Farm record keeping, summary, and analysis. Allocation of resources to maximize farm profits.)

Other Production Agriculture

Related Instruction

- Occupational experience programs
  - Student occupational experience programs, record keeping, supervision.
- Leadership training
  - Conduct activities to develop leadership abilities. The FFA.

WHEN TO TEACH CERTAIN PRODUCTION AGRICULTURE UNITS

Timeliness of instruction has always been considered important in vocational agriculture. However, in providing for the teaching of related problems in single blocks of time, seasonal teaching becomes more difficult. These blocks of time or units of instruction should be scheduled as nearly as possible to coincide with the decisions being made and the operation being performed in the agriculture of the community.

Another consideration is the year during which certain subject matter should be taught. Certain units should logically appear early in the four-year program while others should be scheduled later in the program.

Some guiding principles for the teacher, concerning when certain units of production agriculture should be taught, are as follows:

First and Second Years

1. Provide for instruction of basic science of soils, plant and animal life as it relates to agriculture.
2. Provide educational experiences that assist students to make an intelligent assessment of career opportunities in agriculture.
3. Provide an opportunity for the students to solve individual problems encountered in farming and related agricultural occupations.
4. Provide for basic experience in record keeping, summarization, and analysis of business records.
5. Provide for some basic instruction in agricultural mechanics.

Third and Fourth Years

1. Provide for relating basic soil, plants, and animal science to the total farm business management situation.
2. Provide for training and experience in marketing food and fiber.
3. Provide training for the selection, operation, maintenance, and repair of agriculture and processing equipment used in the agricultural area. Make application of basic agricultural mechanics skills in constructing items required in the farm business.
4. Provide for understanding and ability to make sound farm management decisions through complete farm record keeping, summarization, analysis, and adjustments for balanced farming programs as opposed to individual enterprises.

All Four Years

1. Provide for proper learning experiences based on past achievements and present needs.

2. Provide an opportunity for the student to apply his knowledge, skills, and abilities to actual situations through an occupational experience program.

3. Provide students with available information relative to character of the opportunities in, and the qualifications necessary to become established in farming and related agricultural occupations.

4. Provide for study of certain phases of farm business management based on the immediate needs of student's home farm situation and community.

5. Provide opportunities to develop rural leadership through FFA and other community activities.

TEACHING UNITS

Each area of instruction is divided into teaching units. The teaching units are confined to one body of subject matter within a given area of instruction. This divides the areas of instruction into manageable units that facilitate teacher planning and student comprehension.

VOCATIONAL OBJECTIVES

Vocational education in agriculture has the responsibility of providing agricultural education for those persons requiring knowledge and skills in agriculture for entry into and advancement in farming or agriculturally related occupations.

The vocational educator should be assisting students in choosing their vocational objectives. His teaching should be based on the fact that students will be applying their knowledge of agriculture when they are conducting occupational experience programs and upon entry into their chosen occupations.

Each teaching unit lists the occupational objectives for its area of study. These objectives may be divided into primary and secondary areas of work. The agricultural production program prepares students for entry into production agriculture or for continuing education. Achievement of many of the secondary objectives requires additional vocational, technical, or collegiate education.

MAJOR COMPETENCIES

The program in agricultural production must equip the student with the competencies required for entry into and advancement in farming or other agriculturally related occupations. Each teaching unit lists the major competencies thought to be important for that unit of instruction.

PROCEDURE FOR RECORDING DATA ON THE CURRICULUM SHEETS

1. Carefully study and familiarize yourself with the total curriculum guide in production agriculture. Secure a copy of the blank curriculum sheet* and a sample "work sheet" before you start to develop a curriculum plan for your department of vocational agriculture.

2. Fill in the "date" column from top to bottom with the first week of school, list month and week date; for example, September 4-8, 11-15, 18-22, etc.

3. Obtain from the local school calendar the dates and events of each week during the coming school year along with all allowable vacation days, assemblies, and any other <u>irregularities</u> which may affect your teaching program. Fill out the first (left side) column on the curriculum sheet with these dates and events.

MAKE ALL ENTRIES ON CURRICULUM "WORK SHEETS" WITH PENCIL SO ADJUSTMENTS CAN BE MADE EASILY BEFORE COPYING ONTO THE FINAL CURRICULUM FORM

4. For the purpose of making better utilization of your agricultural mechanics shop facilities, it is suggested that you first list the <u>teaching units</u>, <u>skills</u>, and <u>practices</u> which you plan to teach in the area of agricultural mechanics under each column (course of study).

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*"Curriculum Sheet" may be obtained free of charge from State Department of Education, Vocational Agriculture Service, State Office Building, G16, Columbus, Ohio 43215, or from the Department of Agricultural Education, Agricultural Administration Building, The Ohio State University, Columbus, Ohio 43210.

Be specific as space will permit. Do not list only farm power and machinery - specify - for example, Seeding Equipment, Troubles - Parts - Functions - Operation - Repair - Calibration - Storage - Evaluation - etc. List these in sequence of intended instruction during the period they are to be taught.**

Plan your agricultural mechanics instruction on a seasonal basis in order that such instruction can be coordinated with production agriculture subjects. For example, the study of Hay Balers and Forage Harvesters may well be at such time as you would be teaching better pastures, meadows, and hay making.

5. Under each column (course of study) list all livestock teaching units you expect to teach throughout the school year. Include those units which you think are essential according to the needs of the students and the teaching of the previous year. Include the individual and class work on occupational experience programs which apply to livestock such as agreements, budgets, summary, analysis, etc.

6. Under each column (course of study) list all crop teaching units that you expect to teach during the school year. Be certain to include all class or individual work on the crop phase of the occupational experience program under these columns.

7. Under each column (course of study) list those items that you expect to teach in Farm Business Management. List, for example, farm policy, taxes, insurance, family living, etc.

8. Under each column (course of study) list the FFA activities which will need class time.

9. Check each column (course of study) from top to bottom to make certain that all weeks are accounted for in each course.

10. Finally, check the completed curriculum sheet against the evaluation sheet in the back of this publication.

11. You may choose to color code your planned curriculum sheets according to Agdex colors. Some teachers believe that by color coding, it is easier to see the time being devoted to certain phases of the complete program. For example, orange for agricultural mechanics, red for animal science, green for crops, and yellow for farm business management.

12. Post the curriculum sheet on the bulletin board or similar place where it is convenient for you and school officials to check frequently and also where the students can readily see it. Do not stuff it away in the files!

**If for example, you plan to teach more than one unit or parts of several during the same week, you may indicate this by drawing diagonal lines between each specific unit or problem taught, as shown below:

Sept. 11-15 / seeding equipment / troubles / repair

Planning a Daily Teaching Schedule

1. To make the "curriculum" more meaningful, each teaching unit should be spelled out in detail on the daily teaching schedule (Agdex .30). The curriculum sheet is only an over-all guide by the week while more specific information is needed for the teaching days ahead.

2. Start with the first week and list the specific problem, topic or activity for each day on the daily teaching schedule (Agdex .30).

3. When the first six weeks have been specifically worked out in detail for Vocational Agriculture I, then start with Vocational Agriculture II, etc., until each week has been planned in detail for all courses.

4. From this "daily teaching schedule" you are now ready to make out your lesson plans and arrange for your major teaching materials. The daily teaching schedule should at all times be planned for six weeks in advance.

ADDITIONAL SUGGESTIONS TO MAKE THE TEACHING PROGRAM MORE EFFECTIVE

1. Before school starts, review with your school administrator your program of instruction for each class.

2. Soon after school starts, plan the year's work with the students in each class.

3. Record each week those changes made in courses taught. (These data will be necessary for planning the curriculum in succeeding years.)

4. Review your teaching schedule each month according to needed changes. Keep your program up-to-date.

First and Second Year Planned With Agricultural Production, Science, and Mechanics Integrated
Third and Fourth Year Planned With Agricultural Mechanics and Farm Business Management Integrated
"EXAMPLE NO. 1"

MONTH	FIRST YEAR COURSE	SECOND YEAR COURSE	THIRD YEAR COURSE	FOURTH YEAR COURSE
	Orientation LIVESTOCK: Occup. Oppor. Selection-Breeding	Orientation PLANT - Identification Processes - population Seed Production	Grain Drills-Princ. Calibration Combines Land Judging	Buildings-Conveniences Animal & Plant Judging Demonstrations
	Economic Importance Marketing - Functions Nutrition Requirements Feed Materials-Methods	Diseases & Insects Records Electricity Projects Welding - Arc. + Acet.	Youth Org.-Prog.-Act Harvesting Equipment Corn picker - Crop Crop storage - losses	Youth Org.-Records Agricultural Bus. Mgt. Marketing-Credit needs
	Occupational Exp. YOUTH ORGANIZATIONS: Functions - Purposes Program of Activities PLANT SCIENCE:	Hot Metal Work-Projects YOUTH ORGANIZATIONS: Activities Occup. Experiences Animal Nutrition	Farm Business Mgt. Introduction to Farm Bus. Mgt. Farm Bus. Goals Inventory Resources	Insurance Government Problems
	Occupational Oppor. Soil Capabilities Occup. Exp. Programs	Feed Nutrients Balancing Feed Mixtures	Soils Related to Farm Bus. Management Farm Bus. Records	Taxes Social Security
	Financing - Budgets Agreements, Voc.Object. AGRICULTURAL MECHANICS Basic skills in Agr. Mechanics based on need of student	Records-Summary & Anal. Livestock Health Diseases - Housing	Summarize Records Analyze Records Tractor Maintenance Principles of opertn. Trouble shooting repair	Land Resources
	Power tools Shop & Tool Maintenance Projects	Plant Production Management Seed Production:	Maintenance-Evaluation Plows - Tillage Equip. Principles - troubles Forage Systems-Mowers	AGRICULTURAL MECHANICS
	PLANT SCIENCE: Soil Preparation Plant Needs	Fertility Program Varieties - Laws Certification-Weed Con. Tractor Safety & Small gas engines	Choppers - Methods Balers - Quality Hay Pasture Improvement Records	Selected Teaching
	Plant Seeding Fertility Program	Maintenance Evaluation	Finalizing years work-planning ahead	Units
	Occup. Exp. Programs EXAMS - Summary	Plumbing Fencing Occup. Exp. Programs RECORDS - Summary	Summary SUMMER ACTIVITIES	Summary

First and Second Year Designed in Large Blocks of Time With Agricultural Science, Production and Mechanics Integrated
Third and Fourth Year Alternating Farm Business Management and Agricultural Mechanics by Semesters
"EXAMPLE NO. 2"

VOCATIONAL AGRICULTURE CURRICULUM

MONTH	FIRST YEAR COURSE	SECOND YEAR COURSE	THIRD YEAR COURSE	FOURTH YEAR COURSE
	Orientation	Orientation	Orientation	Orientation
	LIVESTOCK: Occup. Oppor. Selection-Breeding Economic Importance Marketing - Functions Nutrition Requirements Feed Materials-Methods Occupational Experiences	AGRICULTURAL MECHANICS: Electricity and Selected Teaching Units in Mechanics	FARM BUSINESS MANAGEMENT Introduction to Farm Business Management Farm Bus. Goals Inventory Resources Soils Related to Farm Bus. Management Farm Bus. Records Summarize Records Analyze Records & Farm Bus. Farm Business Planning Net Worth Statement	AGRICULTURAL MECHANICS Selected Teaching Units
	YOUTH ORGANIZATIONS Functions - Purposes Program of Activities	YOUTH ORGANIZATIONS Activities Business Procedure		
	PLANT SCIENCE Occup. Oppor. Soil Capabilities Seeding Crop Financing - Budgets Agreements, Voc.Object. Occup. Exp. Programs	LIVESTOCK Nutrition Records Products Summary Record Analysis and Expansion		
	AGRICULTURAL MECHANICS Basic skills in Agr. Mechanics based on need of student	PLANT SCIENCE Agronomic Problems Chemical Problems Plant Identification Insect & Weed Control	AGRICULTURAL MECHANICS Selected Teaching Units	FARM BUSINESS MANAGEMENT Marketing in the Farm Bus. Planning Credit Needs Insurance Taxes Government Programs Securing Farm Land Resources
	PLANT SCIENCE Soil Preparation - Plant Needs Plant Population Fertility Program	AGRICULTURAL MECHANICS Small Gas Engines and Maintenance		
	AGRICULTURAL MECHANICS Power Tools Shop & Tool Maintenance Projects	LIVESTOCK SCIENCE Health, Marketing Quality Milk		
	Occup. Exp. Programs EXAMS - Summary	Occup. Exp. Programs EXAMS - Summary	Occup. Exp. Programs EXAMS - Summary	Occup. Exp. Programs EXAMS - Summary

First Year - Designed for Emphasis in Plant Science -Third Year - Emphasis in Agricultural Mechanics
Second Year - Designed for Emphasis in Livestock Science-Fourth Year - Emphasis in Farm Business Management
"EXAMPLE NO. 3"

VOCATIONAL AGRICULTURE CURRICULUM

MONTH	FIRST YEAR AGRICULTURAL COURSE SCIENCE	SECOND YEAR AGRICULTURAL COURSE PRODUCTION	THIRD YEAR AGRICULTURAL COURSE MECHANICS	FOURTH YEAR FARM BUS. COURSE MANAGEMENT
	LIVESTOCK SCIENCE Selection Livestock Feeding	AGRICULTURAL MECHANICS	Seeding Tools Soil & Water Engineer -	Introduction to farm mgt. Inventories of bldgs., equip. and livestock
	Occupational Experiences		Land Judging Grain harvesting equip.	Soils inventory of land capability & use
	Youth Organizations PLANT SCIENCE Soils Record Keeping	Youth Organizations LIVESTOCK SCIENCE Livestock Breeding	-Principles of opertn. -Measuring field losses -Adjustments	Record keeping for the farm (bus.)(case farm) AGRICULTURAL MECHANICS
	AGRICULTURAL MECHANICS Basic Skills		-Economics of ownership Electricity, light & power	Marketing crops and livestock
	OCCUPATIONAL EXPERIENCES PLANT SCIENCE Seed production Plant nutrition	Occup. Exp. Records AGRICULTURAL MECHANICS Small Gas Engines	Occupational Exp. Summary & Analysis Tractor Maintenance	Summary and analysis of farm accounts Leadership Development
	Plant seed identification Plant Insects	LIVESTOCK SCIENCE		Agricultural Bus. planning-application of economic principles
	Weed Control AGRICULTURAL MECHANICS	Health-Sanitation	Forage harvesting equipment Tillage equipment	Taxes credit
	Basic Skills	PLANT SCIENCE Disease control Weed control	Buildings Material Handling	Insurance Summer Program
	Final Summary	Home Improvement Final Summary	Summer Program Exams	Exams

SUPERVISED OCCUPATIONAL EXPERIENCE (A TEACHING OUTLINE)

I. Assisting students in establishing vocational objectives.

- A. What are the opportunities for starting farming?
  - 1. The home farm.
  - 2. The local community and county.
  - 3. Opportunities in the state.
- B. What income can the beginning farmer expect?
- C. What requirements must the beginning farmer meet?
  - 1. Capital.
  - 2. Livestock.
  - 3. Machinery.
- D. What arrangements are desirable for starting?
  - 1. Partnerships.
  - 2. Renting.
- E. How can a high school student acquire needed capital and experience?
- F. How have some local young farmers become established?
- G. Opportunities in non-farm agricultural businesses which require proficiency in certain agricultural production skills.

II. Why have an occupational experience program?

- A. Putting theory into practice.
  - 1. To gain practical experience in the production of agricultural products for market.
- B. To learn how to manage labor.
- C. To learn how to plan production sequences.
  - 1. Performing operations at the best time.
- D. To learn how to invest money in a production enterprise.
- E. To gain experience in marketing products.
- F. To gain experience in record keeping and in summarizing and analyzing records.
- G. To use previous experience in planning new production enterprises.

III. What is an occupational experience program?

- A. Students should plan long-time occupational experience programs which include:
  - 1. Production enterprises.
    - a) Field crop production.
    - b) Horticultural crop production.
    - c) Livestock production.
      - (1) Breeding herds or flocks.
      - (2) Feeder stock.
  - 2. Improvement projects.
  - 3. Supplementary farm practices.
  - 4. Agricultural mechanics projects.
  - 5. Farm placement--may be used when home farm is inadequate to provide experiences.

AGRICULTURAL PRODUCTION

SUPERVISED OCCUPATIONAL EXPERIENCE (A TEACHING UNIT)

Approximate Teaching Time

The supervised occupational experience unit should be started early in the first year of the agricultural production course. Various aspects of the record keeping, summary, and analysis of the programs will extend throughout the entire agricultural production course. (See Enterprise Accounting for Vocational Agriculture in Ohio.)

Approximately 45 classroom hours would be required for teaching the unit. Additional teaching time is required in developing a satisfactory program involving the student and his parents. About two hours per student would be required.

Vocational Objectives

Primary vocational objectives.

1. To help students to become satisfactorily established in farming and other production agriculture.

Secondary vocational objectives.

1. To prepare students for off-farm agricultural businesses requiring practical farm experience for proficiency.

Major Competencies

1. To select profitable farm enterprises.
2. To successfully conduct farm enterprises through a complete cycle of production.
3. To keep accurate records.
4. To summarize and analyze records.
5. To make decisions based on information provided by records.
6. To appraise opportunities for establishment in farming.

IV. Selecting individual occupational experience programs.

- A. Type of occupational experience program needed by the student.
    - 1. Experiences required for successful achievement of vocational objectives.
    - 2. Interests of the student.
    - 3. Experience and ability of the student.
- B. Home situation.
    - 1. Size of home farm and type of farming operation.
    - 2. Size of family, age of parents, and other family members.
    - 3. Financial situation and farm tenure.
        - a) Farm ownership.
        - b) Renting.
    - 4. Machinery and equipment available.
- C. Availability of production enterprises.
    - 1. On home farm.
        - a) Crops and livestock raised.
        - b) Production and management practices followed.
    - 2. In community.
        - a) Crops and livestock raised.
        - b) Production and management practices followed.
- D. Capital requirements.
    - 1. Amount of money required--livestock, feed, seed, fertilizer, labor, machinery, and other operating costs.
    - 2. Availability of capital. Savings on credit.
- E. Opportunity for successful completion.
    - 1. The market outlook.
- F. Labor requirements.
    - 1. Amount of student labor.
    - 2. Amount of other party labor.

V. What are the marks of a satisfactory occupational experience program?

- A. Farming program.
    - 1. Student ownership.
        - a) Full ownership.
        - b) Partnership with parents, other family members, or neighbors.
    - 2. Student management.
        - a) The student should have full or part responsibility for all management decisions.

3. Student labor.
    a) The student should perform all labor possible. Should gain experience in each part of the production cycle.
4. Size of enterprise.
    a) The enterprise should be large enough to challenge the student and provide meaningful experiences.
    b) The enterprises should grow in size as the student advances in school.
5. Provide opportunity for profit.
    a) Provide money for personal expenses.
    b) Provide money for expansion.
6. Quality of farming programs.
    a) The quality of the enterprises should meet market demands and insure pride of ownership.
7. Provide opportunity to expand into farming or finance further education.
8. Has student, parent, and teacher approval.

B. Farm placement.
1. Provide opportunity for student to gain wide range of experience in enterprises common in community.
2. Provide a plan of experiences to be made available to the student.
3. Provide for supervision and instruction by the employer.
4. Provide for fair wages to be paid the student by the employer.
5. Provide for a record of experiences gained and money received.
6. Provide for evaluation by the employer of quality of work performed by student.
7. Provide for supervision by the teacher.
8. Provide for agreement of the parents of the student.

VI. Record keeping in vocational agriculture.
Reference: Enterprise Accounting for Vocational Agriculture in Ohio.

A. The importance of keeping complete and accurate records.
B. Planning the budget for production projects.
C. Preparing project agreements for production projects.
D. Taking inventories in production projects.
E. Entering receipts and expenses in production projects.
F. Overhead and operating expenses for production projects.
G. Summarizing production enterprise.
H. Analyzing production enterprise.
I. Using project record information in decision-making.
J. Keeping improvement project records.
K. Preparing net worth statement.

AGRICULTURAL PRODUCTION

PLANT SCIENCE

Teaching Units in Plant Science Area of Instruction

Field Crop Growth, Development and Nutrition

Crop Seed Production and Selection

Preventing Common Crop Diseases

Prevention and Control of Crop Insects

Weed Control

Grain Marketing

FIELD CROP GROWTH, DEVELOPMENT, AND NUTRITION (A TEACHING UNIT)

Approximate Teaching Time

It is recommended that the field crop growth, development, and nutrition unit be taught as an entire unit during either the first or second year of the agricultural production course. This would be determined by the needs and interests of the students.

Approximately 40 classroom hours would be required for teaching the unit. Additional teaching time is devoted to individual instruction based on the student's occupational experience program. Approximately three hours per student would be required.

Vocational Objectives

Primary vocational objectives.

1. Farm crop production. Producing farm crops for feed, seed, or sale.

Secondary vocational objectives.
The field crop growth, development, and nutrition unit will prepare students to enter certain occupations on a limited basis or to enter more advanced educational programs.

1. Agricultural business occupations concerned with the sale of fertilizer, lime, seed, chemicals, machinery,

and analyzing various crop production problems.
2. Vocational education programs at third and fourth year high school levels requiring a knowledge of plant science such as horticulture.
3. Technical schools.
4. College of Agriculture.

Major Competencies

1. Understand processes involved in plant growth, and factors affecting the growth processes.
2. Ability to apply knowledge of plant growth processes in crop production.
3. Understand nutrient needs of crops and the effect they have on plant growth.
4. Interpret soil and plant analysis tests.
5. Provide crop nutrient needs through application of lime, manure, and fertilizer.
6. Ability to select the correct kind and amount of commercial fertilizer and limes for a particular crop.

FIELD CROP GROWTH, DEVELOPMENT, AND NUTRITION (A TEACHING OUTLINE)

Managing the environmental factors of soil fertility, light moisture, temperature, and tillage methods to obtain maximum crop production.

I. Seeding the crop.

- A. The germination of seed in the soil.
  - 1. Requirements for seed to germinate.
    - a) Moisture.
      The osmosis process.
    - b) Temperature.
    - c) Air.
    - d) Light (required for some seeds).
  - 2. Seed structure characteristics.
    - a) Monocote - corn.
    - b) Dicote - soybeans.
    - c) Seed parts - what they do.
      Pericap.
      Endosperm.
      Embryo.
  - 3. Respiration.
  - 4. Cell growth and development of seedling.
    - a) Growing point.
    - b) Root development.

5. Providing soil conditions favorable for germination.
    a) Temperature of soil depending upon time of year.
        Moisture content of soil.
        Color of soil.
        Depth of planting.
        Contact of seed and soil. (Tillage method, soil structure.)
    b) Moisture.
        Time of planting in relation to rainfall.
        Water holding capacity of soil. (Soil type, tillage method.)
        Ground cover.
        Depth of planting.
        Contact of seed and soil. (Tillage method, soil structure.)
    c) Air.
        Density of soil. (Tillage method, soil structure and type.)
        Depth of planting.
        Moisture content of soil.

B. Effect of date of planting on later plant growth and development.
    1. Seasonal requirements - effect of temperature on plant growth.
    2. Use of available moisture by plants.
    3. Use of available rainfall during growing season.
    4. Best use by plants of available sunlight. Hours of sunlight during growing season.

II. Growing the crop from seedling stage to harvest. (Base teaching on crops important in community.)

A. Needs of the plant for growth and development.
    1. Air - CO_2.
    2. Water - H_2O.
    3. Sunlight - energy.

B. How plants grow. Use of air, water, and sunlight.
    1. Important parts of a plant and their function.
        a) Roots - take in water.
            store manufactured food.
            anchor plant in soil.
        b) Stem - transport water to leaves.
            transport manufactured food to roots.
            store some manufactured food.
        c) Flowers, fruit, and seed -
            reproduction.
            store manufactured food.
        d) Leaves - food manufacture.
            stomata - take in air - move out water.

2. Plant processes required for normal crop growth.
    - a) Photosynthesis process.
      Carbon + water + sunlight energy
      Dioxide in chlorophyll →

      Simple sugar + water + oxygen
      (First food)

      Glucose or simple sugar is the first food manufactured by the photosynthesis process.
    - b) Respiration process.
      Energy release.
      Chemical breakdown (digestion).

      Simple sugar + oxygen → Water + Energy

    - c) Transpiration process.
      Water loss through stomata.
      Water entry through plant roots.
      Effect of air temperature.
    - d) Assimilation process.
      Converting energy and food to cell parts.
    - e) Diffusion process.
      Movement of water and nutrients into the plant.

C. Plant population - row spacing of crops.
1. Space requirements for plants to grow. Compare species.
2. Effect of species and variety on plant population.
3. Effect of plant population on crop yields.
4. Choosing machinery system to seed, till, and harvest crops at different populations.

III. Planning the fertility program.

Plants use air and water through the process of photosynthesis to make simple sugar. Most mature plants are composed of about 90 per cent carbon, hydrogen, and oxygen. Why do plants need other nutrients?

A. Nutrient materials required for plant growth and development.
1. Major nutrients.
    - a) Element name.
    - b) Nutrient form.
    - c) Plant function.
2. Secondary nutrients.
    - a) Element name.
    - b) Nutrient form.
    - c) Plant function.
3. Micro nutrients.
    - a) Element name.
    - b) Nutrient form.
    - c) Plant function.

B. Determine nutrient requirements for maximum economic crop yields.
   1. Crop nutrient requirements.
      a) Corn.
      b) Soybeans.
      c) Small grains.
      d) Forage crops.
         (1) Grass.
         (2) Legumes - nitrogen fixing bacteria. Inoculation.
   2. Crop nutrient deficiency symptoms. Hunger signs for those crops on which nutrient shortages can be observed.
   3. Soil analysis.
      a) Sampling procedure.
      b) Testing procedures.
      c) Interpreting results.
         (1) pH
         (2) O.M.
         (3) K_2O
         (4) P_2O_5
   4. Plant analysis.
      a) Sampling procedure.
      b) Testing procedures.
      c) Interpreting reports.

C. Determine fertilizer recommendation for maximum economic crop yields.
   1. Determine crop yield goals.
   2. Determine crop needs.
      a) Major nutrients.
      b) Secondary nutrients.
      c) Micro nutrients.
   3. Determine availability of nutrients.
      a) Available from the soil. (Soil test.)
      b) Available from manure.
         (1) Handling and storage.
         (2) Time of application.
      c) Available in crop residue.
         (1) Legume sod.
         (2) Grass sod.
         (3) Corn stalks or small grain stubble.
   4. Determining fertilizer requirements for maximum economic crop yields.
      a) Determine difference between nutrients supplied and nutrients required to meet yield goals.
   5. Determine point of diminishing returns in the application of fertilizer.

D. Selection and application of commercial fertilizer.
   1. Application of fertilizer.
      a) Time of year.
      b) Method of application.
         (1) Broadcast.
         (2) At planting.
         (3) Row.
         (4) Pop up.
         (5) Side dress.

- c) Placement in relationship to seed (diffusion).
- d) Amount to apply.
  Build up fertilizer reserve in soil.
  Supply immediate need of current crop.
- e) Mix with herbicide or insecticide.

2. Form of fertilizer to apply.
   - a) Physical form.
     Liquid, dry, gas.
   - b) Chemical form.
     Availability, solubility, fixation in soil, soil type.
3. Cost per pound of available plant nutrient.

F. Application of lime for maximum economic crop production.
1. Crop needs.
2. Soil pH - cation exchange.
3. T.N.P. of liming materials.
4. Type of liming materials.
   - a) Magnesium needs (dolomite).
   - b) Calcium needs.
5. Fineness of liming materials.
6. Plowing depth in relation to amount of lime applied.

IV. Plant identification.
(May be taught on a separate unit.)
(Plant identification information may be used with each of the plant science units.)
(Suggest that study of plants be limited to those used in the agronomy contest.)

A. Dicot plant characteristics.
1. Leaf.
2. Stipule.
3. Stolons.
4. Pubescence.
5. Rhizomes.

B. Monocot plant characteristics.
1. Leaf.
   - a) Blade.
   - b) Sheath.
2. Stem.
3. Auricle.
4. Ligule.
5. Pubescence.
6. Inflorescence.
7. Rhizomes.

AGRICULTURAL PRODUCTION

PLANT SCIENCE

CROP SEED PRODUCTION AND SELECTION (A TEACHING UNIT)

Approximate Teaching Time

It is recommended that the crop seed production and selection unit be taught as an entire unit during either the first or second year of the agricultural production course. This would be determined by the needs and interests of the students.

Approximately 25 classroom hours would be required for teaching the unit. Additional teaching time is devoted to individual instruction based on the student's occupational experience program. Approximately one hour per student would be required.

Vocational Objectives

Primary vocational objectives.

1. Crop farming for production of crops for sale and feed.
2. Certified seed production for sale of seed to farmers.

Secondary vocational objectives.
Most of the secondary vocational objectives would require additional vocational, technical, or college education for entry into the jobs.

1. Field inspection to inspect crops grown for certified seed.
2. Laboratory technician to inspect and test seeds.
3. The packaging, wholesaling, retailing, and advertising of seeds.
4. Scientists, who search for new use of seeds.
5. Professional persons such as teachers of vocational agriculture who counsel with farmers.
6. Those persons who plan to continue their education at the college level in agronomy.

Major Competencies

1. To recognize the economic value of using quality seed in the production of field crops.
2. To identify the job opportunities in the seed production industry.
3. To apply the knowledge of how plants reproduce seed to the production of quality seed.
4. To identify crop and weed seeds.

5. To describe a crop variety and how new varieties are produced.
6. To produce certified seed.
7. To select quality seed for commercial crop production.
8. To use federal and state laws for protection in buying seed.
9. To determine the most economical seed to purchase.

CROP SEED PRODUCTION AND SELECTION (A TEACHING OUTLINE)

I. Importance of farmer using quality seed.

- A. Effect of seed quality on crop production.
  - 1. Crop losses resulting from using poor quality seed.
    - a) Yield loss.
      - (1) Poor germination.
      - (2) Low test weight.
      - (3) Winter killing.
    - b) Seed quality lowered.
      - (1) Disease and insect damage.
      - (2) Mixed with other crop and weed seed.
      - (3) Not mature - low test weight.
  - 2. Determine probable costs and returns from using seeds of different quality.
    - a) Use common field crops as examples.

II. Production of quality seed.

- A. Crop varieties and how they are developed.
  - 1. Plant classifications - plant kingdom.
    - a) Seed producing plants.
      Gyminosperms (confiers).
      Avgiosperms (crop plants in their group).
    - b) Augiosperm division.
      Dicots - soybeans and other legume plants.
      Monocots - corn and small grains all other grass plants.
    - c) Further breakdown of classification (both dicots and monocots).
      - (1) Order.
      - (2) Family.
      - (3) Tribe.
      - (4) Genes.
      - (5) Specie.
    - d) Plant specie such as corn, wheat, etc. are broken down into varieties.
  - 2. What is a variety?
    - a) Rank within a specie.
    - b) Distinguished by capital name before the specie name (Fulton wheat).

c) Varieties are developed by man, other classifications are not.
d) Names often confused with variety names. (Type, strain, blend, brand, hybrid.)

3. How are varieties developed?
  a) Plant reproduction.
    (1) Asexual - negative propagation - grafting, budding, cuttings, new plant like parent plant.
    (2) Sexual -
  b) The plant flower.
    (1) Male and female reproductive parts and their function.
    (2) Other flower parts.
  c) The flowers of grass plants and how they are different.
    (1) Lack sepals and corolla.
    (2) Corn plant - male and female parts located on different section of plant.
  d) Plant pollination.
    (1) Self-pollination.
    (2) Cross-pollination.
  e) How plants acquire characteristics.
    (1) The plant cell.
      Cytoplasm.
      Nucleus.
      Chromosomes.
      Genes.
    (2) Transmitting of plant characteristics.
      Dominant genes.
      Recessive genes.
  f) Steps in variety development.
    (1) "Weed out" undesirable characteristic.
    (2) Build up desirable characteristic.
  g) Procedures used in plant breeding.
    (1) Cross-pollination.
    (2) Self-pollination.
    (3) Progeny testing.
    (4) Back crossing.
    (5) Hybridizing.
  h) Development of varieties of small grains and soybeans.
  i) Development of hybrid varieties of corn.
    (1) Inbreeding.
    (2) Crossing.
      Male sterility (cytoplasm as a heredity factor).
  j) Development of hybrid wheat.

III. Production of quality seed.

- A. Certified seed.
  - 1. Quality guarantee of certified seed.
  - 2. The Ohio Seed Improvement Association.
    - a) Non-profit organization.
    - b) Controls and regulates production and sale of certified seed.
    - c) Keeps pedigree records of crop varieties.
    - d) Supervised
      - (1) Field inspection,
      - (2) Harvesting and cleaning,
      - (3) Laboratory testing.
  - 3. Production of certified seed.
    - a) Who may produce.
    - b) Procedures required
      - (1) Field,
      - (2) Equipment,
      - (3) Laboratory.
    - c) Seed classes required
      - (1) Breeder,
      - (2) Foundation,
      - (3) Registered,
      - (4) Certified.
  - 4. Standards required for each seed class.
    - a) Weed seeds.
    - b) Other crop seeds.
    - c) Germination.
    - d) Inert matter.
- B. Protection offered seed buyers by state and federal seed laws.
  - 1. License requirements.
  - 2. Seed package label requirements.
    - a) Per cent germination, inert matter, other crops seeds, hard seeds.
    - b) Number of primary noxious and secondary noxious seed per grains of crop seed.
    - c) Date germination test made.
    - d) Name of crop and variety.
    - e) Certified seed and the "blue tag."
  - 3. Penalties for seed law violation.

IV. Purchasing quality seed.

- A. Which variety?
  - 1. Disease restraint.
  - 2. Adapted to growing conditions, maturity length.
  - 3. Growth characteristics.
    - a) Straw or stalk strength.
    - b) Amount of straw or stalk size.

B. Label information.
    1. Per cent germination.
    2. Per cent hard seeds.
    3. Cost of seed.

formula $\dfrac{\text{cost per bushel}}{\text{purity \% x germination \%}}$ = cost of pure line seed

V. Seed identification.
(May be taught during the seed production unit or as a separate unit.)
(Suggest limit study of seeds to those used in agronomy contest.)

A. Crop seeds.
    1. Dicots.
        a) Shape.
        b) Size.
        c) Color.
        d) Hilum.
        e) Seed cost characteristics.
    2. Monocots.
        a) Same as dicots except use rachis and awn characteristics.
B. Weed seeds - primary and secondary noxious; other weed seeds (division the same as crop seeds).

AGRICULTURAL PRODUCTION

PLANT SCIENCE

PREVENTING COMMON CROP DISEASES (A TEACHING UNIT)

Approximate Teaching Time

It is recommended that the preventing common crop diseases uni be taught as an entire unit either during the first or second year of the agricultural production course. This would be determined by the needs and interests of the students.

Approximately eight classroom hours would be required for teaching the unit. Additional teaching time is devoted to individual instruction based on the student's occupational experience program. Approximately one hour per student would be required.

Vocational Objectives

Primary vocational objectives.

1. Providing competencies for preventing crop diseases in the crop production phase of farming.

Secondary vocational objectives.

1. Agricultural business sales and service dealing with crop disease preventing chemicals and seeds.
2. Custom application of crop disease preventing chemicals.
3. Entrance to technical schools for courses dealing with farm chemicals.
4. Entrance to college of agriculture for professional training in agronomy and plant pathology.

Major Competencies

1. Identify the common crop diseases that are present problems.
2. Understanding of how disease organisms cause damage to crops.
3. Ability to prevent crop disease losses.

PREVENTING COMMON CROP DISEASES (A TEACHING OUTLINE)

I. Crop losses that occur from disease infestations (include only those diseases that are present problems).

- A. Types of losses caused by diseases.
    - 1. Yield loss - (smut of small grain and corn).
    - 2. Seed quality - (scab of wheat).
    - 3. Plant quality - (alfalfa leaf spot).

II. What ways are diseases caused and can they be prevented?

- A. Infections or parasitic.
    - 1. Fungi.
        - a) Prevention.
        - b) How spread.
        - c) Common characteristics of fungi - leaf spots, molds, seed smuts.
    - 2. Bacteria.
        - a) Prevention - control.
        - b) How spread.
        - c) Common characteristics of bacteria.
    - 3. Virus.
        - a) Prevention - control.
        - b) How spread.
        - c) Common characteristics of nemotode.

III. Infectious diseases are often mistaken for other abnormal plant growth.

- A. Non-infectious diseases or physiological disorders.
    - 1. Mechanical injury.
    - 2. Herbicide injury.
    - 3. Unfavorable weather.
    - 4. Plant nutrient deficiency.

IV. How can the farmer identify the common crop diseases? (Part of the plant they affect.)

- A. Seed diseases.
    - 1. Crops affected.
    - 2. Description and cause.
      Example: Loose smut of wheat - entire seed head replaced by black smut - fungus.
- B. Leaf and stem diseases.
    - 1. Crops affected.
    - 2. Description and cause.

V. How can the farmer reduce losses by disease prevention methods?

- A. Use of fungicide on seeds or plants.
    - 1. Diseases prevented.
    - 2. Material used.
      Example: Stinking smut of wheat - Caoptan.
- B. Resistant varieties.
    - 1. Disease prevented.
    - 2. Variety namo.
      Example: Phytophtera root rot soybeans - Harosoy 63.

C. Cultural practice.
    1. Disease prevented.
    2. Practice used.
        Example: Scab of wheat - do not sow wheat in corn ground.

D. Intermediate plant host.
    Example:
    1. Johnson grass rhizoner - Maize Dwarf Mosaic.
    2. Common barberry - Black Stem Rust of Wheat.

AGRICULTURAL PRODUCTION

PLANT SCIENCE

PREVENTION AND CONTROL OF CROP INSECTS (A TEACHING UNIT)

Approximate Teaching Time

It is recommended that the prevention and control of crop insects unit be taught as an entire unit either during the first or second year of the agricultural production course. This would be determined by the needs and interests of students.

Approximately 10 classroom hours would be required for teaching the unit. Additional teaching time is devoted to individual instruction based on the student's occupational experience program. Approximately one hour per student would be required.

Vocational Objectives

Primary vocational objectives.

1. Providing competencies for preventing crop insect damage in the crop production phase of farming.

Secondary vocational objectives.

1. Agricultural business sales and service dealing with insect prevention and control chemicals.
2. Custom application of crop insect prevention and control chemicals.
3. Entrance to technical school for courses dealing with farm chemicals.
4. Entrance to college of agriculture for professional training in agronomy and entomology.

Major Competencies

1. Identify the common crop insects and type of damage done.
2. Understand how different insects damage crops.
3. Understand insect life cycles.
4. Ability to select and use prevention and control methods.

PREVENTION AND CONTROL OF CROP INSECTS (A TEACHING OUTLINE)

I. Crop losses that occur from insect damage. (Limit to common crops and insects that are present problems.)

- A. What insects cause damage to our crops?
  - 1. Corn - borer - ear worm - root worm - aphid.
  - 2. Wheat - Hessian fly - cereal leaf beetle.
  - 3. Alfalfa - weevil - leafhoppers.
- B. How much crop damage may these insects do?
  - 1. Alfalfa weevil.
  - 2. Corn root worm.
  - 3. Aphid.
  - 4. Leafhopper.

II.

- A. Life cycle of insects.
  - 1. Without metamorphosis (no common crop insects - chicken lice and hog lice are examples).
  - 2. Gradual metamorphosis. Leafhoppers an example.
  - 3. Incomplete metamorphosis - none in this group are important crop insects.
  - 4. Complete metamorphosis - most crop damaging insects in this group.
    - a) Egg.
    - b) Larvae.
    - c) Pupae.
    - d) Adult.
- B. Types of mouth parts.
  - 1. Chewing - eat leaves, stems, and roots of plants - alfalfa weevil, corn rootworm.
  - 2. Sucking - puncture and withdraw plant juice - leafhopper.
  - 3. Sponge - absorb soluble material (home fly).
  - 4. Tube - siphon like (butterfly and moths).

III. Identifying the insect and damage done to a crop or crops. Alfalfa, corn, and small grains.

- A. Part of plant damaged and description.
- B. Time of year damage is done.
- C. Stage of insect life cycle and description.

IV. What prevention and control practices can be used?

- A. Cultural practices.
  - 1. Crop rotations.
  - 2. Destroying crop residue.
  - 3. Resistant or tolerant varieties.
  - 4. Intermediate hosts.

B. Insecticides.
    1. Stomach poisons.
    2. Contact.
    3. Vapor action.
C. Insect parasites.
D. Mechanical action.
    1. Flaming.

AGRICULTURAL PRODUCTION

PLANT SCIENCE

WEED CONTROL (A TEACHING UNIT)

Approximate Teaching Time

It is recommended that the weed control unit be taught as an entire unit either during the first or second year of the agricultural production course. This would be determined by the needs and interests of the students.

Approximately 15 classroom hours would be required for teaching the unit. Additional teaching time is devoted to individual instruction based on the student's occupational experience program. Approximately one hour per student would be required.

Vocational Objectives

Primary vocational objectives.

1. Providing competencies for the prevention and control of weeds in the crop production phase of farming.

Secondary vocational objectives.

1. Agricultural business sales and service dealing with herbicides and cultivating equipment.
2. Custom application of herbicides.
3. Entrance to technical schools for courses dealing with farm chemicals.
4. Entrance to college of agriculture for professional training in agronomy.

Major Competencies

1. Ability to identify weed and crop plants.
2. Determining crop losses caused by weeds.
3. Ability to understand growth characteristics of weed plants.
4. Ability to understand how herbicides kill weeds.
5. Ability to select the correct herbicides to control a weed plant.
6. Ability to prepare and apply herbicides to control weeds.

WEED CONTROL (A TEACHING OUTLINE)

I. How serious are crop losses from weed infestations?

- A. Seed losses (from seed production outline).
- B. Nutrient and water competition.
- C. Hay and pasture loss from poor quality forage.

II. Plant identification.
(See plant identification section.)

- A. Identification of problem weeds and their characteristics.

III. Why are some weeds more difficult to control?

- A. Perennials (live for several years).
    - 1. New plants come from roots and seeds.
    - 2. Have rhizomes.
- B. Biennials (live for 2 years).
    - 1. Produce flower and seed 2nd year.
- C. Annuals (new plant from seed each year).
    - 1. Winter annuals.
    - 2. Spring annuals.

IV. What types of herbicides are used to kill plants?

- A. Non-selective - kills all plant life.
    - 1. Contact.
    - 2. Soil sterilant.
    - 3. Systemic.
- B. Selective - kills certain plants and not others.
    - 1. Enzyme action.
    - 2. Degree of absorption.
    - 3. Systemic.
- C. Place of application.
    - 1. Foliar.
    - 2. Soil.
- D. Type of material.
    - 1. Wettable powder.
    - 2. Ester - emulsion.
    - 3. Granular.

V. What cultural practices are helpful in controlling weeds?

- A. Plowing time.
- B. Soil preparation (or lack of).
- C. Cultivation.
- D. Fallowing.
- E. Crop rotations.

VI. How to use herbicides to control specific weeds such as quack grass.

- A. Crop to be grown and the cropping sequence.
- B. Weeds to control.
- C. Herbicides to use.
- D. Time of application.
- E. Method of application.
    - 1. Amount of herbicide.
    - 2. Amount of water.

AGRICULTURAL PRODUCTION

PLANT SCIENCE

GRAIN MARKETING (A TEACHING UNIT)

Approximate Teaching Time

It is recommended that the grain marketing unit be taught during the first or second year of the agricultural production course. This is an elementary unit. A more complete unit on marketing is recommended during the fourth year farm business management area of instruction.

Approximately five classroom hours would be required.

Vocational Objectives

Primary vocational objectives.
1. Crop farming. Marketing of grain crops.

Secondary vocational objectives.
1. Agricultural business - grain buying or selling.

Major Competencies

1. To determine best time and method of marketing grain.

GRAIN MARKETING (A TEACHING OUTLINE)

I. Importance of efficient grain marketing.

  A. Income from grain crops sold from a farm, county, state, nation.

II. Market outlets for grain.

  A. Local markets available.
  B. Feed to livestock.

III. Grain prices.
  A. Seasonal fluctuations of prices.
    1. Determine best time to sell.

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AGRICULTURAL PRODUCTION

ANIMAL SCIENCE

Teaching Units in Animal Science Area of Instruction

Livestock Feeding

Livestock Selection and Breeding

Livestock Marketing

Livestock Health

Quality Milk Production

LIVESTOCK FEEDING (A TEACHING UNIT)

Approximate Teaching Time

It is recommended that the livestock feeding unit be taught as an entire unit during either the first or second year of the agricultural production course. This would be determined by the needs and interests of the students.

Approximately 30 classroom hours would be required for teaching the unit. Additional teaching time is devoted to individual instruction based on the student's occupational experience program. Approximately two hours per student would be required.

Vocational Objectives

Primary vocational objectives.

1. Livestock farming. To plan feeding programs and to feed livestock.
    a. Registered livestock breeders engaged in the development and sale of breeding stock.
    b. Commercial livestock farmers engaged in the production and sale of meat, milk, and wool.

Secondary vocational objectives. (Non-farm occupations related to livestock farming.)

The livestock feeding unit will prepare the student to enter certain occupations on a limited basis or to enter more advanced educational programs.

1. Agricultural business dealing with feed sales, feed additives, dealerships, veterinary supplies, feed manufacturing.
2. Technical school - feed laboratory technician.
3. College of agriculture - nutritionist, veterinarian, vo-ag teacher, county agent.

Major Competencies

1. To recognize the need for and uses of feed for efficient production.
2. To identify body processes and their relationship to nutrition of animals.
3. To identify food nutrients, sources, and their characteristics.
4. To identify the characteristics and functions of various foodstuffs.
5. To determine needs and requirements of animals at all stages of life for confinement and pasture.
6. To determine an economical balanced ration for a specific kind of livestock.
7. To select a method of preparing feed stuffs for livestock.
8. To select a feeding system and schedule for livestock.

LIVESTOCK FEEDING (A TEACHING OUTLINE)

I. The need for and uses of feed for efficient livestock production.

A. Need for feed.
   1. Growth.
   2. Maintenance.
   3. Reproduction.
   4. Production.
   5. Fattening.

B. Uses of feed stuffs - define each.
   1. Roughages - supplying bulk, energy, and nutrients.
      High carbohydrate.
      High protein.
   2. Concentrates.
      Carbohydrate concentrates - grains supplying energy.
      Protein concentrates - animal and plant by-products and synthetic sources - supplying body-building materials.
   3. Mineral and vitamin feed supplements and feed additives for body composition, regulation, and health.

- C. Efficient production from adequate feeding. (Use examples from beef, dairy, sheep, and swine enterprises.)
    - 1. Improved grains.
    - 2. Better and faster growth.
    - 3. Increased production of milk and wool.
    - 4. Improved quality of production.
    - 5. Improved efficiency of production.
    - 6. Improved health of animals.

II. Utilization of food nutrients by animals.

- A. Define digestion.
- B. Identify parts of the digestive system of simple stomach animals and fowl.
- C. Identify the digestive system of ruminants and related body processes.
- D. Explain how food is broken down and nutrients absorbed in the blood stream.
    - 1. Mouth.
    - 2. Stomach.
    - 3. Small intestine.

      (simple stomach animals and ruminants)

III. The food nutrients, sources, and characteristics.
Identify the function and make-up of each nutrient.
Identify major feed stuffs where nutrients may be found.

- A. Carbohydrates.
- B. Fats.
- C. Proteins.
- D. Minerals.
- E. Vitamins.
- F. Water.

IV. Common feeds for farm animals, their characteristics, and functions.

- A. Identify the following:
    - 1. Digestible protein.
    - 2. Nitrogen-free extract.
    - 3. Total digestible nutrients.
    - 4. Net energy.
- B. Identify common feeds.
    - 1. Roughages.
        - a) Hays.
        - b) Haylage.
        - c) Grass silage.
        - d) Green chop.
        - e) Pasture.
        - f) Corn silage.
    - 2. Grains.
        - a) Shelled corn.
        - b) High moisture corn.

        c) Ear corn.
        d) Small grains.
    3. Supplements.
        a) Protein - animal and plant by-products and synthetics.
        b) Mineral supplements.
        c) Vitamin supplements.
    4. Feed additives.
        a) Antibiotics.
        b) Hormones.
        c) Iodinated casein.
        d) Arsenical.
        e) Detergent.
        f) Tranquilizer.
        g) Rumen organism.

V. Animal needs and requirements.

Identify ration requirements as protein, total digestible nutrients, net energy, mineral, and vitamin requirements for different stages of growth, production, and methods of feeding - use of feeding standards.

A. Beef cattle.
    1. Calves and yearlings - stockers and feeders.
    2. Cows.
B. Dairy cattle.
    1. Veal.
    2. Calves.
    3. Heifers.
    4. Cows by breed and production.
C. Swine.
    1. Gilts and sows by ranges of weight.
    2. Market hogs.
D. Sheep.
    1. Breeding flock.
    2. Lambs.

VI. Balancing rations for different stages of production for each species. (Beef, dairy, sheep, swine.)
Breeding stock during different stages of reproduction cycle.

A. Young stock.
B. Meat production.
C. Milk production.
D. Identify feeds to use and composition of each.
    1. Grains.
    2. Roughages.
        a) Evaluate quality - (analysis of protein).
    3. Supplements - per cent protein.
        a) Commercials.
        b) Others.

E. Identify limitations of the amount of specific feeds in ration (as oats for fattening hogs).
F. Identify status of animals and requirements for same.
  1. Age, weight.
  2. Production - (lbs. and % B.F. of milk).
G. Define ration, balanced ration, protein, digestible protein, T.D.N., N.F.E., N.R., and N.E.
H. Identify characteristics of a good ration.
I. Use the trial and error method of balancing a ration and compare against requirements.
J. Use the Pearsons square method to balance a ration. (Balance a ration for beef, dairy, swine, sheep.)

VII. Preparation of feed stuffs for livestock.
(Beef, dairy, swine, sheep.)

A. Define mastication and rumination.
B. Value of feed vs. digestibility.
C. Preparation of feed - its effect on nutritive value.
  1. Grinding.
  2. Pelleting.
  3. Soaking.
  4. Cooking.
  5. Chopping.
  6. Crumping.
  7. Cracking.

VIII. Feeding systems and practices.
(Beef, dairy, swine, sheep.)

A. Daily intake of feed - its effect on animal performance.
  1. Condition of animal.
  2. Purpose for which feed is to be used.
B. Methods of feeding - advantages and disadvantages. (Beef, dairy, swine, sheep.)
  1. Self-feeding.
  2. Hand-feeding.
  3. Limited feeding.
  4. Crop feeding.
C. Schedule for hand feeding.
  1. Importance of regularity.
  2. Once, twice, or three times daily.

AGRICULTURAL PRODUCTION

ANIMAL SCIENCE

LIVESTOCK SELECTION AND BREEDING (A TEACHING UNIT)

Approximate Teaching Time

It is recommended that the livestock selection and breeding unit be taught as an entire unit during either the first or second year of the agricultural production course. This would be determined by the needs and interests of the students.

Approximately 45 classroom hours would be required for teaching the unit. Additional teaching time is devoted to individual instruction based on the student's occupational experience program. Approximately two hours per student would be required.

Vocational Objectives

Primary vocational objectives.

1. Livestock farming - breeding and selection of livestock.
    a. Registered livestock breeders engaged in the development and sale of breeding stock.
    b. Commercial livestock farmers engaged in the production and sale of meat, milk, and wool.

Secondary vocational objectives. (Non-farm occupations related to livestock farming.)

Most of the agricultural occupations related to the livestock breeding and selection unit will require additional vocational, technical, or college training for entry into a job.

1. Agricultural businesses - sale of breeding supplies, breeding associations, artificial insemination.
2. Technical school - laboratory technician.
3. College of agriculture - animal science majors, agricultural education, veterinarian.

Major Competencies

1. To select a breed of livestock and evaluate breed characteristics in terms of their economic importance.
2. To select individual breeding stock for the herd and identify the traits that are important to the farmer and consumer.

3. To breed animals for efficient production of livestock products.
4. To manage the female breeding stock for the reproductive role.
5. To manage the male breeding stock for its role.
6. To identify causes of infertility.
7. To determine the breeding programs to use to improve livestock.

LIVESTOCK SELECTION AND BREEDING (A TEACHING OUTLINE)

The study may be centered around the species of livestock (beef, swine, dairy, sheep) that are important to the students in the class.

I. Selecting a breed of livestock.

- A. Define species, breed, grade, purebred, registered, crossbred, scrub.
- B. Characteristics of breeds.
  1. Appearance, physical traits.
  2. Breeding characteristics.
  3. Production characteristics - application to breeds of beef, swine, dairy, sheep common in Ohio.

II. Selecting individual breeding stock.

- A. Define livestock traits (type).
- B. Identify livestock traits that are important to the farmer and consumer.
  1. Identify the exterior parts of the animal.
  2. Identify the ideal type.
  3. Identify the wholesale and retail cuts of meat (beef, swine, sheep, veal).
  4. Identify quality of livestock products (milk and wool).
  5. Identify the quality and kind of meat products demanded by consumer.
     - a) Quality of meat.
     - b) Appearance of cuts.
     - c) Size of cuts.
     - d) Freedom from disease.
  6. Determine efficiency of feed conversion (beef, swine, dairy, sheep).
  7. Breeding ability.
  8. Health.
  9. Temperament.
  10. Ability to raise young.
  11. Amount of wool - (sheep).
  12. Ease of milking - (dairy).

      13. Milk producing ability.
      14. Type - size.
   - C. Selecting livestock for commercial feeding. (Beef, swine, sheep, veal.)
      1. Production testing.
      2. Feeder grades.

III. Breeding animals for efficient production of livestock products.

- A. Influence of heredity and environment on offspring.
- B. Degree of heritability traits chromosomes, genes (beef, swine, dairy, sheep).
- C. Improving livestock through selecting for desirable traits.
   1. Number of traits to select for at one time.
   2. Rate of change to expect.

IV. Selection and management of female breeding stock for most efficient reproduction of quality young.

- A. Reproductive organs and how they function.
   1. Identify organs and their functions.
   2. Formation of eggs.
      - a) Meiosis and mitosis (inheritance).
      - b) How female transmits traits.
      - c) Estrous.
      - d) Regulatory hormones and glands.
      - e) Number of eggs produced.
      - f) Number of young for species.
- B. Breeding ages and amount of service.
- C. Types of mating.
   1. Natural.
   2. Artificial.
- D. Traits carried by egg.
- E. Feeding and management of female livestock during breeding season (beef, swine, dairy, sheep).
   1. Condition of animal (flushing).
   2. Age to breed, symptoms of heat.
   3. Time of year.
- F. Feeding and management of female during gestation period.
   1. Normal development of fetus in uterus.
   2. Regulatory; hormones.
   3. Feeding and management recommendations for each species (beef, swine, dairy, sheep).
      - a) Length of gestation.
      - b) Normal rate of development of fetus.
      - c) Feeding and management recommendations.
      - d) Milk production and dry period (dairy).
      - e) Wool production and shearing (sheep).
- G. Care and management of female and young at birth.
   1. The birth process.
   2. Influence of regulatory hormones.

3. Normal position of fetus.
4. Predelivery symptoms (beef, swine, dairy, sheep).
5. The afterbirth and its disposal.
6. Assistance during delivery if required.
7. Attention to give newborn animals.
8. Feeding and management of female during and just after delivery.
   a) Return of reproduction organs to normal.
   b) Regulatory hormones.
   c) Rebreeding (beef, swine, dairy, sheep).

H. Care and management of young from birth to weaning (beef, dairy, swine, sheep).
1. Colstrum in milk of mother.
2. Special practices - ear marking, navel treatment, dehorning, castration, weaning, worming, etc.

V. Selection and management of male breeding stock for most efficient service.

A. Reproductive organs and how they function.
1. Identify organs and their function.
2. Puberty and the production of the sperm.
   a) How male transmits traits.
   b) Number of sperms produced.

B. Breeding age and amount of service.

C. Breeding by artificial insemination (dairy, beef).
1. Advantages and disadvantages.
2. Selection of a bull.
3. Detecting heat.
4. Notifying inseminator.

D. Feeding and management of male during breeding season.
1. Condition of animal.
2. Number of animals to breed.

VI. Problem of infertility.

A. Age and fertility.

B. Nourishment and care.
1. Effect of nutrition.
2. Effect of heat and environment.

C. Diseases of reproduction.

D. Physical defects.

E. Purposeful sterility - castration.

VII. Breeding programs to improve livestock.

A. Progress in selection.
1. Heritability traits (beef, swine, dairy, sheep).
2. Generation interval.
3. Selection differential.
4. Selection pressure.

B. Types of selection.
    1. Single (tandem).
    2. Culling levels.
    3. Merit scales.
C. Aids to selection.
    1. Pedigrees.
    2. Progeny records.
        a) Bull proofs.
        b) Certified offspring.
    3. Individual performance.
        a) D.H.A. records.
        b) Beef improvement.
        c) Sheep improvement records.
        d) Swine improvement records.
D. Systems of breeding.
    1. Inbreeding.
        a) Line breeding.
    2. Outbreeding.
        a) Cross breeding.

AGRICULTURAL PRODUCTION

ANIMAL SCIENCE

LIVESTOCK MARKETING (A TEACHING UNIT)

Approximate Teaching Time

It is recommended that the livestock marketing unit be taught during the first or second year of the agricultural production course. This is an elementary unit. A more complete unit on marketing is recommended during the fourth year farm business management area of instruction.

Approximately six classroom hours would be required.

Vocational Objectives

Primary vocational objectives.

1. Livestock farming - marketing of livestock and livestock products.

Secondary vocational objectives. (Non-farm occupations related to livestock marketing.)

1. Agricultural businesses - livestock yards and markets, meat packers, wholesalers, and retailers.

Major Competencies

1. To recognize the need for efficient livestock marketing.
2. To select an efficient marketing system for livestock or livestock products.
3. To determine ways farmers can receive higher prices for their livestock and livestock products.

LIVESTOCK MARKETING (A TEACHING OUTLINE)

I. Importance of efficient livestock marketing.

   A. Income from livestock and livestock products sold from a farm, county, state, nation.
      1. Beef cows and steers.
      2. Dairy cows, veal, milk.

   3. Sows and pigs.
   4. Ewes and lambs.
   5. Poultry and eggs.

II. Marketing systems for livestock and livestock products.

- A. Market outlets.
  - 1. Auctions.
  - 2. Daily markets.
  - 3. Terminal markets.
  - 4. Direct "off market" channels.

III. Livestock prices.

- A. Seasonal price fluctuations.
  - 1. Determine when to buy or sell (beef, dairy, swine, sheep).

IV. Ways farmers can receive higher prices for their livestock and livestock products.

- A. Preventing livestock losses.
  - 1. Eliminate bruises.
    - a) Outlaw clubs and whips.
    - b) Eliminate protruding nails and broken boards.
    - c) Remove machinery from feedlots.
    - d) Remove horns.
    - e) Bed the truck properly.
    - f) Check the truck for danger points.
    - g) Load carefully.
    - h) Load wisely.
    - i) Protect from weather.
    - j) Drive carefully.
- B. Improve grades of livestock and livestock products.
  - 1. Improve grades of livestock.
    - a) Beef.
      - (1) Meat type.
      - (2) Production testing program.
      - (3) Feeder cattle grades.
      - (4) Market cattle grades.
      - (5) Carcass grades.
    - b) Swine.
      - (1) Meat type.
      - (2) Pork yield evaluation - carcass data.
      - (3) Pork Improvement Association.
      - (4) Market classes and grades of feeder pigs.
      - (5) Slaughter, barrow and gilt standards for grades.
      - (6) Market classes and grades of pork carcasses.
    - c) Sheep.
      - (1) Grades of sheep.
      - (2) Grades of slaughter lambs.
      - (3) Carcass grades.

- d) Dairy.
  - (1) Slaughter cattle grades (see beef).
  - (2) Milk.
    - (a) Grades of milk.
    - (b) Blend price.
    - (c) Federal milk marketing orders.

C. Keep livestock shrinkage at a minimum.
- 1. Identify shrinkage.
- 2. Causes of shrinkage.
- 3. Define pencil shrinkage.
- 4. Keep shrinkage at a minimum.
  - a) Condition cattle before shipping.
  - b) Plan shipping program.
  - c) Select best type of transportation.
  - d) Provide attendant for large shipment.
  - e) Sort different size animals.
  - f) Keep off feed and water up to 12 hours before shipping.
  - g) Provide protection from weather.
  - h) Take advantage of feed, water, and rest stops on long journeys.
  - i) Provide for fillback if in transit more than 12 hours.
  - j) Plan movements during desirable part of day.

D. Plan livestock marketings for seasonal peaks.
- 1. Identify seasonal price fluctuations.
- 2. Identify production cycles. (Beef, dairy, swine, sheep.)

E. Sell at proper market weights.

AGRICULTURAL PRODUCTION

ANIMAL SCIENCE

LIVESTOCK HEALTH (A TEACHING UNIT)

Approximate Teaching Time

It is recommended that the livestock health unit be taught as an entire unit during either the first or second year of the agricultural production course. This would be determined by the needs and interests of the students.

Approximately 24 classroom hours would be required for teaching the unit. Additional teaching time is devoted to individual instruction based on the student's occupational experience program. Approximately one hour per student would be required.

Vocational Objectives

Primary vocational objectives.

1. Livestock farming - to maintain livestock health for efficient production.
    a. Registered livestock breeders.
    b. Commercial livestock farmers.

Secondary vocational objectives.
The livestock health unit will prepare students to enter certain occupations on a limited basis or to enter more advanced educational programs.

1. Agricultural businesses - sale of veterinary supplies and feed additives, feed manufacturers, drugs.
2. Technical school - laboratory technician.
3. College of agriculture - animal science.
4. College of veterinary medicine.

Major Competencies

1. To recognize the need for prevention of losses due to livestock diseases and parasites.
2. To identify unhealthy animals.
3. To determine causes of infectious and non-infectious diseases.
4. To identify how animals are protected from disease.
5. To recognize how animal diseases are treated and when professional assistance is needed.

6. To recognize symptoms, causes, and prevention of common diseases of farm animals.
7. To determine how common parasites are controlled.
8. To identify common internal and external parasites of farm animals, method of infestation, injury, and control.

LIVESTOCK HEALTH (A TEACHING OUTLINE)

I. Losses from animal diseases and parasites.

- A. Animal losses.
  - 1. Cattle.
  - 2. Calves.
  - 3. Sheep.
  - 4. Swine.
- B. Income loss - annually.
  - 1. Bangs.
  - 2. Bovine Mastites.
  - 3. Vibrosis.
  - 4. Leptospirosis.
  - 5. Bloat.
    Annual cattle losses.
    Annual swine losses.
- C. Other losses.
  - 1. Poor gain.
  - 2. Increased labor.
  - 3. Increased feed costs.

II. Recognizing signs of good health vs. unhealthy conditions.

- A. Visual indications.
  - 1. Contentment.
  - 2. Alertness.
  - 3. Eating habits.
  - 4. Sleek coat and pliable, elastic skin.
  - 5. Bright eyes and pink eye membranes.
  - 6. Normal feces and urine.
- B. Other indications.
  - 1. Normal temperature.
  - 2. Pulse rate.
  - 3. Breathing rate.

III. Causes of diseases.

- A. Infectious.
  - 1. Bacteria.
  - 2. Virus.
  - 3. Fungi.

- B. Non-infectious.
  - 1. Metabolic.
  - 2. Faulty nutrition.
  - 3. Poison in feed.
  - 4. Heredity.
  - 5. Misc. - eating, hardware, mechanical, injury, etc.

IV. Protection from animal disease.

- A. Sanitation.
  - 1. Disinfectant.
  - 2. Manure removal.
  - 3. Removal of afterbirth.
- B. Immunization.
  - 1. Vaccination.
    - a) Vaccines.
    - b) Anti-serums.
    - c) Bacterins.
    - d) Toxoids.
- C. Isolation.
  - 1. Quarantine.
- D. Housing.
  - 1. Space requirements.
  - 2. Ventilation requirements.
- E. Immunity.
  (Identify sanitary practices for beef, dairy, swine, sheep)

V. Treating animal diseases (Layman - Veterinarian).

- A. Medical methods.
  - 1. Oral.
  - 2. Intramuscular.
  - 3. Introperitoneal.
  - 4. Subcutaneous.
  - 5. Intravenous.
  - 6. Rectal.
  - 7. Skin absorption.
- B. Physical aids.
  - 1. Tranquilizers.
  - 2. Trocar and cannular.
  - 3. Restrain.
  - 4. Throw.
  - 5. Balling gun.
  - 6. Intravenous set.
  - 7. Hypodermic.
  - 8. Leads.
  - 9. Holder-swine.
  - 10. Lancing.
- C. Professional services - veterinarian.
  - 1. The veterinarian's role.
  - 2. Identify diseases to be controlled by veterinarian.

VI. Symptoms, causes, prevention, and control of common diseases.

- A. Identify how diseases spread.
  - 1. Direct or immediate contact with a diseased individual.
  - 2. Contacts through inanimate objects.
  - 3. Contact with disease carriers.
  - 4. Infection from soil.
  - 5. Infection from food and water.
  - 6. Infection from blood sucking arthropods.
  - 7. Air-borne infections.
  - 8. Infection from organisms normally carried.
- B. Common diseases. (Beef, dairy, swine, sheep.)
  - 1. Shipping fever.
  - 2. Pinkeye.
  - 3. Foot-rot.
  - 4. Bloat.
  - 5. Mastitis.
  - 6. Brucellosis.
  - 7. Leptospirosis.
  - 8. Tuberculosis.
  - 9. Hog cholera.
  - 10. Swine influenza.
  - 11. Virus pneumonia.

VII. Controlling parasites of farm animals.

- A. Knowledge of life cycle of parasites.
- B. Direct control.
  - 1. Insecticide.
  - 2. Pesticide.
  - 3. Arsenical.
  - 4. Vermifuge.
  - 5. Systemic.
  - 6. Repellent.
  - 7. Residue.
  - 8. Spray.
  - 9. Dust.
  - 10. Dip.
- C. Indirect control.
  - 1. Disposal.
  - 2. Rotation.
  - 3. Sanitary.
  - 4. Carcass removal.
  - 5. Filth.
  - 6. Disinfection.
  - 7. Dilution.
  - 8. Regulatory.

VIII. Common internal and external parasites of farm animals, method of infestation, injury, and control.

- A. Identify how parasites spread.
    - 1. Travel - fly, on animals, conveyances.
    - 2. Host animals.
    - 3. Intermediate host.
    - 4. Natural enemies.
- B. Internal parasites.
    - 1. Roundworms.
    - 2. Trichina.
    - 3. Lungworms.
    - 4. Kidney worms.
    - 5. Tapeworms.
    - 6. Flukes. (Identify parasites and know life cycle.)
- C. External parasites. (Beef, dairy, swine, sheep.)
    - 1. Heelfly.
    - 2. Ticks.
    - 3. Mites.
    - 4. Flies.
    - 5. Lice.
    - 6. Fleas.

AGRICULTURAL PRODUCTION

ANIMAL SCIENCE

QUALITY MILK PRODUCTION (A TEACHING UNIT)

Approximate Teaching Time

It is recommended that the quality milk production unit be taught during either the first or second year of the agricultural production course. It would only be included in the local curriculum when students had a need and interest in this subject-matter area.

Approximately 15 classroom hours would be required for teaching the unit. Additional teaching time is devoted to individual instruction based on the student's occupational experience program. Approximately two hours per student would be required.

Vocational Objectives

Primary vocational objectives.

1. Dairy farming.

Secondary vocational objectives.

1. Agricultural business. Selling and servicing dairy supplies and equipment.
2. Advanced study at the college level in dairy science or dairy technology.

Major Competencies

1. To manage the milking herd to maintain udder health and insure production of a quality product.
2. To conduct the milking operation to maintain udder health and to produce a quality product.
3. To maintain and operate milking equipment and storage units to insure delivery of a quality product.

QUALITY MILK PRODUCTION (A TEACHING OUTLINE)

I. The importance of producing quality milk.
   1. Economic importance.
   2. Human health aspects.

II. The cow's udder and how it functions.
  1. The anatomy of the cow's udder.
  2. The vascular system.
  3. Sympathetic system.
  4. Hormonal control of udder development, milk secretion and "let down" (see Livestock Breeding unit).

III. Infections and udder health.
  1. Definition of mastitis.
  2. Classification of mastitis.
  3. Causes of mastitis.
  4. The development of mastitis within the udder.
  5. Diagnosis of mastitis.
  6. Prevention of mastitis.
  7. Treatment of mastitis.
  8. Public health aspects of mastitis.

IV. Maintaining efficient and healthy udders.
  1. Inheritance and udder function.
  2. Udder and teat conformation.
  3. Cow age.
  4. Leason.
  5. Level of production and udder health.
  6. State of lactation.
  7. Feed.
  8. Housing.
  9. Sanitation.
  10. Over and under milking.
  11. Drying up process.
  12. Records.

V. Proper machine function and providing a safe water supply.
  1. Importance of good machine function.
  2. Machine operation.
  3. Pipeline system.
  4. Milking system analysis.
  5. Milking equipment maintenance.
  6. Sources of water and possible contamination.

VI. Factors affecting the quality of milk.
  1. Definition of normal milk.
  2. Characteristics of abnormal milk.
  3. Milk flavors.
  4. Sources of bacteria in milk.
  5. Interpretation of tests run on milk.

AGRICULTURAL PRODUCTION

AGRICULTURAL MECHANICS

Teaching Units in Agricultural Mechanics Area of Instruction

Farm Power and Machinery

Farm Buildings and Conveniences

Soil and Water Management

Rural Electrification and Processing

Agricultural Construction and Maintenance

FARM POWER AND MACHINERY (A TEACHING UNIT)

Approximate Teaching Time

It is recommended that the major portions of the farm power and machinery unit be taught during the third and fourth year of the four-year program. The small gasoline engine unit may be taught during the second year.

Approximately 180 classroom and laboratory teaching hours would be required.

Vocational Objectives

Primary vocational objectives.

1. Farming - custom operator.

Secondary vocational objectives.

1. Agricultural business occupations concerned with the sales and/or repair of agricultural equipment.
    a. Local machinery dealers.
    b. Private repair shops.
    c. State and regional distributorships.
2. Further training in a special program such as advanced technical school or college.

Major Competencies

1. To operate, adjust, service, and maintain farm tractors, including spark ignition and diesel types and small internal combustion engines.

2. To operate, adjust, and service field machines including lubrication, recognition of malfunction such as harvest loss; make the operating adjustments and properly hitch implements; calibrate planting, fertilizing, and spraying equipment.
3. To plan and execute a program of preventative maintenance including protection-shelter, rust prevention, periodic inspection and adjustment to compensate for wear, and repair in anticipation of breakage.
4. To adjust, adapt, and modify machinery to satisfy local conditions such as trash cover control, hillside operation, specialized crop use and multiple hitching.
5. To determine and use safe operating practices with special emphasis on speed, protection from moving parts, and stopping the machine to adjust and remove obstructions and for refueling.
6. To recognize and identify the fundamental principles involved in machines, the relationship of mechanisms and systems to processes and functions; and that the basic processes are unchanging but mechanisms vary with systems employed in machine design.
7. To select power units and machines with regard for adaptation of systems of machines to types of farming considering the compatability of individual machines with other components of the machinery system; size and number of power units, hours of utilization, annual cost, and availability of custom rental and dealer service.
8. To locate and remedy common operating troubles due to wear of parts, breakage, misalignment, and other improper functioning.
9. To make repairs and parts replacement.
10. To recognize the need for major repairs involving the use of specialized tools and equipment and determine appropriate methods of getting such work done.

FARM POWER AND MACHINERY (A TEACHING OUTLINE)

Competencies and Skills Desirable for the Vocational Agriculture Student in Farm Power and Machinery

A. One cylinder engines.
   1. To clean engine and prepare it for maintenance and adjustments.
   2. To identify parts and their functions.
   3. To check for compression.
   4. To clean and adjust the carburetor.
   5. To replace and adjust the points.
   6. To check and/or replace the condenser.
   7. To clean, adjust, and install the spark plug.

8. To test and/or replace the coil.
9. To install the head.
10. To determine the proper idling and running speed.
11. To prepare the engine for proper storage.
*12. To grind and reseat valves.
*13. To adjust valves.
*14. To check and install the crankshaft.
*15. To replace and torque the connecting rod.
*16. To check and replace the rings and piston.

*Optional - used primarily in joint vocational schools.

B. Tractors.
1. Economics of tractor ownership.
    a) Ownership vs. rented.
    b) Size suited to needs.
    c) Type of fuel.
    d) Type of tractor.
2. To clean a tractor and prepare it for maintenance and adjustment.
3. To use safe operating practices.
4. To identify the systems on a tractor and describe the function of each. To have a knowledge of the major parts within each system and their functions.
5. To identify the type of fuel storage to use.
6. To check, adjust, repair, and replace the component parts of each of the following systems:
    a) Cooling.
    b) Ignition.
    c) Fuel and air.
7. To select the proper lubricants for the tractor. To change oil in the crankcase, to lubricate gear boxes and other parts.
8. To analyze tractor engine troubles.
    a) When starting.
    b) When idling.
    c) When under load.
    d) Faulty operation.
       Low oil pressure, missing, sludge formation, lack of power, pinging.
9. To maintain pneumatic tires.
10. To perform a major overhaul of the tractor.
11. To torque the engine head.
12. To replace and adjust the clutch.
13. To bleed the hydraulic system.
14. To use a dynamometer.
15. To use a fuel flow meter.
16. To replace* and/or adjust brake bands.

*Optional - used primarily in joint vocational schools.

C. Combines.
  1. Economics of combine ownership.
    a) Ownership vs. custom or rental arrangement.
    b) Size of combine suited to needs.
    c) Machine operating efficiency.
  2. Value of doing a good job of combining.
    a) Field losses.
    b) Crop quality.
    c) Market value.
    d) Storage requirements.
  3. To identify the operations performed by the combine and the system within the combine performing the operation. To identify the major parts within each system and their functions.
    a) Cutting and feeding.
    b) Threshing.
    c) Separating.
    d) Cleaning.
  4. To practice safe operating procedures.
  5. To identify losses from each of the operating areas of the combine.
  6. To perform adjustments in correct sequence to reduce losses.
    a) Machine speed.
    b) Cylinder clearance, cylinder speed.
    c) Cutter bar heighth.
    d) Reel.
    e) Speed forward travel.
    f) Cleaning sieves and fan blast.
  7. To adjust belt tensions, chains, and slip clutches.
  8. To select and apply lubrication.
  9. To prepare for storage.
  *10. To replace defective parts on a combine when needed.

*Optional - used primarily in joint vocational schools.

D. Corn picker.
  1. Economics of corn picker ownership.
    a) Ownership vs. custom or rental arrangement.
    b) Alternate harvesting methods.
    c) Size of corn picker needed - row spacing.
    d) Machine operating efficiency.
  2. Value of doing a good job of picking.
    a) Field losses.
    b) Moisture level of corn.
    c) Storage requirements.
    d) Market value.
  3. To identify the functional areas of the corn picker and to identify their parts and their functions.

      a) Gathering.
      b) Elevating and snapping.
      c) Husking.
      d) Cleaning.
   4. To practice safe operating procedures.
   5. To measure losses and to identify their source.
   6. To determine mechanical condition of the picker and to correct deficiency.
      a) Check for worn snapping and husking rolls. Replace if required.
      b) Check for worn bearings and to replace if required (snapping rolls, etc.).
      c) Check condition of working parts, gears, chains, belts; repair or replace as required.
      d) Check linkage on levers making adjustments.
   7. To perform adjustments required to maintain minimum acceptable losses.
      a) P.T.O. speed.
      b) Snapping roll clearance and timing position in relation to ground surface.
      c) Gathering snouts.
      d) Gathering chains. Timing and position.
      e) Forward speed of travel (3 m.p.h.).
      f) To provide shielding to prevent loss of shelled corn.
      g) To adjust chains, belts, and slip clutches.
   8. To select and apply lubricants.
   9. To prepare for storage.
   *10. To replace defective parts on the picker when needed.

*Optional - used primarily in joint vocational schools.

E. Mowers.
   1. Economics of mower ownership.
      a) Size and type mower required.
      b) Machine efficiency.
   2. To identify the parts of the mower and describe their functions.
   3. To practice safe operating procedures.
   4. To repair the cutter bar unit.
   5. To adjust the cutter bar for lead.
   6. To adjust register of the knife.
   7. To repair and adjust the pitman.
   8. To repair and adjust drive gears.
   9. To adjust the tension of springs, V belts and chains.
   10. To determine correct ground speed.
   11. To properly lubricate the mower.
   12. To determine causes of poor cutting.
   13. To determine causes of knife breakage.

  14. To determine causes of bunching.
  15. To make proper adjustments in the field as needed.
  16. To select and apply lubricants.

F. Grain drills.
  1. Economics of grain drill ownership.
    a) Ownership vs. rental or custom work.
    b) Size of drill required for operation. Machine efficiency.
  2. To identify the parts of the grain drill and describe their functions. (Types of seeding mechanism.)
  3. To practice safe operating procedures.
  4. To calibrate the rate of seeding.
  5. To calibrate the rate of fertilizer applications.
  6. To adjust the disc scrapers.
  7. To adjust the pressure springs and furrow openers.
  8. To replace worn parts.
  9. To determine need of and to make adjustments in the field.
  10. To determine efficient ground operating speeds in the field.
  11. To prepare for proper storage.

G. Corn planter.
  1. Economics of corn planter ownership.
    a) Ownership vs. renting or custom work.
    b) Size of machine needed. (Machine efficiency.)
  2. To practice safe operating procedures.
  3. To identify the parts of the corn planter and describe their function.
  4. To determine when and how to replace shoes.
  5. To repair and adjust the clutch.
  6. To determine and adjust rates of planting.
  7. To determine and adjust rates of fertilizing.
  8. To determine proper planting speed.
  9. To determine cause of shoe plugging.
  10. To determine and correct cause of kernel cracking.
  11. To determine proper planting depth.
  12. To prepare for proper storage.

H. Balers.
  1. Economics of baler ownership.
    a) Ownership vs. custom or rental.
    b) Alternate harvesting methods.
    c) Size and type of machine.
  2. To identify the parts of the baler and describe their function.
  3. To practice safe operating procedures.
  4. To time the baler.
  5. To adjust baler and ground speed.
  6. To adjust twine and wire tensions.
  7. To adjust the parts of the tying mechanism.
  8. To sharpen and replace shearing knives.

   9. To determine and correct causes of improperly shaped bales.
   10. To determine and correct causes of failure to tie properly.
   11. To prepare for proper storage.
   12. To replace worn and broken parts.

I. Forage harvester.
   1. Economics of forage harvester ownership.
      a) Ownership vs. custom or rental.
      b) Alternate harvesting methods.
      c) Size and type of machine.
   2. To identify the parts of the forage harvester and describe their function.
   3. To practice safe operating procedures.
   4. To determine correct ground operating speed.
   5. To determine and adjust correct speeds of the various parts of the machine.
   6. To sharpen, balance, and replace knives.
   7. To adjust the length of cut.
   8. To adjust the feed roll tension.
   9. To determine and correct ground speed to prevent clogging of the machine.
   10. To determine and correct causes of excessive vibrations.
   11. To replace worn or broken parts.
   12. To prepare for proper storage.

J. Plows.
   1. Economics of plow ownership.
      a) Ownership vs. rental or custom work.
      b) Alternate tillage operations.
      c) Size of plow required for operation.
   2. To practice safe operating procedures.
   3. To recognize quality plowing.
      a) Furrow conformation and uniformity.
      b) Quality of tilled surface.
      c) Trash coverage.
   4. To determine the hitch attachment for drawn plows that will insure most efficient operation.
   5. To perform adjustments in correct sequence to insure most efficient operation.
      a) Depth.
      b) Pitch.
      c) Level.
      d) Width.
   6. To adjust coulters and jointers.
   7. To replace or adjust the clutch or hydraulic life devices.
   8. To check and replace sprung beams, frogs, and moldboards.
   9. To determine proper operating speed.

10. To determine proper weight shift on mounted plows.
11. To determine and reduce wheel slippage on drawn plows.
12. To prepare for proper storage.

K. Sprayers.
  1. Economics of sprayer ownership.
    a) Ownership vs. rental or custom work.
    b) Size and type of machine needed.
  2. To practice safe operating procedures.
  3. To select the correct nozzles for the job.
  4. To select and repair the pump.
  5. To calibrate the sprayer.
  6. To calibrate the nozzles.
  7. To determine and adjust pressure.
  8. To determine proper ground speed for the job.
  9. To prevent excessive drift.
  10. To determine and correct uneven applications.
  11. To properly clean sprayer between the use of different chemicals.
  12. To clean and prepare for proper storage.

AGRICULTURAL PRODUCTION

AGRICULTURAL MECHANICS

FARM BUILDINGS AND CONVENIENCES (A TEACHING UNIT)

Approximate Teaching Time

It is recommended that the farm buildings and conveniences unit be taught during the third year of the agricultural production course.

Approximately 38 classroom and laboratory teaching hours would be required.

Vocational Objectives

Primary vocational objectives.

1. Farming - livestock and crop production.

Secondary vocational objectives.

1. Agricultural business occupations concerned with the sales and/or construction of farm buildings and conveniences.
    a) Carpenter - contractor - mason.
    b) Lumber yard - salesman.
    c) Draftsman.
2. Further training in a special trade such as apprenticeship, technical school, or college.

Major Competencies

1. To recognize good construction methods and work with standard building materials.
2. To recognize and be prepared to correct common occupational hazards to life and property; fire, accident, wind, lightning.
3. To lay out a farmstead and plan an integrated farm improvement program, evaluate existing buildings, analyze the needs for new or remodeled construction.
4. To plan buildings for utilities and production equipment systems to meet the operating needs of the farmer: elevators, conveyors, water distribution and disposal systems, light and power, feed handling, and processing devices.
5. To recognize and meet requirements for environmental and sanitation control: temperature, ventilation, light, and moisture.

6. To select suitable building materials for specific uses; durability, functional performance, strength, ease of application, availability, economy and appearance. Recognize standard commercial units, grade, estimate quantities and determine construction costs.

FARM BUILDINGS AND CONVENIENCES (A TEACHING OUTLINE)

Competencies and Skills Desirable for the Vocational Agriculture Student in Farm Buildings and Conveniences

A. Farm buildings.
   1. To identify the parts of a building.
   2. To lay out a farmstead (including feed lots).
   3. To evaluate existing buildings.
   4. To level and plumb a building site.
   5. To estimate construction cost.
   6. To identify and select building materials.
   7. To recognize good construction methods.
   8. To recognize grades and kinds of lumber.
   9. To identify and select types of fasteners.
   10. To lay out and cut rafters.
   11. To develop and carry out a building maintenance program.
   12. To identify and select insulation.
   13. To determine environmental requirements for livestock. Temperature, light, moisture, air, sanitation, water, feed, space.
   14. To determine requirements for materials handling and storage.

B. Fencing.
   1. To identify and select fence materials.
   2. To identify, select, and treat fence posts.
   3. To set post and stretch fence.
   4. To install electric fence.
   5. To construct a livestock guard.

C. Concrete.
   1. To accurately estimate quantities of materials needed.
   2. To accurately estimate the cost of materials needed for a job.
   3. To properly select materials.
   4. To determine and measure the proper proportions of materials.
   5. To prepare and construct farms.
   6. To properly mix concrete.
   7. To place and work concrete.
   8. To reinforce concrete.
   9. To finish concrete.
   10. To protect and properly cure concrete.
   11. To properly remove forms.
   12. To lay concrete blocks.

AGRICULTURAL PRODUCTION

AGRICULTURAL MECHANICS

SOIL AND WATER MANAGEMENT (A TEACHING UNIT)

Approximate Teaching Time

It is recommended that the soil and water management unit be taught during the third year of the agricultural production course.

Approximately 30 classroom and laboratory teaching hours would be required.

Vocational Objectives

Primary vocational objectives.

1. Farming - livestock and crop production.

Secondary vocational objectives.

1. Agricultural business occupations concerned with sales and services related to soil and water management.
    a. Supply centers.
    b. Soil conservation service.
    c. Aide to a surveyor.
2. Further training in a special program at the technical level or college.

Major Competencies

1. To relate equipment and tillage practices to soil erosion control.
2. To plan and lay out typical irrigation systems considering the advantages and limitations of the various types of irrigation systems.
3. To maintain irrigation and drainage systems.
4. To make land surveys, read soil survey and aerial maps, run levels, and contours by using the farm level, locating and placing grade stakes, and making contour maps.
5. To plan terracing and simple farm drainage systems, estimate costs of construction, and maintenance.
6. To plan and lay out farm reservoirs.

SOIL AND WATER MANAGEMENT (A TEACHING OUTLINE)

Competencies and Skills Desirable for the Vocational Agriculture Student Studying Soil and Water Management

A. Surveying.
   1. To learn the nomenclature of equipment and its functions.
   2. To read a soil survey map.
   3. To learn proper procedures for recording data in a field book.
   4. To draw a contour map.
   5. To read an aerial map.
   6. To draw a tile drainage map.

B. Drainage.
   1. To dig a ditch to grade.
   2. To plan and install a tile drainage system.
      a) Selection of tile (quality, quantity, type, cost, number).
      b) To lay and cover tile.
   3. To construct a sod waterway.
   4. To construct a terrace.
   5. To construct a diversion ditch.
   6. To provide surface drainage.
   7. To calculate the expected flow into a pond from the watershed area.

AGRICULTURAL PRODUCTION

AGRICULTURAL MECHANICS

RURAL ELECTRIFICATION AND PROCESSING (A TEACHING UNIT)

Approximate Teaching Time

It is recommended that the wiring portion of this unit be taught during the second year. The electric motors and materials handling units might be taught during the third year.

Approximately 45 classroom and laboratory teaching hours would be required.

Vocational Objectives

Primary vocational objectives.

1. Farming.

Secondary vocational objectives.

1. Agricultural business occupations concerned with the sales and service of electrical and processing equipment.
    a) Power company representative.
    b) Service center repairman.
    c) Service center salesman.
    d) Rural electrician.
2. Further training as a specialized technical program or college entry.

Major Competencies

1. To perform maintenance jobs and simple wiring installations.
2. To recognize difficulties which require the attention of trained personnel.
3. To select lighting equipment and locate it in the yards, lots, buildings, and work areas to provide adequate illumination.
4. To select electrical home appliances and farm equipment, including motors and controls. Consider safety, quality, energy consumption, life, and servicing.
5. To plan wiring systems and rewiring for adequacy, convenience, and safety, including determination of probable future electrical loads.

6. To adapt electricity to the farm enterprises, coordinating the equipment with the size and arrangement of the farm buildings.
7. To repair, service, and maintain electrical equipment. Locate and correct troubles and hazards in connection with: fuses, controls, switches, fixtures, cords and wiring, motors, heating appliances, and lamps.
8. To install electric equipment considering power transmission, equipment ventilation, servicing, safety, etc.

RURAL ELECTRIFICATION AND PROCESSING (A TEACHING OUTLINE)

Competencies and Skills Desirable for the Vocational Agriculture Student Studying Rural Electrification and Processing

A. Wiring.
   1. To define electrical terms.
   2. To determine present electrical loads.
   3. To plan for future electrical loads.
      a) Lighting.
      b) Electrical power.
      c) Electrical tools.
   4. To recognize and determine type and size of wire to use.
   5. To determine the size of service entrance required and to install a service entrance box.
   6. To perform simple wiring skills.
      a) Splicing, pigtail, western union, tap, and solderless connector.
      b) To install lighting fixtures and other electrical equipment.
   7. To install a simple electrical circuit.
      a) Determine number and kind of outlet.
      b) Polarize the circuit.
      c) Wire single pole, 3-way, and 4-way switches.
      d) To ground the circuit.
      e) To determine the proper type and size of protection device (fuse, circuit breaker, etc.) for the circuit.
   8. To install electrical equipment.
      a) Grounding.
      b) Protective devices.
   9. To read a meter and determine cost of electricity.
   10. To read and draw circuit diagrams.

B. Electric motors.
   1. To select motors and controls.
   2. To select drive devices for motors.

3. To clean, service, and lubricate motors.
4. To reverse the direction of rotation.
5. To change wiring for different voltages.
6. To adjust belt tension.
7. To determine motor maintenance programs.
8. To determine the cost of operation.
9. Determine the size of pulleys, sprockets, and gears to use.

C. Materials handling equipment.
    1. Economics of materials handling equipment.
        a) Cost of equipment.
        b) Cost of performing work by hand vs. using labor-saving equipment.
        c) Alternate methods of handling materials.
        d) Expanding volume of business through using materials handling equipment.
        e) Age and health of farm operator.
        f) Matching materials equipment to specific farm situations.
    2. To identify the various pieces of materials handling equipment and to describe their functions.
    3. To practice safe operating procedures for the various pieces of equipment.
    4. To determine use capabilities and select proper size of equipment for the job.
    5. To service and maintain various pieces of equipment.
    6. To repair or replace equipment.

AGRICULTURAL PRODUCTION

AGRICULTURAL MECHANICS

AGRICULTURAL CONSTRUCTION AND MAINTENANCE (A TEACHING UNIT)

Approximate Teaching Time

A major portion of the agricultural construction and maintenance unit would be taught during the first and second year of the agricultural production course.

Approximately 192 classroom and laboratory teaching hours would be required.

Vocational Objectives

Primary vocational objectives.

1. Farming.

Secondary vocational objectives.

1. Agricultural business occupations concerned with construction, repair, and/or sales of farm equipment and facilities.
2. Further training as an apprentice or entering a technical school.

Major Competencies

1. To promote the establishment of a home farm shop or farm service center.
2. To recognize dangers and hazards connected with the use of tools and equipment and guard against them.
3. To select hand and power tools and shop equipment for the home farm shop, including makes, models, sizes, quantities, and grades.
4. To sharpen, repair, maintain, and safely use the common shop tools and equipment.
5. To install, safely use, service, and maintain power tools found in the agricultural mechanics shop.
6. To do electric arc and oxyacetylene welding, including cutting bronze welding and hard surfacing.
7. To do hot metal work including bending, shaping, and heat treating.
8. To do cold metal work including cutting, drilling, filing, tapping, threading, riveting, and bending.
9. To do sheet metal work including cutting, bending, and fastening.

10. To do pipe and tubing work and make simple plumbing repairs.
11. To select lumber, hardware, and other building materials and calculate bills of material.
12. To supervise and assist with construction and maintenance of smaller farm buildings and equipment.
13. To do painting and glazing. Apply wood preservatives.

AGRICULTURAL CONSTRUCTION AND MAINTENANCE (A TEACHING OUTLINE)

Competencies and Skills Desirable for the Vocational Agriculture Student Studying Agricultural Construction and Maintenance

A. Woodworking.
  1. To read a plan, blueprint or ozalid.
  2. To make a sketch.
  3. To make an accurate bill of materials, including cost calculations.
  4. To recognize and select grades and kinds of lumber.
  5. To practice safe working procedures.
  6. To lay out stock.
  7. To identify, select, and use common hand and power tools.
  8. To learn and practice safety procedures in using hand and power tools.
  9. To identify and select fasteners.
  10. To select and use glue.
  11. To select and use coated abrasives.
  12. To construct woodworking projects.

B. Finishing.
  1. To select a paint by its type.
  2. To select paint for wood, metal, and concrete.
  3. To select wood preservatives.
  4. To calculate quantity of materials needed for a job.
  5. To identify paint problems.
  6. To prepare a surface for finishing.
  7. To identify, select, and use brushes.
  8. To operate a spray gun.
  9. To clean and store a spray gun.
  10. To clean and store brushes.

C. Tool fitting and care.
  1. To select oil stones and grinding wheels.
  2. To make a template to check for correct angle.
  3. To dress and true a grinding wheel.
  4. To sharpen single edged tools.
  5. To sharpen double edged tools.
  6. To sharpen auger bits and twist drills.
  7. To clean, joint, set and sharpen (hand, circular, chain) saws.
  8. To fit handle in tools.
  9. To prevent tools from rusting.

D. Soldering.
  1. To select and use an electric soldering iron.
  2. To operate a blow torch.
  3. To select and operate an electric soldering gun.
  4. To operate an L-P torch.
  5. To solder with a welder.
  6. To mend small holes.
  7. To make a lock seam joint.
  8. To make a riveted joint.
    a) Include pop-rivets.
  9. To sweat a patch.
  10. To solder a lap seam.
  11. To solder galvanized metal.
  12. To solder copper.
  13. To solder stainless steel.

E. Welding.
  1. Electric arc.
    a) To identify types of welders and describe their characteristics.
    b) To practice safe operating procedures.
    c) To identify and select electrodes.
    d) To identify metals (including spark test).
    e) To cut and pierce metal.
    f) To use the carbon arc torch.
    g) To identify correct heat control.
    h) To minimize metal distortion.
    i) To make lap, corner, fillet, edge, and butt welds.
    j) To weld horizontally.
    k) To weld vertically.
    l) To weld overhead.
    m) To weld cast iron.
    n) To weld steel castings.
    o) To weld round stock.
    p) To hard-surface.
    q) To braze (arc torch).
    r) To make a pad weld (build up worn arc).
  2. Oxy-acetylene welding.
    a) To identify the parts of the welder and their functions.
    b) To practice safe operating procedures.
    c) To assemble a welder and test for leaks.
    d) To select proper tips.
    e) To heat and cut metal.
    f) To make a flange weld.
    g) To braze mild steel.
    h) To braze cast iron.
    i) To bend, wrinkle, and weld pipe.
    j) To silver solder.
    k) To apply hardsurfacing.

F. Metal work.
  1. To practice safe working procedures.
  2. To identify, select, and use files, chisels, punches, drills, hacksaws, taps, dies, and tin snips.
  3. To operate a power grinder, power hacksaw, power drills, and lathes.
  4. To make out a bill of materials.
  5. To read plans and plan a procedure in doing the work.
  6. To read a caliper.
  7. To lay out metal with a scribe.
  8. To make an elongated slot.
  9. To cut threads.
  10. To operate a gas furnace.
  11. To anneal metal.
  12. To temper metal.
  13. To upset metal.
  14. To normalize metal.
  15. To draw metal.
  16. To cut hot metal.
  17. To remove broken studs.
  18. To use screw extractors.

G. Plumbing.
  1. To identify pipe fittings.
  2. To identify kinds and sizes of pipe and tubing.
  3. To measure and cut pipe to a given dimension.
  4. To ream and thread pipe.
  5. To determine correct size and type of pipe to use.
  6. To repair a faucet.
  7. To insulate a pipeline.
  8. To install plastic pipe.
  9. To install galvanized pipe.
  10. To cut, flare, and solder copper pipe.
  11. To use pipe thread compound.
  12. To install soil pipe.
  13. To determine type of pump to install.
  14. To determine and correct an air logged tank.
  15. To determine and correct a water logged tank.
  16. To determine reasons for and correct low pressure.

H. Glazing.
  1. To prepare sash for glass.
  2. To measure sash for glass.
  3. To cut glass.
  4. To fasten glass with glazier points.
  5. To use glazing compound.

AGRICULTURAL PRODUCTION

FARM BUSINESS MANAGEMENT

Teaching Units in Farm Business Management Area of Instruction

- Introduction to Farm Business Management
- Farm Business Goals
- Inventorying the Resources
- Soils as Related to Farm Business Management
- Farm Business Records
- Marketing in the Farm Business
- Summarizing Farm Business Records
- Analyzing the Farm Business
- Mechanization of a Farm Business
- Net Worth
- Financing the Credit Needs of a Farm Business
- Farm Business Planning
- Insurance
- Taxes
- Government Programs
- Selecting Farm Land Resources

Approximate Teaching Time

This course outline is designed to be used as the basis for teaching farm business management to junior or senior students in a comprehensive high school or as a course for senior students in a joint vocational school. This course is designed to make use of a "case" farm situation whereby students could make application of the principles taught to their home farm situations.

Approximately 284 classroom hours would be required for teaching the farm business management course. The student's occupational experience program would require about 240 hours. The on-the-farm instruction by the teacher would require three to five hours per student.

Vocational Objectives

Primary vocational objectives.

1. This course of instruction provides students with the competencies needed by the beginning manager of a farm business firm.

Secondary vocational objectives.

1. This course of instruction also provides students with many of the basic competencies which will better prepare them for advanced education in vocational or technical schools and the college of agriculture. Advanced education could prepare students for such positions as:
    a. Farm management analysis service personnel.
    b. Farm management service fieldmen.
    c. Farm management specialists in agricultural extension, area vocational schools, farm supply companies, and farm service companies.
    d. Teachers of vocational agriculture.
    e. County agricultural agents.
    f. Credit organization personnel.

Major Competencies

1. To identify the opportunities for using management skills on the farm and in related ag-businesses.
2. To develop and use a systematic accounting plan (case farm situation).
3. To evaluate the facts from a set of farm accounts and translate them into meaningful measures of performance.
4. To reorganize a farm business to increase the net profit.
5. To choose adequate and meaningful goals for a farm business.
6. To organize a financial plan for maximizing profits.
7. To solve related farm management problems in credit, marketing, insurance, taxes, and government programs.

AGRICULTURAL PRODUCTION

FARM BUSINESS MANAGEMENT

INTRODUCTION TO FARM BUSINESS MANAGEMENT (A TEACHING UNIT)

Approximate Classroom Teaching Time 7 Hours

Major Competencies

1. To describe what farm business planning as a total concept means.
2. To list related businesses in which farm management skills would be of value.
3. To describe employment opportunities for which farm management training would be basic.
4. To use the case farm information and situation as a tool for learning practical planning and management skills.

INTRODUCTION TO FARM BUSINESS MANAGEMENT (A TEACHING OUTLINE)

I. What is a farm business and how is it managed?

  A. List businesses in the community.
  B. Characteristics of any business.
  C. Compare a farm to other businesses.
  D. Steps in managing a business for highest profits.
    1. Analyze the present situation.
      a) Inventory resources.
      b) Keep business records.
      c) Summarize those records.
      d) Find strengths and weaknesses.
    2. Locate the problems.
    3. Identify business goals.
    4. Evaluate alternatives and their probable outcome.
    5. Decide the course of action.
    6. Put the plan into action.

II. What businesses other than farming might training in farm management be useful?

  A. List businesses.
  B. Identify how farm management skills would be helpful.
  C. Prepare specific job requirement reports.

III. Present the case farm situation and explain its implication in learning about farm management. How important are farm records in planning and operating a farm business?

A. Motivation - develop a realistic approach to problem solving.
B. Present an outline of the whole area of instruction showing how the case farm is to be followed.
C. Develop student understanding of the whole picture of planning and managing a farm business. (Possibly even use student suggestions for expanding the units.)

AGRICULTURAL PRODUCTION

FARM BUSINESS MANAGEMENT

FARM BUSINESS GOALS (A TEACHING UNIT)

Approximate Classroom Teaching Time 7 Hours

Major Competencies

1. To identify the importance of setting realistic goals.
2. To identify the various types of goals in a farm business.
3. To develop adequate and meaningful goals for a farm firm.

FARM BUSINESS GOALS (A TEACHING OUTLINE)

I. Why set goals for a farm business?

- A. Define goals.
- B. Explain what goals do for a business manager.

II. What goals should a farm business have?

- A. Farm and family characteristics.
    1. Size of family.
    2. Age of operator.
    3. Size and type of farm business.
    4. Farming situation - manager, partnership, part-time, ownership.
    5. Family desires and values.
    6. Social values.
    7. Financial structure of the farm business.
- B. Sample goals - prepared list.
    1. Types of goals.
        - a) Immediate.
        - b) Intermediate.
        - c) Long-range.
    2. Identify by areas.
        - a) Economic goals.
        - b) Family living.
        - c) Citizenship.
        - d) Livestock and crops.
- C. Prepare a challenging set of goals for the case farm.

AGRICULTURAL PRODUCTION

FARM BUSINESS MANAGEMENT

INVENTORYING THE RESOURCES (A TEACHING UNIT)

Approximate Teaching Time 15 Hours

Major Competencies

1. Develop the ability to measure storage facilities on a farm.
2. Develop the ability to place reasonable values on livestock, buildings, and equipment.
3. Develop the ability to make a map of a farm showing field arrangement and the major soil types.
4. Develop the ability to calculate the capacity of storage facilities.

INVENTORYING THE RESOURCES (A TEACHING OUTLINE)

This unit would be taught almost entirely through the use of field trips to a "case" farm whereby the students would get actual practice in taking inventory.

I. What are the available resources on the "case" farm? This would be determined by student participation in the following activities:

   A. Measuring fields and making a map of the farm showing field arrangement.
   B. Taking soil samples to be used in determining the soil potential on this farm.
   C. Measuring buildings, bins, cribs, silos, mows, etc.
   D. Placing a value on all power and equipment items.
   E. Placing a value on all livestock.
   F. Calculating the amount of grain, hay, silage, etc., stored on the farm.

AGRICULTURAL PRODUCTION

FARM BUSINESS MANAGEMENT

SOILS AS RELATED TO FARM BUSINESS MANAGEMENT (A TEACHING UNIT)

Approximate Classroom Teaching Time 20 Hours

Major Competencies

1. Understanding of why soils differ.
2. Ability to identify different soil types.
3. Understanding of the numbering system given to Ohio soils.
4. Ability to read a soil map.
5. Ability to classify soils according to their capability.
6. Ability to recognize the potential of a certain soil.
7. Ability to plan a cropping system according to soil classification and potential.

SOILS AS RELATED TO FARM BUSINESS MANAGEMENT (A TEACHING OUTLINE)

I. What factors should be considered relative to soils, in determining the best cropping system on a farm?

- A. Topography - slope.
  - 1. Crops best adapted to sloping land.
  - 2. Crops best adapted to level land.
  - 3. Slope classifications.
- B. Erosion.
  - 1. Crops that cause erosion problems.
  - 2. Crops that prevent erosion.
  - 3. Erosion classifications.
- C. Texture.
  - 1. Kinds of texture and how determined.
    a) Sand, b) Silt, c) Clay.
  - 2. Different textures in relation to crop growing capacity.
    - a) Water retention, b) absorbtion, c) ease of tillage, d) plant nutrient availability.
- D. Soil depth.
  - 1. Crops requiring deep soils.
  - 2. Barriers to soil depth.
    - a) Distance to rock (parent material).
    - b) Distance to hard pan (impervious clay)

3. Crops that will grow on shallow soils.

E. Air and water movement in the soil.
   1. Drainage profiles.
      a) excessive, b) good, c) poor.
   2. Depth to mottling - description of mottling.
   3. Crops adapted to different drainage profiles.
      a) time of planting, b) water requirements.

II. How can the soil on a farm be classified as to the crop production potential?

A. Soil map information.
   1. Soil family and type numbering system.
      Catena numbers
      a) Origin - glacial - residual - laenstrine - parent material (underlying rock).
   2. Soil position.
      a) allevial, b) terraced, c) upland.
   3. Drainage profile numbering system.
   4. Texture numbering system.
   5. Slope lettering system used to indicate amount of slope.
   6. Erosion numbering system used to indicate degree of erosion.

B. Land classes for soils suitable for crop production.
   1. Roman numeral system.
   2. Color code.
   3. Possible cropping systems to be used for each land class.

C. Land classes for soils suitable for production of permanent vegetation such as permanent pasture, woodland, or recreation.
   1. Roman numeral system.
   2. Color code.
   3. Type of vegetation to use to apply for each class.
      a) woodland, b) permanent pasture.

AGRICULTURAL PRODUCTION

FARM BUSINESS MANAGEMENT

FARM BUSINESS RECORDS (A TEACHING UNIT)

Approximate Classroom Teaching Time 30 Hours

Major Competencies

1. To identify the need and uses of accurate records in a farm business.
2. To list the kinds of records for a farm business.
3. To select a workable accounting system for a farm firm.
4. To identify the importance and procedure for taking an inventory.
5. To record and complete a year of accounts for a farm business (inventory, cash receipts, expenses, production, enterprise, etc.).

FARM BUSINESS RECORDS (A TEACHING OUTLINE)

I. Why keep farm records?

A. Income tax reporting.
B. Basis for making decisions.
    1. Strengths and weaknesses.
    2. Planning.
C. Margin of farm profit is continually narrowing.
    1. Statistics - by years, size of farms, income, capital needs.
    2. Technical advances.
D. Factors that influence success of a business.
E. Show that records are necessary to get facts that apply to that business.

II. What records of a farm business should be kept?

A. Inventory.
    1. Feed and supplies.
    2. Raised livestock.
    3. Purchased livestock.
    4. Market livestock.
    5. Machinery.
    6. Buildings.
    7. Land.

B. Receipts and expenses.
C. Net worth.
D. Supplemental records.
  1. Crops - land use, map, yield, fertility, disposition.
  2. Livestock - feed, production, cost.
  3. Labor - by enterprise, months.
  4. Gas refunds, etc.

III. What should be considered when choosing an accounting system for a farm business?

A. Kinds of account books available.
  1. Bank.
  2. Machinery dealers.
  3. Ohio account book.
  4. Ohio commercial book.
  5. Others.
B. Advantages and disadvantages of each type of book.
C. Items to consider in selecting a complete accounting system.
  1. Complete enough to give important facts.
  2. Simple enough that the system will be used.
  3. Can be expanded to include more complete accounting.
  4. Acceptable source for tax information.
  5. Choosing cash method or accrual method of accounting (explain difference).

IV. Recording a year's account records for a farm business (case farm).

A. Use Ohio Commercial Account Book.
B. Inventory.
  1. Choose areas - livestock, machinery, etc.
  2. Establish values.
  3. Develop depreciation schedule.
C. Cash receipts.
  1. Operating receipts.
  2. Sale of capital gain items.
  3. Non-operating receipts (loans, etc.).
  4. Non-farm receipts.
D. Cash expenses.
  1. Operating expenses.
  2. Purchases eligible for capital gains.
  3. Personal expenses.
  4. Non-operating expenses (principle repayment).

E. Net worth.
   1. Beginning and closing inventories.
   2. Change in inventory (net worth).
   3. Combining personal and business net worth.
F. Supplemental records.
   1. Feed records.
   2. Cost records.
   3. Enterprise records.
   4. Production records.

AGRICULTURAL PRODUCTION

FARM BUSINESS MANAGEMENT

MARKETING IN THE FARM BUSINESS (A TEACHING UNIT)

Approximate Teaching Time 24 Hours

Major Competencies

1. To explain our agricultural marketing system.
2. To evaluate marketing services and choose the service giving the greatest net profit.
3. To explain the concept of price determination (supply, demand, and quality).
4. To use the marketing concepts in making marketing decisions for a farm business.
5. To evaluate market outlook information.
6. To recognize factors influencing the price of agricultural products.

MARKETING IN THE FARM BUSINESS (A TEACHING OUTLINE)

I. What markets are available in our area for selling agricultural products?

- A. Marketing agencies and how each operates.
    1. Local buyers.
    2. Cooperatives.
    3. Auctions.
    4. Central or terminal markets.
    5. Direct or contract.

II. What services do these marketing agencies provide for us?

- A. Livestock marketing (as an example).
    1. Market.
        - a) Transportation (farm to market).
        - b) Assembling.
        - c) Sorting (grading.
        - d) Weighing.
        - e) Selling.
        - f) Holding.
        - g) Risk bearing (financing).
    2. Packer.
        - a) Transportation (market to packer).
        - b) Slaughtering.

- c) Processing (cut, cure, wrap).
- d) Sorting (grading).
- e) Storing.
- f) Selling.
- g) Transportation (packer to retailer).
- h) Risk bearing (financing).

3. Retailer.
    - a) Processing.
    - b) Storing.
    - c) Displaying.
    - d) Selling.

III. What determines the price we receive for our agricultural products?

- A. Demand.
    1. Elastic and inelastic demand.
    2. Population trends.
    3. Consumer tastes.
    4. Religious beliefs.
    5. Consumer income.
    6. Availability of substitutes.
    7. Foreign trade.
- B. Supply.
    1. Elasticity of supply.
    2. Weather conditions.
    3. Insect and disease hazards.
    4. Government programs.
        - a) Acreage allotments on various crops.
    5. Production cycles.
        - a) Products usually affected by production cycles.
        - b) Why certain products are affected by cycles.
- C. Quality (use grain as an example).
    1. Moisture content.
    2. Test weight per bushel.
    3. Shrunken or broken kernels.
    4. Amount of foreign material.
    5. Disease or insect damage.

IV. What can we do to market products to receive the maximum net return?

- A. Quality control.
    1. Selection of breeds, types, and varieties.
    2. Breeding, feeding, cultural practices, harvesting, and storing.
- B. Study production and price cycles and adjust farming operations to take advantage of high price periods.
    1. Beef.
    2. Hogs.
    3. Sheep.

C. Evaluate market outlook information.
    1. Acreage to be planted.
    2. Sows to be farrowed.
    3. Cattle on feed.

D. Determine the best combination of enterprises, in relation to marketing, in order to realize the greatest net return. (Use case farm as an example.)
    1. Marketing grain through livestock vs. direct sale.
    2. Produce the maximum acreage of high value crops and the best combinations of crop enterprises.

E. Study the process of "hedging" as a means of protection against a drop in price.
    1. Grain.
    2. Feeder cattle.

AGRICULTURAL PRODUCTION

FARM BUSINESS MANAGEMENT

SUMMARIZING FARM BUSINESS RECORDS (A TEACHING UNIT)

Approximate Classroom Teaching Time 7 Hours

Major Competencies

1. To list the uses for a farm business summary.
2. To identify what should be included in a farm business summary.
3. To summarize the farm business accounts for manual or computer analysis.

SUMMARIZING FARM BUSINESS RECORDS (A TEACHING OUTLINE)

I. Why summarize farm business records?

- A. Income tax information.
- B. Provide information for making a check of strengths and weaknesses.

II. What should be included in a summary of the farm records?

- A. Special forms for recording summary information.
  - 1. Form 7363 - Farm Business Summary, extension service, OSU.
  - 2. Summary pages of the farm account book.
  - 3. Enterprise information sheets.
- B. Summary of income.
  - 1. Cash farm income.
    - a) Capital gains.
    - b) Operating income.
  - 2. Non-cash income.
- C. Summary of expenses.
  - 1. Operating expenses.
  - 2. Non-operating expenses.
    - a) Principle payments.
    - b) Capital purchases.
    - c) Personal expenditures from the firm.
- D. Inventory change - net worth evaluation.
- E. Enterprise evaluation.
  - 1. Size.
  - 2. Production
  - 3. Costs - money, labor, other resources.

III. How is a summary of a farm business made?

- A. Explanation of case farm summary.
- B. Use appropriate forms to record information for analysis.

IV. What items should be checked for accuracy of a summary of a farm business?

- A. Cash accounts reasonable.
- B. Inventories for reasonable weights and values.
- C. Crop and feed report for completeness.
- D. Check, if a tenant, for sharing expenses and returns.
- E. Clerical procedures.

AGRICULTURAL PRODUCTION

FARM BUSINESS MANAGEMENT

ANALYZING THE FARM BUSINESS (A TEACHING UNIT)

Approximate Classroom Teaching Time 14 Hours

Major Competencies

1. To list the uses of a farm business analysis.
2. To describe the up-to-date analysis services and aids available to the modern farm business man.
3. To describe a basic plan for computing efficiency factors for a farm business.
4. To compare levels of performance to an accepted standard.
5. To evaluate the strengths and weaknesses of a farm business.

ANALYZING THE FARM BUSINESS (A TEACHING OUTLINE)

I. Why analyze a farm business?

- A. Determine strengths and weaknesses.
- B. Facts for making decisions.
- C. Organize the business for maximum profit.
    1. Selecting enterprises based on facts.
    2. Determining the size of each enterprise.
    3. Insurance needs.
    4. Credit planning.
    5. Pay correct taxes.
    6. Evaluate kinds and amounts of resources.

II. What services are available to assist in analysis of a farm business?

- A. Vocational agriculture departments.
    1. Adult classes.
    2. Farm business analysis and planning classes.
- B. Area Extension service.
    1. County agricultural agent.
    2. University computer service.
    3. Area agricultural agent.

C. Commercial services.
  1. Buckeye Farm Records service.
  2. Farm management services - Doans, Opekasit, etc.
D. Individuals.

III. How are records analyzed?

A. Start with an accurate summary of parts of the business to be analyzed.
B. Techniques (procedures).
  1. Hand method - step-by-step procedure.
  2. Adapting to a computer.
  3. Combining the two.
C. Use case farm summary for complete analysis.

IV. How is a farm business measured? What does a complete business analysis show?

A. Importance of profit.
  1. Acceptable standard of living.
  2. Encouraging growth of the business.
  3. Records must be accurate to show true profit.
B. Kinds of profits.
  1. Cash farm profit.
  2. Net farm profit.
  3. Labor and management.
  4. Management profits.
  5. Profit to capital.
C. Size of the business.
  1. Crop acres.
  2. Capital invested.
  3. Gross income.
  4. Man hours (PMWU).
D. Relationship between investment and income.
  1. Rate of return to capital.
  2. Gross ratio - the per cent of gross income going to all expenses.
  3. Operating ratio - per cent of gross going to operating expenses.
  4. Overhead ratio - per cent going to fixed or overhead expenses.
E. Analysis of the cropping system.
  1. Crop yield.
  2. Crop yield index.
  3. Gross value of crop per acre.
  4. Special crop information.
F. Analysis of the livestock system.
  1. Over-all efficiency.
    a) Net livestock increase.
    b) Return per $ feed.

   2. Individual enterprises.
      a) Daily rate of gain.
      b) Feed per 100 lbs. gain.
      c) Returns over feed.
      d) Production per unit.

G. Analysis of labor and machinery.
   1. Crop acres per man.
   2. Gross income per man.
   3. PMWU per crop acre.
   4. Power and equipment costs per acre.
   5. Power and equipment investment per crop acre.
   6. Machinery cost per PMWU.
   7. Man-year equivalents.

H. Analysis of the net worth
   1. Inventory change.
   2. Depreciation.
   3. Total capital invested.
   4. Ratios of assets to liabilities -
      net capital, working, current.

AGRICULTURAL PRODUCTION

FARM BUSINESS MANAGEMENT

MECHANIZATION OF A FARM BUSINESS (A TEACHING UNIT)

Approximate Classroom Teaching Time 28 Hours

Major Competencies

1. To describe the concepts involved in selecting and maintaining machinery in a farm business.
2. To plan for changes in farmstead arrangement, building construction, and labor-saving equipment.

MECHANIZATION OF A FARM BUSINESS (A TEACHING OUTLINE)

I. What should be considered when organizing a machinery plan for the farm business?

- A. Selecting machinery.
  1. Inventory of machinery resources.
  2. Using a partial budget - making selection based on profitability.
  3. Buying, leasing, or custom hiring.
  4. Comparing similar equipment available.
- B. Developing a plan for having machinery operational when needed.
  1. Providing facilities for maintenance and repair.
  2. Using a check list for maintenance jobs.
  3. Organizing a record system for repairs and use.
  4. Analysis of equipment use and repair as a basis for planning mechanization.
- C. Shop work on at least one major machine.
  1. Showing importance of planned maintenance.
  2. Developing a maintenance plan.
  3. Using a maintenance plan.
  4. Developing student skills in shop work.

II. What should be considered when planning changes in the farmstead arrangement, construction of buildings, and labor-saving devices?

- A. Principles of arrangement and construction.
- B. Developing a plan.
- C. Student construction of one major structure or device.

AGRICULTURAL PRODUCTION

FARM BUSINESS MANAGEMENT

NET WORTH (A TEACHING UNIT)

Approximate Classroom Teaching Time 7 Hours

Major Competencies

1. To evaluate or compare various net worth statements.
2. To identify ways the net worth statement is used to improve the management of a farm business.
3. To make a complete net worth statement for a farm business.
4. To make a net worth statement for securing a loan and know why it might differ from the business statement.

NET WORTH (A TEACHING OUTLINE)

I. What is a net worth statement?

   A. Annual statement form - pg. 58 of Commercial Account Book.
   B. Comparison of net worth by years.
      1. Assets, pg. VV.
      2. Liabilities, pg. WW.
   C. Forms from lending institutions.

II. Uses of a net worth statement.

   A. Strengths and weaknesses of business.
   B. Show growth of the business.
   C. A basis for planning the use of borrowed credit.

III. How is the net worth used to determine a business' soundness? How can sudden demands for payment of debts be considered secure?

   A. Meaning of soundness, solvency of the farm business.
   B. Net capital ratio.
      1. Divide total assets by total liabilities.
      2. General rule - 2:1 ratio.

C. Working ratio.
    1. Divide current and working assets by deferred and current liabilities.
    2. General rule - 6:1 ratio.
D. Current ratio.
    1. Divide current assets by current liabilities.
    2. General rule - 8:1 ratio.

IV. Prepare a net worth statement for case farm business and for credit.

AGRICULTURAL PRODUCTION

FARM BUSINESS MANAGEMENT

FINANCING THE CREDIT NEEDS OF A FARM BUSINESS (A TEACHING UNIT)

Approximate Classroom Teaching Time 14 Hours

Major Competencies

1. To define capital and explain why a farm business may use capital from outside sources.
2. To identify various sources of credit and evaluate their effectiveness in maximizing farm profits.
3. To calculate the cost of credit based on the more common credit plans.
4. To use the time comparison principle to evaluate the total cost of a capital purchase over a period of time.
5. To evaluate a farm business and identify if optimum use of capital is being made.
6. To develop a financial plan for a farm business.

FINANCING THE CREDIT NEEDS OF A FARM BUSINESS (A TEACHING OUTLINE)

I. What is credit?

- A. Define capital.
- B. Kinds of capital.
  - 1. Money in bank or pocket (current).
  - 2. Livestock, machinery (working).
  - 3. Land, buildings (fixed).
  - 4. Crops, seed, feed market animals (current).
- C. Uses of credit.
- D. When to borrow.
  - 1. When capital is limited.
  - 2. When profit justifies risks.
  - 3. Ability to pay back and show profit.
- E. How to borrow - credit instruments.
  - 1. Check.
  - 2. Drafts.
  - 3. Mortgage.
  - 4. Warehouse receipts.
  - 5. Bill of lading.
  - 6. Sales contract.

II. How are credit costs computed?

- A. Explanation of interest as a cost to a business (time comparison principle).
- B. Interest calculation.
    1. Annual interest on the original amount.
    2. Interest paid in advance (discounted).
    3. Annual interest on the unpaid balance.
    4. Extra charges - carrying, insurance, office fees, etc.

III. Where can money be borrowed?

- A. Kinds of credit.
    1. Short-term.
    2. Intermediate.
    3. Long-term.
- B. Agencies lending money for farm businesses.
    1. Banks.
    2. PCA.
    3. Federal Land Banks.
    4. FHA.
    5. Insurance Co.
    6. Individuals.
    7. High risk - high interest rates.
- C. Characteristics of lending agencies.
    1. Dependability.
    2. Service designed to meet a farmer's needs.
    3. Lending policies.
    4. Cost of the service.
- D. Comparing all sources of credit.

IV. How is a total credit plan for a farm business made? (Case farm.)

- A. Determine the credit available - the amount that can be borrowed.
    1. Total net worth.
    2. The amount of net worth that can be used to borrow on.
    3. A cash flow chart showing when cash is available by months.
- B. Determine the needs for extra capital in the farm business.
    1. Where investment will give greatest return (opportunity cost principle).
    2. Applying analysis information to decision-making.
    3. Considering alternate opportunities (substitution principle).
        - a) Capital purchases.
        - b) Resource expansion (diminishing returns principle).
        - c) Repairs and maintenance.
    4. Cash flow chart showing when cash will be needed by months.

C. Choosing a total repayment plan.
   1. Cash flow chart showing the logical time of year to make payment.
   2. Consider family living and savings needs.
   3. Amount of annual profit needed for payment of principal.
   4. The length of time needed to repay.
   5. Maintaining a good credit rating.
      a) Keep all credit in one place.
      b) Use a complete plan for creditor.
      c) Plan ahead.
      d) Know consequences of failure to repay.
   6. Consider future capital purchases to be made.

AGRICULTURAL PRODUCTION

FARM BUSINESS MANAGEMENT

FARM BUSINESS PLANNING (A TEACHING UNIT)

Approximate Classroom Teaching Time 42 Hours

Major Competencies

1. To identify that a well-planned operation forms the foundation of a profitable business.
2. To list the characteristics of poorly organized and a well-organized farm business.
3. To identify the basic principles of farm business planning.
4. To evaluate analysis information for a farm and suggest alternative plans to improve total profits.
5. To identify profitability of choosing alternatives in a farm plan.
6. To choose a total farm plan that would give maximum returns to the resources of land, labor, capital, and management.

FARM BUSINESS PLANNING (A TEACHING OUTLINE)

I. What are the basic principles of planning a farm business?

A. Decision-making as a process.
   1. Facts (quality).
   2. Values.
   3. Problem-solving method.
B. Economic principle of decision-making (use instructional units on profit-maximizing principles).
   1. Pricing (supply and demand).
   2. Diminishing returns.
   3. Fixed-variable costs.
   4. Substitution.
   5. Opportunity costs (equa-marginal).
C. Concepts of farm business organization.
   1. Volume - efficiency.
   2. Combination of enterprises.
   3 Technology of production.
   4. Prices.

II. What are the production resources of a farm business? How are they evaluated?

A. Resources vary from farm to farm.
   1. Scarce resources command above-average returns.
   2. Plentiful resources command below-average returns.
   3. Adjusting plentiful resources to give maximum total returns from scarce resources.
B. Land.
   1. Fertility (yield potential).
   2. Topography.
   3. Improvements.
   4. Climate.
   5. Adaptation of crops.
C. Labor.
   1. Manager labor.
   2. Family or hired.
   3. Labor costs.
   4. Scheduling (demands).
   5. Quality (skill).
D. Capital.
   1. Liquid (cash flow chart).
   2. Production (inventory).
   3. Fixed (land and buildings).
   4. Buy enterprises or equipment.
   5. Credit rating.
E. Management.
   1. Ability to organize.
   2. Capacity to make a plan work.
      a) Make decisions.
      b) Follow up with action.
      c) Make adjustments easily.

III. What are the steps in reorganizing a farm business to give maximum returns?

A. Set personal and business goals.
B. Inventory production resources available.
   1. Use business accounting inventory.
   2. Present situation as it really exists.
   3. Identify all resources for substitution.
C. Budgeting of business by enterprises.
   1. Forecast future prices and yields.
   2. List all alternatives.
   3. Set up a unit budget for each alternative (enterprise) showing resources used.
   4. Estimate receipts of each enterprise.
      a) Limiting factors.
      b) Opportunity cost principle.
      c) Marketing of production.

5. Estimate costs of each enterprise.
    a) Cash expenses.
    b) Fixed costs (fixed variable cost principle).
6. Estimate income of each enterprise.
    a) Return per unit of labor.
    b) Return per unit of capital.
    c) Return per crop acre.
    d) All other important resources.
7. Combining alternatives into a final plan.
    a) Effect on income.
    b) Land utilization.
    c) Capital required.
    d) Labor demanded - total, seasonal, skill, length of time to make change, when to begin.
    e) Specific resources needed - buildings, machinery, government allotment.

D. Partial budgeting for minor changes in the total farm plan.
1. Uses for partial budgeting.
    a) For adding an enterprise.
    b) Changing an existing enterprise.
    c) Purchasing machinery.
2. Partial budget outline.
    a) Additional receipts plus reduced costs.
    b) Reduced receipts plus increased costs.
    c) Difference (whether to make the change).
3. Testing alternate choices by using partial budgeting.

E. Limitations of reorganizing a business.
1. Facts not available or accurate (records).
    a) Resources.
    b) Yields.
    c) Efficiency.
2. Uncertainty of future.
    a) Prices.
    b) Demand.
3. Time involved in making calculations limits the number of alternatives that can be considered.

IV. How can a computer be programmed to assist in reorganizing a farm plan? What is linear programming?

A. Applying arithmetic to regular budgeting process.
1. Linearity - straight line proportions.
2. Divisibility - units must be divisible.
3. Addibility - sum must add up to total.
4. Finitness - a limit on alternatives.

B. Establishing resource limitations.

C. Rate individuals according to management ability.

D. Prepare unit budgets for resource requirements.

   1. List all costs - fixed and variable.
   2. Get exact returns.
   3. Calculate returns per unit of resource.

E. Prepare a resource limitation table.
   1. Resources and amounts of each.
   2. Maximum amount of each enterprise possible.

F. Each enterprise is compared one against the other.

G. If all costs and returns are accurate, no other combination will give a higher return.

AGRICULTURAL PRODUCTION

FARM BUSINESS MANAGEMENT

INSURANCE (A TEACHING UNIT)

Approximate Classroom Teaching Time 14 Hours

Major Competencies

1. To identify risk as a cost to a farm business.
2. To choose all types of risks too great for a farm business to carry and list various ways they may be shared economically.
3. To outline a plan of total insurance protection for a farm business to maximize the net profits.

INSURANCE (A TEACHING OUTLINE)

I. Why does a farmer need insurance protection?

- A. Reasons for insurance.
  - 1. Protect against prohibitive losses.
  - 2. Savings - endowment.
- B. Kinds of losses that can occur.
  - 1. Fire and wind.
    - a) Buildings.
    - b) Livestock.
    - c) Machinery.
    - d) Crops.
  - 2. Liability claims (injuries).
    - a) Property owner.
    - b) Employer.
    - c) Workman's Compensation.
    - d) Auto operator.
  - 3. Auto collision, etc.
  - 4. Manager income.
    - a) Life.
    - b) Disability.
    - c) Mortgage (term life).
  - 5. Health expenses.
  - 6. Social security.
- C. Extent of various losses.
- D. Risk of loss as a cost to a farm business.
  - 1. Losses more economical to share.
  - 2. Losses the business can bear.

II. What should be considered when selecting a total insurance plan for a farm business?

- A. When to insure.
    - 1. Net worth.
    - 2. Savings.
    - 3. Age.
    - 4. Experience.
- B. What to insure.
    - 1. Fire.
    - 2. Liability.
    - 3. Life.
- C. Selecting a reliable insurance agency.
    - 1. Personal service.
    - 2. Size of company.
    - 3. Rates.
    - 4. Insuring policies.
    - 5. Variety of protections available.

III. Develop an insurance plan for the case farm.

AGRICULTURAL PRODUCTION

FARM BUSINESS MANAGEMENT

TAXES (A TEACHING UNIT)

Approximate Classroom Teaching Time [illegible] Hours

Major Concepts

1. To list all taxes which are important to a farm business.
2. To [illegible] a farm [illegible] of taxes in the farm business [illegible].
3. To identify the importance of good records in reporting tax information.
4. To [illegible] [illegible]

TAXES (A TEACHING UNIT)

I. What are taxes?

   A. Use of tax moneys.
   B. Kinds of taxes in farm business.
      1. [illegible]
      2. Personal property tax.
      3. Real estate tax.
      4. [illegible]
      5. [illegible]
   C. Taxes of the individual.
      1. Income tax.
      2. Sales tax.
      3. [illegible] tax.
      4. Inheritance tax.
      5. Social security (insurance).

II. What is the procedure for paying the taxes of the farm business? When? Where? How?

   A. Personal property tax.
   B. Real estate.
   C. [illegible]

III. How can the farm business [illegible] [illegible]?

c. Economic summary.
  1. Ability to reduce income fluctuation from year to year.
  2. Estimate income before end of year.
  3. Ways to reduce fluctuation.
    a Shifting sales of crops.
    b Increase deductions.
    c [illegible] [illegible] tips.

7. What is the procedure for paying income tax and social security?

a. When and where to pay.
b. Reporting taxable farm income.
  1. Schedule F (Form 1040) - farm income and expenses.
  2. Schedule D (Form 1040) - capital gains or losses.
  3. Schedule E (Form 1040) - retirement income.
  4. Form 3468 - investment credit.
c. Computing income tax for the individual.
  1. Social security.
    a Self-employed - Schedule SE (1040).
    b Employees.
  2. U.S. Individual income tax return (Form 1040).
  3. Estimated tax - [illegible] of 1040.

8. Prepare tax statements for the basic farm business and income tax forms for the farmer.

AGRICULTURAL PRODUCTION

FARM BUSINESS MANAGEMENT

GOVERNMENT PROGRAMS (A TEACHING UNIT)

Approximate Classroom Teaching Time 14 Hours

Major Competencies

1. To explain the purpose of government programs.
2. To evaluate up-to-date government programs as they influence the profitability of a farm business.
3. To choose government programs that maximize farm profits.

GOVERNMENT PROGRAMS (A TEACHING OUTLINE)

I. What is the purpose of the U.S. Department of Agriculture?

- A. Activities of U.S.D.A.
  - 1. Education.
  - 2. Control production.
  - 3. Protect health.
    - a) Check livestock sold.
    - b) Slaughtered meat.
    - c) Grains.
    - d) Shipping.
- B. Agencies of U.S.D.A.
  - 1. Education Service, Washington, D.C.
    - a) Bulletins.
    - b) Statistics.
    - c) Reports.
  - 2. Agricultural Stabilization and Conservation (ASC).
    - a) Allotment.
    - b) Conservation payments (booklet available).
  - 3. Soil Conservation Service.
    - a) Technical assistance.
    - b) Farm planning.
  - 4. Credit and other agencies.
    - a) FHA.
    - b) Federal Land Bank.
    - c) Crop Insurance.
- C. National Agriculture policies.

II. Government programs other than at the federal level.

A. State colleges.
   1. Extension service.
   2. Vo-Ag departments.

III. How should government programs and assistance be used to maximize income of a business?

A. Inventory allotments.
B. Identify all services available.
C. Apply partial budgeting to each alternative (increased income plus reduced costs minus reduced income plus increased costs).

AGRICULTURAL PRODUCTION

FARM BUSINESS MANAGEMENT

SECURING FARM LAND RESOURCES (A TEACHING UNIT)

Approximate Classroom Teaching Time 7 Hours

Major Competencies

1. To describe the methods of securing farm land.
2. To select a farm for rent or purchase.

SECURING FARM LAND RESOURCES (A TEACHING OUTLINE)

I. How can farm land be secured for a farm business?

A. Purchasing land.
   1. Advantages of owning land.
   2. Terms (deed, administrator, beneficiary, bequeath, chattel, collateral, dower, easement, eminent domain, executor, fungible, grant, lease, tenant).
   3. Land contracts.
      a) Characteristics.
      b) When to use.
   4. Legal procedure of a purchase.

B. Renting or leasing.
   1. Types of leases.
      a) Cash.
      b) Crop share.
      c) Livestock share.
   2. Limitations of leasing.
   3. Advantages of leasing.
   4. Essentials of a good lease.

C. Inheritance.
   1. Transfer by descent.
   2. Transfer by will.
   3. Transfer by marriage.

D. Partnership or joint ownership.
   1. Tenancy in common.
   2. Joint tenancy.
   3. Tenancy by entirety.
   4. Advantages of joint ownership.
   5. Disadvantages of joint ownership.

II. What should be considered when choosing a farm for rent or purchase?

- A. Type of farming anticipated.
- B. How to locate possibilities.
  - 1. Contact established farmers.
  - 2. Credit agencies.
  - 3. Auctioneers.
  - 4. Ads.
  - 5. Farm managers.
  - 6. Vo-Ag or extension persons.
- C. Characteristics of a good renter.
- D. Appraisal of a farm.
  - 1. Land.
    - a) Soil type.
    - b) Slope and erosion.
    - c) Intensity of crops possible.
    - d) Acreage allotment.
  - 2. Buildings.
    - a) House, barns, etc.
    - b) Condition - value.
    - c) Capacity - storage.
    - d) Conveniences.
  - 3. Water available.
  - 4. Fences.
  - 5. Landscaping.
- E. Whether a particular farm unit would give the volume to use labor supply, capital, etc.
- F. What is the actual procedure for purchasing a farm?
  - 1. Legal assistance.
  - 2. Securing a clear title.
    - a) Legal description of a farm by determining land location.
  - 3. Recording in court house.
  - 4. Surveying when necessary.
  - 5. Down payment and contracts.
- G. What should a good farm lease contain?
  - 1. Legal assistance.
  - 2. Factors of a good lease.
  - 3. Sample lease contracts.
  - 4. Father and son agreements.
- H. Corporations.
  - 1. Real.
  - 2. Pseudo.
  - 3. Partnership.

AGRICULTURAL PRODUCTION

LEADERSHIP TRAINING (A TEACHING UNIT)

Approximate Teaching Time

Although much leadership development is accomplished beyond normal classroom hours, it is recommended that sufficient emphasis be given in the teaching process to develop this area adequately. It may be noted in the following curriculum guide that Leadership is a series of developmental activities that are normally taught as separate units rather than a complete "leadership" unit. In normal circumstances, it is expected that 25 hours should be allotted for the entire leadership unit. This time should be distributed throughout the entire four-year course of study.

Vocational Objectives

1. To develop the ability to get along with one's associates. Be adaptable.
2. To develop the ability to become a good listener.
3. To develop the ability to analyze a situation and come to a logical conclusion.
4. To develop an understanding of classmates or associates.
5. To be cooperative, rather than individualistic.

Major Competencies

1. To develop a feeling of confidence in the ability to achieve success in individual and group activities.
2. To work cooperatively with others in achieving common goals.
3. To be accepted by the group.
4. To assume initiative in group leadership when appropriate.
5. To develop the ability to serve as chairman of a meeting.
6. To express oneself effectively before groups. To speak with authority.
7. To participate in group meetings using accepted procedures.
8. To participate in committee activities.
9. To practice appropriate social graces, personal grooming, and other superior personal qualities.
10. To develop tact.
11. To develop poise.

LEADERSHIP TRAINING (A TEACHING OUTLINE)

I. Orientation to leadership training.

The purpose of this unit is to acquaint incoming students with organization within the school and specifically with the FFA.

A. Understanding why students should belong to selected school activities including the FFA.
  1. What is the purpose of the organization?
  2. What is the program of activities?
  3. What is the plan of operation?
  4. What are the membership requirements?
  5. What is the image created?
  6. What are the major activities?
  7. What is the value of the organization:
     a) To the school?
     b) To the individual?
  8. What is the desirability of membership in the FFA?
     a) Participate in social activities.
     b) Provides activities that encourage personal development.
     c) Provides an opportunity to work cooperatively with fellow students.
     d) Provides an opportunity to practice principles of democracy.
     e) Provides encouragement for those who need assistance.
     f) Provides recognition for those who achieve success.

B. Growing into active FFA membership.
  1. The need for followers and workers as well as leaders.
     a) Stressing the importance of each individual.
     b) New members helping with assigned duties.
     c) New members encouraged to accept responsibilities.
     d) Exhibiting the willingness to work for the benefit of the group as well as for personal gain or recognition.
  2. Committee membership.
     a) Gathering information.
     b) Organizing information.
     c) Reporting results of committee work.
  3. Committee chairman.
     a) Organizing the committee.
     b) Assignment and acceptance of responsibility.
     c) Presenting report to the organization.
  4. Participation in organization meetings.
     a) Become familiar with chapter procedure.
        (1) Presenting a motion.
        (2) Amending motions.
        (3) Tabling a motion.

(4) Removing from the table.
(5) Referring to a committee.
(6) Leaving the chairman's station.
(7) Making a point of order.
(8) Appeal the decision of the Chair.
(9) To reconsider a motion.
(10) Suspend the rules.
(11) Adjourning.
5. Chairing a small group practice meeting.
6. Expressing oneself before a group by means of presenting a speech.
a) Types of speeches.
(1) Informative.
(2) Persuasive.
(3) Humorous.
(4) Special.
b) Preparing and presenting the speech.
(1) Determining theme or topic.
(2) Preparing outline of introduction, body, summary.
(3) Developing content.
c) Preparing and presenting the speech, continued
(1) Making the presentation
(a) Interest techniques.
(b) Voice.
(c) Stage presence.

II. Becoming acquainted with the FFA.

A. Understanding the history of the FFA.
1. Background of vocational agriculture.
2. Development of the FFA organization.
a) National.
b) State.
c) Local.
B. Understanding the objectives of FFA.
1. Aim and purposes.
2. Creed.
3. Motto.
C. Understanding the organizational structure of FFA.
1. Levels of the organization.
a) National.
b) Local.
c) State.
2. Constitution and by-laws.
3. Relation to vocational agriculture.
4. Membership.
a) Active.
b) Associate.
c) Honorary.
d) Collegiate.

5. Degrees.
    a) Greenhand.
    b) Chapter Farmer.
    c) State Farmer.
    d) American Farmer.

D. Understanding program of activities and the incentives award program.
  1. National Activities and Awards.
  2. State Activities and Awards.
  3. Local Activities and Awards.

III. Developing the individual to work with others in organized groups.

The FFA organization is an excellent vehicle to use in developing those traits and abilities that are desirable in working with others. It is especially effective in developing and maintaining interest in the student so that he may be receptive to learning, in addition to providing situations for "Learning by Doing." This type of work must be performed outside the classroom in committee meetings and FFA meetings.

A. Participating in group discussions.
  1. Possible situations for adult group participation.
    a) Community meetings.
    b) Professional staff meetings.
    c) Committees.
    d) Programs.
  2. Types of group discussions.
    a) Panels.
    b) Symposiums.
    c) Forums.
    d) Dialogues.
    e) Roundtable.
  3. Possible roles group participants assume.
    a) Initiating an activity (suggesting new ideas, etc.).
    b) Seeking information (asking questions for information).
    c) Giving information (providing facts or other information).
    d) Giving opinion (expressing a belief).
    e) Summarizing (restating or concluding previous ideas).
    f) Testing (applying the situation to life conditions).
  4. Position roles which maintain and improve a meeting.
    a) Encouraging (permissive atmosphere, inviting discussion).
    b) Gatekeeping (giving all a chance to participate).
    c) Expressing group feelings (summarizing group feeling).

        - d) Compromising (cooperating so that objective may be reached).
        - e) Harmonizing (making the group feel congenial).
        - f) Concensus taking (testing group feeling).
        - g) Following (being interested in the presentation of others).
    5. Position roles which degrade a meeting.
        - a) Being aggressive (trying to degrade the status of others).
        - b) Blocking - opposing (unreasonably).
        - c) Recognition seeking (drawing attention to oneself).
        - d) Being a playboy (making a conscious display of non-involvement, as whispering, reading a paper, horseplay, etc.).
        - e) Dominating (asserting authority, giving directions, interrupting others).
        - f) Special-interest pleading (cloaking a personal prejudice by speaking for "the small farmer," "the housewife," etc.).

IV. Developing personal habits and traits.

Social graces, personal grooming, grammar usage, integrity, and other personal traits are highly important in the development of a desirable image. The FFA provides an ideal situation for the development of many of these qualities. It is recommended that the adviser and members give emphasis to personal development through example. These are not abilities that can be mastered within the classroom. Rather, the members must be able to practice desirable personal traits in connection with FFA activities.

A. Ways in which personal traits are revealed in adult life.
    1. Personal appearance.
    2. Personality exhibited.
    3. Manners used.
    4. Type and method of conversing.
    5. Willingness to participate and carry one's share of the load.

B. Some personal traits for development.
    1. Personal appearance.
        - a) Appropriate dress for the situation.
        - b) Clean, well-pressed clothes.
        - c) Correct posture.
    2. Grooming.
        - a) Personal cleanliness.
        - b) Hair neatly arranged.
        - c) Neat clothes, including shoes and accessories.
    3. Social graces.
        - a) Table manners.
        - b) Courtesies with ladies.
        - c) Attitudes.

4. Work habits.
    a) Punctuality.
    b) Initiative.
    c) Reliability.
5. Oral communication.
    a) Grammar.
    b) Ability to converse easily.
    c) Refraining from vulgarity, cursing, and "loud talk."
6. Personality.
    a) Friendliness, warmth.
    b) Sincerity.
    c) Helpfulness.
7. Integrity.
    a) Honesty.
    b) Reliability.
    c) Morality.

V. Committee work.

Due to the failure of many committees to function effectively and the desirability of a good committee work, this activity is presented separately from the area of "organized groups" which is outlined earlier in this unit. FFA Chapters make considerable use of committee work which is excellent preparation for effective committee participation in later life. This is not an item for classroom teaching. Rather, committee work procedures should be a part of the operational procedure of the organization. New members will become acquainted with the procedure as they work with committees.

A. How the FFA uses committees.
    1. Use of standing committees to provide leadership in major program areas.
    2. Use standing committees to provide leadership for major chapter activities.
    3. Use short-term committees to accomplish major or minor job assignments of a short duration.
B. Some principles to be followed in making committees function effectively:
    1. Select members wisely.
    2. Notify all members of their responsibility.
    3. Secure acceptance from all committee members.
    4. Define goals and specific responsibilities.
    5. Recognize individual effort.
    6. Encourage written reports.
    7. Have reports submitted to parent organization with appropriate action.
    8. Recognize the contribution of committees at meetings of the parent organization.
    9. Discharge committees upon completion of their work.

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The Play School in Teaching Child Development.

Lewis, Irene & Savage, Marjorie
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*CHILD DEVELOPMENT, *PRESCHOOL CHILDREN, *CHILD CARE, CHILD PSYCHOLOGY, *NURSERY SCHOOLS, *HOME ECONOMICS EDUCATION, HIGH SCHOOLS, PROGRAM DEVELOPMENT, EQUIPMENT, ACTIVITIES, OBSERVATION,

A detailed guide is presented for organizing, operating, and utilizing the play school as a tool for teaching child development to high school students. Such a program provides real experiences and takes advantage of adolescent interest in children to stimulate understanding of self and others. Objectives of the child care unit are to help students understand how growth and learning take place in young children, to provide a good environment for children in the play school, and to help students offer intelligent guidance by realizing why children behave as they do and learning to see things from a child's point of view. Generalizations to support each objective are included. Developmental characteristics of 3- to 5-year olds are discussed and specific guidelines for teaching young children are listed in two columns, "Do This" and "Not This." Equipment lists, activity schedules, observation techniques, and record forms suggest supplies and procedures. A reference section lists books, pamphlets, and tests for teacher and student use. This article is published in the "Illinois Teacher of Home Economics," volume [illegible], number [illegible], [illegible]. [illegible] copy #1

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THE PLAY SCHOOL IN TEACHING CHILD DEVELOPMENT

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THE PLAY SCHOOL IN TEACHING CHILD DEVELOPMENT

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Marjorie Savage, Ed. D., University of Illinois

Miss X locks at her calendar and discovers that the unit in Child Care is scheduled to begin in three weeks. Her deep sigh reveals a lack of self-confidence with respect to the goals she can help pupils attain. Miss X feels that maybe she needs a vitamin pill to combat spring fever. She vaguely remembers a principle learned in one of her courses which had reference to the value of accepting a child's feelings and helping the child express these feelings constructively. At the present time, she realizes that her own feelings of insecurity are difficult to accept and express in desirable channels.

At a recent meeting, she heard some educators expound concerning the values derived from a play school. Miss X reviews her notes from this panel with a bit of skepticism. First of all, a play school entails responsibility for young children assumed by the high school students in her second and third year classes. Some of her students have been very irresponsible in past situations. Did she dare to assume that each girl could be responsible for her own job in the total program of play school activities? After all, the cakes which did not turn out well were still consumed by the amateur cooks. A good job of pressing corrected some of the sins in those skirts worn in the recent style show. But the reactions would be an entirely different matter if a child were hurt or received improper guidance in the play school.

Teen-agers seem to need so much supervision that Miss X wonders how they could guide anyone else. From all that has been said about the importance of generalizations, Miss X is puzzled as to how a teacher or her pupils would have time to think of any of these in a play school situation.

Will it be wise for Miss X to take some vitamins for spring fever and try her first play school or skip the idea altogether? To read subject matter out of a text with occasional case situations and movies would be *so* much easier!

Miss X decides to consider the possibility of a play school to provide interesting activities for her child care units. According to the bulletin by Mildred Weigley Wood, *Play School in the Homemaking Program*, "A play school is used as a teaching device; because, in this way, high school students learn faster about children, about personality development, and about getting along with others, than they do by the method of class discussion alone!"

EXCELLENT REASONS FOR HAVING A PLAY SCHOOL

In order to explain the needs involved in directing a play group, it is necessary to illustrate and thus define the purpose of play school. It is possible then to take one teacher, Miss X, and see how she copes with typical problems. Within her scope, must be understanding of the high school students who are learning the processes of good sound play along with their own emotional development. So rewarding are these real experiences to students that the play school, once tried, is accepted as a must, no matter how much additional work is involved.

Seeing Is Believing

What one sees and does impresses more than what one hears. When Billy overturns his juice that first morning at play school, the teacher shows that she is really able to practice what she tells students. Susan believes that seeing her high school teacher, Miss Smith, in action in the play school is adequate proof that she really accepts the feelings of children.

Susan has little difficulty responding to the problem which appears on the weekly evaluation sheet. In fact, she enjoys a test for a change. Billy, a three-year old, overturns his glass of fruit juice and the juice lands on the table at Jane's place next to him. Billy does manage to catch the cup before it reaches the floor. Select the statement or statements which you feel would be most suitable for the teacher to use.

____ a. Have Billy remain in his chair while you clean up the juice.
____ b. Tell Billy he should be more careful. Ignore the fact that he caught the cup.
____ c. Give him a towel to help clean the table as Jane is using his paper napkin to clean the spilled juice.
____ d. Tell him that nice children keep still while they are drinking juice.
____ e. Say to him, "You reached for the cup quickly. That's fine. Together we can wipe up the spilled juice in no time."

Even though Billy and Tommy each had separate accidents at juice time, Susan feelsshe understands certain principles which will transfer to future situations. Thus evaluation can be seen based upon real happenings. Real life situations which accompany reading and discussion can give new meaning to many generalizations. Without the experience with children, Susan feels she would have had some difficulty understanding certain principles.

Another example of the value of real experience occurred. The excitement over an earthworm which one child found at school could have resulted in a quarrel because several children who were near claimed the worm. Class discussion was directed toward ways in which this incident could have been handled.

One spring morning a group of five children who were digging become quite interested in the worms they are finding. At one place where they all appear to be digging, an unusually large worm comes to the surface. All the children are fascinated with the size of the worm. Each one wishes to take the worm home with him. Select the statement or statements which you feel would be most suitable for the teacher to use.

____ a. Explain to the children that around the stump is the worm's home where he lives. Therefore, it is best to let the worm stay there.
____ b. Scold the children for spending time digging in the dirt.
____ c. Use their interest in worms the next day at story time.
____ d. Destroy the worm in the presence of the children.
____ e. Provide opportunities for the children to discover and to observe insects of different kinds.
____ f. Require the children to transfer to another type of activity since they disagree about the ownership of the worm.

A teacher's action will establish within the child an evaluation of his own seeing and believing. If the teacher contends that the worm should be allowed to live, she will influence the children more positively than if she were to scold them.

Susan had read that the attention span of children is short. Opportunity is provided at play school for Susan to recognize that activities such as clay and marbled sand are well-liked and result in holding the attention of the children much longer than some other activities. One day Susan notices that the children are enjoying marbled sand for twenty minutes; another time, clay is enjoyed for twenty-five minutes.

The grocery store idea provides another activity which helps Susan understand how happy children can be in their shifting play groups for some time. She is surprised that empty cartons, boxes, and paper sacks from home can provide the materials for a grocery store.

Susan finds that she has fun and learns a great deal from observing the grocery store activity. As a result of her observations on three different days, she gives the grocery store a high rating on most of the items in the following check list:

The activity allows the children to have freedom of movement and expression and is not definitely restricted to one type of movement.
Excellent____ Average____ Needs Improvement____ Comments________

Activity provides opportunity for the child to broaden his environment with a variety of things about him.
Excellent____ Average____ Needs Improvement____ Comments________

The activity is one which bears repetition.
Excellent____ Average____ Needs Improvement____ Comments________

Opportunity is given to verbally express and convey his ideas and experiences to others.
Excellent____ Average____ Needs Improvement____ Comments________

Activity provides opportunity for the child to express needs and feelings.
Excellent____Average____Needs Improvement____Comments________

The activity provides for spontaneity on the part of the individuals in the group.
Excellent____Average____Needs Improvement____Comments________

The content of the activity is familiar in the everyday life of the pre-school child.
Excellent____Average____Needs Improvement____Comments________

Eye-opener for Parents

The entire homemaking program gains respect as a result of play school. One mother said she never realized that home economics was much more than cooking and sewing. Another parent, as a result of visiting the exhibit of toys at school, was stimulated to make some of the same equipment for her children at home. Some teachers have found time spent on informal publicity is a way of interpreting the breadth of the program to the community. Informal cues to interest adult classes can stem from parents' contacts in play school. Miss X found that a frequent remark from parents was that their children seemed to enjoy eating a hearty lunch after attending play school. From the group meeting and informal conversation over coffee, she recognized that the child's appetite at the age of three and three and one-half was a real problem to parents in the group. What an excellent opportunity to schedule the film which has been widely accepted by educators, "Food as Children See It," (General Mills Company). Miss X already has the interest and basis for discussion at an early meeting of her adult class in the fall.

Adolescent Interests

As homemaking teachers, we recognize that the child development unit will fall short of the needs it can meet if advantage is not taken of the adolescents' interest in children.

After an analysis of adolescent characteristics, the Nevada Course of Study concludes that a major objective for the young adolescent in junior high is increasing ability to undertake responsibility for baby sitting tasks. For the older adolescents, who feel that they are close to marriage and a home, a major objective to be emphasized is that of performing effectively with young children. In the process of play schools, both ages of adolescents inevitably learn to better understand themselves through their growth in understanding young children.

Adolescent Needs

Adolescents are groping to understand themselves, their own feelings and aspirations. The adolescent has certain needs which will be important for a teacher to recognize in every phase of her program. Much of the adolescent's striving occurs because she is interested in satisfying these needs. The environment of the school can provide for each of the following needs of the adolescent:

a. The need for security.
b. The need to love and be loved.
c. The need for companionship.
d. The need for ego satisfaction, that is, for a sense of worth through accomplishment and through the regard of others.
e. The need for variety.

Under adverse or insensitive conditions, an adolescent can be deterred because of lack of understanding.

Concerning the need for security, the environment of the school may be too difficult for the adolescent because scholastic requirements are beyond her ability, the teacher is sarcastic, and discipline is too strict and inconsistent. With respect to the need for love and companionship, the school environment may picture unfriendly teachers and very formal classroom situations. This type of environment in a play school situation would inhibit learning of young children as well as adolescents. The need for ego satisfaction could not be met in the school if the work is too difficult, leadership positions are given to only a few, and the grading system forbids success to some. As for the need for variety, a classroom environment in which we find unimaginative teaching and sedentary activities seem to discourage learning.

Spot Light on Young Children

Throwing the spot light on young children is one of the most practical, profitable and stimulating ways to help adolescents meet their need of understanding human relationships. Yet it is very important that an interesting and satisfactory experience be provided which is geared toward meeting the needs of young children.

Needs of Pre-school Child

This paper will not attempt to fully list all the possible needs of the pre-school child. The pertinent ones are listed. For a fuller reference, consult the small book *Understanding the Young Child* by James Hymes. (It should be in your library).

Some needs of the pre-school child which may be satisfied through a play school are as follows:

*To develop a feeling of belonging

*To develop habits of eating, resting, dressing, and toilet habits which represent a sound foundation for further growth

*To use his imagination and express his ideas, needs, and feelings through use of materials

*To begin to solve his own problems and to think independently

*To learn to share

*To learn to do what is important for group welfare

Values Derived From Play

Pupils must be helped to realize that play is the media through which the child achieves physical, mental, social and emotional development. Dr. Ernest Groves has stated that "children do not play because they are young; they are young, so they can play." Charlotte Garrison once said that the child begins his study and mastering of objects around him when very young. The value of these early childhood experiences depend largely upon the wisdom of adults in providing him with materials which stimulate desirable habits of thought, feeling and action.

Play is a time for experimenting, attempting to reproduce a world he can control and conquer. To the child, play is a serious business. The child gains much through play. Play provides:

*Development of muscular co-ordination

*Opportunity for self-expression

*Ability to solve problems

*Habits of caring for materials, for neatness and orderliness

*Habits for developing social adjustment, leadership, co-operation, self-control, consideration of others, self-reliance, resourcefulness and independence

*Opportunity for corredt concept of things.

Toys are the tools of play. Just as adults need the correct tools and materials, the child needs appropriate play materials for productive play.

BASES FOR SUCCESS

Before trying to sell a play school to others, some teachers learn the hard way that they must really believe in it themselves. This is a simple idea, but it is important before expecting others to identify with the project and to be enthusiastic! Most teachers enjoy the lift given to high school teaching when they include spring units in child care, centering around the play school. The teen-ager perks up, and there is no time for spring fever when true-to-life experiences with children give meaning to and reinforce what is presented through reading and discussion.

Personal Attitudes

A teacher's attitude toward children influences the success she can hope to achieve in the play school. The degree of success or satisfaction the teacher has derived from her own past experience with children will determine whether or not she has a genuine liking for them.

As young children are quite sensitive to the attitudes of people around them, it will not only be important that the teacher have a genuine liking for children, but that the students have wholesome attitudes also. At an early date, the teacher should determine how the high school students feel about young children. In order to obtain valuable information concerning the attitudes of students, the test, "Bringing Up Children: An Inventory of Attitudes," by Remmers and Stedman is quite pertinent.

Varieties in Past Experience

Although past experience in working with children will vary for individuals, some teachers are able to utilize knowledge derived from such experience in planning a play school. The high school teacher may have had pleasant experiences with children in college nursery schools, church nurseries and/or summer camps. Married teachers can profit from experiences they have with children in their own homes.

Information Concerning Students

Some information concerning a group of students enables the teachers to plan more intelligently the nursery school schedule and provides opportunity for the teenager to have some degree of success in working with small children. Furthermore, the teacher can feel more secure as she recognizes or takes into account the assets of her students. A number of items on a personal data sheet would be available as a result of the teacher's having worked with students in other aspects of homemaking. However, a summary and tabulation of information concerning the total group would help the teacher have an over-all picture of what the group is like.

The hypothetical Miss X decides to take a look at the past experience of her students with respect to pre-school children. Students will vary in terms of their past experience with young children. Different opportunities will have been available to individuals.

Personal Data Sheet

From examining a few personal data sheets, Miss X finds that being able to hold the attention of children with interesting stories and musical activities has been a part of the past experience of several of her students. Often students have regular jobs in community baby-sitting; these girls seem to have received a variety of experiences, while other students reveal that they have had only limited experience with young children for short periods of time.

An example of the personal data sheet she used with her students is as follows:

Personal Data Sheet

How many sisters?____ Their ages?__________________

How many brothers?___ Their ages?__________________

Are there additional young children living in your home?

What age children are they?

Are there young neighbor children?

Do you have nieces and nephews?

Do you earn any money by baby-sitting?

Have you taught a beginners' Sunday School class?

Have you cared for children while the parents were away?

Do you like to play with children?

Have you bathed and dressed children?

Have you directed play activity for children?

If so, what was the type of activity?

Did you ever teach finger plays to children?

Did you ever read a story to a pre-school child?

State the greatest problem you have had in dealing with children?

As a result of summarizing the information from the personal data sheets, the teacher finds particular assets revealed for different students. In cases where specific problems and limitations seem evident concerning other students, Miss X decides to utilize these results to advantage in early planning.

Unless some data sheet reveals a highly personal problem, a student committee can be given an assignment to summarize information from this sheet. Then, both teachers and students have common information with which to work.

Good Mental Health

According to Redl and Wattenberg, a person who has mental health is well-adjusted, mature, and normal. They further state that complete adjustment is very rare; perfect adjustment is unknown. Most people seem to fall in between the two extremes. Yet, it is wise for a teacher to be aware of the conditions which foster good mental health.

Miss X is interested in trying to meet both the needs of young children and adolescents in the play school experience. If she and the high school students have learned to achieve reasonably good mental health in their day-to-day relationships with others, they will have more likelihood of succeeding with the children. Then, Miss X and her students will be more able to give attention to the needs of the children rather than to concentrate upon their own unmet needs!

Recent Course Work

Miss X realizes that the recent summer workshop which she attended at one of the state universities gives her a basis for feeling secure. Knowledge derived from her undergraduate courses in Child Development, plus a workshop on the graduate level, better enables Miss X to understand and explain to her high school students ways of dealing with behavior situations.

Access to Available Materials

Resource materials can greatly enrich the thinking of a teacher who wants to succeed in the play school venture. In the following references, suggestions can be derived. Some of these recent materials which Miss X asks for her library before attempting to plan with her students are as follows:

Books

Landreth, Katherine, Education of the Young Child, New York, John Wiley & Sons, Inc., 1949.

Read, Katherine, The Nursery School, Philadelphia, W. B. Saunders Co., 1955.

Pamphlets

Baruch, Dorothy, How to Discipline Your Children.
Source: Public Affairs Pamphlets
22 East 38th Street
New York 16, New York
Price 25¢

Bureau of Maternal and Child Health, New York State Department of Health, *The Pre-School Years*, 1957.
Source: Health Education Service
P. O. Box 7283
Albany 1, New York
Price 60¢

Colina, Tessa, *Finger Plays and How to Use Them.*
Source: Standard Publishing Company
Cincinnati, Ohio
Price 50¢

Extension Service in Agriculture and Home Economics, *Your Child and his Money*, Circular 741, *Your Child the First Six Years*, *Sex Education for Young Children*, and *Caring for Young Children at Adult Group Meetings.*
Source: University of Illinois
College of Agriculture
Extension Service
Urbana, Illinois
One copy of each bulletin free to teachers

Grossman, J. S. and Leshan, E. J., *How Children Play...for Fun and Learning.*
Source: Science Research Associates
57 West Grand Avenue
Chicago 10, Illinois
Price 50¢

Jackson, Janet, *Finger Plays for Little Folks.*
Source: Church School Press
Elgin, Illinois

Langdon, Grace, *How to Choose Toys* and *Children Need Toys.*
Source: American Toy Institute
200 Fifth Avenue
New York 10, New York
Free in quantity

Michigan Inter-Departmental Staff on Children and Youth, *Baby-Sitting.*
Source: Gerbers Products Company
Freemont, Michigan
Free

National Safety Council, *You're in Charge* and *Truly Yours.*
Safety Educational Data Sheets:
No. 4 - *Toys and Play Equipment*
No. 29 - *Play Areas*

Play Schools Association, Inc., *How to Make a Play School Work.*
Source: Play School Association, Inc.
119 West 57th Street
New York 19, New York
Price 35¢

[illegible], Mrs., Some Special Problems of Children Aged 2 to 5 Years.
Source: National Association for Mental Health, Inc.
1790 Broadway
New York 19, New York
Price 30¢

Taking Care of a Pre-School Child.
Source: [illegible]
Box 135, Martha Van Rensselaer Hall
Ithaca, New York
Price 25¢

Utah State Department of Public Instruction, Observing and Working with Children in the Homemaking Program, and Let's Enjoy a Play School.
Source: Utah State Department of Public Instruction
223 State Capitol
Salt Lake City, Utah
Price $1.00 each

United States Department of Labor, Children's Bureau, Your Child from One to Six, Publication No. 30, 1945.
Source: Children's Bureau, U. S. Dept. of Labor
Washington, D. C.
One copy free from County Home Adviser's Office

Tests

Arny, Clara B., Ryan, Dorothy [illegible]., and Pattison, Margaret [illegible]., Evaluation Tests for Homemaking Skills—Child Care.
Source: Science Research Associates
57 West Grand Avenue
Chicago, Illinois
Price—5¢ for [illegible]

[illegible], [illegible], Evaluation Materials in Child Development, Ninth Grade, Price 30¢, Evaluation Materials in Child Development, Eleventh and Twelfth Grades, Price 30¢.
Source: Iowa State College Bookstore
Iowa State College
Ames, Iowa

Remmers, H. H. and Stedman, Louise A., [illegible] Toward Children An Inventory of Attitudes.
Source: Science Research Associates
57 West Grand Avenue
Chicago, Illinois
Price—$3.00 per 100 copies

Co-operative [illegible]

Plans must be completed to a point where the help of others has been worked out in detail. Co-operation from the following will be necessary in most situations:

Administrators
Students
Other teachers from whom help is requested
Janitors
Parents

Sometimes a form letter to other teachers and parents is the most effective and time-saving method for reaching these people.

Alton Senior High School
2200 College Avenue
Alton, Illinois

Dear Parents:

The first and seventh hour Family Living Classes are setting up a three week play school on Wednesdays and Thursdays, beginning Wednesday, May 1 and ending Thursday, May 16 as part of the Child Care unit.

We are inviting your pre-school child to participate in our Play School, which will meet in the Living Room of the Home Economics Department on the second floor of the Main Building.

In order that both first and seventh hour class members can participate we will conduct the Play School from 9:00 – 10:20 on Wednesdays and from 1:00 – 2:30 p.m. on Thursdays. We hope your child will be able to participate in both Wednesday and Thursday sessions for the three weeks.

Eighteen girls are enrolled in our class. At each Play School session half of the class members will observe and half will help with the Play School.

We are hoping to have an enrollment of 10 to 15 pre-school children. Since we have classes following and preceding the Play School period, we would like for you to bring and come after the children. There is no charge in connection with the Play School. If you have any questions regarding the Play School, you may contact our teacher, Miss Liebig, by calling her at the Main Building, [illegible], Extension 5.

We are hoping that you will find it convenient to participate and help us make our project a success.

Very truly yours,

[illegible], Class Secretary

Prevention Better Than Cure

Some points that have been suggested from experienced teachers have been enumerated. From people who have had successful experiences, one may secure the following pointers which help to avoid trouble:

*Provide a conveniently placed listing of names of the children with addresses and telephone numbers.

*Check constantly on mothers' whereabouts in case of an emergency. Try to encourage a mother to tell you if she expects to be away from home while the child is at schoo. Also secure information as to where the mother can be reached.

*Have an awareness of daily absenteeism.

*Encourage parents to telephone of the child's absence with reasons.

*Have suggestions for the children's needs at play school.

*Emphasize the value of treating in the strictest of confidence children's personal information at school or revealed in their behavior.

*Give parents some help with respect to marking and identification of children's clothing. In one play school, the shoes were so much alike in shape and color that one child wore another child's shoes home. Another incident was quite vivid when one little boy screamed all the way home because he lost his cap.

*Leave out of sight those play materials which will not be used until a later time. In one play school, the free play period almost became a free-for-all confusion because there was so much to do.

*Provide labeled temporary storage for each child's clothing.

*Emphasize to the parents that children must not come to play school with colds, fevers, or disease symptoms.

*Secure knowledge of school liability in case of accident or injury to a child.

*Plan to alternate play school sessions with class meetings so that adequate educational value is gained by students as well as the pleasure gained by the children.

Other problems will arise which will have to be cleared according to the individual situation. No one answer covers all questions. The individual problems must be met as they occur.

SUGGESTIONS FOR OPERATING A PLAY SCHOOL

Time Period

The time period usually lasts three to six weeks. Many teachers have more satisfactory results if children come two or three days a week. The remaining days, then, could be used to evaluate results, to analyze how generalizations were applied, and to plan the ongoing program.

Bases for Selection of Children

Ages three to five years—It is best not to have too wide an age range among the group of children. Some teachers find the problems connected with a play school too difficult in terms of supervision when children as young as two and one-half years are included in the group.

Number of children—Limiting the number of children to a group of not more than ten or twelve is recommended for the average-sized high school class. Most room arrangements and physical facilities in the high school laboratory will not accommodate a larger group. According to the purpose of a play school, the teacher is not only attempting to guide the small child but also to assist the adolescent who is assuming responsibility. It is, therefore, very necessary to limit the number of children.

Toilet habits established—A number of toilet accidents may occur in the early days of play school. The teacher, however, should find out for certain from parents that the child has established bladder control before she enrolls him as a member of the group.

Division between sexes—An approximately equal number of boys and girls is the goal of teachers setting up a play group. This division makes it possible to see whether or not play interests and abilities differ between children of the opposite sex.

Source of children—The plan for securing children will need to be carefully worked out with the administration and explained to students. Other arrangements may be quite simple and satisfactory. Each pupil could be responsible for securing one child of a given age.

Transportation of children—The administration may require the parents to transport their children to and from school. Whatever the policy recommended by the school, Miss X will need to have it defined and clearly understood. Serious consequences could result for a teacher if high school girls have this responsibility.

Physical Safety

Protection of the children is of utmost importance. It would be extremely helpful if a unit on first aid could precede the play school experience. This unit would probably be taught by the health or physical education teacher.

Some of the following suggestions are adapted from the bulletin Taking Care of a Pre-School Child published by the National Safety Council and are very important:

*Do not plan to take care of a child if you have a cold, or know that you have been exposed to a contagious disease. A teacher in charge of a play school should be responsible for the high school students and herself in the observance of the above rule.

*Discourage planning of field trips for children attending play school. There is usually enough of interest which can be provided within the bounds of school itself.

*Control danger spots in and around play school. The teacher and her students will need to determine the safe areas in which children may play.

*Be sure that refrigerators are within your sight when little children are present. Be definitely sure that the lock cannot be manipulated by children.

*Pay attention to the child when he is near a stove, hot water heater, electric cord, sewing machine, windows, or stairs.

*Avoid any use of balloons at play school. Children have been known to suck a balloon down their windpipe.

*Check sand in the sandbox and have it strained periodically for glass or other hazardous materials.

*See to it that horns, bubble blowers, etc., are strong enough to prevent the user's sucking parts of it into his throat.

*Check frequently to see that crayons and paint brushes are not being held in the mouth. In case of a fall, serious mouth or throat injuries could result, or part of the object might be swallowed.

*Be sure that blocks and toys are not within the passage areas of the room.

*Require the children to wear rubber-soled sneakers, if the floor covering of the room is such that wax is used or there is any danger of falling.

*Have available short blunt-edged scissors if the activity of cutting is to be provided.

*Have children help you pick up toys, such as blocks, after they have been used. When toys are left on stairs, floors, or sidewalk, it is possible for others to stumble over them.

*Be aware of the danger involved in a moving swing. The supervision of children in a swing plus those moving in the direction of a moving swing is a heavy responsibility requiring constant attention.

*Check outside play equipment, such as boxes on which children may be climbing. Play equipment should be dry because wet pieces are often slippery.

*Sterilize bubble pipes with proper disinfectant if they are to be used for blowing bubbles.

*Know what first aid supplies are available and where they are located.

*Have some knowledge as to how to treat a slight burn, scratch, or bump.

*Always remove pins, matches, medicines, and cleaning agents from the child's reach.

*Inspect grounds daily for bottles, nails, and other harmful rusty metals.

*Restrict pushing and rough-and-tumble play, which is unnecessary.

*Keep children away from strange dogs and cats. Do not allow children to play in areas where there are wild squirrels.

*Check all the locks on doors. Be sure that it is not possible for children to lock themselves in the bathroom or any of the rooms where play school is being held.

*Children who seem to be showing the first signs of a cold should not be left with the group.

The bulletin, You're In Charge, a part of the National Safety Council packet, asks the question, "What safety reminders are most frequently needed by children?" See this bulletin for the answers.

The Administrator and the Play School

Encourage the superintendent to participate in making suggestions regarding policies of conducting a play school. In addition to helping with a policy concerning physical safety, administrators in the local school need to understand the educational goals of a play school, budgetary needs, plans for space and equipment, method of selecting children, and the place of the play school in the total yearly program.

Prior to a play school venture, let your superintendent help evaluate the policy regarding safety and react to these suggestions:

a. Parents who wish to send their children should have their family physician sign a health record sheet prior to attendance at play school.

b. Parents should sign a slip saying they do not hold the school or teachers liable in case of an accident.

c. Services of the school nurse should be made available for the informal inspection of the children each day.

Discuss your plans for dealing with parents with your administrator. Follow his suggestions, because he is accepted by the community as the administrator. Moreover, once he has approved your plans, he is responsible for supporting these plans in every way possible.

Consider the suggestions of parents. Often a teacher finds visiting the home of each child extremely helpful. However, in other instances, the teacher may ask each parent to come for a conference before a child is accepted as a member of the group. At the time of the conference, a <u>personal</u> <u>information</u> <u>sheet</u> is filled out.

Nursery School Information Sheet

Name of Parents . . . .

Street Address . . . . .Telephone. . . . . . .

Name of Child . . . . .Date of birth. . . . . .

Child's sisters and brothers . . . .

Names and ages. . . . .

Does Mother work outside of home? if so, during which hours? . . .

. . . .

INTRODUCING THE UNIT

If the Family Living course includes a unit on Child Care, and if the Play School is a traditional part of the unit, the teachers needs to spend little time on an interest approach. The young teacher, or the teacher who is contemplating the play school as part of the Child Care unit for the first time, may be hesitant. However, if she recalls the fact she so well knows that "adolescents are groping to understand themselves, their own feeling and aspirations," the child development unit would fall short of the needs it can meet if advantage is not taken of the adolescents' interest in children by means of a play school.

Throwing the spot light on young children is one of the most practical, profitable and stimulating ways to help adolescents meet their need of understanding human relationships.

Preliminary Steps

"Bringing Up Children," form A, by Remmers and Stedman, is helpful to the teacher and interesting to the class members. After having completed the inventory, each pupil scores her own test and determines her own percentile. This score which tells how she compares with others of her own sex and age arouses interest and serves as an incentive for further study.

A bulletin board display of "Play-School Activities" is all that is needed to arouse interest in having a play school as part of the Child Care unit.

Understanding the adolescents' interest in children, we recognize why high school students are impatient to set up the play school. The teacher knows the type and amount of study, understanding, and pupil preparation that must precede the play school period. Therefore, before beginning a play school, the teacher must help students recognize the need of a basic understanding of child guidance principles so that a happy experience may be provided for the children and a worthwhile, educational experience for the class.

What Students Must Understand

A brief outline of the requisites in setting up the play school may be an aid in helping the class members understand the need for careful planning, the amount of work that is involved, and the need for an understanding of the child guidance principles, which means reading and study on their part.

As previously discussed, there are certain important matters to clear with the administration, such as:

1. Available space
2. Insurance in case of accident
3. Transportation of children
4. Securing certain basic equipment
5. In emergencies securing cooperation of other teachers if necessary to release students from another class
6. Securing permission for a student to be excused from assemblies during the play school time

Class members should realize the need for committee work as well as assignments. The class will undoubtedly have to be reminded that the first question they must answer when contacting the faculty and other students is "What are the objectives of a play school?"

This brings in the matter of available books and pamphlets for the unit. A suitable bibliography of books and pamphlets needs to be in readiness. The class needs to know where the material is, whether in the school library or the classroom.

Over-all Objectives

From class study and discussion, pupil interest, and unit goals, the following over-all objectives for the play school would evolve:

1. To better understand how growth and learning take place in young children.

To achieve this objective the class would realize that another objective would be:

2. To provide a good environment for children in the play school.

3. To help students realize why children behave as they do, to learn to see things from a child's point of view, and thereby guide children more intelligently.

To attain these objectives requires study on the part of both the teacher and her students. The point of view of the authors is that both the teacher and her students can work together to determine some of the principles of child guidance from films, filmstrips, and pamphlets.

COMMON DENOMINATORS

The material presented in this section deals with what is called a "norm" or average. Some understanding of the characteristic reaction of children who will attend play school should be helpful. What can we expect of children at certain ages?

What the Experts Say

According to Franks', How to Help Your Child in School, "growth charts are general guides only; they are statements about averages, not about individuals." The common denominators, if used wisely, can be of value to parents and teachers of a play school. It is helpful to know that certain behaviors are characteristic of a particular stage of growth. If we know what to expect, we may plan the environment or set the stage for children to exercise their growing powers, as well as guide undesirable behavior into constructive channels. At the same time, parents will become more willing to accept a certain range of behaviors on the part of the child.

Dr. James Hymes speaks of the sequence in the growth process in this way: "A child must be a complete and utter capitalist when he is first developing a sense of property--'Mine, mine, mine'--or there are no grounds to nourish sharing at a later stage. . ." "Messing and dirt and goo and goosh when you are small are the basis for accepting cleanliness later." Certain behaviors which are annoying are often necessary for him to really grow as he normally should.

Individual Differences

The fact that there are individual differences in the time at which each child arrives at a particular stage in the growth sequence is most important. Emphasis is being placed on the right which each child should have to live out a particular stage. Although every child will go through each of the stages, the time for arriving at a particular "turning point" will vary according to the rate and pattern of growth of individual children. Therefore, any anxiety on the part of parents may be due to their lack of knowledge concerning this range.

The importance of the "Common Denominator" needs to be recognized; however, there needs to be developed an understanding that each child is a unique individual whose own individual characteristics must be respected and aided toward optimum development.

A logical goal might be "to learn what can be expected of the 2-3 and four-year old child." Pupils can be guided to work out various procedures by which the age characteristics of the common denominator for each age level is ascertained.

After a discussion of films and filmstrips, and after studying books and pamphlets, individuals or committees should prepare written reports on the characteristics of each age level. These reports must be carefully read and analyzed by the teacher.

Use Filmstrips

An important generalization is that a mature behavior exists at any stage of development. In order to arrive at this generalization, an essential requirement on the part of the learner is some basic understanding of the maturity indicators. Through the use of a filmstrip available from McGraw-Hill text films, "Child Care and Guidance", which shows the growth process, the teacher enables students to get a clear view of the special learnings which are typical for a given age and the order in which they occur. After the filmstrip is shown, there is a review of the major principles of continuity of development and growth sequence. The filmstrip is shown again to the class and at definite intervals the teacher stops the filmstrip and gives opportunity for the class members to suggest problems which may normally arise from a particular stage of development.

At this time students begin to think in terms of how they believe certain problems should be solved on the basis of former situations. This discussion may lead to some difference of opinion among students. Near the end of the class period, the teacher lists problems on the board and suggests available resource materials as a means of guidance in the solution of these problems. She plans to use the problems for later lessons in development of the unit.

Later Use Films

The viewing of the films, "The Terrible Twos and the Trusting Threes," and "The Frustrating Fours and the Fascinating Fives," will also help in understanding what to expect from each age level.

Three-Year Old

Language--One of the child's achievements about this time is his ability to use language effectively and to be responsive to verbal guidance. Since maturity of the nerve centers which govern inhibition has taken place, the child does not get lost between opposite extremes as he formerly did and can make a choice. Certain words like surprise, guess who, etc., are attractive to him. Many children respond well to whispering when there is a group pressure situation. At this age, the child seems to be able to solve his problems more successfully than earlier.

Routines--Routines are enjoyed and fairly well accepted by most three-year-old children. It is interesting to see the child at this age do many things he does not particularly like to do if he is given a reason, along with the fun of participating in a game and some adult help. Patience is needed in helping the child develop independence as he participates in certain routines, such as dressing himself. Since the child has advanced so much in language development, he frequently has difficulty combining dressing and talking. Therefore, he may wish to pause and finish his story before he completes an activity.

In regard to toilet habits, the three-year-old seldom has daytime "accidents." Usually he makes known his desire to go to the bathroom by action or speech. The three-year-old can wash and dry his hands without help. In dressing himself, he can usually assume some responsibility.

Schedules--In adapting to the schedule at play school, the child seldom experiences difficulty in making transitions from one activity to another, provided the one guiding him does not pressure him and warn him of the need for changing activity. A schedule needs to be flexible for a child of this age.

Activities--The child at this age needs some time for "free" play when he can exercise some choice in terms of what he would like to do. In activities, such as drawing with crayon, building with blocks, dressing dolls, looking at pictures, and working a peg board, the child tends to keep himself occupied without too much supervision on the part of the adult. Of course, the stage must be set to stimulate the interest of children in these kinds of activities.

Children at this age like to take part in group activities, such as simple games and music. They like acting out or "let's pretend" activities.

Sociability--By this time, the child seems to be arriving at a friendly and sharing "we" stage.

Although sharing or taking turns may be difficult for some children, it is accepted by most children of this age when they have had adequate past experiences. At this age, one sees a glimpse of cooperative play. Yet many children engage in and enjoy parallel play, which is often quite helpful when tensions seem to be evident.

Three and One-Half--Growing Pains

The parent and teacher of play school begin to say goodbye to the delightful stage of equilibrium which was present at three years. The degree of dis-equilibrium manifested by individual children at this time will vary.

Language--Children may begin to stutter when no previous signs of stuttering have been evident.

Routines--If parents and teachers understand that insecurity and incoordination characterize the child at this period, they can understand the value of patience and can more wisely guide routines.

Schedule and Activity--The children at play school often respond better to a planned activity, such as soap bubbling or marbled sand, to start the early morning play time. Outside active motor play needs careful supervision as motor in-coordination may be evident. The child may show a tendency to stumble, fall, or fear heights.

Sociability--The child who may be uncertain and insecure during this period, may discriminate against other children and give annoying commands. Sometimes he resorts to hitting and pushing and displays extremes of behavior.

Four-Year Old

Language--At this time, the child becomes very curious about his environment and frequently asks "why" and "how". He responds well to verbal direction. Sometimes, as he boldly uses language, he may wish to exclude certain children from the group. Guidance is necessary for the talkative, lively four-year-old who may engage in tattling, disputes, and have difficulty distinguishing between fact and fancy.

Routines--The four-year-old engages in routines more smoothly than he did at the age of three. A certain out-of-bounds behavior may occur in connection with toileting. Therefore, adult guidance is needed in connection with this part of the routine. At this age there are few daytime "accidents". Most children are able to go to the bathroom alone and without help.

The child of four years has achieved more independence in dressing himself. In certain instances, he may need help with outdoor clothing, close-fitting clothes and shoe laces.

Schedule--The child needs more carefully planned activities. He shows improvement as he engages in group activity. The schedule should still provide for alternating periods of active and quiet play because he has a high motor drive now.

Activities—As the child at this age is imaginative and versatile, he likes to engage in dramatic play. Children often like to act out certain stories, such as "Little Red Hen" and "Billy Goat's Gruff".

He finds that at this age the child is usually able to draw with pencil and crayon a simple, but recognizable picture of a man, animal, etc., [illegible]

Sociability—The child is highly sociable. However, guidance is needed to curb his characteristic out-of-bounds behavior.

Four and One-Half—Pulling in From Out-of-Bounds

Language—They like to discuss various things in the environment as well as stories they hear. Their desire for realism is shown in their response to certain happenings and in their desire for detail and information.

Routines—There is less need for adult control. Children show a tendency to stay with a routine much better than at the age of four years.

Interests and activities—Again the tendency is seen to stay with activities, such as block building, and achieve a certain goal. Children at this period sometimes need more time to complete an activity in which they are interested. They are interested in making their drawings look more like the real thing. Increased motor control is seen in outdoor play as well as in drawing pictures.

Sociability—Since the child at this time seems to be pulling in from his out-of-bounds behavior which is characteristic of four, he seems to be a more sociable individual.

Sometimes it is wise for a nursery school teacher to [illegible] her four-year group [illegible] from five-year olds. This reduces her problem of guidance and permits opportunities for the children to experience play without being dominated by [illegible]

Five-Year Old—[illegible]

Language—The child has a good command of language and talks freely. He seems to enjoy talking and expressing his ideas.

Routines—Routines, such as washing, dressing, eating, and toileting himself are often seen as the [illegible] of individual abilities. Rarely, the child may need occasional help.

Activities—The child needs alternating periods of active and quiet play. Although the child is noisy and vigorous, he may become tired rather easily. In everything, he likes to know reasons concerning the here and now world.

Activities—His activity seems to have definite direction or be repetitive at this time. The child enjoys some group activity but he may become tired of the group. Although he may enjoy playing in a small group of five or six children, his interests are still self-centered. Dramatic play is enjoyed by the 4-year old child. Children need opportunity for plenty of activity.

Sociability—At this stage, there seems to be a good balance between self-sufficiency and sociability. He is interested in staying near the home base.

[illegible]

When a class decides to learn about young children, the goals of the class vary in accordance with changing aspects of interest in early and late adolescence. The objectives and desired outcomes for either age level might be to help the students get an understanding of how growth and learning take place in young children and provide a good environment for children in play school. Since the juniors and seniors are interested more in preparation for the care of their own children, the objectives and desired outcomes for this age level would be to help them realize why children behave as they do and how to guide children more intelligently.

Application of Principles

Whatever the age of the group, the primary purpose of the play school is to provide opportunities for observation of small children and to apply the principles of child guidance learned. The class members must be helped to realize that a basic understanding of the principles of child guidance is important in order that observation and guidance may be as meaningful as possible.

The material which is discussed at this point stimulates thinking in terms of the kind of [illegible] [illegible] which is suggested for children. It is, however, important that teachers and high school students have some understanding as to the use which can be made of this type of [illegible] by individual children.

Adjustment-Maladjustment Scale

Because of the nature of the background of each child, there may be either acceptance, rejection, or other frustration by individual children who are present in the play school situation where the following principles are applied. It is important for teachers to help students recognize that variety in types of background will color the individual child's reaction to the situation and produce different behaviors. In a home situation where the child has been unfamiliar with anyone saying "Let's" or "Shall we" do a certain thing, he may experience a great deal of anxiety in the absence of the commands of his parents or others. Some children may experience a certain amount of distress in a setting which has entirely different expectations from those of the home base. Other children may display a tendency to be negative in the new situation at play school. In other words, a child may [illegible] anywhere on the continuum of an adjustment-maladjustment scale.

Individual Differences

Informing students of the fact that children may not only be from different kinds of backgrounds, but also have arrived at different points in achieving various degrees of learning may enable them to work more intelligently with the children. One child, who comes from a democratic family, may feel very secure and have experienced the feeling of ownership. Therefore, when he comes to play school, this particular child may have little difficulty participating in the business of sharing, taking turns, or giving up to another child. Whereas, a child who has been reared in an atmosphere of complete freedom may not have any awareness of social values, such as sharing. Therefore, it is quite understandable that he behaves the way he does.

Emotional Climate

Finally, in absence of any scientific documentation, the principles below on How to Handle Youngsters are those which we have found worthwhile.

Do This	Not This
Plan for opportunities for children to feel that they belong to the group. Each should have a chance to be a leader in the band if he wishes.	Allow certain children to assume responsibility repeatedly.
Look at the child's life as a whole to find the reason for undesirable behavior and try to eliminate the causes.	Work on the symptoms and fail to find the root of the problem.
Help the child feel that he can do some things well.	Have him develop a negative picture of himself.
Let the child know that you like him, even though you dislike what he is doing.	Say "I don't like you if you bite other children."
Have more than one of the more popular and much used toys. Remember that duplicate toys simplify situations.	Demand concepts of sharing before children are mature.
Let children have a chance to experiment and enjoy the process as they engage in creative activity.	Furnish a model or standard for children to follow, e.g., teacher asks child, "What are you making?"
Permit the child some freedom of choice in joining a group activity as long as he does not disturb the larger group.	Pressure the child to participate in what most of the other children do.

Do This	Not This
Keep your hands off the children unless they initiate the contact. For example: steady the equipment instead of the child.	Immediately help the child or show a distrust in the child's ability to use the equipment.
Use positive clear statements when a request is necessary. For example: "It is clean-up time."	Ask him, "Would you like to clean up?" which may result in a "no."
Allow a choice if it is really possible for the child to exercise choice.	Insist upon certain action at precise time.
Appear as calm as possible. Show no outward irritation no matter how trying a child or group may be.	Become angry because the group displayed out-of-bounds behavior (Maybe there had been too much quiet activity and this was needed).
Manner and tone of voice can invite the co-operation of the child. For example: whispering is effective with three and four-year-olds.	Invite resentment by the quality of a dictatorial tone in giving a command.
Remember that words like "let's" and "shall we" help children want to carry out suggestions.	Give a forceful command which may invite negativism.
Remember that a few reasonable clearly defined limits help children feel secure.	Furnish complete freedom by absence of limits.
Form the habit of re-directing undesirable activity.	Say immediately, "Don't do that."
Use the positive approach, "puzzles are used at the table."	Say, "Don't use puzzles on the floor," and encourage negativism.
Enforce desired action by physical presence and direction, e.g., even though the teacher might say, we take it easy going down the steps, one at a time—her presence and the reminder may be needed.	Expect each child to remember correct performance in the excitement of leaving the building.
Forestall undesirable activity by making the desirable behavior attractive. The teacher says to the boys approaching and preparing to burst the cakes of sand, "Maybe you would like to be the guests and come to Janie's birthday party."	Give the child opportunity to get reward through being destructive.

Do This	Not This
Suggest to children desirable social techniques to use, e.g., The child seems to want to join the group but needs help in making a constructive approach.	Allow children to fail to be included and accepted by others.
Channel the child's energy and interest. "Here's something you might like to do."	Punish him for inability to wait his turn.
Differentiate between "indoor" and "outdoor" voices by setting an example.	Threaten the child by ridicule, sarcasm or shame.
Help children want to learn new things because the process of learning is fun and interesting. New textures in foods can be exciting, e.g., the finger foods at juice time are crisp and easy to handle.	Use rewards like stars to bribe them into better eating habits.
Let child approach a new activity through watching, feeling some security and wishing to participate before he tries it, e.g., children often like to observe the finger paint or clay being made before they have opportunity to use it. The first approach to paint at least for awhile may be with just a poke with one little finger.	Have child feel he must immediately participate.
Be willing to observe children and let them proceed in their own way as long as they are playing safely.	Hover over the children; interfere; try to do something when help is not really needed.
Try to see things from the child's point of view.	Expect children to act as miniature adults.
Treat the personality of little children with the same respect that would be given an adult.	Shame or ridicule a child into prescribed behavior.
Remember that a busy child tends to be a happy child.	Provide one activity at a time only.
Not only accept a child's feelings, but also help him express them so the desirable feelings can take the place of negative ones.	Fail to provide opportunity for him to express negative feelings in a constructive way.

Do This	Not This
Set the stage for constructive play, so that participation is possible and attractive for children.	Make it difficult for him to participate by having to use carelessly mixed easel and finger paints, inadequate materials.
Respect and appreciate differences in performance among individual children.	Encourage competition among the children or respect only those children who excel in certain ways.
Give child opportunity for responsibility.	Do all complicated jobs for the child.
Be willing to make adjustments in the schedule to meet immediate interests.	Have too definite a schedule.
Direct child toward another activity if he is upsetting the group.	Scold him for being uncooperative.
Enter situation where quarrel is brewing and help children to settle difficulties themselves.	Decide for the children what should be done.
Remember your promise that the child who needs a scarce item will have a turn, see to it that he does have a turn very soon.	Allow each child to look out for himself.
Attempt to show without punishing or scolding, that blocks, for example, are for building, not for throwing, except in special cases.	Threaten the children because they are incorrectly using the blocks.
Assist children in putting their things away, e.g., "We need to put our blocks away, because we will soon be going home!"	Command the children to take over the task.
Assure the child of acceptance and approval whether he is a success or failure.	Encourage an atmosphere of competition and being first among children.
Respect the personality of each child.	Form the habit of labelling behavior as good or bad and using these terms.
Carry out routines without evident fuss, commands, or tense preparation.	Use command and expect sudden adjustment to new activity.

Do This	Not This
Avoid using pressure in introducing children to new experiences. If one child does not want to join the group he may play quietly away from it.	Make an issue about the child who refuses to join the group.
Have patience; children make many mistakes when they are trying to learn.	Blame children for making mistakes.
Frequent punishment is unwise; use it cautiously.	Believe punishment can have the opposite effect of reward.
Remember that the experience play school gives can only be supplementary to life at home.	Try to place too much responsibility for a temporary experience.
Remember it is easier to prevent problems rather than try to cure those which have occurred.	Fail to set the stage for constructive activity (adequate space for block building, etc.)
Remember that the child learns through enjoyable activity.	Allow dissatisfaction to be the result of activity.
Give opportunity for children to express their feelings.	Have behavior problems as a result of bottled up feelings.
Offer a substitute when a squabble begins to brew over use of a toy. For example, "Can't we find a special toy for Janie?"	Expect disputes to be settled according to adult standards.
Set the stage and plan arrangements so that the child enjoys being with others.	Make sharing an issue in itself.
Realize that many difficulties children get into are a part of growing up.	Scold and be cross when certain difficulties arise.
Realize that children need positive help, such as genuine praise.	Be critical and set impossibly high standards.
Help children want to take responsibility by making certain kinds of activity fun. For example, make a game of helping them pick up blocks.	Challenge his ability.

Evolving Principles or Generalizations

Because of the enormous information which is available, generalizations must be evolved. No one individual can retain more than some selected generalizations that might be expected to apply to most situations. To test the validity of a generalization, it must meet specific criteria:

must be clearly stated
must be true
must be significant enough to influence behavior
must apply in most situations

The teacher is faced with the question of how to teach principles or generalizations. This can best be accomplished by means of the problem-solving method. Case situations from filmstrips, films, and books can be presented and pupils encouraged to discuss their ideas of desirable solutions to the problem. From these solutions, a general statement can usually be formulated. The test of whether it is a generalization is to try whether it applies to two or three other, but similar situations.

After student acceptance has been achieved, the teacher should arrange that periodically these generalizations can be applied in new situations. Only through the three steps of problem solving can principles or generalizations become working knowledge for each student.

Generalizations to Support Selected Objectives

The following material presents only some of the generalizations to develop the selected objectives.

Objective

1. To better understand how growth and learning take place in young children.

Generalizations

a. A relaxed atmosphere is conducive to learning in a play school.
b. Young children learn by example, imitation and experimentation.
c. The attention span of young children is short; however certain kinds of activity encourage a longer playtime.
d. Toys can be made to encourage learning if they have the following characteristics: safety, sturdiness, suitability for age, interests, and abilities; stimulating to active participation on the part of the child.
e. Each individual faces particular needs as he grows and matures.
f. Simple stories about familiar things help a young child to better understand his world and the people in it.
g. A child learns through having a variety of play materials: for large muscular development, for sensory, experience, for developing his imagination, for engaging in dramatic play, for stimulating interests.
h. Growth and development follow an orderly sequence.
i. Each child has his own individual rate of learning.

Objective

2. To provide a good environment for children in the play school.

Generalizations

- a. Children should not be interrupted in their play as long as they are achieving some degree of success and not interferring with others.
- b. Children like to engage in different types of play according to their particular stage of development.
- c. Young children frequently engage in parallel play.
- d. Shifting play groups are characteristic of the pre-school child.
- e. A good schedule provides for alternating periods of active and quiet play.
- f. Dramatic play will take place both inside and outdoors if appropriate materials and climate are provided.
- g. Dramatic play fosters good mental health by providing opportunity for a child to express his feelings, protest against certain conditions, and better understand adult roles.
- h. Acceptance of children by both teacher and students is the first requisite in setting the stage for constructive play.

Objective

3. To help students realize why children behave as they do, to learn to see things from a child's point of view, and thereby guide children more intelligently.

Generalizations

- a. There is always a reason why a child behaves as he does.
- b. The same behavior may result from causes which are entirely different.
- c. The same cause may produce behaviors which are entirely different.
- d. Most children are sensitive to the feelings of people in their environment.
- e. Children often appear stubborn and negative in an atmosphere of hurry and pressure.
- f. Bad feelings need to be expressed before a child can be expected to have good feelings.
- g. Children need to express their feelings but they also need guidance in directing their feelings into constructive channels.
- h. In order to help a child, it is most desirable to deal with causes rather than external symptoms.
- i. Each stage of growth has particular characteristics.

Case Situation

Objective: To better understand how growth and learning take place in young children.

Generalizations: Young children learn by example, imitation and experimentation. A child learns through having a variety of play materials: for large muscular development; for sensory experience; for developing his imagination; for engaging in dramatic play; for stimulating interests.

John is playing at the ladder bar, falls to the ground, and gets a slight scratch on his knee. It has taken John longer than the other children to feel at ease on the ladder bar. Select the procedure which you think it would be wise for the teacher to follow. Place an X to the left of the statement or statements which you choose.

__1. Smile and say, "That's right; up you come," as he examines the scratch and asks for a bandaid like his mother uses at home, say "That's right, we do need some merthiolate and a bandage!"
__2. Say, "Mean--bad ladder bar!" "We will play somewhere else."
__3. If he cries, tell him to stop crying. When he asks for a bandage, ignore his request and scold him for being careless.
__4. Show John how to hold on and swing his feet so that he will not be as likely to fall next time. With a little help, enable him to experience success.
__5. Be abrupt with John while placing the bandage. Also spend time talking about how terrible this accident might have been.

Objective: To help students realize why children behave as they do, to learn to see things from a child's point of view, and thereby guide children more intelligently.
Generalizations: Bad feelings need to be expressed before a child can be expected to have good feelings.
Children need to express their feelings but they also need guidance in directing their feelings into constructive channels.

A field trip to the neighboring farm had been planned for a week and the children came to school with the intention of going. Unforeseen circumstances over which the teacher had no control prevented the group from going to the farm. One child named Kenneth, who had many pressures at home, was much more disturbed than anyone else concerning the change plans. Following the news, he hit the teacher and started tormenting the children. Place an X in the column to the left of those sentences which you feel would be helpful to the teacher in handling this situation.

__1. The teacher, after taking Kenneth to her lap, said "It looks as though you are feeling mean. It's all right to feel mean. I know you are angry with me because I told you we couldn't go to the farm today. I know how you feel."
__2. The teacher said, "Let's play nicely today--you didn't really want to go to the farm."
__3. The teacher has the janitor go to the special storage room early in the morning and bring a surprise which is a group of car seats for bouncing which the children have not used for a long time.
__4. The teacher said to Kenneth, "You are a naughty boy because you hit the teacher and bothered a part of the group.
__5. The teacher constructed the play situation with blocks in order that Kenneth might play with two children with whom he liked and got along well.

EQUIPMENT FOR PLAY SCHOOL

If kindergarten tables and chairs are available from within the system or from a near-by church school, one big problem of equipment is taken care of. If such equipment is not available, the boxes, orange crates, benches made from boards or children's chairs brought by class members, may be the answer.

Booklets of play school equipment may be of help in getting assistance from the industrial department in making some simple equipment. After several years of conducting a play school, several suitable pieces might be collected.

From the compiled list of equipment the class must decide what is essential equipment and what are some of the articles and equipment that will make the play school more interesting and contribute to the greater development of the children:

Needed Equipment

Basic Furnishings:
- Toilets equipped with step arrangement for children.
- Two to six tables.
- Twelve chairs.
- Boxes for storage toys.
- Two wash basins or washing facilities in or near the room.
- Rag rugs for resting, or placing heads on table for resting.

Play materials:
- Easel painting paper, newsprint 18" x 24", wrapping paper, or back side rolls of old wall paper.
- Easel and paint--red, yellow, and blue.
- Shelf paper and finger paint.
- Aprons or smocks which girls can make out of daddy's old shirt or plastic.
- Paint brushes.
- Old pie tins, spoons, and sifters to be used in play with marbled sand and in dramatic play.
- Dress up clothes--hats, shoes, purses, etc.
- Books and scrapbooks.
- Blunt scissors.
- Colored chalk.
- Sand or salt.
- Clay.
- Three dolls.
- Colored construction paper.
- Paste.

For outside use:
- Wooden sawhorses and kegs.
- Boards and packing cases for playhouses, boats, and cars.
- Hollow blocks (5½" x 11" x 11") for furniture or seats on trains.
- Supplementary toys to enrich block play; cigar box trains.
- Old car steering wheel mounted on a wooden block.

Transportation toys--source, cheesebox
Wedgies and standpatters--source, clothespins on wooden bases
Airplanes--source, clothespins
Sandbox made from tractor tires, plenty of shovels, pie tins,
   large strainers and cans with edges smoothed
Provision for water play--large tub with floating toys
Bouncing apparatus such as old car seat

Be Resourceful

With such a variety of suggestions for equipment for the play school, the initiative and creative ability of every class member can be challenged. A class requirement might be that each member contribute either a piece of equipment or work in a committee to prepare and be in charge of some type of activity.

Securing Needed Equipment

Visit to the local junk yard

Tractor tires make excellent sand boxes and provide opportunity for parallel play. More than one tire can be used with a group of eight children. Two or three children can play in one tire.

Old inner tubes with a leak and pieces of old hose may be used for dramatic play. These materials when combined with an old pump provide excellent opportunity for children to assume various roles in dramatic play. Such activity can last for as long as twenty-five minutes with the same children participating. In fact, this activity is so popular that two sets of such material is recommended for eight or nine children.

Old car seats provide experience in active jumping and bouncing. The children will like to take turns bouncing and will enjoy playing "follow the leader."

A steering wheel or old car wheel can be mounted on a wooden block. The wheel will need a shaft 25 inches long. One-half inch water pipe can be welded on the wheel for the shaft. After the wheel and shaft are attached to a box, a crutch tip on the end of the shaft will guard against cuts from the end of the shaft. An old radiator cap on a round block of wood can be nailed to top of the box for realism. Hand tools are adequate for all the work needed to make this simple toy. An entire car without wheels can be made for $3.00.

Visit the local paint store

Broken lots of wallpaper can be used for easel painting and coloring with crayons. Many dealers are glad to give away broken lots which they do not plan to re-stock. Old wallpaper books furnish material for paper-cutting and pasting.

Visit the school cafeteria

Obtain large size cans (No. 10) which can be used for drums. Large glass containers may also be secured for storage of finger paints, easel paints, etc.

Band Instruments at Little Cost

Maracas can be made by persons saving old light bulbs and the cardboard rolls from inside toilet tissue. With these two items, plus a package of paper mache, eight or nine instruments can be made in a short time. The socket end of the light bulb is broken off and the roll from the toilet tissue inserted. The bulb and roll are entirely covered with paper mache. When the maracas is thoroughly dry, it is necessary to break up the light bulb section with a hammer. The glass then makes for an attractive sound. Girls will like to decorate each maracas with attractive paints, etc.

Rhythm-paddles can also be fun. Have your [illegible] make [illegible]. Another easy way is to buy enough [illegible] wood for each child to have his own paddle. Enough [illegible] for eight or nine children would cost about fifteen cents in some hardware stores. Dimensions of each paddle should be approximately 3" x 4" and can easily be cut out of scrap lumber by the Industrial Education Department. Girls would have fun painting the paddles, [illegible] for each paddle, and applying simple decorations.

Xylophones may be [illegible] and excellent opportunity provided to experiment with sound when glass milk bottles are filled with varying amounts of water and tapped with a spoon.

Drums may be made from old pieces of inner tube, [illegible] cans open at both ends, a large needle, and cord for lacing. Children may bring pieces of inner tube from home which is pulled tightly over each end of the cans. These sections of inner tube are then laced between the ends of the cans.

Tambourines can be made from paper plates, jingle bells, large needle and heavy cord. Two paper plates are placed so as to have their sides [illegible], joined together with [illegible] needle and jingle bells at both top and bottom of plates.

Toys Can Be Evaluated

Name ____________________

RATING SCALE

Score each toy for evaluating the suitability of toys for children: 1 is superior; 2 is adequate; and 3 is poor

1	2	3	Score
Safety Rough edges, sharp edges and corners, poisonous paints, small pieces that can be swallowed or put in ears and nose.		Smooth edges, blunt edges, rounded corners, non-poisonous paints, large pieces	______

Durability Easily broken, chipped or bent	Solid pieces, not easily chipped or bent.	____
Decoration Poor paint, material falls apart, fades in water	Easily washed, fast color	____
Attractiveness Dull, muddy color	Bright, clear colors; realistic (life like) in color and design	____
Suitability Mechanical toy does it only to be watched. Passive.	Leads to constructive play, stimulates child's interest, makes noise.	____
Size Too large and awkward to be handled by the child	Easily stored, small enough to be handled easily by a child but also large enough to be interesting to him.	____
Cost Too cheap, too expensive in relation to type of toy. Difficult to repair	Inexpensive in relation to value child may derive from it. Easily repaired.	____
Construction Flimsy, [illegible], corners likely to fall apart, loose screws	Sturdy, solidly built, nicely finished in corners, tight screws.	____

SCHEDULE OF ACTIVITIES

It is advisable to have a day, or better, two days, after the play school is equipped before the actual opening of the school. During the time when committees are at work, one committee works out a schedule for the play school period. In case there are two Family Living Classes, the morning sessions must be dovetailed with the foods or clothing laboratory sessions. An afternoon session of play school is not advisable as it will mean that children will miss afternoon naps. However, if the Family Living Class meets in the afternoon, that may be the only time a play school can be scheduled. In this case, each class works out its individual schedule.

Example of Schedule

	A.M.	P.M.
Opening time Nurse Inspection	8:40	1:40
Bathroom Drink	8:40-8:45	1:40-1:45
Free indoor play	8:45-9:10	1:45-2:10
Rest--ready for lunch	9:10-9:15	2:10-2:15
Lunch period	9:15-9:30	2:15-2:30
Story telling or Records or Music or Movie	9:30-9:45	2:30-2:45
Walk or outdoor play	9:45-10:10	2:45-3:10
Drink and bathroom	10:10-10:15	3:10-3:15
Ready to go home	10:15-10:20	3:15-3:20
Class members put room into order	10:20-10:30	3:20-3:30

Preparation of Room

The arrangement of the activity centers of the play school must be given some consideration before articles begin to arrive. A rough sketch on the chalk board or on a large sheet of paper may be helpful. If an adjoining foods or clothing laboratory is available, more activity centers may be provided.

If the regular Family Living room is to be transferred into a play school, consideration must be given to the clearing out of the regular class room furniture.

ASSUMING RESPONSIBILITIES

A very important experience for the class members is to work out a class schedule of student observation and participation. After experience with several sessions of play school, it has been discovered that the play school session is more enjoyable and more profitable to the student if she participates for fifty minutes as well as observes for the same period of time.

Participation-Observation Schedule

Class members are scheduled for participation and observation before the play school starts. If there are few absences or schedule changes, the class schedule should work out quite satisfactorily. All members must understand the work involved in each job as set up. Two girls work at all jobs so as to inter-change at the end of the fifty minute period or to replace the one who is absent. A summary of duties for each job is worked out and placed on the bulletin board, thus serving as reference:

Date	Register Toilet	Lunch	Play School Schedule Housekeeping Corner	Boys Corner Large Equipment	Paints Color Clay	Recreation Stories Records
Participate						
Observe						

Attendance

The registrar has an important job. She must take roll, have the sheet of names of enrollees, parents' names, and addresses and telephone numbers in a convenient place so anyone can procure the sheets in case of an emergency. She must at all times keep her eye on the school enrollment. Of course the teacher also does this, but the registrar must feel the responsibility of being able to account for each child in attendance. This last requisite means that all class members have been instructed how to call and inform parents in case of an emergency. The teacher does the calling in most cases, but students need to know what to do in case the situation arose.

Attendance Sheet

Parents' Names	Address	Phone	Age	Child's Name	Girl's Name

Role of Observers

In order that class members can derive the greatest benefit from their observation periods, they need guidance in how to observe and what to look for. The observer should be seated on a low chair so she is on a level with the children. The observer should not disturb the children's activity by her movements or conversation with other adults, either observers or participants.

Hints for Observers

The observer should remain in the background, at no time giving any indication of amusement or making comments or conversation with the children. If the child asks questions of the observer, he should be answered in a pleasant matter of fact manner.

Observations should be completed during the observation period. It might be wisest to have observation sheets turned in at the close of each observation period.

Students observing the same child might find it interesting and help to compare observations. Opportunity should be provided for the discussion of observations.

Observation Record Sheet

Since high school students need much help in interpreting their observations as well as in preparing for their participation duties, play school should meet every other day or only two days a week.

The teacher needs to be present at all times, first to be of assistance in problems pertaining to the children and secondly to observe and make recordings of student observation and participation.

Observation Record

General Instructions

The chief object of your observation is to give you a greater knowledge and better understanding of little children. You can best gain this by (1) remaining in the background, giving no indication of amusement, making no comment, and starting no conversation with the children or with others; (2) locating your chair so you are not in the way of the children, and not hiding any of the playthings; (3) not disturbing their activity by either your coming or going.

A. What does the child do?

1. How many different activities does he engage in during the period observed?
2. How long does he engage in each activity?
3. Does he play contentedly and satisfactorily with others?
4. Does he play contentedly by himself?
5. With whom does he play?
6. What toys does he use?
7. Does he imitate someone else, or do others imitate him?
8. Is he enthusiastic in his play?
9. When he changes from one play to another, what reason do you see for the change?
10. What appear to be his favorite activities?

B. To what extent can the child help himself?

1. What personal care is he able to give himself?
2. What personal care that he should give himself is done for him?
3. Does he get out his toys?
4. Does he put them away?
5. Does he often say, "Do this"?

C. How does he act toward other children? (Give specific example.)

1. Is he bossy?
2. Does he interfere with the play of other children?
3. Is he selfish?
4. Is he generous?
5. Does he show off?

6. Is he shy?
7. Is he irritable?
8. Is he quarrelsome?
9. Is he sympathetic?
10. Does he tease and annoy others?
11. Is he cooperative?

D. What guidance measures did the teacher or mother use?

1. Did she give verbal instruction?
2. Did she tell the child to stop doing something? or,
3. Did she suggest he do something else?
4. Was corporal punishment of any type used? What? Was it desirable? What other means of discipline might have been used?

What conclusions do you draw concerning the characteristics of the child observed?

PLAY SCHOOL ACTIVITIES

In this section, some activities are presented and discussed with respect to a few of their values, needed student responsibilities, and materials.

Easel Paints

Values: Provides opportunity for gradual development of skill
Provides opportunity for the release of feelings and emotions
Provides opportunity for manipulation and experimentation with colors
Provides opportunity for freedom of movement

Materials

Non-poisonous, washable paint
Newsprint, wallpaper, or other large unprinted paper
Long brushes (3/4" x 1") and long handles (8")
Easel with rack and proper height
Aprons and smocks

Student Responsibilities

Display paintings on wall with each child's name on his picture
Limit the number of children who easel paint--recommended number to paint at one time is two
Avoid asking what child is making
Provide full colors, large paper, brushes, containers for paint so that each child has his own equipment
Avoid hurrying children to finish

Finger Paints

Values: Opportunity for experimenting with color and messing
Opportunity for expression of feeling and release of tension
Opportunity for maximum freedom of movement
Opportunity to experience a feeling of rhythm and real satisfaction
Opportunity to directly handle material of different consistency

Student Responsibilities

Arrange adequate table space
Limit the number of children who finger paint at one time to three children
Provide proper materials: adequate supply of finger paint; paper with wax-like surface
Provide for auxiliary materials, such as mops, sponges, and water
Display painting on wall with each child's name on his own picture
Avoid hurrying children to finish
Cover some types of table surface with oilcloth
Immerse shelf paper in water or use spong to wet paper
Smooth paper before child begins
Provide place where children may wash
Never ask what they are making

Materials

Aprons and smocks for children and students participating
Paper with slick surface
Deep pan for wetting paper
Non-poisonous paint, clear in color
Sponge for additional wetting of paper

Recipe for finger paint:

1 Cup Linit Starch	5 Cups boiling water	1/2 Cup soap flakes

Mix the starch with enough cold water to make a smooth paste. Add the boiling water and cook mixture until it is glossy. Stir in the dry soap flakes while the mixture is warm. Cool. Add vegetable coloring or powder color. Put into jars. This mixture will keep a week or longer if covered with a tight lid.

Blocks

Values: Opportunity to develope balance and coordination
Opportunity to grow familiar with sizes, weights, and shapes
Opportunity to provide basic play material
Opportunity to have experience with a medium which may stimulate dramatic play

Student Responsibilities

- Enforce simple rules concerning safety in use of blocks
- Point out to the children that a few may be removed from the shelf and carried at a time as needed for building
- See that children respect other people's building
- Provide adequate space for building
- Provide for accessory toys

Materials

- Blocks and accessory toys
- Cabinets for storage of blocks

Housekeeping Corner

Values: Provides opportunity for children to engage in dramatic play and to act how they feel

Children have a chance to better understand what it is like to be big, feel closer to adults, and look forward to assuming adult roles at a later time. In one house corner, a little girl, who was pretending to be the "mother," told the child who was playing "daddy" that she didn't like pouting "daddies." The little boy from the point of view of the teacher seemed to be in a good mood. This was not true through the eyes of the child.

Student Responsibilities

- Sit near the doll house corner and be aware of what the children are doing.
- Make it possible for the child who wants to play with the group but is unable to do so alone to be accepted.
- Redirect a few children to some other activity in case the house corner becomes too crowded.
- Re-arrange the house corner at certain times.
- Provide special activities, such as washing doll clothes, washing dishes, or giving the doll a bath.
- Allow their placing blankets and doll clothes on the floor, to be picked up later
- Discourage children climbing on furniture in house corner.

Materials

- Old clothes, furniture made out of orange crates and boxes, dolls, tables and chairs.
- Accessory toys, such as telephones, dishes, cooking utensils

Clay

Values: Provides opportunity for release of tension through pounding, etc.
Provides experience with a solid medium and makes possible alteration of shape and size
Stimulates constructive parallel play
Provides opportunity for children to enjoy each other, and exchange ideas

Student Responsibilities

Set the stage in terms of adequate space and clay
Provide protection for clothing
Encourage children to use clay at table
Avoid furnishing a model for children to follow
Sit so you will be on child's level and try to enjoy the progress of manipulation

Materials

Adequate amount of clay for each child
Aprons

Recipe for cooked clay:

Mix 1 cup flour and ½ cup corn starch with 1 cup cold water in large bowl or pan.

Boil 4 cups water and 1 cup malt in large-based pan.

Pour boiling water slowly into bowl mixture. Return milky-looking fluid to the pan and stir on low heat until thickened (3-5 minutes). Cool and stir in 4 - 5 cups of flour. Color now if using powder paint. Separate into batches for different colors. If vegetable coloring is used, add color before flour is added. It takes a considerable amount for a good color. Knead in 4 - 5 cups of flour, until correct consistency, pliable and soft, but not sticky.

This play-dough is spongier and less drying to the hands than uncooked salt dough. It is more usable in that you can add flour to it if it draws moisture due to weather changes while stored. If it becomes too stiff with flour from use or drying, work more water into the dough. It keeps indefinitely in a covered crock, pottery jars, foil-lined tin or pliofilm bag.

Note: Takes more water for Faultless.
Dissolve Faultless in more cold water; 1½ cup

Stories

Suggestions: Stories may be offered informally if children ask for them
See that children do not bring playthings or other books to the story group
Children who do not wish to listen to the story can find something else to do in the form of some quiet activity which does not distract the story group
A check list can be a motivating device for story-telling.

Check list

"Responsibility for Storytime"

Goals for Storytime	Excellent	Average	Needs Improvement
Mechanics			
1. Opportunity was provided for each child to sit comfortably in the circle and get ready to listen.			
2. The student was able to hold the book so that it was within the range of each child in the story group.			
3. The student seemed to have the essential points of the story well in mind.			
4. The story seemed to be a part of the student as she was able to look away from the book and communicate with the children.			
Selection			
5. The content of the story was familiar in the every-day life of the pre-school child.			
6. The children were able to enjoy the story through repetition, familiar phrases or rhythmic effects.			
7. The pictures or other illustrative material contributed to the enjoyment of the story.			
8. The length of the story was within the attention span of the particular age group.			
9. The story was one which increased the child's ability to listen.			
Feelings			
10. The experience was one which seemed to be enjoyed by the student.			
11. Ideas expressed by the children at the completion of the story showed appreciation, understanding or intellectual curiosity.			

Goals for Storytime	Excellent	Average	Needs Improvement
12. The student was able to use a positive approach in the event there was likelihood of a behavior difficulty.			

Music

Suggestions: Music is offered informally in connection with other activities.
There may be a scheduled music period each day.
Children who do not wish to participate in the music can find some other quiet activity.
Children at the age of three and 3½ years enjoy playing instruments like those in a band. They also like to march to good rhythm records.
Games which provide activity related to the familiar in the environment are lots of fun when accompanied by simple piano music and singing.
Interesting records can be used when a piano is not available.

Listening to Records

The following records are suggested:

Sunday in the Park
Muffin in the City
Muffin in the Country
Little Fireman
Little Grey Ponies

Source: Creative Playthings, Inc., 5 University Place, New York 3, N. Y.

Singing and Dramatic Play

Book needed: Songs for the Nursery School, prepared by Laura MacCartney. In this book there are found many interesting activities for children connected with simple piano music. Willis Music Co., Cincinnati, Ohio, $2.50

The series of records entitled "Childhood Rhythms" is excellent for dramatic play. When familiar subjects in the child's environment are used in the musical experience, each is free to interpret the music or dramatize in his own way. Write: Ruth Evans, Box 132, P.O. Branch X, Springfield, Mass.

Again, a check list may be an incentive for evaluation and motivation of students.

"Having Fun With Rhythms"

Goals for Rhythmic Activities	Excellent	Average	Needs Improvement
Individual Difference			
1. To what extent did the activity allow for spontaneity on the part of children in the group?			
2. Did the standards set by the students allow for individual differences in children?			
3. Was there evidence of children becoming tired of the activity or going out-of-bounds?			
Reward			
4. Was there appreciation on the part of the student of the performance or contribution to the activity on the part of the individual children?			
5. Was there opportunity for children to assume any leadership or offer suggestions as to the activity?			
6. Did the time for rhythms give the children opportunity to express their feelings? (Release of tension)			
Preparation			
7. Did adequate plans seem to be made toward having arrangements in order for the activity?			
8. Did students who participated with the children appear to enjoy the activity?			
9. Did there appear to be enough variety in the rhythmic activity?			
Type of Learning			
10. Had the children learned to associate a particular rhythm with special music?			
11. Did the student appear to emphasize the experience of doing rather than perfect performance?			

As can be seen, this year's program has been an [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible], [illegible] [illegible] [illegible], suggestions for [illegible] a play school, [illegible] of the [illegible], [illegible] [illegible], [illegible] of [illegible] [illegible], [illegible] for play school, [illegible] [illegible], and play school [illegible].

It is hoped that these suggestions prove helpful in your programs.

Finger Plays

Beverly's class of four-year-olds [illegible] [illegible] finger plays [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible]. [illegible] [illegible] [illegible] [illegible] [illegible] [illegible], [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] the [illegible] [illegible]. The children [illegible]. [illegible] [illegible] [illegible] [illegible], "[illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible]?" the children [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible]. [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] the children [illegible] [illegible] [illegible] [illegible] the [illegible] [illegible] [illegible]. [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible]. [illegible], [illegible] [illegible] [illegible] [illegible] the finger play, the children all [illegible], "[illegible] [illegible] [illegible] [illegible]."

The children also wanted to [illegible] one of their favorite finger plays. [illegible] [illegible] [illegible] [illegible] [illegible] [illegible]. [illegible] [illegible] [illegible], [illegible] [illegible] [illegible] [illegible] [illegible] of the [illegible] finger plays already learned by the children. It was fun to repeat their favorites.

For a discussion of values derived from finger plays, see the following, Finger Plays and How to Use Them, by [illegible].

Examples of Finger Plays:

Five Little Baby Mice

Five little baby mice
Snuggled in their beds
With the warm cover tucked right over their heads
Then all at once—they crawled out of bed.
Let's go out and see the world, they said.

Little Turtle

There was a little turtle
He lived in a box
He swam in a puddle
He climbed on the rocks.

He snapped at a mosquito
He snapped at a flea
He snapped at a minnow
He snapped at me.

He caught the mosquito
He caught the flea
He caught the minnow
But he didn't catch me.

Bunny Song

Here is a bunny, with ears so funny
And here is his hole in the ground
When a noise he hears, he pricks up his ears
And then he jumps into the ground.

Singing Games

For these singing games, children join hands in a circle and walk around to the music of the chorus. After the chorus, children stop and pretend to do activities in verses. Children may suggest various activities which are acted out with appropriate gestures. No attempt is made to insist that each child do exactly the same thing in the same way.

Here We Go 'Round the Mulberry Bush

1. Here we go 'round the mulberry bush
   The mulberry bush, the mulberry bush,
   Here we go 'round the mulberry bush
   So early in the morning.

2. This is the way we wash our clothes, etc.
   So early Monday morning.

3. This is the way we iron our clothes, etc.
   So early Tuesday morning.

4. This is the way we scrub the floor, etc.
   So early Wednesday morning.

5. This is the way we mend our clothes, etc.
   So early Thursday morning.

6. This is the way we sweep the house, etc.
   So early Friday morning.

7. Thus we play when our work is done, etc.
   So early Saturday morning.

Looby Loo

Here we dance Looby Loo,
Here we dance Looby Light,
Here we dance Looby Loo,
All on a Saturday night.

1. I put my right hand 'way in,
   I put my right hand 'way out,
   I give my hand a shake, shake, shake,
   And turn myself about.

2. I put my left hand in, etc.
3. I put my right foot 'way in, etc.
4. I put my left foot in, etc.
5. I put my head 'way in, etc.
6. I put my whole self in, etc.

VT003 185

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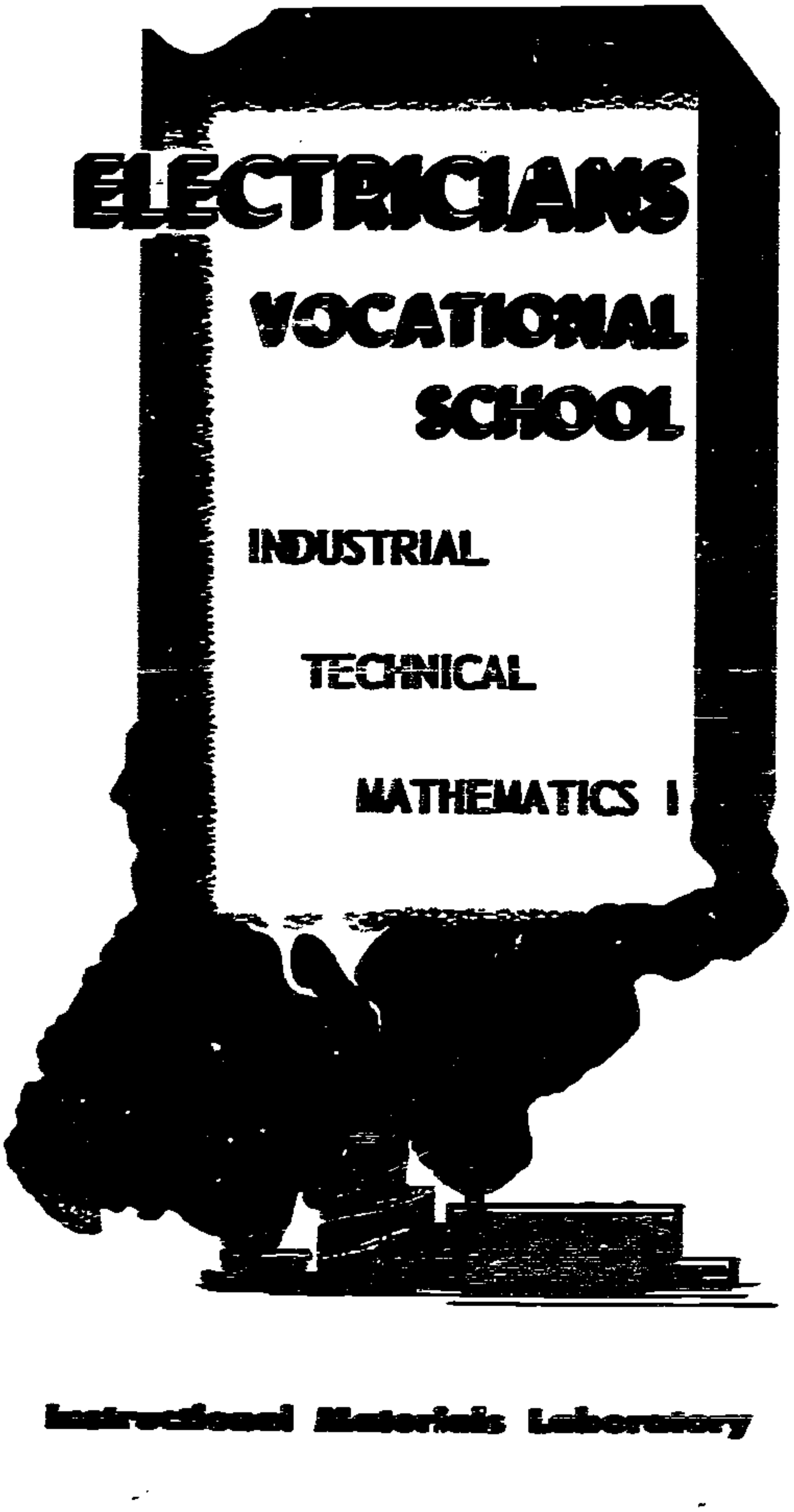
*STUDY GUIDES, *TRADE AND INDUSTRIAL EDUCATION, *ELECTRICIANS, *MATHEMATICS, TESTS, INDIVIDUAL INSTRUCTION, *APPRENTICESHIPS,

The purpose of the course, designed for apprentice programs, is to provide the necessary training in the fundamentals of mathematics needed by the electrician. This book of assignment sheets was developed by a vocational coordinator, a vocational director, and members of an electricians' joint apprenticeship committee. The course was designed around the concept and philosophy of using individual assignment sheets to allow each student to progress at his own rate and to enable the teacher to devote most of his time to individual instruction. Each of the 14 assignment sheets provides the student with the references, assignment, and technical terms. Tests, to be used to identify the mathematical ability of the student, and answer sheets are included for each assignment. This book is for teacher use only. The students are to use the assignment, test, and answer sheets in loose, unbound form. When the student completes an assignment sheet, he returns it to the teacher and secures the test. After taking the test, the student is given the next assignment sheet. This document is available for $1.05 from Division of Industrial Education, Indiana State University, Terre Haute, Indiana 47809. "Industrial Technical Mathematics II" (VT 003 188) is available. (HC)

VOCATIONAL

Trade – Industrial – Technical Education

STATE of INDIANA



ELECTRICIANS

VOCATIONAL SCHOOL

INDUSTRIAL
TECHNICAL
MATHEMATICS I

Instructional Materials Laboratory

INDUSTRIAL TECHNICAL MATHEMATICS I

for

ELECTRICIANS

Electricians Vocational School
Bloomington, Indiana

State of Indiana
Division of Vocational Education
Trade-Industrial-Technical Education Branch

Instructional Materials Laboratory
Trade and Industrial Education
Indiana State College
Terre Haute, Indiana

MEMORANDUM

TO: The ERIC Clearinghouse on Vocational and Technical Education
The Ohio State University
980 Kinnear Road
Columbus, Ohio 43212

FROM: (Person) Thomas E. Eachus (Agency) Vocational Instructional Materials Laboratory

(Address) Division of Industrial Education, Indiana State University, Terre Haute

DATE: August 5, 1967

RE: (Author, Title, Publisher, Date) Industrial, Technical Mathematics I for Electricians 1964

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PREFACE

This course in Industrial Technical Mathematics I for Electricians is designed for the apprentice electrician. The basic purpose or objective is to provide the necessary training in the fundamentals of mathematics as needed by the electrician. Additional advanced courses in the program will follow this basic course.

This book of assignment sheets is designed for the instructors use. Students are to use the assignment sheets in loose, unbound form. The individual differences of the students may be taken care of if the assignment sheets are used as described in "Directions to Instructor".

Appreciation is made to Delmas Vaughn, vocational coordinator of Bloomington High School; Joe Stradling, vocational director of Bloomington High School and to Russel Noel, Henry Richards, Lester Noel and Russel Isom, all members of the Electricians Joint Apprenticeship Committee of Bloomington. The coordinated and cooperative efforts of all made the development of this course possible.

DIRECTIONS TO THE INSTRUCTOR

This course was developed around the concept and philosophy of using individual assignment sheets. If these sheets are used correctly, each student will be allowed to progress at his own rate. The abilities of all will be developed to their fullest extent.

The instructor only, should use this book. The loose individual assignment sheets are used by the students. The following method of operation has proven satisfactory:

Each student should have two folders in the file; one for the "completed" work, the other for the "incomplete" work. The assignment sheets should be filed in consecutive order in another drawer. The instructor should lay out the student folders before class time. This prevents congestion and a bottleneck around the file cabinet at the beginning and ending of class. When the student completes an assignment sheet, he turns this into the instructor, then secures the next sheet.

Tests are included periodically. These may be used to identify the mathematical ability of each student. This makes it possible to start the students at the proper level in the course. The tests may also be used in the traditional manner.

If the course is used as it should be, the instructor will be freed of many routine activities and will be able to devote his time almost entirely to individual instruction.

It must be kept in mind that the assignment sheets are only a teaching aid or device. Necessary instruction is still necessary.

An accurate record of each student's progress should be kept by the instructor.

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TERRE HAUTE, INDIANA

ELECTRICIANS VOCATIONAL SCHOOL

INDUSTRIAL TECHNICAL MATHEMATICS-I

SUBJECT: Whole Numbers

Assignment M-I-1

Remarks and Purpose ____

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____

Reference: 1. BASIC MATHEMATICS SIMPLIFIED-C. Thomas Olivo; Albany, New York: Delmar Publishers, Inc.; Fourth Edition Dated Feb. 1955, Volume I.

2. PRACTICAL PROBLEMS IN MATHEMATICS-ELECTRICAL TRADES; Delmar Publishers, Inc.; Albany, New York.

Assignment: 1. Addition of Whole Numbers
- a. Read pages 1 through 5 in reference #1.
- b. Work problems 1, 2, 6 on page 7 of reference #1.
- c. Work problems 1, 2, 5, 6, 8, 10, 12 on pages 1 and 2 of reference #2.

2. Subtraction of Whole Numbers
- a. Read pages 8 through 10 in reference #1.
- b. Work problems 2, 4, 5, 7, 9, 11, 13, 15 on pages 3 and 4 of reference #2.

3. Multiplication of Whole Numbers
- a. Read pages 13 through 16 in reference #1.
- b. Work problems 1, 2, 3, 4, 7 on page 5 of reference #2.

4. Division of Whole Numbers
- a. Read pages 19 through 22 in reference #1.
- b. Work problems 2, 6, 7, 8, 9, 10, 12 on pages 23 and 24 of reference #1.
- c. Work problems 2, 5, 8, 11, 15 on pages 6 and 7 of reference #2.

TECHNICAL TERMS

Whole Numbers

Arithmetical Processes

Computed Answer

Estimated Answer

Arabic System

Simplified Form

Expanded Form

SAFETY

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TERRE HAUTE, INDIANA

Test

ELECTRICIANS VOCATIONAL SCHOOL

INDUSTRIAL TECHNICAL MATHEMATICS-I

SUBJECT: Test on Whole Numbers   Assignment M-I T-1

Remarks and Purpose ____

Assignment: Work the following problems in the space provided on the answer sheet, and place your answers in the space provided.

1. In wiring eight houses the electricians find that they must install 68, 58, 89, 84, 72, 59, 69 and 57 outlets respectively. How many outlets must be roughed-in all together?

2. In the course of 4 months an electrician used the following switch outlet boxes on different jobs: 56, 9, 86, 36, 93, 105, 42 and 56. What is the total number used?

3. From 2 barrels of dry cells 325 cells were placed in the stock room, 45 cells were placed on the shelf in the show room and 18, 25, 30, 24 and 6 dry cells were sold. What was the total number of cells packed?

4. An electrical supply house purchased in separate lots 35, 40, 125, 200, 75, 90, 20 and 30 lbs. of solder. What was the total number of pounds of solder purchased?

5. A school has twelve electrical circuits which have a capacity of 545, 650, 750, 1820, 2462, 2571, 1360, 1540, 793, 1225, 330 and 793 watts respectively. What is the total number of watts consumed when all these circuits are being used under their total loads?

6. BX cable in the following amounts was used on an apartment house job: 625 ft., 785 ft., 75 ft., 140 ft., 310 ft., 325 ft., and 120 ft. What was the total amount used on the job?

7. An electrician took out of stock 500 ft. of BX cable on Monday; on Tuesday 250 ft.; and on Wednesday 750 ft. On Friday 339 ft. of BX were returned. How many feet of BX were used?

8. An inventory sheet showed 565 outlet boxes on January 1. On January 10, 145 were taken out of stock. On January 14, 35 were returned to stock. How many outlet boxes were left?

9. A 1000 ft. reel of fairly large R.C. stranded cable weighed 1106 lbs. Of this 365 lbs. were used on a certain job from the switch to the first pull box and 422 lbs. from the first box to the last box. How many pounds of wire were left on the reel?

80

10. At inventory time 435 lbs. of magnet wire for winding motors were checked as being available. In ten successive days, the following number of pounds of wire was taken out of stock; 15, 6, 24, 12, 3, 8, 17, 32, 16 and 13. How many pounds were left?

11. A supply house has 804 solenoids for 5 hp. G.E. motor controls. The clerk must reorder this item when the supply reaches 60. On January 1, 14 were sold; on January 16, 75 were sold. How many more can be sold before reordering?

12. A buyer was told he could purchase 70 screw drivers. He needed ten 4" lengths, twelve 6" lengths, twenty 8" lengths, twenty 10" lengths. How many heavy 24" length screw drivers can he buy and remain within his quota?

13. If two of these forms were used and the wire was of such a size that only 42 layers and 98 turns per layer could be wound, how many turns would there be in both coils?

14. If we were using in a building, sixteen 50 watt, nine 15 watt, twelve 25 watt, six 75 watt and four 100 watt lamps, how many watts are consumed when all the lights in the building are burning?

15. In a 182 ft. run of BX wiring the staples are placed 4 ft. apart. How many staples were used? Add one to the number of spaces. What did they cost per staple if the total cost was \$1.88?

16. A total load of 25,620 watts was distributed equally over 15 branch circuits. What would be the load per circuit in watts?

17. How many 250 ft. rolls of BX wiring are required on a job requiring 5250 ft.?

18. Two electricians worked a total of 640 hours on a job. Each worked on an 8 hour, 5 day week schedule. How many weeks did each man work?

19. Twenty-five hundred feet of BX cable were ordered, to be shipped in 250 ft. coils. How many coils were received?

20. The cost of 3600 insulated staples was \$6.30. What was the cost per standard package of one hundred?

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Test Answer Sheet

ELECTRICIANS VOCATIONAL SCHOOL

INDUSTRIAL TECHNICAL MATHEMATICS-I

SUBJECT: Test on Whole Numbers

Assignment M-I T-1

Date____________________

Name________________________

Class____________________

Score__________

Instructions: You are to place the answers for each problem of the test on this sheet. Also, show all the work in the space provided.

1. Answer__________________

2. Answer__________________

3. Answer__________________

4. Answer__________________

5. Answer__________________

SUBJECT: Test on Whole Numbers

6. Answer ____________

7. Answer ____________

8. Answer ____________

9. Answer ____________

10. Answer ____________

11. Answer ____________

SUBJECT: Test on Whole Numbers

12. Answer_______________

13. Answer_______________

14. Answer_______________

15. Answer (a.)_______________

(b.)_______________

16. Answer_______________

17. Answer_______________

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SUBJECT: Test on Whole Numbers

Assignment M-I T-1 Page 4.

18.

Answer________________

19.

Answer________________

20.

Answer________________

NOTE: Turn your test into the instructor as soon as it is completed.

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ELECTRICIANS VOCATIONAL SCHOOL

INDUSTRIAL TECHNICAL MATHEMATICS-I

SUBJECT: Fractions

Assignment M-I-2

Remarks and Purpose ____________________

Reference: 1. BASIC MATHEMATICS SIMPLIFIED-C. Thomas Olivo; Albany, New York: Delmar Publishers, Inc.; Fourth Edition Dated Feb. 1955, Volume I.

2. PRACTICAL PROBLEMS IN MATHEMATICS-ELECTRICAL TRADES; Delmar Publishers, Inc.; Albany, New York.

Assignment: 1. Addition of Fractions
- a. read pages 28 through 32 and pages 36 through 38 in reference #1.
- b. work problems 2, 3, 4, 8, 10, 13 on pages 9 and 10 in reference #2.

2. Subtraction of Fractions
- a. read pages 40 through 43 in reference #1.
- b. work problems 1, 2, 6, 8, 10 on pages 11 and 12 in reference #2.

3. Lowest Common Denominator
- a. review pages 36 through 38 in reference #1.
- b. work problems 1, 3, 5 on page 14 in reference #2.

4. Multiplication of Fractions
- a. read pages 47 through 50 in reference #1.
- b. work problems 1, 3, 5, 7, 10 on pages 15 and 16 in reference #2.

5. Division of Fractions
- a. read pages 54 through 56 in reference #1.
- b. work problems 1, 2, 4, 6, 8, 12 on page 17 in reference #2.

TECHNICAL TERMS

Common Fractions
Numerator
Denominator
Improper Fractions
Proper Fractions
Lowest Terms
Mixed Numbers
Cancellation
Lowest Common Denominator

SAFETY

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TERRE HAUTE, INDIANA

Test

ELECTRICIANS VOCATIONAL SCHOOL

INDUSTRIAL TECHNICAL MATHEMATICS-I

SUBJECT: Test on Fractions

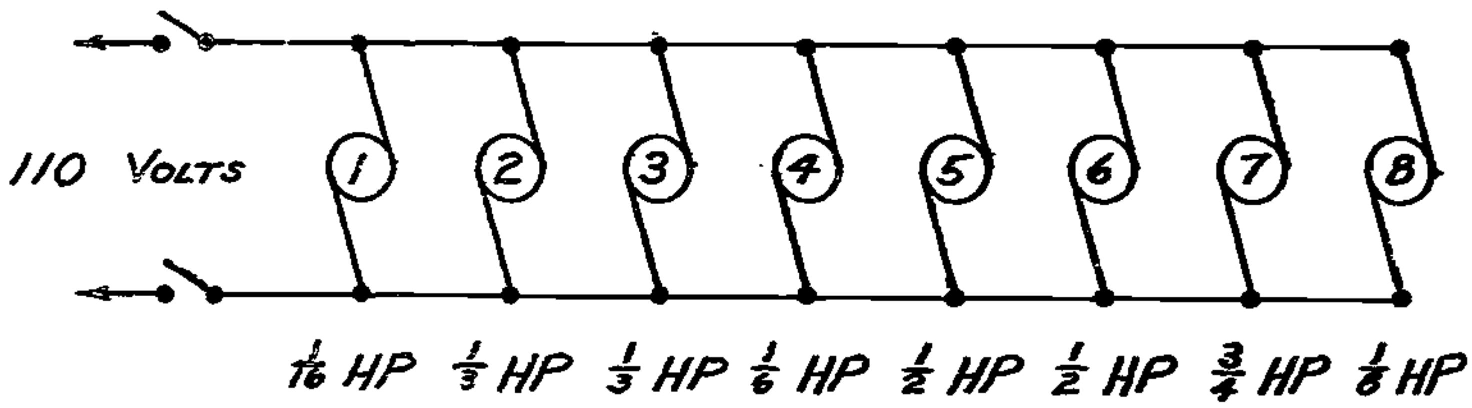
Assignment M-I T-2

Remarks and Purpose ______________________________

Assignment: Work the following problems in the space provided on the answer sheet, and place your answers in the space provided.

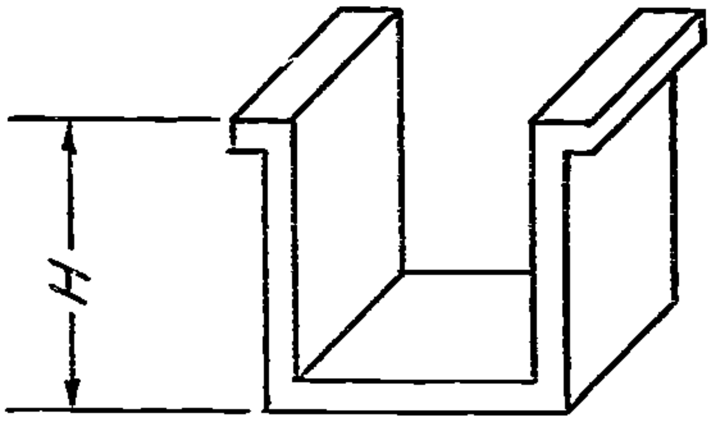
1. Eight motors, having rated horsepower as indicated on the diagram below, were connected in a circuit. What is the total horsepower of motors No. 1 to No. 4 inclusive?

2. What is the total horsepower of motors No. 5 to No. 8 inclusive, shown on diagram below?



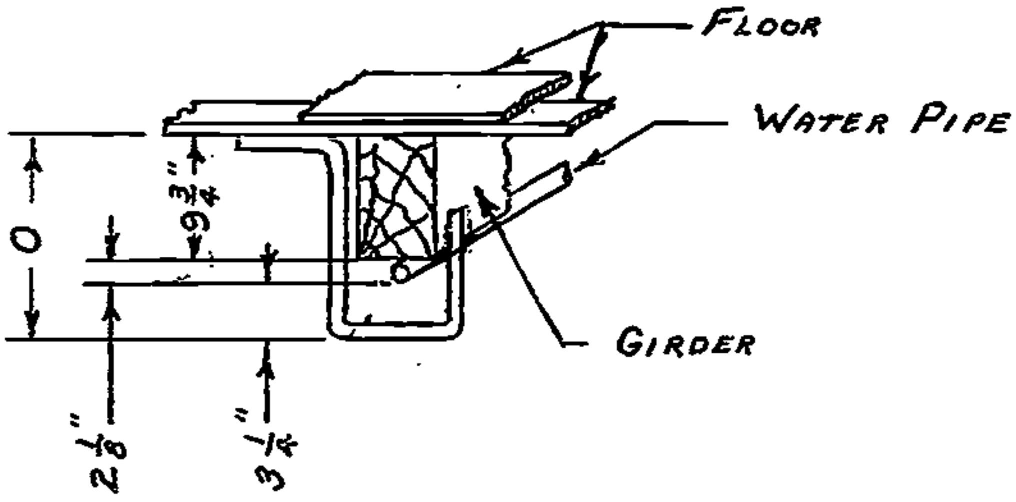
3. A piece of carbon 31/32" thick has a copper plating of 1/64" on each side. What is the total thickness?

4. On a theater repair job, it was found that a fixture had been hung from several pieces of wood spiked together. A bracket (see figure) was made to take the place of the wood. The wooden pieces were 7/8", 1 3/4", 2 3/4", 15/16" and 11/16" thick. What was the height, "H", of the bracket?



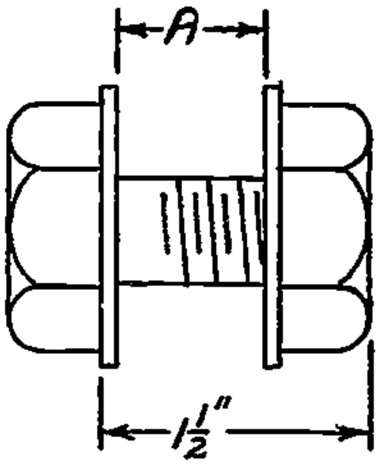
SUBJECT: Test on Fractions

5. Find distance O for bending electrical conduit in the figure.



6. What space on a bolt will six washers or spacers of the following thicknesses occupy: 1/16", 1/2", 1/8", 3/32", 3/64", 3/16"?

7. On a bolt 1 1/2" long under the head, were placed a 1/8" washer and a 3/32" washer. What distance (A in the figure) was left between the two washers after the 1/2" nut was screwed on to its full thickness?



8. If the same bolt (in the figure above) was inserted through a block 11/16" thick with the 1/8" washer, how much of the bolt would extend beyond the nut when drawn up tightly?

9. A slot in a piece of copper is too wide for a wire to be held in tightly. The slot is 5/32" in width and the wire 3/64". How much larger is the slot than the wire?

10. What is the lowest common denominator?
1/16, 3/4, 7/8, 31/32, 10/12

11. What is the lowest common denominator?
3/4, 8/12, 5/8, 5/9

12. If an electrician worked 4 3/4 hours a day on a certain job at $1.72 1/2 an hour, what was his pay for a 5 day work week?

13. A department in a factory had three 3/4 hp. (horsepower) motors, five 1/4 hp. motors, six 3 1/3 hp. motors and eight 7 1/2 hp. motors. What was the total connected motor load in horsepower rating?

14. A wiring job calls for thirty-two pieces of 1/2" conduit 7 1/2 ft. long, eight pieces 13 1/4" long, three pieces 7 3/4" long and six pieces 9 5/8" long. What is the total number of feet of 1/2" conduit required for the job?

15. An oblong coil has two sides 5 5/8" long and two sides 9 1/4" long with 1325 turns. What is the total length of the wire?

16. A coil of BX has 85 1/2 turns and an average diameter of 1 2/3 ft. Multiply the diameter by 3 1/7 to obtain the average length of each turn and then estimate the total length.

17. How many 7 3/8" pieces of conduit can be cut from a 10 ft. length?

18. A lot of bushings cost $3.69. If the price per bushing was 4 1/2¢, how many bushings were in the lot?

19. How many whole wedges 3 7/8" long can be made from 20 wedge strips, each 3 ft. long?

20. How many 16 3/8" lengths can be cut from a 10 ft. length of conduit?

21. If a spool of magnet wire was purchased for $7. 87, how many pounds did the spool contain if a pound cost 31 1/2¢?

22. A motor base must be blocked up 6 1/8". If two blocks are used one of which is 3 3/4", how thick is the other? (see figure)

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Test Answer Sheet

ELECTRICIANS VOCATIONAL SCHOOL

INDUSTRIAL TECHNICAL MATHEMATICS-I

SUBJECT: Test on Fractions

Assignment M-I T-2

Date____________________

Name________________________

Class____________________

Score____________

Instructions: You are to place the answers for each problem of the test on this sheet. Also, show all the work in the space provided.

1. Answer________________

2. Answer________________

3. Answer________________

4. Answer________________

5. Answer________________

6. Answer________________

7. Answer________________

8. Answer________________

9. Answer________________

10. Answer________________

11. Answer________________

SUBJECT: Test on Fractions

12. Answer________________

13. Answer________________

14. Answer________________

15. Answer________________

16. Answer________________

17. Answer________________

SUBJECT: Test on Fractions

18. Answer________________

19. Answer________________

20. Answer________________

21. Answer________________

22. Answer________________

NOTE: Turn your test into the instructor as soon as it is completed.

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ELECTRICIANS VOCATIONAL SCHOOL

INDUSTRIAL TECHNICAL MATHEMATICS-I

SUBJECT: Decimals

Assignment M-I-3

Remarks and Purpose

Reference: 1. BASIC MATHEMATICS SIMPLIFIED-C. Thomas Olivo; Albany, New York; Delmar Publishers, Inc.; Fourth Edition Dated Feb. 1955, Volume I.

2. PRACTICAL PROBLEMS IN MATHEMATICS-ELECTRICAL TRADES; Delmar Publishers, Inc.; Albany, New York.

Assignment: 1. Addition of Decimals
- a. read pages 68 through 69 in reference #1.
- b. work problems 1, 2, 4, 6, 10 on pages 20 and 21 in reference #2.

2. Subtraction of Decimals
- a. read page 72 in reference #1.
- b. work problems 2, 4, 7, 10, 14 on pages 23 and 24 in reference #2.

3. Multiplication of Decimals
- a. read pages 75 through 77 in reference #1.
- b. work problems 1, 4, 7, 11, 16 on pages 26 and 27 in reference #2.

4. Division of Decimals
- a. read pages 80 through 81 in reference #1.
- b. work problems 2, 3, 6, 9, 12 on pages 29 and 30 in reference #2.

5. Conversion of Fractions
- a. read pages 82 through 83 in reference #1.
- b. work problems 2, 5, 10, 13 on pages 31, 32 and 33 in reference #2.

TECHNICAL TERMS

Divisor
Decimal System
Digits
Degree of Accuracy
Rounding Off
Pointing Off
Places
Per Cent
Dividend

SAFETY

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Test

ELECTRICIANS VOCATIONAL SCHOOL

INDUSTRIAL TECHNICAL MATHEMATICS-I

SUBJECT: Test on Decimals

Assignment M-I T-3

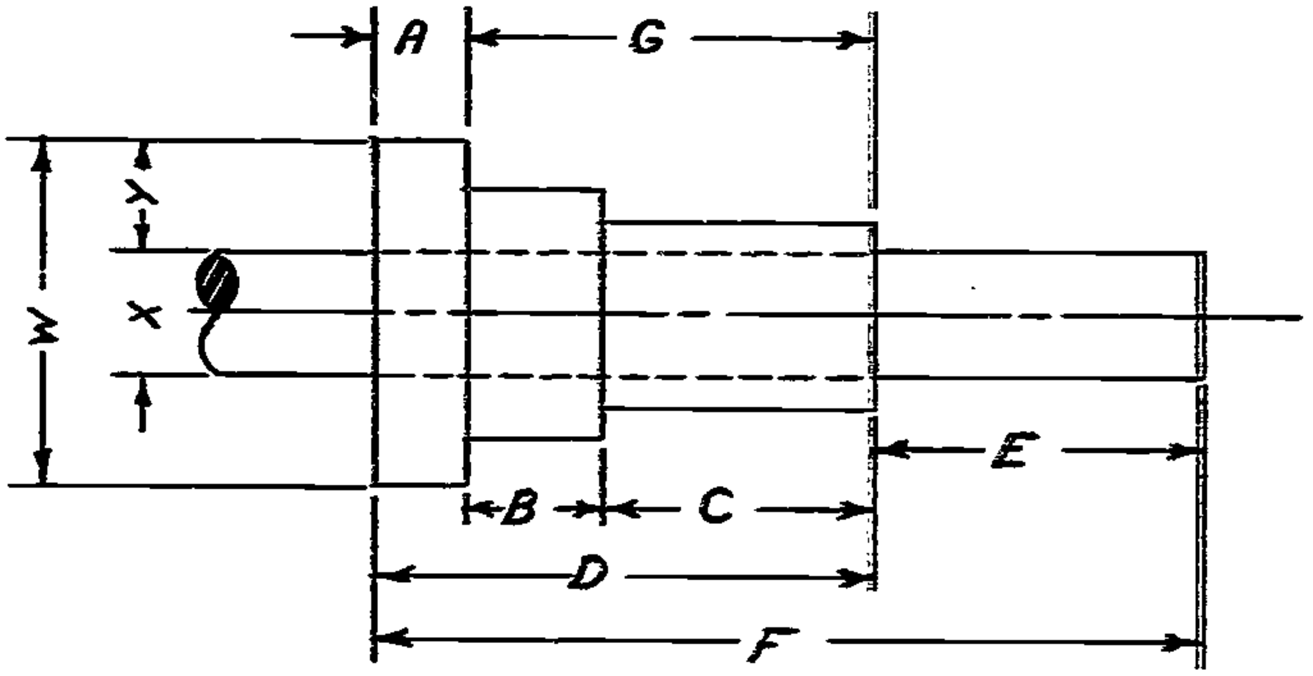
Remarks and Purpose ______________________________

Assignment: Work the following problems in the space provided on the answer sheet, and place your answers in the space provided.

1. What would be the cost of winding an automobile armature if it took 1 lb. of #16 E.S.C.C. (enamel single cotton covered) wire at $0.29; 1 pt. of insulating varnish at $.56; 2 oz. of Tufflex insulation at $0.20; top sticks; $0.08; 1/16" gray fibre, 2 oz., $0.20; 1/2 yd. varnished cambric $0.15; and labor for 2 hours $3.50?

2. A contractor required the following additional items for a certain job: BX cable $32.65; conduit pipe, $2.56; toggle switches, $24.45; loom boxes, $7.50. What was the total cost of these additional materials?

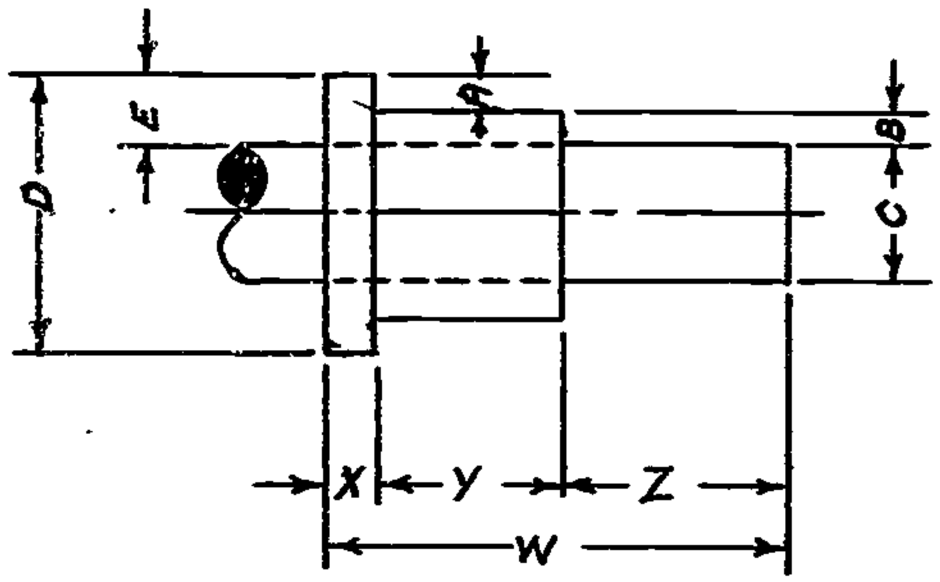
3. Refer to sketch. If A .375", B .875", C 1.0625", find D.



4. If X .9375" and Y .875", find W. (Refer to sketch)

5. A pin insulator measures 1.312" in diameter at the small end and 1.9375" at the other. What is the difference in diameter?

6. In the sketch below, if D=1.875" and C=1.250", find E.



7. In the same sketch, if X =.250", Y=2.0625" and W=3.375", find Z.

8. A wire is 72 thousandths of an inch in diameter. What number wire is it?

9. A motor shaft that was 1" in diameter has worn down to 996 1/2 thousandths. How much has the diameter been reduced by wear? Write your answer decimally and also in words.

10.. What would be the cost to operate this [illegible]

11. A commutator has a diameter of 2.375". What is the circumference of the commutator?

12. What would be the resistance of 2.5 mil ft. if the resistance of one mil ft. 10.4 ohms (unit of electrical resistance)?

13. What will 1750 ft. of BX cost at $.2475 per ft.?

14. If a dry cell delivers avout 1.375 volts, what voltage will 27 dry cells deliver, if connected in series? (In series connection the voltage is equal to the sum of the voltages of the cells).

15. If the power company charged a city $14.60 per street lamp per year, and 1125 street lamps were supplied with current, what would the city's power bill be, per month?

16. If it costs $938.50 for constructing 1/3 of a mile (5,280 ft. 1 mile) of an underground transmission system, what is the average cost of this job per foot?

17. If porcelain tubes cost $10.56 per M (thousand), what would be the loss to the school over a period of 27 school days if an average of 3 were broken per day?

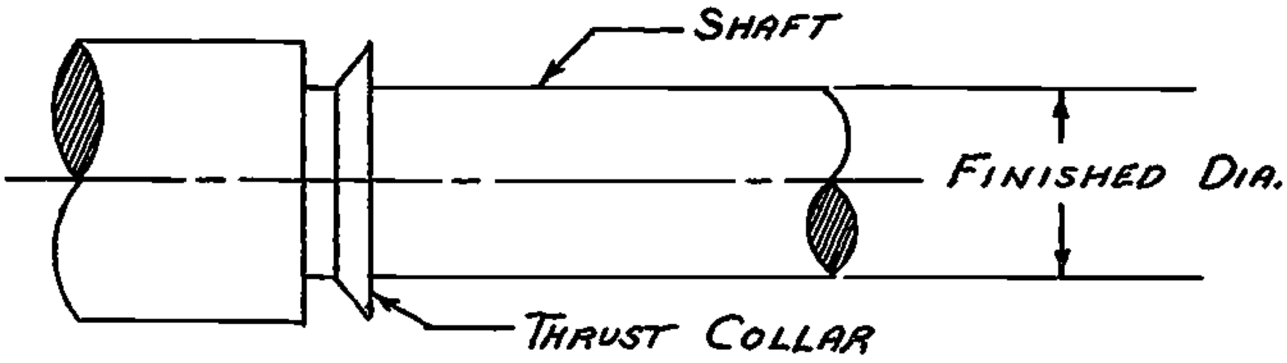
18. A panel board 28" in width is to have 7 holes spaced equally across it in a straight line. Each hole will be 1.25" in diameter, and the distance from the edge of the panel to the first and last hole will be equal to the distance between the edges of consecutive holes. What will be the spacing between holes?

19. A Christmas tree lighting set having 8 lamps in series will have about the same number of volts across each lamp. The number of volts across each lamp.will equal the voltage applied to the circuit (112.5 volts) divided by the number of lamps in the set. What is the voltage across each lamp?

20. Number four 0 (0000) cable (three conductor) weighs 3530 lbs. per M ft. What would be the weight (net) of a reel of this cable 475'-0" long?

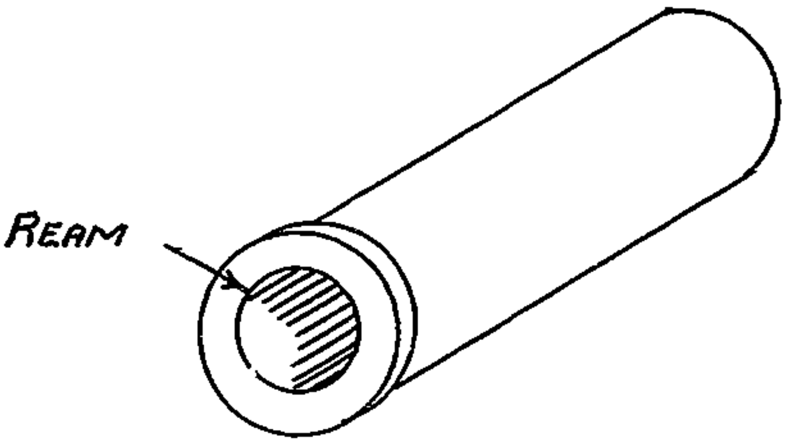
21. The weight of A. B. C. flexible #14-2 conductor cable is 145 lbs. per M ft. What would it cost to ship 600'-0" of this cable at 70¢ per hundred lbs.?

22. An armature shaft (see figure) originally 1 3/8" in diameter was turned 1/16" smaller in diameter due to the irregular surface caused by running in a dry bearing. What was the finished size of the shaft, expressed as a decimal?



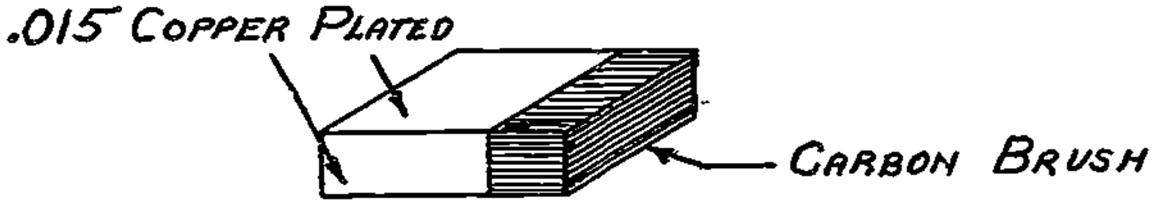
23. What size (expressed decimally) drill would you use to drill holes for bolting a meter to a switchboard, if the studs on the meter measured .4365"? The holes are to be 1/32" larger than the studs.

24. What fraction size reamer should be used to ream a hole in a motor bearing to fit a shaft that measures 1.625" in diameter? (See Figure)



25. A bearing with a diameter of 1 1/4" is found to be .008" oversize for the armature shaft. What should the bore (hole through center) of the bearing be, to fit the shaft? Allow .002" for lubrication.

26. A carbon brush (see figure) measuring 23/32" thick and 1 15/32" wide is to have a copper plating on the sides .015" thick. What are the finished dimensions?



27. A set of 2" wide x 5/8" thick carbon brushes fitted the brush holders too tightly. 5/1000" was taken off the width and .015" off the thickness by sanding. Give the dimensions of the width and thickness of the carbon brush after sanding.

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Test Answer Sheet

ELECTRICIANS VOCATIONAL SCHOOL

INDUSTRIAL TECHNICAL MATHEMATICS-I

SUBJECT: Test on Decimals

Assignment M-I T-3

Date________________

Name__________________

Class________________

Score____________

Instructions: You are to place the answers for each problem of the test on this sheet. Also, show all the work in the space provided.

1\. Answer_______________

2\. Answer_______________

3\. Answer_______________

4\. Answer_______________

5\. Answer_______________

SUBJECT: Test on Decimals

6. Answer____________

7. Answer____________

8. Answer____________

9. Answer____________

10. Answer____________

11. Answer____________

SUBJECT: Test on Decimals

12.

Answer______________

13.

Answer______________

14.

Answer______________

15.

Answer______________

16.

Answer______________

17.

Answer______________

SUBJECT: Test on Decimals

18. Answer________________

19. Answer________________

20. Answer________________

21. Answer________________

22. Answer________________

23. Answer________________

NOTE: Turn your test into the instructor as soon as it is completed.

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ELECTRICIANS VOCATIONAL SCHOOL

INDUSTRIAL TECHNICAL MATHEMATICS-I

SUBJECT: Simple Percentages

Assignment M-I-4

Remarks and Purpose ______________________________

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Reference: 1. BASIC MATHEMATICS SIMPLIFIED-C. Thomas Olivo; Albany, New York: Delmar Publishers, Inc.; Fourth Edition Dated Feb. 1955, Volume I.

2. PRACTICAL PROBLEMS IN MATHEMATICS-ELECTRICAL TRADES; Delmar Publishers, Inc.; Albany, New York.

Assignment: 1. Simple Percentage
- a. read pages 165 through 167 and 170 through 172 in reference #1.
- b. work all problems on page 35 in reference #2.

TECHNICAL TERMS

Discount ____________

Percent of increase

Percent of decrease

Base ____________

Rate ____________

SAFETY

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ELECTRICIANS VOCATIONAL SCHOOL

INDUSTRIAL TECHNICAL MATHEMATICS-I

SUBJECT: Interest and Discount

Assignment M-I-5

Remarks and Purpose ______________________________

Reference: 1. BASIC MATHEMATICS SIMPLIFIED-C. Thomas Olivo; Albany, New York: Delmar Publishers, Inc.; Fourth Edition Dated Feb. 1955, Volume I.

2. PRACTICAL PROBLEMS IN MATHEMATICS-ELECTRICAL TRADES; Delmar Publishers, Inc.; Albany, New York.

Assignment:
1. Interest
   a. read pages 170 through 172 in reference #1.
   b. work problems 1, 3, 6, 7, 9, 12 on pages 36 and 37 of reference #2.
2. Discount
   a. read pages 185 through 187 in reference #1.
   b. work problems 2, 4, 7, 10 on pages 38 and 39 in reference #2.
3. Compound Interest
   a. read pages 185 through 187 in reference #1.
   b. work problems 1, 2 on page 39.

TECHNICAL TERMS

Overhead
Depreciation
Average
List price
Multiple discount
Net price
First discount
Second discount
Simple interest
Compound Interest
Semi-annually

SAFETY

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Test

ELECTRICIANS VOCATIONAL SCHOOL

INDUSTRIAL TECHNICAL MATHEMATICS-I

SUBJECT: Test on Percentage and Discount — Assignment M-I T-4-5

Remarks and Purpose A knowledge of percentage is very useful and necessary in all walks of life. It is especially applicable to many phases of the electricians work. This is a check-up to see if you have mastered the fundamentals of percentage and discount.

Assignment: Work the following problems in the space provided on the answer sheet and place your answers in the space provided.

1. How much is 2 per cent of 25; 3 per cent of 15; $\frac{1}{2}$ per cent of 50?
2. What per cent of 80 is 8?
3. $2.00 is 5 per cent of how many dollars?
4. The input to an electric motor is 7 kw. If it delivers 7.1 hp., what per cent of the input is delivered?
5. A 15 amp fuse carried a 15 per cent overload for 3 seconds. What current flowed through the fuse during this time?
6. What is the efficiency of a transmission line if the power supplied is 4,500 watts and the power delivered is 4, 200 watts?
7. The National Electric Code specifies a maximum of 2 per cent voltage drop in a house line. What is the minimum voltage at a load if the supply voltage is 120 volts?
8. A solenoid exerts a pull of 0.9 lb. at its rated voltage. What pull is exerted at 85 per cent of its rated voltage?
9. The voltage lost in a line supplying a motor is 5 per cent of the generator voltage of 220 volts. Find (a) the voltage lost and (b) the voltage supplied to the motor.
10. The effective value of an a-c wave is 70.7 per cent of the peak value. What is the effective voltage of a wave which reaches a peak of 165 volts?
11. How many watts of power are lost in a transformer rated at 250 watts if 3 per cent of the energy is lost in heat?
12. If 100 ft. of a 250-ft. roll of wire has been used, what per cent has been used?

13. A motor has an output of 5 hp. This amount is 85 per cent of the power put into the motor. Calculate the power input.

14. The plate voltage on a radio tube may vary up to 10 per cent of its rated value and still be satisfactory. A tube rated at 200 volts has a plate voltage of 185 volts. Is this within the normal variation.

15. What per cent of the power taken by a transformer is delivered if it takes 200 watts and delivers 190 watts?

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Test Answer Sheet

ELECTRICIANS VOCATIONAL SCHOOL

INDUSTRIAL TECHNICAL MATHEMATICS-I

SUBJECT: Test on Percentage and Discount

Assignment M-I T-4-5

Date____________________

Name________________________

Class____________________

Score__________

Instructions: You are to place the answers for each problem of the test on this sheet. Also, show all the work in the space provided.

1. Answer____________________

____

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2. Answer____________________

3. Answer____________________

4. Answer____________________

SUBJECT: Test on Percentage and Discount

5. Answer________________

6. Answer________________

7. Answer________________

8. Answer________________

9. Answer (a)________________

(b)________________

10. Answer________________

11. Answer________________

12. Answer________________

13. Answer________________

14. Answer________________

15. Answer________________

NOTE: Turn your test into the instructor as soon as it is completed.

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INDUSTRIAL TECHNICAL MATHEMATICS-I

SUBJECT: Powers of a Number

Assignment M-I-6

Remarks and Purpose ____________________

Reference: 1. BASIC MATHEMATICS SIMPLIFIED-C. Thomas Olivo; Albany, New York: Delmar Publishers, Inc.; Fourth Edition Dated Feb. 1955, Volume II.

2. PRACTICAL PROBLEMS IN MATHEMATICS-ELECTRICAL TRADES; Delmar publishers, Inc.; Albany, New York.

Assignment: 1. Power of a Number
- a. read pages 292 through 294 in reference #1.
- b. work problems 1, 3, 5, 6, 8, 10, 13, 15, 17, 18, 19, 21, 23, 25, on pages 41 and 42 in reference #2.

TECHNICAL TERMS

W = watts - power
E = volts - pressure
I = amperes - current
R = ohms - resistance
Power
Factor
Like factors
Exponent
Exponential form
Factorial form
Raised

SAFETY

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INDUSTRIAL TECHNICAL MATHEMATICS-I

SUBJECT: Square Root

Assignment M-I-7

Remarks and Purpose

Reference: 1. BASIC MATHEMATICS SIMPLIFIED-C. Thomas Olivo; Albany, New York: Delmar Publishers, Inc.; Fourth Edition Dated Feb. 1955, Volume II.

2. PRACTICAL PROBLEMS IN MATHEMATICS-ELECTRICAL TRADES; Delmar Publishers, Inc.; Albany, New York.

Assignment: 1.Square Root
- a. read pages 305 through 308 in reference #1.
- b. work problems 1, 2, 4, 6, 8, 11, 12, 13, 15, 17, 19, 22, 24, 26 on pages 43, 44 and 45 in reference #2.

TECHNICAL TERMS

Radical symbol

Extracting square root

Squared

Perfect square

Approximation method

SAFETY

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Test

ELECTRICIANS VOCATIONAL SCHOOL

INDUSTRIAL TECHNICAL MATHEMATICS-I

SUBJECT: Powers of a Number and Square Root

Assignment M-I T-6-7

Remarks and Purpose ____

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Assignment: Work the following problems in the space provided on the answer sheet, and place your answers in the space provided.

1. Raise the following expressions to the power indicated:

   a. 8^2
   b. 10^2
   c. 8^3

2. If the volts were 220 and the resistance 3.6 ohms, how many watts would be used?

3. Solve the following expressions and carry the results out to two places:

   a. $\sqrt{169}$
   b. $\sqrt{892}$
   c. $\sqrt{2000}$

4. Five hundred fifty ohms, hot resistance, and 22 watts have a current of how many amperes flowing?

$$\text{Amps.} = \sqrt{\frac{22}{550}}$$

5. What current would be required in a circuit of 25 watts and 64 ohms?

$$\text{Amps.} = \sqrt{\frac{25}{64}}$$

6. When the resistance is 73.3 (hot) and the wattage is 165, what current would be necessary?

$$\text{Amps.} = \sqrt{\frac{165}{73.3}}$$

7. If a 250,000 C.M. cable is composed of 37 strands, what is the approximate diameter of each strand?

8. A 750,000 circular mil cable is composed of 61 strands of copper wire of equal size. What is the approximate diameter of one of the strands?

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Test Answer Sheet

ELECTRICIANS VOCATIONAL SCHOOL

INDUSTRIAL TECHNICAL MATHEMATICS-I

SUBJECT: Powers of a Number and Square Root

Assignment M-I T-6-7

Date____________________ Name________________________

Class____________________ Score__________

Instructions: You are to place the answers for each problem of the test on this sheet. Also, show all the work in the space provided.

1. Answer (a)____________
(b)____________
(c)____________

2. Answer________________

3. Answer (a)____________
(b)____________
(c)____________

4. Answer________________

5. Answer________________

6. Answer________________

7. Answer________________

8. Answer________________

NOTE: Turn your test into the instructor as soon as it is completed.

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INDUSTRIAL TECHNICAL MATHEMATICS-I

SUBJECT: Ratio and Proportion — Assignment M-I-8

Remarks and Purpose ________________________________

Reference: 1. BASIC MATHEMATICS SIMPLIFIED -C. Thomas Olivo; Albany, New York: Delmar Publishers, Inc.; Fourth Edition Dated Feb. 1955, Volume II.

2. PRACTICAL PROBLEMS IN MATHEMATICS-ELECTRICAL TRADES; Delmar Publishers, Inc.; Albany, New York

Assignment: 1. Ratio
  a. read page 279 in reference #1.
  b. work problems 1, 2, 3, 5, 8 on page 47 in reference #2.

2. Proportion
  a. read pages 282 through 285 in reference #1.
  b. work problems 2, 4, 5, 7, 10 on page 48 in reference #2.

TECHNICAL TERMS

Ratio
First term
Second term
Proportion
Extremes
Means
Direct Proportion
Indirect Proportion
Inverse order
R.P.M.
Driven gear
Driver gear

SAFETY

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INDUSTRIAL TECHNICAL MATHEMATICS-I

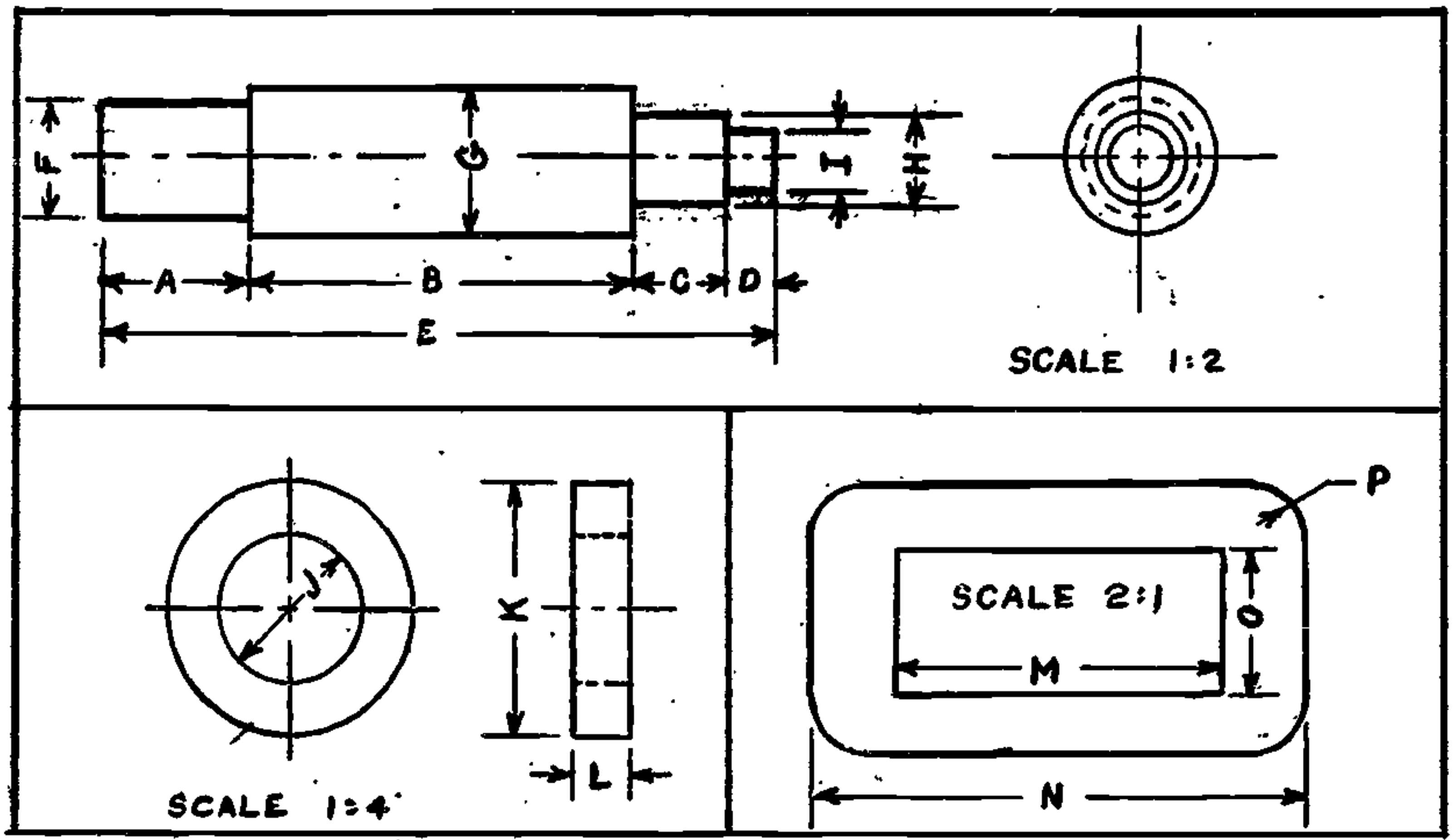
SUBJECT: Test on Ratio and Proportion

Assignment M-I T-8

Remarks and Purpose ______________________________

Assignment: Work the following Problems:

1. Measure the various lengths and diameters as shown on each drawing. Then, using the scale given for each drawing, compute the actual size.



2. What is the ratio of a pinion gear with 14 teeth to a driven gear with 72 teeth?

3. What is the inverse ratio of the r.p.m. of two motors if the first motor turns 1750 and the second turns 3500?

4. What is the ratio of two generators if the outputs are 3500 watts and 24500 watts respectively?

5. If an electrically driven sump pump discharges 125 gals. of water in 4.5 mins., in what time will it discharge 320 gals?

6. A wire 750 ft. long, has a resistance of 1.893 ohms. How long is a copper wire of the same area whose resistance is 3.156?

7. A wire 2725 ft. long, 85 mils in diameter, has a resistance of .372 ohms. Find the resistance of a wire of the same material 3600 ft. long.

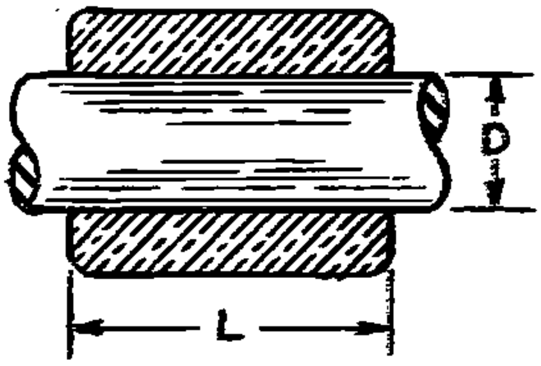
8. Four men did a certain electrical job in 120 hours. How long would it take three men to do the same type of job?

9. One hundred twenty feet of conduit cost $7.89. What would 250 ft. cost at the same rate?

10. A pinion driver gear has 24 teeth; the driven gear, 84 teeth. What is the ratio of the driver gear to the driven gear?

11. Give the ratio of a primary winding of 350 turns to a secondary winding of 17 1/2 turns.

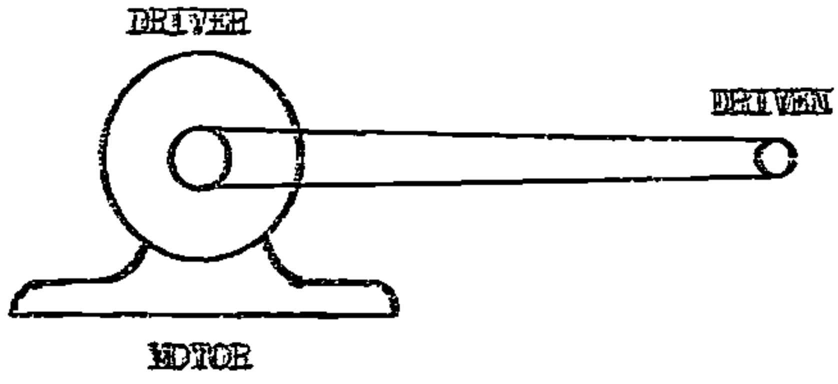
12. Determine the ratio of the shaft diameter (D) to bearing length (L) in problems A through E.



	Shaft Diameter	Bearing Length
A	1.000"	2 1/2"
B	.750"	1.500"
C	1.250"	3.750"
D	.312"	1"
E	.625"	1 7/8"

13. A wire that is 925 feet long has a resistance of 2.92 ohms. Determine the length of copper wire of the same area that has a resistance of 4.24 ohms.

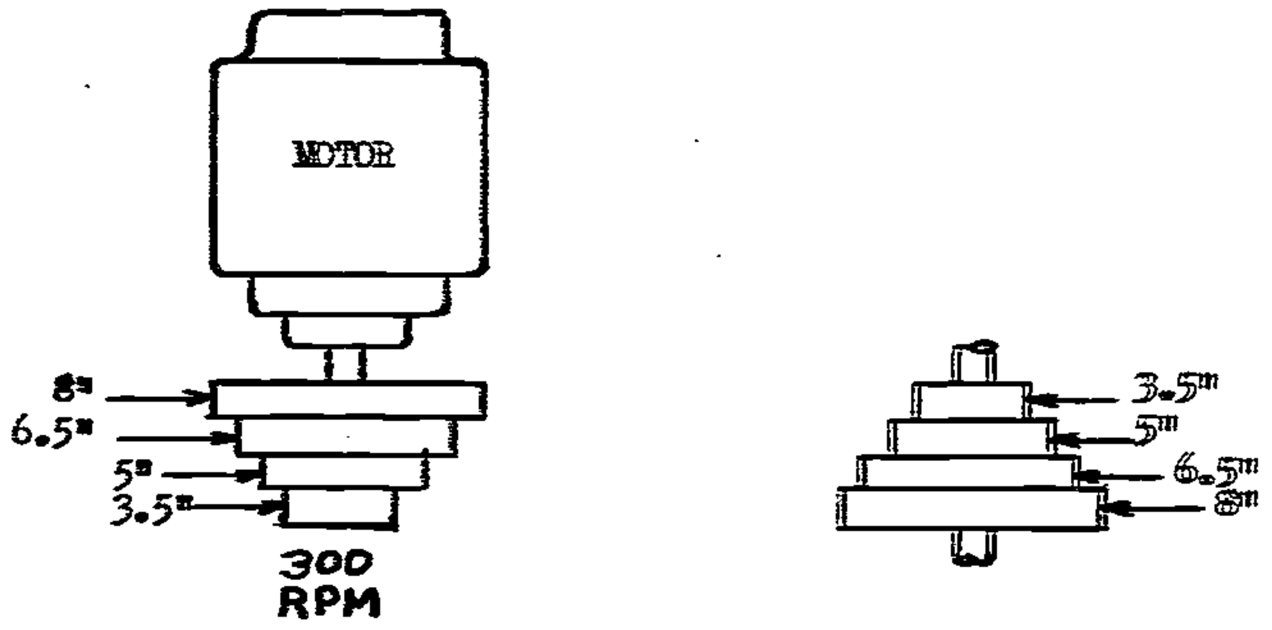
14. In the direct drive illustrated, the 4" drive pulley revolves at 1700 RPM. What size pulley is needed to increase the RPM of the driven pulley to 3200? Round off pulley diameter to nearest 1/2".



15. Compute the missing value for gears A through E.

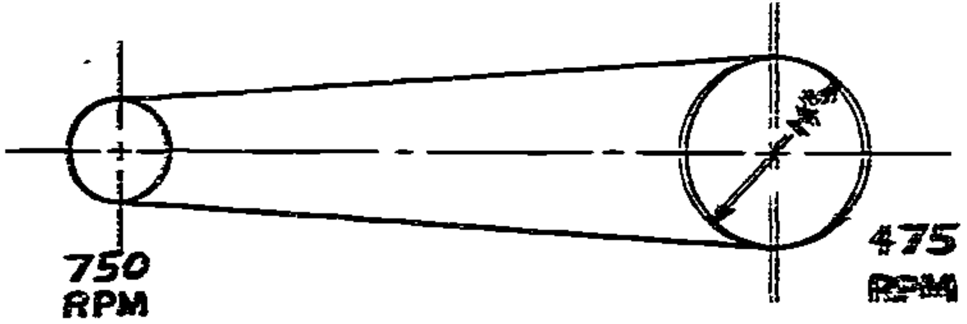
	No. Teeth in Driver	No. Teeth in Driven	RPM of Driver	RPM of Driven
A	24		200	150
B	56	72		300
C	8	36	70	
D		144	50	32
E	72	96	60	

16. Determine the spindle speed for each step of the step cone pulley and drive illustrated.



17. A crew of 12 men assemble 45 units a day. If the production is to be increased to 80 units a day, how many additional men will be needed?

18. Determine the diameter of the smaller pulley.



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Test Answer Sheet

ELECTRICIANS VOCATIONAL SCHOOL

INDUSTRIAL TECHNICAL MATHEMATICS-I

SUBJECT: Test on Ratio and Proportion

Assignment M-I T-8

Date____________________

Name________________________

Class____________________

Score__________

Instructions: You are to place the answers for each problem of the test on this sheet. Also, show all the work in the space provided.

1. Answer_______________

2. Answer_______________

3. Answer_______________

4. Answer_______________

5. Answer_______________

SUBJECT: Test on Ratio and Proportion

6.

Answer________________

7.

Answer________________

8.

Answer________________

9.

Answer________________

10.

Answer________________

11.

Answer________________

SUBJECT: Test on Ratio and Proportion

12. Answer (a)_______________

(b)_______________

(c)_______________

(d)_______________

(e)_______________

13. Answer_______________

14. Answer_______________

15. Answer (a)_______________

(b)_______________

(c)_______________

(d)_______________

(e)_______________

16. Answer_______________

17. Answer_______________

SUBJECT: Test on Ratio and Proportion

18.

Answer ____________________

NOTE: Turn your test into the instructor as soon as it is completed.

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ELECTRICIANS VOCATIONAL SCHOOL

INDUSTRIAL TECHNICAL MATHEMATICS-I

SUBJECT: Solution of Simple Formulas

Assignment M-I-9

Remarks and Purpose

Reference: 1. BASIC MATHEMATICS SIMPLIFIED-C. Thomas Olivo; Albany, New York: Delmar Publishers, Inc.; Fourth Edition Dated Feb. 1955, VolumeII.

2. PRACTICAL PROBLEMS IN MATHEMATICS-ELECTRICAL TRADES; Delmar Publishers, Inc.; Albany, New York.

Assignment: 1. Solution of Simple Formulas
- a. read page 323 in reference #1.
- b. work problems 1, 2, 3, 6, 7, 10, 11, 13, 14, 15, 16, 17, 18, 19, 21, 22, 25, 26, 30, 31, 33, 34, 35, 36 on pages 50, 51, 52, 53, 54, 55, 56 in reference #2.

TECHNICAL TERMS

Formula
Known quantity
Unknown quantity
Substitution
Literal value
Numerical value
Simplify
Horsepower
Lead pitch
Load center
Bars
Poles
Frequency
Percent efficiency
Resistance
Internal resistance
Electral motive force (e.m.f.).
Centigrade temperature
Fahrenheit temperature
Power factor (P.F.)
Impedance
Reactance

SAFETY

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Test

ELECTRICIANS VOCATIONAL SCHOOL

INDUSTRIAL TECHNICAL MATHEMATICS-I

SUBJECT: Test on Solution of Simple Formula   Assignment M-I T-9

Remarks and Purpose ______________________________

Assignment: Work the following problems in the space provided on the answer sheet, and place your answers in the space provided.

1. $R=\frac{KL}{d_2}$

When R = resistance
K = specific resistance of copper (10.8)
L = length in feet
d = diameter in mils

What is the resistance of 240 ft. of a 2-wire circuit using #10 S.B.W.P. wire with a cross-sectional area of 10,380 cir. mils?

2. $I=\frac{E}{R+r}$

When I = amperes
E = volts
r = internal resistance
R = resistance of external circuit

If a cell has an e.m.f. of 2.4 volts, an internal resistance of 0.03 ohms, and is connected to an electromagnet with a resistance of 1.5 ohms, what current will the magnet receive?

3. $I=\frac{E \times ns}{(r \times ns)+R}$

When E = volts of one cell
ns = number of cells in series
r = internal resistance of one cell
R = resistance of external circuit
I — amperes

If the internal resistance of five cells is 1.8 ohm each, and the cells are connected, as shown in the diagram, to a 2 ohm resistance, what current will flow through the circuit?

e.m.f. per cell 1.5 volts

4. R_3 is the unknown resistance of a wheatstone bridge arrangement. If R_1= 22 ohms, R =30 ohms, R_2=200 ohms, find the resistance of R_3 by substituting in the formula given below.

$$\frac{R}{R_2} = \frac{R_1}{R_3}$$

When R =) variable resistance
R_1 =) in arms of bridge
R_2 =)
R_3 = unknown resistance

5. $$HP = \frac{IE\ \%Eff.}{746}$$

When I = current in amperes
E = voltage in volts
%Eff. = %efficiency of motor
HP = horsepower

Find the current required by a motor when the horsepower, % efficiency of the motor and the voltage are known. Transpose the above equation to get the value of I.

6. What is the impedance of a coil with 3 ohms resistance and 12 ohms reactance?

$$Z = \sqrt{R^2\ X^2}$$

When Z = impedance
R = resistance
X = reactance

7. A 3-phase 3-wire circuit supplying power to several motors takes 275 amps. If the pressure is 220 volts and the power factor P.F. 80%, what is the kilowatt load?

$$KW. = \frac{I \times E \times 1.73 \times P.F.}{1000}$$

When KW = 3-phase power in kilowatts
I = current in amperes
E = pressure in volts
P.F. = % power factor

8. A 2-phase 4-wire circuit with an e.m.f. of 220 volts is connected to a group of motors that requires 85 amps. at 80% P.F. What will the load be in kw.?

$$KW. = \frac{I\ E \times 2\ P.F.}{1000}$$

When KW. = 2-phase power in kilowatts
I = amperes
E = volts
P.F. = % power factor

9. What would be the amps. in a 3-phase circuit when the load is 67.5 HP, 90% eff,, pressure 440 volts and 80% P.F.?

$$HP = \frac{I \times E \times 3 \times \%Eff. \times P.F.}{746}$$

10. What is the frequency (in cycles) of the current furnished by an alternator having 8 poles and running at a speed of 900?

$$f = P \times \frac{N}{60}$$

When f = frequency
P = number of pairs of poles
N = revolutions per minute

SUBJECT: Test on Solution of Simple Formula

Assignment M-I T-9

6. Answer________________

7. Answer________________

8. Answer________________

9. Answer________________

10. Answer________________

NOTE: Turn your test into the instructor as soon as it is completed.

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ELECTRICIANS VOCATIONAL SCHOOL

INDUSTRIAL TECHNICAL MATHEMATICS-I

SUBJECT: Ohm's Law

Assignment M-I-10

Remarks and Purpose ______________________________

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Reference: 1. BASIC MATHEMATICS SIMPLIFIED-C. Thomas Olivo; Albany, New York: Delmar Publishers, Inc.; Fourth Edition Dated Feb. 1955, Volume II.

2. PRACTICAL PROBLEMS IN MATHEMATICS-ELECTRICAL TRADES; Delmar Publishers, Inc.; Albany, New York.

Assignment: 1. Ohm's Law
- a. read page 323 in reference #1.
- b. work problems 1 through 14 on pages 57 and 58 in reference #2.

TECHNICAL TERMS

Potential (E.)

Ammeter reading (I.)

Volt meter

SAFETY

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Test

ELECTRICIANS VOCATIONAL SCHOOL

INDUSTRIAL TECHNICAL MATHEMATICS-I

SUBJECT: Test on Ohm's Law

Assignment M-I T-10

Remarks and Purpose ____________________

Assignment: Work the following problems in the space provided on the answer sheet, and place your answers in the space provided.

1. A neon electric sign draws $1\frac{1}{4}$ amps. If its resistance is 92 ohms, find the voltage needed.

2. What current is drawn by a 6,000 ohm electric clock when operated from a 110 volt line?

3. What is the resistance of a motor if it draws 5 amp from a 110 volt line?

4. A 110 volt line is protected with a 15 amp fuse. Will the fuse "carry" a 5.5 ohm load?

5. A voltage of 28.8 volts is required to send 7.2 amp of current through a wire 5 miles long. (a) What is the resistance of the wire? (b) What is the resistance per mile of a wire?

6. If a 0.6 ohm rail connector accidentally shorted the 12 volt system of a model railroad, what current would flow?

7. According to the National Electrical Code, No. 14 asbestos-covered type A wire should never carry more than 32 amp. Is this wire safe to use to carry power to a 10 ohm 230 volt motor?

8. A 600 watt soldering iron is used on a 120-volt line and has a resistance of 24 ohms. Find the current used.

9. What is the smallest number of insulators, each rated at 12,000 volts that should be used to safeguard a 220,000-volt transmission line?

10. Find the resistance of an electric furnace drawing 41 amp from a 230 volt line?

11. Find the resistance of an iron if it draws 3.8 amp from a 110-volt line?

12. The resistance of the field coils of a shunt motor is 60 ohms. What is the field current when the voltage across the coils is 220 volts?

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Test Answer Sheet

ELECTRICIANS VOCATIONAL SCHOOL

INDUSTRIAL TECHNICAL MATHEMATICS-I

SUBJECT: Test on Ohm's Law

Assignment M-I T-10

Date ____________________

Name ________________________

Class ____________________

Score __________

Instructions: You are to place the answers for each problem of the test on this sheet. Also, show all the work in the space provided.

1.

Answer ________________

2.

Answer ________________

3.

Answer ________________

4.

Answer ________________

5.

Answer (a) ______________

(b) ______________

SUBJECT: Test on Ohm's Law

6. Answer________________

7. Answer________________

8. Answer________________

9. Answer________________

10. Answer________________

11. Answer________________

12.

Answer________________

NOTE: Turn your test into the instructor as soon as it is completed.

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ELECTRICIANS VOCATIONAL SCHOOL

INDUSTRIAL TECHNICAL MATHEMATICS-I

SUBJECT: Power Formulas

Assignment M-I-11

Remarks and Purpose ______

Reference: 1. BASIC MATHEMATICS SIMPLIFIED-C. Thomas Olivo; Albany, New York: Delmar Publishers, Inc.; Fourth Edition Dated Feb. 1955, Volume II.

2. PRACTICAL PROBLEMS IN MATHEMATICS-ELECTRICAL TRADES; Delmar Publishers, Inc.; Albany, New York.

Assignment: 1. Power Formulas
- a. read page 323 in reference #1.
- b. work problems 1, 2, 3, 4, 5, 11, 12, 14, 15, 18, 19, 20, 22, 25, 27 on pages 59, 60, 61 and 62 in reference #2.

TECHNICAL TERMS

10.8 constant

Substation

Annunciator cable

Volt drop (e.)

SAFETY

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Test

ELECTRICIANS VOCATIONAL SCHOOL

INDUSTRIAL TECHNICAL MATHEMATICS-I

SUBJECT: Test on Power Formulas

Assignment M-I T-11

Remarks and Purpose ____________________

Assignment: Work the following problems in the space provided on the answer sheet, and place your answers in the space provided.

1. What would be the length of a copper wire 0.104" in diameter and having a resistance of 3.1 ohms?

2. What are the watts consumed in a circuit with an e.m.f. of 115 volts and a current of 7.5 amps. flowing?

$$W = E \times I$$

W = watts
E = volts (e.m.f.)
I = amps.

3. What pressure, in volts, is necessary for a circuit of 1625 watts and a current of 14.3 amps.?

$$E = \frac{W}{I}$$

4. What current will flow through a 550 watt electric iron when a pressure of 112 volts is maintained?

$$I = \frac{W}{E}$$

5. What is the current required in a circuit having a resistance of 26.5 ohms and 500 watts?

$$I = \sqrt{\frac{W}{R}}$$

6. What is the lost wattage in the armature of a generator having an internal resistance of 0.3 ohm and a pressure of 125 volts across its terminal?

NOTE: 6 volts lost in armature circuit.

$$W = \frac{E^2}{R}$$

7. What is the resistance of the coils of an electric bell if 0.25 amp. flows when a pressure of 2.8 volts is applied?

$$R = \frac{E}{I}$$

E = volts (pressure, e.m.f.)
R = resistance in ohms
I = current in amperes

8. What is the resistance of an electromagnet connected to a cell having an e.m.f. of 2.2 volts and a current of 0.3 amp. flowing through it?

9. Find the resistance of one conductor of an annunciator cable operating on a 12 volt circuit with a 1.2 volt drop and line current of 2 amps. The cable is 160 ft. long.

10. A 110 volt battery supplies current for signal lights and switch operation between 2 factory substations. The cable is composed of thirty #12 gage copper conductors. The length of the cable is 2200 ft. and the diameter of one conductor is 80.8 mils. Find the resistance of the circuit.

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Test Answer Sheet

ELECTRICIANS VOCATIONAL SCHOOL

INDUSTRIAL TECHNICAL MATHEMATICS-I

SUBJECT: Test on Power Formulas

Assignment M-I T-11

Date________________

Name________________________

Class________________

Score__________

Instructions: You are to place the answers for each problem of the test on this sheet. Also, show all the work in the space provided.

1. Answer________________

2. Answer________________

3. Answer________________

4. Answer________________

5. Answer________________

SUBJECT: Test on Power Formulas

6. Answer________________

7. Answer________________

8. Answer________________

9. Answer________________

10. Answer________________

NOTE: Turn your test into the instructor as soon as it is completed.

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ELECTRICIANS VOCATIONAL SCHOOL

INDUSTRIAL TECHNICAL MATHEMATICS-I

SUBJECT: Areas Assignment M-I-12

Remarks and Purpose ____________________

____

____

Reference: 1. BASIC MATHEMATICS SIMPLIFIED-C. Thomas Olivo; Albany New York; Delmar Publishers, Inc.; Fourth Edition Dated Feb. 1955, Volume II.

2. PRACTICAL PROBLEMS IN MATHEMATICS-ELECTRICAL TRADES; Delmar Publishers, Inc.; Albany, New York.

Assignment: 1. Areas of Rectangles
- a. read pages 116 through 120 in reference #1.
- b. work problems 1, 2, 3 on pages 65 in reference #2.

2. Areas
- a. read pages 116 through 128 in reference #1.
- b. work problems 2, 3, 4, 5, 8, 10, 13, 15, 17, 19, 22 on pages 66, 67 and 68 in reference #2.

TECHNICAL TERMS	SAFETY
Square measure	____________________
Surface measure	____________________
Bus-bar	____________________
Linear measure	____________________
Rectangle	____________________
Electral magnetic	____________________
Transformer	
Contact Area	
Rigid Steel	
Conduit	

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Test

ELECTRICIANS VOCATIONAL SCHOOL

INDUSTRIAL TECHNICAL MATHEMATICS-I

SUBJECT: Test on Areas

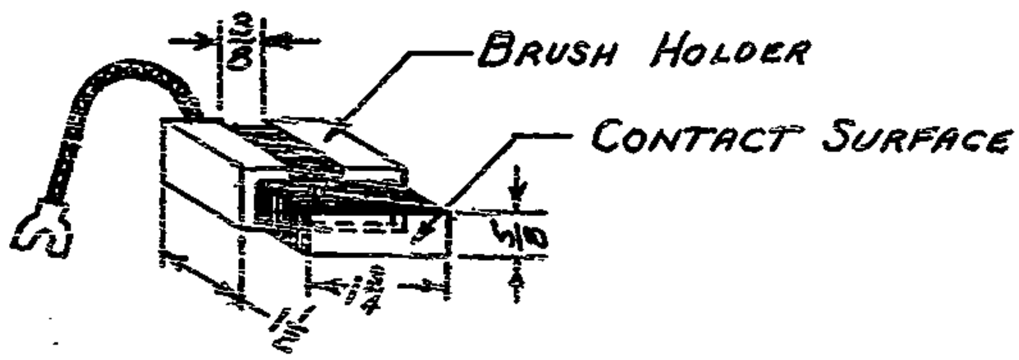
Assignment M-I T-12

Remarks and Purpose____

Assignment: Work the following problems in the space provided on the answer sheet and place your answers in the space provided.

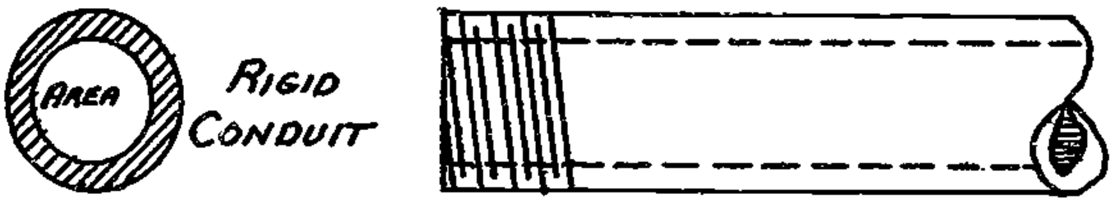
1. A piece of copper bus-bar, 5/8" x 1" in cross section, has an area of how many sq. mils?

2. Carbon brushes have a certain contact surface area. What would be the contact surface area of the brush shown below?



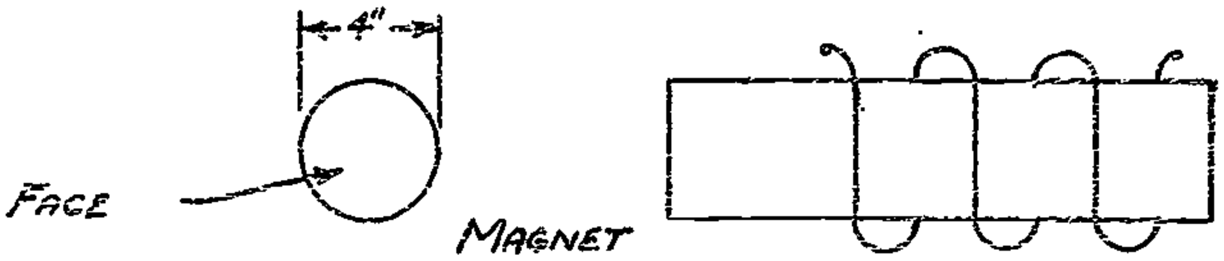
3. If the brush in the above sketch was 2" long and placed in a 4 sided brush holder with a depth of 1 1/2", what amount of surface would be making contact with the brush holder?

4. Give the inside areas of the following sizes of rigid steel conduit: 1/2" conduit, inside diameter .622; 3/4" conduit, inside diameter .824; 1" conduit, inside diameter 1.049. See Figure.



5. A lead covered 500,000 3/c (three conductor) cable has an approximate outside diameter of 2.44". What is the approximate cross-sectional area of this cable?

6. The tractive force of a magnet is proportional to the square of the density of the lines of force per square inch and is propörtional to the area of the surface contact. What is the area of the face of a magnet that has a 4" diameter? See figure.

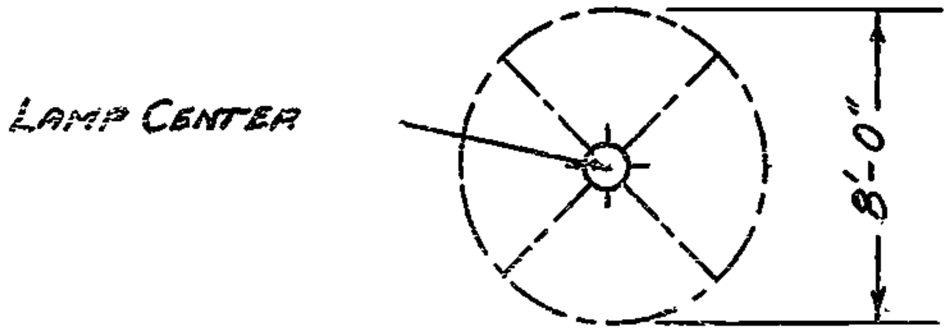


7. What is the square mil area of the cross section of a #0, B and S gauge copper wire? Refer to wire tables.

8. What is the square mil area of a wire 1/4" in diameter?

9. What is the surface contact area of a magnetic pole that has an outside diameter of 5.563"?

10. An electromagnetic brake used a brake lining that is 1 3/4" wide and the outside diameter is 8". What is the area of braking surface if 4 brake linings are used per brake?



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Test Answer Sheet

ELECTRICIANS VOCATIONAL SCHOOL

INDUSTRIAL TECHNICAL MATHEMATICS-I

SUBJECT: Test on Areas

Assignment M-I T-12

Date__________________

Name________________________

Class_________________

Score_________

Instructions: You are to place the answers for each problem of the test on this sheet. Also, show all the work in the space provided.

1. Answer_________________

2. Answer_________________

3. Answer_________________

4. Answer_________________

5. Answer_________________

SUBJECT: Test on Areas

6. Answer____________________

7. Answer____________________

8. Answer____________________

9. Answer____________________

10. Answer____________________

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INDUSTRIAL TECHNICAL MATHEMATICS-I

SUBJECT: Right Triangles

Assignment M-I-13

Remarks and Purpose ______________________________

Reference: 1. BASIC MATHEMATICS SIMPLIFIED-C. Thomas Olivo; Albany, New York: Delmar Publishers, Inc.; Fourth Edition Dated Feb. 1955, Volume II.

2. PRACTICAL PROBLEMS IN MATHEMATICS-ELECTRICAL TRADES; Delmar publishers, Inc.; Albany, New York

Assignment: 1. Right Triangles
- a. read pages 305 through 308 in reference #1.
- b. work all problems on page 70 in reference #2.

TECHNICAL TERMS

Right triangle

Hypotenuse

Short leg

Long leg

Pythagorean theorum

SAFETY

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ELECTRICIANS VOCATIONAL SCHOOL

INDUSTRIAL TECHNICAL MATHEMATICS-I

SUBJECT: Right Triangles

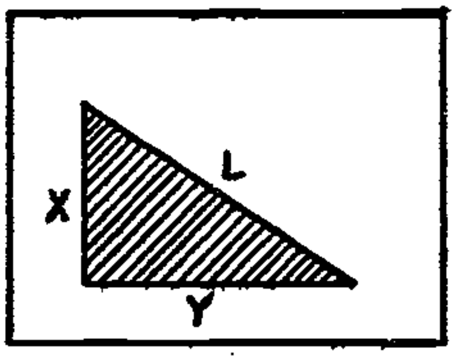
Assignment M-I T-13

Remarks and Purpose ______________________________

Assignment: Work the following problems:

1. Determine the length of side (L) for triangles A through E. Substitute the values given in the table in the equation,

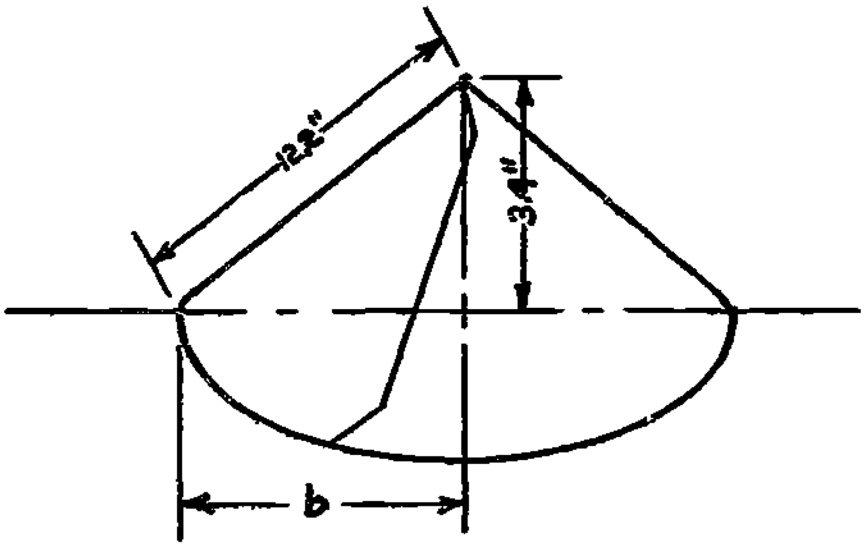
$$L = \sqrt{X^2 + Y^2}$$



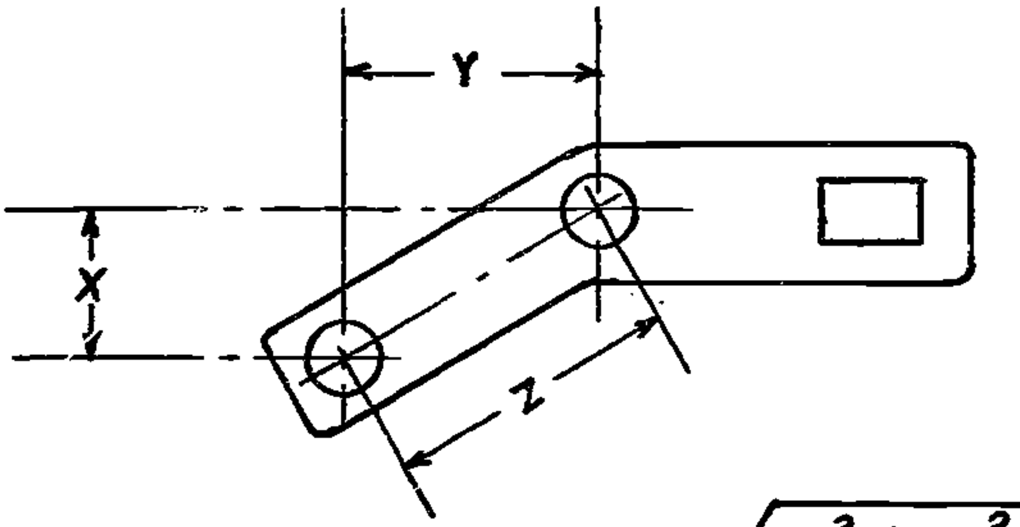
	A	B	C	D	E
X	3"	6.6"	1'	10"	5.6"
Y	4"	8.8"	2'	16"	7.8"

2. Determine length (b) when

$$b = \sqrt{c^2 - a^2}$$



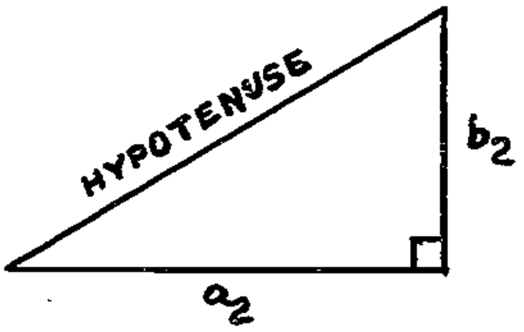
3. Compute dimension Z of the part illustrated, for each dimension given for X and Y, correct to three decimal places. Wherever practical, use the table of square root values.



	Given Values	
	X	Y
A	3	4
B	6	7
C	12.5	15
D	8.6	10.5

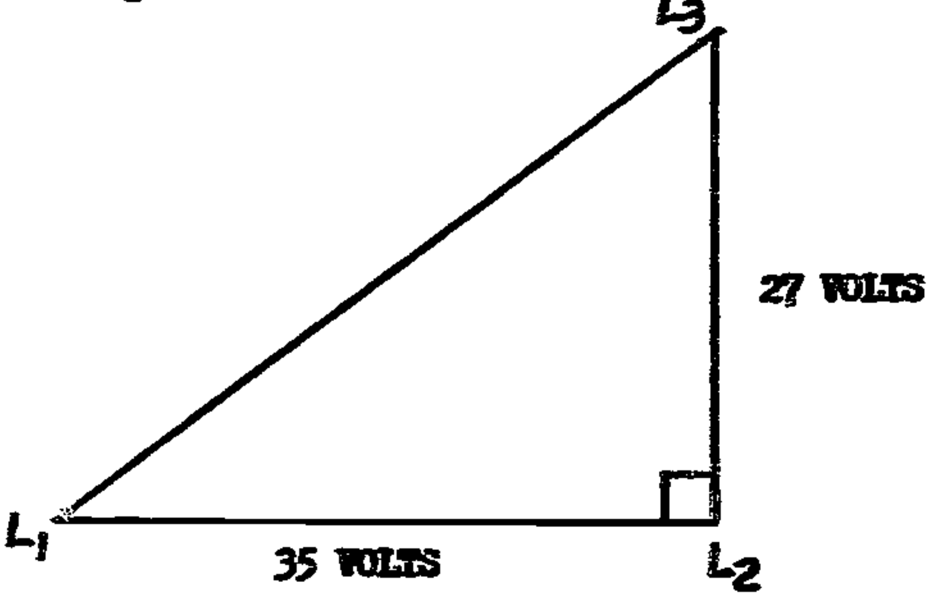
$$Z = \sqrt{X^2 + Y^2}$$

4. The largest side (hypotenuse) of a 90° triangle is $= \sqrt{a^2 + b^2}$
Find the hypotenuse for triangles A, B and C.

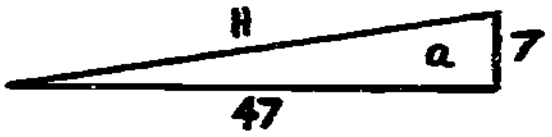


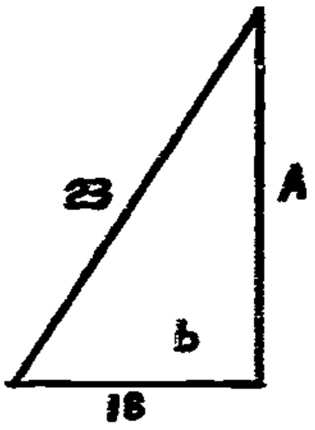
Triangle	A	B	C
Side a=	6 1/2"	7 1/2"	11.5"
Side b=	2"	3 1/2"	4.5"

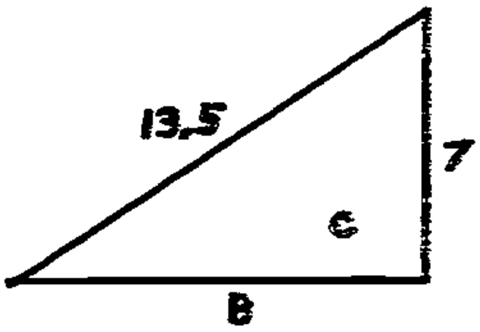
5. The vector diagram shows a voltage of 27 between L_3 and L_2 and 35 volts between L_1 and L_2. What is the voltage across L_1 and L_3? This voltage is equal to the square root of the sum of the squares of the other two sides of the triangle.



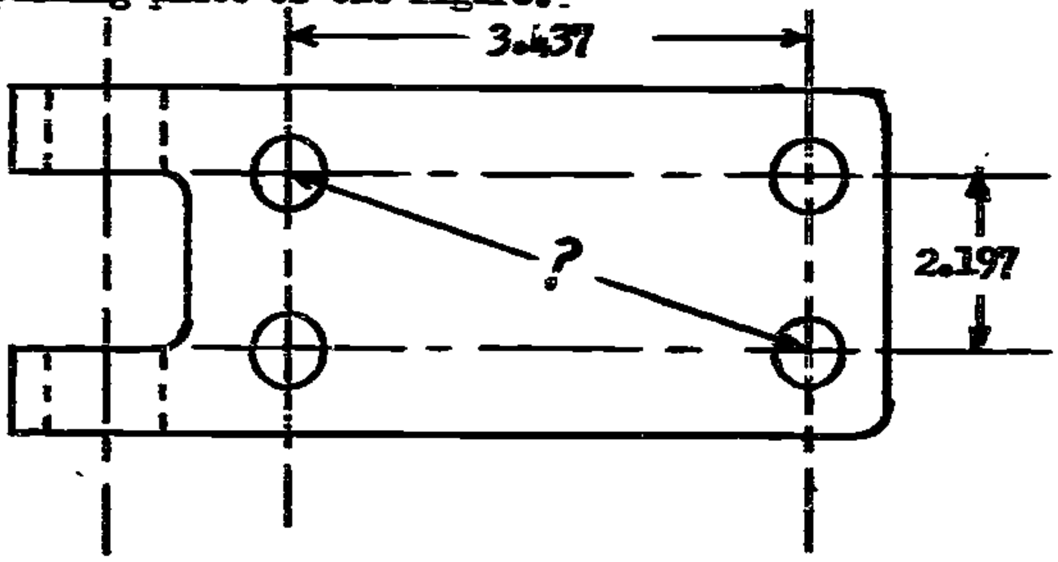
6. Find the length of the missing side in each of the following right triangles.







7. Find the diagonal distance between the two drill bushing holes shown in the bushing plate of the figure.



8. If an acre of land is laid out in the form of a rectangle and one side of the rectangle is 153 feet long, what is the length of the other side?

9. How long can a piece of sheet metal be which is 2 ft. wide and can be placed inside of a box 2 ft. wide X 3 ft. high X 4 ft. long? Disregard its thickness.

10. What length of wire will be required to wind around a bar 18 inches long, 1 15/16 inches in diameter, with a lead of 2 1/4 inches if the wire is 1/16 inch in diameter?

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Test Answer Sheet

ELECTRICIANS VOCATIONAL SCHOOL

INDUSTRIAL TECHNICAL MATHEMATICS-I

SUBJECT: Test on Right Triangles

Assignment M-I T-13

Date____________________

Name____________________

Class____________________

Score____________

Instructions: You are to place the answers for each problem of the test on this sheet. Also, show all the work in the space provided.

1\.

Answer (a)______________
(b)______________
(c)______________
(d)______________
(e)______________

2\.

Answer__________________

3\.

Answer__________________

4\.

Answer (a)______________
(b)______________
(c)______________

5\.

Answer__________________

SUBJECT: Test on Right Triangles

6.

Answer (a)____________

(b)____________

(c)____________

7.

Answer________________

8.

Answer________________

9.

Answer________________

10.

Answer________________

NOTE: Turn your test into the instructor as soon as it is completed.

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ELECTRICIANS VOCATIONAL SCHOOL

INDUSTRIAL TECHNICAL MATHEMATICS-I

SUBJECT: Impedance Diagram

Assignment M-I-14

Remarks and Purpose

Reference: 1. BASIC MATHEMATICS SIMPLIFIED- C. Thomas Olivo; Albany, New York: Delmar Publishers, Inc.; Fourth Edition Dated Feb. 1955, Volume II.

2. PRACTICAL PROBLEMS IN MATHEMATICS-ELECTRICAL TRADES; Delmar Publishers, Inc.; Albany, New York.

Assignment: 1. Impedance Diagram
- a. read pages 305 through 308 in reference #1.
- b. work problems 1, 2, 3, 5, 6, 7, 8, 9, 10 on pages 71 and 72 in reference #2.

TECHNICAL TERMS

Impedance (Z.)

Inductance

Inductance reactance drop (E_{XL})

SAFETY

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Test

ELECTRICIANS VOCATIONAL SCHOOL

INDUSTRIAL TECHNICAL MATHEMATICS-I

SUBJECT: Impedance Diagram

Assignment M-I T-14

Remarks and Purpose ______________________________

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____

Assignment: Work the following problems in the space provided on the answer sheet, and place your answers in the space provided.

1. A circuit has an impedance of 45 ohms. The current flowing is 1.3 amp. What is the e.m.f. across the circuit?

2. Find the impedance of a coil which draws 4.6 amp. when connected across a 110-volt 25-cycle line.

3. A circuit has an impedance of 35.2 ohms. What is the effective voltage if the maximum value of the current is 11.4 amp.?

4. What is the impedance of a circuit which has a resistance of 48 ohms and a capactive reactance of 64 ohms?

5. The impedance of a certain appliance is 52 ohms at 60 cycles. If this device can take 10.6 amperes safely, at what 60-cycle a-c voltage can it be operated?

6. The 60-cycle impedance of a circuit is 37 ohms. When connected across a 60-cycle source of supply the current in the circuit is 1.06 amp. at the instant when 18° of the cycle have been completed. If a voltmeter is connected across this circuit, what should its reading be?

7. The instantaneous value of the current in a certain circuit is 15 amp. when 40° of its cycle have been completed. If the impedance of the circuit is 12 ohms, how many volts would be indicated by a voltmeter connected across the circuit?

8. A coil whose impedance is 15.8 ohms is connected across a line where the e.m.f. is 200 volts. Find the instantaneous value of current 29° after its zero value.

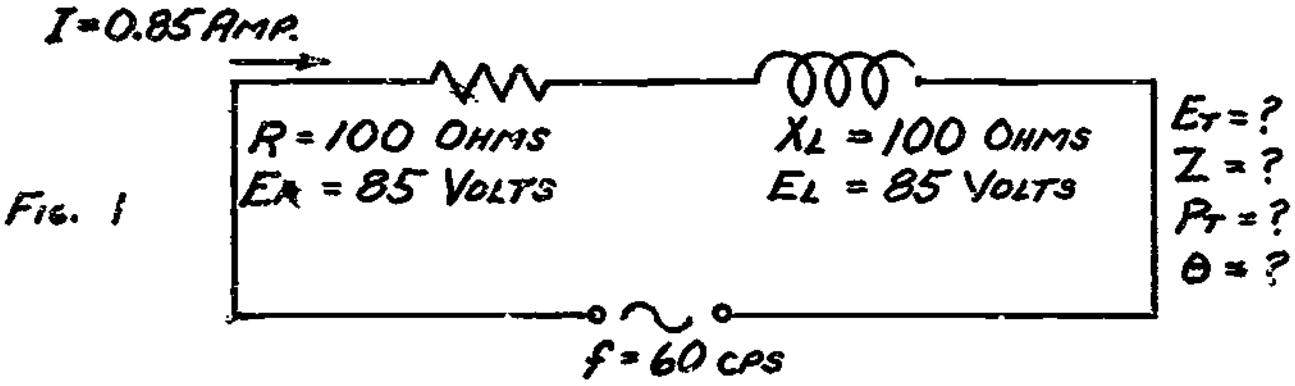
9. A circuit has an impedance of 37.8 ohms. What would a voltmeter read when connected across this circuit, if the instantaneous current is 4.9 amp. 75° after the 0° position?

10. What effective voltage is necessary to force 11.5 amp. through a circuit whose resistance is 9.1 ohms and whose reactance is 7.2 ohms?

11. The reactance of a circuit is equal to 1/3 of its impedance. If the resistance of the circuit is 24 ohms, calculate the impedance and reactance values.

12. In Fig. 1 find (a) the total voltage, (b) the impedance, (c) the phase angle, and (d) the power.

Fig. 1

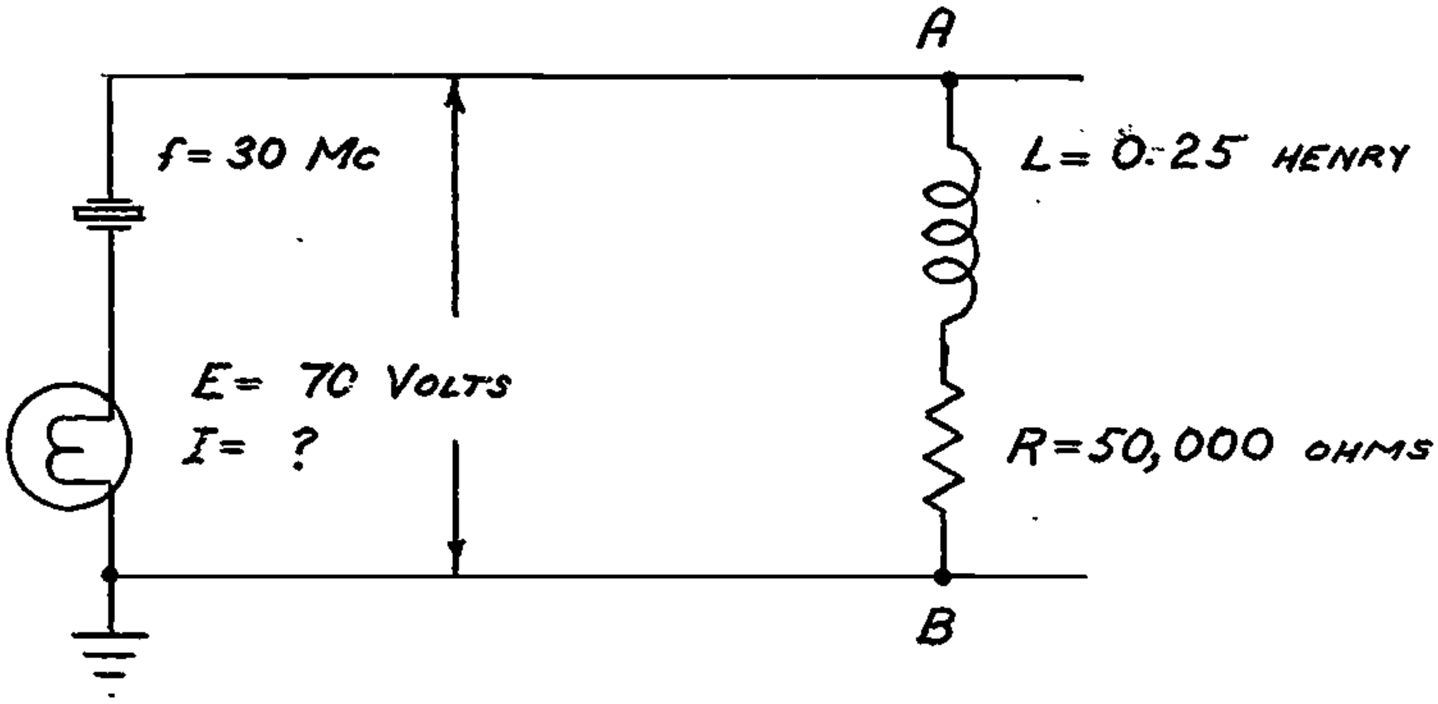


13. An inductance of 0.17 henry and a resistance of 50 ohms are connected in series across a 110-volt 60-cycle line. Find (a) the inductive reactance, (b) the impedance, (c) the total current, (d) the voltage drop across the resistor and the coil, (e) the phase angle, and (f) the power used.

14. A resistance of 5 ohms is in series with a coil whose inductive reactance is 12 ohms. If the total voltage is 104 volts, find (a) the impedance, (b) the total current, (c) the voltage drop across each part, (d) the phase angle, and (e) the power.

15. Part of the oscillator circuit for a continuous-wave transmitter is shown in Fig. 2. Find the current from point A to point B if the voltage drop is 70 volts.

Fig. 2



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Test Answer Sheet

ELECTRICIANS VOCATIONAL SCHOOL

INDUSTRIAL TECHNICAL MATHEMATICS-I

SUBJECT: Test on Impedance Diagram

Assignment M-I T-14

Date________________

Name________________________

Class________________

Score__________

Instructions: You are to place the answers for each problem of the test on this sheet. Also, show all the work in the space provided.

1. Answer________________

2. Answer________________

3. Answer________________

4. Answer________________

SUBJECT: Test on Impedance Diagram

5. Answer____________________

6. Answer____________________

7. Answer____________________

8. Answer____________________

9. Answer____________________

10. Answer____________________

SUBJECT: Test on Impedance Diagram

11\.

Answer (a)______________

(b)______________

12\.

Answer (a)______________

(b)______________

(c)______________

(d)______________

13\.

Answer (a)______________

(b)______________

(c)______________

(d)______________

(e)______________

(f)______________

14\.

Answer (a)______________

(b)______________

(c)______________

(d)______________

(e)______________

15\.

Answer______________

NOTE: Turn your test into the instructor as soon as it is completed.

VT003 186

VT 003 186
Carpentry, Building Trades Area.

Building Trades Teachers and Journeymen Carpenters of Ind
Indiana State Dept. of Public Instruction, Indianapolis
Indiana State Univ., Terre Haute. Instr. Materials Lab.
Pub Date - 65
MF AVAILABLE IN VT-ERIC SET 111p.

*CURRICULUM GUIDES, *TEACHING GUIDES, STUDY GUIDES, *TRADE AND INDUSTRIAL EDUCATION, *CARPENTERS, *CARPENTRY, HIGH SCHOOLS,

This curriculum guide was designed to aid the instructor in orienting students to and preparing them for entrance into the carpentry trade through experiences in practical construction and study of technical related information. The material was developed by building trades teachers and journeymen carpenters in a workshop under the supervision of the Supervisor of Trade and Industry. The units are (1) Form Building, (2) Floor Framing, (3) Wall Framing, (4) Roof Framing and Sheathing, (5) Exterior Covering and Trim, (6) Insulation, (7) Interior Finish, (8) Stair Building, and (9) Scaffolding. Each unit has assignment sheets with objectives, textbook references, related technical information topics, on-the-job information and work topics, and a student study guide. Emphasis is on light or resident-type construction, and a building project is used as the vehicle for instruction. The course is designed for day school trade classes. The students enrolling in the course should be high school juniors at least 16 years of age who intend to complete 2 years of training and enter the trade. Basic references and supplementary materials are listed in the bibliography. A suggested list of hand tools and equipment and the by-laws and articles of incorporation for the Vocational Building Trades, Inc. are included. This document is available for $1.00 from Division of Industrial Education, Indiana State University, Terre Haute, Indiana 47809. (HC)

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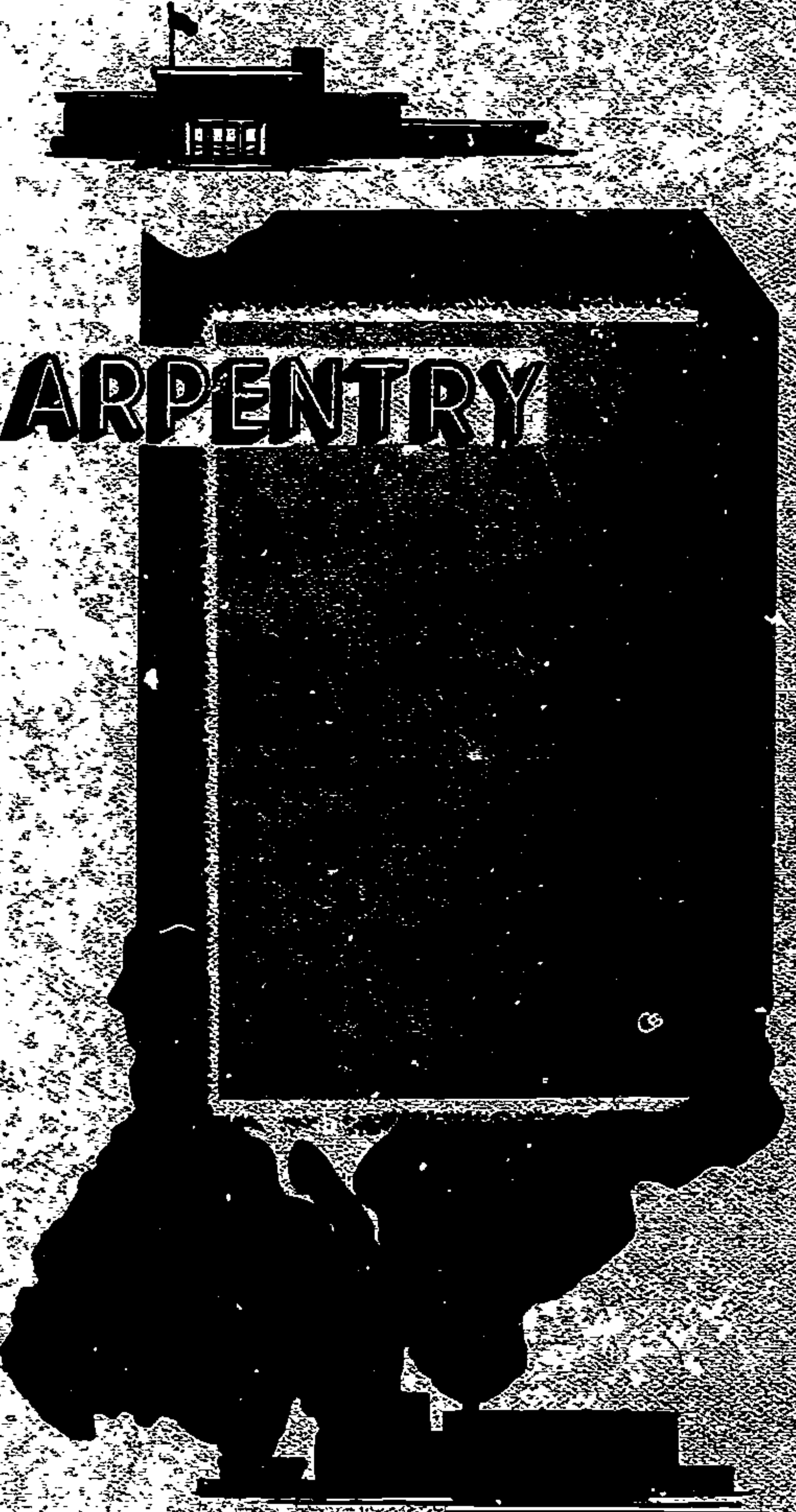
Trade — Industrial — Technical Education
STATE of INDIANA



CARPENTRY

Instructional Materials Laboratory

CARPENTRY

Building Trades Area

developed by

BUILDING TRADES TEACHERS AND JOURNEYMEN CARPENTERS

of

INDIANA INDUSTRIAL WORKSHOPS

State of Indiana
Division of Vocational Education
Trade-Industrial-Technical Education Branch

Instructional Materials Laboratory
Trade and Industrial Education
Indiana State College
Terre Haute, Indiana

This Course Outline and Course of Study For

CARPENTRY
BUILDING TRADES AREA

was approved by the Indiana General Commission,
The State Board of Education, Board of Vocational
Education

1965

MEMORANDUM

TO: The ERIC Clearinghouse on Vocational and Technical Education
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PREFACE

This curriculum guide has been developed primarily for use by the instructors of the day trade classes. Emphasis has been placed on light or resident type of construction so as to meet the objectives of these day trade classes in the public schools.

Instructors in the apprenticeship program and journeymen also can use this guide to good advantage. The technical related portions can be used together with the regular question assignments for apprentices. Journeymen can use any parts or assignments for instructional purposes as needed to further their knowledge of or proficiency in the carpentry trade.

Additional units concerning industrial types of carpentry construction must be added to those in the guide in order to fulfill all the basic requirements necessary for a complete carpentry course of study for apprentices and journeymen upgrading program.

Carpentry utilizes the major portion of the time in the day trade classes; therefore, the set of units for this area has been developed first. Sets of units in the other trades, with which the classes are concerned, will be developed later.

The material for this volume was developed by teachers of building trades and journeymen carpenters of Indiana in summer workshops under the auspicies and guidance of the Supervisor of Trade and Industry of the State of Indiana.

Special acknowledgement is made to the State Board of Vocational Education of Illinois for permission to use material developed by the building trade teachers of that state.

INDIANA DEPARTMENT OF PUBLIC INSTRUCTION
VOCATIONAL EDUCATION DIVISION
TRADE AND INDUSTRIAL SERVICE

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INDIANA STATE COLLEGE
TERRE HAUTE, INDIANA

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OBJECTIVES

General:

To prepare the boy for advantageous entrance in the carpentry trades.

Specific:

1. To orient students in the carpentry trade.
2. To develop skills and knowledge through practical construction.
3. To develop appropriate and safe work habits.
4. To develop the ability to apply technical related information.
5. To develop a wholesome understanding of trade and social problems.
6. To develop desirable attitudes of initiative, responsibility,
7. To develop a pride in good workmanship.

Standards For Day Trade Programs:

1. Students shall be at least 16 years of age & have junior standing.
2. Students shall enroll with the intention of completing two years of building trades.
3. Students shall enroll with the intention of entering the trade.
4. It is recommended that all enrollees in the building trades have at least one year of previous industrial arts on an exploratory basis. Exceptions may be made where an enrollee enters from a school where industrial arts courses are not available.
5. A building project equivalent to a two bedroom residence shall be constructed as a vehicle for instruction. In cities and towns where outside projects cannot be built a project within the shop area may be built. The area available would determine the size of the house to be built.
6. With a one-half day program, it is better to spend two years on one project than to sacrifice on giving all the necessary technical related information.
7. Classes shall be limited to <u>16</u> students.

BUILDING TRADES CARPENTRY

BUILDING TRADES CARPENTRY

UNIT # 1	FORM BUILDING
ASSIGNMENT # 1	TYPES OF SOIL IN FOUNDATION WORK
ASSIGNMENT # 2	LAYOUT OF FOUNDATIONS
ASSIGNMENT # 3	BUILDING FOOTING & PIER FORMS
ASSIGNMENT # 4	BUILDING WALL FORMS
ASSIGNMENT # 5	STAIR AND STEP FORMS
ASSIGNMENT # 6	COLUMN AND BEAM FORMS
ASSIGNMENT # 7	SIDEWALK AND FLOOR FORMS
ASSIGNMENT #	ARCH CENTER FORMS
ASSIGNMENT # 9	FORMS FOR CAPS, SILLS AND LINTELS

CARPENTRY

UNIT I. FORM BUILDING

ASSIGNMENT 1. TYPES OF SOILS IN FOUNDATION WORK.

REFERENCES

1. Concrete Form construction pp. 1-7
2. Lair, pp. 13-14
3.
4.
5.

The nature of the prevailing soil should be known, because soils are the determining factors for a permanent base for a foundation.

CLASSROOM	ON THE JOB	
Related technical information	Information to be given on the job	Work to be done on the job
Bearing strength of sub-soils	Data of climate and area drainage	Tests: Open pit method. Auger Method.

STUDENT STUDY GUIDE

1. List three types of soil encountered in small building foundations?
2. What type of soil makes the best footing base?
3. Why is clay the most uncertain of soils for building foundations?
4. Name three types of soil that are less suitable as a foundation soil?
5. What is the common cause of foundation movement?
6. What is the depth of the frost line in your community?
7. What might happen if frost does get under the footings?
8. How can the footings be protected against frost?
9. How may water be drained from foundation soils?
10. How is soil tested by the "open pit" method?

CARPENTRY

UNIT I. FORM BUILDING

ASSIGNMENT 2. LAYOUT OF FOUNDATIONS

REFERENCES

1. Durbahn, Vol. II pp. 18-22, 456-467
2. Lair, pp. 7-13
3. Concrete Form Construction, pp. 8-13
4.
5.

The purpose of this unit is to describe in detail the methods of laying out foundations, setting batter boards, establishing building lines, and checking the layout by 6-8-10 method.

CLASSROOM	ON THE JOB	
Related technical information	Information to be given on the job	Work to be done on the job
Safety Precautions. Study Local Building Codes. Read Plot Plans and Survey maps. Orientation in use of transit of dumpy level.	Safety Precautions. Apply Building Codes. How to square by 6-8-10 rule. How to check diagonals. How to make and set batter boards. Use of Plumb bob and line.	Locate Property Line. Establish Front Building Line. Locate other building lines. Set Batter Boards. Layout offsets. Locate Excavation Lines. Locate Footing Lines.

STUDENT STUDY GUIDE

1. Why is it important to check the plot plan or have a survey made?
2. Why are the restrictions of the local code?
3. Why is it important to follow all the provisions of the local code?
4. Why should all layout dimensions be checked?
5. Tell how to establish a base line from the surveyor's lines.
6. Describe the "6-8-10 method" of squaring corners and explain why these figures are used.
7. Explain how the "diagonal method" is used to square a building.
8. What is the purpose of batter boards?
9. Should batter boards be erected level? Why?
10. How are corners relocated after the excavation is made?
11. What factors determine the size of the excavation as compared to the size of the foundation?
12. How are excavation and footing lines located?
13. List the tools and equipment necessary for laying out building lines.

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UNIT I. FORM BUILDING

ASSIGNMENT 3. BUILDING FOOTING & PIER FORMS

REFERENCES
1. Dalzell and Townsend, Vol. II pp. 8-14
2. Durbahn, Vol. II pp. 24-26
3. Concrete Form Construction, pp. 34-54
4. Local Code
5.

The purpose of this lesson is to teach the names, sizes and proper construction of each type of footing forms.

CLASSROOM	ON THE JOB	
Related technical information	Information to be given on the job	Work to be done on the job
Safety Precautions.	Safety Precautions.	Locate footing lines.
Reasons For Footings.	Locate depth and level footing lines.	Establish corners to correct level.
Types and Sizes of Footing Forms.	Footing keyways.	Build, brace and level outside forms.
Methods of Leveling Forms	Locate steel in footings.	Build, brace and level inside forms
Estimating.	Size of piers.	Build special footings, piers, for chimneys and special appliances.
Math related to forms and materials.		Installation of steel.
Load weight for piers and spans.		

STUDENT STUDY GUIDE

1. How are footing lines determined?
2. What two items must be taken into consideration when determining the width of footings?
3. What rule of thumb is used to determine the width and depth of footings?
4. What can be done to strengthen a footing which passes over a filled area?
5. Describe method of leveling footing forms.
6. Why should outside footing forms be built first?
7. What provision should be made in the footing for bonding the wall?
8. Sketch two types of special footing forms used for piers.
9. How is the straight edge used in form building?
10. Write a brief step-by-step procedure of how to build a form for a tapered footing.

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UNIT I. FORM BUILDING

ASSIGNMENT 4. WALL FORMS

REFERENCES

1. Dalzell and Townsend, Vol. pp. 14-25
2. Durbahn, Vol. II pp. 26-44
3. Concrete form construction pp. 14-33, 53-72, Checking Your Knowledge.
4.
5.

The purpose of this lesson is to familiarize the student with the various types, methods of construction, erection, tying, and bracing of forms for concrete walls.

CLASSROOM

Related technical information

Safety Precautions.
Materials Used in Form Building.
Lubrication of Forms
Study spreaders, wholers, and ties.
Scaffolds pertaining to runways.
Math related to wall forms.
Anchors, tie rods, reinforcements and clamps.

ON THE JOB

Information to be given on the job

Re-check form lines.
How to make and set wall forms.
Bracing forms.
How to erect runways.
Opening sizes for windows, doors and other openings.

Work to be done on the job

Re-check building corners and lines.
Building, plumbing, bracing, and lubricating outside wall forms.
Building plumbing, bracing, inside wall forms.
Building runways
Establish concrete wall levels.
Setting window, door, and other opening frames.
Removal of forms.

STUDENT STUDY GUIDE

1. How is the building or wall line located on the footing?
2. How are the studs fastened at the footing?
3. Studs for forms should be located 12", 16", 24", 28" O.C.
4. Give the actual sizes of the following pieces used in form work--2 x 4; 2 x 6; 2 x 8; 2 x 10; 2 x 12.
5. How much lumber would one order to compensate for lack of actual width?
6. Describe procedure for making a form panel.
7. How does the length of the inside form differ from the outside form? Explain.
8. What is the difference in function between the wholer and the spreader?
9. Name and describe three types of tie rod fasteners.
10. Why should a ladder be used when entering or leaving basement after wall forms are in place?
11. Name the parts of a wall form that contribute to rigid bracing.
12. How are door and window openings, water pipes entrances, grider pockets, etc., formed in concrete walls.

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UNIT I. FORM BUILDING

ASSIGNMENT 5. STAIR AND STEP FORMS

REFERENCES

1. Dalzell and Townsend, Vol. I, pp. 331-335
2. Durbahn, Vol. II, p. 40
3. Townsend, pp. 180-182
4. Concrete Form Construction, pp. 73-87
5.

The purpose of this assignment is to acquaint the student with the correct methods and procedures in the construction of forms for concrete stairs and steps.

CLASSROOM	ON THE JOB	
Related technical information	Information to be given on the job	Work to be done on the job
Safety Precautions	Safety precautions.	Locate stairs.
Types of Concrete Steps & Advantages of Each.	How to make and use a pitch board.	Layout & locate stringers.
Estimating.	Why reinforcement steel is used.	Bracing & shoring.
Formulas: a. Height, Width of steps. b. Tread Pitch for drainage.	How to layout stringers. Determining sub-grades.	Placing Reinforcements.

STUDENT STUDY GUIDE

1. What two measurements must be determined before steps can be laid out?
2. The proper height of a concrete step is 6, $6\frac{1}{2}$, 7, $7\frac{1}{2}$, or 8 inches.
3. How are number of steps determined?
4. State a general rule indicating the relationship between the height of riser and the width of tread?
5. How is the relationship between riser and tread a safety factor?
6. How is a pitch board made and used?
7. In the open stair form, the joist (need, neednot) extend beyond the slab supporting sheathing. Explain.
8. What is the purpose of beveling the bottom of the riser board?
9. Why should the open stair horse have shoring wedges under the posts?
10. Why is it desirable to build step forms so that the risers and side forms can be easily removed?
11. How close to the top of the step slab should the reinforcing steel be placed:
12. Sketch an undercut and an ornamental riser.
13. What are the advantages of concrete steps over wooden steps?
14. Why is good workmanship so important in building forms for concrete steps?

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UNIT I. FORM BUILDING

	REFERENCES
ASSIGNMENT 6. BUILDING COLUMNS AND BEAM FORMS	1. Dalzell and Townsend, Vol. II, pp. 26-27 2. Durbahn, Vol. II, pp. 45-47 3. Giese, pp. 54-55 4. Concrete Form Construction, pp. 42-43 5.

The purpose of this lesson is to explain the types and methods of construction forms for concrete columns and beams, as well as setting, bracing and shoring in position.

CLASSROOM	ON THE JOB	
Related technical information	Information to be given on the job	Work to be done on the job
Safety precautions. Material used in construction. Methods of anchoring.	Safety Precautions. How to build forms for columns and beams. Bracing columns and beam forms.	Setting, spacing and shoring posts and other supports. Sheathing forms.

STUDENT STUDY GUIDE

1.(a). What is the purpose of a column?
  (b). What is the purpose of a beam?
2. Why are triangular strips placed in the corners of column and beam forms?
3. How long should the forms be left in place after pouring a load bearing column?
4. What is the function of a yoke?
5. Illustrate two types of yokes which can be made on the job?
6. Indicate the number and spacing of yokes on a column two feet square and ten feet high.
7. Explain how a beam form is held in position.
8. What advantages are there in making up panels for column and beam forms?
9. Why is it recommended to use tongue and grove sheathing in the construction of column forms?
10. What special consideration must be kept in mind when making forms of plywood for short columns or piers?
11. Explain the advantages of a tapered form for short piers or columns?

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UNIT I. FORM BUILDING

ASSIGNMENT 7. SIDEWALK & FLOOR FORMS

REFERENCES

1. Dalzell and Townsend, Vol. I pp. 313-319; 339-346
2. Giese, pp. 33-35
3. Concrete Form Construction, pp. 90-93

This lesson is to familiarize the student with the methods and materials used to construct forms for sidewalks, and to explain the laying out, setting and bracing of straight and curved forms for walks, drives and terraces.

CLASSROOM	ON THE JOB	
Related technical information	Information to be given on the job	Work to be done on the job
Safety Precautions	Safety Precautions.	Locate & level walk.
Types & sizes of walks straight & curved.	Pitch or slope for sidewalks & driveways.	Excavate & level area to receive walk.
Soil Conditions & drainage.	Materials used in expansion joints.	Construct & set forms.
Use of expansion joints in slab concrete.	Setting & leveling screeds.	Brace & level forms.
Estimating.		Provide for expansion joint.
The Use of screeds.		Setting screeds.

STUDENT STUDY GUIDE

1. What type of lumber is usually used for sidewalk forms?
2. Why should the edge of forms be straight?
3. What pitch should be provided for the width of a sidewalk.
4. Explain how an expansion joint is provided for in sidewalk forming?
5. How are the edges of sidewalk forms aligned?
6. State two reasons for the use of spreaders in sidewalk forms?
7. Sketch a layout for building curved walk forms?
8. How thick should a sidewalk be constructed.

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UNIT I. FORM BUILDING

ASSIGNMENT 8. ARCH CENTER FORMS

REFERENCES

1. Architectural Graphic Standards, p. 23
2. Concrete Form Construction, pp. 94-105
3.
4.
5.

The purpose of this assignment is to familiarize the student with the types and sizes of arch centers, and the methods of laying out and constructing.

CLASSROOM	ON THE JOB	
Related technical information	Information to be given on the job.	Work to be done on the job
Safety Precautions. Study types and where used; functions.	How constructed. Use of tool for arches.	Use of framing square and trammel points in laying out arches.
Materials to be supported.	Safety practices.	Layout and construction.
Type of construction of forms for arched openings.		"Plumb and line" (Set) Brace in position.
Flat, jack, segmental, semi-circular, and semi-elliptical arches.		

STUDENT STUDY GUIDE

1. What is the function of arch centers?
2. Why is a slight crown built in a flat arch?
3. Explain the advantages of a segmental arch.
4. What is meant by lagging?
5. Sketch a method of setting forms for arch center installation.
6. Why do the side walls of a crowned arch opening need solid support?
7. How are segments laid out for the semi-circular arch?
8. Illustrate on a drawing the following: spring line, strut, tie and cleat.
9. What is the purpose of the spring line?
10. Sketch the following types of arches: Gothic Roman, Tudor, Elliptical and Jack.

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UNIT I. FORM BUILDING

ASSIGNMENT 9. FORMS FOR CAPS, SILLS & LINTELS AREAWAYS.

REFERENCES

1. Dalzell and Townsend, Vol. II, pp. 99; 185-188; 190, 245, 273.
2.
3.
4.
5.

The purpose of this assignment is to familiarize the student with the various methods of building and anchoring forms for caps.

CLASSROOM	ON THE JOB	
Related technical information	Information to be given on the job	Work to be done on the job
Safety precautions.	Safety precautions.	Build forms to size.
Bracing for precast forms.	How to hold form in place for casting in position.	Brace & tie properly for pre-cast form.
Types of forms for coping.		Layout & construct forms for casting in position.
Methods of Holding Forms in place for casting in position.	How to brace & tie for precast forms.	Set forms for areaways.
Types of forms for areaways.	How to drain the areaways.	

STUDENT STUDY

1. Why should precast concrete lintels be made at least three weeks before using?
2. How far from the bottom of a solid reinforced concrete lintel should the reinforcing bars be placed.
3. Make a sketch showing how a lintel can be made from 8" x 8" concrete blocks?
4. Under what conditions is it more desirable to cast caps in position?
5. What problems do you have when pouring a cap on an open masonary or block wall?
6. Sketch a plan for a chimney precast cap form to fit a two-flue chimney. Flue sizes $8\frac{1}{2}$" x $8\frac{1}{2}$". Chimney size 16" x 30". Show bracing.
7. What is the purpose of areaways?
8. How are areaways fastened to the main foundation when they are not poured as an integral unit?

BUILDING TRADES CARPENTRY

UNIT # 2 FLOOR FRAMING

ASSIGNMENT # 1	SILL CONSTRUCTION
ASSIGNMENT # 2	POSTS OR COLUMNS
ASSIGNMENT # 3	GIRDERS OR BEAMS
ASSIGNMENT # 4	FLOOR AND CEILING JOISTS
ASSIGNMENT # 5	FRAMING OPENINGS
ASSIGNMENT # 6	PLACING OR BRIDGING
ASSIGNMENT #7	LAYING SUB-FLOOR

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UNIT II. FLOOR FRAMING

ASSIGNMENT 1. SILL CONSTRUCTION

REFERENCES

1. Durbahn, Vol. II, pp. 54-57
2. Lair, pp. 28-33
3. Framing Sheathing and Insulation, pp. 14-23
4.
5.

The purpose of this construction unit is to familiarize the student with the name, size, and location of each member of the most common types of sill construction and to demonstrate the proper construction of each type of sill.

CLASSROOM	ON THE JOB	
Related technical information	Information to be given on the job	Work to be done on the job
Safety precautions.	Safety precautions	Selection of material and location of each member of sill.
Shrinkage	Tools used.	Placing of termite shield.
Comparative cost of different types of sills.	Various locations of sills.	Laying out and fitting mud sill.
Nominal & actual sizes of lumber.	Why mud sill is laid in fresh mortar or mastic.	Level and anchor mud sill in fresh grout or mastic.
Termite shielding.		

STUDENT STUDY GUIDE

1. Make a sketch of a box sill.
2. Name three other types of sill construction.
3. Which type of sill construction is affected least by shrinkage?
4. Name four species of lumber commonly used for sill construction. Which is to be preferred? Why?
5. Show on the sketch of box sill where termite shields are installed.
6. Why are termite shields necessary?
7. What are the advantages of back filling before beginning sill construction?
8. What are the disadvantages of back filling before beginning sill construction?
9. Figure the board feet of material necessary for the sill used in the project house?
10. How are sills anchored to foundations?
11. What standard lengths of 2" planks would be used for the mud sill of a house 24'-0" x 30'-0"? Show by sketch.
12. What safety measures are necessary while installing sills?

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UNIT 11. FLOOR FRAMING

ASSIGNMENT 3. POSTS OR COLUMNS

REFERENCES

1. Durbahn, Vol. II, pp. 57-59.
2. Lair, pp. 18-41
3. Framing, sheathing and insulation, pp. 36-48.
4.
5.

The purpose of this assignment is to familiarize the student with the various type of posts or columns used for carrying floor loads. They must be carefully selected, spaced and designed to stand up under the required load. It is important to make a careful study of ground conditions relative to the bearing load before footings are poured.

CLASSROOM	ON THE JOB	
Related technical information	Information to be given on the job	Work to be done on the job
Safety precautions.	Safety precautions.	Selection, size, spacing.
Types, kinds & costs.	Determine length.	Construction or fabrication.
Comparative strengths.	Procedure of installation	Setting, fastening and anchoring.
Load calculations.		
Methods of anchoring.		

STUDENT STUDY GUIDE

1. Name three materials used for posts and columns.
2. How are the bottoms of wood posts protected from moisture and termites?
3. How is the wood post anchored at the bottom?
4. Why should posts or columns have a bearing plate at the top?
5. What is a good method to use to find the exact length of a post or column?
6. What is the relationship of the cross-section size of a wood timber to its load capacity?
7. From the chart on page 40, framing, sheathing and insulation, figure the difference in load capacity between a 6" x 6" wood post and an 8" x 8" wood post both seven feet long. Give answer in tons.
8. What is the minimum size (cross-section) recommended for a wooden post?
9. How do you usually determine the span between posts?
10. What safety measures should be observed while erecting posts or columns?

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UNIT II. FLOOR FRAMING

ASSIGNMENT 3. GIRDERS OR BEAMS

REFERENCES

1. Durbahn, Vol. II, pp. 57-60
2. Lair, pp. 33-41
3. Framing, sheathing and insulating, pp. 24-25
4.
5.

The purpose of this assignment is to familiarize the student with the various types of girders or beams used to support floor loads. They should be carefully selected and constructed so that they will carry this load.

CLASSROOM	ON THE JOB	
Related technical information	Information to be given on the job	Work to be done on the job
Types, kinds and cost.	Method of procedure.	Selection, size, spacing.
Load calculation.	Safety precautions.	Construction or fabrication.
Comparative strength.		
Bearing.		Placing.

STUDENT STUDY GUIDE

1. What types of materials are used for girders or beams? Which is best? Which is most expensive?
2. How much bearing should a beam have on an outside wall?
3. What factors determine the size of a girder or beam?
4. Which is stronger for any given cross-section size, the built-up or the solid beam?
5. When constructing a built-up beam or girder, what rule must be followed as to location of splices?
6. Why should air space be left around the end of a wooden girder resting on an outside wall?
7. What is the maximum span for a wooden girder 6" x 8" for a one story house?
8. Figure the number of board feet needed for the beam or girder used in the project house.
9. Sketch the end view of a steel girder showing girder supporting floor joist.
10. List the safety measures to be followed when installing beams or girders.

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UNIT II. FLOOR FRAMING

ASSIGNMENT 4. FLOOR & CEILING JOISTS

REFERENCES

1. Durbahn, Vol. II, pp. 61-66; 97-100
2. Lair, pp. 41-48
3. Framing, sheathing and insulation, pp. 43-52
4.
5.

The purpose of this assignment is to familiarize the student with the horizontal framing members of a building which supports floors & ceilings & the selection of material, estimating loads, laying out, truing, leveling & fastening of these members.

CLASSROOM	ON THE JOB	
Related technical information	Information to be given on the job	Work to be done on the job
Safety precautions.	Safety precautions.	Selection, size, location.
Function of joists.	Selection of crown edge.	
Grade, selection & cost.	Doubling joists for partition & added weight.	Cutting, fitting, nailing.
Estimating of floor & ceiling joists.		
Methods of framing joists.	Selecting nails.	

STUDENT STUDY GUIDE

1. What are the functions of floor and ceiling joists?
2. What are the standard spacings between joists?
3. What factors determine these standard?
4. The minimum span for 2" x 10" joists, 12" O. C. with 40 pounds live load plastered ceiling is ____________.
5. Make a sketch showing how the "bow" or "crown" of joists must be placed, give reason.
6. In fitting joists around steel beam, allowance should be made for ____________.
7. The __________metal support is recommended when framing joists against wood beams on girders.
8. How do you determine the O. C. spacing of the first and second joists installed?
9. How do you lay out joists locations along a box sill? What does the X indicate?
10. After setting and nailing all joists, the next procedure is to ____________ outside joists and brace them.
11. How is the center of the joists span spaced after installation? Why is it necessary to space them?
12. List three factors which determine the maximum joists span.
13. Where are joists doubled? Why? Sketch two ways this may be done.
14. Figure the cost of the joists for the project house.

CARPENTRY

UNIT II. FLOOR FRAMING

ASSIGNMENT 5. FRAMING OPENINGS

REFERENCES

1. Durbahn, Vol. II, p. 64
2. Lair, pp. 47-49
3. Framing, sheathing and insulation, pp. 53-59
4.
5.

The purpose of this assignment is to familiarize the student with the framing of floor and ceiling openings.

CLASSROOM	ON THE JOB	
Related technical information	Information to be given on the job	Work to be done on the job
Safety precautions. Purpose. Size. When framed. Joist hangers.	Safety precautions. Method of procedure. Kinds of openings. Names of members.	Location & method. Cutting, fitting and nailing.

STUDENT STUDY GUIDE

1. What are the purposes of "trimmers?"
2. What are the sizes of "trimmers?"
3. Give three examples illustrating when it is necessary to frame openings in floor joists?
4. State the purposes or uses of joists "headers?"
5. Why should iron stirrups be used with "headers?"
6. What determines the spacing of "headers" and "trimmers"?
7. Tail joists run from __________ to ______________.
8. When is it advantageous to use double headers?
9. What should be the dimensions of the rough opening for an 8" x 8" flue?
10. In framing around a chimney, how much space should be left between chimney and joists?
11. Sketch a typical opening labeling all parts.
12. How many feet of lumber will be needed for framing all the openings in the first floor of the project house?
13. A ____________ rail should be placed around the stairwell opening. Why?

CARPENTRY

UNIT II. FLOOR FRAMING

ASSIGNMENT 6. PLACING OF BRIDGING

REFERENCES

1. Durbahn, Vol. II, pp. 68-71; 101-103
2. Lair, pp. 53-54.
3. Framing, sheathing and insulation, pp. 50-52.
4.
5.

The purpose of this assignment is to familiarize the student with the methods of laying out, cutting and installing bridging. The purpose of building is to prevent warping and stiffen the joists.

CLASSROOM	ON THE JOB	
Related technical information	Information to be given on the job	Work to be done on the job
Safety precautions.	Safety precautions.	Locating, measuring, cutting, & installing.
Sizes.		
Types of bridging.	Methods of laying out bridging.	
Reasons for using bridging.		
Kind, size & number of nails used.		
Bridging regulations.		

STUDENT STUDY GUIDE

1. Name three types of bridging.
2. In F.H.A. specifications, the maximum span allowed without bridging is ______.
3. The nails are generally started in the _________ of cross bridging before if is installed.
4. The most common time to install bridging ________________________________.
5. The final nailing of the bridging should be after ______ has been installed.
6. Give two methods of cutting bridging A. _____________ B. ____________.
7. What size material could be used for cross bridging?
   A.______X_______ B.__________X______ C.______X______ D.______X______.
8. If joists have a span of 20 feet, how many rows of bridging will be needed?
9. What is the advantage of using steel bridging?
10. Sketch the end view of two floor joists showing cross bridging.
11. How many linear feet of 1" x 3" bridging will be needed for the project house?

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UNIT II. FLOOR FRAMING

ASSIGNMENT 7. LAYING SUB-FLOOR

REFERENCES

1. Durbahn, Vol. II, pp. 66-68; 101-103
2. Lair, pp. 54-60
3. Framing, sheathing and insulation pp. 60-65
4.
5.

The purposes of this assignment is to familiarize the student with the different types and applications of sub-flooring. The sub-floor provides a working floor, strengthens the construction, provides a base for finish floors and adds deadening and insulating properties to the building.

CLASSROOM	ON THE JOB	
Related technical information	Information to be given on the job	Work to be done on the job
Safety precautions.	Safety precautions.	Selection as to size and quality of material.
Kinds of quality of sub-flooring.	Methods of laying & nailing.	
Estimating material.	Expansion joints.	Cutting.
Advantages & disadvantages of different methods of floor laying.		Nailing.

STUDENT STUDY GUIDE

1. What are two methods of laying sub-floor?
2. Rough flooring is generally nailed with __________ penny nails.
3. Squeaky floors are sometimes caused because the sub-floor is not ____nailed.
4. What percentage of allowance for waste is necessary for 1" x 8" shiplap laid diagonally?
5. 1/2" to 3/4" space should be left between the flooring and the outside walls to allow for __________of the boards when they become wet.
6. When the sub-floor is laid ________the finish floor may be laid directly on the sub-floor in either direction.
7. What types of lumber are used for sub-flooring?
8. Give four reasons why sub-flooring is used.
9. Should two consecutive joints be made on the same joist?
10. Sketch the two methods of laying sub-floor.
11. Figure the number of square feet in the floor of the project house.
12. Figure the cost of 6" T&G needed for sub-floor of the project house if it is laid diagonally.
13. If plywood is used for the sub-floor, how many 4' x 8' sheets will be needed for the project house? What thickness is usually used?

BUILDING TRADES CARPENTRY

UNIT # 3	WALL FRAMING
ASSIGNMENT # 1	PLATFORM FRAME
ASSIGNMENT # 2	BALLOON FRAME
ASSIGNMENT # 3	DOOR FRAMING
ASSIGNMENT # 4	WINDOW FRAMING
ASSIGNMENT # 5	PARTITION FRAMING
ASSIGNMENT # 6	FIRE PLACE FRAMING
ASSIGNMENT # 7	SLIDING DOOR FRAMING
ASSIGNMENT # 8	FURRING
ASSIGNMENT # 9	GROUNDS & BACKING
ASSIGNMENT # 10	FRAMING GABLES ENDS
ASSIGNMENT # 11	OUTSIDE WALL SHEATHING

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UNIT III. WALL FRAMING

ASSIGNMENT 1. PLATFORM FRAMING

REFERENCES
1. Durbahn, Vol. II, pp. 103-112
2. Lair, pp. 6-7; 62-67
3. Framing, sheathing and insulation, pp. 88-95
4.
5.

The purpose of this assignment is to familiarize students with platform framing.

CLASSROOM	ON THE JOB	
related technical information	Information to be given on the job	Work to be done on the job
Safety precautions. Study local building codes. Study floor plans and wall selections. Study types of framing. Nails and nailing. Bracing corner posts.	Safety precautions. Tools used. Local building codes. How to space studs. How to plumb walls How to tie and brace walls.	Layout and cut sole plates. Cut studs. Construct corner posts and angles.

STUDENT STUDY GUIDE

1. State two methods of installing permanent corner bracing.
2. Figure number of studs needed on a problem furnished by your instructor
3. Sketch two methods of constructing corner posts.
4. Figure the lineal feet of sole and top plate needed as in problem #2.
5. Why are studs placed 16" apart on center?
6. What two methods may be used to straighten the walls and plate?
7. What size nails are ordinarily used in wall framing?
8. Show by diagram the wall construction in a platform structure.
9. Should stud spacing be for the inside or outside or both sides of the walls? Why?
10. How far apart should top plate joints be staggered?
11. When doubling the wall plate, what is the minimum distance for staggering joints?
12. Sketch the method of lapping corners on top plates

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UNIT III. WALL FRAMING

ASSIGNMENT 2. BALLOON FRAMING

REFERENCES

1. Durbahn, Vol. II, pp. 51-52
2. Lair, pp. 3-4; 67-68
3. Framing, sheathing and insulation, pp. 66-67
4.
5.

The purpose of this assignment is to familiarize students with the balloon type framing.

CLASSROOM	ON THE JOB	
Related technical information	Information to be given on the job	Work to be done on the job
Safety precautions. Study local building codes. Study floor plans & wall sections. Study types of framing. Nails & nailing.	Tools used. Local building codes. How to space studs. How to locate partitions. How to plumb walls. How to tie & brace walls. Safety precautions.	Layout and cut sole plates. Cut studs. Construct corner posts and angles.

STUDENT STUDY GUIDE

1. State two methods of wall bracing.
2. Figure the number of studs needed on a problem furnished by your instructor.
3. Sketch two methods of constructing corner posts.
4. Figure the lineal feet of top plate needed on the project house.
5. Why are the studs placed 16" O. C.?
6. What two methods may be used to straighten walls and plates?
7. List four advantages of balloon construction.
8. Where must fire stops be installed? Why?
9. Show by diagram on the back of your paper the wall construction in balloon structure.
10. Should stud spacing be for the inside or outside or both of the sides of the walls? Why?

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UNIT III. WALL FRAMING

ASSIGNMENT 3. DOOR FRAMING,
EXTERIOR,
INTERIOR

REFERENCES

1. Durbahn, Vol. II, pp. 75-76
2. Lair, pp. 62; 155.
3. Framing, sheathing and insulation, pp. 81-83
4.
5.

The purpose of this assignment is to familiarize the student with the best methods of framing outside and inside door openings.

CLASSROOM	ON THE JOB	
related technical information	information to be given on the job	Work to be done on the job
Safety precautions.	Safety precautions.	Determine location and size of openings from floor plans.
Types and Kinds of doors.	How to determine length of cripples.	Construct headers.
How to determine allowance for all types of doors.	How to determine open allowances.	Install headers and cripples.
	How to construct and place headers.	Cut and place upper cripples.
	How to place trimmer for wood sills.	Layout, cut and place trimmers.
	How to place trimmers for concrete.	Layout and install a trussed opening.

STUDENT STUDY GUIDE

1. Which dimension is stated first on a door schedule?
2. How do you determine the size of the rough opening?
3. What size opening must be framed for a 3' -0" x 6'-8" exterior door.
4. How long are the cripples over a 6'-8" door using two 2" x 4" on edge as a header, on an 8'-1" ceiling?
5. What is the purpose of the story pole?
6. What is the difference between a header and trimmer?
7. Explain the difference between an outside and an inside door jamb.
8. How do you determine the size of the rough opening of an inside door?
9. Determine the size opening for a 2'-4" x 6'-8" inside door.
10. What length headers are necessary for a 2'-6" door?
11. How are the header heights determined?
12. Sketch two types of trusses that may be used over an inside door opening.
13. Name one other method that is used for support over large openings, besides the truss.
14. What is the cost of all the door jambs in the project house?

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UNIT III. WALL FRAMING

ASSIGNMENT 4. WINDOW FRAMING

REFERENCES
1. Durbahn, Vol. II, pp. 74-78; 117-119.
2. Lair, 65-68; 187-191
3. Framing sheathing and insulation pp. 78-87
4.
5.

The purpose of this assignment is to familiarize the student with the best methods of framing window openings.

CLASSROOM	ON THE JOB	
Related technical information	Information to be given on the job	Work to be done on the job
Safety precautions. Types and kinds of windows. When to use a trussed opening. How to determine size of members of a trussed opening. How to determine allowance for various types of sash balances.	How to determine opening allowances. How to determine lengths of cripples and trimmers. How to construct and place headers. How to place sills and trimmers. How to layout, cut and install members of a trussed opening.	Determine location and size of openings from floor plans. Construct headers and sills. Cut and place trimmers. Layout, cut and install members for a trussed opening.

STUDENT STUDY GUIDE

1. Which dimension is stated first on a window schedule?
2. Which part of a window does the dimension in a window schedule refer to?
3. What allowances are made in determining the size of a rough opening?
4. How are the lengths of cripples determined?
5. Explain the following abbreviations: 24" x 26", 2 lt. D. H.
6. How is window header height determined?
7. What is the distance from the corner of the building to the window opening in Figure 1?

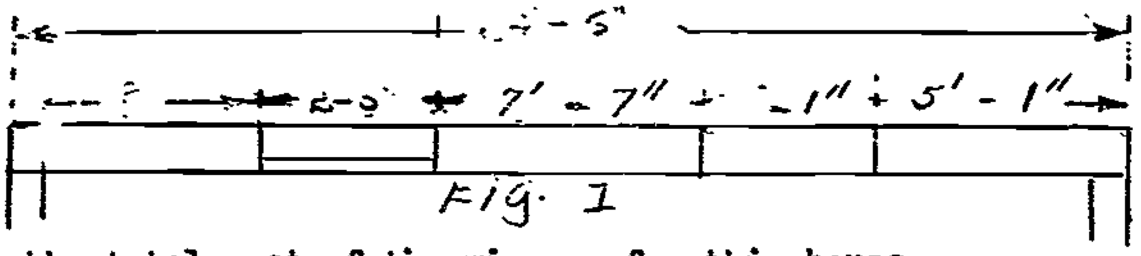

FIG. 1

8. Figure the total cost of the windows for this house.

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UNIT III. WALL FRAMING

ASSIGNMENT 5. PARTITION FRAMING

REFERENCES

1. Durbahn, Vol. II, pp. 72-74
2. Lair, pp. 67; 155
3. Framing, sheathing and insulation, pp. 67; 155.
4.
5.

The purpose of this unit is to describe the most common methods of framing partitions.

CLASSROOM	ON THE JOB	
Related technical information	Information to be given on the job	Work to be done on the job
Safety precautions.	Tools used.	Layout and cut soles and plates.
Study local building codes.	Local building codes.	Locate and cut interior door openings.
Standard blue print dimensioning for partition location.	How to figure cutouts for door openings.	Sole plates.
Information about bearing and non-bearing partitions.	How to put up partitions in restricted spaces.	Cut studs.
Special partition framing for studs.	How to tie partitions to exterior walls.	Assemble, erect and straighten partitions.
Method of partition framing with roof trusses are used.		Tie partitions to exterior walls.
		Tie partitions to ceiling joists.

STUDENT STUDY GUIDE

1. What is the purpose of interior partitions?
2. How should the openings in bearing partitions be constructed in order to keep them from being weakened?
3. Figure the opening cut out for a 2-6 door; for a 2-8 door.
4. How much set over must you make from the blueprint dimensions to properly locate the partition?
5. Why are partition studs spaced 16" O.C.?
6. Sketch two ways of tying partitions to exterior walls.
7. Describe a simple way of tying partitions to ceiling joists which run parallel to partition walls.
8. How much allowance should be made for the head jamb and finish floor?
9. The load-bearing partitions support what part of the house frame?
10. What is the difference between a bearing and a non-bearing partition?
11. Can partitions be framed after the plastering is done?
12. Explain how a stud in a partition may be straightened.
13. Make a list of tools and equipment needed for framing partitions.

CARPENTRY

UNIT III. WALL FRAMING

ASSIGNMENT 6. FIREPLACE FRAMING

REFERENCES

1. Dalzell and Townsend, pp. 282-286
2. Book of successful fireplaces,
   Donley Bros. Co.
3. Manufactures' Literature
4.
5.

The purpose of this assignment is to describe the various types of framing necessary for different types of fireplaces.

CLASSROOM	ON THE JOB	
Related technical information	Information to be given on the job	Work to be done on the job
Safety precautions. Fire safety requirements. Local codes governing framing around flues. Types of flues & chimneys. Heat circulating liners for fire places.	Necessary allowances for masonry clearance. Trussing requirements. Proper blocking for later finish. Importance of allowing for shrinking of wood & settling of flue. Safety precautions.	Lay out & cut soles, plates & install same. Cut studs & install. Cut headers & install. Cut required trussing & install set in blocks for fastening mantels & trim.

STUDENT STUDY GUIDE

1. How far should the framing be kept from the brick work?
2. Sketch the layout of framing members around the fireplace opening:
   a. For a fireplace on an outside wall
   b. For a fireplace on an inside wall
3. If the partition in front of the fireplace were non-bearing, how much trussing would be required?
4. If the fireplace is on an exterior wall, how must the clearance requirements be modified to insure a tight wall?
5. What are some of the advantages of using a metal circulator in the fireplace?
6. What are the advantages of having a fireplace in a home? Are these advantages worth the extra cost? Give your reasons.

CARPENTRY

UNIT III. WALL FRAMING

ASSIGNMENT 7. POCKET TYPE SLIDING DOOR FRAMING

REFERENCES

1. Manufactures Literature
2.
3.
4.
5.

The purpose of this assignment is to familiarize the student with the best method of framing for sliding doors.

CLASSROOM	ON THE JOB	
Related technical information	Information to be given on the job	Work to be done on the job
Safety precautions. Places where sliding doors are used. Different types of sliding door hardware on the market Advantages of sliding doors.	Figure needed space for door opening & pocket. Importance of adequate bracing to prevent sagging. How to install track.	Frame door space needed. Cut & nail in required headers. Install bracing needed at head & sides of framing. Notch last full stud to take plaster base. Nailing strips. Rip & install thin studs at opening of pocket. Nail on lath nailing strips. Install overhead track.

STUDENT STUDY GUIDE

1. Why are sliding doors sometimes substituted for swinging doors?
2. How much space must you allow in framing to use a 2-6 door?
3. Sketch the framing for a sliding door.
4. Sketch two forms of overhead bracing you could use for the framing for a sliding door.
5. What is the cost of sliding door hardware?
6. Estimate the cost of sliding doors over the conventional type of swinging doors.

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UNIT III. WALL FRAMING

ASSIGNMENT 8. FURRING

REFERENCES
1. Durbahn, Vol. II, p. 306.
2. Framing, sheathing and insulation, pp. 205-211
3.
4.
5.

The purpose of this assignment is to give the student an **understanding** of the necessary furring for plumbing, electrical & heating fixtures, different types of dry wall construction.

CLASSROOM	ON THE JOB	
Related technical information	Information to be given on the job	Work to be done on the job
Safety precautions	Where are walls furred?	Furring walls.
Amount & placement of wall furring	When is floor furring necessary?	Cross-furring.
Purpose of floor furring?		Furring floors.
Types & sizes of furring.	Spacing of furring on ceilings.	Furring ceilings.
Purpose of ceiling furring.		

STUDENT STUDY GUIDE

1. What is the function of a furring strip?
2. What kind and size of stock is usually used for furring strips?
3. How many lineal feet of 2" x 2" furring is necessary for a bathroom wall 10' long and 8' - 1' high?
4. Why is it necessary to furr out around a chimney?
5. Why are furring strips sometimes used under a finished floors?
6. What is the proper spacing of furring strips under finished floors?
7. How can floor furring strips be held to a concrete floor?
8. How should furring strips be nailed?
9. Would you furr a poured concrete wall on which you placed a knotty pine covering? Why?
10. How much space should be left between the face of the masonry wall and the back of the wall covering?
11. Would a concrete wall, above grade, need to be furred before plaster or dry wall was applied? If the voids in the blocks were filled with insulation would the wall need to be furred?
12. How are furring strips used in connection with the installation of acoustical and dry wall?

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UNIT III. WALL FRAMING

ASSIGNMENT 9. BACKING AND GROUNDS

1. Durbahn, Vol. II, pp. 84-87
2. Lair, pp. 144-145
3. Framing, sheathing and insulation, pp. 205-211

The purpose of this assignment is to give the student an understanding of the necessity for backing and grounds for interior trim and plaster.

CLASSROOM	ON THE JOB	
Related technical information	Information to be given on the job	Work to be done on the job
Safety precautions. Amount and placements of plaster grounds. Purpose of grounds. Size of grounds.	Where interior and fixture grounds are applied. Where lath and plaster backings are placed. Methods of installing grounds accurately. Safety precautions.	Installing plaster grounds, backing corners.

STUDENT STUDY GUIDE

1. What is the primary purpose of a plaster ground?
2. What determines the thickness of grounds?
3. What is the ordinary thickness of plaster grounds?
4. The sizes and methods of application of grounds vary. What are some of the causes of these variations?
5. Why is it necessary to exercise special care in placing grounds?
6. Why must backing be placed on a non-bearing partition?
7. Why is it necessary to back a corner or partition intersection?

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UNIT III. WALL FRAMING

ASSIGNMENT 10. FRAMING GABLE ENDS

REFERENCES

1. Durbahn, Vol. II, pp. 198-199
2. Lair, pp. 221-226
3. Framing, sheathing and insulation, pp. 126-127
4.
5.

The purpose of this lesson is to acquaint the student with the proper methods of cutting and installing gable end framing members.

CLASSROOM	ON THE JOB	
Related technical information	Information to be given on the job	Work to be done on the job
Safety precautions.	Safety procedures.	Laying out studding.
Estimate materials.	How to make the top	Cutting studding.
Methods of Making top cuts.	How to prevent crowning of the end rafter.	Installing gable studs.
Methods of prevention of crowning of end rafter.	How to frame for louvers.	Framing for louvers.
Purpose of louvers.	How to frame for veneer walls.	Installing gable studs for veneer walls.
Kinds of louvers.		Set in end rafter for veneer walls.
Methods of installing studs for veneer walls.		
How to figure extra overhang for veneer walls.		
Estimating size of louvers.		

STUDENT STUDY GUIDE

1. From what points may the spacing of gable end studs be started?
2. What methods may be used to determine the length of gable studding?
3. Show by diagram two ways to make the top cut on gable end studding.
4. Briefly explain how gable end studs are erected.
5. What method is used in lining up gable end studs?
6. How long is the first short gable end stud on a 1/3 pitch roof if the studs are spaced two feet on centers?
7. How is the amount of material needed for gable ends estimated?
8. What two sizes of common nails are used for nailing the studs?
9. What is the purpose of louvers?
10. Are louvers usually made on the job or purchased ready made?
11. What should be the minimum louver opening per square foot of ceiling area in the attic?
12. How is ventilation provided for in a hip roof with box cornice?

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UNIT III. WALL FRAMING

ASSIGNMENT 11. OUTSIDE WALL SHEATHING

REFERENCES

1. Durbahn, Vol. II, pp. 78-84
2. Lair, pp. 70-76
3. raming, sheathing and insulation, pp. 96-99
4.
5.

The purpose of this assignment is to demonstrate the proper application of wall sheathing.

CLASSROOM	ON THE JOB	
Related technical information	Information to be given on the job	Work to be done on the job
Safety precautions. Relative strength of various types of sheathing materials. The additional wall needed to cover a given area when dressed or matched stock is used. Comparitive rigidity of diagonal & horizontal application of sheathing.	How to make horizontal applications of dressed or matched sheathing. How to make diagonal applications of sheathing. How to apply composition sheathing.	Determine length of sheathing. Align first course of sheathing. Nail sheathing in place. How to sheath around window & door openings.

STUDENT STUDY GUIDE

1. When is the sheathing put on the building?
2. For what purpose is sheathing applied?
3. In what sections of the country is diagonal sheathing most widely used?
4. Name three or four kinds of sheathing materials.
5. What are the advantages of diagonal applications of sheathing?
6. Why is the diagonal application of sheathing more expensive than horizontal applications?
7. Is composition board gaining favor as sheathing material with contractors and builders?
8. How is the amount of sheathing necessary for gable ends estimated?
9. Figure the cost of the side wall sheathing of the project house?
10. Figure the difference in cost of sheathing the house 8" shiplap and 4' x 8' composition board.
11. How many pounds of 8d common nails will be needed to apply 8' shiplap horizontal sheathing on the project house?
12. What safety factors must be considered while erecting and working on scaffolds?

BUILDING TRADES CARPENTRY

ROOF FRAMING AND SHEATHING

UNIT # 4

ASSIGNMENT # 1	GENERAL INFORMATION
ASSIGNMENT # 2	FRAMING A GABLE ROOF
ASSIGNMENT # 3	FRAMING A SHED ROOF
ASSIGNMENT # 4	FRAMING A HIP ROOF
ASSIGNMENT # 5	FRAMING INTERSECTING ROOFS
ASSIGNMENT # 6	FRAMING A GAMBREL ROOF
ASSIGNMENT # 7	FRAMING OF UNEQUAL PITCH ROOFS
ASSIGNMENT # 8	FRAMING DORMERS
ASSIGNMENT # 9	FRAMING FLAT DECKS
ASSIGNMENT # 10	FRAMING TRUSS ROOFS
ASSIGNMENT # 11	ROOF SHEATHING
ASSIGNMENT # 12	COLLAR BEAMS
ASSIGNMENT # 13	FRAMING FOR ROOF OPENINGS
ASSIGNMENT # 14	FRAMING A SNUB GABLE
ASSIGNMENT # 15	FRAMING A LEAN-TO ROOF
ASSIGNMENT # 16	FRAMING A CHIMNEY SADDLE

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UNIT IV. ROOF FRAMING AND SHEATHING

ASSIGNMENT 1. GENERAL INFORMATION

REFERENCES

1. Durbahn, Vol. II, pp. 133-144
2. Lair, pp. 83-103
3. Wilson and Werner, pp. 1-7
4. Framing, sheathing and Insulation pp. 115-127
5.

Previous to the framing of a roof, it is necessary that one become acquainted with local building regulations specified in the local building code and/or FHA specifications as it applies to the different kinds of roof design. The student should acquire: (1) Knowledge of different kinds of roofs. (2) How rafter lengths are determined. (3) How to interpret roof code regulations. (4) The procedure for selecting the roof framing material, e.g., kinds, quality & quantity of material. (5) Knowledge of applicable safety precautions.

CLASSROOM	ON THE JOB	
Related technical information	Information to be given on the job	Work to be done on the job
Local building requirements. Different types of roofs. Safety precautions on roof construction.		

STUDENT STUDY GUIDE

1. What are the local building regulations regarding roofs?
2. What are the four types of roofs commonly used in house construction?
3. What is meant by the following terms: rafters: span: rise: run: pitch: rafter length: rafter thrust?
4. What are the two methods of laying out rafter lengths?
5. Give the rule for finding the rise when you know the span and pitch?
6. What is meant by rise per foot of run?
7. What is meant by the rafter length per foot of run?
8. Describe the following terms: topcut; seat cut; and tail cut.
9. Name four kinds of rafters.
10. Describe the methods of using the framing square in laying out the cuts of rafters.

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UNIT IV. ROOF FRAMING
AND SHEATHING

ASSIGNMENT 2. FRAMING A
GABLE ROOF

REFERENCES

1. Durbahn, Vol. II, pp. 182-183; 150-156
2. Lair, pp. 83-103
3. Wilson and Werner, 9-20
4. Framing, Sheathing and Insulation, pp. 115-127

The purpose of this assignment is to demonstrate the methods of framing a gable roof.

CLASSROOM	ON THE JOB	
Related technical information	Information to be given on the job	Work to be done on the job
Methods of determing span, rise, run, and pitch of roof. Relationship between unit and total measurement. Methods in rafter lay-out; step-off, unit length, and rafter tables. Kinds, size and grades of lumber. Use of square	Safety precautions Determine the pitch, span and rise. Size of material. Length of tail. Size of nails. Scaffold and/or holding devices. How to nail	Determine pitch, span, and length. Layout and cut common rafters. Spacing of rafters on the plate. Erect and nail. Bracing. Install Ridge.

STUDENT STUDY GUIDE

1. What is an equal pitch gable roof?
2. Define the rise, run and pitch of a common rafter.
3. What does the term "unit length" mean to you?
4. Describe the following methods of laying out rafters: step off; rafter table; unit length.
5. What is the length of a common rafter for a gable roof with a span of 27 feet and 1/3 pitch.
6. What is the unit of run for common rafters?
7. What is the unit of rise for a roof of $\frac{1}{2}$ pitch?
8. Is it advisable to have an overhang on a gable roof? Why?
9. What will be the length of the tail of a common rafter of 1/3 pitch if a 1" x 12" is used for the plancher?
10. What is the length of a common rafter per unit of run for 1/3 pitch; for $\frac{1}{2}$ pitch?

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UNIT IV. ROOF FRAMING
AND SHEATHING

ASSIGNMENT 3. FRAMING A
SHED ROOF

REFERENCES

1. Durbahn, Vol. II, pp. 184-185
2. Lair, pp. 95-99
3. Wilson and Werner, pp. 110-111

The purpose of this assignment is to demonstrate the way to lay out and cut common rafters of various pitches and spans.

CLASSROOM	ON THE JOB	
Related technical information	Information to be given on the job	Work to be done on the job
Determine basic roof information.	Determine the length, pitch, and run.	Layout and cut rafters, common space and nail rafters.
How to lay out plate cut and overhang.	Sizes and kinds of material. Tools used.	
Use of framing square in laying out rafters.	Safety precautions.	Bridge on long runs.
Rafter tables.		
Common pitches.		
How to find pitch.		
Rafter cuts		
Estimating.		

STUDENT STUDY GUIDE

1. Where are shed type roofs used? What makes them of added importance at this time?
2. What type rafter is used in a shed type roof?
3. Compare the shed and gable roof.
4. What are the advantages and disadvantages of the shed roof?
5. Describe two methods of finding the length of a common rafter?
6. What is the length of the common rafter for a shed roof with a 17 foot span and 1/6 pitch?
7. What numbers on the square will give a plumb cut for 1/6 pitch?
8. What new materials and methods make this roof satisfactory for ranch type homes?
9. Figure the cost of the rafters for a shed roof the size of which will be given by your instructor.

CARPENTRY

UNIT IV. ROOF FRAMING
AND SHEATHING

ASSIGNMENT 4. FRAMING A
HIP ROOF

REFERENCES

1. Durbahn, Vol. II, pp. 135; 183-k84
2. Lair, pp. 83-98; 99-103
3. Wilson and Werner, pp. 21-49
4. Framing, sheathing and insulation, pp. 128, 137
5.

Another kind of roof framing is the hip roof. This type not only employs the common rafter but other kinds of rafters known as the hip, and jack. This roof is used for many designs of homes, and also in combination with the gable type roof. When considering construction and costs, the hip roof has some advantages and disadvantages.

CLASSROOM	ON THE JOB	
Related technical information	Information to be given on the job	Work to be done on the job
Advantages and disadvantages in different methods. How to determine span, rise, run and pitch of roof. Relationship between unit length and total length. Estimating. Methods used in rafter layouts, step off, unit length and rafter tables. Safety precautions.	Tools used. Safety precautions. Ridge cut specifications. Specifications for sizes of material and spacing. Consider pitch and span, and determine rafter length, seat cut, overhang, tail cut, cheek cuts, and dropping or backing. Size of nails, location, and technique in nailing.	Layout and cut common rafter. Layout and cut hip rafter pattern. Layout and cut jack rafter. Space and locate, erect, and nail rafters. Consider pitch and span, and determine rafter length, seat cut, over hand, and check cut.

STUDENT STUDY GUIDE

1. What are the specifications for hip roof as set forth in the local code?
2. Describe the method of calculation of a common rafter.
3. Describe the method of calculating a hip rafter.
4. Describe the method of calculating and cutting a jack rafter.
5. What are the advantages of a hip roof?
6. What is the unit of run of a hip rafter? Why?
7. What is the length of a hip rafter for a roof of 29' span and 1/4" pitch?
8. Is the unit of rise for a hip rafter of 1/3 pitch the same as the unit of rise of a common rafter of 1/3 pitch?
9. What numbers on the square are used to get a plumb cut on a hip of 1/4 pitch?
10. What is meant by "dropping" and "backing"?
11. What numbers on the square are used to get the side cut on a hip rafter of 1/3 pitch?
12. What is the cost of the rafters for the project house?

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UNIT IV. ROOF FRAMING AND SHEATHING

ASSIGNMENT 5. INTERSECTING ROOFS

REFERENCES

1. Durbahn, Vol. II, pp. 167; 177-184
2. Lair, pp. 99-103
3. Wilson and Werner, pp. 51-71
4. Framing, sheathing and insulation, pp. 128-138

The purpose of this unit is to give the information necessary to construct the frame work for such intersecting roofs.

CLASSROOM	ON THE JOB	
Related technical information	Information to be given on the job	Work to be done on the job
How to use basic roof information in determining length and cuts of rafters. How to use framing square in laying out valley, hip, cripple and jack rafters.	Safety precautions. Figure lengths with square of hip, valley, jack and cripple rafters. Figure side, seat and ridge cuts of valley, jack, hip and cripple rafters.	Layout valley rafters. Layout cripple rafters. Layout jack rafters. Layout hip rafters. Cut rafters. Erect rafters.

STUDENT STUDY GUIDE

1. Where are valley rafters used?
2. How does a valley rafter differ from a hip rafter?
3. How is the length of a valley rafter found?
4. What figure on the square should be used for the unit of run in cutting valley rafters?
5. How should the seat cut of a valley rafter be made?
6. How should the side cut of a valley rafter be made?
7. How does a valley jack rafter differ from a hip jack rafter?
8. How should the layout for the seat cut for a valley jack rafter be made?
9. How should the length of a valley jack rafter be found?
10. What is a cripple jack rafter?

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UNIT IV. ROOF FRAMING AND SHEATHING

ASSIGNMENT 6. FRAMING A GAMBREL ROOF

REFERENCES
1. Durbahn, Vol. II, pp. 189-191, 377-383
2.
3.
4.
5.

The purpose of this assignment is to demonstrate the methods of framing a gambrel roof.

CLASSROOM	ON THE JOB	
Related technical information	Information to be given on the job	Work to be done on the job
Safety precautions. Gable vs. gambrel roof. Advantages and disadvantages How to layout the roof members. Use of the purline. Use of braces on rafters. Size of material to use. Methods of erecting. Estimating.	Safety precautions. How to layout. Use of the purline Spacing rafters.	Layout rafters for a gambrel roof. Layout rafter parts and assemble, if no purline is used. Install framing members.

STUDENT STUDY GUIDE

1. How does the gambrel roof differ from the gable roof?
2. What are the advantages and disadvantages of a gambrel roof?
3. What is a purline?
4. How are rafters cut to fit to a purline?
5. Why are braces necessary?
6. Why is the gambrel a good roof for a barn construction?
7. Figure the cost of the rafters in a gambrel roof of a problem given by your instructor.

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UNIT IV. ROOF FRAMING AND SHEATHING

ASSIGNMENT 7. FRAMING UNEQUAL PITCHED ROOFS

REFERENCES

1. Durbahn, Vol. II, pp. 206-211
2. Wilson and Werner, pp. 73-96
3. Framing, sheathing and insulation, pp. 163-175

An equal pitch roof is one in which the main part has a different pitch from the projecting part. The width and height of an intersecting roof of a hip or gamble type is sometimes restricted, in this case, the rise per foot run of the main common rafter may be different from that of the gable common rafter.

CLASSROOM	ON THE JOB	
Related technical information	Information to be given on the job	Work to be done on the job
Methods of determining span, rise, run, and pitch of roof. Methods of layout and cutting rafters. Method of erecting roof without rafter tails. Method of erecting roof with rafter tails.	Safety precautions. Determine the pitch, span, and rise. Size of materials. Size of nails.	Determine pitch, span, and length. Layout, roof plan. Layout common jack, and valley rafters for main and projecting roof. Erect and nail.

STUDENT STUDY GUIDE

1. List the three conditions by which two roofs will have unequal pitches?
2. Where is the measuring line for rafters in unequal pitch roofs if there is to to be no rafter tails?
3. By what means is the unit run of the valley rafter, of an unequal pitch roof determined?
4. The problems involved in framing the unequal pitch roof divide themselves into two parts? List each.
5. How is the length of common rafters determined on an unequal pitch roof?
6. Explain the layout process of the ridge cut of an unequal pitch valley rafter?
7. What new principal is involved in finding the angle of side cuts on a valley rafter? (unequal pitch roofs)

CARPENTRY

UNIT IV. ROOF FRAMING
AND SHEATHING

ASSIGNMENT 8. FRAMING DORMERS

REFERENCES
1. Durbahn, Vol. II, pp. 169; 186-188
207-213
2. Lair, pp. 184-186
3. Wilson and Werner, pp. 106-109; 110
4. Framing, sheathing and insulation, pp. 150-156
5.

The purpose of this assignment is to provide a working knowledge of framing for any of the common types of dormers.

CLASSROOM	ON THE JOB	
Related technical information	Information to be given on the job	Work to be done on the job
Types and purposes of dormers. How to determine the meeting point of two slopes. Finding top cut of dormer rafters. Finding common difference of stud lengths.	Safety precautions. How to layout opening. How to layout dormer studs and rafters. How to layout headers.	Layout and frame opening in main roof. Layout and cut dormer studs. Layout and cut dormer rafters. Layout and frame wall opening. Erect dormer frame work.

STUDENT STUDY GUIDE

1. Name three types of dormers?
2. How is the dormer opening determined?
3. Illustrate the framing of one type of dormer opening?
4. Describe the method used to determine the meeting points of two slopes?
5. Illustrate the layout of the rafter cuts.
6. Describe the laying out of the different stud lengths?
7. Why are dormers used?
8. Problem in estimating or figuring cost of material to be given by the instructor?

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UNIT IV. ROOF FRAMING AND SHEATHING

ASSIGNMENT 9. FRAMING FLAT DECKS

REFERENCES
1. Burbank, p. 41
2. Mix and Cirou, pp. 122
3. Townsend and Dalzell, pp. 211-213
4.
5.

A roof having a pitch of less than 1/8 is considered a deck roof. A deck roof may be a shed or a hip. In either case, the rafters are framed in the same manner as for other roofs having the same kind of rafter.

CLASSROOM	ON THE JOB	
Related technical information	Information to be given on the job	Work to be done on the job
Purpose of the deck. Advantages. Disadvantages. Estimating.	Safety precautions. Determine lengths of material.	Layout, assemble and nail. Put in position if necessary and frame as needed.

STUDENT STUDY GUIDE

1. What are some uses for a deck roof?
2. Compare the cost of a deck roof with that of a gable roof.
3. What is the greatest slope ordinarily allowed for which a built-up covering is used.
4. Describe two methods of construction to obtain the desired slope.
5. How are the sizes of rafter-joist determined for a roof deck?
6. What type of sheathing is often used where the rafter is also used for the ceiling joist?
7. Where an overhang is involved on all sides of the house, describe or sketch the type of construction used.
8. What is the ratio between the distance from wall-line to double header and the overhang?
9. What is the purpose of sheet metal edging used on flat decks.

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UNIT IV. ROOF FRAMING
AND SHEATHING

ASSIGNMENT 10. FRAMING TRUSS
ROOFS

REFERENCES
1. Small House Carpentry, pp. 71, 75-77
2. Small Homes Council, Circular Series
E2. 1, pp. 6-8
3. Small Homes Council "W" Truss Instruction
Sheet A, I, A, 19 B 3
4.
5.

Trusses as used in commercial and farm buildings are of long standing. Their use in small home construction is, however, relatively new. These trusses are similar to the conventional gable roof with the exception that the use of trusses permits spacing the entire width of a house without the need of interior partitions for ceiling or roof support. This measure is economical from the standpoint of both labor and materials.

CLASSROOM	ON THE JOB	
Related technical information	Information to be given on the job	Work to be done on the job
Methods of determining span, rise, run, and pitch of roof. Relationship between unit and total measurement. Methods used in rafter layout. Step off, unit length, and rafter tables. Size, kinds, and grades of lumber. Truss fastenings.	Safety precautions. Pitch, span, and rise calculations. Size requirements for materials Calculations for length of tail. Truss fastenings. Kind and size of nail.	Determine pitch and span. Layout and cut common rafters. Arrange construction jig on sub-floor. Fabricate trusses. Raise trusses onto plates. Space, erect and nail brace.

STUDENT STUDY GUIDE

1. Sketch a 16 foot simple truss.

2. Sketch a jig for assembly of the above truss.

3. Compare member sizes with those used in conventional construction.

4. List advantages and disadvantages; also limitation of this type of construction.

5. Figure thrust, compression and shear at main points of truss.
(Problems to be given by instructor).

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UNIT IV. ROOF FRAMING
AND SHEATHING

ASSIGNMENT 11. ROOF SHEATHING

REFERENCES
1. Duroahn, Vol. II, pp. 11 -122
2. Lair, pp. 76-79
3.
4.
5.

Sheathing is some form of rigid material used to support the weather repellant roof covering. The material used for the sheathing and the workmanship exhibited in laying of same. Greatly contributes to the value of the building and the durability of the roof covering. The carpenter should become well acquainted with the particulars contributing to a good sheathing job.

CLASSROOM	ON THE JOB	
Related technical information	Information to be given on the job	Work to be done on the job
Safety precautions Study types of sheathing from the standpoint of durability, cost & desirability. Estimating. Sheathing for different roofs. How to cut for hips & valleys.	Safety precautions. Nailing information. Staying of rafters. Breaking joints. Use of metal tie clips or plywood sheathing.	Layout. Cut and nail in place. Line and cut ends if necessary.

STUDENT STUDY GUIDE

1. List common materials used for sheathing.
2. What size nails should be used and how many in each shiplap?
3. What is the purpose of sheathing?
4. Describe the methods of applying solid roof sheathing.
5. Figure the cost of various kinds of roof sheathing for a problem given by the instructor.
6. Write a summary on the use of roof boards for wood shingles. Include size, spacing, nailing, etc.
7. What change in the roof framing is necessary for prefinished insulated plank roofing?

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UNIT IV. ROOF FRAMING AND SHEATHING

ASSIGNMENT 12. COLLAR BEAMS

1. Durbahn, vol. II, pp. 197-198
2. Lair, pp. 102-103
3. Wilson and Werner, pp. 113-115

To strengthen roofs most rafters are tied together with collar beams. Your job is to be able to cut and place collar beams of the proper size in the proper location to insure good construction.

CLASSROOM	ON THE JOB	
Related technical information	Information to be given on the job	Work to be done on the job
Saety precautions. Purpose of collar beams. Location of collar beams. Sizes of collar beams. Estimating. Spacing collar beams	Determine length of collar beams. Locate collar beams. Determine size of collar beams.	Layout pattern for collar beams. Cut out collar beams. Nail collar beams in place.

STUDENT STUDY GUIDE

1. Where are collar beams used?
2. What is the purpose of collar beams?
3. What size stock is used for collar beams?
4. What determines the length of a collar beam?
5. How is a collar beam laid out?
6. How often are these beams used in a roof?
7. When should they be nailed in place?
8. How is the distance between attic floor and the collar beam determined?
9. Give the formula for figuring the lengths of collar beams.
10. What is the length of a collar beam for a $\frac{1}{4}$ pitch roof when the beam is to be placed 2 feet from the ridge?

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UNIT IV. ROOF FRAMING AND SHEATHING

ASSIGNMENT 13. FRAMING FOR ROOF OPENINGS

REFERENCES

1. Durbahn, Vol. II, pp. 191-194
2. Lair, p. 186
3. Framing, sheathing and Insulation, pp. 156-157; 162
4.
5.

Openings are needed in the roof for various reasons. It is far better that the carpenter cut and frame these openings, as the other mechanics consider this secondary to the performance of their specific job. This will insure a "completed-type job," that the carpenter considers necessary.

CLASSROOM	ON THE JOB	
Related technical information	Information to be given on the job	Work to be done on the job
Safety precautions. Fire regulations. Plumbing regulations. Line projection from one plane to another.	Safety precautions. Use of plumb line or spirit level to locate roof openings. Size of materials. Size of nails.	Methods of locating headers and trimmers for chimneys, sky lights, scuttles, louvers, etc. Methods of locating and drawing plans on attic floor. Methods of supporting and cutting roof members. Methods of nailing headers and trimmers in place.

STUDENT STUDY GUIDE

1. What are some common openings found in roof construction that require special framing?
2. How are roof openings located?
3. Why would a plan of an opening drawn full size on the attic floor help in locating the same opening in the roof?
4. Explain what is meant by a single header. A double header.
5. What are trimmers?
6. How is the cut on the end of a trimmer determined?
7. When trimmers are nailed in place, why should they be in line with the tops of the rafters?
8. Why is a strip nailed across the top of the rafters to be cut?
9. What is a chimney saddle?
10. What determines the span of the saddle?
11. Write a short summary of the steps necessary to frame a chimney opening in a roof.

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UNIT IV. ROOF FRAMING AND SHEATHING

ASSIGNMENT 14. FRAMING A SNUB GABLE

REFERENCES

1. WILSON AND WERNER, pp. 97-102
2. Framing, sheathing and insulation, pp. 177-180
3.
4.
5.

One of the variations used by designers to deviate from the regular type of roof is known as the snub gable. The carpenter should have a knowledge of its layout and construction.

CLASSROOM	ON THE JOB	
Related technical information	Information to be given on the job	Work to be done on the job
Safety precautions. Use of steel square in determining lengths and cuts of rafters. Reasons for snub gable including type of architecture.	Safety precautions. How to determine miter cuts on shortened common rafters. How to determine length of gable plate. How to determine length of hip and jack rafters and make check and seat cuts.	Layout and cut shortened common rafters. Layout and cut gable plate. Layout and cut snub hip rafters and jack rafters and jack rafters. Nail gable plate and snub hip rafters in place. Space and nail jack rafters in place.

STUDENT STUDY GUIDE

1. What is a snub gable?
2. What determines the size of a snub gable?
3. What three spans are involved in a snub gable?
4. How is the height of the plate for the snub gable determined?
5. What are the names of the different rafters used in framing this roof?
6. How does the tail-cut of a hip rafter for a snub gable differ from an ordinary hip rafter?
7. Explain how a T-bevel may be used in framing a snub gable.
8. How is the length of the jack rafters found?
9. Draw a sketch of a snub gable roof.
10. Summarize the operations for framing a snub gable in their proper order.

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UNIT IV. ROOF FRAMING AND SHEATHING

ASSIGNMENT 15. FRAMING A LEAN-TO ROOF

REFERENCES

1. Durbahn, Vol. II, pp. 188-189.
2.
3.
4.
5.

The layout for the lean-to roof rafter is similar to the layout for the shed-dormer rafter with the exception that the lean-to roof extends, in part, over the main roof. The rafter plates for the lean-to roof and the main roof are usually at different heights.

CLASSROOM	ON THE JOB	
Related technical information	Information to be given on the job	Work to be done on the job
Determine Basic roof information.	Determine the length, pitch, and run.	Layout and cut rafters.
How to lay out plate cut and overhang.	Size and kinds of materials.	Space and nail rafters.
How to lay out cut at top end of rafter.	Safety precautions.	

STUDENT STUDY GUIDE

1. Draw a sketch showing a lean-to roof.
2. The layout for the lean-to roof rafter is similar to the layout for the ______________ rafter.
3. How is the top cut laid out for the lean-to roof rafter?
4. What shortening is necessary on a rafter for a lean-to roof?
5. Would a lean-to roof be used most often in new construction or in adding to an old building?
6. A practical problem should be given to the class requiring them to figure the lean-to roof after length.

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UNIT IV. ROOF FRAMING
AND SHEATHING

ASSIGNMENT 16. FRAMING A CHIMNEY SADDLE

REFERENCES
1. Durbahn, Vol. II, pp. 191-194
2. Framing, sheathing and insulation, pp. 180-181
3.
4.
5.

Unless a chimney straddles the ridge, a small gable called a saddle is constructed at the rear of the chimney to keep snow and dirt from collecting. Chimney saddles are constructed and installed prior to covering the roof.

CLASSROOM	ON THE JOB	
Related technical information	Information to be given on the job	Work to be done on the job
Methods of determining span and pitch of saddle. Method of layout and cutting of rafters, valley strip, and ridge boards	Safety precautions. Determine span, pitch, rise, and necessary shortening. Kinds and sizes of materials. Determine length and layout of ridge. Determine necessary shortening of common rafter.	To determine the width of chimney and unit rise of the main roof. To layout and cut various members of the saddle. To assemble and nail in position.

STUDENT STUDY GUIDE

1. What is the purpose of a chimney saddle?
2. What is the span for a chimney saddle and how is it determined?
3. How is the length of a valley strip determined?
4. What size stock is recommended for the valley strip?
5. Why is it necessary to shorten the common rafter of a chimney saddle?
6. Show by diagram a method of finding the required shortening for a common rafter run of a saddle?
7. Show by diagram the layout of the common rafter for the chimney saddle. Identify the ridge cut and the seat cut?
8. How is the ridge layout, that fits against the valley strip, determined?

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BUILDING TRADES CARPENTRY

UNIT # 5 EXTERIOR COVERING AND TRIM

ASSIGNMENT # 1	CORNICE TRIM
ASSIGNMENT # 2	ROOF COVERINGS a. WOOD SHINGLES b. ASPHALT SHINGLES CEMENT ASBESTOS SHINGLES ROLL ROOFING c. METAL ROOFING
ASSIGNMENT # 3	SETTING WINDOW AND DOOR FRAMES
ASSIGNMENT # 4	WALL COVERINGS
ASSIGNMENT # 5	PORCH AND ENTRANCE TRIM

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UNIT V. EXTERIOR COVERING AND TRIM

ASSIGNMENT 1. CORNICE TRIM

REFERENCES

1. Durbahn, Vol. II, pp. 224-231; 265-271
2. Lair, pp. 181-184
3. Interior and Exterior Trim, pp. 1-2
4.
5.

The purpose of a cornice is to provide a definite and satisfactory finish in building construction at the points where the roof and side wall intersect. This usually includes the gutter as a part of its design. The size is largely determined by the type of architecture as well as the size and balance of the house. This unit has as its purpose the teaching of the most common types of cornices and their respective construction.

CLASSROOM	ON THE JOB	
Related technical information	Information to be given on the job	Work to be done on the job
Safety precautions.	Kinds of cornices	Cutting, fitting and placing of frieze boards plancier boards, fascia boards, and barge boards.
Local adaptations.	Rafter tails	
Designs of cornice construction	Guttering	
Kinds and types of materials.	Nailing order and assembly	
Specifications.	Safety precautions.	Cutting and fitting of moulding installation and application
Estimating.		

STUDENT STUDY GUIDE

1. What is a cornice?
2. What are the purposes of a cornice?
3. What are the three common types of cornice?
4. How are rafter ends made even for cornice construction?
5. What is the purpose of the rabbet on the frieze board?
6. What is the proper procedure for erecting the frieze board?
7. Describe a cornice return?
8. Make a sketch of a box cornice and label: plancier, fascia and frieze.
9. What kind of nails are used for cornice work?
10. How would you estimate the material in a box cornice?

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UNIT V. EXTERIOR COVERING AND TRIM

ASSIGNMENT 2. ABC ROOF COVERING

REFERENCES

1. Durbahn, Vol. II, pp. 218-219; 232-246
2. Lair, pp. 105-112
3. Interior and Exterior Trim, pp. 25-40
4.
5.

The purpose of this assignment is to familiarize the student with the various kinds of roof covering and the methods of application.

CLASSROOM	ON THE JOB	
Related technical information	Information to be given on the job	Work to be done on the job
Safety precautions. Adaptability and relative values of different kinds of materials. Selection of nails. Types of valleys. Study of color harmony. Estimating.	Safety precautions. Projection over eaves and gables. Breaking of joints. Beginning the starting ends for courses. Position and nailing of foot locks. How and when to place underlay. Proper nailing of courses.	Scaffolds. Place starting line. Place paper. Place valley tin, copper or slate. Coat roofing. Establish valley shingle line. Placing of nails. Ley starting course. Establish of course lines at ends. Placement of foot locks. Finish of ridge & hips.

STUDENT STUDY GUIDE

1. What kinds of wood are used for shingles?
2. How are shingles graded?
3. What precaution should be taken in nailing valleys and flashing?
4. What kinds of flashings and ridge should be used with wood shingles?
5. What is a square of shingles?
6. How many squares of shingles would be needed to cover a shed for a roof 30 ft. long if the rafters are 15 ft. long?
7. Why should you not use wood shingles on a roof that has less than $\frac{1}{4}$ pitch?
8. Why should wood shingles be spaced 1/8" apart?
9. What advantages do wood shingles have over otherkinds of roofing? Disadvantages?

CARPENTRY

UNIT V. EXTERIOR COVERING AND TRIM

ASSIGNMENT 2B ROOF COVERING-ASPHALT SHINGLES-ASBESTOS SHINGLES-ROLL ROOFING

REFERENCES:

1. Durbahn, Vol. II, pp. 243-266
2. Lair, pp. 112-120
3. Interior and exterior trim, pp. 41-52

STUDENT STUDY GUIDE

1. List three advantages of an asphalt shingle over a wood shingle.
2. What is a starter course?
3. What is a roof scaffold bracket?
4. What is the chief advantage of the cement-asbestos shingle over the asphalt shingle?
5. In roll roofing, what are the two precautions that should be taken before laying on the material?
6. What is the purpose of paper under shingles?
7. Why should you use a chalk line in laying shingles?
8. What is meant by a square of shingles? How many bundles of asphalt shingles in a square?
9. How is the grade of asphalt shingles given?
10. Picture the cost of the roofing material for various problems given by your instructor.

CARPENTRY

UNIT V. EXTERIOR COVERING AND TRIM

ASSIGNMENT 2C ROOF COVERING-METAL ROOFING

REFERENCES:

1. Audel, pp. 653-784 (for tinners)
2. Manufacturer's Literature
3.

STUDENT STUDY GUIDE

1. List four metals used for roofing material.
2. What type of nail is used on the following materials:
    a. galvanized iron
    b. aluminum
    c. copper
    d. zinc
    e. tin
3. What are metal roofs sometimes painted?
4. Describe a temporary patch for a metal roof.
5. What size sheets are commonly available in galvanized iron roofing?
6. Figure the cost of various metal roofs.

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UNIT V. EXTERIOR COVERING
AND TRIM

ASSIGNMENT 3. SETTING WINDOW
AND DOOR FRAMES

REFERENCES

1. Durbahn, Vol. II, pp. 246-254
2. Lair, pp. 187-200
3. Interior and Exterior Trim, pp. 53-77
4. Manufacturer's Specifications
5.

The purpose of the window and door frame is to receive and protect the various types of windows and doors and to permit necessary operation. Details such as opening sizes and methods of setting are determined by frames and methods of setting are determined by tye type of manufactured doors and windows used. Hence a knowledge of the kinds and types of door and window frames and methods of assembly and setting are necessary.

The purpose of this assignment is to give this information.

CLASSROOM	ON THE JOB	
Related technical information	Information to be given on the job	Work to be done on the job
Safety precautions. Lumber & rot proofing. Kinds of paper and insulation. Primers and sealers. Nail sizes and types. Local building codes. Termite proofing. Caulking.	Name, size and location of each member of frame. Safety. Tools used. Kinds of frames and casting. Methods of layout and assembly. Methods of spacing. Methods of bracing. Methods of insulating. Methods of papering or caulking.	Construct and/or assemble. Locate, plumb, level, fasten and brace.

STUDENT STUDY GUIDE

1. Why are frames put in place before exterior wall finish is applied?
2. What is a window rod? How used?
3. List steps in setting window frames.
4. What wood is used for jambs and casing and sills?
5. What size nails? How spaced for both door and window frames?
6. What materials is used for flashing? How is it applied?
7. Do all metal sash require a frame?
8. Figure the differences in cost between wood and metal in windows for a specific house.

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UNIT V. EXTERIOR COVERING AND TRIM

ASSIGNMENT 4. WALL COVERING

REFERENCES

1. Durbahn, Vol. II, pp. 258-265
2. Lair, 125-135
3. Interior and Exterior Trim, pp. 80-95
4.
5.

It is necessary to finish the outside of all building construction with some type of covering. The purposes of wall coverings are to decorate and insulate these structures from the elements. Many kinds of materials can be used and a knowledge of the application of the most common kinds are necessary. A study of construction, durability and design forms one of the most interesting phases of building construction.

CLASSROOM	ON THE JOB	
Related technical information	Information to be given on the job	Work to be done on the job
Safety precautions.	Name, size, type of materials for wall coverings.	Methods of application.
Materials and manufacturing methods.	Tool used.	Methods of finishing, corners.
Pre-construction finishes.	Cutting of different materials.	Methods of trimming intersections.
Expansion and sun action.	Nailing or application of materials.	
Tools and equipment used in wall covering application.	Insulating and caulking.	
	Fitting metal corners.	

STUDENT STUDY GUIDE

1. How are the courses of siding or covering spaced?
2. How do windows determine spacings?
3. Describe how courses are started for three different types of wall coverings.
4. How are courses finished at the corners for three materials?
5. How are courses finished at the cornice and rake for three materials?
6. How are courses kept horizontal? What tools or materials used?
7. How are courses nailed, nail sizes, setting and filling, if necessary, for three materials?
8. How are scaffolds maintained?

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UNIT V. EXTERIOR COVERING
AND TRIM

ASSIGNMENT 5. PORCH AND ENTRANCE
TRIM

REFERENCES

1. Durban, Vol. II, p. 270
2. Interior and Exterior Trim, pp. 96-116.
3.
4.
5.

Porches form sheltered places in which to sit, and generally project from the main body of the building. The term is also applied to small shelters over entrance doorways for the purpose of protection from the weather.

CLASSROOM	ON THE JOB	
Related technical information	Information to be given on the job	Work to be done on the job
Safety precautions. Standards of materials. Designs of porches.	Safety precautions. Tools used. Locating and joining.	Cut and fit the plancier, fascia, crown and cove mould, and special trim. Columns, ceiling, and wainscoating.

STUDENT STUDY GUIDE

1. What safety precaution are taken in porch construction?
2. What has replaced the front porches on many types of present day houses?
3. Name two types of porches and give advantages and disadvantages of each.
4. Does the type of cornice trim on the main house affect the porch trim?
5. What kind of wood is best for a porch floor?
6. What kind of nails should be used when laying porch floorings?

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BUILDING TRADES CARPENTRY

UNIT # 6 INSULATION

ASSIGNMENT #1	GENERAL INFORMATION
ASSIGNMENT #2	LOOSE TYPE
ASSIGNMENT #3	BLANKETS AND BATTS
ASSIGNMENT #4	RIGID BOARD
ASSIGNMENT #5	REFLECTIVE TYPE

CARPENTRY

UNIT VI. INSULATION

ASSIGNMENT 1. GENERAL INFORMATION

REFERENCES

1. Durbahn, Vol. II, pp. 155-182
2. Lair, pp. 212-223
3. Framing, sheathing, & insulation, pp. 231-236
4.
5.

The primary purpose of insulation is to retard the passage of heat or to keep heat where it belongs. The purpose is the same whether insulation in the walls of your refrigerator, or in the walls of your range oven, around the pipes of your furnace, in the walls and ceilings of your home, or in the clothing you wear. The insulation you choose for your house should be selected for its insulating efficiency, its permanence, its resistance to fire and rodents, and the ease and speed with which it can be installed.

Where the attic is insulated, ventilation is necessary to prevent accumulation of excessive moisture and heat.

CLASSROOM	ON THE JOB	
Related technical information	Information to be given on the job	Work to be done on the job
Safety precautions. Study principles of thermal insulation. Study types of insulating materials and compartive values.	Safety precautions.	

STUDENT STUDY GUIDE

1. What is meant by the term "thermal building-installation?"
2. What is the purpose of a vapor barrier?
3. What type of vapor barriers are most effective?
4. How are building materials tested for heat conductivity?
5. What are the methods of preventing the infiltration of cold air?
6. What are the methods of preventing the transmission of heat?
7. Why is attic ventilation necessary with attic insulation?
8. How would you provide for this attic insulation?
9. Figure the cost of insulation of various problems given by your instructor.

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UNIT VI. INSULATION

ASSIGNMENT 2. LOOSE TYPE

REFERENCES
1. Durbahn, Vol. II, pp. 159-160
2. Lair, pp. 212-216
3. Framing, sheathing, and insulation, pp. 231-236
4.
5.

The loose type of insulation is blown or poured into the space between studdings, joists, rafters, or inaccessible places after sheathing and other covering material are in place.

CLASSROOM	ON THE JOB	
Related technical information	Information to be given on the job	Work to be done on the job
Safety precautions. Materials used in manufacturing. Advantages & weakness of this type of insulation. Trade names. Estimations.	Show where this type is best suited. Method of installing. Safety precautions.	Installation on the job.

STUDENT STUDY GUIDE

1. What materials are used in making loose type insulation?
2. What are the advantages of loose type insulation?
3. How is it installed in old buildings?
4. What hazards are encountered in using this insulation both to the building and to the carpenter?
5. How is loose type insulation packaged and sold?
6. If one bag of ozite will cover 3 sq. yards, 1 inch thick, what will be the cost of insulating a ceiling 26' x 36' to a depth of 3 inches?
7. Give some trade names for loose type-insulation:
   a.
   b.
   c.
8. Give the advantages and disadvantages of insulating an old house.

UNIT VI. INSULATION

ASSIGNMENT 3. BLANKETS OR BATTS

REFERENCES

1. Durbahn, Vol. II, pp. 157-159; 162-164
2. Lair, pp. 216-217
3. Framing, sheathing and insulation, pp. 213-236
4.
5.

The purpose of this lesson is to give the student a knowledge of blanket & batt insulation so he will be able to choose and compare its use with other types.

CLASSROOM	ON THE JOB	
Related technical information	Information to be given on the job	Work to be done on the job
Safety precautions. Trade Names. Sizes Used. Spacing. Fastening methods. Insulating qualities of various makes of batts & blankets.	Safety precautions. Proper placement in regards to vapor barrier.	Installation.

STUDENT STUDY GUIDE

1. What are the trade names for some of the various brands of flexible insulation?
2. Explain how flexible insulation is used in masonry walls.
3. Make a sketch showing how blankets are placed between studding in relation to air space and fastening.
4. What are the standard widths of blankets and batts?
5. Explain how this type insulation is held between rafters.
6. Should the vap r barrier be to the inside or the outside in the wall?
7. Where should the greatest amount of insulation be placed?

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UNIT VI. INSULATION

ASSIGNMENT 4. RIGID INSULATION BOARD

REFERENCES

1. Durbahn, Vol. I, pp. 164-171
2. Durbahn, Vol. II, pp. 78-83
3. Lair, pp. 214-215
4.
5.

A common type of insulation used in building is the rigid fiber type made of wood pulp, sugar cane, corn stalks & other vegetable matter. It is made in various sheet sizes & thickness & is water proofed. Rigid insulation boards being strong, are being used today for insulation & sheathing purposes in new house construction.

CLASSROOM	ON THE JOB	
Related technical information	Information to be given on the job	Work to be done on the job
Safety precautions.	Safety precautions.	APPLICATION
Advantages of rigid board.	Nails & nailing.	
Estimating.	Other fasteners.	
Raw materials used in manufacturing.		
Trade names.		
Sizes & colors.		
Film on insulation form celotex corp.		
Heat loss coefficient in relation to blanket or fill insulation.		

STUDENT STUDY GUIDE

1. How are rigid insulation boards applied to the studding?
2. What thickness of insulation boards should be used on the outside of a house for sheathing?
3. List five trade names for rigid insulation boards:
   A.
   B.
   C.
   D.
   E.
4. How many square feet of insulation board are needed to cover the outside of a house with a hip roof that is 30' wide, 34' long, and 9' high? (Do not allow for doors and windows)
5. What will the cost be for the material in Problem 4 @ $8.00 per square?
6. How does the insulating valve of a 25/32 rigid sheet compare with full thick batts?

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UNIT VI. INSULATION

ASSIGNMENT 5. INSTALLATION OF REFLECTIVE TYPE

REFERENCES

1. Durbahn, Vol. I, pp. 171-173
2. Lair, pp. 216
3.
4.
5.

While reflective insulation was first patented in 1804, it has not been used in the building field until recently. New applications of this insulation are coming on the market constantly. Follow the manufacturer's directions in applying to gain maximum insulation.

CLASSROOM	ON THE JOB	
Related technical information	Information to be given on the job	Work to be done on the job
Safety precautions.	Safety precautions.	Installation.
Study kinds of reflective insulating materials and comparative values.	Demonstration.	
Trade names.		
Cost estimating		
Heat loss coefficient in relation to blanket or fill insulation and rigid insulation.		

STUDENT STUDY GUIDE

1. By what principle does reflective insulation work?
2. What material is used most for reflective insulation?
3. How would you anchor foil surfaced plaster board?
4. How would you anchor foil reflective?
5. What would be the cost of material to insulate an area 28' x 32' at $7.50 per square?
6. When using reflective insulation in the walls where should it be fastened for maximum efficiency?

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BUILDING TRADES CARPENTRY

UNIT # 7 INTERIOR FINISH

ASSIGNMENT #1	FITTING AND HANGING WINDOW SASH
ASSIGNMENT #2	TRIMMING WINDOW OPENINGS
ASSIGNMENT #3	FINISH FLOORS
ASSIGNMENT #4	COMPOSITION AND CERAMIC FLOOR COVERING, TILE, ETC.
ASSIGNMENT #5	SETTING DOOR JAMBS
ASSIGNMENT #6	TRIMMING DOOR OPENINGS
ASSIGNMENT #7	FITTING AND HANGING A DOOR
ASSIGNMENT #8	BASE BOARDS
ASSIGNMENT #9	MISCELLANEOUS MEMBERS
ASSIGNMENT #10	WALL COVERING
ASSIGNMENT #11	INSTALLING PRE-FABRICATED CABINETS

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UNIT VII. INTERIOR FINISH

ASSIGNMENT 1. FITTING AND HANGING WINDOW SASH

REFERENCES

1. Burbank, pp. 127-130
2. Durbahn, Vol. II, pp. 294-304
3. Lair, pp. 196-200
4. Interior and Exterior Trim, pp. 117-126
5. Manufacturers' Literature

The purpose of this unit is to familiarize the student with the various methods and procedures of hanging various types of window sashes. Consideration should be given to the proper workmanship since it is essential that the windows operate or function properly. There are a number of new types of sashes which have been introduced on the market. Manufacturers charts should be consulted for proper installation of these windows.

CLASSROOM	ON THE JOB	
Related technical information	Information to be given on the job	Work to be done on the job
Safety precautions. Methods of hanging. Standard sizes of sash.	Tools used. Check frame for plumbness. Safety precautions.	Trimming & fitting to site. Installing sash.

STUDENT STUDY GUIDE

1. Name four types of window sashes:
   A.　　　　C.
   B.　　　　D.
2. List three safety precautions for storing and installing windows on the job.
3. The members which separate the panes of lights of a divided window are called ______________.
4. The _________ sash of a double hung window is hung first.
5. Sash that are hinged at the verticle edge are called ____________.
6. ___________ are used in place of sash weights in double hung windows.
7. How are window sizes indicated?
8. List the steps in the procedure in fitting and hanging a double hung window.
9. Figure the cost of all the windows in the project house.

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ASSIGNMENT 2. TRIMMING WINDOW OPENINGS

REFERENCES

1. Burbank, pp. 117-123
2. Durbahn, Vol. II, 291-304
3. Interior and Exterior Trim, pp. 153-158
4.
5.

The purpose of this assignment is to familiarize the student with the selection and application of the casing, stools, aprons and stops. Due to the numerous types of casings, selecting the proper kind of wood depends upon the finish to be used. Great care must be taken to avoid hammer marks or any other blemishes on the finished trim members.

CLASSROOM	ON THE JOB	
Related technical information	Information to be given on the job	Work to be done on the job
Types of casings, stools & aprons.	Tools used.	Layout. Cut & fit stool, apron, casing & stops.
Make a size of parts of trim.	Determining lengths of stools, apron, casings & stops.	
Selection & grade of material.	Sizes, numbers & spacing of nails.	
Mullions.	Methods for fitting to wall surface marking.	
Joints used in trim.		

STUDENT STUDY GUIDE

1. Name the four types of window casings and make a sketch illustrating each type.
2. The horizontal member just below the bottom cut of the side casings is called the _______________.
3. The member that is found directly below the stool of a window which covers the rough edge of plaster is called the __________.
4. The vertical trim member between multiple windows is called the ___________.
5. ______ ________ on castings are caused by the incorrect use of the hammer.
6. __________ d nails are used to fasten the outer face of the casing and __________d nails are used for the inner face.
7. The inside stops serve as a ____________ for the lower sash.
8. List the steps in the procedure of applying inside trim for a double hung window.
9. List 4 safety precautions for care of windows and trim in installation of window trim.
   a.
   b.
   c.
   d.

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UNIT VII. INTERIOR FINISH

ASSIGNMENT 3. FINISH FLOORS

REFERENCES
1. Mix & Ciran, Practical Carpentry (Goodland & Wilcox)
2. Lair, pp. 56-59; 166-176
3. Interior and Exterior Trim, pp. 237-343
4.
5.

The purpose of this unit is to familiarize the student with the method and procedures of laying different types of flooring. A great deal of emphasis should be placed on the starting course of flooring in the relationship to the various rooms. Careful selection and matching of boards will tend to make a more desirable appearing finish floor.

CLASSROOM	ON THE JOB	
Related technical information	Information to be given on the job	Work to be done on the job
Safety precautions. Methods of laying. Types of materials for flooring. Grades of flooring Estimating flooring. (No. of ft.) Kinds and sizes of nails. Climatic conditions effecting floor laying.	Safety precautions. Tools used. Method of nailing. Location first course of flooring in relationship to various rooms. Starting course. Finish course.	Preparation for finish floors. A. over concrete 1. Emulsion furring 2. Blocks or strips. 3. Vapor barrier B. Frame structure 1. Applying paper on sub floor Selecting, cutting, fitting and nailing.

STUDENT STUDY GUIDE

1. The preparation of the sub-floor for laying the finish floor consists of:
   A. C.
   B. D.
2. The classifications of finish flooring with reference to the methods of sawing are __________ and __________.
3. __________ marks on the edge of the finish flooring are the result of striking the nail at an improper angle.
4. The recommended size nail for 13/16 finish floor is ________d.
5. The usual amount allowed for waste for 13/16 x 2¼" hardwood floor is _______ per cent.
6. __________ nailing is necessary and permissible when fastening the first and last course of hardwood flooring.
7. Correct __________ matching is as important as edge matching in laying hardwood floor.
8. What is the correct accepted position of the worker when laying flooring?
9. Write a brief summary of the procedure of drawing together and nailing the last few courses of hardwood flooring.
10. Figure the cost of the finish floor for the project house.
11. The standard sizes for flooring are: _______, _______, _______, _______, _______, _______.
12. Nails in hardwood flooring should not be placed more than _____ inches apart.
13. List procedure for flooring over concrete.
14. List several reasons why one should consider climatic conditions when laying finish floor.

CARPENTRY

UNIT VII. INTERIOR FINISH

ASSIGNMENT 4. COMPOSITION AND CERAMIC FLOOR COVERING (TILE)

REFERENCES
1. Burbank, p. 173
2. Durbahn, Vol. II, p. 90
3. Lair, pp. 56-59
4.
5.

The purpose of this assignment is to make the student familiar with these various materials and their application and comparitive cost.

CLASSROOM	ON THE JOB	
Related technical information	Information to be given on the job	Work to be done on the job
Safety precautions. Study of various types of materials. Special mastic. Estimating. Design & color scheme. Manufacture's catalogue. Note: many manufactures have excellent material for free distribution.	Safety precautions. Tools used. Care of material Demonstration.	Installation on over plywood. over old flooring. over any D.T.M. Prepare base. Locate starting point. Apply mastic. Lay tile.

STUDENT STUDY GUIDE

1. List several types of composition floor covering (tile).
2. What are the common sizes and thicknesses of composition tile?
3. How should the base be prepared for composition tile?
4. How are composition tile secured in place?
5. In laying a composition tile floor where is the best place to start?
6. Figure the cost of composition tile for the project house.
7. In what form does ceramic tile come to the worker?
8. To provide a base for ceramic tile, what type of floor and wall construction is necessary?
9. Figure the cost of ceramic wall and floor tile for the project house.
10. What type of underlayment is used for composition flooring on both new and old floors?
11. Name more than one type of fasteners used for underlayment.
12. What types of composition may be layed on concrete below grade.
13. What type of adhesive must be used for floors laid below grade.

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UNIT VII. INTERIOR FINISH

ASSIGNMENT 5. SETTING DOOR JAMBS

REFERENCES

1. Durbahn, Vol. II, pp. 307-310
2. Lair, pp. 154-156
3. Interior and Exterior Trim, pp. 142-143
4.
5.

The purpose of this assignment is to demonstrate the correct way to set and fasten door jambs.

CLASSROOM	ON THE JOB	
Related technical information	Information to be given on the job	Work to be done on the job
Safety precautions.	Safety precautions.	Check opening for plumbness & size.
Protection of surfaces of jambs.	Tools needed.	Assemble frame.
Framing jambs to fit.	Sizes of doors.	Plumbing, blocking, squaring.
Specific doors.	Sizes, kind & location of nails.	Locating & fastening to rough opening.
Methods and information concerning plumbing, blocking, squaring and fastening.	Kinds of blocking.	
Estimating.	Type of fastening.	
When to install-wood-metal thickness to sizes.		

STUDENT STUDY GUIDE

1. Rough openings are usually made ______inches larger each way than the size of the door to be hung.
2. When setting the frame, the ________is used on the side jambs and the ________ is used on the head jamb.
3. Standard width of the door jambs for plasterd walls is ______inches.
4. Width of door jambs for bull nosed finish is ________ inches.
5. Inside door jambs are usually ________inches in thickness.
6. The __________joint is used in the construction of door jambs.
7. Summarize the steps in the procedure in setting and fastening an inside door frame.
8. How do wood and metal frames compare in price?
9. In labor costs are a factor to consider, which type frame is less expensive.

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UNIT VII. INTERIOR FINISH

ASSIGNMENT 6. TRIMMING DOOR OPENINGS

REFERENCES

1. Durbahn, Vol. II, pp. 291-311
2. Lair, pp. 157-160
3. Interior and Exterior Trim, pp. 144-152.
4.
5.

The purpose of this assignment is to familiarize the student with the selection of types, the cutting, locating, and fastening of door casings and stops. When selection is made, consideration should be given to the types of joinery used for best results. Emphasis should be placed on materials as to durability and beauty.

CLASSROOM	ON THE JOB	
Related technical information	Information to be given on the job	Work to be done on the job
Safety precautions. Methods of casing joists and door openings. Joinery of casings. Sizes, types, and materials for casings. Location and position of door stops.	Safety precautions. Location of casings on jambs. Sizes, kind, and spacing of nails.	Fit and nail casing and door stops to plaster and grounds. Fit and nail casing and stops to dry wall.

STUDENT STUDY GUIDE

1. What is the primary purpose of door casings?
2. Name three types of door casings and describe each?
3. In what order should the casing be fastened?
4. Why should the casing be of the same variety of wood as the jambs?
5. How far back on the jamb should the casing be set?
6. The approximate distance door stops are fastened on jambs from the side of which the door swings is determined by the ______________.
7. __________d nails are used to fasten the outer face of the casing and __________d nails for the inner face.
8. Summarize the steps in the procedure of installing door casing and stops.

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UNIT VII. INTERIOR FINISH

ASSIGNMENT 7. FITTING AND HANGING A DOOR

REFERENCES

1. Durbahn, Vol. II, pp. 311-325
2. Lair, pp. 204-207
3. Townsend, pp. 423-428
4. Interior and Exterior Trim, pp. 267-263
5.

The purpose of this assignment is to familiarize the student with the operations of fitting and hanging a door. Consideration should be placed on clearance selection, appearance, design, and location of hardware. The gaining of jambs, the use of quickset for hardware should be demonstrated and practiced.

CLASSROOM	ON THE JOB	
Related technical information	Information to be given on the job	Work to be done on the job
Safety precautions.	Safety precautions.	Trim and fit door to opening.
Types, sizes and material of doors.	Tools used.	Layout and install hardware.
Types of hardware.	Selection of door for appearance, and direction door opens.	Hang door.
Parts of a door.	Setting hinges and lock.	Install stop.
Note: Use films and manufacturers catalogues.		

STUDENT STUDY GUIDE

1. The usual amount of clearance on the bottom of an interior door is ________inches.
2. The edges of a door should be ________slightly outward so that there is a greater clearance of the sides striking the stops.
3. ________inches is the usual amount of clearance on the sides and top of the door.
4. The top hinge is usually set down ________inches and the bottom hinge is set up ________inches.
5. The location of the lock on the door is ________inches from the bottom.
6. __________hardware should be used on the interior sides of bathroom doors.
7. The vertical members of a door are called _______, and the horizontal members are called.
8. List and number the steps in order of the procedure of fitting and hanging a door.
9. Figure the cost of the doors in the project house.
10. If a carpenter can fit and hang four doors in an 8-hour working day, and if his wage scale is $4.00, what would be the cost of fitting and hanging all the doors in the project house.

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UNIT VII. INTERIOR FINISH

ASSIGNMENT 8. BASE BOARDS

REFERENCES

1. Durbahn, Vol. II, pp. 292-293; 346-348
2. Lair, pp. 162-163; 166
3. Townsend, pp. 428
4. Interior and Exterior Trim, pp. 159-165
5.

The purpose of this lesson is to teach the proper way to cut, miter, cope and fit base and shoe.

CLASSROOM	ON THE JOB	
Related technical information	Information to be given on the job	Work to be done on the job
Safety precautions.	Safety precautions.	Locate studs.
Study types of base trim and where used.	Tools used.	Take measurements.
Study use of miter box and special boxes.	Measure and demonstrate coping.	Cut, cope fit & nail members.
Review use of block plane.	Inside corner and outside corner.	
Develop with practice pieces, the ability to cut and fit base corners & shoes.	How to scribe.	

STUDENT STUDY GUIDE

1. What is the standard width range for base board?
2. What is the proper way to join interior corners? exterior corners?
3. What advantages have the coped interior joint over the mitered interior joint?
4. Explain step-by-step the proper way to cope a joint.
5. Why is it necessary to scribe the inside corner of the base board?
6. What is the proper nailing space for a base board?
7. Diagram proper nailing of shoe.
8. How many linear feet of base shoe will be needed for the project house?

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UNIT VII. INTERIOR FINISH

ASSIGNMENT 9. MISCELLANEOUS MEMBERS

REFERENCES

1. Burbank, pp. 109
2. Durbahn, Vol. II, pp. 292-293; 289
3. Interior and Exterior Trim, pp. 166-167
4.
5.

The purpose of this lesson is to acquaint the worker with the various molds, their uses and applications. Various decorating effects may be obtained in a room by the use of special molds.

CLASSROOM	ON THE JOB	
Related technical information	Information to be given on the job	Work to be done on the job
Safety precautions.	Safety precautions.	Cut, fit and install members.
Study types of molds and uses.	Method of fastening.	
Study use of miter box.	Tools used.	
Selection of material for proper finish.	Methods of joining.	
	Methods of measuring.	

STUDENT STUDY GUIDE

1. Give two reasons for using batten strips.
2. Diagram a cross section of four types of batten strips.
3. Diagram a cross section of picture mold, chair rail, and cove mold.
4. Make a sketch showing where crown mold is used.
5. Should the miscellaneous molds go in before or after door and window trim?
6. Give name and size of several moldings stocked by lumber yards.

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UNIT VII. INTERIOR FINISH

ASSIGNMENT 10. WALL BOARDS

REFERENCES

1. Burbank, pp. 101-110
2. Durbahn, Vol. II, pp. 277-290
3. Lair, pp. 145-146
4. Interior and Exterior Trim, pp. 131-137
5.

The purpose of this assignment is to familiarize the student with the most common types of interior wall coverings and to demonstrate methods of application. Manufacturer's literature contains a great deal of valuable information related to this assignment.

CLASSROOM	ON THE JOB	
Related technical information	Information to be given on the job	Work to be done on the job
Safety precautions. Study types of wall boards and uses. Estimating. Specifications. Materials & manufacturing methods. (Show samples) Manufacturers catalogues and samples.	Safety precautions. Demonstrate method of installing. Fasteners used.	Install type of wall board specified. Furring. Cut, match, fit and fasten for various designs.

STUDENT STUDY GUIDE

1. What types of wall boards may be used on the interior wall?
2. Illustrate three different methods of joining plywood panels.
3. Sketch four different methods of joining structural insulation board on the interior wall.
4. Describe furring for structural insulation board.
5. What kind of a backing is used for tile board?
6. Where is the correct starting place for applying ceiling tile-board?
7. Give two methods used in concealing the sheetrock joint.
8. Figure the cost of plastering or dry wall for the project house.
9. Describe the recommended method of applying sheetrock in a house with 8'-0" ceiling.
10. Describe how sheetrock joint are finished.

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UNIT VII. INTERIOR FINISH

ASSIGNMENT 11. INSTALLING PREFABRICATED CABINETS

REFERENCES
1. Burbank, pp. 154-165
2. Durbahn, Vol. II, pp. 342-343
3. Interior and Exterior Trim, pp. 172-174
4.
5.

The purpose of this assignment is to familiarize the student with the best methods of installing these prefabricated units. The best source of instructional material is the descriptive literature published by various manufacturers.

CLASSROOM	ON THE JOB	
Related technical information	Information to be given on the job	Work to be done on the job
Safety precautions. Study construction of ready built case, cabinets, ironing boards, etc. Study materials & hardware used in such construction. Estimating. Specifications. Note: Many manufacturers of cabinets have excellent material for free distribution.	Safety precautions. Tools used. Stress importance of good workmanship. Show how work can be installed with minimum change of opening or project.	Check openings for built-in fixtures for size, level & plumbness. Check studs & headers ahead of time for fastening. Make special provisions for fastening where necessary. Installation.

STUDENT STUDY GUIDE

1. Why must special care be taken to check all rough openings left for prefabricated cabinets and cases?
2. Why should shop-built cabinets be designed with excess material along edges and sides?
3. Explain procedure of fastening cabinets to the wall.
4. What is the standard height and depth of kitchen floor units?
5. What is the standard depth of kitchen wall units?
6. How is modular planning used in kitchen cabinets?
7. Figure the cost of the cabinets for problems given by the instructor.

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BUILDING TRADES CARPENTRY

UNIT # 8 STAIR BUILDING

ASSIGNMENT # 1	TYPES OF STAIRWAYS
ASSIGNMENT # 2	STAIRWAY TERMS AND TYPES OF CONSTRUCTION
ASSIGNMENT # 3	HOW TO DETERMINE RISE, RUN & TREAD IN STAIR LAYOUT
ASSIGNMENT # 4	HOW TO DETERMINE HEADROOM, DROP AND LENGTH OF STOCK
ASSIGNMENT # 5	HOW TO LAYOUT AND CUT STAIRHORSES
ASSIGNMENT # 6	HOW TO LAYOUT AND CUT STRINGERS

CARPENTRY

UNIT VIII. STAIR BUILDING

ASSIGNMENT 1. TYPES OF STAIRWAYS

REFERENCES

1. Durbahn, Vol. II, pp. 327-332
2. Lair, pp. 177-181
3. Simplified Stair Layout, pp. 3-8
4. Manufacturers' Literature
5.

In order to understand the rather technical problems involved in stairbuilding, it is necessary to familiarize oneself with the types of stairs in general use. In the past, all stairwork was done on the job. Today, practically all finish stairs are made at the mill, and the man on the job only trims, fits and assembles these in place. The average carpenter only lays out and cuts rough stringers and installs stairs.

CLASSROOM	ON THE JOB	
Related technical information	Information to be given on the job	Work to be done on the job
Safety precautions.	Safety precautions.	Field trip to show different styles of stairways.
Types of stairs.	Determine types of stairs to use.	
Stair terms.		
Audio visual aids to show various styles.		

STUDENT STUDY GUIDE

1. Identify the following terms:

   a. Closed or housed stairway
   b. Open stairway
   c. Stair platform
   d. Stair platform
   e. Straight stairway
   f. Ceiling disappearing stairway

2. Solve problems given by your instructor

   a. What is an "easy" stair (7½" x 10"

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UNIT VIII. STAIR BUILDING

ASSIGNMENT 2. STAIRWAY TERMS AND TYPES OF CONSTRUCTION

REFERENCES
1. Durbahn, Vol. II, pp. 233-235
2. Lair, pp. 177-181
3. Simplified Stair Layout, pp. 8-16
4.
5.

The purpose of this assignment is to familiarize the student with the nomenclature of stair work.

CLASSROOM	ON THE JOB	
Related technical information	Information to be given on the job	Work to be done on the job
Safety precautions.		Field trips.
Stair functions.		
Stair terms.		
Identification of stair parts.		
Types of stairways.		

STUDENT STUDY GUIDE

1. Identify the following:

   a. Sawed-out stair horse
   b. Built-up stair horse
   c. plain stringer
   d. total rise of stairway
   e. total run of stairway
   f. tread rise
   g. tread run
   h. baluster
   i. newel post
   j. nosing
   k. head room

2. Solve problems of stair layout given by the instructor.
   a. How is an "easy" stair computed from given rise and run.

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UNIT VIII. STAIR BUILDING

ASSIGNMENT 3. HOW TO DETERMINE RISE, RUN AND TREAD IN STAIR LAYOUT

REFERENCES

1. Durbahn, Vol. II, pp. 335-340
2. Lair, pp. 177-181
3. Simplified stair layout, pp. 19-26
4.
5.

The purpose of this assignment is to set forth the methods of determining the rise and run of stairs.

CLASSROOM	ON THE JOB	
Related technical information	Information to be given on the job	Work to be done on the job
Safety precautions. Mathematical calculations in finding rise and run. Finding total rise and run. Standards for rise and run. Math calculations for finding the rise and run for a given stairway.	Safety precautions. How to determine the total rise. How to determine the total run.	Measure total rise of stairway. Measure total run of stairway.

STUDENT STUDY GUIDE

1. What is a common rule for the tread rise and tread run of a stair?
2. What factors make a hard stair and easy stair?
3. Problem: A given stair has a total rise of 8' - 2" and total run of 10'-10".
   a. Find the number of risers.
   b. Find the number of treads.
   c. Find the height of each riser.
   d. Find the width of each tread.
4. Problem: A given stair has total rise of 9'-8" and total run of 11'-3".
   a. Find the number of risers.
   b. Find the number of treads.
   c. Find the width of treads.

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UNIT VIII. STAIR BUILDING

ASSIGNMENT 4. HOW TO DETERMINE HEAD ROOM, DROP, AND ACTUAL LENGTH OF STOCK

REFERENCE

1. Durbahn, Vol. II, pp. 338-339.
2. Lair, pp. 177-181.
3. Simplified Stair Layout, 26-31.
4.
5.

After the rise and run have been determined it is necessary to check head room and provide for stair horse drop if the stair is to be satisfactory.

CLASSROOM	ON THE JOB	
Related technical information	Information to be given on the job	Work to be done on the job
Safety precautions. Stair horse drop. Head clearance. Dimensions of stock for stair horses.	Safety precautions. Tools: level, plumb bob, string, square rule or tape.	Secure and check measurements for stair well, total rise, and total run.

STUDENT STUDY GUIDE

1. What is the result if the stairhorse is nailed in place without being "dropped?"
2. If the thickness of the basement stair tread is 1 5/8, what drop should be given to the stair horse?
3. What is a stair rod and how is it used?
4. How is head room measured?
5. What is the recommended head room clearance ?
6. How can head room clearance be increased?
7. How is the length of the stair horse determined?
8. What safety precaution should be taken in the errection of a stair horse?

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UNIT VIII. STAIR BUILDING

ASSIGNMENT 5. HOW TO LAYOUT AND CUT STAIR HORSES

REFERENCES
1. Durbahn, Vol. II, pp. 337-339
2. Lair, pp. 177-181.
3. Simplified Stair Layout, pp. 33-40
4.
5.

Careful layout and cutting of a stair horse is of major importance in securing a satisfactory stair.

CLASSROOM

Related technical information

- Safety precautions.
- Proper use of square in layout.
- Scribing around the square.
- Built up stair horse.
- Precautions in sawing.

ON THE JOB

Information to be given on the job

- Safety precautions.
- Points in selecting stair horses material.
- Methods of anchoring stair horses.
- Cutting stair horses, with power equipment.

Work to be done on the job

- Select material for structural strengths.
- Layout the risers and treads with square.
- Layout seat cut at bottom.
- Mark off for drop.
- Mark for plumb cut at top.
- Cut along final layout lines.
- Nail stair horses in place.

STUDENT STUDY GUIDE

1. What lumber characteristics must be observed in selecting stair horse material?
2. What is a stair gauge and how is it used.
3. How are the rise and the run of a stair used on the carpenters square in the layout of a stair horse?
4. Why is it important to accurately scribe around the square?
5. What happens if you neglect to cut off for stair horse drop?
6. Make two simple sketches showing the difference between sawed-out and built-up stair horses.

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UNIT VIII. STAIR BUILDING

ASSIGNMENT 6. HOW TO LAYOUT AND CUT STRINGERS

REFERENCES

1. Durbahn, Vol. II, pp. 334-335; 338-339.
2. Lair, pp. 177-181.
3. Interior and Exterior Trim, pp. 209-210; 213; 221.
4. Simplified Stair Layout, pp. 43-54.
5.

The purpose of this assignment is to teach the use and construction of stringer boards.

CLASSROOM	ON THE JOB	
Related technical information	Information to be given on the job	Work to be done on the job
Safety precautions.	Safety precautions.	Select proper materials.
Layout a plain stringer.	Points in selecting material.	Plane edges of stock straight and square.
Intersection of stringer and base board.	Determine tread and rise.	Layout and scribe.
Mitered stringer.	Caution in scribing and sawing.	Sawing and fitting.
Housed stringer.		Fastening in place.
Wedges and Wedging.		

STUDENT STUDY GUIDE

1. From which of the two edges may a stair stringer be laid out?
2. From which edge is the layout work done for the risers and treads if the risers are to be mitered.
3. When the stringer is housed, why is the layout work for risers and treads done from the bottom edge?
4. When working from the top edge of the stringer, how is the steel square held for the layout?
5. How is the square to be held if the layout work is to be done from the lower edge?
6. How may a pitch board be used in stringer layout work?
7. Explain the use of a set of square gauges in the layout of a stringer?
8. What is the difference between the layout of the cut-out type of stair stringer and the housed stringer?
9. What is the purpose of the line drawn along the edge of the stringer?
10. What allowance should be made on the top and bottom cuts of the stringer?
11. What should be used in marking the stringer?
12. How is the open stringer laid out?

BUILDING TRADES CARPENTRY

UNIT # 9 SCAFFOLDING

ASSIGNMENT # 1	LOW SCAFFOLDING
ASSIGNMENT # 2	MEDIUM SCAFFOLDING 3 to 10 feet
ASSGINMENT # 3	HIGH SCAFFOLDING
ASSIGNMENT # 4	SPECIAL SCAFFOLDING
ASSIGNMENT # 5	USE OF LADDERS

CARPENTRY

UNIT IX. SCAFFOLDING

ASSIGNMENT 1. LOW SCAFFOLDING

REFERENCES

1. Durbahn, Vol. II, 122-126
2. Lair, pp. 235-248
3. -
4.
5.

It is difficult and unsafe for a carpenter to work on a building unless he can reach the work comfortably. The types and sizes of scaffolds will vary with the different types of work. Scaffolding materials should be structurally sound. Although they are only temporary structures, nevertheless, scaffolds must be designed and built to carry the required load safely, permitting the workman to reach and perform his work with ease and safety.

CLASSROOM	ON THE JOB	
Related technical information	Information to be given on the job	Work to be done on the job
Safety precautions.	Safety precautions.	Selection of type and size.
Types of scaffolds.	Soils and footings.	Location and placing.
Strength of material.	Defects in materials.	Assembly and nailing.
Nailing.	Bracing.	Checking for safety.
Proper fastening to main structure.		

STUDENT STUDY GUIDE

1. What size material should be used for the ledger board on a low scaffold?
2. What precaution should be considered to keep the scaffold from sinking into soft dirt?
3. Make a sketch of a simple low scaffold.
4. Mention several defects found in lumber that make it unsatisfactory for scaffolding.
5. Estimate the materials needed to build a simple scaffold for the 36' side of a one-story house with a hip roof, to be used while building the cornice.

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UNIT IX. SCAFFOLDING

ASSIGNMENT 2. MEDIUM SCAFFOLDING 3 TO 10 FEET

REFERENCES

1. Durbahn, Vol. II, pp. 122-125
2. Lair, pp. 235-248
3. Framing, Sheating and Insulation, pp. 103-105
4.
5.

The purpose of the assignment is to familiarize the student with the proper methods of scaffold construction.

CLASSROOM	ON THE JOB	
Related technical information	Information to be given on the job	Work to be done on the job
Safety precautions.	Safety precautions.	Construct masons squares.
Study types of medium scaffolding.	Select the materials to be used.	Assemble horses.
Reasons for the different types.	Assembly and nailing.	Cutting and fitting.
Materials used.	Bracing of members.	Placing and spacing.
The assembly of each type show safety films.		Nailing assembly.
		Leveling.

STUDENT STUDY GUIDE

1. Name the conventional sizes of wood members in constructing medium scaffolding.
2. What kind and sizes of nails are commonly used in the construction and erection of scaffolding?
3. What is a rolling platform scaffold?
4. Where is a rolling platform used and what are its advantages?
5. How is bracing nailed for greatest strength and rigidity?
6. What are the advantages of two headed nails?
7. Write a brief on the care and use of tools on the scaffold.

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UNIT IX. SCAFFOLDING

ASSIGNMENT 3. HIGH SCAFFOLDING

REFERENCES
1. Durbahn, Vol. II, pp. 122-126
2. Lair, pp. 235-248
3. Framing, Sheathing and Insulation, pp. 100-105
4.
5.

The purpose of this assignment is to familiarize the student with the construction, erection and dismantling of high scaffolding.

CLASSROOM	ON THE JOB	
Related technical information	Information to be given on the job	Work to be done on the job
Safety precautions. Types of scaffolds. Strength of materials. Principles of pulleys. Removal of wrecking. Estimating.	Safety precautions. Purpose of scaffold. Defects in material. Nail sizes. Methods of nailing. Proper dismantling.	Locate & prepare footing area. Selection of material for main scaffold, platform, and hand rail. Erection. Inspection.

STUDENT STUDY GUIDE

1. What standard size material should be used for the ledger board in a scaffold twenty feet high?
2. What standard size material should be used for the uprights in a scaffold twenty feet high?
3. What standard size material should be used for bracing a high scaffold?
4. What is the proper spacing of the uprights on a scaffold twenty feet high?
5. What are the dimensions of mason squares?
6. How high is it safe to scaffold with mason squares?
7. Which is the more rigid figure, a triangle or a rectangle?
8. List several good reasons for handrail.
9. What is the proper height for the handrail above the platform?
10. What is the proper manner in which workmen ascend to the working platform of the high scaffold?
11. List several safety rules which should be considered by the workmen in getting tools and materials onto the platform of a high scaffold

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UNIT IX. SCAFFOLDING

ASSIGNMENT 4. SPECIAL SCAFFOLDING

REFERENCES
1. Audel, Vol. II, pp. 1020
2. Durbahn, Vol. II, pp. 127, 205, 233
3. Lair, pp. 235-248
4. Manufacturers' Literature
5.

The purpose of this assignment is to familiarize the student with special scaffolding. Special scaffolding must be safely and securely constructed to carry loads and traffic that necessitates their construction in the majority of cases.

CLASSROOM	ON THE JOB	
Related technical information	Information to be given on the job	Work to be done on the job
Safety precautions.	Safety precautions.	Placing pre-fabricated horses.
Theory of triangular bracing.	Selection planks.	Making temporary horses.
Strength of materials for scaffolding.	Spacing of planks.	Placing planks and cleats for ramps and runways.
Kinds & sizes of nails.	Defects in materials.	Placing chimney scaffold.
Methods of nailing.	Nails & nailing.	Placing wall brackets.
Cornice hooks & swinging scaffolds.	Safety methods and factors.	Placing patented metal scaffolds.
Manufactured horses (steel) and their assembly.		
Manufactured patented metal scaffolds.		

STUDENT STUDY GUIDE

1. What is the average size of ramp planks?
2. Why and how are planks cleated?
3. Describe two styles of trestle horses?
4. Sketch and explain a chimney scaffold.
5. How would you lay and hold wheeling planks in place?
6. Name five safety factors for ramps or special scaffolding.
7. Sketch and describe three kinds of roof brackets.
8. What are the advantages of the use of wallbrackets?

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UNIT IX. SCAFFOLDING

ASSIGNMENT 5. USE OF LADDERS

REFERENCES

1. Audel, Vol. III, pp. 1024-1028
2. Durbahn, Vol. II, p. 129
3. Lair, pp. 251-252
4.
5.

The purpose of this assignment is to demonstrate safe ladder use.

CLASSROOM	ON THE JOB	
Related technical information	Information to be given on the job	Work to be done on the job
Safety precautions. Types of wood used in ladders. Metal ladders. Types & uses of ladders. Ladder jacks. Center of gravity theory.	Safe angles for ladders. Safe uses of ladder jacks. Bracing & fastening of ladders. Care of ladders.	Selecting & placing ladders. Use of brackets. Using ladders for scaffold planks. Selecting, placing & extending extension ladders. Selecting & placing of scaffold planking. Selecting & placing of roof ladders, hooks & brackets.

STUDENT STUDY GUIDE

1. Name the kinds of ladders.
2. List three rules for the safe setting of ladders.
3. Compare two kinds of ladder jacks.
4. List three causes for ladder accidents.
5. How are ladders fastened to roofs?
6. List several good practices for the care and use of ladders.
7. What woods make good ladders?
8. What is the maximum and minimum angle inclination of a ladder.

AGENDA A

BIBLIOGRAPHY

This list of reference materials is not to be considered a complete listing of all the available items, but it does offer a good cross section of what can be obtained in the area of carpentry. Nor, because any particular item has been included, is it to concluded that this is the best in the field covering any particular subject. Rather, these are the books, pamphlet etc. that are known to the committee to be adequate. It is suggested that others which are equally as good, and with which you are familiar should be included in your own reference list.

The items in part I are considered as basic reference. Reference to these has been made in the individual assignments. Part II contains supplemental materials which are to be used for specific areas in the trade.

Part I.

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AGENDA B

Suggested List of Hand Tools and Equipment

Brace	
10"	2 each
Auger bits	
#4-#16	2 sets
Expansive bit	2 each
bits 7/8" - 3"	
Countersink	2 each
rose type	
Power bore bits	
bits 3/8-1"	1 set
Push drills	
and bits	2 each
Hand drill	2 each
¼" Cap.	
Drills (steel twist)	
1/16 -	6 each
5/64 -	6 each
3/32 -	6 each
1/8 -	6 each
3/16 -	6 each
1/4 -	6 each
bit gage (top)	1 each
Chisel (butt)	
1/4 -	2 each
3/8 -	2 each
1/2 -	2 each
5/8 -	2 each
3/4 -	2 each
1"	2 each
1½"	2 each
2"	2 each
Chisel Cold	
1/4 -	2 each
3/8 -	2 each
1/2 -	2 each

Hammer	
Claw 16 oz.	2 each
Rip 20 oz.	2 each
Ball pein 16 oz.	1 each
" " 24 oz.	1 each
striking 6 lbs.	1 each
Hatchets	
4½" broad	1 each
3½" half	1 each
2½" lathing	2 each
Ripping bars	
goose neck ½" x 12	1 each
" " 3/4 x 24	1 each
" " 3/4 x 30	1 each
Floor Chisel	
3/4" x 18"	2 each
Levels (4 vials)	
24"	1 each
28"	1 each
line	2 each
Awls 3/16"	2 each
Butt gage	2 each
Butt marker	
3½"	1 each
4"	1 each
3"	1 each
Dividers (wing)	
6"	1 each
8"	1 each
Puttey Knife	
1¼"	2 each
3"	1 each
Utility Knife	
with extra blades	2 each
Nail sets	
1/16	2 each
5/64	2 each
3/32	2 each

Pliers	
combination 6"	2 each
lineman 8"	2 each
Saws	
8 pt. crosscut 26"	3 each
10 pt. crosscut 26"	3 each
5½ pt. Rip	3 each
Hack 12"	1 each
Keyhole (nest)	1 each
Coping	2 each
Nail 24"	1 each
Saw Jointer	1 each
Saw vise	1 each
Metal snips	
left 10"	1 each
right 10"	1 each
Straight 10"	1 each
plumb bob 8 oz.	1 each
Wrench adj. jaw	
6"	1 each
8"	1 each
12"	1 each
Planes	
block 6"	2 each
smooth 9"	2 each
jack 14"	2 each
joister 22"	2 each
Spoke shave 10"	1 each
Metal tapes	
6'	1 each
10'	1 each
50'	1 each
100'	1 each

Screw driver	
4"	2 each
6"	2 each
8"	2 each
10"	1 each
12"	1 each
offset	1 each
Phillips	
3" #1	1 each
4" #2	1 each
5" #3	1 each
Screw driver bits ¼	1 each
" 3/8	1 each
Spiral screw drivers	1 each
Squares	
steel 24" rafter	4 each
tri square 8"	2 each
combination 12"	2 each
bevel 8"	2 each
Stones oil combination 8"	2 each
Stair gages	2 sets
glass cutter	1 each
Files	
(mill) 10" Bastard 1 cut	2 each
(mill) 12" 1 cut	2 each
slim typer 6"	12 each
auger bit files	4 each
Cabinet rasps	
8"	4 each
10"	4 each
(file handle)	
Star drills	
¼"	1 each
½"	1 each
3/4"	1 each
Oil cans 1/3 pt. 3" pt.	2 each
Allen wrenches 1/16" to 3/8"	1 set

Machines

1 Radial portable saw	12" (10")
1 Jointer	8"
1 bench saw	12"
2 portable saw	8"
1 portable drill	1/4"
1 portable drill	1/2"
1 router shaper	3/4 HP
1 portable generator	1000 watt

Miscellaneous Equipment and Tools

1. builders transit and rod
2. shovels
3. rakes
4. hoes
5. picks
6. spades

AGENDA C

BY-LAWS

ARTICLE I.

Membership

Section 1 - Qualifications.

There shall be only one class of members, to be designated and known as "General Members."

Every person, firm, association or corporation who pays to the corporation such membership fee as the Board of Directors may, from time to time, establish, shall become a "General Member" and shall be issued a general membership certificate which shall remain in effect until the end of the corporation's then fiscal year, as established by the By-Laws. Such general membership shall not be assignable or transferrable.

Each General Member shall be entitled to one (1) vote at all meetings of the members, so long as the membership fee, as established by the Board of Directors, has been paid for that year.

Section 2 - Annual Meeting.

The annual meeting of the members of this corporation shall be held at the principal office of the company in the City of Elkhart, Indiana, on the second Tuesday of February of each year, or at such other time as the Board of Directors may, by resolution, determine, but in any event, not later than July 1st of each year, for the election of Directors and transaction of such other business as may lawfully come before the meeting. It shall be the duty of the Secretary to give ten (10) days notice of such meeting in person to each member or by mail to each member not personally notified, such notice to state that the meeting is the annual meeting, and the time and place thereof. This notice shall be addressed to each member at his address as the same appears upon the records of the company.

Section 3 - Special meetings.

Special meetings may be called by the majority of the Board of Directors or by the President or by members holding not less than twenty-five (25%) per cent of the membership certificates of the corporation at the time issued and outstanding, filling with the Secretary a written request for such meeting and stating the object thereof and the date and hour. Upon the filing of such request, the Secretary shall give immediate notice of such meeting by mailing written notices thereof to each member at his last address, as the same appears upon the record of the company, and shall state in said notice the time, place and purpose of holding such meeting. Such notices shall be mailed at least ten (10) days prior to the time fixed for such meeting. If all members attend in person, no notice shall be required and such attendance shall constitute a waiver of notice of such meeting.

Section 3 - Quorum.

The members holding a majority of the membership certificates issued by the corporation for the current year shall constitute a quorum at any meeting of such members, and be capable of transacting any business, except when otherwise especially provided by law or by the Articles of Incorporation. If, at any meeting of the members, there be less than a quorum present, a majority in interest of the members present may adjourn from time to time without notice other than by announcement at the meeting until the holders of the number of membership certificates requisite to constitute a quorum shall attend. At any such adjourned meeting at which a quorum shall be present any business may be transacted which might have been transacted at the meeting as originally called and notified.

Section 4 - Organization.

The President, and in his absence the Vice-President, and in their absence any member chosen by the members present, shall call meetings of the members to order and shall act as chairman of such meetings, and the Secretary of the Company shall act as Secretary of all meetings of the members. In the absence of the Secretary the presiding officer may appoint a member to act as Secretary of the meeting.

ARTICLE II.

DIRECTORS

Section 1 - Board of Directors.

The Board of Directors shall consist of five members, who shall be elected annually by a majority of the members at the annual meeting of the members. Such Directors shall hold office until the next annual meeting of the members and until their successors are elected and qualified. A majority of the Directors must be citizens of The United States.

Section 2 - Duties.

The corporate power of this corporation shall be vested in the Board of Directors, who shall have the management and control of the business of the corporation. They shall employ such agents and servants as they may deem advisable, and fix the rate of compensation of such agents and servants. In no event shall any member or members of the Board of Directors be entitled to receive any compensation from the corporation.

Section 3 - Qualifications of Directors.

At least one director shall be chosen from the personnel of each of the three Banks in the City of Elkhart, Indiana, represented on the membership of this corporation, one director shall be chosen from the School City of Elkhart, Indiana, and the one shall be chosen from the Building Trades Council of Elkhart, Indiana. PROVIDED, HOWEVER, that all Directors shall be members of this corporation.

Section 4 - Resignation and removal.

A Director may resign at any time by filing his written resignation with the Secretary. Any Director may be removed for cause at any time and at any regular meeting or of the special meeting of the members of the corporation called for such purpose, by the affirmative vote of the holders of a majority of the membership certificates outstanding for the current year.

Section 5 - Vacancies.

In case of any vacancy in the Board of Directors through death, resignation, removal or other cause, the remaining Directors by the affirmative vote of a majority thereof may elect a successor to fill such vacancy until the next annual meeting and until his successor is elected and qualified.

Section 6 - Annual and regular meetings.

The annual meeting of the Board of Directors shall be held immediately after the annual meeting of the members of the corporation as set by the Board of Directors. There shall be no regular meetings of the Board of Directors other than said annual meeting.

Section 7 - Special meetings.

Special meetings of the Board of Directors shall be held whenever called by the Secretary upon the direction of the President, or a majority of the Board of Directors. It shall be the duty of the Secretary to give notice by telephone, telegraph, letter or any other manner and for such period of time as will reasonably enable the Directors to be present at said meeting. Said meetings may be held at any time or place.

Section 8 - Quorum

A majority of the Directors shall constitute a quorum for the transaction of business; but if, at any meeting of the Board, there shall be less than a quorum present, a majority of those present may adjourn the meeting from time to time.

Section 9 - Organization.

The President and in his absence the Vice-President and in their absence any Director chosen by the Directors present, shall call meetings of the Board of Directors to order, and shall act as Chairman of such meetings. The secretary of the corporation shall act as Secretary of the Board of Directors, but in the absence of the Secretary the presiding officer may appoint any Directors to act as Secretary of the meeting.

Section 10 - Order of Business.

The order of business at all meetings of the Board of Directors shall be as follows:

(1) Roll call.
(2) Reading of the minutes of the preceding meeting and action thereon.
(3) Reports of Officers.
(4) Reports of Committees.
(5) Unfinished Business.
(6) Miscellaneous Business.
(7) New Business.

ARTICLE III.

GENERAL OFFICERS

Section 1 - Election.

The officers of this corporation shall be a President, Vice-President, Secretary and Treasurer, and such other officers as may be created by the By-Laws or by the Board of Directors. The office of Secretary and Treasurer may be combined. The Board of Directors shall annually, at the regular meeting of the Board held immediately following the annual meeting of the members, elect a President, Vice-President, Secretary and Treasurer, or Secretary-Treasurer and such other officers as the corporate articles and By-Laws require. Said officers shall hold office for a period of one (1) year and until their respective successors are elected and qualified. The President shall be elected from the Board of Directors.

Section 2 - Duties.

The principal duties of the several general officers respectively are as follows:

(1) The President shall preside at all meetings of the members and of the Board of Directors. He shall be the chief executive officer of the corporation, and shall have the general supervision, direction and active management of the property, affairs and business of the corporation, subject to the Board of Directors. He shall see that all orders and resolutions of the Board of Directors are carried into effect. He shall sign all certificates, stocks, bonds, deeds, leases, conveyances, commercial paper, contracts, and all other obligations and instruments in writing, unless otherwise ordered by the Board of Directors. He shall submit a complete and detailed report of the corporation for the fiscal year and of its financial condition to the Board of Directors at the annual meeting in each year, and to the shareholders at their annual meeting, and shall, from time to time, report to the Board of Directors all matters within his knowledge which the interest of the corporation may require to be brought to its notice. He shall preform such additional duties as may be prescribed from time to time by the Board of Directors or by the By-Laws.

Section 4 - Execution of documents.

All contracts, leases, notes, commercial paper and other instruments in writing, and legal documents, shall be signed by the President and countersigned by the Treasurer. All bonds, deed and mortgages shall be signed by the President and Treasurer and attested by the Secretary. All membership certificates shall be signed by the Secretary.

Section 5 - Vacancies.

Whenever any vacancies shall occur in any office of the company such vacancy shall be filled by the Directors by the election of a new officer, who shall hold his office until the next annual meeting and until his successor is duly elected and qualified.

ARTICLE IV.

Membership Certificates

Section 1 - Certificates.

The Secretary of the corporation shall issue to each member annually, upon the payment of the dues prescribed by the Board of Directors, a membership certificate indicating the membership of said member in this corporation.

ARTICLE V.

Miscellaneous

Section 1 - Fiscal year.

The fiscal year of this corporation shall begin on the 1st day of January and terminate on the 31st day of December of each year.

Section 2 - Waiver of notice.

Any member, director or officer may in writing waive the giving and the mailing of any notice required to be given or mailed, either by the Statutes of Indiana, the Articles of Incorporation, or by the By-Laws of this corporation, if the waiver sets forth in reasonable detail the purpose for which the meeting is called and the time and place thereof.

ARTICLE VI.

Amendments

Section 1 - Amendments

By-Laws may be adopted, amended or repealed at any meeting of the Board of Directors either regular or special, by the vote of a majority vote of said Directors.

(2) The Vice-President shall discharge the duties of the President in the event of his absence or disability for any cause whatever. He shall perform such additional duties as may be prescribed from time to time by the Board of Directors or as may be prescribed from time to time by the By-Laws.

(3) The Secretary shall sign all membership certificates and attest all bonds, deeds, leases or conveyances executed by the corporation, affix the corporate seal thereto and to all other papers requiring said seal, and shall keep a correct and complete record of all of the proceedings of said corporation, including such as relate to the election of its officers. He shall also keep a book containing the names of all members since its organization showing the place of residence and the status of membership, and shall safely and systematically keep all books, records and papers belonging to the corporation, or in anywise pertaining to the business thereof. He shall attend to the giving and serving of all notices of meetings of the Board of Directors and members. He shall in general perform all of the duties which are incident to the office of Secretary of a corporation, subject to the Board of Directors. He shall perform such additional duties as may be prescribed from time to time by the Board of Directors or as may be prescribed from time to time by the By-Laws.

(4) The Treasurer shall keep account of all moneys, credits and property of the corporation which shall come into his hands and keep an accurate account of all moneys received and disbursed. He shall have the custody of all of the funds and securities of the corporation. Whenever necessary he shall endorse on behalf of the corporation all checks, notes or other obligations and evidence of the payment of money payable to the corporation or coming into his possession, and shall deposit the funds arising therefrom, together with all other funds of depositories of the corporation or properly care for them in such other manner as the Board of Directors may direct. He shall sign all checks and other instruments drawn on or payable out of the funds of the corporation. Whenever required by the Board of Directors so to do, he shall exhibit a true and complete statement of his cash account and of the securities and otherfunds in his custody and control, and shall at all reasonable times within business hours, exhibit his books and accounts to any Director. He shall in general perform all of the duties which are incident to the office of Treasurer of the corporation, subject to the Board of Directors. If the Board of Directors shall so require, he shall give bond in such sum and with such surety as the Board of Directors may direct for the faithful performance of his duties and for the safe custody of the funds and property coming into his possession. He shall perform such additional duties as may be prescribed from time to time by the Board of Directors or by the By-Laws.

Section 3 - Delegation of duties.

In case of the absence or inability to act of any officer of the corporation, the Board of Directors may delegate for the time being the duties of such officer to any other officer or to any Director.

INDIANA DEPARTMENT OF PUBLIC INSTRUCTION
VOCATIONAL EDUCATION DIVISION
TRA AND INDUSTRIAL SERVICE

INSTRUCTIONAL MATERIALS LABORATORY
INDIANA STATE COLLEGE
TERRE HAUTE, INDIANA

A-1
(For use for Indiana Not For Profit
Corporations.) Form prescribed by the
Secretary of State

ARTICLES OF INCORPORATION

of

VOCATIONAL BUILDING TRADES, INC.

The undersigned, being three or more natural persons of lawful age, at least a majority of whom are citizens of the United States, do hereby adopt the following Articles of Incorporation, representing beforehand to the Secretary of State of the State of Indiana and all persons whom it may concern, that a membership list of lists of the above named corporation for which certificate of incorporation is hereby applied for, having heretofore been opened in accordance with law and that at least three (3) persons have signed such membership list.

Be it further remembered that the following Articles of Incorporation and all matters heretofore done or hereafter to be done are in accordance with "An Act concerning domestic and foreign corporations not for profit, providing for fees, providing penalties for the violation thereof, and repealing certain laws", approved March 7, 1935, and all acts amendatory thereof and supplemental thereto.

1. The name of this corporation shall be Vocational Building Trades, Inc.

(Name must include the word "Corporation" or "Incorporated" or one of the abbreviations thereof)

2. The purpose or purposes for which it is formed are as follows: In furtherance and not in limitation of all the powers and rights conferred by law upon non-profit corporations:

a. The particular purpose of this corporation is to provide for the students of School City of Elkhart, Indiana, and students of any school corporation which may be consolidated with said School City, training in the building trades in both theory and practice and to that end to provide facilities to further such training.

b. To promote better means of instruction for said students in all phases of engineering, architecture, construction and other allied sciences.

c. To engage in any other activity for the betterment of said students and the furtherance of their education along said lines or any other phases of education undertaken from time to time.

d. Accept and receive from any branch of Government of whatever nature or kind of financial aid or other assistance provided by law.

e. To acquire, own, hold, use, sell, convey, mortgage, lease or pledge any property to secure payment thereof.

f. To loan or invest its own money upon such security or in such securities as may from time to time be determined by its directors.

g. To borrow money, issue, sell, transfer, assign or pledge its obligations, assets, evidences of indebtedness, enter into contracts; to mortgage or pledge its own property to secure payment thereof.

h. To expand the activities of the corporation to improve service or for community welfare whenever it appears advisable and to the best interest of the corporation.

i. To have and exercise all of the general powers and rights of non-profit corporations provided under the Laws of the State of Indiana as they now exist or all laws amendatory thereto.

3. The period during which it is to continue as a corporation is perpetual years.

4. The post office address of its principal office is 228 W. Franklin Street, Elkhart (City) Elkhart (County) Indiana (State)

5. The name of its resident agent is E. T. Organ

6. The post office address of its resident agent is 1043 E. Jackson Blvd. Street, Elkhart (City) Elkhart (County) Indiana (State)

7. If the memberships are to be divided into classes the designations of the different classes, and a statement as to the voting rights of any such class:

There shall be only one class of members, to be designated and known as "General Members".

Every person, firm association or corporation who pay to the corporation such membership fee, as the Board of Directors may from time to time establish, shall be issued a General Membership Certificate which shall remain in effect until the end of the corporation's then fiscal year as established by the By-Laws. Such General Membership shall not be assignable or transferable.

Each General Member shall be entitled to one vote at all meetings of the members, so long as the membership fee, as established by the Board of Directors, has been paid for that year.

8. The number of directors of this corporation shall be five
(This must be an exact number and cannot be stated in the alternative.)

9. The names and addresses of the first board of directors are as follows:

Name	Street	City	County	State
Charles Minser	916 Cleveland Avenue	Elkhart	Elkhart	Indiana
Chester Huffman	2825 S. Main Street	Elkhart	Elkhart	Indiana
Thomas W. Romberger	1525 Roys Avenue	Elkhart	Elkhart	Indiana
John D. Bentz	101 Highland Avenue	Elkhart	Elkhart	Indiana
C. Robert Bickel	502 Arcade Avenue	Elkhart	Elkhart	Indiana

10. The names and post office addresses of the incorporators are as follows:

Name	Street	City	County	State
Thomas W. Romberger	1525 Roys Avenue	Elkhart	Elkhart	Indiana
John D. Bentz	101 Highland Avenue	Elkhart	Elkhart	Indiana
C. Robert Bickel	592 Arcade Avenue	Elkhart	Elkhart	Indiana

11. A statement of the property and an estimate of the value thereof, to be taken over by this corporation at or upon its corporation:

NONE

12. Any other provisions, consistent with the laws of this state, for the regulation and conduct of the affairs of this corporation, and creating, defining, limiting or regulating the powers of this corporation, of the directors or of the members of any class or classes of members:

a. Meetings of the members of this corporation shall be held at the principal office of the corporation in the City of Elkhart, Indiana, or at such other place as the Board of Directors may from time to time decide.

b. This corporation reserves the right to alter, amend, change or repeal any provisions contained in these Articles of Incorporation in the manner now or hereafter prescribed by statute and all rights granted to or conferred upon the members of this corporation are granted, subject to their reservation.

c. This corporation reserves the right to take advantage of the provisions of any law under which it is organized or of any law applicable or relating to corporations formed under the law now in force or which may hereafter be enacted, and all rights conferred to or upon its members are granted and conferred, subject to this reservation.

Thomas W. Romberger

John D. Bentz

C. Robert Bickel

A minimum of three of the incorporators designated in Article 10 on page -c- should sign above.

STATE OF INDIANA)
)ss:
COUNTY OF Elkhart)

Before me, Alphonse J. Spahn, a Notary Public in and for said County and State, personally appeared

Thomas W. Romberger

John D. Bentz

C. Robert Bickel

and severally acknowledged the execution of the foregoing articles of incorporation.

(SEAL)

WITNESS my hand and notarial seal this

25th day of September, 1957

Alphonse J. Spahn Notary Public

My commission expires February 13, 1961

(Articles of incorporation must be prepared in triplicate on the form prescribed by the Secretary of State, by the incorporators and signed and acknowledged by at least three of them before a Notary Public, and shall be presented in triplicate to the Secretary of State at his office accompanied by the fees prescribed by law.)

VT003 187

VT 003 187
Basic Vacuum Tube and Transistor Theory for Electronics. (Revised Edition).

Electronics Vocat. Technician School, Bloomington, Ind.
Indiana State Dept. of Public Instruction, Indianapolis
Indiana State Univ., Terre Haute. Instr. Materials Lab.
Pub Date - 62
MF AVAILABLE IN VT-ERIC SET 81p.

*STUDY GUIDES, *TRADE AND INDUSTRIAL EDUCATION, *ELECTRONIC TECHNICIANS, *TRANSISTORS, *VACUUM TUBES, THEORIES, INDIVIDUAL INSTRUCTION,

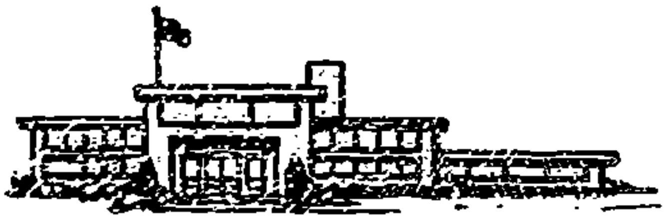
The purpose of this course is to introduce the electronic technician student to the principles of operation of the vacuum tube and transistor. The guide was developed by a vocational coordinator and a committee from industry using notes from instructors who have taught the course. It was designed on the concept and philosophy of using individual assignment sheets to allow each student to progress at his own rate and to enable the teacher to devote most of his time to individual instruction. Assignment sheets for each of the 24 lessons provide the student with an introduction, textbook references, a materials list, a schematic drawing, job procedures, and study questions. The appendix contains charts and schematic drawings related to the lessons. This manual is for teacher use only. The students are to use the assignment sheets in loose unbound form, returning each completed sheet to the teacher and taking the next one. Students should be admitted to the course only upon satisfactory completion of a proficiency test on basic AC-DC electronic theory. This document is available for 90 cents from the Division of Industrial Education, Indiana State University, Terre Haute, Indiana 47809. (HC)

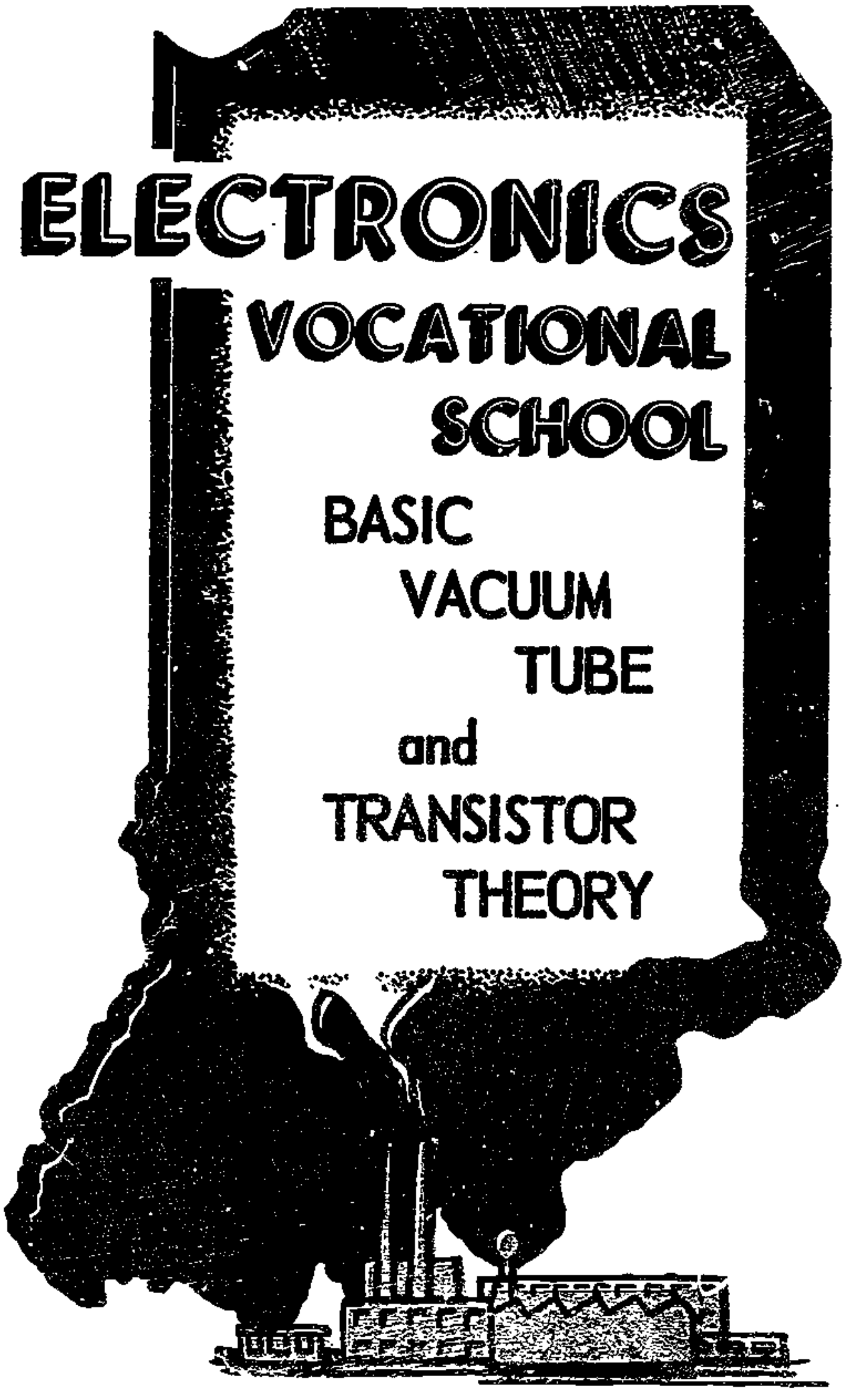
VOCATIONAL

Trade — Industrial — Technical Education

Department of Public Instruction

STATE of INDIANA





ELECTRONICS
VOCATIONAL SCHOOL
BASIC VACUUM TUBE and TRANSISTOR THEORY

INSTRUCTIONAL MATERIALS LABORATORY

Indiana State University

Terre Haute, Indiana

BASIC VACUUM TUBE AND TRANSISTOR THEORY

for

ELECTRONICS

(Revised 1962)

Electronics Vocational Technician School
Bloomington, Indiana

State of Indiana
Division of Vocational Education
Trade-Industrial-Technical Education Branch

Instructional Materials Laboratory
Trade and Industrial Education
Indiana State College
Terre Haute, Indiana

MEMORANDUM

TO: The ERIC Clearinghouse on Vocational and Technical Education
The Ohio State University
980 Kinnear Road
Columbus, Ohio 43212

FROM: (Person) Thomas E. Eachus (Agency) Vocational Instructional Materials Laboratory

(Address) Division of Industrial Education, Indiana State University, Terre Haute

DATE: August 5, 1967

RE: (Author, Title, Publisher, Date) Basic Vacuum Tube & Transistor Theory for Electronics - 1962

Supplementary Information on Instructional Material

Provide information below which is not included in the publication. Mark N/A in each blank for which information is not available or not applicable. Mark P when information is included in the publication. See reverse side for further instructions.

(1) Source of Available Copies:
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Limitation on Available Copies none Price/Unit $.90
(quantity prices)

(2) Means Used to Develop Material:
Development Group P
Level of Group P
Method of Design, Testing, and Trial N/A

(3) Utilization of Material:
Appropriate School Setting N/A
Type of Program Secondary
Occupational Focus P
Geographic Adaptability N/A
Uses of Material P
Users of Material P

(4) Requirements for Using Material:
Teacher Competency P
Student Selection Criteria N/A

Time Allotment P

Supplemental Media --
Necessary ____)
Desirable ____) (Check Which)

Describe

Source (agency)
(address)

ACKNOWLEDGEMENT

Appreciation and acknowledgement is made to Tom Reckerd, Vocational Coordinator of Bloomington High School, and to his committee consisting of Harold Fischel, Morris Robertson, and John Robinson. The committee, all members of industry, made it possible to relate these electronics courses directly to the needs and applications of industry.

The instructors who taught this course kept very complete notes and from these notes this revision was made.

PREFACE

BASIC VACUUM TUBE AND TRANSISTOR THEORY

Basic Vacuum Tube and Transistor Theory is designed to take the student who has a firm foundation in Basic AC-DC Electronic Theory and introduce him to the principles of operation of the vacuum tube and transistor. It is composed of three equally timed areas:

1. Electronics Mathematics IV
2. Electronics Theory II
3. Electronics Laboratory II

The established technician who needs only updating in the transistor field would be better satisfied to wait and take a specialized course in transistor theory only. The new student who wants to enter the training program at this level should be given a proficiency examination over AC-DC theory and should be admitted only upon satisfactory completion of said examination or course.

DIRECTIONS TO THE INSTRUCTOR

This course has been developed around the concept and philosophy of using individual assignment sheets. If these sheets are used correctly, each student will be allowed to progress at his own rate. The abilities of all will be developed to their fullest extent.

The instructor only, should use this book. The loose individual assignment sheets are used by the students. The following method of operation has proven satisfactory:

Each student should have two folders in the file; one for the "completed" work, the other for the "incomplete" work. The assignment sheets should be filed in consecutive order in another drawer. The instructor should lay out the student folders before class time. This prevents congestion and a bottleneck around the file cabinet at the beginning and ending of class. When a student completes and assignment sheet, he turns this into the instructor, then secures the next sheet.

Test are included periodically. These may be used to identify the mathematical ability of each student. This makes it possible to start the students at the proper level in the course. The tests may also be used in the traditional manner.

If the course is used as it should be, the instructor will be freed of many routine activities and will be able to devote his time almost entirely to individual instruction.

It must be kept in mind that the assignment sheets are only a teaching aid or device. Adequate instruction is still needed.

An accurate record of each student's progress should be kept by the instructor.

INDIANA DEPARTMENT OF PUBLIC INSTRUCTION
VOCATIONAL EDUCATION DIVISION
TRADE AND INDUSTRIAL SERVICE

INSTRUCTIONAL MATERIALS LABORATORY
INDIANA STATE COLLEGE
TERRE HAUTE, INDIANA

ASSIGNMENT SHEET

VOCATIONAL ELECTRONIC TECHNICIAN TRAINING

Course III

Basic Vacuum Tube and
Transistor Theory

Lesson 1
Diode Characteristics

Introduction:

We are now ready to enter another major field of electronics. The electron tube is both interesting and a necessary field for our study. About 90% of the maintenance problems will be concerned with the tube. We must be able to understand the construction and operation of the electron tube. Without this knowledge our understanding of the operation of the different stages of the radio would be incomplete. Our study will include interpretation of the data obtained when the tube is tested. In this particular lesson we will study the relationship between the plate voltage and plate current in a vacuum tube.

References:

1. Keith Henney and Glen A. Richardson, Principles of Radio. Sixth Edition. John Wiley & Sons, Inc., New York, 1952. pp. 236-243.

2. Paul Zbar and Sid Schildkraut, Basic Electronics, Laboratory Manual for Radio and Television Technicians. Second Edition. Electronics Industries Association. McGraw-Hill Book Co., Inc., New York, 1958. pp. 1-4.

3. Abraham Marcus and William Marcus, Elements of Radio. Second Edition. Prentice-Hall Publishing Co., Englewood Cliffs, New Jersey, 1948. pp. 258-260.

4. Department of the Army Technical Manual, TM11-662, Basic Theory and Application of Electron Tubes. U.S. Government Printing Office, Washington, D.C., 1952. pp. 9-39.

Materials:

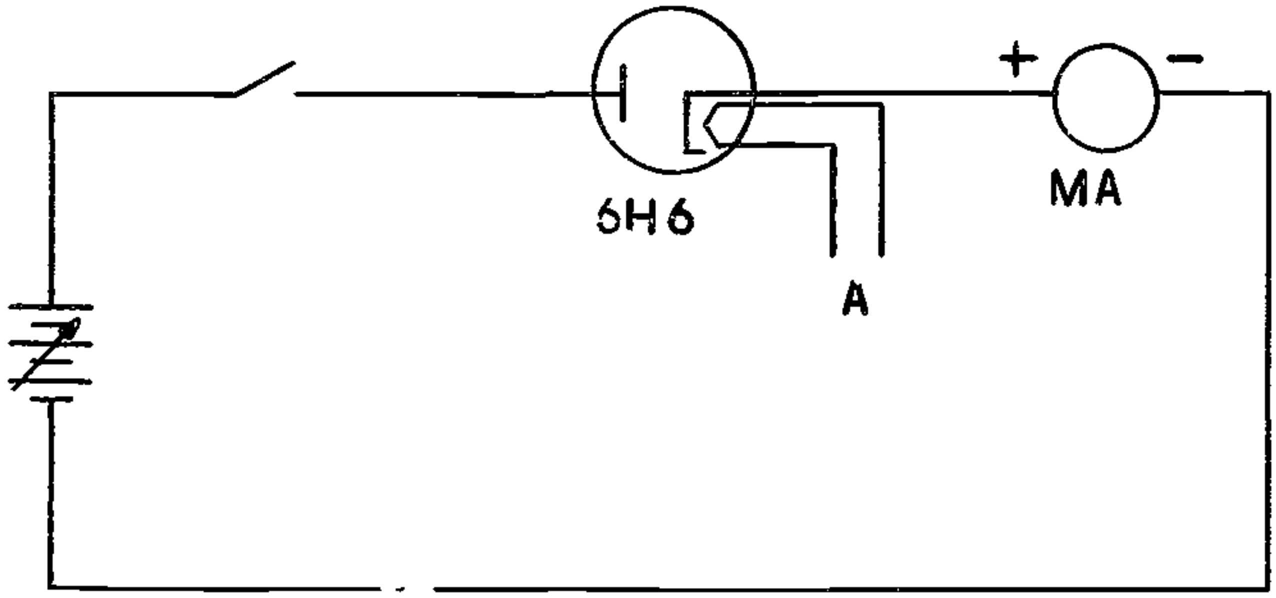
1. Variable "B" Supply
2. "A" Supply
3. VTVM -(Vacuum Tube Voltmeter)
4. VOM -(VoltOhmmeter)
5. Octal tube socker
6. 6H6

Schematic:

1. Included in lesson.

Procedure:

1. Wire the following circuit.



2. Wire "A" supply and see if tube lights.
3. Wire balance of circuit with switch open.
4. Turn "B" supply to zero.
5. Place ma meter on 10 ma scale.
6. Close switch
7. Increase plate voltage in 1 volt steps and record E_p and I_p.
8. Record and draw graph showing relationship.

9. Record and draw graph showing relationship.

PART ONE
SINGLE DIODE

I_p

______

______

______

______

______

______

PART TWO
PARALLEL DIODE

______

______

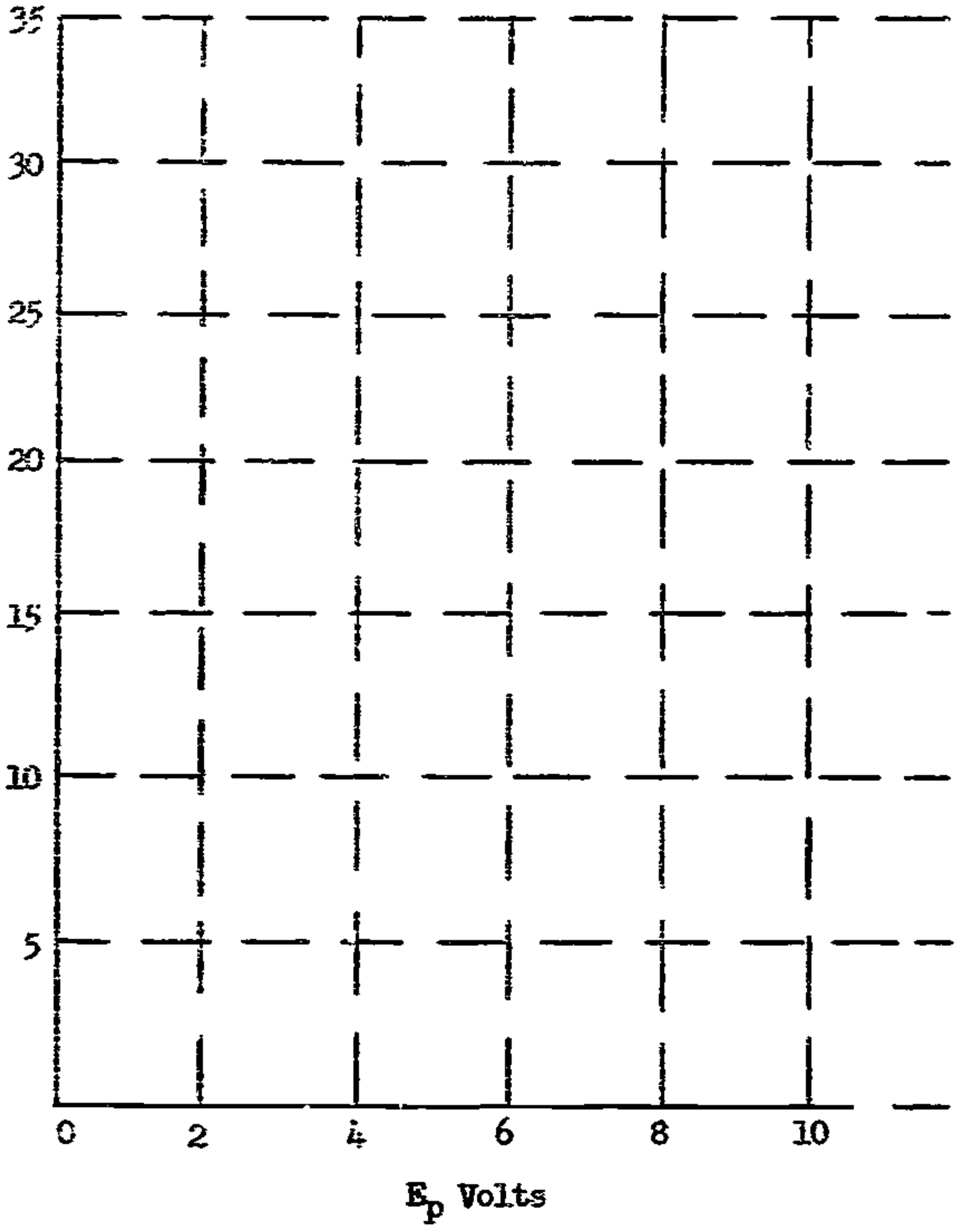
______

______

______

______

DIODE CHARACTERISTICS



Questions:

1. Will a diode ordinarily permit electrons to flow in two directions? Explain.
2. What happens when you parallel the diodes?
3. What portion of the graphs would be considered linear?
4. What are the filament voltage and current requirements of your tube?
5. In placing this tube in parallel with others in a radio what rating must we watch concerning the filament?

6. In placing this tube in series with others in a radio what rating must we watch concerning the filament?

7. Could this tube be used as a practical power supply rectifier? Explain.

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VOCATIONAL ELECTRONIC TECHNICIAN TRAINING

Course III

Basic Vacuum Tube and
Transistor Theory

Lesson 2
PN Junction

Introduction:

The crystal diode has long been with us. We have often used them as rectifiers or valves ad we did the diode vacuum tube in lesson one. Today thorough understanding of their behavior can be had. Complete understanding of the diode in semi-conductors is necessary for transistor study.

References:

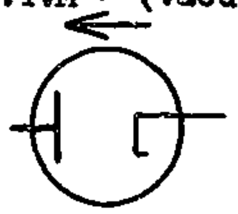
1. Experiment Guide, RCA Transistor Trainer, Models 301-T and 601-T. Government Services, RCA Service Co., Camden, New Jersey, 1960. pp. 1-10.

2. Department of the Army Technical Manual, TM11-690, Basic Theory and Application of Transistors. U.S. Government Printing Office, Washington, D.C., 1959. pp. 12-36.

Materials:

1. Crystal diode

2. VTVM - (Vacuum tube voltmeter)



1. ________

2. ________

3. ________

Schematic:

1. Use schematic #S-III-2 (appendix). See instructor.

Procedure:

1. Plug in VTVM and let it warm up. Adjust for zero center, using DC plus volts.

2. Using the smallest scale possible, the meter now reads:

Full scale right ____________

Full scale left ____________

3. Place the negative lead on the cathode of the crystal. Touch the positive lead to the anode. Do not touch probe with your hand. Explain what takes place.

4. Before a junction is formed what is the net charge of the P type material?

5. Before a junction is formed what is the net charge of the N type material?

6. Why is a slight potential shown when a junction of P and N type is formed?

7. Set VTVM on ohms and adjust.

8. Using a VOM determine the polarity of the VTVM leads when the meter is set on ohms.

AC/Ohms lead ____________

Ground lead____________

9. Place the negative lead on the cathode and the positive lead on the anode.

Record the resistance __________

10. Reverse the leads of the ohmmeter and again record the resistance ______.

11. Explain steps 9 and 10 in terms of forward and reverse bias.

12. Compare valve action of the vacuum tube with that of the crystal.

13. What is reverse current? Where does it exist?

14. Draw a graph illustrating forward and reverse current of the crystal diode. Use graph #G-III-2 (appendix). See instructor.

Questions:

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Course III

Basic Vacuum Tube and
Transistor Theory

Lesson 3
Diode At Work

Introduction:

In this lesson we will study the ability of the diode to rectify and to produce pulsating DC. There are some very high voltages in this lesson. A current as small as 50 ma can cause fatal defects.

References:

1. Keith Henney and Glen A. Richardson, Principles of Radio. Sixth Edition. John Wiley & Sons, Inc., New York, 1952. pp. 236-243.
2. Student Laboratory Manual, RCA Electronic Trainer, Model 121, Government Service Department. RCA Service Co., Camden, New Jersey. p. 8.
3. Department of the Army Technical Manual, TM11-662, Basic Theory and Application of Electron Tubes. U.S. Government Printing Office, Washington, D.C., 1952. pp. 9-14 and 15-39.
4. Paul Zbar and Sid Schildkraut, Basic Electronics, Laboratory Manual for Radio and Television Technicians. Second Edition. Electronics Industries Association. McGraw-Hill Book Co., Inc., New York, 1958. pp. 1-4.

Materials:

1. VTVM - (Vacuum tube voltmeter)
2. Scope
3. 121-1 Power supply

Schematic:

1. Use schematic #S-III-3 (appendix). See instructor.

Procedure:

1. Remove SS-1, C_1, and C_2.
2. Place SS-2 in the circuit.
3. Draw a schematic of the resulting circuit.

4. Using VTVM measure the following voltages (AC):
    a. Measure the voltage of the primary.
    b. Measure pin 4 to ground.
    c. Measure the total secondary of the high voltage winding.
    d. Measure pin 2 to 8 of the rectifier.
5. The transformer has a step up ratio of __________ to ___________ and a step down ratio of ___________ to _________.
6. Using VTVM measure the following DC voltages:
    a. Pin 8 to ground. Explain
7. Using the scope,
    a. Observe and sketch the primary waveform.
    b. Observe and sketch the secondary waveform of pin 4 to ground.
    c. Observe and sketch the secondary waveform of pin 8 to ground.
8. Turn the equipment off and have the instructor check your data.
9. Place SS-1 in the circuit.
10. Using the VTVM measure the following AC voltages:
    a. Voltage primary.
    b. Pin 4 to ground.
    c. Pin 6 to ground.
    d. Total high voltage secondary
11. Using VTVM measure the following DC voltages:
    a. Pin 8 to ground.
12. Using scope,
    a. Observe and sketch primary waveform.
    b. Pin 4 to ground
    c. Pin 6 to ground
    d. Pin 8 to ground

13. Turn gear off and have instructor check.
14. Replace all equipment in original condition.

Questions:

1. What is rectification?
2. Compare the input frequency to the ripple frequency in both the half-wave and full-wave.
3. Compare the DC magnitude of the output to the AC input in both half-wave and full-wave types.
4. Name an advantage of full wave.
5. What are the plate current ratings of the tube we used?
6. What effect does the resistance of the vacuum tube have on the voltage output?
7. What additional refinement must we do to make this a usable power supply?

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Course III

Basic Vacuum Tube and
Transistor Theory

Lesson 4
Selenium Rectifier

Introduction:

In this lesson we will study a half wave semi-conductor power supply.

Reference:

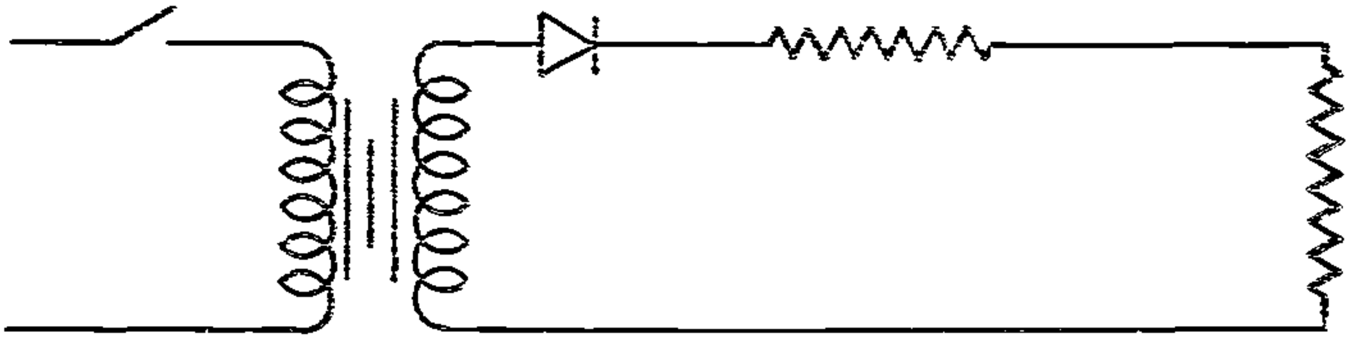
1. Student Laboratory Manual, RCA Electronic Trainer, Model 121, Government Service Department. RCA Service Co., Camden, New Jersey. pp. 28-29.

Materials:

1. RCA 121-67

2. VTVM -(Vacuum tube voltmeter)

3. Scope



Schematic:

1. See schematic above

Procedure:

1. Remove C_1, C_2 and C_3.

2. With VTVM make the following AC voltage measurements:

   a. Transformer primary

   b. Transformer secondary

3. With VTVM make the following DC voltage measurements:
    a. Negative to positive jack
    b. Ground to negative jack
    c. Ground to positive jack
4. Using 'scope, draw waveforms
    a. Primary
    b. Secondary
    c. Negative to positive jack

Questions:

1. Describe the transformer used here.
2. What type of rectification is this?
3. Why is there only one secondary winding?
4. What is the ripple frequency?
5. What is meant by reverse current? Do you see any?

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Course III

Basic Vacuum Tube and
Transistor Theory

Lesson 5
Triode Characteristics

Introduction:

The diode had one important drawback; it could not amplify. With the addition of a third element the tube can now amplify if placed in the proper conditions. This lesson is designed to give us some inside information of the behavior of the triode. A series of graphs will be constructed. It will be very important that one watch his meter very carefully. With so many variables it would be very easy to let one meter go beyond its range.

References:

1. Keith Henney and Glen A. Richardson, Principles of Radio. Sixth Edition. John Wiley & Sons, Inc., New York, 1952. pp. 244-253.
2. Abraham Marcus and William Marcus, Elements of Radio. Second Edition. Prentice-Hall Publishing Co., Englewood Cliffs, New Jersey, 1948. pp. 266-263.
3. Department of the Army Technical Manual, TM11-662, Basic Theory and Application of Electron Tubes. U.S. Government Printing Office, Washington, D.C., 1952. pp. 40-85.
4. Paul Zbar and Sid Schildkraut, Basic Electronics, Laboratory Manual for Radio and Television Technicians. Second Edition. Electronics Industries Association. McGraw-Hill Book Co., Inc., New York, 1958. pp. 9-13.

Materials:

1. One triode vacuum tube, 6J5, 6SN7.
2. VTVM -(Vacuum tube voltmeter)
3. VOM -(VoltOhmmeter)
4. Adapter for 121-1 (121-1A)
5. 121-1 power supply
6. 121-67 bias supply

Schematics:

1. Included in this lesson.

Procedure:

1. Place the 121-1 in the left side of the rack. Make sure all switches are off.

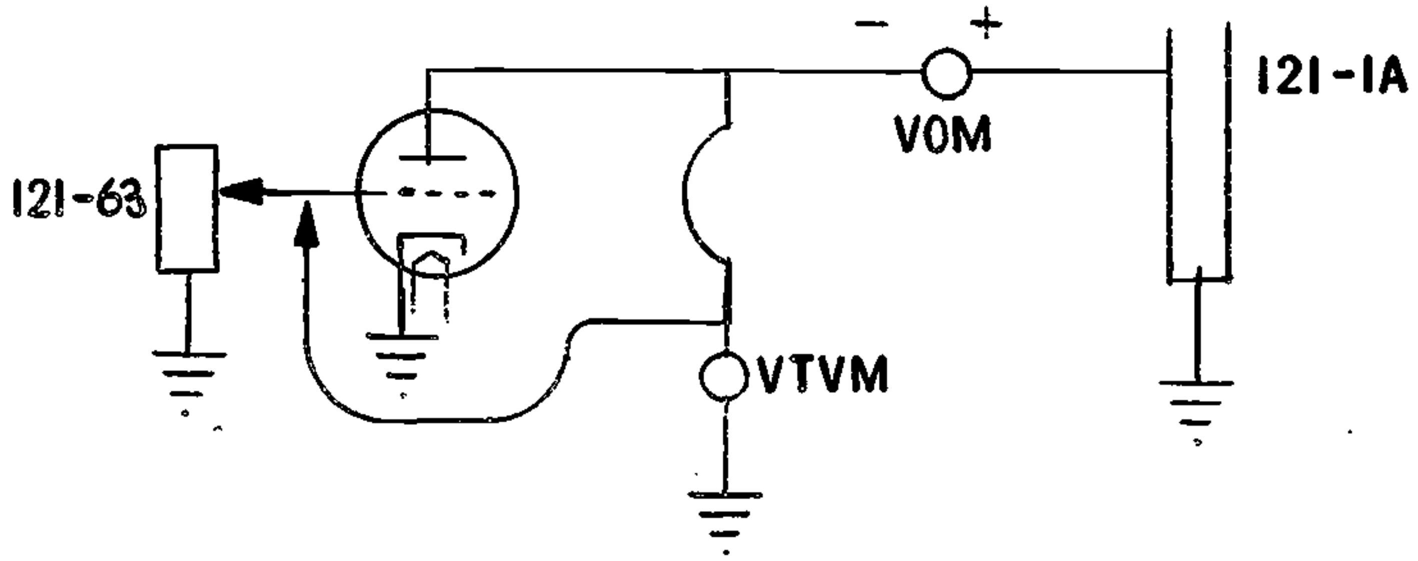
2. Place the 121-1A beside the 121-1, turn control maximum counter-clockwise.

3. Place 121-67 in right side of the rack, turn R_5 maximum clockwise.

4. Place the 6J5 and 6AQ5 in their respective sockets. Wire their filaments from the distribution box.

5. Wire the jumper from the B plus of the 121-1 to the top red jack on left side of variable "B" supply (adapter).

6. Complete wiring as shown in the following schematic:



7. Have the instructor check the circuit.

8. Turn the circuit on and take the following readings.

   a. Set the grid-bias to approximately 10 volts negative. R_5 on the 121-67.

   b. Set the plate voltage to approximately 50 volts positive. Control on 121-1A.

   c. If the tube is not cut-off advance the grid-bias until the tube ceases to conduct.

   d. Decrease the grid-bias one volt at a time until there is no bias on the tube. Record grid voltage and plate current for each step.

   e. Increase the grid-bias to approximately 20 volts negative. Increase the plate voltage to approximately 100 volts positive. Repeat steps c and d.

f. Change the plate voltage to 150 volts and the bias to 30 volts and repeat steps c and d.

g. Draw a set of E_g - I_p curves for the constant values of plate voltage used.

h. Turn plate voltage down to about 50 volts.

i. Set grid voltage to about a minus 4 volts. Increase E_g slowly until the tube starts to conduct. Pick the closest multiple of 25 volts and continue to increase in 25 volt steps recording I_p each time until you reach a plate voltage of approximatley 250 volts. Decrease E_p to see if the tube ceases to conduct at the same place it started to conduct.

j. Change E_g to a minus 6 volts and repeat step i.

k. change E_g to a minus 8 volts and repeat step i.

9. Have the instructor check your data before tearing down the equipment.

10. Draw a set of E_p - I_p curves holding E_g constant at the three test points.

Questions:

1. What is meant by the u (mu) of a triode?

2. Compute the u of the tube that you used by using both sets of curves.

3. What is meant by the dynamic plate resistance? Is this different than the static or DC plate resistance that we found in the diode? How?

4. Compute the R_p of the tube that you used.

5. Compute the r_p of the tube that you used.

6. What is transconductance?

7. Compute the gm of your tube.

8. Draw a graph of R_p vs E_g when E_p was 100 volts.

9. What is the relationship between gm, r_p, and u?

10. Can a triode be used as a variable resistor? Explain.

11. Summarize.

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VOCATIONAL ELECTRONIC TECHNICIAN TRAINING

Course III

Basic Vacuum Tube and
Transistor Theory

Lesson 6
PNP Transistor

Introduction:

In lesson 2 we studied the properties of a PN junction. The next logical step is to experiment with a two junction device such as a PNP configuration. This lesson is designed to teach the characteristics of the PNP configuration which is rightly referred to as a PNP transistor. A basic understanding of the two terminal diode and three terminal (transistor) semi-conductor devices will prove to be a necessity for an understanding of the circuit position of these devices.

References:

1. Experiment Guide, RCA Transistor Trainer, Models 301-T and 601-T. Government Services, RCA Service Co., Camden, New Jersey, 1960. pp. 11-18.

2. Department of the Army Technical Manual, TM11-690, Basic Theory and Application of Transistors. U.S. Government Printing Office, Washington, D.C., 1959. pp. 36-38.

3. Morris Slurzberg and William Osterheld, Essentials of Radio-Electronics. Second Edition. McGraw-Hill Book Co., Inc., New York, 1961. pp. 522-538.

Materials:

1. Transistor lab kit

2. VTVM - Vacuum tube voltmeter

3. VOM - VoltOhmmeter

4. Template No. 2 (If using RCA equipment)

Schematic:

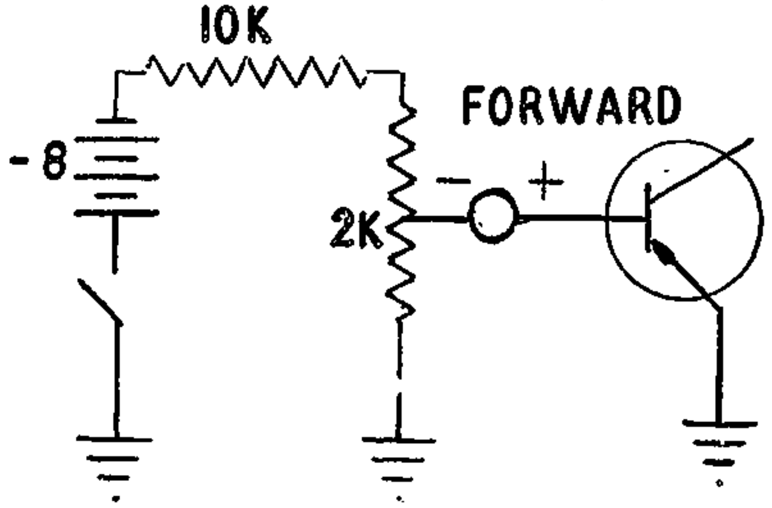
1. Use schematic #S-III-6 (appendix). See instructor.

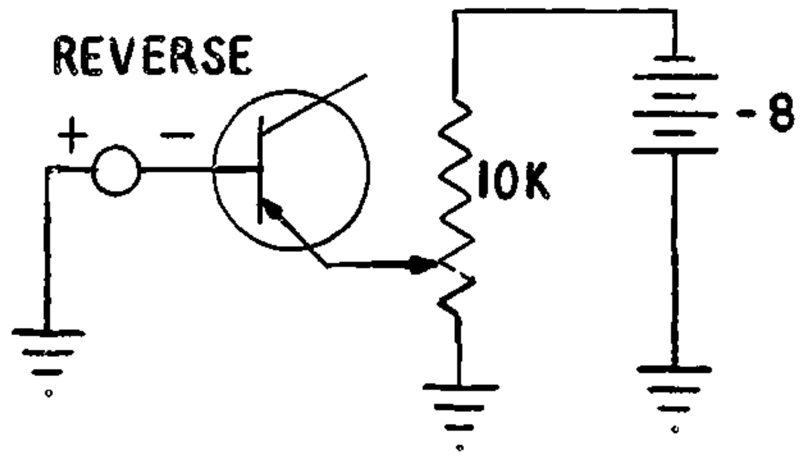
Procedure:

PART A

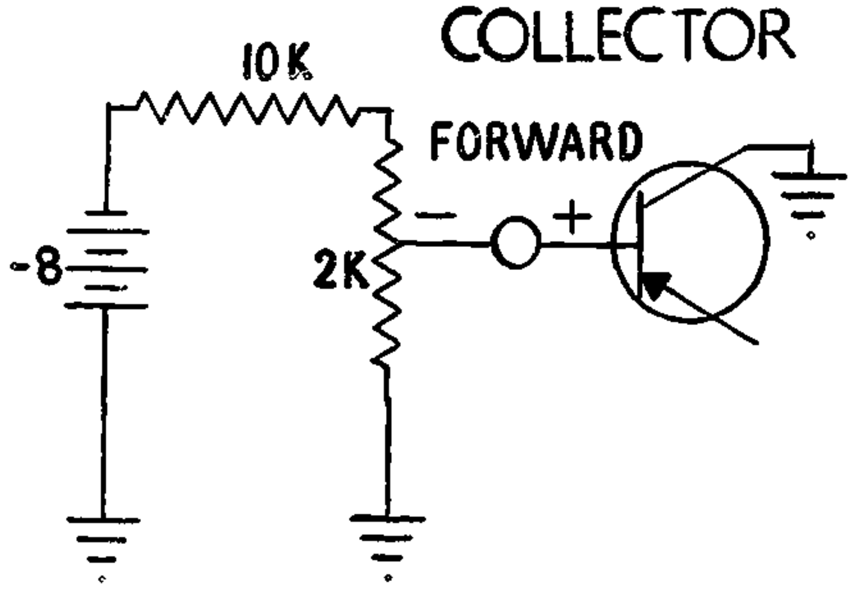
1. Wire the following circuits and record the forward and reverse currents of the individual junctions. Be sure you understand the bias. (Record voltages.

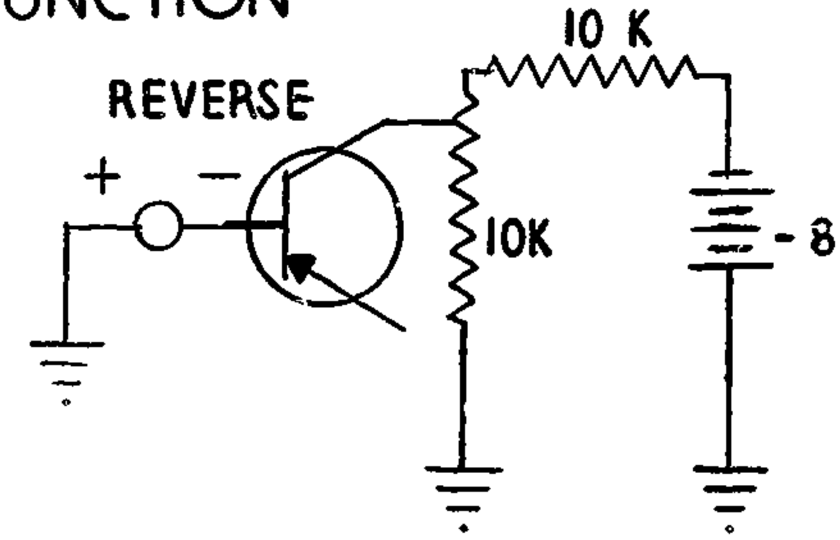
EMITTER JUNCTION





COLLECTOR JUNCTION

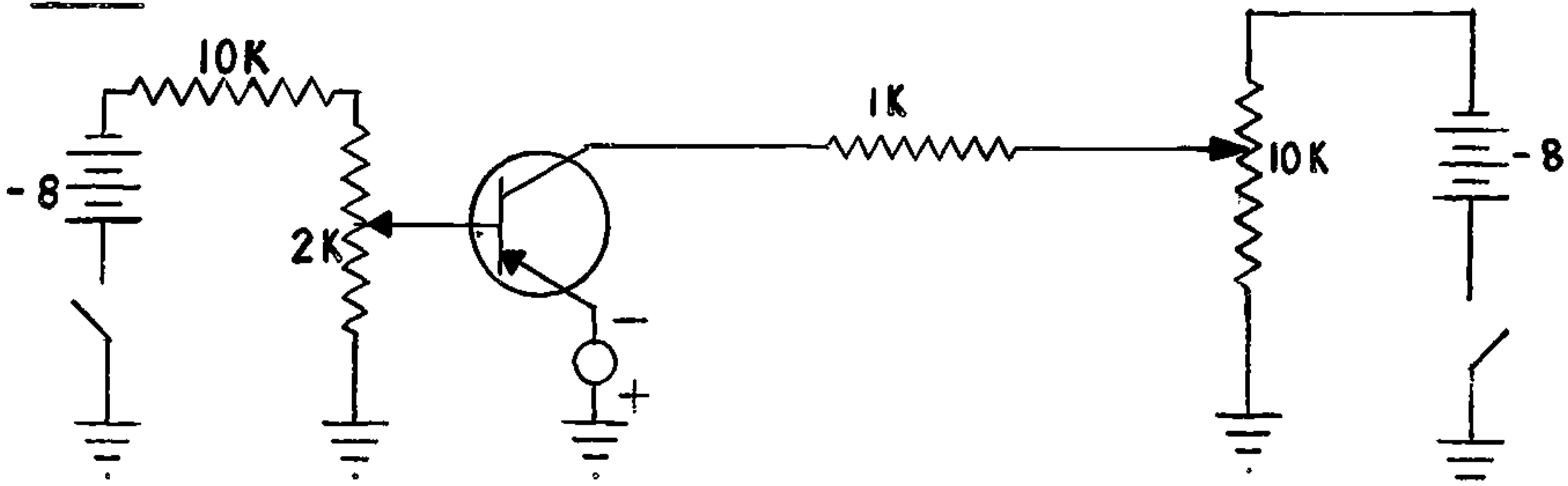




2. How do the two junctions compare?

3. Is this a growth or a fused transistor? Why?

PART B



1. Wire the circuit shown on the bottom of the previous page and adjust the forward bias between emitter and base so the I_e is about 1.2 ma.

2. Adjust the reverse bias on the collector to base to about - 6.0 volts.

3. Adjust the base to emitter to about .14 volts.

4. Readjust to arrive at a V_{be} of .14 and V_{cb} of 6 volts or as close as possible.

5. Record V_{be}, V_{cb}, and I_e.

6. Turn the circuit off and move ma from emitter circuit, replace it with a 27 ohm resistor. Place the ma meter in the collector circuit.

7. Energize the circuit and record V_{be}, V_{ce}, and I_c.

8. Turn equipment off. Remove the ma meter from the collector circuit and place it in the circuit so as to measure I_b.

9. Energize the circuit and record V_{be}, V_{ce}, and I_b.

10. Compute the following:

    a. Alpha or I_c/I_e

    b. Z_{cb} or V_c/I_c

    c. Power out or V_c x I_c

    d. Z_{eb} or V_e/I_e

    e. Power in or V_e x I_e

    f. Power gain

PART C (To study the effect of V_e and V_c on I_c)

1. Using the same circuit used in part B adjust V_c for maximum I_e. (emitter current) Set V_e at the following settings and record I_e.

V_e	I_e
.1	________
.12	________
.14	________
.15	________

Explain what takes place.

2. Remove the ma meter from the emitter circuit and place a 27 ohm resistor in its place.

3. Place the ma meter so as to measure I_c, watch polarity and have the instructor check it.

4. Set V_e equal to .1 volt and vary V_c in the following steps recording I_c.

V_c	I_c
6.0	
5.0	
4.0	
3.0	
2.0	
1.0	

5. Adjust V_c for maximum and vary V_e in the following steps, record I_c.

V_e	I_c
.1	
.12	
.13	
.14	
.15	
.16	

6. How does V_e compare with V_c or the effect on I_c?

Questions:

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Course III

Basic Vacuum Tube and
Transistor Theory

Lesson 7
Triode DC Amplifier

NOTE: This is the first opportunity for students to use voltage regulator.

Introduction:

In lesson 5, we saw how a change in grid voltage was much more effective on plate current than a change in plate voltage. Our job now is to put a load in the plate circuit of the triode and see what effect a change in grid voltage will have on the voltage across the load.

References:

1. Abraham Marcus and William Marcus, Elements of Radio. Second Edition. Prentice-Hall Publishing Co., Englewood Cliffs, New Jersey, 1948. pp. 547-569.

2. Department of the Army Technical Manual, TM11-662, Basic Theory and Application of Electron Tubes. U.S. Government Printing Office, Washington, D.C., 1952. pp. 40-85.

3. Paul Zbar and Sid Schildkraut, Basic Electronics, Laboratory Manual for Radio and Television Technicians. Second Edition. Electronics Industries Association. McGraw-Hill Book Co., Inc., New York, 1958. pp. 14-16.

Materials:

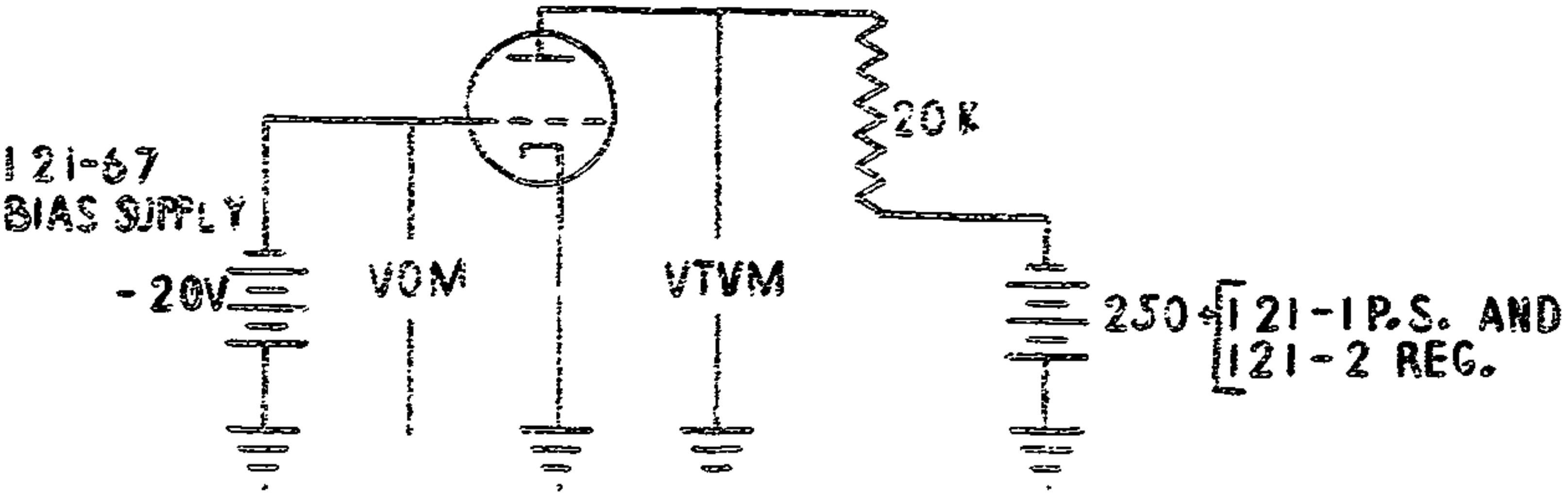
1. Triode vacuum tube
2. One VTVM -(Vacuum tube voltmeter)
3. One VOM -(VoltOhmmeter)
4. 20 K load resistor
5. Tube socket
6. Power supply 121-1
7. Regulator 121-2
8. Bias supply 121-67

Schematic:

1. Included in the lesson.

Procedure:

1. Connect the following circuit:



2. Place the tube in the circuit. Set E_g to a minus 20 volts.

3. Set B plus to 250 volts.

4. Record E_p.

5. Change E_g in one volt steps and record E_p each time. Decrease E_g until you reach zero.

6. Draw the graph of E_p verses E_g. Make E_p the vertical axis.

7. Locate and record on your graph the points which determine the linear portion of the curve. Locate the midpoint.

8. Compute the actual gain on the tube. Show complete work and formula used.

Questions:

1. Complete the plate current at all three points in step 7. Plate current will be equal to the supply voltage minus the plate voltage divided by the load resistor.

2. Explain the gain of a DC amplifier.

3. Compare the gain that you computed in step 8 with the rated mu of the tube.

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VOCATIONAL ELECTRONIC TECHNICIAN TRAINING

Course III

Basic Vacuum Tube and
Transistor Theory

Lesson 8
TRANSISTOR CHARACTERISTIC CURVE

Introduction:

In lesson 6 the characteristics of a PNP transistor were discussed. This lesson is designed to teach the student one way of plotting the collector current, collector voltage characteristics of a PNP transistor.

References:

1. Experiment Guide, RCA Transistor Trainer, Models 301-T and 601-T. Government Services, RCA Service Co., Camden, New Jersey, 1960. pp. 19-23.

2. Department of the Army Technical Manual, TM11-690, Basic Theory and Application of Transistors. U.S. Government Printing Office, Washington, D.C., 1959. pp. 52-63, 102-111.

Materials:

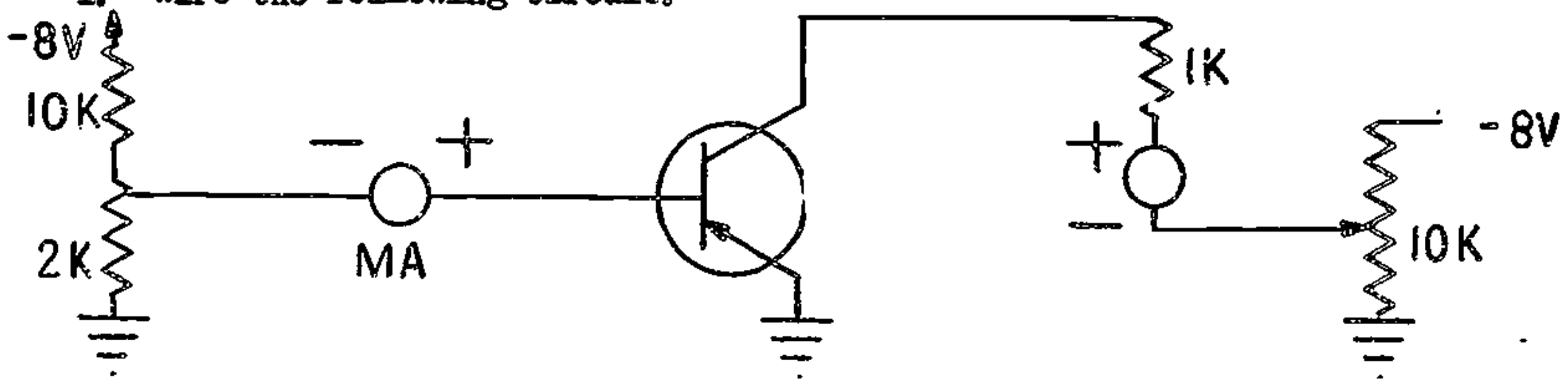
1. Transistor trainer
2. 2 VOM -(VoltOhmmeter)
3. 1 VTVM -(Vacuum tube voltmeter)
4. Template No. 2 (If using RCA equipment)

Schematic:

1. Included in the lesson.

Procedure:

1. Wire the following circuit.



2. Set base current on 15 ua.
3. Set V_c on maximum ua.
4. Maintain I_b at 15, reduce V_c in 1 volt steps recording I_c.
5. When you reach 1 V for V_c go in .5, .25, .1, steps if possible.
6. Repeat for base currents at 25, 40, 50, 70 ua.
7. Draw a set of V_c, I_c curves. Make at least two sets, one for the lesson write up, and one for you to keep. (See instructor for graph form)

Questions:

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Course III

Basic Vacuum Tube and
Transistor Theory

Lesson 9
Triode AC Amplifier

Introduction:

This lesson is designed to show actual wave form so that we may actually see that the tube is amplifying.

Reference:

1. Department of the Army Technical Manual, TM11-662, Basic Theory and Application of Electron Tubes. U.S. Government Printing Office, Washington, D.C., 1952. pp. 40-85.

Materials:

1. Triode vacuum tube
2. 0-30 DC voltmeter
3. One VTVM -(Vacuum tube voltmeter)
4. 20 K load resister
5. Small AC signal course

Schematic:

Procedure:

1. Connect the triode as we had it in lesson 7.
2. Adjust the grid-bias until the tube is operating at the center portion of the curve.
3. Break the grid circuit between the battery and the grid.
4. Insert in this spot an AC signal voltage. Consult the curve you made in lesson 7 so that you do not drive the tube into distortion.
5. Show the signal on the scope in both the grid and plate circuits.
6. Vary the signal so that the signal goes into distortion.
7. Vary the bias so that the signal goes into distortion.

Questions:

1. Where is the input signal in the triode?
2. Where is the voltage out?
3. Why must we have a load to have amplification?
4. How could we compute the actual amplification of the tube?
5. Would this differ from mu?
6. Why is the operating point of a triode so important?

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Course III

Basic Vacuum Tube and
Transistor Theory

Lesson 10
Transistor DC Amplifier Circuit

Introduction:

In circuit design and circuit analysis it becomes necessary to predict the behavior of the circuit components. By proper utilization of basic AC and DC principles we are able to determine, to a close tolerance, the behavior of linear passive components such as resistors and capacitors; however, the behavior of non-linear, active components, such as transistors and vacuum tubes, presents a different situation. This lesson is designed to teach the student a way to predict the behavior of a transistor when it is subjected to a small signal. The circuit configuration shall be limited to common emitter.

References:

1. Experiment Guide, RCA Transistor Trainer, Models 301-T and 601-T. Government Services, RCA Service Co., Camden, New Jersey, 1960. pp. 25-31.

2. Department of the Army Technical Manual, TM11-690. Basic Theory and Application of Transistors. U.S. Government Printing Office, Washington, D.C., 1959. pp. 102-111.

Materials:

1. VTVM -(Vacuum tube voltmeter)

2. VOM -(VoltOhmmeter)

3. Template No. 3 (If using RCA equipment)

4. Transistor Trainer

Schematic:

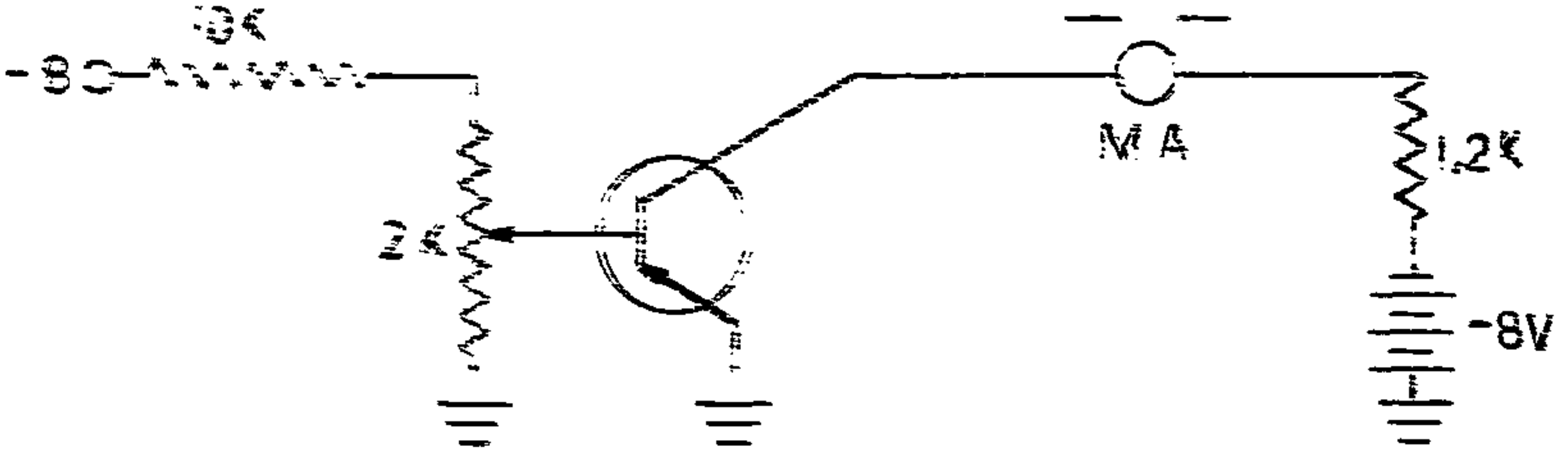
1. Included in the lesson.

Procedure:

1. Using the set of curves that you made in lesson 8, draw a load line for the 2.2K resistor used as load.

2. What current would flow in the collector with this load and collector voltage of -4. -2?

3. Wire the following circuit.



4. Adjust V_{BE} to -.1 volts. Read and record I_C.

5. Adjust V_{BE} to -.2 volts. Read I_C and record.

6. Compare measured values to values obtained from graph.

7. Choose operating point from load line and adjust circuit to meet these requirements.

8. Complete the following chart by varying forward bias around operating point to simulate signal change.

	- SIGNAL	OPERATING POINT	+ SIGNAL
VCE			
VBE			
IB			
IC			

COMPUTE

9. ΔV_{BE} = __________

10. ΔV_{CE} = __________

11. Voltage gain __________

12. ΔI_B = __________

13. ΔI_C = __________

14. Current gain __________

15. Power gain __________

Questions:

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Course III

Basic Vacuum Tube and
Transistor Theory

Lesson 11
Single Stage Amplifier

Introduction:

In this lesson the student is to design and load out a single stage amplifier.

References:

1. Experiment Guide, RCA Transistor Trainer, Models 301-T and 601-T. Government Services, RCA Service Co., Camden, New Jersey, 1960. pp. 19-23 and 33-43.

2. Department of the Army Technical Manual, TM11-690, Basic Theory and Application of Transistors. U.S. Government Printing Office, Washington, D.C., 1959. pp. 69-81

Materials:

1. RCA 121-1
2. RCA 121-28
3. RCA 121-2
4. Audio signal generator
5. Vacuum tube voltmeter
6. Oscilloscope

Procedure:

1. Using the 6AB4, design a circuit with a gain of 40.

Questions:

1. Is the change in plate current or a change in grid voltage more or less when a load is used in the triode circuit? Why?

2. Explain how you go about drawing a load line for a given set of grid-family curves.

3. When can a quiescent value of plate current be obtained?

4. What problems would an inductance cause with a loadline?

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VOCATIONAL ELECTRONIC TECHNICIAN TRAINING

Course III

Basic Vacuum Tube and
Transistor Theory

Lesson 12
Transistor AC Amplifier

Introduction:

In lesson 10 the behavior of a transistor connected in a common emitter configuration was studied when a small DC signal was applied. We shall now apply a small AC signal to a similar circuit and observe the resulting voltage, current and power gains.

References:

1. Department of the Army Technical Manual, TM11-690, Basic Theory and Application of Transistors. U.S. Government Printing Office, Washington, D.C., 1959. pp. 102-111
2. Experiment Guide, RCA Transistor Trainer, Models 301-T and 601-T. Government Services, RCA Service Co., Camden, New Jersey, 1960. pp. 33-43.

Materials:

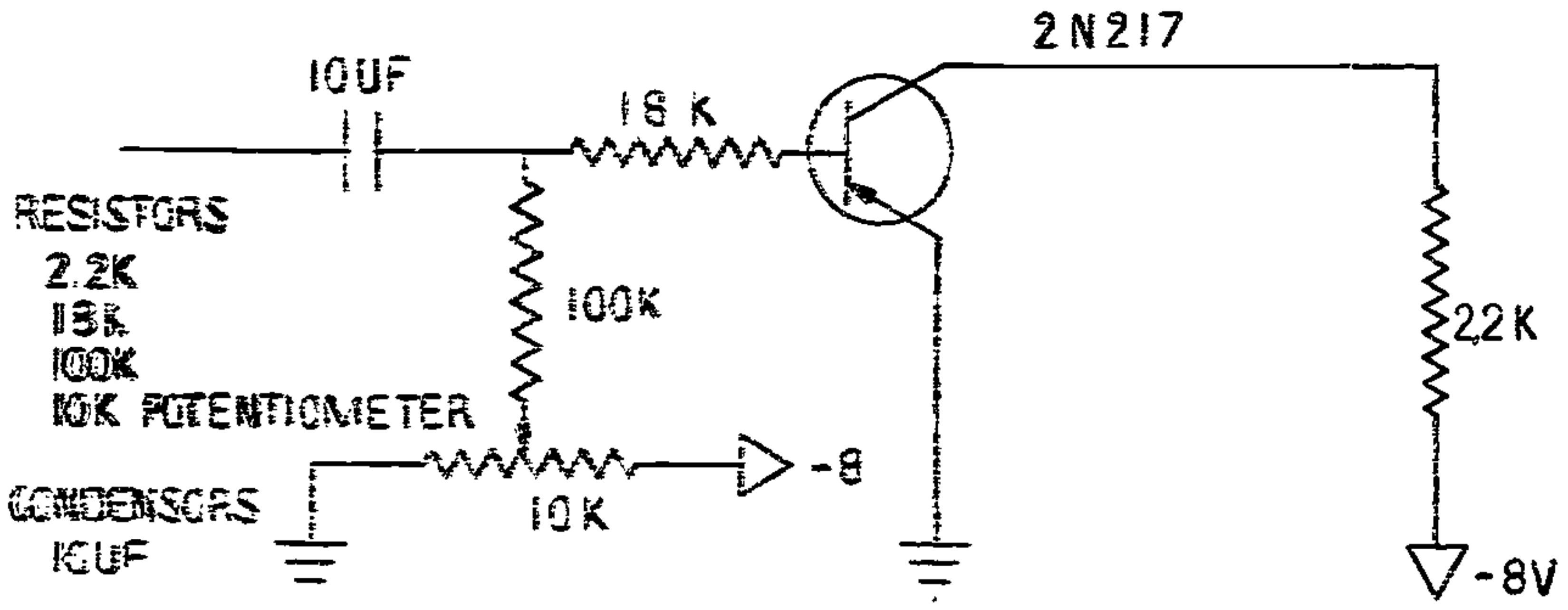
1. Transistor lab equipment
2. Template no. three
3. Scope
4. VTVM -(Vacuum tube voltmeter)
5. Audio generator

Schematic:

1. Included in the lesson.

Procedure:

1. Wire the following circuit.



2. Adjust the forward bias control until an operation point of about 4 volts is reached.

3. Feed a 1 KC signal into the input and adjust the amplitude of the generator until two volts p-p signal appears at the output.

4. Do the following measurements and calculations.

   a. Compute collector current. (2 V p-p/load resistance)

   b. Measure voltage on the base. (Signal voltage)

   c. Measure signal on the base.

   d. Compute the signal across the 18 K resistor.

   e. Compute the base current. (Signal)

   f. Compute current gain.

   g. Compute voltage gain for the system.

   h. Compute the transistor voltage.

   i. Compute input signal power.

   j. Compute output signal power.

   k. Compute power gain.

5. Replace the 2.2 K load resistor with a 33 K or the largest possible resistor under a 33 K that will allow the operating point to be reached.

   a. Adjust for operating point.

b. Apply a 1 KC signal to the base and adjust until the output voltage is approximately 2 V p-p.

c. Compute the collector signal current and record.

d. Measure base signal voltage.

e. Measure output of generator and record.

f. Compute the voltage drop across the 18 K resistor.

g. Compute base signal current.

h. Compute overall voltage gain.

i. Calculate current gain.

j. Calculate power gain.

k. Construct a chart to show the gains of the DC amplifier with the two loads of the AC amplifier.

6. Cut off frequency.

a. Using the 2.2. load adjust for the operating point.

b. Feed a 1 KC signal on the base and adjust the amplitude of the generator for the largest undistorted output. Record the value.

c. Increase the frequency of the generator until the output voltage is .7 of what it was. This is the half-power point.

7. Wire the circuit as shown in figure 5-5 of the transistor manual. (p. 42)

a. Show the direction of all electron flow by drawing the schematic and then placing arrows on it.

b. Adjust the base resistor until the operating point is reached.

c. Record base current.

d. What type of bias are we using?

e. How does this differ from previous methods of bias?

8. Be sure and include your conclusions in your write up.

Questions:

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VOCATIONAL ELECTRONIC TECHNICIAN TRAINING

Course III

Basic Vacuum Tube and
Transistor Theory

Lesson 13
Tetrode and Pentode

Introduction:

In our studies of the vacuum tube we have seen how the plate current is directly related to the plate voltage and how a small change in grid voltage has more effect on plate current than an equal change in plate voltage. The B supply is divided across the vacuum tube and the tube load. Because of the action of the control grid there is a charge that gathers around the cathode which has the name of space charge. This charge increases the resistance of the tube and therefore cuts down on the amplification of the stage. We have also encountered a great deal of feedback in the triode. To help eliminate these two unwanted characteristics of the vacuum tube a second grid was added. A four element tube called the tetrode.

References:

1. R. L. Oldfield, Radio-Television and Basic Electronics. American Technical Society, Chicago, 1957. pp. 143.

2. Department of the Army Technical Manual, TM11-662, Basic Theory and Application of Electron Tubes. U.S. Government Printing Office, Washington, D.C., 1952. pp. 81-94.

Materials:

No materials needed.

Schematic:

1. No schematic needed.

Procedure:

The teacher will set up and run as a class demonstration two plate characteristics for the tetrode. He will use a 6AC7 wired as a tetrode. Draw the curves and answer the following questions.

Questions:

1. How many elements does the tetrode have?

2. How does the u of the tetrode compare with the triode?

3. What is the dynamic plate resistance of the vacuum tube?

4. Compute the dynamic plate resistance of this tube from your curves.

5. What is meant by negative resistance?

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Course III

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Lesson 14
Pentode

Introduction:

In working with the tetrode it was noted that the tube was unstable until the plate voltage had reached a high value. This is believed to be because the electrons are striking the plate at such a high velocity that they dislodge many electrons which are accelerated to the screen grid because of its charge. At low plate voltages the plate may actually emit some interesting changes in the tubes operation.

References:

1. Keith Henney and Glen A. Richardson, Principles of Radio. Sixth Edition. John Wiley & Sons, Inc., New York, 1952. pp. 282-283.

2. R.L. Oldfield, Radio-Television and Basic Electronics. American Technical Society, Chicago, 1957. pp. 144-145.

3. Department of the Army Technical Manual, TM11-662, Basic Theory and Application of Electron Tubes. U.S. Government Printing Office, Washington, D.C., 1952. pp. 86-110.

Materials:

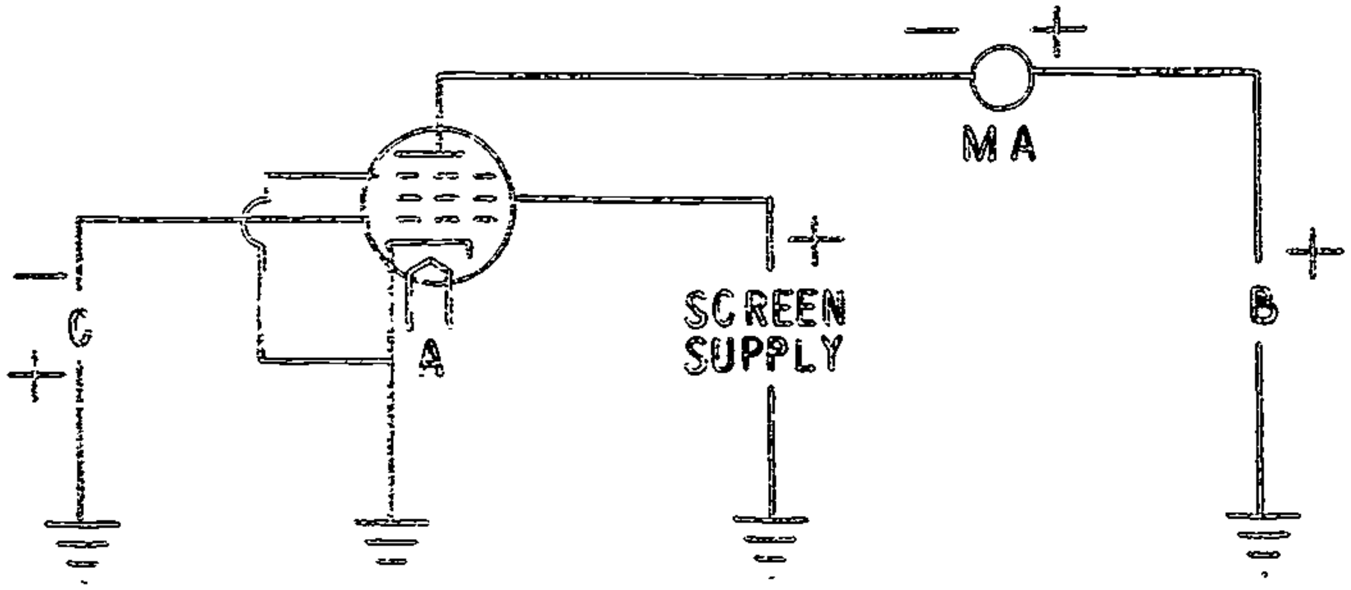
1. Sharp Cut-off pentode, 6AC7
2. VOM -(VoltOhmmeter)
3. VTVM -(Vacuum tube voltmeter)
4. "B" supply
5. Screen supply
6. Tube socket
7. 100 volts available for screen voltage from distribution panel.
8. "C" supply
9. "A" supply

Schematic:

1. Included in the lesson.

Procedure:

1. Wire the following circuit.



2. Wire "A" supply, see if tube gets warm.

3. Wire "C" supply, set at -10 volts.

4. Connect "C" supply and cathode to common ground.

5. Set screen supply at 150 volts. Connect from screen to ground. Leave in off position.

6. Connect "B" supply from plate to ground set at 0 volts.

7. Place a ma meter set on 10 ma to monitor plate current.

8. Wire suppressor grid to cathode.

9. Decrease grid bias to -3 volt.

10. Turn screen on.

11. Increase E_p in 25 volt steps and record E_p and I_p each time.

12. DO NOT pin meters

13. Repeat with E_c of -2, and the -1 volts.

Questions:

1. How many elements does the pentode have?

2. What advantage over the tetrode does the pentode have?
3. What is the grid-plate transconductance of a tube?
4. What is the constant feature of gm?
5. What is the gm of the tube you use? Support this with your data.

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Course III

Basic Vacuum Tube and
Transistor Theory

Lesson 15

Transistor Stability

Introduction:

It is characteristic of transistors to be sensitive to changes in ambient temperature as well as changes in frequency and voltage. This sensitivity to temperature change often produces a drift in the operation of the transistor. This may produce an undesirable distortion of the signal. As a result, the temperature sensitivity of a transistor is generally considered undesirable and compensation circuits have been designed to minimize the effects of temperature change on transistors. This lesson deals with circuits and attempts to explain their operation, function, and application.

References:

1. Department of the Army Technical Manual, TM11-690, Basic Theory and Application of Transistors. U.S. Government Printing Office, Washington, D.C., 1959. Chapter 5, and paragraph 172 - page 167.

2. Experiment Guide, RCA Transistor Trainer, Models 301-T and 601-T. Government Services, RCA Service Co., Camden, New Jersey. Experiment No. 8 - page 59.

Materials:

1. Template No. six

2. VTVM -(Vacuum tube voltmeter)

3. VOM -(VoltOhmmeter)

4. Transistor Trainer

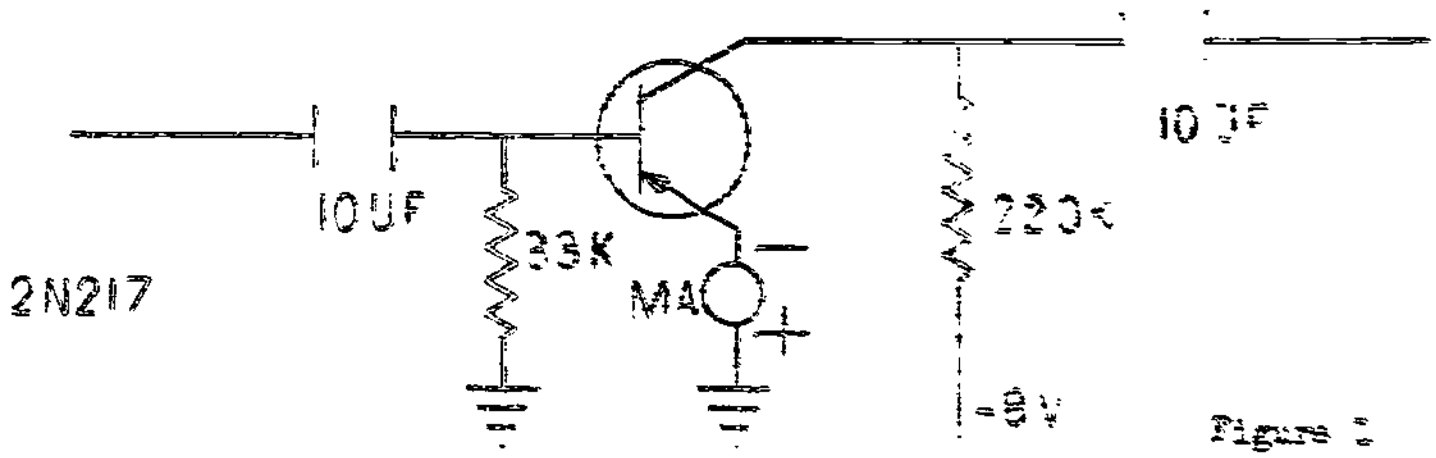

Figure 1

Schematic:

1. Included in the lesson.

Procedure:

1. Using the transistor trainer and template number 6, wire the circuit shown in figure 1.

2. Adjust the base resistor until the self bias results in an operation point with V_{ce} in the range of 3.5 to 4.5 volts.

3. Measure V_{ce} and record.

4. Record I_c.

5. Feed a 1 KC signal through the isolating 10 uf input condenser to the base and adjust the generator to result in an output voltage of 2 volts P-P. We want the largest output without distortion that we can get.

6. Place the VTVM on the base and monitor the voltage present.

7. Hold your hand on the transistor and record the effect on V_{ce} and I_c.

8. Note and record the effect upon waveform.

9. The instructor will discuss and you should read in your references about the increasing of the emitter resistance.

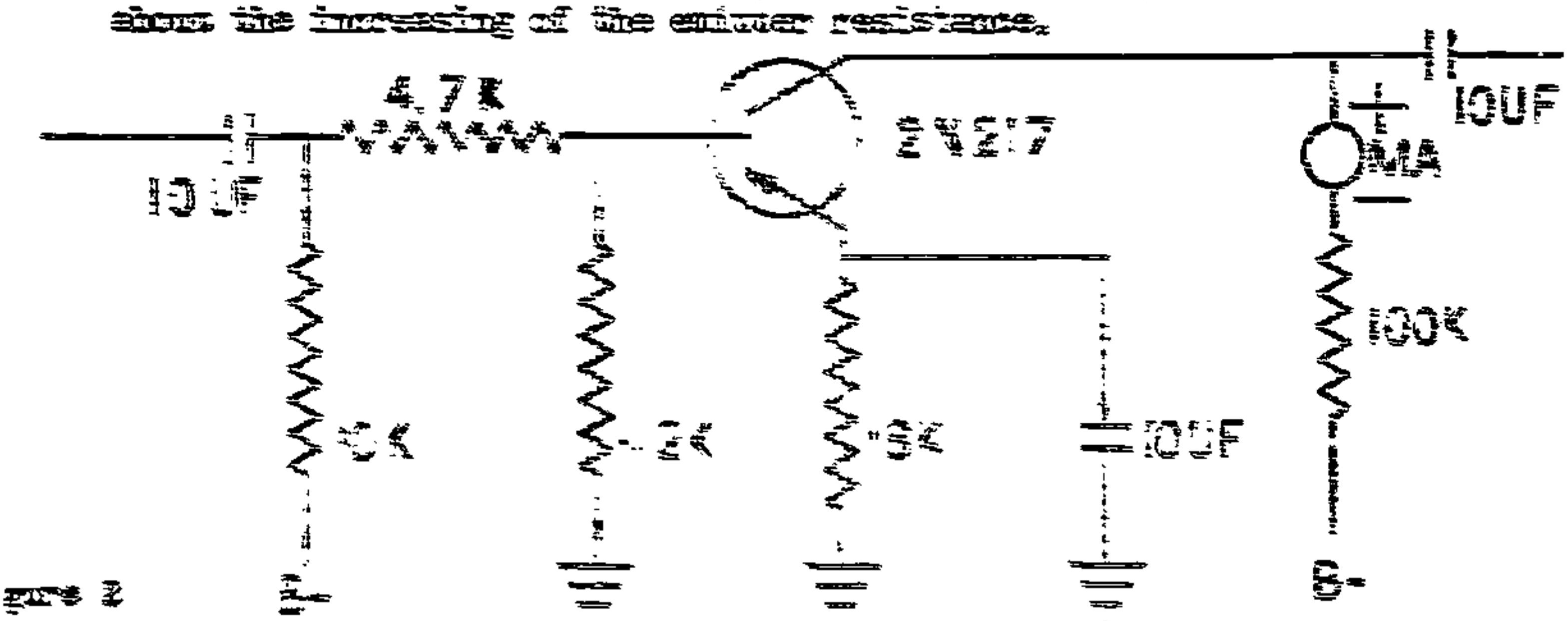

Figure 2

10. Wire the circuit shown in figure 2, reducing the base resistance.

11. Turn on and record the following:

I_e ______________ V_b ______________

I_c ______________ V_e ______________

12. Again apply a 1 KC signal and adjust generator for max undistorted output.

13. Again hold the transistor in your hand and record I_c and V_b.

14. Record the waveform.

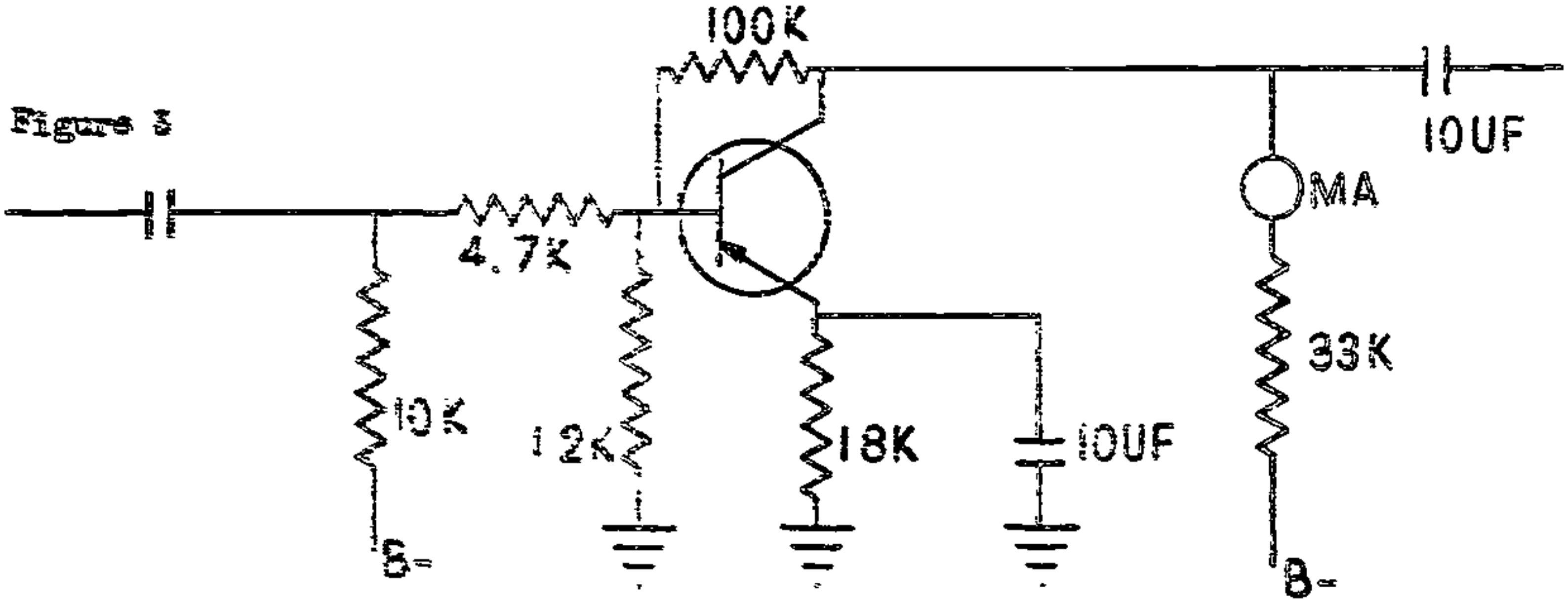

Figure 3

15. Wire the circuit shown in figure 3. Collector-base feedback to improve stabilization.

16. Repeat the same procedures outlined in steps 10-14.

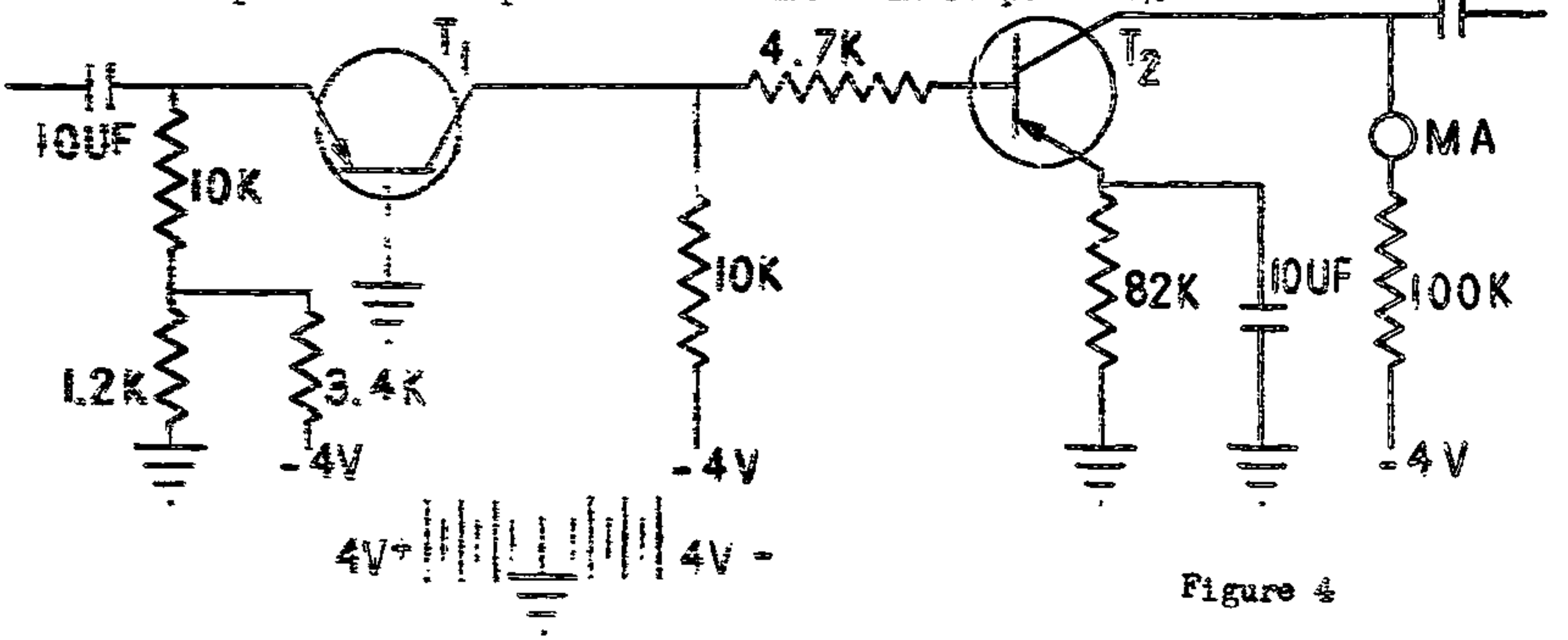

Figure 4

17. Wire the circuit shown in figure 4. Two transistor stabilization.

18. Measure the following and record.

T_1		T_2			
V_e	________	V_e	________	V_b	________
V_c	________	V_c	________	I_c	________

19. Apply heat and note change in T_2 of I_c and V_b.

Questions:

1. List the basic methods of transistor stabilization as outlined in this lesson.

2. Explain the basic theory behind the operation of a transistor.

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Course III

Basic Vacuum Tube and
Transistor Theory

Lesson 16
Power Supply

Introduction:

We have seen half and full-wave rectification using both vacuum tube diodes and semi-conductor. In this lesson we will attempt to convert the pulsating DC current to a steady DC current. We will also study the effect of various loads on output voltage and ripple.

References:

1. Department of the Army Technical Manual, TM11-662, Basic Theory and Application of Electron Tubes. U.S. Government Printing Office, Washington, D.C., 1952. pp. 42-51 and 144-158 (section 1).

2. Student Laboratory Manual, RCA Electronic Trainer, Model 121, Government Service Department. RCA Service Co., Camden, New Jersey. pp. 7-18.

Materials:

1. Chassis 121-1

2. VTVM -(Vacuum tube voltmeter)

3. Oscilloscope

Schematic:

1. Included in the lesson.

Procedure:

1. Obtain chassis 1 from storage rack and remove C_1, C_2, and SS_1.

2. Place SS_2 in position.

3. Turn the equipment on and measure DC voltage out and ripple voltage.

4. Obtain four or five various condensers up to a maximum size of the 8 uf furnished.

5. Starting with the smallest condenser place them in the C_1 position one at a time noting effect on ripple and DC voltage out.

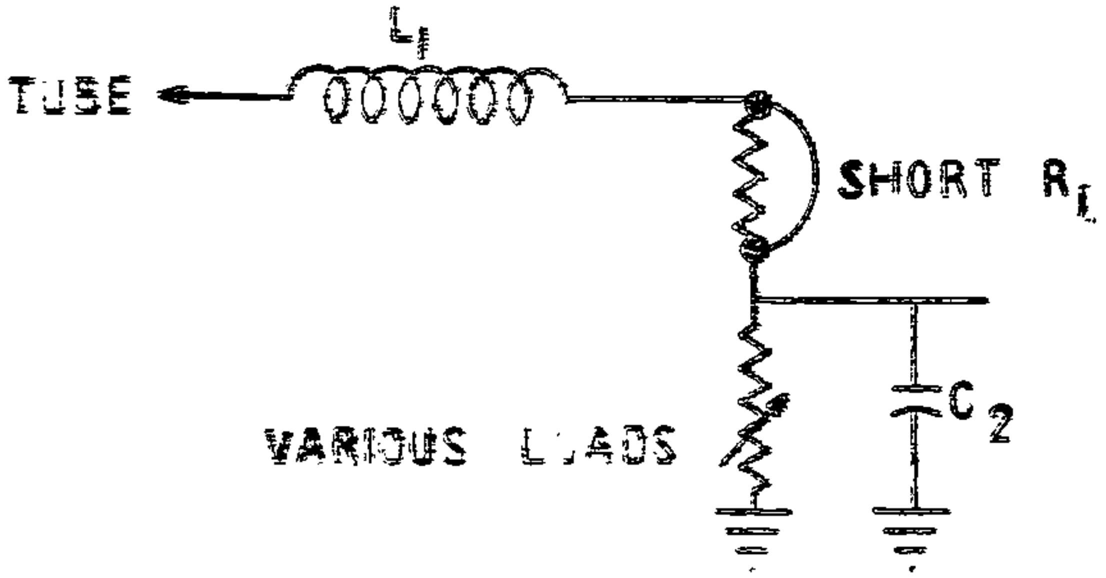
6. Prepare a graph showing these relationships in this simple condenser input filter.

7. Leaving the condenser in the circuit which did the best job, obtain four or five load resistors varying in size between 1.5K and 25K.

8. Change the load resistors one at a time from the largest to the smallest noting the effect on DC voltage and ripple.

9. Place SS_1 in the circuit and repeat step 8.

10. Wire the following circuit and repeat lab procedure as in step 8.



11. Place both C_1 and C_2 in the circuit. Replace R_1 with a shorting strip.

12. Measure DC voltage and ripple voltage across C_1 and C_2.

13. Again place various loads on the power supply and record DC voltage out and ripple at C_1 and C_2.

14. Prepare charts showing the various relationships between filter and voltage out, ripple voltage.

Questions:

1. What comparison is there between input frequency and ripple frequency in a half-wave rectifier, full-wave rectifier?

2. Describe the characteristics of a capacitor input filter.

3. Describe the characteristics of a choke input filter.

4. Why should the rectifier tube have a separate filament winding?

5. Complete the abnormal circuit chart. (If using RCA equipment)

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Course III

Basic Vacuum Tube and
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Lesson 17
Bias Supply

Introduction:

In this lesson we will study a half-wave semi-conductor power supply. This one is designed as a bias supply, that is supply small negative voltages at small currents.

Reference:

1. Student Laboratory Manual, RCA Electronic Trainer, Model 121, Government Service Department. RCA Service Co., Camden, New Jersey. pp. 27-34.

Materials:

1. Chassis 121-1 and 121-67
2. VTVM -(Vacuum tube voltmeter)
3. Oscilloscope

Schematic:

1. Use schematic #S-III-4 from lesson 4 (appendix). See instructor.

Procedure:

1. Place the equipment in the rack.
2. Remove C_1, C_2, and C_3.
3. Place a 1500 ohm resistor in the C_1 position.
4. Observe the waveforms across the transformer secondary, the 150 resistor, and the rectifier. Explain.
5. Replace C_1, C_2, and C_3 and again observe the waveforms.
6. Turn R_4 and R_5 maximum clock-wise.
7. Measure the positive voltage present and the negative voltage present.

8. Measure the voltage from the negative to the positive jack. Compare with the sum of the voltages in step 7.

9. Turn the equipment off and measure both the forward and reverse resistors of diode.

Questions:

1. What would happen if the diode was replaced and wired in backwards?

2. Why is the positive side of C_3 grounded?

3. What would happen to the -1.5 volts if R_2 opened, R_3 opened?

4. Complete both the normal and abnormal charts. (If using RCA equipment)

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Course III

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Lesson 18
Voltage Tripler

Introduction:

The voltage tripler is designed to illustrate the basic design and theory of voltage multiplier found in many pieces of electronics equipment.

References:

1. Previous Lessons
2. Instructors Lecture
3. Student Laboratory Manual, RCA Electronic Trainer, Model 121, Government Service Department. RCA Service Co., Camden, New Jersey. pp. 19-26.

Materials:

1. Chassis No. 1
2. Chassis No. 68
3. VTVM - (Vacuum tube voltmeter)
4. Oscilloscope

Schematic:

1. Use schematic #S-III-18 (appendix). See instructor.

Procedure:

1. Place the chassis No. 1 and 68 in the rack and turn on.
2. Measure the AC secondary voltage on the transformer.
3. Measure the DC voltages across C_1, C_2, C_3 and C_4.
4. Place a 25K-20 watt resistor across the output terminals and repeat the DC measurements.
5. Measure the AC ripple with and without load at the output jacks.

Questions:

1. Compare the various voltages across the condensers with the transformer secondary voltage.

2. Describe the regulation characteristics of this type power supply.

3. What would happen if C_1 is shorted?

4. What is the purpose of R_1?

5. Complete both the normal and abnormal circuit charts. (If using RCA equipment)

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Course III

Basic Vacuum Tube and
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Lesson 19
Voltage Regulator

Introduction:

As you remember from resistive voltage dividers, output voltage at the taps will vary directly with the load conditions. This lesson is to introduce a typical voltage regulator.

References:

1. Student Laboratory Manual, RCA Electronic Trainer, Model 121, Government Service Department. RCA Service Co., Camden, New Jersey. pp. 35-42.

2. Department of the Army Technical Manual, TM11-662, Basic Theory and Application of Electron Tubes. U.S. Government Printing Office, Washington, D.C., 1952. pp. 193-197.

Materials:

1. Chassis No. 1

2. Chassis No. 2

3. VTVM - Vacuum tube voltmeter

Schematic:

1. Use schematic #S-III-19 (appendix). See instructor.

Procedure:

1. Place chassis 2 in the rack beside chassis 1.

2. Place S_2 on chassis 1 in the off position.

3. Place a jumper wire from the B+ connection on chassis 1 to the left hand B+ connection on chassis 2.

4. Adjust R_6 to result in 250 volts at the B+ regulated jack.

5. Measure the following DC voltages:

    a. Regulated B+ output voltage.

b. Drop across $V_1 - V_2$ and R_5.

c. Sum of Reg B+ and $V_1 - V_2$ and R_5.

d. Unregulated B+ output voltage.

e. Bias for $V_1 - E_2$ voltage across R_4.

f. Bias for V_3 (V_4 to R_6).

6. Place two 25K-20 watt resistors in parallel on the output of the voltage resistor.

7. Measure the following DC voltages:

a. Regulated B+ output voltage

b. Drop across $V_1 - V_2$ and R_5.

c. Sum of regulated B+ and $V_1 - V_2$ and R_5.

d. Unregulated B+ output voltage.

e. Bias for $V_1 - V_2$ (voltage across R_4).

f. Bias for V_3 (V_4 to R_6).

8. Complete the normal and abnormal charts. (If using RCA equipment)

Questions:

1. Explain each of the loaded and unloaded relationships in steps 5 and 7.
2. Explain the operation of V_4 and R_1.
3. What two component parts have voltages that combine to form the grid-bias on V_3?
4. Explain the biasing on V_1 and V_2.

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Course III

Basic Vacuum Tube and
Transistor Theory

Lesson 20
Cathode Biased Amplifier

Introduction:

This is the first lesson that we will study which eliminates "c" supply. We will also study the characteristics of a typical vacuum tube audio amplifier.

References:

1. Department of the Army Technical Manual, TM11-662, Basic Theory and Application of Electron Tubes. U.S. Government Printing Office, Washington, D.C., 1952. pp. 111-126.
2. Student Laboratory Manual, RCA Electronic Trainer, Model 121, Government Service Department. RCA Service Co., Camden, New Jersey. pp. 44-50.

Materials:

1. 121-1 Power supply
2. 121-2 Regulator
3. 121-28 Audio amplifier
4. VTVM -(Vacuum tube voltmeter)
5. Audio generator
6. Oscilloscope
7. Various resistors as outlined by instructor.

Schematic:

1. Use schematic #S-III-20 (appendix). See instructor.

Procedure:

1. Place the equipment in the rack and adjust the regulator for a B+ of 250 volts.
2. Place the audio generator on the input of audio amplifier and ground. Adjust the output of the generator for 2 volts p-p (with R_1 maximum clock-wise.)

3. Measure output wave form and compute amplifier gain.

4. Place the resistors as plate loads one at a time. Measure plate voltage and compute gain for each one. (Resistors 10K, 33K, 47K, 100K, 220K, 330K)

5. Replace the load resistor with 220K.

6. Check the gain of the amplifier in several steps from a 100 to 15,000 cycles.

7. Repeat step six but remove the cathode by-pass condenser.

8. Prepare a graph showing the following:

    (a) Gain versus plate voltage.

    (b) Gain versus load resistors.

    (c) Gain versus frequency with cathode by-pass.

    (d) Gain versus frequency without cathode by-pass.

Questions:

1. How is gain affected by the load resistors?

2. How does the load resistors affect the plate load?

3. Why should the cathode resistor be by-passed?

4. What effects should we notice in frequency response versus gain when the by-pass condenser is removed?

5. What class of operation is this amplifier?

6. Complete the normal and abnormal charts. (If using RCA equipment)

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Course III

Basic Vacuum Tube and
Transistor Theory

Lesson 21
Transistor Two-Stage Amplifier

Introduction:

The use of transistors in amplifiers gave few absolutely new circuits to the field of electronics; however, transistors did permit the miniaturization of circuits so vital to the field where minimum space, weight and power loss was becoming a great problem. The guided missile and related industries make wide use of the transistor amplifier in their circuits. In recent years the application of transistor amplifiers have invaded almost every field of electronics from military to commercial and have succeeded in carving a niche in the electronic industry which once was monopolized by the famous vacuum tube. In this lesson we shall attempt to explain how transistors may be used in amplifier circuits.

References:

1. Department of the Army Technical Manual, TM11-690, Basic Theory and Application of Transistors. U.S. Government Printing Office, Washington, D.C., 1959. pp. 15-39 and 127-143.

2. Experiment Guide, RCA Transistor Trainer, Models 301-T and 601-T. Government Services, RCA Service Co., Camden, New Jersey, 1960. Lesson No. 9 - pp. 67-73.

3. Morris Slurzberg and William Osterheld, Essentials of Radio-Electronics. Second Edition. McGraw-Hill Book Co., Inc., New York, 1961. pp. 567-571.

Materials:

1. Transistor lab kit

2. VTVM -(Vacuum tube voltmeter)

3. VOM -(VoltOhmmeter)

4. Scope

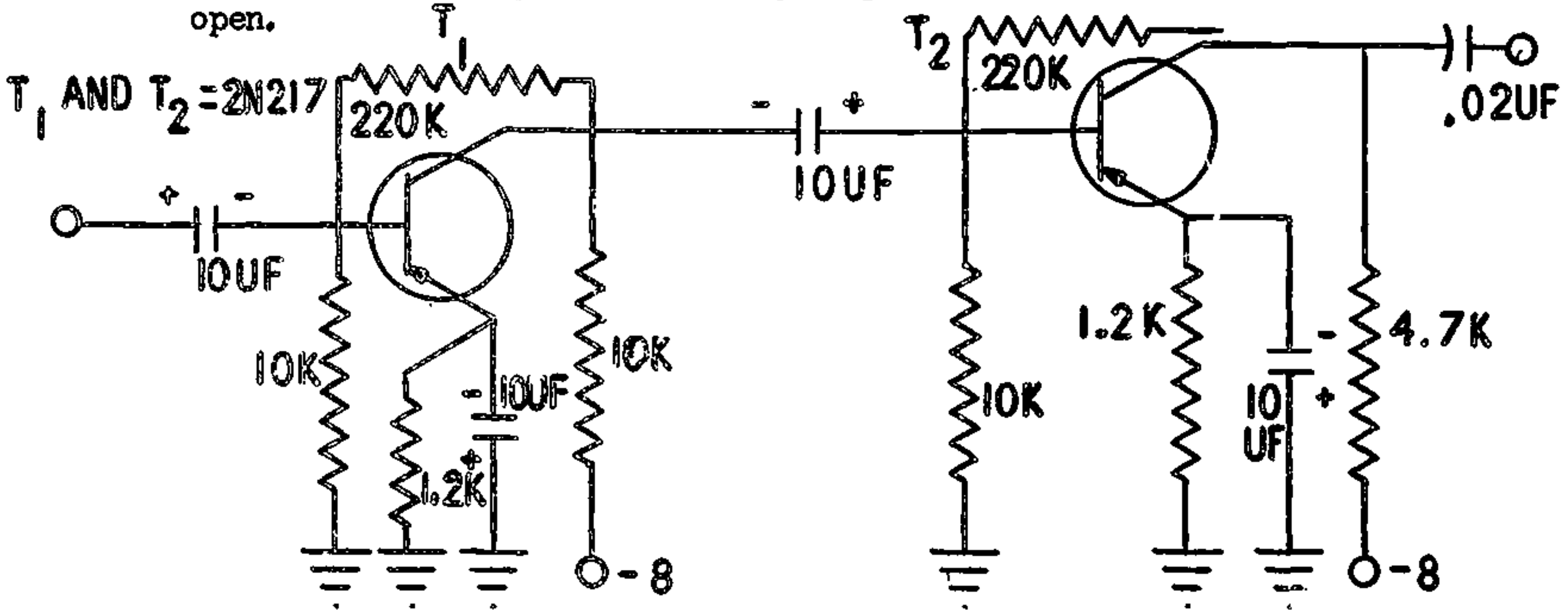
Schematic:

1. Included in the lesson.

Procedure:

DC MEASUREMENTS

1. Wire the following circuit using template number seven. Leave the switch open.



2. Turn circuit on and adjust transistor for approximately 4 volts from collector to emitter.

3. Take the following DC readings using your VTVM.

a. Battery voltage V_{bb} ____________

b. Collector-emitter voltage of transistor 1 V_{c1} ____________

c. Base-emitter voltage of transistor 1 V_{be1} ____________

d. Emitter voltage of transistor 1 V_{e1} ____________

e. Voltage across the load of transistor 1 V_{L1} ____________

f. Voltage collector-emitter of transistor 2 V_{ce2} ____________

g. Base-emitter voltage of transistor 2 V_{be2} ____________

h. Emitter voltage of transistor 2 V_{e2} ____________

i. Voltage across load of transistor 2 V_{L2} ____________

j. Collector to base voltage of transistor 1 V_{cb1} ____________

k. Collector to base voltage of transistor 2 V_{cb2} ________

4. Compute the following:

a. I_{e1} ________

b. I_{e2} ________

c. Battery I of transistor 1 E_{L1}/R_{L1} ________

d. Battery I of transistor 2 E_{L2}/R_{L2} ________

e. Power dissipated transistor 1 (Step C) V_b ________

f. Power dissipated transistor 2 (Step D) V_{bb} ________

g. Total power P_1 plus P_2 ________

h. Collector to base voltage of transistor 1 V_{ce1} minus V_{be1} ________

i. Collector to base voltage of transistor 2 V_{ce2} minus V_{be2} ________

AC MEASUREMENTS

1. Using a 1 KC audio signal at the input of T-1, adjust the generator so that the output of T-2 is the largest possible undistorted signal.

2. Measure E_{in} and E_{out} using the oscilloscope and compute overall voltage gain.

3. Measure the voltage out of transistor number one and compute its gain.

4. Measure the voltage in of transistor number two and compute its gain.

5. What relationship exists between the individual gains and total gain?

6. Advance the generator setting until the output of T-2 distorts. Measure and record waveshape of E_{in}, E_{out} of transistor 1, E_{in} of transistor 2, and E_{out} of system.

7. Return the generator to the largest signal possible producing undistorted output. Measuring the input voltage each time and keeping it constant compute total gain at the following frequencies.

30, 50, 100, 250, 1 KC, 5 KC, 10 KC, 20 KC, 30 KC

8. Draw a graph of the gains in step 7. (See figure 9-4, RCA Lab Manual) Draw a dotted line showing the half power point in relation to 1 KC.

9. If time permits the instructor will discuss with you the effect of changing parts on the operation of this amplifier.

10. Check your data and then return all equipment to its original condition and storage position.

Questions:

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ASSIGNMENT SHEET

VOCATIONAL ELECTRONIC TECHNICIAN TRAINING

Course III

Basic Vacuum Tube and
Transistor Theory

Lesson 22
Phase Splitter

Introduction:

There are common types of phase splitters, the transformer and the vacuum tube. This experiment is about the vacuum tube. This amplifier gives us two outputs of equal amplitude and 180 degrees apart.

Reference:

1. Student Laboratory Manual, RCA Electronic Trainer, Model 121, Government Service Department. RCA Service Co., Camden, New Jersey. pp. 52-58.

Materials:

1. Chassis 121-1
2. Chassis 121-2
3. Chassis 121-29
4. VTVM -(Vacuum tube voltmeter)
5. Scope
6. Audio generator

Schematic:

1. Use schematic #S-III-22 (appendix). See instructor.

Procedure:

1. Place the equipment in the rack and adjust the power supply for 250 volts.
2. Set the generator on 1,000 cycles and place lead on input and ground of phase splitter.
3. Set generator on 2 volts P-P output.
4. Measure the AC output at both output jacks.
5. Ask the instructor to help you and determine the phase relationship of the output wave to the input wave.

6. Complete the normal and abnormal charts. (If using RCA equipment)

Questions:

1. If the amplifier had unequal outputs which parts would you suspect?
2. Would this amplifier have a higher heater to cathode voltage than normal?
3. Would an output voltage appear across R_4 with plate voltage missing?

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VOCATIONAL ELECTRONIC TECHNICIAN TRAINING

Course III

Basic Vacuum Tube and
Transistor Theory

Lesson 23
Transistor Audio Amplifier

Introduction:

The purpose of this lesson is to acquaint the student with amplifiers that fit in the general classification of audio amplifiers. Audio amplifiers are used extensively in radar, radio, television, public address systems, sound recorders and many other places. An audio amplifier is broadly defined as any amplifier which operates within the frequency range of approximately 20-20,000 cycles per second.

References:

1. Department of the Army Technical Manual, TM11-690, Basic Theory and Application of Transistors. U.S. Government Printing Office, Washington, D.C., 1959. pp. 127-143.

2. Experiment Guide, RCA Transistor Trainer, Models 301-T and 601-T. Government Services, RCA Service Co., Camden, New Jersey, 1960. pp. 75-79.

3. Morris Slurzberg and William Osterheld, Essentials of Radio-Electronics. Second Edition. McGraw-Hill Book Co., New York, 1961. pp. 571-592.

Materials:

1. Transistor trainer
2. Template number eight (If using RCA equipment)
3. Audio oscillator
4. Scope
5. VTVM -(Vacuum tube voltmeter)

Schematic:

1. Included in the lesson.

Procedure:

1. Wire the circuit as shown in figure 1. This circuit differs from the original one in the lab manual in the following respects:

   a. Volume control

   b. Tapping off volume control

   c. Biasing of power amplifier

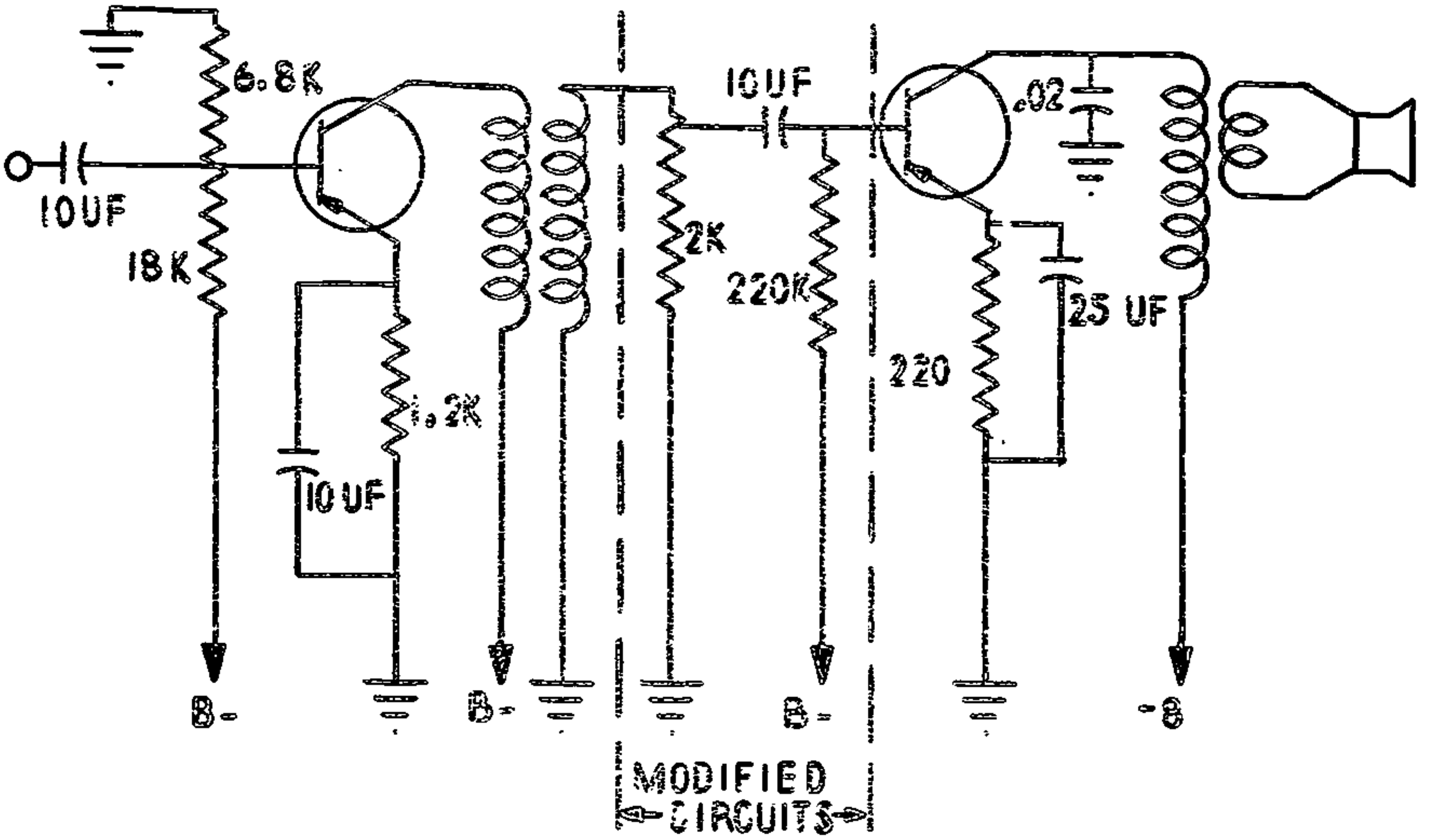
   d. Resistor five is changed to a 220 K ohm resistor.

   e. Volume control and coupling condenser will have to lay on top of template and jumper wires used.

2. Have the instructor check your circuit before applying power.

3. Apply a 1 KC signal at the input. Have the generator set on a low amplitude range.

4. Place the scope across the speaker leads and adjust the generator and volume control for the maximum signal with minimum distortion.



5. If you have trouble adjusting generator and volume control move scope and signal trace trouble step by step.

6. Vary generator amplitude setting and note effect on output.

7. Vary volume control setting and note effect on output.

8. Return the settings to give maximum undistorted output.

9. Place a 10 K potentiometer with jumpers across the generator input leads. Adjust the potentiometer used as a rheostat until the output signal is half what it was. (Do not change the generator setting)

10. Remove the potentiometer and measure its value. This is the approximate input impedance of the amplifier.

11. The output impedance is determined by the speaker and is approximately 12 ohm in this case.

12. Measure voltage in and compute power in.

13. Measure voltage out and compute power in.

14. Compute power gain of this amplifier.

15. Return set to maximum undistorted signal if any changes have occurred.

16. Set the scope to result in only a vertical line for voltage measurements.

17. Reduce the setting of the generator in 200 cps steps, recording voltage out for each step until the voltage out is .707 of maximum. Maintain the input voltage constant.

18. Increase the setting of the generator in 1 KC steps from 1,000 cycles and record the voltage out for each step until the voltage out is .707 of what it was for 1,000 cycles. Maintain the input voltage constant at all times.

19. Draw a graph of the voltage out at the different points.

20. If time permits, with the instructor's supervision, simulate shorts, opens, and the changing of sizes of the various parts noting effect on output.

Questions:

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VOCATIONAL ELECTRONIC TECHNICIAN TRAINING

Course III

Basic Vacuum Tube and
Transistor Theory

Lesson 24
Vacuum Tube Power Amplifier

Introduction:

In order to drive a dynamic speaker, we must have more power. The power amplifier together with the matching transformer will give us the necessary power for the speaker.

References:

1. Department of the Army Technical Manual, TM11-662, Basic Theory and Application of Electron Tubes. U.S. Government Printing Office, Washington, D.C., 1952. pp. 111-126.

2. Student Laboratory Manual, RCA Electronic Trainer, Model 121, Government Service Department. RCA Service Co., Camden, New Jersey. pp. 59-67.

Materials:

1. 121-1 Power supply
2. 121-2 Regulator
3. 121-29 Phase splitter
4. 121-26 Audio power amplifier
5. Oscilloscope
6. VTVM -(Vacuum tube voltmeter)
7. Audio signal generator

Schematic:

1. Use schematic #S-III-24 (appendix). See instructor.

Procedure:

1. Plug in power supply and regulator and adjust for 250 volts B plus.

2. Skip a space or two and plug in the phase splitter and the power amplifier.

3. Check B plus for 250 volts.

4. Connect the signal generator to the input of the phase splitter and set on 1 kc.

5. Connect the 10 ohm resistor on the test stand across the speaker transformer.

6. Adjust the generator level to obtain 2 volts p-p across the speaker leads.

7. Adjust the load resistor to obtain the best match to the tube. Be careful not to plug in to the B plus line on the output plates.

8. Check the amplifier for proper balance at the correct test points.

9. Determine the phase relationships of the signal at all test points compared with the input at the phase splitter. Draw a block diagram indicating this.

10. Measure the voltage and determine its frequency across R_3. Explain.

11. Remove C_1 and again measure the voltage and determine its frequency across R_3. Explain.

12. Remove C_1 and V_1 in the power amplifier and again measure the voltage and determine its frequency across R_1.

13. Return C_1 and V_1, this places the power amplifier in its normal operating condition.

14. Temporary short a turn in the output transformer and note effect in output.

15. Complete normal and abnormal charts. (If using RCA equipment)

Questions:

1. What order harmonics are dropped in a push pull amplifier?

2. List the formula which relates turns ratio of a transformer to impedance.

3. Why is C_1 included in this amplifier?

4. Why does plate voltage on the output tubes approach B plus? The other amplifiers only had B plus when the tube was cut off.

APPENDIX

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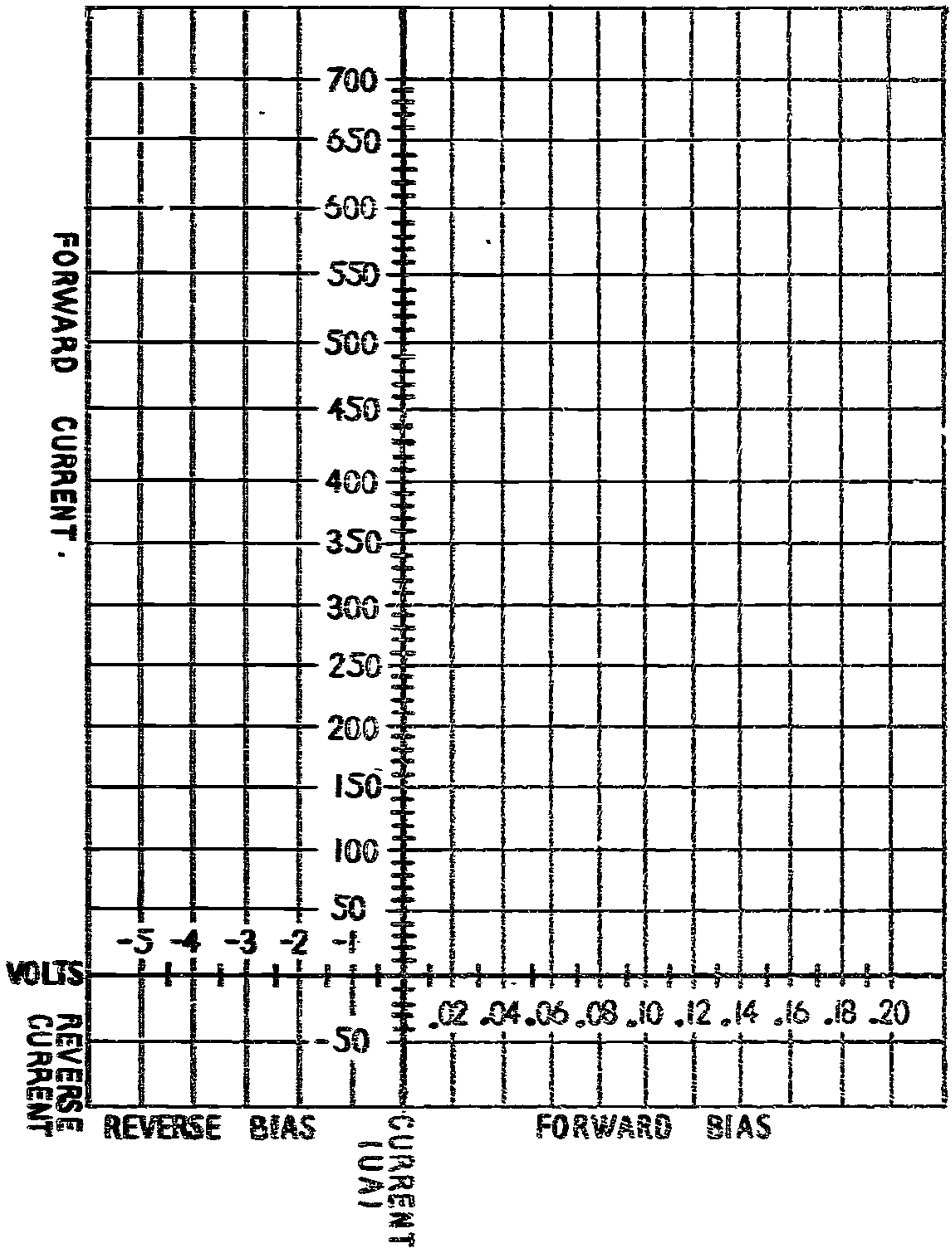
APPENDIX

G-III-2

CURRENT-VOLTAGE CHARACTERISTIC CURVE FOR A PN JUNCTION



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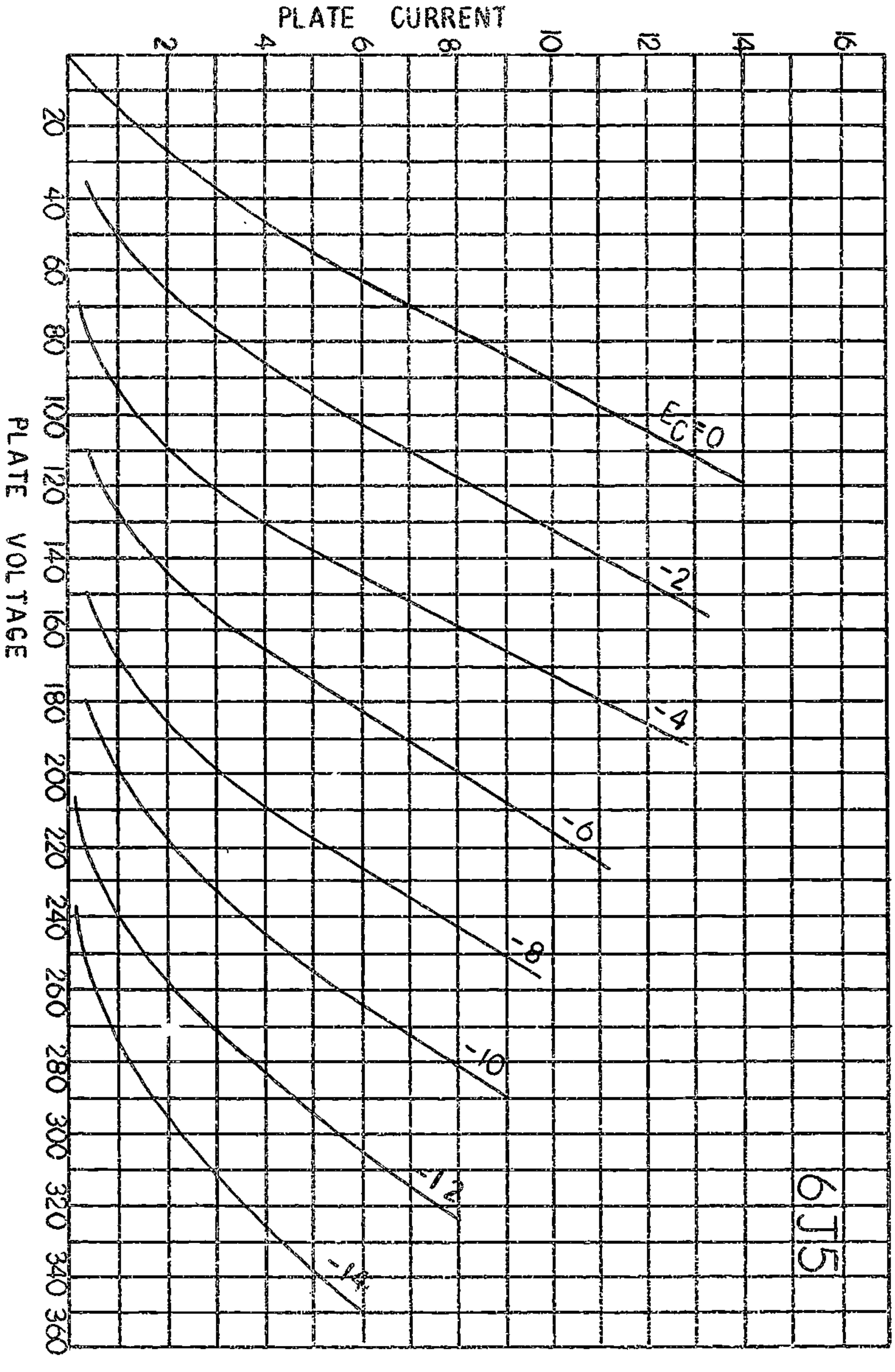

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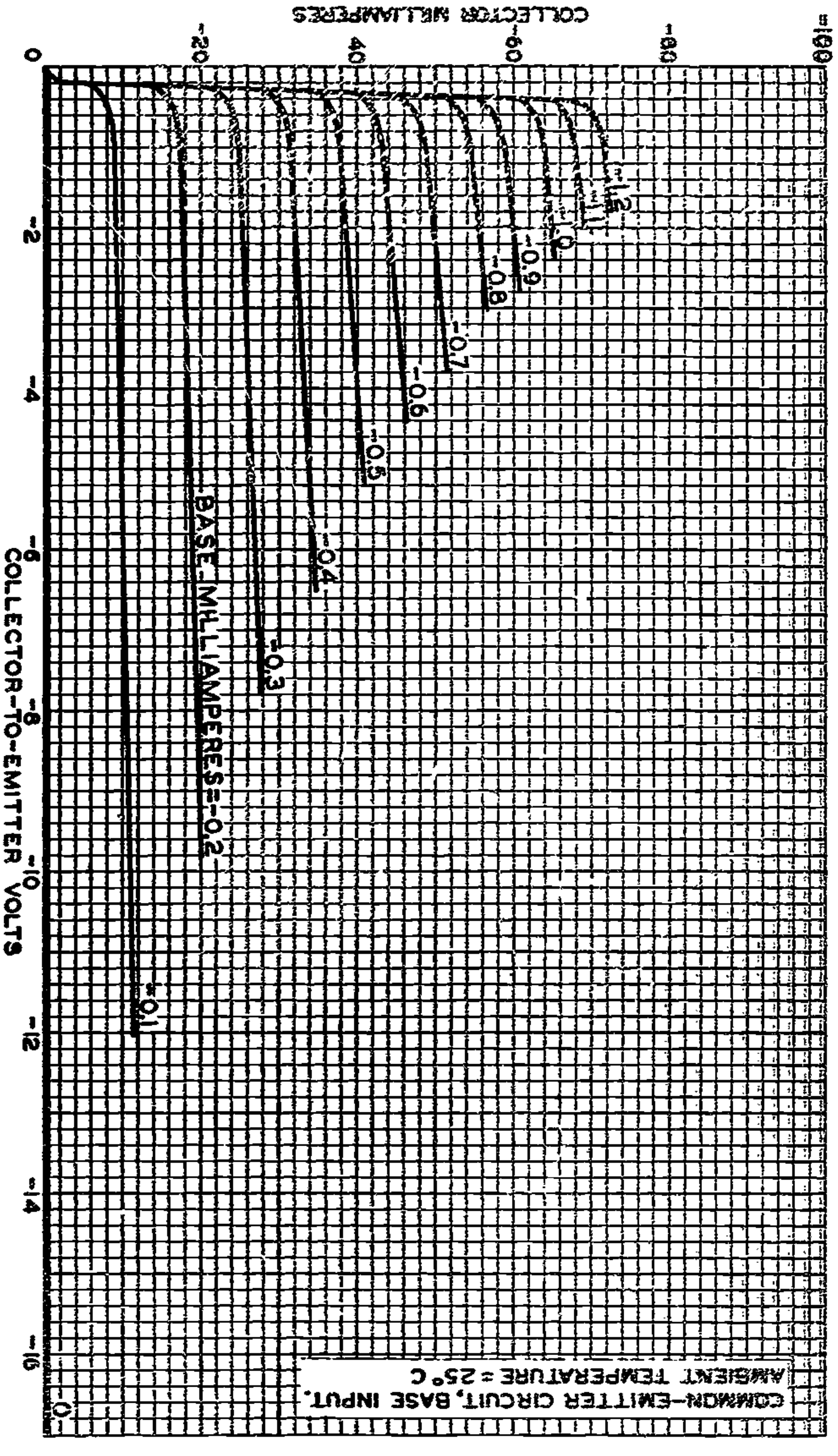
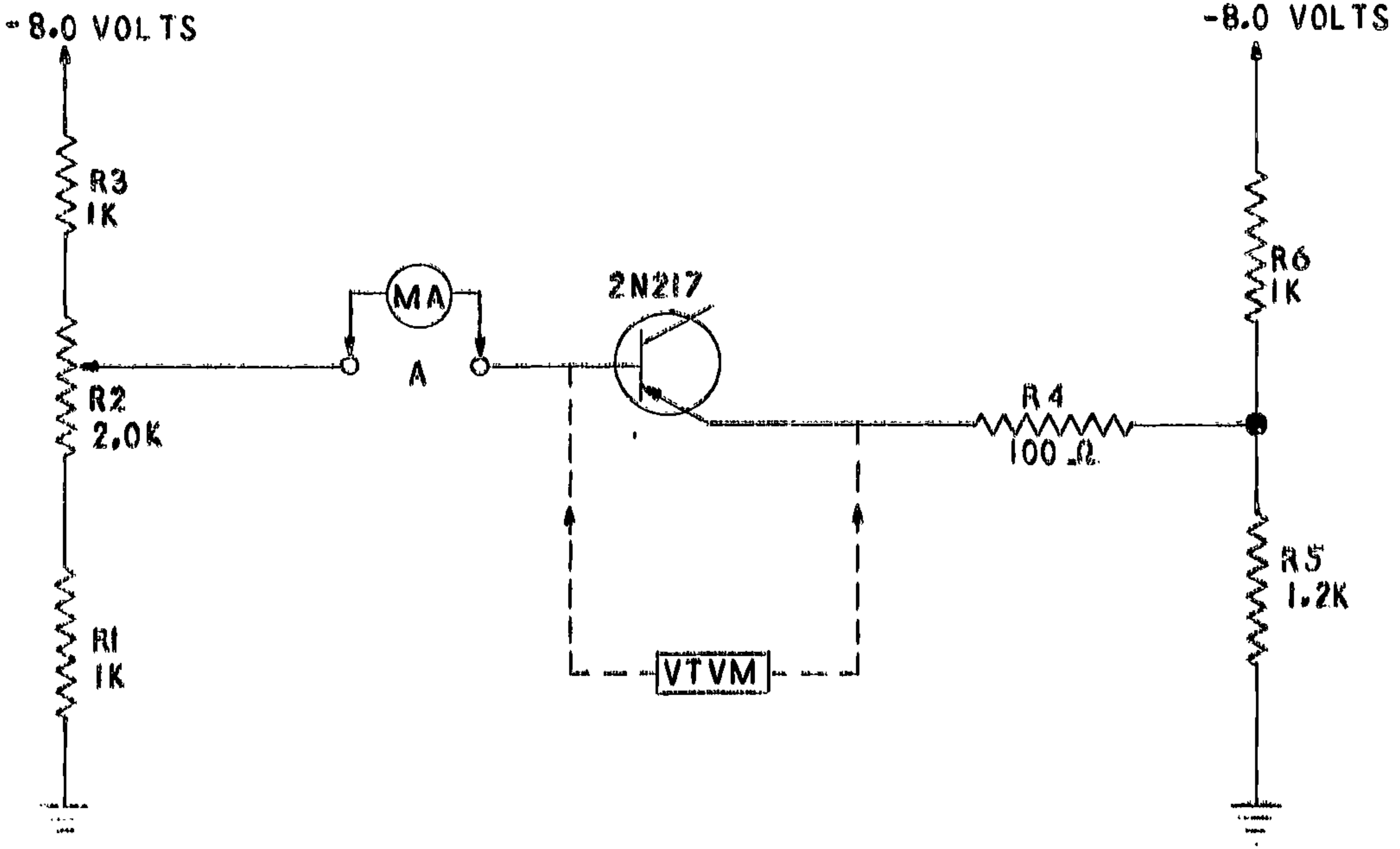
2N109

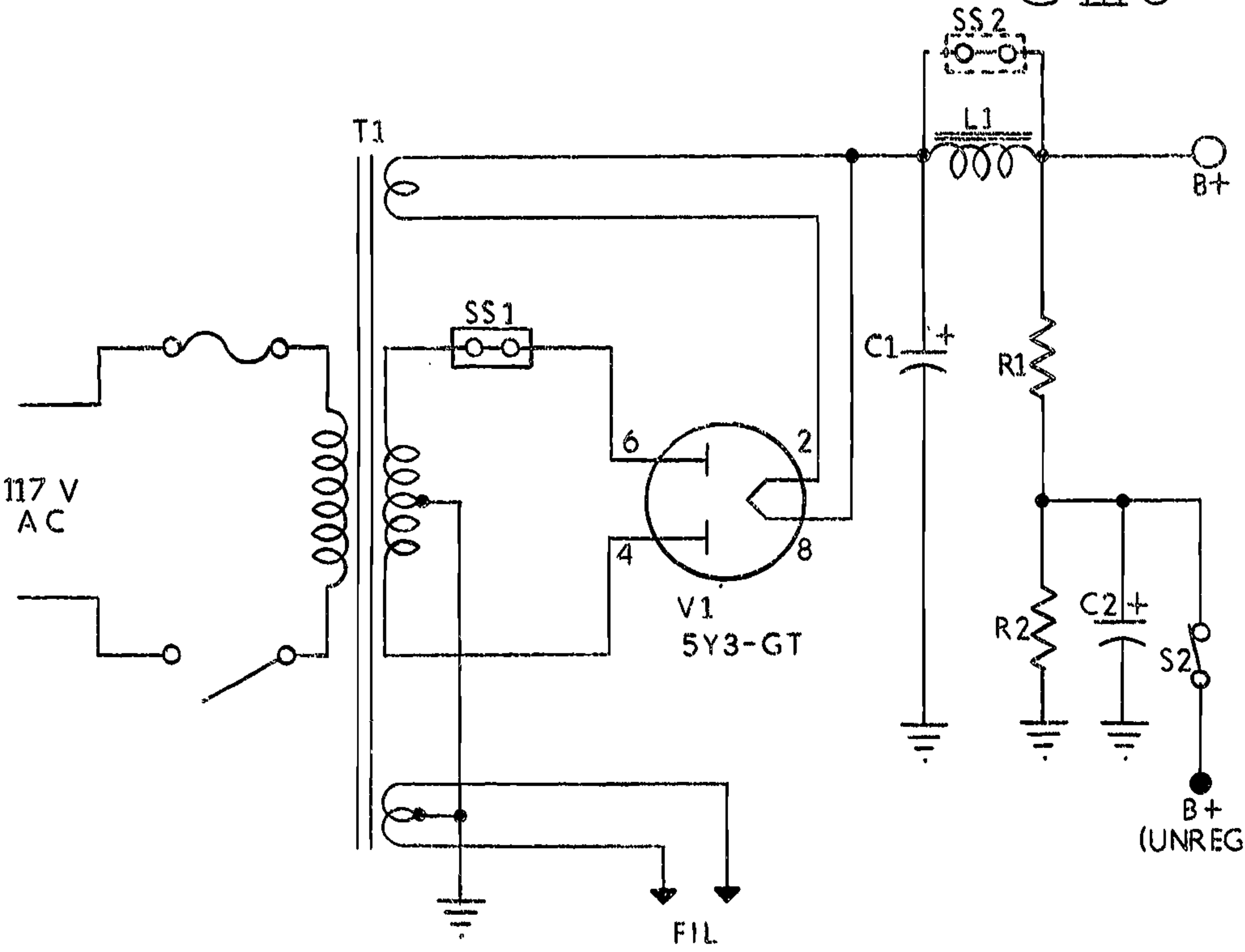


AVERAGE COLLECTOR CHARACTERISTICS



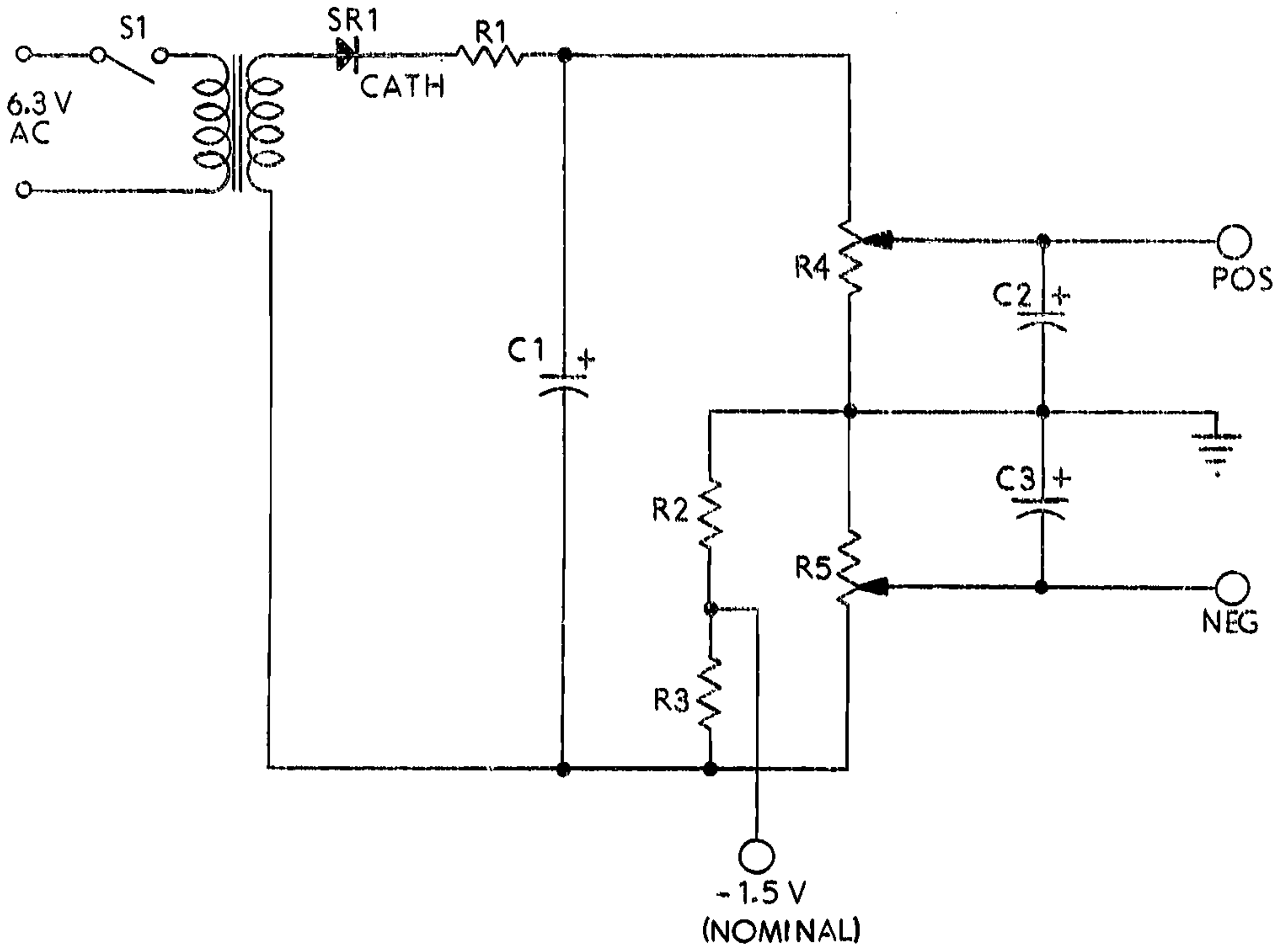
MEASUREMENT OF FORWARD AND REVERSE CURRENT ACROSS A PN JUNCTION

S-III-3



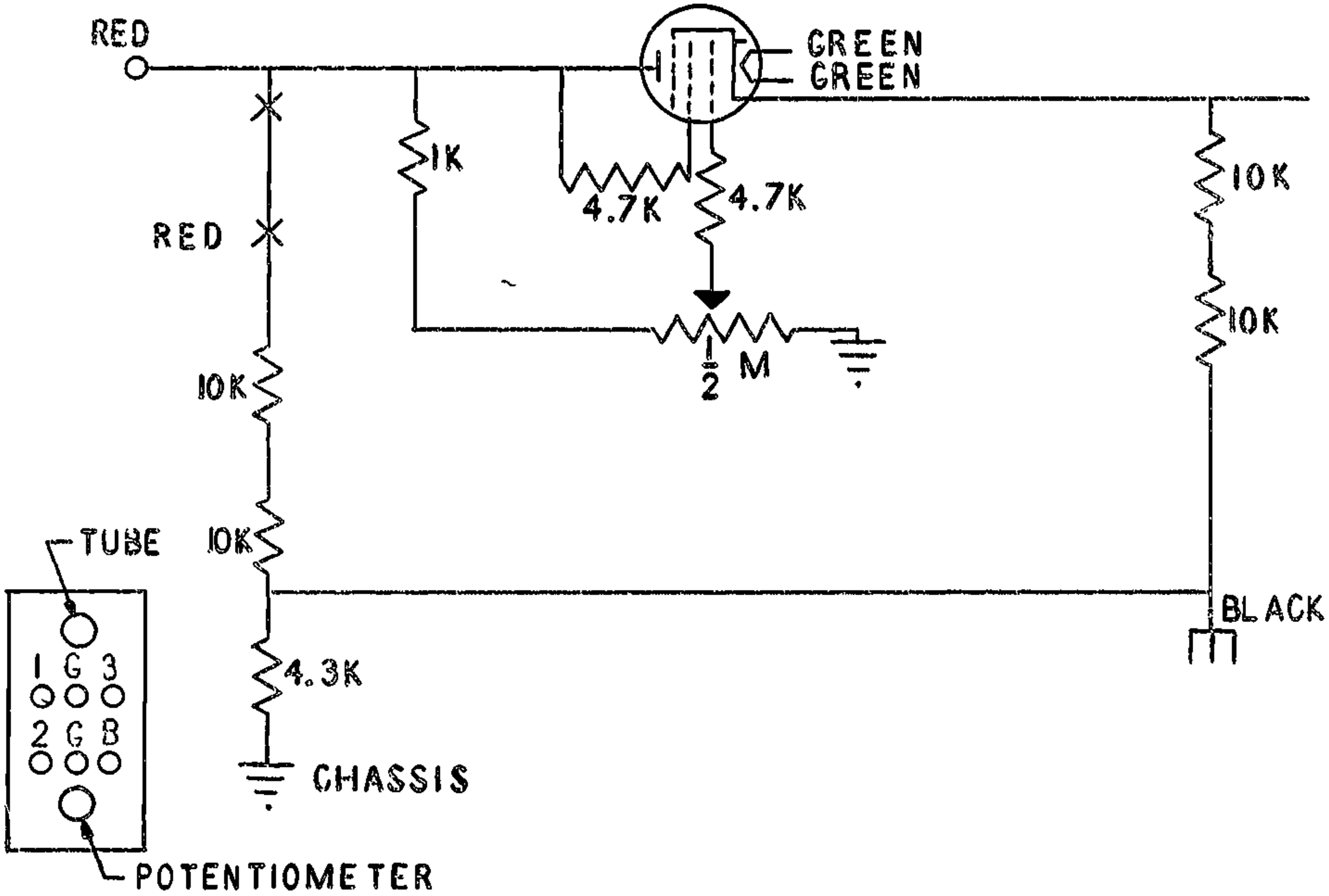
POWER SUPPLY

S-III-4

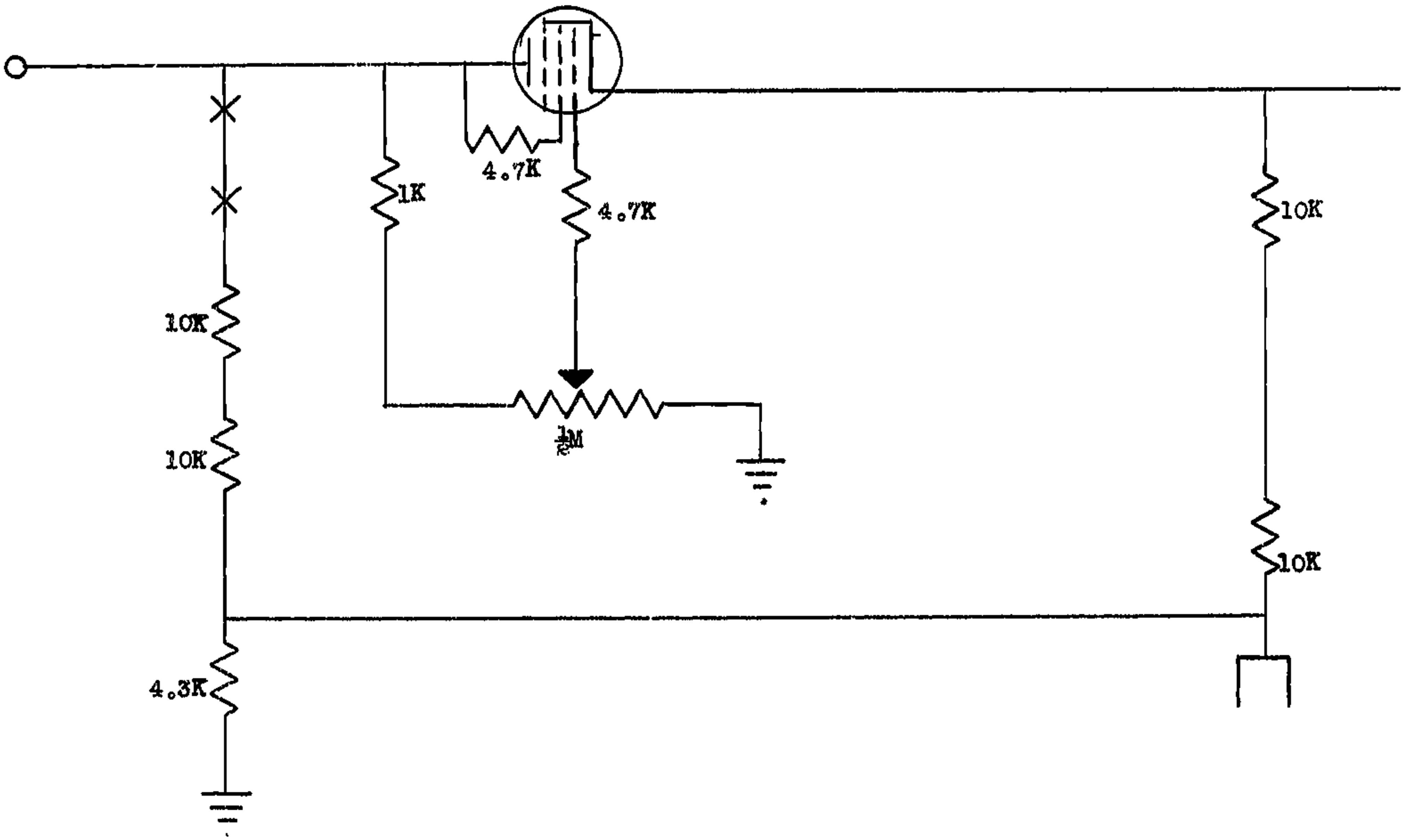


BIAS SUPPLY

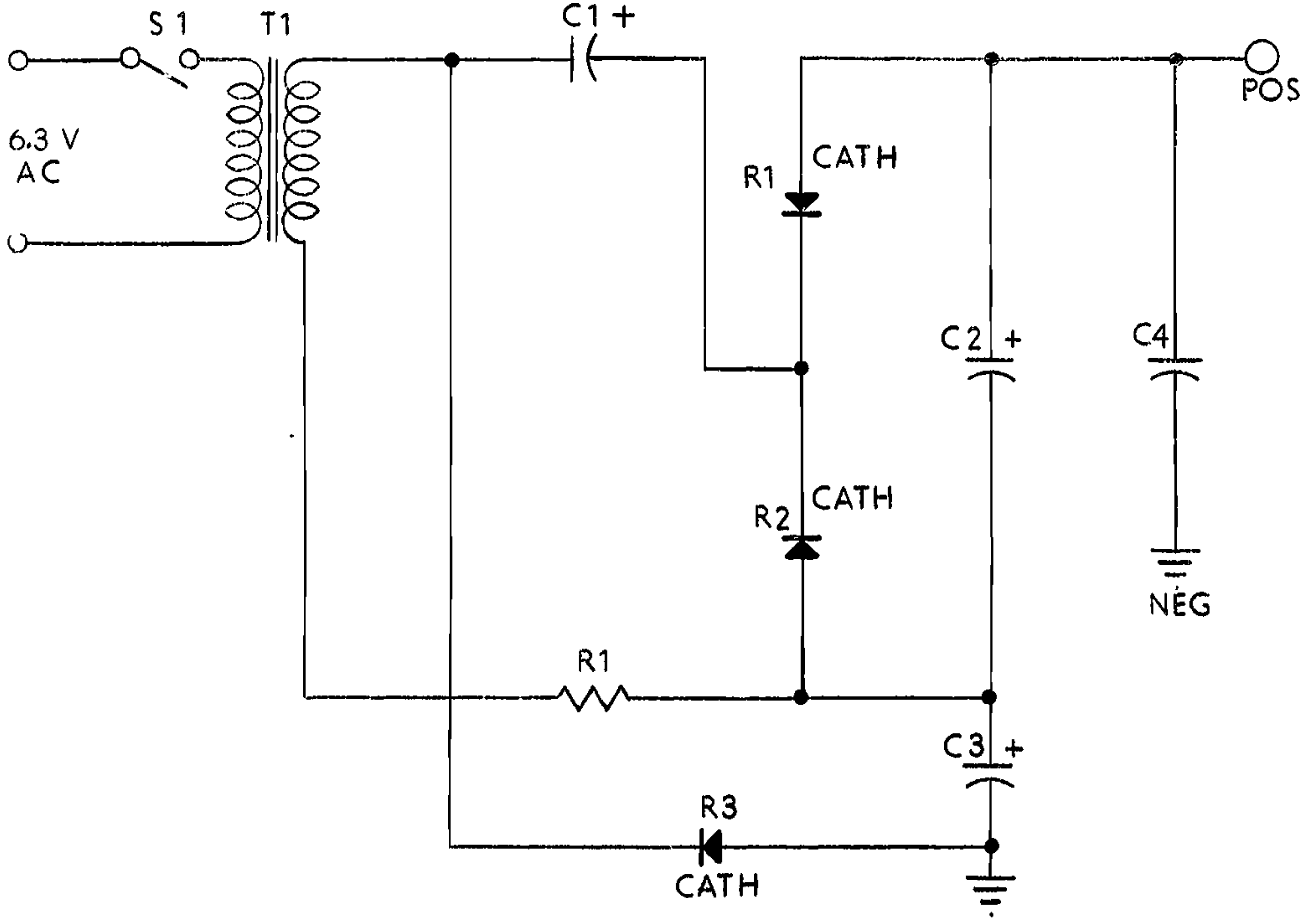
ADAPTER 121-1A
VARIABLE "B" SUPPLY



ADAPTER 121-1
VARIABLE "B" SUPPLY



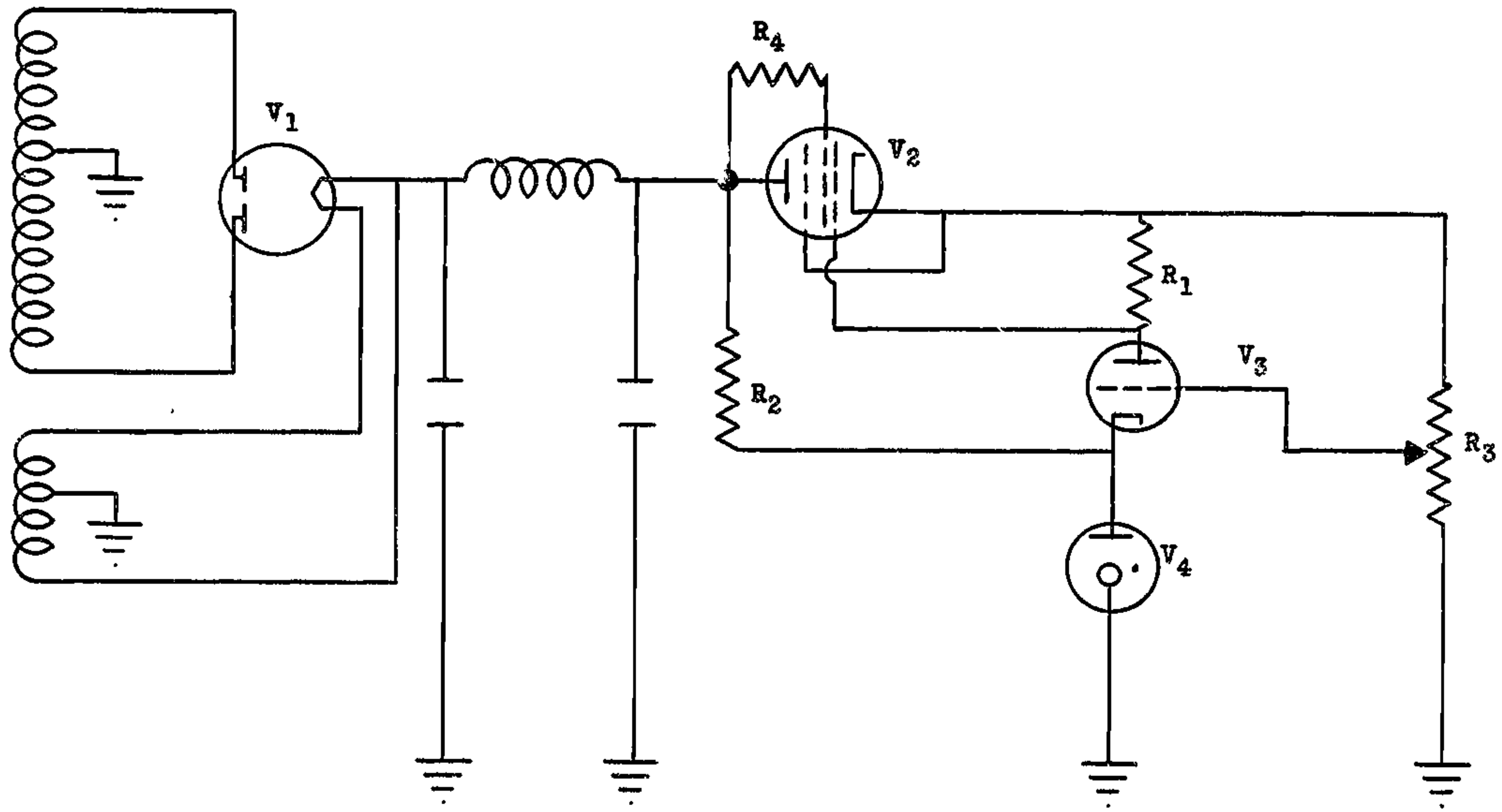
S-III-18



VOLTAGE TRIPLER

APPENDIX

REGULATED POWER SUPPLY S-III-19



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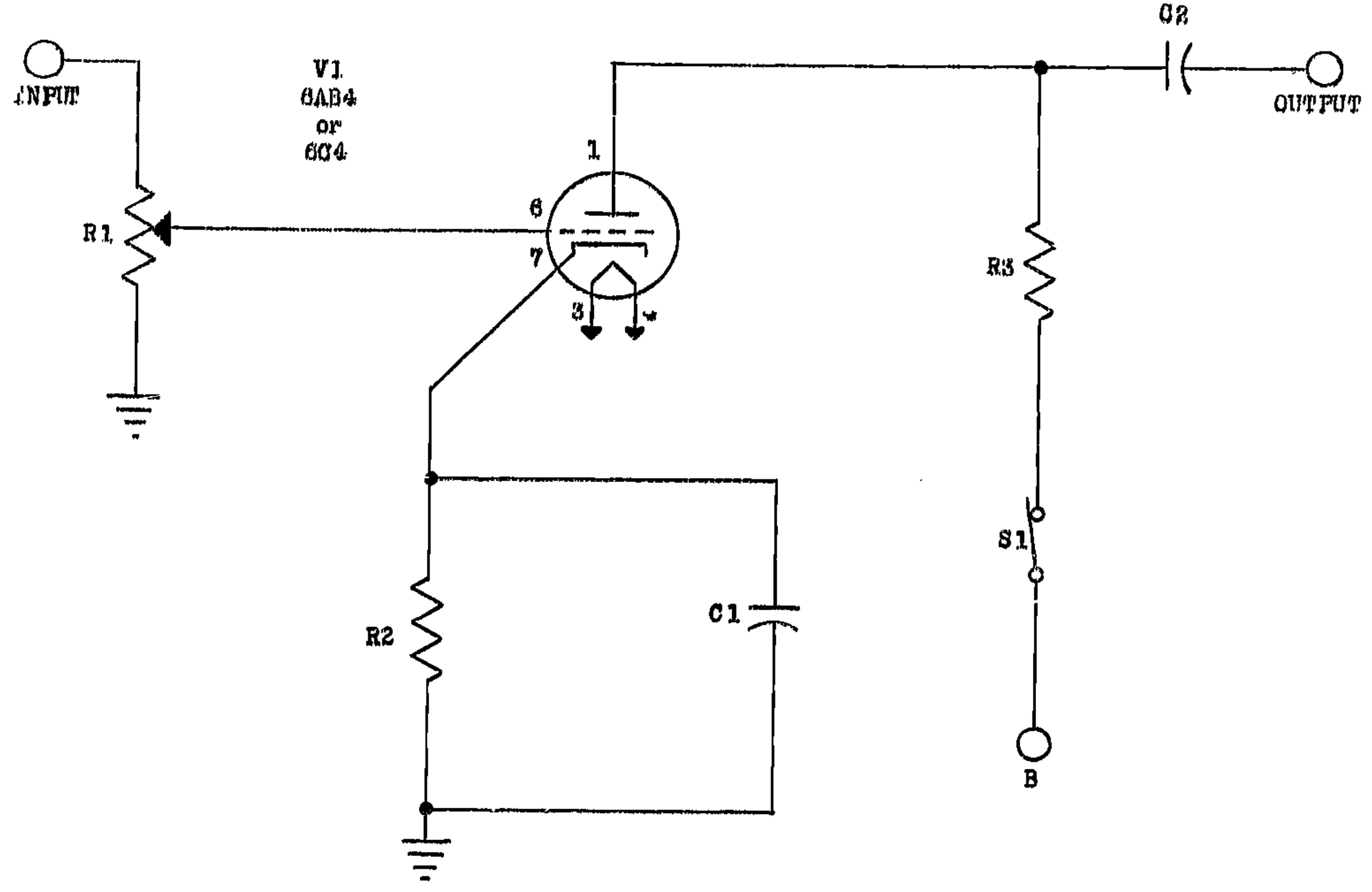
S-III-20



AUDIO VOLTAGE AMPLIFIER

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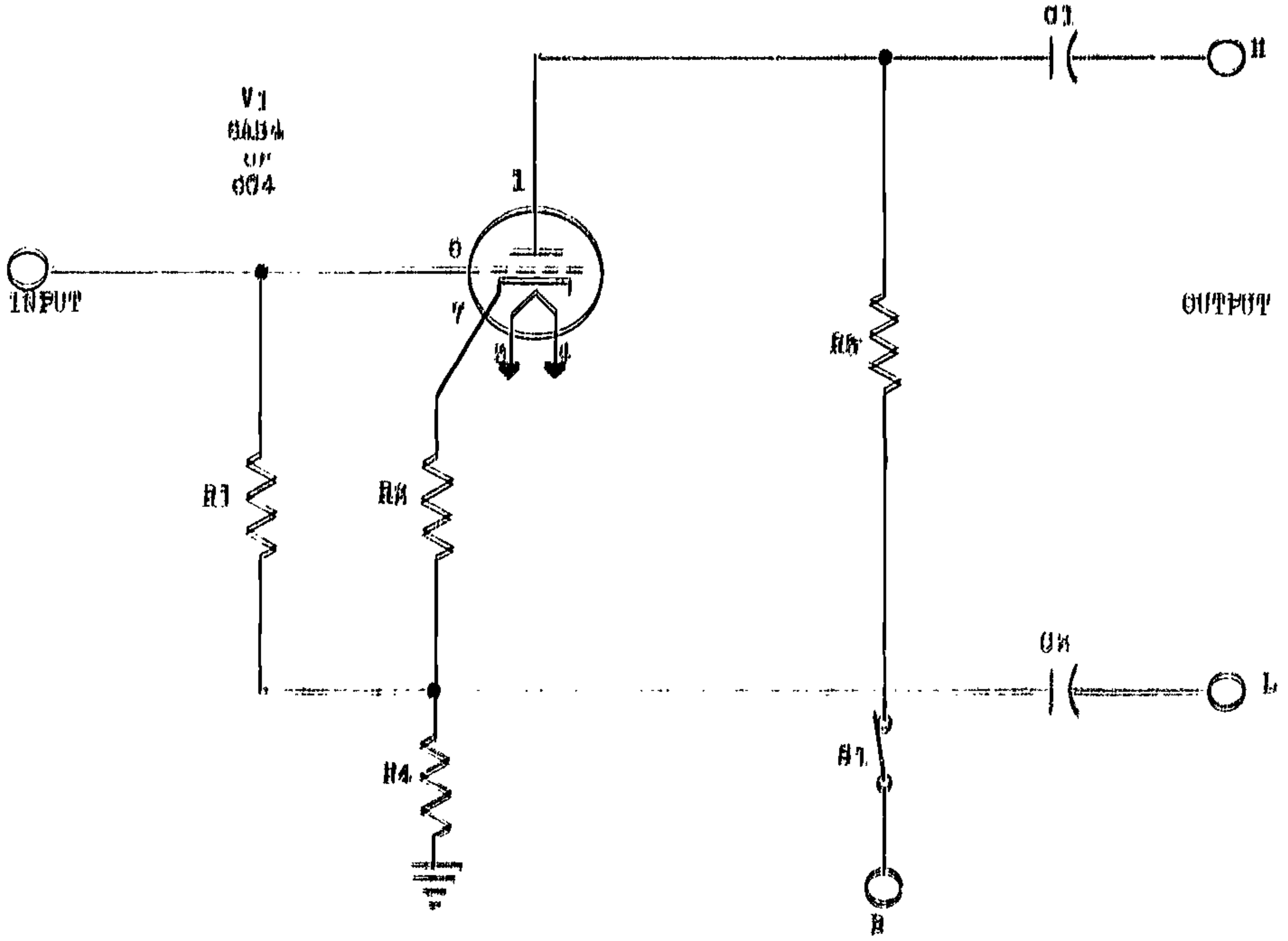
S-III-22



PHASE SPLITTER

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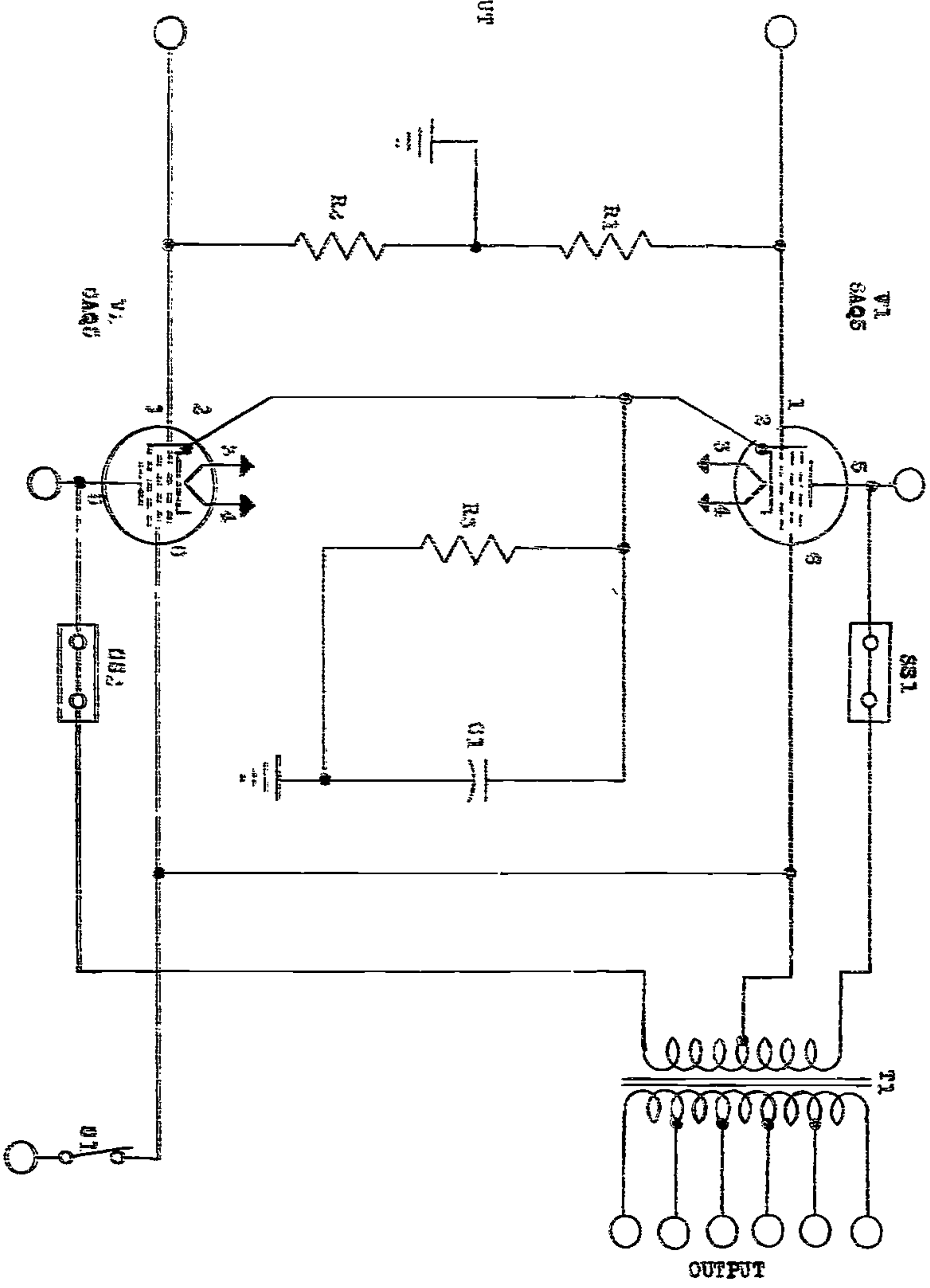
AUDIO POWER AMPLIFIER

S-III-24



VT003 188

VT 003 188
Industrial Technical Mathematics II for Electricians.

Electricians Vocational School, Bloomington, Ind.
Indiana State Dept. of Public Instruction, Indianapolis.
Indiana State Univ., Terre Haute. Instr. Materials Lab.
Pub Date - 64
MF AVAILABLE IN VT-ERIC SET 45p.

*STUDY GUIDES, *TRADE AND INDUSTRIAL EDUCATION, *ELECTRICIANS, *MATHEMATICS, INDIVIDUAL INSTRUCTION, *APPRENTICESHIPS,

The purpose of this course is to develop the fundamental skills of algebra as applied to the problems of the electrician's trade. This study guide was developed by a vocational coordinator, a vocational director, and members of an electricians' joint apprenticeship committee. It was designed on the concept and philosophy of using individual assignment sheets to allow each student to progress at his own rate and to enable the teacher to devote most of his time to individual instruction. Each of the 35 assignment sheets provides the student with the textbook references and assignments. An algebra textbook and an electrician's mathematics textbook are used as references. The assignment sheets are increasingly difficult so that the course may be used for both apprentice and journeyman electrician training programs. This book is designed for teacher use only. The student is to use the assignment sheets in loose unbound form. When he completes an assignment sheet, he returns it to the teacher and secures the next one. Tests are included periodically to identify the mathematical ability of the student. This document is available for 65 cents from the Division of Industrial Education, Indiana State University, Terre Haute, Indiana 47809. "Industrial Technical Mathematics I" (VT 003 185) is available. (HC)

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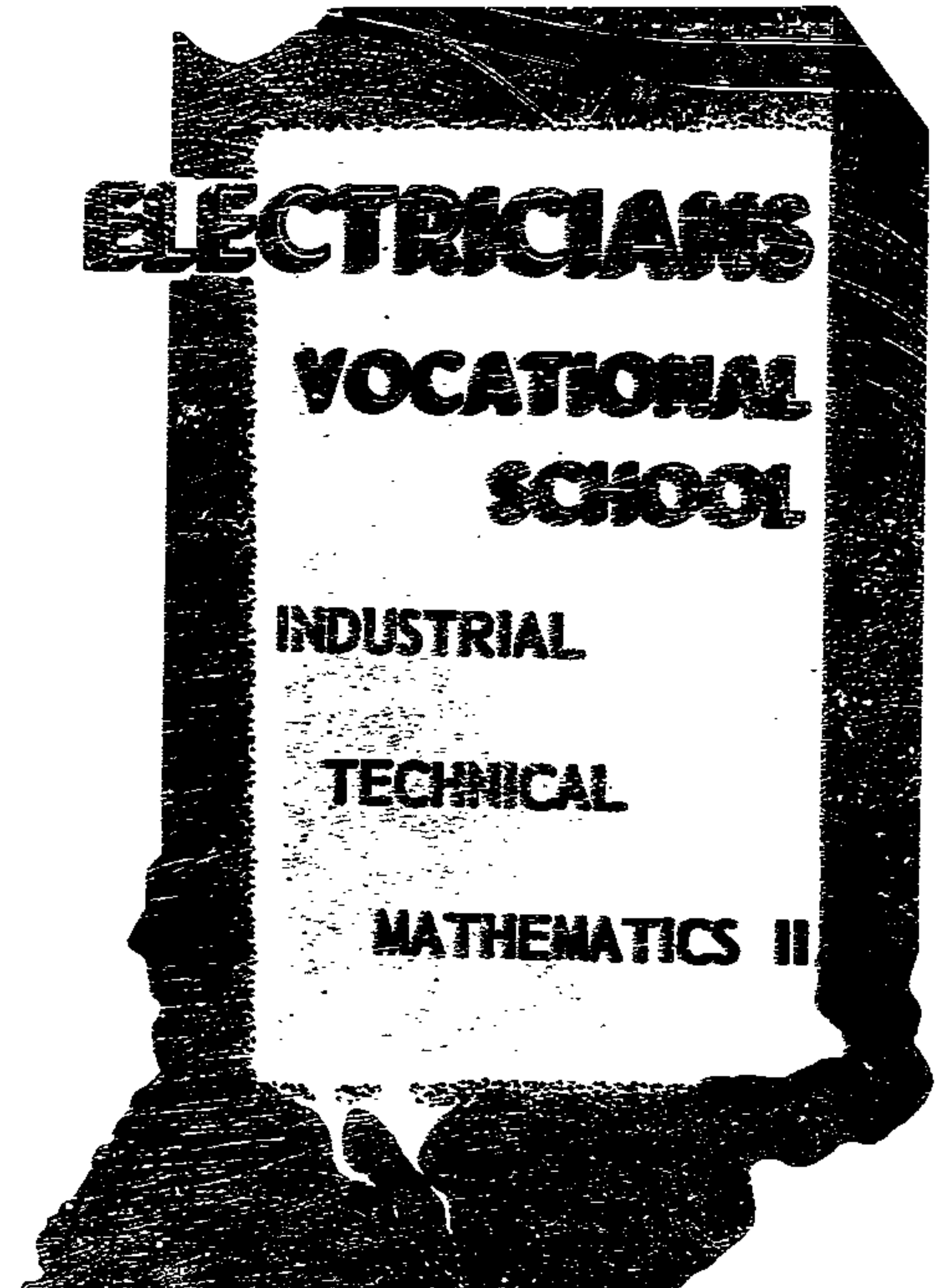

ELECTRICIANS
VOCATIONAL SCHOOL

INDUSTRIAL
TECHNICAL
MATHEMATICS II

Instructional Materials Laboratory

INDUSTRIAL TECHNICAL MATHEMATICS II

for

ELECTRICIANS

Electricians Vocational School

Bloomington, Indiana

State of Indiana
Division of Vocational Education
Trade-Industrial-Technical Education Branch

Instructional Materials Laboratory
Trade and Industrial Education
Indiana State College
Terre Haute, Indiana

PREFACE

Industrial Technical Mathematics II for Electricians is designed to follow Industrial Technical Math I. In order for electricians to be competent in advanced mathematics, they must be proficient in the fundamental skills of algebra. These algebraic skills are useless unless they can be applied to the problems of the trade. This course was written with this basic principle in mind.

A new easy to understand algebra text was used as reference for the algebraic assignment sheets. A well-known reliable electrician's math text was used for the basic text for the assignment sheet to make application of the algebraic skills. The assignment sheets for each text are increasingly difficult. This will make it possible for this course to be used for both apprentice and journeyman electricians.

This book is designed for the instructors use only. Students are to use the assignment sheets in loose unbound form. The individual differences of students may be taken care of if the assignment sheets are used as described in "Directions to Instructor."

Appreciation and acknowledgement for a job well done is made to Delmas Vaughn, Vocational Coordinator of Bloomington High School: Joe Stradling, Vocational Director of Bloomington High School and to Russell Noel, Henry Richards, Lester Noel and Russell Isom, all members of the Electricians Joint Apprenticeship Committee of Bloomington. These people in cooperation with Lester Hale representing the Trade-Industrial-Technical Education Branch of the Division of Vocational Education of Indiana, have made the development of this course possible.

DIRECTIONS TO THE INSTRUCTOR

This course was developed around the concept and philosophy of using individual assignment sheets. If these sheets are used correctly, each student will be allowed to progress at his own rate. The abilities of all will be developed to their fullest extent.

The instructor only, should use this book. The loose individual assignment sheets are used by the students. The following method of operation has proven satisfactory:

Each student should have two folders in the file; one for the "completed" work, the other for the "incomplete" work. The assignment sheets should be filed in consecutive order in another drawer. The instructor should lay out the student folders before class time. This prevents congestion and a bottleneck around the file cabinet at the beginning and ending of class. When the student completes an assignment sheet, he turns this into the instructor, then secures the next sheet.

Tests are included periodically. These may be used to identify the mathematical ability of each student. This makes it possible to start the students at the proper level in the course. The tests may also be used in the traditional manner.

If the course is used as it should be, the instructor will be freed of many routine activities and will be able to devote his time almost entirely to individual instruction.

It must be kept in mind that the assignment sheets are only a teaching aid or device. Necessary instruction is still necessary.

An accurate record of each student's progress should be kept by the instructor.

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INDUSTRIAL TECHNICAL MATHEMATICS-II

SUBJECT: Algebra--Symbols

Assignment M-II-1

Remarks and Purpose ______________________________

____

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Reference: ALGEBRA IN EASY STEPS with Modern Units--Edwin I. Stein; Princeton, New Jersey: D. Van Nostrand Company, Inc.; 1961.

Assignment:

1. Read pages 2 through 4 in the reference.
2. Work problems 1, 2, 7, and 13 in the Diagnostic Test on page 4.
3. Work SET 3 and 8 of Related Practice Examples on page 4 and 5.
4. Work problem 6 of III, in the Review of Unit One on page 7.

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INDUSTRIAL TECHNICAL MATHEMATICS-II

SUBJECT: Applied Algebra

Assignment M-II-1a

Remarks and Purpose ____________________

Reference: MATHEMATICS FOR ELECTRICIANS—Martin H. Kuehn; York, Pennsylvania: The Maple Press Company, McGraw-Hill Book Company, Inc; Third Edition: 1958.

Assignment:
1. Read articles 1 through 10 of Chapter I in the reference.
2. Work problems 1 through 10 of article 2 on page 1.
3. Work problems 1 through 8 of article 3 on page 2.
4. Work problems 2, 4, and 6 of article 4 on page 2.
5. Work problems 2, 4, 6, and 8 of article 5 on page 3.
6. Work problems 2, 4, 6, 8, and 10 of article 6 on page 4.
7. Work problems 1, 3, 5, and 9 of article 7 on page 4.
8. Work problems 1, 3, 5, 9, 14, and 20 of article 8 on page 5.
9. Work problems 3, 4, and 6 of article 9 on page 6.
10. Work problems 2, 5, and 7 of article 10 on page 6.

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INDUSTRIAL TECHNICAL MATHEMATICS-II

SUBJECT: Algebra—Evaluation

Assignment M-II-2

Remarks and Purpose

Reference: ALGEBRA IN EASY STEPS with Modern Units—Edwin I. Stein; Princeton, New Jersey: D. Van Nostrand Company, Inc.; 1961.

Assignment:
1. Read pages 8 and 9 in the reference.
2. Work problems 1 and 10 on page 8.
3. Work problems 6, 8, 12 and 20 in the Diagnostic Test on page 9.
4. Read pages 10 and 11.
5. Work problems 3, 5, 7, 10 and 18 in the Diagnostic Test on page 11.
6. Read pages 12 through 16.
7. Work problems 9, 13, 17 and 20 in the Diagnostic Test on page 13.
8. Work problems 4 and 6 in the Diagnostic Test on page 14.
9. Work problem 19 in the Review of Unit Two on page 16.

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INDUSTRIAL TECHNICAL MATHEMATICS-II

SUBJECT: Algebra--Making Formulas

Assignment M-II-3

Remarks and Purpose ____________________

Reference: ALGEBRA IN EASY STEPS with Modern Units--Edwin I. Stein; Princeton, New Jersey: D. Van Nostrand Company, Inc.; 1961.

Assignment: 1. Read pages 17, 18, and 19 in the reference.

2. Work problems 1, and 4 in the Diagnostic Test on page 19.

3. Work problems 1, and 5 in SET 1 on page 20.

4. Work problem 4 in SET 2 on page 21.

5. Work problem 4 (all parts) on page 24.

6. Work problem 5c (Measurements) on page 25.

7. Work problem 3 in the Review of Unit three on page 28.

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INDUSTRIAL TECHNICAL MATHEMATICS-II

SUBJECT: Applied Algebra

Assignment M-II-3a

Remarks and Purpose

Reference: MATHEMATICS FOR ELECTRICIANS--Martin H. Kuehn; York, Pennsylvania: The Maple Press Company, McGraw-Hill Book Company, Inc; Third Edition: 1958.

Assignment:
1. Read articles 11 through 16 of chapter 1 in the reference.
2. Work problems 1, 3, 5, and 7 of article 11 on page 7.
3. Work problems 4, 6, 8, 15, 20, and 23 of article 16 on page 8.
4. Work problems 2, 4, 6, 10, 12 and 16 of article 16 on page 10.
5. Work problems 1, 3, 6, 14 and 16 of article 16 on page 11.
6. Work problems 1, 4, 9, 12, 16, and 20 of article 16 on page 12.

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INDUSTRIAL TECHNICAL MATHEMATICS-II

SUBJECT: Algebra--Equations

Assignment M-II-4

Remarks and Purpose ____

Reference: ALGEBRA IN EASY STEPS with Modern Units--Edwin I. Stein; Princeton, New Jersey: D. Van Nostrand Company, Inc.; 1961.

Assignment: 1. Read pages 29, 30, 31 and 32 in the reference.

2. Work problems 3, 5, and 6 in the Diagnostic Test on page 30.
3. Work problems 1 through 10 of SET 4 on page 31.
4. Work problems 2, 4, 10 in the Diagnostic Test on page 33.
5. Read pages 34, 35, and 36 in the reference.
6. Work problems 1, 3, 6, and 9 in the Diagnostic Test on page 34.
7. Work problems 5, 9, and 18 in the Diagnostic Test on page 36.
8. Read pages 38, 42, and 43 in the reference.
9. Work problems 1, and 3 in the Practice Problems on page 42.
10. Work problems 3, and 5 in SET 1 on page 43.
11. Work problems 1a, 2b, and 4b on page 44.

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INDUSTRIAL TECHNICAL MATHEMATICS-II

SUBJECT: Algebra-Equations

Assignment M-II-4-Page 2

12. Read pages 45 through 51 in the reference.
13. Work problem 1 on page 46.
14. Work problems 1, 4, 6, and 8 on page 47.

TECHNICAL TERMS

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INDUSTRIAL TECHNICAL MATHEMATICS-II

SUBJECT: Applied Algebra

Assignment M-II-4a

Remarks and Purpose ______________________________

Reference: MATHEMATICS FOR ELECTRICIANS--Martin H. Kuehn; York, Pennsylvania: The Maple Press Company, McGraw-Hill Book Company, Inc; Third Edition: 1958.

Assignment:
1. Read chapter 2 in the reference.
2. Work problems 1 through 10 and 30 through 39 on page 14.
3. Work problems 1, 4, 6, 10 and 14 on page 15.
4. Work problems 24, 26, 28, and 30 on page 16.
5. Work problems 1, 3, 6, 10, 12 and 16 on page 18.

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INDUSTRIAL TECHNICAL MATHEMATICS-II

SUBJECT: Algebra—Equations

Assignment M-II-5

Remarks and Purpose ______________________________

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Reference: ALGEBRA IN EASY STEPS with Modern Units—Edwin I. Stein; Princeton, New Jersey: D. Van Nostrand Company, Inc.: 1961.

Assignment 1. Read pages 45 through 51 in the reference.

2. Work problems 1, 4, and 10 under E. on page 48.

3. Work problems 2, 4, and 5 on page 49.

4. Work problems 1, 6, 9 on page 50.

5. Work problems 1, 6, and 10 in the Review of Unit Four on page 51.

6. Work problems 17 and 20 in the Cumulative Algebra Review on page 51.

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INDUSTRIAL TECHNICAL MATHEMATICS-II

SUBJECT: Applied Algebra

Assignment M-II-5a

Remarks and Purpose

Reference: MATHEMATICS FOR ELECTRICIANS—Martin H. Kuehn; York, Pennsylvania: The Maple Press Company, McGraw-Hill Book Company, Inc.; Third Edition: 1958.

Assignment:
1. Read chapters 3 and 4 in the reference.
2. Work problems 1, 3, 5, and 10 of article 30 on page 22.
3. Work problems 5, 10, 15 and 20 of article 31 on page 23.
4. Work problems 3, 6, 9, 12, and 16 of article 32 on page 23.
5. Work problems 3, 6, 9, 14, and 16 of article 32 on page 25.
6. Work problems 6, 12, 18, 25 and 40 of article 32 on page 26.
7. Work problems 3, 5, 6, 9, and 22 of article 33 on page 28.
8. Work problems 1, 4, 6, 10, and 11 of article 37 on page 33.
9. Work problems 12, 15, 17, 20, and 25 of article 37 on page 35.

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INDUSTRIAL TECHNICAL MATHEMATICS-II

SUBJECT: Algebra--Positive and Negative Numbers Assignment M-II-6

Remarks and Purpose ____

Reference: ALGEBRA IN EASY STEPS with Modern Units--Edwin I. Stein; Princeton, New Jersey: D. Van Nostrand Company, Inc.; 1961.

Assignment:
1. Read and study pages 53, 54 and the top of page 55.
2. Work problems 1, 3, 8, 10 and 12 in the Diagnostic Test on page 55.
3. Work problems 16 and 18a of Related Practice Examples on page 58.
4. Work all the problems in part b of Miscellaneous Examples on page 59.
5. Read and Study page 60.
6. Work problems 1, 4, and 7 in the Related Practice Examples on page 61.
7. Study examples on page 62 and work problem 1 of Part 1 on page 62.
8. Work problems 1 and 3 of Part 2 on page 63.
9. Work all problems in SET 1 and SET 4 of Part 3 on page 63.

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INDUSTRIAL TECHNICAL MATHEMATICS-II

SUBJECT: Algebra--Positive and Negative Numbers Assignment M-II-7

Remarks and Purpose ____________________

Reference: ALGEBRA IN EASY STEPS with Modern Units--Edwin I. Stein; Princeton, New Jersey: D. Van Nostrand Company, Inc.: 1961.

Assignment:
1. Read and study page 64. in the reference.
2. Work problems 1, 7, and 11 in the Diagnostic Test on page 64.
3. Work problems 2, 7, and 11 on page 65.
4. Study Exercise 19 including III on page 67.
5. Work problems 5 and 10 in Related Practice Examples on page 67.
6. Work all the problems in Part 1--Averages, and work the problems in SET 1 of Part 2--Equations on page 68.
7. Study page 69 and work problems 1 and 14 in the Diagnostic Test on the same page.
8. Work problems 1 and 5 under Applications on page 70.

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INDUSTRIAL TECHNICAL MATHEMATICS-II

SUBJECT: Algebra--Positive and Negative Numbers   Assignment M-II-8

Remarks and Purpose

Reference: ALGEBRA IN EASY STEPS with Modern Units--Edwin I. Stein; Princeton, New Jersey: D. Van Nostrand Company, Inc.: 1961.

Assignment:
1. Study Exercise 21 on page 71 in the reference.
2. Work problems 1 through 4 in the Diagnostic Test on page 71.
3. Study Exercise 22, and work problems 9 and 12 of the Diagnostic Test on page 72.
4. Work all problems on page 73.

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INDUSTRIAL TECHNICAL MATHEMATICS-II

SUBJECT: Applied Algebra

Assignment M-II-8a

Remarks and Purpose ______________________________

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Reference: MATHEMATICS FOR ELECTRICIANS--Martin H. Kuehn; York, Pennsylvania: The Maple Press Company, McGraw-Hill Book Company, Inc.; Third Edition: 1958.

Assignment:

1. Read chapters 5, and 7 in the reference.
2. Work problems 1, 3, and 5 of article 38 on page 39.
3. Work problems 9, 13, 17, and 20 of article 38 on page 40.
4. Work problems 32, 34, and 38 of article 38 on page 42.
5. Work problems 1, 3, 5, and 9 of article 39 on page 43.
6. Work problems 1, 2, 4, 6, 15, 16, 19, and 21 of article 40 on page 44.
7. Work problems 28, 34, 35, 38, 42, 48, and 52 of article 40 on page 45.
8. Work problems 4, 8, 14, 18, and 25 of article 41 on pages 46 and 47.
9. Work problems 2, 4, 6, and 12 of article 42 on page 48.

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INDUSTRIAL TECHNICAL MATHEMATICS-II

SUBJECT: Applied Algebra

10. Work problems 3, 6, 10, and 15 of article 43 on page 49.
11. Work problems 2, 4, 8, 12, 16, and 18 of article 44 on page 51.

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INDUSTRIAL TECHNICAL MATHEMATICS-II

SUBJECT: Algebra--Fundamental Operations — Assignment M-II-9

Remarks and Purpose ____

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Reference: ALGEBRA IN EASY STEPS with Modern Units--Edwin I. Stein; Princeton, New Jersey: D. Van Nostrand Company, Inc.: 1961

Assignment:
1. Read the Introduction to Unit 6 on page 74 in the reference.
2. Read and Study page 75.
3. Work the even numbered problems in the Diagnostic Test on page 76.
4. Work problems 1 through 6 in the Related Practice Examples on page 76.
5. Work problems 13, 15, and 20 in the Related Practice Examples on pages 77 and 78.
6. Work problems 1 and 2 under Applications on page 78.

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INDUSTRIAL TECHNICAL MATHEMATICS-II

SUBJECT: Algebra--Fundamental Operations

Assignment M-II-10

Remarks and Purpose

Reference: ALGEBRA IN EASY STEPS with Modern Units--Edwin I. Stein; Princeton, New Jersey: D. Van Nostrand Company, Inc.: 1961.

Assignment:
1. Read and Study the examples at the top of page 79 in the reference.
2. Work the odd numbered problems in the Diagnostic Test on page 76.
3. Work problems 2, 6, and 10 on page 80.
4. Work all the problems in SET 12a, 12b, and 14 on page 81.
5. Work problems 1 and 3 under Applications on page 81.

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INDUSTRIAL TECHNICAL MATHEMATICS-II

SUBJECT: Algebra--Fundamental Operations

Assignment M-II-11

Remarks and Purpose ______________________________

Reference: ALGEBRA IN EASY STEPS with Modern Units--Edwin I. Stein; Princeton, New Jersey: D. Van Nostrand Company, Inc.: 1961.

Assignment:
1. Read and study the top of page 82 in the reference.
2. Work problems 6, 11, 12, and 16 in the Diagnostic Test on page 82.
3. Work problems 1, 4, 6, 10 and 13 on page 83.
4. Work all the problems of SET 15 and 16 on page 84.
5. Work problems 1 and 2 under Applications on page 84.

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INDUSTRIAL TECHNICAL MATHEMATICS-II

SUBJECT: Algebra--Fundamental Operations Assignment M-II-12

Remarks and Purpose ______________________________

Reference: ALGEBRA IN EASY STEPS with Modern Units--Edwin I. Stein; Princeton, New Jersey: D. Van Nostrand Company, Inc.: 1961.

Assignment: 1. Read and study the top of page 85 in the reference.

2. Work problems 3, 5, 7, and 8 in the Diagnostic Test on page 85.

3. Work problems 3, 7, and 9 on page 86.

4. Work all problems in SET 11 on page 87.

5. Work problems 1 and 2 under Applications on page 87.

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INDUSTRIAL TECHNICAL MATHEMATICS-II

SUBJECT: Algebra--Fundamental Operations

Assignment M-II-13

Remarks and Purpose ____________________

Reference: ALGEBRA IN EASY STEPS with Modern Units--Edwin I. Stein; Princeton, New Jersey: D. Van Nostrand Company, Inc.: 1961.

Assignment:
1. Read and study the top of page 88 in the reference.
2. Work problems 1, 7, and 15 in the <u>Diagnostic Test</u> on page 88.
3. Work the problems in <u>SET</u> 3, 7, 12 and 17 on page 89.
4. Read and study <u>Inclosing Terms within Parentheses</u> on page 90.
5. Work all the problems in <u>SET</u> 2, 4, and 9 on page 91.

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INDUSTRIAL TECHNICAL MATHEMATICS-II

SUBJECT: Algebra—Fundamental Operations — Assignment M-II-14

Remarks and Purpose ______________________________

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Reference: ALGEBRA IN EASY STEPS with Modern Units—Edwin I. Stein; Princeton New Jersey: D. Van Nostrand Company, Inc.: 1961.

Assignment:
1. Read and study Monomial by a Monomial on page 92 in the reference.
2. Work problems 1, 7, 13 and 18 in the Diagnostic Test on page 92.
3. Work problems 1, 4, 8 and 14 on page 93.
4. Work problems 3 and 5 under Applications-I on page 94.
5. Work problems 2 and 3 under Applications-II on page 94.

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INDUSTRIAL TECHNICAL MATHEMATICS-II

SUBJECT: Algebra-Fundamental Operations

Assignment M-II-15

Remarks and Purpose ________________________________

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Reference: ALGEBRA IN EASY STEPS with Modern Units--Edwin I. Stein; Princeton, New Jersey: D. Van Nostrand Company, Inc.: 1961.

Assignment:
1. Read and study Polynomial by a Monomial on page 95 of the reference.
2. Work problems 6, 10 and 16 in the Diagnostic Test on page 95.
3. Work all the problems in SET 1 and 6 on page 95.
4. Work all the problems in SET 11 and 18 on page 96.
5. Read and study Polynomial by a Polynomial on page 97.
6. Work problems 1, 3, 5, 21, and 23 in the Diagnostic Test on page 97.
7. Work problems 1, 4, and 10 in the Related Practice Examples on page 98.
8. Work the problems in SET 24 c page 99

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INDUSTRIAL TECHNICAL MATHEMATICS-II

SUBJECT: Algebra—Fundamental Operations Assignment M-II-16

Remarks and Purpose ____

Reference: ALGEBRA IN EASY STEPS with Modern Units--Edwin I. Stein; Princeton, New Jersey: D. Van Nostrand Company, Inc.: 1961.

Assignment:
1. Read and study Removal by Multiplication on page 100 in the reference.
2. Work all problems in the Diagnostic Test on page 100.
3. Work all problems in SET 4 and 12 on page 101.
4. Read and study A Monomial by a Monomial on page 102.
5. Work problems 1, 6, 12, and 20 in the Diagnostic Test on page 102.
6. Work problems 1, 3, 9, and 13 on page 103.
7. Work all problems in SET 20 on page 104.

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INDUSTRIAL TECHNICAL MATHEMATICS-II

SUBJECT: Applied Algebra

Assignment M-II-14a

Remarks and Purpose

Reference: MATHEMATICS FOR ELECTRICIANS—Martin H. Kuehn; York, Pennsylvania: The Maple Press Company, McGraw-Hill Book Company, Inc.; Third Edition; 1958.

Assignment:
1. Read pages 52 through 60 in the reference.
2. Work problems 1, 2, 4, 6, and 8 of article 44 on page 52.
3. Work problems 16, 18, 20, and 22 of article 44 on page 53.
4. Work problems 1, 3, 5, 9, and 14 of article 46 on page 54.
5. Work problems 1, 5, 10, 15, 18, 26, and 34 of article 47 on page 56.
6. Work problems 1 and 4 of article 50 on page 58.
7. Work problems 8, 10, 13, 15 and 18 of article 50 on page 59.
8. Work problems 22, 24, 28, and 30 of article 50 on page 60.

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INDUSTRIAL TECHNICAL MATHEMATICS-II

SUBJECT: Algebra—Fundamental Operations

Assignment M-II-17

Remarks and Purpose

Reference: ALGEBRA IN EASY STEPS with Modern Units—Edwin I. Stein; Princeton, New Jersey: D. Van Nostrand Company, Inc.; 1961.

Assignment:
1. Read and study A polynomial by a Monomial on page 105 in the reference.
2. Work problems 1, 3, 5, 8, 11, 12, and 15 in the Diagnostic Test on page 105.
3. Work problems 1 and 3 in Related Practice Examples on page 105.
4. Work problems 4, 6, 10, and 14 on page 106.
5. Read and study A Polynomial by a Polynomial on page 107.
6. Work problems 2, 6, 10, and 18 in the Diagnostic Test on page 108.
7. Work all the problems in SET 1 and SET 5 on page 108.
8. Work all the problems in SET 12 and SET 20 on page 109.

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INDUSTRIAL TECHNICAL MATHEMATICS-II

SUBJECT: Algebra--Fundamental Operations Assignment M-II-18

Remarks and Purpose ______________________________

Reference: ALGEBRA IN EASY STEPS with Modern Units--Edwin I. Stein; Princeton, New Jersey: D. Van Nostrand Company, Inc.; 1961.

Assignment: 1. Work all the problems on page 110 in the reference.

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INDUSTRIAL TECHNICAL MATHEMATICS-II

SUBJECT: Algebra--Equations and Word Problems — Assignment M-II-19

Remarks and Purpose

Reference: ALGEBRA IN EASY STEPS with Modern Units--Edwin I. Stein; Princeton, New Jersey: D. Van Nostrand Company, Inc.; 1961.

Assignment:
1. Read and study pages 111, 112, and 113 in the reference.
2. Work all the problems in SET 1, 2, and 10 in Review on page 113.
3. Work problems 1 through 8 in the Diagnostic Test on page 113.
4. Work all the problems in SET 1, 3, and 8 in Related Practice Examples on page 113.
5. Work all the problems in SET 12, 17, and 22 on page 114.
6. Read and study page 115.
7. Work problems 1 and 7 in Type 1 on page 116.
8. Work problems 1, 5, and 6 in Type 3 on page 117.

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INDUSTRIAL TECHNICAL MATHEMATICS-II

SUBJECT: Algebra--Equations and Word Problems Assignment M-II-20

Remarks and Purpose ____________________

Reference: ALGEBRA IN EASY STEPS with Modern Units--Edwin I. Stein; Princeton, New Jersey: D. Van Nostrand Company, Inc.; 1961.

Assignment:
1. Read and study Changing Statements Into Equations on page 118 in the reference.
2. Work problems A, B, D, and F in Practice Problems on page 118.
3. Read and Study page 119.
4. Work problems a, b, and d on page 120.
5. Read and Study Age Problems on page 121.
6. Work all the problems in Practice Problems on page 121.
7. Read and Study Coin and Mixture Problems on page 122.
8. Work the problems under B on page 123.

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INDUSTRIAL TECHNICAL MATHEMATICS-II

SUBJECT: Algebra--Equations and Word Problems Assignment M-II-21

Remarks and Purpose ______________________________

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Reference: ALGEBRA IN EASY STEPS with Modern Units--Edwin I. Stein; Princeton, New Jersey: D. Van Nostrand Company, Inc.; 1961.

Assignment: 1. Read and study Motion Problems on page 124 in the reference.

2. Work problems A and B on pages 124 and 125.

3. Work all the problems on page 126.

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INDUSTRIAL TECHNICAL MATHEMATICS-II

SUBJECT: Applied Algebra

Assignment M-II-21a

Remarks and Purpose

Reference: MATHEMATICS FOR ELECTRICIANS--Martin H. Kuehn; York, Pennsylvania: The Maple Press Company, McGraw-Hill Book Company, Inc.; Third Edition: 1958.

Assignment:
1. Read pages 61 through 69 in the reference.
2. Work problems 34, 36, 38, and 40 of article 52 on page 64.
3. Work problems 42, 44, 45, and 48 of article 52 on page 65.
4. Work problems 49 and 50 of article 52 on page 66.
5. Work problems 51 and 57 of article 52 on page 67.
6. Work problem 60 of article 52 on page 68.
7. Work problem 67 of article 52 on page 69.

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INDUSTRIAL TECHNICAL MATHEMATICS-II

SUBJECT: Algebra--Special Products and Factoring   Assignment M-II-22

Remarks and Purpose ______________________________

Reference: ALGEBRA IN EASY STEPS with Modern Units--Edwin I. Stein; Princeton, New Jersey: D. Van Nostrand Company, Inc.: 1961.

Assignment: 1. Read and study Factoring Polynomials Having a Common Monomial Factor on page 128 in the reference.

2. Work all the problems in the Diagnostic Test on page 128.

3. Work the problems in SET 5, 7, and 9 on page 129.

4. Read and study Squaring a Monomial on page 130.

5. Work all problems in the Diagnostic Test on page 130.

6. Read and study Square Root of a Monomial on page 130.

7. Work the problems in the Diagnostic Test on page 131.

8. Work the problems in SET 2, 6, and 8 on page 131.

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SUBJECT: Algebra--Special Products and Factoring   Assignment M-II-23

Remarks and Purpose ____

Reference: ALGEBRA IN EASY STEPS with Modern Units—Edwin I. Stein; Princeton, New Jersey: D. Van Nostrand Company, Inc.: 1961.

Assignment:
1. Read and study Product of the Sum and Difference of the Same Two Terms on page 131 in the reference.
2. Work the problems in the Diagnostic Test on page 132.
3. Work the problems in SET 1, 2, 3, and 4 on page 132.
4. Read and study Factoring--Difference of Two Squares on page 133.
5. Work the problems in the Diagnostic Test on page 133.
6. Work the problems in SET 1, 3, 6, and 10 on page 133.
7. Read and study The Square of a Binomial on page 134.
8. Work the problems in the Diagnostic Test on page 134.
9. Work SET 6, 8, 10, and 14 on page 135.
10. Read and study Factoring--Perfect Trinomial Squares on page 135.
11. Work the problems in the Diagnostic Test on page 136.
12. Work the problems in SET 1, 7, and 10 on page 136.

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SUBJECT: Algebra—Special Products and Factoring   Assignment M-II-23-Page 2

13. Read and Study Product of Two Binomials Having a Common Term on page 137.
14. Work the problems in the Diagnostic Test on page 137.
15. Work the problems in SET 1, 2, 3, and 4 on page 138.

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INDUSTRIAL TECHNICAL MATHEMATICS-II

SUBJECT: Algebra--Special Products and Factoring   Assignment M-II-24

Remarks and Purpose

Reference: ALGEBRA IN EASY STEPS with Modern Units--Edwin I. Stein; Princeton, New Jersey: D. Van Nostrand Company, Inc.: 1961.

Assignment:
1. Read and study Factoring--Factors Are Binomials Having a Common Term on page 138 in the reference.
2. Work the problems in SET 1, 3, and 7 on page 139.
3. Read and study General Types--Special Products on page 140.
4. Work the problems in the Diagnostic Test on page 140.
5. Work the problems in SET 1, 3, 4, and 10 on page 140.
6. Read and study General Type--Factoring on page 141.
7. Work the problems in the Diagnostic Test on page 141.
8. Work the problems in SET 3, 4, 6, and 8 on page 141.
9. Read and study Factoring--Prime Factors and Miscellaneous Types on page 142.
10. Work the problems in the Diagnostic Test on page 142.
11. Work the problems in SET 1, 2, and 7 on page 142.

12. Study and practice the examples on page 143.

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INDUSTRIAL TECHNICAL MATHEMATICS-II

SUBJECT: Applied Algebra

Assignment M-II-24a

Remarks and Purpose ______________________________

Reference: MATHEMATICS FOR ELECTRICIANS—Martin H. Kuehn; York, Pennsylvania: The Maple Press Company, McGraw-Hill Book Company, Inc.; Third Edition: 1958.

Assignment: 1. Work the problems 1 through 20 on page 96 in the reference.

2. Work the problems 1 through 12 on page 97.

3. Work the problems 1 through 13 on page 98.

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TRADE AND INDUSTRIAL SERVICE

INSTRUCTIONAL MATERIALS LABORATORY
INDIANA STATE COLLEGE
TERRE HAUTE, INDIANA

ELECTRICIANS VOCATIONAL SCHOOL

INDUSTRIAL TECHNICAL MATHEMATICS-II

SUBJECT: Algebra—Special Products and Factoring   Assignment M-II-25

Remarks and Purpose

Reference: ALGEBRA IN EASY STEPS with Modern Units—Edwin I. Stein; Princeton, New Jersey: D. Van Nostrand Company, Inc.: 1961.

Assignment: 1. Work all the problems on page 144.

TECHNICAL TERMS

SAFETY

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ELECTRICIANS VOCATIONAL SCHOOL

INDUSTRIAL TECHNICAL MATHEMATICS-II

SUBJECT: Algebra--Fractions

Assignment M-II-26

Remarks and Purpose ______

Reference: ALGEBRA IN EASY STEPS with Modern Units--Edwin I. Stein; Princeton, New Jersey: D. Van Nostrand Company, Inc.: 1961.

Assignment:
1. Read and study the Introduction To Unit Nine on page 145 in the reference.
2. Work problems 1 through 7 on page 145.
3. Read and study Reduction of Fractions on page 146.
4. Work the first 15 problems in the Diagnostic Test on page 147.
5. Work the first 10 problems in the Related Practice Examples on page 147.
6. Read and study Multiplication of Fractions on page 148.
7. Work the problems in the Diagnostic Test on page 149.
8. Read and study Division of Fractions on page 150.
9. Work the problems in the Diagnostic Test on page 151.
10. Work the problems in SET 1 on page 151.

TECHNICAL TERMS

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INDUSTRIAL TECHNICAL MATHEMATICS-II

SUBJECT: Algebra--Fractions

Assignment M-II-27

Remarks and Purpose ____________________

Reference: ALGEBRA IN EASY STEPS with Modern Units--Edwin I. Stein; Princeton, New Jersey: D. Van Nostrand Company, Inc.: 1961.

Assignment:
1. Read and study Addition and Subtraction--Like Denominators on page 152 in the reference.
2. Work the problems in the Diagnostic Test A on page 153.
3. Work the problems in the Diagnostic Test B on page 154.
4. Work the problems in Related Practice Examples on pages 155 and 156.
5. Read and study Addition and Subtraction--Monomial Denominators on pages 156 and 157.
6. Work the problems in SET 1, 2, 3, and 4 on page 157.
7. Work the problems in the Diagnostic Test on page 158.

TECHNICAL TERMS

SAFETY

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ELECTRICIANS VOCATIONAL SCHOOL

INDUSTRIAL TECHNICAL MATHEMATICS-II

SUBJECT: Applied Algebra

Assignment M-II-27a

Remarks and Purpose ______________________________

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Reference: MATHEMATICS FOR ELECTRICIANS--Martin H. Kuehn; York, Pennsylvania: The Maple Press Company, McGraw-Hill Book Company, Inc.; Third Edition: 1958.

Assignment:
1. Work the problems 9 through 25 on page 53 in the reference.
2. Work the problems 5 through 12 on page 54.
3. Work the problems 5 through 9 on page 59.
4. Work the problems 51 through 57 on page 67.

TECHNICAL TERMS	SAFETY
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VT003 190

VT 003 190
Basic Mathematics for Electronics.

Electronics Vocational School, Bloomington, Ind.
Indiana State Dept. of Public Instruction, Indianapolis.
Indiana State Univ., Terre Haute. Instr. Materials Lab.
Pub Date - 63
MF AVAILABLE IN VT-ERIC SET 109p.

TEACHING GUIDES, *CURRICULUM GUIDES, STUDY GUIDES, *TRADE AND INDUSTRIAL EDUCATION, *ELECTRONIC TECHNICIANS, *MATHEMATICS, *ELECTRONICS, HIGH SCHOOLS, TESTS, INDIVIDUAL INSTRUCTION,

This course for use in electronic technician programs was designed to develop skill and knowledge in the use of fundamental mathematical skills for the solving of basic electronic problems. This revised teaching guide was prepared by an individual author after teaching the course and using the material for 2 years. It was developed on the concept and philosophy of using individual assignment sheets to allow each student to progress at his own rate and to enable the teacher to devote most of his time to individual instruction. Each of the 36 2-hour lessons has a teaching outline and a student assignment sheet. The outlines provide the textbook reference, discussion topics, the current homework assignment, and the advanced assignment. The assignment sheets contain the textbook reference, an introduction, new terms, the assignment, and the advanced assignment. Sample assignment subjects are Simple Electrical Circuits-Working with Formulas, Electrical Measurement, Graphs-Simultaneous Linear Equation, and Electrical Power. This book is designed for teacher use only. The student is to use the assignment sheets in loose unbound form. After he completes an assignment sheet, he returns it to the teacher and secures the next sheet. Tests are included periodically to identify the mathematical ability of the student. This document is available for $1.50 from Division of Industrial Education, Indiana State University, Terre Haute, Indiana 47809. (HC)

ELECTRONICS
VOCATIONAL
SCHOOL

BASIC

MATHEMATICS

BASIC MATHEMATICS
for
ELECTRONICS

(Revised - Summer 1963)

Electronics Vocational School

Bloomington, Indiana

State of Indiana
Division of Vocational Education
Trade-Industrial-Technical Education Branch

Instructional Materials Laboratory
Trade and Industrial Education
Indiana State College
Terre Haute, Indiana

MEMORANDUM

TO: The ERIC Clearinghouse on Vocational and Technical Education
The Ohio State University
980 Kinnear Road
Columbus, Ohio 43212

FROM: (Person) Thomas E. Eachus (Agency) Vocational Instructional Materials Laboratory

(Address) Division of Industrial Education. Indiana State University, Terre Haute

DATE: August 5, 1967

RE: (Author, Title, Publisher, Date) Basic Mathematics for Electronics - 1963

Supplementary Information on Instructional Material

Provide information below which is not included in the publication. Mark N/A in each blank for which information is not available or not applicable. Mark P when information is included in the publication. See reverse side for further instructions.

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Limitation on Available Copies none Price/Unit $1.50
(quantity prices)

(2) Means Used to Develop Material:
Development Group P
Level of Group P
Method of Design, Testing, and Trial P

(3) Utilization of Material:
Appropriate School Setting N/A
Type of Program Secondary
Occupational Focus P
Geographic Adaptability N/A
Uses of Material P
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(4) Requirements for Using Material:
Teacher Competency P
Student Selection Criteria N/A

Time Allotment P

Supplemental Media --
Necessary ____
Desirable ____ (Check Which)

Describe

Source (agency)
(address)

DIRECTIONS TO THE INSTRUCTOR

This course was developed around the concept and philosophy of using individual assignment sheets. If these sheets are used correctly, each student will be allowed to progress at his own rate. The abilities of all will be developed to their fullest extent.

The instructor only, should use this book. The loose individual assignment sheets are used by the students. The following method of operation has proven satisfactory:

Each student should have two folders in the file; one for the "completed" work, the other for the "incomplete" work. The assignment sheets should be filed in consecutive order in another drawer. The instructor should lay out the student folders before class time. This prevents congestion and a bottleneck around the file cabinet at the beginning and ending of class. When the student completes an assignment sheet, he turns this into the instructor, then secures the next sheet.

Tests are included periodically. These may be used to identify the mathematical ability of each student. This makes it possible to start the students at the proper level in the course. The tests may also be used in the traditional manner.

If the course is used as it should be, the instructor will be freed of many routine activities and will be able to devote his time almost entirely to individual instruction.

It must be kept in mind that the assignment sheets are only a teaching aid or device. Therefore, instruction is still necessary.

An accurate record of each student's progress should be kept by the instructor.

PREFACE

VOCATIONAL ELECTRONIC TECHNICIAN TRAINING

FUNDAMENTALS OF ELECTRONICS   BASIC ELECTRONIC MATHEMATICS

Basic Electronic Mathematics is designed to develop skill and knowledge in the use of fundamental mathematical skills for the solving of basic electronic problems. The course is composed of 36 class meetings of two hours each. A great deal of time will be spent on practice ard drill. There will be such a large amount of electronic theory that the student must use in more advanced courses that the math skills must be his own by the time he reaches that level. Self-discipline will be the key to success in reaching the development of these necessary skills, thereby furthering the students' knowledge in the field of electronics.

ACKNOWLEDGEMENT

Appreciation and acknowledgement is made to Tom Reckerd, former Vocational Coordinator of Bloomington High School, and to his committee consisting of Harold Fischel, Morris Robertson and John Robinson. The committee and all members of industry made it possible to relate this electronics course directly to the needs and applications of industry.

The revision, made in the fall of 1961, is a result of the cooperative efforts of Tom Reckerd, the instructors of Basic Electronics Mathematics at Bloomington, Bedford and Logootee; and the staff of the Instructional Materials Laboratory of Indiana State College. The secretarial staff also worked very diligently in order to produce this revision.

The second revision was made in the summer of 1963 by Robert Porter, Foreman, Sarkes Tarzian Incorporated, Tuner Division. Mr. Robert Porter made this revision after teaching this course and using this material for two years.

INDIANA DEPARTMENT OF PUBLIC INSTRUCTION
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INSTRUCTIONAL MATERIALS LABORATORY
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TEACHERS OUTLINE

VOCATIONAL ELECTRONIC TECHNICIAN TRAINING

FUNDAMENTALS OF ELECTRONICS

BASIC ELECTRONIC MATHEMATICS

Lesson 1
Introduction to Electronics

Reference:

1. Singer, Bertrand B., Basic Mathematics for Electricity, Radio and Television, McGraw-Hill Book Company.

I. Discussion Topics:

A. An element is the fundamental material whose properties are definable by chemistry and are not divisible by chemistry or ordinary methods.
Example: copper, lead, gold, etc.

B. The atom is the smallest portion of an element that still has all of the properties of the element.

1. All matter is electrical in nature.
2. The atom can be broken, but the pieces have none of the elemental properties.
3. Parts of the atom: protons, electrons, and neutrons

C. Structure of the atom

1. The nucleus contains the protons (+) and neutrons (neither charge).
2. The number of planetary electrons in the orbit is equal to the number of protons in the nucleus. Illustration H & He.

D. Free electrons

1. Electrons that are in the orbit farthest from the nucleus are loosely bound, and are called free electrons.
2. Demonstrate static electricity.

E. Electron flow

1. A flow of electrons occurs to do work. Use analogy of water and sand blast.

F. Voltage or pressure

1. Waterhead analogy: Water produced .431 lbs. of pressure per foot of head.
2. Electromotive potential of metals: carbon and zinc (1.5 volts); lead and sulphur (2.1 volts); nickel and iron (1.2 volts)

G. Coulomb, quantity of electricity 6.28×10^{18} electrons

H. Current

TEACHERS OUTLINE

VOCATIONAL ELECTRONIC TECHNICIAN TRAINING

FUNDAMENTALS OF ELECTRONICS — BASIC ELECTRONIC MATHEMATICS

Lesson I (Con't.)
Introduction to Electronics

1. Useful work can be done with motion of electrons. The speed of flow is almost equal to the speed of light. (Motion of electrons by interchange of free electrons) (Use analogy of billard balls.)
2. Current flow as analogous to water flow
3. Current flow of one ampere as defined in coulombs

I. Resistance

1. Conductors and non conductors, the differences in mobility and quality of free electrons
2. Symbol for ohms, the origin of ohm, George Simon Ohm, 1787-1854
3. International Standard; a column of Hg of uniform cross section is 106.3 cm. long and 14.45 grams in weight.
4. When a voltage of 1 volt causes a current flow of 1 amp, the circuit contains 1 ohm of resistance.
5. The resistance of 1,000 ft. of no. 10 copper wire is 1 ohm.
6. Devices that make use of resistance

J. Measurements and circuits, demonstration and lecture

1. Equipment required: DC voltmeter (1 to 10 volts Weston 901 or equivalent) 6 volt 1 amp source (battery or equivalent); DC ammeter (1 to 3 amps); resistor (6 ohms, 10 watts)
2. Placing the ammeter in the circuit
3. Placing the voltmeter in the circuit; the source or the load point
4. Description of equipment: ohmmeter; electrical circuit; open circuit
5. Fuses
   a. Purpose of fuse and construction of fuse
   b. Short circuit conditions
   c. Delayed fuses for motor starting purposes
6. Symbols; bring to attention of pupils (page 10 of Singer)

II. Discussion of Previous Assignment

III. Homework (current) Assignment: Read chapter 1, pages 1-12 in reference 1.

IV. Advanced Assignment: Read pages 13-17 to Multiplication of Fractions. Work the problems on pages 13, 15 and 17 in reference 1.

TEACHERS OUTLINE

VOCATIONAL ELECTRONIC TECHNICIAN TRAINING

FUNDAMENTALS OF ELECTRONICS — BASIC ELECTRONIC MATHEMATICS

Lesson 1 (Con't.)
Introduction to Electronics

1. Useful work can be done with motion of electrons. The speed of flow is almost equal to the speed of light. (Motion of electrons by interchange of free electrons) (Use analogy of billard balls.)
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ASSIGNMENT SHEET

VOCATIONAL ELECTRONIC TECHNICIAN TRAINING

FUNDAMENTALS OF ELECTRONICS

BASIC ELECTRONIC MATHEMATICS

Lesson 1
Introduction to Electronics

Reference:

1. Singer, Bertrand, B., Basic Mathematics for Electricity, Radio and Television, McGraw-Hill Book Company.

Introduction:

In this lesson we will introduce some basic electrical quantities. The purpose of introducing these new terms at this point is so that we may use electrical problems in the further study of mathematics.

New Terms:

1. Element
2. Atom
3. Electrons
4. Voltage
5. Current
6. Resistance
7. Series
8. Parallel

Assignment: Use reference listed above.

1. Write definitions in your own words for the above terms.

2. Read chapter 1, pages 1-12.

Advanced Assignment: Work as much of this assignment as you can before the next meeting.

1. Read chapter 2, pages 13-17 to Multiplication of Fractions.

2. Work the problems on pages 13, 15 and 17.

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TEACHERS OUTLINE

VOCATIONAL ELECTRONIC TECHNICIAN TRAINING

FUNDAMENTALS OF ELECTRONICS

BASIC ELECTRONIC MATHEMATICS

Lesson 2

Simple Electrical Circuits—Application of Fractions

Reference:

1. Singer, Bertrand B., Basic Mathematics for Electricity, Radio and Television, McGraw-Hill Book Company.

I. Discussion Topics:

A. Parts of fractions

1. Numerator 6 ← vinculum
   Denominator 27

2. The fraction denotes division. The denominator denotes how many equal parts the whole has been divided into (or the denomination of the parts). The numerator denotes how many parts of the given denomination are being considered. This is the real meaning of the fraction.

B. Reducing fractions

1. Rule—Divide the numerator and denominator by the same number until division is no longer possible. A fraction is reducible as long as both numerator and denominator can each be divided by the same number with quotients resulting in integers.

C. Proper and improper fractions

1. A fraction is defined as improper when the numerator is larger than the denominator. A fraction is proper when the inverse is true.

D. Mixed number

1. A mixed number is a number composed of an integer and a proper fraction.

E. Changing mixed numbers to improper fractions

1. Rule and explanation of rule

F. Changing improper fractions to mixed numbers

1. Rule and explanation of rule

II. Discussion of Previous Assignment

III. Homework (current) Assignment: Read chapter 2, pages 13-17 to Multiplication of Fractions. Work the problems on pages 13, 15 and 17 in reference 1.

IV. Advanced Assignment: Read pages 17-20 to Ohm's Law. Work the problems on pages 17, 18 and 19 in reference 1.

ASSIGNMENT SHEET

VOCATIONAL ELECTRONIC TECHNICIAN TRAINING

FUNDAMENTALS OF ELECTRONICS   BASIC ELECTRONIC MATHEMATICS

Lesson 2

Simple Electrical Circuits--Application of Fractions

Reference:

1. Singer, Bertrand B., Basic Mathematics for Electricity, Radio and Television, McGraw-Hill Book Company.

Introduction:

Lesson 2 is working with parts of numbers, fractions. The student should try to have a knowledge of relative size of two different fractions. Being able to change from a proper fraction to an improper fraction is a skill often found useful in electronics.

New Terms:

1. Fraction
2. Denominator
3. Numerator
4. Vinculum
5. Proper
6. Improper
7. Mixed number

Assignment: Use reference listed above.

1. Write definitions for the above terms.

2. Read chapter 2, pages 13-17 to Multiplication of Fractions.

3. Work the problems on pages 13, 15 and 17.

Advanced Assignment: Work as much of this assignment as you can before the next meeting.

1. Read pages 17-20 to Ohm's Law.

2. Work the problems on pages 17, 18 and 19.

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TEACHERS OUTLINE

VOCATIONAL ELECTRONIC TECHNICIAN TRAINING

FUNDAMENTALS OF ELECTRONICS

BASIC ELECTRONIC MATHEMATICS

Lesson 3

Simple Electrical Circuits—Application of Fractions

References:

1. Singer, Bertrand B., Basic Mathematics for Electricity, Radio and Television, McGraw-Hill Book Company.

2. Hart, Walter W., Workbook for First Course in Algebra, D. C. Heath and Company, Boston.

I. Discussion Topics:

A. Like denominator

1. Rule—When two fractions having a common denominator are to be added, add the numerator and affix the common denominator.

B. Unlike denominators

1. Rule—When two or more fractions having unlike denominators are to be added, change all of the fractions to fractions having a common denominator. Then, add the numerators and affix the common denominator.

C. The common denominator

1. Rule—The common denominator can be found by multiplying all of the denominators. This is seldom the least common denominator.

D. Changing the fractions to the least common denominator

1. Rule—Choose a value to be the least common denominator. Divide the denominator of the fraction to be changed, into this chosen denominator, then multiply the numerator of this fraction by the quotient just obtained. This is the numerator of the new fractions. Affix the chosen common denominator.

Example: $3/4 + 3/6 + 2/3$ Least common denominator is 12.

$(3)\ (3/4) = 9/12$

$(2)\ (3/6) = 6/12$

$(4)\ (2/3) = 8/12$

$9/12 + 6/12 + 8/12 = 23/12$ or $1\ \ 11/12$ or

$\frac{9 + 6 + 8}{12} = 23/12$ or $1\ \ 11/12$

TEACHERS OUTLINE

VOCATIONAL ELECTRONIC TECHNICIAN TRAINING

FUNDAMENTALS OF ELECTRONICS — BASIC ELECTRONIC MATHEMATICS

Lesson 3 (Con't.)
Simple Electrical Circuits—Application of Fractions

E. Addition of mixed numbers

1. Rule—Change to improper fractions having a common denominator and proceed as in the addition of fractions.

F. Multiplication of fractions

1. Rule—Place the product of the numerators over the product of the denominators and reduce to the lowest terms.

2. Cancellation with the problem
Example: $\overset{2}{\cancel{8}}/2 \times 3/\underset{1}{\cancel{4}} = 6/2 = 3$
Cancellation is reduction to lowest terms before completion of the problem.

G. Division by a fraction

1. Rule—To divide a number or fraction by another fraction, invert the divisor and multiply.
Example:

$$1/2\overline{)5} = 5/1 \times 2/1 = 10$$

$$3/2 \div 3/8 = \overset{1}{\cancel{3}}/\underset{1}{\cancel{2}} \times \overset{4}{\cancel{8}}/\underset{1}{\cancel{3}} = 4$$

II. Discussion of Previous Assignment

III. Homework (current) Assignment: Read pages 17-20 to Ohm's Law. Work the problems on pages 17, 18 and 19 in reference 1.

IV. Optional Assignment: This assignment should be given only if the student or students need additional practice.

Test 3, test 6 and test 7 of workbook in reference 2.

V. Advanced Assignment: Read pages 24-27 to Changing Formulas into Rules. Work the problems on pages 24 and 27 in reference 1.

ASSIGNMENT SHEET

VOCATIONAL ELECTRONIC TECHNICIAN TRAINING

FUNDAMENTALS OF ELECTRONICS — BASIC ELECTRONIC MATHEMATICS

Lesson 3

Simple Electrical Circuits—Application of Fractions

Reference:

1. Singer, Bertrand B., Basic Mathematics for Electricity, Radio and Television, McGraw-Hill Book Company.

Introduction:

Lesson 3 is to develop skill in the combined operations with fractions. Special care should be taken with the addition of fractions as this is used in the study of parallel electrical circuits.

New Terms:

1. Common denominator
2. Lowest common denominator

Assignment: Use reference listed above.

1. Write definitions for the above terms.

2. Read pages 17-20 to Ohm's Law.

3. Work the problems on pages 17, 18 and 19.

Advanced Assignment: Work as much of this assignment as you can before the next meeting.

1. Read pages 24-27 to Changing Formulas into Rules.

2. Work the problems on pages 24 and 27.

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TEACHERS OUTLINE

VOCATIONAL ELECTRONIC TECHNICIAN TRAINING

FUNDAMENTALS OF ELECTRONICS

BASIC ELECTRONIC MATHEMATICS

Lesson 4

Simple Electrical Circuits--Working with Formulas

References:

1. Singer, Bertrand B., Basic Mathematics for Electricity, Radio and Television, McGraw-Hill Book Company.

2. Hart, Walter W., Workbook for First Course in Algebra, D. C. Heath and Company, Boston.

I. Discussion Topics:

A. The general number

1. Definition--a general number is a letter or symbol substitute for a real number whose value is either known or unknown.

2. The use of the general number

a. Formulas - compact way of expression

b. Endless derivations possible by assignment of general numbers

B. Algebraic expressions

1. Definition--an expression that uses signs and/or symbols to express a mathematical relationship.

a. Numerical algebraic expression - signs and numbers only
Example: $8(6 + 2)$

b. Literal algebraic expression - signs and letters only
Example: $I(R + V)$

C. Factor definition

1. When two or more are multiplied together, any individual number, or the product of any combination of the number is a factor of the whole of the product.
Example: 2 ayz can be factored as: (a) (2yz), (2a) (yz), 2(ayz) etc.

D. Co-efficients

1. Any single factor of an expression is also the co-efficient as related to the rest of the parts; thus, in the above expression, 2 is the co-efficient of (ayz); a is the co-efficient of 2yz; etc.

TEACHERS OUTLINE

VOCATIONAL ELECTRONIC TECHNICIAN TRAINING

FUNDAMENTALS OF ELECTRONICS BASIC ELECTRONIC MATHEMATICS

Lesson 4 (Con't.)
Simple Electrical Circuits--Working with Formulas

2. One (1) is an understood co-efficient. This will later prove useful to know.

E. Sign of operation

1. +, -, ÷, and x still prevail.
2. Multiplication is indicated by (·) between symbols or by placing letters adjacent to each other.
3. Division is indicated by vinculum (–). $\frac{A}{Z}$

II. Discussion of Previous Assignment

III. Homework (current) Assignment: Read pages 24-27 to Changing Formulas into Rules. Work the problems on pages 24 and 27 in reference 1.

IV. Optional Assignment: This assignment should be given only if the student or students need additional practice.

Test 8 of workbook in reference 2.

V. Advanced Assignment: Read pages 27-30 to Job 2.6. Work the problems on page 30 in reference 1.

ASSIGNMENT SHEET

VOCATIONAL ELECTRONIC TECHNICIAN TRAINING

FUNDAMENTALS OF ELECTRONICS — BASIC ELECTRONIC MATHEMATICS

Lesson 4

Simple Electrical Circuits—Working with Formulas

Reference:

1. Singer, Bertrand B., Basic Mathematics for Electricity, Radio and Television, McGraw-Hill Book Company.

Introduction:

This is the first lesson where we are concerned with algebraic terms. This will be done using electrical formulas.

New Terms:

1. General numbers
2. Algebraic numbers
3. Arithmetic numbers
4. Term
5. Factor
6. Co-efficient
7. Sign of operation

Assignment: Use reference listed above.

1. Write definitions for the above terms.

2. Read pages 24-27 to Changing Formulas into Rules.

3. Work the problems on pages 24 and 27.

Advanced Assignment: Work as much of this assignment as you can before the next meeting.

1. Read pages 27-30 to Job 2.6.

2. Work the problems on page 30.

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TEACHERS OUTLINE

VOCATIONAL ELECTRONIC TECHNICIAN TRAINING

FUNDAMENTALS OF ELECTRONICS — BASIC ELECTRONIC MATHEMATICS

Lesson 5

Simple Electrical Circuits—Working with Formulas

References:

1. Singer, Bertrand B., Basic Mathematics for Electricity, Radio and Television, McGraw-Hill Book Company.
2. Hart, Walter W., Workbook for First Course in Algebra, D. C. Heath and Company, Boston.

I. Discussion Topics

A. Equations—definitions

1. General—An equation is a mathematical statement that one number or one quantity is equal to another number or another quantity.

B. An operation that is performed on one side of an equation must be performed on the other side or the equality will no longer exist.

C. A mathematical rule can be put into a formula, or vice-versa.

Example: Rule—The area of a rectangle is equal to its length times its width. Formula or equation $A = (L)(W)$ Show the converse, formula to rule.

D. Axioms

1. Addition: Equals added to equals are equal.

Example: $3 + 4 = 7$

$$(3 + 4) + 8 = 7 + 8$$
$$15 = 15$$

2. Subtraction: Equals subtracted from equals are equal.

Example: $83 - 2 = 81$

$$(83 - 2) - 8 = 81 - 8$$
$$73 = 73$$

3. Multiplication: Equals multiplied by equals are equal.

Example: $8 \times 4 = 32$

$$(8 \times 4) \times 10 = 32 \times 10$$
$$320 = 320$$

4. Division: Equals divided by equals are equal.

Example: $6 \div 2 = 3$

$$(6 \div 2) \div 3 = 3 \div 3$$
$$1 = 1$$

TEACHERS OUTLINE

VOCATIONAL ELECTRONIC TECHNICIAN TRAINING

FUNDAMENTALS OF ELECTRONICS

BASIC ELECTRONIC MATHEMATICS

Lesson 5 (Con't.)

Simple Electrical Circuits—Working with Formulas

5. Other axioms will be studied later.

E. Solution of the unknown

General procedure. Example: $E = IR$ find R
R is desired not I, so apply an axiom that will remove I such as $6 \times 4 = x$ above.
Divide both sides by I. $\frac{E}{I} = \frac{\cancel{I}R}{\cancel{I}}$ or $R = \frac{E}{I}$

II. Discussion of Previous Assignment

III. Homework (current) Assignment: Read pages 27-30 to Job 2.6. Work the problems on page 30 in reference 1.

IV. Optional Assignment: This assignment should be given only if the student or students need additional practice.

Tests 22, 23, 24 and 25 on both sides. Practice workbook in reference 2.

V. Advanced Assignment: Read pages 20-24 and 30-37 to Job 2.8. Work the problems on pages 23, 24, 35, 36 and 37 in reference 1.

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ASSIGNMENT SHEET

VOCATIONAL ELECTRONIC TECHNICIAN TRAINING

FUNDAMENTALS OF ELECTRONICS   BASIC ELECTRONIC MATHEMATICS

Lesson 5
Simple Electrical Circuits—Working with Formulas

Reference:

1. Singer, Bertrand B., Basic Mathematics for Electricity, Radio and Television, McGraw-Hill Book Company.

Introduction:

Lesson 5 concerns the use of developing and solving equations. Many times during the study of electronics the student must develop and solve his own equation. Sometimes it is easier to use several small equations to solve a process and sometimes it is easier to use one large equation. Processes which occur over and over again can best be described by a general equation. Substitution of arithmetic numbers in an algebraic equation changes a general description to a specific case.

New Terms:

1. Axioms
2. General
3. Specific
4. Unknown
5. Given

Assignment: Use reference listed above.

1. Write definitions for the above terms.

2. Read pages 27-30 to Job 2.6.

3. Work the problems on page 30.

Advanced Assignment: Work as much of this assignment as you can before the next meeting.

1. Read pages 20-24 and 30-37 to Job 2.8.

2. Work the problems on pages 23, 24, 35, 36 and 37.

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TEACHERS OUTLINE

VOCATIONAL ELECTRONIC TECHNICIAN TRAINING

FUNDAMENTALS OF ELECTRONICS — BASIC ELECTRONIC MATHEMATICS

Lesson 6
Simple Electrical Circuits—Ohms Law

References:

1. Singer, Bertrand B., Basic Mathematics for Electricity, Radio and Television, McGraw-Hill Book Company.

2. Hart, Walter W., Workbook for First Course in Algebra. D. C. Heath and Company, Boston.

I. Discussion Topics:

A. Ohms Law as stated by George Simon Ohm. Voltage drop is directly proportional to the product of the current and resistance. $E = IR$

1. Draw a simple labeled sketch on blackboard. Stress E = potential analogous to waterhead, energy of suspended weight, etc. Stress I flow analogous to water flow, falling weight, etc. Stress R resistance analogous to friction of air, etc.

B. Resistance, in terms of voltage and current.

1. Develop formula $R = \frac{E}{I}$, from $E = IR$

   Allow students to do so at their desks. Stress the axiom applied.

2. Allow students to apply the converse, transforming $R = \frac{E}{I}$ to $E = IR$ stress axiom involved.

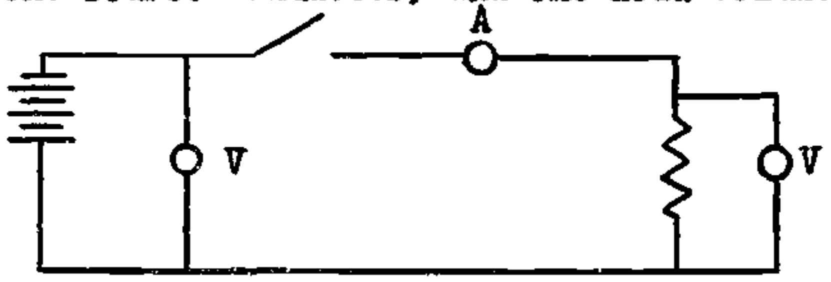
C. Current, in terms of voltage and current.

1. Develop formula $I = \frac{E}{R}$ from $E = IR$. Allow students to participate as in B 1 & 2.

2. Develop formula $I = \frac{E}{R}$ from $R = \frac{E}{I}$ (B • 2) Stress procedure and axioms.

3. Ask students what value of current results when $R = 0$.

D. Show 3 diagrams of simple series circuits; one resistor, one voltage source, one ammeter, one source voltmeter, and one load voltmeter.



TEACHERS OUTLINE

VOCATIONAL ELECTRONIC TECHNICIAN TRAINING

FUNDAMENTALS OF ELECTRONICS

BASIC ELECTRONIC MATHEMATICS

Lesson 6 (Con't.)
Simple Electrical Circuits—Ohm's Law

First,
$R = 8$ ohms $I = 2$ amps
$E = ?$ (16 volts) $V_R = ?$ (16 volts)

Second,
$E = 12$ volts $R = 3$ ohms
$I = ?$ (4 amps) $V_R = ?$ (12 volts)

Third,
$E = 24$ volts $I = 8$ amps
$R = ?$ (3 ohms) $V_R = ?$ (24 volts)

1. Stress (without allusion to Kirchoff's Law) that the voltage <u>must</u> be "used up".

E. Demonstrate procedure of solution of problem by blackboard demonstration of the following steps:

1. Read carefully
2. Diagram, if possible
3. Insert knowns of diagram
4. Write formula
5. Substitute known and unknown in formula
6. Solve
7. Table answers by units

II. Discussion of Previous Assignment

III. Homework (current) Assignment: Read pages 20-24 and 30-37 to Job 2.8. Work the problems on pages 23, 24, 35, 36 and 37 in reference 1.

IV. Optional Assignment: This assignment should be given only if the student or students need additional practice.

Tests 24, 25, back of 25, 26 and 27 of workbook in reference 2.

V. Advanced Assignment: Read pages 37-45 to Multiplication of Decimals. Work the problems on pages 30, 39, 44 and 45 in reference 1.

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VOCATIONAL ELECTRONIC TECHNICIAN TRAINING

FUNDAMENTALS OF ELECTRONICS

BASIC ELECTRONIC MATHEMATICS

Lesson 6
Simple Electrical Circuits--Ohm's Law

Reference:

1. Singer, Bertrand B., Basic Mathematics for Electricity, Radio and Television, McGraw-Hill Book Company.

Introduction:

Ohm's Law is an electrical equation describing the relationship between pressure, opposition, and electron flow. The student should learn this equation and how to adapt it to his particular situation.

New Terms:

1. Volts
2. Ohms
3. Amperes
4. Ohm's Law
5. Kirchoff's Law

Assignment: Use reference listed above.

1. Write definitions for the above terms.

2. Read pages 20-24 and 30-37 to Job 2.8.

3. Work the problems on pages 23, 24, 35, 36 and 37.

Advanced Assignment: Work as much of this assignment as you can before the next meeting.

1. Read pages 37-45 to Multiplication of Decimals.

2. Work the problems on pages 30, 39, 44 and 45.

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VOCATIONAL ELECTRONIC TECHNICIAN TRAINING

FUNDAMENTALS OF ELECTRONICS

BASIC ELECTRONIC MATHEMATICS

Lesson 7

Simple Electrical Circuits--Application of Decimals

Reference:

1. Singer, Bertrand B., Basic Mathematics for Electricity, Radi^ and Television, McGraw-Hill Book Company.

I. Discussion Topics:

A. Decimal fraction definition.
A decimal fraction is a number to the right of the decimal point; the denominator not shown, but understood by the number of places to the right of the point.

1. Examples:
.2 = 2/10 = two tenths
.22 = 22/100 = twenty-two hundredths
.222 = 222/1000 = two hundred twenty-two thousandths

or .2 .20 .200 .2000 etc.

B. Changing a common fraction to a decimal fraction
Rule--Always divide the numerator by the denominator.

1. Example: 1/8 = 8/1.00

C. Division of one decimal by another.
1. The rule of the carrot
The divisor and the dividend are multiplied by 10 or multipliers of ten without disturbing the value of the quotient.

D. Multiplication of one decimal with another.
1. Rule--Complete the multiplication until the product is obtained. In the product point off from right to left the same number of decimal places as the combined number of places in the multiplicand and the multiplier.

Example: .483 x .106

```
  .483      3 places
  .106    + 3 places
  ----    ----------
  2898      6 places
 483
 -----
 51198
```

Add number of zeros necessary when no integer is present, thus,
(.483) (.106) = .051198

E. Addition. Rule--Keep the decimal point in line in both the summates and the sum.

Lesson 7 (Con't.)
Simple Electrical Circuits—Application of Decimals

F. Degree of accuracy

G. Subtraction. Rule--Keep the decimal point in the minuend, subtrahend, and difference in line.

II. Discussion of Previous Assignment

III. Homework (current) Assignment: Read pages 37-45 to Multiplication of Decimals. Work the problems on pages 30, 39, 44 and 45 in reference 1.

IV. Advanced Assignment: Read pages 45-52. Work the problems on pages 46, 48, 49, 51 and 52 in reference 1.

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VOCATIONAL ELECTRONIC TECHNICIAN TRAINING

FUNDAMENTALS OF ELECTRONICS — BASIC ELECTRONIC MATHEMATICS

Lesson 7
Simple Electrical Circuits--Application of Decimals

Reference:

1. Singer, Bertrand B., Basic Mathematics for Electricity, Radio and Television, McGraw-Hill Book Company.

Introduction:

Many times in using numbers it is more convenient to use decimals instead of fractions. A fraction is an exact number where decimals usually describe a rounding off.

New Terms:

1. Decimal
2. Significant places
3. Three place accuracy
4. Rounding off

Assignment: Use reference listed above.

1. Write definitions for the above terms.

2. Read pages 37-45 to Multiplication of Decimals.

3. Work the problems on pages 30, 39, 44 and 45.

Advanced Assignment: Work as much of this assignment as you can before the next meeting.

1. Read pages 45-52.

2. Work the problems on pages 46, 48, 49, 51 and 52.

TEACHERS OUTLINE

VOCATIONAL ELECTRONIC TECHNICIAN TRAINING

FUNDAMENTALS OF ELECTRONICS

BASIC ELECTRONIC MATHEMATICS

Lesson 8

Simple Electrical Circuits—Further Study in Decimals

Reference:

1. Singer, Bertrand B., Basic Mathematics for Electricity, Radio and Television, McGraw-Hill Book Company.

I. Discussion Topics:

- A. Multiplication of decimals
  - 1. Demonstration and practice
    - a. Proper placement of decimal point
- B. Division of decimals
  - 1. Demonstration and practice
    - a. Dividing a whole number by a decimal or by a whole number (example 2-39)
    - b. Dividing a decimal by another decimal smaller than 1/10 (examples 2-40 and 2-41)
    - c. Dividing a very small decimal such as .00004 by another decimal (example 2-42)

II. Discussion of Previous Assignment

III. Homework (current) Assignment: Read pages 45-52. Work the problems on pages 46, 48, 49, 51 and 52 in reference 1.

IV. Advanced Assignment: Read pages 308-310 to Graphs. Work the problems on pages 308 and 309 in reference 1.

ASSIGNMENT SHEET

VOCATIONAL ELECTRONIC TECHNICIAN TRAINING

FUNDAMENTALS OF ELECTRONICS BASIC ELECTRONIC MATHEMATICS

Lesson 8

Simple Electrical Circuits--Further Study in Decimals

Reference:

1. Singer, Bertrand B., Basic Mathematics for Electricity, Radio and Television, McGraw-Hill Book Company.

Introduction:

Decimals are multiplied in exactly the same way that ordinary numbers are multiplied. However, in addition to the normal multiplication, the decimal point must be correctly set in the answer.

Assignment: Use reference listed above.

1. Read pages 45-52.

2. Work the problems on pages 46, 48, 49, 51 and 52.

Advanced Assignment: Work as much of this assignment as you can before the next meeting.

1. Read pages 308-310 to Graphs.

2. Work the problems on pages 308 and 309.

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TEACHERS OUTLINE

VOCATIONAL ELECTRONIC TECHNICIAN TRAINING

FUNDAMENTALS OF ELECTRONICS

BASIC ELECTRONIC MATHEMATICS

Lesson 9

Addition and Subtraction of Signed Numbers

References:

1. Singer, Bertrand B., Basic Mathematics for Electricity, Radio and Television, McGraw-Hill Book Company.

2. Hart, Walter W., Workbook for First Course in Algebra. D. C. Heath and Company, Boston.

I. Addition

A. The negative number.

1. The negative number mathematically defined.

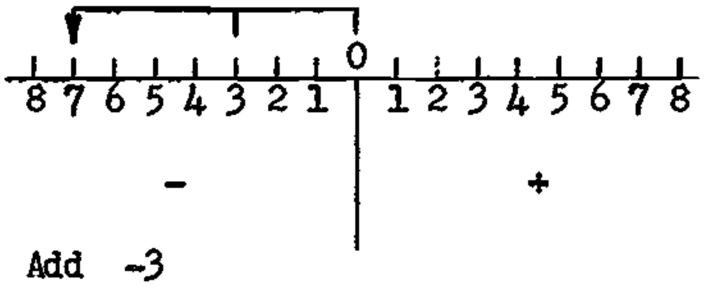
Subtraction $6 - 1 = 5$
$6 - 2 = 4$
$6 - 3 = 3$
$6 - 4 = 2$
$6 - 5 = 1$
$6 - 6 = 0$
$6 - 7 = -1$

2. The negative number as a reference point.

Example: 10.1.2.1. The auto ammeter
10.1.2.2. Temperature
10.1.2.3. Opposite directions from a given point

B. Graphical illustration of algebraic addition, three cases

1. Case 1. Two negative numbers



Add -3
$\underline{-4}$ Start from zero and go left for -3, add 4 more places for -4 and you come to -7.

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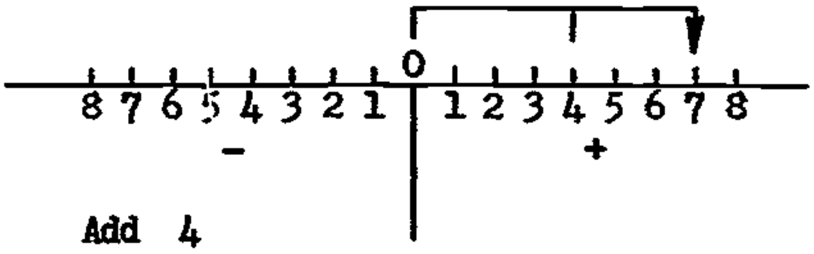
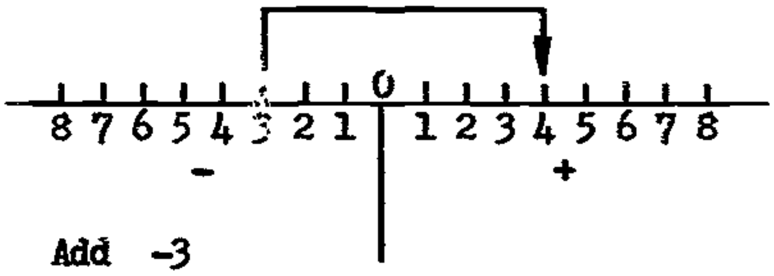
Lesson 9 (Con't.)
Addition and Subtraction of Signed Numbers

2. Case 2. Adding two positive numbers



Add 4
<u>3</u> Locate 4 on the right of zero. Proceed to mark off 3 more places to the right of this point. Answer is 7.

3. Case 3. Adding a positive number to a negative number



Add -3
<u>7</u> Locate -3 on graph. Proceed 7 steps to the right in direction going positive. Answer is 4.

C. Rule—Case 1 and 2, numbers having like signs. Find the arithmetical sum of the absolute number value and affix the common sign.
Example: $4 + 3 = 7$ and $-4 + -7 = -11$

D. Rule—Case 3, numbers having unlike signs. Find the numerical difference of the absolute number value and affix the sign of the greater number.
Example: $-4 + 8 = 4$ and $-18 + 7 = -11$

E. Addition of numbers having like terms

1. Rule—Add the numerical value algebraically and affix the common term.

   a. Example: \$5 + \$3 = \$8

   5 eggs + 8 eggs = 13 eggs (=baker's doz.)

   But, 5 apples + 2 pears = 5 apples + 2 pears
   unless the form is changed and a new name applied.

   Thus, $5a + 8a = 13a$ but, $4x + 2y = 4x + 2y$

F. Summarizing—Only like terms can be added by summing the numerical co-efficients.

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FUNDAMENTALS OF ELECTRONICS | BASIC ELECTRONIC MATHEMATICS

Lesson 9 (Con't.)
Addition and Subtraction of Signed Numbers

II. Subtraction

A. Stress the use of the graph method. The student is finding a difference.

Rule—Change the sign of the subtrahend and add algebraically.

B. Four general cases, work examples of each on the board.

1. Positive from a positive.

2. Negative from a positive

3. Negative from a negative

4. Positive from a negative

C. Have the students make up several problems and work as a group.

III. Homework (current) Assignment: Read pages 308-310. Work the problems on pages 309 and 310 by subtraction in reference 1.

IV. Optional Assignment: This assignment should be given only if the student or students need additional practice.

Work the test on pages 31, 32, 33 and 34 on both sides in reference 2.

V. Advanced Assignment: Read pages 156-162 to Job 7.8. Work the problems on pages 158, 160, 161 and 162 in reference 1.

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VOCATIONAL ELECTRONIC TECHNICIAN TRAINING

FUNDAMENTALS OF ELECTRONICS

BASIC ELECTRONIC MATHEMATICS

Lesson 9

Addition of Sign Numbers

Reference:

1. Singer, Bertrand B., Basic Mathematics for Electricity, Radio and Television, McGraw-Hill Book Company.

Introduction:

In lesson 9 we concern ourselves not only with signs of operation, but with signs of the number. Understanding of graphical method is most important. If a student fully understands this method of solution, the solving of AC circuits will be much easier.

New Terms:

1. Zero
2. Postive number
3. Negative number

Assignment: Use reference listed above.

1. Write definitions for the above terms.

2. Read pages 308-310 to Graphs.

3. Work the problems on pages 308, 309, & 310.

Advanced Assignment: Work as much of this assignment as you can before the next meeting.

1. Read pages 308-310.

2. Work the problems on pages 309 & 310 by subtraction.

3. Read pages 156-162 to job 7.8.

4. Work the problems on pages 158, 160, 161, & 162.

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VOCATIONAL ELECTRONIC TECHNICIAN TRAINING

FUNDAMENTALS OF ELECTRONICS

BASIC ELECTRONIC MATHEMATICS

Lesson 10
Sign Numbers—Multiplication and Division

References:

1. Singer, Bertrand B., Basic Mathematics for Electricity, Radio and Television, McGraw-Hill Book Company.
2. Hart, Walter W., Workbook for First Course in Algebra. D. C. Heath and Company, Boston.

I. Multiplication

A. Like signs. Rule—The product of two numbers having like signs is positive.

1. $(+2) \times (+3) = 6$ (plus sign understood)
2. $(+2) \times (+8) = 16$
3. $(-A) \times (-B) = AB$
4. $(-3A) \times (-4B) = 12\ AB$

B. Unlike signs. Rule—The product of two numbers having unlike signs is negative.

1. $(-2) \times (6) = -12$

   $(+2) \times (-6) = -12$

   $(-A) \times (B) = -AB$

   $(-3A) \times (+4AB) = -12A^2B$

C. Long problems with positive and negative numbers

1. Apply the above rules (A and B) successively.

D. Co-efficients and exponents, review.

1. Rule—Multiply first the co-efficient determining the sign as above, then the literal numbers, obeying the laws of the co-efficient.

   Example: $(-3A) \cdot (2A) \cdot (6B) \cdot (8B) \cdot (C) =$

   $(-3)\ (2)\ (6)\ (8)\ (A)\ (A)\ (B)\ (B)\ (C)$

   $(-288)\ (A^2)\ (B^2)\ (C) = -288\ A^2B^2C$

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VOCATIONAL ELECTRONIC TECHNICIAN TRAINING

FUNDAMENTALS OF ELECTRONICS — BASIC ELECTRONIC MATHEMATICS

Lesson 10 (Con't.)

Sign Numbers—Multiplication and Division

II. Division

A. The teacher should be sure that the student understands the development of the rules for sign numbers by graphical means.

B. Like signs. Rule—The quotient of two numbers having like signs is positive.

Example: $-8 \div -2 = 4$

$8 \div 2 = 4$

$-A \div -B = A/B$

C. Unlike signs. Rule—The quotient of two numbers having unlike signs is negative.

Example: $-8 \div 2 = -4$

$8 \div -2 = -4$

$6A \div -2B = \frac{-3A}{B}$

D. General procedure. Rule—Divide the numerical numbers first and affix the sign from the above rules (B and C). Then divide (or indicate) the literal numbers, obeying all the laws of exponents.

E. Indication of division

1. The fraction is an indicated division. Thus: $2/3$ means $2 \div 3$

$4/17$ means $4 \div 17$, etc.

Examples for D and E:

$$\frac{-6A^4}{2A^3} = \frac{-3A^4}{A^3} = -3A$$

$$\frac{-6A^3B^4C^8}{2A^3B^8C^8} = \frac{-3}{B^4} = -3B^{-4}$$

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Lesson 10 (Con't.)
Sign Numbers—Multiplication and Division

F. The vinculum

1. The vinculum is a sign of grouping. An operation that is involved in a fraction is subject to the vinculum as a sign of grouping.

$$\frac{3A - 4B}{5A - 2B}$$

G. Other signs of grouping: ( ) parenthesis, [ ] brackets, { } brace

H. No sign of grouping can be removed if preceeded by a - (minus) sign without first changing the sign of the expression within.

Example: $43AB - (-42CB) = 43AB + 42CB$ This can be visualized by placing the subtrahend in this case beneath the minuend. Another example: $6A - (42 - AB) (23 - 2B) - (3C - 2A) = 6A - 42 + AB + 23 - 2B - 3C + 2A$

III. Discussion of Previous Assignment

IV. Homework (current) Assignment: Read pages 308-310. Use the problems on pages 309 and 310 for multiplication and division in reference 1.

V. Optional Assignment: This assignment should be given only if the student or students need additional practice.

Work the test on pages 35, 36 and 42, also back of page 42 in reference 2.

VI. Advanced Assignment: Read pages 53-65. Work selected problems on pages 54, 57, 58, 64, 65 and 66 in reference 1.

ASSIGNMENT SHEET

VOCATIONAL ELECTRONIC TECHNICIAN TRAINING

FUNDAMENTALS OF ELECTRONICS BASIC ELECTRONIC MATHEMATICS

Lesson 10
Sign Numbers--Multiplication and Division

Reference:

1. Singer, Bertrand B., Basic Mathematics for Electricity, Radio and Television, McGraw-Hill Book Company.

Introduction:

In lesson 9 and 10 we became concerned with signs of the number as compared with signs of operation. In lesson 13 we will continue with the study of the sign of the number. Students in the past have had a great deal of trouble with multiplication and division of sign numbers. Perhaps at one time you memorized rules for these operations. If you have forgotten those rules, this should illustrate to you that a more thorough knowledge of the number system be used. In this lesson we invite you again to use your graphical method of solution. It will be slower at first, but once mastered you will have a firm foundation and never will be embarrassed by being caught without your rules.

Assignment: Use reference listed above.

1. Read pages 308-310.

2. Use the problems on pages 309 and 310 for multiplication and then division.

Advanced Assignment: Work as much of this assignment as you can before the next meeting.

1. Read pages 308-310.

2. Use the problems on pages 309 and 310 for division.

3. Read pages 53-65.

4. Work selected problems on pages 54, 57, 58, 64, 65 and 66.

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BASIC ELECTRONIC MATHEMATICS

Lesson 11

Electrical Power--Application of Exponents

Reference:

1. Singer, Bertrand B., Basic Mathematics for Electricity, Radio and Television, McGraw-Hill Book Company.

I. Discussion Topics:

A. The meaning of the exponent

1. Parts of the exponential number

3 exponent n exponent
2 base A base

2. The exponent. Definition. The exponent denotes the number of times the base is to be used as a factor, called the power.

a. Example $2^3 = 2 \times 2 \times 2 = 8$ $\qquad A^4 = A\cdot A\cdot A\cdot A$

B. Law of exponent in multiplication

1. To multiply two numbers having a common base but different exponents, add the exponents and affix the common base.

Proof: $A^3 = A^1\cdot A^1\cdot A^1 = A^{1+1+1} = A^3$

Thus $A^n \cdot A^m = A^{n+m}$ and $2\ A^3$ times $6\ A^4 = 12\ A^7$

C. Law of exponents in division

1. To divide two numbers having a common base but different exponents, subtract the exponent of the number in the divisor from the exponent of the number in the dividend and affix the common base.

Proof: $A^3\,\overline{)\,A^6} = \frac{A\ A\ A\ \cancel{A}\ \cancel{A}\ \cancel{A}}{\cancel{A}\ \cancel{A}\ \cancel{A}} = A^3$ or $\frac{A^6}{A^3} = A^{6-3} = A^3$

and $\frac{4A^6}{2A^2} = 2\ A^4$

D. The negative exponent

1. $\frac{A^4}{A^5} = \frac{A\cdot A\cdot A\cdot A}{A\cdot A\cdot A\cdot A\cdot A} = \frac{A^{-1}}{A}$ or $A^{4-5} = A^{-1}$ thus $A/A^2 = A^{-2}$ and $A/A^n = A^{-n}$

TEACHERS OUTLINE

VOCATIONAL ELECTRONIC TECHNICIAN TRAINING

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BASIC ELECTRONIC MATHEMATICS

Lesson 11 (Con't.)
Electrical Power--Application of Exponents

E. The zero exponent

1. $\frac{A^3}{A^3} = \frac{\cancel{A}\cdot\cancel{A}\cdot\cancel{A}}{\cancel{A}\cdot\cancel{A}\cdot\cancel{A}} = \frac{1}{1} = 1$ or $A^{3-3} = A^0 = 1$

   Any number to the zero power, except 0 is equal to 1.

F. The fractional exponent

1. Development $A = A^1$ The exponent can be factored by the laws of multiplication of exponents.

   Thus: $A = A^1 = A^{\frac{1}{2}+\frac{1}{2}} = A^{\frac{1}{2}} \cdot A^{\frac{1}{2}}$

   and $A^1 = A^{\frac{1}{4}+\frac{1}{4}+\frac{1}{4}+\frac{1}{4}} = A^{\frac{1}{4}} \cdot A^{\frac{1}{4}} \cdot A^{\frac{1}{4}} \cdot A^{\frac{1}{4}}$

G. The power of a power

1. To raise an exponent to an "n" power, multiply the exponent by that number.

   $(A^3)^2 = A^3 \cdot A^3 = A^{3+3} = A^6$ or $(A^3)^2 = A^{3\times2} = A^6$

   $(A^m)^n = A^{mn}$

H. Powers of 10, special exponentials

II. Discussion of Previous Assignment

III. Homework (current) Assignment: Read pages 156-162 to Job 7.8. Work the problems on pages 158, 160, 161 and 162 in reference 1.

IV. Advanced Assignment: Read pages 162-173. Work selected problems from pages 162, 171, 172 and 173 in reference 1.

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BASIC ELECTRONIC MATHEMATICS

Lesson 11
Electrical Power—Application of Exponents

Reference:

1. Singer, Bertrand B., Basic Mathematics for Electricity, Radio and Television, McGraw-Hill Book Company.

Introduction:

When working with numbers, we will often use the same number as a factor many times. There is a short method of expressing this situation. This method uses the exponent. Multiplication and division using the exponent is tricky at first, but will save much time in the manipulation of numbers.

New Terms:

1. Exponent
2. Base

Assignment: Use reference listed above.

1. Write definitions for the above terms.

2. Read pages 156-162 to Job 7.8.

3. Work the problems on pages 158, 160, 161 and 162.

Advanced Assignment: Work as much of this assignment as you can before the next meeting.

1. Read pages 162-173.

2. Work selected problems from pages 162, 171, 172 and 173.

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TEACHERS OUTLINE

VOCATIONAL ELECTRONIC TECHNICIAN TRAINING

FUNDAMENTALS OF ELECTRONICS — BASIC ELECTRONIC MATHEMATICS

Lesson 12
Electrical Power—Further Study in Exponents

Reference:

1. Singer, Bertrand B., Basic Mathematics for Electricity, Radio and Television, McGraw-Hill Book Company.

I. Discussion Topics:

A. The radical defined

1. The radical is a different method of expressing a fractional exponent.

Example: $A^{\frac{1}{2}}$ $\sqrt[2]{A}$ The two is omitted ordinarily, and the index number is understood as 2 unless otherwise specified.

$$\underset{\text{index}}{n}\sqrt{\overline{A}}\;\text{—radical}\qquad \xleftarrow{\text{vinculum}}$$

index—$\sqrt[n]{A}$ —radical ← vinculum

2. In a fractional exponent having a numerator other than 1, the numerator is expressed as the power of the radicand while the denominator is expressed as the index number of the radical.

Example: $A^{3/7}$ $\sqrt[7]{A^3}$ $A^{m/n}$ $\sqrt[n]{A^m}$

B. Multiplication

1. Radicals having a common radicand but unlike indexes

Example: $\sqrt[9]{8}$ $\sqrt[8]{8}$

Consider as fractional exponents:

$\sqrt[9]{8}$ $\sqrt[8]{8}$ $8^1/9$ $8^1/8$ $8^8/7^2$ $8^9/7^2$ $8^{17}/7^2$ $\sqrt[7^2]{8^{17}}$

C. Arithmetical square root

1. Demonstration of problem and procedure $\sqrt{482.34}$ = 21.96 answer—21.96

$$\begin{array}{rr}
 & 21.96 \\
 & \sqrt{482.34} \\
 & \underline{4} \\
41 & 82 \\
 & \underline{41} \\
429 & 4134 \\
 & \underline{3861} \\
4386 & 27300 \\
 & \underline{26316}
\end{array}$$

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BASIC ELECTRONIC MATHEMATICS

Lesson 12 (Con't.)

Electrical Power—Further Study in Exponents

II. Discussion of Previous Assignment

III. Homework (current) Assignment: Read pages 162-173. Work selected problems from pages 162, 171, 172 and 173 in reference 1.

IV. Advanced Assignment: Read pages 308-310. Use the problems on pages 309 and 310 for multiplication in reference 1.

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FUNDAMENTALS OF ELECTRONICS BASIC ELECTRONIC MATHEMATICS

Lesson 12

Electrical Power—Further Study in Exponents

Reference:

1. Singer, Bertrand B., Basic Mathematics for Electricity, Radio and Television, McGraw-Hill Book Company.

Introduction:

In lesson 11 we become familiar with the whole numbered exponents. In lesson 12 we will work with the fractional exponent. This is one method of illustrating root problems. Sometimes it is convenient to express roots using the radical while other times the exponent makes the problem seem easier. The easiest way is always the way the student understands at the moment the problem is to be solved. Once a problem has been solved, however, we should review our methods to see if we might not be able to improve our methods for next time. This often entails learning new skills and many hours of practice.

New Terms:

1. Radical
2. Root

Assignment: Use reference listed above.

1. Write definitions for the above terms.

2. Read pages 162-173.

3. Work selected problems from pages 162, 171, 172 and 173.

Advanced Assignment: Work as much of this assignment as you can before the next meeting.

1. Read pages 308-310.

2. Use the problems on pages 309 and 310 for multiplication.

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Lesson 13
Electrical Measurement

Reference:

1. Singer, Bertrand B., Basic Mathematics for Electricity, Radio and Television, McGraw-Hill Book Company.

I. Discussion Topics:

A. Discuss the kilowatt hour and compute the cost of operation of some home appliances.

B. Discuss meter scales. Obtain as many V. O. M. as possible and practice reading the scales. A variable power supply would be a great help.

II. Discussion of Previous Assignment

III. Homework (current) Assignment: Read pages 53-65. Work the selected problems on pages 54, 57, 58, 64, 65 and 66 in reference 1.

IV. Advanced Assignment: Read pages 67-75. Work the problems on pages 71, 72 and 74 in reference 1.

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VOCATIONAL ELECTRONIC TECHNICIAN TRAINING

FUNDAMENTALS OF ELECTRONICS

BASIC ELECTRONIC MATHEMATICS

Lesson 13
Electrical Measurement

Reference:

1. Singer, Bertrand B., Basic Mathematics for Electricity, Radio and Television, McGraw-Hill Book Company.

Introduction:

A series circuit is a circuit such that the current has only one path to follow. It is not a circuit unless there is a source of E. M. F., a load, a set of conductors, and some means of controlling the current flow. Lesson 13 is concerned with measuring its units, E. M. F., current and load.

New Terms:

1. Kilowatt hour
2. Meter sensitivity
3. Full scale
4. Multi-range

Assignment: Use reference listed above.

1. Write definitions for the above terms.

2. Read pages 53-65.

3. Work the selected problems on pages 54, 57, 58, 64, 65 and 66.

Advanced Assignment: Work as much of this assignment as you can before the next meeting.

1. Read pages 67-75.

2. Work the problems on pages 71, 72 and 74.

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BASIC ELECTRONIC MATHEMATICS

Lesson 14
Series Circuits

Reference:

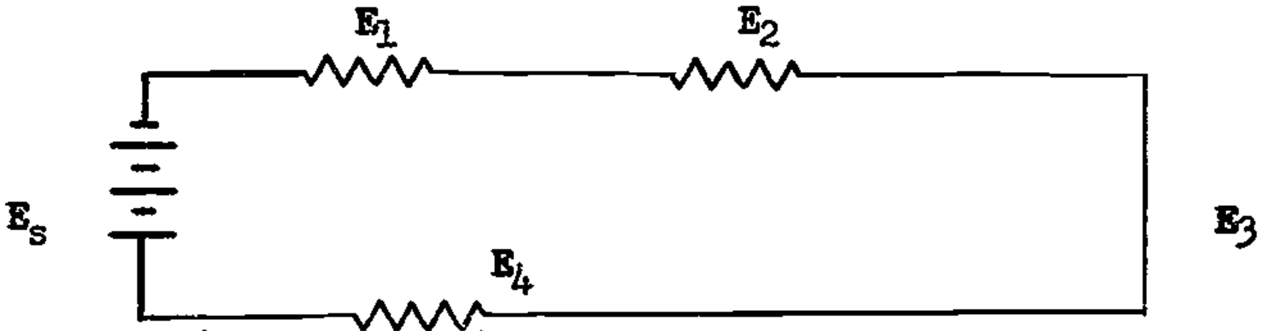
1. Singer, Bertrand B., Basic Mathematics for Electricity, Radio and Television, McGraw-Hill Book Company.

I. Discussion Topics:

A. Law of current. The current in the series circuit is the same throughout any portion of the circuit.

1. This is logical as there is but one single path by definition of a series circuit. Draw illustration.

B. Law of voltage. The sum of the voltage drops throughout the parts of the series circuit is equal to the supply voltage. Or stated differently, the algebraic sum of all the voltage drops in a series circuit equals zero (Kirchoff's Law).



Starting from A (above circuit)

$$E_1 + E_2 + E_3 + E_4 - E_s = 0$$

E_s is minus because in our trace of the circuit it is opposite polarity to all of the other voltages.

C. Law of resistance in the series circuit

1. Resistance, total of the series circuit, has already been established as equal to total voltage over total current. Since the current is equal in all parts of the circuit then the following relationship (circuit of B) is noted:

$$\frac{E_s}{I_s} = \frac{E_1}{I_s} + \frac{E_2}{I_s} + \frac{E_3}{I_s} + \frac{E_4}{I_s}$$

Then by inspection it is obvious that $R_T = R_1 + R_2 + R_3 + R_4 + \ldots R_n$

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Lesson 14 (Con't.)
Series Circuits

D. Current control by adding resistance

1. When the voltage of the source and the resistance of the load is fixed, rated current of the load can be controlled by adding resistance.

A. Problem. A shunt wound motor field draws 2 amps with a 40 ohm resistor in series, the voltage of the source being 150 volts. To increase the speed by 20% the field current must be reduced to 1.5 amps. What change is necessary?

(1) Draw diagram first.
(2) Volts across R of 40 ohms by $E = IR$
$E = (40)\ (2) = 80$ volts
(3) Volts across field before change by Kirchoff's voltage law
150 volts = 80 volts + E_f
$E_f = 150 - 80 = 70$ volts
(4) $R_{field} = \frac{E \text{ source}}{I \text{ before change}} = \frac{70}{2} = 35$ ohm
(5) New current required 1.5 amps. New voltage across field = $(1.5)\ (35) = 52.5$ volts.
(6) New voltage across R (Kirchoff's Voltage Law)
150 volts = 52.5 volt + E_R
$E_R = 150$ volts $- 52.5$ volts $= 97.5$ volts
(7) New R_{field} for change of current $R_f = \frac{E}{I} = \frac{97.5}{1.5} = 65$ ohm
(8) Change required $65 - 40 = 25$ ohm

E. Voltage control by adding resistance

1. When the source voltage and allowed load voltage are fixed, the load voltage can be lowered by adding resistance.

A. Problem example: Source – 6 volts
Load – filaments 1.5 volts, 45 amp.
Resistance required?

Solution

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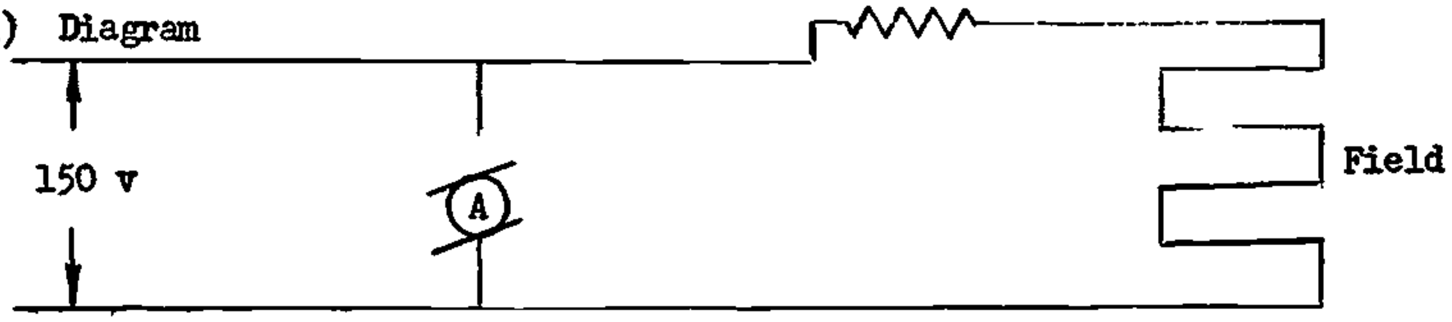
(1) Diagram



(2) R must drop ? volts by Krichoff's Voltage Law. $6 = 1.5v + E_R$

$E_R = 6 - 1.5 = 4.5$ volts

(3) $R = E/I = 4.5v/.45a = 10$ ohm

II. Discussion of Previous Assignment

III. Homework (current) Assignment: Read pages 67-75. Work the problems on pages 71, 72 and 74 in reference 1.

IV. Advanced Assignment: Read pages 75-82. Work selected problems on pages 78, 79, 80 and 81 in reference 1.

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BASIC ELECTRONIC MATHEMATICS

Lesson 14
Series Circuits

Reference:

1. Singer, Bertrand B., Basic Mathematics for Electricity, Radio and Television, McGraw-Hill Book Company.

Introduction:

AT LAST! In this lesson we are scheduled to study series circuits. This lesson will give you a chance to show off some of your math skills in the solution of electrical problems.

New Terms:

1. Current
2. Resistance
3. Voltage
4. Series
5. Load

Assignment: Use reference listed above.

1. Write definitions for the above terms.

2. Read pages 67-75.

3. Work the problems on pages 71, 72 and 74.

Advanced Assignment: Work as much of this assignment as you can before the next meeting.

1. Read pages 75-82.

2. Work selected problems on pages 78, 79, 80 and 81.

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BASIC ELECTRONIC MATHEMATICS

Lesson 15
Series Circuits

Reference:

1. Singer, Bertrand B., Basic Mathematics for Electricity, Radio and Television, McGraw-Hill Book Company.

I. Discussion Topics:

A. In using Ohm's Law, one should realize that its relationships are good for the whole circuit or any single part of it. In lesson 17, we will get some more practice in applying Ohm's Law to a total circuit.

II. Homework (current) Assignment: Read pages 75-82. Work the selected problems on pages 78, 79, 80 and 81 in reference 1.

III. Additional Discussion Topics:

A. Addition and subtraction as used in equation solving

B. Solving equations for current

C. Review series circuits.

IV. Discussion of Previous Assignment

V. Homework (current) Assignment: Read pages 83-93. Work the selected problems on pages 84, 85, 87, 91, 92 and 93 in reference 1.

VI. Advanced Assignment: Review chapter 4 in reference 1 and prepare for actual series circuit laboratory next week.

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BASIC ELECTRONIC MATHEMATICS

Lesson 15
Series Circuits

Reference:

1. Singer, Bertrand B., Basic Mathematics for Electricity, Radio and Television, McGraw-Hill Book Company.

Introduction:

Ohm's Law was used in the last job to find the voltage, current, and resistance of the individual parts of a series circuit. Ohm's Law may also be used to find the total values of voltage, current and resistance in a series circuit.

New Terms:

1. Total voltage
2. Total current
3. Total resistance
4. Total power

Assignment: Use reference listed above.

1. Write definitions for the above terms.
2. Read pages 75-93.
3. Work the selected problems on pages 78, 79, 80, 81, 84, 85, 87, 91, 92, and 93.

Advanced Assignment:

1. Review chapter 4 in reference 1 and prepare for actual series circuit laboratory next week.

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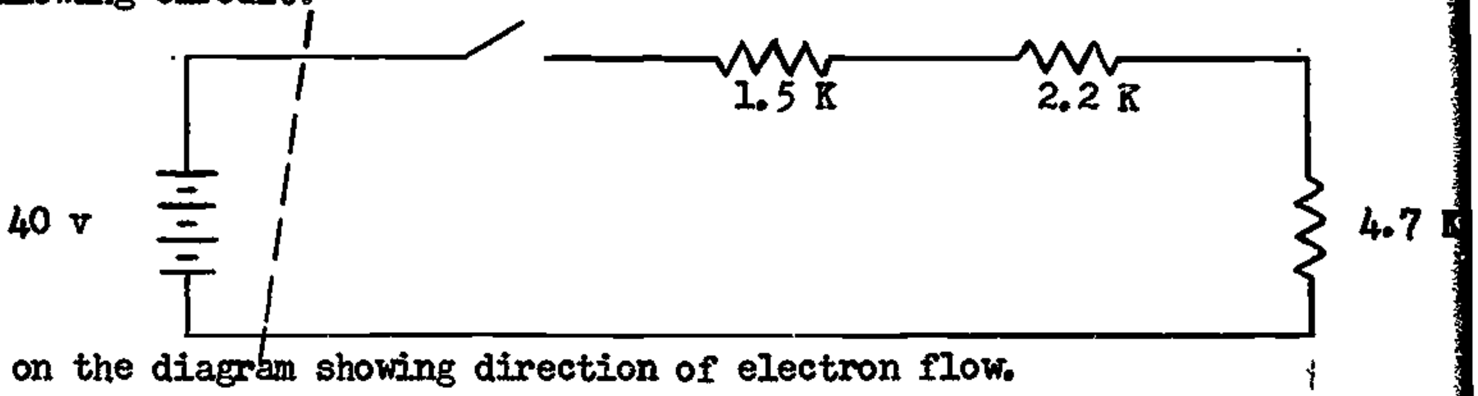
Lesson 16.
Laboratory Series Circuits

Reference:

1. Singer, Bertrand B., Basic Mathematics for Electricity, Radio and Television, McGraw-Hill Book Company.

I. Discussion Topics:

A. Wire the following circuit:



B. Draw arrows on the diagram showing direction of electron flow.

C. Place - and + signs on each resistor showing polarity of voltage drop across each one.

D. Place V. O. M. on 50 volt scale and measure voltage across each resistor only: 1.5 K, 2.2 K, 4.7 K, E total.

1.5 K —
2.2 K —
4.7 K —
E T —

E. Put the minus lead on the minus side of the power supply.

Then place the plus lead on the plus side of power supply.

Then plus side 2.2 K ____________________

Then plus side 4.7 K ____________________

Then minus side 4.7 K ____________________

F. Does this check out? (Step 5)

G. Turn circuit off.

H. Check with instructor before storing equipment to see if data is correct.

Lesson 16 (Con't.)
Laboratory Series Circuits

II. Discussion of Previous Assignment

III. Homework (current) Assignment: Review chapter 4 in reference 1 and prepare for actual series lab for next week.

IV. Advanced Assignment: Test covering chapter 4 and lab procedure, series circuits.

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FUNDAMENTALS OF ELECTRONICS

BASIC ELECTRONIC MATHEMATICS

Lesson 16
Laboratory Series Circuits

Reference:

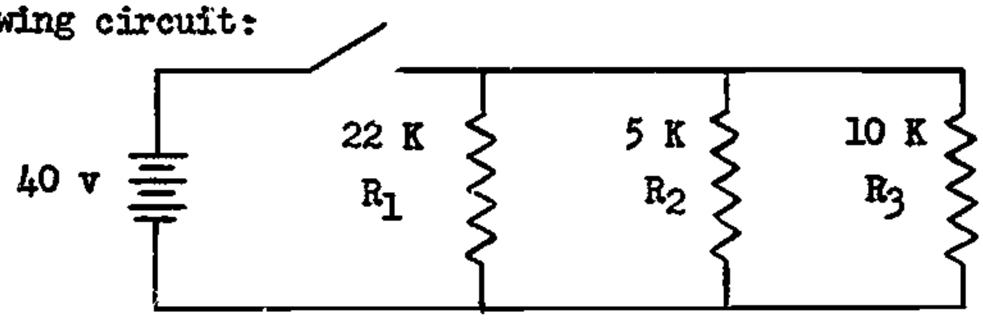
1. Singer, Bertrand B., Basic Mathematics for Electricity, Radio and Television, McGraw-Hill Book Company.

Introduction:

This lesson is to illustrate and prove or disprove Ohm's Law.

Discussion Topics:

1. Wire the following circuit:



2. Draw arrows on the diagram showing direction of electron flow.

3. Place - and + signs on each resistor showing polarity of voltage drop across each one.

4. Place V. O. M. on 50 volt scale and measure voltage across each resistor only: 1.5 K, 2.2 K, 4.7 K, E total.

   1.5 K --
   2.2 K --
   4.7 K --
   E t --

5. Put the minus lead on the minus side of the power supply.

   Then place the plus lead on the plus side of power supply.

   Then plus side 2.2 K ______________________________

   Then plus side 4.7 K ______________________________

   Then minus side 4.7 K ______________________________

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Lesson 16 (Con't.)
Laboratory Series Circuits

6. Does this check out? (Step 5)
7. Turn circuit off.
8. Check with instructor before storing equipment to see if data is correct.

Assignment: Use reference listed above.

1. Review chapter 4 and prepare for actual series lab for next week.

Advanced Assignment: Test covering chapter 4 and lab procedure, series circuits.

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BASIC ELECTRONIC MATHEMATICS

Lesson 17
Test Series Circuits

Reference:

1. Singer, Bertrand B., Basic Mathematics for Electricity, Radio and Television, McGraw-Hill Book Company.

I. Discussion Topics:

A. The first hour should be used to review the laboratory experiment and to work any problems in Singer that may be giving trouble.

II. Discussion of Previous Assignment

III. Advanced Assignment: Read pages 218-226 to Job 9.3. Work the selected problems from pages 218-226 in reference 1.

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VOCATIONAL ELECTRONIC TECHNICIAN TRAINING

FUNDAMENTALS OF ELECTRONICS — BASIC ELECTRONIC MATHEMATICS

Lesson 17
Test Series Circuits

Reference:

1. Singer, Bertrand B., Basic Mathematics for Electricity, Radio and Television, McGraw-Hill Book Company.

Introduction:

The following test should take the best student an hour to complete. The instructor will hand out a test on series circuits that he has made. Be sure and show the formulas used, the original substitution of numbers and your answers complete with the labels or names.

Advanced Assignment: Work as much of this assignment as you can before the next meeting.

1. Read pages 218-226 to Job 9.3.
2. Work the selected problems from pages 218-226 in reference 1.

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BASIC ELECTRONIC MATHEMATICS

Lesson 18

Percentages

Reference:

1. Singer, Bertrand B., Basic Mathematics for Electricity, Radio and Television, McGraw-Hill Book Company.

I. Discussion Topics:

A. Meaning of per cent

1. Definition—literally, the word per cent means by the hundred. Thus, the word means:
    a. Number of units considered out of one hundred such units.
    b. Number of equal parts considered out of one hundred such equal parts of the whole.

B. The whole number per cent designates how many 1/100 parts.

1. 6% means 6 equal parts out of one hundred equal parts: therefore, 6% = .06 or 6/100 of the whole.

C. Per cent to decimal and decimal to per cent

1. If 6% = .06 = 6/100, then to change a per cent to a decimal, divide the % by 100. (Move decimal two places to left)

2. To change a decimal to per cent, multiply by 100.

D. Expressions

1. What per cent is M of N? Solution: divide N by M.
Thus, what per cent is 14 of 28? Solution: 14/28 = .5 = 50%

2. Per cent change

a. A resistor, cold, measures 42 ohms. Because of its temperature coefficient it measures 48 ohms, when carrying rated load current.
What per cent change does this represent?

Solution:
1. Subtract 42 ohms from 48 ohms.
2. This gives actual change in ohms.
3. Compare the change of ohms to the original resistance.
Thus, 6 ohms (change) is what per cent of 42 ohms.
$42\overline{)\,6\quad} = .14$

If the resistor had been 100 ohms, the actual change of resistance would have been 14 ohms.

Lesson 18 (Con't.)

Percentages

3. Per cent of N

(a) To find the per cent of N, change the designated per cent to a decimal and multiply times N.

Example: What is 8% of $600.00.

8% = .08 (.08) ($600) = $48

II. Homework (current) Assignment: Read pages 218-226. Work the selected problems from pages 218-226 in reference 1.

III. Discussion Topic: Efficiency

Often one needs to know the output or the input of a certain device that operates at a certain efficiency. Lesson 18 will give us practice in computing these values.

IV. Homework (current) Assignment: Read pages 230-234. Work the problems on pages 232-234 in reference 1.

V. Advanced Assignment: Read pages 94-102. Work the problems on pages 98, 99, 101 and 102 in reference 1.

ASSIGNMENT SHEET

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Lesson 18
Percentages

Reference:

1. Singer, Bertrand B., Basic Mathematics for Electricity, Radio and Television, McGraw-Hill Book Company.

Introduction:

We have studied parts of numbers expressed as fractions. Many times it is more convenient to express numbers as decimals and per cents. Tolerances and specifications are often given in per cents.

New Terms:

1. Per cent
2. Decimal
3. Tolerance
4. Horse power
5. Power transfer

Assignment: Use reference listed above.

1. Read pages 218-226.
2. Work the problems on pages 218-226.
3. Read pages 230-234.
4. Work the problems on pages 232-234.

Advanced Assignment: Work as much of this assignment as you can before the next meeting.

1. Read pages 94-102.
2. Work the problems on pages 98, 99, 101 and 102.

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BASIC ELECTRONIC MATHEMATICS

Lesson 19
Parallel Circuits

Reference:

1. Singer, Bertrand B., Basic Mathematics for Electricity, Radio and Television, McGraw-Hill Book Company.

I. Discussion Topics:

   A. Branches

   B. Kirchoff's Law

   C. Equivalent resistance

   D. Lowest common denominator

II. Discussion of Previous Assignment

III. Homework (current) Assignment: Read pages 94-111. Work the problems on pages 98, 99, 101, 102, 105, 107 and 109 in reference 1.

IV. Advanced Assignment: Read pages 111-117. Work the selected problems on pages 115, 116 and 117 in reference 1.

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FUNDAMENTALS OF ELECTRONICS

BASIC ELECTRONIC MATHEMATICS

Lesson 19
Parallel Circuits

Reference:

1. Singer, Bertrand B., Basic Mathematics for Electricity, Radio and Television, McGraw-Hill Book Company.

Introduction:

A parallel circuit is a circuit connecting in such a manner that the current flow into it flows in one path.

New Terms:

1. Branches
2. Equivalent resistance

Assignment: Use reference listed above.

1. Write definitions for the above terms.
2. Read pages 94-111.
3. Work the problems on pages 98, 99, 101, 102, 105, 107 and 109.

Advanced Assignment: Work as much of this assignment as you can before the next meeting.

1. Read pages 111-117.
2. Work the selected problems on pages 115, 116 and 117.

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BASIC ELECTRONIC MATHEMATICS

Lesson 20
Parallel Circuits

Reference:

1. Singer, Bertrand B., Basic Mathematics for Electricity, Radio and Television, McGraw-Hill Book Company.

I. Discussion Topics:

A. In lesson 20 we will have some practice in solving parallel circuits for total resistances. The student should have practice using Ohm's Law and total voltage divided by total current as well as the use of reciprocal formula. Special case formulas should be discouraged as much as possible. The assumed voltage method of solution does have a place after the student has established proficiency in the standard methods of solution.

II. Discussion of Previous Assignment

III. Homework (current) Assignment: Read pages 111-117. Work the problems on pages 115, 116 and 117 in reference 1.

IV. Advanced Assignment: Read pages 117-126. Work the problems on pages 118, 119, 122, 123, 125 and 126 in reference 1.

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FUNDAMENTALS OF ELECTRONICS

BASIC ELECTRONIC MATHEMATICS

Lesson 20
Parallel Circuits

Reference:

1. Singer, Bertrand B., Basic Mathematics for Electricity, Radio and Television, McGraw-Hill Book Company.

Introduction:

When resistances are connected in parallel, the total resistance is always less than the resistance of any branch. When resistances are added to a circuit in parallel, they merely provide extra paths for the current to flow. Each extra path will draw its own current from the voltage source, increasing the total current drawn. But resistance is that quality of a circuit which attempts to stop the flow of current. If the addition of a resistance increases the current, then this resistance must be reduced to total resistance.

New Terms:

1. Reciprocal
2. Assumed voltage

Assignment: Use reference listed above.

1. Write definitions for the above terms.
2. Read pages 111-117.
3. Work the problems on pages 115, 116 and 117.

Advanced Assignment: Work as much of this assignment as you can before the next meeting.

1. Read pages 117-126.
2. Work the problems on pages 118, 119, 122, 123, 125 and 126.

TEACHERS OUTLINE

VOCATIONAL ELECTRONIC TECHNICIAN TRAINING

FUNDAMENTALS OF ELECTRONICS — BASIC ELECTRONIC MATHEMATICS

Lesson 21
Parallel Circuits

Reference:

1. Singer, Bertrand B., Basic Mathematics for Electricity, Radio and Television, McGraw-Hill Book Company.

I. Discussion Topics:

A. Lesson 21 will wind up our study of practice problems in parallel circuits. We are after proficiency in this lesson. Total voltage and current division are topics used here as well as a general review.

II. Discussion of Previous Assignment

III. Homework (current) Assignment: Read pages 117-126. Work the problems on pages 118, 119, 122, 123, 125 and 126 in reference 1.

IV. Advanced Assignment: Laboratory Parallel Circuits

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BASIC ELECTRONIC MATHEMATICS

Lesson 21
Parallel Circuits

Reference:

1. Singer, Bertrand B., Basic Mathematics for Electricity, Radio and Television, McGraw-Hill Book Company.

Introduction:

In lesson 21 we will have our final discussion concerning parallel circuits before a natural laboratory situation is attempted. If there are any problems which develop about parallel circuits, they should be solved during this lesson.

New Terms:

1. Current division
2. Line current

Assignment: Use reference listed above.

1. Write definitions for the above terms.
2. Read pages 117-126.
3. Work the problems on pages 118, 119, 123, 125 and 126.

Advanced Assignment: Work as much of this assignment as you can before the next meeting.

1. Laboratory Parallel Circuits

TEACHERS OUTLINE

VOCATIONAL ELECTRONIC TECHNICIAN TRAINING

FUNDAMENTALS OF ELECTRONICS — BASIC ELECTRONIC MATHEMATICS

Lesson 22

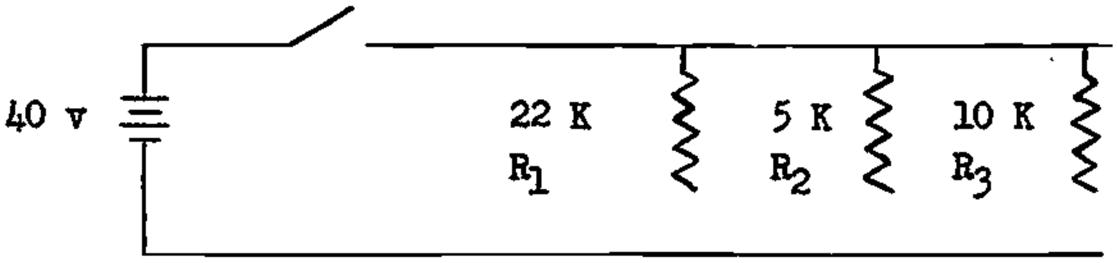
Laboratory Parallel Circuits

Reference:

1. Singer, Bertrand B., Basic Mathematics for Electricity, Radio and Television, McGraw-Hill Book Company.

I. Discussion Topics:

A. Wire the following circuit:



B. Draw arrows showing current flow.

C. Place + and - signs on resistors showing polarity.

D. Measure and record.

E_1 = ______

E_2 = ______

E_3 = ______

E_T = ______

E. Measure and record.

I_1 =

I_2 =

I_3 =

I_T =

F. From experimental data, compute R_1 =

R_2 =

R_3 =

R_T =

TEACHERS OUTLINE

VOCATIONAL ELECTRONIC TECHNICIAN TRAINING

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Lesson 22 (Con't.)

Laboratory Parallel Circuits

G. Compute R_T from rated value of resistors.

H. What is the per cent of error of measured value of R_T (step 6) and theoretical value (step 7)?

II. Discussion of Previous Assignment

III. Homework (current) Assignment: Laboratory Parallel Circuits

IV. Advanced Assignment: Examination. Read chapter 5 and do the laboratory work on parallel circuits.

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BASIC ELECTRONIC MATHEMATICS

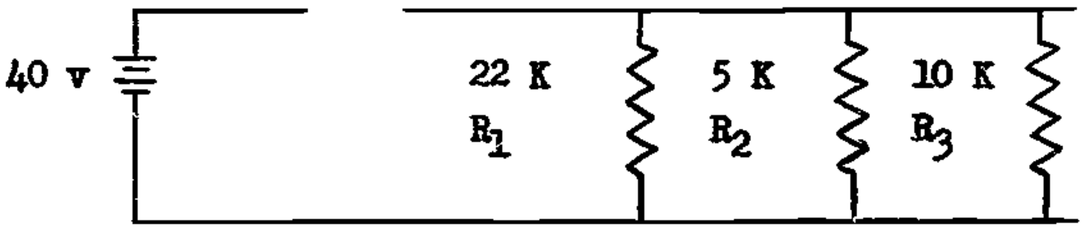
Lesson 22
Laboratory Parallel Circuits

Reference:

1. Singer, Bertrand B., Basic Mathematics for Electricity, Radio and Television, McGraw-Hill Book Company.

Discussion Topics:

1. Wire the following circuit.



2. Draw arrows showing current flow.
3. Place + and - signs on resistors showing polarity.
4. Measure and record.

E_1 = ______
E_2 = ______
E_3 = ______
E_T = ______

5. Measure and record.

I_1 = I_3 =
I_2 = I_T =

6. From experimental data, compute R_1 = R_3 =
R_2 = R_4 =

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Lesson 22 (Con't.)
Laboratory Parallel Circuits

7. Compute R_T from rated value of resistors.

8. What is the per cent of error of measured value of R_T (step 6) and theoretical value (step 7)?

Assignment: Use reference listed above.

1. Laboratory Parallel Circuits

Advanced Assignment: Work as much of this assignment as you can before the next meeting.

1. Examination

2. Read chapter 5 and do the laboratory work on parallel circuits.

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FUNDAMENTALS OF ELECTRONICS

BASIC ELECTRONIC MATHEMATICS

Lesson 23
Test on Parallel Circuits

Reference:

1. Singer, Bertrand B., Basic Mathematics for Electricity, Radio and Television, McGraw-Hill Book Company.

I. Discussion Topics:

A. The first hour should be used as a review of parallel circuit problems and the data obtained in the laboratory experiment.

II. Discussion of Previous Assignment

III. Homework (current) Assignment: Read pages 94-126 in reference 1.

IV. Advanced Assignment: Read pages 127-138. Work the selected problems on pages 133, 134, 136, 137 and 138 in reference 1.

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FUNDAMENTALS OF ELECTRONICS

BASIC ELECTRONIC MATHEMATICS

Lesson 23
Test on Parallel Circuits

Reference:

1. Singer, Bertrand B., Basic Mathematics for Electricity, Radio and Television, McGraw-Hill Book Company.

Introduction:

The following test should take the best student an hour to complete. The instructor will give you an examination. Be sure to draw a schematic for each circuit solved. Show your formulas, original substitution, and the answers complete with labels.

Assignment: Use reference listed above.

1. Read pages 94-126.

Advanced Assignment: Work as much of this assignment as you can before the next meeting.

1. Read pages 127-138.
2. Work the selected problems on pages 133, 134, 136, 137 and 138.

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BASIC ELECTRONIC MATHEMATICS

Lesson 24
Combination Circuits

Reference:

1. Singer, Bertrand B., Basic Mathematics for Electricity, Radio and Television, McGraw-Hill Book Company.

I. Discussion Topics:

A. We have studied series circuits and parallel circuits individually. In practice we will more often find a combination of these circuits. A student here must apply all that he knows about both types of circuits. The instructor should review simple, series, and parallel circuits. Signal tracing is a must from this point on. Electron flow should be traced through each resistor in each problem.

II. Discussion of Previous Assignment

III. Homework (current) Assignment: Read pages 127-138. Work the selected problems on pages 133, 134, 136, 137 and 138 in reference 1.

IV. Advanced Assignment: Read pages 148-157 and 170-173. Work the selected problems on pages 150, 151, 152, 153, 154, 155, 171, 172 and 173 in reference 1.

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Lesson 24
Combination Circuits

Reference:

1. Singer, Bertrand B., Basic Mathematics for Electricity, Radio and Television, McGraw-Hill Book Company.

Introduction:

We have studied both series and parallel circuits. These circuits are often found in simple electrical equipment in their original form. It is more common in electronic equipment to find combinations of these circuits.

New Terms:

1. Series - parallel
2. Parallel - series

Assignment: Use reference listed above.

1. Write definitions for the above terms.

2. Read pages 127-138.

3. Work the selected problems on pages 133, 134, 136, 137 and 138.

Advanced Assignment: Work as much of this assignment as you can before the next meeting.

1. Read pages 148-157 and 170-173.

2. Work the selected problems on pages 150-155 and 171-173.

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VOCATIONAL ELECTRONIC TECHNICIAN TRAINING

FUNDAMENTALS OF ELECTRONICS

BASIC ELECTRONIC MATHEMATICS

Lesson 25
Electrical Power

Reference:

1. Singer, Bertrand B., Basic Mathematics for Electricity, Radio and Television, McGraw-Hill Book Company.

I. Discussion Topics:

A. Power. Definition—power is work times speed.

1. Horse power - The weight (33,000 lbs.) times distance (1 ft.) times time (1/1 min.)

$$1 \text{ Hp} = \frac{33{,}000 \text{ lb. ft.}}{1 \text{ min.}} = \frac{\text{work}}{\text{time}}$$

2. Electrical power, Basic Equation

Q x E is work done. E is force.
Q is charge going past a certain point.

a. The ampere is defined as 1 coulomb (Q) flow past a certain point in one second (Q/F).

b. $P \frac{(Q) \quad (E)}{F}$ and $Q/F = I \therefore P = IE$

Example: What is the power disipated through a resistor when the measured current is 4A and the voltage drop across the resistor is 8 volts?
$P = IE = 4A \times 8V = 32W$

3. From this defining equation, all other equations for power are developed.

B. Power from other circuit values

1. When resistance and current, only, are known. Basic Formula: $P = EI$

a. Suppose that resistor is one of many in the circuit. It is inconvenient to figure voltage.
b. Resistance is known.
c. Current is known.
d. E is unknown.
e. Substitute known values for E by Ohm's Law. $E = IR$
f. $P = (IR) \ (I) = I^2R$

TEACHERS OUTLINE

VOCATIONAL ELECTRONIC TECHNICIAN TRAINING

Lesson 25 (Con't.)

Electrical Power

2. When voltage and resistance, only are known.

   In the same manner substitute in the basic formula ($P = EI$) for the unknown (I).

   By Ohm's Law $I = \frac{E}{R}$

   $$\text{Thus, } P = E(I) = E\left(\frac{E}{R}\right) = \frac{E^2}{R}$$

3. Select problems for demonstration of the above formulas.

C. Other parameters of the circuit can be calculated from the power formulas.

1. $P = EI$ $\qquad I = \frac{P}{E} \qquad E = \frac{P}{I}$
2. $P = I^2R$ Have students derive equations for R and I from this formula.
3. $P = \frac{E^2}{R}$ Have students derive equations for E and R from this formula.

II. Discussion of Previous Assignment

III. Homework (current) Assignment: Read pages 148-157 and 170-173. Work the selected problems on pages 150, 151, 152, 153, 154, 155, 171, 172 and 173 in reference 1.

IV. Advanced Assignment: Read pages 174-191. Work the selected problems on pages 176, 177, 178, 179, 181, 182, 184, 185, 189 and 191 in reference 1.

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BASIC ELECTRONIC MATHEMATICS

Lesson 25
Electrical Power

Reference:

1. Singer, Bertrand B., Basic Mathematics for Electricity, Radio and Television, McGraw-Hill Book Company.

Introduction:

Since we must pay for the electricity we use, relationships concerning electrical power are very necessary. A firm foundation in power will also help us choose the correct parts in design and replacement of failed parts.

New Terms:

1. Horsepower
2. Watt
3. Power

Assignment: Use reference listed above.

1. Write definitions for the above terms.

2. Read pages 148-157 and 170-173.

3. Work the selected problems on pages 150, 151, 152, 153, 154, 155, 171, 172 and 173.

Advanced Assignment: Work as much of this assignment as you can before the next meeting.

1. Read pages 174-191.

2. Work the selected problems on pages 176, 177, 178, 179, 181, 182, 184, 185, 189 and 191.

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VOCATIONAL ELECTRONIC TECHNICIAN TRAINING

FUNDAMENTALS OF ELECTRONICS

BASIC ELECTRONIC MATHEMATICS

Lesson 26

Application of Series and Parallel Circuits

Reference:

1. Singer, Bertrand B., Basic Mathematics for Electricity, Radio and Television, McGraw-Hill Book Company.

I. Discussion Topics:

A. Units and powers of ten

1. Power of ten, definition by mathematics

   Example: $10^3 = 10 \cdot 10 \cdot 10 = 1000$

   $10^{-2} = 1/100 = .01$

2. Rule--To multiply by 10^n move the decimal point of the multiplicand n places to the right. To divide by 10^n move the decimal point of the dividend n places to the left.

B. Scientific notation

1. When large and cumbersome numbers are to be mathematically manipulated, it is often convenient to express them with scientific notation.

   Examples:
   - a. The government is \$2.5 x 10^{11} in debt.
   - b. There are about 1 x 10^{27} electrons in 1 gram of matter.
   - c. A millimicron is about 4 x 10^{-8} inches in length (about 1/25,000,000 inches)
   - d. The surge current in a pulse welder machine was limited by .8 ohms. What peak current resulted when the capacitors were charged to 4800 volts?
     Solution by scientific notation

     (1) .8 ohms = 8×10^{-1} ohms

     (2) 4800 volts = 4.8×10^4 volts

     $$I = \frac{E}{R} \quad \frac{4.8 \times 10^4}{8 \times 10^{-1}} = 0.6 \times 10^5 \text{ amp.} = 6. \times 10^4 \text{ amps} = 6000 \text{ amp.}$$

TEACHERS OUTLINE

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Lesson 26 (Con't.)

Application of Series and Parallel Circuits

2. Rules for changing to scientific notation

   a. To convert a number greater than 10 to scientific notation, move the decimal point to the left until the number is a whole unit between one and ten (this is the same as dividing by 10 to the plus whole n power), then affix a multiplier of 10 to the plus n whole number power.

   Thus, (1) $3.300 = \frac{3300}{10^3} \times 10^3 = 3.3 \times 10^3$

   (2) $46324 = \frac{46324}{10^4} \times 10^4 = 4.6324 \times 10^4$

   b. To convert a decimal to scientific notation, move the decimal point to the right until the number is a whole number between 1 and 10 (this is the same as multiplying by 10 to the plus whole number) then affix a multiplier of 10 to the minus whole number power.

   Example 1. $.0032 = .0032 \times 10^3 \times 10^{-3} = 3.2 \times 10^{-3}$

   Example 2. $.0000483 = .0000483 \times 10^5 \times 10^{-5} = 4.83 \times 10^{-5}$

C. Units, their prefixes

1. Units are altered in value by prefixes which have mathematical meaning. Students are urged to learn the basic prefix values, and never to resort to "conversation tables".

   a. Milli = 1/100 or 10^{-3}
   b. Deci = 1/10 or 10^{-1}
   c. Micro = 1/1,000,000 or 10^{-6}
   d. Millimicro = 1/1000 of micro of $\frac{1}{1,000,000,000} = 10^{-2}$
   e. Micro Micro = 10^{-12}
   f. Picro = Micro Micro = 10^{-12}

2. Have student practice in class. Stress the importance of constant practice and application.

II. Discussion of Previous Assignment

Lesson 26 (Con't.)

Application of Series and Parallel Circuits

III. Homework (current) Assignment: Read pages 174-191. Work the selected problems on pages 176, 177, 178, 179, 181, 182, 184, 185, 189 and 191 in reference 1.

IV. Advanced Assignment: Read pages 196-208 to Job A-11. Work the selected problems on pages 197, 198, 200, 204, 205, 207 and 208 in reference 1.

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BASIC ELECTRONIC MATHEMATICS

Lesson 26

Application of Series and Parallel Circuits

Reference:

1. Singer, Bertrand B., Basic Mathematics for Electricity, Radio and Television, McGraw-Hill Book Company.

Introduction:

In electronics we must work with such large numbers and such small numbers that a special method of notation has been utilized. Powers of ten is sometimes called engineers' shorthand. I think electronics shorthand would be more appropriate. Here is a chance to show off your knowledge of exponent.

New Terms:

1. Powers of ten

Assignment: Use reference listed above.

1. Write a definition for the above term.
2. Read pages 174-191.
3. Work the selected problems on pages 176, 177, 178, 179, 181, 182, 184, 185, 189 and 191.

Advanced Assignment: Work as much of this assignment as you can before the next meeting.

1. Read pages 196-208 to Job A-11.
2. Work the selected problems on pages 197, 198, 200, 204, 205, 207 and 208.

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BASIC ELECTRONIC MATHEMATICS

Lesson 27

Application of Series and Parallel Circuits--Ammeters

Reference:

1. Singer, Bertrand B., Basic Mathematics for Electricity, Radio and Television, McGraw-Hill Book Company.

I. Discussion Topics:

A. Circuit application. The ammeter as a voltmeter.

1. The voltmeter is basically an ammeter with enough resistance added in series to cause the voltage required for full scale (or any point intermediate) deflection to increase.

2. To use an ammeter as a voltmeter adjust the series resistance to give the desired full scale voltage reading with full scale current.

a. Example: It is desired to make a 0 to 1 ma millimeter read 100 volts full scale. Its resistance is 25 ohms. What value of series multiplication is required?

Solution: Given $R_m = 25$ ohms

F_s ma $= 1$ ma

$F_s = 100$ volts

$$R_s = \frac{100 \text{ volts}}{.001} = 100{,}000 \text{ ohms}$$

The meter drop was so insignificant that it was ignored. (.025 volts)

B. Extending the voltmeter range

1. Voltmeter sensitivity. A voltmeter's sensitivity is a measure of the amount of loading the voltmeter imposes on the source. Sensitivity is expressed as ohms per volt. High sensitivity R/volt is desirable to prevent error in reading.

a. Example: What is the sensitivity of a meter which has a resistance of 5 megs. and a full scale reading of 100 volts?

$$\frac{R}{V} = \frac{R_t}{E_t} = \frac{5 \times 10^2}{1 \times 10^2} = \frac{5 \times 10^4}{V} = \frac{50{,}000 \text{ ohm}}{\text{volt}}$$

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FUNDAMENTALS OF ELECTRONICS — BASIC ELECTRONIC MATHEMATICS

Lesson 27 (Con't.)
Application of Series and Parallel Circuits--Ammeters

2. Multipliers. A voltmeter multiplier is a resistor added to the resistance of the meter to increase the range of the meter.

   a. Let's suppose our meter which has a sensitivity of 1000 ohm/volt reads 300 volts full scale. What resistance must be added to give a full scale reading of 600 volts?
   Solution:
   (1) Meter resistance $R_m = \frac{300 \text{ volt}}{1} \times \frac{1000}{\text{volt}} = 30{,}000$ ohms

   (2) F_s ma (full scale current) $= \frac{300 \text{ volts}}{300000 \text{ ohm}} = .001$ amp or

   $F_s \text{ ma} = \frac{1 \text{ volt}}{1000 \text{ ohm}} = .001$ amp

   (3) Total resistance $R_t = \frac{600}{.001} = 600{,}000$

   (4) Resistance to add = 600,000 - 300,000 = 300,000 ohms

3. **Deviation of a formula for multipliers.** From the problem above, it can be seen that to read 5 times as much voltage we would have to add resistance until the total is 5 times greater (meter resistance + multiplier).

   R_s = (multiplier factor x R_m) - R_m
   R_s = resistance to add as multiplier
   R_m = resistance of meter or resistance usually there

   But since the factor (MF) is a number times the meter resistance already there, we can rewrite the formula.

   $$R_s = (MF - 1) \times R_m$$

   a. Give example pages 203 of reference 1.

4. True value. When an ammeter or voltmeter has been extended with a shunt or multiplier, the value apparent on the dial must be multiplied by a factor determined by the shunt or multiplier to determine the true value of current. The general practice in industry is to multiply by factors of 10 or powers of 10, or, when this is not possible—to change the dial face.

II. Discussion of Previous Assignment

Lesson 27 (Con't.)

Application of Series and Parallel Circuits--Ammeters

III. Homework (current) Assignment: Read pages 196-208 to Job A-11. Work the selected problems on pages 197, 198, 200, 204, 205,207 and 208 in reference 1.

IV. Advanced Assignment: Read pages 191-197. Work the problems on pages 195 and 196 in reference 1.

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Lesson 27

Application of Series and Parallel Circuits—Ammeters

Reference:

1. Singer, Bertrand B., Basic Mathematics for Electricity, Radio and Television, McGraw-Hill Book Company.

Introduction:

In lesson 26 we studied a practical application of the parallel circuit. In this lesson we are going to put to work the series circuit. A voltmeter will show us one use made of the series circuit.

New Terms:

1. Multiplier
2. Ohms per volt
3. Sensitivity
4. Loading

Assignment: Use reference listed above.

1. Write definitions for the above terms.

2. Read pages 196-208 to Job A-11.

3. Work the selected problems on pages 197, 198, 200, 204, 205, 207 and 208.

Advanced Assignment: Work as much of this assignment as you can before the next meeting.

1. Read pages 191-197.

2. Work the problems on pages 195 and 196.

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BASIC ELECTRONIC MATHEMATICS

Lesson 28

Application of Series Circuits and Parallel Circuits—Voltmeters

Reference:

1. Singer, Bertrand B., Basic Mathematics for Electricity, Radio and Television, McGraw-Hill Book Company.

I. Discussion Topics:

A. Extending the range of an ammeter

1. Basic Ammeter. Description - An ammeter is essentially a delicately pivoted coil connected to a pointer (indicator). The coil causing movement of the meter by exerting its force against the fixed field of a stationary coil or the field of a permanent magnet. The amount of deflection is in proportion to the amount of current through the field.

2. Since the coil is delicate, its current must be limited. This makes necessary the use of shunts to multiply the current ability.

3. The meter multiplier
   a. F_s ma is the full scale current of the ammeter
   b. The diagram

4. The practical methods. The meter calibration department in a laboratory proceeds as follows:
   a. The current for full scale deflection is set to coincide with the indicated value F_s on the meter face.
   b. The voltage for F_s is read with a K_2 or K_3 voltage potentiometer.
   c. Since the ammeter and the shunt are in parallel, the voltage across the shunt and the meter are the same at F_s (call it E_m).
   d. A shunt resistance will have to be set to carry the shunt current (I_s) in excess of the meter current (I_m) at F_s.
   e. Shunt resistance will then be calculated as $R_s = \frac{E_m}{I_s}$

5. When the resistance and range of the meter is known, the shunt resistance can be calculated by the formula.

Where $I_m = F_s$ ma

R_m = meter R

$$R_s = \frac{I_m \quad R_m}{I - I_m}$$

I = Maximum range of current for meter and shunt

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BASIC ELECTRONIC MATHEMATICS

Lesson 28 (Con't.)

Application of Series Circuits and Parallel Circuits—Voltmeters

6. From the above formula, another formula can be developed.

Old formula: $R_s = \dfrac{I_m \quad R_m}{I - I_m}$

$I_m = F_s$ ma
$R_m =$ meter R
$I =$ line current

Rewrite the formula: $R_s = (R_m) \quad \dfrac{(I_m)}{I - I_m}$ then invert $\dfrac{I_m}{I - I_m}$

But change the sign of operation to divide (-) to keep from disturbing the equality.

Thus, $R_s = R_m - \dfrac{I - I_m}{I_m}$ separate the term $\dfrac{I - I_m}{I_m}$ by expanding it to

$\dfrac{I}{I_m} - \dfrac{I_m}{I_m}$ then $R_s = \dfrac{I}{I_m} - 1$

If we now define $\dfrac{I}{I_m}$ as the ratio of the line current to the meter current, or thus the multiply factor N of the shunt to its meter then

$R_s = R_m$ where $R_s =$ shunt resistor
$R_m =$ meter resistance
$N = \dfrac{\text{Max. new range}}{\text{Max. old range}}$

II. Discussion of Previous Assignment

III. Homework (current) Assignment: Read pages 191-197. Work the problems on pages 195 and 196 in reference 1.

IV. Advanced Assignment: Read pages 208-212. Work the problems on pages 211 and 212.

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Lesson 28

Application of Series Circuits and Parallel Circuits--Voltmeter

Reference:

1. Singer, Bertrand B., Basic Mathematics for Electricity, Radio and Television, McGraw- Hill Book Company.

Introduction:

Lesson 28 is a very practical application of a parallel circuit. This is the way we would modify a current meter to read a higher current. In a later course, you will get an opportunity to do some actual modification of meter scales.

New Terms:

1. Meter
2. Meter-movement
3. Shunt
4. Full scale deflection
5. Infinity

Assignment: Use reference listed above.

1. Write definitions for the above terms.

2. Read pages 191-197.

3. Work the problems on pages 195 and 196.

Advanced Assignment: Work as much of this assignment as you can before the next meeting.

1. Read pages 208-212.

2. Work the problems on pages 211 and 212.

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TEACHERS OUTLINE

VOCATIONAL ELECTRONIC TECHNICIAN TRAINING

FUNDAMENTALS OF ELECTRONICS

BASIC ELECTRONIC MATHEMATICS

Lesson 29

Application of Series and Parallel Circuits—The Bleeder Resistor

Reference:

1. Singer, Bertrand B., Basic Mathematics for Electricity, Radio and Television, McGraw-Hill Book Company.

I. Discussion Topics:

A. The "bleeder" is a very important and useful application of power supply circuits serving two important functions.

  1. The bleeder current maintains a finite amount of current through the inductor of the circuit, thereby insuring better voltage regulation because inductance is a function of current.

  2. The bleeder allows various values of voltage to be tapped for different values of current.

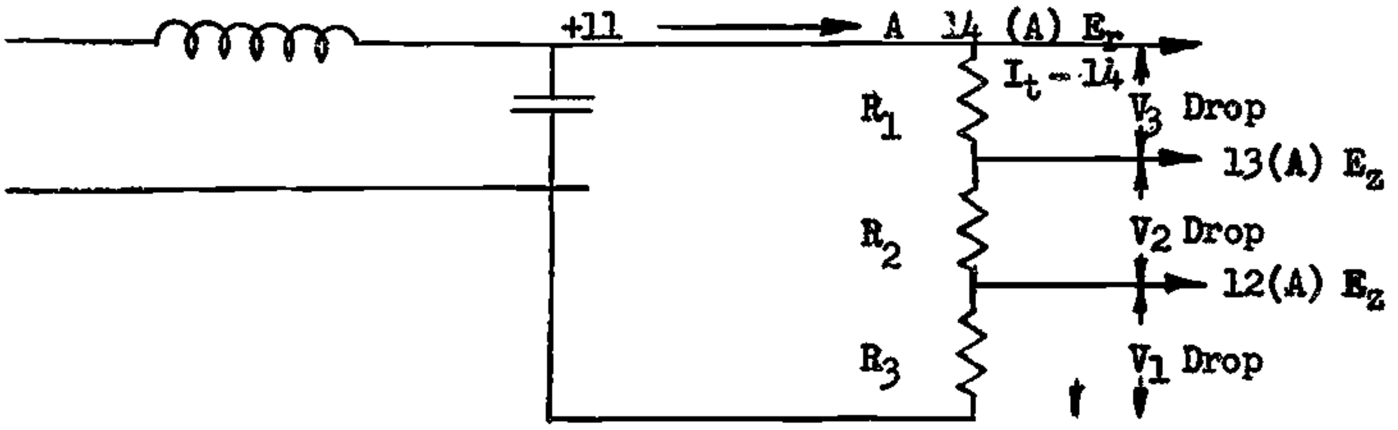
B. A simple procedure for determining exact bleeder values is needed because currents are not equal in all parts of the bleeder.

  1. Procedure:

    a. The bleeder current should be (90% of the p.t. current rating) - (the required current of all of the loads). This value must be established first.

    b. Assume conventional current flow from the top of the drawing (positive of the power supply).

    c. Make a drawing of the bleeder circuit and the functions.



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Lesson 29 (Con't.)

Application of Series and Parallel Circuits--The Bleeder Resistor

d. It is total current entering function A. 14 leaves function A. Thus, the current left through R_1 section is $I_t - 14$. Then the resistance required will be the voltage that was dropped divided by the current or

$$\frac{E_t - E_3}{I_t - 14} = \frac{V_3 \text{ drop}}{I_t - 14} = R$$

e. The next section in the same manner will be

$$\frac{E_3 - E_z}{I_t - 14 - 13} = \frac{V_z \text{ drop}}{I_t - 14 - 13} = R$$

f. In the last section, we must drop what voltage is "left over". Thus,

$$R_3 = \frac{E_t - E_3 - E_z}{I_t - 14 - 13 - 12} = \frac{V_1 \text{ drop}}{I_t - 14 - 13 - 12}$$

II. Discussion of Previous Assignment

III. Homework (current) Assignment: Read pages 208-212. Work the problems on pages 211 and 212 in reference 1.

IV. Advanced Assignment: Read pages 212-217. Work the problems on pages 214, 215 and 217 in reference 1.

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Lesson 29

Application of Series and Parallel Circuits—The Bleeder Resistor

Reference:

1. Singer, Bertrand B., Basic Mathematics for Electricity, Radio and Television, McGraw-Hill Book Company.

Introduction:

In complex electronic circuits the need often arrives for many different voltages. It is usually more convenient to use one supply and a voltage divider network.

New Terms:

1. Bleeder
2. Voltage divider
3. Loaded
4. No load

Assignment: Use reference listed above.

1. Write definitions for the above terms.
2. Read pages 208-212.
3. Work the problems on pages 211 and 212.

Advanced Assignment: Work as much of this assignment as you can before the next meeting.

1. Read pages 212-217.
2. Work the problems on pages 214, 215 and 217.

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BASIC ELECTRONIC MATHEMATICS

Lesson 30

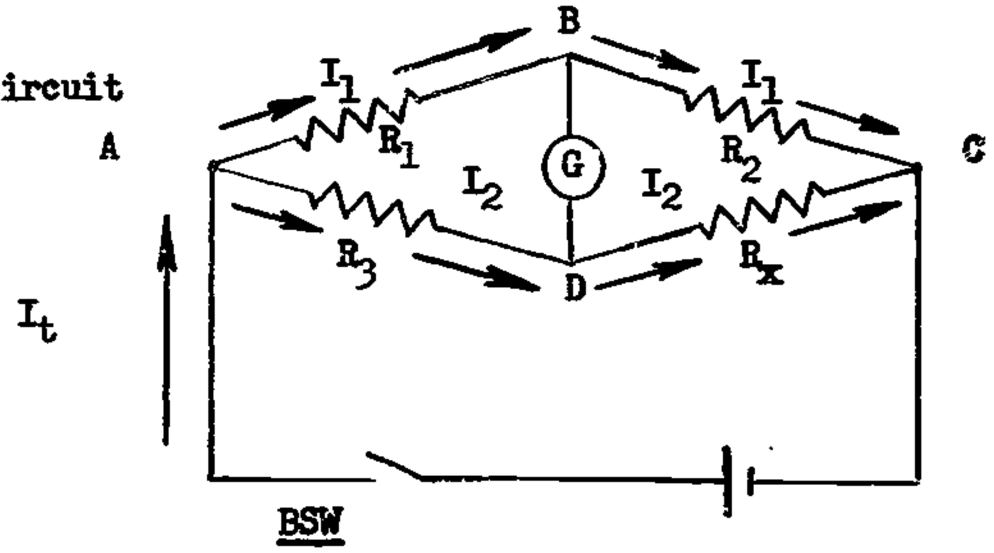
Application of Series and Parallel Circuits
The Wheatstone Bridge and Kirchoff Voltage Law Problems

Reference:

1. Singer, Bertrand B., Basic Mathematics for Electricity, Radio and Television, McGraw-Hill Book Company.

I. Discussion Topics:

A. The Wheatstone bridge circuit



1. R_3 is usually made adjustable.
2. The bridge is adjusted to balance by adjusting R_3 until no current flows in the galvanometer.
3. Then, the voltage from A to B = voltage from A to D or $I_1 \times R_1 - I_2 \times R_3$.
4. In the same manner, voltage of B to C = the voltage from D to C or $I_1 \times R_2 = I_2R_x$.
5. Then, dividing the one equation by the other will give the bridge quotient. Thus:

$$\frac{I_1 \times R_1 - I_2 \times R_3}{I_1 \times R_2 - I_2 \times R_x} \quad \text{or} \quad \frac{R_1 = R_3}{R_2 = R_x}$$

B. A Kirchoff Law problem

1. Review Kirchoff's Laws of current and voltage.

   a. Voltage The algebraic sum of all voltages within a loop is equal to zero.

   b. Current The algebraic sum of all of the currents at a junction is equal to zero.

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Lesson 30 (Con't.)
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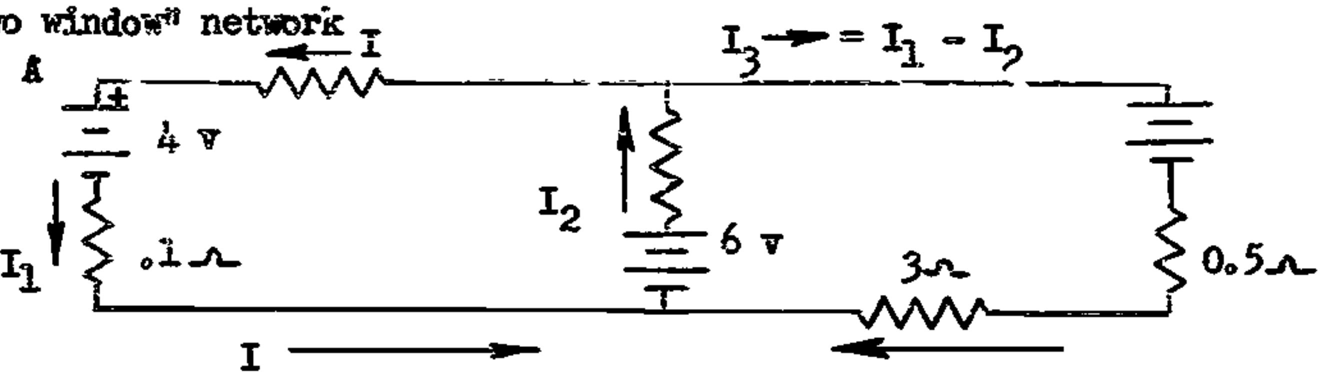
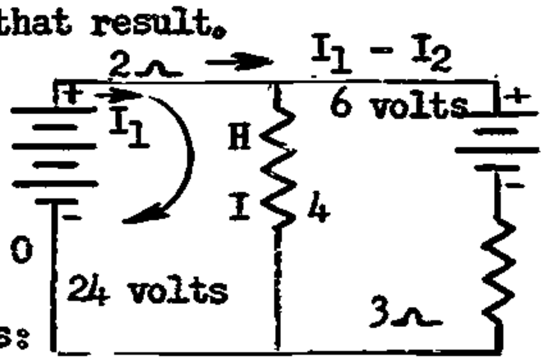
The Wheatstone Bridge and Kirchoff Voltage Law Problems

2. A "two window" network



a. Outline for solution of network

(1) Draw and label a diagram being especially careful of polarities of sources.
(2) Assume a direction of current flow. Try to be logical, but remember that a negative answer will indicate when the assumption was incorrect. When possible, indicate one current in terms of others by Kirchoff's Law of currents.
(3) Trace a path throughout the circuit by Kirchoff's Law of voltages. Trace as many paths as there are unknowns; be sure to include a part of the circuit not previously included for each part traced.
(4) Solve simultaneously the known equations that result.



Example:

Equation 1: $2I_1 + 4I_2 - 24 = 0$

2: $2I_1 + 6 + 3(I_1 - I_2) - 24 = 0$

Solution by addition and subtraction gives:

$I_1 = 5.54$ amps

$I_2 = 3.23$ amps

II. Discussion of Previous Assignment

III. Homework (current) Assignment: Read pages 212-217. Work the problems on pages 214, 215 and 216 in reference 1.

IV. Advanced Assignment: Read pages 235-245. Work the selected problems on pages 237-245 in reference 1.

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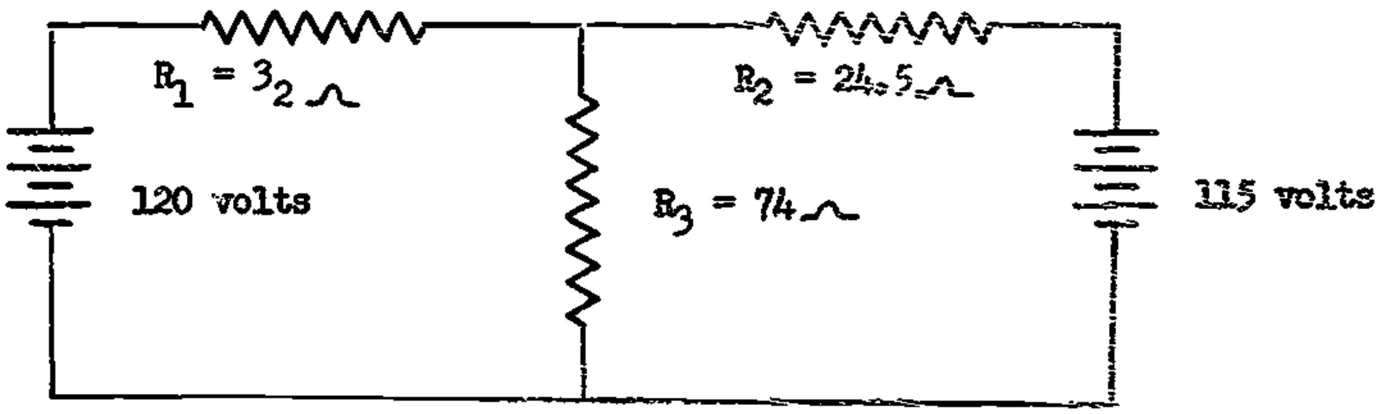
Lesson 30 (Con't.)

Application of Series and Parallel Circuits
The Wheatstone Bridge and Kirchoff Voltage Law Problems

This problem is to be given to students by blackboard.



How much current flows through R_3.

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Lesson 30

Application of Series and Parallel Circuits
The Wheatstone Bridge and Kirchoff Voltage Law Problems

Reference:

1. Singer, Bertrand B., Basic Mathematics for Electricity, Radio and Television, McGraw-Hill Book Company.

Introduction:

Now for some fun. Here is a practical place for you to use your mathematics and electronics. Kirchoff's Laws can provide many hours with popcorn before the fire.

New Terms:

1. Kirchoff
2. Bridge
3. Galvanometer
4. Branch

Assignment: Use reference listed above.

1. Write definitions for the above terms.

2. Read pages 212-217.

3. Work the problems on pages 214, 215 and 216.

Advanced Assignment: Work as much of this assignment as you can before the next meeting.

1. Read pages 235-245.

2. Work the selected problems on pages 237-245.

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VOCATIONAL ELECTRONIC TECHNICIAN TRAINING

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BASIC ELECTRONIC MATHEMATICS

Lesson 31
Electrical Energy

Reference:

1. Singer, Bertrand B., Basic Mathematics for Electricity, Radio and Television, McGraw-Hill Book Company.

I. **Discussion Topics:**

A. Lesson 31 is more practice in computing the cost of operation of electrical devices. Some practical problems from home and industry would make this lesson much more interesting.

II. **Discussion of Previous Assignment**

III. Homework (current) Assignment: Read pages 235-245. Work the selected problems on pages 237, 238, 239, 240, 241 and 245 in reference 1.

IV. Advanced Assignment: Read pages 246-258 to Job 11-4. Work the selected problems on pages 246, 247, 250, 251, 254, 256, 257 and 258 in reference 1.

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BASIC ELECTRONIC MATHEMATICS

Lesson 31

Electrical Energy

Reference:

1. Singer, Bertrand B., Basic Mathematics for Electricity, Radio and Television, McGraw-Hill Book Company.

Introduction:

The electronic technician will be called upon to convert from mechanical to electrical energy and power. He will also have to compose cost of operation, wire size, and fuse sizes for various electrical and mechanical devices.

New Terms:

1. Mechanical energy
2. Electrical energy

Assignment: Use reference listed above.

1. Write definitions for the above terms.

2. Read pages 235-245.

3. Work the selected problems on pages 237, 238, 239, 241 and 245.

Advanced Assignment: Work as much of this assignment as you can before the next meeting.

1. Read pages 246-258 to Job 11-4.

2. Work the selected problems on pages 246, 247, 250, 251, 254, 256, 257 and 258.

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BASIC ELECTRONIC MATHEMATICS

Lesson 32

Resistance of Wire—Ratio and Proportion

Reference:

1. Singer, Bertrand B., Basic Mathematics for Electricity, Radio and Television, McGraw-Hill Book Company.

I. Discussion Topics:

   A. Ratio

      1. Definition--the product or quotient comparison of one number to another.

         a. Examples:

            (1) The Jones' have 3 times as much as we do. (3:1) or 3/1
            (2) Pulley A is 9 inches in diameter. Pulley B is 2 inches in diameter. Therefore, pulley A is $4\frac{1}{2}$ times larger in diameter than pulley B.

      2. Comparisons can be made only when the terms are alike. The example below shows how to make a proper comparison.

         a. Example:

            (1) The ratio $\frac{\$2}{1\text{¢}} = z$ is incorrect, but if it is changed from $\frac{\$2}{1\text{¢}}$ to $\frac{200\text{¢}}{1\text{¢}}$ it is correct. It would be written $\frac{\$2}{1\text{¢}} = \frac{200\text{¢}}{1\text{¢}}$

   B. Proportion

      1. A proportion is the expression of equality of two or more ratios.

         a. Direct proportion. When two interdependent quantities have a relationship such that when the one increases or decreases so does the other respectively, then the two quantities are said to be in direct proportion to each other.

            (1) Examples:

               1. General $\frac{M_1}{M_2} = \frac{N_1}{N_2}$

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BASIC ELECTRONIC MATHEMATICS

Lesson 32 (Con't.)
Resistance of Wire—Ratio and Proportion

2. With a fixed resistor the current with 18 volts applied is 2 amps. What current will result with 54 volts applied? Let (x amps) be the unknown amperage.

$$\frac{18 \text{ volts}}{2 \text{ amps}} = \frac{54 \text{ volts}}{x \text{ amps}}$$

$$18x = 108$$
$$x = 6 \text{ amps}$$

b. Indirect proportion. When two interdependent quantities have a relationship such that the increase or decrease of one will cause a decrease or increase respectively, then the quantities are said to be in inverse proportion to each other.

(1) Examples:

1. General $\frac{M_1}{M_2} = \frac{N_2}{N_1}$

2. When voltage is constant, current flow is inversely proportioned to the resistance of the circuit.

$$I = \frac{E \text{ (constant)}}{R \text{ (variable)}}$$

$$IR = E \quad \text{or} \quad \frac{I_1}{I_2} = \frac{R_2}{R_1} \quad \text{or } I_2 R_2 \quad \text{or } I_1 R_1$$

II. Discussion of Previous Assignment

III. Homework (current) Assignment: Read pages 246-258 to Job 11-4. Work the selected problems on pages 246, 247, 250, 251, 254, 256, 257 and 258 in reference 1.

IV. Advanced Assignment: Read pages 258-274. Work the selected problems on pages 263, 264, 266, 268, 270, 272, 273 and 274 in reference 1.

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BASIC ELECTRONIC MATHEMATICS

Lesson 32
Resistance of Wire—Ratio and Proportion

Reference:

1. Singer, Bertrand B., Basic Mathematics for Electricity, Radio and Television, McGraw-Hill Book Company.

Introduction:

In electronics as in all other fields reactions are often seen to vary directly or indirectly with certain other factors. Resistance normally varies directly with temperature.

New Terms:

1. Ratio
2. Proportion
3. Directly
4. Indirectly

Assignment: Use reference listed above.

1. Read pages 246-258 to Job 11-4.
2. Work the selected problems on pages 246, 247, 250, 251, 254, 256, 257 and 258.

Advanced Assignment: Work as much of this assignment as you can before the next meeting.

1. Read pages 258-274.
2. Work the problems on pages 263, 264, 266, 268, 270, 272, 273 and 274.

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Lesson 33
Resistance of Wire and Size of Wire

Reference:

1. Singer, Bertrand B., Basic Mathematics for Electricity, Radio and Television, McGraw-Hill Book Company.

I. Discussion Topics:

A. The American wire gage table as well as the resistivity of different wire sizes and types should be discussed. Even the association of the terms insulator, semi-conductor and conductor would be a help in future study. The circular mil should also be discussed.

II. Homework (current) Assignment:

A. Read pages 258-274. Work the selected problems on pages 263, 264, 266, 268, 270, 272 and 274 in reference 1.

B. Read pages 275-293. Work the selected problems on pages 277, 278, 279, 280, 284, 290, 291, 292 and 293 in reference 1.

III. Advanced Assignment: Read pages 138-147. Work the selected problems on pages 142, 145, 146 and 147 in reference 1.

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FUNDAMENTALS OF ELECTRONICS — BASIC ELECTRONIC MATHEMATICS

Lesson 33
Resistance of Wire and Size of Wire

Reference:

1. Singer, Bertrand B., Basic Mathematics for Electricity, Radio and Television, McGraw-Hill Book Company.

Introduction:

The resistance and the current carrying capacity of wire depends upon the material it is made from, the diameter of the wire, the length of the wire, and even the insulation and physical placement of the wire in the equipment on the job.

New Terms:

1. Ratio
2. Proportion
3. Power factor
4. Inverse
5. Direct
6. N. E. C.
7. Line drop
8. Buss
9. Entrance

Assignment: Use reference listed above.

1. Write definitions for the above terms.

2. Read pages 258-293.

3. Work the selected problems on pages 263, 264, 266, 268, 270, 272, 273, 274, 277, 278, 279, 280, 290, 291, 292 and 293.

Advanced Assignment: Work as much of this assignment as you can before the next meeting.

1. Read pages 138-147.

2. Work the selected problems on pages 142, 145, 146 and 147.

TEACHERS OUTLINE

VOCATIONAL ELECTRONIC TECHNICIAN TRAINING

FUNDAMENTALS OF ELECTRONICS — BASIC ELECTRONIC MATHEMATICS

Lesson 34

Combination Circuits--Polynomials

Reference:

1. Singer, Bertrand B., Basic Mathematics for Electricity, Radio and Television, McGraw-Hill Book Company.

I. Discussion Topics:

A. Adding and subtracting polynomials

1. The rules of addition and subtraction discussed previously still hold true. (Review rules with student participation.)

2. It is necessary to keep like terms under like terms. Remember literal terms are like dollar signs in money problems, like volts, ohms, and current in electronic problems. Thus, perform the numerical algebra according to the rules, then affix the common literal terms.

3. Examples: Addition— $(2x^2 - 3x + 4) + (x^2 + 2x - 5)$ write in this manner

$$\begin{array}{rr} & 2x^2 - 3x + 4 \\ + & -x^2 + 2x - 5 \\ \hline & x^2 - x - 1 \end{array}$$

Subtraction—

$$\begin{array}{rr} & 8R - 63 - 2T \\ \text{less} & 5R - 63 + 2T \\ \hline & 3R \qquad - 4T \end{array}$$

B. Multiplication

1. A polynomial (many-number) with a monomial (one number)

a. Doing it with numbers (48) (3) consider the same as (40+8) (3) thus,

$$\begin{array}{rl} 40+8 & \text{(polynomial)} \\ 3 & \text{(monomial)} \\ \hline 120+24 & \text{or } 144 \end{array}$$

b. With numerial and literal numbers

$(2x+5)$ $(-4x)$

$$\begin{array}{r} 2x + 5 \\ -4x \\ \hline -8x^2 - 20x \end{array}$$

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Lesson 34

Combination Circuits—Polynomials

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1. Singer, Bertrand B., Basic Mathematics for Electricity, Radio and Television, McGraw-Hill Book Company.

I. Discussion Topics:

A. Adding and subtracting polynomials

1. The rules of addition and subtraction discussed previously still hold true. (Review rules with student participation.)

2. It is necessary to keep like terms under like terms. Remember literal terms are like dollar signs in money problems, like volts, ohms, and current in electronic problems. Thus, perform the numerical algebra according to the rules, then affix the common literal terms.

3. Examples: Addition— $(2x^2 - 3x + 4) + (x^2 + 2x - 5)$ write in this manner

$$\begin{array}{rr} & 2x^2 - 3x + 4 \\ + & -x^2 + 2x - 5 \\ \hline & x^2 - x - 1 \end{array}$$

Subtraction—

$$\begin{array}{rr} & 8R - 63 - 2T \\ \text{less} & 5R - 63 + 2T \\ \hline & 3R \qquad - 4T \end{array}$$

B. Multiplication

1. A polynomial (many-number) with a monomial (one number)

a. Doing it with numbers $(48)\ (3)$ consider the same as $(40+8)\ (3)$ thus,

$$\begin{array}{rl} 40+8 & \text{(polynomial)} \\ 3 & \text{(monomial)} \\ \hline 120+24 & \text{or } 144 \end{array}$$

b. With numerial and literal numbers

$$(2x+5)\quad(-4x)\qquad \begin{array}{r} 2x+5 \\ -4x \\ \hline -8x^2 - 20x \end{array}$$

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VOCATIONAL ELECTRONIC TECHNICIAN TRAINING

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Lesson 34 (Con't.)
Combination Circuits--Polynomials

2. Multiplication of a polynomial with a polynomial

   a. Consider the product of 48 x 23. We could call it (40 + 8) (20 + 3) or (50 - 2) (18 + 5). Consider it the latter.

$$\begin{array}{r}
50 - 2 \\
\underline{18 + 5} \\
250 - 10 \\
\underline{900 - 36} \\
1150 - 46 = 1104
\end{array}$$

   Test it as 48 times 23.

3. From the above comes the rule--to multiply a polynomial by a polynomial take each term of the multiplier times each term of the multiplicand and combine all terms of the product by addition.

Example:

$$\begin{array}{rl}
 & x^2 - 2xy - y^2 \\
\text{times} & \underline{\quad x - y \quad} \\
 & x^3 - 2x^2y - xy^2 \\
 & \underline{\quad - x^2y - 2xy^2 - y^3} \\
 & x^3 - 3x^2y - 3xy^2 - y^3
\end{array}$$

II. Discussion of Previous Assignment

III. Homework (current) Assignment: Read pages 138-147. Work the selected problems on pages 142, 145, 146 and 147 in reference 1.

IV. Advanced Assignment: Read pages 310-319. Work the problems on pages 316-319 in reference 1.

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VOCATIONAL ELECTRONIC TECHNICIAN TRAINING

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BASIC ELECTRONIC MATHEMATICS

Lesson 34
Combination Circuits--Polynomials

Reference:

1. Singer, Bertrand B., Basic Mathematics for Electricity, Radio and Television, McGraw-Hill Book Company.

Introduction:

After our discussion of series circuits, it can be seen that we have some more complicated mathematical expressions ahead of us. In lesson 34, we will gain skill with some more complicated mathematical expressions.

New Terms:

1. Polynomials
2. Monomial

Assignment: Use reference listed above.

1. Write definitions for the above terms.
2. Read pages 138-147.
3. Work the selected problems on pages 142, 145, 146 and 147.

Advanced Assignment: Work as much of this assignment as you can before the next meeting.

1. Read pages 310-319.
2. Work the problems on pages 316-319.

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Lesson 35
Graphs

References:

1. Singer, Bertrand B., Basic Mathematics for Electricity, Radio and Television, McGraw-Hill Book Company.

2. Hart, Walter W., Workbook for First Course in Algebra, D. C. Heath and Company, Boston.

I. Discussion Topics:

A. In the study of AC, vacuum tubes, and transistors, it is much easier to show relationships by graph rather than formulas. The student should be able to choose axis, make divisions and plot curved lines. The E_p I_p curves are a very good example of graphing in electronics. One can predict almost any operational condition of a tube from its set of curves.

II. Discussion of Previous Assignment

III. Homework (current) Assignment: Read pages 310-319. Work the problems on pages 316-319 in reference 1.

IV. Advanced Assignment: Test on pages 57, 58 and 59 in reference 2.

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VOCATIONAL ELECTRONIC TECHNICIAN TRAINING

FUNDAMENTALS OF ELECTRONICS BASIC ELECTRONIC MATHEMATICS

Lesson 35
Graphs

References:

1. Singer, Bertrand B., Basic Mathematics for Electricity, Radio and Television, McGraw-Hill Book Company.

2. Hart, Walter W., Workbook for First Course in Algebra, D. C. Heath and Company, Boston.

Introduction:

A graph is a picture that shows the effect of one variable on another. Graphs are used throughout the electronics industry to present information in simple form, to describe the operation of circuits, and to illustrate relationships that can be shown by data presented in tabular form.

New Terms:

1. Dependent
2. Independent
3. Variable
4. Operating point

Assignment: Use references listed above.

1. Write definitions for the above terms.

2. Read pages 310-319.

3. Work the problems on pages 316-319.

Advanced Assignment: Work as much of this assignment as you can before the next meeting.

1. Test on pages 57, 58 and 59 in reference 2.

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Lesson 36

Graphs--Simultaneous Linear Equation

References:

1. Singer, Bertrand B., Basic Mathematics for Electricity, Radio and Television, McGraw-Hill Book Company.
2. Hart, Walter W., Workbook for First Course in Algebra, D. C. Heath and Company, Boston.

I. Discussion Topics:

A. Simultaneous equations: When a problem exists where there are two or more unknowns, a solution of the problem is not possible unless the same number of different but true equations are available. The simultaneous operation of these two equations will produce values of the unknowns that are satisfactory to all of the equations. This is then the proper solution of the equations.

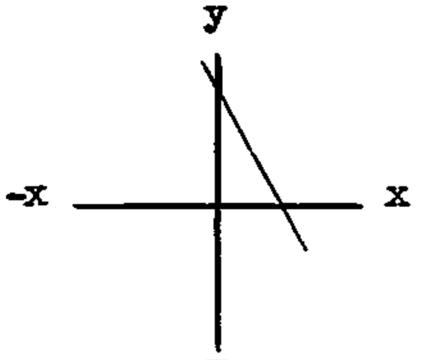
B. Graphical solution

1. The equation $8x + 2y$ equals 14 is a linear equation and its plot on a graph can be accomplished as follows:

a. Find values for y while varying x.

when x equals	then y equals
0	7
-2	15

b. Plot the points obtained.



c. All the points along this straight line are solutions of this equation.

C. Two linear equations will result in a plot with two straight lines. Plotting two straight lines on the same graph will result either in them intersecting in one place or them being parallel. If they intersect, their intersection is a common solution of the two equations.

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TERRE HAUTE, INDIANA

TEACHERS OUTLINE

VOCATIONAL ELECTRONIC TECHNICIAN TRAINING

FUNDAMENTALS OF ELECTRONICS

BASIC ELECTRONIC MATHEMATICS

Lesson 36 (Con't.)

Graphs--Simultaneous Linear Equation

1. The instructor should now issue graph paper and have the class plot the following examples:

a. $3x + 2y$ equals 5
   $2x + (-y)$ equals 8

b. $3x + 7y$ equals 8
   $x + y$ equals 0

D. Solution by addition and subtraction

Rules:

1. If necessary, multiply each equation by a number that will make the coefficients of one of the variables of equal absolute value.
2. If these coefficients of equal absolute value have like signs, subtract one equation from the other; if they have unlike signs, add the equations. In this manner you should have a new equation in only one unknown.
3. Solve the new equation in the usual manner.
4. Substitute the value solved for in one of the original equations and then solve for the other unknown.
5. Check these solutions in the remaining original equation. They should satisfy the equation.

a. The instructor should work a problem illustrating this method. Example:

$$\begin{array}{rl} 3x + 2y & \text{equals } 8 \\ -5x - y & \text{equals } 11 \end{array}$$

$$\begin{array}{rl} 3x + 2y & \text{equals } 8 \\ \underline{-10x - 2y} & \underline{\text{equals } -22} \\ -7x - 0y & \text{equals } -14 \end{array}$$

$$x \text{ equals } 2$$

$$\begin{array}{rl} 3(2) + 2y & \text{equals } 8 \\ 6 + 2y & \text{equals } 8 \\ 2y & \text{equals } 2 \\ y & \text{equals } 1 \end{array}$$

$$\begin{array}{rl} 5(2) + 1 & \text{equals } 11 \\ 10 + 1 & \text{equals } 11 \\ 11 & \text{equals } 11 \end{array}$$

II. Discussion of Previous Assignment

III. Homework (current) Assignment: Read pages 310-319. Work the problems on pages 316-319 in reference 1.

IV. Optional Assignment: This assignment should be given only if the student or students need additional practice.

Work tests 57 and 58 and both sides of tests 59 and 60 in reference 2.

ASSIGNMENT SHEET

VOCATIONAL ELECTRONIC TECHNICIAN TRAINING

FUNDAMENTALS OF ELECTRONICS

BASIC ELECTRONIC MATHEMATICS

Lesson 36

Graphs--Simultaneous Linear Equation

Reference:

1. Singer, Bertrand B., Basic Mathematics for Electricity, Radio and Television, McGraw-Hill Book Company.

Introduction:

Thus far we have solved equations with only one unknown. We may have started with an equation with several variables but have always been able to substitute for all variables except one. We then solved for the remaining one. In this lesson we will study solutions of equations where two unknowns still remain after you have made your substitutions. These equations are called simultaneous linear equations, equations of the first degree.

New Terms:

1. Simultaneous
2. Linear

Assignment: Use reference listed above.

1. Read pages 310-319.

2. Work the problems on pages 316-319.

VT003 191

VT 003 191
Basic A-C D-C for Electronics.

Electronics Vocational School, Bloomington, Ind.
Indiana State Dept. of Public Instruction, Indianapolis
Indiana State Univ., Terre Haute. Instr. Materials Lab.
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*TEACHING GUIDES, *CURRICULUM GUIDES, STUDY GUIDES, *TRADE AND INDUSTRIAL EDUCATION, *ELECTRONIC TECHNICIANS, MATHEMATICS, THEORIES, ELECTRONIC EQUIPMENT, *ELECTRONICS, EXPERIMENTS, INDIVIDUAL INSTRUCTION,

Teaching outlines and assignment sheets are used in this revised teaching guide to direct the student in basic A-C D-C theory in a beginning course in electronic technician training. The course was developed by a vocational coordinator and an electronics instructor in cooperation with the staff of the Trade and Industrial Instructional Materials Laboratory. The electronic theory presented includes a study of simple circuits, series and parallel courses, vacuum tube voltmeters, milliammeters, signal generators, scopes, and other instruments. Reactance, capacitance, and other units are also included. Job experiments illustrating theory and use of these instruments are included. Mathematics is introduced at the time it is needed to understand the theory and work the lab experiments. The teacher's outlines include the lesson introduction and objectives, mathematics references, electronics references, and lab experiment titles. The student assignment sheets provide introduction and objectives, references, materials and equipment list, experiment procedures, and study questions. A bibliography of related textbooks is included. This document is available for $1.00 from Division of Industrial Education, Indiana State University, Terre Haute, Indiana 47809. (HC)

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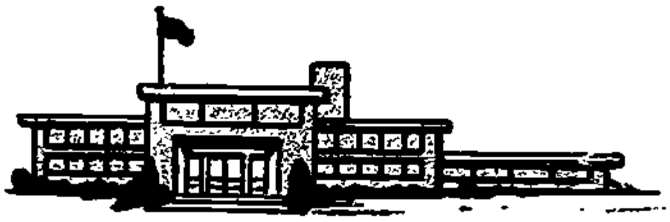
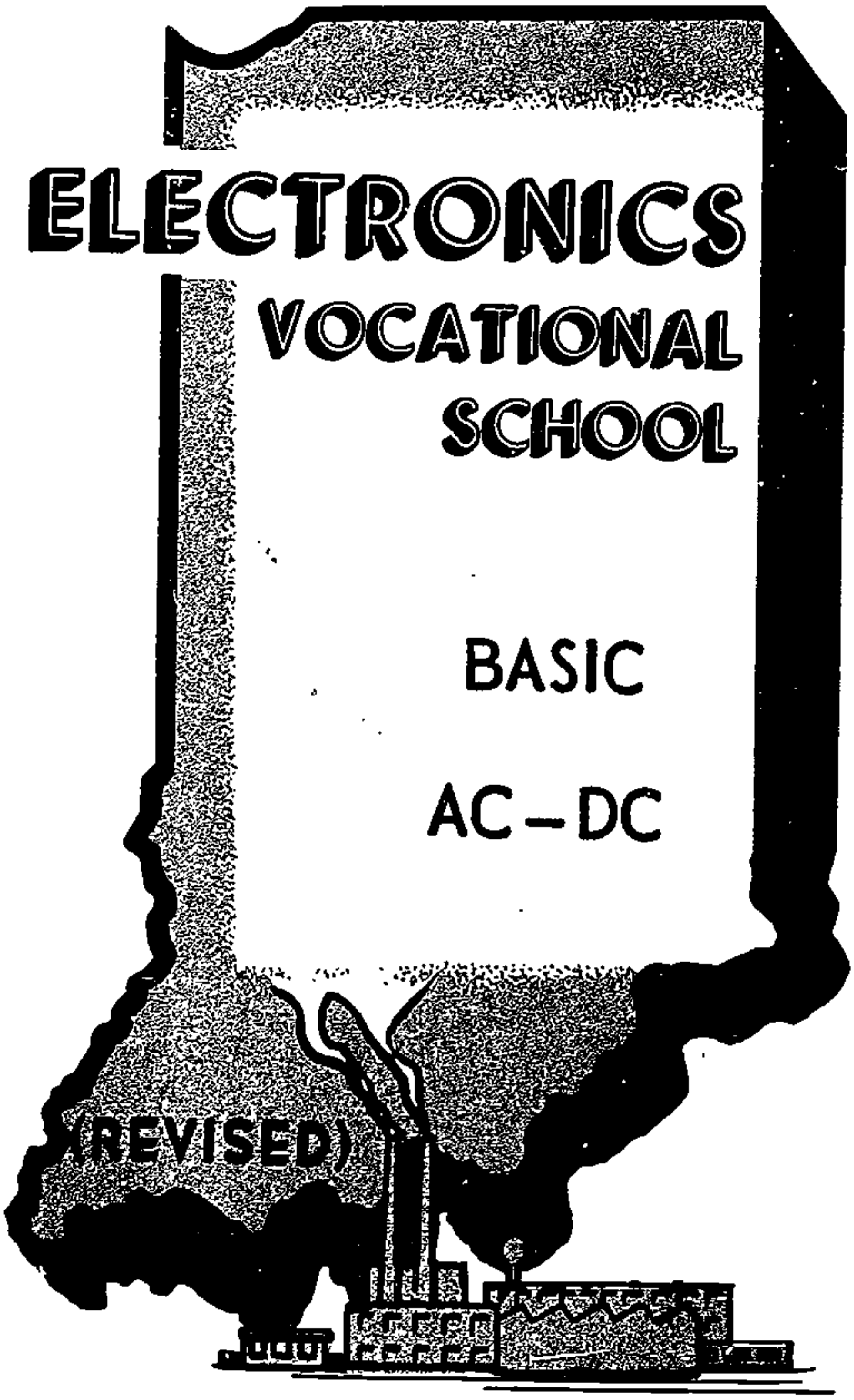
Trade – Industrial – Technical Education
Department of Public Instruction
STATE of INDIANA





ELECTRONICS
VOCATIONAL SCHOOL

BASIC

AC – DC

(REVISED)

INSTRUCTIONAL MATERIALS LABORATORY
Indiana State University
Terre Haute, Indiana

BASIC A-C D-C
for
ELECTRONICS

Electronics Vocational School

Bloomington, Indiana

First Revision
January, 1964

State of Indiana
Division of Vocational Education
Trade-Industrial-Technical Education Branch

Instructional Materials Laboratory
Trade and Industrial Education
Indiana State College
Terre Haute, Indiana

MEMORANDUM

TO: The ERIC Clearinghouse on Vocational and Technical Education
The Ohio State University
980 Kinnear Road
Columbus, Ohio 43212

FROM: (Person) Thomas E. Eacins (Agency) Vocational Instructional Materials Laboratory

(Address) Division of Industrial Education, Indiana State University, Terre Haute

DATE: August 5, 1967

RE: (Author, Title, Publisher, Date) Basic AC - DC for Electronics, (no author) 1964

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ACKNOWLEDGEMENT

Appreciation and acknowledgement is made to Tom Reckerd, Vocational Coordinator of Bloomington High School and Don Dewar, instructor in the electronics program, who, in coordination with the staff of the Trade and Industrial Instructional Materials Laboratory, made possible the development and printing of this course.

PREFACE

This course in Basic A-C D-C is definitely one of the most important basic electronics courses. The person who intends to become an electronic technician will need to master this course before continuing his technician training. It is in the study of Basic A-C D-C that the fundamental electronic theory and mathematics is presented.

The electronic theory presented in this material includes a study of the following: simple circuits, series and parallel circuits, the use of vacuum tube voltmeters, milliammeters, signal generators, scopes and other instruments. Reactance, capacitance and other units are also included. The job experiments make it possible to study and help understand the theory and use of these instruments.

The mathematics presented covers the algebra, geometry and trigonometry necessary for the study and understanding of electronics.

This is set up in such a way that the mathematics, theory and experiments contribute to each other. The math is introduced at the time it is needed to understand the theory and work the lab experiments.

It is believed that this course will be very successful if the suggested teaching plan is followed. The course has been used, corrected, then revised before it was printed.

TABLE OF CONTENTS FOR A-C D-C

TABLE OF CONTENTS FOR A-C D-C

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TEACHERS OUTLINE

VOCATIONAL ELECTRONIC TECHNICIAN TRAINING

Course II

Basic A-C D-C

Lesson 1
Introduction to the Electron Theory

ADMINISTRATION

Names and addresses of students

Introduction of Cooke and Slurzberg

Explanation of lecture and lab set-up

MATHEMATICS TEST (1960-1961 Test)

Objective: The purpose of this test is to find out how much review of mathematics and algebra will be necessary for this group of students. After its evaluation, the review schedule will be set up to provide adequate review Forty minutes will be allowed for the test

MATHEMATICS

Objective: Lesson 1 will be the beginning review of algebra. In this lesson, we will review literal and signed numbers along with the addition and subtraction of signed numbers. There will be an assignment of material to be done by the student as homework. (Express the importance of homework in this type of study.)

1. Literal numbers
2. Signed numbers
3. Addition and subtraction of signed numbers

ELECTRONICS

Objective: Lesson 1 will introduce the student to the basic electron theory. Chapter 2 of Slurzberg will be covered. An assignment of reading material will be given at the end of the lesson.

1. Read Chapter 2 of Slurzberg's, Essentials of Electricity for Radio and Television, pages 45-56.
2. Hand out Lesson 1-A, "The Electron", and explain the purpose of the handout.
3. Hand out Lesson 1-B, "Units".

TEACHERS OUTLINE

VOCATIONAL ELECTRONIC TECHNICIAN TRAINING

Course II

Basic A-C D-C

Lesson 1 (Con't.)
Introduction to the Electron Theory

4. Assign as next week's reading material, pages 45-61, and 67-74 in Slurzberg as prescribed in Lessons 1-A and 1-B.

5. Assign problems to be worked in Cooke's, Mathematics for Electricians and Radiomen, pages 5-19, and in Cooke's, Basic Mathematics for Electronics, Second Edition, McGraw-Hill Book Company, pages 53-74.

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ASSIGNMENT SHEET

VOCATIONAL ELECTRONIC TECHNICIAN TRAINING

Course II

Basic A-C D-C

Lesson 1-A
The Electron

INTRODUCTION

Before starting our study of the electron and its behavior, there are a few basic terms with which we must become acquainted. Although some of you may think this is a boring discussion, you should make every attempt to get this information under your hat. It will be very difficult for you to visualize the electron, which has a mass of 0.0000000000000000000000000000911 grams or the proton which is 1845 times larger.

OBJECTIVE

The purpose of this handout is the same as that of the first hour of lecture on electron theory. Answer the questions on a separate sheet of paper and hand them in along with the handout sheet. If there are any questions about this or any handout, be sure to ask them to the instructor.

REFERENCES

Marcus, Abraham, Elements of Radio, Second Edition, Prentice-Hall, pp. 312-321.

Oldfield, R.L., Radio, Television and Basic Electronics, American Technical Society, pp. 8-16.

Sams, Howard W., Basic Electricity, Twelfth Edition, Job 1, Bobbs Merrill.

Slurzberg, Morris, Essentials of Electricity for Radio and Television, McGraw-Hill Book Company, pp. 45-61.

QUESTIONS

1. What are the two types of charges that a body may take?
2. What are the two types of electricity as defined in class?
3. What is a conductor?
4. What is an insulator?
5. How can an atom become charged?
6. What are the three forms of matter?
7. What is the difference between current and electromotive force?
8. What are the four ways of creating an electromotive force?
9. Explain in what direction electrons flow.
10. How do bodies with like charges behave?
11. How much does the proton weigh?

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ASSIGNMENT SHEET

VOCATIONAL ELECTRONIC TECHNICIAN TRAINING

Course II

Basic A-C D-C

Lesson 1-B
Units

INTRODUCTION

Electronics, like other fields, has a language all of its own. Many of these terms have other meanings elsewhere.

OBJECTIVE

The purpose of this lesson handout is to acquaint you with some of the most common and basic electronic terms. Remember these terms; they will be used again and again.

REFERENCES

Henney, Keith, Principles of Radio, John Wiley and Sons, pp. 26-29.

Marcus, Elements of Radio, Prentice-Hall, Second Edition, pp. 321-327.

Sams, Howard W., Basic Electricity, Twelfth Edition, Job 2, Bobbs Merrill.

Slurzberg, Essentials of Electricity for Radio and Television, McGraw-Hill Book Company, pp. 67-74.

Note: The instructor will usually provide sufficient reading material, however, if he should fail to assign the material from Slurzberg that is specified in these handouts, you are expected to go ahead and read it. Remember, it is for your benefit.

QUESTIONS

1. What is electromotive force?
2. Why are we concerned with differences in pressure?
3. How many electrons make a coulomb of charge?
4. What is an ampere?
5. What is the unit of power for electrical work?
6. Define force.
7. Define energy.
8. R is the symbol for ______________.
9. E is the symbol for ______________.
10. I is the symbol for ______________.

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MATH EVALUATION TEST (1960-1961)

VOCATIONAL ELECTRONIC TECHNICIAN TRAINING

Course II

Basic A-C D-C

Name ______________________ Class ______________________ Date ________________

ADD

1.	-9	2.	16	3.	-2 1/4	4.	.0025	5.	16	6.	-78
	-2		-30		6 5/7		-.1024		66		-47

7.	-8 2/3	8.	-8 5/8
	16 4/5		4 2/3

SUBTRACT

9.	-9	10.	16	11.	-2 1/4	12.	.0025	13.	16	14.	-78
	-2		-30		6 5/7		-.1024		66		-47

15.	-8 2/3	16.	-8 5/8
	16 4/5		4 2/3

MULTIPLY

17. $(5)\ (-4)$

18. $(3)\ (-6)\ (4)$

19. $(a^2)\ (-b^2)\ (-c)$

20. $(x^3)\ (x^5)$

21. $(2ay^2)^3$

22. $(15c^2d^3e)\ (4cz)$

23. $(4 + jx)\ (x)$

24. $3(3x + 4y) + 4(2x + y)$

TEACHERS OUTLINE

VOCATIONAL ELECTRONIC TECHNICIAN TRAINING

Course II

Basic A-C D-C

Lesson 2
Algebra - Review and Application to Electronics

INTRODUCTION

This lesson will consist of three hours of lecture. Approximately two hours will be spent on the review of mathematics. The remaining hour will concern electron theory.

MATHEMATICS

Objective: In the review of mathematics we will concern ourselves mostly with the addition, subtraction and multiplication of signed numbers. The laws of exponents, multiplication of monomials, multiplication of polynomials, and the multiplication of polynomials by polynomials will take up most of the lecture period. This review may be somewhat slow or fast according to the ability of the students. STAY WITH YOUR STUDENTS as much as possible.

Explanation: Continued review of algebra. Cooke's Basic Mathematics for Electronics, Second Edition, pages 74-84, and Cooke's Mathematics for Electricians and Radiomen, First Edition, pages 25-36.

1. Multiplication of signed numbers
2. Laws of exponents
3. Multiplication of monomials
4. Multiplication of polynomials by monomials
5. Multiplication of polynomials by polynomials

Summarization: In this very rapid review of math and algebra fundamentals we have talked of addition, subtraction and multiplication of signed numbers. In your study of electronics, a basic knowledge of these things is an absolute necessity. Be sure that you understand them.

1. Assign problems as homework.

ELECTRONICS

Objective: The objective of this lecture period will be to give the student a clear understanding of potential, current flow, methods of producing an electric current and primarily, Ohm's Law.

TEACHERS OUTLINE

VOCATIONAL ELECTRONIC TECHNICIAN TRAINING

Course II

Basic A-C D-C

Lesson 2 (Con't.)

Algebra - Review and Application to Electronics

Explanation: Review pages 45-57 in Slurzberg's, Essentials of Electricity for Radio and Television. Answer the students' questions.

1. Potential--Discuss potential and potential difference. Give other terms for potential.

2. Current flow--What it is and what it is affected by.

3. Discuss the methods of producing an electric current--chemical, thermal, magnetic and solar.

4. Ohm's Law--Use the hydraulic analogy of current flow.

   a. Rate of flow is equal to the pressure divided by the opposition.

   b. Rate of current flow is equal to the voltage (pressure) divided by the opposition (resistance).

   Therefore, $I = E/R$

5. Discuss Figure 2-18 on page 68 in Slurzberg's, Essentials of Electricity for Radio and Television.

6. Go through Slurzberg's, Essentials of Electricity for Radio and Television, page by page in the Symbols and Abbreviations.

Summarize:

Assign Ohm's Law problems for the students' homework. Select problems from Cooke's Mathematics for Electricians and Radiomen, Cooke's Basic Mathematics for Electronics, Second Edition, and Slurzberg's Essentials of Electricity for Radio and Television.

Hand out Lesson 2-A, "Simple Circuits".

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ASSIGNMENT SHEET

VOCATIONAL ELECTRONIC TECHNICIAN TRAINING

Course II

Basic A-C D-C

Lesson 2-A
Simple Circuits

INTRODUCTION

In order to read electrical diagrams and service electronic equipment, the complete understanding of electrical symbols and diagrams is a necessity.

OBJECTIVE

The purpose of this lesson is to introduce you to the basic electronic symbols and to the circuit diagram. You will complete this just as you did the first two handouts.

REFERENCES

Marcus, Elements of Radio, Prentice-Hall, Second Edition, pp. 332-336.

Radio Electronics and Television Laboratory Manual, Basic Electricity, Lesson 2, Electronic Industries Association, McGraw-Hill Book Company.

Sams, Howard W., Basic Electricity, Twelfth Edition, Job 2, Bobbs Merrill.

Slurzberg, Essentials of Electricity for Radio and Television, McGraw-Hill Book Company, pp. 129-149.

QUESTIONS

1. What four things must a practical electrical circuit have?
2. In what direction do electrons flow?
3. What do we mean by a series circuit?
4. What do we mean by a parallel circuit?
5. The instructor will place several circuits on the board for you to identify.

TEACHERS OUTLINE

VOCATIONAL ELECTRONIC TECHNICIAN TRAINING

Course II

Basic A-C D-C

Lesson 3
Algebra - Review and Exponents

MATHEMATICS

Objective: In this hour of lecture, we will go into the division of signed numbers, the laws of exponents, zero and negative exponents, the division of monomials, and the division of polynomials by monomials. You will be assigned material for study in preparation for a short math quiz on the material covered to date. I will introduce you to the slide rule in the latter part of the hour.

1. Division of signed numbers
2. Law of exponents in division
3. Zero and negative exponents
4. Division of monomials
5. Division of polynomials by monomials

Assign problems 5-2, 5-3, and 5-4 on pages 37-4? in Cooke's, Mathematics for Electricians and Radiomen, and problems 9-5, 9-6, 9-7, and 9-8 on pages 85-91 in Cooke's, Basic Mathematics for Electronics, Second Edition. Work the even problems.

Read "Equations" next week.

Prepare for a math test next week on the material covered so far.

Be sure everyone has a slide rule.

ELECTRONICS

Objective: In this hour of lecture, we will discuss resistance, conductors, and insulators. I will also hand out your first laboratory experiment and explain it to you. You will have approximately one hour in the lab.

1. Resistance, conductors, and insulators
2. Resistors--Show examples of many types.
3. Hand out Lesson 3-A, "Ohm", and Lesson 3-B, "Ohm's Law". Explain 3-B in detail and prepare the class for lab.

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VOCATIONAL ELECTRONIC TECHNICIAN TRAINING

Course II

Basic A-C D-C

Lesson 3-A
OHM

INTRODUCTION AND OBJECTIVE

This is the first real assignment where we begin to use some of the terms we have learned to date. This lesson concerns itself with the ohm. The ohm is the unit of resistance as the inch is the unit of length. The ohm is named for Dr. George Simon Ohm (1784-1854) who was a famous German physicist. Dr. Ohm did very much of the early work in electricity.

REFERENCES

Henney, Keith, Principles of Radio, John Wiley and Sons, pp. 22-24.

Marcus, Elements of Radio, Prentice-Hall, Second Edition, pp. 121, 346, 405.

Oldfield, Radio, Television and Basic Electronics, American Technical Society, pp. 29-35.

Sams, Howard W., Basic Electricity, Twelfth Edition. Lesson 4, Bobbs Merrill.

Slurzberg, Essentials of Electricity for Radio and Television, McGraw-Hill Book Company, pp. 66-82, 129-149.

QUESTIONS

1. Define the ohm as outlined by the Bureau of Standards.
2. Define the ampere as outlined by the Bureau of Standards.
3. Define the volt as outlined by the Bureau of Standards.
4. If the resistance remains constant, an increase in voltage will have what effect upon the circuit?
5. If the voltage remains constant, an increase in resistance will have what effect upon the circuit?
6. A table lamp has a resistance of 220 ohms. How much current does it draw when used on a circuit that has a voltage of 110 volts?
7. What is the symbol for the ohm?
8. Three resistors of 7.15, 4.22, and 9.63 ohms are connected in series across a 110 volt line. How much current will flow?
9. What is the voltage across each resistor above?
10. What is the power expended in each resistor above?

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VOCATIONAL ELECTRONIC TECHNICIAN TRAINING

Course II

Basic A-C D-C

Lesson 3-B
Ohm's Law

INTRODUCTION AND OBJECTIVE

This lesson is to prove or disprove Ohm's Law. Do not turn the circuit on until it has been checked by the instructor. Meters cost money. Ask the instructor for the form to be used on laboratory write-ups. The voltage source will be provided by the instructor.

REFERENCES

Radio Electronics and Television Laboratory Manual, Basic Electricity, Job 7, Electronic Industries Association, McGraw-Hill Book Company.

Sams, Howard W , Basic Electricity, Twelfth Edition, Lesson 4A; Lessons 1A-3A.

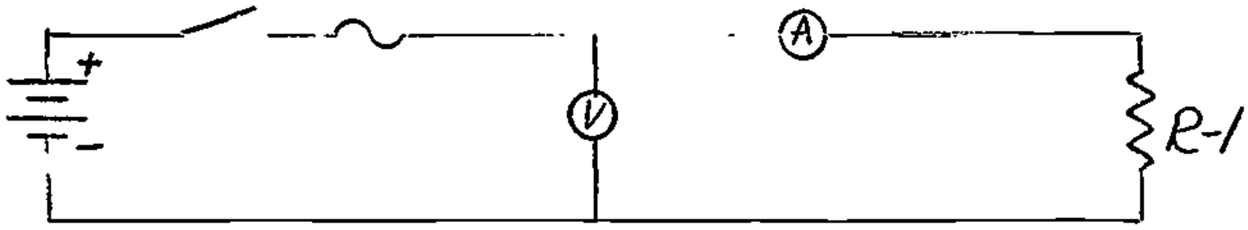
Slurzberg, Morris, Essentials of Electricity for Radio and Television, McGraw-Hill Book Company, Chapter 4.

MATERIAL AND EQUIPMENT REQUIRED

0-30 volt, DC voltmeter; 0-10 ma., DC ammeter; and the following resistors: 3300; 3600; 10000; 12000; and 22000 ohms

PROCEDURE

1. Construct the circuit shown here. Use one of the breadboards the instructor will provide. Insert the 22000 ohm resistor first.



2. Do not close the switch. Have the instructor check the circuit.
3. Make a table and record the following data:
   a. The applied voltage
   b. The current flowing through the circuit
4. Remove the 22000 ohm resistor and repeat step 3 with each of the other resistors. Use the larger values first.

ASSIGNMENT SHEET

VOCATIONAL ELECTRONIC TECHNICIAN TRAINING

Course II

Basic A-C D-C

Lesson 3-B (Con't.)

Ohm's Law

5. Compute the value of R in each case. The resistance in any circuit is equal to the voltage across the resistor divided by the current flowing through the resistor.

QUESTIONS

1. Explain the color code on the 10000 ohm resistor.
2. Explain any difference found between the rated and computed values of R.
3. With a fixed resistance, one that does not change, what is the effect of doubline E?
4. With a fixed voltage, what is the effect of doubling R?
5. What must one remember concerning the units when using Ohm's Law?
6. Did we prove or disprove Ohm's Law? Explain.
7. Summarize in a paragraph or two.

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TEACHERS OUTLINE

VOCATIONAL ELECTRONIC TECHNICIAN TRAINING

Course II

Basic A-C D-C

Lesson 4

Algebra - Review of Equations, Primes, and Subscripts

INTRODUCTION AND OBJECTIVE

In this lecture period we will continue our review of algebra by starting on equations, literal equations and primes and subscripts. There will be a short math test on the material you have covered to date. In the electronics portion of the lecture, I will answer any questions which arose in last lesson's introduction to the laboratory. We will work several Ohm's Law problems. I will also hand out Lesson 4-A. This will measure the resistance of the current meter. It may clear up some inaccuracies in the last experiment.

MATHEMATICS

1. Equations
2. Primes and subscripts
3. Math test--Allow 30 minutes.
4. Assign: 7-1 through 7-6, pp. 55-59, in Cooke's, Mathematics for Electricians and Radiomen; 10-1 through 10-6, pp. 92-97, in Cooke's, Basic Mathematics for Electronics, Second Edition, as reading and work material for next week.

ELECTRONICS

1. Review Ohm's Law and any questions on last week's handouts and laboratory.
2. Work problems assigned last week.
3. Hand out Lesson 4-A, "Meter Resistance Measurement" and explain.
4. Assign 12-16, page 84, in Slurzberg's, Essentials of Electricity for Radio and Television, to work by next week.
5. There will be a short quiz on Ohm's Law if time permits.

ASSIGNMENT SHEET

VOCATIONAL ELECTRONIC TECHNICIAN TRAINING

Course II

Basic A-C D-C

Lesson 4-A
Meter Resistance Measurement

INTRODUCTION AND OBJECTIVE

Some of the inaccuracy encountered in Lesson 3-B was due to the resistance of the milliammeter, which was actually in series with the resistor. Meter movement may be damaged if measured with an ohmmeter. In this short experiment, you will measure the resistance of the meter indirectly.

REFERENCE

Lesson 3-B

PROCEDURE

1. Construct the same circuit that you had in Lesson 3-B. Use the 3.3 k ohm resistor. Disconnect the voltmeter from the circuit and attach leads to its terminals.

2. Have the instructor check the circuit before you apply the voltage.

3. Measure the voltage across the milliammeter terminals and record it along with the current reading.

4. Compute the resistance of the milliammeter.

QUESTIONS

1. What was the computed resistance of your milliammeter?
2. How is it possible to damage a current meter with an ohmmeter?
3. Since the milliammeter was in series with the resistors being measured in Lesson 3-B, it was also limiting the current. Therefore, the resistance you computed in each case was the total resistance of the meter and the resistor.
4. Subtract the resistance of the meter from each computed resistance in Lesson 3-B. Compare the results with the rated value of each resistor.

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TEACHERS OUTLINE

VOCATIONAL ELECTRONIC TECHNICIAN TRAINING

Course II

Basic A-C D-C

Lesson 5

The Slide Rule - Powers of Ten

INTRODUCTION AND OBJECTIVE

In this lecture period we will review or critique the last period math test. There will be more preparation for the use of the slide rule. We will start our study of powers of ten. In the electronics portion of the lecture, you can be sure to ask any questions you have on the lab experiments. You will be introduced to the multimeter, a new piece of test equipment. There will be a short electronics quiz following this lesson.

MATHEMATICS

1. Review math test.

2. Preparation for the use of the slide rule
    a. Powers of ten
    b. Work chapter 7 over to and including problems 7-2 in Cooke's, Mathematics for Electricians and Radiomen, pp. 55-62. Work chapter 10 over to and including problems 10-8 in Cooke's, Basic Mathematics for Electronics, Second Edition, pp. 92-100.

3. Assign the rest of chapters 7 and 10 for next week.

ELECTRONICS

1. Review last week's lab.
2. Pass out and explain Lab Lesson 5-A, "Resistors in Series".
3. Explain and demonstrate the use of the ohmmeter portion of the multimeter.
4. Work some of the problems on pages 156-157 in Slurzberg's, Essentials of Electricity for Radio and Television.
5. Assign problems 6-13 on pages 156-157 in Slurzberg's, Essentials of Electricity for Radio and Television. Use the slide rule as much as possible.
6. There will be a short electronics quiz.

LAB

1. Lesson 5-A, if all other lab work is completed.

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Lesson 5-A
Resistors in Series

INTRODUCTION AND OBJECTIVE

In this lesson we will see what occurs when we put more than one resistor in series on a single voltage source. You are to use a new instrument, the ohmmeter.

REFERENCES

Radio Electronics and Television Laboratory Manual, Basic Electricity, Job 8, McGraw-Hill Book Company, Electronic Industries Association.

Slurzberg, Essentials of Electricity for Radio and Television, McGraw-Hill Book Company, pp. 118-162.

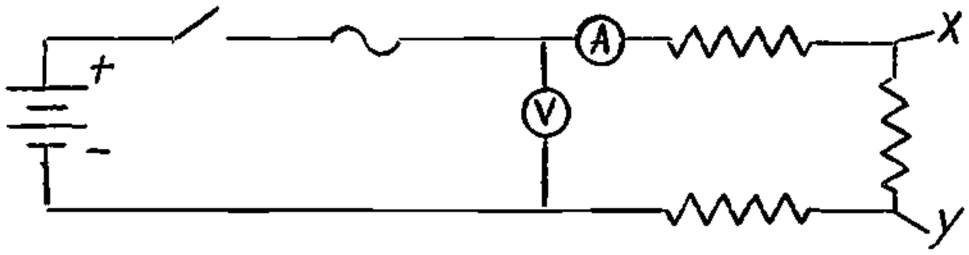
MATERIALS AND EQUIPMENT USED

0-30 volt, DC voltmeter; 0-10 ma, DC millimeter; multimeter; and the following resistors: R-1, 330; R-2, 510; R-3, 1000; R-4, 2200; R-5, 3900: and R-6, 4700 ohms.

PROCEDURE

1. Measure the following combinations with the ohmmeter. Record your readings.
    - Combination A--R-1, R-3 and R-5
    - Combination B--R-2, R-4 and R-6
    - Combination C--R-1, R-4 and R-2
    - Combination D--R-2, R-3 and R-5

2. Complete the following circuit. Have the instructor check it. Place combination A in the circuit first.



3. Record the following information for each combination. Do combination D last.
    - a. Total E
    - b. I measured
    - c. R computed (E divided by I)

ASSIGNMENT SHEET

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Basic A-C D-C

Lesson 5-A (Con't.)
Resistors in Series

4. Using combination D, move the current meter so as to measure the current flowing through point X and then point Y.

5. Remove the voltmeter from its place and measure the voltage across each resistor. Watch the ammeter as you do this.

6. Ask the instructor for a vacuum-tube voltmeter and repeat Step 5 under his supervision.

QUESTIONS

1. How can we compute the total resistance of a series circuit prior to taking voltmeter, ammeter readings?
2. Explain any differences found between rated, measured and computed values of R.
3. What is the relationship between the current passing through each resistor in a series circuit?
4. Would changing positions of the resistors in a series circuit have any effect on the flow of electrons? Why?
5. What did you notice about the sum of the voltages in Step 5?
6. What did you notice about the sum of the voltages in Step 6?
7. What is the total power being expanded in combination D?
8. Summarize the experiment.

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Course II

Basic A-C D-C

Lesson 6
The Use of the Slide Rule - Ohm's Law

INTRODUCTION AND OBJECTIVE

In this lecture period we will continue our study of the slide rule and work Ohm's Law problems. I will try to give you sufficient time to catch up on the lab work.

MATHEMATICS

1. Continue with powers of ten as far as power of a product.
2. Assign for next week, problems 7-3, pages 64 and 65, Cooke's, Mathematics for Electricians and Radiomen, First Edition and problems 10-3, pages 102 and 103, Cooke's, Basic Mathematics for Electronics, Second Edition.
3. Finish chapter 7, Cooke's First Edition and chapter 10, Cooke's Second Edition.

(Blackboard quiz)

1. Multiply: $(0.0036 \times 10^{-5} \times 450 \times 0.007 \times 10^{-5})$
2. Draw schematic on board.
    a. E is 1.73 volts, R is 600 ohms, find I.
    b. I is 3.25 ma, R is 2,500 ohms, find E.
    c. An electric lamp is designed to carry 0.75 amperes. Its resistance is 148 ohms. For what line voltage is it designed?

ELECTRONICS

1. Use and operation of the ohmmeter.
2. Work problems 7, page 156 in Slurzberg's, Essentials of Electricity for Radio and Television.
3. Study Ohm's Law, chapter 9, page 75, Cooke's First Edition and chapter 13, page 135, Cooke's Second Edition. Lecture on first three paragraphs and the first group of problems.
4. Assign problems 9-1, page 78, Cooke's First Edition and problems 13-1, page 139, Cooke's Second Edition.

TEACHERS OUTLINE

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Course I

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Lesson 6 (Con't.)

The Use of the Slide Rule - Ohm's Law

5. Assign as reading material, chapter 9, pages 75-84, Cooke's First Edition and chapter 9, pages 135-145, Cooke's Second Edition.

LAB

1. Answer any questions and go to Lab 5-A.

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VOCATIONAL ELECTRONIC TECHNICIAN TRAINING

Course I

Basic A-C D-C

Lesson 7

Electronic Circuits - Series and Parallel

INTRODUCTION AND OBJECTIVE

Math will continue in the use of the slide rule and math that will parallel the electronics theory. In electronics I will introduce you to the parallel circuit. We will study many formulas for computing total resistance.

MATHEMATICS

1. Work problems 7-3, page 64, in Cooke's, Mathematics for Electricians and Radiomen, First Edition and problems 10-3, page 102, in Cooke's, Basic Mathematics for Electronics, Second Edition.

2. Review the rest of the chapter on powers of ten.

3. Study chapter 9 in Cooke's First Edition, pp. 75-91. Work problems 9-1, page 78; 9-3, page 89 in Cooke's First Edition.

   Study chapter 13 in Cooke's Second Edition, pp. 135-158. Work problems 13-1, page 139, 13-2, page 145, 13-3, page 151 in Cooke's Second Edition.

4. Next week's assignment will include 7-3, 9-2 and 9-3 in Cooke's First Edition and 10-3, 13-2 and 13-3 in Cooke's Second Edition.

5. Assign problems 30, 31 and 32, page 85, in Slurzberg's, Essentials of Electricity for Radio and Television. Use the slide rule when solving these problems.

ELECTRONICS

1. Explain Lab 5-A on any points that are not clear to the students.

2. Ask for lab hand-in to be handed in as soon as they are ready.

3. Review the operation of the ohmmeter.

4. Work problems on page 78 of Cooke's First Edition and problems on page 139 in Cooke's Second Edition

5. Parallel circuits
   - a Current, voltage, resistance and power
   - b Characteristics, page 135 in Slurzberg's, Essentials of Electricity for Radio and Television

TEACHERS OUTLINE

VOCATIONAL ELECTRONIC TECHNICIAN TRAINING

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Basic A-C D-C

Lesson 7 (Con't.)

Electronics Circuits - Series and Parallel

6. Pass out Lesson 7-A and fully explain.

7. Briefly explain the use of the ammeter scale of the multimeter.

8. Next week's assignment:
   a. Read pages 133-137 in Slurzberg's, Essentials of Electricity for Radio and Television.
   b. Read pages 163-165 in Cooke's First Edition and pages 231-235 in Cooke's Second Edition.
   c. Work problems 14-1, page 165 in Cooke's First Edition and problems 18-1, page 235, in Cooke's Second Edition.

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Lesson 7-A

Parallel Circuits

INTRODUCTION AND OBJECTIVE

The purpose of this experiment is to study the flow of electrons in parallel circuits. In parallel circuits, the electrons have a choice of paths to follow. We must remember that the ammeter goes in series with the load.

REFERENCES

Cooke, Mathematics for Electricians and Radiomen, pages 102, 165.

Cooke, Basic Mathematics for Electronics, pages 170, 235.

Marcus, Elements of Radio, Prentice-Hall, Second Edition, pp. 94-96, 333-335.

Oldfield, Radio, Television and Basic Electricity, American Technical Society, pp. 43-45.

Radio, Electronics and Television Laboratory Manual, Basic Electricity, McGraw-Hill Book Company, Electronic Industries Association, Job 9.

Slurzberg, Essentials of Electricity for Radio and Television, pp. 134-135, Chapter 14.

MATERIALS AND EQUIPMENT USED

0-10 DC milliammeter; 0-30DC voltmeter; multimeter; vacuum-tube voltmeter; and the following resistors: R-1, 1k; R-2, 3.3k; R-3, 4.7k; and R-4, 2.7k ohms.

PROCEDURE

1. Measure each resistor with the ohmmeter and record its value in a table opposite its rated value.

2. Form the following parallel combinations and measure the combinations with the ohmmeter. Record their value.
   a. Combination A--R-1, R-2 and R-3
   b. Combination B--R-2, R-3 and R-4
   c. Combination C--R-3, R-1 and R-4
   d. Combination D--R-1, R-2 and R-4

3. Connect the following circuit, using combination A first.

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Course II | Basic A-C D-C

Lesson 7-A (Con't.)
Parallel Circuits

4. Record the value of the applied voltage and the current that is flowing. Compute the value of R_t by dividing E by I.

5. Repeat with combinations B, C and D. Leave C in the circuit for the next part of the experiment.

6. Place the VOM in the circuit as an ammeter and only the electrons through R-1. Let the instructor check the circuit before you turn the circuit on.

7. Repeat for the number of electrons in R-3 and R-4.

QUESTIONS

1. Compute the value of each of the combinations by the special formula that you will find in the reference material for parallel circuits.
2. Explain any differences found between the measured value of R (Step 2), computed R (Step 4 and 5), and the values found in question 1.
3. What relationship, if any, do we notice between the total current and the current in the individual branches?
4. What is true concerning the voltage across each resistor in a parallel circuit?
5. What is the total power consumed in combination C?
6. What effect does the milliammeter's resistance have on the circuit?
7. Summarize the experiment.

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Lesson 8

Parallel Circuit Problems

INTRODUCTION AND OBJECTIVE

In this period of lecture and discussion we will continue using parallel circuits. In order to fully acquaint you with the characteristics of parallel circuitry, we will work several problems.

MATHEMATICS

1. Review of reciprocals
2. Power of a power
3. Work last week's assignment.
4. Work problems 9-3, page 89, in Cooke's, Mathematics for Electricians and Radiomen, First Edition and problems 13-3, page 151, in Cooke's, Basic Mathematics for Electronics, Second Edition.
5. Study Ohm's Law--Parallel circuits.
6. Work example, bottom of page 164 in Cooke's First Edition and example on page 235 in Cooke's Second Edition.
7. Assign for next week: Problems 14-1, page 165, in Cooke's First Edition and problems 18-1, page 235, in Cooke's Second Edition.

ELECTRONICS

1. Review parallel circuits.
2. Review the operation of the multimeter to date.
3. Explain Lab 7-A and ask for questions about it.
4. Read pages 133-137 in Slurzberg's, Essentials of Electricity for Radio and Television.
5. Assign for next week: 18, 19 and 20, page 157, in Slurzberg's, Essentials of Electricity for Radio and Television.

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Lesson 8 (Con't.)

Parallel Circuit Problems

LAB

1. Continuation of last week

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VOCATIONAL ELECTRONIC TECHNICIAN TRAINING

Course II

Basic A-C D-C

Lesson 9

Simple Series - Parallel Combination Circuits

INTRODUCTION AND OBJECTIVE

So far we have studied series circuits and parallel circuits separately. Seldom in electronics will you see these circuits in this simple form. Electronic circuits consist of a combination of series and parallel circuitry In this lecture period, you will be introduced to simple series-parallel circuits. The next lab experiment will be of this type.

MATHEMATICS

1. Work problem 16 in problems 9-2, page 84, Cooke's, Mathematics for Electricians and Radiomen, First Edition and problem 16, problems 13-2, page 146, Cooke's, Basic Mathematics for Electronics, Second Edition.

2. Work problems 9-3, page 89, Cooke's First Edition and problems 13-3, page 150, Cooke's Second Edition.

3. Review parallel circuits, page 162, Cooke's First Edition and parallel circuits, page 230, Cooke's Second Edition.

4. Study formulas -- examples on pages 163-164, Cooke's First Edition and examples on pages 233-235, Cooke's Second Edition.

5. Work problems 14-1, page 165 and 14-2, page 167, in Cooke's First Edition. Work problems 18-1, page 235, and 18-2, page 238, in Cooke's Second Edition.

6. Assign problems 14-1, 14-2 and 14-3, pages 165-173, in Cooke's First Edition and problems 18-1, 18-2 and 18-3, pages 235-243, in Cooke's Second Edition for next week.

7. Assign paragraph 14-3, page 168, to read in Cooke's First Edition and paragraph 18-3, page 238, to read in Cooke's Second Edition.

ELECTRONICS

1. Review parallel circuits.

2. Simple combination circuits.

3. Work example 4-9, page 138, in Slurzberg's, Essentials of Electricity for Radio and Television.

TEACHERS OUTLINE

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Course II

Basic A-C D-C

Lesson 9 (Con't.)
Simple Series - Parallel Combination Circuits

4. Series and parallel battery combinations
5. Work example 4-11 on page 142 in Slurzberg.
6. Work problems on pages 156-157, in Slurzberg, if time permits.
7. Assign as reading material for next week on pages 137-154, in Slurzberg.
8. Assign problems 18 through 24 on page 157 in Slurzberg.

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Course II

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Lesson 9-A
Combined Series and Parallel Circuits

INTRODUCTION AND OBJECTIVE

We have studied the reaction of pure resistive load in simple series and parallel combinations. Now we are going to place them both in the same circuit at the same time.

REFERENCES

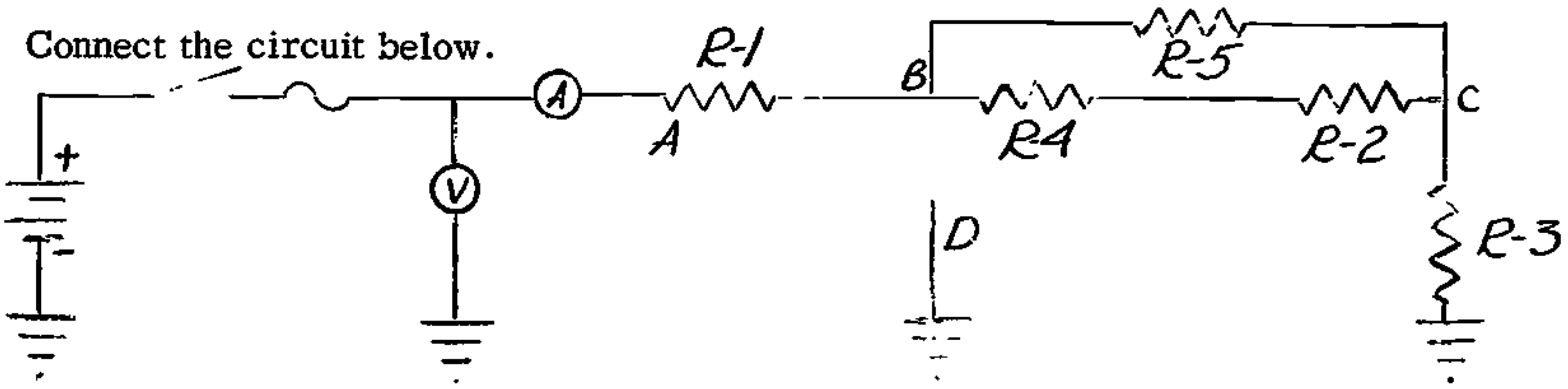
Lessons 1-8

MATERIAL AND EQUIPMENT USED

0-10 DC ma meter; 0-30 DC voltmeter, vacuum-tube voltmeter; multimeter; and the following resistors: R-1, 330; R-2, 470; R-3, 1000; R-4, 2200; R-5, 3900 ohms

PROCEDURE

1. Measure and record the resistance from point A to D.
2. Connect the circuit below.



3. Measure and record the resistance from point A to D.
4. Measure and record the resistance from point B to C.
5. Place the ammeter so as to measure total current. Be sure to place the switch so as to protect both meters.
6. Measure and record total voltage and the voltage across each resistor. Remember we have to use a VOM so as not to load the circuit.
7. Record the total current and the current through R-2 only.

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Basic A-C D-C

Lesson 9-A (Con't.)
Combined Series and Parallel Circuits

8. Record the current through R-4 only.

9. Record the current through R-5 only.

10. Remove R-2 from the circuit. This is what would happen if that resistor burned out. What does the current read now?

QUESTIONS

1. Compute the resistance from point B to C by the formula for parallel resistors.

2. How can we compute the total resistance from A to D so that we might predict the current?

3. How does the voltage across R-5 compare with the sum of the voltages across R-4 and R-2?

4. Calculate the resistance of the parallel branch by using total current.

5. Calculate the total resistance by using the total current.

6. Calculate the current in each branch by using rated values for the resistors.

7. What is the power consumed in the circuit?

8. Summarize the experiment.

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Course II

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Lesson 10
Bridge Circuits

INTRODUCTION AND OBJECTIVE

This lecture is a continuation of complex resistive circuits. In the mathematics portion of the lecture, we will discuss a new circuit known as the bridge. If you find that the math discussion seems to be electronics and vice versa, keep in mind that the two are actually inseparable. You must understand them both to really understand either. In the electronics hour, you will meet the pesky voltage divider. You will also be assigned another lab handout.

MATHEMATICS

1. Compound circuits
2. Bridge circuits; The Wheatstone Bridge
3. Work example 1 on page 178 in Cooke's, Mathematics for Electricians and Radiomen, and example 6 on page 274 in Cooke's, Basic Mathematics for Electronics, Second Edition.
4. Work the problems in last week's assignment.
5. Assign problems 1 and 2 of 14-5 on pages 179-180 in Cooke's, Mathematics for Electricians and Radiomen, and problems 1 and 2 of 20-3 on page 275 in Cooke's, Basic Mathematics for Electronics, Second Edition.
6. Assign any problems we have covered that the students seem to need practice on.

ELECTRONICS

1. Parallel and combination circuits
2. Start in Slurzberg's, Essentials of Electricity for Radio and Television, on page 137.
3. Rheostats and potentiometers
4. Voltage dividers
5. Work problems 18-24 in Slurzberg's, Essentials of Electricity for Radio and Television, pages 154 and 155.
6. Critique Lab 9-A.

TEACHERS OUTLINE

VOCATIONAL ELECTRONIC TECHNICIAN TRAINING

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Basic A-C D-C

Lesson 10 (Con't.)

Bridge Circuits

7. **WARNING:** Exam on electronics to date, however, it will be mainly on parallel and combination circuits. Next week.

8. Assign problems 26, 30, 32 and 40 on pages 159-160 in Slurzberg's, Essentials of Electricity for Radio and Television.

9. Hand out Lab Lesson 10-A, "The Voltage Divider", and explain.

LAB

1. Continuation of work assigned.

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Course II

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Lesson 10-A
The Voltage Divider

INTRODUCTION AND OBJECTIVE

We have to this time seen a need for many power supplies. A, B, C and filament supplies must all be obtained for the receiver. We have seen that each individual tube in a set may require different voltages for operation. To have a seperate supply for each need would make us utilize a moving van for the power supply only. In this lesson we will demonstrate how one supply may be utilized to supply the many different voltages needed in electronic circuitry.

REFERENCES

Henney, Keith, Principles of Radio, John Wiley and Sons, pp. 25, 317-319.

Marcus, Elements of Radio, Prentice-Hall, Second Edition, pp. 163-169.

Oldfield, Radio, Television and Basic Electricity, American Technical Society, p. 154.

Radio, Electronics and Television Laboratory Manual, Basic Electricity, McGraw-Hill Book Company, Electronic Industries Association, Job 12 and 13.

Slurzberg, Essentials of Electricity for Radio and Television, McGraw-Hill Book Company, pp. 149-154.

MATERIAL AND EQUIPMENT USED

0-10 ma meter, volt-ohmmeter, four 1200 ohm resistors and the following load resistors: 1000, 3300, 2200, 3900, 4700, 5600, 6800, 8200 and 10000 ohms

PROCEDURE

1. Connect the following circuit.

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VOCATIONAL ELECTRONIC TECHNICIAN TRAINING

Course II

Basic A-C D-C

Lesson 10-A (Con't.)
The Voltage Divider

2. Record the following with the switch open.
    a. Voltage A-F
    b. Voltage B-F
    c. Voltage D-F
    d. Voltage C-F
    e. Voltage E-F
    f. Current through load

3. Place the 10,000 ohm load in the circuit and take all the voltage and current readings again.

4. Using each of the other resistors, one at a time and repeat all voltage readings, record in chart form. (Use the larger value of resistance first.)

5. Place the VOM in the circuit as to measure current in the load. Have the instructor check.

6. Place the 10,000 ohm load in the circuit and record the divider and load current.

7. Repeat with each remaining load, recording both currents and record in chart form.

QUESTIONS

1. How does the load current vary with the load?
2. Graph the load current versus the divider current for this particular circuit.
3. What is the relationship between voltage E to F and C to F?
4. What relationship does voltage B to F have with A to F?
5. What two important items must we know about the load in order to design a voltage divider?
6. An amplifier requires the following voltages and currents:
    a. 250 volts at 40 mils
    b. 180 volts at 10 mils
    c. 90volts at 5 mils

    The bleeder current is 10 mils. Design a suitable divider.
7. Summarize the experiment.

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Course II

Basic A-C D-C

Lesson 11

Review for Mid-Term Electronics Exam

INTRODUCTION AND OBJECTIVE

During this hour of lecture, which will be devoted to math, we will review the slide rule and bridge circuits. An examination will be given during the second hour on the electronics to date. Any time left will be spent in lab.

MATHEMATICS

1. Problems 14-3 on pages 171 and 172 in Cooke's, Mathematics for Electricians and Radiomen, and problems 18-3 on pages 241 and 242 in Cooke's, Basic Mathematics for Electronics, Second Edition.

2. Bridge circuits 14-5 on page 177 in Cooke's, Mathematics for Electricians and Radiomen, and bridge circuits 20-4 on page 272 in Cooke's, Basic Mathematics for Electronics, Second Edition.

3. Explain the Wheatstone Bridge.

Problems 14-5, 1 and 2 on pages 179-180 in Cooke's, Mathematics for Electricians and Radiomen, and problems 1 and 2 of 20-3 on page 275 in Cooke's, Basic Mathematics for Electronics, Second Edition.

5. Stress the slide rule and review problems on R_t of parallel circuits.

6. Page 170, example 4, in Cooke's, Mathematics for Electricians and Radiomen, and example 9 on page 240 in Cooke's, Basic Mathematics for Electronics.

ELECTRONICS

1 Assign material to work and study for next week.

2. Give mid-term electronics exam.

3. Any time left will be spent in lab.

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ELECTRONICS EXAM

VOCATIONAL ELECTRONIC TECHNICIAN TRAINING

Course II — Basic A-C D-C

NAME ______________________________

Underline the correct answers and place the letter in the blank at the right.

1. A voltmeter is used to measure
   a. electron flow. c. electrical current.
   b. electrical power. d. electromotive force. ________

2. An instrument that will measure AC and DC voltages, resistance, and direct current is called
   a. an ammeter. c. a multimeter.
   b. a voltmeter. d. an ohmmeter. ________

3. A meter that will read current in thousandths of an ampere is called
   a. a rheostat.
   b. an indicator.
   c. a milliammeter. ________

4. Materials which do not permit electrons to flow through them are called insulators or
   a. resistance extensions. c. non-conductors.
   b. service wires. d. trimmers. ________

5. The amount of current flowing through a conductor that has a resistance of 10 ohms and a voltage of 130 volts impressed across it is
   a. 0.07 amperes. c. 1.07 amperes.
   b. 130 amperes. d. 13 amperes. ________

6. The unit of electrical power is the
   a. volt. c. watt.
   b. ohm. d. ampere. ________

7. An electric heater takes seven amperes when connected to a 120 volt circuit. Its resistance is
   a. 0.5 ohms. c. 840 ohms.
   b. 17.14 ohms. d. 0.58 ohms.
   e. 580 ohms. ________

8. If an electric iron has a resistance of 30 ohms and five amperes are required to keep it hot, the voltage necessary for the proper operation of the iron is
   a. 150 volts. c. 0.166 volts.
   b. 6 volts. d. 16.6 volts. ________

ELECTRONICS EXAM

VOCATIONAL ELECTRONIC TECHNICIAN TRAINING

Course II — Basic A-C D-C

Page 2 — NAME ____________________

9. The pressure that forces or pushes electrons through an electrical circuit is called
   a. current. c. resistance.
   b. voltage. d. wattage. ______

10. The flow of electrons through a circuit is called
   a. current. b. voltage. c. wattage. ______

11. The opposition of electron flow that is found in all circuits is
   a. resistance. c. electromotive force.
   b. conductance. d. wattage. ______

12. Electromotive force is measured in
   a. ohms. c. volts.
   b. watts. d. ampere. ______

13. The unit resistance is the
   a. volt. c. ampere.
   b. ohm. d. watt. ______

14. When bare wires touch each other so that an unwanted path is made through which current can flow, a
   a. two-circuit ground exists.
   b. short circuit is said to exist.
   c. leakage of flux can be detected. ______

15. If three light bulbs are connected in parallel, the voltage across each bulb is
   a. more than that of the source.
   b. the same as that of the source.
   c. less than that of the source. ______

16. The amount of current flowing through a conductor that has a resistance of 210 ohms and a voltage of 110 impressed upon it is
   a. 0.21 amperes. c. 2,100 amperes.
   b. 2.1 amperes. d. 0.523 amperes. ______

17. If a carbon resistor of 2 ohms has 10 amperes of current flowing through it, the voltage impressed across it is
   a. 0.5 volts. c. 20 volts.
   b. 0.2 volts. d. 5 volts. ______

ELECTRONICS EXAM

VOCATIONAL ELECTRONIC TECHNICIAN TRAINING

Course II

Basic A-C D-C

Page 3

NAME ______________________________

EXPRESS THE FOLLOWING AS NUMBERS BETWEEN 1 AND 10, TIMES A POWER OF TEN

1. 0.000025
2. 8,000
3. 312,000
4. 0.0000079
5. 159×10^{3}
6. 7,830
7. 683
8. 83
9. 259×10^{-4}
10. 186,000

TEACHERS OUTLINE

VOCATIONAL ELECTRONIC TECHNICIAN TRAINING

Course II

Basic A-C D-C

Lesson 12
Geometry - Angles

INTRODUCTION AND OBJECTIVE

In this lecture you will be introduced to the geometry necessary for the study of alternating current. We will study angles, their generation and how they are measured. The electronics portion of the lecture will continue with what was already started, the voltage divider.

MATHEMATICS

1. Work problems 26, 30, and 32 in Slurzberg's, Essentials of Electricity for Radio and Television, pages 158-159.

2. The study of angles: Chapter 22 in Cooke's, Mathematics for Electricians and Radiomen, First Edition, and chapter 26 in Cooke's, Basic Mathematics for Electronics, Second Edition.

3. Study 22-1 on pages 327 and 328 in Cooke's First Edition, and 26-1 on pages 385 and 386 in Cooke's Second Edition.

    a. Go through part of this material from the book.
    b. Give terms to understand.

4. Generation of angles: 22-2 on pages 328 and 329 in Cooke's First Edition, and 26-2 on pages 387 and 388 in Cooke's Second Edition.

5. The sexagesimal system: 22-3 on pages 329-331 in Cooke's First Edition, and 26-3 on pages 388 and 389 in Cooke's Second Edition.

6. Angles of any magnitude: 22-4 on pages 329-330 in Cooke's First Edition, and 26-4 on page 389 in Cooke's Second Edition.

7. Assign problems 22-1 on page 332 in Cooke's First Edition, and problems 26-1 on page 390 in Cooke's Second Edition.

8. Assign problems 3, 4, 6, 7, 8, 28, 36, and 38 on pages 154-155 in Slurzberg's, Essentials of Electricity for Radio and Television, as hand-in material.

ELECTRONICS

1. Review voltage dividers.

TEACHERS OUTLINE

VOCATIONAL ELECTRONIC TECHNICIAN TRAINING

Course II

Basic A-C D-C

Lesson 12 (Con't.)

Geometry - Angles

2. Work problem 37 in Slurzberg, page 159.

3. Review Lab Lesson 10-A.

4. Give parallel and combination quiz.

5. The rest of the time will be spent in the laboratory.

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TEACHERS OUTLINE

VOCATIONAL ELECTRONIC TECHNICIAN TRAINING

Course II

Basic A-C D-C

Lesson 13

Geometry - The Voltmeter Circuit

INTRODUCTION AND OBJECTIVE

You have used the voltmeter in several instruments--the multimeter, the vacuum tube voltmeter, and the small voltmeter on your breadboard. In this lecture we will see how a voltmeter works. You will have a lab experiment in which you will take a meter movement and design a voltmeter circuit. We will continue our study of angles during the math portion.

MATHEMATICS

1. Review these terms:

   a. angle
   b. vertex
   c. sides
   d. right angle
   e. acute angle
   f. obtuse angle
   g. complementary angle
   h. supplementary angles
   i. initial side
   j. terminal side
   k. standard position
   l. positive angle
   m. negative angle
   n. first quadrant
   o. degrees
   p. minutes
   q. seconds

2. Read 22-4, "Angles of Any Magnitude", in Cooke's, Mathematics for Electricians, First Edition, page 331, and 26-4, in Cooke's, Basic Mathematics for Electronics, Second Edition, page 389.

3. The circular or natural system of measurement:

   a. Explain radian and pi measurements.
   b. Convert radians to degrees.
   c. Convert degrees to radians

4. Work example 1 on page 334 in Cooke's First Edition and example 1 on page 392 in Cooke's Second Edition.

5. Work example 2 and problems 22-2 on page 334 in Cooke's First Edition and example 2 and problems 26-2 in Cooke's Second Edition, page 392.

TEACHERS OUTLINE

VOCATIONAL ELECTRONIC TECHNICIAN TRAINING

Course II

Basic A-C D-C

Lesson 13 (Con't.)

Geometry - The Voltmeter Circuit

6. Read 22-6, "Similar Triangles", in Cooke's First Edition, page 335 and 26-6, page 392, in Cooke's Second Edition.

7. Explain the right triangle, hypotenuse, altitude and base.

8. Explain briefly the square and square root on the slide rule.

9. Assign problems 22-4, page 338, in Cooke's First Edition and problems 26-4, page 395, in Cooke's Second Edition.

10. Assign the first three problems of 22-2, page 334, in Cooke's First Edition and the first three problems of 26-2, page 392, in Cooke's Second Edition.

11. Assign as reading material: Pages 339-345 in Cooke's First Edition and pages 397-403 in Cooke's Second Edition.

ELECTRONICS

1. Review any questions on the voltage divider lab experiment.

2. Voltmeters: Explain and review the following:

   a. How to connect a voltmeter in a circuit
   b. Construction of a voltmeter
   c. Example 6-1, page 211, in Slurzberg's, Essentials of Electricity for Radio and Television
   d. How to obtain more ranges
   e. Example 6-2, page 212, in Slurzberg's, Essentials of Electricity for Radio and Television
   f. Sensitivity of voltmeters
   g. Ohms per volt rating
   h. Precautions to be observed when using a voltmeter

3. Read pages 210-215 in Slurzberg's, Essentials of Electricity for Radio and Television, by next week.

4. Assign problems 8 and 9, page 239, in Slurzberg's, Essentials of Electricity for Radio and Television.

TEACHERS OUTLINE

VOCATIONAL ELECTRONIC TECHNICIAN TRAINING

Course II

Basic A-C D-C

Lesson 13 (Con't.)

Geometry - The Voltmeter Circuit

5. Short math quiz

LAB

1. Voltage divider

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VOCATIONAL ELECTRONIC TECHNICIAN TRAINING

Course II — Basic A-C D-C

Lesson 13-A
Voltmeter

INTRODUCTION AND OBJECTIVE

We have had several lessons using Ohm's Law and have been studying the behavior of different electronic circuits. In our studies we have used several different types of meters. In all the circuits we had electrons flowing. Some of our meters read current while others read volts or ohms. They all have one thing in common; they depend upon the flow of electrons for their operation. A voltmeter will develop into a simple series circuit.

REFERENCES

Marcus, Elements of Radio, Prentice-Hall, Second Edition, pp. 375-376.

Slurzberg, Essentials of Electricity for Radio and Television, McGraw-Hill Book Company, pp. 210, 213, 218, and 220.

Radio, Electronics and Television Laboratory Manual, Basic Electricity, McGraw-Hill Book Company, Electronic Industries Association, Job 14.

You should try to read at least one or two of these references on voltmeters.

MATERIAL AND EQUIPMENT USED

0-1 ma meter movement; vacuum-tube voltmeter; and various series resistors

NEW TERMS

1. Meter movement
2. Sensitivity (of meter movement)
3. Multiplier

PROCEDURE

1. Find the sensitivity of your meter-movement.
2. Find the resistance of your meter movement. Have the instructor help you. **METERS ARE EXPENSIVE.**

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Course II

Basic A-C D-C

Lesson 33-A (Con't.)

Voltmeter

3. What is the value of the multiplier needed to convert your meter into a 0-50 voltmeter?

4. Construct the voltmeter and have the instructor check it with you.

QUESTIONS

1. What does the ohms per volt rating of a voltmeter refer to?
2. Why is the ohms per volt rating important?
3. What would the ohms per volt rating of a voltmeter be if it had a 50 micro ampere meter movement?
4. Show the work necessary for converting a 50 ua meter into a 0-500 voltmeter.
5. Name at least two main precautions that we must watch when using a voltmeter.
6. What is the ohms per volt rating of the meter you constructed?
7. Summarize the experiment.

TEACHERS OUTLINE

VOCATIONAL ELECTRONIC TECHNICIAN TRAINING

Course II

Basic A-C D-C

Lesson 14

Basic Trigonometric Functions

INTRODUCTION AND OBJECTIVE

This lesson will cover more mathematics for a-c. You may think that we are never going to get into actual theory, however, if you understand the math we are covering, the a-c theory will come much easier for you. In this lecture, you will be introduced to the trigonometric terms for the first time. They are sine, cosine, tangent, and the solution of problems concerning right angles.

MATHEMATICS

1. Radians and degrees
2. Obtuse and acute triangles
3. Right triangles
4. Trigonometric functions
    a. Read the first paragraph in Cooke's, Mathematics for Electricians and Radiomen, First Edition, page 339, and the first paragraph in Cooke's, Basic Mathematics for Electronics, Second Edition, page 397.
    b. Draw 23-1 on page 339 in Cooke's First Edition and 27-1 on page 398 in Cooke's Second Edition on the board and explain fully.
    c. Sine, cosine, and tangent
    d. Cotangent, secant, and cosecant
5. Adjacent, opposite, and hypotenuse
6. Work the example on page 341 in Cooke's First Edition, and the example on page 399 in Cooke's Second Edition. Explain fully.
7. Reciprocal relations of the functions
8. Complementary angles: Explain 343 in Cooke's First Edition, using figure 23-4 as an example, and explain 401 in Cooke's Second Edition, using figure 27-4 as an example.
9. Assigned as reading material, pages 234-350 in Cooke's First Edition, and pages 401-408 in Cooke's Second Edition.

TEACHERS OUTLINE

VOCATIONAL ELECTRONIC TECHNICIAN TRAINING

Course II

Basic A-C D-C

Lesson 14 (Con't.)

Basic Trigonometric Functions

10. Work the first ten problems of 23-1, on page 344, in Cooke's First Edition; and work the first ten problems of 27-1, on page 402, in Cooke's Second Edition.

ELECTRONICS

1. Review the voltmeter lab assignment.
2. Assign pages 215-220, in Slurzberg's, Essentials of Electricity for Radio and Television.
3. Review problems 7 and 8, on page 239.
4. Assign pages 163-177 in Slurzberg.

TEACHERS OUTLINE

VOCATIONAL ELECTRONIC TECHNICIAN TRAINING

Course II

Basic A-C D-C

Lesson 15

Trigonometric Functions - Introduction to Magnetism

INTRODUCTION AND OBJECTIVE

Mathematics will concern the same topic as last period. We will continue to study the trigonometric functions. In the electronics portion of the class, you will be introduced to magnetism. In lab we will discover how to extend the range of the current meter.

MATHEMATICS

1. Review the basic trigonometric functions.

2. Work problems 23-1, pages 344-345, in Cooke's, Mathematics for Electricians, First Edition, and problems 27-1, pages 402-403, in Cooke's, Basic Mathematics for Electronics, Second Edition.

3. Read pages 345-347, in Cooke's First Edition and pages 403-405, in Cooke's Second Edition.

4. Study the signs of the functions, page 346, in Cooke's First Edition and pages 404-405, in Cooke's Second Edition.

5. Study 23-8, Functions of 45°, page 349; 23-9, Functions of 60° and 30°, page 349; and 23-10, Functions of 0°, page 350, in Cooke's First Edition.

   Study 27-8, Functions of 45°, pages 406 and 407; 27-9, Functions of 60° and 30°, pages 407 and 408; and 27-10, Functions of 0°, pages 408 and 409, in Cooke's Second Edition.

6. Study and review line representation of the functions.

7. Assign problems 23-3, page 355, in Cooke's First Edition and problems 27-3, page 412, in Cooke's Second Edition.

8. Assign as reading material pages 356-366, in Cooke's First Edition and pages 413-423, in Cooke's Second Edition.

ELECTRONICS

1. Review the lab assignment.

2. Introduction to magnetism, pages 162-177, in Slurzberg's, Essentials of Electricity for Radio and Television.

TEACHERS OUTLINE

VOCATIONAL ELECTRONIC TECHNICIAN TRAINING

Course II

Basic A-C D-C

Lesson 15 (Con't.)

Trigonometric Functions - Introduction to Magnetism

3. Hand out lab Lesson 15-A. "Current Meters", and explain fully.

4. Assign pages 182-197 in Slurzberg's, Essentials of Electricity for Radio and Television.

5. There will be a quiz on voltmeters.

LAB

1. Meters

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Course II

Basic A-C D-C

Lesson 15-A
Current Meters

INTRODUCTION AND OBJECTIVE

In the voltmeter lesson we learned that even the voltmeter depends upon the flow of electrons for its operation. In this lesson we will learn how we can take a basic meter-movement and make it read the current scale that we need. The ammeter is actually a simple parallel circuit.

REFERENCES

Marcus, Elements of Radio, Prentice-Hall, Second Edition, pp. 373-375.

Slurzberg, Essentials of Electricity for Radio and Television, pp. 215-218.

Radio Electronics and Television Laboratory Manual, Basic Electricity, McGraw-Hill Book Company, Electronic Industries Association, Job 15.

MATERIALS AND EQUIPMENT USED

0-1 ma meter and the vacuum-tube voltmeter

NEW TERMS

1. Shunt
2. Full-scale deflection

PROCEDURE

1. What is the full-scale deflection of your meter?
2. What is the resistance of your meter movement?
3. What is the voltage drop across your meter at full-scale?
4. Compute the value of shunt required to convert the basic movement to a 0-10 ma meter.
5. Design a circuit that will allow us to test your meter, but call the instructor before testing.

ASSIGNMENT SHEET

VOCATIONAL ELECTRONIC TECHNICIAN TRAINING

Course II

Basic A-C D-C

Lesson 15-A (Con't.)

Current Meters

QUESTIONS

1. Compare the voltage across the shunt with that across the meter movement.
2. Compare the resistance of the shunt with that of the meter movement.
3. Compare the current through the shunt with that of the meter movement.
4. Compare the value of shunt needed to convert your meter to a 0-100 ma meter.
5. Compute the value of shunt needed to convert your meter to a 0-1 ammeter.
6. What precautions must we observe when using a current meter?
7. What is the purpose of the shunt?
8. Will a good ammeter show a great amount or a small amount of resistance? Why?
9. Summarize the experiment.

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TEACHERS OUTLINE

VOCATIONAL ELECTRONIC TECHNICIAN TRAINING

Course II Basic A-C D-C

Lesson 16

Review of Mathematics - Ohmmeter and Current Meter

INTRODUCTION AND OBJECTIVE

In this lesson there will be a review of all the math to date. In the electronics portion we will discuss the ohmmeter and the current meter. There will be a test to see what you have learned to the present in both math and electronics. No new material will be discussed as we will possibly have new people about the time we discuss the section in the book on alternating current.

MATHEMATICS

1. Review.

2. Work a few of the series and parallel problems on pages 156-161 in Slurzberg's, Essentials of Electricity for Radio and Television.

ELECTRONICS (New terms for discussion)

1. The ohmmeter

2. Multiplier

3. Limiter

4. Zero adjustment

5. Hand out lab Lesson 16-A, "The Ohmmeter", and explain fully.

6. Give tests.

LAB

1. Meters

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MATH QUIZ

VOCATIONAL ELECTRONIC TECHNICIAN TRAINING

Course II

Basic A-C D-C

NAME ______________________________

1. Solve for x. $21 - 15x = -8x - 7$

2. Solve for R. $P = I^2R$

3. Express as numbers between 1 and 10 to a power of ten:

   a. 643,000,000

   b. 0.0000000000125

4. Solve:

   a. 13.5 kv equal ______________ volts.

   b. 0.350 amps equal ______________ milliamperes.

   c. 165,000 ohms equal ______________ megohm.

   d. 36.5 kw equal ________________ milliwatts.

5. The potential across a 600 ohm resistor is 1.73 volts. How much current is flowing in the circuit?

6. A voltmeter connected across a 1500 ohm resistor reads 3 volts:

   a. How much power is being expended in the resistor?

   b. How much current flows in the resistor?

7. Find the joint resistance of 10, 15 and 30 ohm resistors connected in parallel.

8. Find the joint resistance of 500 ohms and 250 ohms connected in parallel.

9. You have three 12 ohm resistors. Draw a schematic of how you would connect them to have a total resistance of 18 ohms.

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ELECTRONICS QUIZ

VOCATIONAL ELECTRONIC TECHNICIAN TRAINING

Course II

Basic A-C D-C

NAME ______________________________

1. A shunt resistor is used in the ________________.

2. A limiter resistor is used in the ________________.

3. A voltage multiplier is used in the ________________.

4. The adjustable resistor in the ohmmeter is used to adjust for a varying ________________.

5. The instrument that must NOT be used in a live circuit is the ________________.

6. We must remember to place the ________________ in parallel with the load.

7. We must remember to place the ________________ in series with the load.

8. To increase the range of an ammeter we add a resistor of ________________ value than the meter movement.

   a. larger   b. smaller   c. either larger or smaller

9. In making a 0-25 voltmeter, using a 0-1 ma meter-movement with a 1000 ohm resistance, we need a multiplier of ________________ ohms.

10. Total resistance offered by the meter in 9 is ________________.

11. In converting a 0-10ma with a 500 ohm resistance to a 0-15 ma meter we must use a shunt resistor of ________________ ohms.

12. Total resistance offered by meter in 11 is ________________.

13, 14, 15, 16, 17, 18, 19 and 20. Design a series ohmmeter using a 0-1 ma meter with a resistance of 1000 ohms, a rheostat of 2000 ohms is to be used. The power supply is to be 6 volts.

R_t ________________

ohms at 3/4 scale ________________

R of limiter ________________

ohms at 1/2 scale ________________

I limiter at full scale ________________

ohms at 1/4 scale ________________

ohms at full scale ________________

ohms at 0 scale ________________

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VOCATIONAL ELECTRONIC TECHNICIAN TRAINING

Course II

Basic A-C D-C

Lesson 16-A
The Ohmmeter

INTRODUCTION AND OBJECTIVE

This lesson is designed so that we will be able to take our basic meter movement and construct a meter that will use Ohm's Law. A meter that will have the value of resistance calibrated on the dial. We know by now that all meters depend upon current flow for their operation.

REFERENCES

Henney, Keith, Principles of Radio, John Wiley and Sons, pp. 60-61.

Marcus, Elements of Radio, Prentice-Hall, Second Edition, pp. 378-379, 383.

Oldfield, Radio, Television and Basic Electricity, American Technical Society, pp. 103-104.

Radio, Electronics and Television Laboratory Manual, Basic Electricity, McGraw-Hill Book Company, Electronic Industries Association, Job 16.

Sams, Howard W., Basic Electricity, First Edition, Lesson 14, Bobbs Merrill.

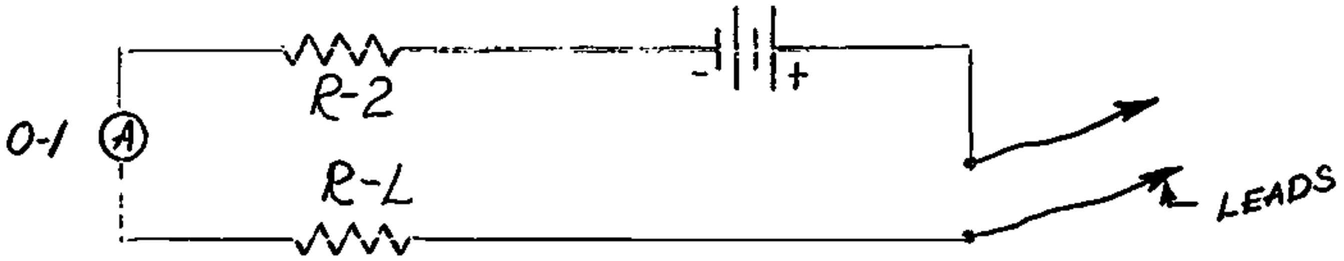
Slurzberg, Essentials of Electricity for Radio and Television, McGraw-Hill Book Company, pp. 222-225.

MATERIALS AND EQUIPMENT USED

0-1 or 0-10 ma meter, 500 ohm potentiometer, and assorted resistors

PROCEDURE

1. Connect the circuit below. R-1 must be computed much as the voltage multiplier in the voltmeter. Using the available voltage and meter-movement compute R-1 to give full scale deflection when the circuit is shorted. Choose R-1 to be a value of 250 ohms less than the computed value to allow for the potentiometer.



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Course III

Basic A-C D-C

Lesson II-A (Con't.)
The Ohmmeter

2. Short the test leads and adjust for full scale deflection. Draw a meter face on your paper and label full scale deflection as zero.

3. Open the test leads, the meter will now read no deflection. It is measuring infinity. Notice that the circuit is not drawing any current now. This type of an ohmmeter is a series ohmmeter, and the leads must be left open when not in use to prevent the batteries from running down.

4. Compute the value of resistance that you would have to measure in order to get one-quarter, one-half, and three-quarter scale deflection.

5. Get resistors close to these values and test your meter.

QUESTIONS

1. What is the center scale marking on a series ohmmeter using a 50 ma meter that has a resistance of 2,000 ohms? Use a battery of six volts.
2. Upon what does the center scale reading of a voltmeter depend? Explain.
3. What must we be sure to take into consideration when using an ohmmeter?
4. What must we take into consideration when measuring resistance in a radio circuit?
5. What is a shunt type ohmmeter?
6. Why must a shunt ohmmeter have a switch to turn it off and on?

TEACHERS OUTLINE

VOCATIONAL ELECTRONIC TECHNICIAN TRAINING

Course II

Basic A-C D-C

Lesson 17
Magnetism

INTRODUCTION AND OBJECTIVE

The study of magnetism is essential in order that you understand alternating current. This lecture will be almost entirely about magnetism. In the laboratory, you will be introduced to a new piece of equipment, the oscilloscope.

ELECTRONICS

1. Maxwell - one magnetic line
2. Magnetic flux - total magnetic lines leaving or entering a pole
3. Oersted - unit of field intensity
4. Flux density - B - number of magnetic lines per sq. cm. in a perpendicular field
5. Reluctance · opposition - not constant in magnetic fields
6. Gauss - unit of magnetic inductance
7. Reluctivity
8. Permeance - the reciprocal of reluctance
9. Retentivity - the ability of a material to hold its magnetism
10. Assign as reading material, pages 177-179 in Slurzberg's, Essentials of Electricity for Radio and Television.
11. The magnetic field surrounding a wire carrying a current
12. Demonstrate Fig. 5-29 on page 183 in Slurzberg, if possible.
13. Relation of magnetic field to electron flow
14. The magnetic field about a wire increases as the current decreases.
15. Left-hand rule
16. Coils
17. Assign related reading material in Slurzberg.

ASSIGNMENT SHEET

VOCATIONAL ELECTRONIC TECHNICIAN TRAINING

Course II

Basic A-C D-C

Lesson 17-A
Cells and Batteries

INTRODUCTION AND OBJECTIVE

We have to date used only DC electricity. That is electricity that flows in one direction only. We have obtained this power from cells and batteries. This lesson is designed to give you some background in the chemical action that takes place in a cell or battery.

REFERENCES

Henney, Keith, Principles of Radio, John Wiley and Sons, pp. 41-42.

Marcus, Elements of Radio, Prentice-Hall, Second Edition, pp. 336-344.

Sams, Howard W., Basic Electricity, Twelfth Edition.

Slurzberg, Essentials of Electricity for Radio and Television, McGraw-Hill Book Company, pp. 59, 87-115.

MATERIALS AND EQUIPMENT USED

Several cells or batteries, wires and the voltmeter

PROCEDURE

1. Connect at least three cells in series, read the total voltage.

2. Connect at least three cells in parallel and read the total voltage.

QUESTIONS

1. Explain the difference between a cell and a battery.
2. Upon what does the amount of voltage a cell develops depend?
3. What does the voltage developed by a battery depend?
4. What is the ampere hour rating?
5. Connecting batteries in series will change what rating of the battery?
6. Connecting batteries in parallel will change what rating?
7. What type of electricity does your car depend?
8. What keeps the battery in your car from becoming discharged?
9. Summarize.

TEACHERS OUTLINE

VOCATIONAL ELECTRONIC TECHNICIAN TRAINING

Course II

Basic A-C D-C

Lesson 18
Theory of the Alternating Current

INTRODUCTION

This is the first lesson concerning the alternating current theory. Just as in the basic D-C theory, the first few lessons are the most important. It is essential that you understand its basis before taking on more complex ideas. The lecture in electronics will begin with magnetism. Math will consist of the trigonometric functions necessary for the study of A-C theory.

ELECTRONICS

Objective: The objective of this lecture period is to introduce the student to the basic theories of magnetism. There will be many new terms. These terms may occasionally have other meanings in every day usage. Don't confuse them.

REFERENCE

Slurzberg, Morris, and William Osterheld, Essentials of Electricity for Radio and Television, Second Edition, McGraw-Hill Book Company, Inc., New York, 1950, pages 169-186.

EXPLANATION

1. Terms
   - a. Magnetic field
   - b. Magnetic flux
   - c. Magnetic lines
   - d. Lines of force
   - e. Field intensity
   - f. Flux density
   - g. Magnetic induction

2. Magnetic properties
   - a. Reluctance
   - b. Permeance
   - c. Retentivity

3. Physical shapes of magnets
   - a. Horseshoe
   - b. Bar
   - c. Laminated

4. Magnetic field due to current flow
   - a. Field around a current carrying wire
   - b. Relationship of field and amount of current flow
   - c. Relationship of field and direction of current flow

5. Left hand rules

6. Field around a coil

TEACHERS OUTLINE

VOCATIONAL ELECTRONIC TECHNICIAN TRAINING

Course II

Basic A-C D-C

Lesson 18 (Con't.)

Theory of the Alternating Current

ASSIGNMENT

1. Study pages 234-242 in Slurzberg's, Essentials of Electricity for Radio and Television.
2. Hand in the answers to the first twelve questions on page 263 in Slurzberg's, Essentials of Electricity for Radio and Television.

MATHEMATICS

Objective: The purpose of this hour of lecture will be to re-acquaint the student with the basic trigonometric functions of angles. Chapter 22 in the First Edition of Cooke or Chapte 26 in the Second Edition will be covered.

REFERENCES

Cooke, Nelson M., Mathematics for Electricians and Radiomen, First Edition, McGraw-Hill Book Company, Inc., New York, 1942, Chapter 22, pages 327-339.

Cooke, Nelson M., Basic Mathematics for Electronics, Second Edition, McGraw-Hill Book Company, Inc., New York, 1960, Chapter 26, pages 385-397.

EXPLANATION

1. Angles
2. The generation of angles
3. The sexagesimal system
4. The circular or natural system
5. Similar and right triangles

ASSIGNMENT

1. Work problems 22-4 on page 338 in Cooke's First Edition or problems 26-4 on page 395 in Cooke's Second Edition.
2. Read pages 339-349 in Cooke's First Edition or pages 397-406 in Cooke's Second Edition

LAB

1. Hand out Lesson 18-A, "Scope Controls", and explain.

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ASSIGNMENT SHEET

VOCATIONAL ELECTRONIC TECHNICIAN TRAINING

Course II

Basic A-C D-C

Lesson 18-A
Scope Controls

INTRODUCTION

The oscilloscope has come into use with television and radar. It can be very useful in all of our work and should be thought of as one of our fundamental instruments. This lesson will acquaint you with the many knobs on the scope.

MATERIALS

The scope and manufacturer's manual

PROCEDURE

1. Place the scope on a wooden bench or leave it on its stand if it is mobile.

2. Turn on and allow the unit to warm up.

3. Advance the intensity control unit until a spot is seen. You may have to rotate the positioning controls to locate the spot.

4. Turn the course frequency control to a mid-frequency.

5. Rotate the focus to get the sharpest line.

6. Set the intensity to the best setting.

7. Turn the vertical gain to maximum counter-clockwise.

8. Place your hand on the vertical input and rotate the vertical gain with the other.

9. Touch your other hand to the cabinet.

10. Connect a lead from the test jack on your scope to the vertical input.

11. Set the course and fine frequencies control until one or two complete cycles appear on the screen.

12. Change the horizontal gain through its position.

13. Set the sweep selector switch to the external position.

ASSIGNMENT SHEET

VOCATIONAL ELECTRONIC TECHNICIAN TRAINING

Course II — Basic A-C D-C

Lesson 18-A (Con't.)
Scope Controls

14. Place your finger on the horizontal input.

15. Place the sync selector to line.

16. Return the sweep selector to internal and adjust for one or two cycles.

17. Rotate the positioning controls and notice the effect.

QUESTIONS

1. What great advantage does the scope have over other instruments we have used?
2. What is the purpose of the cathode-ray tube?
3. What is the purpose of the heater, the cathode and the control grid in the cathode ray tube?
4. Which control on the scope varies the bias on the control grid?
5. What is the purpose of the first and second anodes?
6. Explain the deflection system of the scope.

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TEACHERS OUTLINE

VOCATIONAL ELECTRONIC TECHNICIAN TRAINING

Course II

Basic A-C D-C

Lesson 19

Magnetism and A-C Math - The Scope

INTRODUCTION

This lesson is a continuation of the study of magnetism and a-c mathematics. There is a lot of math and theory to be covered before the student is ready for a-c lab work. A short scope lab practice will help you to understand this valuable piece of test equipment and to appreciate its uses.

MATHEMATICS

Objective: In order to understand a-c theory, you must know how it is generated and its characteristics. We will resume where we left off in the last lesson.

REFERENCES

Cooke, Nelson M., Mathematics for Electricians and Radiomen, First Edition, McGraw-Hill Book Company, Inc., New York, 1942, pages 339-349.

Cooke, Nelson M., Basic Mathematics for Electronics, Second Edition, McGraw-Hill Book Company, Inc., New York, 1960, pages 392-407.

EXPLANATION

1. The right triangle
2. Read problems 22-4 on page 338 in Cooke's First Edition and problems 26-4 on page 395 in Cooke's Second Edition.
3. Trigonometric functions
4. Read problems 23-1 on page 344 in Cooke's First Edition and problems 27-1 on page 402 in Cooke's Second Edition.

ASSIGNMENT

1. Work the first 10 problems 23-1 on page 344 in Cooke's First Edition and problems 27-1 on page 402 in Cooke's Second Edition.
2. Read pages 339-351 in Cooke's First Edition and pages 397-409 in Cooke's Second Editio

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TEACHERS OUTLINE

VOCATIONAL ELECTRONIC TECHNICIAN TRAINING

Course II

Basic A-C D-C

Lesson 19 (Con't.)

Magnetism and A-C Math - The Scope

ELECTRONICS

Objective: We will review the basic magnetic theory. Most of this material was covered during the last lesson. Now we will go further into detail so that you will thoroughly understand them.

REFERENCE

Slurzberg, Morris, and William Osterheld, Essentials of Electricity for Radio and Televisio
Second Edition, McGraw-Hill Book Company, Inc., New York, 1950, pages 174-242.

EXPLANATION

1. Magnetic properties

2. Current carrying wires
   - a. Field about a current carrying wire or conductor
   - b. Relationship of field and amount of current
   - c. Relationship of field and direction of current

3. Left hand rules

4. Field of a coil

ASSIGNMENT

1. Read pages 234-242 in Slurzberg's, Essentials of Electricity for Radio and Television.

LAB

1. Hand out Lab Lesson 19-A, "A-C Scope Calibration", and explain.

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ASSIGNMENT SHEET

VOCATIONAL ELECTRONIC TECHNICIAN TRAINING

Course II

Basic A-C D-C

Lesson 19-A
A-C Scope Calibration

OBJECTIVE

The object of this lesson is to prepare the student to calibrate the oscilloscope to be used as a measuring device for alternating current voltages.

MATERIAL USED

Oscilloscope, various a-c sources and a vacuum tube voltmeter

PROCEDURE

1. Calibrate the oscilloscope using the calibrating voltage on the scope. (Be sure to measure or determine the voltage with the VTVM to assure correct calibration.)

2. Measure the following a-c voltages:

   a. The voltage off the power transformer secondary of the RCA Trainer.

   b. The voltage off the secondary of T_1 in the voltage tripler chassis.

   c. The voltage off the filament transformer supplied to the tables.

3. Using the voltage from the box on the table, perform the following: (R_1 is 220 ohms, R_2 is 820 ohms, R_3 is 2700 ohms and R_4 is 10k ohms).

   a. Connect R_1 and R_2 across the transformer and measure the voltage across each one with the scope and VTVM.

   b. Repeat with the following groups of resistors: (1) R_2-R_3, (2) R_3-R_4, (3) R_2-R_4, (4) R_1-R_4.

QUESTIONS

1. Does Ohm's Law still apply to a-c circuits of this type?
2. Does Kirchoff's Law apply to a-c circuits in which resistors are used?
3. Which do you think has the greater accuracy, the oscilloscope or the vacuum tube voltmeter? Why?

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VOCATIONAL ELECTRONIC TECHNICIAN TRAINING

Course II

Basic A-C D-C

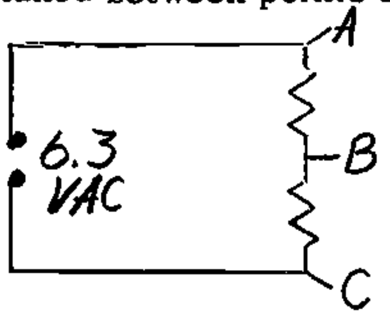
Lesson 19-B

Scope Lab Practice #1

1. Calibrate the scope using 6.3 VAC as a calibrating voltage.

2. Use the following resistors: R-1, 330; R-2, 820; R-3, 2,200; and R-4, 10,000 ohms.

3. Connect the following circuit. For each combination use the smaller value of resistance between points A and B.



4. Make the following measurements. E_t, E_A to B, and E_B to C with the oscilloscope, using the following combinations of resistors.

   a. R-1, R-2
   b. R-3, R-4
   c. R-2, R-4
   d. R-3, R-2
   e. R-1, R-3

5. Make the measurements with a VTVM to check the accuracy.

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TEACHERS OUTLINE

VOCATIONAL ELECTRONIC TECHNICIAN TRAINING

Course II

Basic A-C D-C

Lesson 20
Trigonometry Applied to A-C Problems

INTRODUCTION

So far we have had a lot of discussion concerning angles and trig functions. We will soon be applying this to the solution of actual circuit problems This lesson will be a continuation of the last one.

MATHEMATICS

Objective: This lesson will attempt to teach the student the trig functions necessary for the solution of certain a-c problems and how to apply the functions to the actual problems.

REFERENCES

Cooke, Nelson M., Mathematics for Electricians and Radiomen, McGraw-Hill Book Company, Inc., New York, 1942, Chapter 23, pp. 339-356.

Cooke, Nelson M., Basic Mathematics for Electronics, McGraw-Hill Book Company, Inc., New York, 1960, Chapter 27, pp. 397-413.

EXPLANATION

1. Trig functions

2. Work the first 10 problems of problems 23-1 on page 344 in Cooke's First Edition, or the first 10 problems of 27-1 on page 402 in Cooke's Second Edition.

3. Cover all of the material in the chapter up to the functions of 0° angles.

ASSIGNMENT

1. Read pages 349-355 in Cooke's First Edition or pages 408-412 in Cooke's Second Edition.

2. Assign problems 22-23 in problems 23-2 on page 348 in Cooke's First Edition, or problem 15-21 in problems 27-2 on page 405 in Cooke's Second Edition.

ELECTRONICS

Objective: In this section we will give the student a clearer understanding of the different types of electrical power apparatus.

TEACHERS OUTLINE

VOCATIONAL ELECTRONIC TECHNICIAN TRAINING

Course III

Basic A-C D-C

Lesson 20 (Con't.)

Trigonometry Applied to A-C Problems

REFERENCE

Slurzberg, Morris, and William Osterheld. Essentials of Electricity for Radio and Televisio
Second Edition. McGraw-Hill Book Company, Inc., New York, 1950. Chapter VII, pages 234-
249.

EXPLANATION

1. Electrical power apparatus
   - a. Direct current
   - b. Alternating current
   - c. Faraday's discovery
   - d. Fleming's right hand rule
   - e. Value of induced emf
   - f. The a-c generator. Explain fully 7-4, fig. 7-5, pages 239-241, in Slurzberg's, Essentials of Electricity for Radio and Television.
   - g. A-C characteristics
     - (1) Alternation
     - (2) Cycle
     - (3) Frequency

ASSIGNMENT

1. Read pages 242-251 in Slurzberg's, Essentials of Electricity for Radio and Television.

LAB

1. Hand out Lesson 20-A, "Scope Lab Practice", and explain.

ASSIGNMENT SHEET

VOCATIONAL ELECTRONIC TECHNICIAN TRAINING

Course II

Basic A-C D-C

Lesson 20-A
Scope Lab Practice

OBJECTIVE

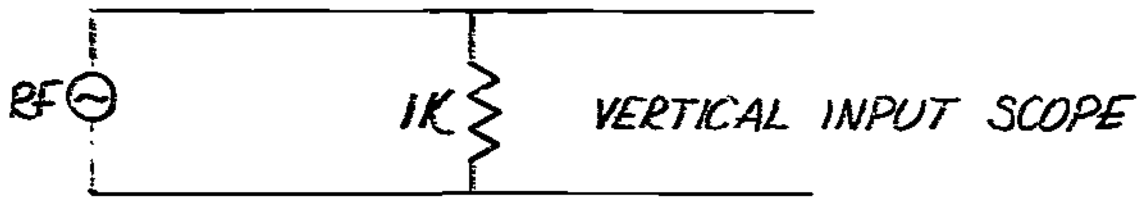
To calibrate the scope for reading a small AC signal. The signal used will be of the rf type in the 100 millivolt range.

MATERIAL USED

Scope, WR 49-B signal generator, used as a 100 kc source, 1000 ohm terminating resistor and a vacuum tube voltmeter.

PROCEDURE

1. Use the following set-up circuitry, steps 4-7.



2. Measure a-c calibrating voltage on the scope with the VTVM.

3. Calibrate the scope with this voltage.

4. Now using the voltage multiplier switch on the scope, set it to read the rf signal of 100 millivolts or 0.1 volts.

5. Verify your reading with the instructor.

6. Slowly change the frequency of the signal generator and watch the amplitude of the rf signal measured on the scope. This indicates that the amplitude of the signal will change with a change in frequency on this particular generator.

7. Set the sweep frequency switch on the scope so that it shows a single sine wave. Have the signal generator set at 100 kc at this time. Again slowly increase the frequency of the signal generator and the sweep frequency of the scope to keep the sine wave. Note the frequency on the signal generator when the scope will no longer follow.

ASSIGNMENT SHEET

VOCATIONAL ELECTRONIC TECHNICIAN TRAINING

Course II

Basic A-C D-C

Lesson 20-A (Con't.)
Scope Lab Practice

QUESTIONS

1. As the frequency is increased on the WR 49-B, what happens to the amplitude of the signal?

2. At what frequency are you no longer able to obtain a single sine wave on the scope?

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TEACHERS OUTLINE

VOCATIONAL ELECTRONIC TECHNICIAN TRAINING

Course II

Basic A-C D-C

Lesson 21

Trig Functions - Cycle and Frequency

INTRODUCTION

This lesson will be a continuation of the math and trig functions that we have been working with for the last few lessons. We will work some problems using these functions. In the electronics portion more a-c theory will be covered concerning cycle and frequency and we will have a discussion of instantaneous values.

MATHEMATICS

Objective: In the math portion we will continue to use the functions for the solution of angles and especially those of the most used angles. Trig is interesting if you apply yourself when studying the basics.

REFERENCES

Cooke, Nelson M., Mathematics for Electricians and Radiomen, First Edition, McGraw-Hill Book Company, Inc., New York, 1942, pages 345-370.

Cooke, Nelson M., Basic Mathematics for Electronics, Second Edition, McGraw-Hill Book Company, Inc., New York, 1960, pages 403-427.

EXPLANATION

1. Function of any angle

2. Signs of the functions

3. Computations of the functions

4. Functions of 45°, 60°, 30°, and 0° angles

5. Table of functions
   a. Work problems 1-3 in problems 24-1 on page 358 in Cooke's First Edition, or work problems 1-3 in problems 28-1 on page 415 in Cooke's Second Edition.
   b. Work problems 1-4 in problems 24-3 on pages 368-369 in Cooke's First Edition, or work problems 1-4 in problems 28-3 on page 425 in Cooke's Second Edition.

NEXT WEEK'S ASSIGNMENT

1. Read pages 362-370 in Cooke's First Edition or pages 419-427 in Cooke's Second Edition

2. Assign problems 1-10 on page 369 in Cooke's First Edition, or problems 1-10 on page 425 in Cooke's Second Edition.

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VOCATIONAL ELECTRONIC TECHNICIAN TRAINING

Course II

Basic A-C D-C

Lesson 21 (Con't.)

Trig Functions - Cycle and Frequency

ELECTRONICS

Objective: The purpose of this portion of lecture will be to explain additional characteristics of alternating current. We will use some of the trig functions previously discussed.

REFERENCE

Slurzberg, Morris, and William Osterheld, Essentials of Electricity for Radio and Television, Second Edition, McGraw-Hill Book Company, Inc., New York, 1950, pp. 241-249.

EXPLANATION

1. Define alternation, cycle and frequency.

2. Instantaneous values
   a. The sine wave
   b. Maximum value
   c. Average value
   d. Effective or RMS value

3. The a-c ampere

NEXT WEEK'S ASSIGNMENT

1. Read pages 241-249 in Slurzberg's, Essentials of Electricity for Radio and Television.

2. Work problems 12-15 on page 264 in Slurzberg's, Essentials of Electricity for Radio and Television.

3. Work problems 22-27 on page 265 in Slurzberg's, Essentials of Electricity for Radio and Television.

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TEACHERS OUTLINE

VOCATIONAL ELECTRONIC TECHNICIAN TRAINING

Course II

Basic A-C D-C

Lesson 22

Solution of Right Triangles - Inductive Reactance

INTRODUCTION

This lecture period will consist of a continuation of previous material. Quite a bit of theory and math must be covered before you are ready for the next lab exercise, which will be on inductive reactance. In the electronics lecture, you will be introduced to inductance and inductive reactance.

MATHEMATICS

Objective: To apply trig functions to the solution of right triangles.

REFERENCES

Cooke, Nelson M., Mathematics for Electricians and Radiomen, First Edition, McGraw-Hill Book Company, Inc., New York, 1942, Chapter 25, pp. 371-381.

Cooke, Nelson M., Basic Mathematics for Electronics, Second Edition, McGraw-Hill Book Company, Inc., New York, 1960, Chapter 29, pp. 428-439.

EXPLANATION

1. The solution of a problem concerning the right triangle.

2. Work as many examples and problems as time will permit.

ELECTRONICS

Objective: The opposition to direct current is called resistance. With alternating current, we have other opposition besides resistance. This is called reactance. In this lesson, we will discuss inductive reactance. This is one of two types of reactance. The other, capacitive reactance will be covered later.

REFERENCE

Slurzberg, Morris, and William Osterheld, Essentials of Electricity for Radio and Television, Second Edition, McGraw-Hill Book Company, Inc., New York, 1950, Chapter VIII, pp. 267-306.

EXPLANATION

1. Definition of inductance and inductive reactance

2. Factors affecting inductance

Lesson 22 (Con't.)
Solution of Right Triangles - Inductive Reactance

3. Time constant and angle of lag

4. Impedance

NEXT WEEK'S ASSIGNMENT

1. Read Slurzberg's, Essentials of Electricity for Radio and Television, on pages 267-280 and 284-287, and work the problems 18-24 on page 304.

TEACHERS OUTLINE

VOCATIONAL ELECTRONIC TECHNICIAN TRAINING

Course II

Basic A-C D-C

Lesson 23

Right Triangles - Circuits Containing Inductance

INTRODUCTION

In this lesson period we will continue the study of a-c. The math will mainly on the solution of problems concerning right triangles. The electronics lecture will be on inductance and inductive reactance. We have a lab exercise called "Inductive Reactance". It will help you to understand the principle of inductance and to apply some of the math that you have learned.

MATHEMATICS

Objective: In this math portion we will study the solution of problems concerning the right triangle. This is an absolute necessity for the understanding of alternating current.

REFERENCES

Cooke, Nelson M., Mathematics for Electricians and Radiomen, First Edition, McGraw-Hill Book Company, Inc., New York, 1942, Chapter 25, pages 371-381.

Cooke, Nelson M., Basic Mathematics for Electronics, Second Edition, McGraw-Hill Book Company, Inc., New York, 1960, Chapter 29, pages 428-439.

EXPLANATION

1. Study 25-1 on page 371 in Cooke's First Edition, or 29-1 on page 428 in Cooke's Second Edition.
2. Solution when given the acute angle and hypotenuse
3. Solution when given the hypotenuse and one side
4. Solution when given two sides

NEXT WEEK'S ASSIGNMENT

1. Study problems 25-2 on page 371 in Cooke's First Edition, or 29-2 on page 429 in Cooke's Second Edition.
2. Study problems 25-3 on page 373 in Cooke's First Edition, or 29-3 on page 430 in Cooke's Second Edition.
3. Study problems 25-4 on page 375 in Cooke's First Edition, or 29-4 on page 433 in Cooke's Second Edition.

TEACHERS OUTLINE

VOCATIONAL ELECTRONIC TECHNICIAN TRAINING

Course II

Basic A-C D-C

Lesson 23 (Con't.)

Right Triangles - Circuits Containing Inductance

ELECTRONICS

Objective: In this lesson we will continue with what was introduced in the last lesson. Inductance, inductive reactance, and circuits containing these properties will be discussed.

REFERENCE

Slurzberg, Morris, and William Osterheld, Essentials of Electricity for Radio and Television, Second Edition, McGraw-Hill Book Company, Inc., New York, 1950, Chapter VIII, pages 267-306.

EXPLANATION

1. Work problems 22-27 on page 265 in Slurzberg's, Essentials of Electricity for Radio and Television.
2. Inductive reactance
3. Effect of resistance in the circuit
4. Time constant

NEXT WEEK'S ASSIGNMENT

1. Read "Time Constant" on page 277 to "Mutual Inductance" on page 280 in Slurzberg's, Essentials of Electricity for Radio and Television.
2. Work problems 18-24 on page 304 in Slurzberg's, Essentials of Electricity for Radio and Television.

LAB

1. Hand out Lab Lesson 23-A, "Inductive Reactance", and explain.

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VOCATIONAL ELECTRONIC TECHNICIAN TRAINING

Course II

Basic A-C D-C

Lesson 23-A
Inductive Reactance

OBJECTIVE

In this lab lesson you will take an rf type choke of unknown value and find its value. You will use a known frequency a-c voltage and a resistance. You will also use the oscilloscope as a voltage measuring instrument.

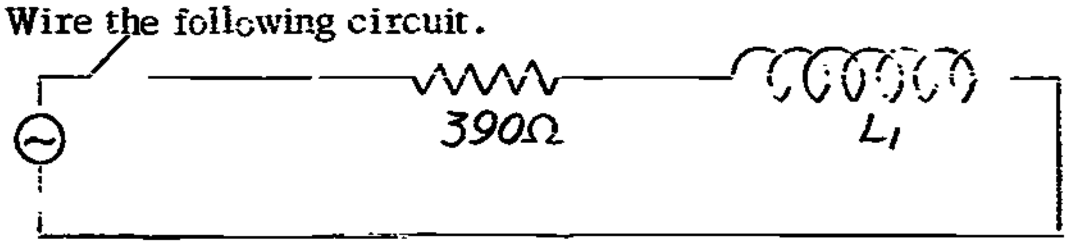
MATERIALS USED

RF generator to supply 100 millivolts at 100 kc., VTVM, oscilloscope, an unknown value rf choke, a 390 ohm resistor and a resistor equal to the dc resistance of the choke.

PROCEDURE

1. Measure the resistance of the choke with the ohmmeter. Measure the resistance of the resistors with the ohmmeter and record.

2. Wire the following circuit.



3. Complete the following table. (Be sure to show examples of your calculations used in conversion.)

	P-P	RMS
ET		
ER		
EL		

4. Replace the coil with the equal resistor and repeat the experiment if possible.

5. Have the instructor demonstrate how to measure the inductance of the choke on the Q meter (inductance bridge).

QUESTIONS

1. Compute I of step 3 and step 4. How do they compare?

2. Compute X_L of the choke.

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VOCATIONAL ELECTRONIC TECHNICIAN TRAINING

Course II

Basic A-C D-C

Lesson 23-A (Con't.)
Inductive Reactance

3. Compute L of the choke.
4. What is the Z of the circuit?
5. Show X_L, R, and Z by vectors.
6. What happened when the equal resistor was used? Why?
7. Summarize.

TEACHERS OUTLINE

VOCATIONAL ELECTRONIC TECHNICIAN TRAINING

Course II

Basic A-C D-C

Lesson 24

Inductance in Series or Parallel

INTRODUCTION

Math will be more practice concerning the solution of problems concerning triangles. Practice makes perfect is a good rule to follow, so we will work several examples. Just as certain rules apply for resistance in series and parallels, so do certain rules apply when we place inductance in series or parallel. In the electronics lecture we will discuss these rules.

MATHEMATICS

Objective: We intend to further your proficiency with trig functions in the solution of problems concerning right triangles. You have possibly reasoned that you must apply some of this math to the lab lesson on inductive reactance. Listen closely and be sure to ask any questions that you may have.

REFERENCES

Cooke, Nelson M., Mathematics for Electricians and Radiomen. First Edition. McGraw-Hill Book Company, Inc., New York, 1942, Chapter 25, pages 371-381.

Cooke, Nelson M., Basic Mathematics for Electronics, Second Edition. McGraw-Hill Book Company, Inc., New York, 1960, Chapter 29, pages 428-439.

EXPLANATION

1. Work examples assigned last lesson.

2. Work problems 18-24 on page 304 in Slurzberg's, Essentials of Electricity for Radio and Television.

3. Work problems 28-1 on page 412 in Cooke's First Edition or problems 32-1 on page 471 in Cooke's Second Edition.

NEXT WEEK'S ASSIGNMENT

1. Work problems 25-29 on page 304 in Slurzberg's, Essentials of Electricity for Radio and Television.

2. Read and work pages 422-430 in Cooke's First Edition or pages 482-491 in Cooke's Second Edition.

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TEACHERS OUTLINE

VOCATIONAL ELECTRONIC TECHNICIAN TRAINING

Course II

Basic A-C D-C

Lesson 24 (Con't.)

Inductance in Series or Parallel

5. Work problems 29-1 on page 422 in Cooke's First Edition, or problems 32-1 on page 477 in Cooke's Second Edition.

ELECTRONICS

Objective: This lesson will complete the lecture on inductance. You will find a similarity to resistance in series and parallel inductive circuits.

REFERENCES

Slurzberg, Morris, and William Osterheld. Essentials of Electricity for Radio and Television. Second Edition. McGraw-Hill Book Company, Inc., New York. 1950. Chapter VIII, pages 267-306.

Cooke, Nelson M. Mathematics for Electricians and Radiomen. First Edition. McGraw-Hill Book Company, Inc., New York. 1942. Chapter 29, page 422.

Cooke, Nelson M., Basic Mathematics for Electronics. Second Edition. McGraw-Hill Book Company, Inc., New York. 1960. Chapter 33, pages 482-518.

EXPLANATION

1. Series inductance
2. Parallel inductance
3. Measuring inductance

NEXT WEEK'S ASSIGNMENT

1. Read pages 284-302 in Slurzberg's. Essentials of Electricity for Radio and Television.

LAB

1. Continue Lesson 25-A, "Inductive Reactance".

TEACHERS OUTLINE

VOCATIONAL ELECTRONIC TECHNICIAN TRAINING

Course II

Basic A-C D-C

Lesson 25
Instantaneous Values in A-C

INTRODUCTION

Understanding what we mean by instantaneous values is essential in a-c study. We will work several problems of this type in the math period. In the electronics portion we will discuss several inductive terms and properties. You will be introduced again to a "must know" formula for computing inductive reactance.

MATHEMATICS

Objective: With this lesson you should be able to solve most of the fundamental problems concerning instantaneous values. We will work several problems. Be sure to work as many problems in your spare time as possible. Our time in class should be for the introduction of new material, so we can't spend too much time on practice.

REFERENCES

Cooke, Nelson M., Mathematics for Electricians and Radiomen, First Edition, McGraw-Hill Book Company, Inc., New York, 1942, Chapters 28 and 29, pages 407-457.

Cooke, Nelson M., Basic Mathematics for Electronics, Second Edition, McGraw-Hill Book Company, Inc., New York, 1960, Chapters 32 and 33, pages 466-518.

EXPLANATION

1. Instantaneous values

2. The inductive circuit

NEXT WEEK'S ASSIGNMENT

1. Work problems 28-3 on page 417 in Cooke's First Edition, or problems 32-3 on page 476 in Cooke's Second Edition.

2. Read to the end of the chapter on "Fundamental Ideas", in Cooke's First and Second Editions.

ELECTRONICS

Objective: The thing called inductance is used not only as an opposition of a-c, but also to couple signal or voltage from one circuit to another. We will discuss coupling action in this lesson.

TEACHERS OUTLINE

VOCATIONAL ELECTRONIC TECHNICIAN TRAINING

Course II

Basic A-C D-C

Lesson 25 (Con't.)
Instantaneous Values in A-C

REFERENCE

Slurzberg, Morris, and William Osterheld, Essentials of Electricity for Radio and Television, Second Edition, McGraw-Hill Book Company, Inc., New York, 1950, Chapter IX, pages 306-357.

EXPLANATION

1. Review inductance.
2. Formula for inductive reactance
3. Mutual coupling
4. Coefficient of coupling

NEXT WEEK'S ASSIGNMENT

1. Read pages 306-311 in Chapter IX in Slurzberg's, Essentials of Electricity for Radio and Television.

LAB

1. Hand out Lesson 25-A, "Series Inductance", and explain.

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VOCATIONAL ELECTRONIC TECHNICIAN TRAINING

Course II

Basic A-C D-C

Lesson 25-A
Series Inductance

OBJECTIVE

To observe the effect upon voltage, current and impedance when inductances are connected in series.

MATERIALS USED

Scope, VTVM, 2 rf chokes, 330 ohm resistor and the RCA WR 49-B rf signal generator which will be used as a 125 kc signal source at a 100 millivolt level.

PROCEDURE

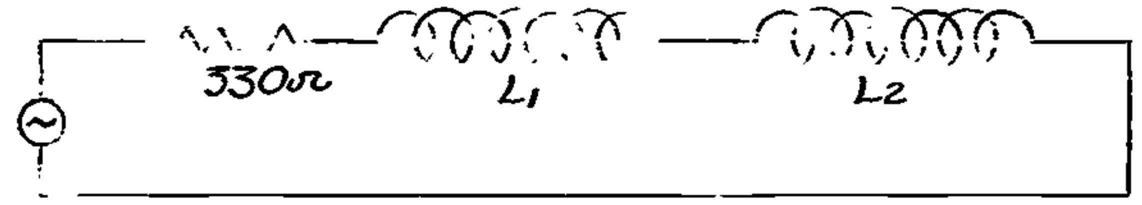
1. Measure the inductances on the Q meter and record. Let the larger inductor be L_1.

   L_1 ________________ L_2 ________________

2. Connect the two in series and measure on the Q meter.

   L_t ________________

3. Wire the following circuit.



4. Measure and record the following: E_t, E_{L_1}, E_{L_2}, E_r and E_{L_t}.
5. Compute E, I and total inductance using the experimental method explained for the last lesson.

QUESTIONS

1. Write a formula to describe inductances in series.
2. Write a formula describing total inductive reactance in series.
3. Compare the computed value in step 5 to the measured value in step 2 and the value obtained from the formula in question 1.
4. What would happen if the lines of force from one coil were to reach the other?
5. What is the phase relationship in L_1, L_2, and R?

ASSIGNMENT SHEET

VOCATIONAL ELECTRONIC TECHNICIAN TRAINING

Course II

Basic A-C D-C

Lesson 25-A (Con't.)
Series Inductance

6. What other component has a formula that compares to series inductance?
7. Summarize.

TEACHERS OUTLINE

VOCATIONAL ELECTRONIC TECHNICIAN TRAINING

Course II

Basic A-C D-C

Lesson 26
Series and Parallel Capacitive Reactance

INTRODUCTION

As stated before, inductive reactance was only one of two types of a-c opposition, the other being capacitive reactance. In this lesson, you will be introduced to capacity and to the opposition it produces, capacitive reactance. Note how capacity and inductance compare.

MATHEMATICS

Objective: In this math period, we will work problems which will help in the solution of capacitive circuits.

REFERENCES

Cooke, Nelson M., Mathematics for Electricians and Radiomen, First Edition, McGraw-Hill Book Company, Inc., New York, 1942, Chapter 29, pages 422-457.

Cooke, Nelson M., Basic Mathematics for Electronics, Second Edition, McGraw-Hill Book Company, Inc., New York, 1960, Chapter 33, pages 482-518.

EXPLANATION

1. The capacitive circuit
2. Series and parallel capacity

NEXT WEEK'S ASSIGNMENT

1. Work problems 29-3 on page 435 in Cooke's First Edition, or problems 33-3 on page 496 in Cooke's Second Edition.
2. Read 29-6 to 29-9 on pages 436-442 in Cooke's First Edition, or 33-6 to 33-9 on pages 497-504 in Cooke's Second Edition.
3. Work problems 29-4 on page 442 in Cooke's First Edition, or problems 33-4 on page 503 in Cooke's Second Edition.

ELECTRONICS

Objective: You will be introduced to capacity; what it is and what it does.

TEACHERS OUTLINE

VOCATIONAL ELECTRONIC TECHNICIAN TRAINING

Course II

Basic A-C D-C

Lesson 26 (Con't.)

Series and Parallel Capacitive Reactance

REFERENCE

Slurzberg, Morris, and William Osterheld, Essentials of Electricity for Radio and Television, Second Edition, McGraw-Hill Book Company, Inc., New York, 1950, Chapter IX, pages 306-357.

EXPLANATION

1. Capacitance and capacitor action

2. Types of capacitors

3. Capacitive reactance

NEXT WEEK'S ASSIGNMENT

1. Read pages 311-329 in Slurzberg's, Essentials of Electricity for Radio and Television.

LAB

1. Hand out lab Lesson 26-A, "Inductances in Parallel", and explain.

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VOCATIONAL ELECTRONIC TECHNICIAN TRAINING

Course II

Basic A-C D-C

Lesson 26-A
Inductance in Parallel

OBJECTIVE

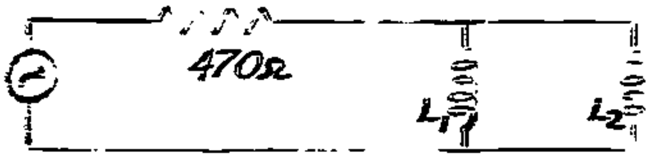
To study and observe the effect on voltage, current and impedance in a circuit where two inductors are connected in parallel.

MATERIALS USED

VTVM, scope, 125 kc signal source at 100 millivolt level, 2 rf chokes, and one 470 ohm resistor

PROCEDURE

1. Wire the following circuit.



2. Measure and record E_t, E_r, E_{L_1}, and E_{L_2}.

3. With the scope reading the voltage across R, move one coil near the other. Observe the reading on the scope. Now reverse the coil and observe. Explain.

4. Compute I_t.

5. Compute total inductive reactance.

6. Compute total inductance.

7. Increase the frequency to 200 kc and repeat steps 1-6.

QUESTIONS

1. Write a formula for parallel inductances and total inductance.

2. Write the formula relating total inductive reactance to parallel inductive reactance.

3. How does frequency affect X_L? Support this from your data.

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Course II

Basic A-C D-C

Lesson 26-A (Con't.)
Inductance in Parallel

4. How does frequency affect L? Support this from your data.

5. What is the phase relationship in the coil?

6. Compute Z of both circuits.

7. Summarize.

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TEACHERS OUTLINE

VOCATIONAL ELECTRONIC TECHNICIAN TRAINING

Course II

Basic A-C D-C

Lesson 27

Vectors and A-C Circuits

INTRODUCTION

In this lab and lecture period, you will be able to clear up any questions that you have on vectors. The math portion will consist mainly of vectors and RC circuits. In the electronics portion, we will go ahead with the discussion of capacitors.

MATHEMATICS

Objective: We will study, as stated above, vectors, RC circuits and power in a series circuit.

REFERENCES

Cooke, Nelson M., Mathematics for Electricians and Radiomen, First Edition, McGraw-Hill Book Company, Inc., New York, 1942, Chapter 29, pages 422-457.

Cooke, Nelson M., Basic Mathematics for Electronics, Second Edition, McGraw-Hill Book Company, Inc., New York, 1960, Chapter 33, pages 482-518.

EXPLANATION

1. Power in LC circuits
2. RL in series
3. RC in series
4. Vector diagrams
5. Work examples.

NEXT WEEK'S ASSIGNMENT

1. Read pages 447-453 in Cooke's First Edition, or pages 508-514 in Cooke's Second Edition.
2. Work all problems 29-4 on page 422 in Cooke's First Edition, or problems 33-4 on page 503 in Cooke's Second Edition.

TEACHERS OUTLINE

VOCATIONAL ELECTRONIC TECHNICIAN TRAINING

Course II
Basic A-C D-C

Lesson 27 (Con't.)
Vectors and A-C Circuits

ELECTRONICS

Objective: Although our math doesn't exactly parallel the electronics, you will find that it is impossible to keep them separate. We will study capacity and some of its circuit characteristics and more of related math.

REFERENCE

Slurzberg, Morris, and William Osterheld, Essentials of Electricity for Radio and Television, Second Edition, McGraw-Hill Book Company, Inc., New York, 1950, Chapter IX, pages 306-357.

EXPLANATION

1. Charge and discharge
2. Time constant
3. Voltage and current phase relationship
4. Capacitive reactance
5. Voltage ratings and losses
6. Series and parallel capacity
7. Power in capacitive circuits
8. Work problems 20-45 on pages 354-356 in Slurzberg's, Essentials of Electricity for Radio and Television.

NEXT WEEK'S ASSIGNMENT

1. Work problems 25-35 on pages 354-355 in Slurzberg's, Essentials of Electricity for Radio and Television.
2. Read pages 329-343 in Slurzberg's, Essentials of Electricity for Radio and Television

LAB

1. Hand out lab Lesson 27-A, "Capacitive Reactance", and explain.

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VOCATIONAL ELECTRONIC TECHNICIAN TRAINING

Course II

Basic A-C D-C

Lesson 27-A
Capacitive Reactance

OBJECTIVE

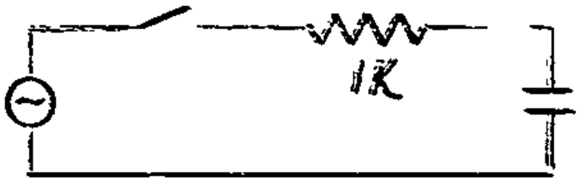
To observe and study the effect on voltage, current, and impedance, in a capacitive circuit.

MATERIALS USED

1. Four capacitors, 0.01 mfd, 0.022 mfd, 0.033 mfd and 0.047 mfd; scope; vacuum tube voltmeter; 1,000 ohm resistor and RCA WA-44C signal generator, used as a 5 kc, 2 volt peak to peak source

PROCEDURE

1. Measure and record each capacitor with the condenser checker. You will have to use all one checker, so while you are waiting, go ahead with the following.
2. Construct the following circuit. Use the 0.01 mfd capacitor first.



3. Record E_t, E_r, E_c. Compute I, X_c, and C.
4. Repeat steps 2 and 3 for the other three capacitors.
5. Compute Z for each capacitor-resistor combination.

QUESTIONS

1. How does F affect C?
2. What is the phase relationship in a capacitor?
3. How does the phase in a capacitor compare with an inductor?
4. Which capacitor has the largest reactance?
5. Summarize.

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TEACHERS OUTLINE

VOCATIONAL ELECTRONIC TECHNICIAN TRAINING

Course III

Basic A-C D-C

Lesson 25

Notation and Conversion - RLC Series Circuits

INTRODUCTION

In this lesson we will study various forms of notation. We will study the conversion from one type of notation to another. In the math portion more a-c problems will be discussed.

MATHEMATICS

Objective. We will discuss RLC series circuits, then go into notation. This study is necessary, as these forms of notation are used in many textbooks and in technical articles and publications.

REFERENCES

Cooke, Nelson M., Basic Mathematics for Electronics, Second Edition, McGraw-Hill Book Company, Inc., New York, 1960, Chapter 33, pages 482-518.

Cooke, Nelson M., Mathematics for Electricians and Radiomen, First Edition, McGraw-Hill Book Company, Inc., New York, 1942, Chapter 29, pages 422-457.

EXPLANATION

1. Work problems 29-4 on page 442 in Cooke's First Edition, or problems 33-4 on page 503 in Cooke's Second Edition.
2. Resistance, inductance, and capacity in series
3. Power in a series RLC circuit
4. Notation for series circuits
5. Conversion from rectangular to polar and vice versa

NEXT WEEK'S ASSIGNMENT

1. Study the general series circuit, page 450, in Cooke's First Edition or page 511 in Cooke's Second Edition.
2. Work problems 29-5 on page 452 in Cooke's First Edition, or problems 33-5 on page 515 in Cooke's Second Edition.

TEACHERS OUTLINE

VOCATIONAL ELECTRONIC TECHNICIAN TRAINING

Course II

Basic A-C D-C

Lesson 28 (Con't.)
Notation and Conversion - RLC Series Circuits

ELECTRONICS

Objective: We will study more about series RLC circuits, vectors, power, and impedance in a-c circuits.

REFERENCE

Slurzberg, Morris, and William Osterheld, Essentials of Electricity for Radio and Television, Second Edition, McGraw-Hill Book Company, Inc., New York, 1950, Chapters IX and X, pages 306-392.

EXPLANATION

1. Work problems 20-45 on pages 354-355 in Slurzberg's, Essentials of Electricity for Radio and Television.
2. Study Chapter X, page 357, in Slurzberg.
3. Complex circuits
4. Vectors
5. Power in a-c circuits
6. Series circuit problems 10-10 through 10-13 on pages 378-392 in Slurzberg.

NEXT WEEK'S ASSIGNMENT

1. Read pages 375-378, parallel circuits, in Slurzberg's, Essentials of Electricity for Radio and Television.
2. Work problems 7-27 on pages 386-388 in Slurzberg.

LAB

1. Hand out lab Lesson 28-A, "Capacitance in Series", and 28-B, "Parallel Capacitance", and explain.

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Course II

Basic A-C D-C

Lesson 28-A
Series Capacitance

OBJECTIVE

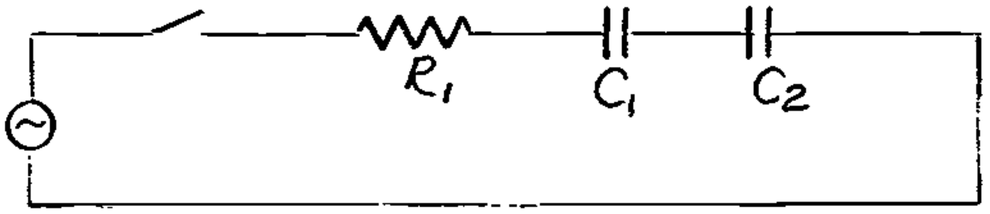
To study the effect of voltage and current in a series capacitive circuit and to study the effect on total capacity and total capacitive reactance when they are placed in series.

MATERIALS USED

RCA WA-44C audio generator, oscilloscope, the capacitor workboard and the following capacitors: C_1-0.01 mfd, C_2-0.022 mfd, C_3-0.033 mfd and C_4-0.047 mfd

PROCEDURE

1. Set up the following circuit using the 0.01 mfd and the 0.022 mfd capacitors.



2. Set the signal generator to 50kc, and the amplitude to 1 vrms.
3. Measure E_t, E_r, and E_{ct}.
4. Compute I, X_c and C_t.
5. Compute C_t using the rated values and formula for series capacitors.
6. Repeat steps 1-7 using the 0.022 and 0.033 capacitors.
7. Repeat steps 1-7 using the 0.01 and the 0.047 capacitors.

QUESTIONS

1. Write a formula for capacitors in series.
2. Compute C_t by the formula. How does it compare to step 4?
3. How does E_{ct} plus E_r compare to E_t?
4. What is the phase relationship in a capacitor?

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VOCATIONAL ELECTRONIC TECHNICIAN TRAINING

Course II

Basic A-C D-C

Lesson 28-A (Con't.)
Series Capacitance

5. Compute Z in each of the three combinations.

6. Draw a vector diagram. Show Z, X_C, R and the phase angle in each combination.

7. Summarize.

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Course II

Basic A-C D-C

Lesson 28-B
Parallel Capacitance

OBJECTIVE

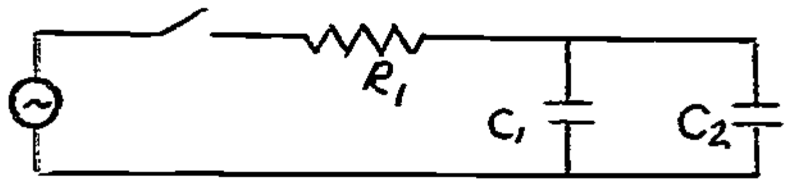
To study and observe voltage and current in a circuit where capacitors are in parallel and to study the effect on total capacity and capacitive reactance in a parallel circuit.

MATERIAL USED

WA-44C, RCA audio generator, scope and capacitor board

PROCEDURE

1. Connect the following circuit using the 0.022 mfd and the 0.033 mfd capacitors.



2. Set the signal generator to 5 kc at a 1 vrms level.

3. Compute I, X_C, and C_t using these measurements: E_t, E_r and E_{ct}.

4. Compute C_t using the formula for parallel capacitors.

5. Repeat steps 1-4 using the 0.01 and 0.033 capacitors.

6. Repeat steps 1-4 using the 0.022 and 0.047 capacitors.

7. Repeat steps 1-4 using the 0.01 and 0.022 capacitors.

QUESTIONS

1. Draw a vector diagram showing X_c, R, Z and the phase angle for each of the four combinations.

2. Write a formula for parallel capacitors.

3. Compute C_t by the above formula and compare it to the calculated C_t in the experiments.

4. How does increasing the frequency affect the I, the C_t and X_C? (Assuming the amplitude is kept the same.)

5. Summarize.

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TEACHERS OUTLINE

VOCATIONAL ELECTRONIC TECHNICIAN TRAINING

Course II

Basic A-C D-C

Lesson 29
Resonance in Series and Parallel

INTRODUCTION

We shall continue with a-c study. By now, you are acquainted with inductance and capacitance. Now we will study some new terms. Resonance, both series and parallel, will be discussed.

MATHEMATICS

Objective: The forms of notation are occasionally difficult to understand. But they are not solutions to the problems themselves. They are for simplification of description of a-c circuits.

REFERENCES

Cooke, Nelson M., Basic Mathematics for Electronics, Second Edition, McGraw-Hill Book Company, Inc., New York, 1960, Chapter 33, pages 482-518.

Cooke, Nelson M., Mathematics for Electricians and Radiomen, First Edition, McGraw-Hill Book Company, Inc., New York, 1942, Chapter 29, pages 422-457.

EXPLANATION

1. Review of rectangular and polar coordinates
2. Explain paragraph 14, the general series circuit.
3. Work the example on the series circuit.
4. Series resonance
5. Q
6. The resonant frequency formula

NEXT WEEK'S ASSIGNMENT

1. Work problems 29-5 on page 452 in Cooke's First Edition, or problems 33-5 on page 513 in Cooke's Second Edition.
2. Work problems 29-6 on page 455 in Cooke's First Edition, or problems 33-6 on page 516 in Cooke's Second Edition.

TEACHERS OUTLINE

VOCATIONAL ELECTRONIC TECHNICIAN TRAINING

Course II

Basic A-C D-C

Lesson 29 (Con't.)

Resonance in Series and Parallel

3. Read pages 457-461 in Cooke's First Edition or pages 518-523 in Cooke's Second Edition.

ELECTRONICS

Objective: We will discuss more about series RLC circuits, power, voltage, current, and impedance. At this time you will find it is very difficult to separate math and electronics.

REFERENCE

Slurzberg, Morris, and William Osterheld, Essentials of Electricity for Radio and Television, Second Edition, McGraw-Hill Book Company, Inc., New York, 1960, Chapter X, pages 357-392.

EXPLANATION

1. Power in a-c circuits
2. Series circuits
3. Work problems at the end of the chapter.

NEXT WEEK'S ASSIGNMENT

1. Read section 10-9, "Parallel Circuits", on pages 375-378.
2. Assign problems 16-25 on page 385 at the end of the chapter.

LAB

1. Continue with the lab lessons on capacity.

TEACHERS OUTLINE

VOCATIONAL ELECTRONIC TECHNICIAN TRAINING

Course II

Basic A-C D-C

Lesson 30

Mathematics Applied to Resonant Circuits

INTRODUCTION

Inductance and capacitance are present to some extent in all circuits. Series parallel L and C circuits and the accompanying math will be covered in this lesson.

MATHEMATICS

Objective: To acquaint the student with the math involved in resonant circuits. We will study the "j" factor, inductance and capacitance in series, and assumed voltages.

REFERENCES

Cooke, Nelson M., Basic Mathematics for Electronics, Second Edition, McGraw-Hill Book Company, Inc., New York, 1960, Chapters 33 and 34, pages 482-483.

Cooke, Nelson M., Mathematics for Electricians and Radiomen, First Edition, McGraw-Hill Book Company, Inc., New York, 1942, Chapters 29 and 30, pages 422-483.

EXPLANATION

1. Work problems 29-5 on pages 452 and 453 in Cooke's First Edition, or problems 33-5 on pages 513 and 514 in Cooke's Second Edition.

2. Resonant frequency

3. Parallel circuits
   - a. "J" factor
   - b. Inductance and capacity in parallel
   - c. Vector addition of current
   - d. Assumed voltages

NEXT WEEK'S ASSIGNMENT

1. Work problems 4 and 5 on page 456 in Cooke's First Edition, or problems 4 and 5 on page 517 in Cooke's Second Edition.

2. Read pages 457-467 in Cooke's First Edition, or pages 518-529 in Cooke's Second Edition

ELECTRONICS

Objective: More about RC circuits, resonance and non-resonance circuits will be discussed.

TEACHERS OUTLINE

VOCATIONAL ELECTRONIC TECHNICIAN TRAINING

Course II

Basic A-C D-C

Lesson 30 (Con't.)
Mathematics Applied to Resonant Circuits

REFERENCES

Cooke Nelson M., Basic Mathematics for Electronics. Second Edition, McGraw-Hill Book Company, Inc., New York, 1960.

Cooke, Nelson M., Mathematics for Electricians and Radiomen, First Edition, McGraw-Hill Book Company, Inc., New York, 1942.

Slurzberg, Morris, and William Osterheld. Essentials of Electricity for Radio and Television, Second Edition, McGraw-Hill Book Company, Inc., New York, 1950, Chapter 10, pages 357-392.

EXPLANATION

1. Series RLC circuits
2. Series resonance
3. Work problems 11-12 on pages 372 and 373 in Slurzberg.
4. Work problem 12 on page 387 in Slurzberg.
5. Work problems 18, 21, and 24 on pages 387 and 388 in Slurzberg.

NEXT WEEK'S ASSIGNMENT

1. Re-read section 10-9, "Parallel Circuits", on pages 375 and 376 in Slurzberg.
2. Work example 10-14 on page 376 in Slurzberg.
3. Work problems 25, 28, and 29 on pages 388 and 389 in Slurzberg.

LAB

1. Hand out lab Lesson 30-A, "Series Resonance", and explain.

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VOCATIONAL ELECTRONIC TECHNICIAN TRAINING

Course II

Basic A-C D-C

Lesson 30-A

Series Resonance

OBJECTIVE

To study and observe voltage and current in a series resonant circuit.

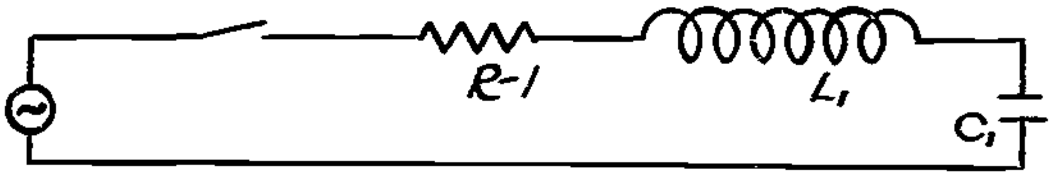
MATERIALS USED

Audio generator, scope, various coils and capacitors

PROCEDURE

A. Find the resonant frequency of the circuit.

1. Wire the following circuit.



2. Set the frequency range switch to X1000 and find the resonant frequency of L and C. Resonance is that frequency where E_c and E_L are equal since X_c and X_L are equal. To check, place the scope across L and C in series and observe a null on the voltage amplitude by slowly varying the frequency.

3. Check the capacity of C on the capacitor checker and assume this to be the correct capacity.

4. From this information compute the value of L.

B. Construction of a series circuit resonant at 30,000 cps.

1. Compute the C required to resonate with L (step 4) at a frequency of 30,000 cps.

2. Acquire this capacity by paralleling and checking with the capacitor checker.

3. Construct a series circuit to see if resonance is obtained.

QUESTIONS

1. How did the computed L compare with the rated or measured L?

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VOCATIONAL ELECTRONIC TECHNICIAN TRAINING

Course II

Basic A-C D-C

Lesson 30-A (Con't.)

Series Resonance

2. How did you find the resonant frequency of the original circuit?

3. What capacity did you use in the 30, 000 resonant circuit?

4. At what resonance in a series circuit, is current maximum or minimum?

5. Compare X_L and X_c at resonance.

6. What is the phase angle at resonance?

7. In step A, what is the Z of the circuit at resonance?

8. Summarize.

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Course II

Basic A-C D-C

Lesson 31

Solution of RLC Circuit Problems

INTRODUCTION

The solution of RLC circuit problems is quite complex at times. In this lesson we will go ahead with the discussion of RLC circuits. The lesson will be predominantly math as we have covered the theory fairly well.

MATHEMATICS

Objective: We will work several math examples to further your acquaintance with parallel RLC circuits.

REFERENCES

Cooke, Nelson M., Basic Mathematics for Electronics, Second Edition, McGraw-Hill Book Company, Inc., New York, 1960, Chapter 34, pages 518-546.

Cooke, Nelson M., Mathematics for Electricians and Radiomen, First Edition, McGraw-Hill Book Company, Inc., New York, 1942, Chapter 30, pages 457-483.

EXPLANATION

1. A-C parallel circuits
2. Assumed voltages
3. Resistance and inductance in parallel
4. Resistance and capacitance in parallel

NEXT WEEK'S ASSIGNMENT

1. Read section 30-6 on pages 463-464 in Cooke's First Edition, or 34-6 on pages 518-519 in Cooke's Second Edition.
2. Work problems 30-1 on page 466 in Cooke's First Edition, or 34-1 on page 529 in Cooke's Second Edition.

ELECTRONICS

Objective: A theory review should assist you in understanding what we've been talking about in the last few lessons. We intend to clarify any questions you may have on RLC circuits in this lecture period.

Lesson 31 (Con't.)
Solution of RLC Circuit Problems

REFERENCE

Slurzberg, Morris, and William Osterheld. Essentials of Electricity for Radio and Television, Second Edition. McGraw-Hill Book Company, Inc., New York, 1950. Chapter X, pages 357-392.

EXPLANATION

1. Series RLC circuits
   - a. L, C, and a-c source are in series.
   - b. X_L is equal to X_C.
   - c. At F_r, current is maximum.
   - d. At F_r, circuits act as a low resistance.
   - e. E_C and E_L are 180° out of phase.
   - f. I_C, I_L, and I_t are equal.
   - g. E_C or E_L may be larger than E_a.
   - h. Increasing R decreases I.
   - i. Increasing L or C lowers F_r.
   - j. Decreasing L or C lowers F_r.
2. Parallel RLC circuits
   - a. Discuss 10 steps on page 375.
   - b. Work example 10-4.

NEXT WEEK'S ASSIGNMENT

1. Read section 10-10 on page 378, parallel-series circuits, in Slurzberg.
2. Work example 10-15 on page 379 in Slurzberg.
3. Work problems 30-32 on page 389 in Slurzberg and HAND IN.

LAB

Continue series resonance. Explain some experiments the students may wish to perform. Changing L, C, or F are examples.

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TEACHERS OUTLINE

VOCATIONAL ELECTRONIC TECHNICIAN TRAINING

Course II

Basic A-C D-C

Lesson 32

Math of RLC Series and Parallel Circuits

INTRODUCTION

Here is more about RLC, series, and parallel circuits. We will also prepare for the final lab experiment and final exams.

MATHEMATICS

Objective: In order for A-C theory to mean anything to you, you must review and review. You have a very good text and reference in Cooke's book. Keep going back to the A-C chapters for review.

REFERENCES

Cooke, Nelson M., Basic Mathematics for Electronics, Second Edition, McGraw-Hill Book Company, Inc., New York, 1960.

Cooke, Nelson M., Mathematics for Electricians and Radiomen, First Edition, McGraw-Hill Book Company, Inc., New York, 1942.

EXPLANATION

1. Inductance, capacitance, and resistance in parallel
2. Work problems 30-1 on page 466 in Cooke's First Edition, or problems 34-1 on page 529 in Cooke's Second Edition.
3. Math in Slurzberg
4. Work problems 29-31 on page 389 in Slurzberg's, Essentials of Electricity for Radio and Television.

NEXT WEEK'S ASSIGNMENT

1. Read section 30-7 on page 467 in Cooke's First Edition, or 34-7 on page 529 in Cooke's Second Edition.
2. Work problems 30-2 on pages 474-475 in Cooke's First Edition, or problems 34-2 on pages 537-540 in Cooke's Second Edition.

REVIEW FOR FINAL EXAM

1. Study chapters 24, 25, 29, and 30 in Cooke's First Edition, or chapters 28, 29, 33, and 34 in Cooke's Second Edition.

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TEACHERS OUTLINE

VOCATIONAL ELECTRONIC TECHNICIAN TRAINING

Course II

Basic A-C D-C

Lesson 32 (Con't.)

Math of RLC Series and Parallel Circuits

ELECTRONICS

Objective: To further acquaint you with RLC circuits and the related math.

REFERENCE

Slurzberg, Morris, and William Osterheld, Essentials of Electricity for Radio and Television, Second Edition, McGraw-Hill Book Company, Inc., New York, 1950, Chapter 10.

EXPLANATION

1. Math at the end of Chapter 10 in Slurzberg's, Essentials of Electricity for Radio and Television

NEXT WEEK'S ASSIGNMENT

1. Work problems 35, 36, and 37 on page 390 in Slurzberg and hand in.

ASSIGNMENT FOR FINAL EXAM

1. Questions at the end of chapters 8, 9, and 10 in Slurzberg

LAB

1. Explain a parallel resonant circuit and have the students select their own components and equipment. Have them write up and explain.

2. All lab write-ups must be in by the next meeting.

Course II

Basic A-C D-C

Lesson 33
RLC Circuitry - Math

INTRODUCTION

This is more math concerning the RLC circuitry. This will be the final lesson on a-c math and theory as such. Many problems will be worked and theory will be discussed. In the next lesson we will review the a-c semester of the course, both math and theory. The final exam will be given the following meeting.

MATH AND ELECTRONICS

Objective: To help the student understand a-c math and theory more clearly.

REFERENCES

Cooke, Nelson M., Basic Mathematics for Electronics, Second Edition, McGraw-Hill Book Company, Inc., New York, 1960, Chapters 33 and 34.

Cooke, Nelson M., Mathematics for Electricians and Radiomen, First Edition, McGraw-Hill Book Company, Inc., New York, 1942, Chapter 30.

Slurzberg, Morris, and William Osterheld, Essentials of Electricity for Radio and Television, Second Edition, McGraw-Hill Book Company, Inc., New York, 1950, Chapter 10.

EXPLANATION

1. Work the problems in Slurzberg in Chapter 10.
2. Work problems 30-2 on pages 474-477 in Cooke's First Edition, or problems 34-2 on pages 537-540 in Cooke's Second Edition.

NEXT WEEK'S ASSIGNMENT

1. Same as last lesson

LAB

1. Describe possible experiments for the student. Allow him to choose his own equipment and components. Some possible experiments are:
    a. Z of filter choke or transformer.
    b. Step up or step down ratio of a transformer.
    c. Find the value of an unknown capacitor or inductor.
    d. Find the frequency of an unknown source.
2. Write a short paragraph or two describing the experiment and hand it in.

TEACHERS OUTLINE

VOCATIONAL ELECTRONIC TECHNICIAN TRAINING

Course II

Basic A-C D-C

Lesson 34
Review of Math and Theory

INTRODUCTION

In this lecture period we will review all math and theory that was covered in the final semester of the course.

MATHEMATICS

Objective: To cover all math from the trig functions to parallel a-c circuits.

REFERENCES

Cooke, Nelson M., Mathematics for Electricians and Radiomen, First Edition, McGraw-Hill Book Company, Inc., New York, 1942.

Cooke, Nelson M., Basic Mathematics for Electronics, Second Edition, McGraw-Hill Book Company, Inc., New York, 1960.

EXPLANATION

1. Angles
2. Trig functions and the tables of functions
3. Solution of right triangles
4. Fundamental ideas
5. Series and parallel circuits

ELECTRONICS

Objective: To review the theory of inductance and capacitance and what they mean in an alternating current circuit.

REFERENCE

Slurzberg, Morris, and William Osterheld, Essentials of Electricity for Radio and Television, Second Edition, McGraw-Hill Book Company, Inc., New York, 1950.

EXPLANATION

1. Inductance

TEACHERS OUTLINE

VOCATIONAL ELECTRONIC TECHNICIAN TRAINING

Course II

Basic A-C D-C

Lesson 34 (Con't.)
Review of Math and Theory

2. Capacity
3. RL circuits
4. RC circuits
5. RLC circuits

NEXT WEEK'S ASSIGNMENT

1. All the material covered in this lesson.

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Henney, Keith, and Glen A. Richardson, Principles of Radio. Sixth Edition, John Wiley and Sons, Inc., New York, 1958.

Marcus. Abraham, Elements of Radio. Second Edition, Prentice-Hall, Englewood Cliffs, New Jersey.

Oldfield, R. L., Radio, Television and Basic Electronics. First Edition, American Technical Society, Chicago, 1957.

Radio Electronics and Television, Laboratory Manual, Basic Electricity. Electronics Industries Association, (New York Trade Schools Manual, Paul Zbar).

Sams, Howard W., Basic Electricity. Bobbs Merrill Publishing Company, Indianapolis, Indiana.

Slurzberg, Morris, and William Osterheld, Essentials of Electricity for Radio and Television. Second Edition, McGraw-Hill Book Company, Inc., New York, 1950.

VT003 192

VT 003 192
Basic Vacuum Tube and Transistor Application for Electronics.

Electronics Vocat. Technician School, Bloomington, Ind.
Indiana State Dept. of Public Instruction, Indianapolis.
Indiana State Univ., Terre Haute. Instr. Materials Lab.
Pub Date - 64
MF AVAILABLE IN VT-ERIC SET 63p.

*STUDY GUIDES, *TRADE AND INDUSTRIAL EDUCATION, *ELECTRONIC TECHNICIANS, TRANSISTORS, VACUUM TUBES, *ELECTRONICS, HIGH SCHOOLS, EXPERIMENTS, ASSIGNMENTS, INDIVIDUAL INSTRUCTION,

The purpose of this course is to introduce the high school electronic technician student to the applications of vacuum tubes and transistors. This study guide was developed by a vocational coordinator and personnel of the electronic industry. The course was designed on the concept and philosophy of using individual assignment sheets to allow each student to progress at his own rate and to enable the teacher to devote most of his time to individual instruction. Emphasis is placed upon audio application and the study of RF, IF, and oscillator circuits. The lessons are experimental in nature. Assignment sheets for each of the 19 lessons provide a lesson introduction, textbook references, a materials list, a schematic drawing, and job procedures. Questions are given at the end of each job to test the student's comprehension of the completed work. Mathematics and theory are included and taught as needed. This book is designed for teacher use only. The student is to use the assignment sheets in loose unbound form. When he completes an assignment sheet, he returns it to the teacher and secures the next sheet. The student taking the course should have mastered the theory and basic understanding of the vacuum tube and transistor in previous courses. This document is available for 85 cents from the Division of Industrial Education, Indiana State University, Terre Haute, Indiana 47809. (HC)

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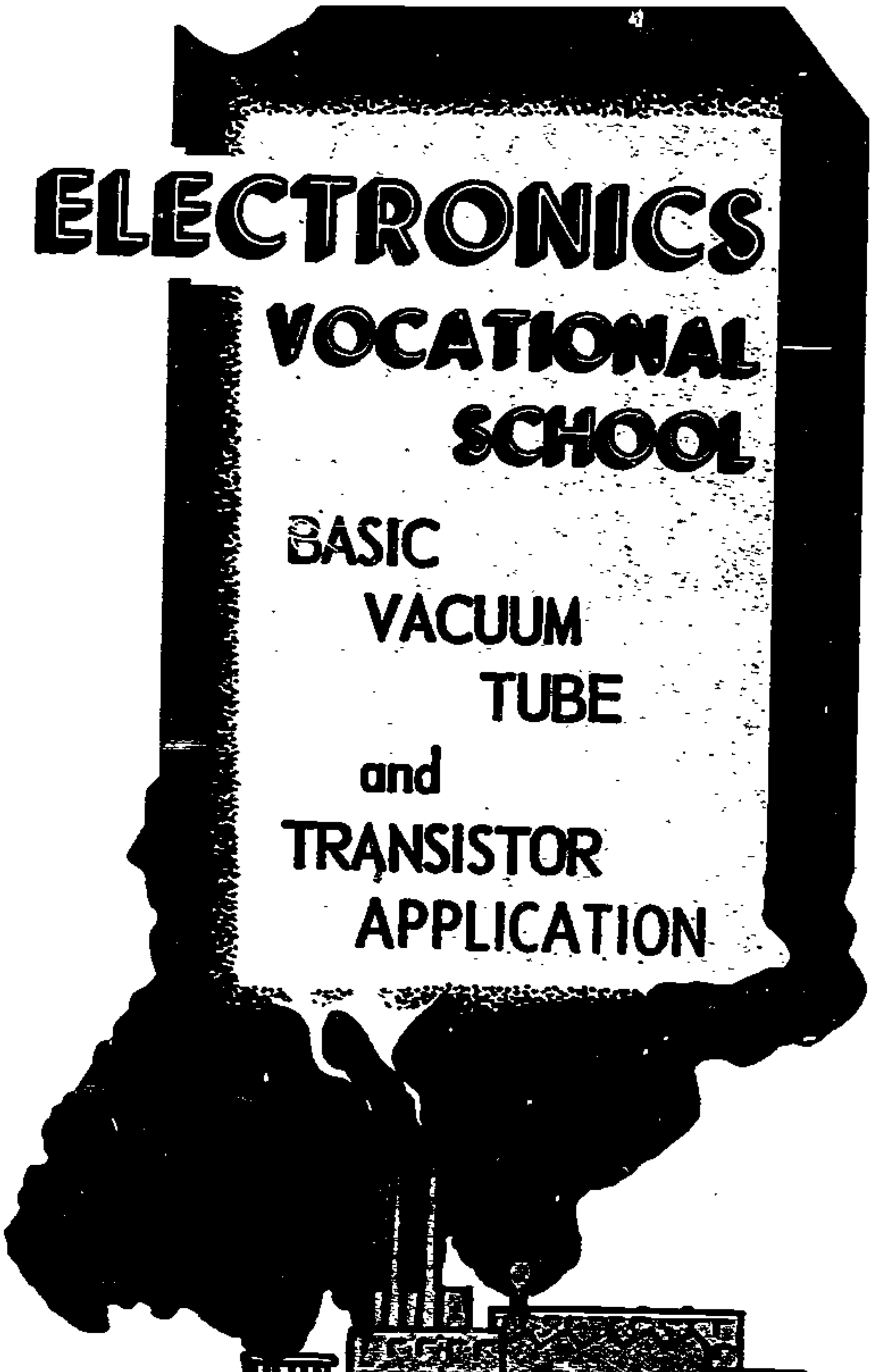

ELECTRONICS
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BASIC VACUUM TUBE and TRANSISTOR APPLICATION

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BASIC VACUUM TUBE AND TRANSISTOR APPLICATION

for

ELECTRONICS

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PREFACE

This is the age of technological change and advancement. Electronics is a vital part of this technological upheaval. Every aspect of our lives - military, production, education, communications, entertainment, health - is being influenced by the impact of electronics.

In order for our technology to continue its swift advancement, electronic technicians must be available. These technicians must be trained on modern equipment and devices. They must be trained in both theory and application.

This course in Vacuum Tube and Transistor Application is designed for the technician who has mastered the theory and basic understandings of these two all-important electronic devices. Emphasis is placed upon audio application and the study of RF, IF, and oscillator circuits. The lessons are experimental in nature. By following a logical sequence of jobs in which he learns basic technical skills, the student is taught electronic, radio and television principles which contribute to his technician preparation. The required materials, references, schematics, and procedures are clearly set forth. At the end of each job, questions are posed to test the student's comprehension of the completed work. Mathematics and theory are included and taught as needed.

This course is another block in the foundation of electronic skills and understanding which all qualified technicians must have.

DIRECTIONS TO THE INSTRUCTOR

This course has been developed around the concept and philosophy of using individual assignment sheets. If these sheets are used correctly, each student will be allowed to progress at his own rate. The abilities of all will be developed to their fullest extent.

The instructor only, should use this book. The loose individual assignment sheets are used by the students. The following method of operation has proven satisfactory:

Each student should have two folders in the file; one for the "completed" work, the other for the "incomplete" work. The assignment sheets should be filed in consecutive order in another drawer. The instructor should lay out the student folders before class time. This prevents congestion and a bottleneck around the file cabinet at the beginning and ending of class. When a student completes and assignment sheet, he turns this into the instructor, then secures the next sheet.

Test are included periodically. These may be used to identify the mathematical ability of each student. This makes it possible to start the students at the proper level in the course. The tests may also be used in the traditional manner.

If the course is used as it should be, the instructor will be freed of many routine activities and will be able to devote his time almost entirely to individual instruction.

It must be kept in mind that the assignment sheets are only a teaching aid or device. Adequate instruction is still needed.

An accurate record of each student's progress should be kept by the instructor.

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ASSIGNMENT SHEET

VOCATIONAL ELECTRONIC TECHNICIAN TRAINING

Course IV

Basic Vacuum Tube and
Transistor Application

Lesson 1
Audio Amplifier System Laboratory

Introduction:

This lesson is to acquaint the student with the electrical characteristic of a quality audio amplifier.

References:

1. Student Laboratory Manual, RCA Electronic Trainer, Model 121, Government Service Department. RCA Service Co., Camden, New Jersey. pp. 301-310.

2. Department of the Army Technical Manual, TM11-662, Basic Theory and Application of Electron Tubes. U.S. Government Printing Office, Washington, D.C., 1959. pp. 111-121.

Materials:

1. VTVM -(Vacuum tube voltmeter)
2. Scope
3. Chassis 121-26 Audio power amplifier
4. Chassis 121-29 Phase splitter
5. Chassis 121-28 Audio voltage amplifier
6. Chassis 121-1 Power supply
7. Chassis 121-2 Regulator
8. Audio generator

Schematics:

1. Use schematic #S-IV-1 (appendix). See instructor.

Procedure:

1. Assemble chassis 28, 29, and 26 to form a standard audio amplifier.
2. Turn volume control on chassis 28 maximum clockwise.
3. Using regulated power supply adjust E_B for 250 volts.

4. Use 10 ohm resistor load provided on stand.

5. Apply 1 KC signal at input and adjust matching transformer for maximum signal.

6. Adjust audio generator for maximum undistorted output from amplifier as viewed on oscilloscope.

7. Calibrate scope and record value of output.

8. Check the amplifier for balance at phase splitter, output grid, and output plate, record signal level.

9. Is the amplifier balanced?

10. Remove cathode bypass from power amplifier.

11. Measure AC voltage across cathode resistor.

12. What is the frequency of step 11? What causes it?

13. Remove one output to simulate unbalanced output.

14. Again measure AC signal across cathode resistor and determine frequency. Explain.

15. Replace both output tubes and check output signal (across load) for 60 cycle by placing scope sweep on line frequency.

16. Return equipment to original condition and set for maximum undistorted output at 1 KC.

17. Compute power out

$$P_o = \frac{(E_o)^2}{R_o} \qquad P_o = \frac{(E_o)^2}{10}$$

Compute power in

$$P_{in} = \frac{(E_{in})^2}{Z}$$

Z determined output of generator.

18. Compute power gain of amplifier.

19. Complete chart, figure 3, page 107 of Lab Manual.

20. Plot gain in DB in reference to 1 KC on chart like #G-IV-1 (appendix). See instructor.

21. Have the instructor simulate a typical trouble and you locate it by signal tracing.

Questions:

1. A push pull power amplifier provides less (odd, even) harmonic distortion than a single ended stage.

2. Convert the following power ratios to decibels.

   a. 100 to 1---------------db

   b. 1000 to 1--------------db

   c. 10000 to 1-------------db

3. A push pull power amplifier does not ______________ the output transformer core.

4. Gas in a tube generally causes a (larger, smaller) than normal plate current.

5. A (shorted, open) cathode bypass capacitor results in distortion because the operating point of the tube is shifted to a (linear, non-linear) part of the characteristic curve.

6. The output signals from chassis 29 are (equal, unequal) in amplitude but are (in phase, 180 degrees out of phase).

7. What components on chassis 29 must be matched?

8. What reference frequency is used in testing the power gain of audio amplifiers?

9. If a microphone is rated at -55 DBM what gain (in DB) would a pre-amplifier stage require to bring the level up to zero DBM?

10. If an amplifier capable of 10 watts output were to be used with the microphone of question 9, to realize full power at 1000 cycles, what overall gain in DB would the system require?

11. Zero DBM is decibels gain referred to one milliwatt in ______________ ohms at ______________ cycles.

12. A class B amplifier conducts plate current for:

    a. 360 degrees of the input cycle.

    b. 90 degrees of the input cycle.

    c. 180 degrees of the input cycle.

    d. More than 180 degrees but less than 360 degrees of the input cycle.

    e. Class B amplifiers never conduct plate current.

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VOCATIONAL ELECTRONIC TECHNICIAN TRAINING

Course IV

Basic Vacuum Tube and
Transistor Application

Lesson 2
Audio Amplifier System Laboratory

Introduction:

The purpose of this lesson is to acquaint the trainee with some of the fundamentals of an AM modulated wave, percentage modulation detector load, and RF filters are all a part of this lesson.

References:

1. Department of the Army Technical Manual TM11-662, Basic Theory and Application of Transistors. U.S. Government Printing Office, Washington, D.C., 1959. pp. 148-154.
2. Morris Slurzberg and William Osterheld, Essentials of Radio-Electronics. Second Edition. McGraw-Hill Book Co., New York, 1961. pp. 68-79.
3. Student Laboratory Manual, RCA Electronic Trainer, Model 121, Government Service Department. RCA Service Co., Camden, New Jersey. p. 115.

Materials:

1. Scope
2. RF signal generator
3. VOM - (VoltOhmmeter)
4. 100 K Resistor
5. 121-23 (IF amplifier)
6. 121-27 Diode detector
7. 121-1 Power supply
8. 121-2 Regulator

Schematic:

1. No schematic needed.

Procedure:

1. Place 121-1 and 2 in rack. Adjust for B+ of 250 volts.
2. Skip at least one space and then install IF amplifier and diode detector.
3. Place a 100 K resistor across the input connections of the IF amplifier.
4. Place a scope on output of IF amplifier.

5. With all gear on adjust frequency of generator for maximum unmodulated signal on scope. This tunes the frequency of generator to scope.

6. Remove scope leads.

7. Place ground lead of scope on ground.

8. Take following waveforms and explain.

    a. Pin 2 of 7AL5 to ground

    b. Across C_1

    c. Across C_2

    d. Output of detector to ground

9. Adjust modulation control to approximately 75% and complete waveforms a, b, c, and d.

10. Turn equipment off and remove C_1 and R_1. Place earphones in place of C_1. Draw equivalent circuit.

11. Remove IF amplifier and place standard broadcast tuned circuit in place of input of detector.

12. Set modulated generator at 1000 KC and lay cable close to antenna.

    Remarks:

13. Remove earphones and replace R_1 with shorting strip. Place scope on output. Apply 1000 KC signal again.

    Remarks:

14. Remove tube and replace with crystal in socket.

    Remarks:

15. Remove scope and plug in complete audio amplifier.

Remarks:

16. What would be undesirable in the design of a satisfactory communication receiver?

Remarks:

Questions:

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VOCATIONAL ELECTRONIC TECHNICIAN TRAINING

Course IV

Basic Vacuum Tube and
Transistor Application

Lesson 3
RF Voltage Amplifier

Introduction:

The fundamental requirement that an RF signal must meet besides frequency is that it must be strong enough to operate the detector.

References:

1. Student Laboratory Manual, RCA Electronic Trainer, Model 121, Government Service Department. RCA Service Co., Camden, New Jersey. pp. 75-83
2. Morris Slurzberg and William Osterheld, Essentials of Radio-Electronics. Second Edition. McGraw-Hill Book Co., New York, 1961. pp. 140-157.
3. Department of the Army Technical Manual, TM11-662, Basic Theory and Application of Electron Tubes. U.S. Government Printing Office, Washington, D.C., 1952. p. 111.

Materials:

1. 121 test stand with
   a. 121-1 Power supply
   b. 121-2 Voltage regulator
   c. 121-67 Bias supply
   d. 121-21 RF amplifier
2. RF generator
3. Oscilloscope
4. VTVM-(Vacuum tube voltmeter)

Schematic:

1. Use schematic #S-IV-3 (appendix). See instructor.

Procedure:

1. Set the regulator so that it provides 250 volts.

2. Set the number one grid by using the bias supply connected to the AVC end or R_1 (see schematic) to -1 volt.

3. Place a 600 kc unmodulated signal on the 6BA6 RF amplifier in one of the methods described by your instructor.

4. Tune the RF amplifier tuned circuit for maximum signal at the output jack as viewed on the oscilloscope.

5. Check grid bias and set at minus one.

6. Compute stage gain.

7. Repeat for 800, and 1,000 kc.

8. How does this compare with the theoretical gain of a pentode?

9. Set the RF generator and amplifier to obtain 1,000 kc at output. Plot a curve showing upper and lower sidebands. Mark the 3 and 6 db points.

10. If time permits join this circuit with the detector lesson.

Questions:

1. Which end of the band is the trimmer adjusted? Why?

2. An RF amplifier mainly improves ________________?

3. Why is band width important?

4. Explain - carrier, audio, AM modulation.

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VOCATIONAL ELECTRONIC TECHNICIAN TRAINING

Course IV

Basic Vacuum Tube and
Transistor Application

Lesson 4
TRF Receiver

Introduction:

TRF receiver was one of the first attempts to make the radio receiver more sensitive. It adds more stage of RF amplifier in front of the detector.

Reference:

1. Morris Slurzberg and William Osterheld, Essentials of Radio Electronics. Second Edition. McGraw-Hill Book Co., New York, 1961. pp. 441-444.

Materials:

1. The RF voltage amplifier, chassis 21
2. Dio detector, chassis 27
3. Audio voltage amplifier, chassis 28
4. Phase splitter, chassis 29
5. Audio power amplifier, chassis 26

Schematic:

1. No schematic needed.

Procedure:

1. Set the detector audio power amplifier stage in the rack and test for operating condition.
2. Place the RF amplifier stage in front of the detector stage. The equipment is not made to operate in this manner, so check with the instructor for methods of coupling. RC coupling should be used first.
3. Tune in a radio station if possible.
4. Add the second RF stage in front of the first RF. Check with the instructor for methods of coupling.

5. Attempt to tune in a radio station.
6. Return the equipment to its original condition.

Questions:

1. What does TRF refer to, and why was it introduced?
2. Draw a block diagram of a TRF receiver.
3. Describe the purpose of the detector and TRF receiver.
4. Name two common methods of coupling RF amplifiers.
5. Name a disadvantage of a TRF receiver.
6. Would lead dress be a problem in a RF receiver?

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VOCATIONAL ELECTRONIC TECHNICIAN TRAINING

Course IV

Basic Vacuum Tube and
Transistor Application

Lesson 5
Hartley Oscillator

Introduction:

The various mechanical means of generating are not practical. Here we study the vacuum tube used as a generator or oscillator.

References:

1. Student Laboratory Manual, RCA Electronic Trainer, Model 121, Government Service Department. RCA Service Co., Camden, New Jersey. pp. 67-75.
2. Morris Slurzberg and William Osterheld, Essentials of Radio-Electronics. Second Edition. McGraw-Hill Book Co.: New York, 1961. pp. 297-299, 596-599.
3. Department of the Army Technical Manual, TM11-662, Basic Theory and Application of Electron Tubes. U.S. Government Printing Office, Washington, D.C., 1959. pp. 165-177.
4. Department of the Army Technical Manual, TM11-690, Basic Theory and Application of Transistors. U.S. Government Printing Office, Washington, D.C., 1959. pp. 165-177.

Materials:

1. Scope
2. VTVM -(Vacuum tube voltmeter)
3. 121-41 RF oscillator
4. 121-1 Power supply
5. 121-2 Voltage regulator

Schematic:

1. Use schematic #S-IV-5 (appendix). See instructor.

Procedure:

1. Place the chassis 41 on table without power applied.

2. Then loosely wind 10 or 12 turns of wire around L_1 and connect the RF signal generator to the coil of wire.

3. Place the scope across the tuned circuit.

4. Close the tuning condenser and adjust the RF generator to get maximum indication on the scope.

5. Repeat with the tuning condenser half way and fully opened. Record all 3 values.

6. Remove the coil of wire from L_1 and place chassis 41 in the test stand.

7. Adjust B+ for 250 volts.

8. Place the scope on the output jack and ground.

9. Rotate the tuning condenser and note the effect on the waveform on the scope.

10. Measure and record all the potentials around the pins of the oscillator tube and explain each.

11. Remove the cathode resistor of the oscillator and explain what takes place.

12. Replace the cathode resistor with its original size. Place a 470,000 ohm resistor in place of the 33,000 ohm grid resistor. Explain what takes place.

Questions:

1. This oscillator generates a (1) sine, (2) square, (3) saw-tooth wave?

2. This is a (1) series, (2) shunt Hartley Oscillator?

3. Draw both a series and a shunt fed Hartley Oscillator.

4. If time permits complete the trouble shooting chart for this lesson.

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Lesson 6
IF Amplifier

Introduction:

One of the disadvantages of the TRF is that each stage must be variable tuned for each station to be received. This makes alignment difficult and lead capacitance critical. The IF amplifier is an example of an RF frequency amplifier which is factory aligned to one frequency or band of frequencies.

References:

1. Department of the Army Technical Manual TM11-662, Basic Theory and Application of Transistors. U.S. Government Printing Office, Washington, D.C., 1959. p. 111.

2. Morris Slurzberg and William Osterheld, Essentials of Radio-Electronics. Second Edition. McGraw-Hill Book Co., New York, 1961. pp. 605-611, 615-617.

3. Student Laboratory Manual, RCA Electronic Trainer, Model 121. Government Service Department. RCA Service Co., Camden, New Jersey pp. 109-122.

4. Experiment Guide, RCA Transistor Trainer, Models 301-T and 601-T. Government Services, RCA Service Co., Camden, New Jersey, 1960. p. 81.

Materials:

1. 121-1 Power supply
2. 121-2 Voltage regulator
3. 121-23 IF amplifier
4. 121-27 Diode detector
5. Scope
6. VTVM - (Vacuum tube voltmeter)
7. RF generator

Schematic:

1. Use schematic #S-IV-6 (appendix). See instructor.

Procedure:

1. Set the equipment up using a plate supply of 250 volts.
2. Place the ground leads of the VTVM and scope on chassis ground.
3. Place RF generator on input of the IF and ground.
4. Place scope on output of detector.
5. Using 60% modulation tune generator until the output on scope is at a maximum.
6. Note and record output signal voltage.
7. Record AVC signal voltage with VTVM.
8. Remove generator (DO NOT CHANGE AMPLITUDE OR FREQUENCY SETTING)
9. Record voltage out and AVC voltage now present.
10. Replace generator and change frequency until 6 db points are reached on both sides of center frequency.
11. Draw a graph showing frequency response.
12. Fill out the normal circuit chart as shown in the RCA Lab Manual. Ask instructor for blank sheet.

Questions:

1. An IF amplifier improves selectivity of a radio receiver. True or false? Why?
2. What is the resonant frequency of the IF amplifier?
3. Why is the transformer called a double tuned circuit?

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Lesson 7
Converter
Complete Radio

Introduction:

A special tube was designed to take the place of both the mixer and oscillator. This was the pentagrid converter.

References:

1. Student Laboratory Manual, RCA Electronic Trainer, Model 121, Government Service Department. RCA Service Co., Camden, New Jersey. pp. 123-139 and 311-329.

2. Morris Slurzberg and William Osterheld, Essentials of Radio-Electronics. Second Edition. McGraw-Hill Book Co., New York, 1961. pp. 446-459.

Materials:

Complete Radio:

1. Power supply 121-1
2. Regulator 121-2
3. Converter 121-22
4. IF 121-23
5. Detector 121-27
6. Audio voltage amplifier 121-28
7. Phase splitter 121-29
8. Power output 121-26
9. VTVM- (Vacuum tube voltmeter)
10. RF Generator
11. Scope
12. .01 uf Isolation condenser

Schematic:

1. Use schematic #S-IV-7 (appendix). See instructor.

Procedure:

1. Set equipment in correct order to now have a complete radio. Have instructor check before turning on.

2. Set B+ on 250 volts.

3. Place scope on speaker leads and place switch so that resistor is used in place of speaker.

4. Using audio output of RF generator signal trace audio section.

5. Place generator on 455 kc modulated about 60%.

6. Connect generator to ground and through isolation condenser. Connect hot side to grid one of IF amplifier.

7. Short oscillator section of converter to ground.

8. Adjust last IF for maximum deflection on scope.

9. Move hot lead to signal grid of converter and adjust first IF for maximum deflection.

10. Readjust both input and output IF CANS for maximum deflection on scope.

11. You have now aligned the IF to 455 kc.

12. The oscillator section must now be aligned. This one is more involved than most.

13. Remove the short that you previously placed on the oscillator.

14. Set the RF generator at 540 kc. Place hot lead on primary side of converter transformer and ground lead on ground.

15. Close tuning condenser for maximum capacitance.

16. Adjust C_4 for maximum signal. (This is not usually included in commercial radio).

17. Change generator to about 1600 kc and adjust $C3_A$ and C3 open.

18. Readjust C_4 and $C3_A$ for maximum output at scope.

19. Place set on outside antenna and obtain a weak station. Adjust $C1_A$ for maximum signal.

20. You have now completely aligned the radio. Signal tracing can be accomplished by one of these main methods or combinations thereof.

	General Position	Scope Position
A.	Start at last stage and work forward.	Speaker or detector load.
B.	At input	Start forward and work AFT.
C.	Input to any stage	Output of same stage.

21. Obtain a detector probe if possible and use B&C Method for signal tracing.

22. Complete both charts on converter stage. Page 129 and 130 RCA Lab Manual.

23. Have instructor place a trouble in radio for you to locate.

Questions:

1. Explain operation of each tube element in converter.

2. What three operations does converter do?

3. Why are two condensers ganged?

4. Describe a fast way to check to see if oscillator is working.

5. What is image?

6. What is a harmonic?

7. Where does the signal first audio?

8. How would you change bands on a broadcast Superhet radio?

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Lesson 8
Radio Trouble-Shooting and Repair

Introduction:

The purpose of this lesson is to do actual repair of a commercial radio receiver.

References:

1. All previous lessons.
2. Schematic of receiver.

Materials:

1. Radio receiver
2. All test equipment as needed.

Schematic:

1. See reference 2.

Procedure:

1. Inspect the line cord, replace if dangerous.
2. Place the receiver on a bench with a wooden top.
3. See if the tubes are lit when the receiver is turned on.
4. If the tubes do not light, turn the unit off and test the tubes.

   Remove ONLY ONE tube at a time. Replace the tube which you have tested, before removing the second tube.
5. If the tubes light try to tune a station. If you are unable to receive a station, follow the steps in testing tubes as outlined in step four.
6. Check to see if the antenna is properly connected.
7. Remove the set from the cabinet.
8. Familiarize yourself with the individual stages of the receiver, by consulting schematic.

9. It is convenient to isolate the troubles to one of the three main sections of the receiver.

    a. Power supply

    b. Audio section

    c. RF and IF section

10. Check B plus. Usually around 100 volts.

11. Signal trace in regular manner.

12. Test oscillator grid for negative voltage, usually around 5.0 volts.

13. By this time you should have located the trouble to a specific area. Turn the receiver off and take some readings with the ohmmeter of the suspected area.

14. Locate the bad part and report to the instructor. He will tell you what to do next.

15. This is only one method for trouble-shooting a receiver. Other methods will be explained at a later time.

Questions:

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Lesson 9
Transistor Superhet

Introduction:

In this lesson we will study the characteristics of a complete transistor radio. It is very much like the vacuum tube radio. Some of the differences that should be noted by the students are as follows:

1. Coupling
2. Converter stage
3. Amounts of voltage

References:

1. Experiment Guide, RCA Transistor Trainer, Models 301-T and 601-T. Government Services, RCA Service Co., Camden, New Jersey, 1960. pp. 87-96.
2. Morris Slurzberg and William Osterheld, Essentials of Radio-Electronics. Second Edition. McGraw-Hill Book Co., New York, 1961. pp. 593-626.

Materials:

1. RCA trainer
2. VTVM - (Vacuum tube voltmeter)
3. Oscilloscope
4. Template No. 11 (If using RCA equipment)
5. .002 uf condenser

Schematic:

1. No schematic needed.

Procedure:

1. Place all the parts in the template as noted.
2. Place the oscilloscope on the speaker leads.

3. Signal trace audio section and compute voltage gain per stage. (Be sure and use isolation condenser in hot lead of generator and have amplitude as low as possible.)

4. Set RF generator on 455 kc.

5. Disable local oscillator.

6. Place hot lead of generator through isolation condenser on the base of Q_2.

7. Adjust output IF to maximum signal.

8. Place the hot lead of the generator on the base of Q_1 and adjust both transformers for maximum signal.

9. Place the local oscillator in operating condition.

10. Set the RF generator on 550 kc, adjust the tuning condenser until it is fully closed.

11. Loosely couple the RF generator to the transistor antenna and adjust the oscillator slug for maximum signal.

12. Open the tuning condenser and set the RF generator on about 1600 kc.

13. Adjust the oscillator trimmer for maximum signal.

14. Repeat steps 9-13.

15. Tune the radio into a weak station adjust the RF trimmer for maximum signal.

16. Contact the instructor. He will now place a trouble in the receiver for you to repair.

Questions:

1. What type of oscillator is used in a converter stage?

2. How is the oscillator coupled to the converter?

3. How does the RF section differ from the vacuum tube RF section?

4. How does the AGC voltage vary with signal strength?

Conclusions:

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Lesson 10
The Cathode Follower

Introduction:

This circuit is an excellent impedance matching device. It is found very useful in matching high impedance circuits to low impedance devices.

References:

1. Student Laboratory Manual, RCA Electronic Trainer, Model 121, Government Service Department. RCA Service Co., Camden, New Jersey. pp. 228-236.

2. Morris Slurzberg and William Osterheld, Essentials of Radio-Electronics. Second Edition. McGraw-Hill Book Co., New York, 1961. pp. 202-208.

Materials:

1. Chassis 121-77
2. Chassis 121-1
3. Scope
4. VTVM -(Vacuum tube voltmeter)
5. Audio generator
6. Chassis 121-24

Schematic:

1. Use schematic #S-IV-10 (appendix). See instructor.

Procedure:

1. Place chassis 1 and 77 in the rack and turn on.
2. Place the audio generator on the input of 77.
3. Adjust the input to 3 volts P-P 1,000 cps.
4. Measure the output signal voltage and compute stage gain.

5. Place S_1 on chassis 77 in the other position and again compute stage gain.

6. Determine the phase relationship between input and output signals.

7. Turn the equipment off and place chassis 28 so that it feeds into 77. (Place a jumper wire from the output of 28 to the input of 77.)

8. Place S, of chassis 77 in ground position.

9. Place the oscillator on the input of chassis 28 and using the oscillator adjust the generator level so that chassis 28 has the largest undistorted output.

10. Measure the output of the cathode follower. If it is distorted reduce the generator level to obtain the maximum undistorted signal.

11. Place S, in the nongrounded position and compare single handling capabilities with the grounded position.

12. Remove chassis 28 and with the signal set at 3 volts P-P connect to the input of the cathode follower.

13. Prepare a chart showing frequency response versus gain of the cathode follower.

14. Complete both the normal and abnormal charts. (If using RCA equipment)

Questions:

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Lesson 11
Common Collector Circuit

Introduction:

The common collector transistor configuration reminds us of the cathode follower vacuum tube stage.

References:

1. Experiment Guide, RCA Transistor Trainer, Models 301-T and 601-T. Government Service Department. RCA Service Co., Camden, New Jersey. pp. 53-58.

2. Morris Slurzberg and William Osterheld, Essentials of Radio-Electronics. Second Edition. McGraw-Hill Book Co., New York, 1961. pp. 545-546.

3. Department of the Army Technical Manual, TM11-690, Basic Theory and Application of Transistors. U.S. Government Printing Office, Washington, D.C., 1959. pp. 108-111.

Materials:

1. Template No. 5 (If using RCA equipment)

2. VTVM -(Vacuum tube voltmeter)

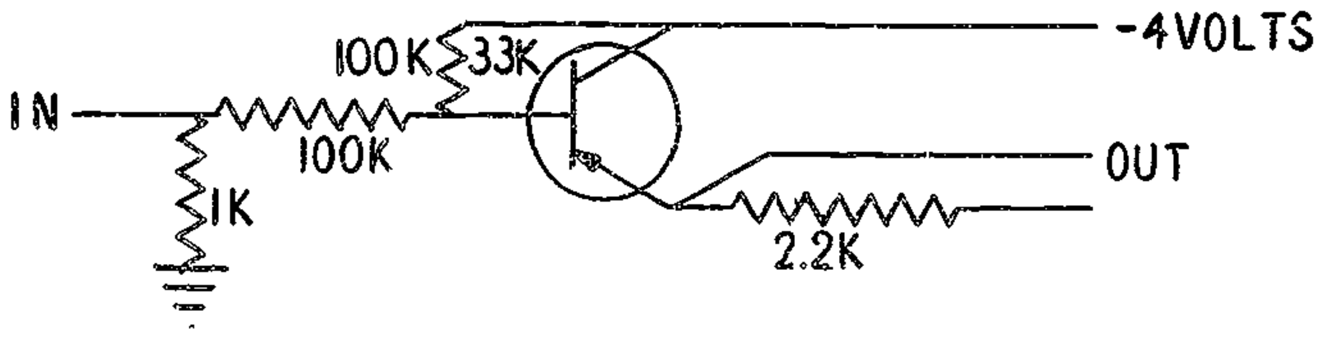
3. MA -(Milliammeter)

Schematic:

1. Use schematic below.

Procedure:

1. Wire the following circuit.



2. Plug in and record the following:

V_e = ____________ I_b = ____________

V_b = ____________ I_c = ____________

V_c = ____________ I_e = ____________

3. Apply a positive DC voltage in the range of 3-6 volts at the DC input.

   Record the readings as before.

4. Compute the change in V_e and V_b.

5. Compute the voltage gain of the stage. Be careful to divide input by output.

6. Compute the change in I_b and I_e.

7. Compute the current gain of the stage.

8. Compute power in power out and power gain.

9. Using a 1 kc test signal, setup and test the frequency response of the stage.

Questions:

1. How does the common collector compare with the common emitter?

2. How does the common collector compare with cathode follower?

3. Draw a graph showing the frequency response and mark the half power point.

4. Mark the 6 db point on the graph.

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Lesson 12
RC Oscillator

Introduction:

The RC oscillator is an example of one of the first oscillators we will study without an LC circuit. This oscillator is usually fixed frequency. Be sure and notice the phase shifting network.

Reference:

1. Student Laboratory Manual, RCA Electronic Trainer, Model 121, Government Service Department. RCA Service Co., Camden, New Jersey. pp. 132-138.

Materials:

1. 121-1 Power supply
2. 121-2 Voltage regulator
3. 121-52 Oscillator
4. Oscilloscope
5. Audio generator

Schematic:

1. Use schematic #S-IV-12 (appendix). See instructor.

Procedure:

1. Set up the power supply with the regulator and adjust for 250 volts B+.
2. Plug in the RC oscillator and using the output jack to an oscilloscope adjust R_3 and R_1 for a good clean output on the scope.
3. Place a set of leads on the horizontal input of scope to output of RC oscillator and adjust for inphase indications.
4. Read page 134 in the RCA Lab Manual and any oscilloscope manual on phase relationships.
5. Determine the phase shift between plate signal and the intersection on C_1R_1.

6. Determine the phase relationship between the plate and the intersection of C_2R_2.

7. Determine the phase relationship between the plate and the grid.

8. Remove the previous wiring and wire what ever necessary to determine the frequency of the oscillator by TWO different methods.

9. Change R_3 and determine its effect on frequency and amplitude. Explain.

10. Change R_4 and determine its effect on frequency and amplitude. Explain.

Questions:

1. How much phase shift must be accomplished between plate and grid?

2. Name the three main parts of an oscillator.

3. Complete the normal and abnormal charts. (If using RCA equipment)

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Lesson 13
Plate-Coupled Multivibrator

Introduction:

The multivibrator is a very common relaxation oscillator. This circuit is found in many different applications.

References:

1. Student Laboratory Manual, RCA Electronic Trainer, Model 121, Government Service Department. RCA Service Co., Camden, New Jersey. pp. 151-158.

2. Morris Slurzberg and William Osterheld, Essentials of Radio-Electronics. Second Edition. McGraw-Hill Book Co., Inc., New York, 1961. p. 288.

3. Bureau of Naval Personnel, Basic Electronics, Navy Training Courses, NAVPERS 10087. U.S. Government Printing Office, Washington, D.C., 1955. pp. 324-335, 620-688.

Materials:

1. 121-57 Plate-coupled multivibrator
2. 121-1 Power supply
3. 121-2 Voltage regulator
4. Scope
5. VTVM -(Vacuum tube voltmeter)

Schematic:

1. Use schematic #S-IV-13 (appendix). See instructor.

Procedure:

1. Plug in the power supply, regulator, skip a couple of spaces and then the multivibrator.

2. Turn all equipment on and adjust the B plus to 250 volts.

3. Place the scope on the H jack and adjust R_3 for symmetrical operation.

4. Measure and record waveshape and size on each pin of the 6J6.

5. Determine the frequency of the multivibrator.

NOTE: During the next portion we will change sizes and notice effect on frequency. It is not necessary to determine the new frequency. Just notice the effect on it.

6. Change both plate loads to 15 K. Note frequency effect ____________.

7. Replace the original plate loads and change R_2 to 100 K, adjust R_3 to same value. Note effect ___________.

8. Change R_2 to 3.3 meg and adjust R_3 to same value. Note effect __________.

9. Replace original grid lead resistors and change the coupling condensers C_2 and C_3 to 100 mmf. Note change in frequency.

10. Change the coupling condensers to .01 mf and note change in frequency.

11. Write a summary noting effect of changing grid lead combination on frequency.

12. Complete the normal and abnormal charts. (If using RCA equipment)

Questions:

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Lesson 14
Transistor Multivibrator

Introduction:

In this lesson we will look at a free running transistor multivibrator. Understanding this type will make all the other multivibrators easier.

References:

1. Experiment Guide, RCA Transistor Trainer, Models 301-T and 601-T. Government Services, RCA Service Co., Camden, New Jersey, 1960. pp. 97-100.

2. Department of the Army Technical Manual, TM11-690, Basic Theory and Application of Transistors. U.S. Government Printing Office, Washington, D.C., 1959. pp. 181-183.

Materials:

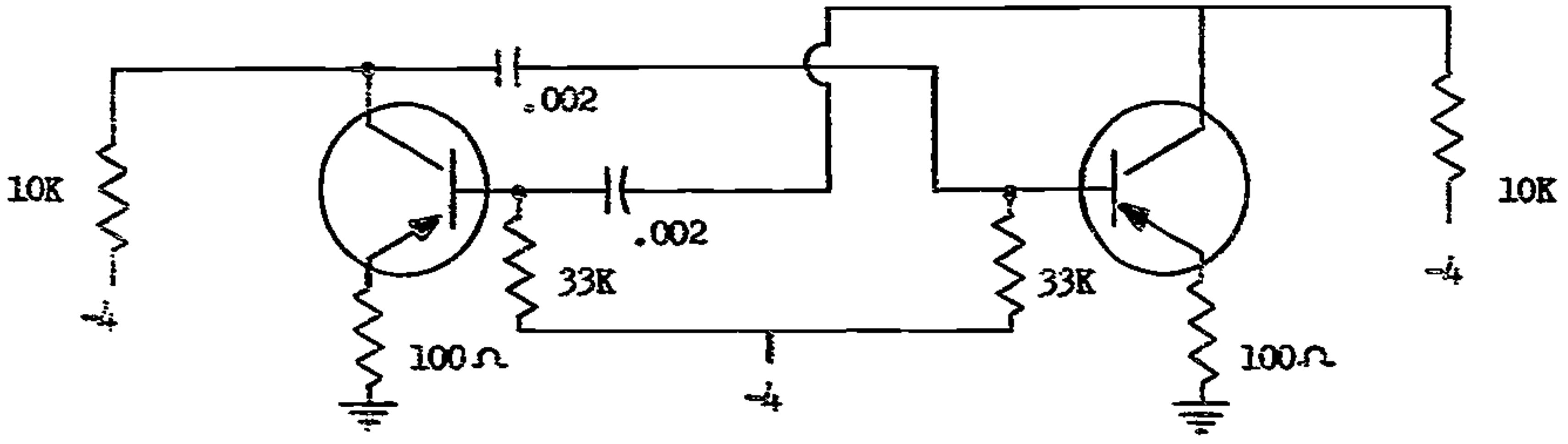
1. Template No. 12 (if using RCA equipment)
2. VTVM - (Vacuum tube voltmeter)
3. Scope
4. Square wave generator

Schematic:

1. Use schematic below.

Procedure:

1. Wire the following circuit.



2. Turn the circuit on and start it oscillating.

3. Take all waveforms and DC voltages.

4. Increase the size for first one and then the other coupling condenser noting effect on waveform.

Questions:

1. Explain the reaction when the coupling condensers are changed.

2. What would happen if one of the base resistors increased in size?

3. Explain the waveshape obtained.

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Lesson 15
Vacuum Tube Sawtooth Generator

Introduction:

The vacuum tube sawtooth generator is not really a generator but a waveshaping device.

Reference:

1. Student Laboratory Manual, RCA Electronic Trainer, Model 121, Government Service Department. RCA Service Co., Camden, New Jersey. pp. 246-254.

Materials:

1. Chassis 65 Vacuum tube sawtooth generator
2. Chassis 57 Multivibrator
3. Chassis 2 Voltage regulator
4. Chassis 1 Power supply
5. VTVM (Vacuum tube voltmeter)
6. Scope

Schematic:

1. Use schematic #S-IV-15 (appendix). See instructor.

Procedure:

1. Plug in power supply and regulator, adjust B+ for 250 volts.
2. Skip a space and plug in chassis 57.
3. Skip another space and plug in chassis 65.
4. Using a 1.2 ohm resistor for isolation connect the upper jack of the multivibrator to the input of the sawtooth generator.
5. Set R_3 on both chassis to mid-range.
6. Turn all equipment on and observe waveshape into and out of the generator.

7. Measure all DC voltages around the generator.

8. Turn off the multivibrator and repeat all DC voltages around the generator.

9. Explain any change in the voltage readings.

10. Rotate R_3 on the sawtooth generator chassis noting effect on waveshape of output. Explain.

11. Decrease the size of C_1 on chassis 65 and note effect. Explain.

12. Return 65 to original condition and then vary R_3 on multivibrator chassis. Explain change to output signal.

Questions:

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Lesson 16
Thyratron Sawtooth Generator

Introduction:

The thyratron generator operates much as the neon bulb generator. The behavior of the grid is very interesting and important.

References:

1. Student Laboratory Manual, RCA Electronic Trainer, Model 121, Government Service Department. RCA Service Co., Camden, New Jersey. pp. 238-244.

2. Morris Slurzberg and William Osterheld, Essentials of Radio-Electronics. Second Edition. McGraw-Hill Book Co., New York, 1961. pp. 645-646.

Materials:

1. Chassis 66 Thyratron sawtooth generator
2. Chassis 1 Power supply
3. Chassis 67 Bias supply
4. Oscilloscope
5. VTVM (Vacuum tube voltmeter)

Schematic:

1. Use schematic #S-IV-16 (appendix). See instructor.

Procedure:

1. Plug in the power supply and the sawtooth generator. Skip several spaces between.
2. Turn both units on.
3. Measure the waveshape of the generator.
4. Vary R_1 and note the effect.
5. Turn the equipment off and place the bias supply next to the generator.

6. Run a lead from the negative jack of the bias supply to the bias jack on the generator.

7. Turn all equipment on.

8. Vary the bias supply and note effect on the output of generator.

Questions:

1. Explain the action of the grid in the gas tube.

2. Explain the charge and discharge cycle of C_1.

3. What mainly determines the firing point of the gas tube?

4. What determines the cut-off point of the gas tube?

Advance Work:

Determine the firing point and cut-off point of this gas tube for various settings of grid voltage.

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Lesson 17
Single-Swing Blocking Oscillator

Introduction:

The blocking oscillator is a very common oscillator found in the modern television receiver. While there are many types their operation all depends upon the same principles as this one.

References:

1. Student Laboratory Manual, RCA Electronic Trainer, Model 121, Government Service Department, RCA Service Co., Camden, New Jersey. pp. 141-148.

Materials:

1. Chassis 53 Single swing blocking oscillator
2. Chassis 2 Voltage regulator
3. Chassis 1 Power supply
4. VTVM - (Vacuum tube voltmeter)
5. Scope

Schematic:

1. Use schematic #S-IV-17 (appendix). See instructor.

Procedure:

1. Plug in the regulator and power supply. Adjust the B+ for 250 volts.
2. Turn the power off and plug in the oscillator. Skip several spaces.
3. Place S_1 on the oscillator in the ground position.
4. Turn on all equipment.
5. Measure the waveform at the L and H jacks and the control grid of the oscillator.

6. Vary R_1 and note effect on waveforms.
7. Measure DC voltages around the oscillator.
8. Remove C_1 and measure voltages and waveforms. **Explain.**

Questions:

1. What is meant by single swing blocking?
2. Explain action of C_1.
3. Explain action of R_3.
4. What type waveshape is offered by this oscillator?

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Lesson 18
One-Shot Multivibrator

Introduction:

This oscillator is an interesting application of the multivibrator. Its ability to switch or key makes it very useful.

References:

1. Student Laboratory Manual, RCA Electronic Trainer, Model 121, Government Service Department. RCA Service Co., Camden, New Jersey. pp. 160-165.

Materials:

1. Chassis 76 One-shot multivibrator
2. Chassis 53 Single swing blocking oscillator
3. Chassis 2 Voltage regulator
4. Chassis 1 Power supply
5. VTVM -(Vacuum tube voltmeter)
6. Scope

Schematic:

1. Use schematic #S-IV-18 (appendix). See instructor.

Procedure:

1. Plug in power supply and regulator. Adjust B+ to 250 volts.
2. Turn the power supply off. Skip several spaces and install chassis 76.
3. Turn the equipment on and measure DC voltages around the multivibrator.
4. Measure waveforms around chassis 76.
5. Turn the power supply off and install the blocking oscillator to the left of chassis 76. Have S_1 in the grounded position.
6. Turn the power supply on and repeat the DC and waveforms around the chassis 76. Explain the behavior. (Run a wire from the L jack of the blocking oscillator to the input of the multivibrator.

7. Rotate R_4 on the multivibrator and note the effect on the output waveforms.

8. Change the frequency of the blocking oscillator and note effect on output of multivibrator.

Questions:

1. What part is left out of the multivibrator compared with the previous multivibrator?

2. Which tube is normally off?

3. If the cathode resistor would increase what effect would it have on the multivibrator?

4. Explain the relationship between the H and L signals.

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Basic Vacuum Tube and
Transistor Application

Lesson 19
Cathode Ray Oscilloscope

Introduction:

Now is the time.

References:

1. Student Laboratory Manual, RCA Electronic Trainer, Model 121, Government Service Department. RCA Service Co., Camden, New Jersey. pp. 255-264.
2. Morris Slurzberg and William Osterheld, Essentials of Radio-Electronics. Second Edition. McGraw-Hill Book Co., New York, 1961. pp. 644-649.

Materials:

1. Chassis 69 CRT
2. Chassis 67 Bias supply
3. Chassis 68 Voltage tripler
4. Chassis 1 Power supply
5. Chassis 52 RC oscillator
6. Chassis 53 Blocking oscillator
7. Chassis 77 Cathode follower
8. Chassis 76 One-shot multivibrator
9. Chassis 65 One-shot multivibrator
10. VTVM - Vacuum tube voltmeter
11. Scope

Schematic:

1. Use schematic #S-IV-19 (appendix). See instructor.

Procedure:

1. Connect the power supply and voltage tripler in the rack.

2. Skip several spaces and place the CRT in the rack.

3. Turn the equipment on.

4. Adjust R_7 and R_8 so that the spot is centered. How is this accomplished?

5. Adjust R_1 and R_3 to give the smallest and brightest dot.

6. Adjust R_1 so that the spot will not burn the screen.

7. Measure all the voltages around the tube.

8. Turn the equipment off and place the bias supply next to the CRT.

9. Turn the equipment on and readjust if necessary.

10. Measure the diameter of the screen.

11. Connect a jumper from the positive jack to the H jack of the CRT.

12. Adjust the bias supply until the spot moves to the outer edge.

13. Measure the amount of voltage that caused the deflection and record the direction.

14. Now connect the jumper to the negative jack of the bias supply and repeat steps 12 and 13.

15. Find the horizontal deflection sensitivity in VDC/IN. from your data.

16. Repeat this procedure for the vertical plates and compute the vertical deflection sensitivity.

17. Turn the equipment off.

18. Remove the bias supply and return it to its storage place.

19. Connect two rolls on the rack together with the use of the cable for this purpose.

20. On the rack above the already installed chassis 1, 68, and 69 install from left to right the following:

Chassis 53	Single swing blocking
Chassis 77	Cathode follower
Chassis 76	One shot multivibrator
Chassis 65	Vacuum tube sawtooth generator

21. Connect the L jack on the 53 to the input of the follower, connect the output of the follower to the input of the multivibrator and L jack of the multivibrator to the input of the sawtooth generator.

22. Turn the equipment on and take waveshapes at test points along the last installed roll.

23. Connect the output of the sawtooth generator to the H input of the CRT.

24. Adjust and focus the trace on the CRT.

25. Turn the equipment off and install chassis 52 next to the CRT.

26. Connect a jumper from the output of 52 to the vertical input of the CRT.

27. Turn the equipment on. Center and focus the trace if necessary.

28. Connect a jumper from the H jack of the multivibrator to the Z input of the scope.

29. Explain what took place.

Questions:

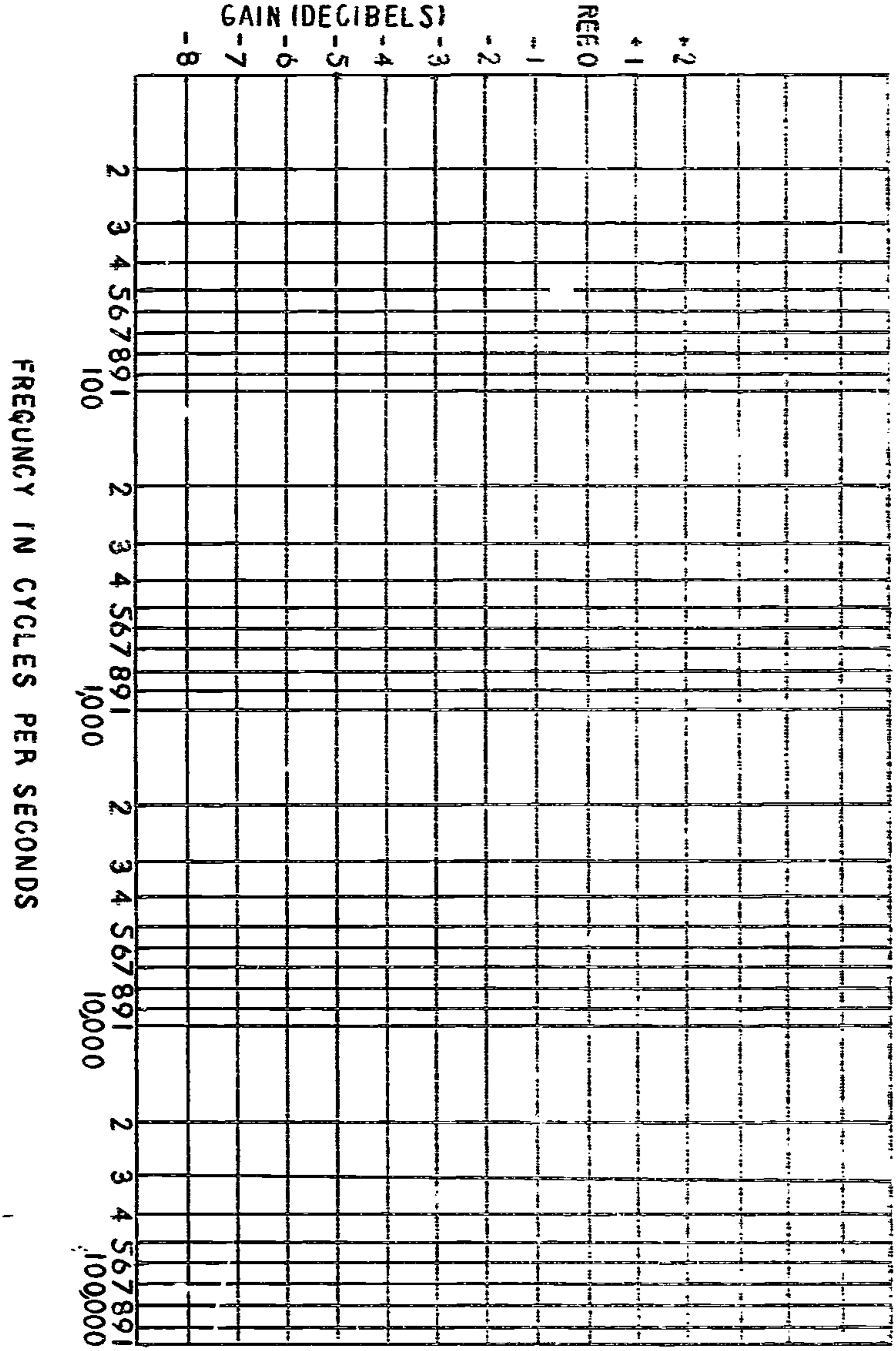
1. Explain the uses of the parts on the CRT chassis.
2. Why is the Z axis provided?
3. What is blanking?
4. Obtain a schematic of a commercial oscilloscope and compare.
5. Why is the oscilloscope so important?
6. Why is the deflection sensitivity of a CRT important?
7. What design feature of a CRT would effect deflection sensitivity?

APPENDIX

APPENDIX

GRAPH OF GAIN VS FREQUENCY FOR AUDIO AMPLIFIER

G-IV-1



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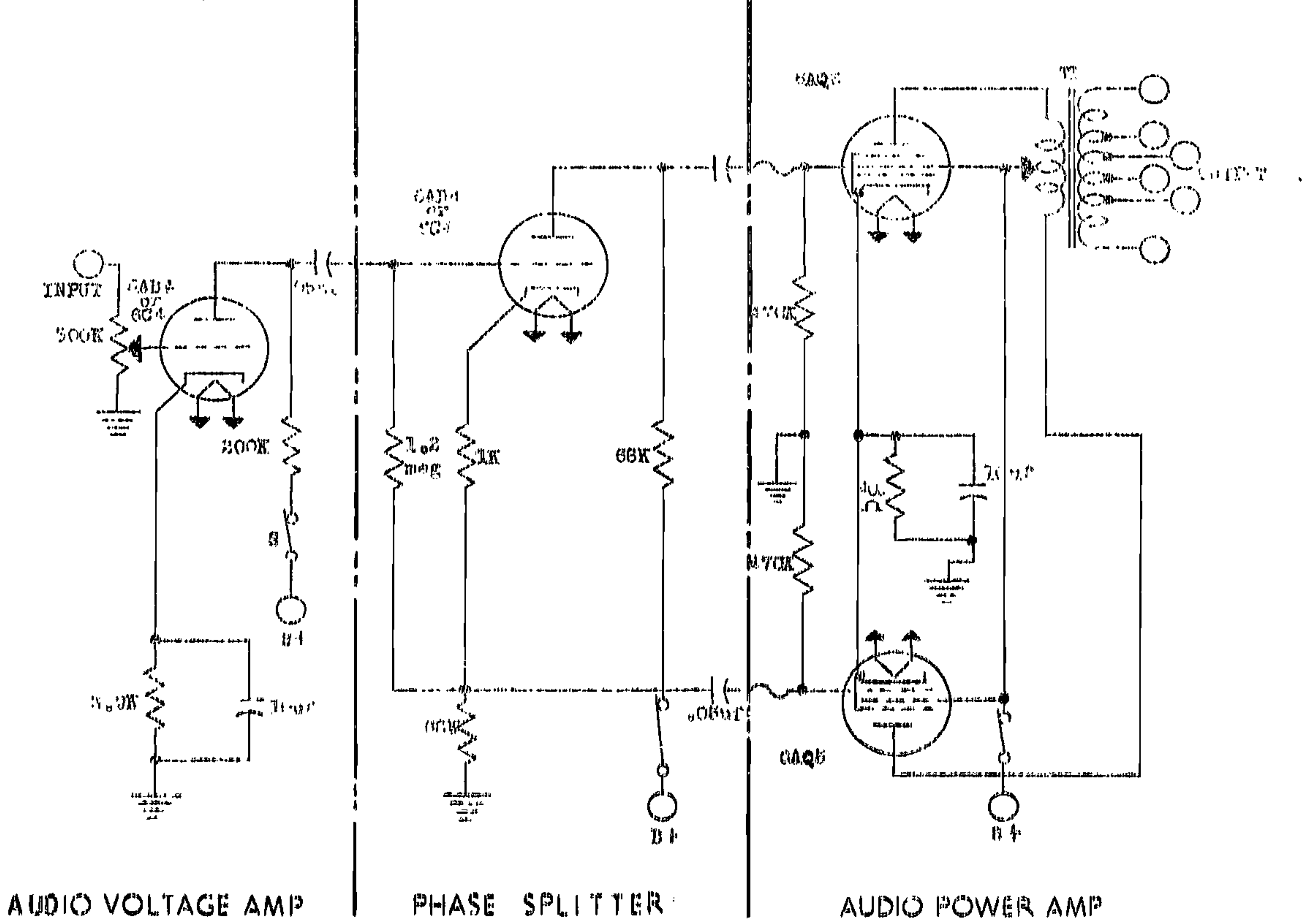
S-IV-1



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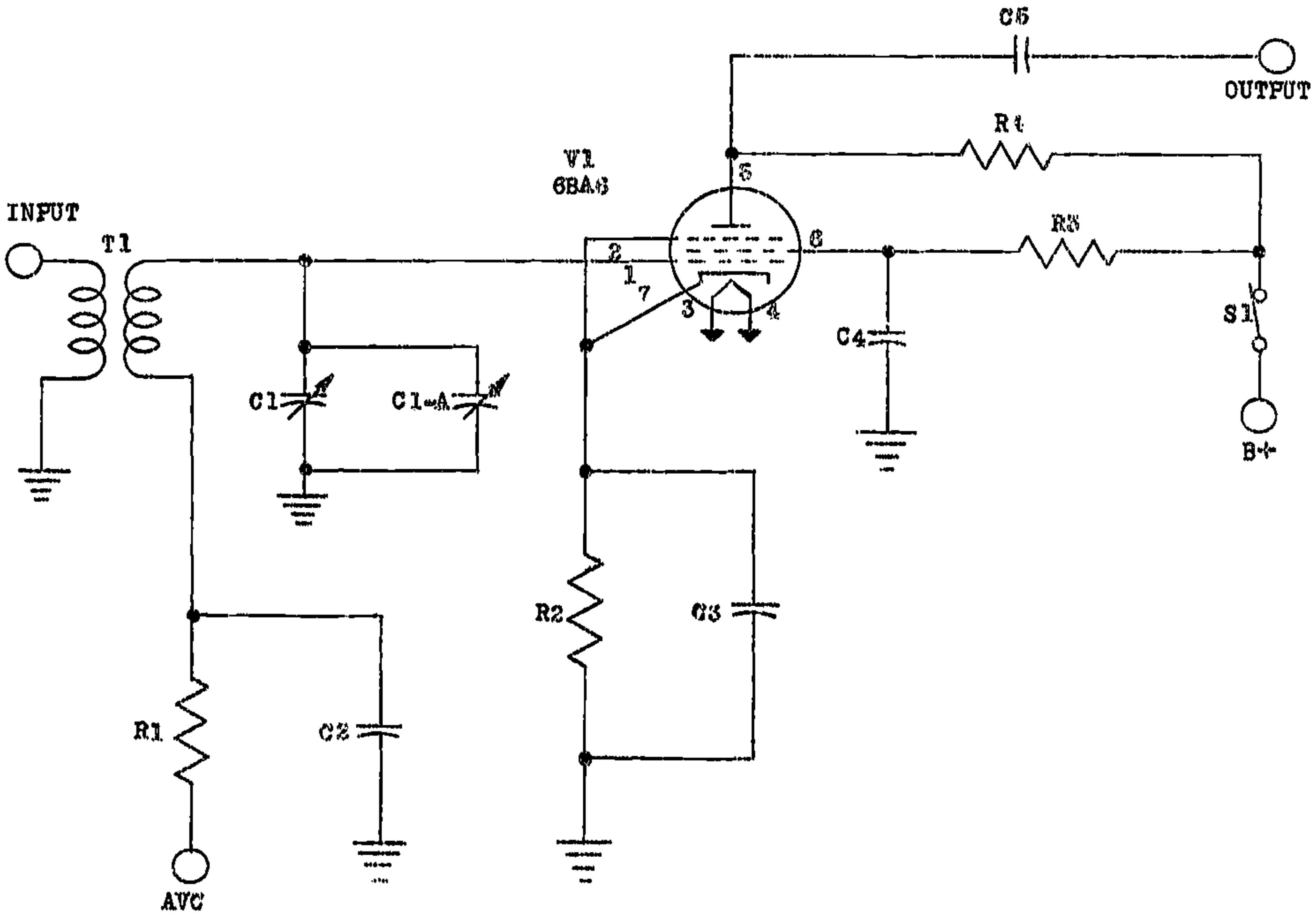

R-F VOLTAGE AMPLIFIER

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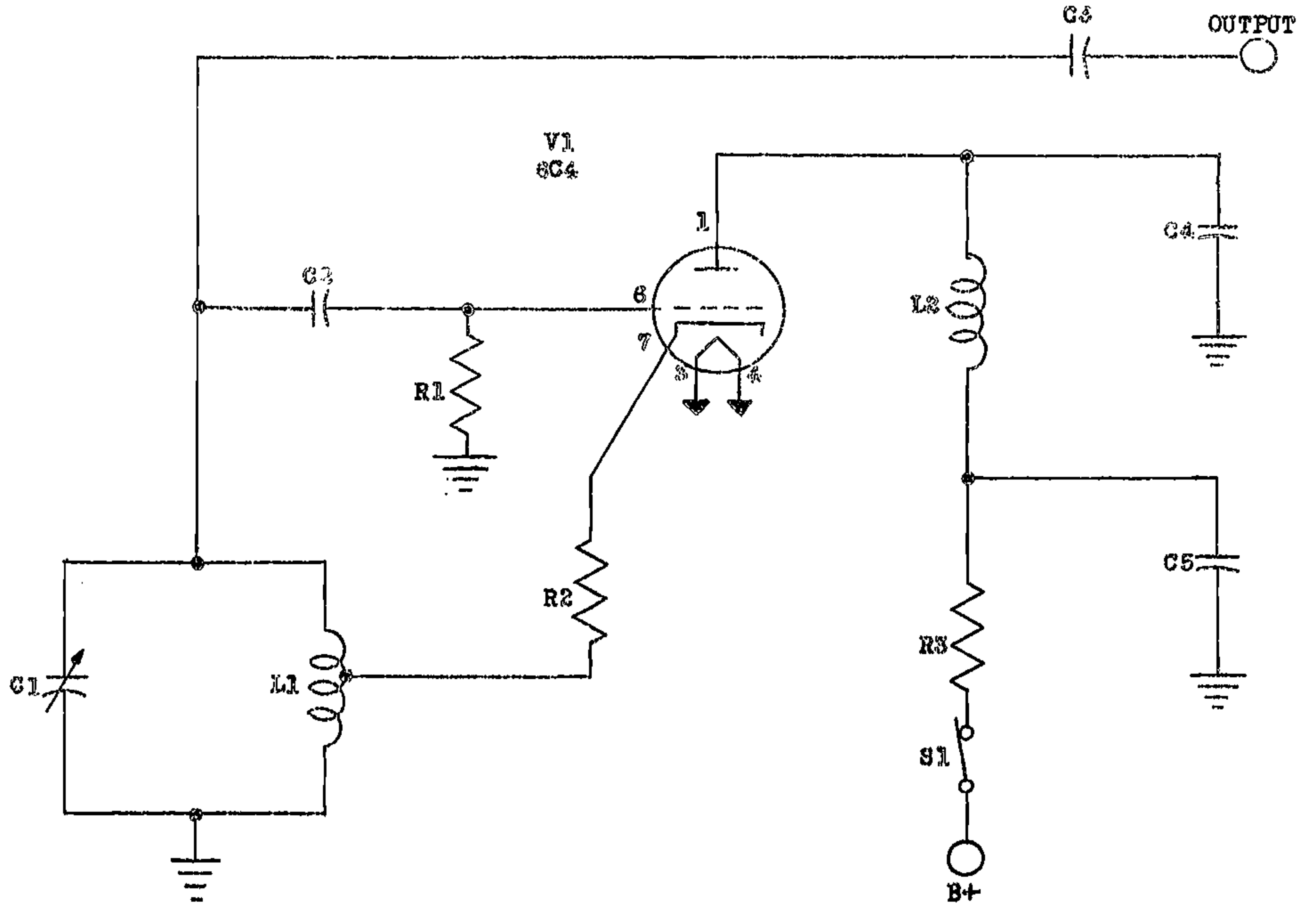
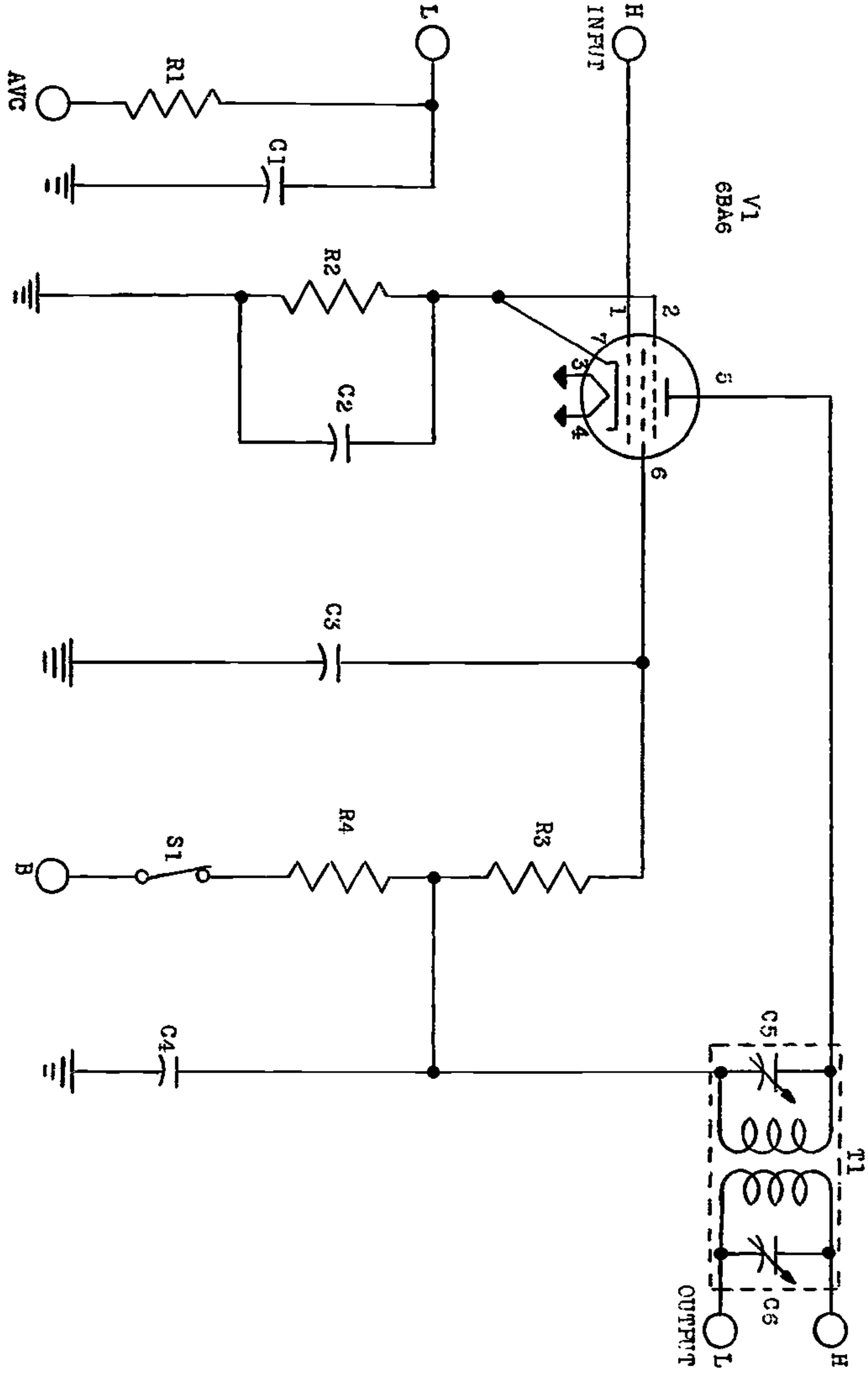
S-IV-5



R-F OSCILLATOR

APPENDIX

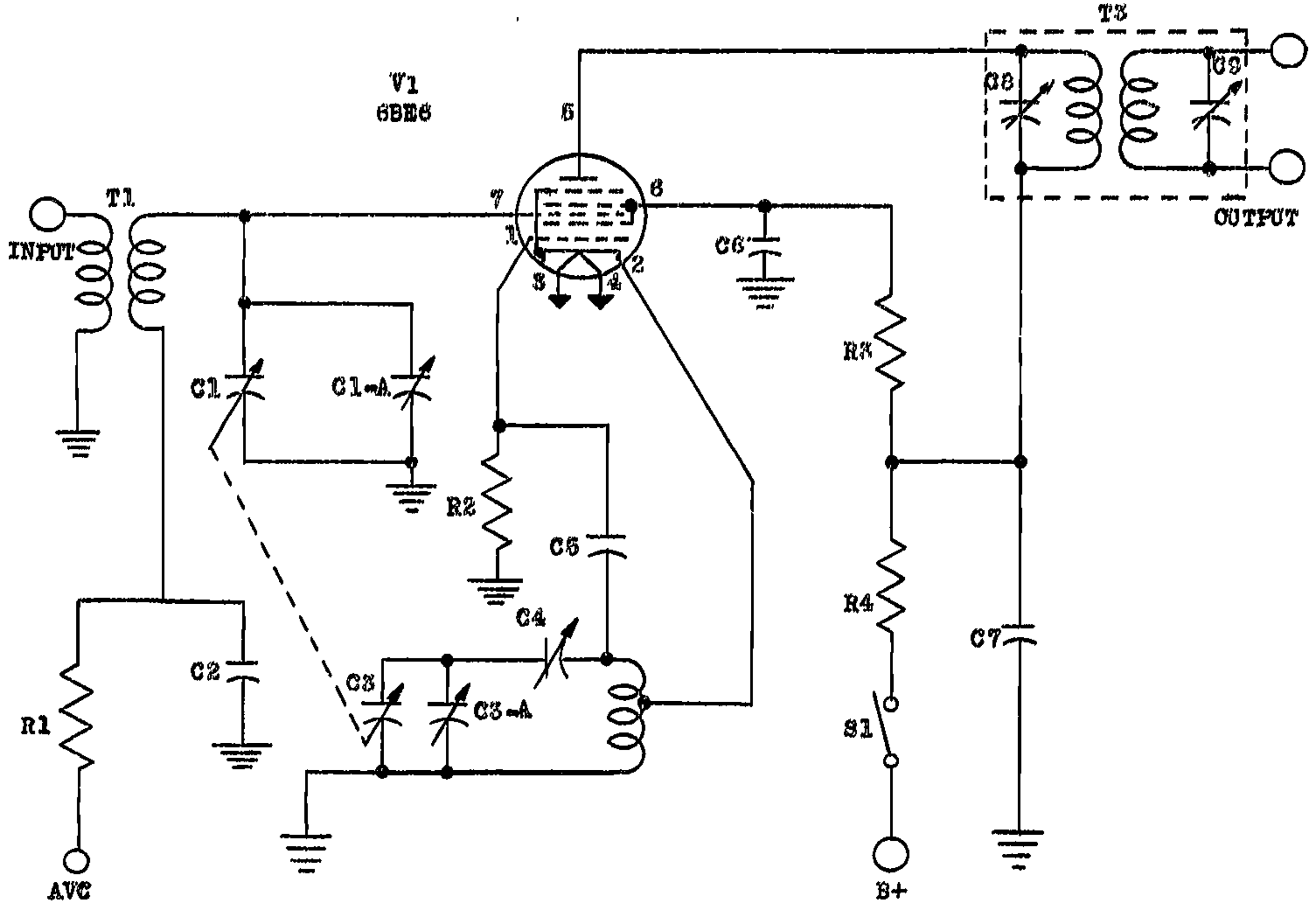
S-IV-6



I-F AMPLIFIER

APPENDIX

S-IV-7



R-F CONVERTER

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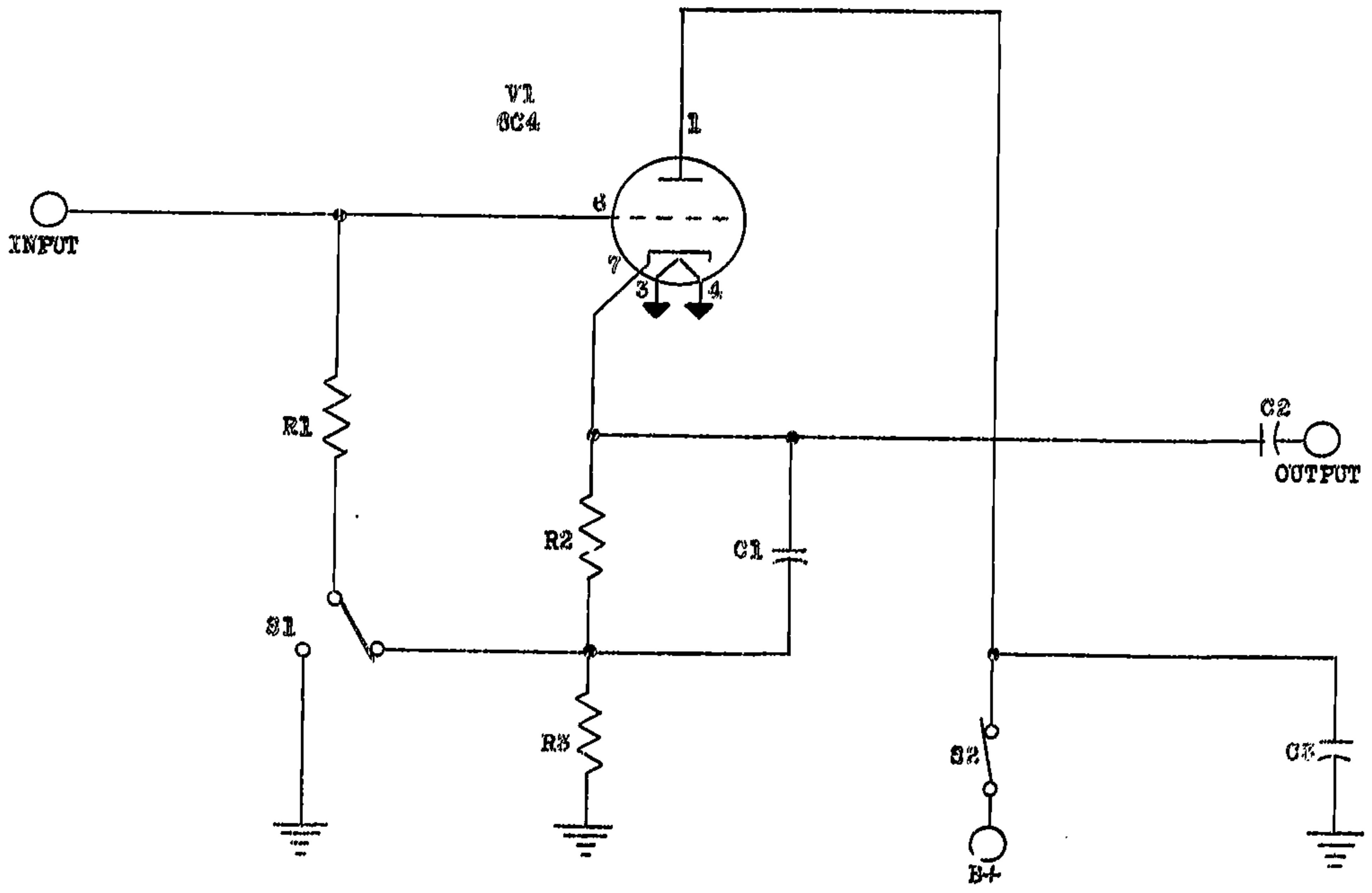
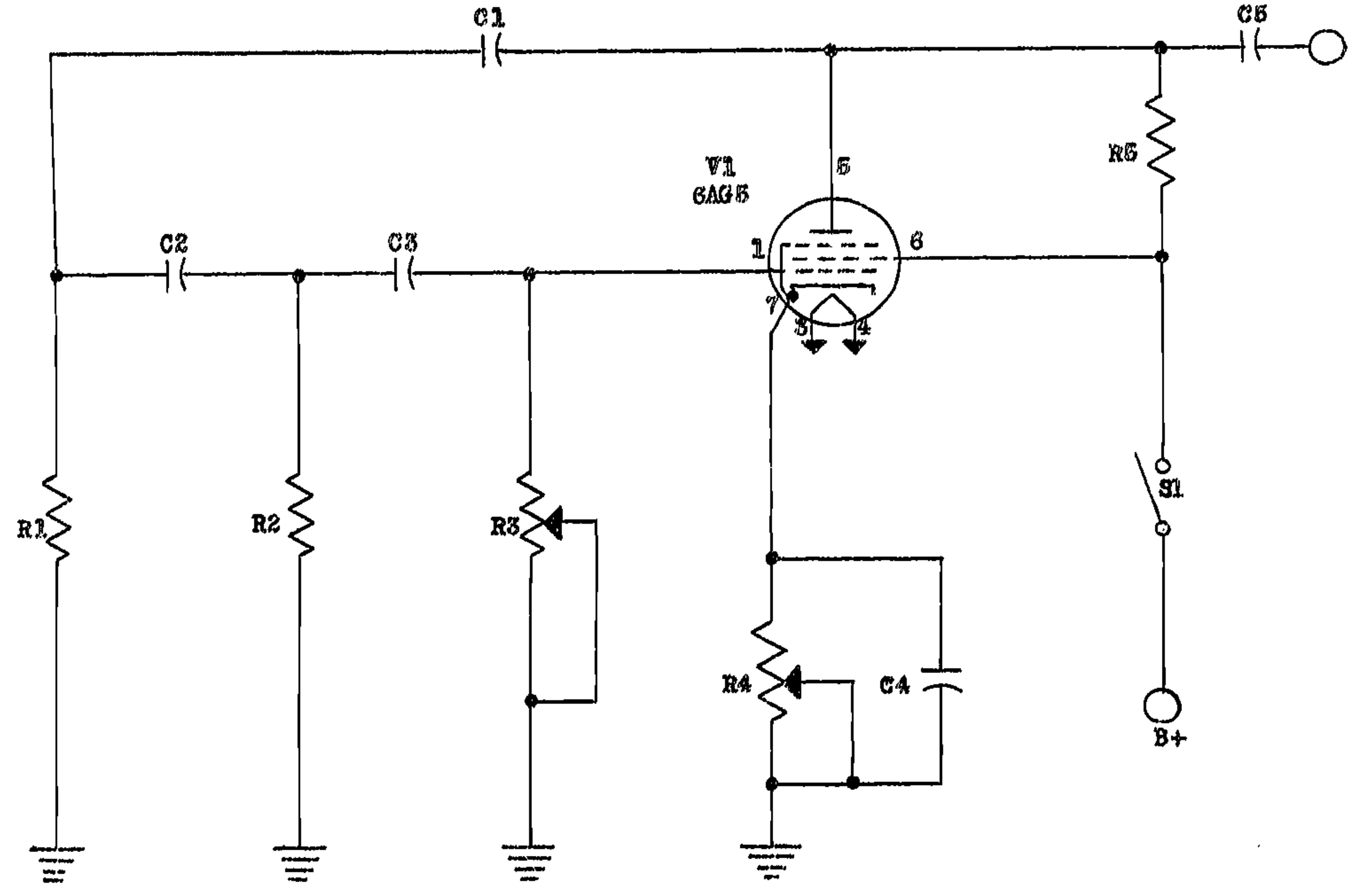
S-IV-10



CATHODE FOLLOWER

APPENDIX

S-IV-12



R-C OSCILLATOR

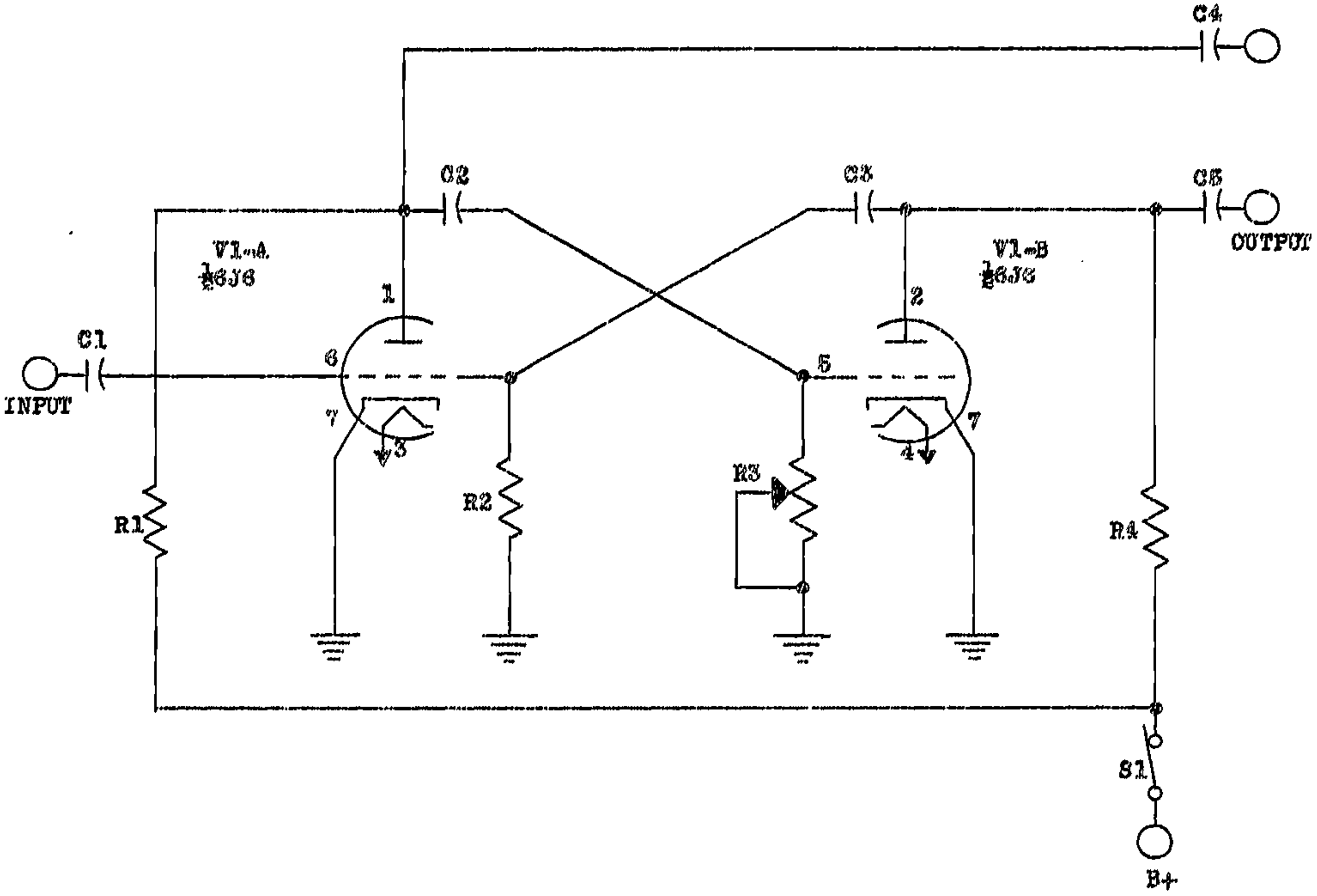
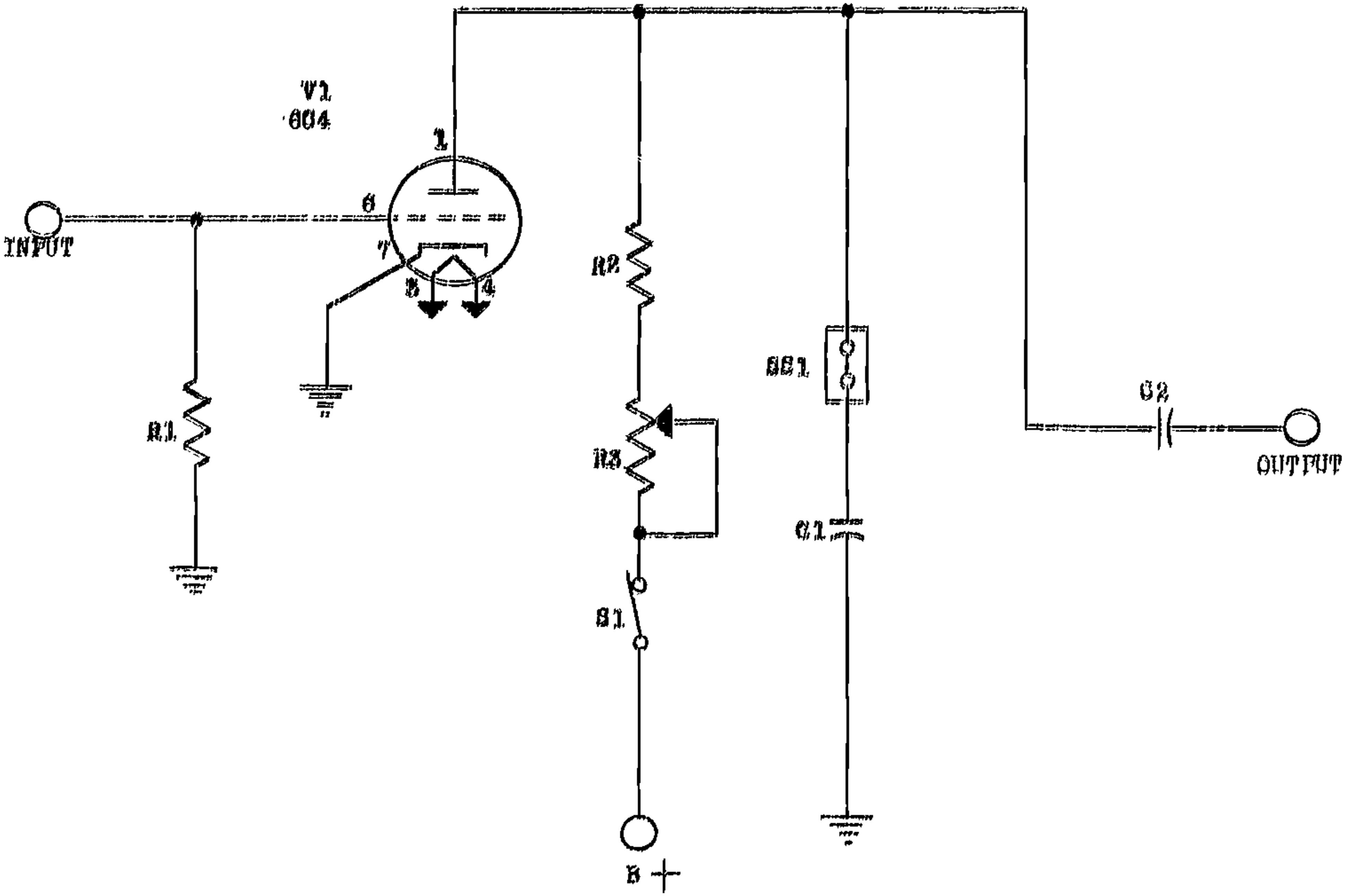


PLATE-COUPLED MULTIVIBRATOR



VACUUM-TUBE SAWTOOTH GENERATOR

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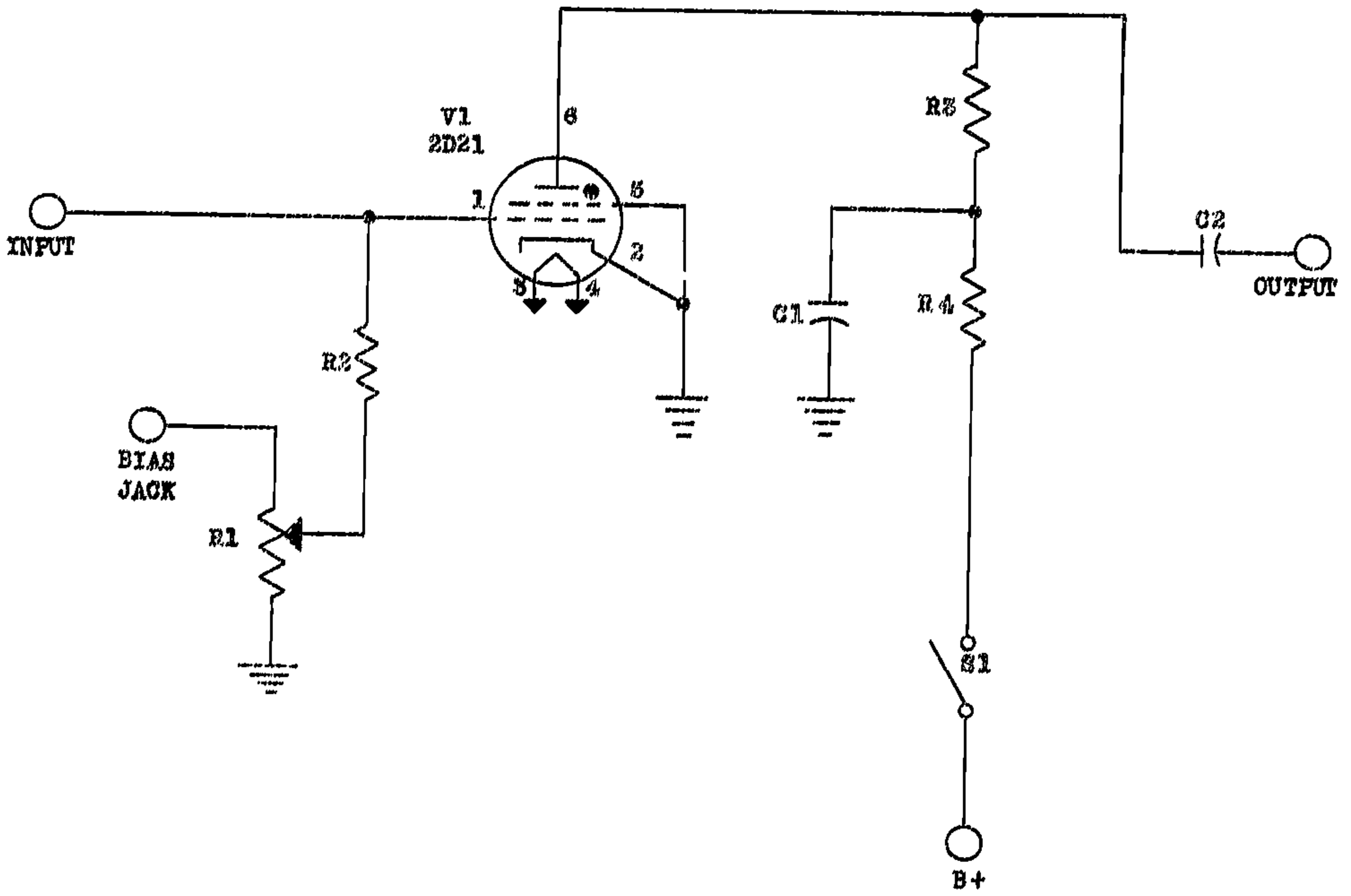
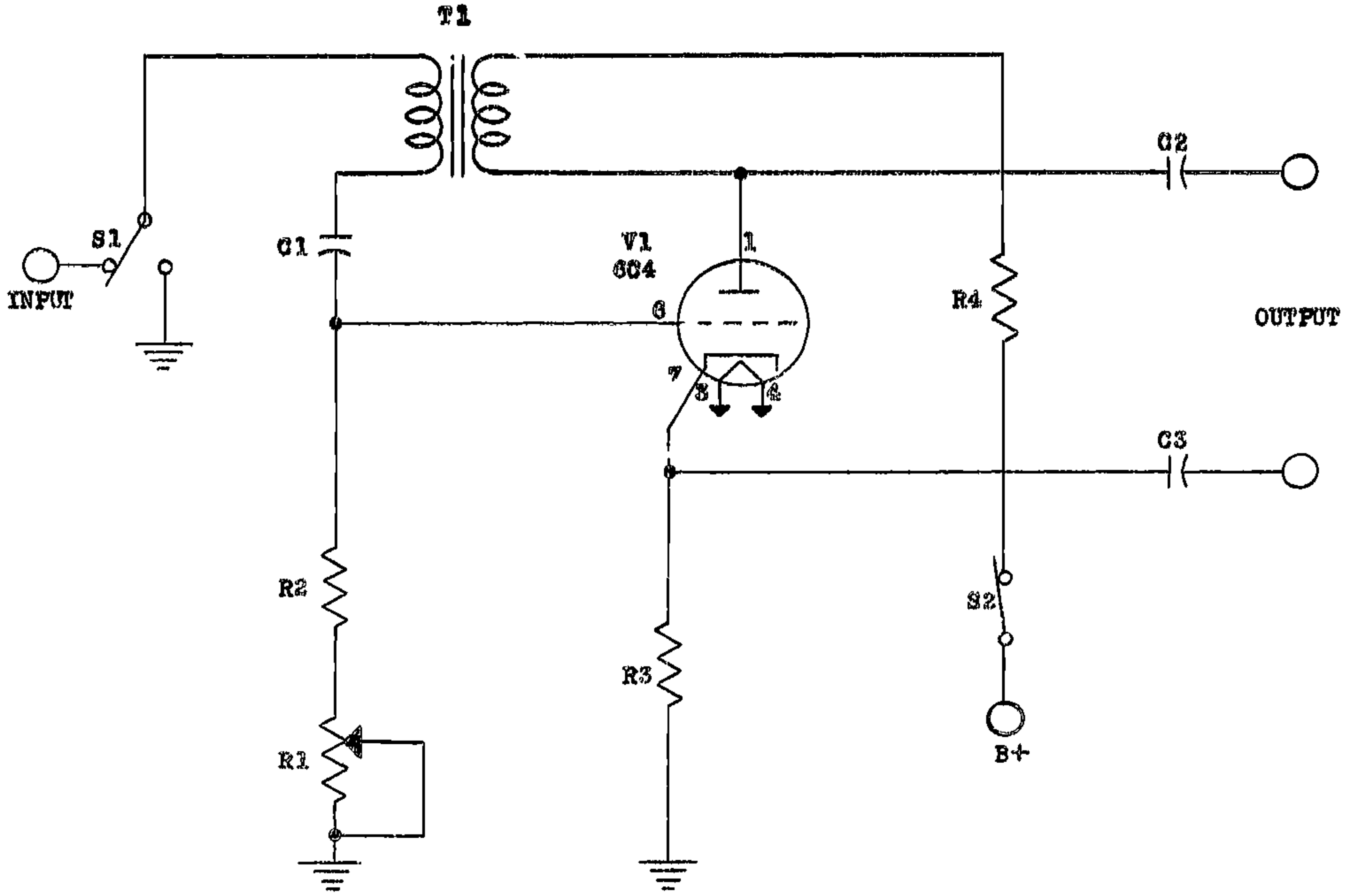
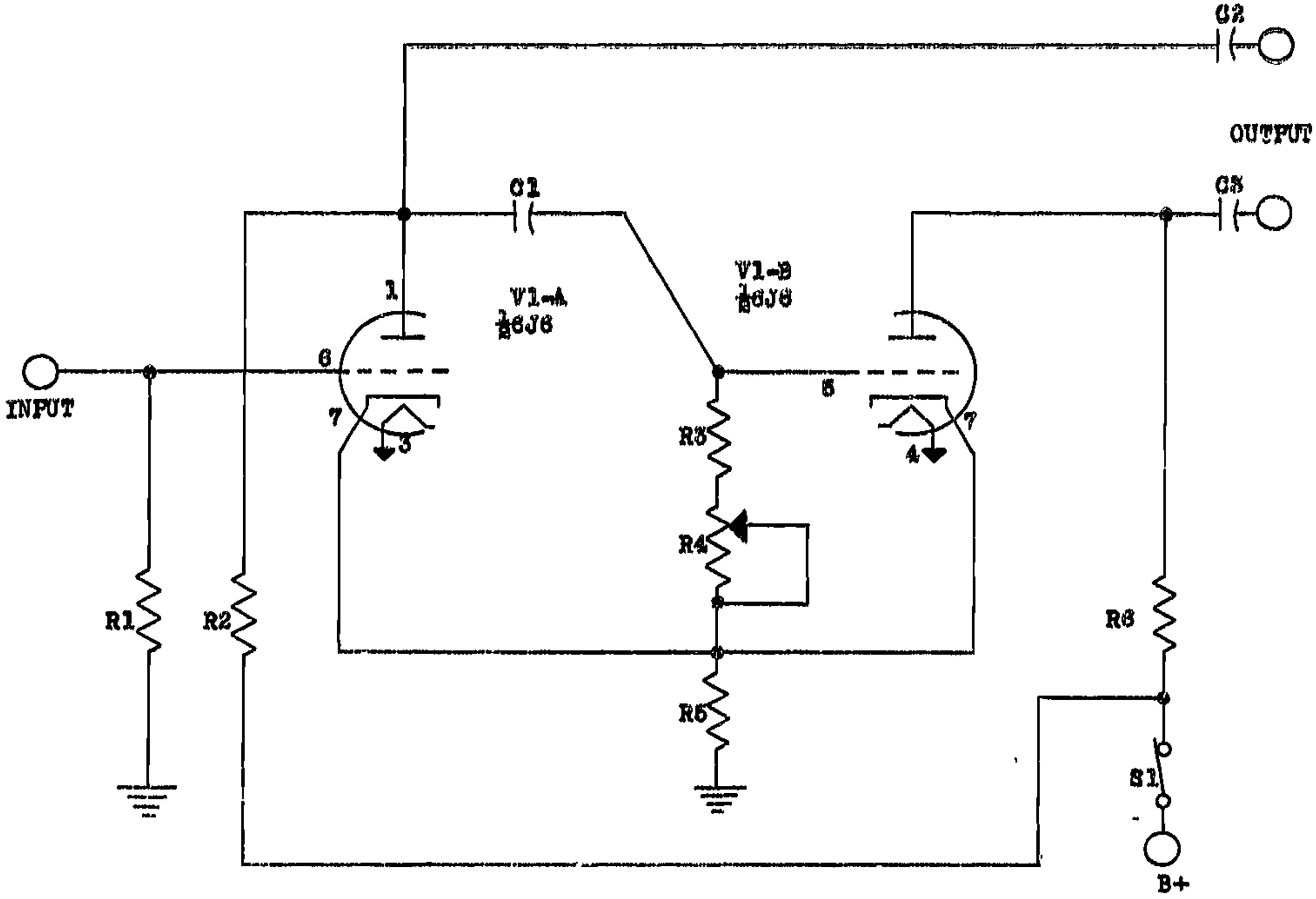
S-IV-16



THYRATRON SAWTOOTH GENERATOR



SINGLE-SWING BLOCKING OSCILLATOR



ONE-SHOT MULTIVIBRATOR

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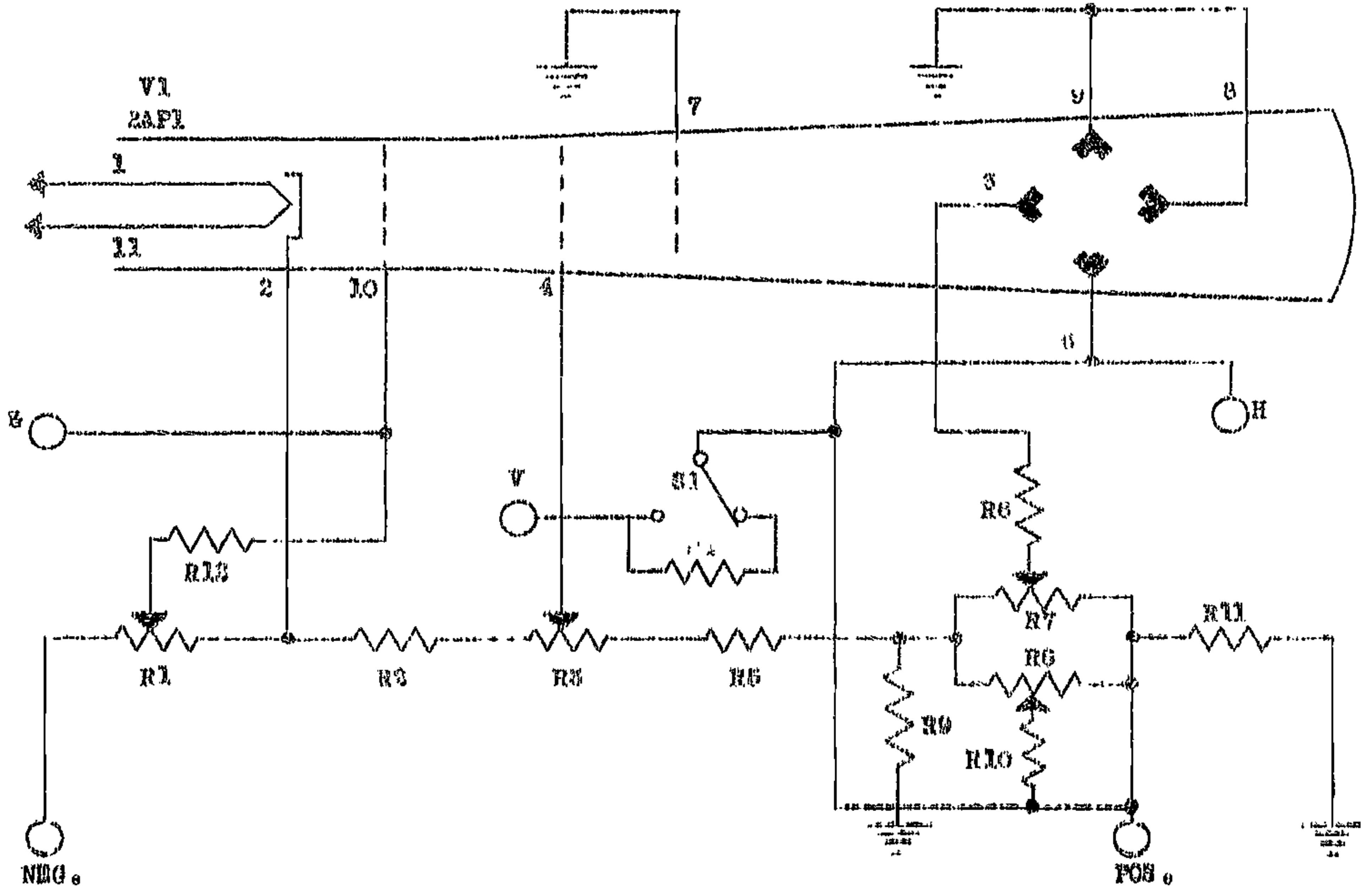
S-IV-19



CATHODE-RAY OSCILLOSCOPE

VT003 193

VT 003 193
Blueprint Reading and Sketching.

Louisiana Vocat. Curriculum Develop. and Res. Center
Pub Date - 67
MF AVAILABLE IN VT-ERIC SET 121p.

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PART I

SKETCHING AND THE THEORY OF MECHANICAL DRAWING

BLUEPRINT READING

SKETCHING AND THE THEORY OF MECHANICAL DRAWING

1. What Blueprints Are:

A blueprint is a copy of a working drawing or mechanical drawing made by engineers and draftsmen in industry. A working drawing shows by means of lines, figures, notes, and dimensions, the information needed by the workman in order to build a certain structure. If the engineering department of an industry were to take the time to write a letter to a man in the field telling him to build a base for a pump at a certain location, giving him the exact location of the bolts, the height of base, the dimensions of the base, and all other information necessary to complete the job, the letter would be long and complicated. The workman would have to take the time to read the letter several times trying to understand what the engineer meant and trying to get a mental picture of the pump base before he could begin work. Then the workmen would probably make some error in locating the bolts or placing the base in the wrong direction, due to some little mistake in English, and this would cause delay and change in construction.

Blueprints are considered the language of industry. They are the engineer's means of explaining to the workmen what he wants done. The working drawings made by a German engineer could be understood and followed by an American workman, with the exception of a few German notes that would be made on the drawing. All the lines of the drawing would be the same no matter in what country or industry it was drawn even though the unit of measure be different. The workman who wants to advance with industry and be able to meet changes that take place should prepare himself by learning to read the language of industry, which is the blueprint made by the engineering department of the company for which he works.

The draftsman makes his working drawings on thin white tracing paper, or a high grade of cloth, which has been starched and treated so that it is transparent. The paper is used for jobs which are temporary or in cases where permanent records are not necessary. The cloth is much more expensive and is used where the working drawing must be kept for many years. These working drawings on either cloth or thin paper are used in making blueprints in the same way that the negative of a photograph is used to make a print. Blueprint paper is yellowish green on one side and white on the other side. A bright light will make it change color so it must be kept in a dark room. In making a blueprint the working drawing is placed over the blueprint paper and the sunlight or the light from an electric arc allowed to shine through the tracing paper. The lines, either ink or pencil, keep the sunlight from shining on the blueprint paper so that the color of the blueprint paper changes every place except where there are lines on the tracing paper. The blueprint paper is then taken out of the light and placed in water where the color change is completed. Every place where there were lines turns white, and the rest of the paper turns blue, and so we have a blueprint. The working drawing may be used to make as many copies or blueprints as are needed. After the blueprints have been made, the tracings or working drawings are stored in a dry place and kept as records. If the blueprint happens to be of a pump base and the engineering department decides to install a new pump or change the pump house in any way, the engineer can go to the filing room and get the original working drawing at any time and know exactly what is in the pump house and make changes whithout having to make a trip to the location.

2. Use of Blueprints in Industry:

The blueprint made from an accurate working drawing should have all the information needed for the workmen to do the job. Before the workman asks for more information he should first read every note and symbol on the blueprint. He should remember that the blueprint is an exact copy of the working drawing on file in the drafting room, and if he follows every detail and note on the blueprint, he will be protected in case of error. If he checks accurately with the blueprint, the blame will be placed squarely on the draftsmen in the office.

A working drawing shows an object from one or more sides with all lines and all angles drawn exactly as they are. All dimensions or measurements, the radius of any curve, the kind of material, the finish of the surface, and any other notes necessary to fully describe the object should be given on the working drawing. The working drawing usually shows three views of the object and there is usually a note to tell whether it is a front view, the top view, the plan, the end view, or whatever it may be. The workmen should remember that the blueprint was put in water in developing and a piece of paper that has been wet shrinks up so that measurements made with a rule on the blueprint are not accurate. The result is that the workman shall take all measurements as they are figured out and shown on the blueprints by dimension lines and only make measurements when the draftsman has failed to put on a dimension. An accurate blueprint will give all measurements and all information necessary to complete the object.

The engineering department spends considerable money in providing blueprints for the workman and the least that the workman should be expected to do is to take care of the blueprints. The blue color will fade if left exposed to the sunlight for any length of time, so the workman should take care that blueprints are not left exposed to the sunlight when not in use. The blueprints are usually 24 inches by 36 inches or

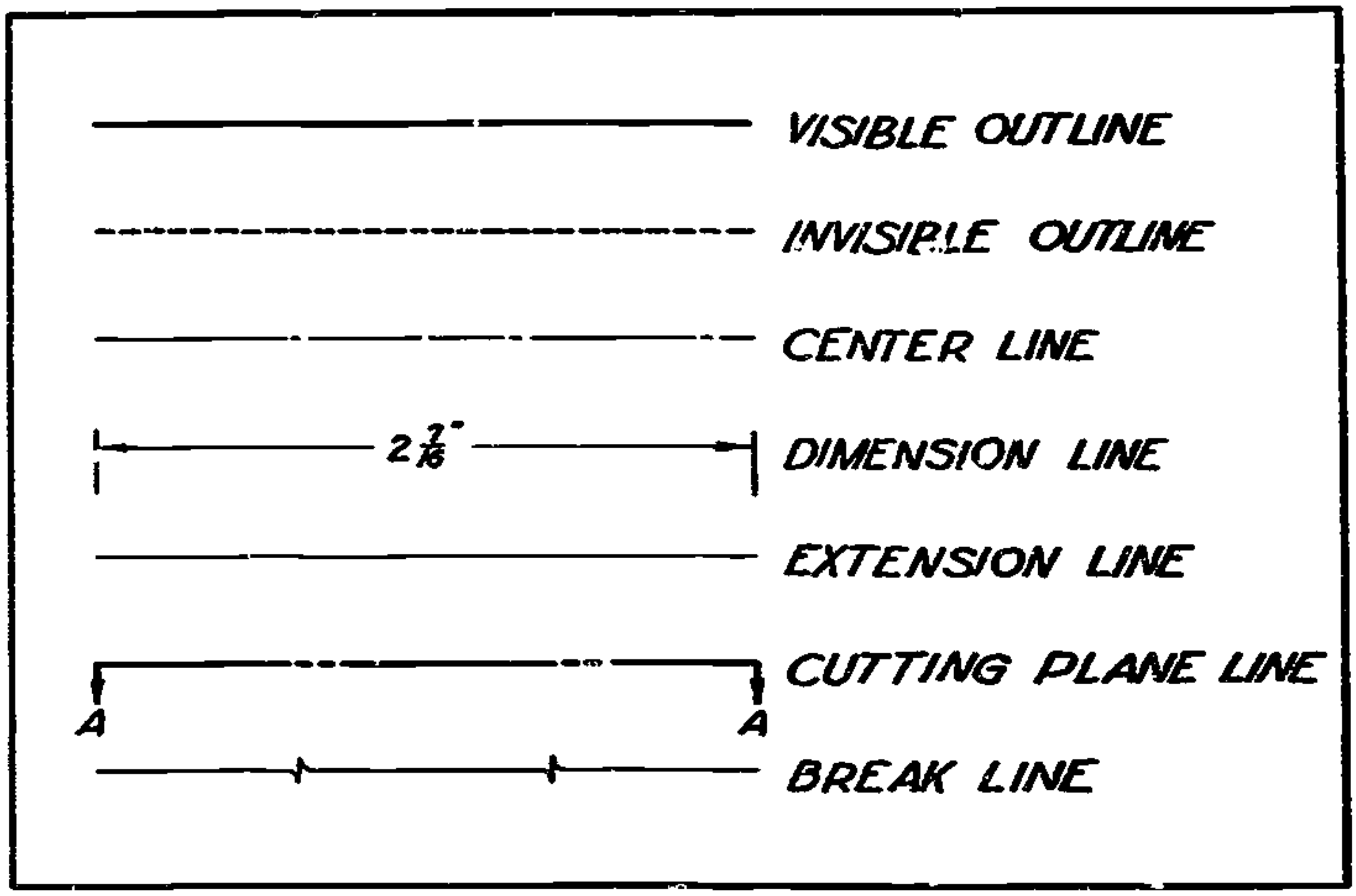


Fig.1

some other size which may be decided upon by the engineering department. It is necessary, therefore, to have some way of folding or rolling the blueprints, and the usual method is to roll them. The workman should take care to preserve the blueprint in whatever form he receives it, and never fold it if it was intended to be rolled.

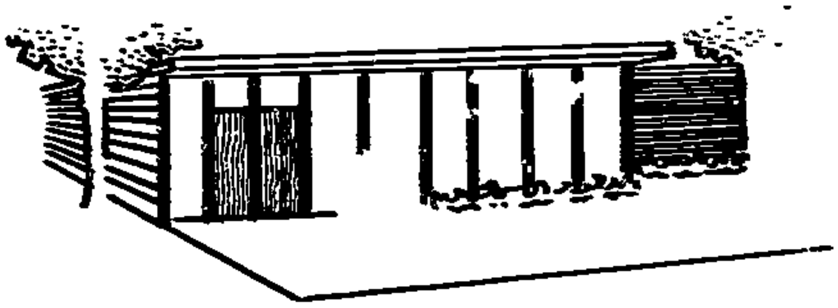


Fig. 2

In order to read blueprints the workman must know something of the principles of making working drawings. This is quite a bit like learning a new alphabet and to read a printed page. The workman should first understand that a blueprint is a record of instructions given to him to read. Secondly, he should realize that the language used by the draftsman is largely a language of lines and that unless he knows how to read the lines, the instructions recorded on the blueprint are almost in a foreign language.

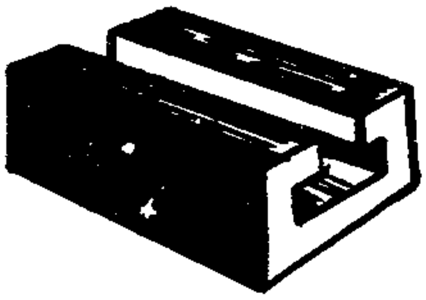


Fig.3

Blueprint Reading

Fig. 1 shows the more common lines which go to make up the language of industry. The visible outline is a heavy white line on the blueprint and is used to represent the lines of the object which can be seen from the side that is being drawn. The dotted line called the invisible outline is used to represent any line in the object which cannot be seen. The dimension line is a light white line on the blueprint which is used to indicate the distance between any two points. The extension line is also a light solid line which is used to extend to points outside the object so that the draftsman will have more space to place the dimension line. The heavy line with two dots and a long dash and the arrows pointing to each end is called the cutting plane line and is used to show where sections are taken. This is necessary in the case of complicated objects because the regular views do not clearly show the shape of parts inside the object. The break line is used to show that a part of the object has been left out because it was too large to be drawn on the paper.

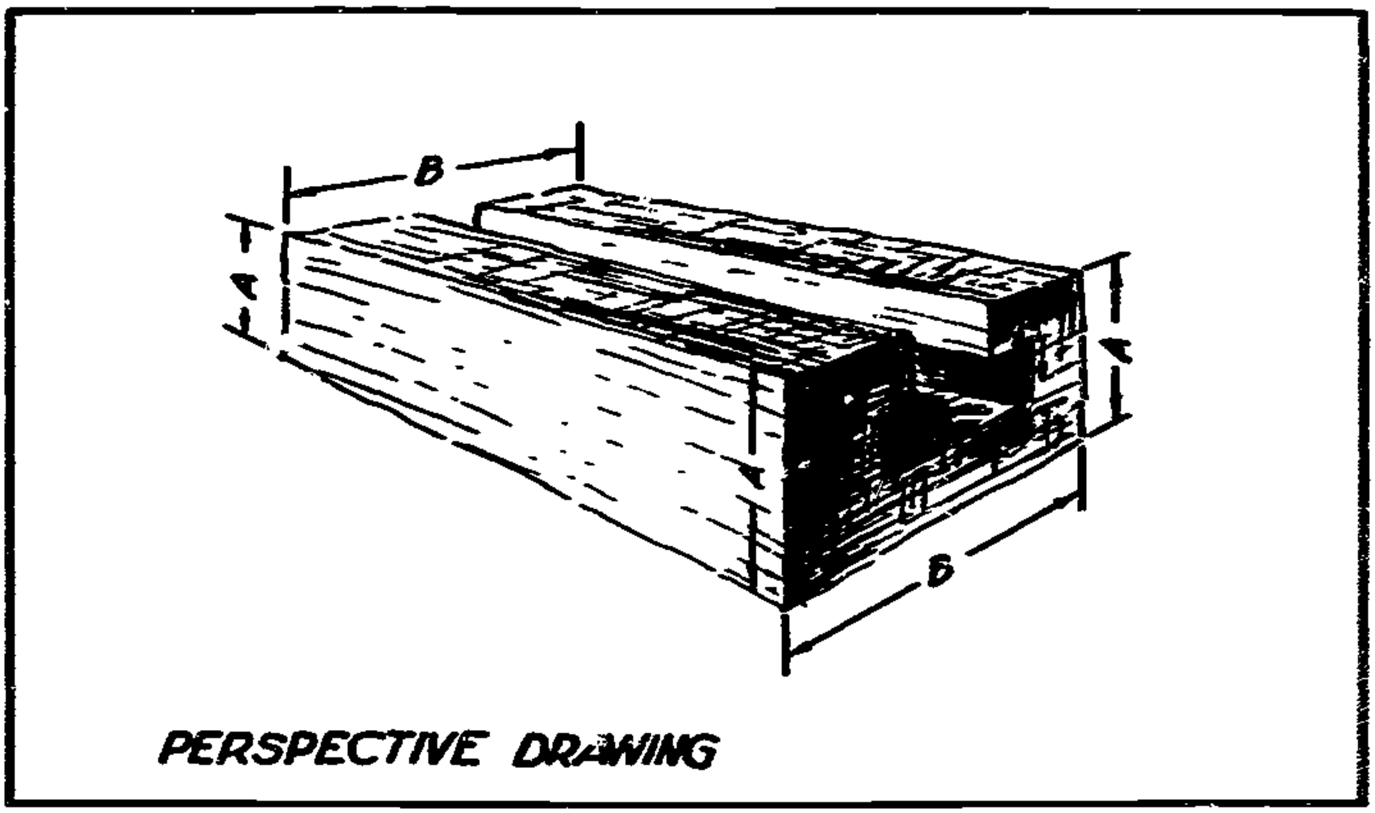
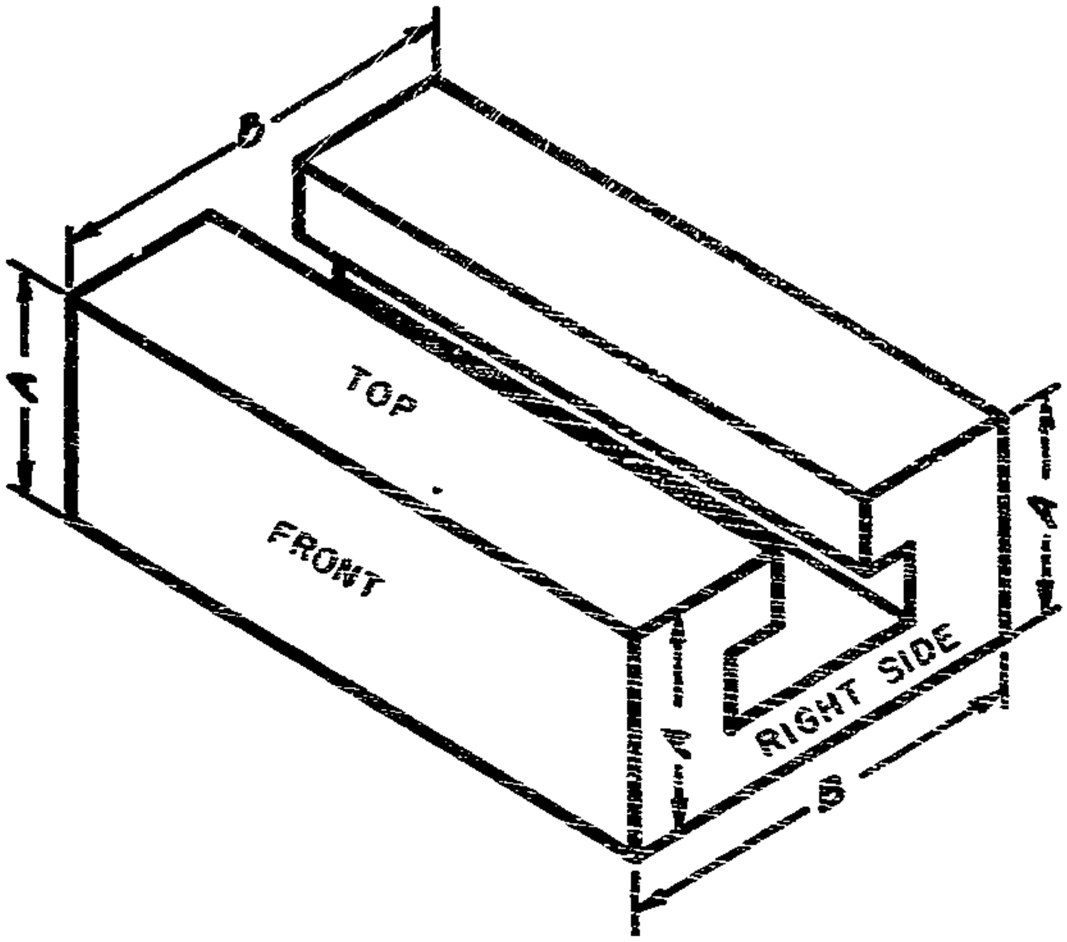


Fig 4

After the workman has become familiar with these lines he has completed his first lesson in learning the language of blueprints. In order to read a blueprint, the first thing to do is to study the different views until one has a mental picture of what he is to build. The drawings all are made on a flat sheet of paper and it is necessary to study these and use the imagination to make the lines and views stand up off the paper and obtain a mental picture. Next, all letters and notes should be read and considered. Carelessness in any one of these respects is not to be excused.

3. Freehand Isometric Sketching:

A pictorial drawing is any kind of drawing which resembles a picture. Fig. 2 shows an actual photograph of a building.



ISOMETRIC DRAWING

FIG.5

We know that the building is the same height in the rear as it is in the front and that the two dimensions marked "A" and "B" are the same, but it can be seen at a glance that they do not show up equal in the picture. The picture gives a very clear mental image of the building but it gives no information that will help the workman to construct the building. Therefore, it is plain that a photograph is of little value to the workman.

Fig. 3 is a photograph of a block. It shows very clearly the shape of the block and again the workmen get a very clear mental image, but it will be noticed that the information is not such that he could actually make the block.

Fig. 4 is a perspective drawing of the same block and it will be noticed that the three dimensions marked"A" should be equal but they are not, and likewise the two dimensions marked "B". This form of drawing is similar to an actual photograph inasmuch as it is possible to get a very good mental image but it, too, fails to give sufficient information to be of value to the man in industry.

Fig. 5 is known as an isometric drawing. It will be noticed that the dimensions marked "A" in this drawing are equal and also that the dimensions marked "B" are equal. Some measurements can be made on an isometric drawing and this gives it much more value than a perspective drawing. This form of drawing is becoming more important in the drafting room as it shows a little better picture than the three-view type drawing and the workman should acquaint himself with isometric drawing so that he can become able to make a simple freehand sketch of any part of his work, which will be a valuable aid to him in explaining to a foreman how he did a particular job. There are two other forms of pictorial drawing, the oblique drawing and the cabinet drawing, but as they are used very little in some industries, they will not be discussed at this time.

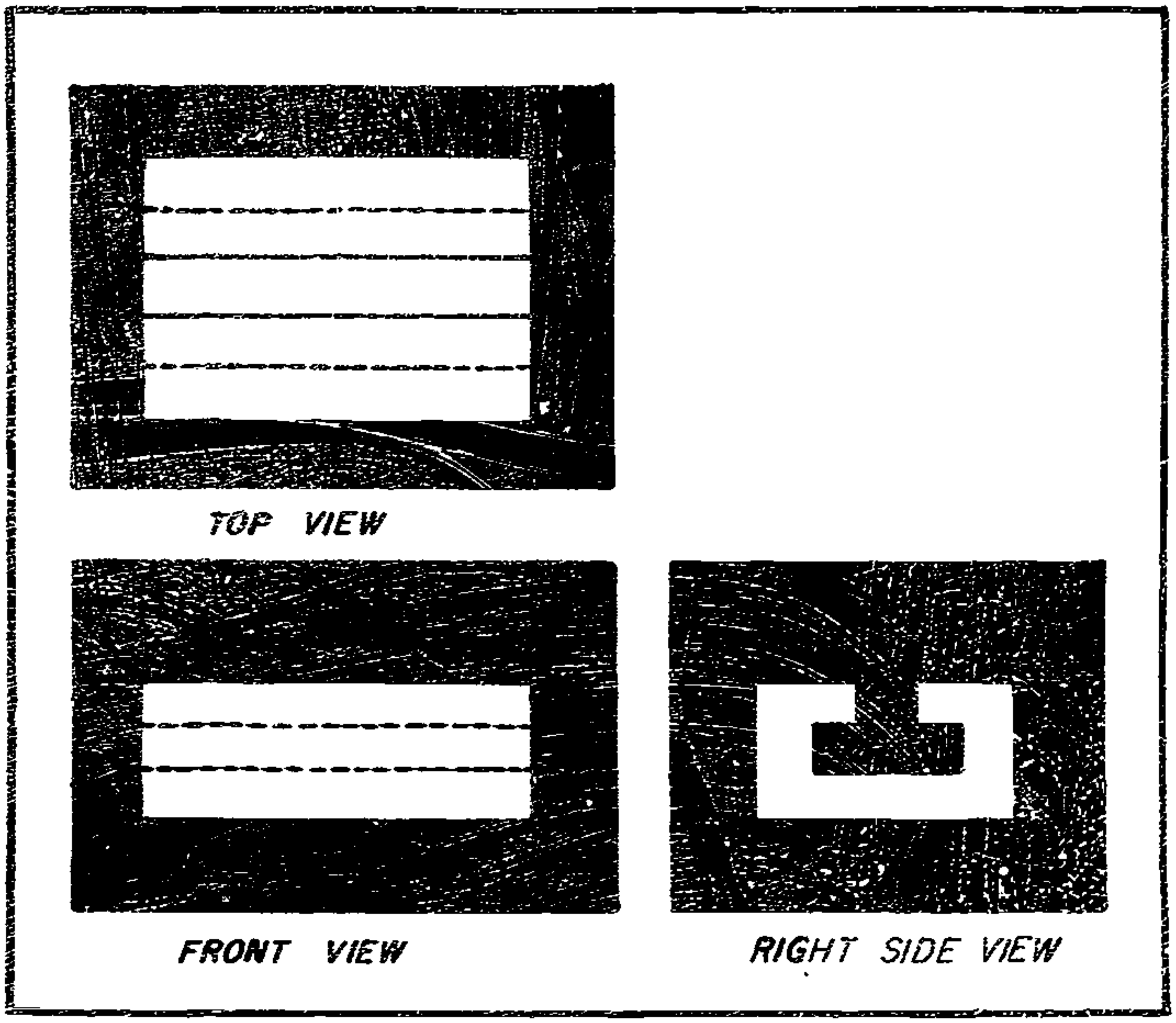
4. The Theory of Mechanical Drawing:

Three-view drawing is another name for working drawing. In most cases three views of an object are drawn. The three views commonly shown are front view, right side view, and top view. A view of an object, for instance, the front view, is almost what one would see if he were directly in front of the object, and, likewise, the top view of an object is what one would see if he were looking directly down on top of it, and in the same way, the right side view is what a person would see if he were looking at the object from a point directly out from the right side of the object.

Fig. 6 is an arrangement of three photographs of the block. In each case the camera was placed at a point directly out from the center of the front of the block. This operation was repeated using the right side view and the top view. These pictures have been arranged in the same order as the draftsman would arrange them in making a working drawing. The dotted lines have been added to the front and top views so as to give the same information as would be given on a working drawing.

These three views have a certain arrangement on the blueprint. The draftsman usually draws the front view first, and the top view is placed up above the front view, and the right side view is placed to the right of the front view, as is shown in Fig. 6, and, if a bottom view were drawn, it must be placed below the front view. The reason for placing these views in this arrangement is that this is a standard method of making a working drawing, and if all draftsmen are taught to make drawings in this way, and all workmen learn that working drawings are made in this way, then there will be no misunderstanding between the workman and the draftsman. If the draftsman takes a notion to change this arrangement and workman is not told about the change, it can very easily cause an error, so we learn this arrangement of the views and do not change them.

Fig. 7 shows a three-view drawing of the same simple block that was shown in the preceding figures. Fig. 3 is a photograph of the block. Fig. 4 is a perspective sketch of the block.


TOP VIEW

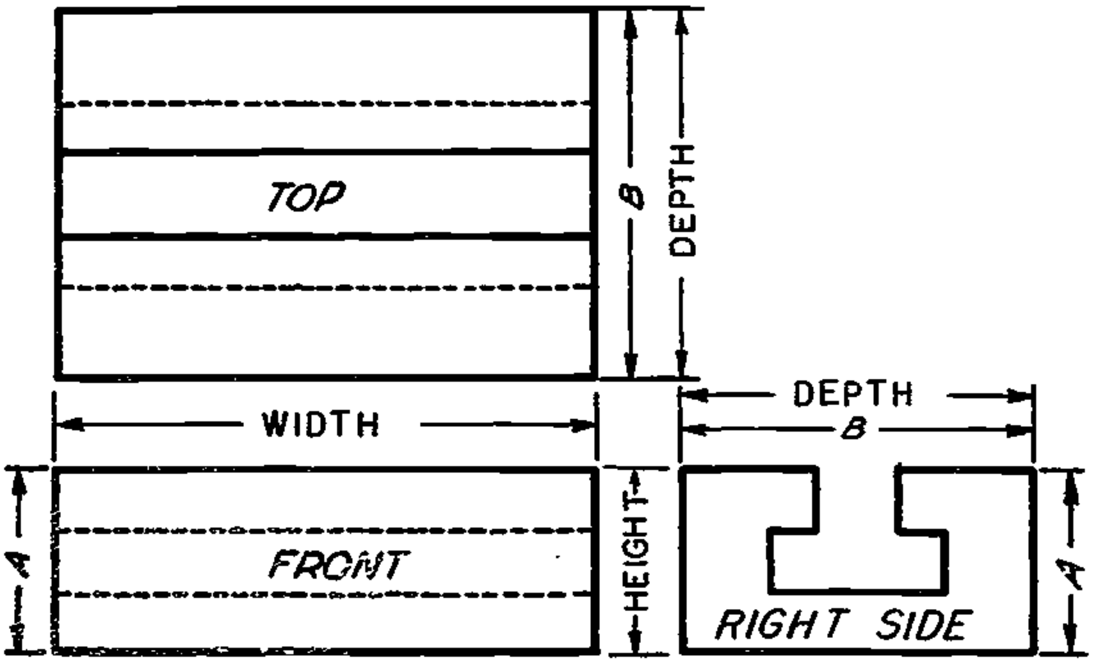
FRONT VIEW

RIGHT SIDE VIEW

FIG.6

Fig. 5 is an isometric drawing of the block. Fig. 6 is photographs of three actual views of the block, and Fig. 7 is a working drawing of the block. The student will get a better idea of three-view drawings by going over these figures again and comparing each one with the working drawing. This working drawing is the means industry uses to instruct the workman to do a job.

The shape of an object determines the number of views required to show it. The purpose of a working drawing is to instruct the workman on what is needed for the job and how to make it. In the case of a section of six-inch pipe four feet long, the right side view of the pipe would show the outside diameter of the pipe, the thickness of the pipe, and the inside diameter. The front view of the pipe would give the length and a top view would be exactly like the front view, so that the front and right side views are all that would be necessary. As the object becomes more complicated more views will be required. In the case of a complicated pipe hook-up, 3 or 4 views will be necessary to give the workman all of the required dimensions and, in some cases, the draftsman will furnish an isometric drawing to give the workman a little better picture of how all the parts will be arranged and assembled, so that the number of views required are the number of views that are necessary for the workman to get the job done.



THREE-VIEW DRAWING OR WORKING DRAWING

Fig 7

5. Kinds of Drawings:

Drawings are divided into two principal classes, pictorial drawings and three-view drawings, as has been mentioned. The pictorial drawings are divided into four types; perspective, isometric, oblique, and cabinet. The isometric drawing is the important one of these and its use is becoming more general. Working drawings or three-view drawings may be classified according to type of work, for instance, sheet metal drawings, piping drawings, architectural drawings, machine drawings, structural steel drawings, etc. In industry the worker must know a little about each of these types of working drawings because even though he may be employed in one branch of work, for instance, pipe work, occasionally he will have a job which deals with sheet metal work. The principles of working drawings are the same regardless of the kind of work, and a good draftsman is capable of making several types of drawings.

6. Making Isometric Sketches from Three-View Drawings

The ability to read a blueprint is to be able to study a blueprint and form a mental picture of the object represented by the working drawings. If the student can study a blueprint and make a mental picture, he should be able to make the picture on paper. The sheet of paper with the diagonal lines at the back of this book is known as isometric ruled paper. If a sheet of typewriting paper or other reasonably thin paper be placed over this isometric paper the isometric lines can be seen through the typewriting paper. If the student has studied the working drawing in Problem 1 and has formed a mental image of the object he should next place a sheet of typewriting paper over the isometric paper and draw the isometric drawing of the object, which is a simple block of wood. The heavy lines of the ruled paper are one inch apart and the lighter lines give half-inch spaces, so that by using this method of sketching it is not necessary to use a ruler for making measurements and a reasonably accurate drawing is obtained. All lines should be made freehand as ability to draw freehand is the result of practice.

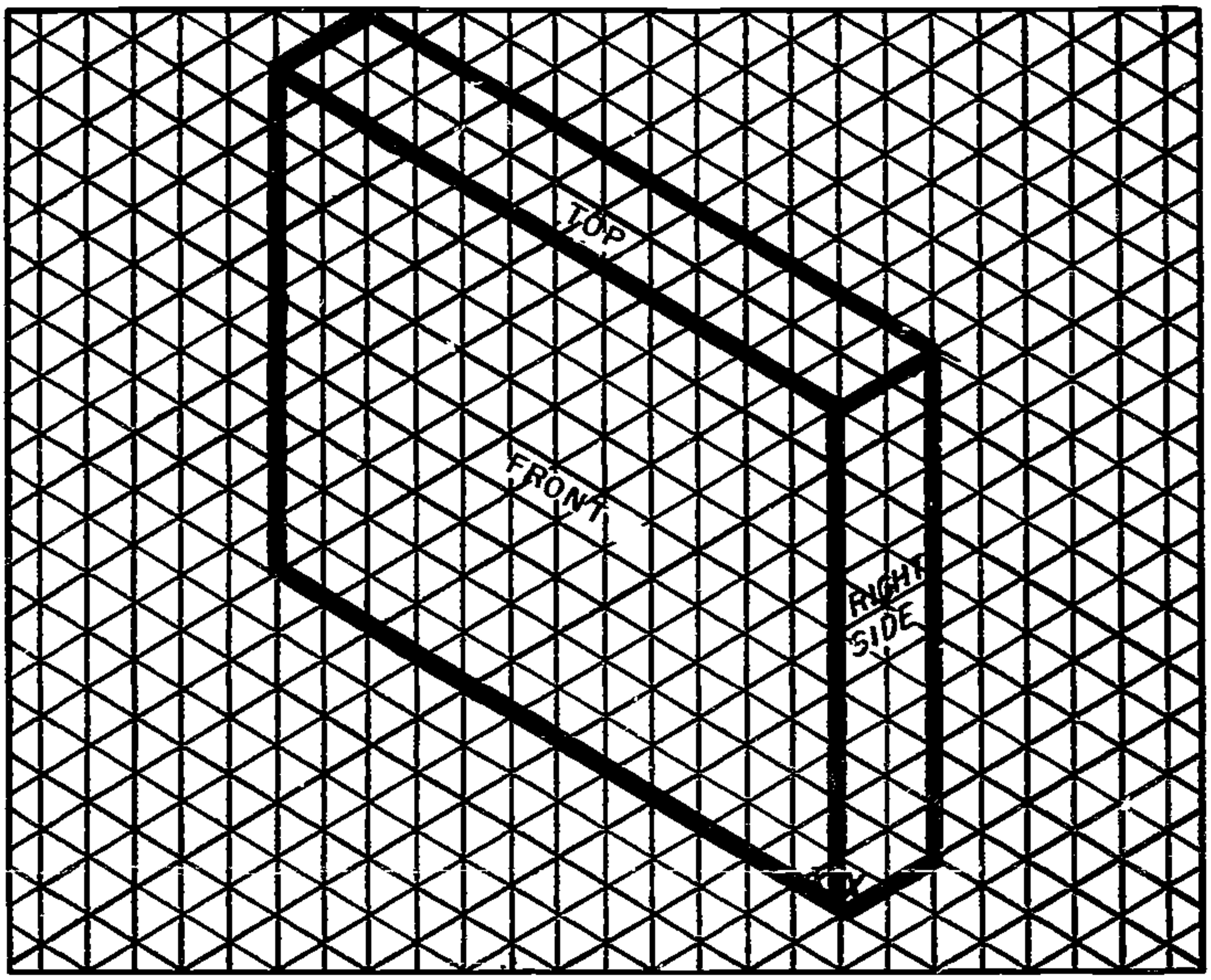


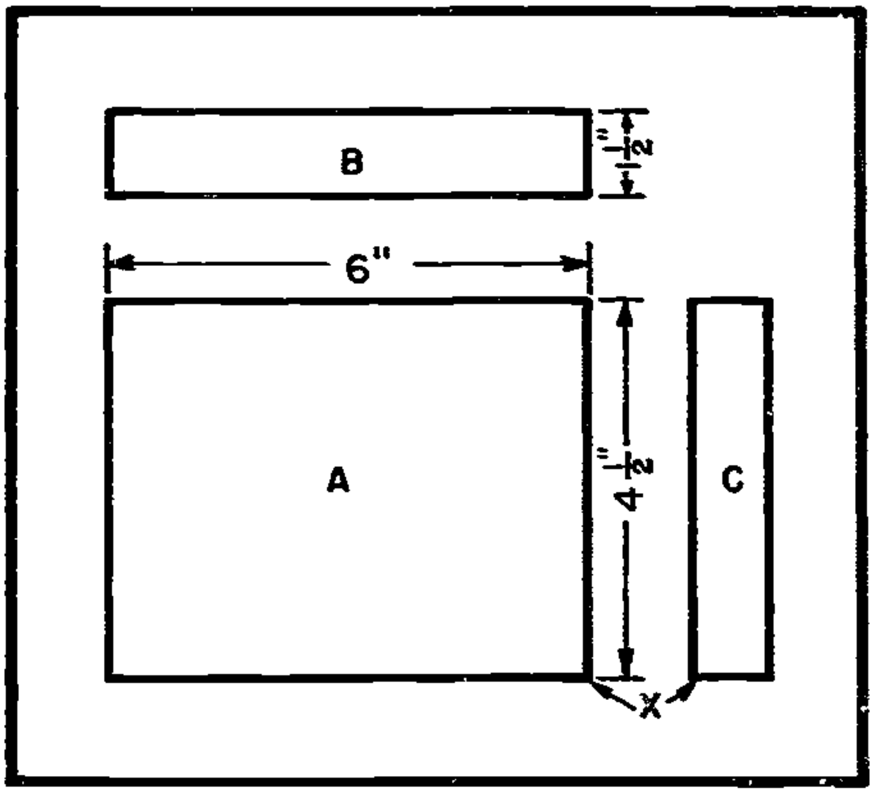
Fig 8

Fig. 8 will illustrate how the object should be drawn. The corner of the object should be drawn. The corner of the object marked "X" should be placed well towards the bottom of the sheet at the intersection of three heavy lines. These three heavy lines on which the drawing is started are called the isometric axes. The isometric axes always are located before the drawing is started. Complete the three views of the isometric drawing by taking the information necessary off the working drawing. After the student has finished the isometric drawing of Problem 1, he should answer the following questions about the working drawing. Although these problems look very simple, the student will find it well worth his time to make carefully a freehand sketch of each problem as directed and answer carefully each question asked about the problem.

Blueprint Reading

Problem No. 1

Make an isometric drawing of this block placing the corner marked "X" on the isometric axes. Do not dimension. Questions to be answered about the working drawing on this sheet:



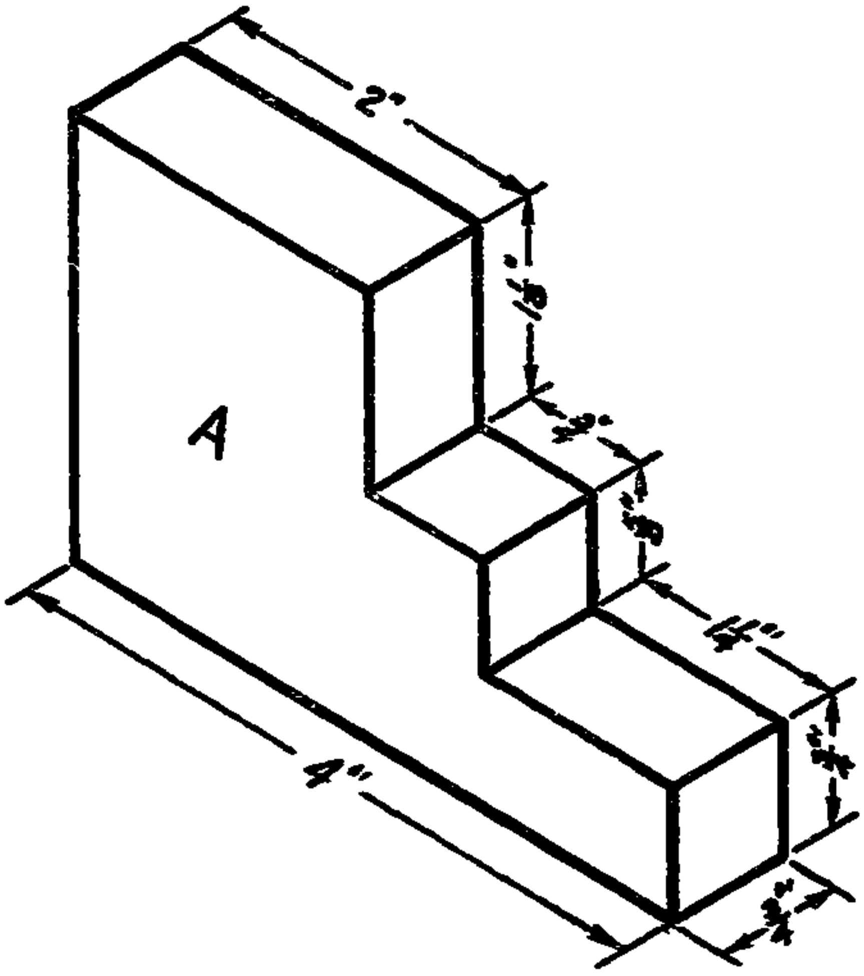
Problem 1

1. What view shown above is labeled "A"? ________
2. What view shown above is labeled "C"? ________
3. What view shown above is labeled "B"? ________
4. Is the front view longer horizontally or vertically? ________________
5. The depth of the block is shown in what views? ________________
6. The width of the block is how many inches? ______
7. The width of "A" is the same as the width of what view? ________________
8. Is "B" longer horizontally or vertically? ________
9. Is "C" longer horizontally or vertically? ________
10. The top view is always directly above the ________ view.
11. In a three-view drawing we see the ________ form.
12. The working drawing uses three views to show the block which the isometric drawing shows the block in but ______ view.
13. Each of the views drawn in the working drawing form a geometric figure called ____________.

Now in order to see if the student has learned what a working drawing is, Problem 2 will be just the opposite. An isometric drawing of a gauge block is given and the student is to make a three-view drawing. Rectangularly ruled paper will be found in the back of the book and if a sheet of typewriting paper be placed over it, the lines will show through and this will save the trouble of making measurements and also will be helpful in drawing straight lines freehand.

The views should be arranged in the proper manner and the dimensions given so that sufficient information is given to enable a workman to make the gauge block.

This kind of drawing is used by many men in the field and in many cases, blueprints are made by the engineering department from such sketches sent in by foremen and workmen.



Problem No. 2

Make a three-view drawing of this gauge block using side "A" as the front view.
Questions to be answered after the drawing has been completed:

1. Straight lines that never meet, no matter how far they are extended are called ______________ lines.
2. Any line drawn at 90° with a horizontal line is called a ______________________ line.
3. The longest dimension in the front view is ________ inches.

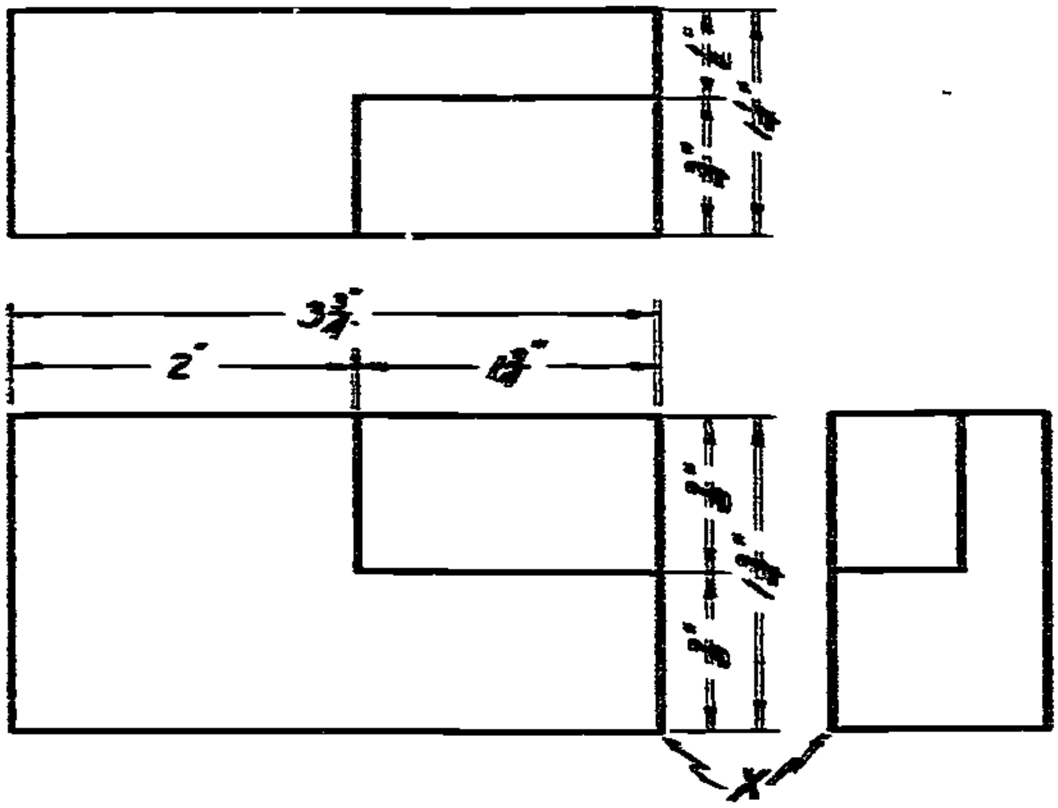
4. The right side view is placed to the right of the __________ view.

5. The block is made of material of what width? __________

6. The top and right side views form geometric figures called ____________________.

7. The shortest dimension on the block is how much? ________

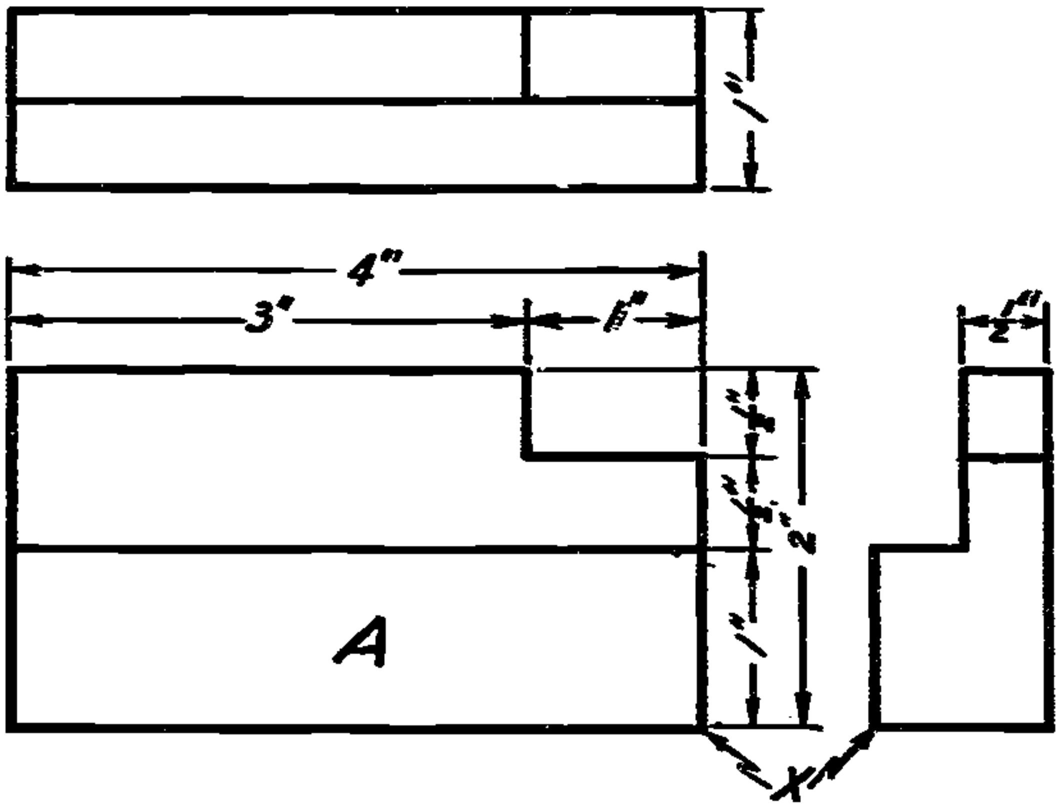
8. What size piece of boiler plate would be required to make this block? ____________________



Problem No. 3

Make an isometric drawing of this notched block placing the corner marked "X" on the isometric axes. Questions to be answered about the working drawing on this sheet:

1. The size of the piece taken out of this block is _____ x _____ x _____.
2. The intersection of two planes in the front part of an object is shown by a _____________ line.
3. The shortest dimension on the block is _____ inches.
4. The longest dimension on the block is _____ inches.
5. How many views are needed to show the shape of the notch? _____________
6. The width of the right side view can be obtained from what view? _____________
7. The length of the top view can be obtained from what view? _______________
8. Which two views show the depth of the block? ________ _______________
9. An angle of 90° is called a _______ angle.
10. How many right angles are there inside a rectangle? _________________



Problem No. 4

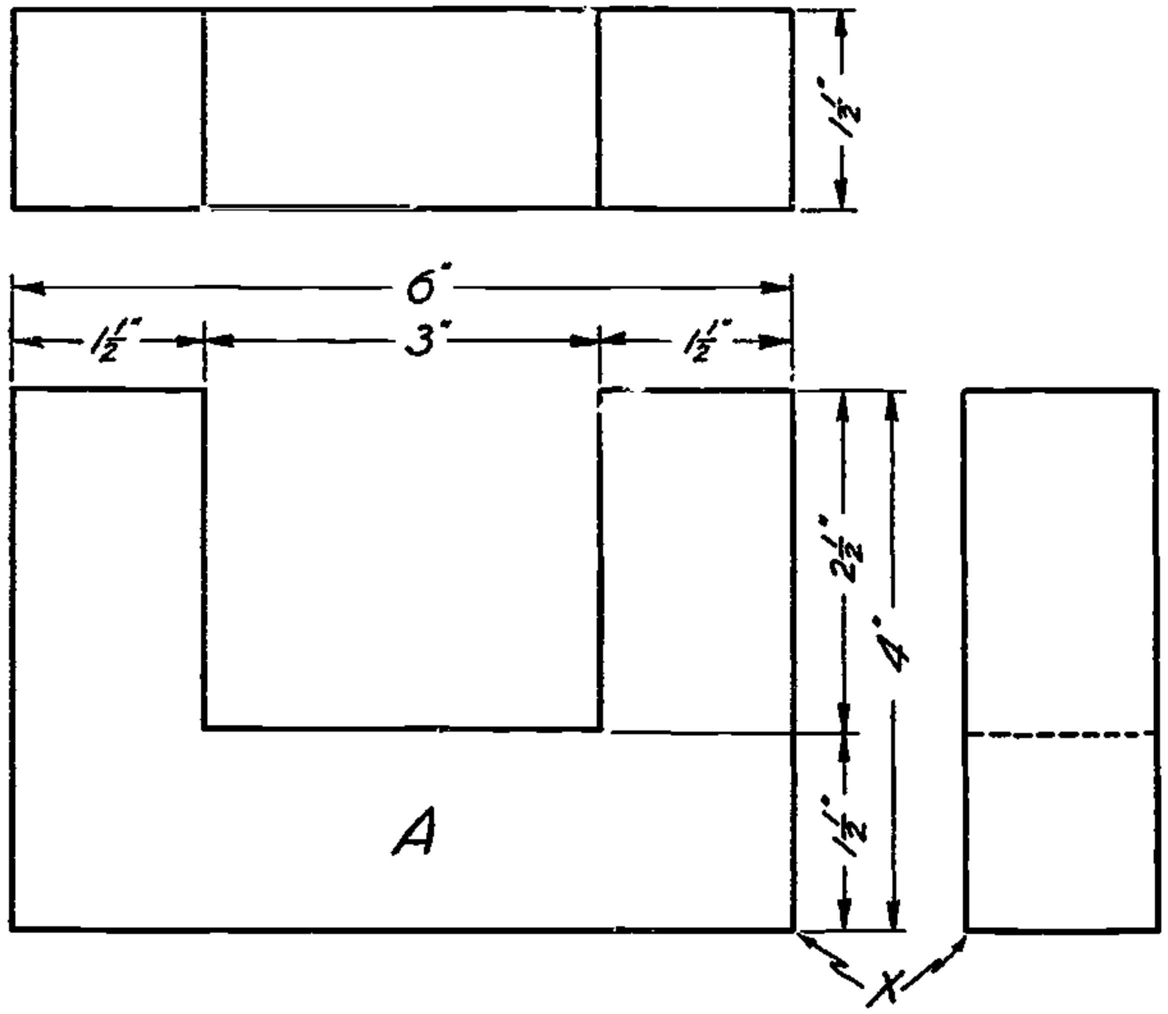
Make an isometric drawing of this block placing the corner marked "X" on the isometric axes. Questions to be answered about the working drawing on this sheet:

1. Isometric drawing is a form of _________ drawing.
2. The over-all length of the block is _______ inches.
3. The over-all width of the block is ________ inches.
4. Mark an "X" on the line in the right end view which represents surface "A".
5. The isometric axes are at an angle of how many degrees with each other? ______________________.
6. Measurements in making isometric drawings can be made only on the _____ axes or on lines __________ to it.
7. What must one do to the right side view to make it a complete rectangle? ____________________________________
8. Considering the two pieces are cut from the block, what are the dimensions of the largest piece removed? __________

Blueprint Reading

9. What size piece of material would be required to make this block? ________ x ________ x ____________.

10. Is the top view in this drawing necessary? ____________



Problem No. 5

Make an isometric drawing of this block, placing the corner marked "X" on the isometric axes. Questions to be answered about the working drawing on this sheet:

1. Why is the side "A" used as the front view?
2. Why doesn't all of the notch in the isometric drawing show? ____________________
3. If the shape of the notch was shown in the isometric drawing, it would have to be with a ________ line.
4. Which view of the working drawing most clearly shows that a notch has been cut out of the block? ____________
5. The depth of the notch is shown on the right side view by a ________ line.
6. An edge which is behind some other part of the object is shown by a ________ line.

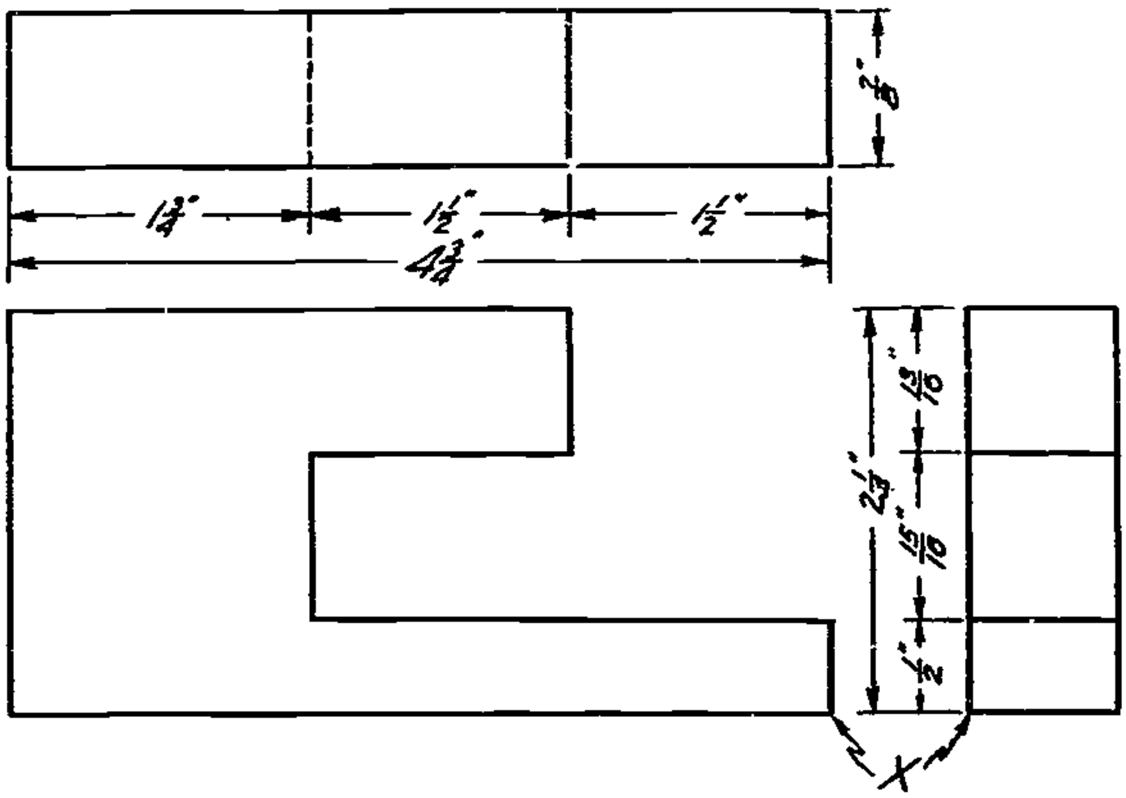
Blueprint Reading

7. In case an invisible line is directly behind a solid line it is ________ shown.

8. The size of the piece cut out of this block is ________ high, ________ wide, and ____________ deep.

9. There are no dotted lines in the top view because ________ ________________.

10. What size piece of stock is required to make this block? ______________________________



Problem No. 6

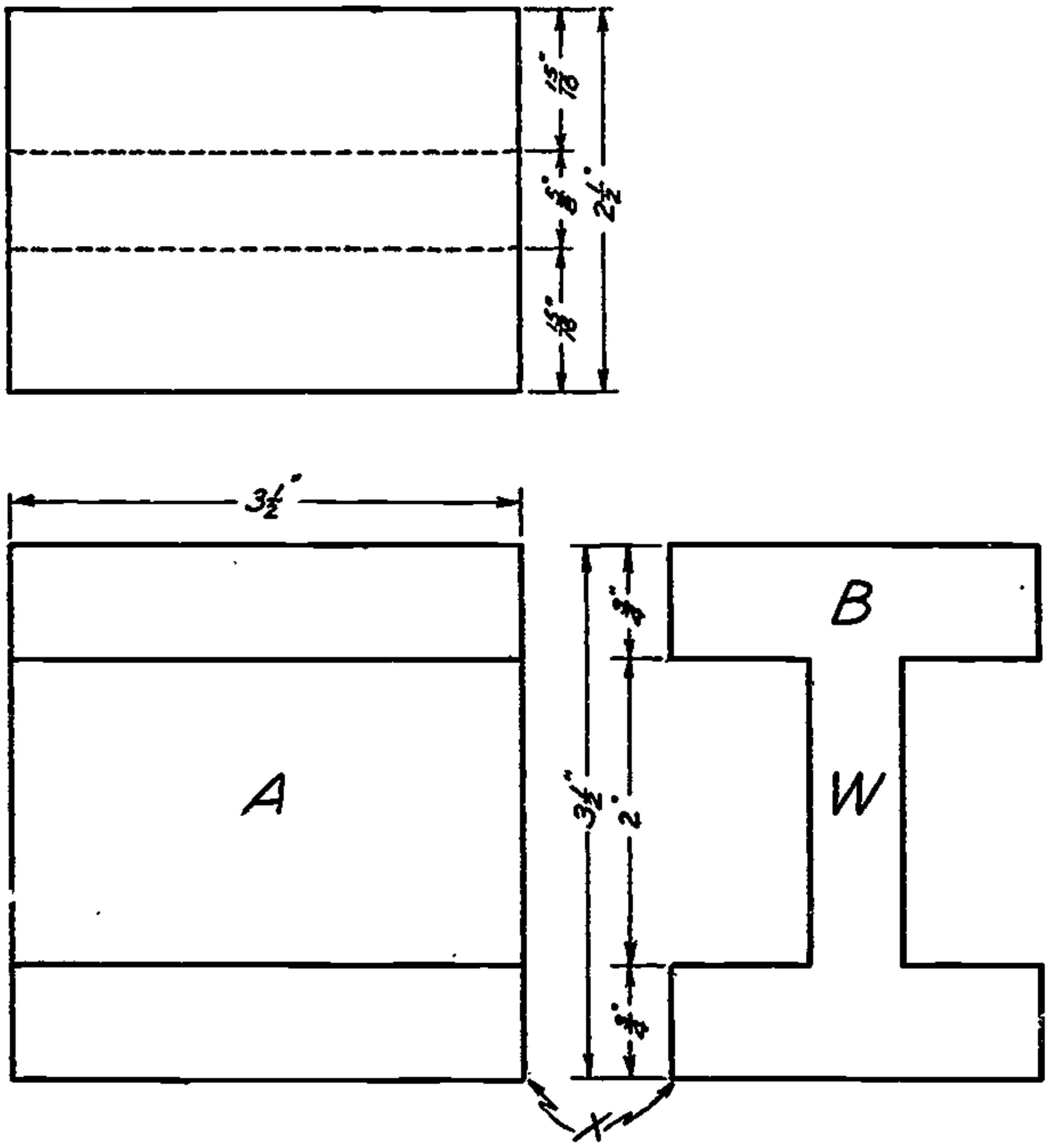
Make an isometric drawing of this block, placing the corner marked "X" on the isometric axes. Questions to be answered about the working drawing on this sheet:

1. The only invisible line in the working drawing is in the ____________ view.
2. What size piece of stock would be required to make this block? ________________
3. The right side view makes a geometrical figure known as a ________________
4. What are the over-all dimensions of the piece cut out of the block? ____________________
5. What kind of a line is used to show an invisible surface? __________________
6. Which line is drawn heavier, an invisible outline or a dimension line? ________________
7. Which view of the working drawing most clearly describes the shape of the block? __________________________
8. How long is the top of the block? _________________

Blueprint Reading

9. How wide is the bottom of the block? ________________

10. What is the shortest dimension in the working drawing?
____



Problem No. 7

Make an isometric drawing of this I-beam. Questions to be answered about the working drawing on this sheet:

1. How many invisible lines are there in the drawing?

   ____

2. These invisible lines represent the intersection of the "W" and the top piece marked ____________.

3. The web of the I-beam is ________ inch in thickness.

4. Why are there no invisible lines in the front view?

   ________________ ________________

5. Which view most clearly gives the shape of the object?

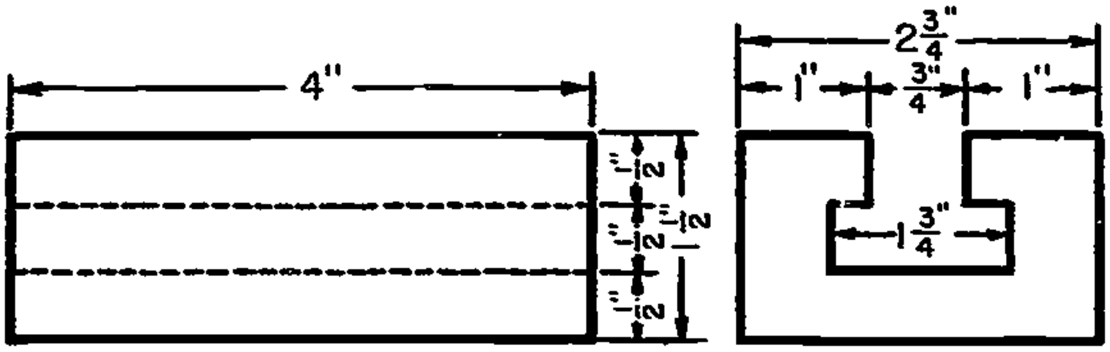
   ____

Blueprint Reading

6. How thick are the flanges of the I-beam?________________

7. What is the distance from the under side of the top flange to the bottom of the beam? ________________________

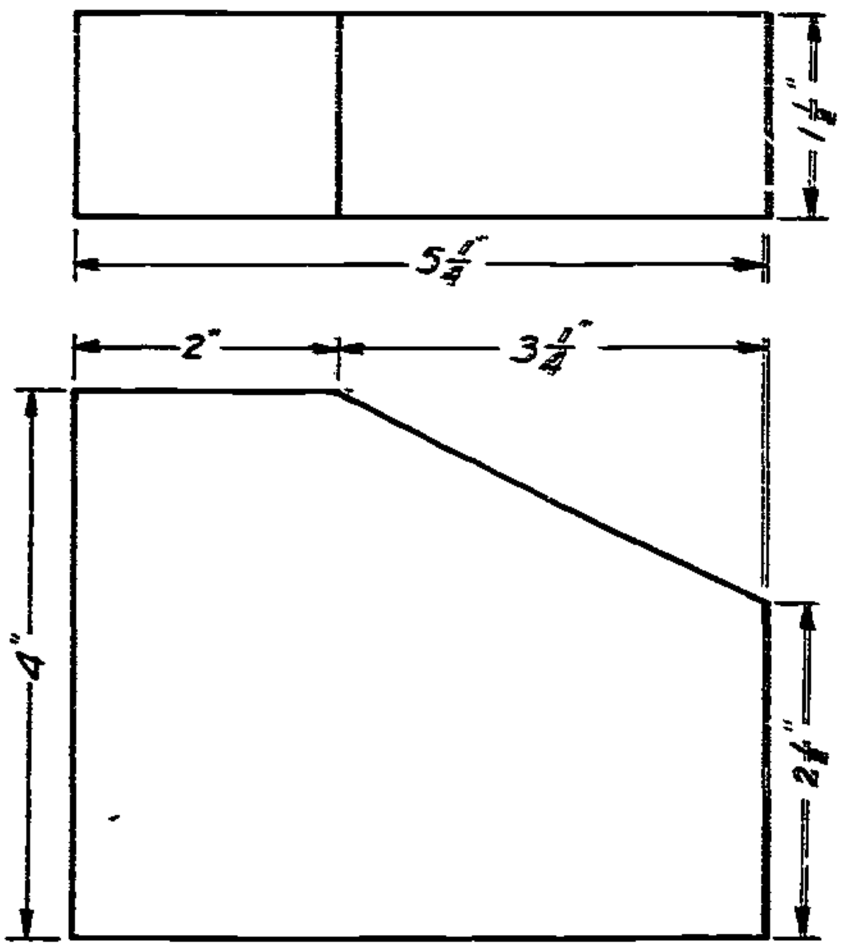
8. What are the two dimensions of surface "A"? ____________



Problem No. 8

Make an isometric drawing of this block. Questions to be answered about the working drawing on this sheet:

1. Would two views give the workman enough information to make the block? Why? ______________________
2. How many invisible lines are in the drawing? ________
3. The height of the "T" slot is shown on an invisible line in the ______ view.
4. What is the depth of the slot at the upper part of the block? ____________
5. What is the depth of the bottom part of the slot?______
6. What view best shows the shape of the slot? ________
7. In the alphabet of lines, invisible lines are made ______ than the outline lines.
8. What determines how many views a draftsman will make of an object? ______________________



Problem No. 9

Make an isometric drawing of this block. Questions to be answered about the working drawing on this sheet:

1. The true length of the sloping surface is shown in the ______________ view.

2. The best procedure in drawing a sloping line when the angle is not shown is to locate its ___________ points.

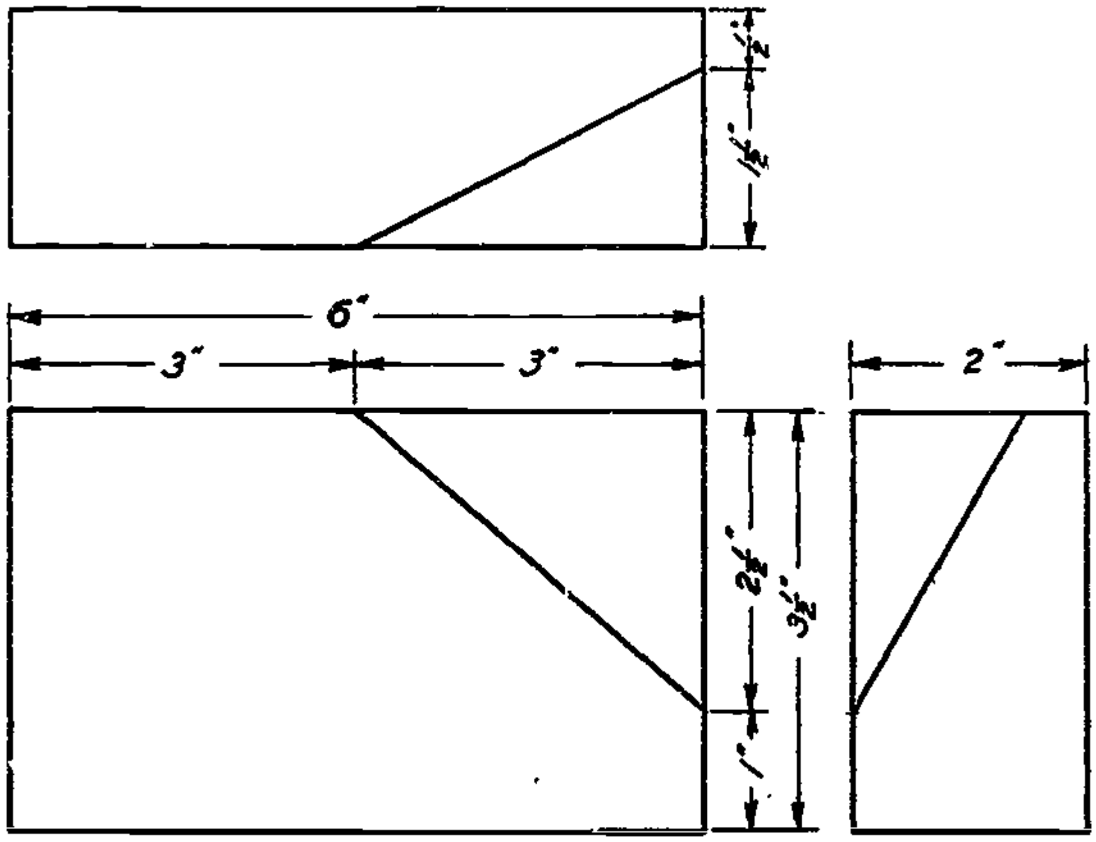
3. All measurements in isometric drawings must be made along the ______________________.

4. The front view contains three right angles and two other angles larger than the right angles which are called ___________________ angles.

Blueprint Reading

5. Do the two views of this object give the workman enough information to enable him to make the object?__________

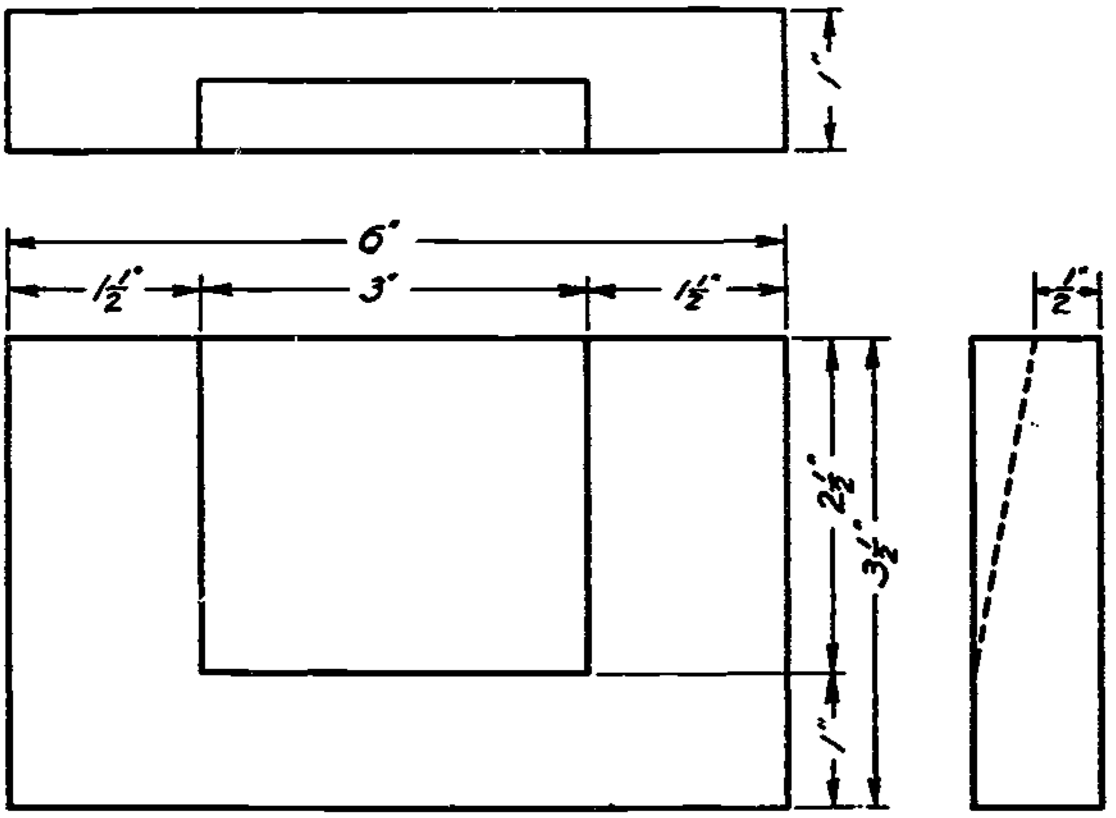
6. Is there a dimension in the working drawing which gives the true length of the sloping surface?________________



Problem No. 10

Make an isometric drawing of this block which has had a corner cut off it. Questions to be answered about the working drawing on this sheet

1. Does the slanting line in the right side view show in its true length? ____________
2. Does the slanting line in the top view show in its true length? ____________
3. In drawing slanting lines it is usually best to locate the ____________________ points.
4. The true shape of the sloping surface is shown in which of the three views? ____________________
5. Would less than three views enable the workman to make the object? ________________________



Problem No. 11

Make an isometric drawing of this block. Questions to be answered about the working drawing on this sheet:

1. Which view shows that the notch is slanting? __________

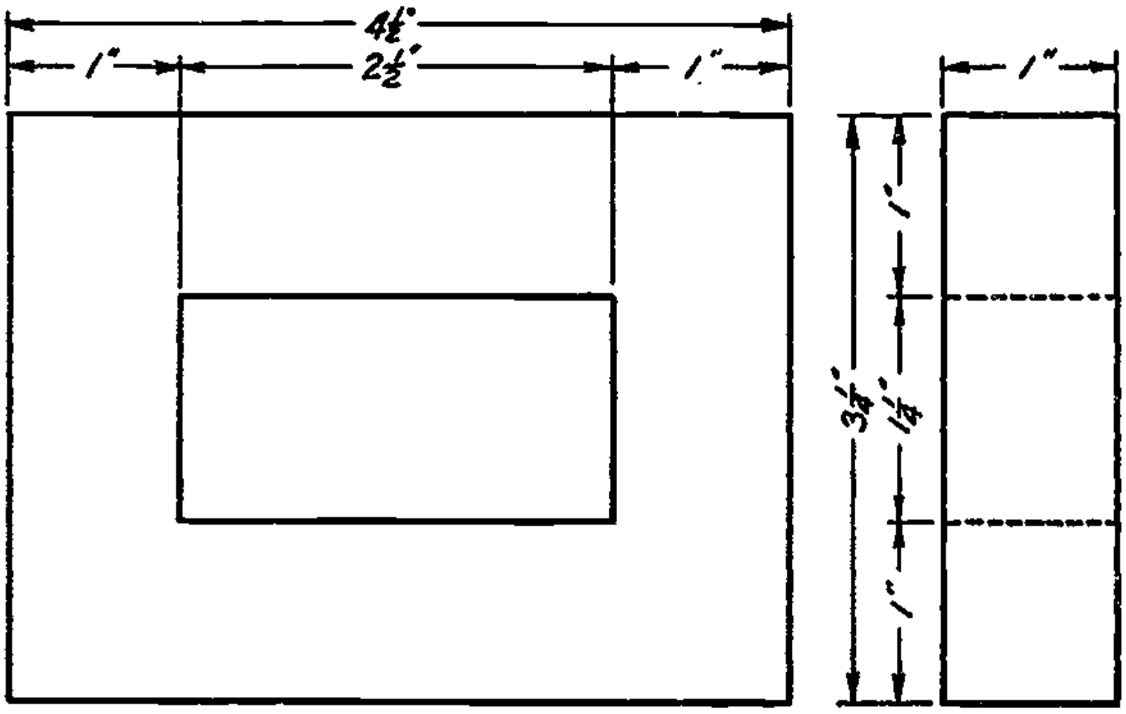
2. The lines on which the figures are placed are called ____________ lines.

3. The lines which extend out from the drawing in order to show exactly where the dimensions begin and end are called ______________ lines.

4. Arrow heads should always ______________ the extension lines.

5. The line between the enumerator and denominator of a fraction should be in line with the _____________ line.

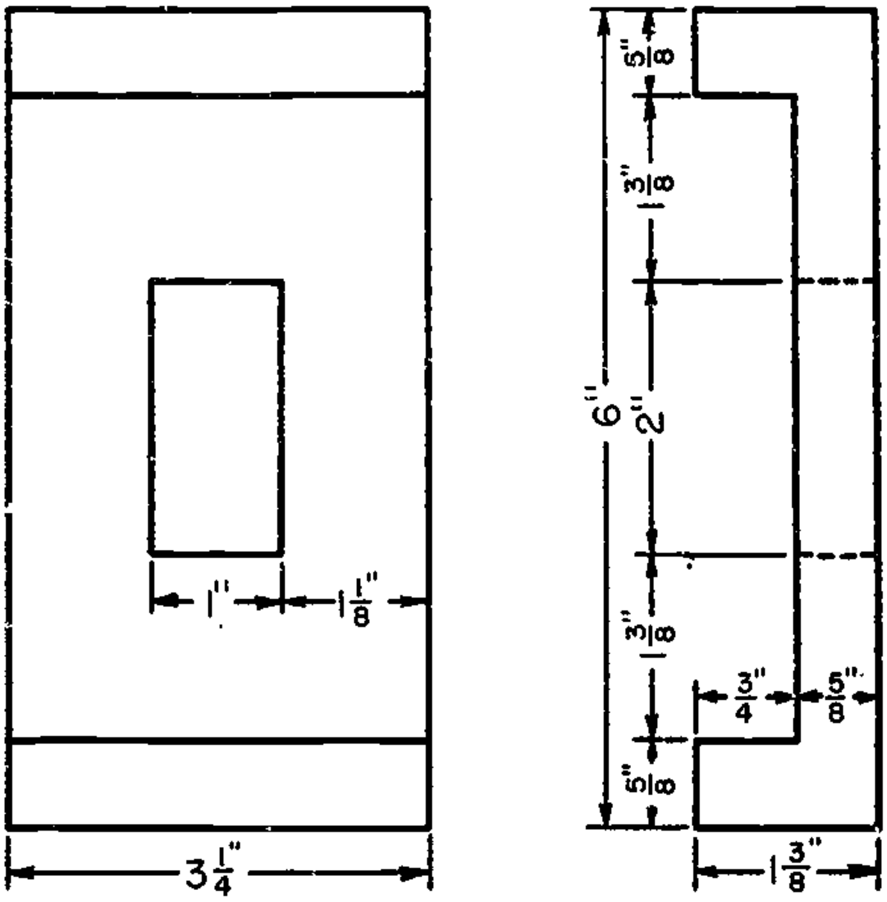
6. Would less than three views enable the workman to make this object? Why? ____________________________________



Problem No. 12

Make an isometric drawing of this block. Dimension the drawing. Questions to be answered about the working drawing on this sheet:

1. What are the dimensions of the piece cut out of this block?
   ____
2. Which view shows that the hole goes all of the way through?
   ____
3. What are the over-all dimensions of the block? ________ x ___________ x__________.
4. Which view shows the width of the block?
5. Do the two views give the workman enough information to make this block? ________________
6. Which view gives the better mental picture of the block?
   ____



Problem No. 13

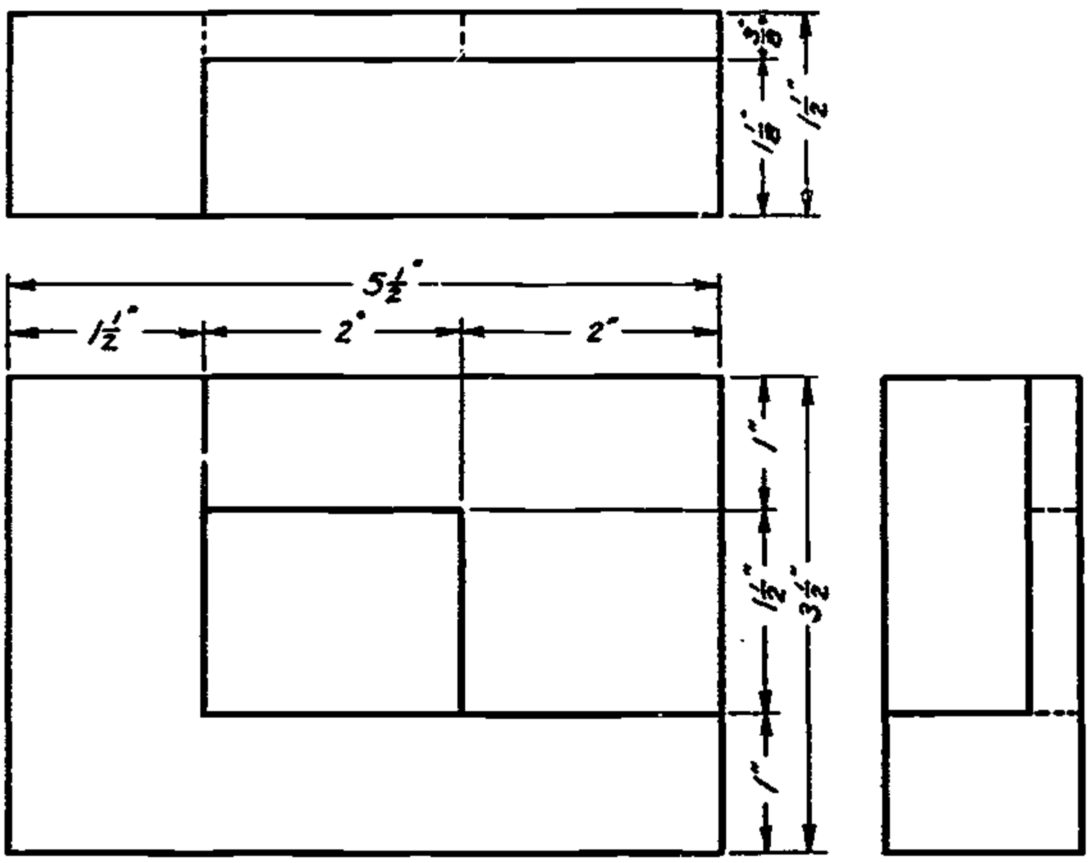
Make an isometric drawing of this section of channel iron. Dimension the drawing. Questions to be answered about the working drawing on this sheet:

1. How thick is the web of this channel iron? ____________
2. How thick are the flanges? ______________
3. What is the size of the hole cut in the web? __________
4. What is the distance from the bottom of the flange to the hole? ______________________
5. Which view shows that the hole goes all the way through the web? ______________________

Blueprint Reading

6. Which view shows better the shape of the object? ________

7. What information do engineers give to describe channel iron? ____________________



Problem No. 14

Make an isometric drawing of this block. Questions to be answered about the working drawing on this sheet:

1. What is the size of the material cut out of the small hole which goes entirely through the block? ____ x______ x____
2. Which two views show that the hole goes entirely through the block? ______________________
3. What are the over-all dimensions of the block?___________
4. What is the depth of the thinnest part of the block?
   ____
5. What is the distance from the bottom of the block up to the hole? ________________________
6. What is the size of the larger piece cut out of the block?
   ____

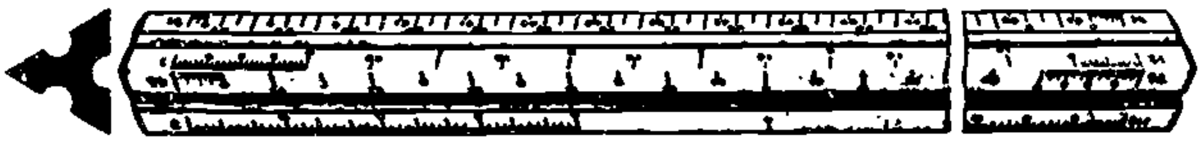
7. Measurements:

The draftsman makes measurements with a tool known as a scale. This resembles a rule with which the workman is familiar. The scale commonly used has three sides as is shown in Fig. 9. It will be noticed that the scale shown is known as an architect's scale divided into the following ratios: 3/32, 3/16, 1/8, 1/4, 3/8, 1/2, 3/4, 1, 1 1/2, and 3 inches to the foot. It also contains a full size scale of 12 inches and divided into sixteenths. This type scale is also available divided into tenths and is used in civil engineering work and is known as an engineer's scale.

Triangular Boxwood Scales

U. S. Standard. Made of Thoroughly Seasoned, Highest Quality Boxwood. Machine Divided.

WHITE CELLULOID FACED



Architect's Scale, 12-inch. Open divided: 3/32, 3/16, 1/8, 1/4, 3/8, 1/2, 3/4, 1, 1 1/2, 3 inches to the foot, 1/16-inch.

Engineer's Scale, 12-inch. Full divided: 10x20x30x40x50x60 parts to the inch.

Fig 9

A small object would always be drawn full size, that is, if the length of an object were four inches and the width two inches, the draftsman would make the drawing to the actual size. However, it is necessary generally to make the drawing smaller than the actual object. This is done for convenience and this reduction of an object so that it can be conveniently put on a certain size of paper is known as drawing an object to scale.

The foot usually is used as the basis in determining the scale to be used in laying out a drawing. If the scale is half size, it would be written 6" = 1' -0", or half-size; 1/4th size would be written 3" = 1' -0", etc. A scale of 3/4" = 1' -0" means that every three-quarters inch on the drawing represents one foot. A scale of 1/4" = 1' -0" means that every quarter-inch on the drawing equals one foot; a scale of 1/8" -1' -0" means that every eighth-inch on the drawing equals one foot. Nearly all architectural drawings are laid out on a scale of 1/4" = 1' -0". If the building is very large, this scale is 1/8" = 1' -0". Pump bases, engine houses, foundations, tank walks, and other objects will be drawn to scale, depending upon the size of the object and the size of the paper which the draftsman will have to use.

The student will find it worth his while to obtain a scale and examine it. On one side will be found a foot laid out in standard inches showing sixteenths. This, of course, is a full sized scale. It will be noticed that there are figures printed at the end of the scale. These will be found to be 3, 1 1/2, 1,. 3/4, 1/2, 3/8, 1/8, and 3/32. These figures mean that the scale so marked is divided into feet and that the unit marked on the end is taken as the foot. Take the end of the scale marked "3", and it can be seen that the unit is three inches, which is divided into twelve parts. Each one of these twelve parts is divided into eight parts. Thus, the smallest division on the scale 3" = 1'0" is 1/8th of an inch. If it is desired to measure off one foot on this scale, one would start at the zero mark and run to the point marked "1". Then if three inches were to be added to the foot, the three inches would be added out of the foot which is marked in feet and inches. Fig. 10, scale "A", will illustrate how this is done.

Scale "B" represents the scale, 1 1/2" = 1' -0". Here the measurement 2' -9 1/2" has been laid out. Here again the method of scaling was to start at the zero point and run to the 2' point and then returning to the zero point running 9 1/2" into the divided foot. It will be noted that on this scale 1" measures 1/8" on the full size scale. Many large details which the petroleum worker will read will be drawn to this scale and workman can easily scale these drawings by using an ordinary rule.

Scale "C" is scale 1" = 1'0", and the measurement 4' -4 3/4" has been set off. Scale "D" is the scale 3/4" = 1' -0", and here the measurement 6' -10" has been set off. It will be noticed that the 1" division on this scale is equal to the 1/16" on a full sized scale or the workman's rule. This scale is also used very often on details and such blueprints are easily scaled by using an ordinary rule.

Scale "E" is the scale 1/2" = 1' -0" and the measurement 9' -7 1/2" has been laid off. The next scale on Fig. 10 is the scale 1/4" = 1' -0", and it should be remembered that this is the one to which most architectural and mechanical blueprints are made. On this scale the measurements 20' -6" has been laid off. The last scale in Fig. 10, scale "G", is used for large buildings or any large object in order to use paper of standardized size. Scale "G" shows how 31' -8" would be laid off at the scale of 1/8" = 1' -0".

Each side of the scale is used for two different sized scales. It should be noted that one is just half the other in each case, and this should be remembered in using the scale in order to avoid errors.

In laying out work, the written dimension should be followed. For example, if you find that the length of a pump base details five feet and seven inches but has a written dimension of six feet and seven inches, make that pump base six feet and seven inches long. You will find the following sentence inserted after each set of specifications: "Where figures are given they are to be followed in preference to measurement by scale." Sometimes the scale is actually shown on the drawing. Where this is done the workman uses it exactly as you would a regular scale.

8. Taking Information off Blueprints:

Many symbols are used on drawings to indicate the kind of finish, kind of material, kind of thread, etc. The draftsman can write the symbol and give the needed information in a very small space where a large space and more time would be required if the information were written out. Fig. 11 gives a few of the common notes and symbols used by the draftsman. The symbol F.A.O. is used when the draftsman wishes to tell the machinist that the machine part being detailed is to be finished all over. Therefore, F.A.O. means finished all over. The student will find many of the symbols and notes shown in Fig. 11 on the problems and blueprints to be presented later in this study.

Problem No. 15

Problem 15 is a working drawing for a rectangular steel face plate. The working drawing shows a front and right side view. The front view shows that there are six 1" holes drilled in the plate; that these holes are centered 2" on either side of the horizontal center line; that two holes are drilled on the vertical center line and the other holes are centered four inches on either side of the vertical center line. The right side view shows that the plate is three-quarters inch thick, and the dotted lines in the right side view show that the holes go all the way through the plate.

The student should first study the drawing, read all notes, and form a mental picture of the object. If this is done he will then be able to proceed to answer the questions about the problem.

SYMBOLS

F.A.O.	FINISH ALL OVER	C.I.	CAST IRON
f	FINISH	C.R.S.	COLD ROLLED STEEL
CT BORE	COUNTER BORE	℄	CENTER LINE
R	RADIUS	O.C.	ON CENTERS
U.S.S.	UNITED STATES STANDARD	P TAP	PIPE TAP
		L.H.	LEFT HAND
S.A.E.	SOCIETY OF AUTOMOTIVE ENGINEERS	CSK	COUNTERSUNK
		P	PITCH
O.S.M.	OUTSIDE MEASUREMENT	▨	CAST IRON
		▨	STEEL

Fig.11

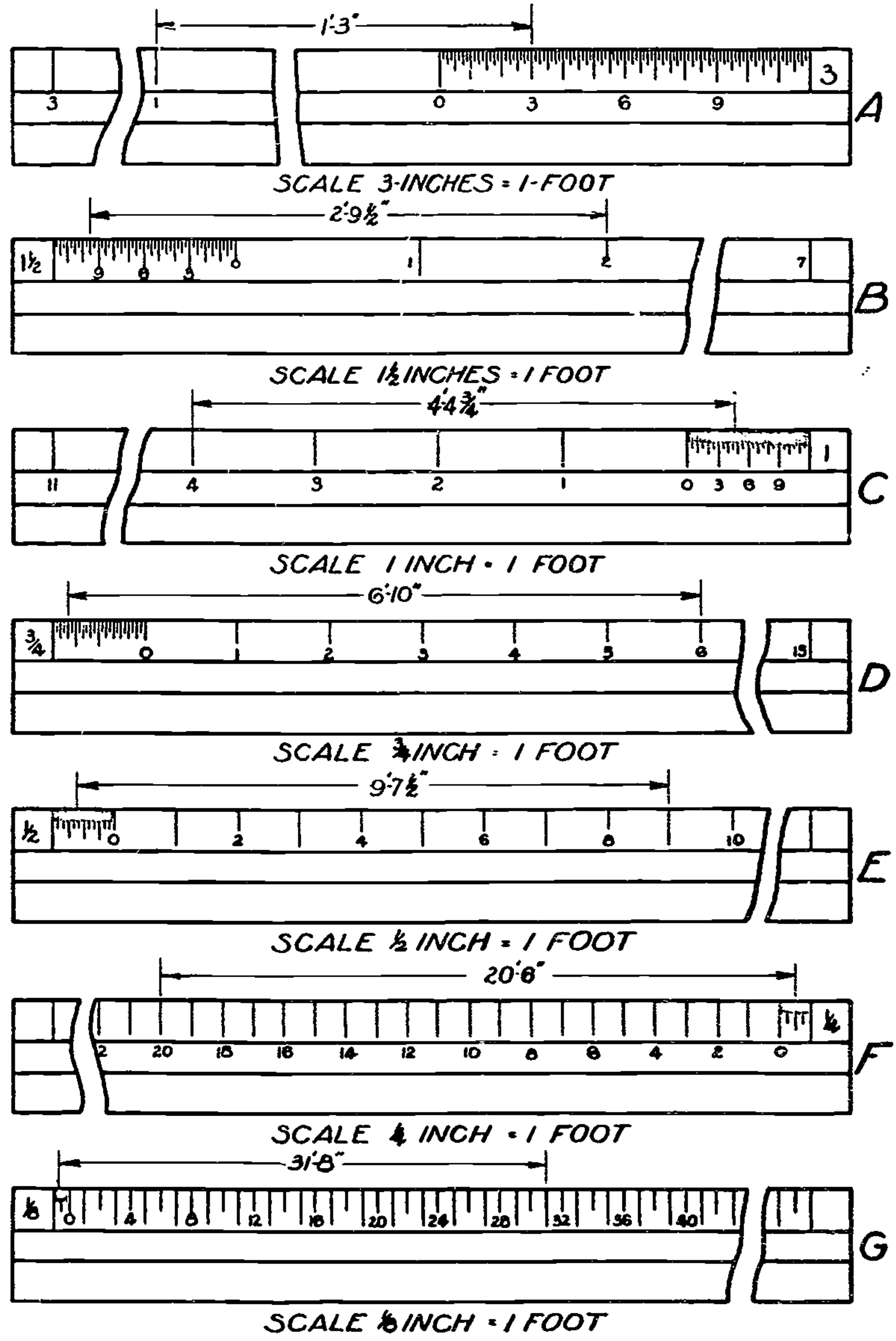
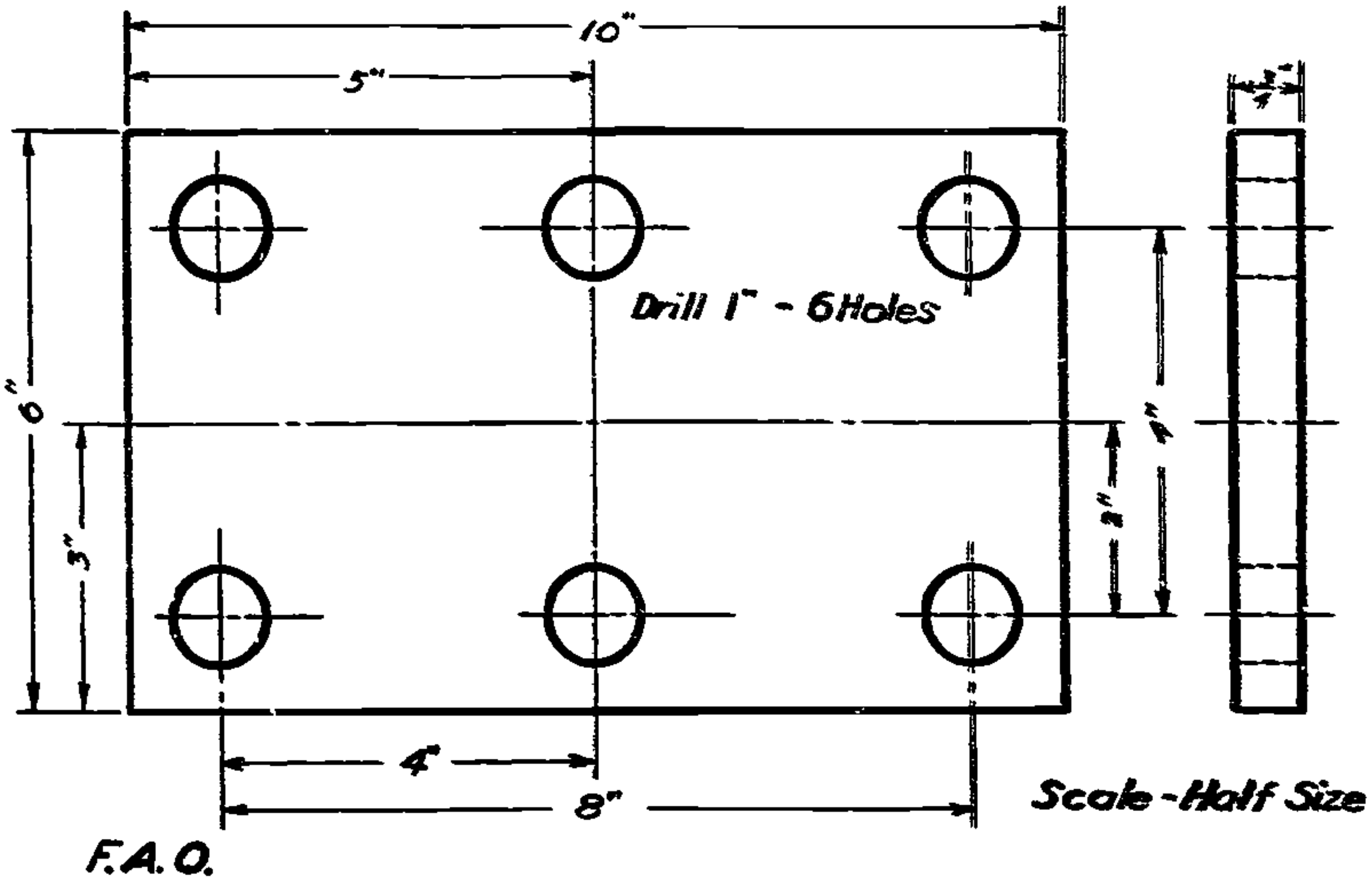
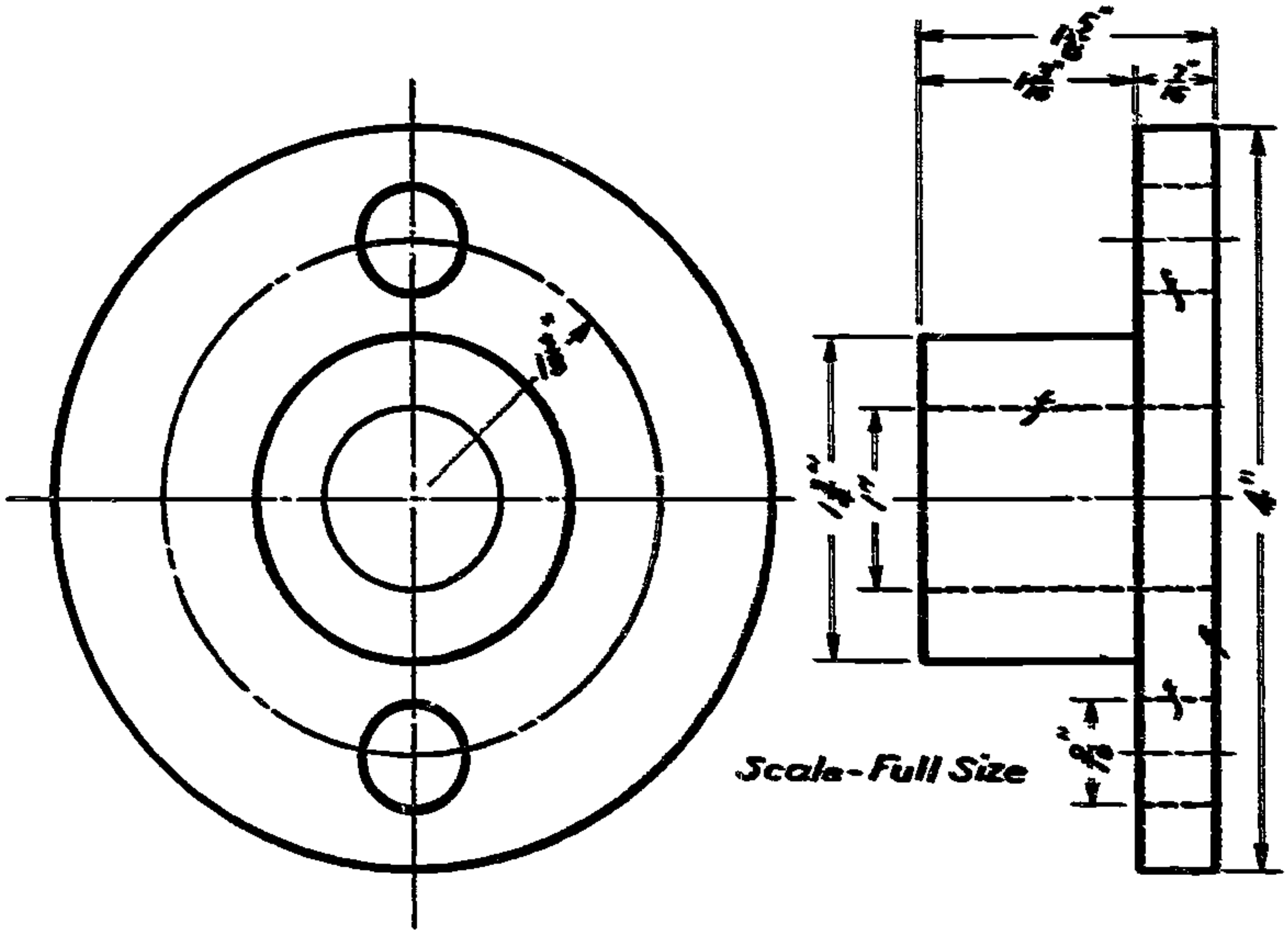

1'-3"
3
3 1 0 3 6 9
A
SCALE 3-INCHES = 1-FOOT
2'-9½"
1½
9 6 3 0 1 2 7
B
SCALE 1½ INCHES = 1 FOOT
4'-4¾"
1
11 4 3 2 1 0 3 6 9
C
SCALE 1 INCH = 1 FOOT
6'-10"
¾
0 1 2 3 4 5 6 15
D
SCALE ¾ INCH = 1 FOOT
9'-7½"
½
0 2 4 6 8 10
E
SCALE ½ INCH = 1 FOOT
20'-6"
¼
22 20 18 16 14 12 10 8 6 4 2 0
F
SCALE ¼ INCH = 1 FOOT
31'-8"
⅛
0 4 8 12 16 20 24 28 32 36 40
G
SCALE ⅛ INCH = 1 FOOT

FIGURE 10



PROBLEM 15



PROBLEM 16

Questions to be answered about problem No. 15:

1. What is the size of the holes drilled in the plate?

    ____

2. Do these holes go all the way through the plate? _______
3. What is the height of the plate? _____________
4. What is the width of the plate? ______________
5. What is the depth of the plate? ____________
6. What is the vertical distance between the center lines of the holes?
7. What is the horizontal distance between the center of a center hole and the center of either outside hole?_______
8. What is the distance between the center of the holes and the edge of the plate? _________________
9. What parts of the plate are to be finished? ____________

Problem No. 16

Problem 16 is a working drawing for a packing gland. A pattern is to be made from which a casting is poured. The surfaces marked "f" must be machined reasonably accurately. The two small holes are to be drilled through the casting and the radius of the circle on which they are located is given.

Questions to be answered about Problem No. 16:

1. What is the size of the center hole? _______________
2. What is the length of the center hole? _____________
3. What is the size of the bolt holes? _______________
4. How far are the bolt hole centers from the center of the bore? ___________________
5. What is the largest over-all measurement of the gland base?

    ____

6. How deep is the base? ______________________
7. How many surfaces are to be finished? _____________
8. To what scale was this drawing made?

Problem No. 17

Problem 17 is a working drawing for a bearing. It also is made from a casting and certain parts of it are to be finished while others may be left as the casting comes from the mold. The center of the bearing must be located an exact distance above the bottom of the base. The bolt holes must be located accurately and also must be located by center lines as the outside edges of the casting aren't to be finished and won't be true.

Questions to be answered about Problem No. 17:

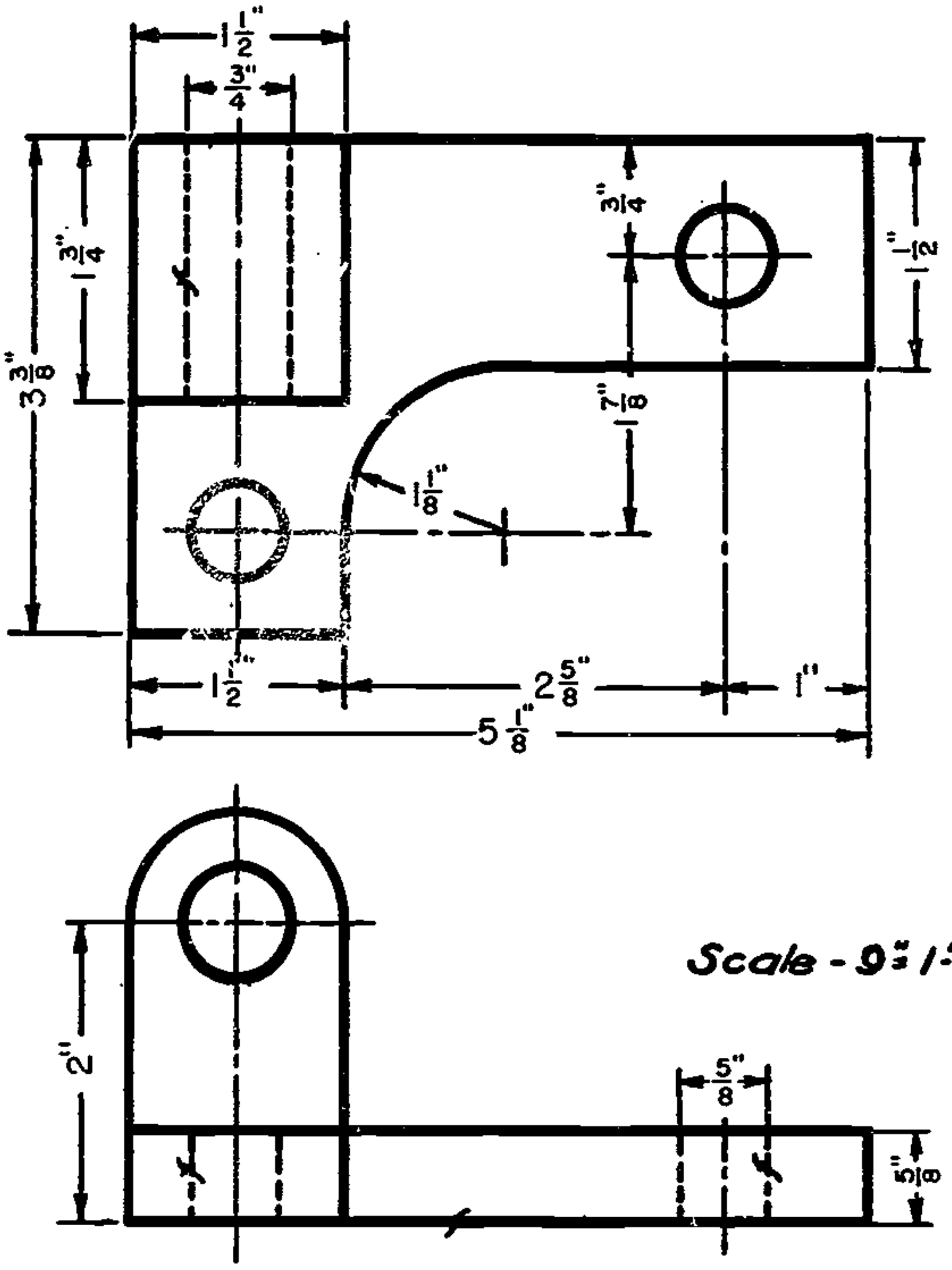
1. What are the over-all measurements of the bearing base? ____________________
2. How high is the bearing base? ____________________
3. The bearing is for what size shaft? ____________________
4. How long is the bearing? ____________________
5. How far is center of shaft above bottom of base? __________
6. How many bolt holes are there? ____________________
7. Bolt holes are what size? ____________________
8. How are the bolt holes located? ____________________
9. How many surfaces are to be finished? ____________________

Problem No. 18

Problem 18 is a working drawing for a round cover. It is also a casting and must be machined to fit the end of a pump cylinder. Other parts of the casting may remain as it comes from the mold.

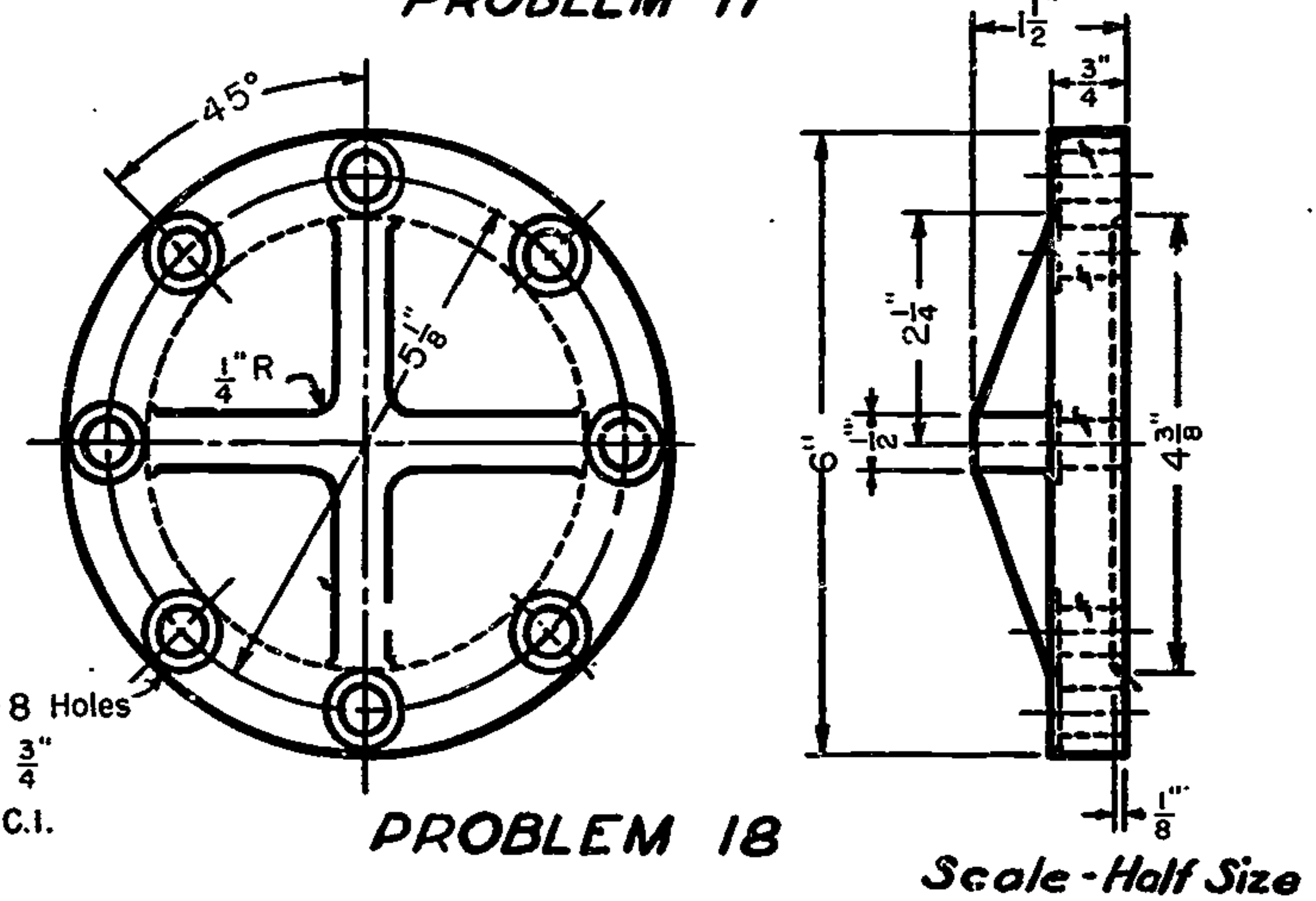
Questions to be answered about problem No. 18:

1. What is the depth of the rim of the cover? __________
2. What is the depth of the cover over the ribs? __________
3. How wide are the ribs? ____________________
4. What is the diameter of the holes? ____________________
5. What is the angle between the holes? ____________________
6. How many holes are there? ____________________



Scale - 9" = 1'-0"

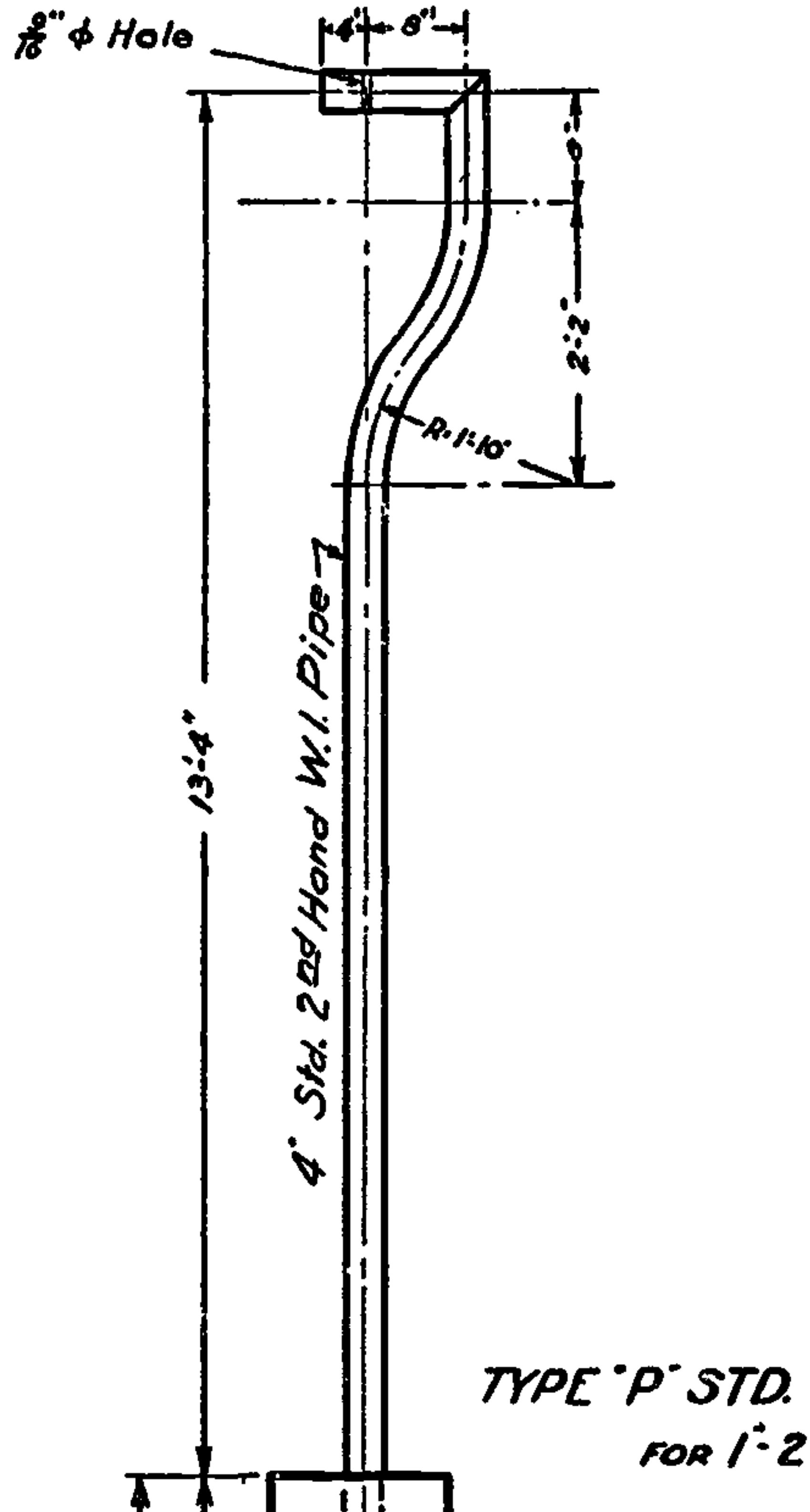
PROBLEM 17



Drill 7/16" - 8 Holes
Spotface 3/4"
Material C.I.

PROBLEM 18

Scale - Half Size



TYPE "P" STD. PIPE SUPPORT
FOR 1"-2" OR 3" LINE

PROBLEM 19

7. What is the size of the spotface? ____________________

8. What is the depth of the recess in the bottom of the cover? ____________________

9. What is the diameter of the recess? ____________________

10. What is diameter of the bolt circle? ____________________

11. What parts of the cover are to be finished? ____________________

12. Of what material is the cover made? ____________________

13. What is the outside diameter of the cover? ____________________

14. How thick is the cover inside the recess, not including the ribs? ____________________

Problem No. 19

Problem 19 is a working drawing of a standard pipe support. The height of the pipe support may be changed to meet the needs of a particular job, but all other dimensions are to remain the same. It will be noticed that this support is made to carry three sizes of pipe line. There are two symbols used on this drawing which should be noted. The hole drilled through the top end is noted with a symbol which means that it is to be a round hole and the note pointing to the bottom of the pipe uses the symbol for "plate," instead of spelling out the word.

Questions to be answered about Problem No. 19:

1. What is the height of concrete footing? ____________________

2. What is width and depth of concrete footing? ____________________

3. How far does pipe extend into concrete? ____________________

4. What mix is used for the footing? ____________________

5. What size plate is welded to bottom of pipe? ____________________

6. What size hole is drilled through top end of pipe? ____________________

7. How far is the center of the hole from the end of the pipe? ____________________

8. How much is pipe offset? ____________________

9. What is height of horizontal section of pipe above concrete footing? ____________________

10. What kind of pipe is to be used in making the pipe support? ____________________

11. What size lines will this support carry? __________

12. What is radius of curve in offset? __________

Problem No. 20

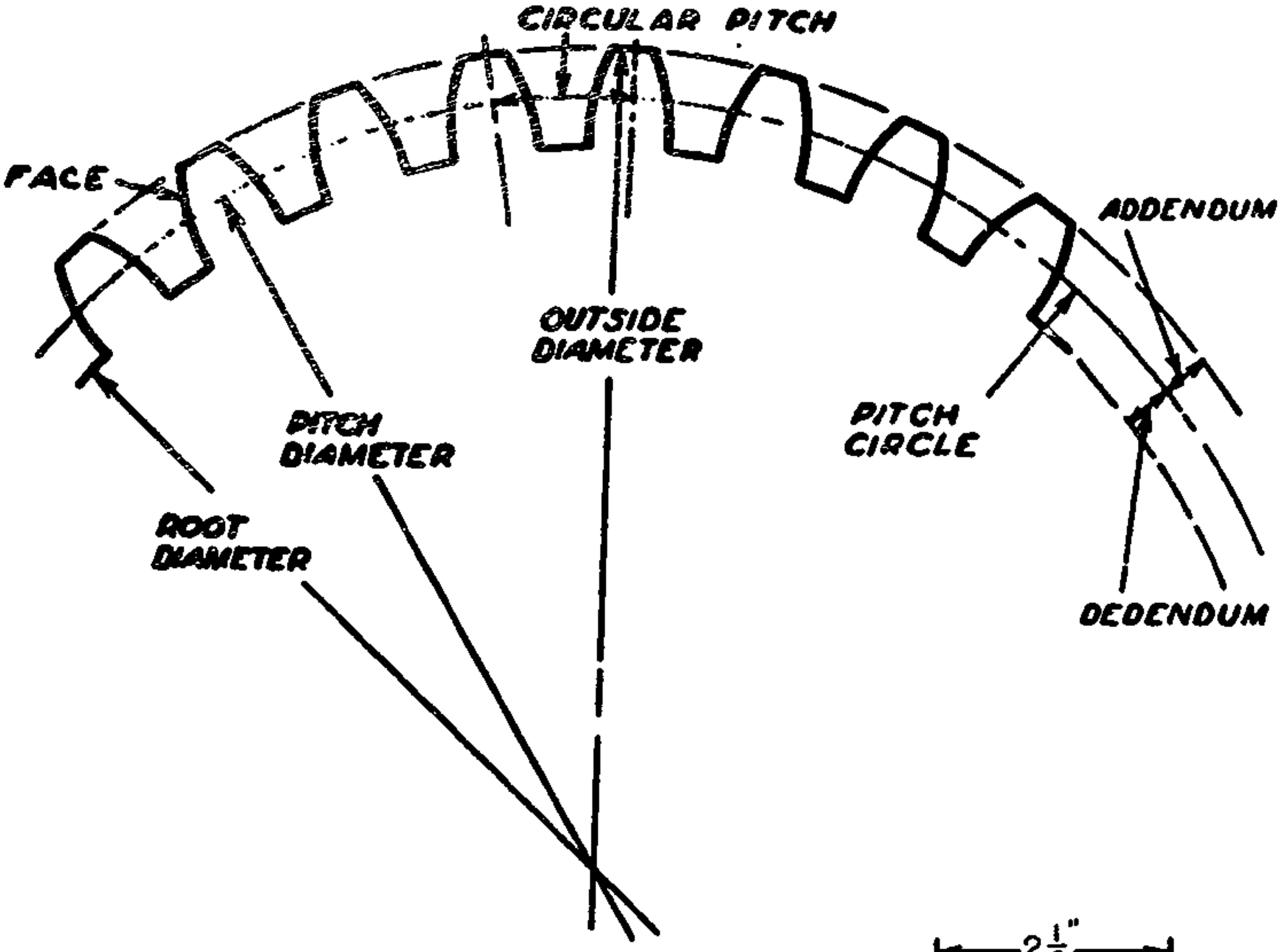
Problem 20 is a working drawing of a gear. The petroleum worker should be familiar with gears as they are used in practically every machine in any industry. Some of the terms used in gear design will be of very little value to the petroleum worker, but if he is not already familiar with the different gear parts it would be well to study Problem 20 for a short time. The diagram at the top of Problem 20 gives the names of the parts of the gear. The working drawing at the lower part of the sheet shows a front and side view of a gear. The gear is designed to fit a certain size shaft as given in the note and the accuracy required for the bore is noted immediately after the diameter of the bore. The machinist who makes this gear knows how much he is allowed to vary from the specified bore, or, in other words, he knows what tolerance is allowed. Such terms as addendum, dedendum and circular pitch are of interest to the experienced machinist and pattern maker.

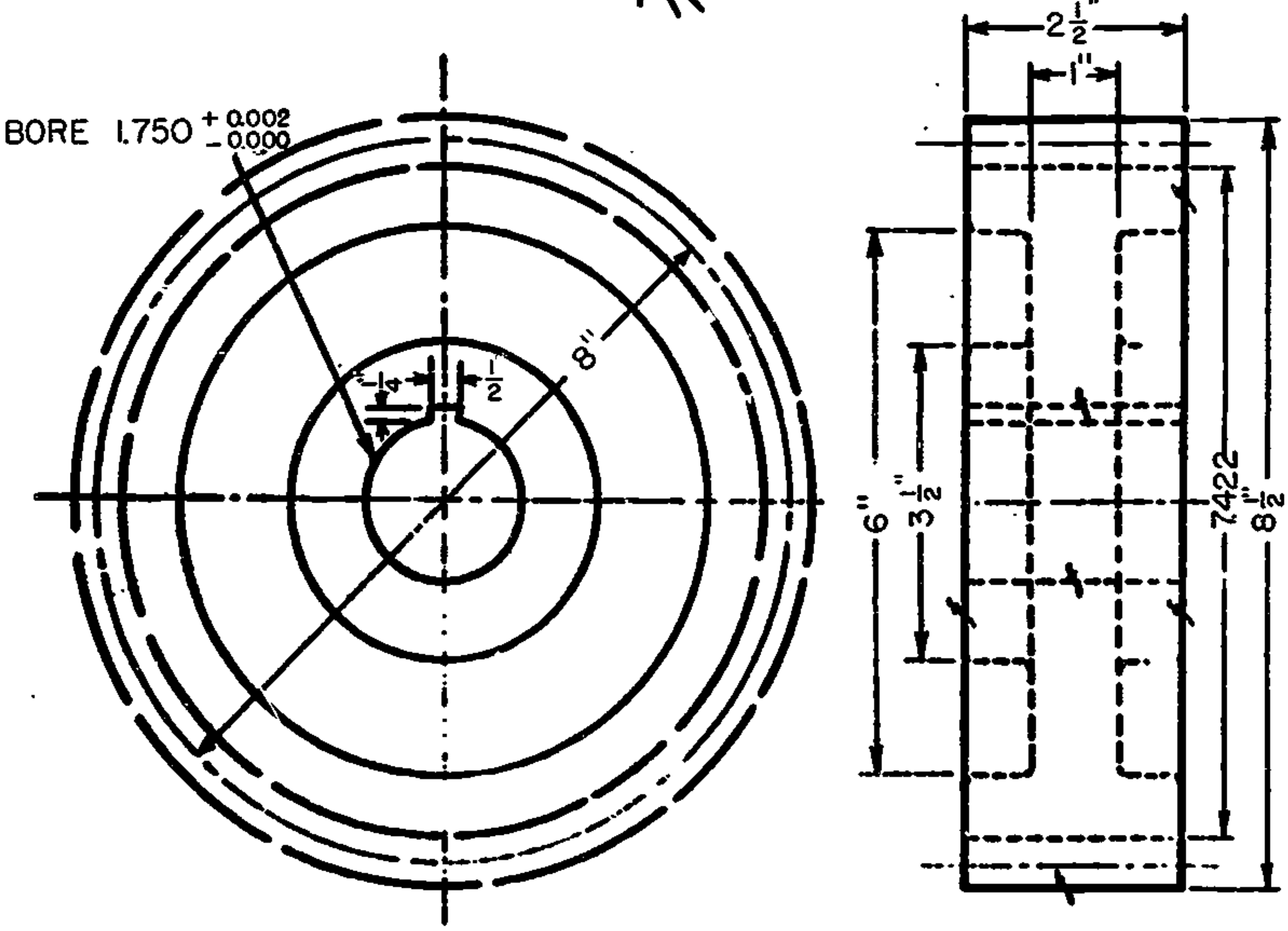
Questions to be answered about Problem No. 20

1. What is the outside diameter of the gear? __________
2. What is the root diameter? __________
3. What is the diameter of the pitch circle? __________
4. What is the width of the face of the gear? __________
5. What is the size of the bore? __________
6. How much tolerance is allowed? __________
7. What size keyway is to be cut? __________
8. What is the diameter of the hub? __________
9. What is the thickness of the web? __________
10. What is the addendum (figure this)? __________

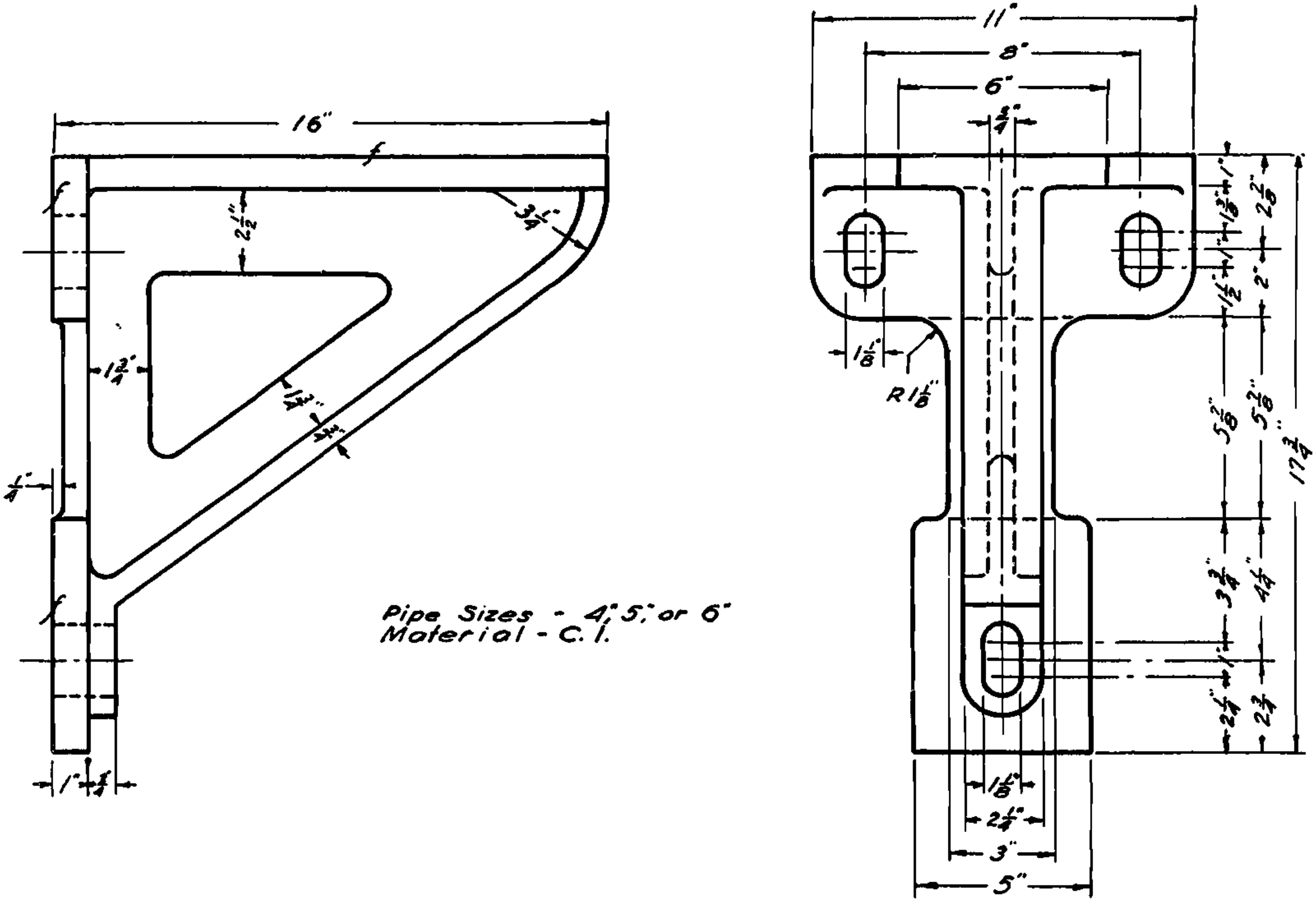
Problem No. 21

Problem 21 is a working drawing for a pipe bracket. The bracket is to be bolted to a wall and a bronze shoe or roller attached to the upper flange so as to provide a support for pipe carrying hot liquids and gases. The roller or shoe allows


CIRCULAR PITCH
FACE
ADDENDUM
OUTSIDE DIAMETER
PITCH DIAMETER
PITCH CIRCLE
ROOT DIAMETER
DEDENDUM

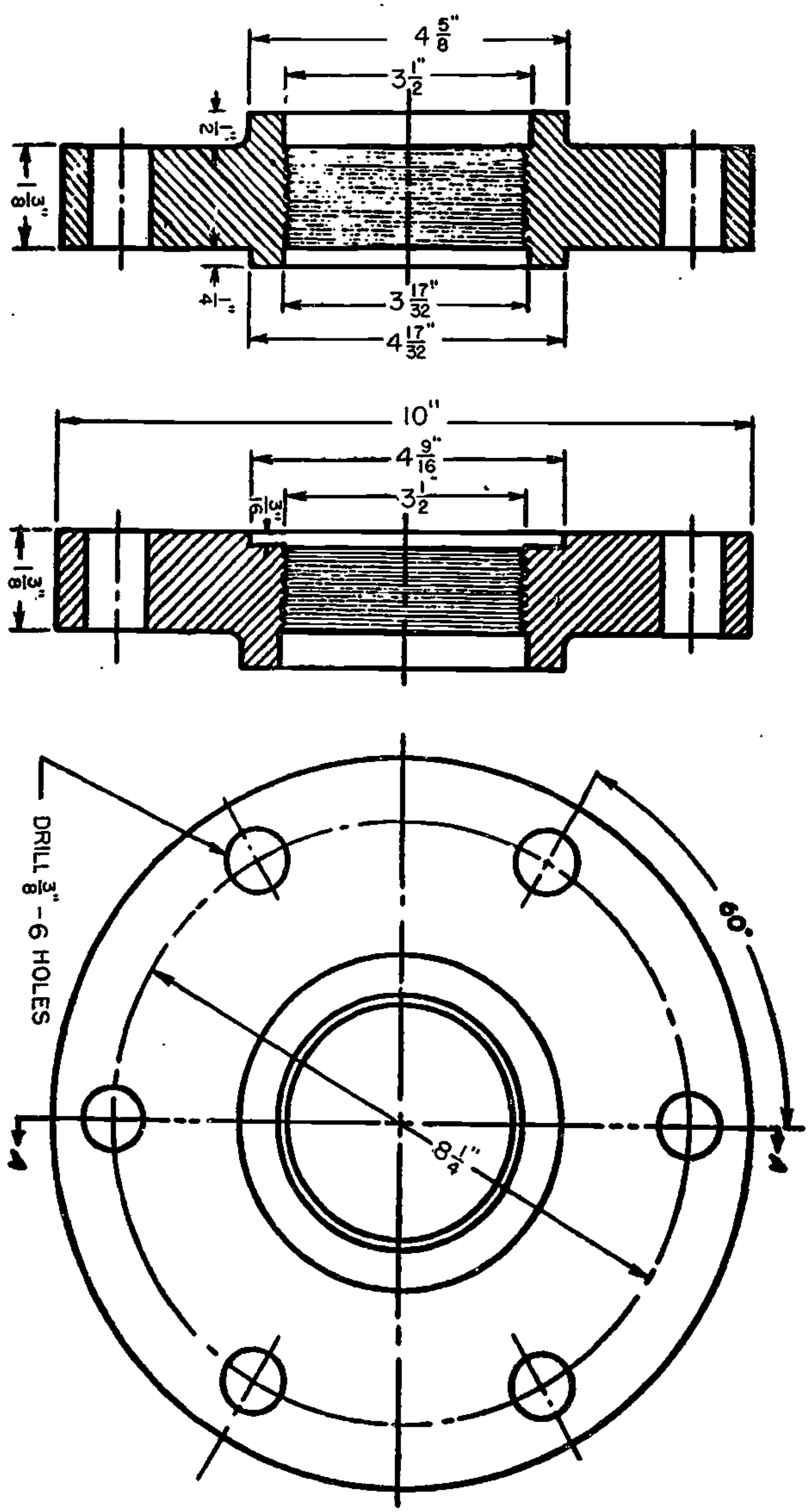

BORE 1.750 +0.002 −0.000
1/4
1/2
8"
2 1/2"
1"
6"
3 1/2"
7422
8 1/2"

PROBLEM 20

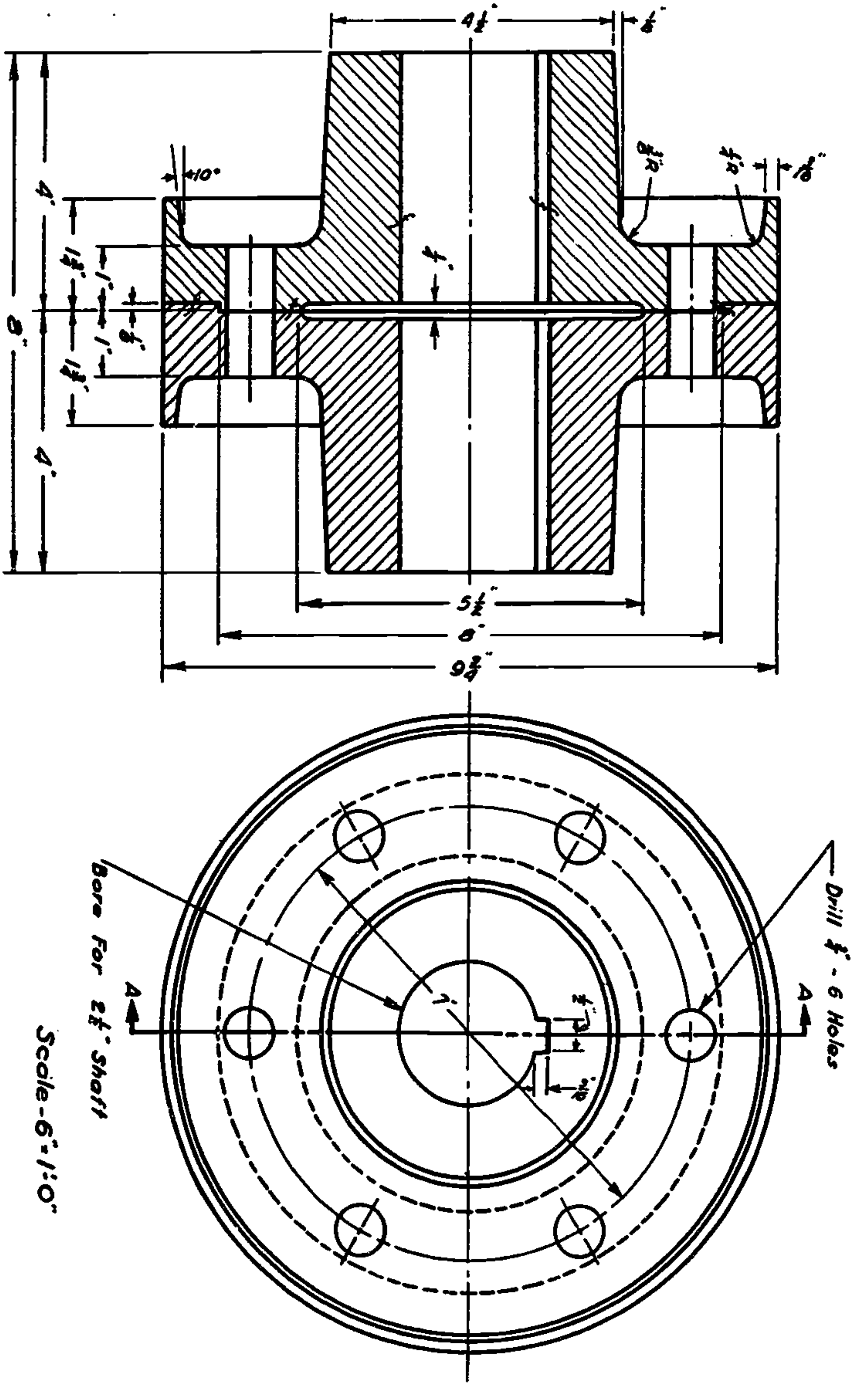


Pipe Sizes - 4", 5", or 6"
Material - C.I.

PROBLEM 21


4 5/8"
3 1/2"
1/2"
1 3/8"
1/4"
3 17/32"
4 17/32"
10"
4 9/16"
3 1/2"
3/16"
1 3/8"
DRILL 3/8" - 6 HOLES
60°
8 1/4"

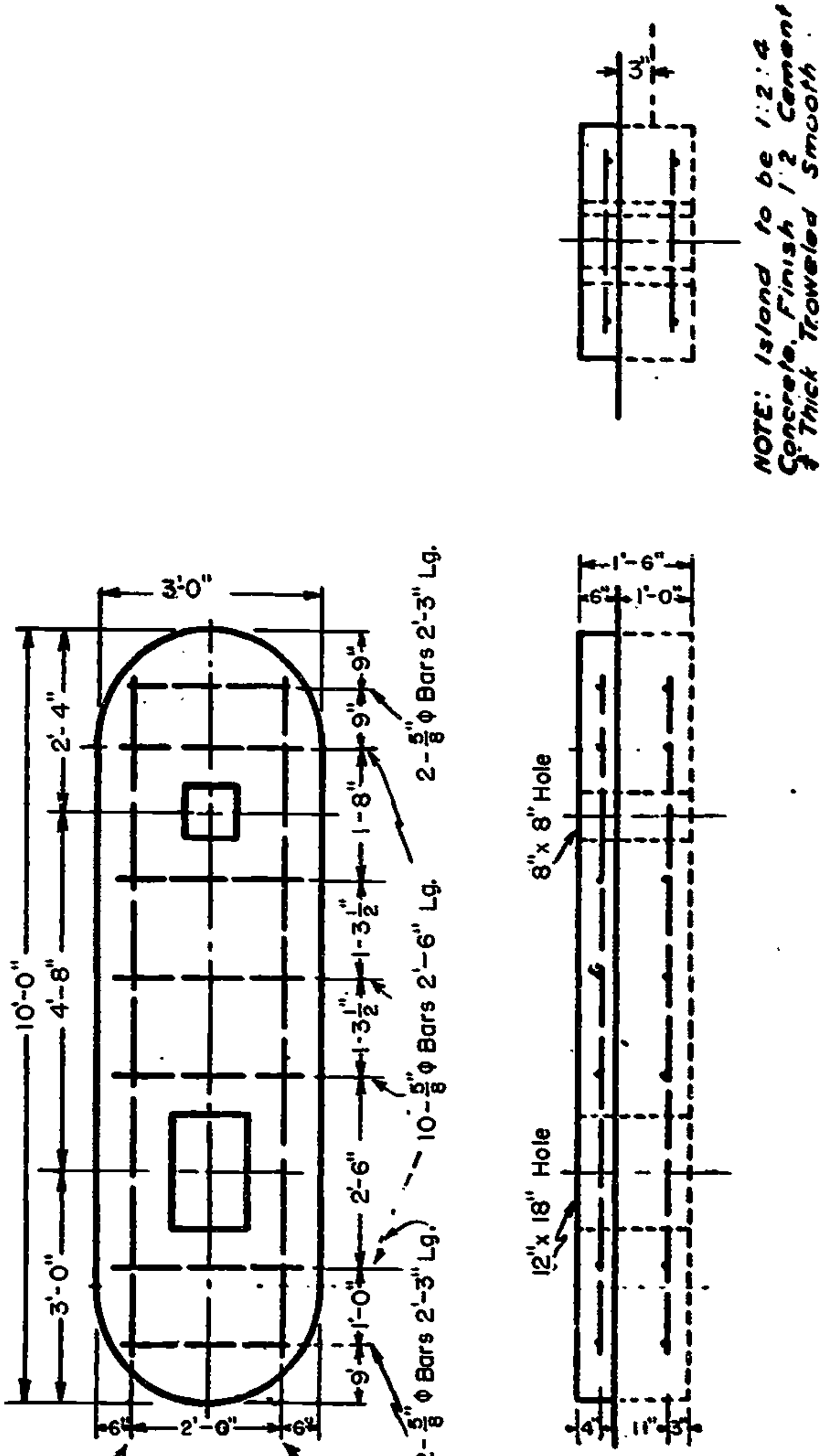
PROBLEM 22



SEC. A-A

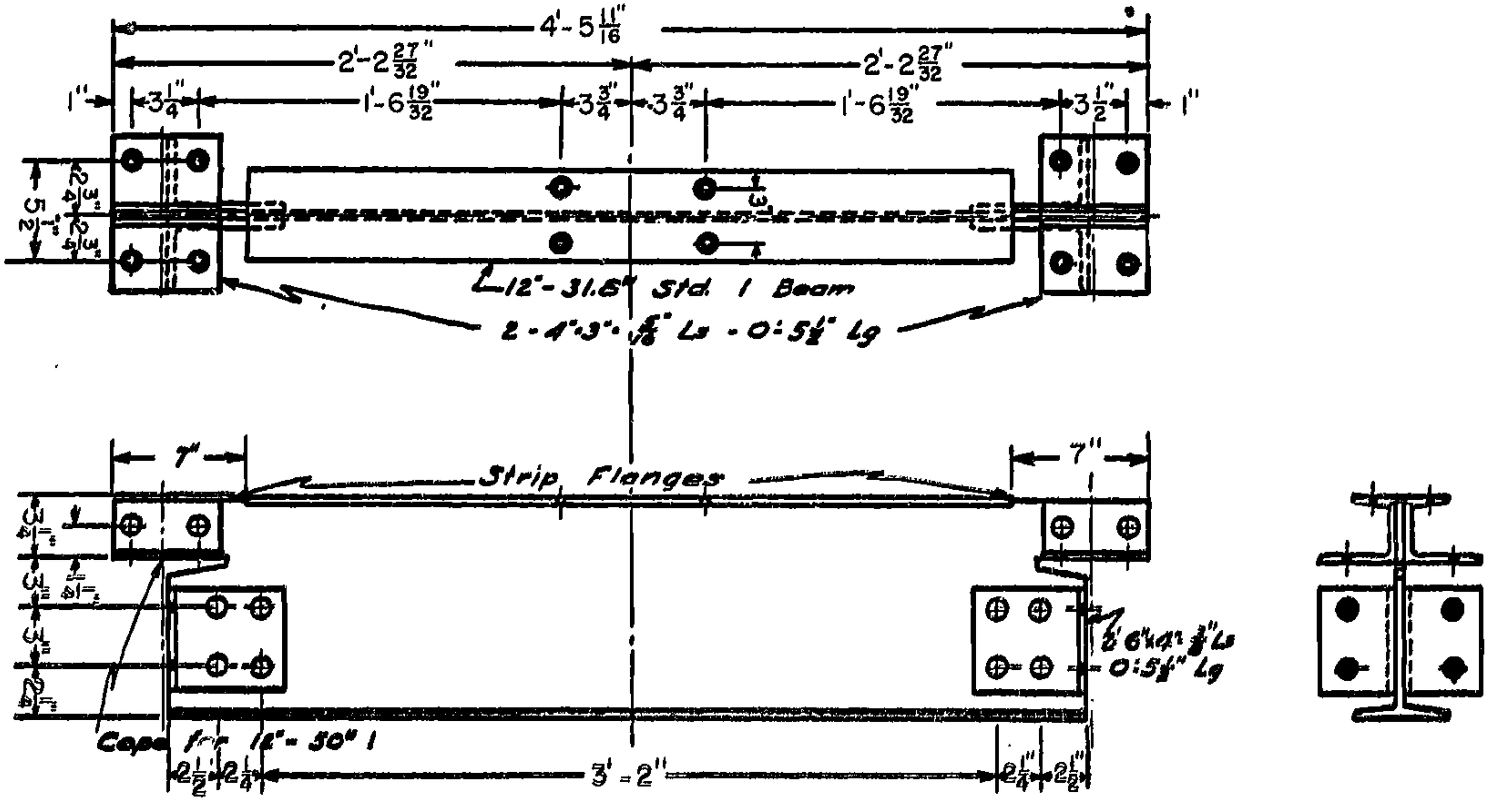
PROBLEM 23

Scale-6"=1'-0"



NOTE: Island to be 1:2:4 Concrete, Finish 1:2 Cement ¾" Thick Troweled Smooth.

PROBLEM 24



NOTE: All Holes 13/16" ⌀
All Rivets 3/4" ⌀

PROBLEM 25

movement of the pipe due to contraction or expansion as the pipes become hot or are allowed to cool. The slotted holes in the bracket permit adjustment so that the bracket may be raised or lowered in order to straighten the pipe line.

Questions to be answered about Problem No. 21:

1. The bracket is designed to carry what size pipe? __________
2. Of what material is the bracket made? _______________
3. What is the width of the slotted holes? _______________
4. What is the length of slotted holes? _______________
5. What is the distance from the top of the bracket to the center of the top slotted hole? _______________
6. What is the distance from the top of the bracket to the center of the lower slotted hole?
7. What is the thickness of the material through which the upper slotted holes are cut? _______________
8. What is the thickness of the material through which the lower slotted hole is cut? _______________
9. What is the thickness of the top flange? _______________
10. What is the width of the top flange? _______________
11. How far does bracket extend out from wall? ____________
12. What is height of the bracket? _______________
13. What is thickness of web reinforcing? _______________
14. What is width of web reinforcing along bottom side of top flange? _______________
15. What is width of web reinforcing along back flange and diagonal flange? _______________
16. What is width of back flange at the top? _______________
17. What is width of lower part of back flange? ____________
18. What is width of middle part of back flange? ____________
19. How thick is back flange at the middle section? __________
20. How wide is the diagonal flange? _______________

Problem No. 22

Problem 22 is a working drawing for a pair of standard pipe line flanges. The drawing consists of a front view which will apply to either flanges and to sectional views of both flanges. These flanges are Standard Pipe Line and the measurements do not apply to American Hydraulic flanges. They are flanges for three-inch pipe. Note that the two flanges are made in pairs so as to fit together.

Questions to be answered about Problem No. 22:

1. What is the diameter of the bolt circle? ____________
2. What is the diameter of the bolt holes? ____________
3. The holes are spaced how many degrees apart? __________
4. How many bolts will be required per pair of flanges? _____
5. What is the outside diameter of the flanges? ___________
6. What is the thickness of the flanges at the points where the bolts go through? __________________
7. How deep is the recess on the face of the right-hand flange? _________________________
8. What is the diameter of the recess? _______________
9. How long is the extended part on the other flange which fits in the recess? ____________________
10. What is the outside diameter of the extended part? _____
11. When assembled, how much clearance will there be between the two flanges? __________________
12. When the two flanges are bolted together, how much space will there be between the two flanges where the bolts are? __________________

Problem No. 23

Problem 23 is a working drawing for a flanged shaft coupling. The two parts are made in pairs so as to fit together. The working drawing consists of a right side view and a front view which is in section. The flanges are keyed to the ends of the shafts and then bolted together.

Questions to be answered about Problem No. 23:

1. The coupling is for what size shaft? _______________
2. What size keyway is to be cut? _______________

3. What is diameter of bolt circle? ____________________

4. What size holes are to be drilled for the bolts? ________

5. What is depth of recess in each part of coupling? ________

6. What is diameter of this recess? ________________

7. What is diameter of hub? __________________

8. What is measurement over both flanges after they are assembled? ______________________

9. What is the width of flange of the right-hand piece of the coupling? __________________

10. What is the width of flange of the left-hand piece of the coupling? __________________

11. How thick is the flange at the outer edge? _____________

12. At what angle does inner side of flange taper back to web? _______________________

13. What is over-all length of the coupling? _______________

14. What is the difference in diameter of the hub at the outer edge and the diameter of the hub next to the web? _______ ___________________

15. What is the thickness of the web of each part of the coupling at the points where the bolts go through? _________________

16. How many surfaces are to be finished? _____________________

Problem No. 24

Problem 24 is a working drawing for an island to be built in a filling station driveway to receive gasoline pumps, and water and air connections. The great numbers of filling stations that have been built and that are being built have caused more or less standardization of filling station design and accessories. Each oil company decides on a standard design for its own filling stations. Problem 24 is a design for a ten-foot island. The symbol used in giving the sizes of the reinforcing bars should be noticed. This symbol, as has been pointed out before, stands for the word "round," thus, as it is used in this case it indicates that round reinforcing bars are used. If square bars had been used, the circular part of the symbol would have been replaced by a small square.

Questions to be answered about Problem No. 24:

1. What is the width of the island? ____________________

2. What is height of the top of the island above the driveway? ____________________

3. How thick is the concrete in the island? ________________

4. What concrete mix is to be used? ____________________

5. What kind of finish is to be put on the concrete? __________ ________________________

6. How far is the lower layer of reinforcing bars to be placed above the bottom of the foundation? ____________________

7. How far is the top layer of bars to be placed below the top of the concrete? ____

8. How many different lengths of bars are required? _________

9. Make a list of all reinforcing bars required. ___________
____
____

10. What are the sizes of the holes running through the concrete?
____

11. What is the measurement between these holes center to center?
____

12. Make a freehand three-view sketch of the island, giving all the information that one would need to actually lay out and build the island.

Problem No. 25

Problem 25 is a working drawing for the fabrication of a structural steel cross-member to be used in a Dubbs Still Cleaner. The crossmember is a I-beam and fastened in place by means of angle irons. The symbol for angle iron will be noticed as well as the symbol for round holes as has been pointed out previously. The small circles indicate rivets and the circles which have been filled in with ink represent open holes.

Questions to be answered about Problem No. 25:

1. What length I-beam is required? ____________________

2. What is the weight of the I-beam per foot? ______________

3. What is the size of all holes? ________________________

Blueprint Reading

4. What size rivets are used? ____________________

5. How many holes must be punched in the I-beam? ________

6. The I-beam is to be coped to fit what size I-beam? _____ ________________

7. How many different sizes of angle irons are required? ______________________

8. The wide flange of each of the larger angle irons is fastened to the web of the I-beam with how many rivets? _____ ________________

9. What is the distance center to center between the open holes of the small angle irons measured lengthwise with the beam? __________________________

10. What is the distance between the open holes of the small angle irons measured across the I-beam center to center? ____________________________

PART II

PIPE LAYOUT

DEFINITIONS

Fabrication--To build up from parts, to forge

Complicated--Difficult to understand; many parts closely combined

Well-Versed--Well-read; know the meaning of

Templet--Pattern of shape to be cut

Centerline--A line used in blueprints denoting the center of holes, parts, etc. It is a line made up of long and short dashes — – —

Angle--A measure of the amount of turning to get around a corner. An angle is given degrees.

Diameter--Longest possible distance from one side of a circle to the other.

Horizontal--Parallel to the horizon or on a level

Circumference--the distance around a circle

Segment--Part of a whole

Compass--Instrument used in drafting to draw a circle

Perpendicular--a line is said to be perpendicular when it intersects a second line at ninety degrees

Base line--bottom line of a drawing; line representing base plane

Intersects--crosses

Slant line--slope line

Points--places or locations

Intersections--Crossings

Originating--beginning or starting place

Parallel--Two lines are said to be parallel when they are side by side, and will never cross regardless of the distance they are extended

O.D.--Outside Diameter   I.D.--Inside Diameter

Technique--Way or method of performing an operation or job

Friction--The resistance to relative motion between two bodies in contact

Elevation--Height from some known point or the view of a blueprint showing the heights of the object.

Turbulence--a swirling, turning, moving mass of gas or liquid

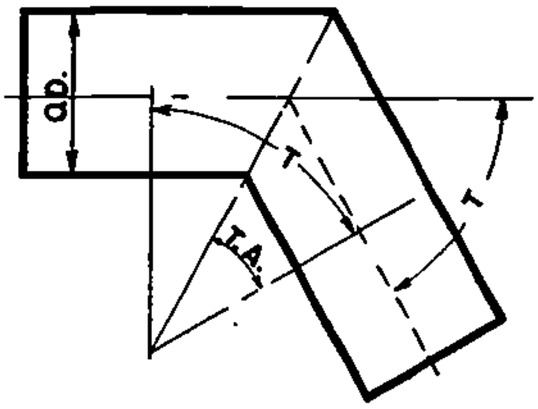
Job 1

Many fittings of varied shapes are needed in the fabrication of complicated piping systems. By the time the student has reached this point in the course, he has become familiar with most of the welding fittings available from the pipe supply houses.

There are often needs for the shop fabrication of connections between pipes and fitting for changing the size or direction of a run of pipe. The well-versed pipe man should know how to draw templets to be used in the shop as patterns for cutting pipe and and shaping it into the desired form.

This section of the text will be devoted to giving the student a sound understanding of how the various templets are developed.

The first problem which will be considered is the change of direction with a simple two-piece turn.



T - Total Turn Angle
TA - Templet Angle
OD - Outside Diameter

Figure 1

Everyone who has ever watched the work done by pipe welders has seen the flat patterns which the layout man wrapped around the pipe. The pattern end of the templet was outlined on the pipe with soapstone. This outline was used as the cutting line for the torch.

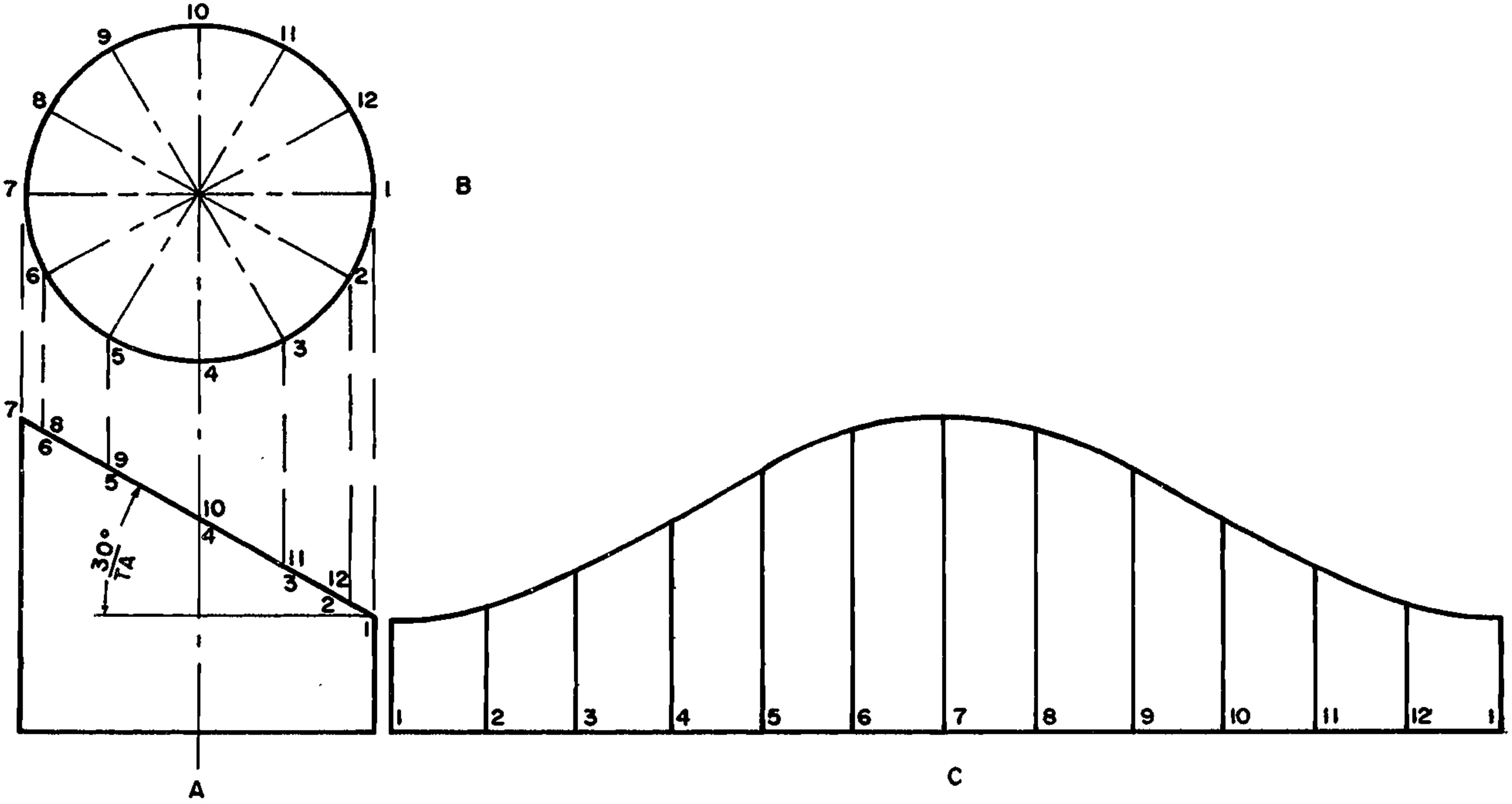
The angle of turn is the change of direction of the centerline of the pipe (see fig. 1.) To make a simple 2-piece turn, this angle of turn is divided by the number of pieces to be used in changing direction. The result of dividing the angle of turn by the number of pieces of pipe used is known as the templet angle.

Draw a side view of a piece of pipe showing the turn desired. Use the outside diameter of the pipe for the width of the view. Move up from the base line a distance great enough to give room for the hands in handling the templet angle above the horizontal as is shown in "A" of fig. 2.

Directly above "A", draw a circle with the outside diameter of the pipe used. Be sure that the center used for the circle is exactly above the center of the side view.

Divide the circumference of the circle into the desired number of equal parts. This may be done by stepping around the circle with the compass set at approximately 1/12th of the circumference. Each segment should be marked lightly. When 12 segments have been laid off, note how far short of or how far past the beginning point the last segment ends. Either lengthen or shorten the setting of the compass by 1/12th of the error, and step around the circle again. When the proper setting has been found, mark the circle into twelve segments and number as shown in "B."

Draw a line perpendicular to the base line of "A" which passes through each pt. on the circumference of the circle "B" and intersects the slant line of the side view. Number these pts. of intersection with the same numbers as their originating points in the circle "B."



TWO PIECE TURN OF
ANY ANGLE

FIG. 2

Extend the base line of "A" out to the right a little more than the circumference of the pipe. Move to the right a little distance and draw a perpendicular line through this point which is numbered "1." From this beginning, lay out toward the right 12 segments, each equal to 1/12th the circumference of the pipe with a perpendicular line drawn through each point and numbered up through 12, with the last line again given the number "1." Here we have effectively cut the side view along a vertical line at the right hand edge and unrolled it. Thus the templet begins and ends with lines marked 1.

Draw a line from pt. 1 in "A" parallel to the base line to intersect both vertical lines marked 1 in "C."

Draw a horizontal line from pt. 2 & 12 in "A" to intersect lines 2 and 12 in "C."

Draw a horizontal line from pt. 3 & 11 in "A" to intersect lines 3 and 11 in "C."

Draw a horizontal line from pt. 4 & 10 in "A" to intersect lines 4 and 10 in "C."

Draw a horizontal line from pt. 5 & 9 in "A" to intersect lines 5 and 9 in "C."

Draw a horizontal line from pt. 6 & 8 in "A" to intersect lines 6 and 8 in "C."

Draw a horizontal line from pt. 7 in "A" to intersect line 7 in "C."

Now all the intersection points in "C" should be connected in order by a smooth curved line. This completes the templet and it may now be cut from the material. (Leave a little material on each end as suggested by dashed line for lapping.)

The number of divisions in this example was 12. This was taken at random, but is a satisfactory number for smaller size pipes. As the O.D. of the pipe increases and as greater accuracy is desired, a greater number of segments should be used.

Assignment 1 of Job 1

Learning methods of laying out angles and the use of wrap around for pipe.

Reference: The Pipe Fitters and Pipe Welder's Handbook
By Thomas W. Frankland
Pages 31-34, 72-77

Job 2

In the previous assignment, the student learned how to develop the templet for any degree of turn, using two pieces of pipe and only one weld.

Make a templet using the technique in the last lesson for a 45 degree, two-piece turn. Keep in mind that although the total turn is 45 degrees, the slope on each piece used accounts for 22½ degrees which is of course, the templet angle.

Assignment 1 of Job 2

Find the angle of cut and lay out a two-piece 35° turn using the wrap around method; cut and weld.

Reference: The Pipe Fitter's and Pipe Welder's Handbook
By Thomas W. Frankland
Page 80

Job 3

A two piece 90 degree turn is often used in making an abrupt change of direction in a pipe line. This type of turn needs a templet of the same general construction as the templets for smaller angles.

Make a templet drawing for a two piece, 90 degree turn.

Assignment 1 of Job 3

Find the angle of cut and lay out a two piece 80° turn using the wrap around method.

Reference: The Pipe Fitter's and Pipe Welder's Handbook
By Thomas W. Frankland
Pages 78-79

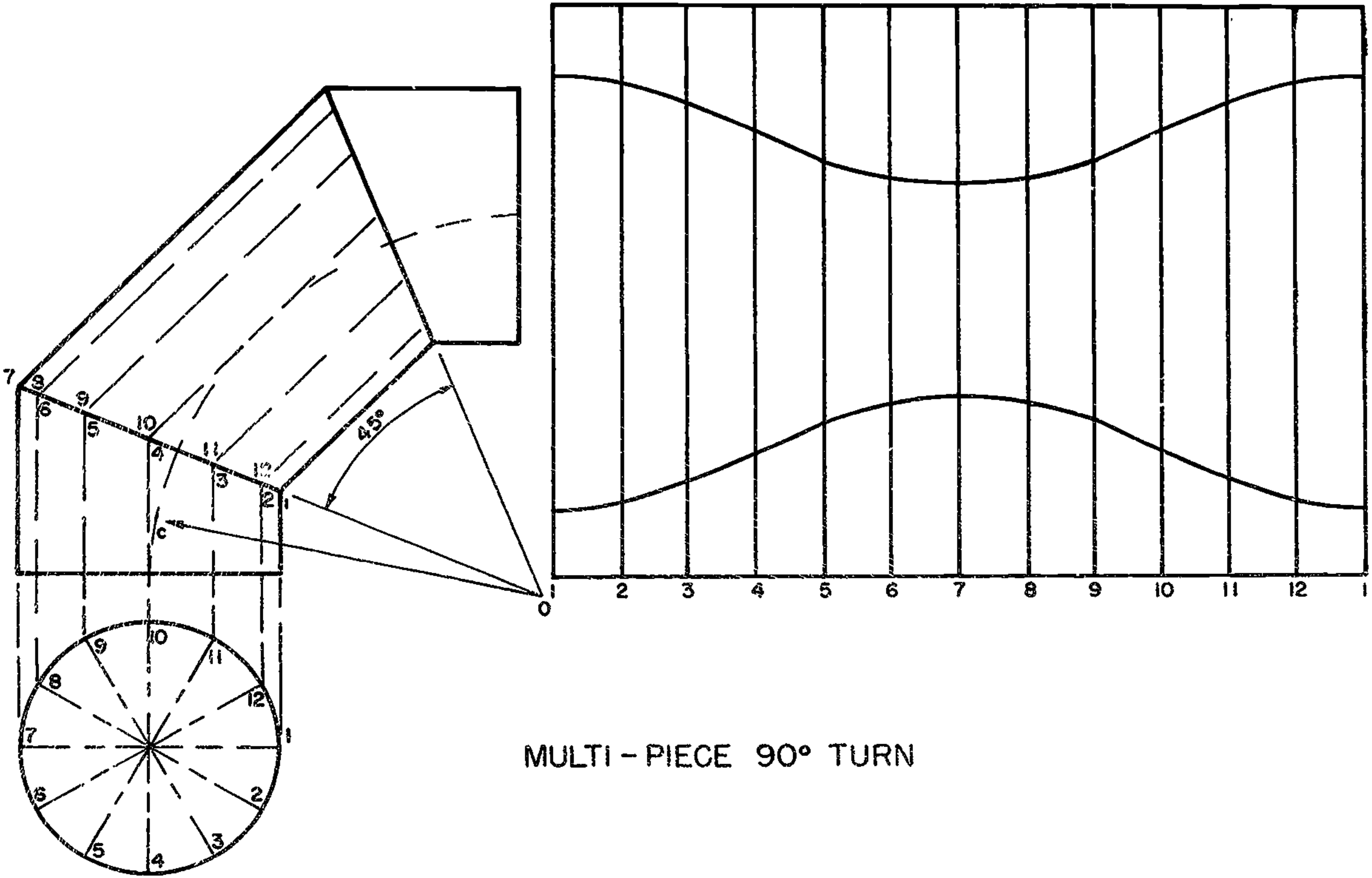
Job 4

A two piece 90 degree turn is so abrupt that the friction and turbulence losses are greater than desirable. The same change in direction may be secured by making two 45 degree turns in succession in the same direction turn. When this is done the resulting turn is known as a three piece 90 degree turn. Figure 3 in this section shows an elevation of such an item. The total turn angle is of course 90 degrees. This angle is made by breaking the turn into two 45 degree turns. Each 45 degree turn is divided into two 22½ degree templet angles, one on each piece of pipe that meet at the weld.

The distance on the drawing OC is known as the radius turn. This radius may be varied as much as is desirable to give a longer sweep to the turn. Since the radius of the turn does not change the total turn angle or the number of pieces in the turn, it is obvious that the templet angle will not change; therefore, the same templet may be used for any radius of turn as long as the same size pipe is used. The only thing that is changed as the radius of turn is increased is the length of the center section of the turn.

By the time the student has reached this point in the course, he should be developing a real understanding of how the pattern for a templet of turn is developed, and why the profile of the sloping cut on the pipe appears to be a straight line, while the templet has a smooth curve for marking the cut.

Make a templet drawing for a three piece 90 degree turn in a three-inch line.



MULTI - PIECE 90° TURN

FIG. 3

It should be explained at this time that, whereas it is common practice to call the entire pattern (including the hand hold and overlapping material) a templet, this is actually not true. If the student will draw a straight line from the beginning of the curve on the templets he has drawn to the end of the curve, he will find that the part above the line that shows the contour of the cut to be made on the pipe is actually the templet, while all the other material is left on the templet for convenience. Also, if the student will extend lines No. "1" upward a distance equal to the height of the first pattern at the center point and connect the ends of these two extensions with a straight line, he will find that actually he has drawn two templets any time the curve is established once. The lower templet begins and ends at the shortest point on the pipe, while the upper one begins and ends at the longest point.

Assignment 1 of Job 4

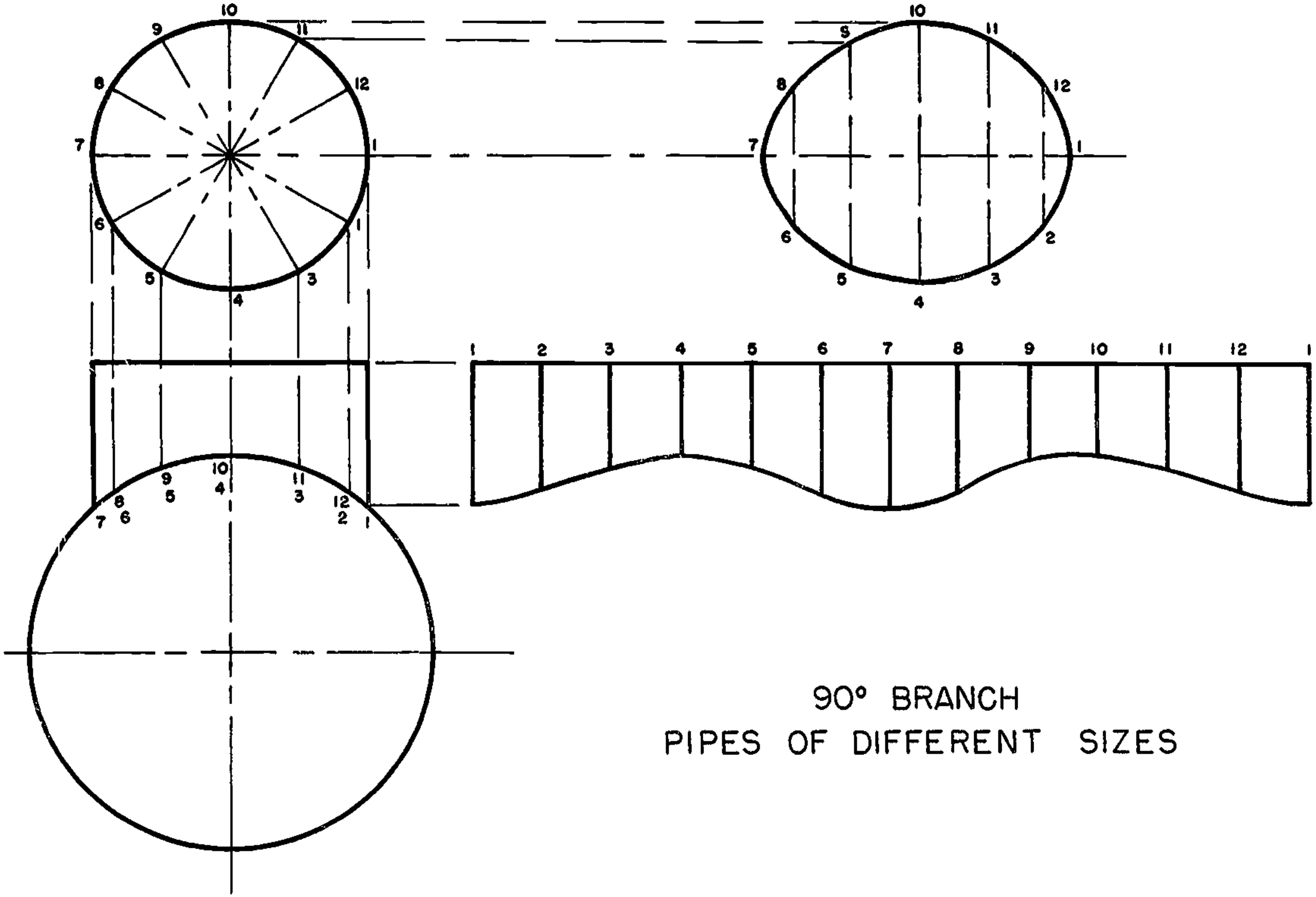
Find the angle of cut and lay out a three piece 80° turn with a 12 in. radius using the wrap around method; cut and weld.

Reference: The Pipe Fitter's and Pipe Welder's Handbook
By Thomas W. Frankland
Page 82

Job 5

Another type of pipe connection for which templets should be drawn, is intersections of pipes. Everyone is familiar with the common tee, in which a small pipe intersects a larger one at 90°. Figure 4 of this section shows the fundamentals of the development of templets for such an intersection. On the left side of the figure there is a drawing which shows the cross section of the larger pipe with a profile or elevation of the smaller pipe intersecting at the top. The cross section and elevation are drawn using the outside diameters of the pipes involved. Along the centerline and above the elevation a circle is drawn of the same outside diameter as the smaller pipe below. This circle is divided into 12 equal parts (or the number desired) by the same technique used in previous work. These points along the circle are numbered in the usual manner after which the points are projected downward with dashed lines to intersect the cross section of the larger pipe of the tee. Examine the elevation closely. It will be evident that the length of each line from the top of the piece to its intersection with the larger pipe is a true length and needs only to be transferred by projection to the right to intersect segment lines running downward from a base line. If these points of intersection are connected by a smooth curve, the templet for the smaller pipe is complete.

The drawing of a templet for the hole which must be cut in the larger pipe presents a little new thinking which must be understood.



90° BRANCH
PIPES OF DIFFERENT SIZES

FIG. 4

To facilitate this thinking, let the student imagine a piece cut out of the top of the larger pipe which appears to be a round piece when the eye is directly over the hole. Let a line running lengthwise through the piece which was removed be known as the longitudinal axis, and a line running across the piece (around the pipe) be known as the transverse axis. The piece of pipe which was cut out to form the hole is shaped exactly like the templet which will be needed for marking such a piece. If the piece which was cut out is flattened out it will be noted that the diameter along the longitudinal axis is the same as the diameter of the small pipe which will fit into the opening. Because this is true, we have a beginning place to start drawing the templet for the hole. Project the top and bottom edges and the center of the plan view of the smaller pipe to the right any convenient distance (at least two small pipe diameters out of the circle) and draw a perpendicular line which cuts all three of the horizontal lines. This perpendicular will be a centerline.

Re-examine the elevation of the smaller pipe and it will be seen that the lines projected down from the circle above intersect the cross section of the larger pipe. Measure with a compass the distance from the centerline of the elevation to the intersection of line 3-11 with the cross section. With the same setting of the compass, place the point at the intersection of the horizontal and vertical centerlines in the drawing of the hole templet and mark an arc on the horizontal centerline to the right and to the left of the vertical centerline. The mark to the right of the center will be used in locating points 3 and 11, while the mark to the left will be used in locating points 5 and 9. Points 4 and 10 are already located in the hole templet. Points 1 and 7 are located where the last arcs to the right and left of the vertical center line in the templet cross the horizontal center line. Project points 9 and 11 in the plan of the smaller pipe to intersect the vertical lines through the first mark to the right and left of the vertical center line in the templet, thus locating 9 and 11 on the templet curve. Next, project points 8 and 12 in the plan of the smaller pipe to intersect the vertical lines through the second mark to the right and left of the vertical center line in the templet, thus locating 8 and 12 on the templet curve. Next, project points 6 and 2, and 5 and 3 to intersect the proper verticals in the templet. When all the curve points have been located, join them with a smooth curve and the templet has been completed.

Draw the templets for the smaller branch and for the hole in the larger pipe necessary for marking for fabrication of a smaller 90 degree branch intersecting a larger pipe on the center line.

Assignment 1 of Job 5

Lay out a reducing tee using both methods.

Reference: The Pipe Fitter's and Pipe Welder's Handbook
By Thomas W. Frankland
Pages 90-94

Job 6

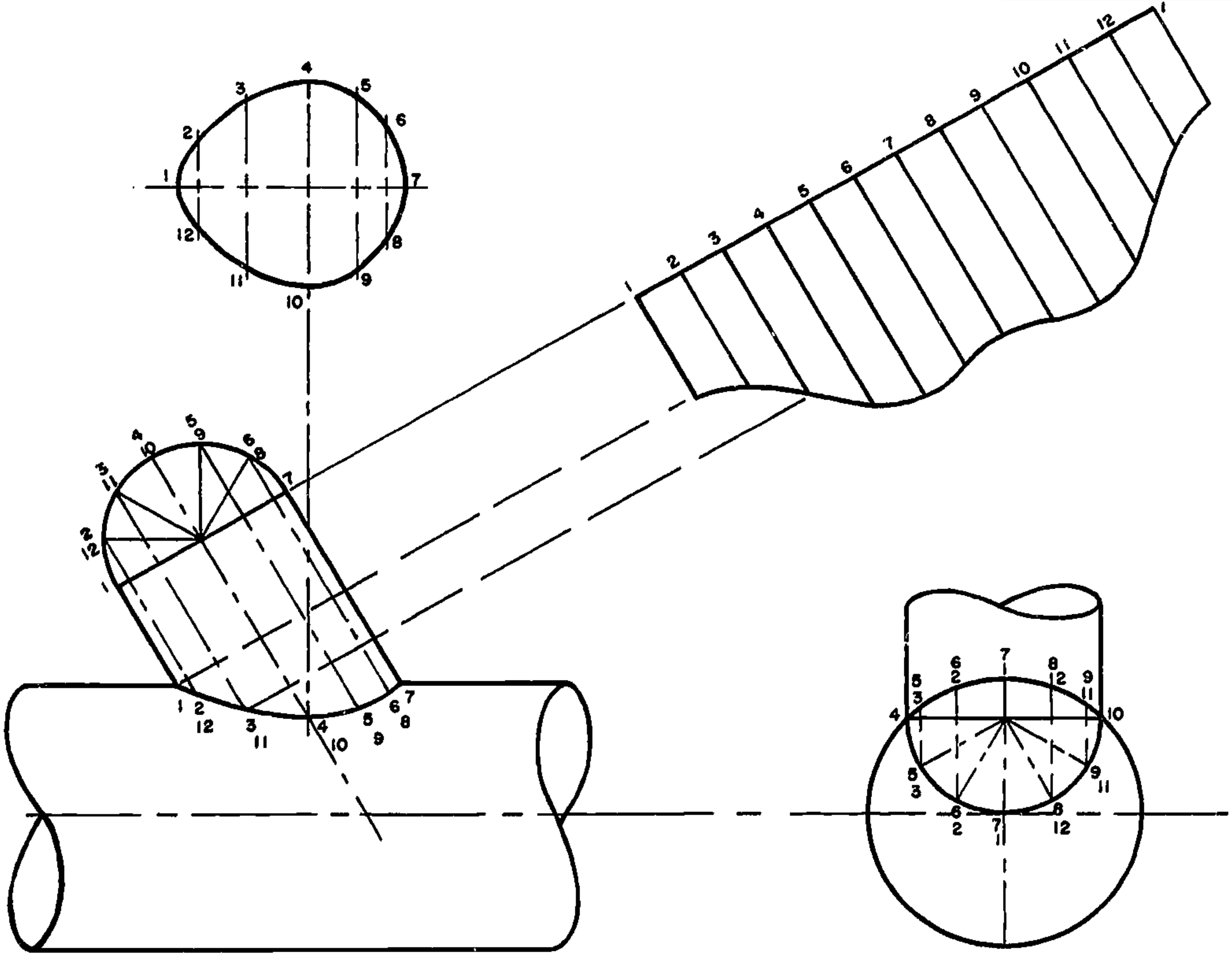
This assignment will give the student the method of laying out the templets necessary for marking the material for cutting to make an intersection of two pipes of different sizes at any angle other than 90 degrees.

Figure 5 of this section of the text gives the fundamentals of such a development. First, a front view is drawn showing the side of the larger pipe and the smaller branch intersecting at the desired angle. In this view the sides of the two pieces may be drawn, but the curve showing the intersection of the walls of the two pipes must wait to be established.

Using the intersection of the centerline of the small branch with its end as a center, draw a semi-circle with the same O.D. as the small pipe. This ½ circle is divided into 6 equal parts and numbered from left to right and back again. Here is seen the use of a semi-circle instead of a full circle for getting the points for projection. A full circle was used earlier to give the student a chance to understand the method which lies behind such technique.

Project each of the points on the semi-circle along lines parallel to the center line of the branch to intersect both the top end of the branch and the large pipe.

Extend the center line of the large pipe in front view to the right. On this center line, erect a perpendicular to serve as the vertical center line of the end elevation. Using the intersection of the two center lines as a center, draw an end view of the large pipe, using the outside diameter. Draw the sides of the small



INTERSECTION OF PIPES OF DIFFERENT SIZES AT ANY ANGLE

FIG. 5

branch. Draw a line connecting the points of intersection of the sides of the small branch with the walls of the large pipe. Using the intersection of this line with the vertical center line as a center, draw a semi-circle below the base line using the diameter of the small branch. Divide the semi-circle into 6 equal parts and number as shown in figure 5. Project these points upward to intersect the large pipe. Number these points of intersection to agree with the numbering of the semi-circle. Project these points horizontally to the left to intersect with correspondingly numbered lines at the lower end of the small branch. The intersections of these lines locate the curve of intersection of the walls of the two pipes. Draw the curve smoothly.

At this point, the templet for the small branch may be drawn. Extend the sloped upper end of the branch out a convenient distance upward to the right. Mark off 12 divisions, each equal to one segment on the semi-circle, and number them from the left to the right. Erect perpendiculars to the base line through each of these points extending downward.

To draw the templet for the hole which must cut in the large pipe, move above the front view and draw a horizontal center line. Project the points of intersection of the two pipes in the front view upward to intersect the horizontal center line just drawn. Measure the distance along the circumference of the large pipe in the end view from pt. 1-7 to 2-12. Set this distance off above and below the center line just drawn on all the lines except 1 and 7. This locates pts. 6, 8, 2, and 12. Measure the distance along the circumference of the large pipe in the end view from pt. 9-11 to 10. Set this distance off above and below the second arc on the middle line. This locates points 4 and 10.

Connect all the points so located with a smooth curve and the templet for hole is complete.

Draw the templets necessary for marking the pipe to make an intersection of smaller pipe with a larger pipe at an angle of 60 degrees.

Assignment 1 of Job 6

Lay out a reducing lateral with the branch at 60° to the header; cut and weld.

Reference: The Pipe Fitter's and Pipe Welder's Handbook
By Thomas W. Frankland
Pages 95-99

Job 7

Previous lessons in the making of templets were concerned only with changing the direction of a run of pipe or with the intersection of pipes. This assignment will bring in the idea of reducing the size of a pipe while continuing in the direction of run. The fitting which is used for this purpose is known as a swage, or reducer. The first to be considered will be the concentric swage, in which the center line of the run is maintained through the piece, while the walls of the pipe are necked in.

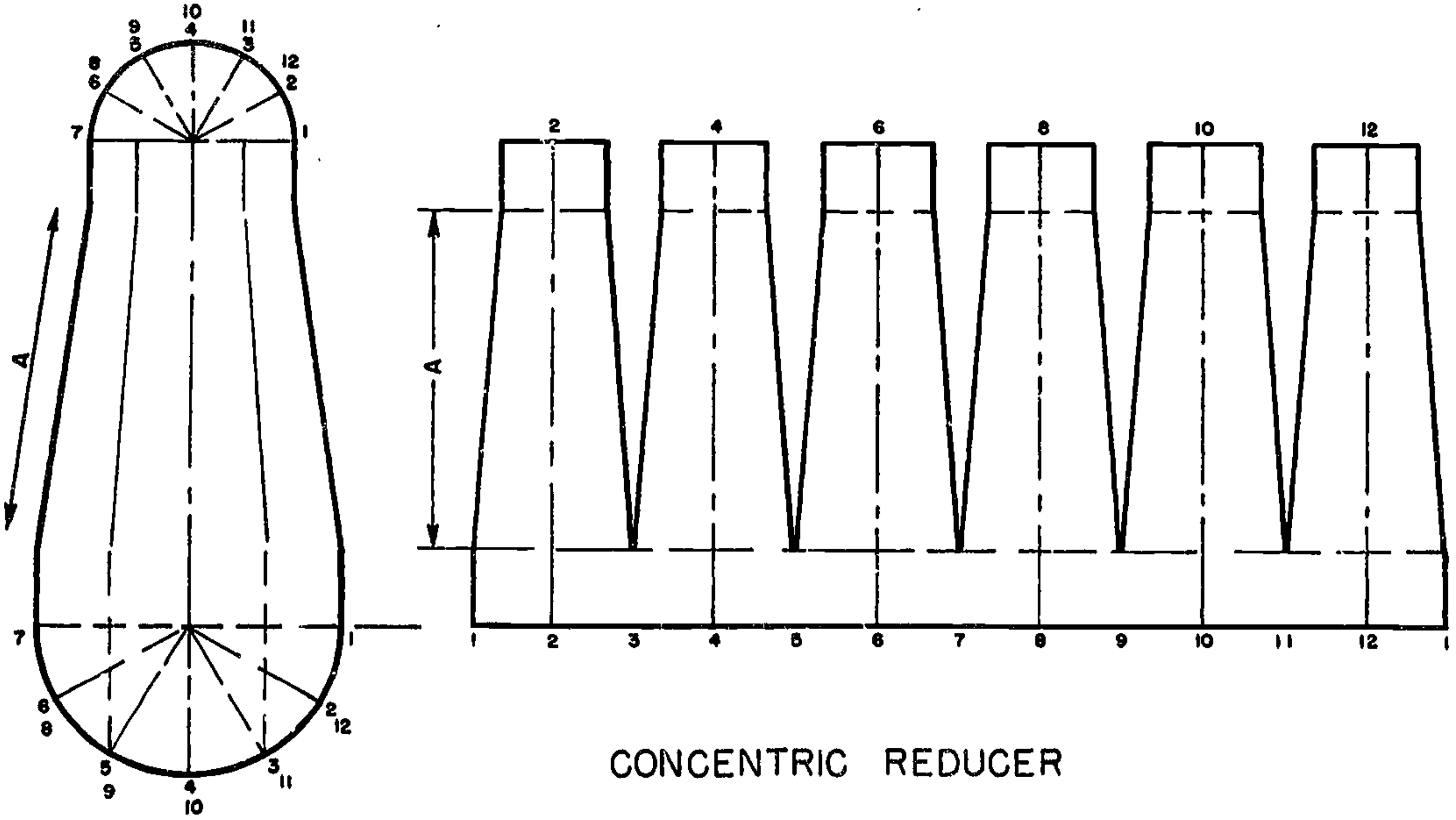
Figure 6 shows such a swage.

An elevation of the reducer desired is drawn, using the outside diameters of both pieces of pipe. The length of the piece of pipe in which the reduction is actually being made is left up to the worker or designer, but this distance should be long enough to enable the metal to be bent handily.

At the lower end of the elevation, a semi-circle using the larger diameter is inscribed. This semi-circle is divided into 6 equal segments using the previously described method.

At the upper end of the elevation, a semi-circle using the smaller diameter is inscribed. This semi-circle is divided into 6 equal segments.

The base line of the elevation is extended to the right and has 12 sections marked off along its length, each section equal in length to one segment of the lower semi-circle. Begin numbering with the mark at the left end, each even-numbered pt. serves as the location of a vertical center line.



CONCENTRIC REDUCER

FIG. 6

The beginning point of the reduction is projected to the right parallel to the base line.

The slant distance "A" is measured on the elevation and set off on the center line of the first section of the templet as shown in the figure. Project this pt. to the right and left of the length of the pattern.

The straight length of the smaller pipe is measured and added to the height of the pattern.

The length of a segment of the larger semi-circle is laid off to the right and left of each center line in the pattern along the horizontal line which marks the beginning of the reduction.

The length of a segment of the smaller semi-circle is laid off to the right and left of each center line in the pattern along the horizontal line which marks the end of the reduction.

The points located form the outline of the pattern.

Draw the templet for a concentric swage which reduces from 3" to 2" with a height along the center line of 6", 1" at each end is to be left straight.

Assignment 1 of Job 7

Lay out a concentric reducing swage.

Reference: The Pipe Fitter's and Pipe Welder's Handbook
By Thomas W. Frankland
Pages 103-104

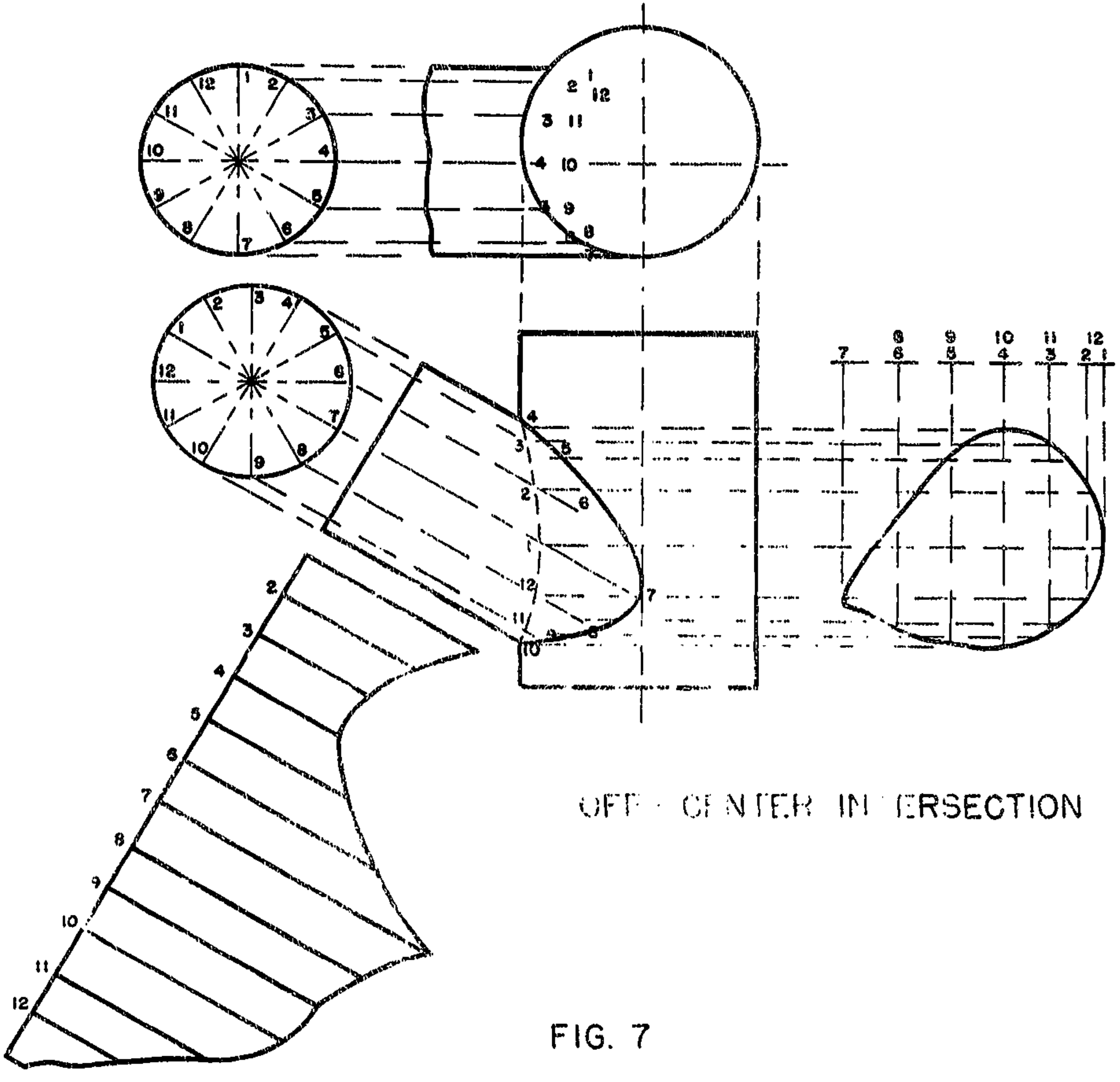
Job 8

A previous assignment describes the method of making the templets for a lateral when the branch is smaller than the header and when the centerline of the branch intersects the centerline of the header.

Another similar problem which arises is illustrated in Figure 7. In this case the smaller branch has its centerline missing the centerline of the header.

Draw the elevation of the lateral showing the sides and centerlines of both the branch and header. On the centerline of the branch, draw a circle using the smaller pipe's O.D. as the diameter. Divide the circle into 12 equal parts and number each pt. along the circumference as shown. Directly above the elevation draw the end view of the header and show the outer walls of the branch offset the amount desired. On the centerline of this branch, construct another circle using the O.D. of the branch as the diameter. Divide this circle into 12 equal parts and number each pt. along the circumference. Notice that the numbering on this circle appears to be different from the numbering on the circle in the elevation. Closer examination will show that the points represented are actually the same.

Now project the points on the circle in the plan view to the right to intersect the end view of the header. Number these points of intersection the same as they were in the branch circle. For example, pts. 2 and 12 in the branch circle are projected to the right to intersect the header pt. 2-12.



OFF - CENTER INTERSECTION

FIG. 7

Now bring a vertical line from pt. 1 on the end view of the header down into the elevation. Draw a line from pt. 1 of the branch circle of the elevation, parallel to the walls of the branch to intersect the vertical line from pt. 1 in the top view. Number this pt. of intersection 1 also. Proceed to pts. 2, 3, 4, etc. Connect the pts. thus located with a solid line where the pipe intersection can be seen and a dashed line where the pipe intersection cannot be seen.

These operations have been performed in order to secure a true elevation of the intersections of the two pipes. Now the templets for the branch and the hole in the header may be drawn.

To the right of the elevation, draw a horizontal line which will act as a base line for drawing the hole templet. Place pt. 1 near one end of the base line. With a compass, or dividers, measure the distance between 1 and 2-12 on the top view of the header and set this distance from 1 along the base line. Number the new pt. 2-12. Set each of the distances obtained from the top view of the header, along the hole base line, taking care that the numbering remains the same.

Now, drop perpendicular lines from these pts. on the base line. Project the pts. on the elevation horizontally to intersect the vertical construction line which bears the same number. Example: Pt. 6 on the elevation is projected horizontally to the right to intersect vertical line 6.

The pts. thus located must be joined together by a smooth curve (where possible) to give the templet for the hole which must be cut in the header.

The method of laying out the templet for the branch is obviously an adaptation of a technique used often before.

Draw the necessary templets for marking the pipe for making an off-center intersection of a smaller branch intersecting a larger header at 90 degrees. Offset the branch enough to put one surface of the branch tangent to one surface of the header.

Assignment 1 of Job 8

Make a 90° off-center lateral.

Job 9

There are often requirements in industrial piping for the construction of a true Y with the three pipes involved having the same diameter.

Such a Y is shown in Figure 8.

Draw an elevation of the Y with the two top pipes, known as branches, intersecting the main at the same angle.

Connect the pts. of intersection of the walls of the pipe and the pt. of intersection of the centerlines with straight lines.

Figure 8 shows the construction semi-circle on the end of the main pipe with division pts. projected parallel to the sides of the main to intersect the intersection line between the main and the branches.

The remaining technique for preparing the templet for the main is identical to that used many times before and requires no further explanation.

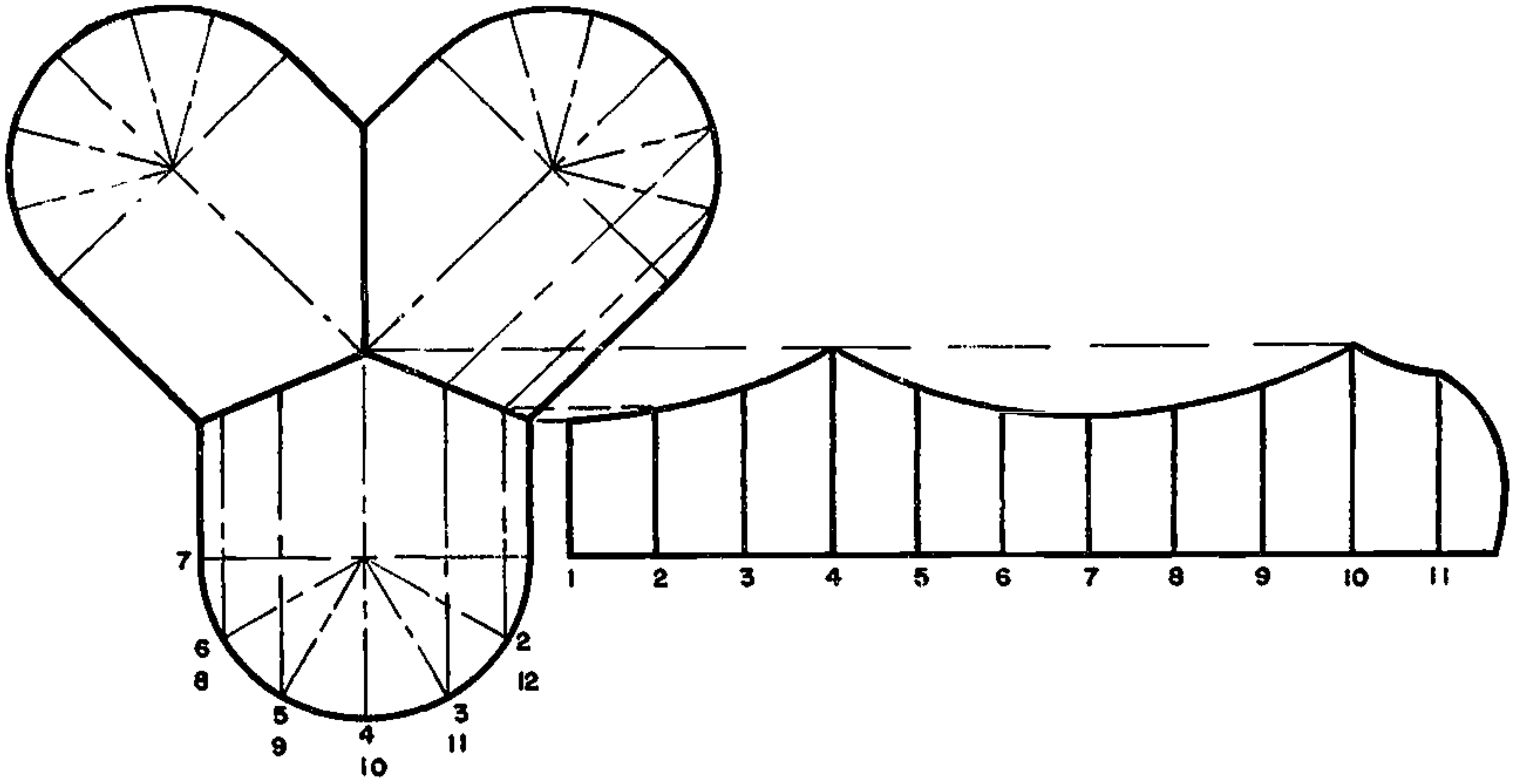
The templets for the two branches will be identical. The method of preparing these templets is obvious.

Draw the templets necessary for marking pipe to make a true Y. Let the angle between the main and each branch be 120 degrees.

Assignment 1 of Job 9

Lay out a full size true Y; cut and weld.

Reference: The Pipe Fitter's and Pipe Welder's Handbook
By Thomas W. Frankland
Pages 100-102



TRUE "Y", PIPES THE SAME SIZE

FIG. 8

Job 10

This assignment concerns itself with a study of how to draw the templet for an Orange Peel Plug or Head. This method is used to seal the end of a piece of pipe and is both effective and strong.

Figure 9 shows the construction of the templet necessary for marking the pipe to make such a piece.

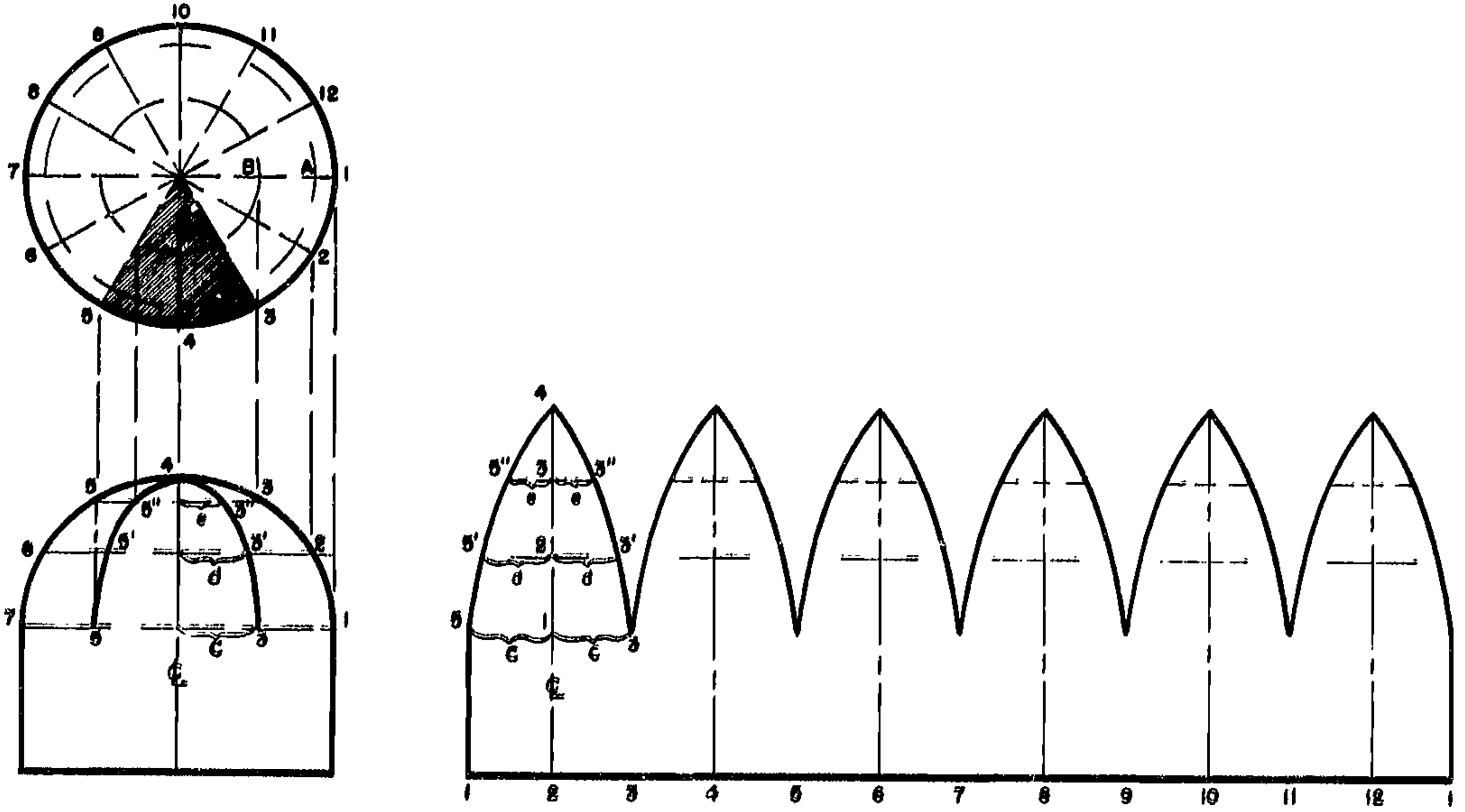
The following describes the procedure for making a similar templet.

Draw an elevation of the pipe, using the O.D. of the pipe. Show the centerline and let it extend well above the elevation.

With a compass, and using ½ of the O.D. of the pipe as a radius, place the point of the compass on the centerline at the top of the elevation, and draw the semi-circle touching both walls of the pipe. Draw a horizontal line through the center used in making this semi-circle. This line will be the line along which all bending is started when the "Orange Peels" are shaped.

Above the elevation, with the compass point set on the elevation centerline, draw a circle equal in diameter to the O.D. of the pipe. Divide this circle into 12 small segments which should be numbered as shown. In making an Orange Peel Plug from small pipe, 6 sections are enough; so use two of the small arcs of the circle to represent one section of the Orange Peel.

Drop a perpendicular line from each of the points on the circle to the horizontal centerline of the circle. With the



ORANGE PEEL PLUG

FIG. 9

same center as the large circle, draw small circles passing through these points on the horizontal centerline. This gives two smaller circles "A" and "B".

Drop vertical lines from points 1-7 to intersect the semi-circular top of the elevation. Number these points of intersection as shown.

On the elevation, draw straight lines connecting point 2 with 6 and 3 with 5. Drop pts. 3, 3', and 3" to intersect lines 1-7, 2-6, and 3-5 in the elevation. Connect these points of intersection with a smooth curve. Locate and draw curve 5-5'-5" in the same manner.

Draw a horizontal base line to the right of the elevation. Set off along this line 12 segments, each equal to the length of one of the 12 arcs on the outer circle in the top view. Number the points along the base line, beginning with 1 at the left end.

From pt. 1 on the elevation draw a horizontal line to extend over the base line. This is the bend line.

Erect vertical lines from each point on the base line to intersect the bend line. Let each even numbered line extend well above the bend line.

Measure the distance on the elevation from 1 to 2, and set this off on centerline number 2 of the templet above the bend line.

Measure 2 to 3 on the elevation and set off above the 1st segment on centerline number 2. Do the same with the distance 3 to 4.

Draw horizontal lines through pts. 2, 3, and 4. Let these lines cross each centerline of the templet sections.

Lay off distances d and e on each side of the centerlines in the templet.

Connect the points thus located by smooth curved lines. This completes the templet.

Draw the templet and the necessary construction views for making an Orange Peel Plug in a piece of pipe nominal size.

Assignment 1 of Job 10

Lay out an Orange Peel and a Bull Plug; cut and weld orange peel.

Reference: The Pipe Fitter's and Pipe Welder's Handbook
By Thomas W. Frankland
Pages 113-117

Job 11

Figure 10 shows the development of the templets for a Welded Tee with both pipes of the same size.

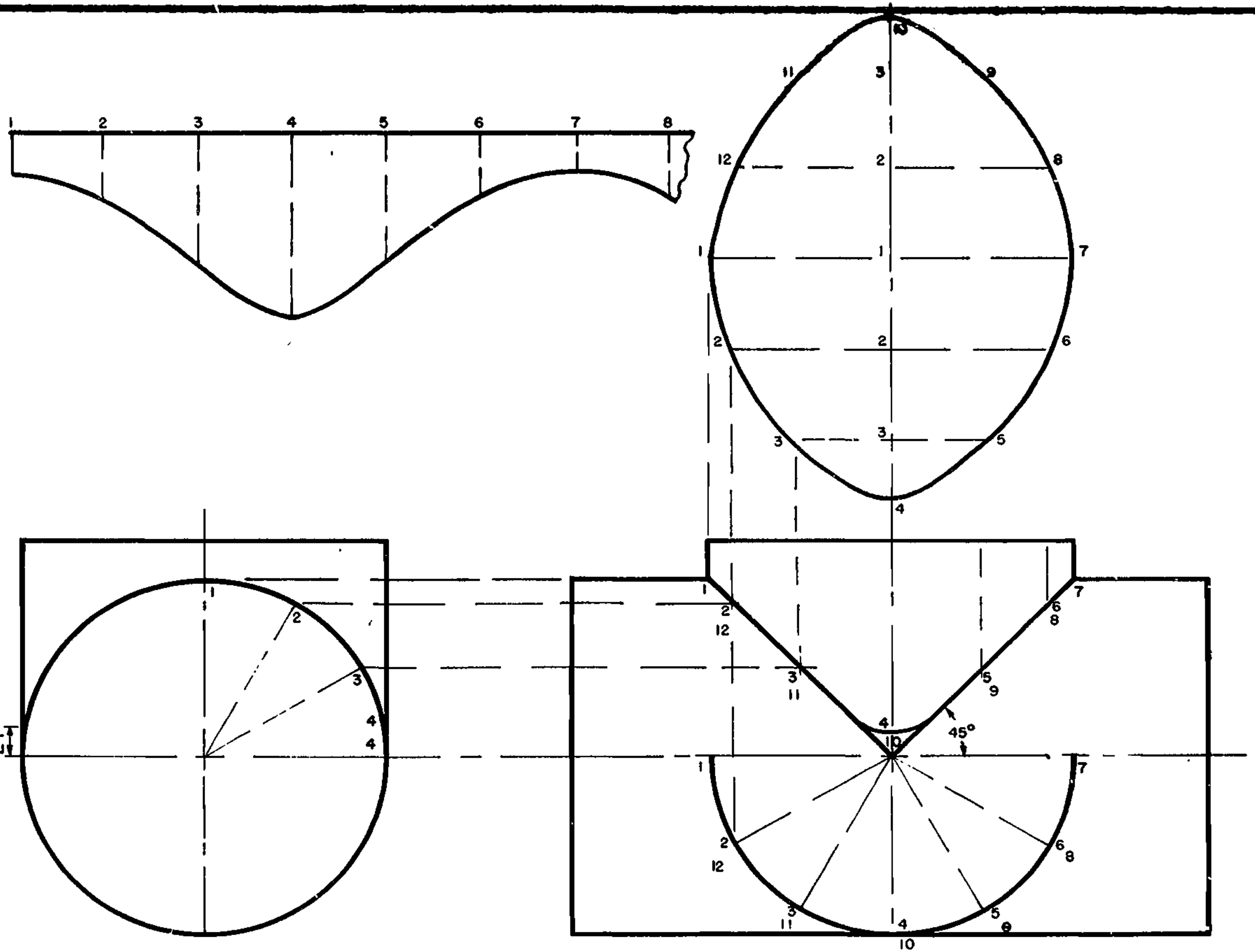
Draw the end elevation of the tee. Divide the upper right quadrant of the main into 3 equal parts. Number the points on the circumference 1 through 4 as shown.

Draw the elevation of the tee. Represent the intersection of the two pipes as straight lines at 45 degrees with the centerline of the main. If the cut in the main were made to pt. 4, it would mean making a sharp notch halfway through the main. Because of the resulting weakening of the main, it is desirable to stop the cut a distance of two times the thickness of the main before the half-way pt. has been reached. In figure 10 the cut is stopped at 4" and the line of intersection is rounded with a smooth curve.

In the lower half of the main in the elevation, draw a construction semi-circle with the compass set at the outside radius of the branch and with the needle point at the intersection of the two centerlines.

Divide the semi-circle into 6 equal parts and number the divisions as shown. Project these pts. up to intersect the pts. projected horizontally from the end view. These two projected lines will intersect along the weld line on the elevation.

Extend the centerline of the branch weld above the elevation. Draw a horizontal centerline cutting this vertical centerline at pt. 1.



TEE, PIPES OF SAME SIZE
FIG. 10

Above and below this pt. 1, locate pts. 2, 3, and 4' the same distance apart as the same numbers on the end view. Through these pts., draw horizontal lines extending past the centerline on both sides.

Project pts. 1 through 12 upward from the elevation to intersect the horizontal lines on the hole templet. Number these intersections with numbers as shown. Connect all these pts. with a smooth curve.

The templet for the branch is easily constructed using procedure which by this time is well known to the student.

Draw the templet necessary for marking the pipe for making a ninety degree intersection of two pipes.

Assignment 1 of Job 11

Lay out a full size tee; cut and weld.

Reference: The Pipe Fitter's and Pipe Welder's Handbook
By Thomas W. Frankland
Pages 87-89

Job 12

A previous lesson explained the method of drawing the templet for a concentric reducer.

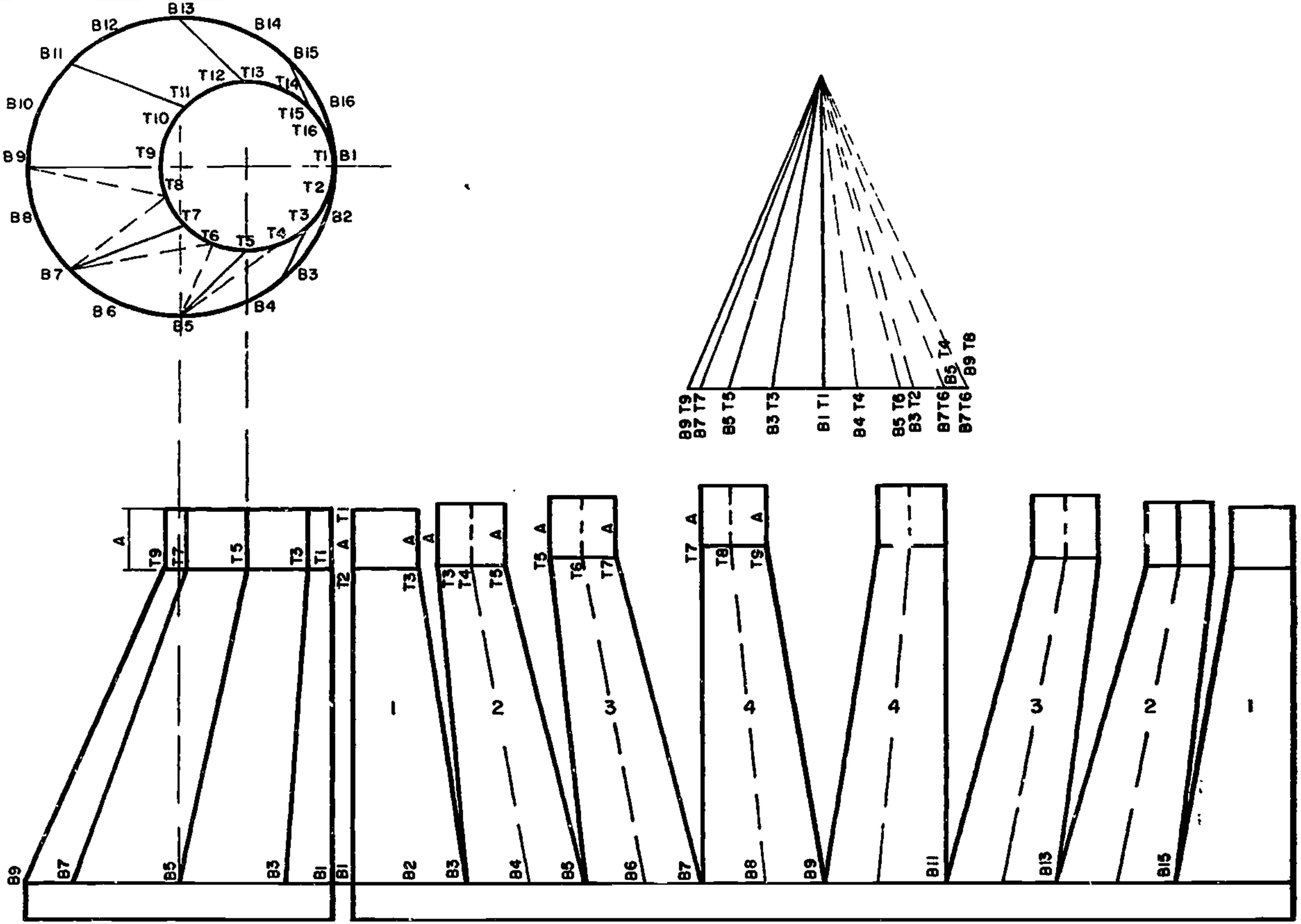
Another type of reducer has the centerline offset in such a manner that the bottom, or one wall, of the two ends lies in the same plane. This is called an eccentric reducer.

Figure 11 shows the development of the templet for such a reducer.

Draw the elevation of the large end using the O.D. of the pipe. Extend the right wall of the pipe upward. Draw the left wall of the reduction section at 22½ degrees with the vertical. Where this sloped line is the same horizontal distance from the right wall as the O.D. of the small section, draw a horizontal line cutting both walls of the reducer. Now draw in the small section of the reducer. The procedure to this pt. results in an outline of the reducer.

Above the elevation, draw a horizontal centerline. Extend the centerline of the large end of the reducer upward to intersect the horizontal centerline. With this pt. of intersection as the center, and the radius equal to ½ the O.D. of the large end of the reducer, draw a top view of the large end. Divide this circle into 16 equal parts and number as shown.

Extend the centerline of the small end of the reducer upward to intersect the horizontal centerline. With this pt. as center, draw a circle with a diameter equal to the O.D. of the small end. Divide this circle into 16 equal parts and number as above.



ECCENTRIC REDUCER
FIG. 11

In making a reducer such as this, it is advisable to have as few arms to cut and form as is practicable. For reducing small pipe, 8 arms are enough. Therefore, begin at pt. T1-B1 and proceed counter clockwise connecting every alternate number on the upper circle with alternate numbers on the larger lower circle. For example, T3 connects with B3; T5 connects with B5; etc. This completes the top view of the reducer showing the arms by means of which the reduction is made.

Drop each of the main pts. on the small circle to the top of the small section of the reducer and draw the vertical lines on the small end of the elevation. Number as shown.

Drop each of the main pts. on the large circle to the top of the large reducer section and number as shown.

Connect the pts. located in this manner with straight lines. Example; B3-T3 on the elevation, etc.

To the right of the elevation, draw a horizontal base line. Along this line, set off 16 small segments, each equal in length to one segment on the large circle in the plan view. Number all the pts. located as shown.

The remaining procedure is quite complicated and can only be mastered through careful inspection of figure 11, and systematic study of the written description to follow.

Erect a perpendicular line at B1 on the templet base line. Lay off distance B1-T1 the same as B1-T1 on the elevation. This is the only true distance which may be taken from the elevation. All other true distances are found by using B1-T1 as the height of a right triangle, and the horizontal distance taken from the top view as the base. The true length is equal to the hypotenuse of this triangle. For example, the true length of B3-T3 is found in the following manner. Measure the distance between pts. B3 and T3 in the top view. Set this off on the horizontal line in the triangulation figure to the left of the vertical line. Measure from this point to pt. 0 and this gives the true length of B3-T3. For convenience, all odd numbered points are placed to the left of the vertical centerline, and all even numbered points are placed to the right of the vertical centerline.

With B3-T3 as a radius and B3 on the templet as the center, strike an arc above B3. With T1-T3 from the top view as the radius and T1 on the templet as the center, strike an arc cutting the first arc at T3.

Extend B1-T1 the distance A (from the elevation) to pt. T1'. With T3 as center and A as the radius, strike an arc above T3. With T1' as center and T1-T3 as the radius, strike a second arc intersecting the first one at T3. Connect all pts. which have been located by heavy lines, thus outlining arm No. 1 at the left end of the templet. Arm No. 1 at the right end is identical to the one just explained except that it is reversed.

In drawing Arm No. 2, find true distance B3-T4 on the triangle. With this distance as the radius, and B3 on the templet as the center, strike an arc above the base line. With the true distance B5-T4 as the radius, and B5 as the center, strike a second arc intersecting the first one at T4. Connect B4 and T4 with a centerline.

With T4 as the center and the distance T3-T4 (from the top view) as the radius, strike arcs to the left and right of T4.

With B3 as the center and B3-T3 (from triangle) as the radius, strike an arc intersecting the small arc to the left of T4 at pt. T3. With B5 as the center, and B5-T5 (from triangle) as the radius, strike an arc intersecting the small arc to the right of T4 at T5.

Connect pts. T3 and T5. Erect a perpendicular centerline from pt. of intersection of the centerline B4-T4 and line T3-T5. Along this centerline, set off distance A from line T3-T5. This locates pt. T4'. With A as the radius and T3 and T5 as centers, strike arcs intersecting the first two at pts. T3' and T5'.

Connect all pts. with straight lines. This outlines arm No. 2 on the left side of the templet. No. 2 at the right side of the templet is identical except that it is reversed.

Development of the other arms is accomplished by the use of the same procedure as described for Arm No. 2.

Study and re-study this lesson; then develop the templet for a 3" x 2" eccentric reducer. The angle of greatest slope in the reducer is 22½ degrees. Have a short straight length at both ends of the reducer.

Assignment 1 of Job 12

Lay out a concentric reducer five inches long; cut and weld.

Reference: The Pipe Fitter's and Pipe Welder's Handbook
By Thomas W. Frankland
Pages 107-109

PART III

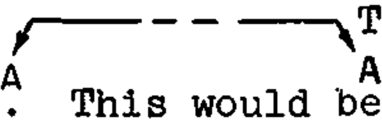
SUPPLEMENTARY INFORMATION

BLUEPRINT READING

REVISION - is a change made on a drawing because of:

1. Customer's request
2. Error by draftsman
3. Error in design

Revisions are stamped in red on the drawing with the date revised.

CUTAWAY SECTION - View taken as if the item was cut in half at some location shown by arrows. 

This designates a cross-sectional or cutaway view. This would be termed --- Section "A-A".

NOTES - Notes are written on drawings to simplify or explain or to point out certain procedures to be followed during fabrication. An example might be a note to galvanize or paint some object, or a note to refer the reader to another drawing.

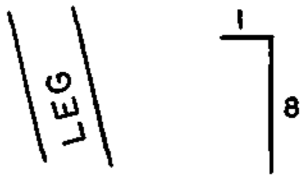
ELEVATION - An elevation is a view from the side or front of an object or structure.

PLAN - A plan is a view from the top (looking down) on the object.

SECTION - A section might designate a cutaway or cross-sectional view of the object. Also it may be a view of one side or end, or one part of a structure or object.

DETAIL - A detail is a closer or enlarged view of some particular part of an object or structure. A detail might clarify or explain the way something is built or the manner in which it is welded.

SLOPE SYMBOL - A slope symbol as shown on a drawing gives the angle of inclination or the amount of lean of a jacket leg. An example would be this symbol on a jacket leg:



This means that for every 8 feet down the pipe, the leg shifts 1 foot to the right.

FIELD INSTALLED - This designation means that the item is to be welded or fitted at the job sight where the structure is going to be erected.

BLUEPRINT READING

A line is the distance between two points and has only one dimension, length.

The end view of a line is a point and has position only. It has no dimensions.

A straight line does not change its direction at any point and is the shortest distance between two points.

A curve line changes its direction at every point.

A broken line changes its direction at some, but not all points.

Parallel lines never meet, regardless of how far they are extended.

A horizontal line is parallel to the horizon.

A vertical line makes an angle of 90 degrees (90°) with the horizon, or in other words, it extends straight up.

An angle is the difference in direction between two straight lines which meet.

The vertex of an angle is the point where the two lines meet.

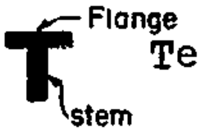
The sides of an angle are the lines which meet to form it. The lengths of the sides have no effect on the angle, because the difference in direction between them is not related to their lengths.

Perpendicular lines are those which meet to form two 90° angles. The Babylonians believed that the heavens revolved around the earth and that the year contained 360 days, so they divided the circle (which represented the cycle of one year) into 360 parts, calling each part a degree and thus establishing our present-day system of circular measurement. If two lines meet in such a manner that they include 90 of these 360 degrees, they are perpendicular to each other. The angles thus formed are also called right angles.

An acute angle is smaller than a right angle. That is, it contains fewer than 90 degrees.

An obtuse angle is greater than a right angle.

SYMBOLS

■	Square Bar	Size-symbol-length	½ ◻ 6'-4
●	Round Bar	Size-symbol-length	¾ Ø 8'-6
▬	Plate	Symbol-width thickness-length	PL 6 x ¼ x 9
	Equal Leg Angle	Symbol-leg-leg-thickness-length	∠ 2 x 2 x ½ x 12'-0
	Unequal Leg Angle	Symbol-long-leg-short-leg-thickness-length	∠ 2 x 1½ x ¼ x 9'-0
	Bulb Angle	Symbol-web-flange-weight-length	Bulb ∠ 5 x 2½ x 7.3 x 8'
	Channel	Height-symbol-weight-length	6 [10.5 x 15'4
	Standard Beam	Height-symbol-weight-length	12 I 31.8 x 10'-2
	Wide Flange Shape	Height-symbol-weight-length	8 WF 8.5 x 30'-6¼
	Structural Tee	Symbol-Height-weight-length	ST 4 WF 8.5 x 30'-6¼
	Tee	Symbol-flange-stem-weight-length	T 4 x 3 x 11.5 x 11'-5
	Zee	Symbol-web-flange-weight length	Z 5 x 3¼ x 14.0 x 7'-11
○	Pipe	Nominal diameter-name-Thickness	24 Ø .500
	Rail	Weight per yard-name	30 lb. rail

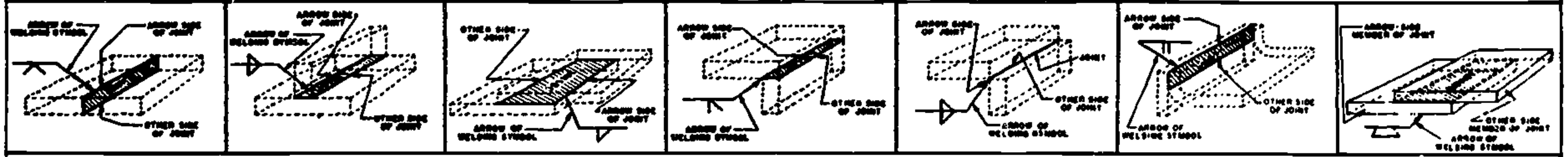
DATE

APPROVED

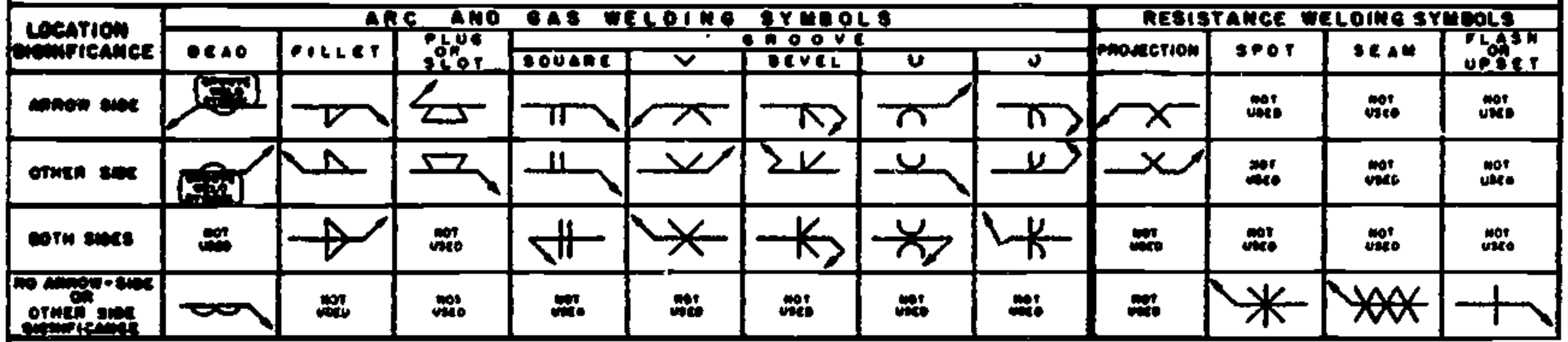
AMERICAN WELDING SOCIETY

SUMMARY OF STANDARD WELDING SYMBOLS

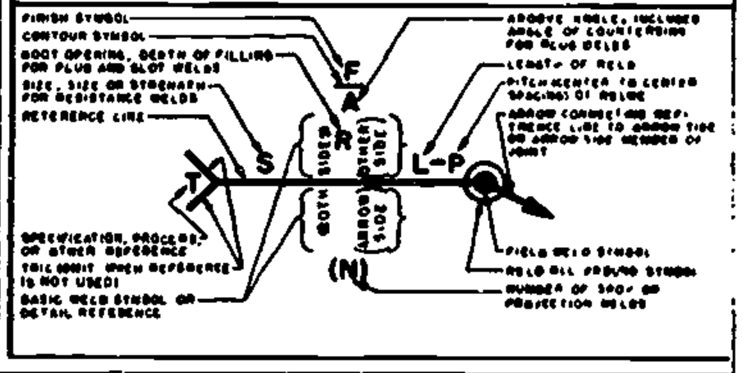
IDENTIFICATION OF *ARROW* SIDE AND *OTHER* SIDE OF JOINT AND *ARROW*-SIDE AND *OTHER*-SIDE *MEMBER* OF JOINT



BASIC WELDING SYMBOLS

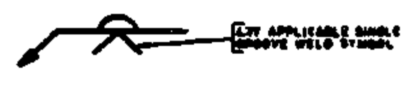


LOCATION OF ELEMENTS OF A WELDING SYMBOL



TYPICAL WELDING SYMBOLS

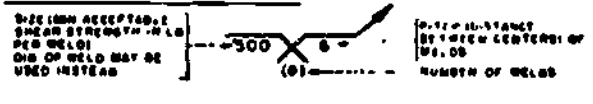
BEAD WELD SYMBOL INDICATING BEAD TYPE BACK WELD



STAGGERED INTERMITTENT-FILLET WELDING SYMBOL

WELDING SYMBOLS FOR COMBINED WELDS

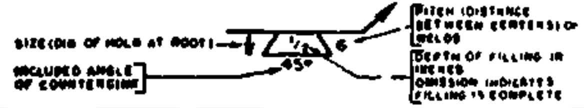
PROJECTION WELDING SYMBOL



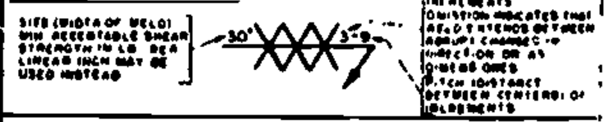
DUAL BEAD WELD SYMBOL INDICATING BUILT-UP SURFACE

SINGLE-V GROOVE WELDING SYMBOL

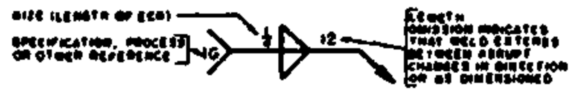
PLUG WELDING SYMBOL



SEAM WELDING SYMBOL

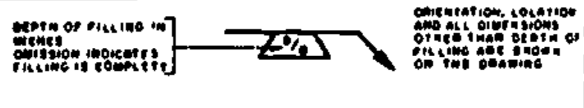


DOUBLE-FILLET WELDING SYMBOL

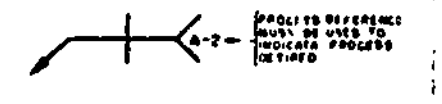


SINGLE-V GROOVE WELDING SYMBOL, INDICATING ROOT PENETRATION

SLOT WELDING SYMBOL

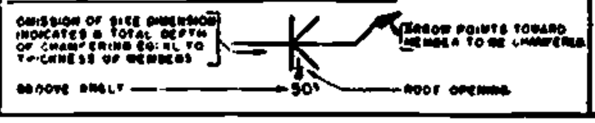


FLASH OR UPSET WELDING SYMBOL

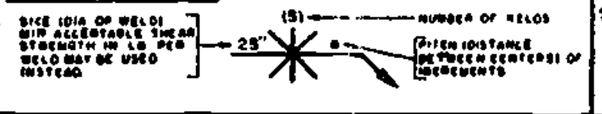


CHAIN-INTERMITTENT-FILLET WELDING SYMBOL

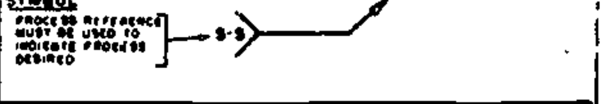
DOUBLE-BEVEL GROOVE WELDING SYMBOL



SPOT WELDING SYMBOL

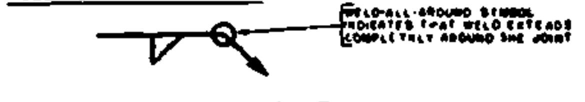


BRAZING, FORGE, THERMIT, INDUCTION AND FLOW WELDING SYMBOL

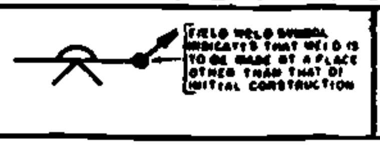


SUPPLEMENTARY SYMBOLS USED WITH WELDING SYMBOLS

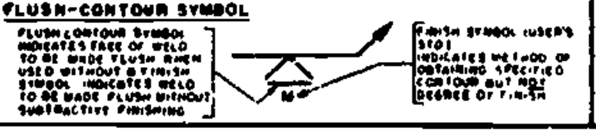
WELD-ALL-AROUND SYMBOL



FIELD WELD SYMBOL



FLUSH-CONTOUR SYMBOL

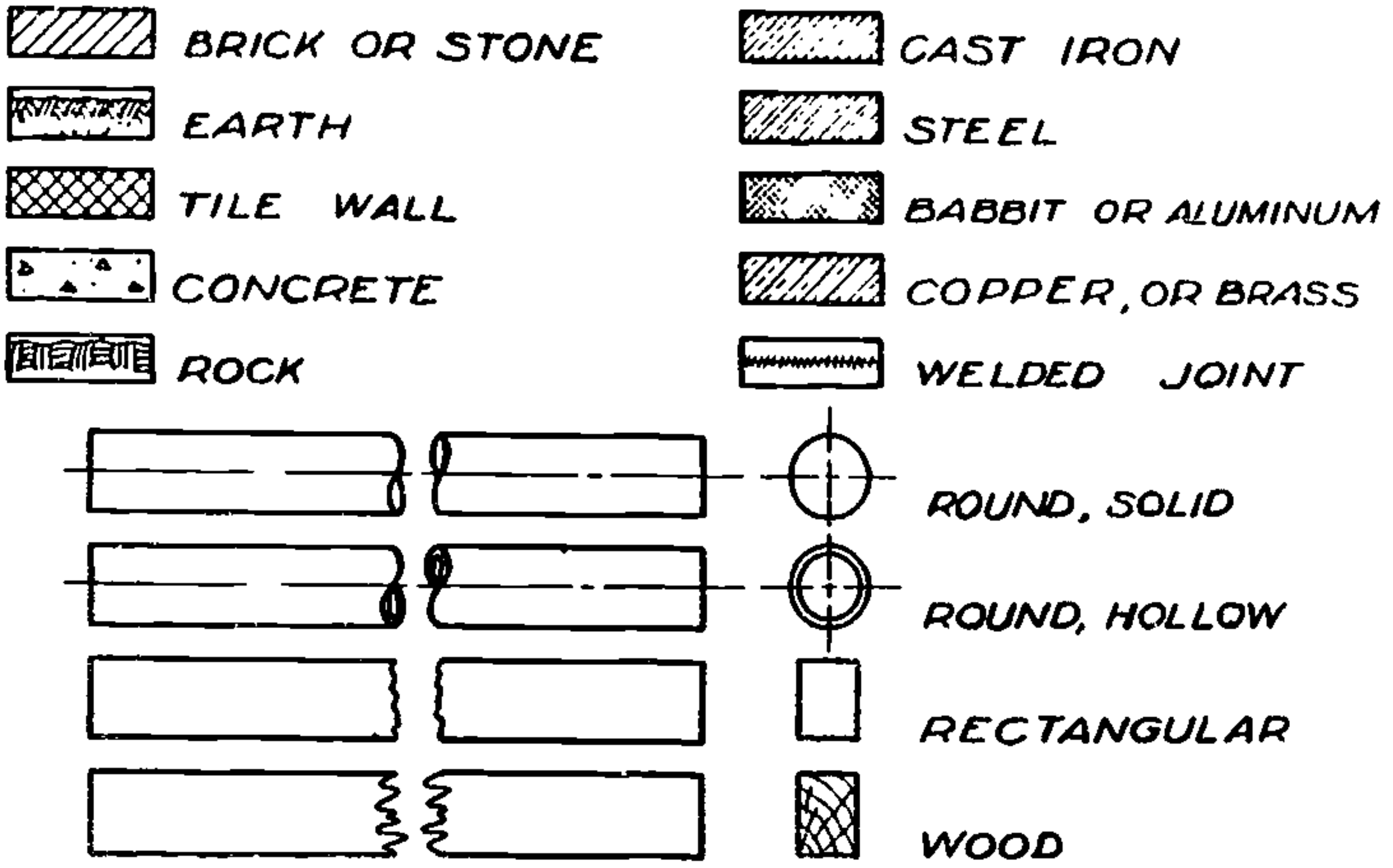


CONVEX-CONTOUR SYMBOL

Bulletin 820 1M-3-51
©LECO

Litho in U.S.A.

SYMBOLS AND ABBREVIATIONS



	OPEN END OF A PIPE	Red.	REDUCER
Ø	ROUND BAR	Lg	LONG
⌀	SQUARE BAR	STD.	STANDARD
℄	CENTER LINE	S.H	SECOND HAND
[s	CHANNEL IRONS	Ga.	GAGE
Ls	ANGLE IRONS	C.R.	COLD ROLLED
PL	PLATE	BtoB	BACK TO BACK
MK	MARK	REQ'D	REQUIRED
O.C.	ON CENTER	W.I.	WROUGHT IRON
Ctrs.	CENTERS	G.I.	GALVANIZED IRON
[illegible]	OUTSIDE DIAMETER	Bz	BRONZE
I.D.	INSIDE DIAMETER	@	AT

FIGURE 12

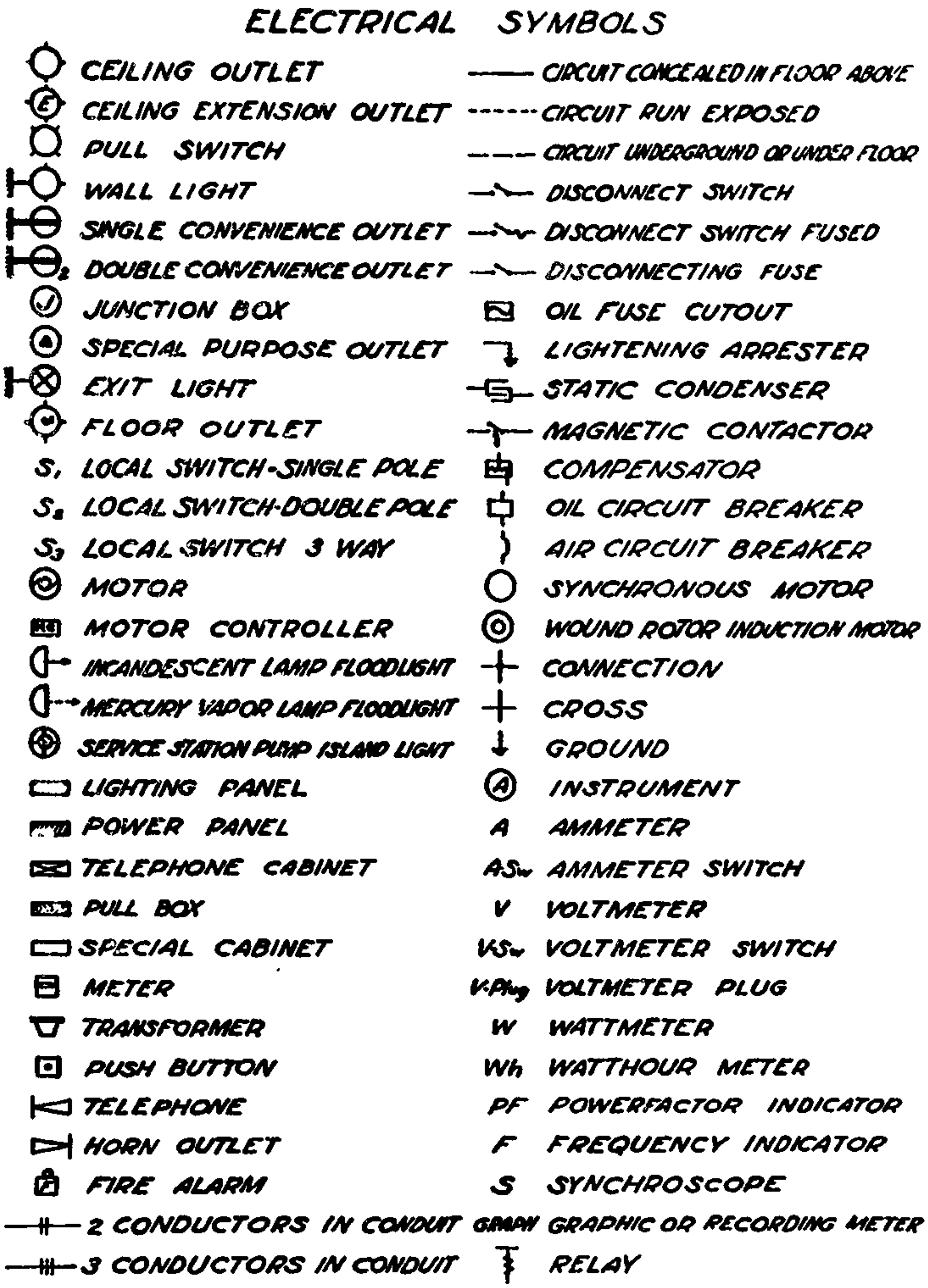

ELECTRICAL SYMBOLS
CEILING OUTLET
CEILING EXTENSION OUTLET
PULL SWITCH
WALL LIGHT
SINGLE CONVENIENCE OUTLET
DOUBLE CONVENIENCE OUTLET
JUNCTION BOX
SPECIAL PURPOSE OUTLET
EXIT LIGHT
FLOOR OUTLET
S, LOCAL SWITCH-SINGLE POLE
S₂ LOCAL SWITCH-DOUBLE POLE
S₃ LOCAL SWITCH 3 WAY
MOTOR
MOTOR CONTROLLER
INCANDESCENT LAMP FLOODLIGHT
MERCURY VAPOR LAMP FLOODLIGHT
SERVICE STATION PUMP ISLAND LIGHT
LIGHTING PANEL
POWER PANEL
TELEPHONE CABINET
PULL BOX
SPECIAL CABINET
METER
TRANSFORMER
PUSH BUTTON
TELEPHONE
HORN OUTLET
FIRE ALARM
2 CONDUCTORS IN CONDUIT
3 CONDUCTORS IN CONDUIT
CIRCUIT CONCEALED IN FLOOR ABOVE
CIRCUIT RUN EXPOSED
CIRCUIT UNDERGROUND OR UNDER FLOOR
DISCONNECT SWITCH
DISCONNECT SWITCH FUSED
DISCONNECTING FUSE
OIL FUSE CUTOUT
LIGHTENING ARRESTER
STATIC CONDENSER
MAGNETIC CONTACTOR
COMPENSATOR
OIL CIRCUIT BREAKER
AIR CIRCUIT BREAKER
SYNCHRONOUS MOTOR
WOUND ROTOR INDUCTION MOTOR
CONNECTION
CROSS
GROUND
INSTRUMENT
A AMMETER
AS AMMETER SWITCH
V VOLTMETER
VS VOLTMETER SWITCH
V-Plug VOLTMETER PLUG
W WATTMETER
Wh WATTHOUR METER
PF POWERFACTOR INDICATOR
F FREQUENCY INDICATOR
S SYNCHROSCOPE
GRAPH GRAPHIC OR RECORDING METER
RELAY

FIGURE 12A

STANDARD PIPING SYMBOLS

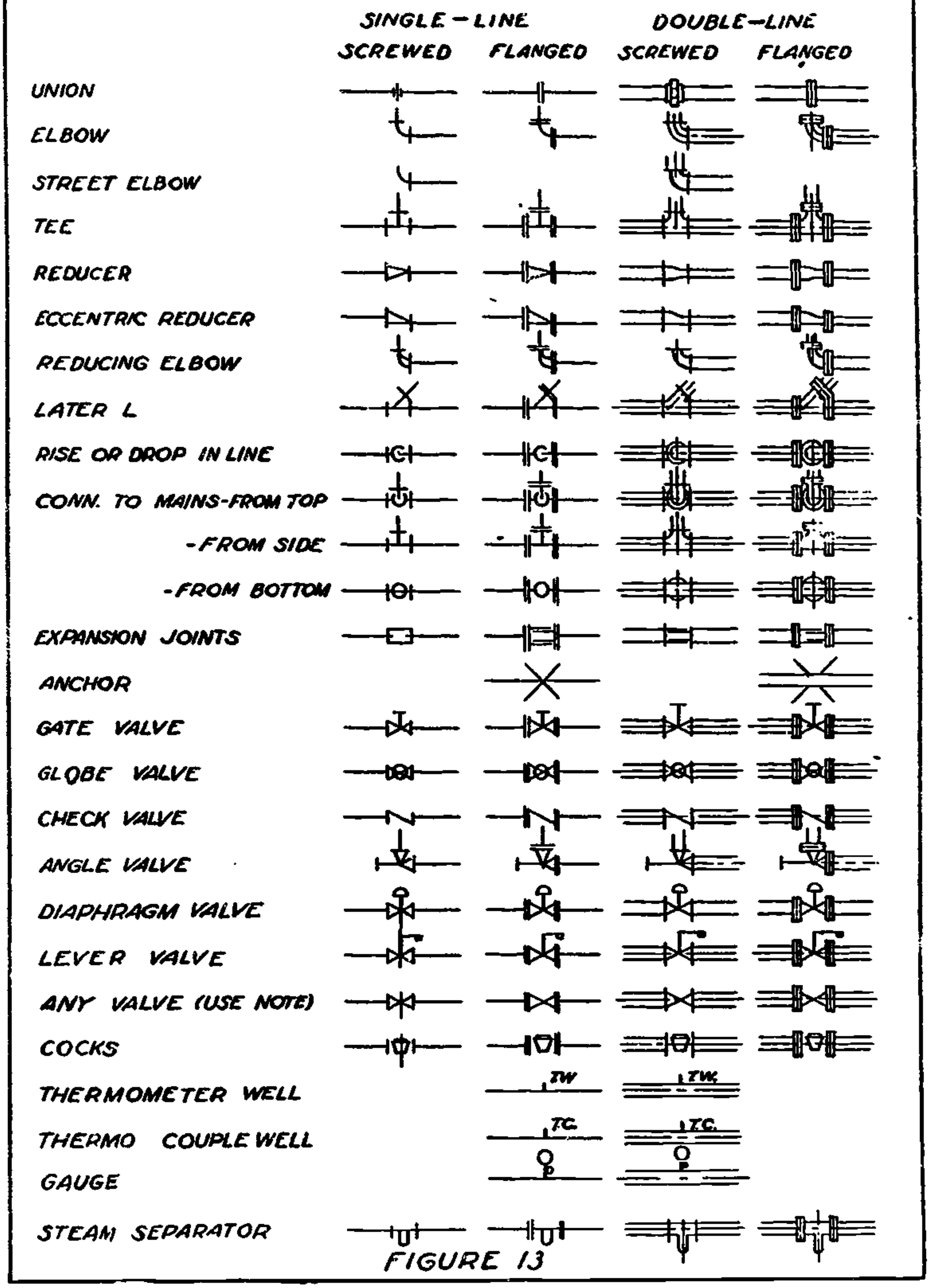


FIGURE 13

STRUCTURAL STEEL DRAWINGS

The importance of steel to industry cannot be over-stated. Structural steel is the very backbone of industrial enterprise. Structural steel sections make up the thousands of miles of steel rails over which thousands of tank cars of oil are transported each day. Structural steel sections go to make up the bridges over the rivers. Structural steel made possible the $35,000,000 Golden Gate Bridge at San Francisco, California, and so we find structural steel used in the derricks of the production department, in the towers and buildings of the refinery; in the pump stations of the pipe line company; and in every phase of the petroleum industry.

1. Symbols and Conventions:

Most of the symbols and conventions used in structural steel drawings are found in Fig. 12. These will be found to be very closely related to the things which they represent. A study of the symbols in the figure will show that a structural steel plate is indicated by a "P" with an "L" drawn through it. The I-beam is so-called because its section resembles an "I". The symbol for angle iron resembles the capital "L", and this is used because it forms an angle between two lines. The other symbols will be seen to be connected likewise with the structural members which they represent.

2. Abbreviations and Notes:

Many notes are required in order to explain fully the meaning of structural steel drawings. Due to the fact that drawings must be made to small scale in order to get everything on a small sheet of paper, the structural sections are very small and there must be a note by every structural member to give its full description. Notes are used also to indicate the method of assembly, that is to say, that all members should be welded in the field or that all shop work is to be riveted, and field work to be bolted, or whatever method of assembly that is specified by the engineering department. The workman must read all notes or writing on every blueprint because these are as much a part of the drawing as are the lines.

3. Structural Steel Sections:

The most common structural steel section is the angle iron. This is used for frame work and all light structural steel parts where a solid frame work is required but no great load is to be carried. The angle iron is always dimensioned in one particular way. The dimensions are always in the following order: the width of the wider flange by the width of the narrower flange by the thickness and the length. In many cases angle irons are used where the two flanges are the same so the proper method of dimensioning would be a 6" x 4" x ½" ∠ , 4' - 11" long. The channel iron is used for carrying greater loads than the angle iron, and where an I-beam is not required, channel irons may be used. The I-beam is used for load carrying purposes. The "H" section is used for columns, it being so constructed as to resist bending in either direction. Channel irons, I-beams, and "H" sections are dimensioned by giving the depth of the beam, that is, the distance over the flanges, and the weight of the beam per running foot. A channel iron would then be dimensioned by giving the measurement of the flanges, such as 10", and the weight per running, such as 15#. The strength of these sections depends upon the thickness of the flanges and web, and giving the weight per foot is the method of indicating the thickness of the parts.

VALVES

A. Basic Facts on Valves

Valves are used to start, stop and regulate fluid flow within a pipe line. The common valve consists of the following components:

1. A body to house the valve and gives a means of connecting it to the pipe.
2. A valve seat.
3. A valve or disc.
4. A valve stem and a means of operating the stem, usually a hand wheel.
5. A top.
6. A packing to prevent leakage around the stem as it emerges from the top.

Valves are sized by the nominal inside diameter of the pipe to which they are connected, i.e. 4" valve for 4" nominal pipe (4½" O.D. pipe). Valves are furnished for either screwed, flanged or welding connections.

Types of material used in valves:
1. Brass
2. Cast Iron
3. Cast Steel
4. Forged Steel
5. Alloy Steel
6. Malleable Iron

B. Valve Identification

In addition to the manufacturer's brand and size mark, a basic service rating appears on most valves. Pressure and temperature ratings are expressed in terms of steam, unless otherwise indicated.

1. Steam Ratings: (Iron & Brass Valves)
   Steam ratings are used as a basis for determining the suitability of a material for a given application. For lower temperatures the safe working pressure of a material is usually greater than the steam rating.

2. Cold Ratings: (Iron & Brass Valves)
   Most valves have two service ratings. In addition to the steam rating, explained above, cold service ratings are usually designated by the mark WOG, which stands for cold water, oil or gas, non-shock. Examples --
   2" - 125#S - 200#WOG
   3" - 250#S - 500#WOG

CONT...

3. Ratings - Steel Valves:
Cast and forged steel valves bear a mark such as 150, 300, 600, etc. These figures denote the maximum pressure at a certain maximum temperature for which an item is suited. A certain 600 pound steel valve, for example, may be suited for 600 pound pressure at temperatures up to 900°F. But, if the temperature exceeds that point up to 1,000°F., let's say, the valve is not recommended for pressure over 380 pounds. Other factors affecting the pressure for which the valve is suited are:

   1. shock.
   2. vibration.
   3. line stresses.

   Steel valves are intended to be used with steel flanges. A flanged 600# valve has flanges that make up with 600# ASA companion flanges.

TYPES OF VALVES

A. Gate Valves

This type is the most widely used in industrial piping. It gets its name from the gate-like disc that operates at a right angle or perpendicular to the path of flow through the valve. Gate valves function by raising or lowering the disc into the stream of flow. Most gate valves have a wedged disc with matching tapered seats. As a general rule, gate valves should be used only as stop valves, i.e. to turn off the flow, as opposed to regulatory or throttling the flow, since the flow meets the disc head on. Flow moves through the valve in a straight line with practically no resistance to flow when the disc is fully raised or open. A 6" gate valve fully closed having a gate or disc area of 28 square inches and holding a pressure of 300 pounds per square inch, subjects the disc to a total load of over 4 tons on one side, if there is only atmospheric pressure on the other.

Force equals Pressure x Area
F equals 300 psi x 24 in.^{2} equals 8400# or 4.2 tons

While seated tight, there is no wear or undue strain on the disc or the seats. But each time the valve is cracked open there is a threat of erosion of the seating surfaces by the high velocity of fluid flow. Repeated movement of the disc near the point of closure under high velocity flow may create a drag on the seating surfaces and cause galling or scoring on the downstream side. A slightly opened disc can cause turbulent flow with vibration and chattering of the disc.

CONT...

Types of Discs used in gate valves:

1. Solid Wedge Disc
2. Double Disc
3. Flexible Wedge Disc
4. Split Wedge Disc

B. Globe Valves:

The globe valve gets its name from the globular shape of its body. Unlike the perpendicular seating in gate valves, globe valve seating is parallel to the line of flow. The fluid undergoes a change in direction as it flows through the globe. All contact between the seat and the disc ends when the flow begins.

Globe valves are recommended for use in throttling or regulatory fluid flow. There is a directly proportional relation of the size of the seat opening to the number of turns of the handwheel. An operator can gauge the rate of flow by the number of turns of the wheel. Shorter disc travel, with fewer turns required to operate globe valves, saves considerable time and work. It also saves wear on the valve parts. The disc and seat in most globe valves can be conveniently repaired or renewed often without removing the valve body from the line. Some of the disadvantages of globe valves are:

1. They do not allow a line to drain completely.
2. They offer more frictional resistance than gate.

On lines where continuous flow is desired, it is safer to have the pressure below the disc. For example, a disc may become separated from its stem and automatically shut off flow if the pressure is above the disc.

In general, however, unless pressure under the disc is definitely required, a globe or angle valve will give more satisfactory service when installed with pressure above the disc.

C. Check Valves

Check valves are designed to permit the flow of fluids in one direction only. Fluid flow keeps these valves open and gravity or a reversed flow closes them automatically, thereby preventing backflow along the line.

There are two (2) basic types of check valves.

1. Swing Check
   A swing check valve consists of a disc on the inside which is hinged at the top and seats against a machined

CONT...

seat inside the valve in a tilted position. Fluid flow is approximately in a straight line, comparable to flow through a gate valve. The disc swings freely in an arc from a fully closed position to an open position providing an unobstructed flow. The valve is kept open by flow, with the size of the opening varying with the volume of flow. Gravity and a reversal of flow, seat the disc thereby preventing backflow. Generally used in combination with gate valves. Swing checks can be used in a horizontal or vertical line, but will not function properly unless installed with pressure under the disc.

2. Lift Check Valve
Constructed very much like a globe valve. Flow through a lift check valve is similar to the flow through the globe valve in that the flow follows a turning course. Lift checks will operate in horizontal lines only. Line pressure lifts the disc from the seat as fluid flows through the valve. The disc is equipped with a guide which allows it to move vertically. The disc is automatically seated by backflow, or by gravity when there is no flow and is free to rise and fall depending on the pressure under it. They are generally used in combination with globe valves.

D. Angle Valve

These valves have the same operating characteristics as globe valves. They are used when making a 90° turn in a line. It reduces the number of joints and saves make-up time.

E. Plug Valves

Plug valves operate by turning of a plug by means of a wrench or handle. There are two general types of plug valves which are lubricated and non-lubricated.

1. Lubricated Plug Valves
These are used in application where the possible contamination of the fluid flowing through the line is of no importance. They have either a tapered or cylindrical plug. A circulation of lubricant, under pressure as the valve is opened or closed, is maintained through sealing grooves machined on the surface of the plug. The function of pressure lubrication is to keep the plug in a freely working condition, to seal against leakage, and to protect the adjoining surfaces from wear and corrosion. Lubricant under pressure is provided and maintained by turning of the lubricant screw.

This valve makes use of a principle known as Pascal's Law whereby the pressure exerted by the lubricant screw on the

CONT...

lubricant is transmitted through the grooves and the resultant force multiplied depending on the area upon which the lubricant acts.

a. Proper lubrication - The use of the proper lubricant is most important since, in operation, the valve structure and the lubricant or sealing film are an integral unit, each component dependent on the other for effective performance.

For efficient hydraulic action and lubrication, the lubricant system must be kept completely full of the proper type of lubricant. The type of lubricant used is dependent on several considerations.

1. The material flowing in the line.
2. The temperature of the material.

A lubricant that is recommended for, let's say, water between 50° F. and 175° is not suitable for water below 50° F. or above 175° F. Nor is it suitable for, say, oil at 100° F. Each application has to be considered on its own merits and the proper lubricant determined from the service conditions of the valve.

New valves normally come with an "assembly" lubricant in the valve. This lubricant should be replaced with the proper lubricant as its only purpose was for use when testing the valve at the factory.

2. Non-Lubricated Plug Valves
These are used where contamination of the product, as foods or certain chemicals, must be avoided. It consists of a plug cock equipped with a mechanical device that lifts the plug from the body seats, turns it the required 90 degrees and reseats the plug tight in the body seats in a single operation. No lubrication is required to seal the valve. The valve is sealed against pressure by a packing gland.

FLANGES

Used for the joining of pipe and also for connecting pipe to valves and equipment. Flanged joints are made up by bolting the two flanges together with a gasket between their machined faces to assure a tight seal.

A. Types of Flanges

1. Weld Neck
2. Slip On
3. Lap Joint
4. Screwed
5. Socket Welding
6. Blind
7. Reducing

B. Pressure Ratings

1. A.S.A. (American Standards Association)
   - a. 150#
   - b. 300#
   - c. 400#
   - d. 600#
   - e. 900#
   - f. 1500#
   - g. 2500#
2. A.P.I. (American Petroleum Institute)
   - a. 2000#
   - b. 3000#
   - c. 5000#
   - d. 10,000#

The above ratings do not apply to cast iron flanges and do not indicate the actual allowable working pressure but only the Primary Pressure Rating based upon the relation between temperature and pressure of the fluid in the line.

3. Cast Iron Flanges
   - a. Class 125 (125# Steam)
   - b. Class 250 (250# Steam)

C. Types of Facings

1. Raised face
2. Flat face
3. Ring Joint
4. Male & Female
5. Tongue & Groove

Flanges come from the factory with a machine tool finish on the facing. This facing should be protected prior to use of the flange with a coat of grease and a cover plate. Dirt or

CONT...

sand, if allowed to come into contact with the face, may score or damage the machined finish. A coating of grease on the facing will prevent the formation of rust. All grease, dirt, sand, etc. should be removed by a thorough cleaning of the flange with a solvent prior to use of the flange.

Cleanliness of the flanged joint cannot be overemphasized. A pressure-tight connection is dependent upon a true seal between the machined faces of the flanges and a gasket between them. Any foreign material on the facing such as dirt or sand will prevent the joint from being made pressure tight. The fact that the joint is not pressure tight will not usually be discovered until pressure is applied to the joint in a hydrostatic test.

Flange facings should be alike. Do not attempt to get a tight flanged joint with flange faces which are not alike. Steel valves and fittings are normally manufactured with raised flange faces. Cast iron valves and flanged connections in equipment such as pumps have cast iron flanges with flat faces. Although the drilling templets of Class 125 case iron and 150# ASA steel are alike and Class 250 cast iron and 300# ASA steel are alike, cast iron flange should not be made up to steel flanges unless the raised face on the steel flange is removed and a full face gasket used. Unless this is done there is a very good chance of breaking the relatively brittle cast iron flange when the joint is made.

D. Identification

Flanges are stamped with the necessary information for easy identification and in compliance with code requirements as follows:

1. Nominal size
2. Primary Pressure Rating
3. Material Designator
4. Schedule number or bore of matching pipe

FLANGE STUDS

The number, size and length of flange studs are not arbitrarily selected as a result of what is handy or in stock. One particular size, quantity and length is specified by the American Standard Association (A.S.A) for each different flange size, type and rating. These sizes have been recommended by A.S.A. as those required to safely withstand the pressure for which the flange is intended. The recommended sizes are published in handbooks, catalogues, etc.

For example, a 2" - 150# A.S.A. Raised Face Weld Neck Flange requires 4 - 5/8" diameter x 3" studs. As a result all 2" - 150# Raised Face Weld Neck Flanges come with 4 - 3/4" diameter holes regardless of what company manufactures them. When any two of the above mentioned flanges are bolted together with the 3" length studs and two nuts, there is ample stud thread length engaged with each nut to safely withstand the working pressure of the flanges. This usually consists of a full nut with 1/4" of stud length extending past the nut on each end. If a shorter or smaller diameter stud is used, the studs could possibly fail while the flanges are in service. A longer stud should not be used due to the increased cost.

GASKETS

The kind of gasket used makes a big difference in flanged joints. What is good for one service may not last in another. Gaskets are made in various materials.

1. Rubber
2. Asbestos compositions
3. Metal

For low pressure and cold services rubber gaskets are generally used. For cold service at higher pressures and hot services up to about 750° F., asbestos composition are frequently used. Metallic gaskets are used for intermediate and high temperatures and pressures.

A. Flat Ring Gaskets

These cover the face of the flange to the inside of the bolt holes. The inside diameter of the gasket equals outside diameter of pipe. Their thicknesses range from 1/64" to 1/8". Their width ranges from 1/4" upwards. Narrow gaskets are preferable since they require lower bolt loads for joint tightness, but they must not be too narrow or the bolt load will crush them. Usually made of rubber, asbestos composition, or metal. Used when making up steel to steel flanges and cast iron to cast iron flanges.

B. Flat Full Face Gaskets

These cover the face and the outside edge of the flange. The inside diameter equals the outside diameter of the pipe. The stud-bolts are inserted through punched holes in the gasket. Usually made of rubber or asbestos composition. These are used when making up cast iron to cast iron flanges or cast iron to steel flanges.

Both the flat ring and the flat full face gaskets are specified by thickness for the size and rating of the flange on which they are to be used. For example:

1. 1/16" flat ring gasket for 3" - 150# R.F. flanges (3 1/2" inside diameter x 5 3/8" O.D.)

2. 1/16" full face gasket for 2" - 125# cast iron flange (2 3/8" inside diameter x 6" outside diameter.)

C. Ring Joint Gasket

Usually made of soft carbon steel or alloy steel. They are available in oval and octagonal cross section. Ring joint gaskets fit into the machined grooves in the matching flange faces, and form a pressure tight seal when the

CONT...

flange bolts are tightened. Ring gaskets are specified by number. For example, Ring Joint Gasket #R23 is used with 2" - 600# Ring Joint flanges. These gaskets should be thoroughly cleaned with a solvent prior to their use.

D. Male & Female Gaskets

These gaskets are the same as the flat ring gasket except that the outside diameter of the gasket extends to the outer edge of the large male face of the male flange. Usual thickness - 1/16".

E. Tongue & Groove Gaskets

These gaskets cover the bottom of the recess in the "Groove" flanges. Usual thickness - 1/16".

PIPE SCHEDULE NUMBERS

In 1939, the commonly used pipe terms "Standard," Extra Strong," and "Double Extra Strong" were made obsolete and, instead, pipe wall thicknesses were to be designated by Schedule Numbers.

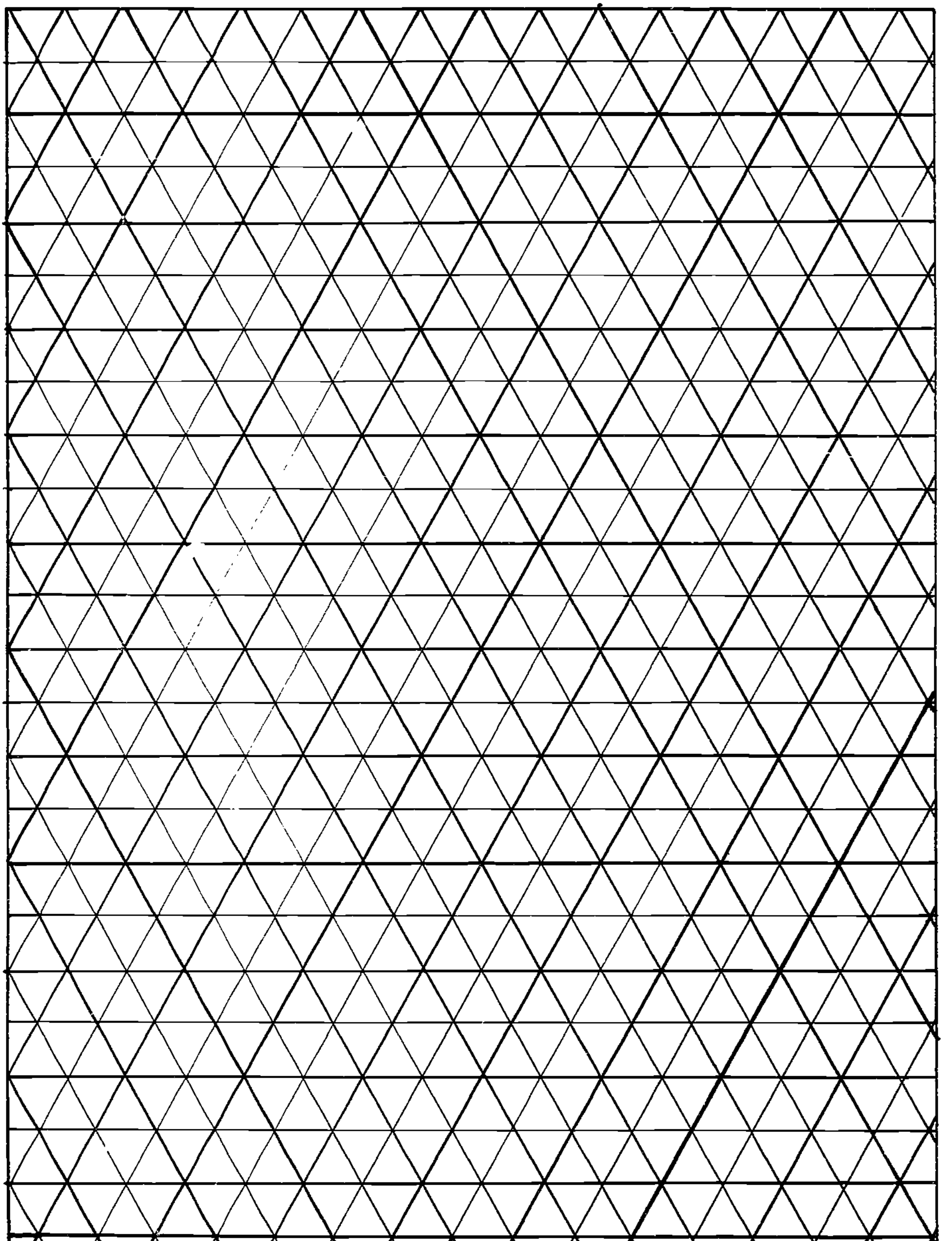
The Schedule Numbers are an approximation of the value of the expression:

Schedule Number - 100 P/S

When P = internal pressure in pounds per square inch, gage.
S = allowable fibre stress in pounds per square inch

Thus it will be seen that the Schedule Numbers represent a rational relationship between wall thickness and pipe diameter this relationship determining into which Schedule Number the pipe falls.

Application of this formula places "Standard Pipe Thickness" pipe in Schedule Number 40 in sizes 10 inch and smaller. "Extra Strong Pipe Thickness" becomes Schedule Number 80 in sizes 8 inches and smaller. The formula is not applied to sizes smaller than one inch. Therefore, dimensions and weights which have been traditional in commercial lists for "Standard Weight" and "Extra Strong" have been retained in pipe sizes 1/8 inch through 3/4 inch.



VT003 265

VT 003 265
Career Development Unit--Personal Development and Human Relations.

Sparks, Mavis C. * Chancey, Gilbert E.
Kentucky Univ., Lexington. Instructional Materials Lab.

Pub Date - Mar67
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*TEACHING GUIDES, HIGH SCHOOLS, TRANSPARENCIES, *DISTRIBUTIVE EDUCATION, *HYGIENE, *PERSONALITY, WORK ATTITUDES, *INDIVIDUAL DEVELOPMENT,

The purpose of this guide is to help teachers develop in high school distributive education students the personal characteristics, social skills, work habits, and attitudes essential to job success and advancement. It was developed by the Instructional Materials Laboratory at state level for use by certified distributive education teachers. Content areas are (1) importance of appropriate dress and grooming, (2) importance of good health habits, (3) appropriate etiquette for distributive employment, (4) practicing good ethics on the job, and (5) development of good work habits, attitudes, and relations with others. Information for student use, a bibliography, and 24 transparencies are included. (MM)

DE 63

CAREER DEVELOPMENT

UNIT: PERSONAL DEVELOPMENT AND HUMAN RELATIONS

Major Teaching Objective

To develop the personal characteristics, social skills, work habits, and attitudes essential to job success and advancement

Suggested Learnings (Competencies) To Be Developed

1. To understand that appropriate grooming and dress are very important in the field of distribution
2. To understand the importance of practicing good health habits in the world of work
3. To exercise the etiquette appropriate for distributive employment
4. To understand the importance of practicing good ethics on the job
5. To develop work habits and attitudes that make work and relations with others easier

Prepared by
Mrs. Mavis C. Sparks
Specialist, Business and Office Education

and

Gilbert E. Chancey
Specialist, Distributive Education

Instructional Materials Laboratory
Division of Vocational Education
College of Education
University of Kentucky

March, 1967

MEMORANDUM

TO: The ERIC Clearinghouse on Vocational and Technical Education
The Ohio State University
980 Kinnear Road
Columbus, Ohio 43212

FROM: (Person) Gilbert E. Chancey (Agency) Instructional Materials Laboratory

(Address) Div. of Vocational Education, College of Educ., Univ. Of Ky., Lexington, Ky. 40506.

DATE: July 28, 1967

RE: (Author, Title, Publisher, Date) Mrs. Mavis C. Sparks, Specialist, Business & and Office Education and Gilbert E. Chancey, Specialist, Distributive Education, Personal Development and Human Relations, March, 1967, Instructional Materials Laboratory.

Supplementary Information on Instructional Material

Provide information below which is not included in the publication. Mark N/A in each blank for which information is not available or not applicable. Mark P when information is included in the publication. See reverse side for further instructions.

(1) Source of Available Copies:
Agency Instructional Materials Laboratory, Div. of Voc. Educ., College of Educ.
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Not available to teachers outside of Ky. One (quantity prices)
or two copies will be supplied to the professional staff in Voc. Educ. that is responsible for teaching materials in each state.

(2) Means Used to Develop Material:
Development Group Mrs. Mavis C. Sparks and Gilbert E. Chancey
Level of Group State
Method of Design, Testing, and Trial Developed for Distributive Education Programs in Kentucky by Instructional Materials Laboratory.

(3) Utilization of Material:
Appropriate School Setting High School
Type of Program Distributive Education first or second year.
Occupational Focus Distributive Occupations
Geographic Adaptability None
Uses of Material Guides for developing lesson plans for teachers use only.
Users of Material Distributive Education Teachers.

(4) Requirements for Using Material:
Teacher Competency Certified distributive education teacher
Student Selection Criteria First or second year - distributive education

Time Allotment

Supplemental Media --
Necessary X
Desirable
(Check Which)

Describe Reference materials as contained with unit and as listed within unit required to prepare lesson plans.
Source (agency)
(address)

DE 63 (3/67)

CAREER DEVELOPMENT

UNIT: PERSONAL DEVELOPMENT AND HUMAN RELATIONS

Suggested Teaching Time

Time or class periods for teaching

Group teaching in classroom, at school ________ ________
Group teaching outside classroom ________ ________
Field trips (away from school) ________ ________

Time devoted to individual projects and training

In classroom, at school ________ ________
Total . . . . ________

Month(s) to be taught ________________

Place of the Unit in the Course of Study

Since personal traits account for about 90 percent of job success, this unit should be taught before employment is secured with the entire class participating. The knowledge and understandings acquired should be integrated with other classwork and should be practiced throughout the year.

The amount of time required for this unit will depend upon the students' need for this training. Factors of appearance and personality in which the students (the majority) are weakest should be given major consideration. Some students may require additional individualized training.

Attention should be given to improving the students' appearance and personality over a long period. This training should not be just a short one-time teaching function.

Suggestions for Introducing the Unit

"To be successful, you should look successful" is an old saying. Generally one can identify successful business people by the way they dress and act. Successful people know that it pays to be well dressed and they pay a great deal of attention to ensuring that their dress and actions are appropriate. A good position demands a good appearance. To secure a good position, your appearance should fit what is expected in a successful business. Often, employees fail to be considered for promotion because they do not exhibit the appearance desired in the organization.

There are many factors which affect appearance. Each of these factors can be enhancing or detracting to the impression that your appearance makes upon others. Often people are not aware of the factors that create unfavorable impressions. Each student should analyze his or her appearance to ensure that posture and bodily movements, facial expressions, physique, health, grooming, dress and mannerisms are positive rather negative factors.

Deciding What Is to be Taught

Since the area of personal development crosses all vocational and general studies areas, its study in distributive education classes should be devoted specifically to areas applicable to the distributive situations. Students having special problems may be referred to the home economics, speech, physical education or health teacher for further training. In some cases they may need to be referred to a specialist.

Competencies and learnings to be developed should be determined. The students may be well oriented in health and grooming, for example, but have little knowledge of work habits desirable in distributive situations. Knowledge of socio-economic background, content in other courses studied, subjective evaluations of the personal appearance of the individuals in the class, along with student checklists will be helpful in deciding what to teach. Arrangements should be made to provide appropriate instruction both for males and for females. Class activities should be planned so that both sexes are not embarrassed at being in the class, made to feel left out, or made to think that this is an area important only to one sex.

Introducing the Unit to the Class

Some approaches which may be used in beginning the unit with the class are:

a. Show and discuss the transparency "Will You Be A Success?" (DE 63 TM1)

b. State attention-getting facts such as those below to emphasize the importance of a desirable appearance and personality:

-- Experience and opinion surveys show that employers want workers who are sociably acceptable.
-- Analysis of factors relating to job success reveals that 90 percent of dismissals are due to poor personal traits rather than lack of skills.
-- A United States Government survey showed that girls with charm training make $50-$100 more per month than those with comparable training without the charm course.

c. Define personality and manners (everyday and dictionary). It is easier to recognize an unattractive personality than it is to define the specific items that makes acceptable personality. Constantine Panunzio in her Student's Dictionary of Sociological Terms gives this definition:

> "The totality of qualities and characteristics of a given person, ordinarily attributed to original nature, expressing themselves in modes of carriage, language, manners, clothes, ways of speaking, interest, attitudes, and other reactions to the social milien."
> (See transparency master DE 63 TM5)

d. Discuss appropriate quotations such as:

- -- "A false sense of humility is just as phony as a false sense of superiority." -- anonymous (See transparency master DE 63 TM2)
- -- "A genuine person has the same qualities at home and in his social life as he has on the job." -- anonymous (See transparency master DE 63 TM3)
- -- "Unless a garment fits well and is worn with grace, it cannot be made 'smart' by quality or cut." -- anonymous (See transparency master DE 63 TM4)

e. Have displays illustrating the whole picture of personal development.

- -- Manners are the "frosting" on your cake.
- -- On what are we judged? (Show picture of a judge)
  - (1) What we think
  - (2) What we say (Show illustrations of these)
  - (3) What we do
- -- "U" are Unique! (List and illustrate various personality traits)
- -- Formula for personality:
  - (1) Do more than exist -- Live
  - (2) Do more than look -- Observe
  - (3) Do more than read -- Absorb
  - (4) Do more than hear -- Listen
  - (5) Do more than listen -- Understand
  - (6) Do more than think -- Ponder
  - (7) Do more than talk -- Say something
  - (8) Do more than desire -- Do something about it!

f. To change one's personality and manners, one must adapt himself or herself to the acceptable modes of the society in which one exists. Harry H. Hepner is his Psychology Applied to Life and Work states:

> "Adaptability is far more than knowledge. It is a mental habit that can be acquired by anyone who really seeks it. Adaptability is the habit of finding and using opportunities in the environment and following not the line of least resistance but those of greatest opportunity. The habit of acquiring new points of view, new skills, new facts, and new habits can be learned." (See transparency master DE 63 TM6)

g. Have students analyze themselves to point up areas for individual and group emphases. A rating sheet may be used. Responses may be secured by reading a list of desirable traits and having each student indicate areas of weakness or areas in which he is interested in improving.

Learnings (Competencies) To Be Developed

1. To understand that appropriate grooming and dress are very important in the field of distribution

Before studying the fundamentals in grooming and dress, it should be pointed out that appearance is important in job success and that grooming and dress requirements may differ according to the type of position held.

This may be done by illustrating and evaluating, in terms of appearance, men and women holding important distributive positions. Some types of employment require conservative, expensive clothing while others require durable, inexpensive work clothes.

Standards of Good Business Dress

a. William Shakespeare wrote "For the apparel oft proclaims the man." Students' dress habits are normally swayed by the modes established within their group. Such fashions, although providing a sense of security when one is within his own group, are often not appropriate in the business world. Extremes in style have great attention value within one's own group but are questionable devices for gaining admiration in the business world. A young person entering the world of work should first observe what other employees are wearing. He should then confine his dress to similar items that will be considered appropriate to the activities required in employment. Young workers should abstain from loud and gaudy colors, excess ornamentations, current fads, extreme styles, and being too casual or too formal in dress.

b. Generally, business clothing is more subdued than the clothing students are accustomed to wearing. Students should carefully plan wardrobes that will be suitable to their employment and working conditions, to their physical build, and to their particular individuality. (For some persons certain colors are not appropriate.) Students should avoid the effect of cheapness in their dress. Neither should students strive to obtain the most expensive clothing. Careful study and research should lead to the development of good tastes in dress.

c. Persons when choosing clothing items should carefully consider:

- -- Appropriateness of dress, jewelry, footwear
- -- Distracting influence of dress
- -- Acceptable dress customs for employment and working conditions
- -- Overcoming physical characteristics through dress (See transparency master DE 63 TM7)

Standards of Good Business Grooming

a. There are few reasons why any person in the United States should be unaware of standards of good grooming. Advertising media constantly remind us of the importance of good grooming. A person cannot change his physical appearance to a great extent but he can keep himself groomed properly. "Body odor" or "halitosis" is unexcusable. Yet, there is a large number of persons who allow this offensive condition to exist. Frequently we offend others unknowingly with our bad habits of grooming and sanitation. We should constantly be on guard to insure that we are properly groomed at all times. Only if we are honest with ourselves and face up to the facts can we be sure that we possess no faults. (The checklist on page 22 of <u>How to Improve Your Personality</u>, 3rd edition, will assist in testing for proper grooming.) Every bad habit of grooming can be corrected. Students should become aware of the necessity for good habits pertaining to:

-- Cleanliness and personal hygiene
-- Proper use of daytime cosmetics
-- Attractive business hair styles
-- Well-kept hands and nails
-- Good posture
-- Distraction caused by grooming on the job
(See transparency master DE 63 TM8.)

Behavior Affecting Appearance

a. Even the best of appearances can be torn down if one has habits, attitudes, and mannerisms that antagonize others. An initial impression containing anatagonizing habits, attitudes, and mannerisms often cannot be overcome. (Pages 25 and 26 of <u>How to Improve Your Personality</u>, 3rd edition, contains a list of fifty habits and attitudes that are handicaps and which antagonize others. Page 59 of same book list some feminine and masculine gestures that should be avoided.)

-- Annoying mannerisms
-- Actions affecting personal appearance

Summary

One needs a yardstick to measure his achievement in proper grooming. It would be better if a person could see himself as others see him. (See transparency master DE 63 TM9.) This is not always feasible. To simplify the grooming process, one should establish certain tests and checks that will ensure proper grooming of himself. (Check lists for men and women are on pages 84 and 85 of <u>Business Behavior</u>, 3rd edition.)

<u>Suggested Teaching-Learning Activities</u>

a. An important objective is to arouse an awareness within each student to investigate and determine what is considered the well-dressed look for business.

b. Use lectures and demonstrations by local beauticians, barbers, the school nurse, representatives from make-up studios, home economics experts, personnel managers, teachers of "executive" courses in local business schools or other qualified people. (Some of your students may have taken charm courses or have done modeling.) Also have students complete over a period of time the tests as shown on pages 140 and 141 of Store Salesmanship, 6th edition.

c. Show advantages of simplicity in clothes--dark versus light colors for easy care; basic, classic, tailored clothes for good style through several seasons versus fads and short-lived styles. Teach the wisdom of keeping a clothing budget.

d. Discuss types of jewelry and dress which distract on the job.

e. Discuss uniforms and dress suited for working conditions; how to dress to disguise physical shortcomings.

f. Explain and illustrate mannerisms which annoy co-workers.

g. Explain reasons for a company policy regarding gum chewing, smoking or eating on the job.

h. Have students come to class dressed in proper business attire.

i. Have students demonstrate correct and poor posture.

j. Have students list the changes in their present wardrobe that will be necessary when they enter the business world.

k. Have students decide what "lines" of costume are most becoming to them. Have them decide what facial shape they have and what lines of hairdos or haircuts are best for their facial shape. (See pp. 60-67, How to Improve Your Personality for information pertaining to young women.)

References for Student and Teacher

a. Basic sources of information

-- Business Behavior (3rd edition), pp. 65-75, 79-87
-- Etiquette, pp. 454-467, 468-489
-- Fundamentals of Selling (8th edition), pp. 131-142
-- How To Improve Your Personality (3rd edition), pp. 23-24, 46-54, 55-59 and 60-67
-- Retail Merchandising (6th edition), pp. 572-574
-- Retailing Principles and Practices (4th edition), pp. 47-50
-- Sales Horizons (2nd edition), pp. 56-57
-- Salesmanship Fundamentals (3rd edition), pp. 88-101
-- Store Salesmanship (6th edition), pp. 137-142
-- The P.I. Instructor (P.I. for "Personal Improvement"), a magazine free to all schools which deals with upgrading students in grooming and interpersonal relationships. Charm Division, Milady Publishing Company

b. Supplementary sources of information

-- Integrated Secretarial Studies (Jubilee edition), pp. 6-9
-- Secretarial Office Practice (6th edition), pp. 15-28
-- Clerical Office Practice (6th edition), pp. 14-26
-- A Secretary's Guide to Beauty, Charm, and Poise. Milady Publishing Company, 3839 White Plains Rd., Bronx, N. Y. 10467. Approximately $7.50. When bought in quantity, there is a considerable price reduction. ("Success Insurance," a student booklet containing personality tests, grooming charts, etc., can be purchased to accompany this book for a small charge. It is free if the student purchases the chart book. Also available is a series of 300 slides on different phases of grooming.)
-- Charm. Gregg Division, McGraw-Hill Book Company, 1964, $6.95

Instructional Materials

a. Teaching aids

-- Good grooming charts for men and women. "Good Grooming Is Good Business" for girls. Available free from Lever Brothers Co., 390 Park Ave., New York, N. Y.
-- Color charts. Charts for girls available as basic references. A chart suitable for the boys is given in the supplement attached to the back of this unit. Also a chart is shown on page 70 of Business Behavior (3rd edition).
-- Stain removal charts. Lever Brothers Co., listed above, publishes a chart free to teachers which is very good on stains likely to be encountered by distributive workers. Cookbooks are also good sources for charts of this nature.
-- Pictures of up-to-date business fashions. Secretarial, office, women's and men's magazines are good sources for these.
-- Pictures of up-to-date hairdos and haircuts. Beauty shops and barber shops may be able to lend appropriate magazines and advertising posters. The magazines mentioned above are also good sources.

b. Booklets and leaflets for the students

-- For the girls
"Do You Pass the Model Test?" H. W. Gossard Company, 111 N. Canal St., Chicago 6, Illinois, (free)
"How to Dress Like a Model," H. W. Gossard Co., $.10.
"Secrets of Dress and Grooming," (Better Secretary Series) Prentice-Hall, Inc., 1961, Englewood Cliffs, N. J. 17632, small charge
-- For the boys
"Good Grooming Guide," Esquire, Circulation Dept., 488 Madison Avenue, New York, New York 10022, $1
"What Every Clerk Should Know." National Association of Retail Grocers, 360 North Michigan Ave., Chicago, Illinois 60601, free
-- For both girls and boys
Guide to Good Grooming (5-862), Science Research Associates, Inc., 259 E. Erie St., Chicago, Illinois 60611, $.65 each

c. Films

- -- "How to be Well Groomed," University of Kentucky, 1 reel, $1.50, for boys and girls
- -- "A More Attractive You," Modern Talking Pictures, 1212 Avenue of the Americas, New York, New York 10036, free. Accompanying beauty and health hint booklets are available free, for girls.
- -- "The Beauty Habit," Modern Talking Pictures
- -- "Good Looks," Association Films, 324 Delaware Ave., Oakmont, Pennsylvania 15139, boys and girls, 20 min. color
- -- "Dressin' Up," Association Films, boys and girls, 13½ min., color
- -- "Lessons in Loveliness," Association Films, girls (makeup), 12½ min., color

2. <u>To understand the importance of practicing good health habits in the world of work</u>

Good health is important

a. The first step in obtaining good health is the observation of good health habits. Many people do not appreciate good health until they are in danger of losing it. If one abuses his health, his health will eventually break down. Good health can build vitality and confidence which will reflect an attractiveness that can be magnetic. Good health provides the basis for physical endurance which is necessary for a successful career in distribution.

b. Health is important in job success in the areas of job advancement, enjoyment of work, and mental well-being. The effects of poor health on job success are seen in absenteeism, chronic afflictions, job dissatisfaction, and job dismissal due to health.

Workers should maintain good physical health. A good retail person is a person who takes pride in achieving a pleasing personal appearance that has evolved from good grooming, health habits, and personality development. To maintain good physical health, one should consider:

a. Cleanliness. Many men have a reputation of not bathing often enough. "B.O." is just as bad in a man as in a woman. Men often are careless about beard growth, dirty hands and fingernails. Some smokers often emanate tobacco odor. Some persons are guilty of permitting dandruff fallout to accumulate on their clothing. Frequent shampooing of hair normally will control dandruff. (See transparency master DE 63 TM')

b. Eating habits. (Food is fuel for efficiency, energy, and endurance.) Many distributive education students, having had numerous health classes throughout their schooling, may fail to see the necessity for health education. Good health habits, especially good eating habits, are very important to persons entering the distributive field of work. Students, because of working conditions and hours of employment, have inclinations to skip meals or to eat foods (especially sweets and starches) which do not provide the required energy for endurance. (See transparency master DE 63 TM11.)

c. Medical and dental examinations. One should not wait till something is wrong before visiting a doctor or dentist. Visits should be made to a doctor at least once a year and to a dentist twice a year. (See transparency DE 63 TM12.)

d. Posture. A habit that can be developed is good posture. Unless one has physical defects, there is no reason why an individual cannot develop good posture. A poor posture is often an indication of an apathetic, indifferent, disgruntled individual. One who walks tall, stands tall, and sits tall provides a reflection of an energetic, enthusiastic individual. Shoulders back, abdomen in, and ears reaching for the ceiling will help in developing a good posture. (See transparency DE 63 TM13.)

e. Rest. At least eight hours of sleep is required for growing youth. Distributive education students are usually growing youth. Proper rest is also reflected in one's personality and appearance. Sufficient rest is required if one is to be alert and efficient at work. (See transparency master DE 63 TM14.)

Aids to good mental and neurological health

a. Leisure-time activities. Participating sports provides one a key to recreation. Other extracurricular activities (such as those obtainable through DECA) can furnish enjoyable relaxation. Every person should exercise regularly and vigorously each day. (See transparency master DE 63 TM15.)

b. Emotions and mental health. Harry W. Hepner is his book Psychology Applies to Life and Work wrote that "those who distribute goods work in the dynamic area of ideas." Hepner believes distributive personnel should look upon such work as more than a way of earning a living. A career of this nature has social values which a person should regard as important and should respect. Yet, our distributive system contains many unrelenting pressures. Conflicts abound in the world of work. One must learn to control negative emotions that might arise. It would be much better if a person could substitute positive emotions before the tendency to submit to negative emotions. Individuals should plan a campaign to control negative emotions. The first step is identifying the emotions. The next step is determining when, how, and why (the circumstances surrounding) the emotions occur. The third step is to determine the actions required to control these destructive emotions. The fourth step is the application of positive measures required. The best defense against negative emotions is to develop enthusiasm for the work to be done. Anyone, who is confident, has faith in and possesses optimism about the job to be done, and strives to accomplish his beliefs, is a better mentally adjusted person. (See transparency master DE 63 TM16.)

Summary

To succeed in the world of distribution, one should develop good habits that will lead to advancements. Many of our faults can be corrected if we will take the time required to identify them, determine remedial actions, and apply positive measures to ensure desired changes. Often, mental alertness and the necessary desires for corrective actions will provide improvements that will develop greater job happiness and success.

Suggested Teaching-Learning Activities

a. Use talks by the health teacher, school nurse, home economics teacher, physical education teacher, or other qualified people.

b. Discuss the importance of breakfast, well-balanced meals, and dangers in unregulated diets and food fads. Point out the wisdom of regular physical, dental, and eye examinations.

c. Have students observe the effects of good and poor eating habits on themselves or others.

d. Explain health aspects of well-fitted, nonrestrictive clothing and shoes.

e. Explain the necessity of sufficient sleep to avoid job fatigue.

f. Evaluate recreation as counter-active to daily occupation; for example, active versus spectator sports; hobbies; cultural and intellectual activities.

g. Identify recreations not recommended, such as those similar to daily work, dissipating activities, and those which interfere with daily work.

h. Discuss the problem of submerging personal problems while working.

i. Have each student record his or her entire food intake for two days and evaluate his diet. (This could also be done for rest and exercise.)

j. Have the students list various places in the community where there are opportunities for regular exercise.

References for Student and Teacher

a. Basic sources of information:

-- Business Behavior (3rd edition), pp. 51-60
-- Fundamentals of Selling (8th edition), pp. 135-139
-- How to Improve Your Personality (3rd edition),
pp. 47-50, 200-208

- -- Retail Merchandising (6th edition), p. 575
- -- Retailing Principles and Practices (4th edition), pp. 48-50
- -- Sales Horizons (2nd edition), pp. 56-57
- -- Salesmanship Fundamentals (3rd edition), pp. 89-90, 114-115
- -- Store Salesmanship (6th edition), pp. 138-139, 153-154

b. Supplementary sources of information--same as for Learning 1

Instructional Materials

a. Teaching aids

- -- Calorie charts (Available in health books and cookbooks.)
- -- Exercise charts (Charm books and health books offer appropriate illustrations for girls. Consult with the physical education teacher for appropriate illustrations for boys.)
- -- Posture charts (Sources mentioned above, plus illustrations in the typewriting books and typewriting posture posters.)

b. Films

- -- "Improving Your Posture," University of Kentucky, 1 reel, $1.50, for boys and girls.

c. Booklets and leaflets for the students

-- For boys and girls (Available from Science Research Associates, Inc. for $.65 each.)
"Your Behavior Problems" (5-800)
"You and Your Health" (5-517)
"Growing Up Emotionally" (5-866)
"Enjoying Your Leisure Time" (5-515)

3. To exercise the etiquette appropriate for distributive employment

Many young people are especially weak in knowing specifically **what etiquette** is appropriate for distributive employment. Others **are indifferent** to or lax in using appropriate etiquette. Employees **who constantly** are before the public must be on guard at all times **to be sure** their actions will generate customer goodwill. Discovering **what is proper**, and then using mental alertness in applying appropriate **etiquette**, is of great importance for job success. Distributive **employees** should become familiar with several important areas of etiquette.

General behavior

a. A definition for behavior is "the manner of conducting oneself." Thus, behavior is the way we live our daily life. This daily living involves many activities, including our actions and our associations with others.

b. The manner in which we conduct ourselves daily stamps us with either good, poor, or bad behavior.

c. Some people appear to have been born with proper behavior patterns. Actually, behavior patterns are acquired from things we have observed and learned. Behavior patterns can be changed if one wishes them changed. General behavior has many aspects far too numerous to list. However, some general behavior patterns important in distribution are:

-- Common courtesies
-- Consideration of others, and their property
-- Degree of sincerity--compliment frequently and honestly
-- Tactfulness--consideration of others and their feelings
-- Cheerfulness--reflects confidence
-- Willingness to assume more than your share
-- Agreeableness--not demanding your way all the time
-- Avoiding faultfinding and discussion of others
-- Generosity--not so much with money but with your time, praise, thoughtfulness, kindness, smiles, understanding, empathy, appreciation, courtesy, work, and effort
-- Crudities of speech
(See transparency masters DE 63 TM17 and DE 63 TM18)

d. Alleen R. Russon in Business Behavior (pp. 31 and 32) states some excellent principles underlying business behavior.

Acceptable business and social customs

a. It has been stated that manners are a part of one's character. Manners evolve from customs.

b. One definition for custom is the usage or practice common to many or to a particular place or class.

c. Certain usages or practices have developed within our business and social worlds. Persons who do not conform to these are considered ill-mannered.

d. Some usages and practices which have evolved concern:

-- Formality in the business setting
-- Acceptable business ethics, behavior, and customs
-- Procedures concerning gifts and collections
-- Principles regarding the degree of separation of business life from the social life
-- Responsibility involving family life
-- Customs concerning table etiquette, expenses, and tipping
-- Telephone use

Maintaining harmony and morale

a. The "U" in you will determine how well your associations with others are accepted. A person who continues to improve his human relations skills should discover friendlier relationships with his fellow employees, as well as his superiors.

b. Assuming a fair share of the workload, being friendly with all persons regardless of their positions, being cheerful and maintaining a smile, and keeping a right frame of mind are some things which will assist a person in making necessary adjustments on his job.

c. Things to be aware of include:

   - -- Non-acceptance of group standards. Self-control is often required to accept rules and regulations that have been established. A person should not allow himself to seethe over trivial things.
   - -- Friction. Avoid feuds and cliques like you would a plague. Do not become involved in personal affairs and romances. Perform a fair share of the workload. Accept reprimands with thanks.
   - -- Conflicts in personalities. Accept the individualities of your fellow employees and supervisors. Keep your balance and do not react to facades that may not represent the real situation.
   - -- Difficulties of work. New employees usually are not expected to be perfect. Accept your errors and mistakes with grace. Avoid gossip, especially with a "tattletale." (See transparency master DE 63 TM19)

Summary

A constant awareness and a desire to succeed will greatly assist the new employee in adjusting to the working conditions he encounters. It may be well for the new employee to be somewhat impersonal and detached until he has become more familiar with the firm and his fellow employees.

Suggested Teaching-Learning Activities

a. Explain briefly differences that men and women may expect in business etiquette as compared to social etiquette.

b. Teach proper forms of business greetings, introductions, and common business courtesies.

   - -- Discuss several ways to begin a conversation with a new employee or a new acquaintance.
   - -- Discuss ways to help one remember names.
   - -- Have the students dramatize at least five types of introductions common to the business situations.

c. Discuss how a business employee should handle situations involving profanity, slang, and obscenities.

   - -- Have each student list ten "trite" expressions which he uses and for each write a proper substitute.

d. Discuss when not to use first names and nicknames, and the dangers of a social club atmosphere in business.

  -- Point out dangers of employees losing dignity at general holiday parties or special celebrations for co-workers.
  -- Discuss good or bad points in forming friendships with co-workers and in having business romances.

e. Distinguish between collections for organizations and co-workers (the times and places of each); distinguish between receiving personal gifts from co-workers or employers, and those from customers or salesmen.

f. Explain harm done by agitators and gossip and how irritability can be caused by fatigue, inequitable work distribution, salaries, and promotion.

  -- Explain techniques for dealing with difficult co-workers, moodiness, and temperaments.
  -- Discuss the necessity of working under pressure, meeting deadlines, building esprit de corps, and teamwork.
  -- Have the students describe a human-relations problem which exists among those they know and tell what might be done to correct the situation.
  -- Have each student choose a person with whom he has a "strained" relationship and attempt to improve this relationship.
  -- Have each student make a list of all the negative statements heard during a single day. Have the class discuss positive substitutes.

g. Mention the necessity for everyone to maintain an acceptable business appearance--dusting, supplies, cleaning equipment.

References for Student and Teacher

a. Basic sources of information

  -- Business Behavior (3rd edition), pp. 31, 145-152, 159-170, 267-282
  -- Fundamentals of Selling (8th edition), pp. 147-162
  -- How To Improve Your Personality (3rd edition), pp. 98-118, 123-162, 169-208
  -- Retail Merchandising (6th edition), pp. 574-576
  -- Retailing Principles and Practices (4th edition), pp. 47-53
  -- Sales Horizons (2nd edition), pp. 56-81
  -- Salesmanship Fundamentals (3rd edition), pp. 66-81
  -- Store Salesmanship (6th edition), pp. 143-154

b. Supplementary sources of information

  -- "Instant Etiquette for Businessmen," Arco Publishing Co., 219 Park Avenue South, New York, N. Y. 10003, $.95 (paperback)
  -- Art and Skill of Getting Along With People, Prentice-Hall, Inc. 1961

- -- Etiquette in Business, Gregg Division, McGraw-Hill Co., 1961, $6.50
- -- Etiquette by Emily Post, "Etiquette in Business," pp. 544-559, New edition, $2.00, Funk and Wagnalls Company, Publishers, New York, 1945
- -- Vogue's Book of Etiquette, "Men's Manners," pp. 25-32; and "Women's Manners," pp. 33-35, $3.50

Instructional Materials

a. Films

-- "Improve Your Personality," University of Kentucky, 1 reel, 10 min, $1.50, for boys and girls. Defines personality and illustrates several ways in which it can be improved. Shows boys and girls of high school age, in typical situations, with friends, strangers, and "small fry." Stresses concentration on the other person as one effective means of improving your personality.

b. Booklets and leaflets for the students

-- "Table Manners," Ladies Home Journal, P.O. Box 1155, Weston, Connecticut 06388, 25¢
-- "Office Etiquette," Ladies Home Journal, 25¢
-- Available from Science Research Associates, Inc. for $.65 each:
"Exploring Your Personality" (5-594)
"Making and Keeping Friends" (5-565)
"How to Solve Your Problems" (5-561)
"Understanding Yourself" (5-152)
"Growing Up Socially" (5-510)
"Where Are Your Manners" (5-567)

4. To understand the importance of practicing good ethics on the job

Long-term job success, harmony, and good morals in any firm depend on all employees following the basic principles of good moral philosophy. Employees have as much responsibility as the owners of a firm to ensure that the money invested earns a profit. The ultimate goals of all should be to safeguard the success of the firm. Employees and employers should develop appreciation for the other's interests and problems. This appreciation must also be expanded to the firm's customers. The customer goodwill and satisfaction created will be the determining factor whether employment opportunities will continue to exist. Thus each employee must develop a set of moral principles and values which will fit harmoniously with the goals and objectives of the firm.

Good ethics in distributive businesses

a. Man, possessing knowledge, skills, and characteristics required for the operation of a firm, is also a religious, social, political, economic, and psychological creature.

Thus man is not a machine. He is a human and cannot eliminate other phases of his life from his employment situation. Distribution, being people-oriented, must involve itself with this qualitative, changing, and abstract human factor. There must be a mutual concern between employers and employees for the welfare of the other.

b. If mutual concern is to exist, each employee must develop good work habits. Some work habits that should be developed involve time, neatness, efficiency, integrity, judgment, loyalty, morality, honesty, responsiblity, dependability, trustworthiness, and adequate consideration for the rights of others. Many persons need to learn the dignity of a good day's work. Some things which affect good work habits are:

-- Absenteeism
-- Punctuality
-- Stalling or loafing on the job
-- Using company time for personal matters
-- Borrowing company equipment, supplies, or money
(See transparency master DE 63 TM20)

c. In addition to being loyal to one's employer, an employee must also be loyal to his fellow-employees. An employee should assume his fair share of the workload. He should not irritate his co-workers with negative habits. An employee should not blame or criticize his co-workers for mistakes or faults. Respect for the private lives of others should be observed at all times. Regardless of one's position, abilities, and knowledge, an employer should follow established procedures and respect the lines of authority. Employees should develop suitable beliefs concerning:

-- Loyalty to employers
-- Loyalty to co-workers
-- Actions to be undertaken where conflicting loyalty situations arise (working for several supervisors and decisions regarding resignations)

Summary

Teamwork is very important in the distributive world. When a person is not available to perform his share of the workload, other employees must assume responsibility for performing the functions required to service customers. Some workers, even though present, exert negative influences on their fellow-workers. Jealous, resentful, or tricky persons who are not ashamed of taking advantage of others can do tremendous damage to the future of any business. New employees, just beginning a career in distributive businesses, must remember that it is their responsibility to get into step with the basic principles of good moral philosophy which are necessary for a firm to be successful.

Suggested Teaching-Learning Activities

a. Teach the economic principles of employment: (1) The company has invested time and money in equipment, goods and in training employees to give service in return for a fair profit. (2) The employee has also invested his time and money in the company.

b. Use the moral precept that stealing time is similar to stealing money--a form of dishonesty or "biting the hand that feeds."

c. Contrast absences for sickness versus those for personal matters.

d. Show the unfairness of tardiness; unnecessarily prolonged lunch hours, coffee breaks, and time in restrooms; stalling or loafing.

e. Teach the unfairness of using company time for such personal matters as telephone calls, visitors, and personal work; and of using company supplies, equipment, or money for personal matters.

f. Point out wisdom of keeping information confidential, adhering to firm policies, and established lines of authority.

g. Show that loyalty includes avoiding outside activities which interferes with work; that it also includes obligation to work to capacity, with regard to quality and quantity of work.

h. Point out that loyalty to co-workers demands avoiding gossip and "under-cutting."

i. Point out that giving adequate notice to employer, training replacement, and speaking well of previous employer when leaving a job are considered ethical in the business world.

j. Questions for student discussion:

- -- Could you be loyal to an employer whose business practices you have learned are dishonest?
- -- Give some examples of how you can show loyalty on the job.
- -- What are some means of saving supplies and equipment?

k. Class discussion of case studies involving punctuality and use of company supplies. See "Case Studies" at end of unit.

References

Basic sources of information

- -- Business Behavior (3rd edition), pp. 117-118, 145-152, 161-170
- -- Fundamentals of Selling (8th edition), pp. 151-152, 157, 516
- -- How To Improve Your Personality (3rd edition), 127-128, 180-196, 200-201

- -- Retail Merchandising (6th edition), pp. 596-599
- -- Retailing Principles and Practices (4th edition), pp. 73-77, 79-82
- -- Sales Horizons (2nd edition), pp. 210-211
- -- Salesmanship Fundamentals (3rd edition), pp. 75, 80, 82
- -- Store Salesmanship (6th edition), pp. 151-153, 343-345, 351

Instructional Materials

a. Booklets and leaflets for students

- -- "How to be a Super Secretary," Remington Rand, free, for girls
- -- "The Girl With the Halo," Underwood Corporation, free, for girls
- -- "A Fair Day's Work for a Fair Day's Wage," (The personality and attitudes necessary to a good day's work), by Peggy Norton Rollason, March, 1965, 2 pages, $.15 (Order from Reprint Department, Today's Secretary, 330 West 42 Street, New York, N. Y. 10036)
- -- "Ethics for Everyday Living" (5-1175), Science Research Associates, Inc., $.65
- -- "What Is Honesty?" (5-593), Science Research Associates, Inc., $.65

b. Films

- -- "Personal Qualities for Job Success," Coronet Films and University of Kentucky, 1 reel, 11 min., $2.50
- -- "How to Keep a Job," Coronet Films, Coronet Building, Chicago 1, Illinois, 11 min., $2.50

5. To develop work habits and attitudes that make work and relations with others easier

A combination of many personal traits and attitudes is required to obtain success in life. Different persons have conflicting ideas about the meanings and the values of these traits and attitudes. These conflicting ideas are the result of many factors. Some of these factors are environmental influences (home and community in which one is raised, schools one has attended, etc.), level of education, religious background, association influences, and the like. There is no definite agreement about the depth and scope any given trait or attitude should encompass. Each person must arrive at his own understandings of the meaning and value of these traits and attitudes. (See transparency master DE 63 TM21.) Yet, a person's understandings and values must conform to those of the majority of our society or one will be looked upon as being a nonconformist. One should determine acceptable meanings for the terms used to designate characteristics. One should then compare his own understandings and values with those considered acceptable by society. From such evaluations, one should determine the place of these characteristics in his own life. Some of the many characteristics which have tremendous influence on a person's life are:

a. Characteristics which make work easier and involve the best method for accomplishing a job

accuracy
adaptability
alertness
awareness
common sense
dependability
discretion
efficiency
emotional stability
endurance
following directions
foresight
good habits
honesty
humor
industriousness
ingenuity
intelligence
interest
judgment
memory
organization
patience
persistence
pride in work
punctuality
resourcefulness
responsibility
thoroughness
versatility

(See transparency master DE 63 TM22)

b. Characteristics which make relations with others easier

acceptance
appreciation
cheerfulness
consideration
cooperation
courtesy
criticism
empathy
friendliness
generosity
loyalty
manners
poise
recognition
respect
refinement
sincerity
sympathy
tact
thoughtfulness
tolerance
understanding
unselfishness
voice tone
willingness

(See transparency master DE 63 TM23)

c. Characteristics which make job advancement easier

ambition
competitive spirit
imagination
initiative
inventiveness
public-relations ability
public-speaking ability
reputation
self-improvement

(See transparency master DE 63 TM24)

Summary

Traits and attitudes are not easy to explain or understand. Some traits and attitudes are more positive than others. Some may even be negative. The way we think of traits and attitudes is important. However, our beliefs can be changed. If we possess traits and attitudes that do not measure up to acceptable patterns, we should re-examine our beliefs to determine whether we should change. If we are unwilling to change, we should be willing to take the consequences that may result from these beliefs and attitudes.

Suggested Teaching-Learning Activities

a. Illustrate or define the above terms or have pupils look up their meanings.

b. Give an illustration of how each term fits into the business picture--its effect on working relations with others or advancement on the job.

c. Dramatize various conversations illustrating a lack of tact and failure in other traits. Suggest ways of improvement.

d. Have each student tactfully refuse an invitation to lunch with his employer when this is against his better judgment.

e. Have each student talk with an experienced worker in his field of job interest and list the qualities and the personal traits that would be helpful for the job.

f. Invite a local businessman to discuss the importance of personality development and to tell what business is looking for in people.

g. Ask a former student to discuss personality traits that are necessary for his position.

h. Have each student prepare for class discussion a list of the personality traits and behavior patterns for a job in which he is interested.

i. Have each student choose his weakest personality trait and for one week make a daily attempt to improve it. These efforts may be described in diary form as a written assignment.

j. Questions for discussion:

-- What attitude should a beginning worker take when his work is criticized?
-- What does teamwork mean in business?
-- Does attitude count before you go to work? In school? At home?
-- Can a student whose attitude in school is uncooperative suddenly change after he goes to work?
-- What are some things you should do in the morning before your regular duties?
-- If quitting time comes and you have not finished a job which will take 10 to 20 minutes longer, do you put it off or do you finish it before leaving.

k. Have each student meet, through his own efforts, five men and five women during a week and report to the class.

l. Discuss programs of self-improvement available to businessmen such as Dale Carnegie courses, Toastmasters' Club, etc.

m. Cause the student to become familiar with written materials that outline work responsibilities and procedures.

References for Student and Teacher

a. Basic sources of information:

- -- Business Behavior (3rd edition), pp. 5-8, 19, 37, 117-118, 142, 145-154, 164-170, 194-199, 228-230, 255-259, 279-280
- -- Fundamentals of Selling (8th edition), pp. 15, 241, 538
- -- How To Improve Your Personality (3rd edition), pp. 189-196
- -- Retail Merchandising (6th edition), pp. 575, 596-600
- -- Retailing Principles and Practices (4th edition), pp. 238-239, 243
- -- Sales Horizons (2nd edition), pp. 379-391
- -- Salesmanship Fundamentals (3rd edition), pp. 66-82, 216, 232, 288, 444
- -- Store Salesmanship (6th edition), pp. 151-154

b. Supplementary sources of information

- -- "How to Win Friends and Influence People," Pocket Books, Inc., 630 Fifth Avenue, New York, N. Y. 25¢

Instructional Materials

a. Case studies (attached at end of this unit)

b. Posters

- -- "Personality, UGH!" (Lemon Lizzie - Smile!--Gossipy Gussie, Keep Confidential Information Confidential--Messy Mary--Borrowing Bob, Draw Your Own Supplies--Noisy Nellie--Bossy Bess) $1 for set of 6, Poster Visual Aids, Dept. B-3, 58 Union Street, Milford, New Hampshire

c. Films

- -- "Mr. Finley's Feelings," Association Films, 10 min., color. Deals with the problem of mental stresses in daily living and discusses ways of understanding and handling tensions

d. Pamphlets and leaflets for students (From Science Research Associates, Inc. at $.65 each)

- -- "Guide to Good Leadership" (5-562
- -- "Getting Along with Others" (5-158)
- -- "Your Personality and Your Job" (5-1178)
- -- "How to Increase Your Self-Confidence" (5-833)

Simulated and Continued Practice Activities

a. Have students attend class in business attire at least once a month.

b. Have a standard system regarding absences and makeup work. Place upon the student the responsibility for reporting reasons for absences and for making arrangements for makeup work. Each student could fill out "an absence from work form," for example, as standard procedure.

c. Have each student keep a personal development notebook to be evaluated monthly.

Title: My Outline for Self-Improvement

Contents

1. Personal Appearance and Behavior Appropriate in the Business World*

    a. Grooming and dress
    b. Health habits
    c. Etiquette
    d. Ethics
    e. Work habits and attitudes

2. My Program for Self-Improvement**

    Evaluate yourself in each of the following areas. State phases which you need to improve and develop the plan you intend to follow.

    a. Personal appearance
    b. Wardrobe for school and work
    c. Health habits
    d. Etiquette and ethics
    e. Work habits and attitudes

3. Monthly Evaluation: What I Have Done Toward Self-Improvement This Month.***

    This should be a short description of the accomplishments the student has made in the program he has outlined. The teacher may ask that a standard rating sheet be prepared for evaluating all areas of personal development to accompany the student's special emphasis report.

* A short composition summarizing learnings may be written at the end of the unit and used as a part of the unit evaluation.

** May be outlined daily as each learning is secured. Leave space at end of each section for teacher comments.

*** Submitted the last day of each month without reminder by the teacher. Leave space at end of each section for teacher comments.

d. A smile and a friendly "Good morning" or "Good afternoon" should be a daily greeting between students and teacher.

e. Assignements in other units of study should require accuracy, following directions, use of common sense, teamwork, and imagination. Good work habits should be practiced in all phases of the classroom work.

f. Have students make a habit of writing instructions which are given or are to be given orally.

Evaluating the Unit

a. The student's self-rating by rating sheets and his program for self-improvement as outlined in his personal development notebook may be used daily and at the end of the unit to summarize his work.

b. Tests or ratings in the following areas may be used:

-- Personality traits
-- Emotional traits
-- Grooming
-- Business and social customs
-- Health

c. An objective test on basic understandings should be given.

d. Subjective evaluation by students and teacher of changes in behavior.

e. The Instructional Materials Laboratory, Division of Vocational Education, College of Education, University of Kentucky would appreciate suggestions by teachers for improving the unit.

REFERENCES

Business Behavior (3rd edition), Russon; (South-Western Publishing Co., Cincinnati, Ohio -- 1964), 304 pp.

Clerical Office Practice (3rd edition), Agnew and Meehan; (South-Western Publishing Co., Cincinnati, Ohio -- 1961)

Etiquette, Post, Emily; (Funk and Wagnalls Company, Publishers -- 1945)

Fundamentals of Selling (8th edition), Wingate and Nolan; (South-Western Publishing Co., Cincinnati, Ohio -- 1964), 570 pp.

How To Improve Your Personality (3rd edition), Newton and Green; (Gregg Publishing Division, McGraw-Hill Book Co. -- 1963), 219 pp.

How To Win Friends and Influence People, Carnegie; (Pocket Book, Inc., New York -- 1961)

Integrated Secretarial Studies, Whitmore; (South-Western Publishing Co., Cincinnati, Ohio -- 1964)

Retail Merchandising (6th edition), Wingate and Weiner; (South-Western Publishing Co., Cincinnati, Ohio -- 1963), 620 pp

Retailing Principles and Practices (4th edition), Richert, Meyer, and Haines; (Gregg Division, McGraw-Hill Book Co., New York -- 1962), 504 pp.

Sales Horizons (2nd edition), Haas and Perry; (Prentice Hall, Inc., Englewood Cliffs, N. J. -- 1963), 404 pp.

Salesmanship Fundamentals (3rd edition), Ernest and DaVale; (Gregg Division, McGraw-Hill Book Company, New York -- 1965), 470 pp.

Secretarial Office Practice (6th edition), Agnew and Meehan; (South-Western Publishing Co., Cincinnati, Ohio -- 1960)

Store Salesmanship (6th edition), Robinson, Blackler, and Logan; (Prentice-Hall, Inc., Englewood Cliffs, N. J. -- 1966), 368 pp.

Vogue's Book of Etiquette, Fenwick; (Simon and Schuster, New York -- 1948)

Your Attitude Is Changing, Chapman; (Science Research Associates, Inc., Chicago, Illinois -- 1966), 217 pp.

FOR STUDENT USE
DE 63 (3/67)

CASE STUDIES

1.

Judy, who had finished high school in June, was working for an advertising company. As she kept late hours at night, it was difficult for her to arrive at work on time. Even when she was punctual, she would take several minutes to freshen up before going to her desk.

She had been told by her older brother who owned a business that it was important to report at the proper time to begin work since tardiness is frowned upon by most supervisors. She would always reply, "Mr. Jones never says anything when I come in late."

Before long Mr. Jones called her in his office to reprimand her for being late. He said that he wanted her to be at her desk promptly at 9 a.m. and that she would have to be dismissed if she continued being late.

1. Should Judy have offered an alibi for being tardy?
2. Should she offer to make up the time she has lost?
3. What precautions might Judy make to assure being on time in the future?
4. How important it is to be on time anyway?

2.

Mary Jane and Sue Ellen are co-workers in the credit office of the ABC Company. On numerous occasions when Mary Jane had needed stamps for her personal correspondence, she has taken them from the roll of stamps in the petty cash box. Several times lately Mr. Henry, the credit manager, needed stamps and became suspicious because the supply was noticeably low. He knew these two girls were the only persons who had access to the box. He called these young women to his office and pointed out it is against the rules to use office stamps for personal use. He also warned them that if this practice continued, he would find it necessary to dismiss them.

Mary Jane continues to use the stamps since she does not care to be dismissed. She feels that a dismissal will not affect her career because she plans to move from the community in a few weeks.

Sue Ellen is alarmed because she needs to work and is interested in achieving success on her first job.

1. If you were Sue Ellen, would you say anything to Mr. Henry when you and Mary Jane were called to the office? If so, what would you say? If not, why?
2. If your answer is "no," would you say anything to Mr. Henry later?
3. Would you discuss the matter with Mary Jane in an attempt to influence her to stop the practice? If your answer is "yes," what argument or arguments would you use?

Written by Miss Margaret Moberly of Eastern Kentucky State University and Mrs. Maxine Shanks of Broward County, Florida Community College.

FOR STUDENT USE
DE 63 (3/67)

PERSONAL DEVELOPMENT AND WORK HABITS

Introduction

The Need for Training

That boys need training in personal development is pointed out by young men in business, employers, and teacher. Young men desiring promotion often lack the urge for more "polish." Surveys of executive opinion report that employers want sociably acceptable people. Employers find that a student is not of much use in the business world if he has A's and B's but is "uncouth in manners, vulgar in speech and actions, pitiful in choice of colors and style for his clothes, and appalling in his ignorance of fine arts and of world events."

Difficulties Encountered

The material man and the social man are difficult to match. Almost any young man who resents the effort necessary for self-improvement may point to people who have succeeded in business in spite of personality. Since this is a minority occurrence, any young man with this attitude should review successful businessmen in his community to discover the real truth of the matter.

Skill in handling people and executive ability do not come through reading books but through daily practice in dealing with janitors, sales clerks, teachers, fellow employees, friends, and members of the family. Role playing and case studies can be used to simulate employer-employee and employee-employee interaction so that necessary experience can be obtained.

Grooming and Dress

Many young men miss their opportunities because of the following:[1]

a. Improper wardrobe
b. Poor grooming (nicotine-stained hands, dirty nails, grimy collar, spotted tie)
c. Offensive odors--body and oral
d. Unshined shoes
e. Run down heels
f. Untidy socks
g. Extreme hair styles, greasy hair dressing, or the need of a haircut
h. "Five o'clock shadow"
i. Dandruff flakes on shoulders
j. Unpressed pants

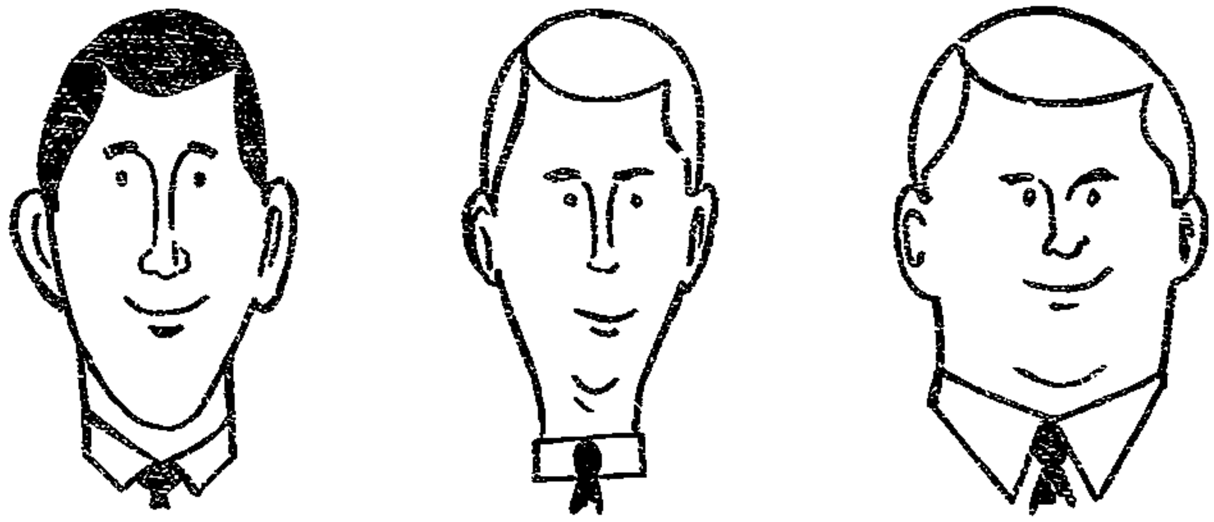
Clothing Selection

Suits, shirts, socks, ties, coats, handkerchiefs, shoes, and hats for men are well standardized. Masculine colors are subdued, but a touch of color in a tie, shirt, or handkerchief can be quite effective. To accomplish that "young executive look," and lift his personality as well, a young man needs only to make the proper choice of clothes. He should aim for harmony of ensemble. His tie, hat, shirt, and suit should have a color relation to one another. Bright, gaudy colors are not acceptable for business wear. The pamphlet "What Every Woman Should Know About Men's Fashions," and the chart "Appearance Counts" from The Van Heusen Company (attached as part of this unit) should be helpful. The color chart suggested by Curlee Clothes should prove a helpful guide in matching colors.

Choosing Suits. The choice of suit material depends upon the season. The fabric should be fade-proof; and the finish should give style, yet be such that cleaning and pressing will not be a problem. One-hundred percent wool is best for holding crease and for good wearing qualities. Darker suits are easier to combine with shirts and ties and may be used for evening dress when combined with white shirt, dark tie, black hose, and black shoes. A suit with a marked pattern is difficult to combine with a figured shirt. White shirts can usually be worn only one day to work. To be avoided are mix-match combinations with trousers and coats of different material and the high-cut trousers that seem to belt under the armpits.

Men who are underweight should wear lighter colors and loose-fitting jackets. Those who are overweight should favor dark, solid colors and stress vertical stripes. They should avoid suits of plaid or wide-striped material. Large-framed men should wear rough, heavy materials. Small-framed men should choose closely woven, smooth fabrics. Unbroken lines are best for those who are short.

Choosing Shirts. White shirts are always acceptable in business. However, styles in shirt colors vary; and soft pastels and patterned shirts are acceptable in some situations. Cotton material serves best for business hours and is the best bet for sending to the laundry. Collar styles, frequently taken for granted, are an important consideration. The illustration below will help in making a suitable choice.[2]



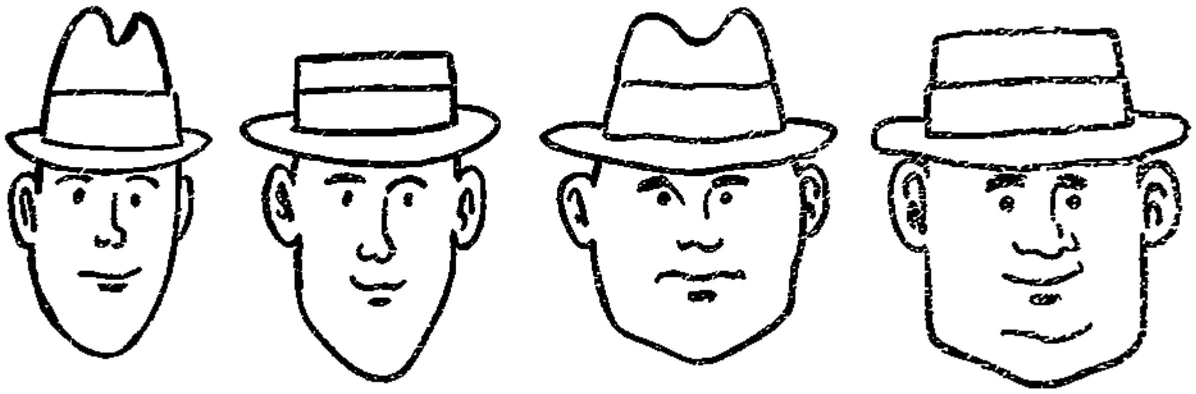
Choosing Ties. The tie should harmonize with the shirt and suit. Solid-color, knit ties or reps, challis, and foulards in neat stripes, small prints, or solid colors are always fashionable. Caution should be observed in attempting to match figured ties and patterned shirts.

Both shirts and ties should emphasize each man's good points in coloring. A pallid complexion requires shirts and ties that give color to the face, while a florid-colored complexion requires shirts and ties that subdue the face coloring.

Choosing Shoes. Shoes should be selected for comfort and wearing qualities. Leather plain toe, wing tip, or moccasin-stitched, lace types are best for business. Loafers and sport shoes are unacceptable.

Choosing Socks. These should harmonize with tie and suit. White should not be worn for business.

Choosing Hats. Hats are not as important as they once were. Young men in business, however, are better dressed when they wear appropriate head gear. The hat chosen should be the sort that a gentleman would wear and should be becoming to the shape of face.[3]



Black is recommended for heavy duty. Brown and gray are also appropriate.

Choosing Coats. The black Chesterfield (single or double breasted) is a good choice, and it can be worn no matter how formal the occasion. Other coats of simple lines and unobtrusive patterns, such as a black-and-gray herringbone coat, are also in good taste. Wearing a dingy, light-colored trench coat or rain coat in good and bad weather gives a business employee a slovenly look.

Choosing Gloves. Gray, black, or natural pigskin is appropriate for almost any business costume.

General Guidelines

The entire wardrobe should be selected according to working conditions. The lead of the company's executives may be followed. Archer suggests the following list of guiding questions for making wise purchases:[4]

a. Is it something I really need, or just a novelty that has caught my eye?
b. Does this style suit me?
c. Does it fit?

d. Is the fabric of good quality and easily cared for?
e. Is it well made?
f. Is it comfortable?
g. Does the color look well on me?
h. Will it combine with other clothing I already own?
i. Does the price represent a "good buy"?
j. Can I afford it?

Some things to avoid are:

a. The sweater-sport shoes combination on the job
b. Fads in the color and cut of clothing
c. Extremes in the selection of shoes
d. Loud sport-shirts and extreme clothing designs

Clothing Care

To look completely well dressed, everything worn should be clean and pressed. Clean gloves, a well-brushed hat, and a tie without spots are important details of the over-all, good-looking picture. Socks and handkerchiefs should be kept laundered, and underclothing should be changed each day.

Suits should be brushed and hung up after each wearing. All the pockets should be emptied, and the coat should be buttoned. If care is taken in hanging the trousers properly, the wrinkles will "hang out," the vertical crease will remain sharp, and the horizontal crease (usually caused by throwing the trousers carelessly over a thin wire hanger) will not form. All stains and spots should be removed before pressing.

A clean shirt should be worn each day. Frayed and soiled ends on collars and cuffs should be avoided. Nothing spoils the effect of a well pressed suit like a soiled shirt and faded, rolled down socks. Ties should be kept clean and free from wrinkles. They should be discarded when they become unsightly.

Since the shape of a hat gives it its style, it should be kept well blocked; and care should be taken to preserve its shape. For this reason, men should be careful to remove soft felt hats by lifting them from the top.

A weekly wardrobe inspection should be made for minor repair jobs--loose buttons, torn pockets, frayed cuffs, open seams or hems. Clothes should be pressed frequently. A man should learn to sew on buttons if there is no one to do it for him.

Wearing with Pride

A young businessman who wishes to represent himself and his company well should keep his collar buttoned and his tie in place. He should wear his suit coat at work.

Jewelry is out of place on a man. Buttons and service club pins may be effective. A wrist watch and a tie clasp are businesslike.

Health, Cleanliness and Personal Appearance

Health

Practicing good health habits is important to job success. The young man who feels well finds it easier to get along with his co-workers and to keep his work up to par. Because of the sedentary nature of distributive work, he will find that he needs to eat less fat, bread, potatoes, and rich desserts than those who perform heavy physical labor. He will also find himself in a better "frame of mind" for work if some of his recreational activities are of a physically active nature.

Cleanliness

A bath and the use of deodorant daily are a must. Sometimes, however, the problem may not be body cleanliness but the habit of wearing a shirt more than one day. Nails should be manicured at least once a week. Hands should be washed after using aftershave to prevent its being left on the hands of persons greeted during the day. The handkerchief and pocket comb carried should be clean.

Personal Appearance

Young men will find it wise to select a conservative hair style. A short, fairly close masculine haircut will give a smart, businesslike appearance. It should be trimmed regularly so that the neck will not get shaggy and an appearance of neatness will be given. Regular shampooing is an order. An effort should be made to select the hair style best suited to individual traits. For example, a crew cut is suitable for a boy whose hair is of coarse texture; for a round-shaped head, the hair should be of medium length at sides and top; fine-textured hair should be worn in a pompadour, relatively short. To be avoided are sideburns and extreme crew cuts.

To maintain an air of efficiency, a young men should avoid eating, chewing gum, or smoking on the job. He should not comb his hair or take care of other personal grooming functions in public.

He should shave at least once daily; twice, if going out in the evening. Some men keep an electric shaver in the office for just such occasions.

Checklist for Good Grooming

Bell provides the following checklist for men in her book Business Behavior.[5]

A man is well groomed when:

His body and teeth are clean and free from odors. He uses mouth wash and deodorants.
His skin is clear, not oily, and he is freshly shaven.
His hands have a cared-for look. His fingers are free of nicotine stain; the nails are clean and unchewed.
His hair is neatly trimmed, clean, and combed, not oily and sticky.
His underwear is clean.
His shoes are shined, and the heels are not run down.
His socks are clean and not allowed to wrinkle around his ankles.
His shirt is fresh daily and worn inside his trousers.
His suit is pressed; the trousers are well creased.
No spots stain his clothing.
His tie harmonizes with his shirt and suit.
His clothing fits the occasion and is odorless.
He wears a coat.

Etiquette[6]

The idea is to give a good impression for the company.

Making Introductions

1. Introducing one man to another.
   a. Say Mr. Joseph, Mr. Manning; Mr. Joseph, this is Mr. Manning; Mr. Joseph, this is my assistant, Mr. Manning (or John Manning).
   b. Avoid "Meet" Mr. Manning; "Shake hands with" Mr. __________; or "I want to make you acquainted with ________________."
2. Introducing an employee (man or woman) to a superior.
   a. Give the superior's name first.
3. Introducing a new employee to co-workers.
   a. Give first name and last name or personal title and last name.
   b. Avoid first names.

Acknowledging Introductions

1. The right response is "How do you do," ______________
2. Always stand when introduced.

3. Always shake hands with a man. Shake hands with a woman only if she offers her hand first. Make the handshake brief but firm. Don't pump the arm up and down.

Receiving a Caller

a. Do not keep him waiting whether he has an appointment or not.

b. Do not keep him standing or let him sit while you talk at length on the telephone, carry on a trivial conversation with your co-workers, doodle absent-mindedly, or shuffle through papers.

c. Do see him as promptly as possible if he has an appointment.

d. Do have the receptionist or secretary advise him when delay is unavoidable. Say, "I'm sorry to have kept you waiting," when you do see him.

e. Do stand when he enters your office. It is customary to shake hands. You offer your hand first. Ask him to be seated, and give him complete attention.

f. Do end the interview courteously if he stays too long. Stand when he leaves. Shaking hands at parting is optional, but customary.

Keeping an Appointment

a. It's wrong to arrive late. That means you have to start with an apology.

b. Do not:

- -- Joke with the receptionist or engage her in unnecessary conversation.
- -- Pace the floor, tap the table, chew gum, or whistle while you wait.
- -- Remain seated if a secretary or the man you are calling on appears.

c. Do:

- -- Be on time or a few minutes early.
- -- Have your briefcase in good order.
- -- Take off your hat as you approach the receptionist, identify yourself, tell her whom you want to see. Thank her, and follow her instructions.
- -- Keep your hat off while waiting; remove your overcoat, hang it on a rack or fold and place on your lap or a chair. Smoking is optional, only if an ash tray is available.
- -- Stand if a secretary or the person whom you are waiting to see approaches.

d. When you go into his office, introduce yourself and wait for him to shake hands. Stand until he tells you to sit, and smoke only if he suggests it. Be alert to signs that he wishes to end the interview.

e. Thank the receptionist on your way out.

Going to Lunch

a. When you give the invitation

- -- The right way is to set the date, place, and time by suggesting possible days, possible places, and possible times. Let your guest make the choice.
- -- Extend the invitation by: "How about having lunch with me?" "Could you have lunch with me next week?" It's wrong to say: "Let's have lunch together." This suggests that each person pay his own check.
- -- Make a reservation, if necessary. It's not proper to take a guest to a restaurant where you'll have to stand in line. If he is late, don't go to the table without him.

b. When you take care of the check

- -- Do not interrupt a conversation to study the amount audibly, check or comment on it, or refer to your expense account.
- -- Never permit a guest to pay all or any part of the check.
- -- Don't leave the tip in nickels and dimes -- never include pennies. Leave the tip in quarters and up, or add it to the bill.
- -- Glance at the check as casually and briefly as possible.
- -- Have money or credit card handy.

c. When you are the guest

- -- After you accept an invitation, choose a day your host suggests, if possible. Be specific as to time; arrive promptly.
- -- Ignore the check.
- -- Watch for signs your host has to get back to the office. Make the first move to leave.
- -- Don't feel obligated to invite your host to a return luncheon. This is not necessary or expected.

FOOTNOTES

1. John G. Kirk, Maurice L. Crawford, and Mark H. Quay, General Clerical Procedures. (3rd edition; Englewood Cliffs, N. J.: Prentice-Hall -- 1959), p. 9

2. Fred C. Archer, General Office Practice. (New York: Gregg Publishing Co. -- 1963), p. 35

3. Ibid, p. 33

4. Archer, op. cit., p. 35

5. Mary L. Bell and Ray Abrams, Business Behavior. (Cincinnati: South-Western Publishing Co. -- 1956), p. 6

6. Lileth MacKnight, "Manners for Managers," Supervisory Management XIX (August, 1966), pp. 13-17

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"Getting Ahead in Retail Selling." Dayton, Ohio: The National Cash Register Company

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SUPPLEMENTARY MATERIALS*

Pamphlet -- "What Every Woman Should Know About Men's Fashion"

Chart -- "Appearance Counts"

*Attached as part of this Unit.

WHAT GOES WITH WHAT
The Curlee Correct Dress Chart*

FOR DRESS	Shirt	Tie	Handkerchief	Hose	Shoes	Belt	Hat
Grey Suit	Blue	Blue & grey	Blue border	Blue	Black	Black	Bluish grey
	Yellow	Yellow & grey	Yellow	Grey	Brown	Brown	Brown
	Grey	Grey & red	Red & grey bdr.	Grey	Black	Black	Grey
	Green	Green & grey	Green border	Green & grey	Brown	Brown	Soft green
Blue Suit	Light blue	Blue & grey	Blue border	Blue	Blue black	Blue black	Blue black
	Grey	Grey & red	Grey & red	Dark grey	Black	Grey	Grey
	Yellow	Yellow & blue	Yellow & blue	Blue	Black	Black	Grey
	Green	Blue & green	Blue & green	Black	Black	Black	Grey
Brown Suit	Tan	Brown & blue	Tan	Brown	Brown	Brown	Tan
	Green	Green & brown	Green	Green	Brown	Brown	Green
	Yellow	Yellow & brown	Yellow	Brown	Brown	Brown	Brown
	Melon	Melon & brown	Melon	Brown	Brown	Brown	Brown

FOR SPORTS	Slacks	Sweater	Sport Shirt (Checked, Striped, Plaid)	Tie	Shoes	Hose
Grey Jacket	Oxford grey	Red	Black & red	Black	Black	Black or grey
	Brown	Brown	Brown & grey	Brown	Brown	Brown or grey
	Olive	Olive	Olive & brown	Olive	Brown or black	Brown
	Blue	Blue	Grey & blue	Blue	Black	Black, blue, or grey
	Grey	Grey	Blue & green	Green	Black	Green or blue
Brown Jacket	Blue	Blue	Tan & blue	Blue	Dark brown	Tan or blue
	Olive	Olive	Olive & tan	Olive	Brown	Olive or tan
	Green	Green	Red & green	Red	Brown	Green or brown
	Tan	Tan	Brown & red	Brown	Brown	Tan, brown, or black
Blue Jacket	Grey	Grey	Grey & red	Blue	Blue black	Grey
	Brown	Brown	Blue & brown	Brown	Brown	Brown or dark blue
	Light grey	Red	Blue & red	Blue	Black	Blue or grey

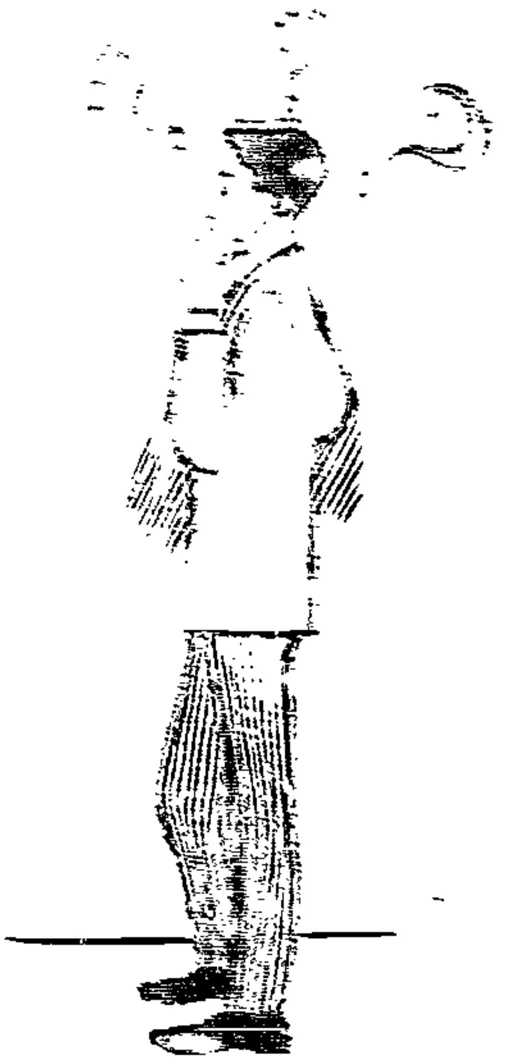
*Prepared by O. E. Schoeffler, Fashion Director of Esquire Magazine
The ability to combine colors effectively is the mark of the well-dressed gentleman.
Use this chart as a guide in coordinating your dress and sports wardrobes.
Important Facts About Your New Curlee Clothes, Curlee Clothing Company, St. Louis 1, Missouri.

Important Facts About Your New Curlee Clothes, Curlee Clothing Company, St. Louis 1, Missouri.

Will You Be A Success?

Do you possess desirable:

1. Posture and bodily movements?
2. Facial expressions?
3. Behavior patterns?
4. Voice and speech?
5. Mannerisms?
6. Attitudes?
7. Abilities?
8. Physique?
9. Grooming?
10. Manners?
11. Health?
12. Dress?



DE 63 TMI

T. [illegible], INST [illegible] LAB. [illegible]

"A false sense of inferiority is just as phony as a false sense of superiority." [illegible]

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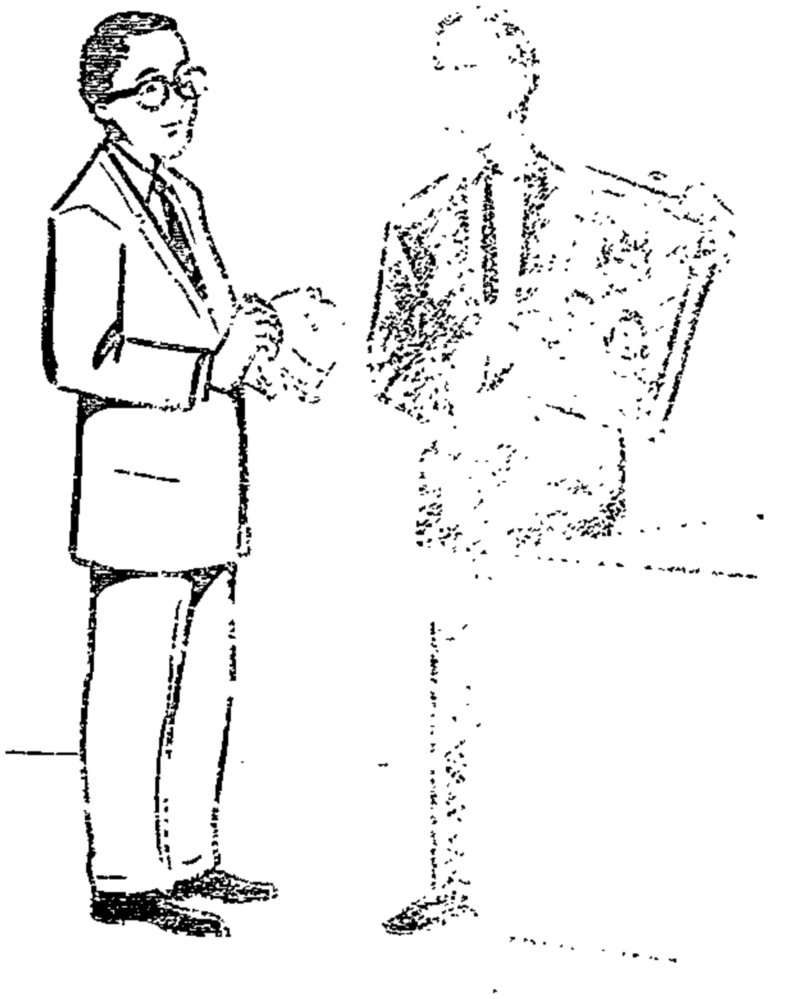
[illegible]



"A genuine person has the same qualities at home and in his social life as he does on the job."
= =anonymous

DE 63 TM3

T. Vantreese, INST. MATL. LAB., U.K.

"Unless a garment fits well and is worn with grace, it cannot be made 'smart' by quality or cut."- -

anonymous

DE 63 TM4

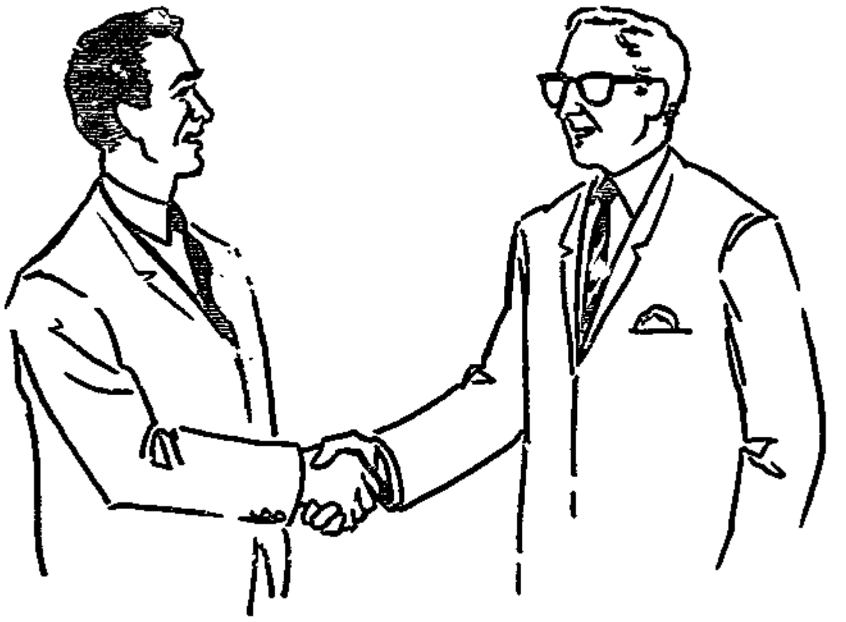
T.Vantreese, INST. MATL. LAB., U.K.

"Personality is the totality of qualities and characteristics of a given person, ordinarily attributed to original nature, expressing themselves in modes of carriage, language, manners, clothes, ways of speaking, interest, attitudes, and other reactions to the social milieu,"

(as defined by Constantine Panuazio in Student's Dictionary of Sociological Terms)

DE 63 TMS

T. Vantreese, INST MAT. LAB, U K



To change one's personality, one must adapt himself to the acceptable modes of the society in which one lives.

"Adaptability is the habit of finding and using opportunities in the environment and following not the line of least resistance but those of greatest opportunity."

(Harry W. Hepner)

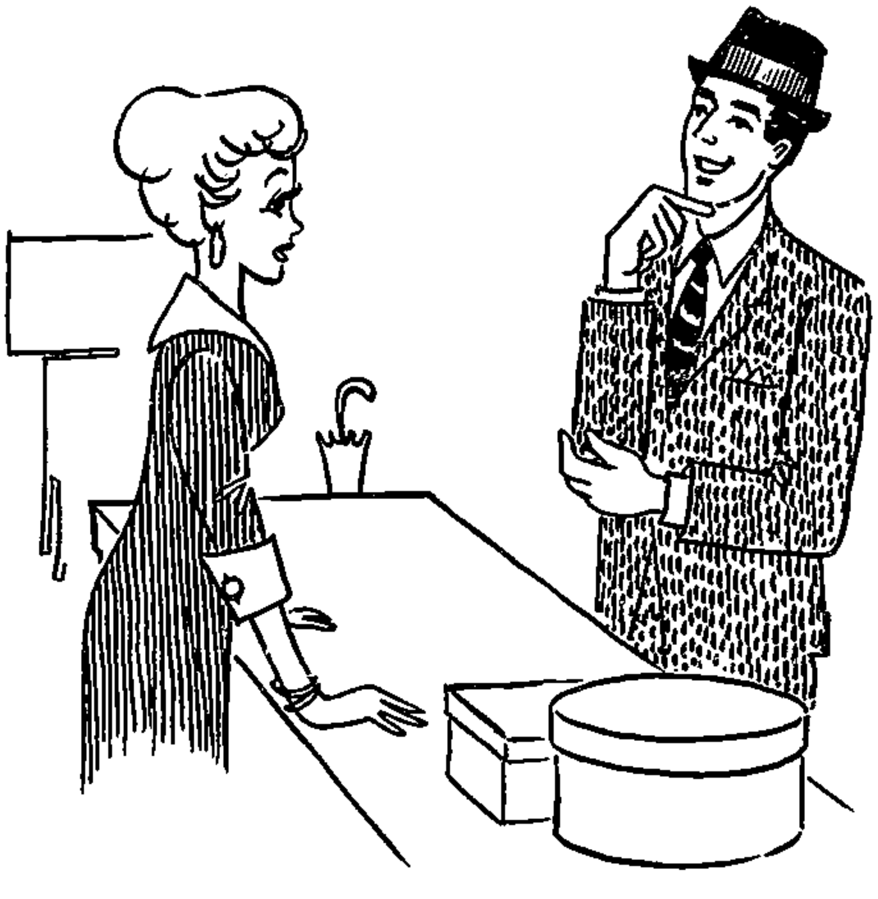
DE 63 TM6

T. FAUNTREESE, INST. MATL. LAB., U.K.

Selection of Clothing Items

When choosing clothing items, carefully consider:

- -- Appropriateness of dress, jewelry, footwear
- -- Distracting influence of dress
- -- Acceptable dress customs for employment and working conditions
- -- Overcoming physical characteristics through dress



DE 63 TM7

T. VANTREESE, INST. MATL. LAB., U.K.

Become Aware of the Necessity for Good Habits Pertaining to:

-- Cleanliness and personal hygiene
-- Proper use of daytime cosmetics
-- Attractive business hair styles
-- Well-kept hands and nails
-- Good posture
-- Distraction caused by grooming
   on the job

De 63 TM8

T.VANTREESE, INST. MATL. LAB., U.K.

DO YOU SEE YOURSELF AS OTHERS SEE YOU?

Really look
at yourself,
and not through
a false mirror

DE 63 TM9

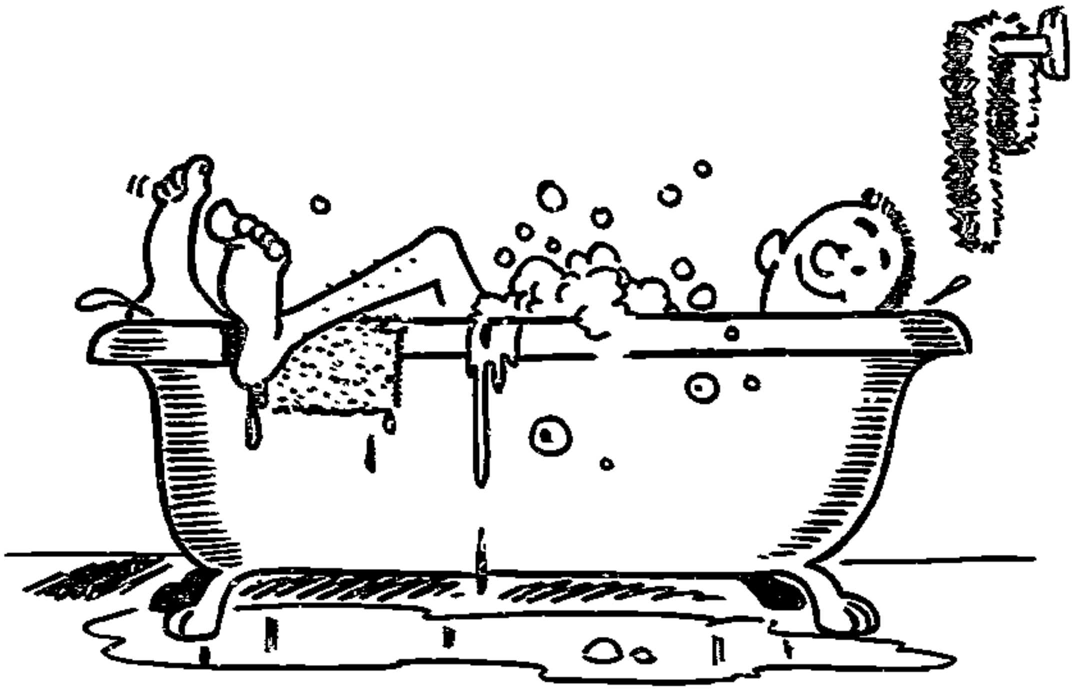
T. [illegible], INST. MATL. LAB, U.K.

DO YOU SEE YOURSELF AS OTHERS SEE YOU?

Really look
at yourself,
and not through
a false mirror

DE 63 TM9

T. [illegible], INST. MATL. LAB, U.K.



CLEANLINESS IS A VIRTUE.

DE 63 TM10

T.[illegible], INST. MATL. LAB., U.K.

YOU ARE WHAT YOU EAT.

DE 63 TM11

T. Vantreease, INST. MATL. LAB., U.K.

SEE YOUR DENTIST TWICE A YEAR

Still as essential as when the expression was first coined.

Should also apply for visits to your doctor.

DE 63 TM12

T Pontrelli, INST MATL. LAB, U.K.

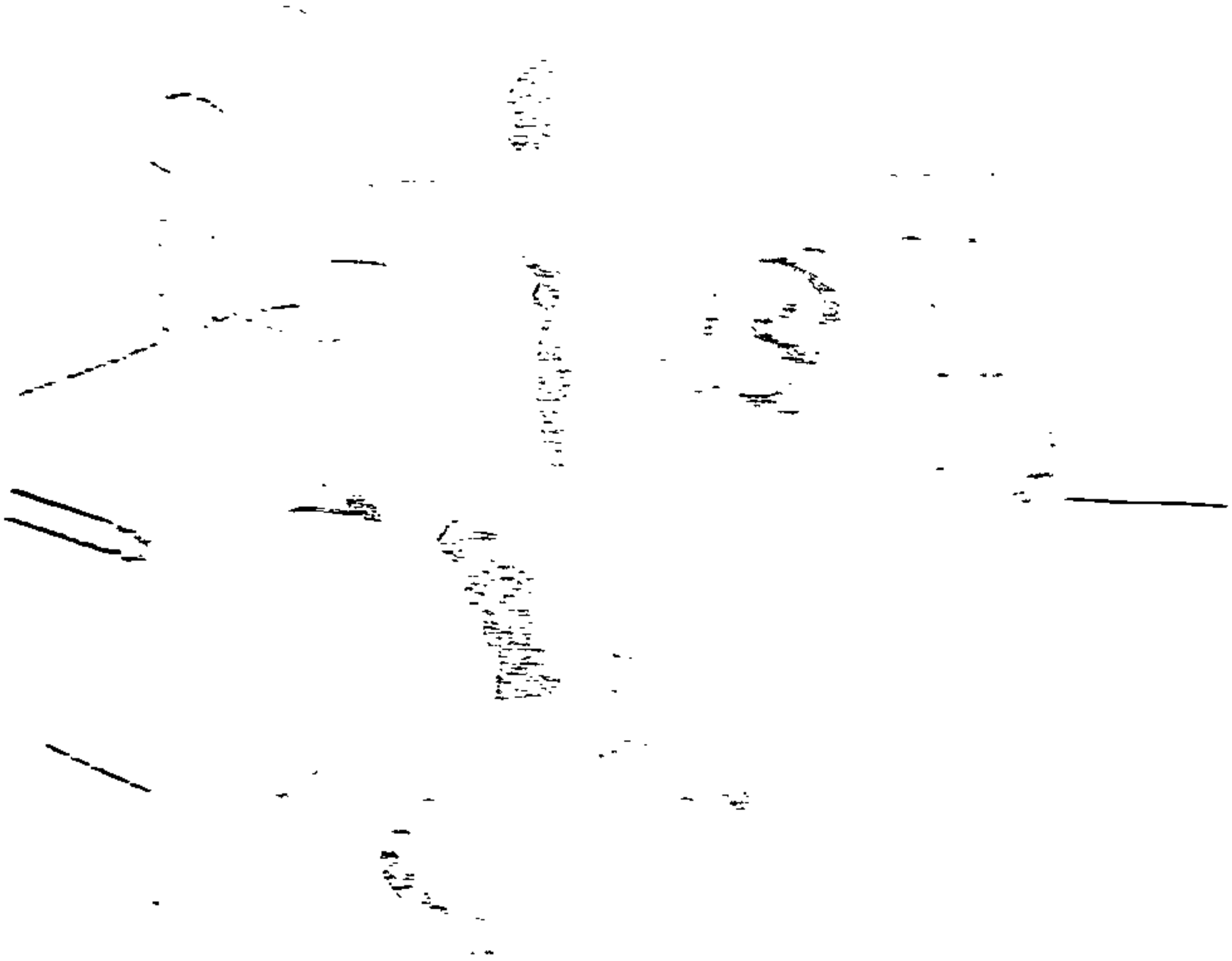
Reach for the s[illegible] ears

-- shoulders [illegible]

DE 63 TM15

T. VANTREESE, INST. MATL. LAB., U.K.

[illegible]



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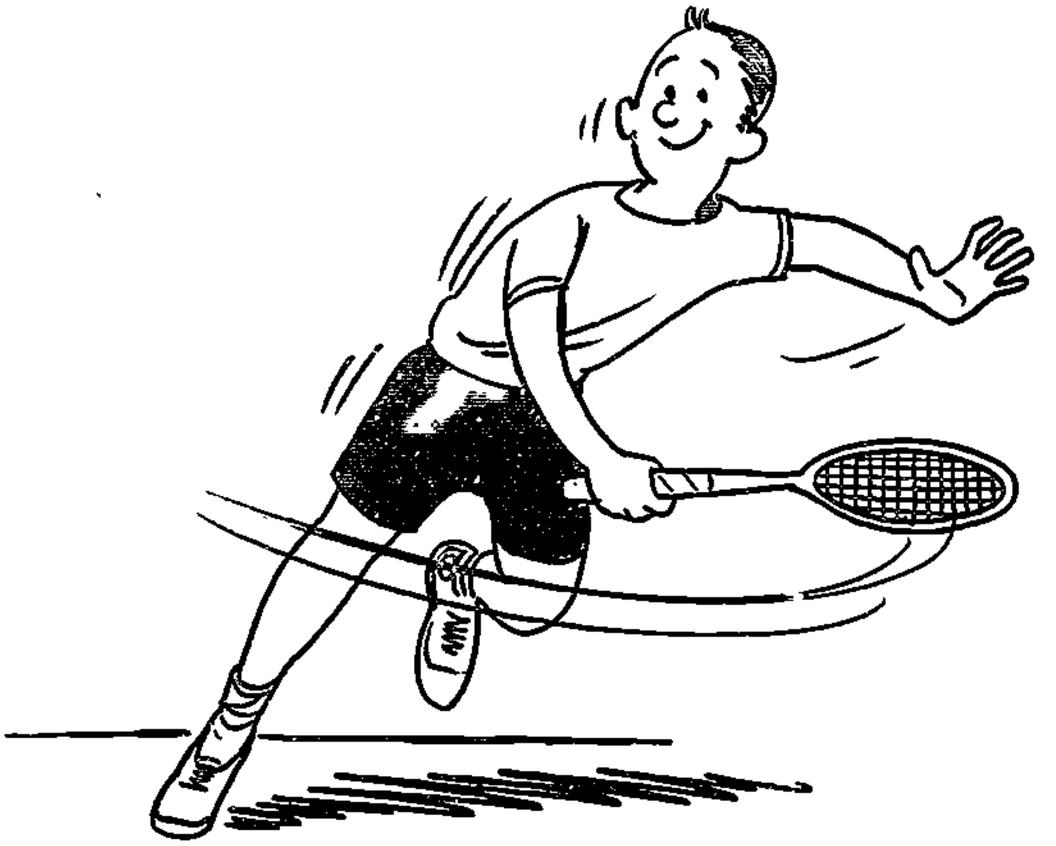


Regular and vigorous exercise and
play is required for good
physical and mental health

DE 63 TM15

T. Va[illegible], INST. MATL. LAB., U.K.

CAN YOU CONTROL YOUR NEGATIVE EMOTIONS?

Plan a campaign to control your negative emotions.

Required steps--

1. Identify negative emotions
2. Determine when, how, and why they occur
3. Determine necessary measures to control
4. Apply remedies and actions for controlling and correcting.

DE 63 TM16

SOME GENERAL BEHAVIOR PATTERNS THAT ARE IMPORTANT IN DISTRIBUTIVE OCCUPATIONS

1. Common courtesies
2. Consideration of others and their property
3. Degree of sincerity--compliment frequently and honestly
4. Tactfulness--consideration of others and their feelings
5. Cheerfulness--reflects confidence
6. Willingness to assume more than your share

DE 63 TM17

T. Vantreese, INST. MATL. LAB., U.K.

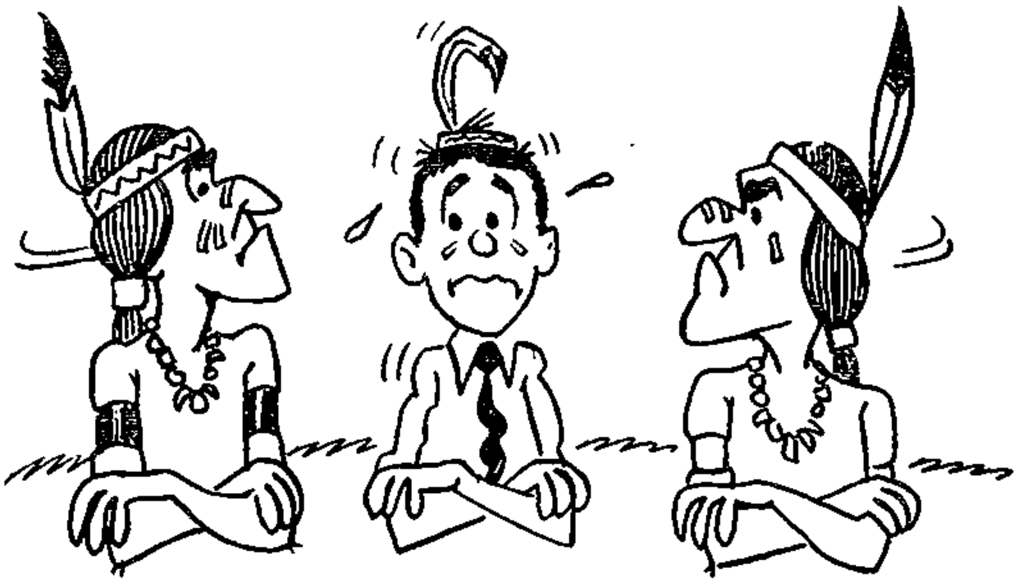
SOME GENERAL BEHAVIOR PATTERNS THAT ARE IMPORTANT IN DISTRIBUTIVE OCCUPATIONS (continued)

7. Agreeableness--not demanding your way all the time
8. Avoiding finding fault and discussing others
9. Generosity--not so much with money but with your time, praise, thoughtfulness, kindness, smiles, understanding, empathy, appreciation, courtesy, work, and effort
10. Crudities of speech

T. Vantreese, INST. MATL. LAB., U.K.

ARE YOU WILLING TO:

1. Accept existing group standards?
2. Avoid existing frictions, feuds, and cliques?
3. Accept existing conflicts of personalities?
4. Accept difficulties of work with grace?

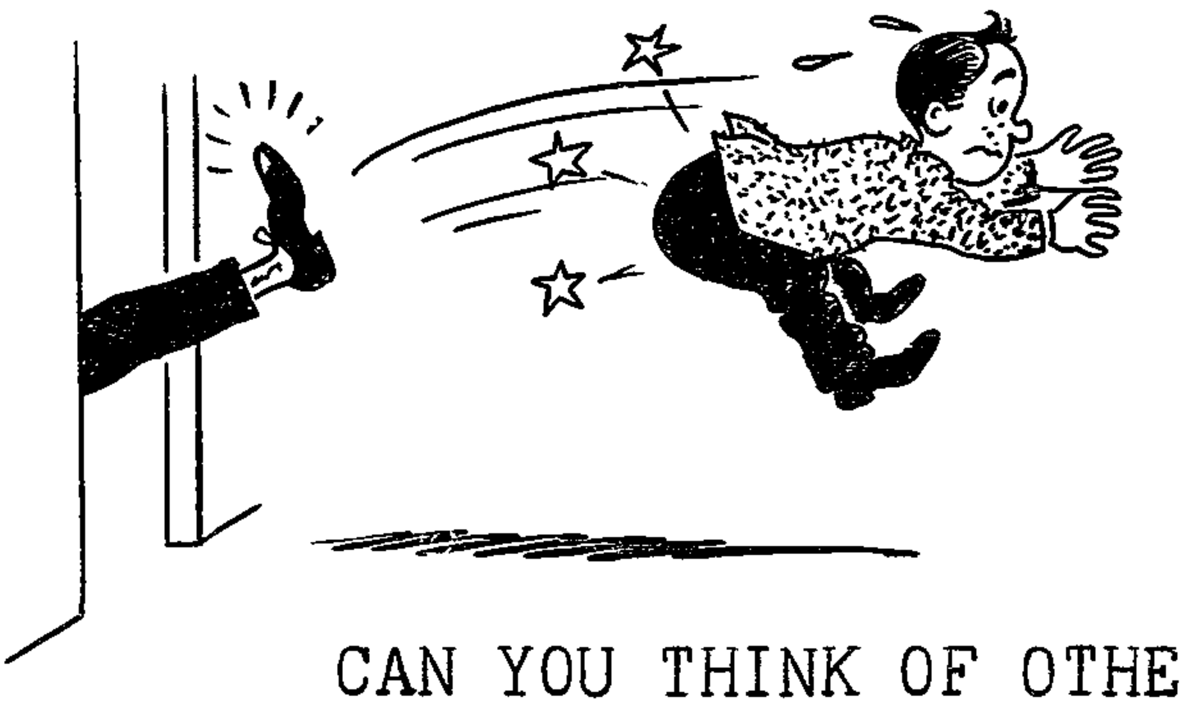


DE 63 TM19

INST MATL. LAB, U.K

IMPORTANT ITEMS AFFECTING WORK HABITS:

1. Absenteeism
2. Punctuality
3. Stalling or loafing on the job
4. Using company time for personal matters
5. Borrowing company equipment, supplies, or money



CAN YOU THINK OF OTHERS?

T. Vantiere, INST. MATL. LAB., U.K.

What values do you place on the personal attitudes, traits, and characteristics which make work and relations with others easier?

A TEAM EFFORT

DE 63 TM21

T. [illegible], INST. MATL. LAB, U.K.

SOME CHARACTERISTICS WHICH MAKE WORK EASIER AND WHICH SUGGEST THE BEST METHODS OF DOING A JOB:

Accuracy
Adaptability
Alertness
Awareness
Common sense
Dependability
Discretion
Efficiency
Emotional stability
Endurance
Following directions
Foresight
Good habits
Honesty
Humor
Industriousness
Ingenuity
Intelligence
Interest
Judgment
Memory
Organization
Patience
Persistence
Pride in work
Punctuality
Resourcefulness
Responsibility
Thoroughness
Versatility

Can you think of other characteristics?

DE 63 TM22

SOME CHARACTERISTICS WHICH AFFECT RELATIONS WITH OTHERS

- Acceptance
- Appreciation
- Cheerfulness
- Consideration
- Cooperation
- Courtesy
- Criticism
- Empathy
- Friendliness
- Generosity
- Loyalty
- Manners
- Poise
- Recognition
- Respect
- Refinement
- Sincerity
- Sympathy
- Tact
- Thoughtfulness
- Tolerance
- Understanding
- Unselfishness
- Voice tone
- Willingness

Can you think of other characteristics?

SOME CHARACTERISTICS WHICH AFFECT JOB ADVANCEMENT

- Ambition
- Competitive spirit
- Imagination
- Initiative
- Inventiveness
- Public-relations ability
- Public-speaking ability
- Reputation
- Self-improvement
- Personality

Can you think of other characteristics?

VT003 266

VT 003 266
The Framing Square.

Giuliano, R. James
Rutgers, The State Univ., New Brunswick, N.J.
Pub Date - Feb66
MF AVAILABLE IN VT-ERIC SET [illegible]

*STUDY GUIDES, *TEXTBOOKS, *TRADE AND INDUSTRIAL EDUCATION, *CARPENTERS, RAFTERS, HIGH SCHOOLS, *INDIVIDUAL INSTRUCTION, TESTS, Framing Square,

This study guide-textbook was developed to direct the individual study of the vocational high school student in a 1-year course of related technical instruction in carpentry. It explains, by means of illustrations and detailed instructions, the various markings on the framing square and the purposes for which it is used by the craftsman in the course of his daily work. The material was prepared by a vocational-technical high school department head and tested in classroom use. The units are (1) Description, Principles, Terminology, (2) Principles and Practices of Rafter Layout, (3) The Equal-Pitch Gable Roof, (4) The Equal-Pitch Hip Roof, (5) The Equal-Pitch Intersecting Roof, (6) Other Uses of the Framing Square, and (7) Summary of Roof Information. Each unit contains lesson assignment sheets with the specific lesson objective, the related information, and assignments. A test is provided at the end of each unit. The teacher should have a science and carpentry background. This document is available for $[illegible] from Vocational-Technical Curriculum Laboratory, Rutgers University, 10 Seminary Place, New Brunswick, N.J. 08903. (HC)

STATE OF NEW JERSEY
DEPARTMENT OF EDUCATION
DIVISION OF VOCATIONAL EDUCATION

THE FRAMING SQUARE

PREPARED BY
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BERGEN COUNTY VOCATIONAL AND TECHNICAL HIGH SCHOOL
HACKENSACK, NEW JERSEY

State of New Jersey
Department of Education
Division of Vocational Education

THE FRAMING SQUARE.

Prepared by
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HARRY C. STEPHAN - Principal

Bergen County Vocational and Technical High School
Hackensack, New Jersey

Vocational-Technical
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M E M O R A N D U M

TO: The ERIC Clearinghouse on Vocational and Technical Education
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(Address) School of Education-Rutgers; 10 Seminary Place, New Brunswick, N J 08903

DATE: August 29, 1967

RE: (Author, Title, Publisher, Date) James Giuliano / ; THE FRAMING SQUARE; 1962

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Appropriate School Setting Related classroom
Type of Program Vocational - high school
Occupational Focus Carpentry
Geographic Adaptability Unlimited
Uses of Material Related classroom text
Users of Material Students

(4) Requirements for Using Material:
Teacher Competency Certification - science - carpentry background / preferred
Student Selection Criteria Student preference and guidance approval

Time Allotment One year

Supplemental Media --
Necessary ____ }
Desirable ____ } (Check Which)

Describe

Source (agency)
(address)

PREFACE

To the novice or uninitiated, a framing square is an inert piece of steel to be used for making a square cut. The markings are of little significance and the maze of figures is unfathomable.

To know the framing square is to trust it. In the hands of a skilled craftsman it becomes a living thing, providing the guide or direction for lines, angles, dimensions, and shapes. To know its secrets and its intricacies is to be able to lay out and control the course of most types of construction. As the transit is to the surveyor, so is the framing square to the craftsman - an instrument of accuracy and excellence. Adequacy and skill in its use separates those who are confident from those who are hesitant, the full journeyman from the apprentice, the master craftsman from the "hammer and saw" carpenter.

There is a feeling among carpenters and apprentices that one must have a knowledge of higher mathematics in order to be a good roof framer. This is simply not true. Despite its numerous scales and figures, there is nothing complicated about it.

This book tells the carpenter and apprentice "How to do it." It explains, by means of illustrations and detailed instructions, the various markings on the square, and the purposes for which it is used by the craftsman in the course of his daily work.

It is my sincere hope that this book will be a valuable aid to the young carpenter who is on his way to becoming a skilled craftsman.

James Giuliano

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UNIT VII - SUMMARY OF ROOF INFORMATION

UNIT I - DESCRIPTION, PRINCIPLES, TERMINOLOGY

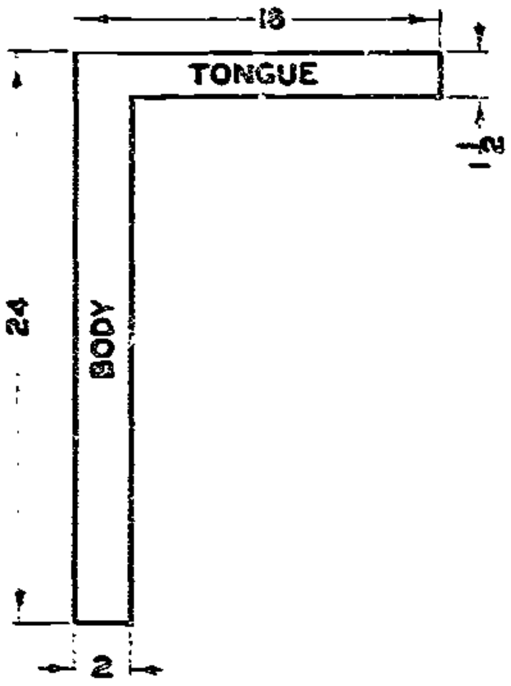
Description of the Framing Square Lesson 1

OBJECTIVE: To become familiar with the parts of the framing square.

INFORMATION:

Modern framing squares are made of steel in various finishes, such as polished blue, copper finished, aluminum, and stainless steel. These squares are marked with various scales and tables, such as rafter and framing tables, Essex board-measure table, octagon scale, and brace tables.

The framing square has many uses in measuring and spacing joists, studs, and rafters. The square is also used as a measuring device for determining the lengths and cuts of common, hip, valley, and jack rafters, and as a layout tool for stair building. The framing square in common use today is the Stanley R100, which is the one that this book is based upon.



THE FRAMING SQUARE

FIG. 1

The parts of the framing square are defined as follows:

Body -- The body is the longer and wider part and it is 24 inches long and 2 inches wide.

Tongue -- The tongue is the shorter and narrow part. It is 16 inches long and $1\frac{1}{2}$ inches wide.

Heel -- The outside edge where the body and tongue meet is called the heel.

Face -- The face of the square is the side on which the name "Stanley" is stamped.

Back -- The back is the side opposite the face.

ASSIGNMENT:

Study this lesson and be able to answer any questions the instructor may ask.

The Scales on the Framing Square — Lesson 2

OBJECTIVE: To become familiar with the scales on the inner and outer edge of the framing square.

INFORMATION:

The scales are the divisions found on the outer and inner edges of the square, marked in inches and fractions of an inch.

The Stanley square has the following scales and graduations:

1. Face of body -- outside edge: inches and sixteenths
   Face of body -- inside edge: inches and eighths

2. Face of tongue--outside edge: inches and sixteenths
   Face of tongue--inside edge: inches and eighths

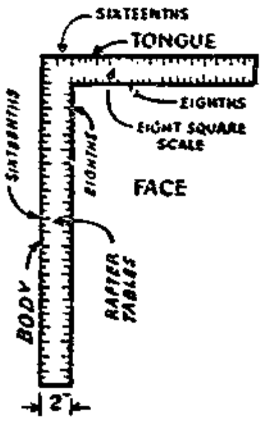


FIG. 2

3. Back of body -- outside edge: inches and twelfths
   Back of body -- inside edge: inches and sixteenths

4. Back of tongue--outside edge: inches and twelfths
   Back of tongue--inside edge: inches and tenths

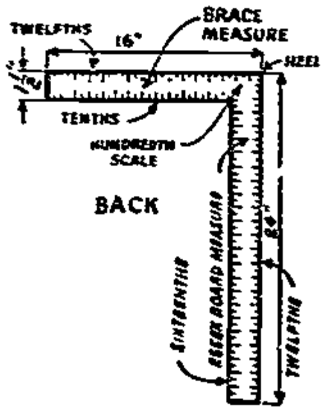


FIG. 3

5. Hundredth scale -- this scale is located on the back of the tongue, in the corner of the square. The hundredth scale is one inch divided into one hundred parts. The longer lines indicate 25 hundredths and the next shorter lines indicate 5 hundredths. Below the hundredths scale is one inch graduated in sixteenths, so the conversion from hundredths to sixteenths can be made at a glance without the need of dividers. This is a convenience when determining rafter lengths, using the figures of the rafter tables where hundredths are given

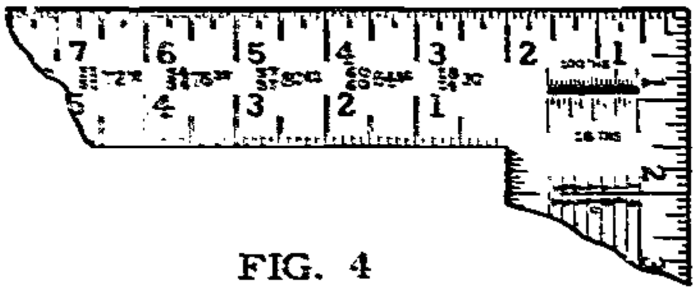


FIG. 4

UNIT I - DESCRIPTION, PRINCIPLES, TERMINOLOGY

The Rafter Tables Lesson 3

OBJECTIVE: To become familiar with the rafter and other tables on the framing square.

INFORMATION:

The framing square has tables for various framing and mathematical problems. Each table is used to solve a specific framing problem.

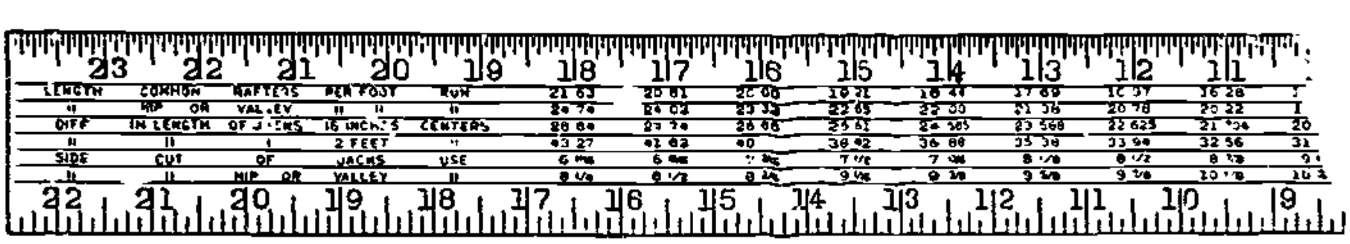


FIG. 5

1. <u>Rafter Tables</u>

   These tables are found on the face of the body, and are used to obtain the mathematical lengths of the various rafters, and their cuts. It consists of six lines of figures, and their use is indicated on the left end of the body.

   The first line gives the length of common rafters per foot of run.

   The second line gives the length of hip and valley rafters per foot of run.

   The third line gives the length of the first or shortest jack rafter and the difference in length of the other jack rafters when spaced 16 inches on center.

   The fourth line gives the length of the first or shortest jack rafter and the difference in length of the other jack rafters when spaced 24 inches on center.

   The fifth line gives the side cut of jack rafters for an equal-pitch roof.

   The sixth line gives the side cut of hip or valley rafters.

2. Octagon Scale

This scale is found along the center of the face of the tongue. As its name implies, this scale is used to lay out octagons, or 8-sided figures.

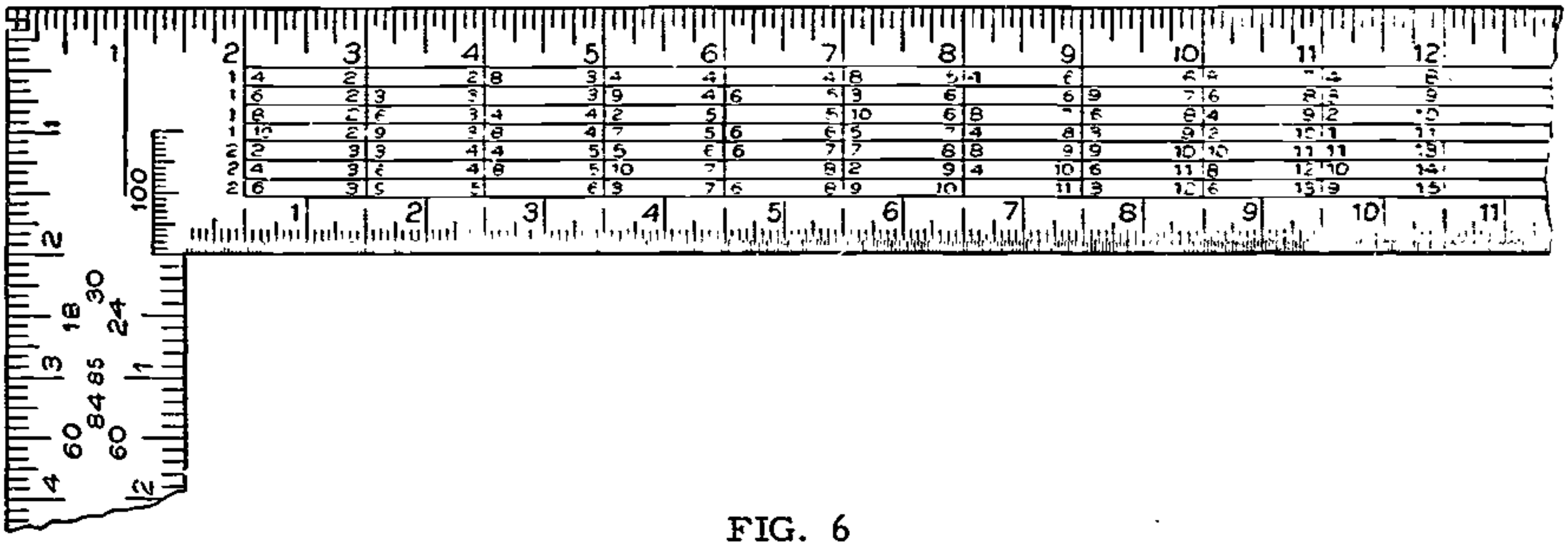


FIG. 6

3. Essex Board Measure Scale

This table is on the back of the body. By the use of this scale the board-foot measure of any size piece of timber can be found.

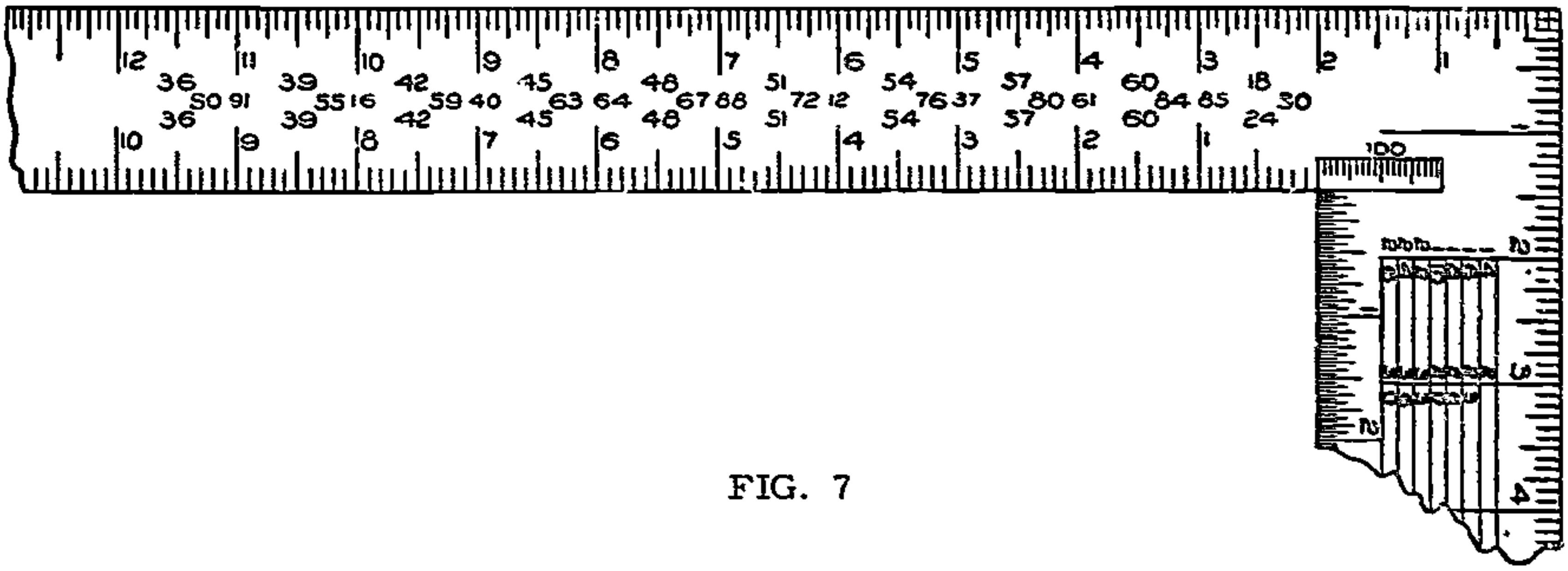


FIG. 7

4. Brace Measure Scale

This table is found along the center of the back of the tongue, and gives the length of the common braces.

ASSIGNMENT:

Study thoroughly the scales and tables on the square and be prepared to answer any questions your instructor may ask concerning them.

UNIT I - DESCRIPTION, PRINCIPLES, TERMINOLOGY

The Right-Angle Triangle Lesson 4

OBJECTIVES: To learn the principles of a right-angle triangle.
To learn the names of the parts of a right-angle triangle.

INFORMATION:

The basis of all roof framing is the geometrical figure called a right-angle triangle. Any gable, hip, or intersecting roof can be built using the fundamental principles of the right-angle triangle.

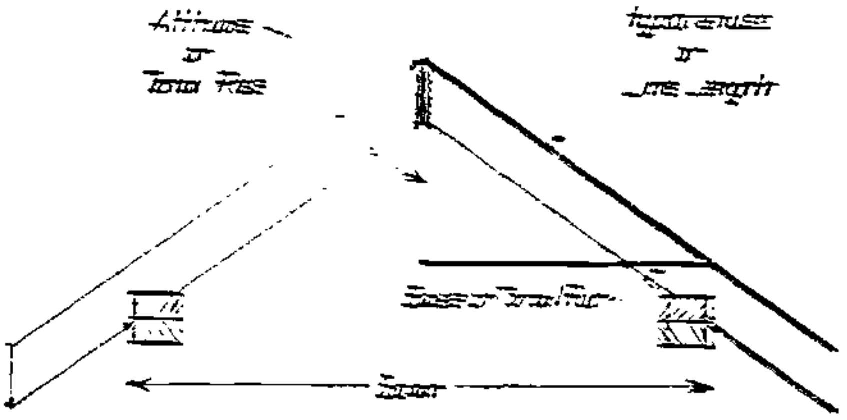


FIG. 4

A right-angle triangle always has one angle that is 90 degrees (the "right" angle), and two acute angles less than 90 degrees. The names of the parts of a right-angle triangle are the BASE, the ALTITUDE, and the HYPOTENUSE. The continued use of these terms would be appropriate if we were studying geometry, but since we are studying roof framing we will call the base TOTAL RUN, the altitude TOTAL RISE, and the hypotenuse the LINE LENGTH.

ASSIGNMENT:

Using the scale of 2 inches equals 1 foot, draw a right-angle triangle in which the run is 4 feet, the rise 3 feet. Find the line length of the triangle.

UNIT I - DESCRIPTION, PRINCIPLES, TERMINOLOGY

Terms Used in Roof Framing Lesson 5

OBJECTIVE: To become familiar with the terms total run, total rise, length, span, rise per foot, and pitch.

INFORMATION:

In order to really master the art of roof framing, it is of the utmost importance to become thoroughly familiar with the proper terms and definitions. These terms and definitions must be memorized, so that when a term or definition is used, a picture will form in your mind of the section of the roof defined.

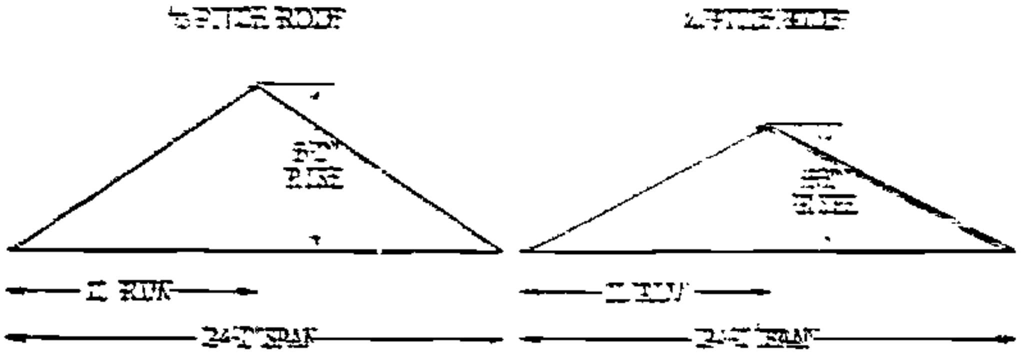


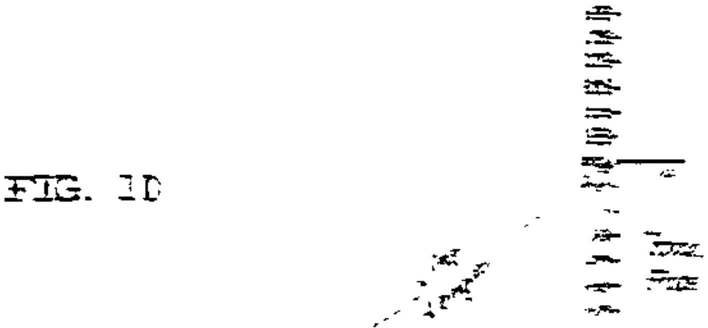
FIG. 1

Terms and definitions:

1. Span
   The span of a roof is the distance between the outside edges of the wall plates on the two opposite sides of the building. The span distance is always given on the blueprint; therefore, to find the span of a roof, read the blueprint.

2. Total Run
   The term total run always refers to the shortest horizontal distance measured from a plumb line passing through the center of the ridge to the outer edge of the wall plate.

FIG. 1b



3. Total Rise
   The total rise is the vertical distance that the ridge is above the plate line.

4. Line Length
   The term line length as applied to roof framing is the hypotenuse of a right-angle triangle whose base is the total run and whose altitude is the total rise. Line length is just what its name implies; no thickness or width of material is considered; it is simply a linear measurement.

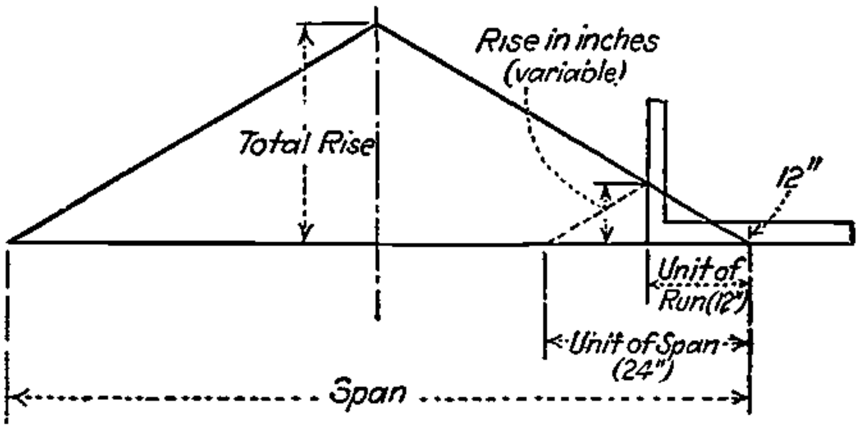


FIG. 11

5. Unit of Run
   The unit of measurement, 1 foot, or 12 inches, is the same for the roof as for any other part of the building. The principle underlying all roof framing is that all run measurements are taken on a level plane. The level plane distance is always spoken of as run; therefore the unit of run is 1 foot or 12 inches.

6. Rise in Inches
   The term rise in inches is the number of inches that a roof "rises" to every foot of run. (See Fig. 11.)

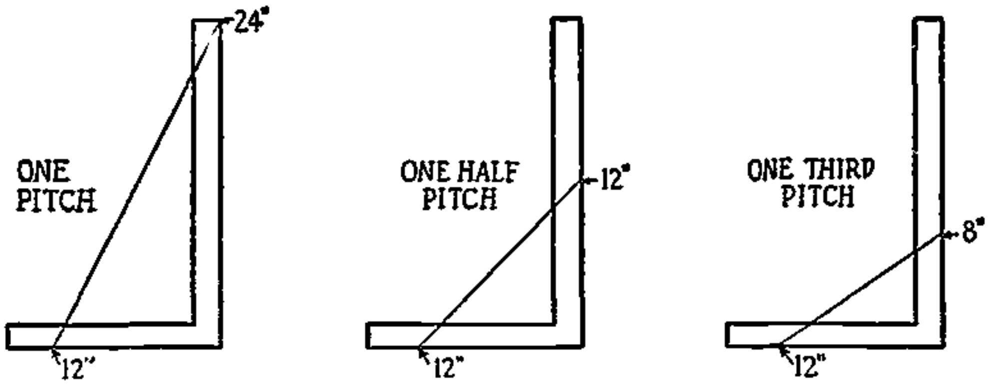


FIG. 12

7. Pitch
   The pitch of a roof is the term used to describe the amount of slope of the roof. It is expressed in terms of one pitch, one-half pitch, one-third pitch, etc.

ASSIGNMENT:

Memorize these terms and definitions and be able to answer any questions the instructor may ask concerning them.

The Pitch of a Roof

OBJECTIVE: To learn the meaning of the term "pitch."

INFORMATION:

Many times the term "pitch" is used when the term "rise per foot" should be used. Though both terms mean practically the same thing, there is a goemetrical difference.

Definition: The pitch of a roof is the angle of inclination that a roof makes with a horizontal plane. It is equal to the total rise divided by the span. The rule to find the pitch is:

Total rise divided by the span will give the pitch.

$$\frac{\text{Total Rise}}{\text{Span}} \text{ equals Pitch.}$$

Example: The span of a building is 32 feet, and the total rise is 8 feet. Following the rule,

$$\frac{\text{total rise}}{\text{span}} = \frac{8}{32} = \frac{1}{4} \text{ pitch.}$$

This means that the height from the level of the wall plate to the top of the ridge is $\frac{1}{4}$ of the total width of the building. To find the rise per foot, multiply the pitch by 24.

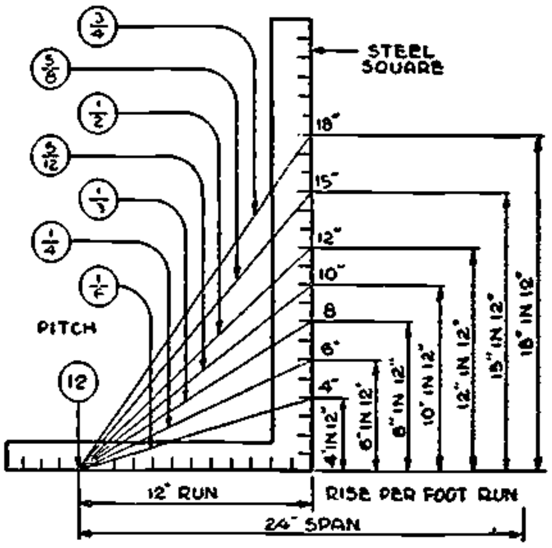


FIG. 13

Fig. 13 is a diagram in which the figures on the framing square are used to illustrate the relationship between the terms "pitch" and "rise per foot."

ASSIGNMENT:

Be prepared to answer any question the instructor may ask concerning "pitch" and "rise per foot."

Find the pitch for the following four roofs:

	Span	Total Rise
1.	27 feet	9 feet
2.	24 feet	8 feet
3.	28 feet	84 inches
4.	40 feet	120 inches

The Measuring Line — Lesson 7

OBJECTIVE: To learn the meaning of the term "measuring line."

INFORMATION:

The measuring line was used exclusively back in the days when lumber was not dressed on four sides as it is nowadays. It is now used only if a straight piece of lumber cannot be found to lay out the pattern rafter.

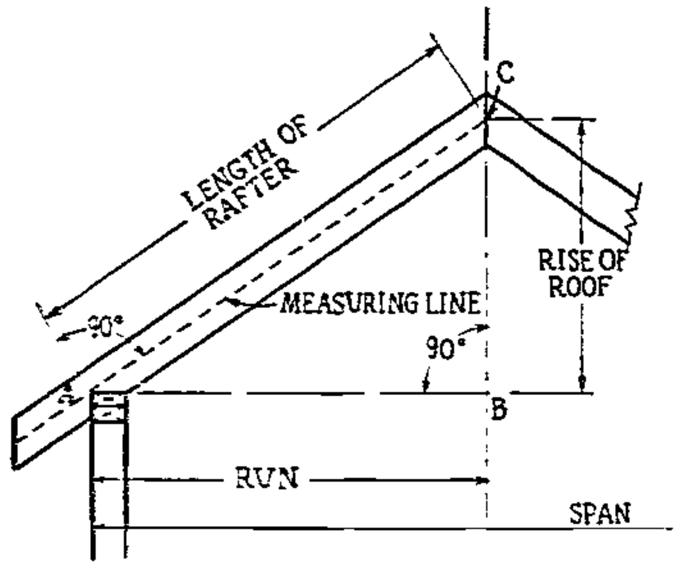


FIG. 14

Definition: A measuring line is a line drawn down the middle of the face of the rafter parallel to the edges. The best way to make the measuring line is by striking a chalk line at the proper place on the pattern material from end to end.

At the present time, when rafter material comes to the job site smooth and straight, the modern carpenter usually uses the edge of the lumber to step off the rafter.

ASSIGNMENT:

Be prepared to answer questions concerning this lesson.

The Structural Members of a Roof

Lesson 8

OBJECTIVE: To become familiar with the several types of rafters in constructing a roof.

INFORMATION:

There are three common types of roofs used in house construction, namely,

1. The gable roof
2. The hip roof
3. The intersecting roof

The gable roof requires only common rafters, but the hip and intersecting roofs require not only common rafters, but also several other types of rafters.

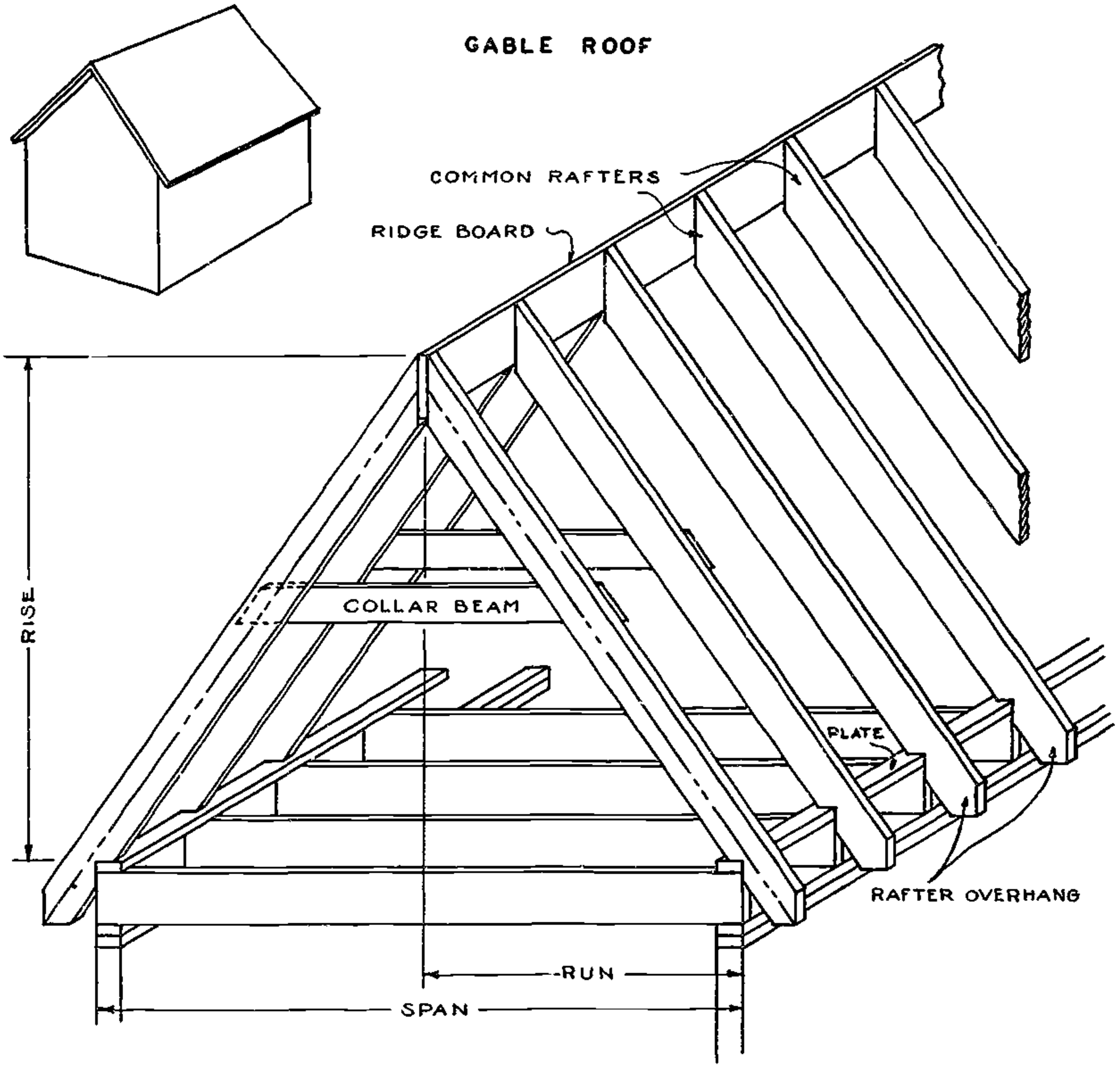


FIG. 15

Definition of roof rafters:

1. The common rafter
   Runs at right angles from the plate to the ridge.

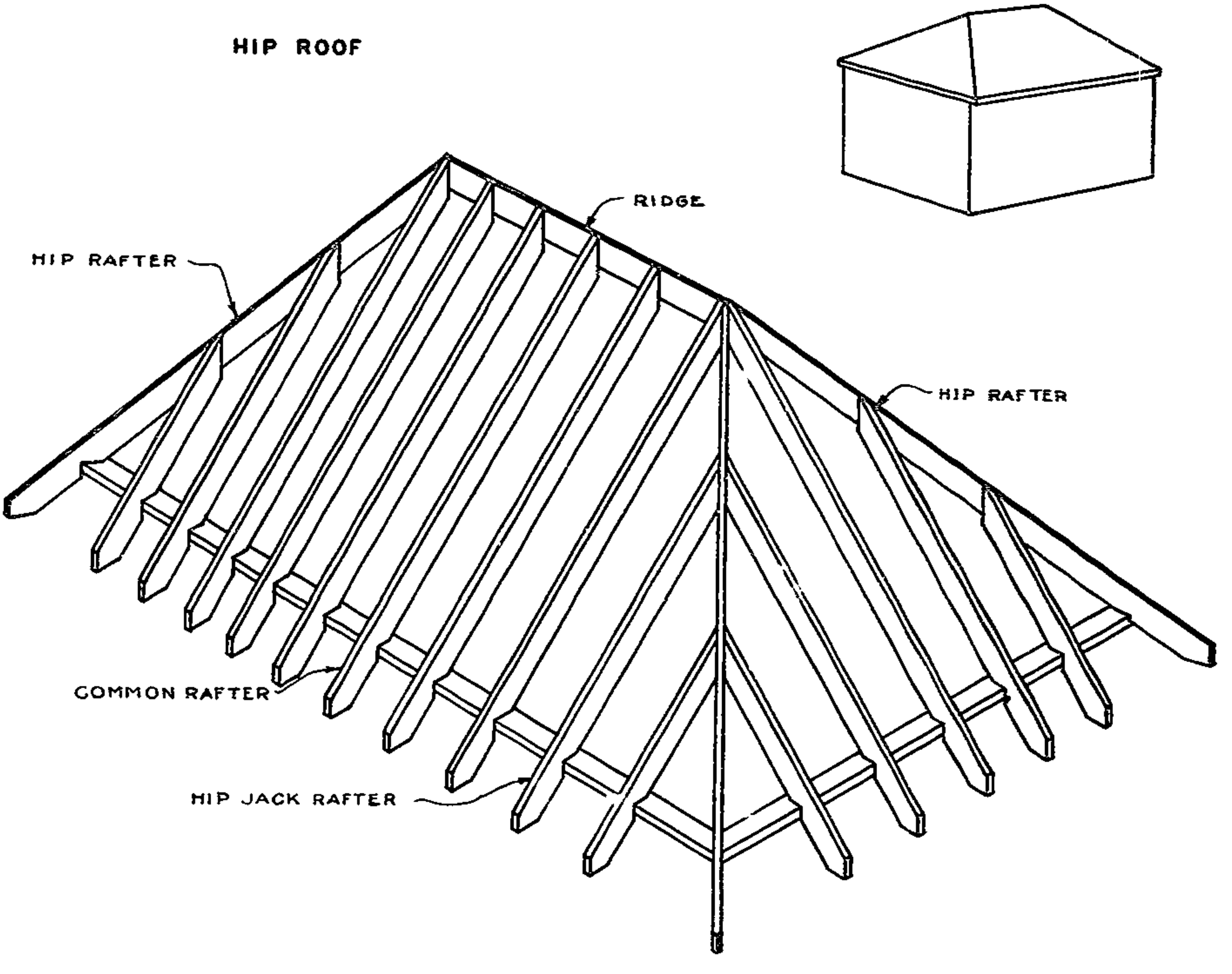


FIG. 16

2. The hip rafter
   Runs diagonally from the plate to the ridge.

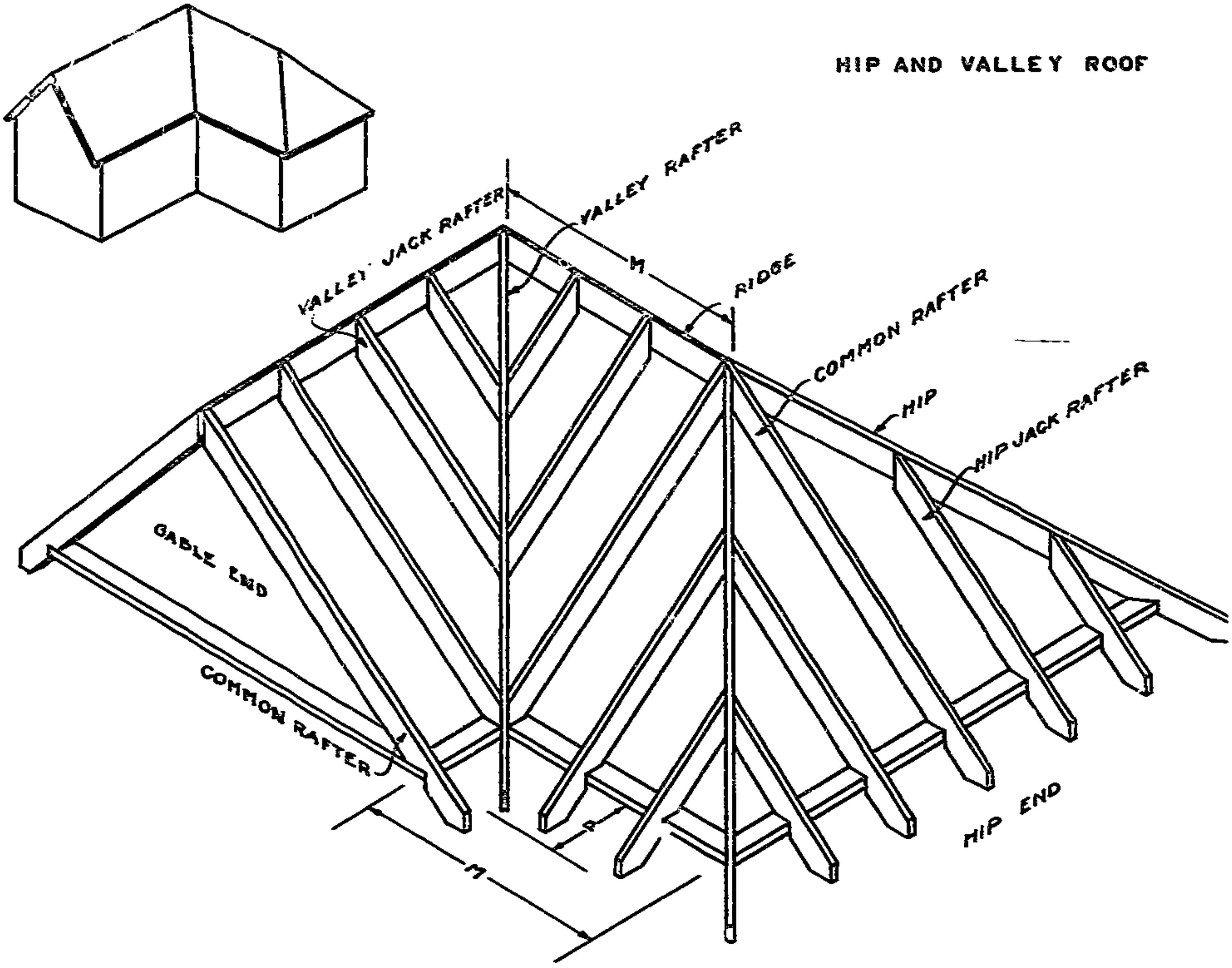


FIG. 17

3. The valley rafter
   Runs diagonally from the plate to the ridge along the line where two roofs intersect.

4. The hip jack rafter
   Runs from the plate to the hip rafter. (See Fig. 16.)

5. The valley jack rafter
   Runs from the ridge to the valley rafter. (See Fig. 17)

6. The cripple jack rafter
   A short rafter that does not touch either the plate or the ridge, usually running from the hip rafter to the valley rafter.

7. The overhang of a rafter
   The overhang extends over the edge of the plate. (See Fig. 15.)

8. The ridge board
   The ridge board is placed between the top ends of the rafters, and the rafters are nailed together on opposite sides of this board. It ties the rafters together. (See Fig. 15.)

9. The collar beam
   The purpose of the collar beam is to keep the rafters from spreading apart. (See Fig. 15.)

ASSIGNMENT:

Study and memorize the different types of rafters and be able to answer any questions the instructor may ask concerning them.

UNIT I - DESCRIPTION, PRINCIPLES, TERMINOLOGY

The Plumb, Level, and Side Cuts of Rafters — Lesson 9

OBJECTIVE: To become familiar with the different cuts of various rafters, and where they are to be made.

INFORMATION:

In order to make the various rafters fit into their proper places, certain cuts must be made. These cuts are called plumb cuts, level cuts, and side or cheek cuts. They must be made in their proper place on the rafter. Any cut that is vertical when the rafter is in its proper place is called a plumb cut, and any cut that is horizontal when the rafter is in its proper place is called a level cut.

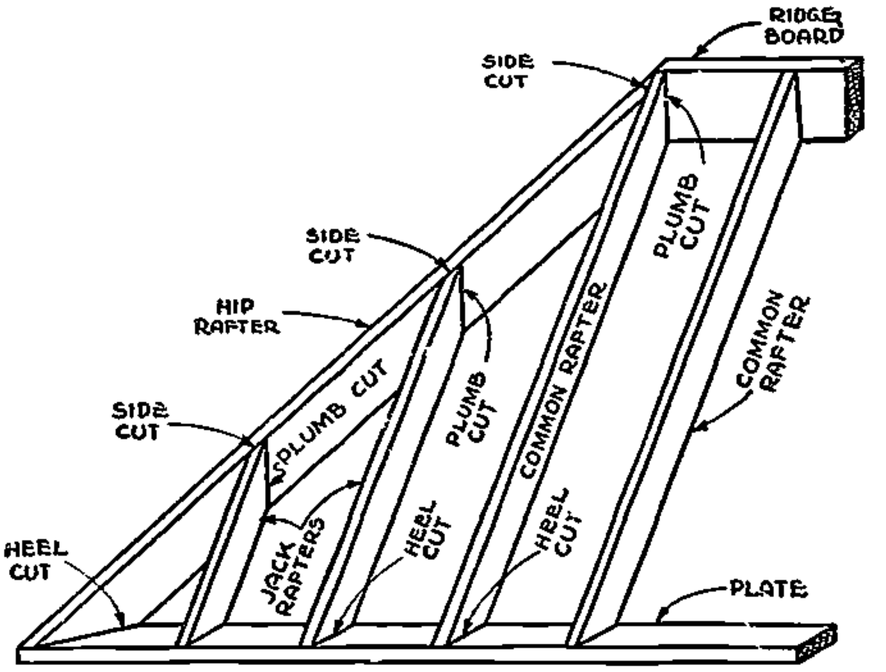


FIG. 18

Definition of rafter cuts:

1. Plumb cut
   The plumb cut is made at the end that is placed against the ridgeboard at the ridge. If the ridgeboard is omitted, which is very seldom, it rests against the opposite rafter.

2. Level or heel cut
   The level cut is sometimes called the heel cut, and rests on the wall plate.

3. Side cuts

   The side cut is sometimes called the cheek cut and is required when a rafter is not at a 90-degree angle to the particular member of the roof that it fits against. Hip and valley rafters require a combination plumb and side cut at the ridgeboard, due to the fact that they meet it at a 45-degree angle. Hip, valley, and cripple jacks also require combination plumb and side cuts.

ASSIGNMENT:

Draw a plan view (as seen from above) of an intersecting roof. (The dimensions will be given individually by the instructor.) Include all rafters - common, hip, valley, and jack. Specify where and what types of cuts are to be made.

UNIT I - DESCRIPTION, PRINCIPLES, TERMINOLOGY

TEST

Complete the following statements by writing in the correct word, number, or phrase.

1. The framing square consists of two parts, the __________ and the __________.

2. The __________ name is stamped on the __________ of the square.

3. The heel of the square is where the __________ and the __________ intersect.

4. The inches on the outside edge of the face of the body are divided into __________.

5. The rafter tables are located on the __________ of the __________ of the square.

6. Inches and twelfths are located on the back of the body on the __________ edge.

7. The hundredth scale is located on the __________.

8. The first line of the rafter tables gives the length of the common rafters __________.

9. Define the terms:

   Span

   Total run

   Total rise

   Unit of run

   Rise in inches

   Pitch

   Measuring line

10. Find the pitch of a roof that has these dimensions:

Span 28 feet   Total rise 7 feet

11. Name the three common types of roofs used in house construction.

12. Fill in the blanks.

A. The common rafter runs at __________ __________ from the __________ to the __________.

B. The hip rafter runs from the __________ to the ridge __________.

C. The ridgeboard is placed __________ the __________ __________ of the rafters.

D. The purpose of the collar beams is ____________________ ______________________________

13. Define the following rafter cuts, and specify on what part of the roof they are placed.

A. Plumb cut

B. Level cut

C. Side cut

Finding the Total Rise

OBJECTIVE: To learn how to find the total rise of a roof when it is not given on a plan.

INFORMATION:

In Unit I Lesson 5, the total rise was explained as "the vertical distance the ridge is above the plate line." Many times this distance is not given in the plan, yet the roof framer must know what the total rise of the roof will be, so that the roof will meet building code regulations and be in proportion to the rest of the house. It is a simple matter to find the total rise by following this mathematical formula:

Multiply the number of feet in the run by the rise per foot.

Example: Find the rise when the run is 14 feet, and the rise per foot is 8 inches.

14 x 8 equals 112 inches, or 9 feet 4 inches, total rise of the roof.

ASSIGNMENT:

Find the total rise for the following roofs:

Run	Rise Per Foot
16 feet	6 inches
18 feet	9 inches
15 feet 6 inches	10 inches

Give answers to the above problems in feet and inches, such as 9 feet 4 inches.

UNIT II - PRINCIPLES AND PRACTICES OF RAFTER LAYOUT

Finding the Rise Per Foot — Lesson 2

OBJECTIVE: To learn how to find the rise per foot of a roof when it is not given on a plan.

INFORMATION:

Very often the architect will not give the rise per foot of a roof, yet it is essential that the roof framer know what the rise per foot is, as it is one of the figures used on the framing square to step off a rafter. Again it is a simple matter to find the rise per foot by following a mathematical formula:

> Divide the total rise (in inches) by the number of feet in the run.

Example: Find the rise per foot when the total rise is 9 feet 4 inches and the run is 14 feet.

Convert 9'4" to inches--- 9 x 12 equals 108 plus 4 equals 112 inches. Number of feet in the run is 14, so, following the formula, 112 divided by 14 equals 8. This means that 8 inches is the rise per foot.

ASSIGNMENT:

Find the rise per foot of a roof where the total rise in 10 feet 6 inches, and the span is 28 feet.

UNIT II - PRINCIPLES AND PRACTICES OF RAFTER LAYOUT

The Unit of Run

Lesson 3

OBJECTIVE: To learn why the total run is broken down to units of run.

INFORMATION:

The term "run," whether it is used in conjunction with total run or unit of run, is applied to a horizontal rafter; no height is indicated. In Unit I Lesson 5, the total run was described as "the horizontal distance from the outer edge of the wall plate to the center of the ridge," or, in other words, the total run can also be described as being one-half the span. In order to use the framing square, which is only 24 inches by 16 inches, the total run must be broken down to figures that can be used on the square when stepping off a rafter to obtain its length.

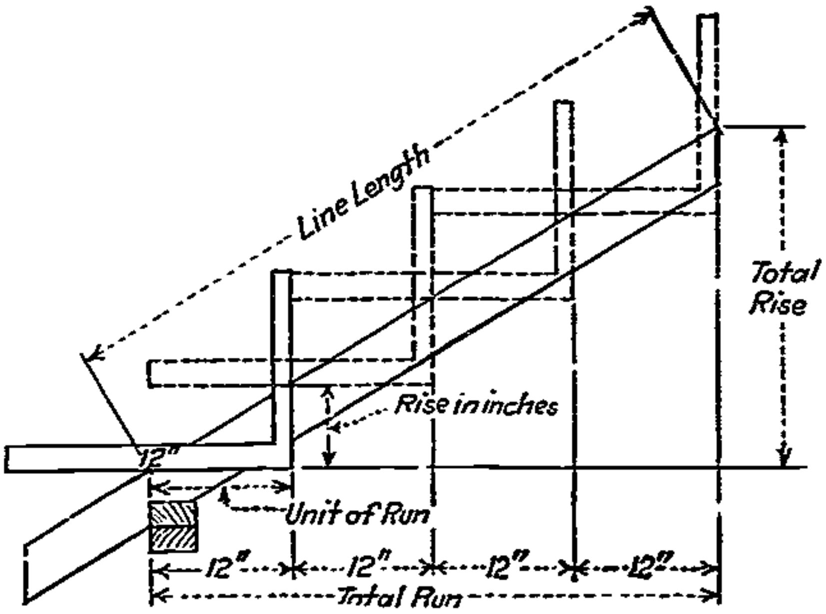


FIG. 19

The common unit of measurement is 12 inches or 1 foot. The total run is broken down into units of 12 inches or 1 foot. Thus, if the total run is 14 feet, it is broken down into 14 units, each unit consisting of 12 inches. Therefore in stepping off a rafter to obtain the length there will be 14 steps. In stepping off a common rafter, the 12-inch mark is always held on the body of the square, and the rise-per-foot mark is always held on the tongue of the square. The figure "12" will give the place for the level cut and the rise-per-foot figure will give the place for the plumb cut.

ASSIGNMENT:

Study Fig. 19 and be prepared to answer any question concerning this lesson.

UNIT II - PRINCIPLES AND PRACTICES OF RAFTER LAYOUT

Length Per Foot of Run — Lesson 4

OBJECTIVE: To learn the principle of the length of the common rafter per one foot of run.

INFORMATION:

In the previous lesson, the total run was broken down into units of 12 inches or 1 foot. The rafter tables found on the Stanley R100 framing square are based on the "rise per foot run" which means that the figures in the tables indicate the lengths of rafters per one foot of run for common rafters for any rise of roof. For example, look at the 10-inch mark on the face of the body of the square. The first figure under the mark is 15.62. This means that a rise of 10 inches per foot of run gives a corresponding length of 15.62 inches for the common rafter.

The rafter length per foot of run is clearly illustrated in Fig. 20. The reason for using this "per foot run" method is that the length of any rafter can be easily determined for any width of building. The length per foot run will be different for different pitches; therefore before you can establish the length of a rafter, you must know the rise of the roof in inches, or the "rise per foot of run." (Unit II Lesson 2.)

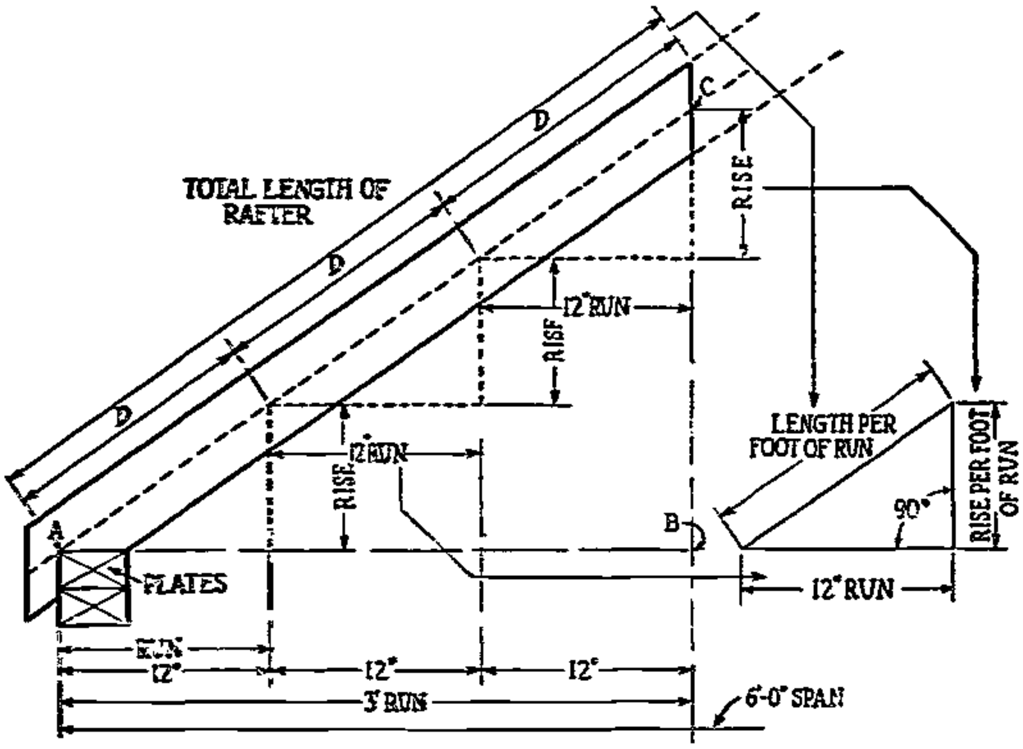


FIG. 20

Example (See Fig. 20):

A roof has a run of 3 feet and a certain rise per foot. The figure may be regarded as a right-angle triangle "ABC," having for its sides the run, rise, and the rafter. The run of the rafter has been divided into three equal parts, each part representing "one foot run." By drawing vertical lines through each division point of the run, the rafter also will be divided into three equal parts "D." Since each part "D" represents "the length of the rafter per one foot of run" and the total run of the rafter equals three feet, it is evident that the total length of the rafter will equal the length "D" multiplied 3 times.

Thus if the rise per foot of run were 10 inches, each length "D" would be 15.62 inches, and the total length of the rafter would be 3 times 15.62, or 46.86 inches.

ASSIGNMENT:

Using the square, find the mathematical length for the following common rafters:

1. Run is 14 feet 6 inches and the rise per foot is 9 inches.
2. Run is 16 feet and the total rise is 10 feet 8 inches.
3. Span is 27 feet and the total rise is 162 inches.

UNIT II - PRINCIPLES AND PRACTICES OF RAFTER LAYOUT

Plumb and Level Lines — Lesson 5

OBJECTIVE: To learn the principles of plumb and level lines.

INFORMATION:

In order for any rafter to fit against another member of a roof, its lines or cuts must correspond to the particular member against which it must fit. These lines or cuts are known as plumb or level cuts. Any line that is vertical when the rafter is in its proper position is called a plumb line, and any line that is level when the rafter is in its proper position is called a level line.

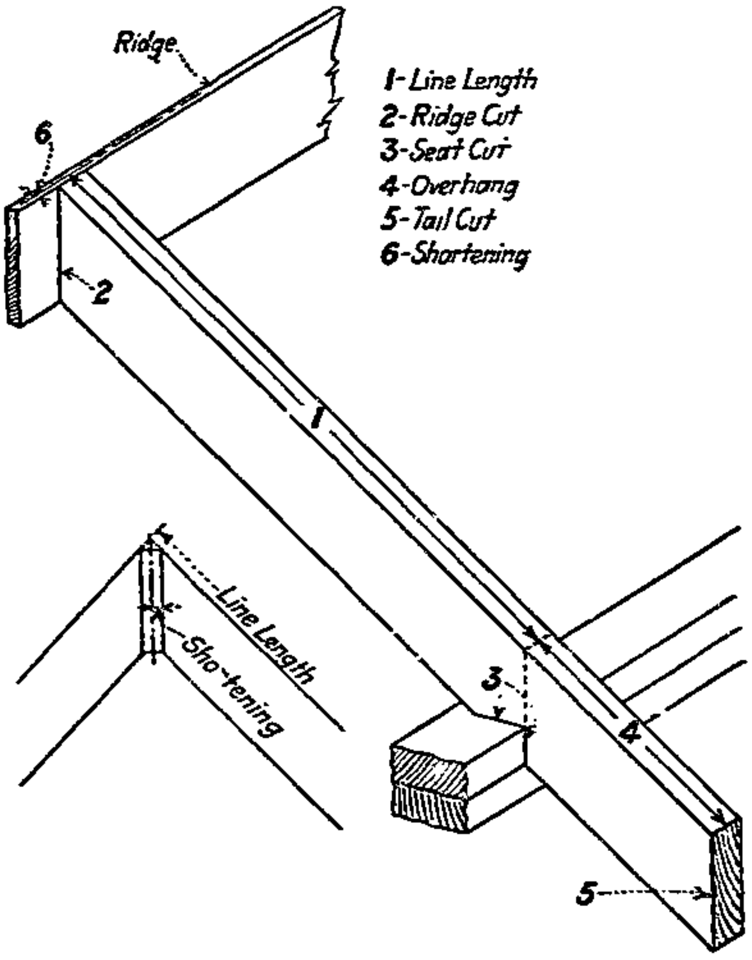


FIG. 21

The ridge cut of a common rafter (See Fig. 21)
The ridge cut of a common rafter is the cut at its top end. It fits against the ridgeboard. This cut, being vertical when the rafter is in its proper position, is called a plumb cut.

Seat cut of a common rafter (See Fig. 21)
The seat cut of the common rafter is the cut that permits the rafter to fit or rest on the top plate of the building. It consists of both plumb and level cuts.

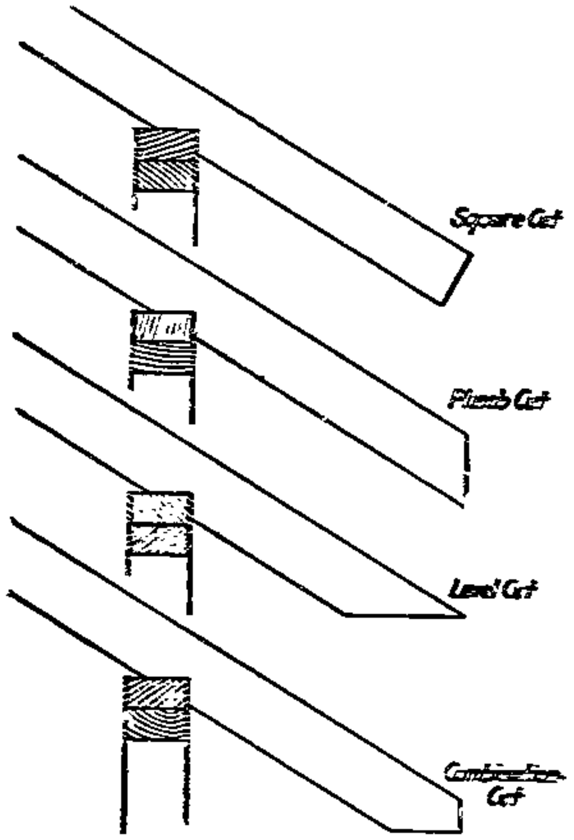


FIG. 21A

Tail cut of a common rafter
The shape of the cut at the exposed end of a common rafter can be a combination of several cuts. Fig. 21A illustrates a few typical cuts that are commonly used. Generally, they are a combination of the plumb and level cuts.

ASSIGNMENT:

1. Take a framing square and lay out a seat cut for a rafter that has a rise per foot of 9 inches, the level line to be the full width of the wall plate.

2. Lay out a ridge cut for a rafter with a rise per foot of 6 inches.

UNIT II - PRINCIPLES AND PRACTICES OF RAFTER LAYOUT

Line Length of a Common Rafter — Lesson 6

OBJECTIVE: To learn the line-length principle of roof framing.

INFORMATION:

The term "line length" simply means the lineal measurement of a rafter: no thickness or width is considered. It is the hypotenuse of the right triangle whose base is the total run and whose altitude is the total rise. Knowing the line length of a rafter is necessary when ordering the material for the rafter.

The line length can be found by measuring across the square from a total rise to a total run, and multiplying the line length by 12. This gives the actual mathematical length.

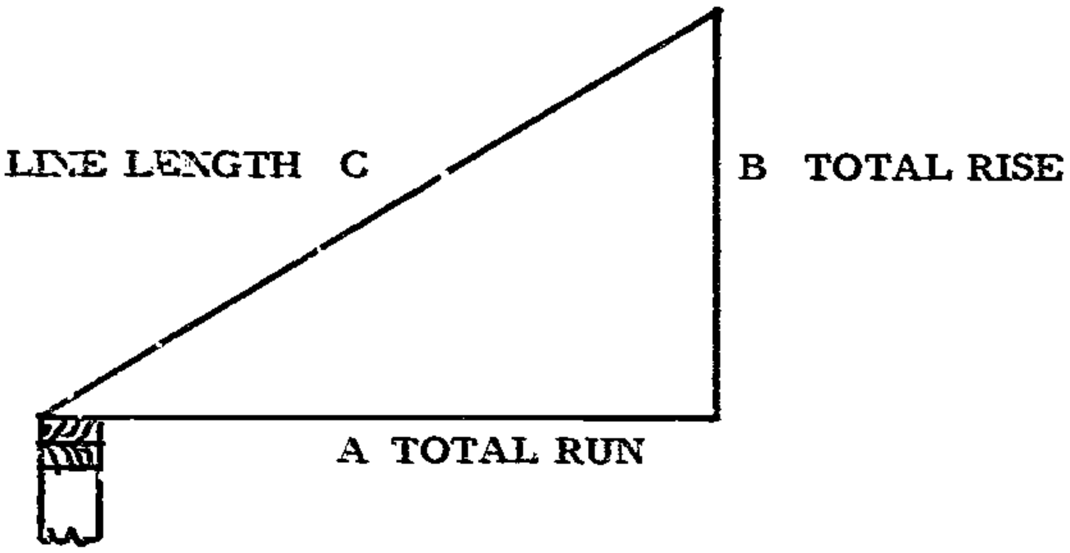


FIG. 22

Example: Total rise is 8 feet, and the total run is 8 feet.

Measuring across the square (hypotenuse) using the above figures will give $11\frac{5}{16}$ feet. Multiplying $11\frac{5}{16}$ by 12 gives $135\frac{3}{4}$ inches. This is the mathematical length of the common rafter. This length does not take into consideration the deduction for the ridgeboard or the extra for the overhang.

Another method of finding the mathematical length of a common rafter is to use the one-twelfth scale on the framing square. In using this scale, one inch stands for one foot, and each twelfth equals one inch. Use the total rise and the total run and measure diagonally across these two figures.

ASSIGNMENT:

Find the line length for the following common rafters:

1. Total rise 7 feet 6 inches, span 20 feet.
2. Total rise 9 feet 4 inches, total run 14 feet 6 inches.
3. Total rise 120 inches, span 22 feet.

Use both methods for each problem, as described in the lesson.

UNIT II - PRINCIPLES AND PRACTICES OF RAFTER LAYOUT

Determining Rafter Lengths Mathematically — Lesson 7

OBJECTIVE: To learn how to figure lengths of rafters using the rafter tables on the square.

INFORMATION:

In the previous lesson, the line length was found by measuring across the square diagonally. The figures given on the rafter tables can also be used to figure lengths mathematically.

Procedure: On the rafter table find the length of the rafter per foot of run for the rise per foot of the roof. Multiply the figure found on the rafter table by the total run. The answer is the mathematical length of the rafter.

Example: Find the length of the rafter if the rise per foot of the roof is 8 inches, and the total run is 11 feet 4 inches.

Under the figure 8 on the rafter table, find the length of the common rafter per foot of run; this will be 14.42 inches. Multiply 14.42 by the total run, $11\frac{1}{3}$ feet. The answer is 163.42 inches.

To find the number of feet, divide 163.42 by 12. This equals 13 feet 7.42 inches. To convert .42 to its fractional equivalent, multiply .42 by 16, which gives 6.72. Using the first number only, that is, 6, call it $\frac{6}{16}$ or $\frac{3}{8}$. (If a more accurate answer is needed, convert to thirty-seconds by multiplying by 32.)

The mathematical length of this rafter is therefore 13 feet $7\frac{3}{8}$ inches.

Note: The terms "line length" and "mathematical length" mean exactly the same.

For hip or valley rafters use the figures for hip and valley rafters on the square.

ASSIGNMENT: Use the rafter tables to find the mathematical length of the following common rafters.

Rise Per Foot	Total Run
8 inches	8 feet
10 inches	9 feet 6 inches
7 inches	14 feet 4 inches

UNIT II - PRINCIPLES AND PRACTICES OF RAFTER LAYOUT

TEST

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1. Find the total rise for roofs that have the following dimensions: (Give answers in feet and inches.

    A. Run 18 feet; rise per foot 4 inches.

    B. Span 32 feet; rise per foot 11 inches.

    C. Run 19 feet 6 inches; rise per foot [illegible] inches.

2. Find the rise per foot for roofs that have the following dimensions:

    A. Total rise is 4 feet 4 inches; run is 14 feet.

    B. Total rise is 7 feet 2 inches; run is [illegible] feet.

3. Explain why the total run is broken down to units of run.

4. Find the mathematical length for the following common rafters, using the table on the framing square:

    A. Run 14 feet; rise per foot [illegible] inches.

    B. Run 18 feet; rise per foot 4 inches.

    C. Span 27 feet; total rise 162 inches.

UNIT III - THE EQUAL-PITCH GABLE ROOF

Length of the Common Rafter Lesson 1

OBJECTIVE: To learn the step-off method to obtain the length of a common rafter.

INFORMATION:

An equal-pitch roof is a roof that has an equal pitch on the two opposite sides. Picture two right-angle triangles opposite each other. This type of roof is the most common and easiest to build, as it consists of only two different parts, the common rafters and the ridge.

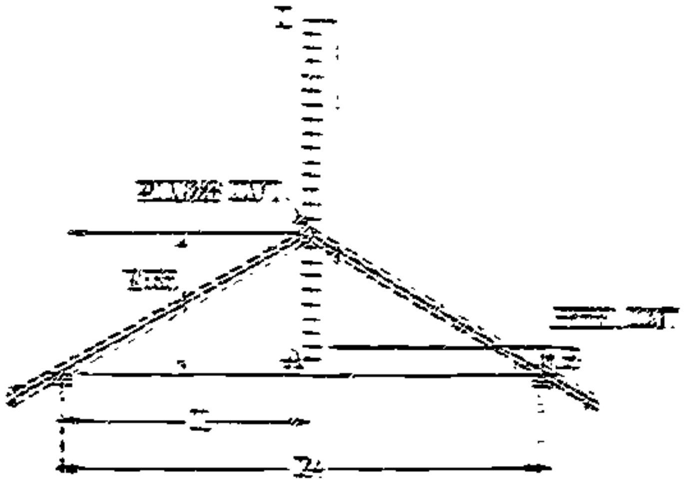


FIG. 25

There are several methods of finding the length of a common rafter, but the most practical on-the-job method is the step-off method. Some roof framers prefer to start at the ridge cut and work down to the seat cut, while others prefer to start at the seat cut and work up to the ridge cut. Both methods are correct. After many years of experience in on-the-job roof framing, I personally prefer the method of starting at the overhang or seat cut and working up to the ridge cut. It is very important that extreme care be used in applying the square; any carelessness will result in an incorrect rafter.

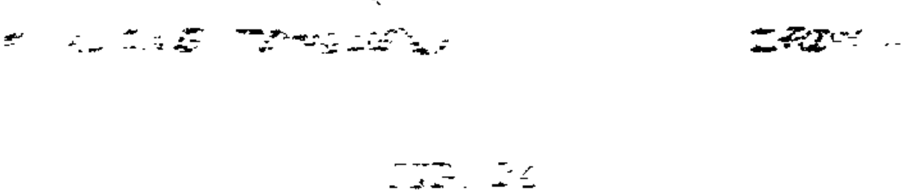


FIG. 26

Procedure:

Select a straight piece of stock and lay it so the crown is toward you. Start at the extreme left end of the stock, and work from left to right. Assume the run is 14 feet and the rise per foot is 8 inches. Hold the framing square face up, the tongue in the left hand and the body in the right hand, the heel toward you. On the edge of the stock hold the 8-inch mark on the tongue and the 12-inch mark on the body, and mark along the outer edge of the tongue. This is the plumb line for the seat cut.

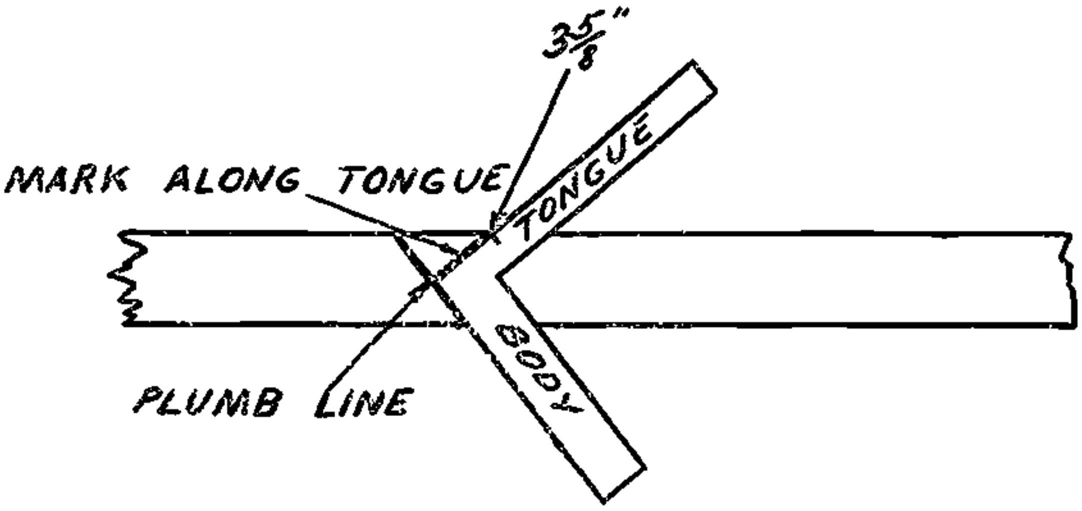


FIG. 25

Turn the square, still face up, and hold the body in the left hand and the tongue in the right hand. Holding the body parallel to the plumb line that was just made, slide the body along this line until the $3\frac{5}{8}$-inch mark on the outer edge of the tongue coincides with the edge of the stock. Mark along the outer edge of the tongue. This is the level line, and is the width of the 2 x 4 wall plate.

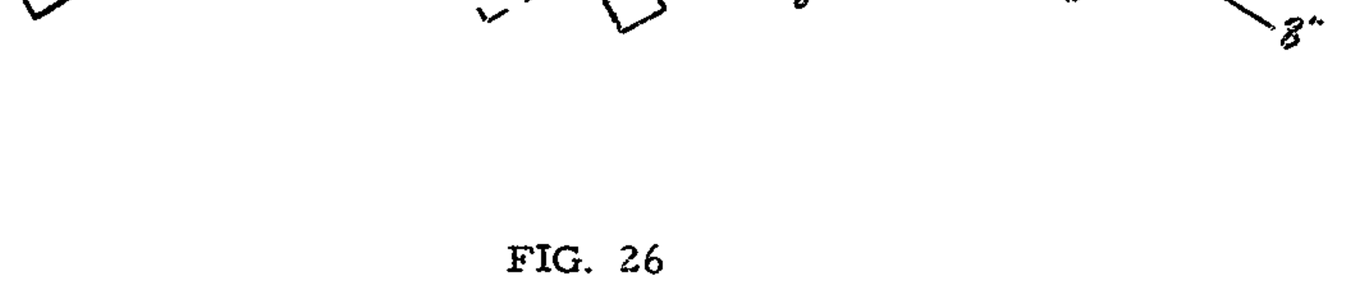


FIG. 26

Swing the square around again, still face up, and hold the body in the left hand, the tongue in the right hand, heel away from you. Hold the 12-inch mark on the body on the edge of the stock nearest you, coinciding with the plumb line of the seat cut, and the 8-inch mark on the tongue on the same edge of the stock; make a mark on the rafter where the 8-inch mark is being held. This is step No. 1. Hold the same figures and slide the square along the edge of the stock until the 12-inch mark on the body coincides with the mark made where the 8-inch mark was held, and make a new mark where the 8-inch mark is now being held. This is step No. 2. Repeat this process a total of 14 times (total run). At the 14th step, draw a full line along the tongue. This gives the plumb cut for the ridgeboard.

The length of rafter just laid out is the length to the center of the ridgeboard. Deduction must be made from this plumb line to allow for the thickness of the ridgeboard.

ASSIGNMENT:

Select a piece of stock 2 x 6 x 14 feet and lay out a common rafter. Total run and rise per foot will be assigned individually by the instructor.

UNIT III - THE EQUAL-PITCH GABLE ROOF

Odd Inches in the Run

Lesson 2

OBJECTIVE: To learn how to step off odd inches in the total run.

INFORMATION:

Many times, in fact most times, the total run of a rafter is not an even number of feet; in the great majority of times it also includes a certain number of inches. For example, if the span of a building is 29 feet, the total run will be 14 feet 6 inches. The 6 inches must be included in the step-off procedure in order to obtain the correct length. For convenience, 6 inches will be used; any other distance, even fractions of an inch, are handled in the same manner.

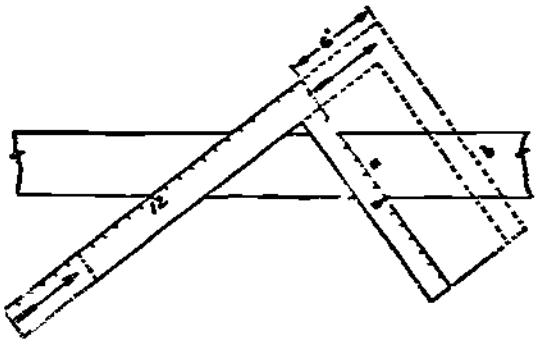


FIG. 27

Procedure:

The stepping-off process is exactly the same as in the preceding lesson up to the last full step. Assume that the total run is 14 feet 6 inches. This means that there are 14 full steps and one partial step. After marking the last full step, slide the square, still holding the 12-inch mark on the body and the 8-inch mark on the tongue until the 6-inch mark on the outside edge of the body is directly over the 14th step plumb line (see Fig. 27). Mark along the outside edge of the tongue. (Again, this measurement is to the center of the ridgeboard, and deduction must be made from this line to allow for the thickness of the ridgeboard.)

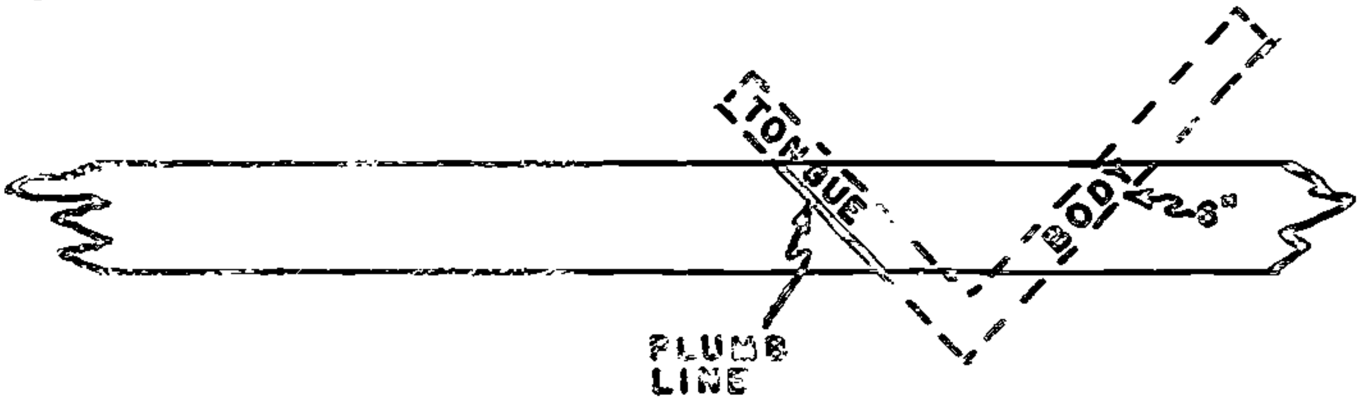


FIG. 28

Another method is to swing the square around and hold the outside edge of the tongue parallel to the last full-step plumb line and make a mark on the outside edge of the body at the required number of inches (see Fig. 28). Lay out a plumb line at this mark, parallel to the last line. (Again, deduction must be made from this line to allow for the thickness of the ridgeboard.)

ASSIGNMENT:

Step off on a piece of stock the lengths for the following common rafters:

Total Run	Rise Per Foot
[illegible] feet 4 inches	7 inches
12 feet 7½ inches	10 inches

Allowance for the Thickness of the Ridgeboard

OBJECTIVE: To learn how to deduct, from the total length of a common rafter, the thickness of the ridgeboard.

INFORMATION:

In stepping off a common rafter, the last plumb line is the length of the rafter if there is no ridgeboard - if the rafters are butted against each other. Since a ridgeboard is used in most cases, this length of rafter will generally be too long. It is necessary therefore, to deduct an amount from the rafter length to allow for the thickness of the ridgeboard. The rule is: "From the last plumb line, deduct one-half the thickness of the ridgeboard."

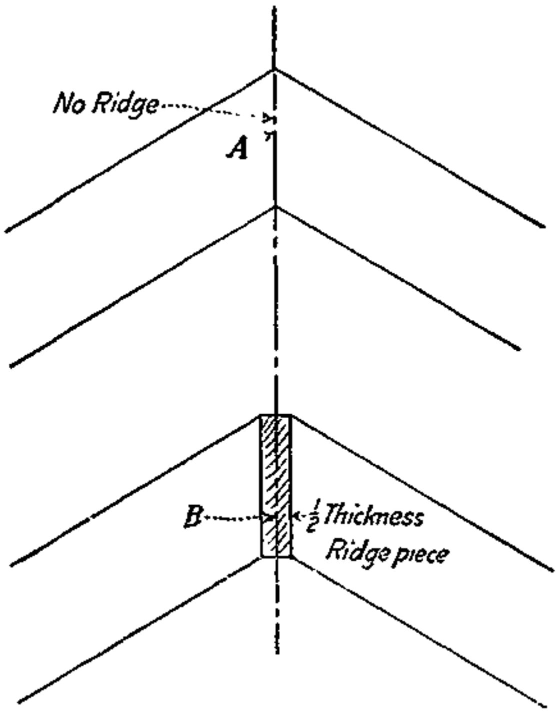


FIG. 29

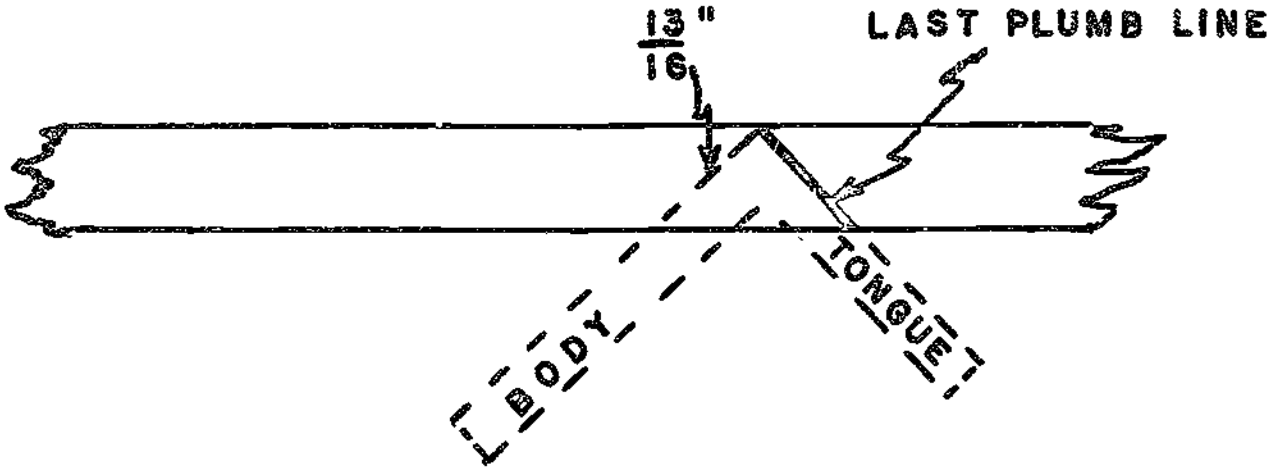


FIG. 30

Procedure:

Work from the last plumb line that was made on the rafter. Hold the square face up, tongue in the right hand, body in the left hand. Hold the outside edge of the tongue parallel to the last plumb line. The body of the square is now at a right angle to the plumb line. Assume the ridgeboard is $1\frac{5}{8}$ inches thick; one-half of $1\frac{5}{8}$ inches is $\frac{13}{16}$ inches. Mark off $\frac{13}{16}$ on the outside edge of the body, and lay out a plumb line on this mark, parallel to the previous plumb line. This is the exact length of the rafter, allowing for the thickness of the ridgeboard.

The figures $1\frac{5}{8}$ and $\frac{13}{16}$ inches were used merely to explain the procedure. Regardless of how thick the ridgeboard may be, one-half the thickness must be deducted to obtain the exact length. In deducting it, always measure at a right angle to the plumb line.

ASSIGNMENT:

Lay out the deductions for the following ridgeboards:

Rise Per Foot	Size of Ridgeboard
8 inches	2 x 8
10 inches	4 x 8
6 inches	6 x 10
$7\frac{1}{2}$ inches	4 x 10

OBJECTIVE: To become familiar with the two different types of overhangs.

INFORMATION:

The overhang of a rafter is the part that extends beyond the wall plate. The distance that the rafter extends beyond the wall plate is determined by either of two factors.

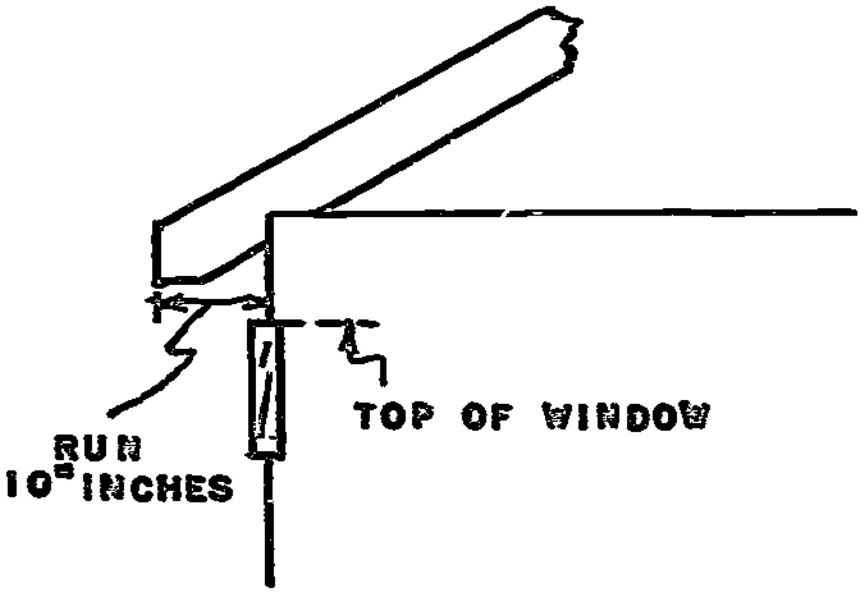


FIG. 31

1. The plan of the building will show the amount of projection (run) that the overhang is to extend beyond the wall plate.

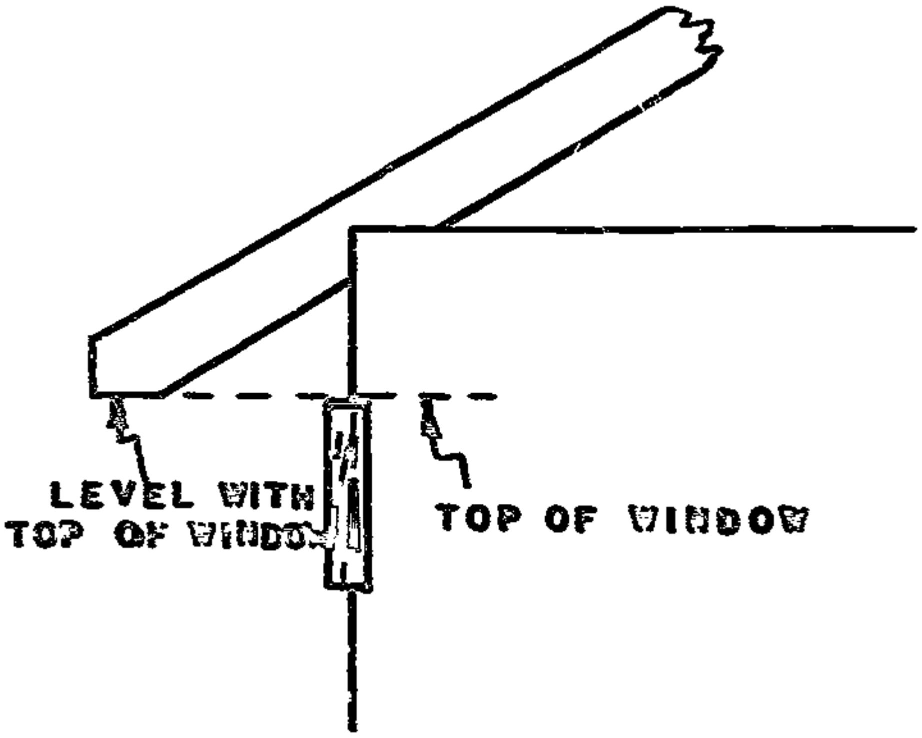


FIG. 32

2. The plan of the building will show that the level cut of the overhang is in a level line with the top of the window, regardless of the amount of projection beyond the wall plate.

In type 1, the blueprint will show that the overhang is to extend, let us assume, 10 inches from the wall plate. This means that it may or may not be on a level line with the top of the window.

In type 2, usually no measurement is given, but the blueprint will show that the level cut of the overhang is level with the top of the window. This type of overhang requires a combination plumb and level cut, the plumb cut to nail the fascia and gutter to, and the level cut to nail the soffit to. (In type 1 there are many types of cuts that can be made, several of which were shown in Fig. 21A).

ASSIGNMENT:

In approximately fifty words each, define the terms "fascia," "soffit," and "gutter." Explain the purpose that each serves on a building.

UNIT III - THE EQUAL-PITCH GABLE ROOF

Overhang When Run Measurement Is Given Lesson 5

OBJECTIVE: To learn how to lay out the overhang when the run measurement is given.

INFORMATION:

This type of overhang may or may not have a combination plumb and level cut. If a soffit, fascia, and gutter are to be nailed to it, then it must have plumb and level cuts, but sometimes, depending on the type of building, it may have only one cut -- either a plumb, or level, or a square cut. (See Fig. 21A.)

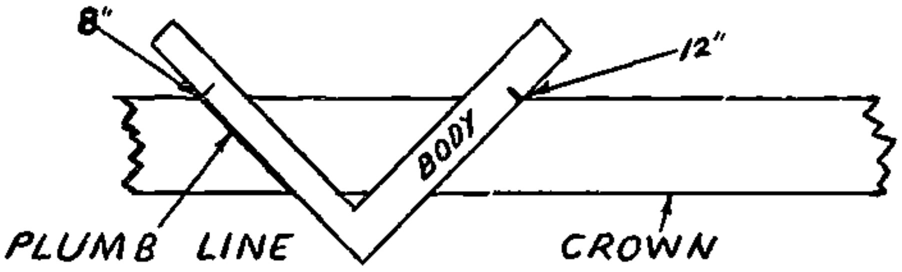


FIG. 35

Procedure:

Lay the stock from which the rafter is to be made, crown toward you. Assume that the run measurement as given on the blueprint is 10 inches, the rise per foot of the roof is 8 inches, and the overhang is to have a combination plumb and level cut. Hold the square, face up, tongue in the left hand, body in the right hand, heel toward you. Hold the 8-inch mark on the tongue and the 12-inch mark on the body, and on the extreme left end of the stock lay out a plumb line.

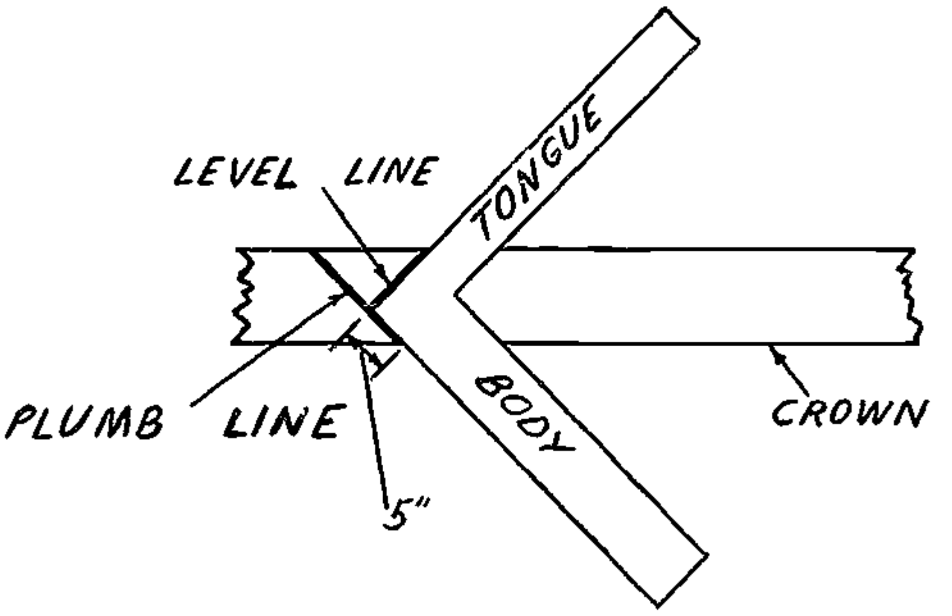


FIG. 36

Swing the square around, body in the left hand, tongue in the right, and hold the body parallel to the plumb line. The tongue is now at a right angle to the plumb line. The amount that is to be left on the plumb line depends upon the width of the fascia board, but usually 4 to 5 inches is left on the plumb line, as this is sufficient to nail the fascia to. We will assume that 5 inches is to be left on the plumb line to nail the fascia to. Hold the body parallel to the plumb line and measure from the crown side of the rafter 5 inches down. From this mark lay out a level line by marking along the outside edge of the tongue. This is the level cut to nail the soffit to.

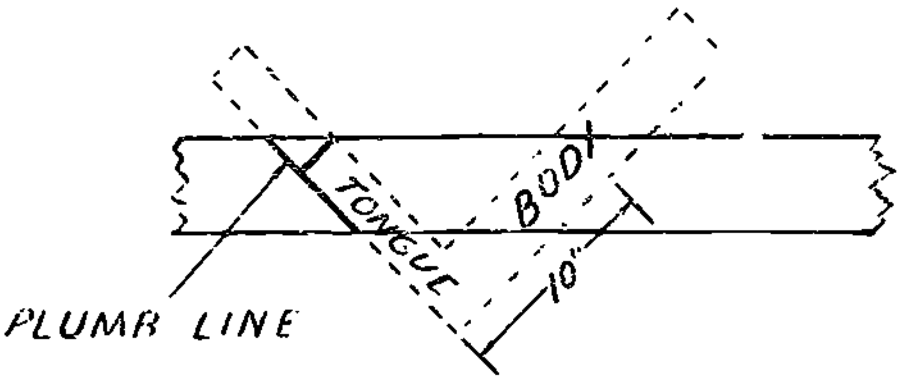


FIG. 37

Now hold the outside edge of the tongue parallel to the plumb line, and mark off on the outside edge of the body the run measurement of the overhang, 10 inches. From this point lay out a seat cut as described in Lesson 1 of this unit. When the rafter is in its proper position on the roof, the overhang will extend 10 inches from the outside wall plate on a level plane.

ASSIGNMENT:

Lay out the following overhangs, including seat cuts:

Rise Per Foot	Run of Overhang
9 inches	12 inches
10 inches	8 inches
12 inches	18 inches

UNIT III - THE EQUAL-PITCH GABLE ROOF

Overhang Level With Top of Windows — Lesson 6

OBJECTIVE: To learn how to lay out the type of overhang where the level cut is on a level line with the top of the windows.

INFORMATION:

This type of overhang (see Fig. 32) will always have a combination plumb and level cut, as the primary purpose is to have a soffit from the rafter overhang to the top of the windows. The drip caps are removed from the window frames so that the soffit can lie on the top rail of the window frame.

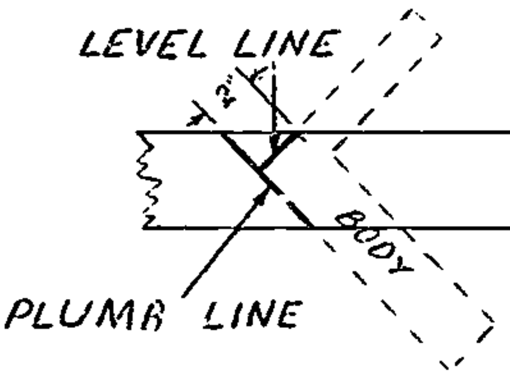


FIG. 39

Procedure:

Assume the rise per foot is 8 inches, and lay out a plumb line at the extreme left end of the stock as described in Lesson 5 of this unit. Hold the body of the square parallel to the plumb line and slide the square along this line until the 2-inch mark on the outside edge of the tongue coincides with the edge of the stock that is away from you. Mark along the outside edge of the tongue. At this stage of the layout procedure, the roof framer must know the vertical distance from the top of the window to the top of the wall plate. If the windows have been nailed in place, measure vertically from the top of the window (minus drip cap) to the top of the wall plate; otherwise obtain this measurement from the plans.

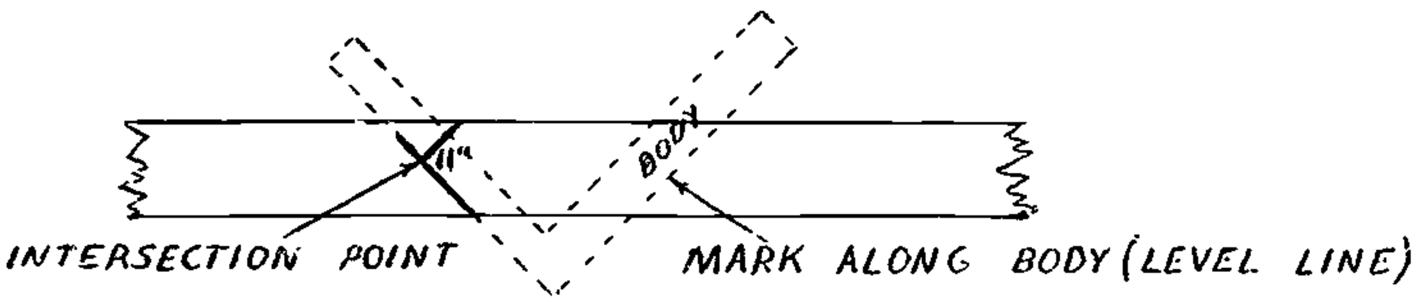


FIG. 40

Assume that the vertical distance is 11 inches. Hold the outside edge of the tongue exactly parallel to the plumb line. When the 11-inch mark on the outside edge of the tongue coincides with the intersection point of the plumb and level lines, mark along the outside edge of the body. This is the level line for the wall plate.

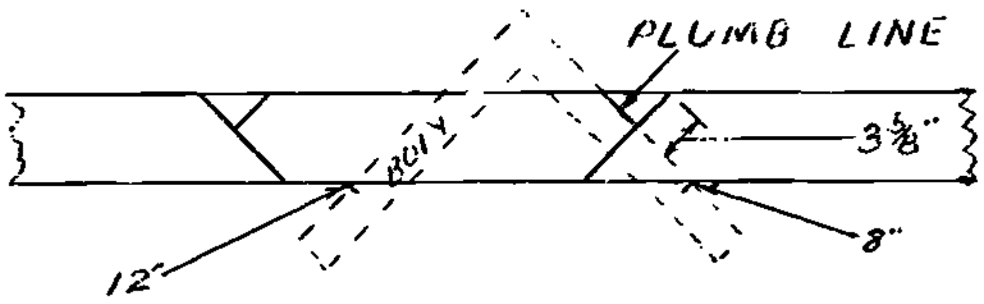


FIG. 41

From the edge of the stock that is away from you, measure along the level line, the width of the wall plate. If the wall plates are 2 x 4's, this measurement will be 3$\frac{5}{8}$ inches. At this mark lay out a plumb line. The stepping off procedure to obtain the length of the rafter starts from this line.

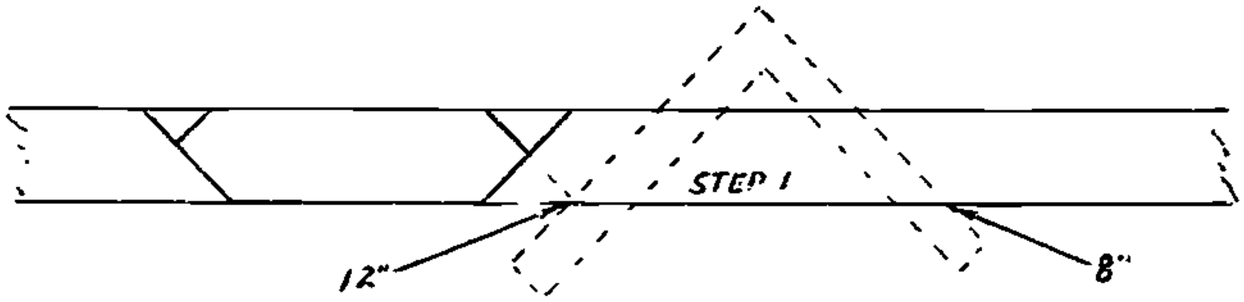


FIG. 42

When the rafter is in its proper position on the roof, the level cut of the overhang will be level with the top of the window. In order for the soffit to be perfectly level with the top of the window, however, the thickness of the stock of the soffit must be deducted from the level line of the overhang.

ASSIGNMENT:

Lay out the following overhangs, including one step of the run:

Vertical Distance	Rise Per Foot	Thickness of Soffit Stock
12 inches	9 inches	$\frac{1}{4}$ inch
14 inches	11 inches	$\frac{3}{8}$ inch
15 inches	6 inches	$\frac{1}{2}$ inch
10 inches	10 inches	$\frac{3}{8}$ inch
16 inches	12 inches	$\frac{1}{4}$ inch

UNIT III - THE EQUAL-PITCH GABLE ROOF

Length of the Ridgeboard   Lesson 7

OBJECTIVE: To learn how to obtain the length of the ridgeboard.

INFORMATION:

The ridgeboard is the horizontal member of a roof used for nailing the plumb cuts of the rafters on one side, to the plumb cuts of the rafters on the other side of the roof. Sometimes in cheap construction the ridgeboard is left out and the plumb cuts of the rafters are nailed together. This method is not recommended.

Procedure:

The length of the ridgeboard of a gable roof is always the same length as that part of the building to which it is parallel.

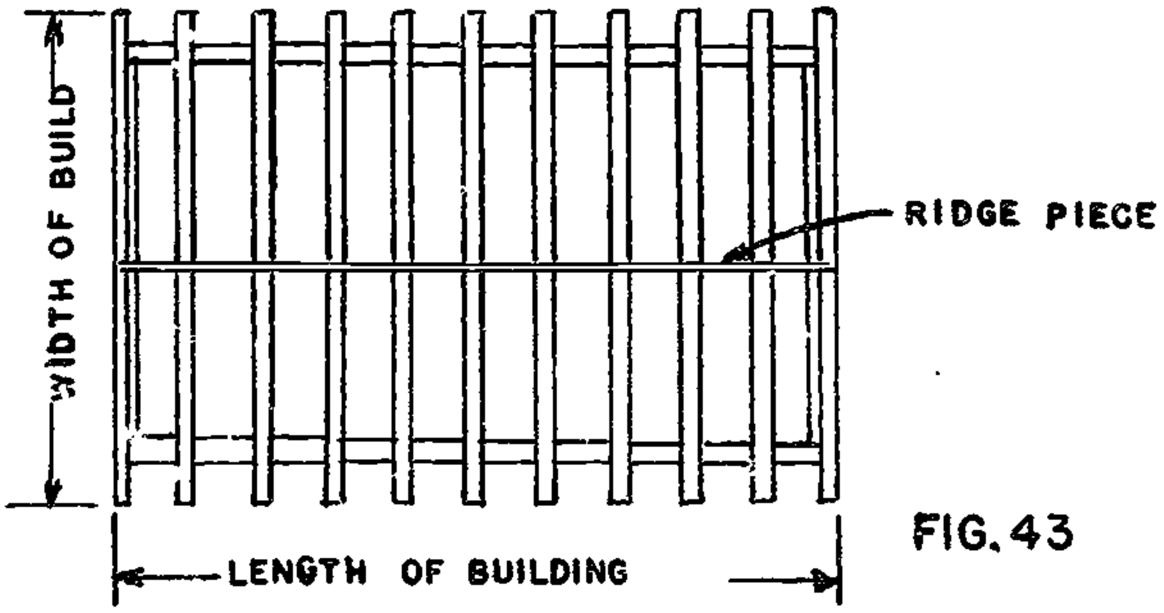


FIG. 43

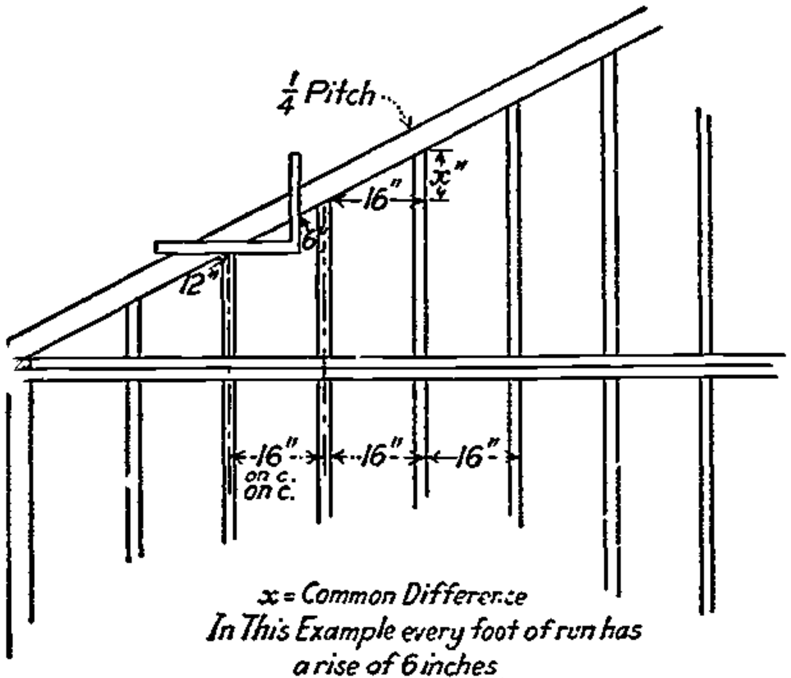
ASSIGNMENT:

Find the length of the ridgeboard if the building is 26 feet wide across the front and the length is 34 feet, the rafters to run from front to back.

UNIT III - THE EQUAL-PITCH GABLE ROOF

The Gable Studs | Lesson 8

OBJECTIVE: To learn how to lay out the gable studs.



x = Common Difference
In This Example every foot of run has
a rise of 6 inches
16" = $1\frac{1}{3}$ ft. Therefore $1\frac{1}{3} \times 6 = 8$, or
x = 8" (Common Difference)

FIG. 44

INFORMATION:

Gable studs are the studs that go from the end rafter to the wall plate. They require an angle cut on the top end to fit against the underside of the end rafter, and a square cut to rest on the wall plate. Cutting in the gable studs is, as a rule, an inconvenient operation, as most carpenters will do the measuring and cutting while standing on the ceiling beams. This inconvenient method of working can be eliminated, as the gable studs can be cut on the ground, provided the difference in length between the gable studs is known. The difference in length of the gable studs is found by applying the following rule:

> Multiply the rise per foot of the roof, expressed as a fraction, by the spacing of the studs.

Example: Assume the rise per foot is 6 inches and the stud spacing is 16 inches. Applying the rule, we get $\frac{6}{12} \times \frac{16}{1}$, which equal 8 inches. Therefore 8 inches is the difference in length.

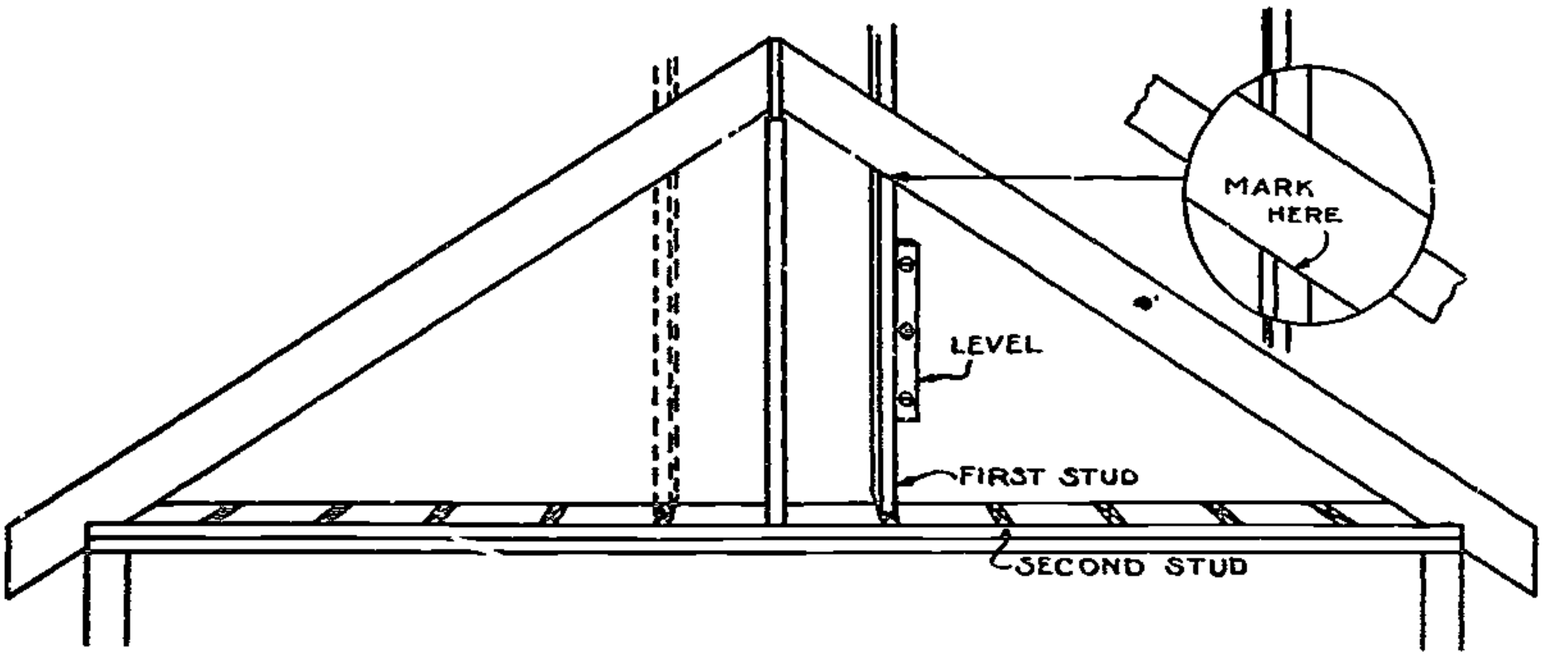


FIG. 45

To lay out the cut for the top end of the gable stud, use the rise per foot and the foot run (12 inches) on the square and cut on the rise. The quickest method of finding the length of the first gable stud is to place the stock in position and mark the length. Usually the first stud to cut is the longest one. The length of the other studs can be found by marking each the difference in length shorter than the previous one. In this example, each stud would be 8 inches shorter than the one next to it.

If a window is to be installed in the gable, measure one-half the opening size on each side of the center line. This is the starting point for the longest gable stud.

ASSIGNMENT:

Use a chalk line and on the floor of the shop lay out a gable and a set of gable studs. The total rise, total run, and spacing will be given to each student individually by the instructor.

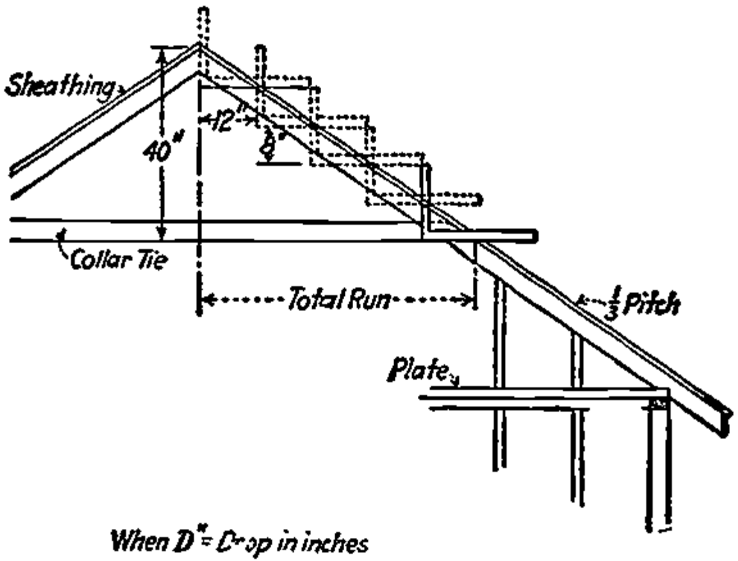
OBJECTIVE: To learn how to determine the length of a collar beam.

INFORMATION:

A collar beam is a piece of stock, usually a 1" x 6" or a 2" x 4", fastened to a pair of rafters in a horizontal position at a desired location between the ceiling joists and the ridge of the roof. The purpose of the collar beam is twofold -- to keep the building from spreading, and to add rigidity to the rafters. The lower the collar beam is from the ridge, the better it serves its purpose; also, the lower it is, the longer it is.

The rule to obtain the length of a collar beam is:

> Divide the "drop" in inches by the rise of the roof per foot of run. This will equal one-half the length of the collar beam. Multiply by 2 to get the actual length of the collar beam.



When D" = Drop in inches

- R" per Run = Rise in inches per foot of run
- L = Length Twice the total Run

$$2\left(\frac{D''}{R'' \text{ per } ' \text{ Run}}\right) = L$$

In this problem, 8 and 12 = cut

40" = Drop of Collar Tie (from peak of roof to under side of collar tie)

$\frac{40}{8} = 5.$ $2 \times 5 = 10$ Ans. 10 ft.

NOTE: For answer in inches multiply by 12

FIG. 46

Example: Assume an 8-inch rise per foot, and the collar beam to be 3 feet 4 inches from the ridge. Following the rule: The drop is 3 feet 4 inches, which equals 40 inches; $\frac{40}{8}$ equals 5. Multiplying 5 x 2 gives 10 feet, which is the length of the collar beam. The angle of the end cut is made by holding the square at the rise-per-foot mark and the foot-run mark (12), and marking along the 12-inch side of the square. The length can be either the top edge or the bottom edge of the collar beam.

Note: Dividing inches by inches does not give a number of feet as a result. What we are actually doing in following this rule is finding out how many steps of 8 inches each are required to step off 40 inches of drop. For every 8 inches of drop, there will of course be 12 inches of run. This represents one-half of the roof. Multiplying by 2 allows for the other half.

ASSIGNMENT:

Use the same roof as in Lesson 8 and lay out a collar beam. Individual figures will be given by the instructor.

UNIT III - THE EQUAL-PITCH GABLE ROOF

TEST

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1. Use the step-off method described in Lesson 1 and lay out the common rafters (exact length) for roofs with the following dimensions:

RUN	RISE PER FOOT	RIDGEBOARD
9'6"	6"	2" x 8"
11'9½"	11"	2" x 10"

SPAN	TOTAL RISE	RIDGEBOARD
31'6"	7'6"	4" x 10"

2. Define the terms

   A. Fascia
   B. Soffit
   C. Gutter

3. Lay out the overhang, including seat cut:

RUN OF OVERHANG	RISE PER FOOT
14"	9"
9"	12"
15"	10"

4. The vertical distance from the top of the window to the top of the plate is 14½ inches. The rise per foot is 11 inches. The thickness of the soffit stock is ¼ inch. Lay out the overhang so that the soffit is exactly level with the top of the window. Allow 3 inches on the overhang level cut to nail the soffit to.

5. The longest gable stud is 7 feet 4 inches, and the rise per foot of the roof is 10 inches. The spacing required is 12 inches. Lay out the gable studs, using the longest gable stud as a pattern.

UNIT IV - THE EQUAL-PITCH HIP ROOF

Description of the Equal-Pitch Hip Roof Lesson 1

OBJECTIVE: To become familiar with the structural members of a hip roof.

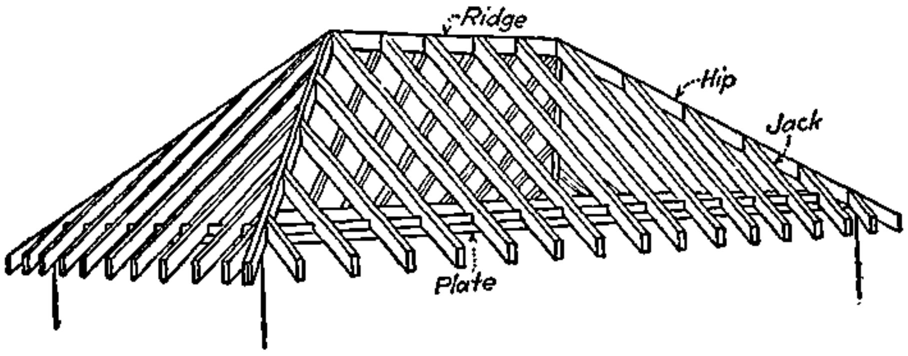


FIG. 47

INFORMATION:

In the preceding units, the gable roof was described as requiring only common rafters, with two slopes meeting at the ridge. An equal-pitch hip roof differs from a gable roof in that it has four slopes instead of two, all four slopes running toward the center of the building. A hip roof, like a gable roof, has common rafters and a ridge, but it also has hip rafters and hip jack rafters.

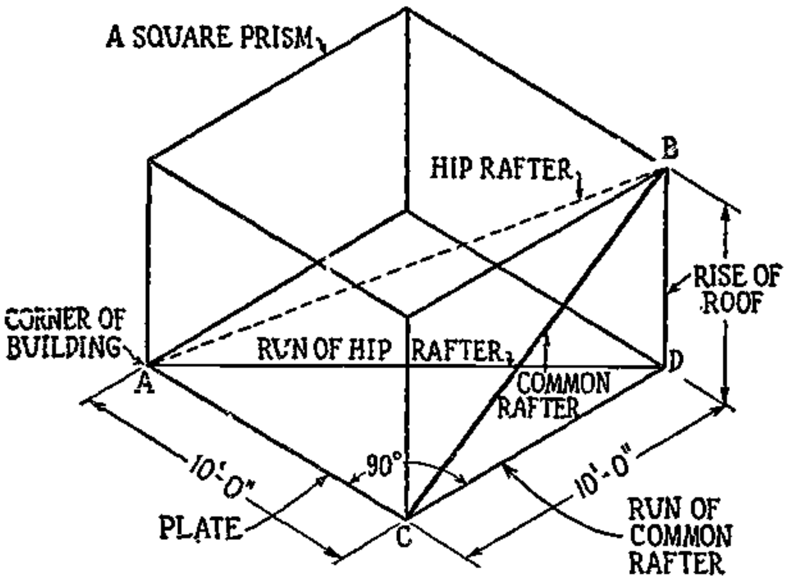


FIG. 48

The Hip Rafter

A hip rafter may be compared to the diagonal of a square prism. Its relation to the common rafter is the same as that of the hypotenuse of a right triangle to one of its sides. In a right triangle, if the sides forming the right angle are 12 inches each, the hypotenuse, that is, the side opposite the right angle, is equal to 16.97 inches, or, for practical purposes, 17 inches. The position of the hip rafter and its relation to the common rafter are clearly shown in Fig. 48.

The names of the cuts of a hip rafter are the same as in the common rafter, that is, a hip rafter will have a combination plumb and cheek cut at the ridge, a seat cut at the wall plate, and a tail cut at the overhang. The similarity ends here however, as the hip rafter cuts are different from the cuts of the common rafter.

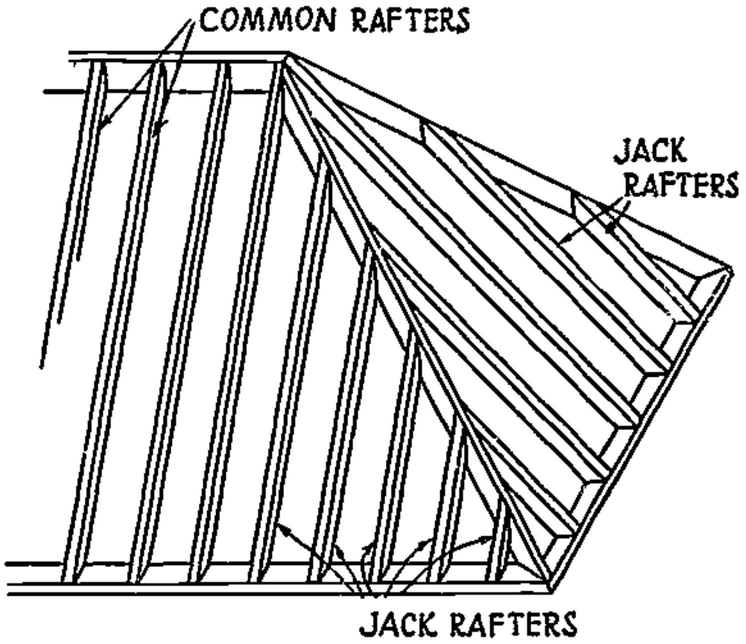


FIG. 49

Hip Jack Rafters

Hip jack rafters are basically common rafters that are progressively shortened to fit from the wall plate to the hip rafter. They are spaced the same distance apart as the common rafters, and, since they fill a triangularly shaped space on the roof, they must vary in length. The seat cut of a hip jack is the same as that of a common rafter. The top cut where it meets the hip rafter is a combination plumb and cheek cut. The combination cut will be described fully in the following lessons.

UNIT IV - THE EQUAL-PITCH HIP ROOF

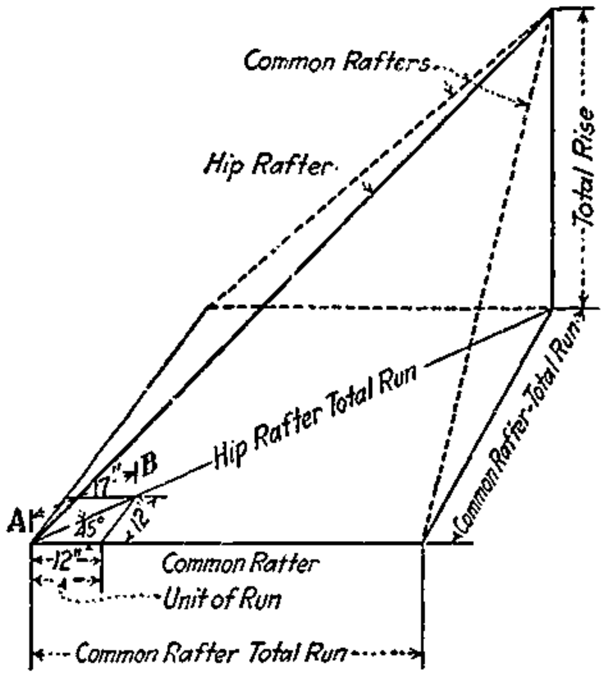
Unit of Run and Line Length

Lesson 2

OBJECTIVE: To become familiar with the unit run of the hip rafter.
To learn how to obtain the line length of the hip rafter.

INFORMATION:

In a gable roof the common rafters run at right angles to the wall plate, but in an equal-pitch hip roof, the hip rafters run at a 45-degree angle from the wall plate. This is the basis that determines the shape of the hip rafter cuts.



A-B Hip Unit of Run = 16.97" or 17"

FIG. 50

The Unit of Run

The unit of run of an equal-pitch hip rafter is based on the unit of run of a common rafter. That is, for every foot of run of the common rafter, the unit run of the hip rafter is the diagonal of a 12-inch square, which is 16.97", or, for practical purposes, 17 inches (see Fig. 50). This means that, instead of holding the 12-inch mark and the rise-per-foot mark to obtain level and plumb cuts, the 17-inch mark and the rise-per-foot mark are held.

Since the hip rafter will rise to exactly the same height as the common rafter, therefore the rise per foot is the same as for the common rafter. Plumb and level cuts are obtained by holding the 17-inch mark and the rise-per-foot mark on the square; the 17-inch mark will give the level cut and the rise-per-foot mark will give the plumb cut.

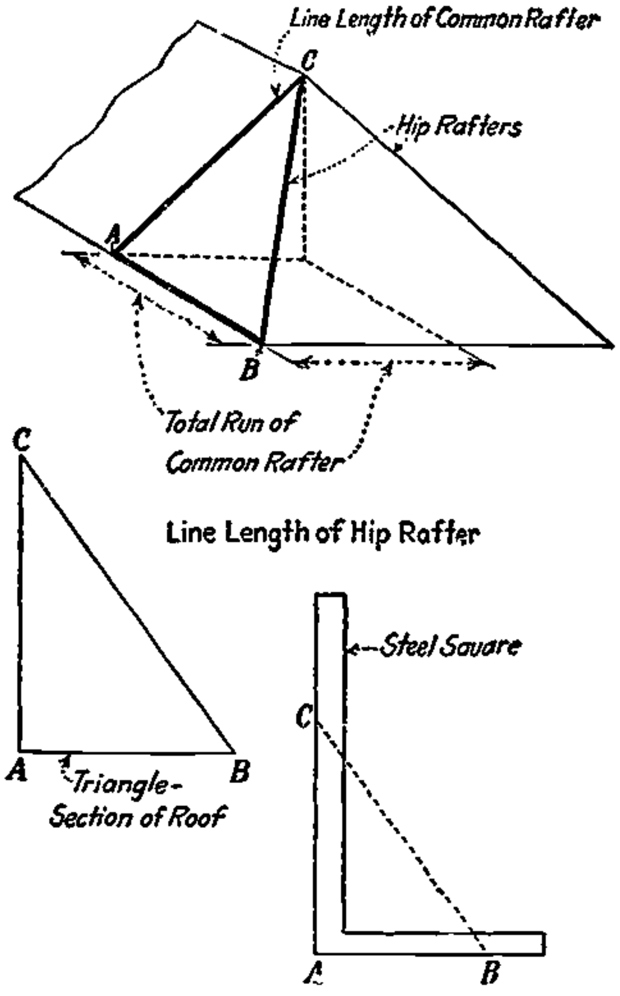


FIG. 51

Line Length

The rule for obtaining the line length of an equal-pitch rafter is:

> Line length equals the diagonal distance between the line length of the common rafter and the total run of the common rafter.

Use the $\frac{1}{12}$th scale on the framing square. The result equals $\frac{1}{12}$th the length of the hip rafter.

ASSIGNMENT:

Obtain the line length of a hip rafter in which the total rise is 8 feet, and the span is 30 feet. Check answer by also finding the mathematical length by using the rafter tables on the square.

Stepping Off the Length of a Hip Rafter

Lesson 3

OBJECTIVE: To learn how to step off a hip rafter.

INFORMATION:

The method of stepping off the length and obtaining the plumb and level cuts for a hip rafter is similar to the method used for the common rafter, except that the unit of run of the hip rafter is greater than that of the common rafter. This was explained in the previous lesson. Since both common and hip rafters are exactly the same height, the rise per foot and the total run are the same as for the common rafter. The hip rafter requires a "cheek" cut at the ridge, and also at the point where a fascia is to be nailed, whether it is at the wall plate or at the overhang. The stock for a hip rafter is almost always wider than the stock used for the common rafter; that is, if 2" x 6" stock is used for the common rafter, the stock for the hip rafter would be 2" x 8" or 2" x 10".

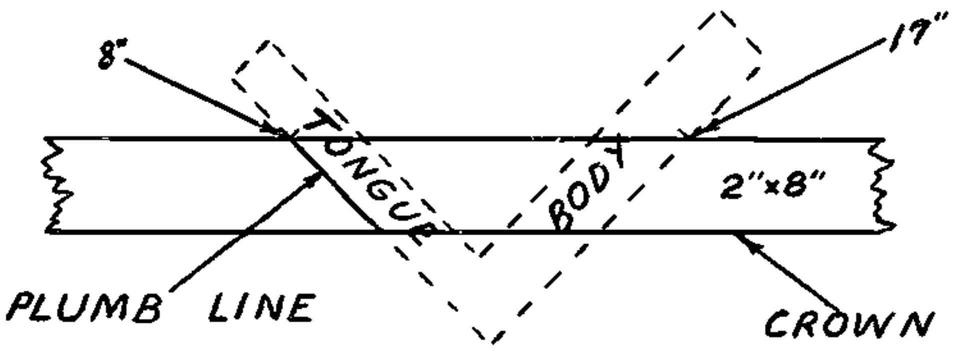


FIG. 52

Procedure:

Assume the rise per foot is 8 inches and the total run is 14 feet. Select the proper stock; in this case let us assume a 2" x 8". Place the crown edge toward you and start the layout at the extreme left end of the stock. Hold the square face up, tongue in the left hand, body in the right hand, heel toward you. Hold the 8-inch mark on the tongue and the 17-inch mark on the body, and mark along the tongue. This is a plumb line.

At this point, a slight difference in procedure in laying out the level line must be made. Since the hip rafter stock is 2" x 8", in order for the top

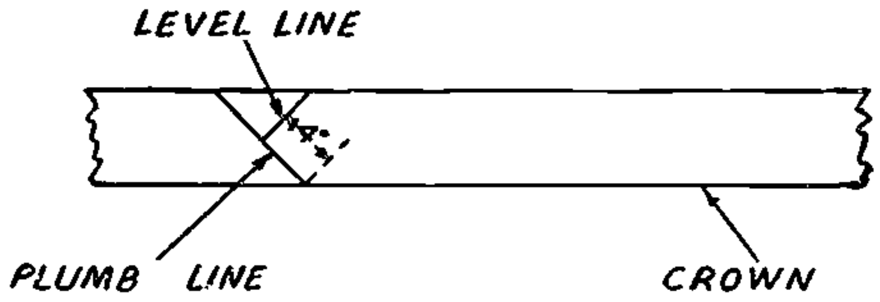


FIG. 53

edge of the common rafter and the top edge of the hip rafter to be exactly level with each other when in their proper positions on the roof, allowance must be made for the difference in width. To lay out the level line of the seat cut for the hip rafter, proceed as follows: At the seat cut of the common rafter, measure down from the top edge, along the plumb line, to the intersection point of the plumb and level lines. Assume this measurement is 4 inches. Then, on the plumb line of the hip rafter, measure along the plumb line, from the crown edge, the measurement found on the common rafter - in this case 4 inches. At this point lay out a level line. This level line will be longer than the level line of the common rafter. Now proceed with the step-off procedure.

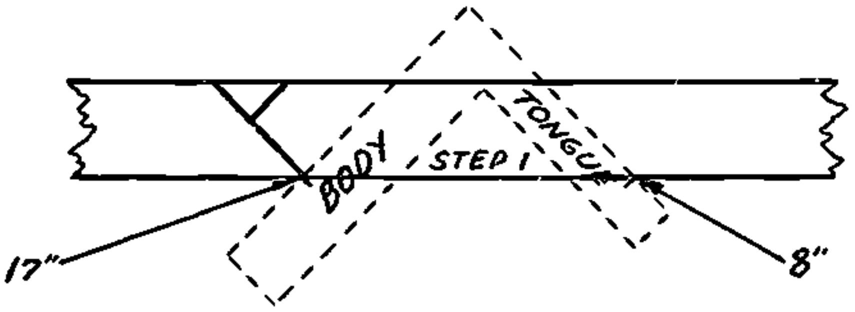


FIG. 54

Hold the square face up, the 17-inch mark on the body in the left hand, the 8-inch mark on the tongue in the right hand, heel away from you, the 17-inch mark coinciding with the plumb line. Step this off along the edge nearest you 14 times. This length is to the center of the ridgeboard.

ASSIGNMENT:

Using the step-off method, obtain the length for the following hip rafters:

Rise Per Foot	Total Run
7 inches	10 feet
9 inches	12 feet
10 inches	8 feet

UNIT IV - THE EQUAL-PITCH HIP ROOF

Backing Off a Hip Rafter — Lesson 4

OBJECTIVE: To learn how to back off a hip rafter.

INFORMATION:

If we were to nail the hip rafter in its proper position on the roof without "backing" it, and started to sheath up the roof, we would find that the sheathing would strike the outside top corners of the hip rafter and leave a space above the center of the hip rafter. Since all measurements in rafter layout work are always considered as being taken on the center line of the rafter, allowance must be made when laying out the hip rafter so that the sheathing will bypass the outside top corners and rest on the center of the hip rafter. This is called backing the rafter.

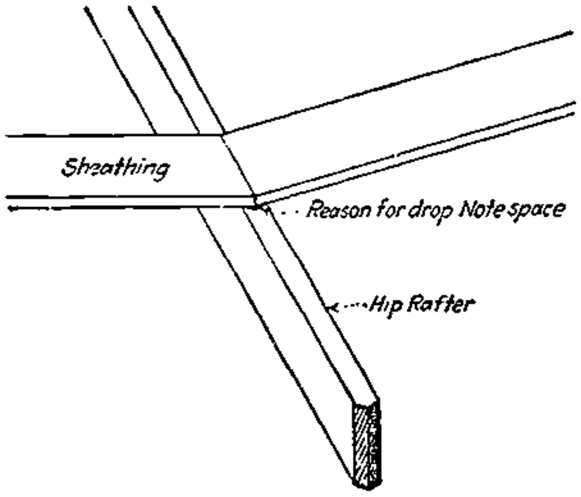


FIG. 55

There are two methods of doing this. Either "drop" the hip rafter by making the level part of the seat cut higher, thus letting the rafter drop, or else back the top edges of the hip rafter by planing them on a bevel, the high part of the bevel being in the center of the hip rafter. Dropping the hip rafter at the seat cut is much the easier method, and can be done when the seat cut is being laid out. The amount of the drop will vary according to the rise per foot of the rafter.

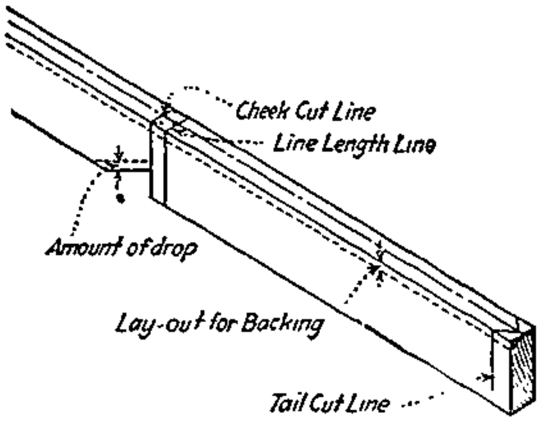


FIG. 56

Procedure for backing

Lay out a seat cut for the hip rafter as explained in the previous lesson. Stand the rafter on edge, crown up. Square a line across the edge at the plumb line, and find the center of the squared line. Mark the center by means of a dot, not a thick pencil line. On the sixth line of the rafter tables read "Side cut of hip or valley use"; look under the rise per foot, in this example 8 inches, and find the figure $10\frac{7}{8}$. Grasp the square, body in the left hand, tongue in the right hand, heel away from you. Hold the 12-inch mark on the body and the $10\frac{7}{8}$-inch mark on the tongue, the outside edge of the body passing through the center mark, and mark along the body of the square. Lay out a second plumb line from this mark. From this second plumb line measure down from the crown edge, the distance previously measured along the first plumb line (4 inches). From this point lay out a second level line. This is the level line to actually cut. Note that the second level line is higher than the first level line. The distance between the first and second level lines is the distance the hip rafter has been "dropped." The side cut made on the edge of the rafter is the side cut at the wall plate if there were no overhang.

ASSIGNMENT:

Lay out the seat cuts, including backing, for the following hip rafters. Common rafters are 2" x 6".

Rise Per Foot	Stock for Hip Rafter
9 inches	2" x 8"
6 inches	2" x 12"
12 inches	4" x 8"
10 inches	2" x 10"

UNIT IV - THE EQUAL-PITCH HIP ROOF

Overhang of the Hip Rafter

Lesson 5

OBJECTIVE: To learn how to lay out the overhang when run measurement is given.

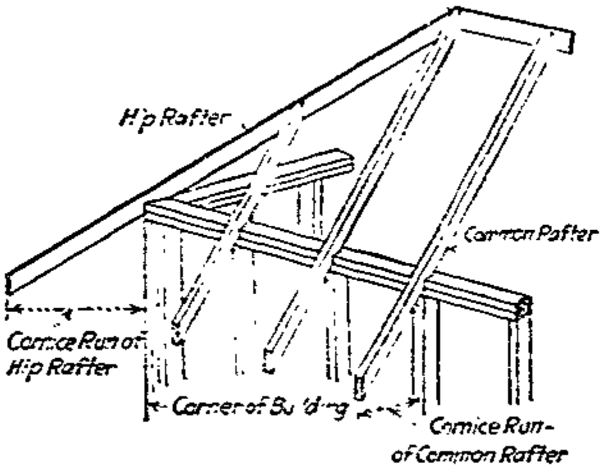


FIG. 57

INFORMATION:

Finding the overhang of a hip rafter is a separate procedure after determining the length. To find the exact overhang length of the hip rafter, the run of the common rafter overhang must first be known, because the overhang run of the hip rafter is the 45-degree diagonal distance based on the overhang run of the common rafter (see Fig. 57). The tail cut of the overhang is usually a double cheek cut, as shown in Fig. 55.

Procedure:

The method of laying out this type of overhang is the same as the method described in Unit III Lesson 5, except that allowance must be made for the difference in the width of the hip rafter stock. This was fully described in Lesson 3 of this unit.

ASSIGNMENT:

Lay out the overhang for the following hip rafters:

Overhang run of common rafter 8" - Rise per foot 9"
Overhang run of common rafter 10" - Rise per foot 12"
Overhang run of common rafter 6" - Rise per foot 8"
Overhang run of common rafter 12" - Rise per foot 6"

Common rafters are 2" x 6"; hip rafters, 2" x 8".

Overhang Level to the Top of Window — Lesson 6

OBJECTIVE: To learn how to lay out this type of overhang.

INFORMATION:

In this type of overhang, no run measurement is given for the overhang; the plan will show that the overhang is level with the top of the window, and a soffit is required from the overhang to the top of the window.

Procedure:

The procedure to lay out this type of overhang is the same as described in Unit III Lesson 6. Allowance must be made for the difference in the width of the hip rafter stock, as described in Lesson 3 of this unit.

ASSIGNMENT:

Lay out the overhang and seat cut for the following hip rafters. The common rafters are 2" x 6" stock; the hip rafter is 2" x 8" stock; soffit stock, $\frac{1}{4}$ inch.

Distance from top of plate to top of window 10"; rise per foot 9"

Distance from top of plate to top of window 14"; rise per foot 8"

Distance from top of plate to top of window 12"; rise per foot 6"

UNIT IV - THE EQUAL-PITCH HIP ROOF

Odd Inches in the Total Run

Lesson 7

OBJECTIVE: To learn the layout procedure for odd inches in the total run.

INFORMATION:

For obtaining the odd inches in the total run of a hip rafter, the procedure is the same as that explained for a common rafter in Unit III Lesson 2, except that, since the unit of run for a hip is 17 inches, the odd inches must also be figured as the fractional part of 17 inches.

To illustrate: Assuming the total run of the <u>common</u> rafter is 10 feet 8 inches, to get the fractional part of the last step for the common rafter, we would simply add 8 inches to the step-off procedure as described in Unit III Lesson 2. In a hip rafter, however, the unit of run is 17 inches. Since $\frac{17}{12}$ equals $1\frac{5}{12}$, we must multiply 8 inches by $1\frac{5}{12}$ if we are to get the correct fractional part of the last step.

$$\begin{array}{r} 8 \\ \times\ 1\frac{5}{12} \\ \hline 3\frac{4}{12} \\ +\ 8 \\ \hline 11\frac{4}{12} \end{array}$$

Thus, instead of 8 inches, add $11\frac{4}{12}$ inches. The rule for odd inches for a hip rafter is:

> Multiply the odd inches in the total run by $1\frac{5}{12}$ to get the number of inches to add.

The method of holding and marking the square is the same as described for the common rafter in Unit III Lesson 2.

ASSIGNMENT:

1. Figure mathematically the number of inches to add to the step-off procedure of a hip rafter if the runs are:

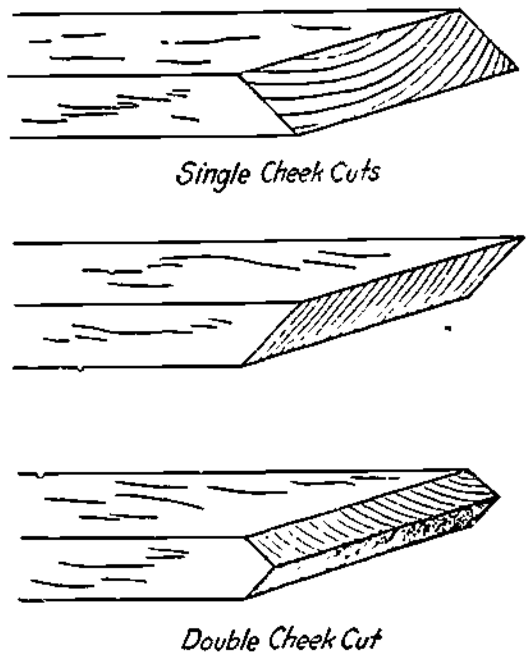
   9 feet 6 inches
   9 feet 9 inches
   9 feet $10\frac{1}{2}$ inches

2. Step off the length of a hip rafter where the rise per foot is 6 inches and the total run is 8 feet 5 inches.
   Use 2" x 6" stock for the common rafter and 2" x 8" stock for the hip rafter.

UNIT IV - THE EQUAL-PITCH HIP ROOF

Deduction for the Ridgeboard - Single Cheek Cut — Lesson 8

OBJECTIVE: To learn the methods of construction at the ridgeboard.
To learn the procedure for the single cheek cut.

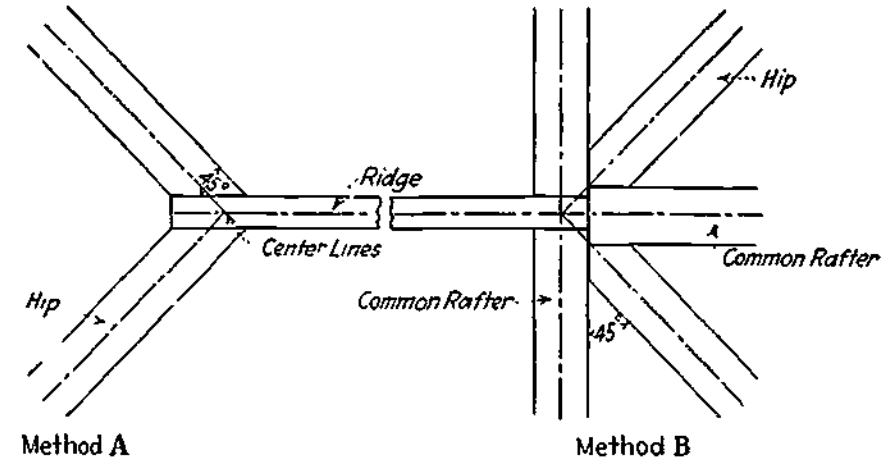

Single Cheek Cuts

Double Cheek Cut

FIG. 58

INFORMATION:

The ridge cut of a hip rafter is not a square cut, but a combination plumb and cheek cut. There are two types of cheek cuts: type A, the single cheek cut, also called a full cheek cut, and type B, the double cheek cut, also called a V-cut. The deduction to be made at the top of the hip rafter for the thickness of the ridgeboard is different from that of the common rafter.



Method A
Hip framed to Ridge

Method B
Hip framed to Common Rafter

FIG. 59

Allowance for the Thickness of the Ridgeboard for Type A

Note that the full thickness of the hip rafter fits against the ridgeboard. This requires a single cheek cut. To obtain the exact length of the hip rafter for this type of construction, apply this rule:

> After stepping off the rafter length (total run), deduct one-half the diagonal distance of the thickness of the ridgeboard, then add one-half the thickness of the hip rafter stock.

It is important that this rule be followed, since no universal figures can be given; the figures in each case will vary according to the thickness of the materials used for the ridgeboard and for the hip rafter. The length of the hip rafter found by applying the rule is to the long edge of the cheek cut.

Note: In applying the above rule, three-fourths of the thickness of the ridgeboard may be used instead of one-half the diagonal distance of the ridgeboard. This is easier to find and easier to figure with. The actual difference between half the diagonal distance of the thickness of the ridgeboard, and three-quarters of the thickness of the ridgeboard is less than the thickness of a pencil line.

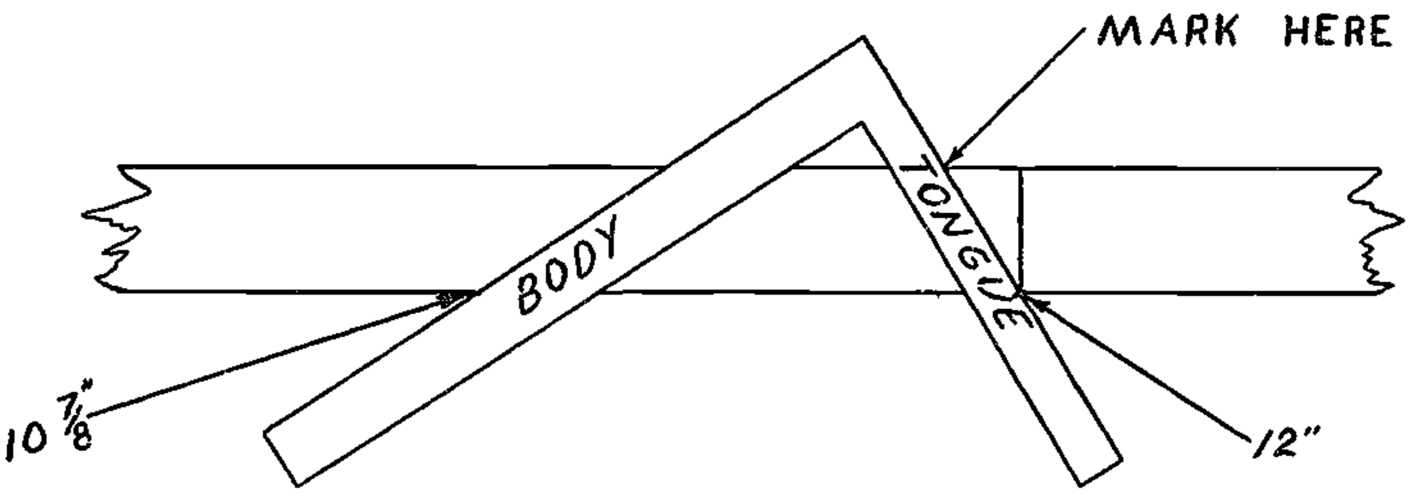


FIG. 60

Procedure To Obtain the Angle of the Cheek Cut

On the rafter table, sixth line down, find the line "Side cut hip or valley use." On the outside edge under the figure 8 inches - which is the rise per foot in this example - on the sixth line of the rafter tables find the figure $10\frac{7}{8}$.

From the plumb line, square across the top edge of the rafter. Hold the square with the tongue in the right hand, body in the left hand, heel away from you; hold the 12-inch mark on the tongue and the $10\frac{7}{8}$-inch mark on the body, so that the 12-inch mark on the tongue meets the line squared across the top edge. Mark along the tongue.

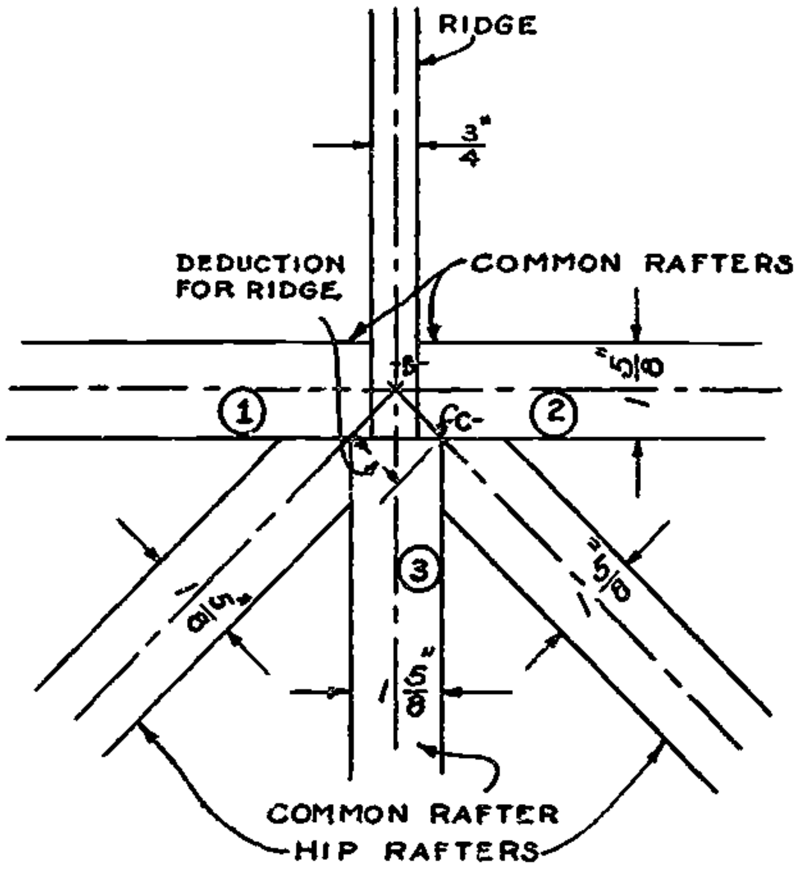
ASSIGNMENT:

Find the exact length of a hip rafter with a full cheek cut:
rise per foot is 10 inches, run is 5 feet 9 inches,
ridgeboard stock is 2 x 8, and the hip rafter stock is 2 x 8.
Include backing at the seat cut and no overhang.

UNIT IV - THE EQUAL-PITCH HIP ROOF

Deduction for the Ridgeboard - Double Cheek Cut Lesson 9

OBJECTIVE: To learn the procedure for the double cheek cut.



INTERSECTION AT RIDGE OF HIP AND COMMON RAFTERS

FIG. 61

INFORMATION:

Fig. 61 shows a plan view of the ridge at the intersection of the hip and common rafters. Common rafters 1 and 2 butt against the two sides of the ridgeboard. Rafter 3 butts against the end of the ridgeboard and acts as a ridgeboard between the two hip rafters. The hip rafters fit into the angles made by the three common rafters; thus a double cheek cut - also called a V-cut - is required. As may be seen, the length of the hip rafter is shorter than the length required for a full cheek cut.

To obtain the exact length of the hip rafter for this type of construction, apply this rule:

> After stepping off the rafter length (total run), deduct one-half the diagonal distance of the thickness of the ridge, or, as explained in the previous lesson, substitute three-fourths of the thickness of the ridge.

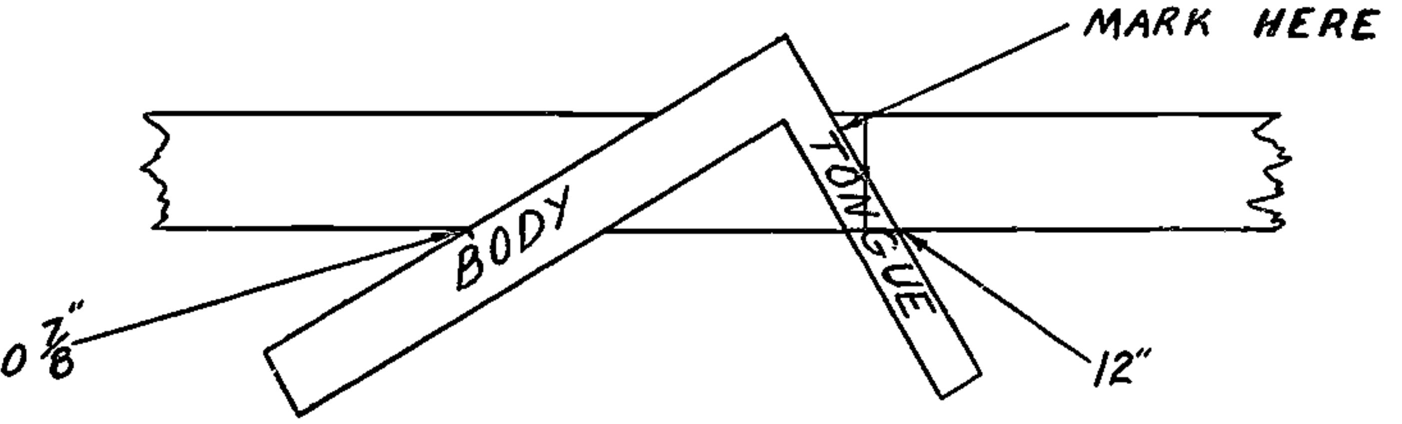


FIG. 62

Procedure to obtain the angle of the V-cut

On the rafter table, sixth line down, find the line "Side cut hip or valley use." On the outside edge, under the figure 8"(rise per foot) on the sixth line of the rafter tables find the figure $10\frac{7}{8}$. From the plumb line, square across the top edge of the rafter. Find the center of this squared line and mark it with a dot (do not make a thick pencil line). Hold the square, tongue in the right hand, body in the left hand, heel away from you; hold the 12-inch mark on the tongue and the $10\frac{7}{8}$-inch mark on the body; slide the square until the outer edge of the tongue passes through the center mark. Mark along the tongue. Mark only from the edge away from you to the center line; do not mark completely across the edge.

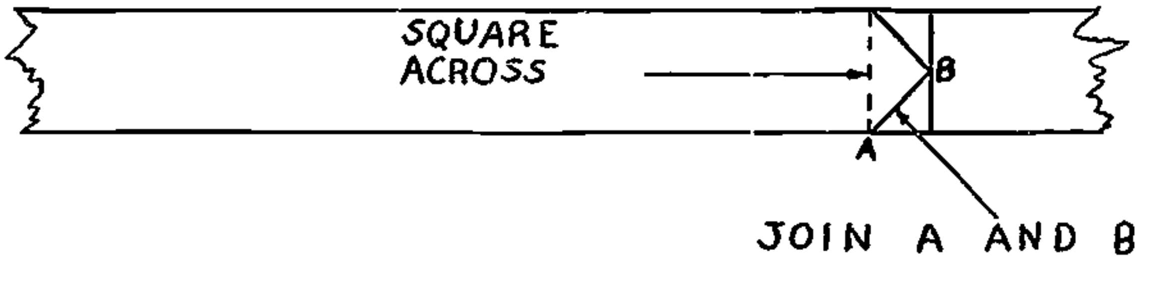


FIG. 63

From the angle line, square across to the edge nearer you; then join the center to the squared line. (See Fig. 63.) From the angle lines a plumb line must be made for cutting purposes.

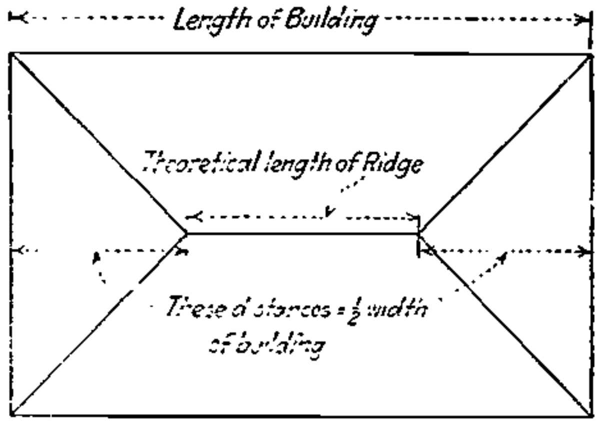
ASSIGNMENT:

> Find the exact length of a hip rafter with a V-cut. Rise per foot, 6 inches; run, 5 feet 10 inches. Ridgeboard stock is 2" x 8" and the hip rafter stock is 2" x 8". Include backing at the seat cut and overhang. The common rafter run for the overhang is 14 inches.

Length of the Ridgeboard

Lesson 10

OBJECTIVE: To learn how to obtain the length of the ridgeboard.



NOTE: Length of Building - Width of Building = theoretical length of Ridge

FIG. 64

INFORMATION:

There are two lengths for a hip-roof ridge: first the theoretical length, and second the actual length. The theoretical length is always the difference between the width and length of the building (see Fig. 64), while the actual length is based on the type of construction used.

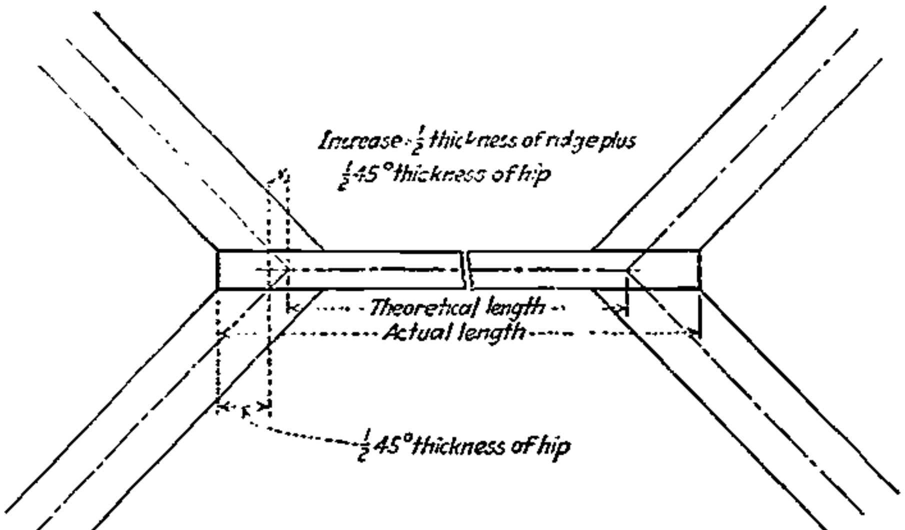


FIG. 65

Fig. 65 illustrates the actual length of the ridge when the hip rafter is framed to it. For this type of construction, to the theoretical length of the ridgeboard must be added the thickness of the ridge stock and the 45-degree thickness of the hip rafter. Fig. 65 shows one-half the thickness added to each end.

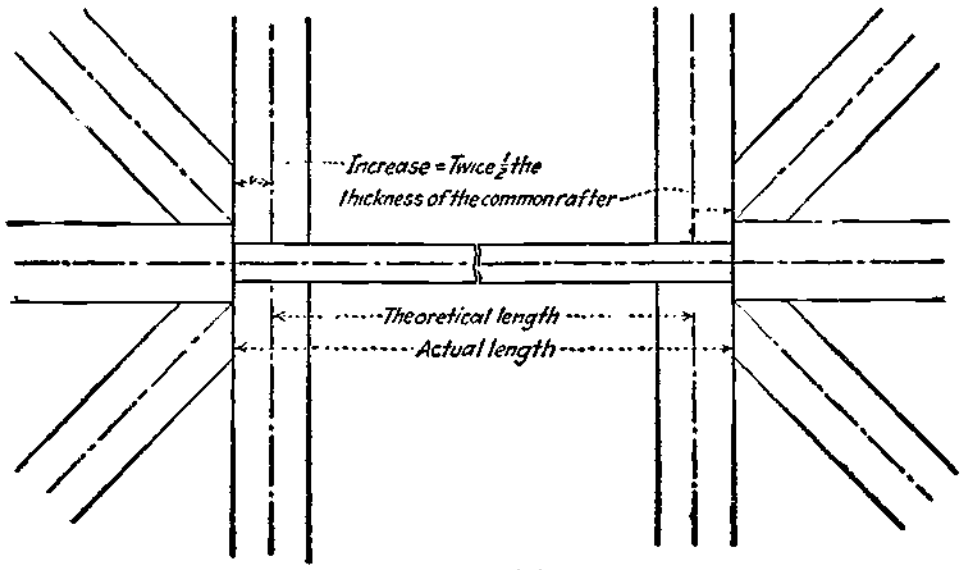


FIG. 66

Fig. 66 shows the ridgeboard length when the hip rafter is framed to the common rafters. In this type of construction only the thickness of the common rafter stock is added to the theoretical length of the ridgeboard.

If the roof is hipped at only one end, the ridgeboard length is increased one-half the amounts described.

OBJECTIVE: To become familiar with the principles of hip jack rafters.

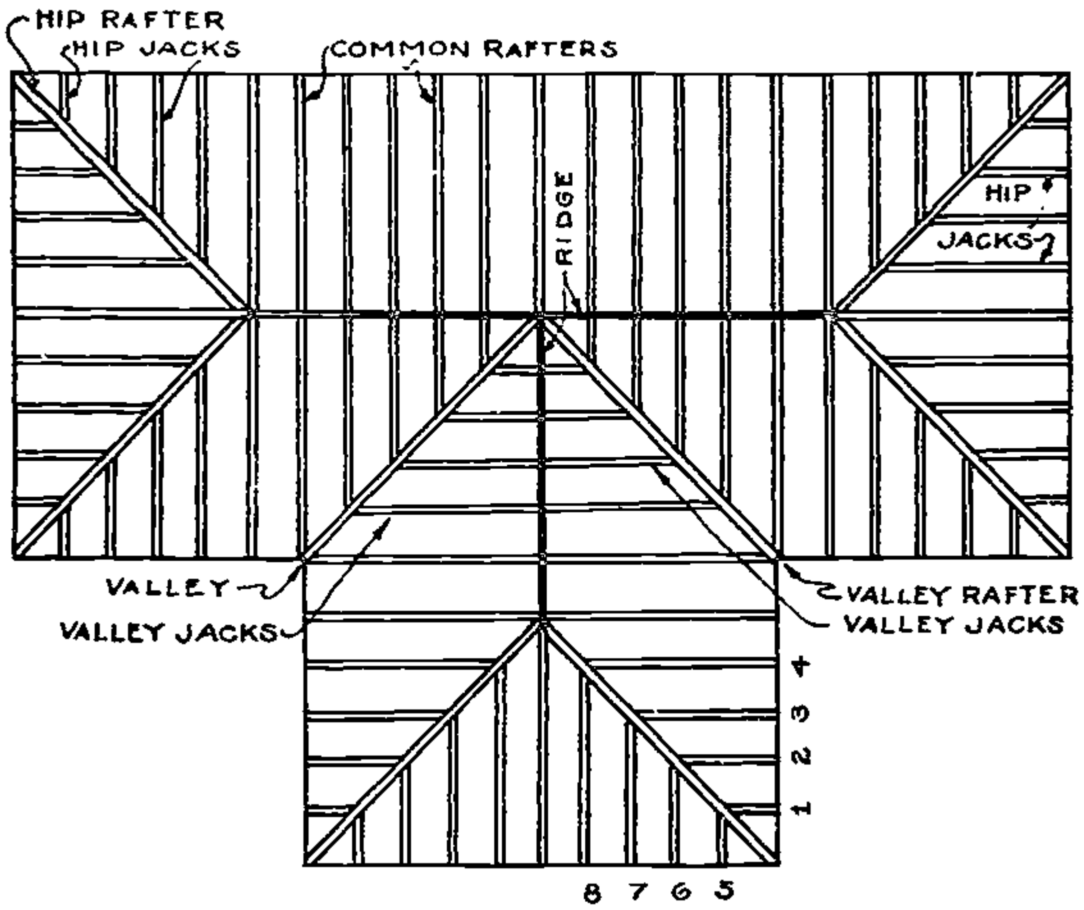


FIG. 67

INFORMATION:

Hip jack rafters are those rafters that extend from the plate to the hip and fill in the triangular spaces between the common rafters and the hip rafters. Basically they are "discontinued" common rafters, or common rafters cut off to fit against the hip rafter. The plumb and level cuts are the same for a common rafter, except that the plumb cut at the top end must be beveled to fit against the hip rafter. This angle is called a cheek or side cut. Since they fill in a triangular space, hip jack rafter lengths will vary, depending on their position on the roof.

Length of Jack Rafters

There are basically two methods to obtain the length of hip jacks, namely, the line-length method, and the step-off method, but there are several ways of doing each method. These methods will be fully explained later. For equal-pitched hip or valley roofs, the rafter tables on the framing square will give the required information to lay out hip jacks. On the rafter tables, 3rd line, is given "Difference in length of jacks 16 inches center," and the 4th line gives the "Difference in length of jacks 24 inches center." These figures indicate the length of the first or shortest jack, which is also the difference in length between the first and second, between the second and third jack, and so on until the longest jack is reached.

Rule: To find the length of a hip jack rafter, multiply the difference in length by the number indicating the position of the jack rafter. This will give the theoretical length. To obtain actual length, deduct three-fourths of the thickness of the hip rafter.

Example: Assume the rise per foot of the common rafter is 7 inches and the spacing of the hip jacks to be 16 inches. The problem is to find the length of the third jack. On the third line of the rafter tables under the figure 7 (rise per foot), find $18\frac{1}{2}$. This means the first or shortest jack is $18\frac{1}{2}$ inches long. It is also the difference in the length of each succeeding jack. Since the length of the third jack is sought, multiply $18\frac{1}{2}$ by 3, which equals $55\frac{1}{2}$ inches. From this length, deduct three-fourths of the thickness of the hip rafter. If the stock of the hip rafter is 2" x 10", $\frac{3}{4} \times 1\frac{5}{8} = 1\frac{7}{32}$ inches. Actual length will be $54\frac{9}{32}$ inches ($1\frac{7}{32}$ inches deducted from $55\frac{1}{2}$ inches), or, for practical purposes, $54\frac{1}{4}$ inches.

The same method is used when the length of jacks spaced 24 inches is required.

ASSIGNMENT:

Find the actual length of the following hip jacks. Use 2" x 8" as the stock for the hip rafter.

Rise per foot 9"	Spacing 16 inches	4th jack
Rise per foot 6"	Spacing 24 inches	3rd jack
Rise per foot 11"	Spacing 16 inches	5th jack

OBJECTIVE: To learn how to lay out hip jack rafters, using the common rafter pattern.

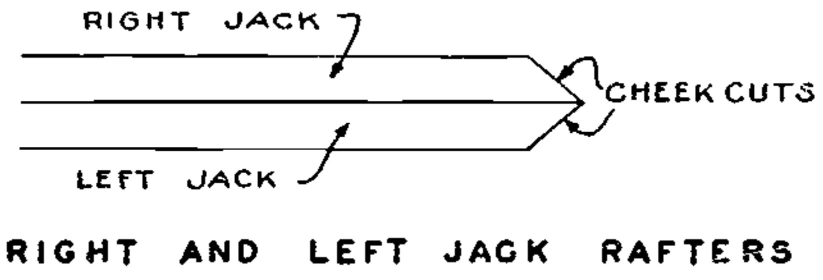


FIG. 68

INFORMATION:

Laying out a set of hip jack rafters is really a simple procedure. The previous lesson described the theoretical way of obtaining jack rafter lengths. In actual practice, the layout procedure is very simple when the common rafter is used as a pattern. The layout is always started from the longest jack for two reasons. The first reason is to make certain that the longest jack is the required number of inches away from the common rafter, and the second reason is to eliminate any waste of lumber, as the short jacks can be cut from the waste of the longer jacks. Two jacks are required for each length - a right and a left - with opposite cheek cuts.

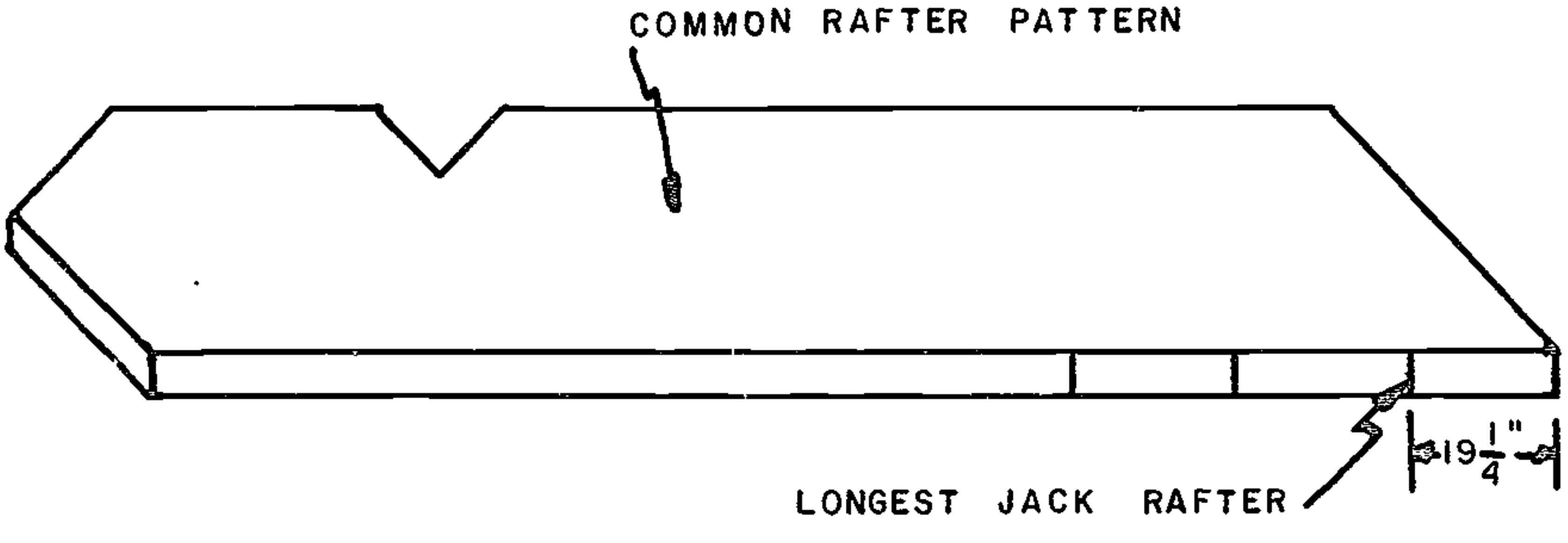


FIG. 69

Procedure:

Assume the rise per foot is 8 inches, the spacing 16 inches. Under the figure 8, third line of the rafter tables, find 19¼ inches. This is the difference in length. On the common rafter pattern, from the long point of the plumb cut, measure back along the top edge 19¼ inches. This is the length of the longest jack. From this point measure back another 19¼ inches. This is the length of the second longest jack. Repeat the procedure until the seat cut of the common rafter has been reached.

Square these marks across the top edge of the common rafter pattern. (See Fig. 69.) From these marks the entire set of hip jacks can be laid out.

ASSIGNMENT:

On the common rafter pattern, lay out the lengths of hip jacks for the following hip roofs:

Rise Per Foot	Span	Spacing
6 inches	22'0"	16 inches on center
9 inches	25'0"	24 inches on center
8½ inches	28'0"	16 inches on center

UNIT IV - THE EQUAL-PITCH HIP ROOF

The Top and Bottom Cuts of Hip Jack Rafters

Lesson 13

OBJECTIVE: To learn how to lay out the cuts of hip jack rafters.

INFORMATION:

As stated in a previous lesson, hip jack rafters are basically discontinued common rafters. As the hip jack rafters are parallel to the common rafters, the figures to use to obtain the cuts of the hip jack rafters are the same figures used for the common rafters. The seat cut, overhang, and overhang cuts are exactly the same as the corresponding parts of the common rafter, so that the common rafter pattern can be used to lay out the seat cut and overhang of the hip jacks. The end of the hip jack that fits against the hip rafter must have a combination plumb and cheek cut. The plumb cut is exactly the same for the common rafter, but the hip jack also has a cheek cut.

Procedure to obtain the cheek cut

RULE: To obtain the cheek cut for a hip jack rafter, take the figure shown on the rafter table, "Side cut of jacks use" under the rise-per-foot figure; hold this figure on the body of the square, and the 12-inch mark on the tongue and mark along the tongue.

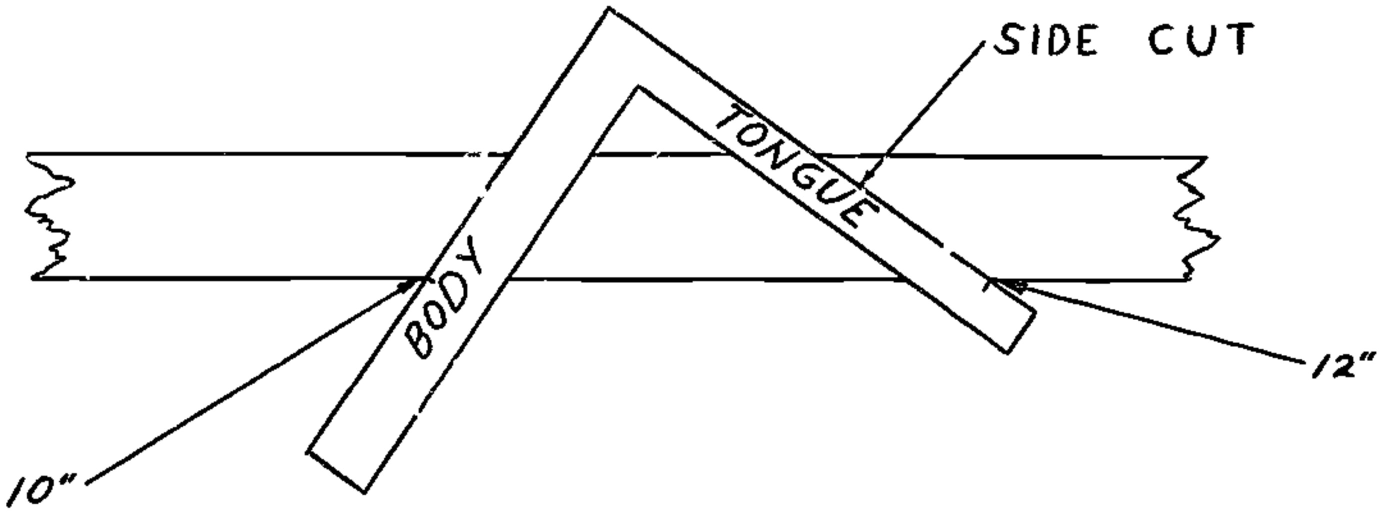


FIG. 70

EXAMPLE: Find the top cut for jack rafters where the rise per foot is 8 inches. Under the figure 8 on the fifth line ("Side cut of jacks use"), find the figure 10. Hold the 10-inch mark on the outside edge of the body of the square in the right hand, and the 12-inch mark on the outside edge of the tongue; mark along the tongue. This is the side cut for the hip jacks. (See Fig. 70.)

The plumb cut is marked across the face of the rafter from the long point of the cheek cut.

ASSIGNMENT:

Lay out the plumb and cheek cuts for the following hip jack rafters:

Rise per foot 9 inches

Rise per foot 12 inches

Rise per foot 15 inches

UNIT IV - THE EQUAL-PITCH HIP ROOF

TEST

---

1. Describe the structural members of a hip roof.

2. How does a hip roof differ from a gable roof?

3. A hip rafter may be compared to the __________ of a __________ __________.

4. In a right triangle, if the sides forming the right angle are 12 inches each, what is the length of the hypotenuse?

5. Describe the various cuts on a hip rafter and where they are placed on a roof.

6. The seat cut of a hip jack rafter is the same as that of a __________ __________.

7. Hip rafters run at a __________ angle from the __________ __________ to the __________.

8. What are the figures to use on the square to obtain plumb and level cuts for a hip rafter? State which figure will give the level cut and which figure will give the plumb cut.

9. Lay out the seat cuts, including backing, for the following hip rafters: Common rafters are 2" x 6".

Rise Per Foot	Stock of Hip Rafter
9"	2" x 8"
12"	2" x 12"
6"	2" x 10"

10. Obtain the length of the following hip rafters, using the step-off method. Use 2" x 8" stock.

Rise Per Foot	Total Run
7 inches	10 feet 4 inches
8 inches	12 feet 9 inches
10 inches	14 feet 10 inches

11. Lay out a complete hip roof, overhang to be level with the top of windows, spacing of rafters to be 16 inches on center. Use 2" x 6" for common rafters, 2" x 8" for hip rafters. The dimensions are as follows:

Total run, 9 feet 6 inches
Rise per foot, 7 inches
Vertical distance from top of window to top of wall plate, 10 inches
Double cheek cut at ridge cut of hip rafter
Soffit stock $\frac{1}{4}$ inch

UNIT V - THE EQUAL-PITCH INTERSECTING ROOF

Types of Rafters in an Intersecting Roof — Lesson 1

OBJECTIVE: To become familiar with the roof members of an intersecting roof.

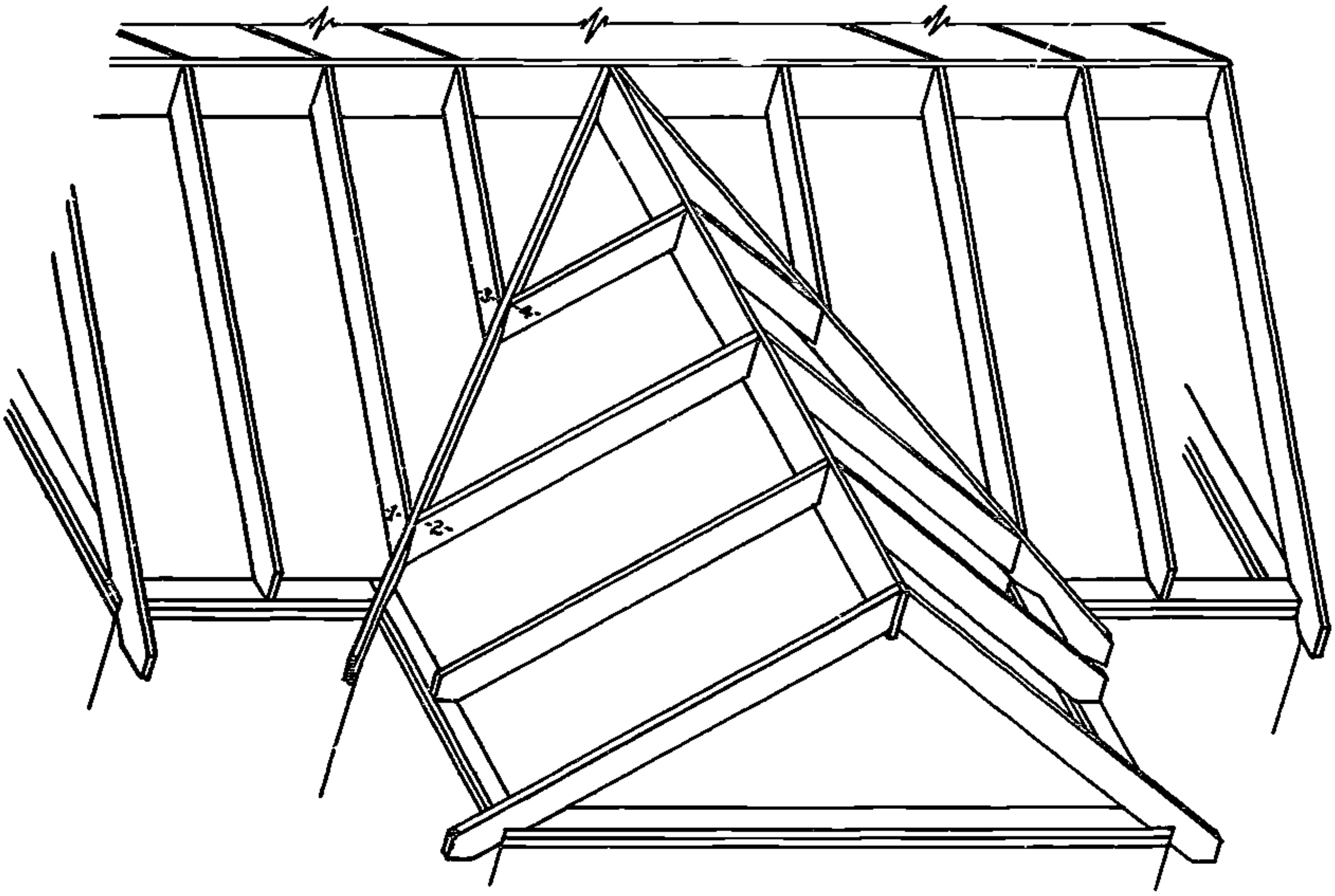


FIG. 71

INFORMATION:

Any building that is square or rectangular in shape will have either a flat, gable, or hip roof. A building that has a wing added to it requires an additional roof. Where any two roofs meet or intersect, several new types of rafters are required. These new rafters are valley rafters and valley jack rafters.

The Valley Rafter

The valley rafter lies at the intersection of the two roofs. The cuts of a valley rafter are similar to those of the hip rafter, that is, a combination plumb and cheek cut at the ridge, a seat cut at the wall plate, and the overhang cuts. The only difference between a hip and valley rafter lies in the seat cut. A hip rafter is "backed" or lowered at the seat cut; a valley rafter is "raised" or picked up at the seat cut. The reason for lowering a hip rafter (and raising a valley rafter) is for sheathing purposes, as explained in Unit IV Lesson 4.

The Valley Jacks

Valley jack rafters are the rafters that fill in the triangular space between the ridgeboard and the valley rafter. In a valley jack rafter, the plumb cut that fits against the ridgeboard is exactly the same as in a common rafter, and the bottom cut that fits against the valley rafter is a combination plumb and cheek cut. (See Fig. 71.)

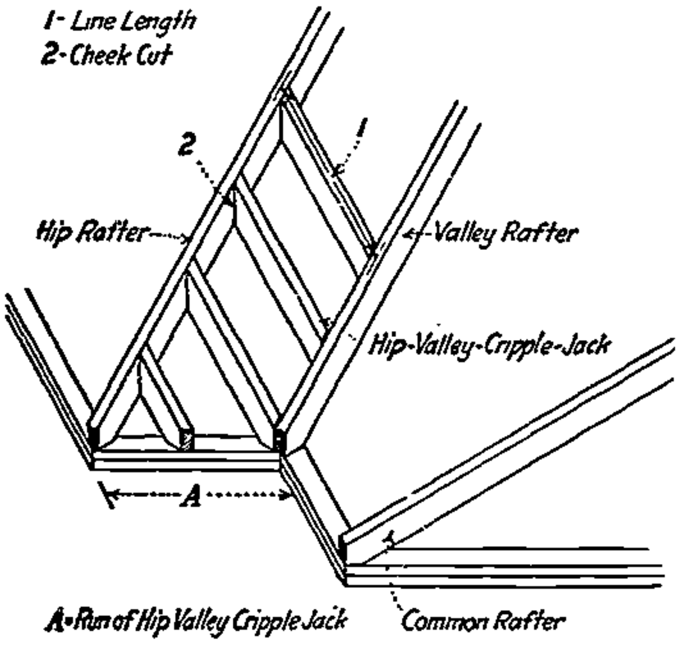


FIG. 72

The Cripple Jack Rafters

Cripple jack rafters can best be described as the jack rafters in an intersecting roof that do not touch either the wall plate or the ridgeboard. They are framed between a hip rafter and a valley rafter and are always required when distance "A" in Fig. 72 is less than one-half the span of the building. As hip and valley rafters in an equal-pitch intersecting roof are always parallel to each other, the length of all the cripple jacks framed between these two rafters will always be the same.

The cuts on cripple jacks are combination plumb and cheek cuts on both ends, the angle of the cuts being in opposite directions.

ASSIGMENT:

Be prepared to answer any question your instructor may ask concerning this lesson.

OBJECTIVE: To learn how to lay out a valley rafter.

INFORMATION:

The method of laying out a valley rafter is similar to the method used to lay out a hip rafter, as both run from the wall plate to the ridgeboard at a 45-degree angle. The only difference is at the seat cut. As explained previously, a hip rafter is lowered, while a valley rafter is raised. The unit of run, which gives the level cut, is the same as for a hip rafter (17 inches), and the rise per foot of the roof gives the plumb cut; cheek cuts are also the same as for a hip rafter.

Procedure:

The procedure in stepping off a valley rafter is the same as for the hip rafter, as described in Unit IV Lesson 3, except at the seat cut, where the valley rafter is raised.

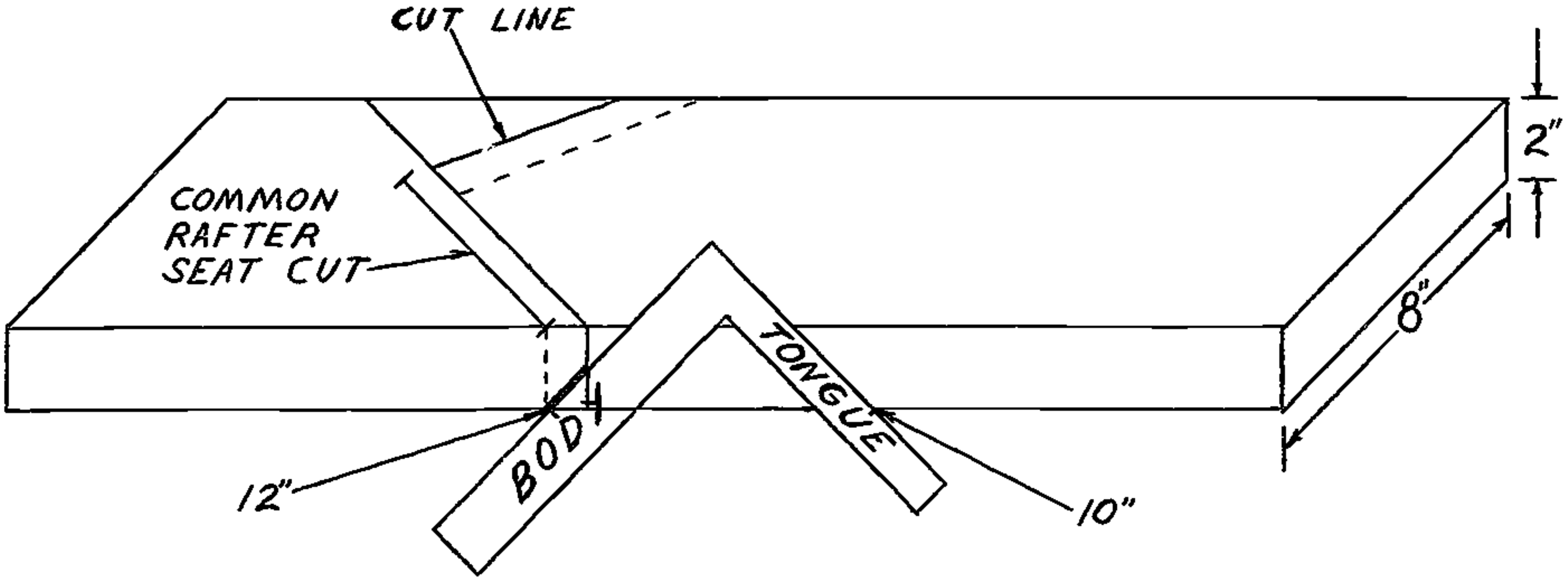


FIG. 73

Procedure in laying out the seat cut for a valley rafter

The procedure is the same as that described in Unit IV Lesson 4, except that the side cut on the top edge is made to the rafter edge nearer you. Square across from the side cut and lay out a plumb line on the face of the valley rafter. Parallel with this second plumb line measure down the required distance (amount left on seat cut of common rafter) and from this point lay out a level line. This level line will be below the first level line, and is the actual line to cut. (See Fig. 73.)

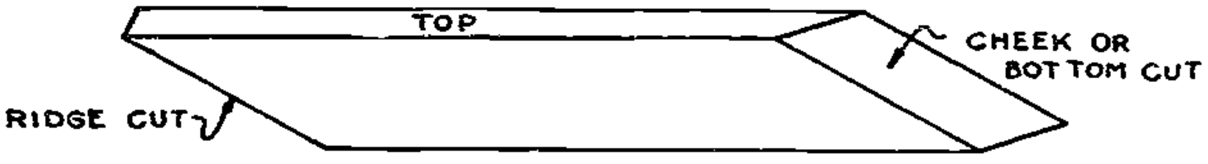
ASSIGNMENT:

Lay out a valley rafter including overhang.
Use 2" x 8" stock.
Rise per foot 8"; total run 5 feet 9 inches;
run of overhang 9".

The Valley Jack Rafter

Lesson 3

OBJECTIVE: To learn how to lay out the valley jack rafters.



VALLEY JACK RAFTER

FIG. 74

INFORMATION:

The valley jack rafters extend from the ridgeboard to the valley rafter. (See Fig. 71 in Lesson 1.) Their lengths are found in the same manner as those of the hip jacks. The ridge cut is exactly the same as for the common rafter, and the end that fits against the valley rafter has a combination plumb and cheek cut. (See Fig. 74.) Like the hip jacks, the valley jacks are also laid out in pairs.

Procedure:

The procedure to obtain the difference in length for the valley jacks is the same as the procedure for the hip jacks. Find the difference in length from the rafter tables, and use the common rafter pattern as described in Unit IV Lessons 12 and 13. The plumb and level cuts are obtained by using the same figures on the framing square as were used for the common rafter. The top end of the valley jack that fits against the ridgeboard requires a square plumb cut, exactly the same as for a common rafter. The bottom end that fits against the valley rafter requires a combination plumb and cheek cut. Valley jacks are also cut in pairs, a left and a right.

ASSIGNMENT:

Lay out a set of valley jack rafters, using the figures given in Lesson 2 of this unit.

The Cripple Jack Rafter — Lesson 4

OBJECTIVE: To learn how to lay out the cripple jack rafter.

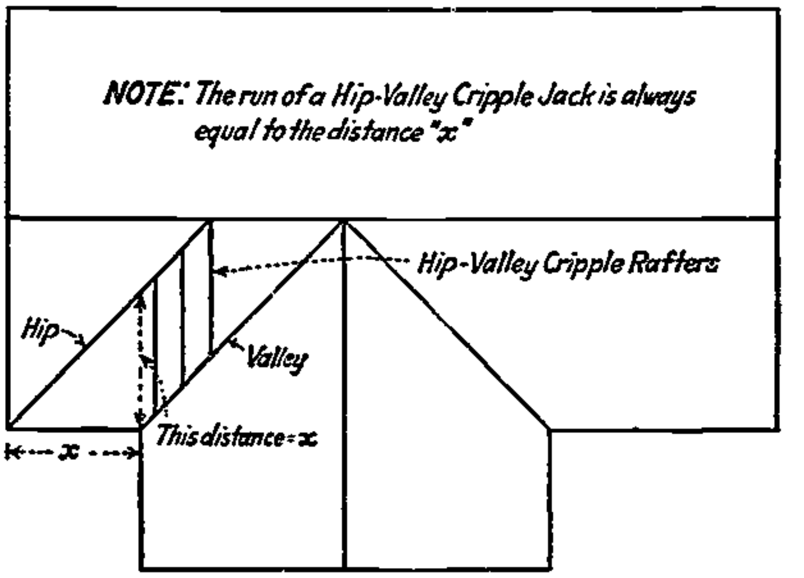


FIG. 75

INFORMATION:

The run of the cripple jack rafter shown in Fig. 75 is always equal to the distance between the seat cuts of the hip and valley rafters. (See X in drawing.) The cheek cuts are found in the same way as the cheek cuts for hip or valley jacks and are parallel to each other.

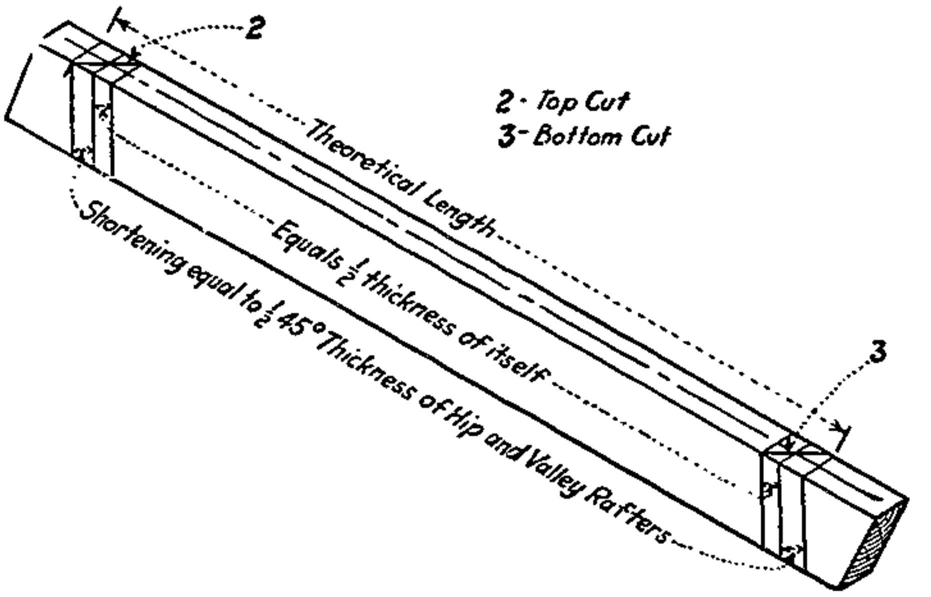


FIG. 76

Procedure:

Find the run of the cripple jack, and use the step-off method to obtain the length. The figures to use on the square are the same as for a common rafter. Deduct three-fourths of the thickness of the hip and valley rafters on each end. This deduction can be combined and deducted from one end. Lay out the side cuts, using the same figures on the square as were used to lay out the side cuts for the hip or valley jacks.

ASSIGNMENT:

Lay out a cripple jack rafter where the distance between the seat cuts of the hip and valley rafters is 3 feet 6 inches.

UNIT V - THE EQUAL-PITCH INTERSECTING ROOF

The Ridgeboards

Lesson 5

OBJECTIVE: To learn how to obtain the length for the intersecting roof ridgeboards.

INFORMATION:

An intersecting roof has two ridgeboards, the ridgeboard for the main roof and the ridgeboard for the wing or projection. There are two basic types of situations, which require different methods for obtaining the lengths: one, where the ridge heights are the same (Fig. 77, next page) and two, where the intersecting roof ridge drops below that of the main roof (Fig. 78).

1. Ridgeboard length when ridges are the same height

> Rule: To obtain the length of the ridgeboard for the projection roof, one-half the span of the main roof, plus the building projection, equals the theoretical length of the ridgeboard.

The actual length is shorter, as one ridge is framed to the other. In actual construction however, it is customary to make the intersecting ridge a few inches longer than its theoretical length. This is done so the common rafters at the gable end can be plumbed with the wall plate, as any extra length can be sawed off after the roof is up. The cut where the two ridges meet is simply a square cut.

2. Ridgeboard length when the ridges are not the same height

> Rule: One-half of the minor span, plus the building projection, equals the theoretical length of the ridgeboard.

As suggested before, the ridgeboard should be cut a few inches longer to allow for plumbing the common rafters at the gable end. The shape of the end of the ridgeboard is a double 45-degree plumb cut.

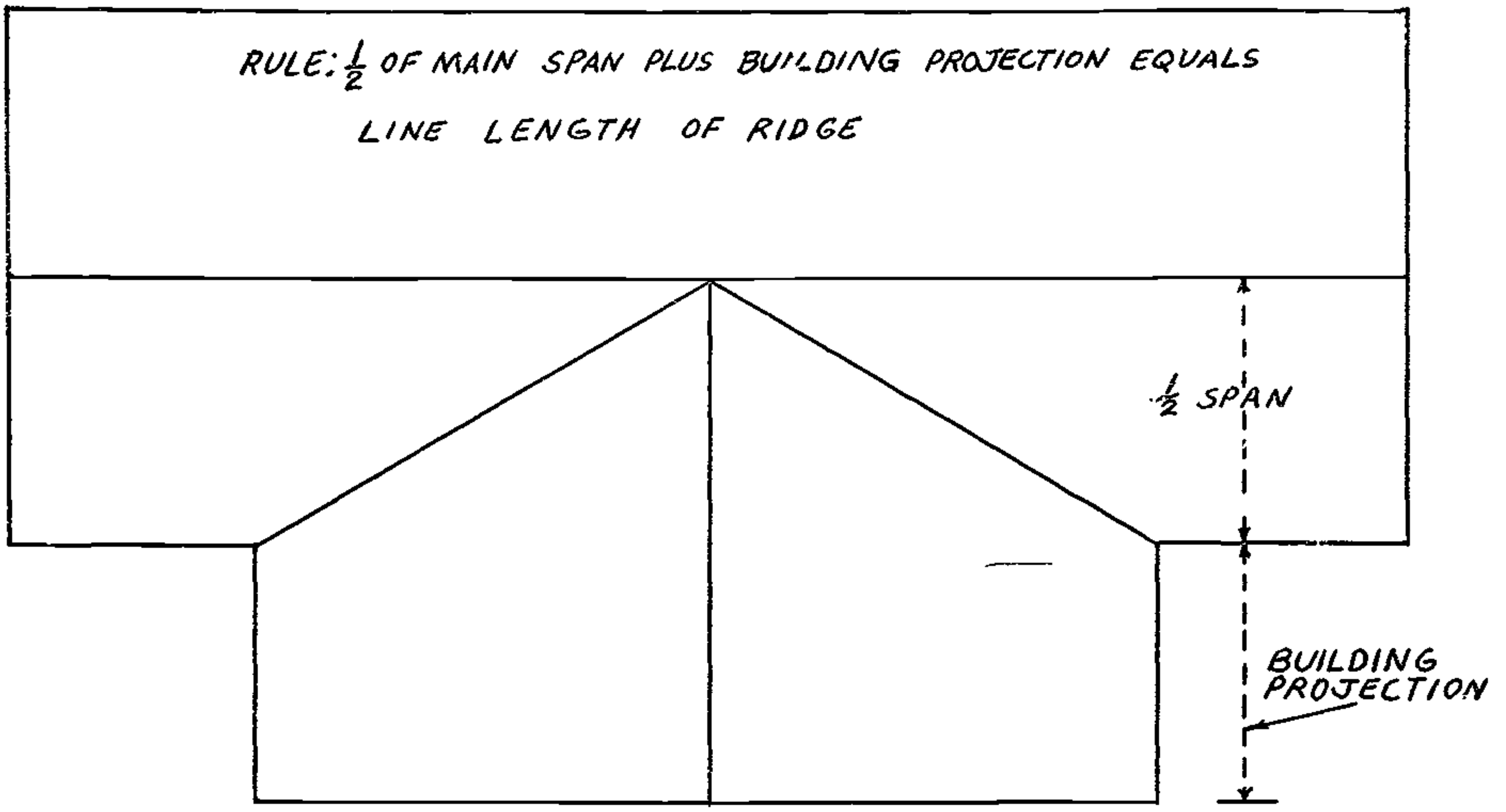

RULE: ½ OF MAIN SPAN PLUS BUILDING PROJECTION EQUALS LINE LENGTH OF RIDGE
½ SPAN
BUILDING PROJECTION

FIG. 77

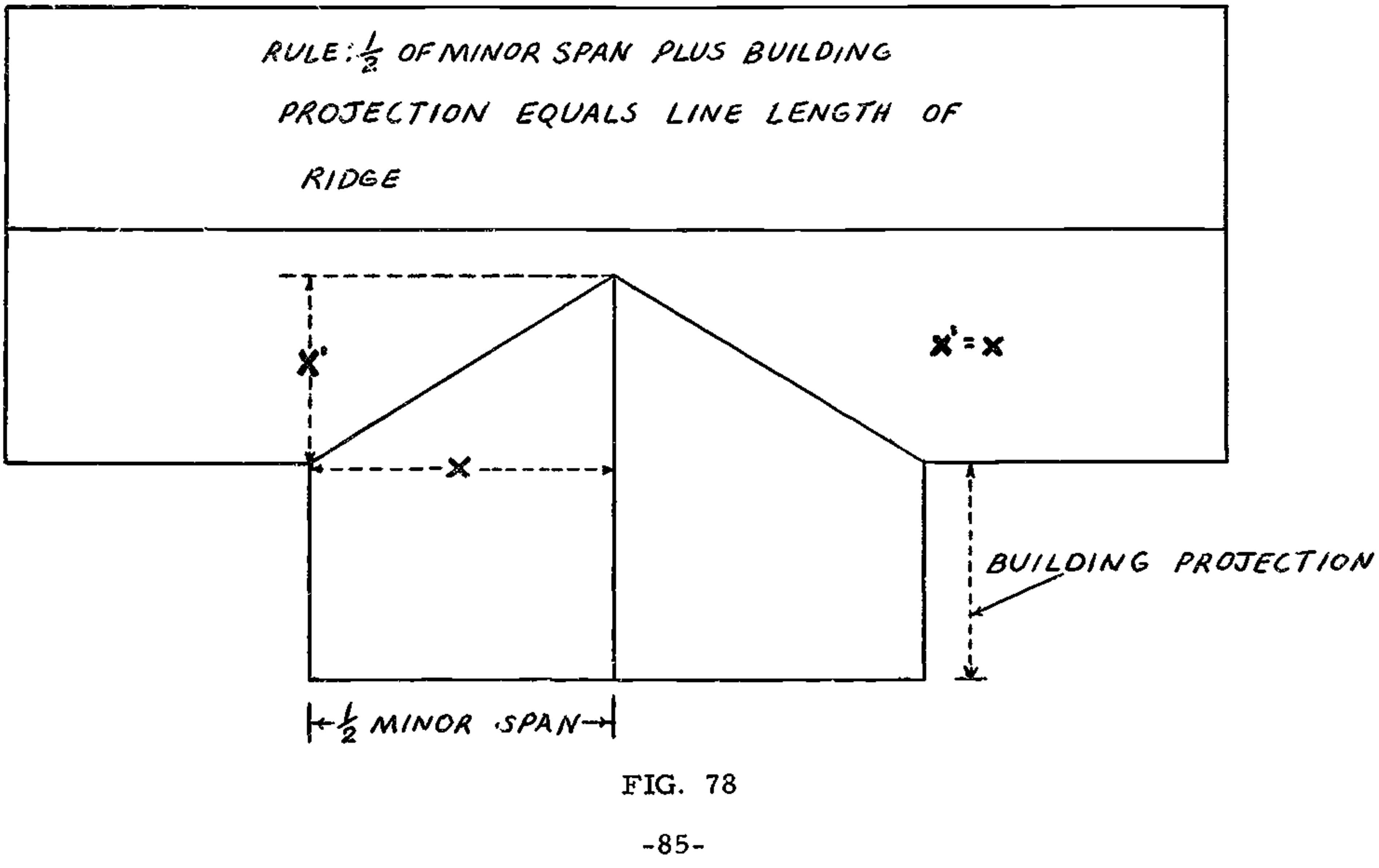

RULE: ½ OF MINOR SPAN PLUS BUILDING PROJECTION EQUALS LINE LENGTH OF RIDGE
X'
X
X' = X
BUILDING PROJECTION
½ MINOR SPAN

FIG. 78

Special Ridge Cut

When the ridge rests on top of the sheathing boards, a special ridge cut is necessary. This is made by using the unit run and the rise per foot of the common rafters and marking on the run side of the square. (See Figs. 79 and 80, below.)

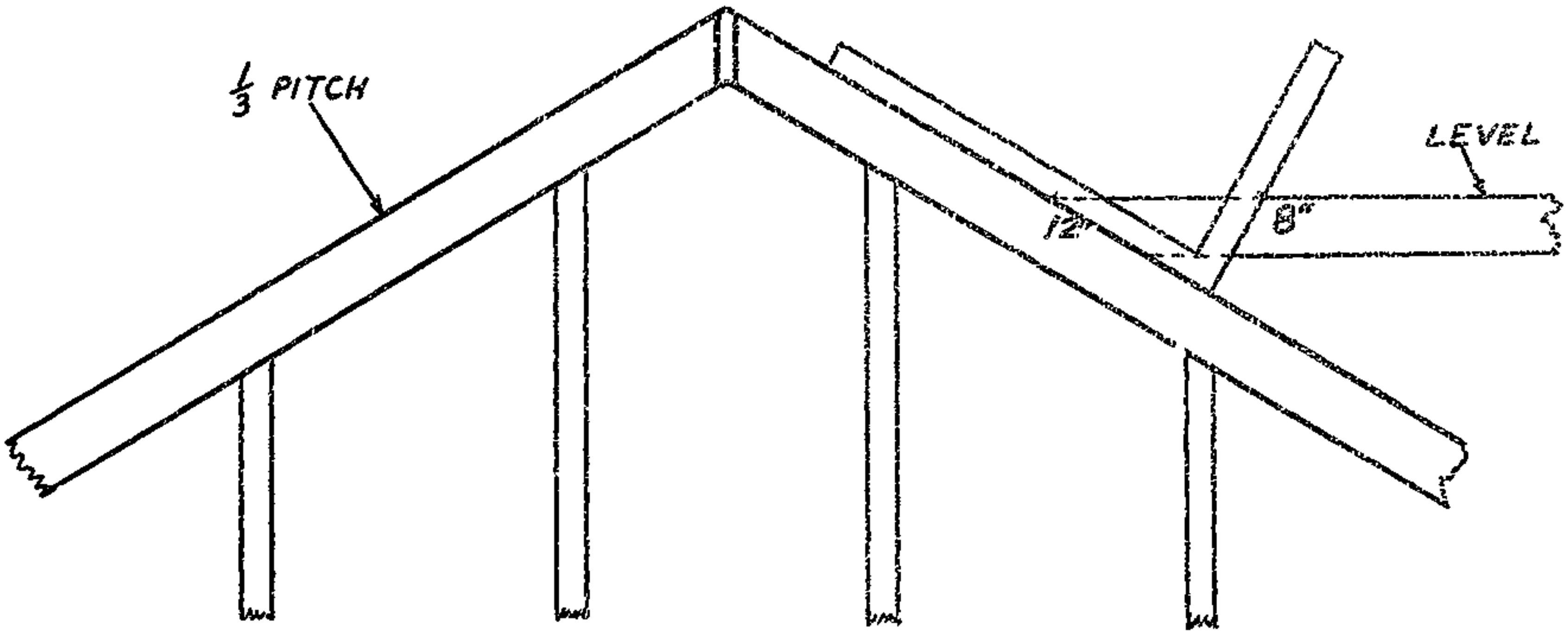


FIG. 79

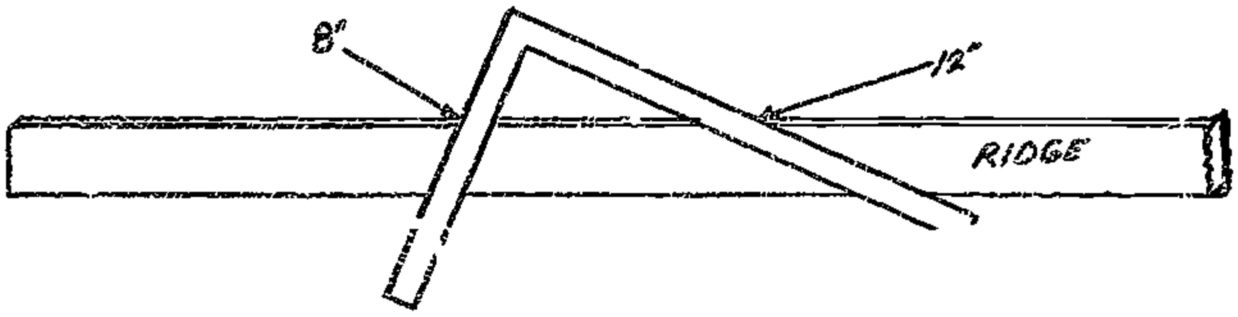


FIG. 80

UNIT V - THE EQUAL-PITCH INTERSECTING ROOF

TEST

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1. Describe an intersecting roof, and tell what types of rafters are required.

2. Describe where a valley rafter is required.

3. What types of cuts are required in a valley rafter, and where do they fit on a roof?

4. What is the difference between a hip rafter and a valley rafter?

5. Valley jack rafters run from the ____________ to the ____________ ____________.

6. The plumb cut of a valley jack rafter is exactly the same as for a ____________ ____________, and fits against the ____________.

7. Describe the bottom cut of a valley jack rafter and where it fits.

8. Describe where cripple jack rafters are placed. What type of cuts are required?

9. Lay out a complete valley rafter:

   Run: 9'6"   Rise Per Foot: 10 inches

10. Lay out a complete set of valley jacks for the above valley rafter.

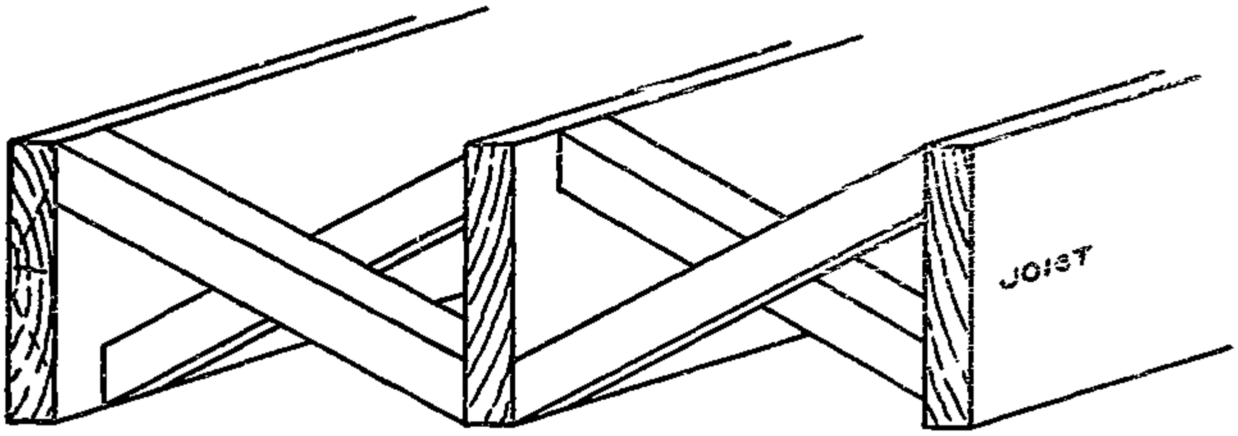
11. Lay out a cripple jack rafter:

    Run: 2 feet 4 inches   Rise Per Foot: 10 inches

UNIT VI - OTHER USES OF THE FRAMING SQUARE

Cross Bridging Lesson 1

OBJECTIVE: To learn how to lay out cross bridging.



BRIDGING IN PLACE

FIG. 80

INFORMATION:

Cross bridging can be defined as short pieces of $1\frac{1}{4}$" x 3" nailed between the floor joists to form a cross or "X" pattern. The primary purpose of cross bridging is to help distribute the load that the floor joists carry, and secondly to keep the floor joists from twisting. The cross bridging should be nailed in double rows, crossing each other from the top of one joist to the bottom of the next. (See Fig. 80.) The rows should be continuous, from one side of the building to the other, and they should be installed not more than 8 feet apart.

Procedure - Laying Out Cross Bridging

Measure the actual distance between the floor joists. This distance, if the floor joists are $1\frac{5}{8}$" thick and spaced at 16 inches on center, will be $14\frac{3}{8}$". Measure the actual width of the floor joists. If 2" x 10" floor joists are used, the actual width will be $9\frac{1}{2}$ inches.

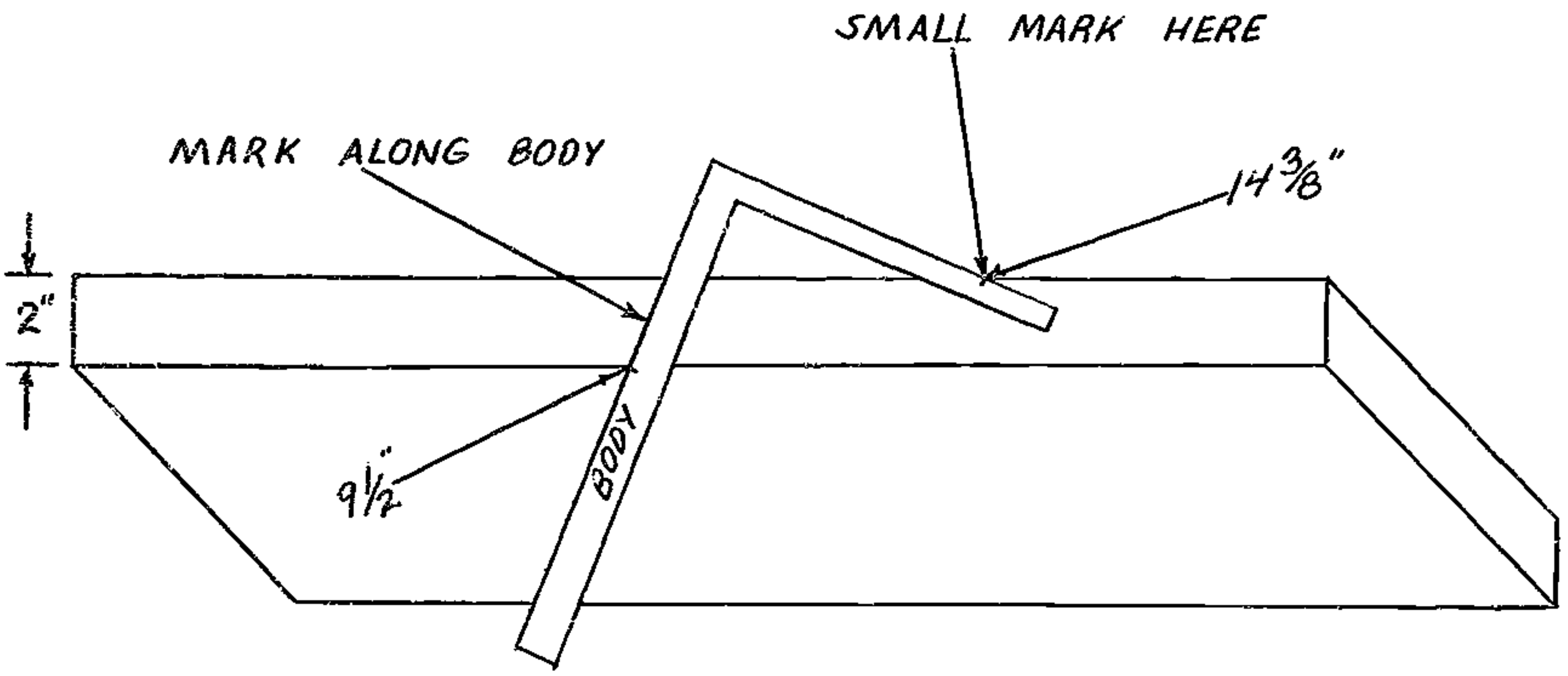


FIG. 81

Lay the square on the edge of the stock, holding the body in the left hand and tongue in the right hand face up; hold the 9½-inch mark on the body and the 14⅜-inch mark on the tongue, as shown in Fig. 81. Note that the marks are being held on opposite edges of the stock. Draw a line along the body of the square, and make a small mark on the edge where the tongue is being held.

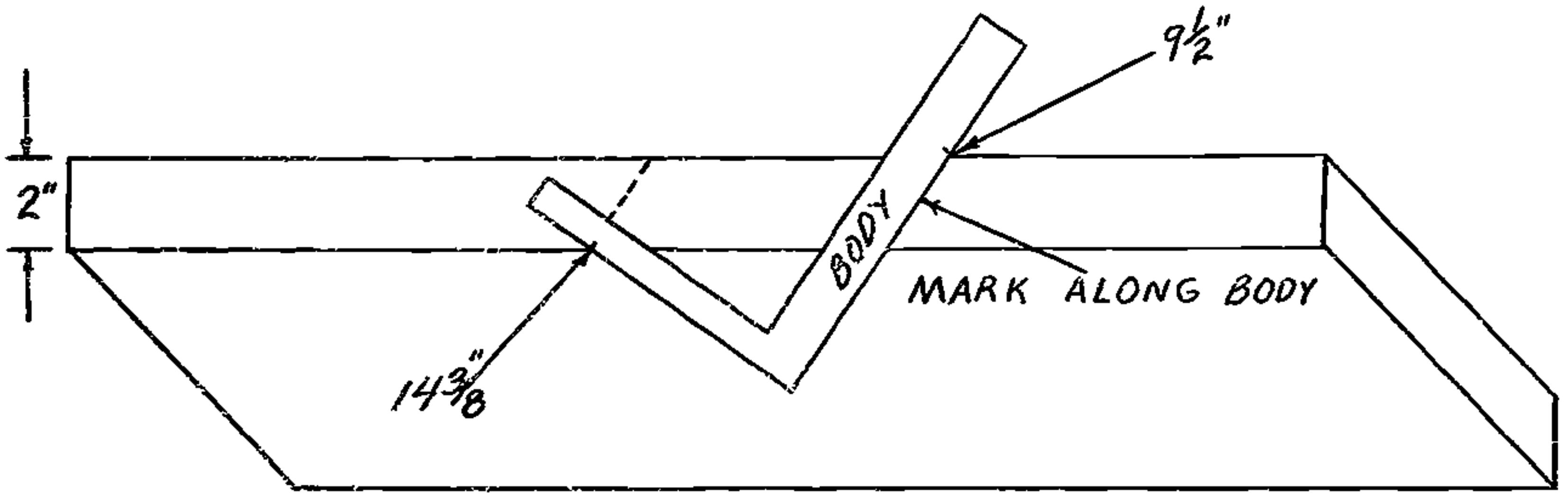


FIG. 82

Reverse the square, keeping the face up, so that the body is now in the right hand and the tongue in the left. Hold the $14\frac{3}{8}$-inch mark on the tongue at the point where the $9\frac{1}{2}$-inch mark had previously been held, and hold the $9\frac{1}{2}$-inch mark on the body at the point where the $14\frac{3}{8}$-inch mark had been held. Mark along the body (see Fig. 82). The two lines on the edge of the stock will be parallel. This is the exact length required for the bridging.

ASSIGNMENT:

Lay out cross bridging for the following floor joists:

Size	Spacing on Center
2" x 8"	16 inches
2" x 10"	14 inches
4" x 8"	16 inches
2" x 12"	12 inches

UNIT VI - OTHER USES OF THE FRAMING SQUARE

The Essex Board Measure Scale — Lesson 2

OBJECTIVE: To become familiar with the use of the Essex board measure scale.

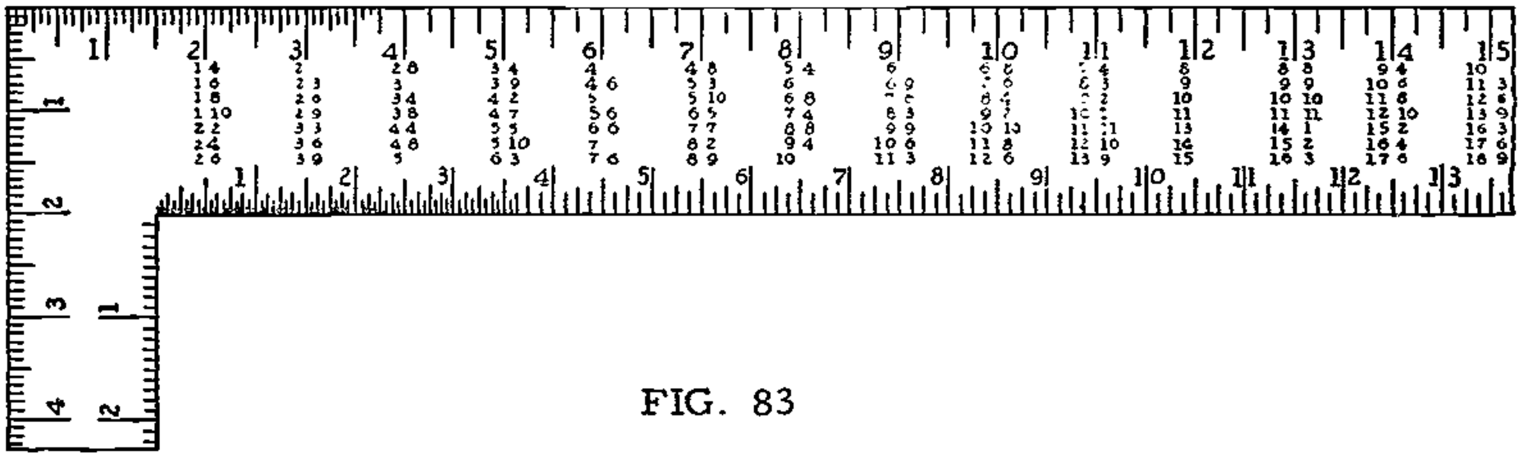


FIG. 83

INFORMATION:

The Essex board measure table is stamped on the back of the body of the square. It is used to figure out the board footage for almost any size of lumber or timber. The key to this table is the figure 12 inches on the outside edge of the square, which is the starting point for all calculations. Each number beneath 12 represents the width of the board, and each number on the edge of the blade from 2 to 24 represents the length of the board. These inch graduations are used in combination with the values given along the seven parallel lines.

Procedure - Finding Board Feet

Under the figure 12 find the number representing the width of the board. Follow horizontally along this set of figures to the figure under the number representing the length of the board. This figure is the total number of board feet for that particular piece of lumber. The board-feet answer will read on the Essex Board Measure Scale as 7 4, 5 10, 18 8, etc., which means $7\frac{4}{12}$ board feet, $5\frac{10}{12}$ board feet, $18\frac{8}{12}$ board feet. These figures are for lumber one inch thick. Multiply these figures by the thickness of the lumber.

Example: How many board feet in a piece of lumber 2 inches by 10 inches by 14 feet long? Under the figure 12 find the width of the board, in this example 10 inches. The figure 10 will be found on the third line down.

Follow horizontally along the third line to the figure under the number 14 (the length) and read $11\frac{8}{12}$. This would be the number of board feet if the lumber were 1 inch thick. Since the lumber is 2 inches thick, multiply $11\frac{8}{12}$ by 2. The amount of board feet in a 2" x 10" x 14'0" board is therefore $23\frac{4}{12}$ board feet.

ASSIGNMENT:

Find the board footage for the following:

1" x 8" x 16'0"

2" x 14" x 22'0"

1" x 4" x 18'0"

3" x 10" x 12'0"

2" x 10" x 20'0"

UNIT VI - OTHER USES OF THE FRAMING SQUARE

The Brace Measure Scale

Lesson 3

OBJECTIVE: To become familiar with the use of the brace measure scale.

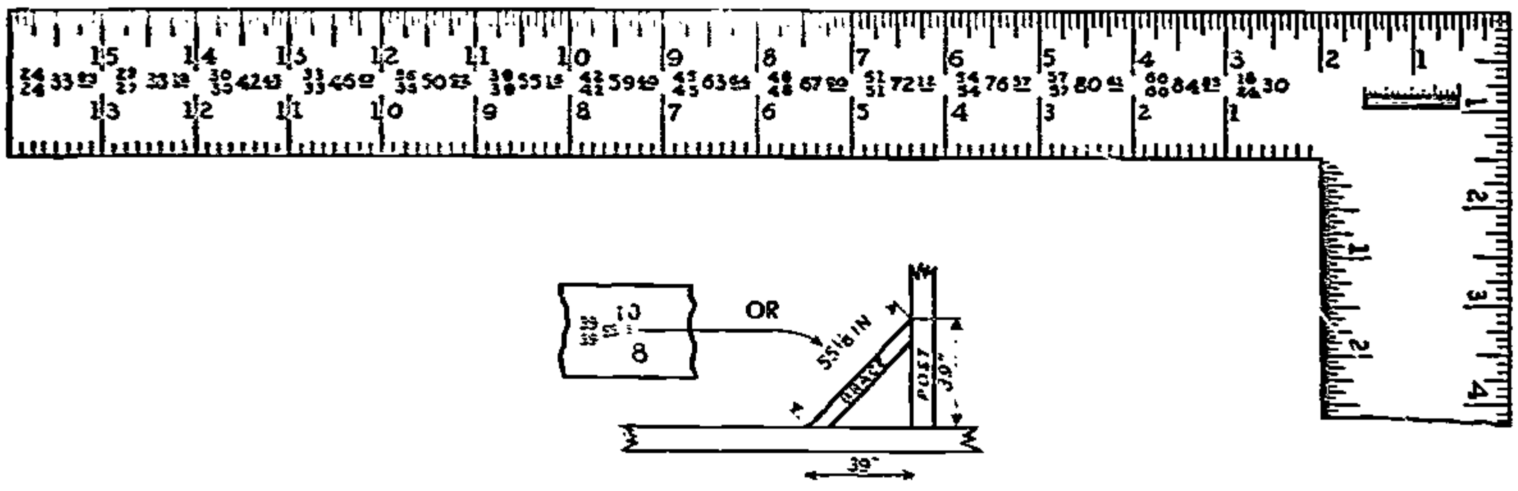


FIG. 84

INFORMATION:

The brace measure scale will be found along the center of the back of the tongue. It gives the lengths of corner braces placed at a 45-degree angle. An example of a brace size stamped on the brace measure scale is $\frac{36}{36}$ 50.91. This means that the length of the brace placed at a 45-degree angle against a 36" corner will be 50.91 inches. In other words, the diagonal distance between 36 inches and 36 inches is 50.91 inches. A brace put against a square angle, 60 inches away from the angle on each side, would be 84.85 inches long. In the same manner, the lengths of other braces are given on the scale.

Braces may be regarded as common rafters. When the brace run on the post is different from the run of the beam, the length of the brace, as well as the top and bottom cuts, may be determined by the figures given on the rafter tables for common rafters.

Note: One figure on the brace measure scale is for a brace not at a 45-degree angle, namely, $\frac{18}{24}$30.

ASSIGNMENT:

Find the length of the following braces:

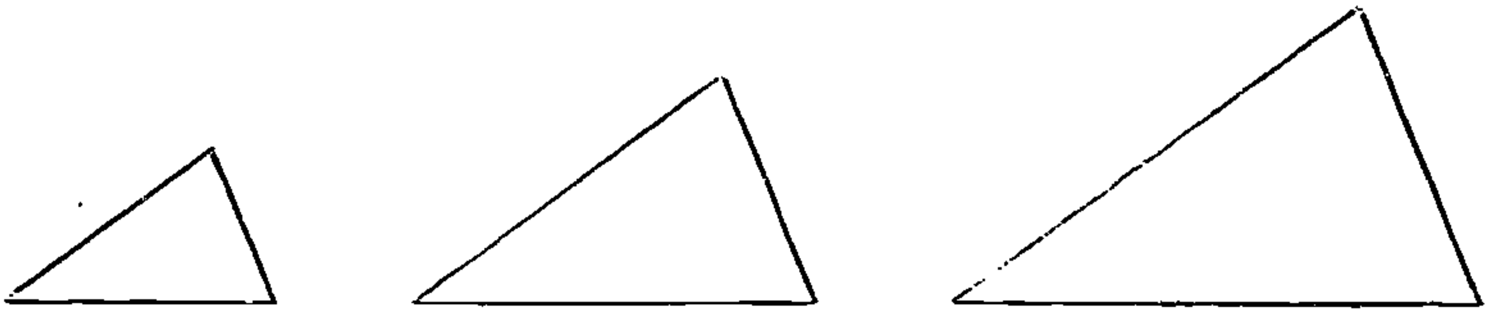
42" x 42"
51" x 51"
18" x 24"
16" x 24"
24" x 36"

UNIT VI - OTHER USES OF THE FRAMING SQUARE

Principles of Similar Triangles

Lesson 4

OBJECTIVE: To become familiar with the principle of similar triangles in rafter layout.



INFORMATION:

Many problems involving angles can be solved by using the geometric principles underlying similar triangles. Similar triangles have identical angles, but are not of the same size. A small triangle can be projected into a larger one or vice versa, with all angles of both remaining the same. (See illustration.) The carpenter can make similar right triangles with the framing square. This procedure is known as slipping the square. This procedure is sometimes used if it is applicable to the layout problem, as it is a practical method to use on the job.

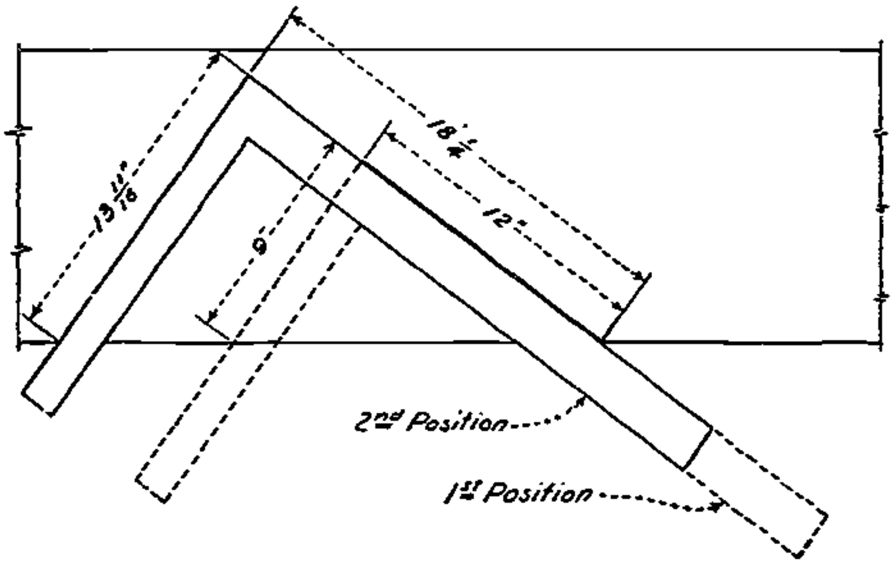


FIG. 85

How to "Slip" the Square

1. Select figures to represent a right-angle triangle, and lay out this triangle, using the $\frac{1}{12}$ scale.
2. Determine one dimension of the similar, larger right-angle triangle required.
3. Lay one edge of the square exactly along one of the lines of the smaller triangle, and "slip" the square along that line until it reaches the known dimension of the larger triangle.
4. Read the figure on the other leg of the square. This figure will be the required second dimension of the larger right-angle triangle.

Example:

Lay out a right-angle triangle with legs 9 inches and 12 inches. The longer leg of the larger similar triangle is 18¼ inches. To find the "rise" of the larger triangle, slip the square along the 12-inch side of the small triangle until the 18¼-inch mark coincides with the edge of the lumber. Read the other leg of the square. The answer (rise) will be $13\frac{11}{16}$ inches. This means that $13\frac{11}{16}$ and 18¼ inches will form the same angles with the edge of the board as 9 and 12 inches.

ASSIGNMENT:

Using the procedure explained above, find the figure to use to obtain the same angles?

Small Triangle	Run of Large Triangle
10" x 12"	17½ inches
6 x 12	20¼ inches
8 x 12	14¾ inches

Length of a Common Rafter By Slipping the Square

Lesson 5

OBJECTIVE: To learn how to obtain the length of a common rafter by slipping the square.

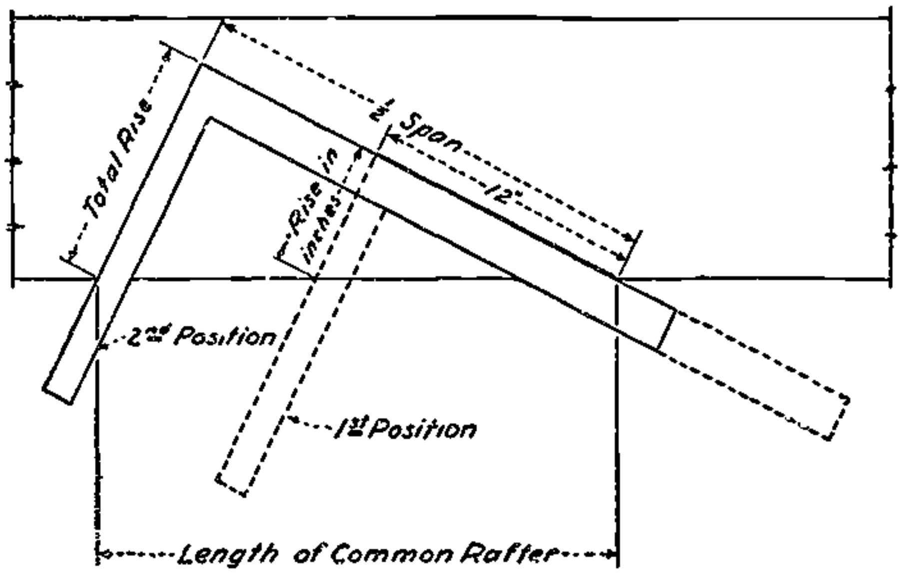


FIG. 86

Procedure:

Using the 12th scale, lay out a right triangle using the rise per foot on the tongue and the foot run (12 inches) on the body. Mark along the run side of the square. Slip the body, perfectly parallel to the 12-inch line, until it reaches the mark that is one-half the span. Read the tongue. This is the total rise of the roof. Measure diagonally from the total rise on the tongue of the square to the one-half-span figure on the body of the square. This measurement is the $\frac{1}{12}$th-scale length of the common rafter.

ASSIGNMENT:

Find the scale length for the following common rafters:

Rise Per Foot	Span
8 inches	30 feet
7 inches	27 feet
10 inches	31 feet 6 inches

Difference in Length of Jack Rafters By Slipping the Square Lesson 6

OBJECTIVE: To learn how to obtain the difference in length of jack rafters by slipping the square.

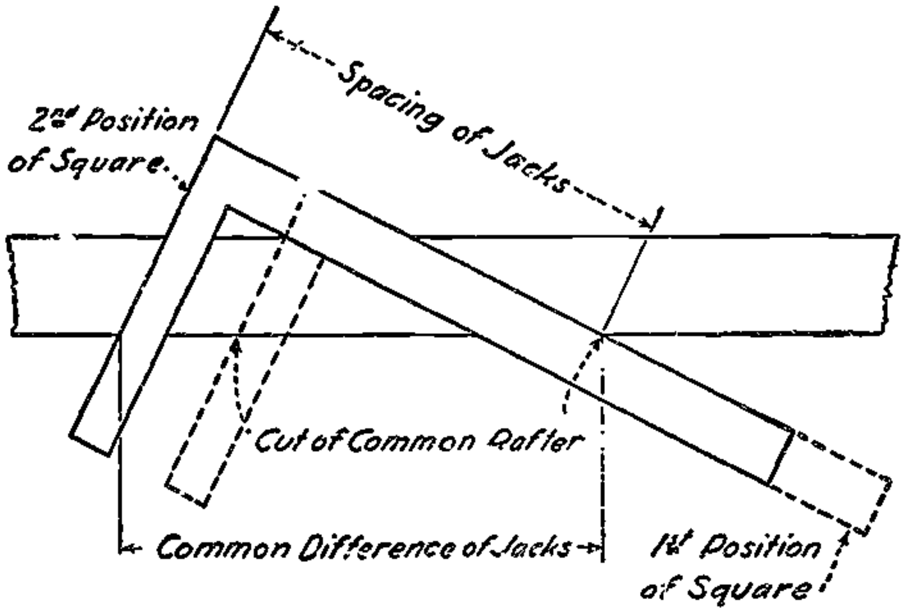


FIG. 87

INFORMATION:

The common difference in length of jack rafters is found on the rafter tables for 16- and 24-inch centers. By using the "slip" method, the difference in length can be found for any spacing.

Procedure:

Using the 12th scale, lay out a right triangle using the rise per foot on the tongue, and the foot run (12) on the body. Mark along the run (body). Slip the body, perfectly parallel to the run mark, until it reaches the figure representing the spacing of the jack rafters. Mark the tongue of the square. Measure from the tongue mark to the run mark. This is the difference in length of jack rafters.

The plumb, level, and cheek cuts are obtained in the same manner as previously described in Unit IV Lesson 13.

ASSIGNMENT:

Find the common difference in length for the following jack rafters:

Rise per foot 10 inches	12 inches on center
Rise per foot 12 inches	20 inches on center
Rise per foot 8 inches	14 inches on center
Rise per foot $6\frac{1}{2}$ inches	10 inches on center

UNIT VI - OTHER USES OF THE FRAMING SQUARE

Difference in Length of Gable Studs By Slipping the Square Lesson 7

OBJECTIVE: To learn how to obtain the difference in length of gable studs by slipping the square.

INFORMATION:

The procedure for laying out and finding the difference in length of gable studs was described in Unit III Lesson 8. The difference in length can also be found by "slipping the square." The same procedure as described in Unit III Lesson 8 is followed to obtain the cut to fit against the common rafter.

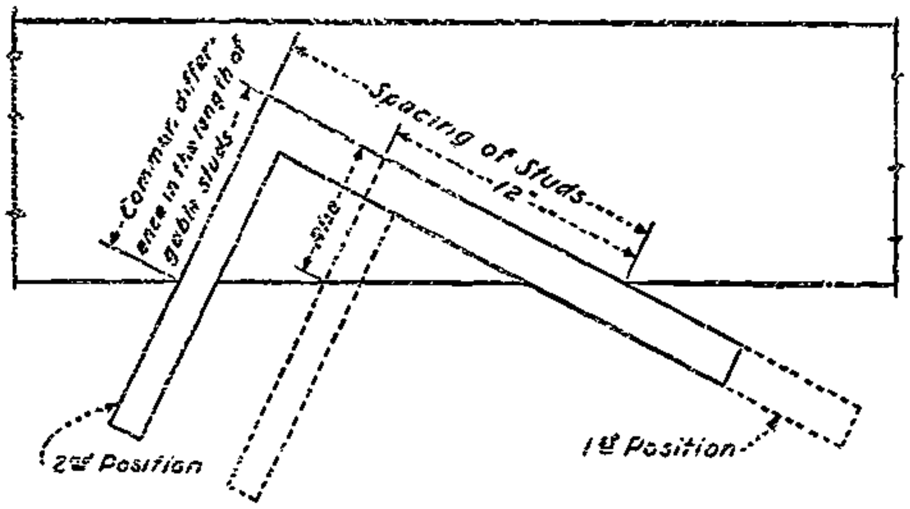


FIG. 88

Procedure:

Using the 12th scale, lay out a right triangle, using the rise per foot on the tongue, and the foot run (12) on the body and mark along the run side of the square. Slip the body, holding it perfectly parallel to the run mark, along the run mark until the body reaches the figure representing the spacing required, and read the dimension on the tongue of the square from the edge of the stock to the heel of the square. This figure is the difference in length of the gable studs.

ASSIGNMENT:

Find the difference in length for the following gable studs:

Rise Per Foot	Inches on Center
8 inches	16
10 inches	14
6 inches	24

Length of the Collar Beams By Slipping the Square

Lesson 8

OBJECTIVE: To learn how to obtain the length of collar beams by slipping the square.

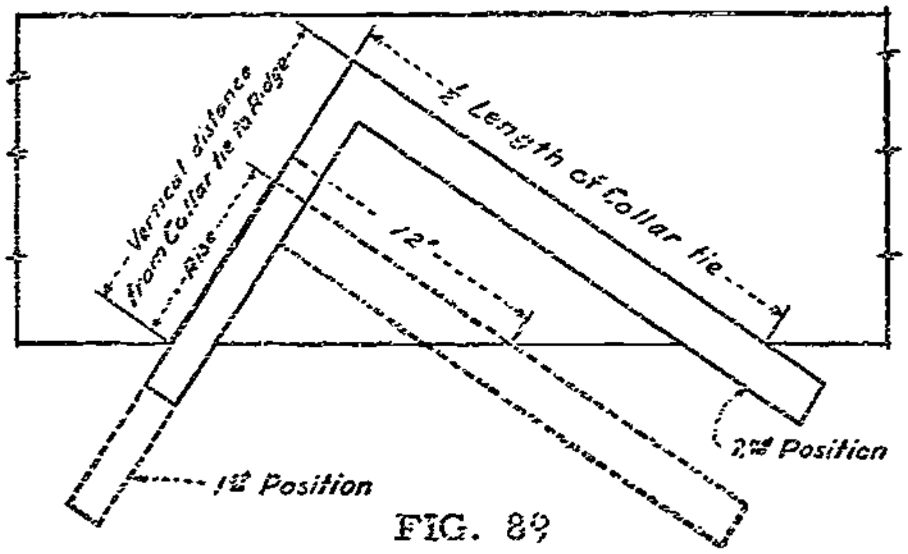


FIG. 89

Procedure:

Collar beam lengths can also be obtained by slipping the square.

Using the 12th scale, lay out a right triangle, using the rise per foot on the tongue and the foot run (12) on the body. Mark along the rise side of the square. Slip the square along the rise mark until the tongue reaches the figure representing the vertical distance that the collar beam is to be from the ridge. Read the new run (see Fig. 89). This represents one-half the length of the collar beam. Multiply this figure (new run, by two to obtain the full length. For the angle cuts on the ends, use the rise per foot and 12, and cut on 12.

ASSIGNMENT:

Find the length of the following collar beams; include the angle cuts.

Rise Per Foot	Vertical Distance from Ridge
9 inches	14 inches
7 inches	18 inches
14 inches	9 inches

Sheathing Cuts To Fit to Hip Rafters

Lesson 9

OBJECTIVE: To learn how to obtain the miter and face cuts on sheathing.

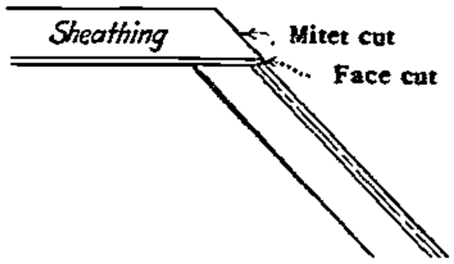


FIG. 90

INFORMATION:

In sheathing a roof with hip rafters, a combination miter and face cut is required. Each cut requires a separate layout, which can be made with the framing square.

The miter cut uses the unit of run (12 inches) and the length of common rafter per foot of run (diagonal of rise per foot and unit run).

The face cut is made on the edge of the board and uses the rise per foot and the diagonal of the cut, as above.

Rule: For the miter cut use run and length and cut on run.
For the face cut use rise per foot and length and cut on rise.

Example:

Assume a $\frac{1}{4}$-pitch roof. The cut for a $\frac{1}{4}$-pitch roof is 6 and 12. The diagonal of the cut is $13\frac{3}{8}$ inches. Therefore for the miter cut use 12 inches and $13\frac{3}{8}$ inches and cut on the 12-inch side of the square. For the face cut use 6 and $13\frac{3}{8}$ and cut on the 6-inch side of the square.

ASSIGNMENT:

On 1" x 6" sheathing boards, lay out the miter and face cuts for roofs with the following pitches:

$\frac{1}{3}$ pitch
$\frac{1}{2}$ pitch
$\frac{3}{8}$ pitch
$\frac{5}{12}$ pitch

The Level Cheek Cut That Fits on a Roof of the Same Pitch

Lesson 10

OBJECTIVE: To learn the procedure for laying out this particular level cheek cut.

INFORMATION:

Sometimes it is advisable to build a dormer gable after the main roof has been framed and sheathed. The advantage of this type of construction lies in the fact that valley rafters are eliminated and the common rafters can be used full length, making the supporting roof not only stronger but simpler to frame. The bottom cut of the rafters that rest on top of the main roof is called the level cheek cut.

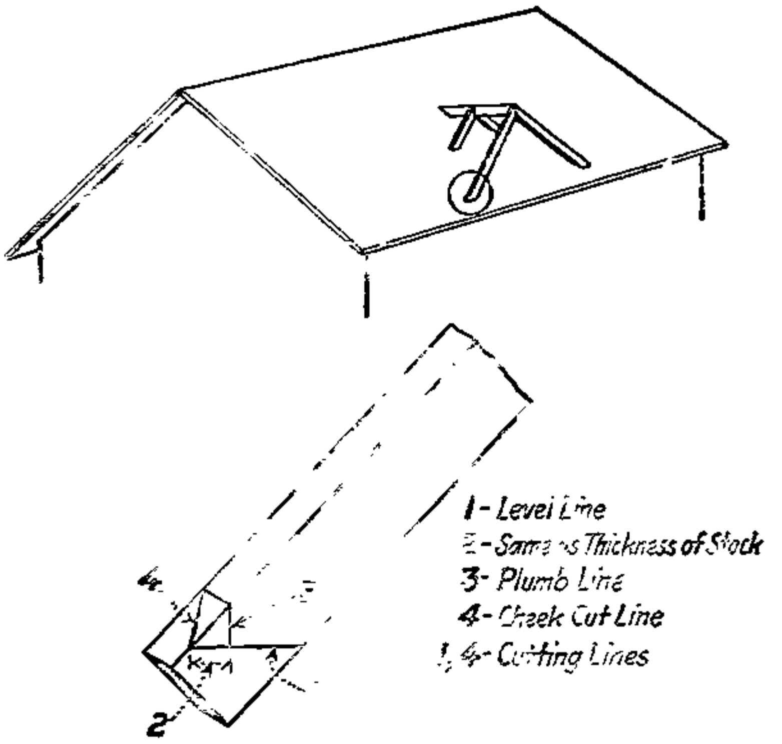


FIG. 91

Procedure:

1. Use the rise per foot and 12 and mark along 12, as at 1 in Fig. 91.

2. Measure on this line from the top edge of the rafter, the distance equal to the thickness of the rafter stock, as at 2.

3. Draw a plumb line at this point, carrying this line to the top edge of the rafter stock, and squaring it across the top (continuation of line 3).

4. Connect the ends of lines 1 and 3, as at 4. Cut on lines 1 and 4; this gives the level cheek cut.

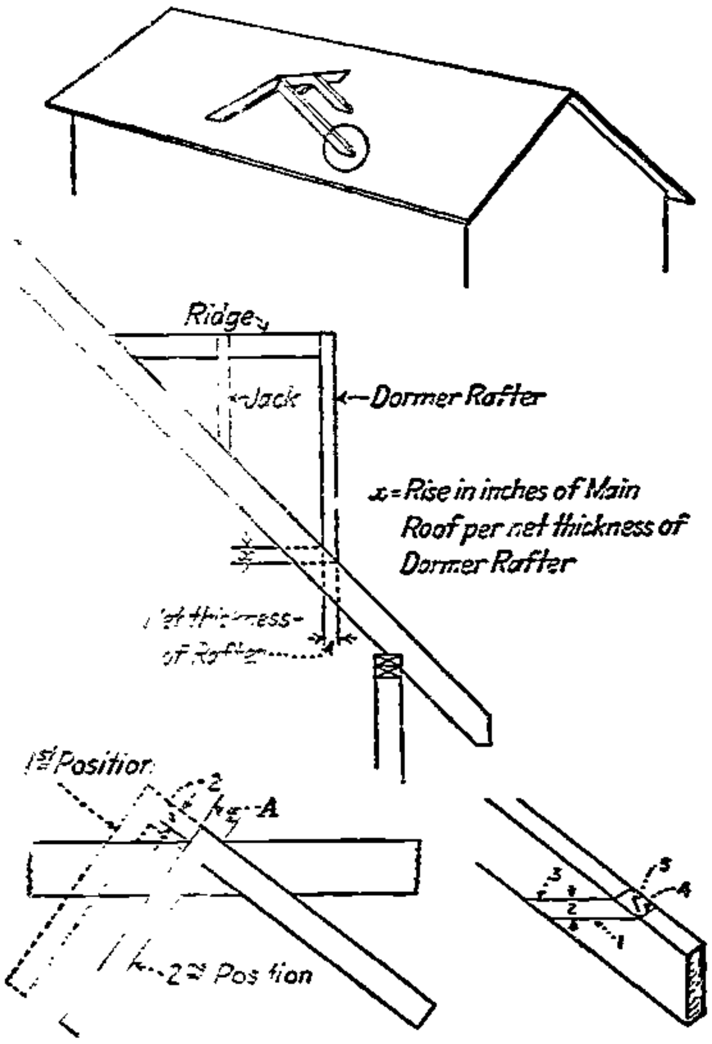
If correctly done, the faces of the rafters when put in position should be plumb, and the bottom cut should exactly fit the slant of the main roof.

ASSIGNMENT:

Lay out a level cheek cut for a roof where both the main roof and the dormer gable have a rise per foot of 8 inches.

The Level Cheek Cut That Fits on a Roof of a Different Pitch — Lesson 11

OBJECTIVE. To learn the procedure for laying out this particular level cheek cut.



NOTE: Rise of Cut at "2" Same Distance

FIG. 92

INFORMATION:

The shape of the level cheek cut that fits on a roof of a different pitch is the same as that of the level cheek cut described in the preceding lesson. The procedure of laying out the cut, however, as the drawing shows, is entirely different.

Procedure:

1. Use the rise per foot of the steep roof and 12; mark along the body to the 12-inch mark (first position of the square in Fig. 92).

2. "Slip" the square until the heel along the body side represents the thickness of the dormer rafter ("A" in illustration). Be sure the square lines up exactly with the run mark.

3. Read the rise figure from the tongue side of the heel. This is the "rise of the cut" at the bottom end of the dormer rafter (figure 2 in the illustration).

4. Lay out a level line on the dormer rafter as at 1 in the illustration.

5. Lay out a second level line above the first level line as at 3. The distance between the two level lines vertically (taken at right angles to the level line) is the distance found in step 3, that is, the "rise of the cut").

6. Make 90-degree (square) lines across the top of the rafter as at 4.

7. Connect these lines with a diagonal line, which will be the angle cut of the dormer rafter, as at 5.

ASSIGNMENT:

Lay out a level cheek cut for a dormer rafter; the main roof is $\frac{1}{3}$ pitch, and the dormer is $\frac{1}{4}$ pitch.

UNIT VI - OTHER USES OF THE FRAMING SQUARE

Making Circles with the Framing Square — Lesson 12

OBJECTIVE: To learn the procedure of laying a circle.

INFORMATION:

Sometimes it is necessary for the layout man to lay out a circle for a particular layout problem. There are several methods of making a circle. The roof framer can lay out a circle with the framing square.

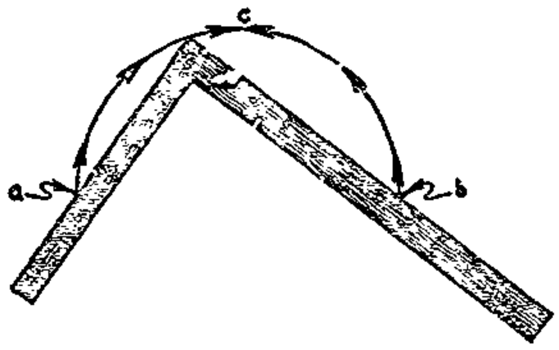


FIG. 93

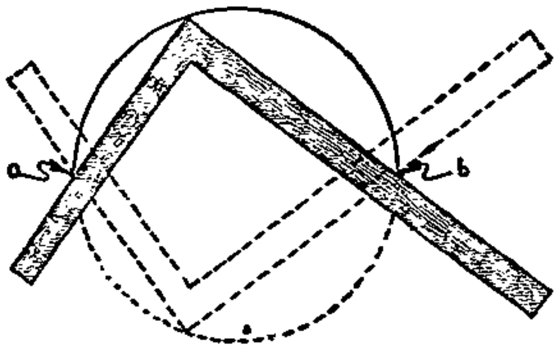


FIG. 94

Procedure:

Drive two nails, as at a and b in Fig. 93, as far apart as the diameter of the circle. Place the square in the position shown, and with a pencil at the heel, mark the circle as the square is moved in the direction of the arrows. When one-half of the circle is marked, place the square in the position shown by the dotted lines in Fig. 94, and proceed to mark the other half of the circle. In case a circle is required that is larger than the square can make, construct a wooden square as large as is needed to make the circle.

ASSIGNMENT:

Use the framing square and lay out a circle with a diameter of 20 inches.

Finding the Center of a Circle

OBJECTIVE: To learn how to find the center of a circle.

INFORMATION:

There are several methods of finding the exact center of a circle. The roof framer can do this easily with the framing square.

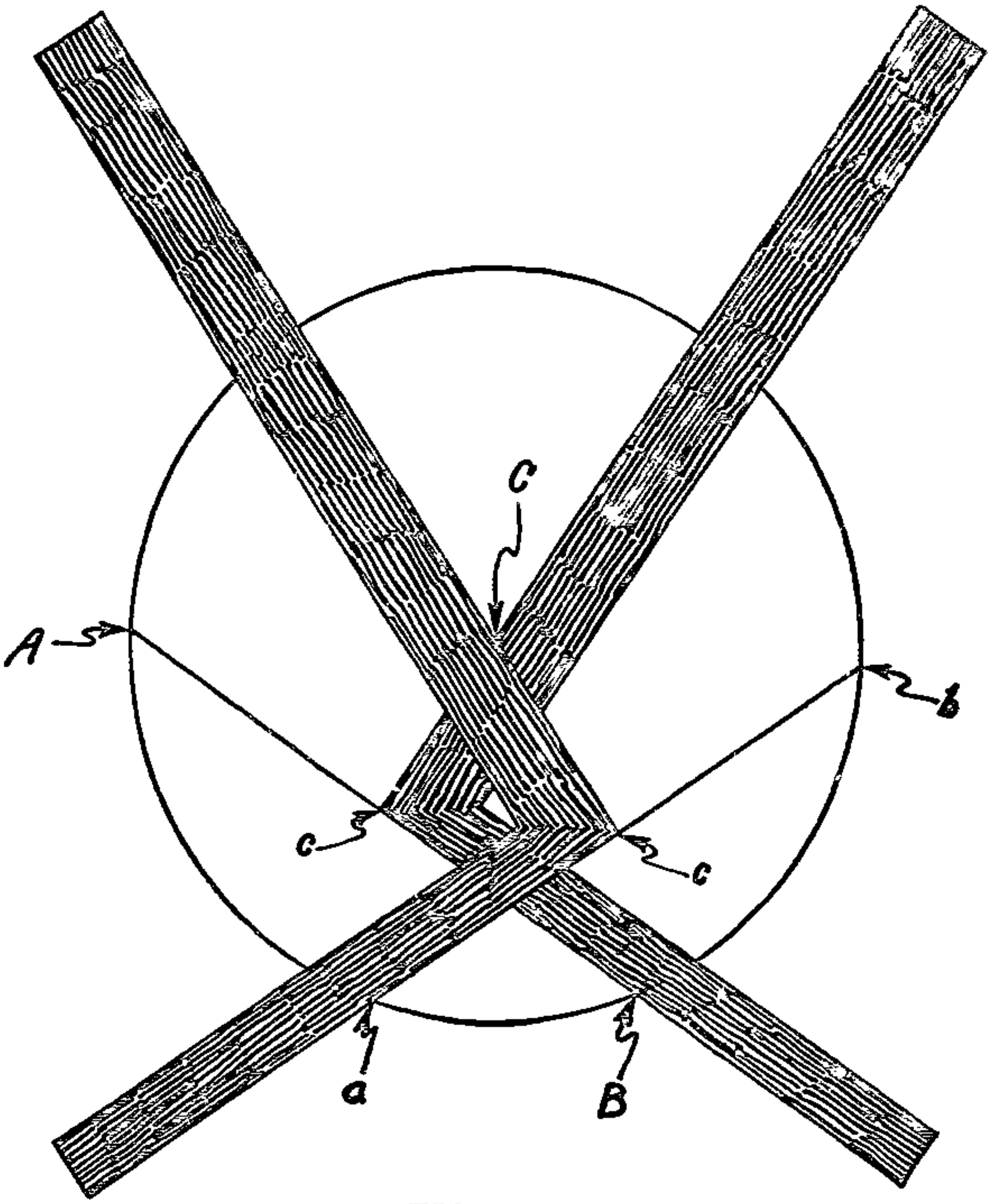


FIG. 95

Procedure:

Draw two lines, similar to lines A-B and a-b in Fig. 95, at any convenient position. Find the centers of the two lines, as at c-c, and place the square in the positions shown, drawing lines along the edge both times. The point at C, where the two lines intersect, will be the center of the circle.

ASSIGNMENT:

Find the center of the circle laid out in Lesson 12.

UNIT VI - OTHER USES OF THE FRAMING SQUARE

TEST

---

1. Lay out cross bridging for the following floor joists:

Size	Spacing on Center
2" x 10"	14 inches
2" x 8"	12 inches
4" x 8"	16 inches
2" x 12"	16 inches

2. Use the Essex Board Measure Scale to find the board footage for the following pieces of lumber:

2" x 10" x 20'0"
4" x 8" x 16'0"
4" x 10" x 14'0"
14" x 14" x 20'0"

3. By means of "slipping the square" find the second dimension of the larger triangles:

Small Triangle	Run of Large Triangle
6" x 12"	15 inches
10" x 12"	20¼ inches
8" x 12"	14¾ inches

4. Find the scale length for the following common rafters by "slipping the square":

Rise Per Foot	Span
9 inches	27 feet
10 inches	28 feet 6 inches
12 inches	26 feet
7½ inches	31 feet

5. Find the common difference in length for the following jack rafters by "slipping the square":

Rise Per Foot	Spacing
9 inches	12 inches
$6\frac{1}{2}$ inches	16 inches
12 inches	18 inches

6. By "slipping the square," find the common difference in the length of the gable studs for the following roof dimensions:

Rise Per Foot	Spacing
12 inches	16 inches
10 inches	14 inches
8 inches	24 inches
6 inches	20 inches

7. Find the length of these collar beams by "slipping the square":

Rise Per Foot	Vertical Distance from Ridge
9 inches	14 inches
12 inches	1 foot 4 inches
7 inches	1 foot 2 inches

8. The rise per foot of the main roof is 8 inches. The rise per foot of the dormer gable is also 8 inches. Lay out the level cheek cut for the dormer common rafter to fit on top of the main roof.

9. Use the framing square and lay out a circle with a diameter of 16 inches; find the center of the circle.

UNIT VII - SUMMARY OF ROOF INFORMATION

General Information Lesson 1

OBJECTIVE: To review the types of roofs and rafters.

INFORMATION:

This unit will serve as a review of the information covered in the preceding units. No explanation of procedures is given. The student should be sure he fully understands the various layout problems before he reads this unit. This review material is divided into three parts:

1. General information
2. Definitions
3. Basic rafter layout principles

Types of Roofs

1. Shed: Slants in one direction only
2. Gable: Slants in two opposite directions
3. Hip: Slants in four directions
4. Intersecting: On buildings that have offsets or angles

Kinds of Rafters

1. Common
2. Hip
3. Valley

Jack Rafters

1. Hip jack
2. Valley jack
3. Cripple

Basic Rafter Cuts

1. Ridge - at the ridge (a plumb cut)
2. Cheek - at top end of hips, valleys, and jacks (an angle cut)
3. Seat - at the plate line (combination plumb and level cut)
4. Overhang - at exposed lower end of rafter (usually a combination plumb and level cut)

Pitch

There are three applications of the term "pitch":

1. Mathematical relationship between total rise and span
2. Equal Pitch: roof has the same slope on all its parts
3. Unequal Pitch: roof has two or more different slopes

UNIT VII - SUMMARY OF ROOF INFORMATION

Definitions — Lesson 2

OBJECTIVE: To review the definitions used in roof framing.

INFORMATION:

The definitions are grouped according to the information required before actual layout work can begin.

Span

1. Total span - distance from outside edge of wall plate to the opposite outside edge of wall plate.
2. Unit of span - always 24 inches.

Rise

1. Total rise - vertical distance from top of wall plate to top of ridgeboard.
2. Rise per foot - number of inches that roof rises per foot of run.

Run

1. Total run - always one-half the total span.
2. Unit of run - always 12 inches

Rafters

1. Common rafter - the rafter that extends at right angles from plate line to ridge
2. Hip rafter - the rafter at the intersection of any two of the four sloping surfaces of a hip roof
3. Valley rafter - the rafter that is framed at the intersection of two slopes of an intersecting roof

Jack Rafters

1. Hip jack - a rafter that runs from the plate to the hip rafter
2. Valley jack - a rafter that runs from the ridge to the valley rafter
3. Cripple jack - a rafter that does not touch either the ridge or the plate

Ridge - the highest part of the roof (where the ridge cuts of the rafters meet)

Rafter Cuts

1. Ridge cut - at the top end of common, hip, valley, and valley jack rafters
2. Seat cut - the cut at the intersection of a rafter with the wall plate, on which it is to be nailed
3. Overhang cut - the cut at the bottom end of any rafter that overhangs to form a cornice
4. Cheek cuts - The single cheek cut: a slanting plumb cut on jack, valley, and hip rafters to make them fit against the piece to which they are framed.
   The double cheek cut: the same as a single cheek cut, except that the slanting cut is in two directions, such as a "V" cut on hip or valley rafters.

Deduction - The amount necessary to shorten each rafter, to allow for the thickness of the stock to which it is framed

Rafter Lengths

1. Mathematical - the exact mathematical length of each rafter, with no allowance made for deduction; also called line length
2. Actual - the actual length of a rafter after deduction has been made

Angle of Cut

1. For common rafter - use rise in inches, and 12 inches
2. For hip and valley rafters - use rise in inches, and 17 inches (for equal-pitch roofs).
3. For unequal pitch roofs - use total rise and total run measurements.

UNIT VII - SUMMARY OF ROOF INFORMATION

Basic Rafter Layout Principles — Lesson 3

OBJECTIVE: To review certain fundamental layout principles

INFORMATION:

Most of the difficulties of rafter layout will disappear as soon as the student has learned to visualize the rafter relationships in their plan view (as seen from above). The pitch of the roof need not be considered. The following rules apply to all rafters when considered in plan view.

1. Common rafters intersect the ridge at a 90-degree (right) angle.
2. Hip, valley, and jack rafters of an equal-pitch roof intersect the roof member to which they are framed at a 45-degree angle.
3. Cheek cuts for equal-pitch roofs are laid out at right angles to the plumb cuts.
4. Hip, valley, and jack rafters for unequal-pitch roofs intersect the member to which they are framed at any angle other than 45 degrees. This is the basic reason why unequal-pitch roofs are more difficult to lay out than equal-pitch roofs.

Principles of Deduction

All rafters that are framed against another roof member must be shortened to allow for the thickness of this member. The rules are as follows:

1. All deductions are on the principle of the plan view; therefore, all measuring is done at right angles to the plumb cut.
2. All deductions are on the basis of one-half the thickness of the stock to which the rafter is being framed.
3. For common rafters, the deduction is one-half the thickness of the ridgeboard.
4. For hip and valley rafters, the deduction is three-quarters of the thickness of the ridgeboard.

5. For jack rafters, if the mathematical length is found, then the deduction is the same as for hip or valley rafters. If the rafter tables on the square are used, then deduction is not necessary.

Note: When figuring out deductions, measuring on the rafter at right angles to the plumb cut automatically shortens it the correct amount, regardless of the pitch of the roof.

Principles of Similar Triangles

For an equal-pitch roof, the angle formed by the rise in inches and 12 inches of run is equal to the angle formed by the total rise and total run. The triangles so formed are known as similar triangles.

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SIMPLIFIED ROOF FRAMING	WILSON & WERNER

VT003 267

VT 003 267
Six Selected Instructional Aids for Teachers of Agriculture.

Drawbaugh, Charles C.
Rutgers, The State Univ., New Brunswick, N.J.
Pub Date - Mar67
MF AVAILABLE IN VT-ERIC SET 60p.

*INSTRUCTIONAL AIDS, *VOCATIONAL AGRICULTURE, *LANDSCAPING, *SOIL SCIENCE, *PLANT IDENTIFICATION, TRANSPARENCIES, FILMSTRIPS, PUBLIC RELATIONS,
Future Farmers of America,

This document describes aids for teacher use in vocational agriculture classes, or for promoting the agricultural program. The aids were developed at an inservice institute by teacher committees who consulted subject matter specialists. Included are (1) overhead projection transparency masters on landscape planning, (2) information and directions for making soil monoliths, (3) a suggested form and pertinent information for teaching identification of 54 landscape plants, (4) questions and answers about vocational agriculture and the Future Farmers of America for a recruitment brochure, (5) a description of 51 slides for promotion of the agricultural program, and (6) plans for an electric quiz board. This document is available for $1.00 from Vocational-Technical Curriculum Laboratory, Rutgers University, 10 Seminary Place, New Brunswick, New Jersey 08903. (JM)

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DEPARTMENT OF EDUCATION
DIVISION OF VOCATIONAL EDUCATION

SIX SELECTED INSTRUCTIONAL AIDS FOR TEACHERS OF AGRICULTURE

CHARLES C. DRAWBAUGH, ASSISTANT PROFESSOR
VOCATIONAL-TECHNICAL EDUCATION DEPARTMENT
RUTGERS-THE STATE UNIVERSITY
NEW BRUNSWICK, NEW JERSEY

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NEW BRUNSWICK, NEW JERSEY

MARCH, 1967

MEMORANDUM

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(Address) School of Education-Rutgers; 10 Seminary Place, New Brunswick, N J 08903

DATE: August 29, 1967

RE: (Author, Title, Publisher, Date) Charles C. Drawbaugh; SIX SELECTED INSTRUCTIONAL AIDS FOR TEACHERS OF AGRICULTURE; March 1967

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PREFACE

During the 1966 Inservice Summer Institute, "Instructional Aids for Teachers of Agriculture," a list of projects relating to teaching materials was developed. From the list the sixteen teachers of agriculture enrolled in the Institute selected the six projects described in this booklet as having the most utility to them in their programs.

Committees were formed to pursue the projects in such a way that the final report would be useful to fellow teachers of agriculture. Preliminary drafts of the materials were presented to class members for improvements, additional suggestions, and a degree of approval. Materials were then returned to committee, re-written, and submitted to the class for final approval.

Specialists from the College of Agriculture and Environmental Science, Rutgers - The State University and the New Jersey Department of Education were consulted by members of the committees. Special recognition is given to Mr. George W. Lange, Director of Agricultural Education, New Jersey Department of Education and to Mr. Robert M. Hanna, Associate Extension Specialist in Soils, College of Agriculture and Environmental Science, Rutgers - The State University, for their continued professional help during the two-week Institute.

The teachers of agriculture are commended for selecting meaningful projects which will help them and fellow teachers with their professional responsibilities.

Charles C. Drawbaugh
Assistant Professor
Vocational Education

TABLE OF CONTENTS

PART I

ORIGINALS FOR PREPARING OVERHEAD TRANSPARENCIES ON LANDSCAPE PLANNING

ORIGINALS FOR PREPARING OVERHEAD TRANSPARENCIES ON LANDSCAPE PLANNING

This series of originals is made available to the teacher for making transparencies. The teacher should not feel obligated to use each original in the set nor should he consider the set to be complete.

To use the originals in this booklet, remove the pages. A transparency is made by placing a piece of specially prepared transparent material over the original and putting both through a copying machine at the correct speed. The process results in a piece of transparent material with an image of the original fixed on it. It is known as a transparency and is used on an overhead projector as an instructional aid.

More than one original and/or transparency may be necessary to explain an idea or a principle of landscape planning. For that reason seventeen originals were prepared to explain ten ideas or principles. To help the teacher use the transparencies in a suggested sequence, a syllabus precedes the originals.

Syllabus of Originals

1. Plan before planting.

2. Plan for usefulness, convenience, safety, comfort, and beauty.

   A complete landscape plan illustrating the above concepts.

   An overlay (place on top of the complete landscape plan).

3. Survey the site - taking an inventory.

4. Measuring and locating points.

5. Draw the site plan to scale.

   A site survey drawn to scale.

6. Three areas of the home landscape.

   A diagram of the three main areas to be planned.

7. Planning the public area - The foundation planting.

   Planning the public area - Frame the house with trees.

   Planning the public area - A well planned public area.

8. Planning the private area.

9. Planning the service area.

10. Kinds of landscape design - Informal garden.

    Kinds of landscape design - Formal garden.

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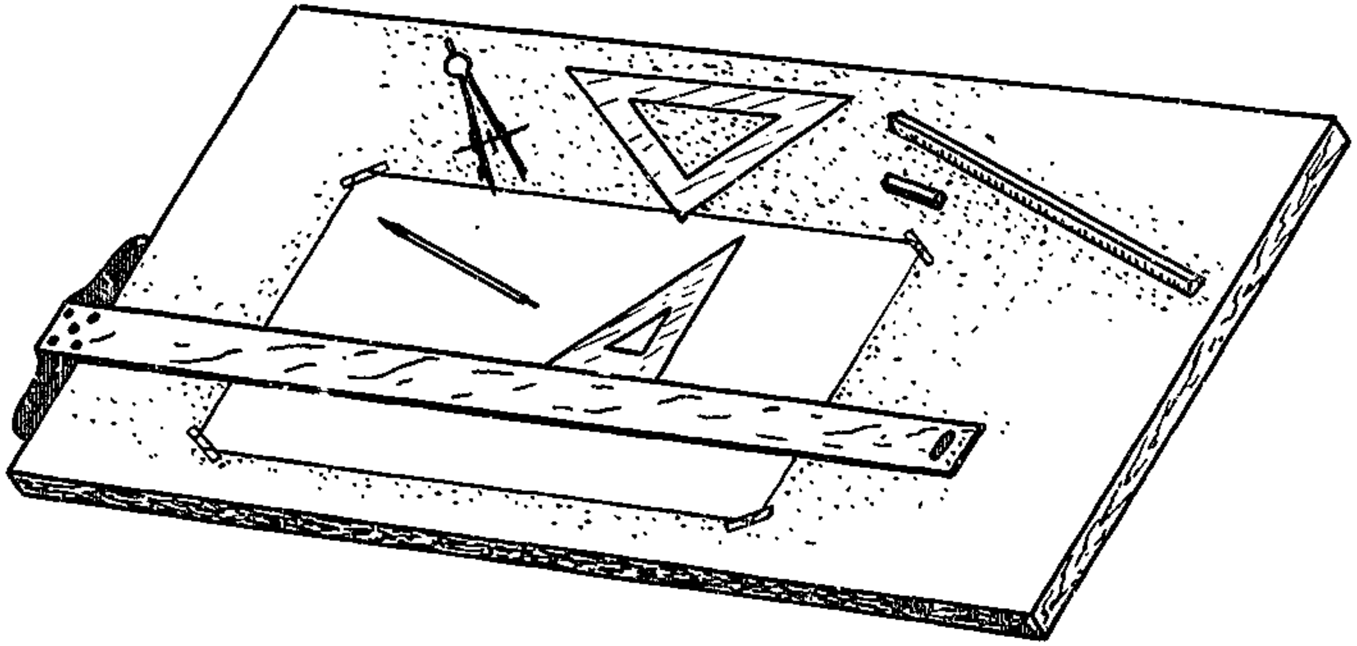
PLAN BEFORE PLANTING



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PLAN FOR:

USEFULNESS

CONVENIENCE

SAFETY

COMFORT

BEAUTY

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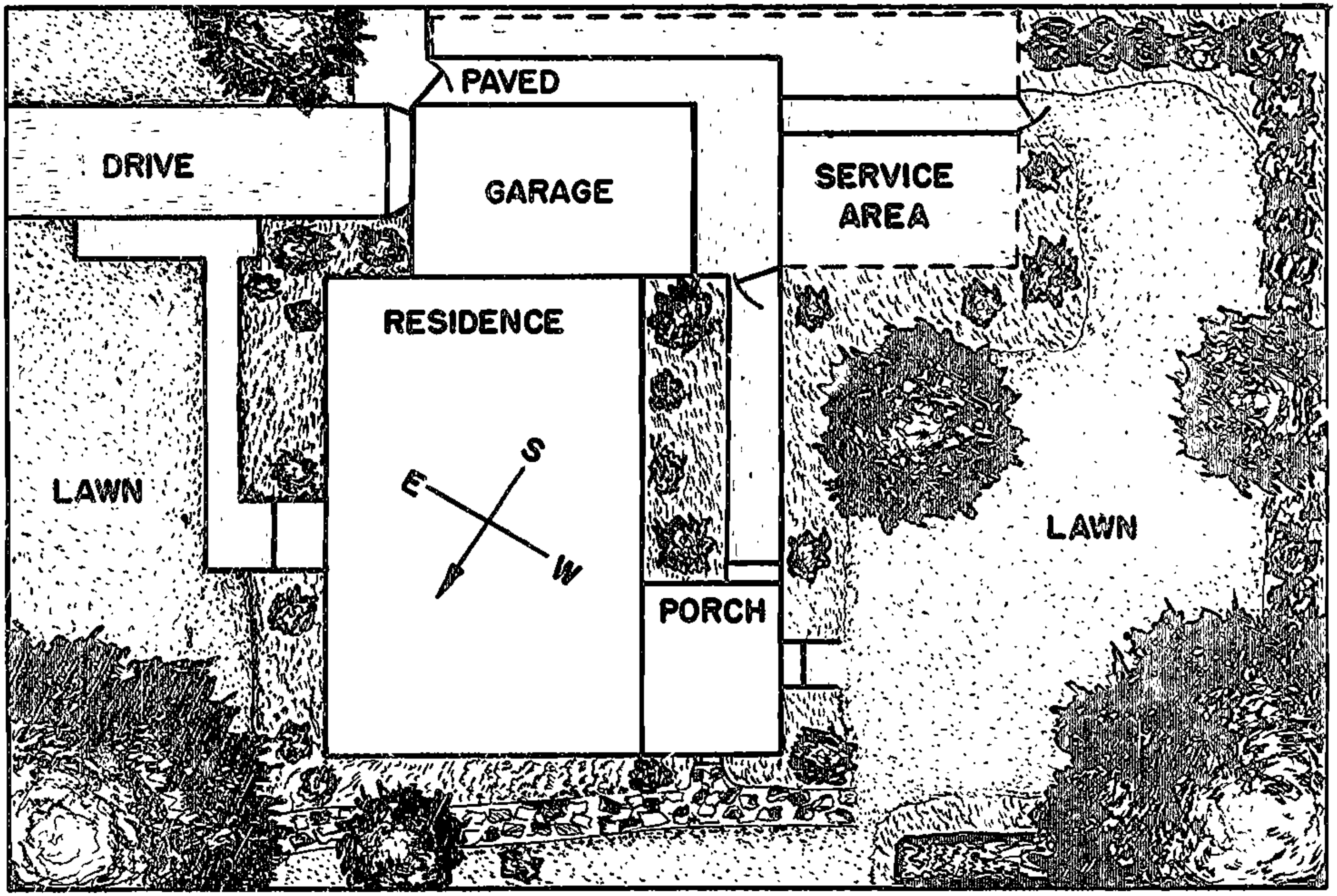
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CONVENIENCE

USEFULNESS

SAFETY

BEAUTY

COMFORT

CUT HERE

SURVEY THE SITE

TAKE AN INVENTORY:

1. MEASURE AND SKETCH THE SITE
2. NOTE SOIL, SLOPE, DRAINAGE, ETC.
3. LOCATE IMPORTANT ITEMS:
   - A. HOUSE, WALKS AND DRIVES
   - B. UTILITIES
   - C. TREES, STREAMS AND ROCKS
4. ORIENTATION TO THE SUN AND PREVAILING WINDS

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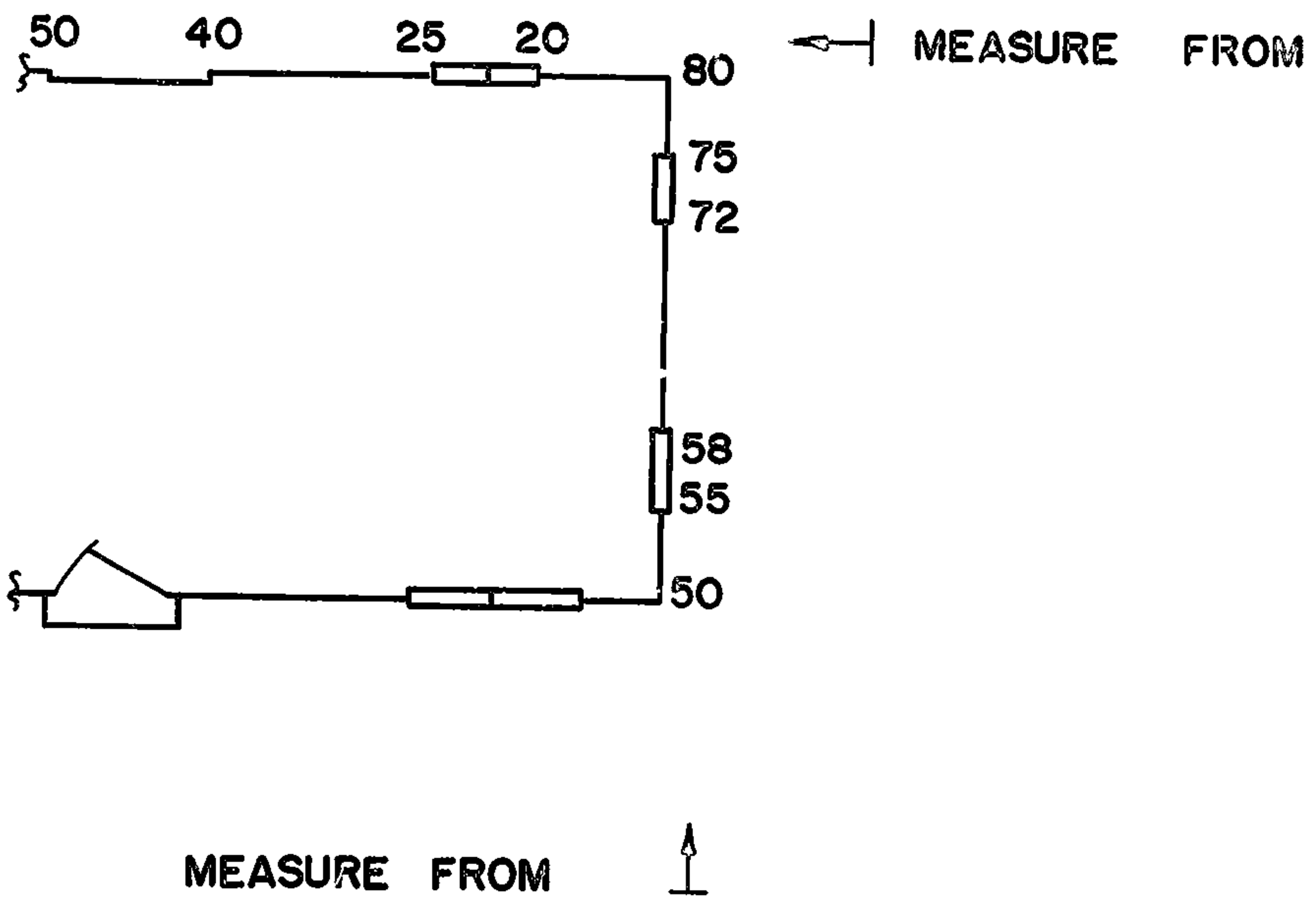
MEASURING AND LOCATING POINTS



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DRAW SITE PLAN TO SCALE

1. SELECT A SUITABLE SCALE
   A. FIT SITE TO THE PAPER
   B. MAKE SCALE AS LARGE AS POSSIBLE
2. USE GRAPH PAPER
   A. LOCATE PROPERTY LINES
   B. LOCATE HOUSE
   C. DRAW IN OTHER IMPORTANT ITEMS
3. DEVELOP LANDSCAPE PLAN ON SITE PLAN

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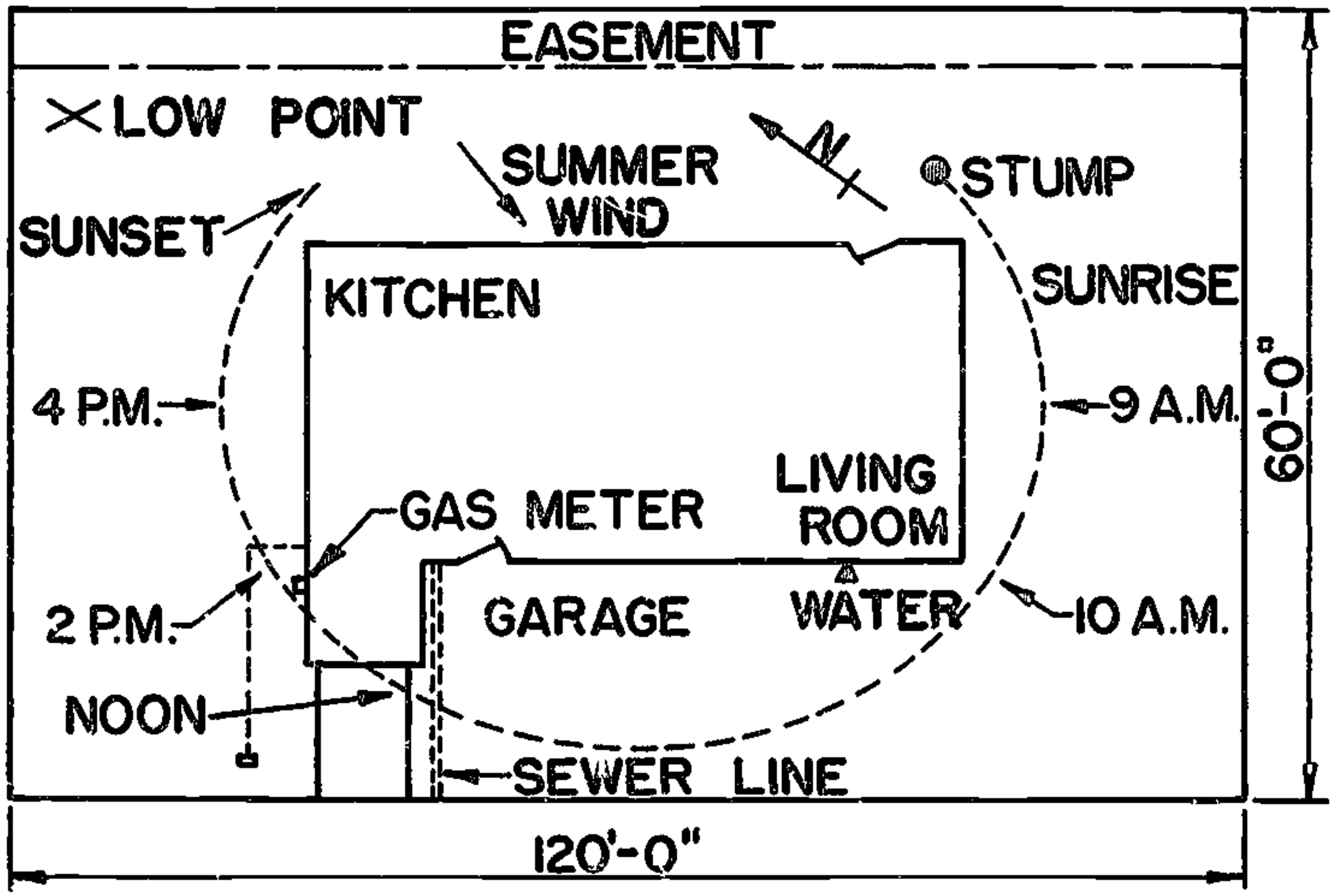
SITE SURVEY DRAWN TO SCALE



SCALE: $\frac{1}{16}$" = 1'-0"

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THREE AREAS OF THE HOME LANDSCAPE:

1. PUBLIC - FRONT AREA VISIBLE TO THE PUBLIC
2. PRIVATE- RELAXATION AND ENJOYMENT
3. SERVICE- UTILITY AREA FOR GARDEN, GARBAGE CANS, ETC.

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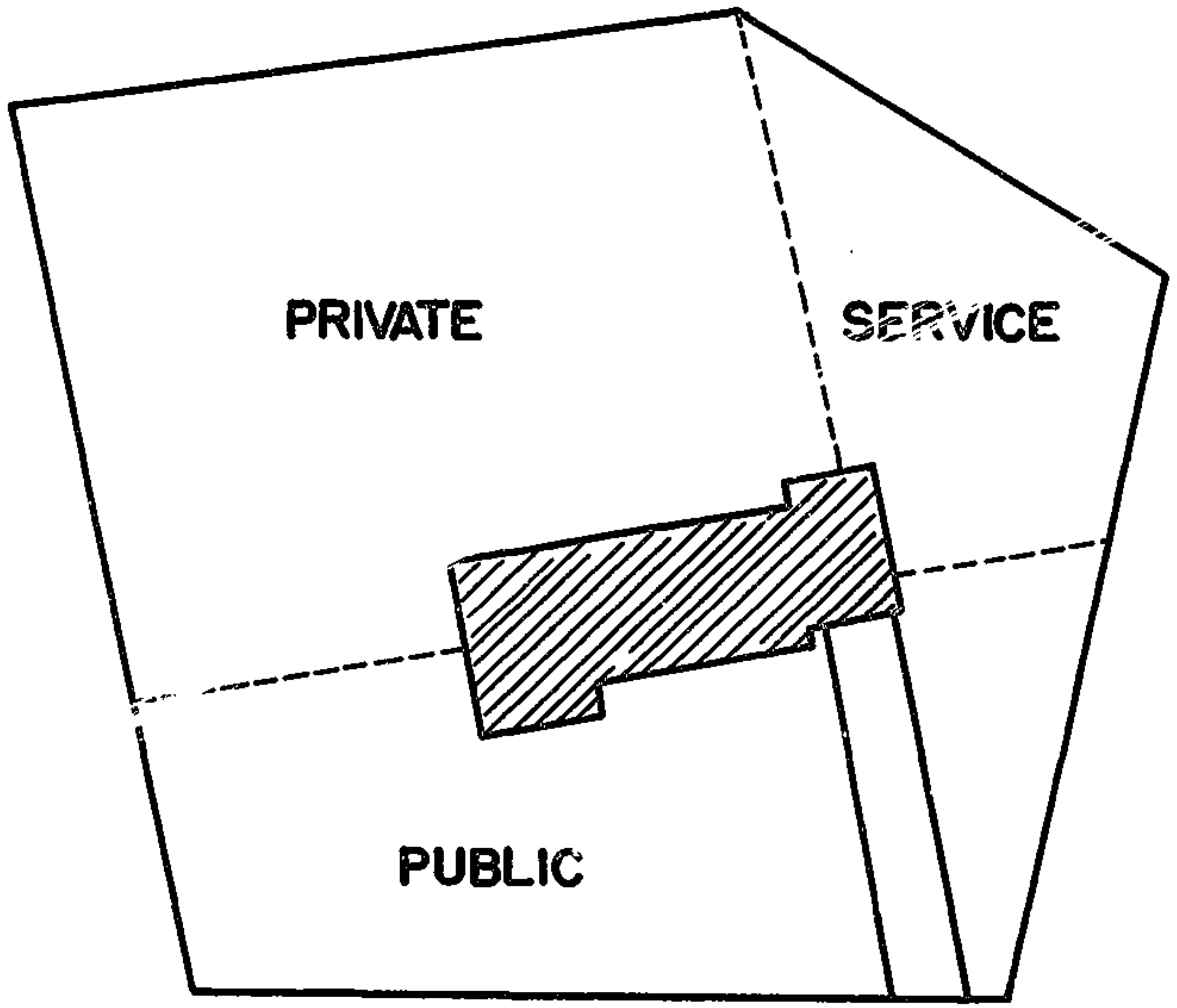
THE THREE MAIN AREAS TO BE PLANNED



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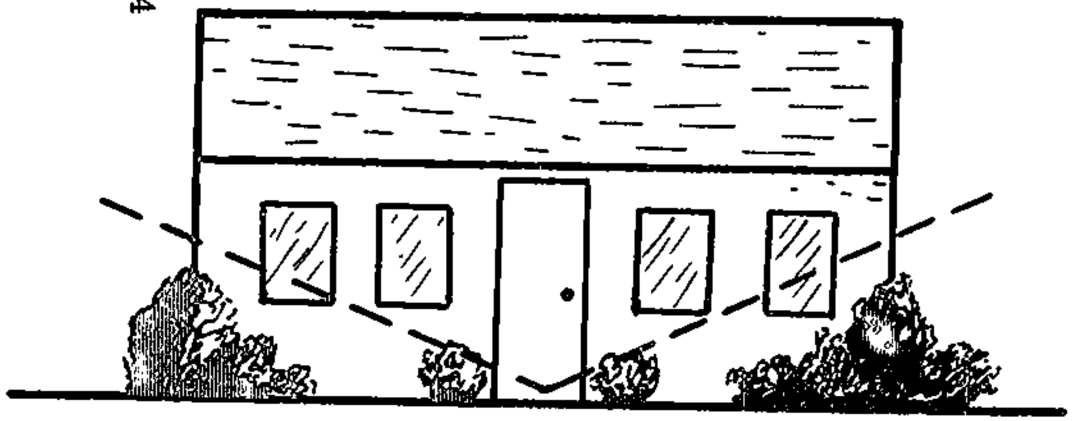
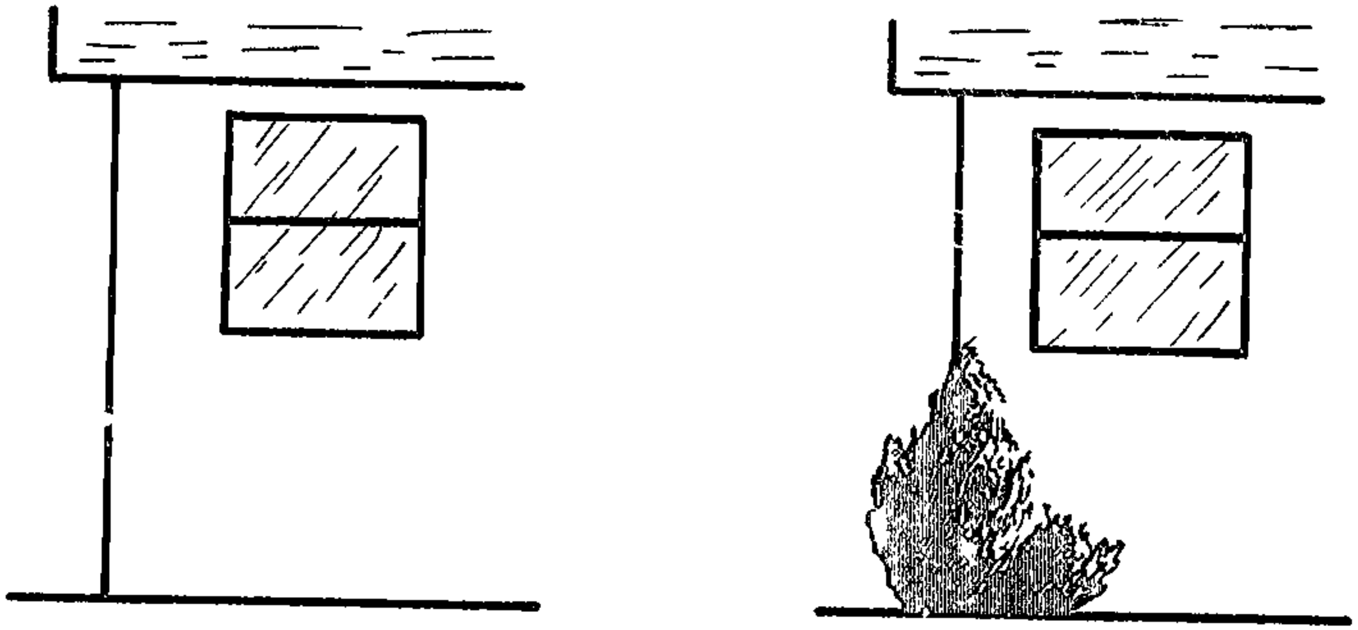
PLANNING THE PUBLIC AREA
THE FOUNDATION PLANTING



FOCUS ATTENTION ON THE ENTRANCE



SOFTEN CORNERS

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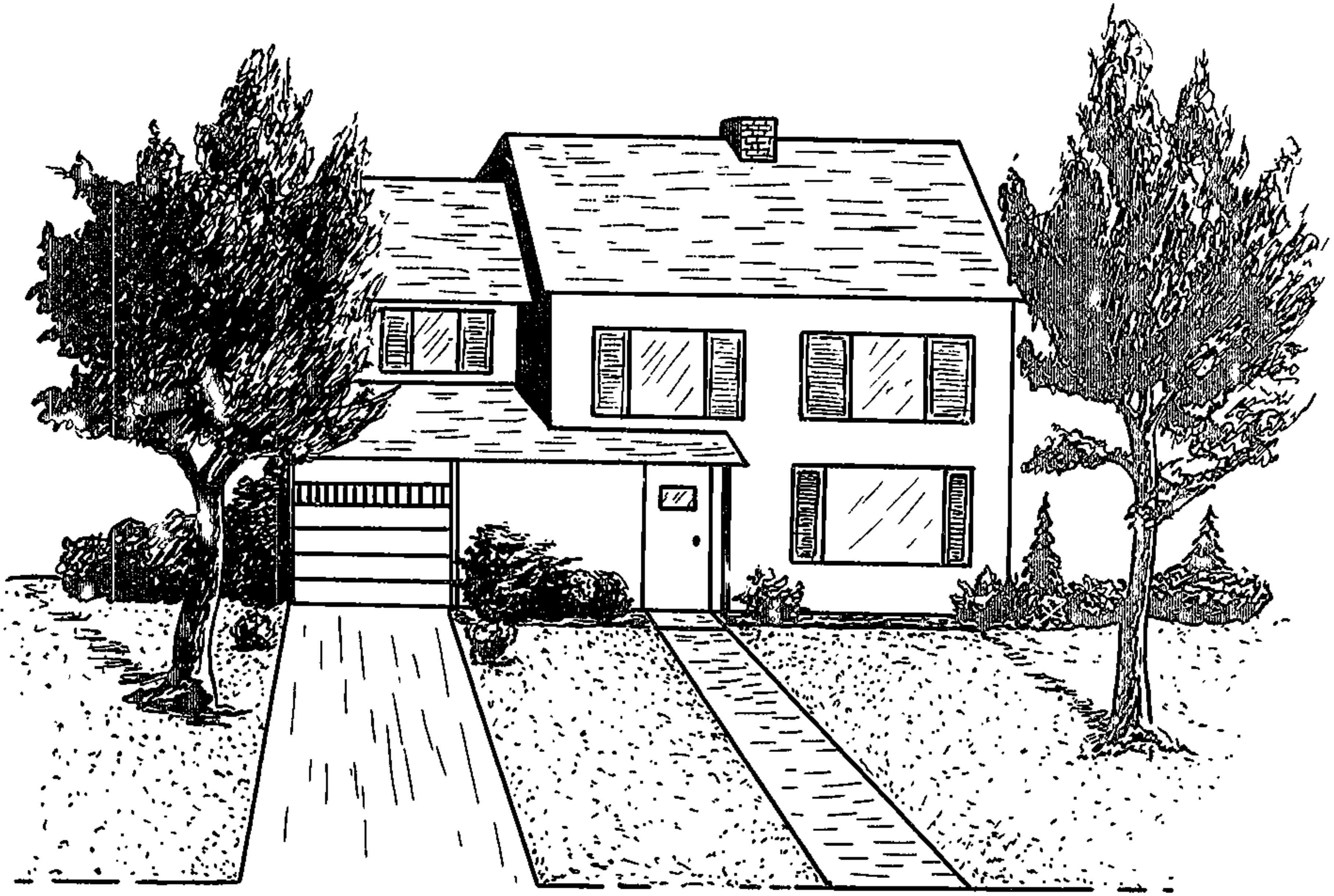
FRAME THE HOUSE WITH TREES



MAINTAIN AN OPEN SPACE

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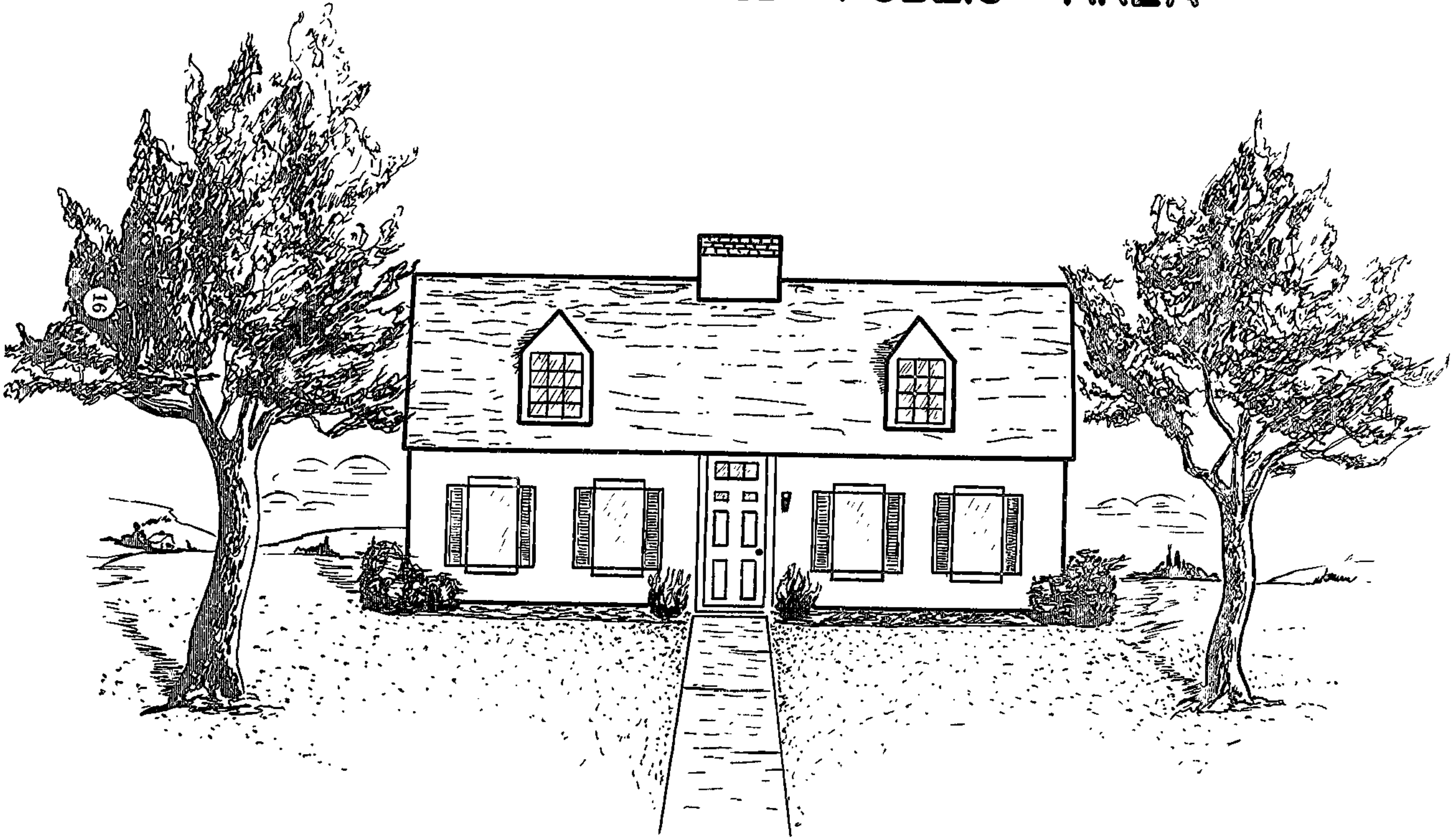
A WELL PLANNED PUBLIC AREA



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PLANNING THE PRIVATE AREA

1. ANALYZE YOUR FAMILY'S NEEDS
2. LOCATE IMPORTANT STRUCTURES
3. CONSIDER CONVENIENCE
4. PLAN FOR SHADE WHERE AND WHEN NEEDED
5. CONSIDER STYLE – FORMAL OR INFORMAL

CUT HERE

PLANNING THE SERVICE AREA

I. SIZE NEEDED:
   - A. VEGETABLE GARDEN
   - B. CUT FLOWER GARDEN
   - C. TOOL SHED
   - D. GARBAGE CANS
   - E. COMPOST PILE
   - F. CLOTHES DRYING

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PLANNING THE SERVICE AREA (cont.)

2. LOCATION
   - A. CONVENIENCE
   - B. RELATIONSHIP TO HOUSE
   - C. SIZE REQUIRED

3. ARRANGEMENT
   - A. EASE OF USE
   - B. SEPARATION FROM OTHER AREAS

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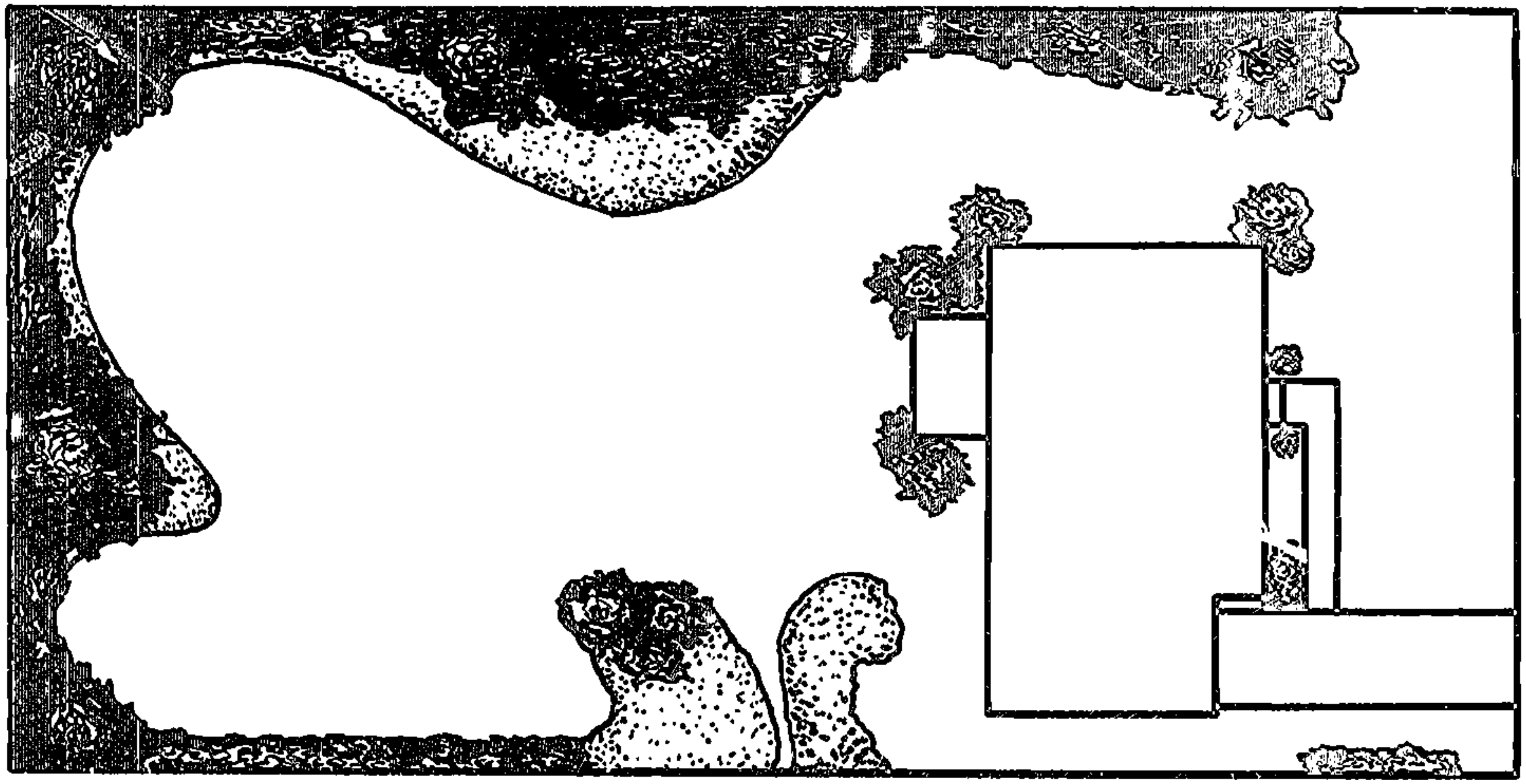
INFORMAL GARDEN



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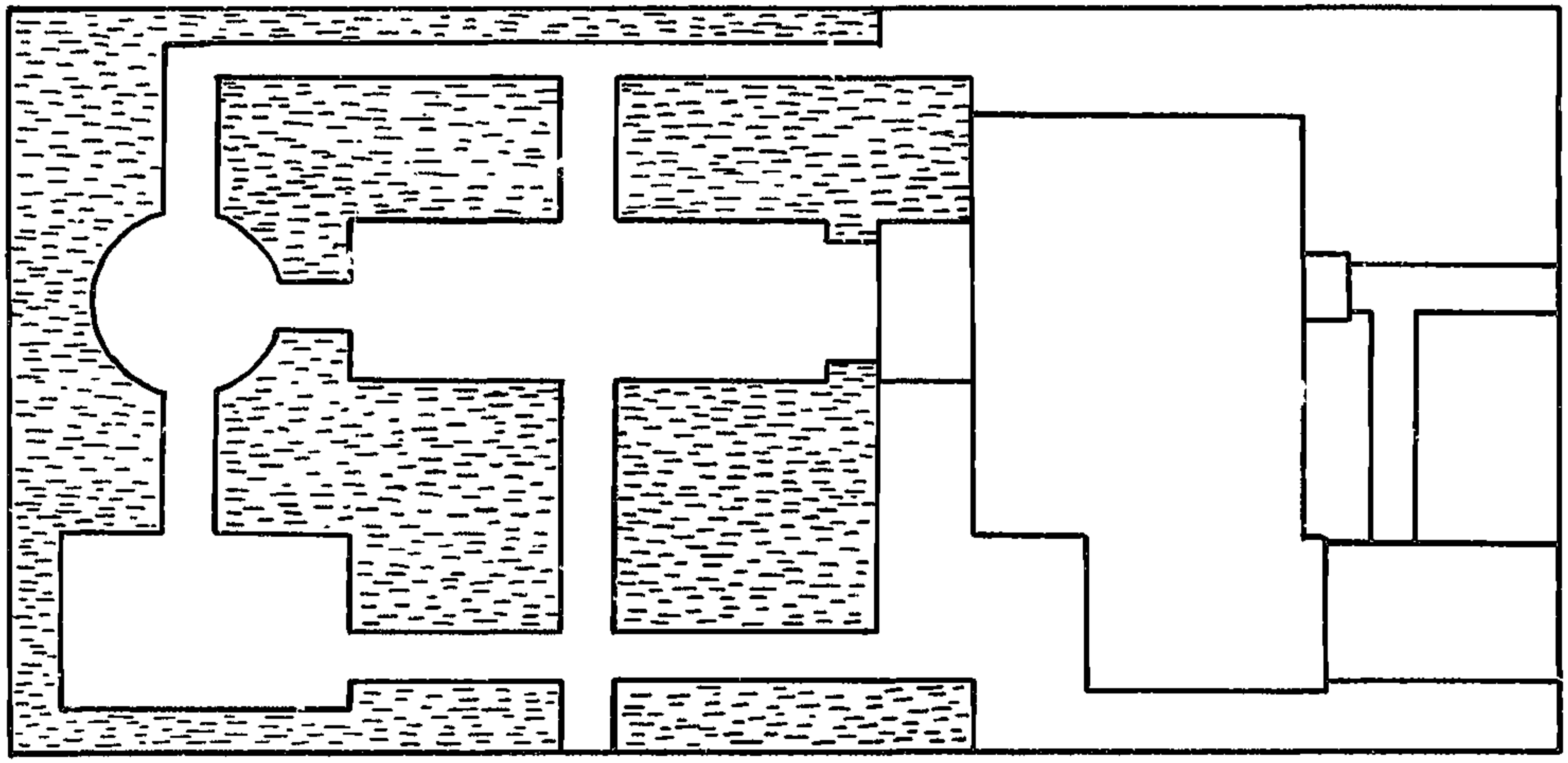
FORMAL GARDEN



PART II

INFORMATION AND DIRECTIONS NECESSARY TO MAKE SOIL MONOLITHS

INFORMATION AND DIRECTIONS NECESSARY TO MAKE SOIL PROFILES

When teachers of agriculture observe soil monoliths on display at fairs and agricultural meetings, they often wish for one or more in their own classroom. Few teachers of agriculture make maximum use of soil monoliths for instructional purposes because they do not have them and they are not readily available.

This section of the booklet is written to encourage teachers and students to make their own soil monoliths. Be advised, however, that while soil monoliths are relatively inexpensive, they do require considerable time to make.

The collection and preservation of soil profiles begins with an interesting field trip and often culminates in an excellent laboratory or science fair project for several of the students. Close supervision by the teacher is necessary to insure success.

The finished profile, stable in a vertical position, adds to the classroom decor when displayed on the wall. In class the soil monolith can be used to teach soil type, structure, horizons, and characteristics relative to the living phase of the profile. It is a useful instructional aid when teaching land judging, doing a television program, or preparing a student demonstration.

Mounted soil profiles are invaluable instructional aids for teaching. The idea is to make them now, use them when the occasions arise, and hang them on the classroom wall until they are needed again.

Materials Needed:

Tools and materials needed to prepare soil monoliths include shovels, flat spade, mattocks, knives, scissors, measuring tape, cloth, string, and several squeeze bottles with solutions premixed. Two one-inch boards, one 6" and the other 8" wide, will be needed to support the profile. The length of the boards, approximately 48", will depend upon the depth of the soil from which the profile is taken.

Solutions Needed:

Solution No. 1 is a diluted solution of cellulose acetate in acetone. It is made by dissolving 140 grams of cellulose acetate in acetone to make one gallon of solution.

Solution No. 2 is a concentrated solution of cellulose acetate in acetone. It is made by dissolving 450 grams of cellulose acetate in acetone to make one gallon of solution.

Solution No. 3 is a mixture of vinylite resin, acetone, and methyl isobutyl ketone. It is made by dissolving 240 grams of the vinylite resin into a 2:1 mixture of acetone and methyl isobutyl ketone to make one gallon of solution.

The solutions are made by preparing a slurry first and then adding additional solvent to the slurry. Prepared solutions can be stored for several days before they are used. Since they solidify when exposed to air, it is important that solutions be kept in closed containers.

Solutions should be applied to soil monoliths with plastic squeeze bottles rather than a spray gun. The gun often becomes clogged and is difficult to clean. Place solution No. 1 in a plastic bottle overnight to test the reaction of the solution on the plastic. THE ACETONE MAY DISSOLVE THE BOTTLE.

Sources of Solution Materials:

Acetone and methyl isobutyl ketone can be purchased at almost any chemical supply house. A source for each of the other two materials is as follows:

Vinylite NYHH resin
Bakelite Corporation
230 North Michigan Avenue
Chicago 1, Illinois

Cellulose acetate
Hercules Powder Company
Cellulose Products Department
Parlin, New Jersey

Site and Soil Conditions:

Factors to consider when selecting a site for preparing a soil profile are as follows:

1. Make sure that all of the horizons are intact if an exposed profile is found at an excavation.

2. Avoid taking profiles in wooded areas because tree roots will interfere with obtaining a good monolith.

3. Do not take a sample from extremely stony or sandy soil if inexperienced at the task. Profiles are difficult to obtain from stony or sandy soils.

4. Make sure the soil is moist before taking the profile sample. If drought persists, soak the site thoroughly with water several days before exposing the profile.

5. Dig the pit large enough and deep enough to expose the full profile. The pit should be at least 3' wide and 5' long. When the pit is dug the strenuous work is done and the more tedious work begins. Slope one of the 3' sides of the pit approximately 5 degrees and plane the surface as smooth as possible. The smoothed surface should be 18" to 24" wide. The center 6" of the smoothed side should be used for the soil profile sample.

Removing the Sample:

Lay the 6" board in the center of the smoothed surface of the prepared pit. Use a knife to mark the soil around the edge of the board. Remove the board and treat the marked area with approximately 1 quart of solution No. 1. Permit the treated area to dry 10 to 15 minutes (longer for heavier soils and cooler days) and treat it the second time with about 1 1/2 quarts of solution No. 2.

Approximately 30 minutes after solution No. 2 has been applied, place the 6" board firmly against the treated area. Trench out the soil 6" to 8" wide and 3" to 5" deep on each side of the board. Next, cut behind the entire length of the soil profile from one of the side trenches. Start from the other trench to cut holes through to the first trench at 6" intervals. Tie the profile securely to the board at each hole. Finally remove the remainder of the soil that is holding the profile to the pit, and carefully lift the profile from the excavation.

Finishing the Monolith:

Carefully transport the soil profile in a horizontal position to the school shop so that the remainder of the work can be done indoors. Place the board which is supporting the profile on a laboratory table in a well-lighted part of the shop.

Apply Solution No. 2 liberally in strips to the 8" board and place it alongside the 6" board which is supporting the profile. Gently transfer, by sliding, the soil profile from the 6" board to the 8" board. Center the profile on the board, allowing space at the top of the board for the soil type name. Now gently press the profile to the 8" board, remove the excess solution, and allow to dry for 24 hours.

After the profile is firmly cemented to the 8" board, it should be trimmed to the desired thickness (1" to 1 1/2"). Natural structure of the soil can be 'brought out' only with considerable patience and time. An ice pick is useful in 'bringing out' the soil structure. Blow the loose soil particles from the profile with air. Brushing will damage soil structure at this point.

When completely satisfied that the soil profile is 'worked down' properly, saturate it with solution No. 3. Apply the solution from a squeeze bottle, allow it to soak in, and apply more solution. Do not apply this solution with a brush because it will result in a smearing of the surface and destroy the aggregate structure of the soil.

Adequate ventilation is needed at all times when using solutions indoors. Inhalation of fumes from the solutions may cause illness and headaches. Open flames and smoking should not be permitted because of the combustible nature of the solutions.

When solution No. 3 is fixed (2 to 3 days) the soil monolith can be framed with 3/4" x 3/4" quarter round moulding glued to the board. The board and moulding should be then sanded and finished with clear sander sealer, gloss lacquer, and varnish. Soil type, horizons, and other pertinent information should be painted neatly in black at the appropriate places on the board and moulding.

Additional free information can be gotten by writing the senior authors for the following publications:

Berger, K. C., and R. J. Muckenhirn. Soil Profiles of Natural Appearance Mounted with Vinylite Resin. Soil Science Society Proceedings 10, 1945. pp 368-370.

Write to University of Wisconsin, Madison.

Smith, H. W., and C. D. Moodie. Collection and Preservation of Soil Samples. Soil Science. 1947, 64:61-69.

Write to Washington Agricultural Experiment Station, Pullman.

PART III

A SUGGESTED FORM AND SOME PERTINENT INFORMATION FOR TEACHING IDENTIFICATION AND VALUE OF 54 COMMON LANDSCAPE PLANTS

A SUGGESTED FORM AND SOME PERTINENT INFORMATION FOR TEACHING IDENTIFICATION AND VALUE OF 54 COMMON LANDSCAPE PLANTS

New Jersey teachers of agriculture have identified what they believe to be the more common landscape plants used in the State. Each of the plants was classified as follows: (a) tree, (b) shrub, (c) small tree, or (d) vine. The plants were also appraised qualitatively for ornamental value. Foliage, flowers, fruit, and other ornamental considerations such as bark, growth habit and rate, texture, and fall coloration were measures of landscape value and also aids to identifying the plants. The list of common landscape plants with identifying characteristics outlined will aid teachers in preparing students for state FFA ornamental horticulture contests.

On the next page is a sample form which can be duplicated and used as an instructional aid. Completed forms, when done by students and kept in their notebooks, aid them in learning to identify landscape plants.

Several pages following the sample form provide the data for partially completing 54 of the school-duplicated forms. The teacher may wish to give the students additional information and encourage them to sketch the plants in the appropriate place on the forms.

Have the students attach several mimeographed forms to their clipboards before the class tours the school grounds, visits the arboretum, or makes a field trip to the local nursery. Use fresh plant samples, colored slides, and plastic nursery labels in class to augment the learning.

IDENTIFICATION AND VALUE OF LANDSCAPE PLANTS

Family ______________________________

Common Name(s) ______________ Specific Name ______________

Identifying Characteristics:

Sketches of Characteristics:

Leaves
Type ______________
Arrangement ______________
Margins ______________
Size, Shape ______________
Other Features ______________
____

Twig
Buds ______________
Leaf Scars ______________
Color ______________
Other Features ______________

Flower
Color ______________
Size ______________
Arrangement ______________
Effective ______________
Other Features ______________
____

Notes on Ornamental Value:

Fruit
Type ______________
Color ______________
Size ______________
Effective ______________
Other Features ______________
____

Bark
Configuration ______________
Color ______________
Other Features ______________
____

Size and Shape
Mature Height ______________
Characteristic Shape ______________
____

ACERACEAE:

1. Norway Maple (Acer platanoides) has leaves which are simple and opposite, and give a bright yellow autumn coloration. A milky sap is present when the petiole is broken. The flowers are small, yellow in color, and appear in late April. The bark, which is black to dark brown, has tight vertical and horizontal ridges. The tree reaches a mature height of 90 feet and is wide spreading. It is not recommended for a street or lawn tree because of a shallow root system.

2. Red Maple (Acer rubrum) has simple and opposite leaves. They are 3 to 4 inches long and wide, with petioles often red in color. The autumn color is a bright red. Young twigs are green but turn red as they mature. Flowers are tinted yellow to bright red, appearing early in the spring before the leaves appear. The 1 inch long, reddish, winged seeds are the fruit of this species. The tree will mature to 120 feet in height, with an upright, spreading shape. Red Maple has a silver gray scalelike bark.

3. Sugar Maple (Acer saccharum) has a simple and opposite leaf, which has autumn colors of scarlet, yellow and orange. This species is a desirable street tree because of its high, spreading branching characteristics. It will reach an average height of 120 feet. The bark is silver-gray in color and has a long and irregular strip configuration. The tree doesn't exfoliate.

APACYNACEAE:

4. Myrtle (Vinca minor) This evergreen has a simple and opposite leaf arrangement, which has a lustrous dark green color. The lilac blue flowers (1/2 - 3/4 inch) are present in late April and add to the species' ornamental value. This vine, which is about 6 inches high, produces excellent ground cover.

AQUIFOLIACEAE:

5. Japanese Holly (Ilex crenata) is an evergreen with a simple, alternate leaf arrangement. The upper surface is dark green and glossy, with the underside of a lighter green color. The black berry-like fruit is 1/4 inch in diameter. It ripens in the fall and lasts the entire winter. This 20 foot high, dense upright shrub makes it desirable for a hedge. It is also of ornamental value for use as a foliage specimen plant.

6. American Holly (Ilex opaca) This evergreen, like the Japanese Holly, has simple, alternate leaves. The leaves, however, have a spiny margin. The top of the leaf is green, with a yellow-green underside. The flowers are not showy and there are male and female plants. The berry-like fruit of a dull red color along with the glossy leaves, makes it of ornamental value. The berries, which are born singly or in small clusters, ripen in the fall and are present until early winter. The smooth light gray bark is characteristic of this pyramidal shaped tree which reaches a height of 45 feet.

7. Convex Leaf Holly (Ilex crenata 'convexa') is an evergreen with a simple leaf in an alternate arrangement. The cup shaped leaves are 1/2 to 1 1/2 inches long. The black berry-type fruit ripens in the fall. The 3 to 4 foot, compact, rounded shrub makes an excellent hedge. The lustrous dark green foliage and the numerous fruits add to its ornamental value.

ARALIACEAE:

8. English Ivy (Hedera helix) has simple leaves that are 4 inches long and have three to five lobes. This evergreen has black berries which ripen in the fall. The clinging vine will reach a height of 90 feet. It is of value for a ground cover and for its foliage.

BERBERIDACEAE:

9. Japanese Barberry (Berberis thunbergi) has simple, alternate leaves which are borne in fascicled spurs. The buds are small and the twigs are reddish to purple in color. Another feature of the twigs is that spines arise at the base of the leaf axils, one at a node. The yellow flower appears in mid May. The red berry fruit ripens in winter and sometimes remains on the shrub for the entire winter. The globe-shaped shrub reaches a height of 7 feet at maturity. In addition to the fruit, the foliage produces a scarlet autumn color.

BETULACEAE:

10. Gray Birch (Betula populifolia) has simple, alternate leaves and a catkin arrangement of the flowers. The smooth gray-white bark has black triangular markings. This small tree reaches a height of 30 feet, usually with several trunks growing in a clump. The ornamental values of the gray birch include the yellow autumn coloration, bark, and its ability to do well in both poor and good soils. It is a rapid growing tree, but has a short life.

BUXACEAE:

11. Boxwood (Buxus sempervirens) is an evergreen with a simple leaf with opposite arrangement. The leaf is glossy green with a yellow-green lower surface. The twigs tend to be green in color and the older twigs become somewhat angular. This slow growing shrub will reach a height of 20 feet. Its foliage makes it of value for a specimen plant or hedge.

CORNACEAE:

12. The leaves of the Flowering Dogwood (Cornus florida) have sharp pointed leaf tips with arched veins. The dense lustrous foliage is comprised of simple leaves on an opposite arrangement. They produce a scarlet fall color. The twigs are green in color when young. The flowers which are small and yellow are surrounded by large showy, white bracts and appear in April to mid-May. The fruit of the dogwood is a bright red drupe, which remains on the tree for most of the winter. The dark brown bark is rough and in broken plates. This small tree may reach a height of 40 feet.

CUPRESSACEAE:

13. Pfitzer Juniper (Juniperus chinensis 'pfitzeriana') This shrub has two types of foliage. The first is the needle-like foliage on the juvenile growth and the second is the scale-like foliage on the adult growth. The fruit is a blue berry which matures in the fall. This spreading, somewhat upright shrub reaches a height of 5 feet. The long, spreading almost horizontal branches and the foliage give the shrub ornamental value.

14. Arborvitae (Thuja occidentalis) is an evergreen with scale-like foliage. The back of the leaf contains a gland. Facial scales have a larger gland. A 1/2-inch long brownish-yellow cone is the fruit of this species. The bark of this tree is reddish brown. A mature tree will stand 60 feet high.

CAPRIFOLIACEAE:

15. Glossy Abelia (Abelia grandiflora) is a half evergreen with an opposite to whorled arrangement of simple leaves. Leaves have a dark green upper surface, a bearded appearance at the base of the midrib, and produce a bronze to purple autumn coloration. The flowers of this shrub are pink in color and persist throughout August. This dense, wide spreading shrub reaches a height of 5 feet and is useful as a hedge.

16. Double File Viburnum(Viburnum plicatum 'tomentosum') The foliage of this species is simple with an opposite arrangement. The underside of the leaf has a dense stellate pubescence with some on the midrib of the upper surface. The buds are scale-like and the twigs also have the stallate pubescence. White flowers appear in late May to early June. The red to blue-black showy drupe is also characteristic of this species. The shrub reaches 9 feet in height, and the horizontal, wide spreading branches are apparent in winter.

ERICACEAE:

17. Kalmia latifolia is the scientific name for the Mountain Laurel. The simple leaves of this evergreen are arranged in an alternate pattern. The [illegible] inch long leaves have a glossy, thick texture, with a yellow-green lower surface. The white to rose-colored flowers bloom in mid June. This globe-shaped shrub will reach a height of 30 feet. It may be used as a foundation planting in a naturalized landscape. It requires an acid soil and is susceptible to leaf spot.

18. Japanese andromeda(Pieris japonica) is similar to the Mountain Laurel in its leaf arrangement. These simple leaves have a glossy surface which adds to its ornamental value. The white flower blooms in mid-April and is long lasting. This upright spreading shrub will reach a height of 9 feet and grows better in the shaded conditions. It also does well in a variety of soils.

19. Catawba Rhododendron (Rhododendron catawbiense) is a simple leaf evergreen with an alternate arrangement. The leaves are thick with a shiny upper surface and a yellow-green lower surface. The buds are green the entire year and the branches are whorled. The 2 1/4 inch flower is a red lilac color which blooms in early June. Olive green spots in the upper most petals are also characteristic of the flower. A capsule fruit does little to add to the ornamental value. This shrub which reaches a height of 6 to 18 feet is wide spreading but not very dense. The species survives on low pH soils and is tolerant to shade.

20. Kurume Azalea (Rhododendron obtusum) has simple and alternately arranged foliage which produces a reddish fall color. The orange-red to bright red flowers bloom in mid May. This shrub will reach a height of 3 feet. It is of interest for its many valuable ornamental varieties.

FAGACEAE:

21. European Beech (Fagus sylvatica) has simple leaves arranged in an alternate pattern. These glossy, dark green leaves have 5 to 9 veins each. The buds are long with a gradual taper. The fruit of this species is a nut. The bark of the 90 foot tree is smooth and blue-gray in color. The European Beech is a good shade tree and has an autumn coloration of bronze. There are also several forms of this species available for ornamental use including the weeping, variegated leaf, and purple leaf forms.

22. Pin Oak (Quercus palustris) has a simple leaf in an alternate arrangement. The chestnut-brown twigs contains long, narrow, sharp pointed buds. The Pin Oak produces the smallest acorn of the oaks. The t[illegible] will reach a mature height of 75 feet and is pyramidal in shape with dro[illegible] branches. The ornamental values of this species are the fine texture of the foliage, growth rate, and the autumn coloration of brown to scarlet.

23. Fastigiate English Oak (Quercus robur 'fastigiata') has a simple leaf and an alternate leaf arrangement. The base of the leaf is heart shaped and the petiole is short. The large acorn fruit is borne on long stalks and has a small cup. The bark is dark gray to black and block-like in configuration. This narrow upright tree reaches a height of 75 feet. It may be used as an accent tree.

24. Red Oak (Quercus rubra) has bristles at the tips of the lobed, ten-inch simple leaf. The leaf arrangement is alternate. In winter the twigs have a red-brown color and contain the largest buds of the oaks. The large acorn has a shallow, flat cup. Red oak has dark brown to black colored bark. This 75 foot tree, which is wide spreading has a rounded top. The ornamental values of this species includes its use for shade and street plantings, and its autumn coloration of red to bronze.

GINKOACEAE:

25. Maidenhair Tree (Ginkgo biloba) The thick leaves of this species are simple with an alternate arrangement. Three to five leaves grow on short spurs. Reddish brown to orange colored twigs contain the blunt buds. Male and female plants are characteristic of this species. The female is undesirable because of the pungent odor of its fruit. The 1 - 1 1/2 inch yellow-brown fruit resembles a drupe. The tree will reach a height of 120 feet with wide spreading but irregular branching. It is resistant to insects and disease, and it makes a specimen tree for large lawns. The autumn color is bright yellow.

HAMAMELIDACEAE:

26. Hamamelis virginiana commonly known as Witch Hazel has a simple leaf with a smooth under surface. The leaf arrangement is alternate. The bright yellow flowers with ribbon-like petals form in clusters and appear in late Autumn to early Winter. This 15 foot shrub contains a capsule fruit. It is tolerant to acid soils and partial shade. The shrub is showy when the leaves have dropped.

27. The star-shaped leaves with a heart-shaped base are characteristic of the Sweet Gum (Liquidambar styraciflua). These simple leaves are alternately arranged. The fruit is a multiple of capsules in a globe-shaped head. They mature in fall and last into early winter. The 125 foot pyramidal-shaped tree has a deeply furrowed bark. The glossy foliage has an autumn coloration of orange to red. Sweet Gum can be planted in wet or moderately dry soils.

LEGUMINOSAE:

28. Silk Tree Mimosa (Albizzia julibrissin) has a compound, doubly pinnate leaf. These alternately arranged leaves contain small sickle-shaped leaflets, appearing feathery. The bright rose pink flowers are 1 to 1 1/4 inches across. The "Balls of Pinkish Thread" flowers appear in mid July to September. The brownish pod fruit is flat and about 6 inches long. These persist through most of the winter. The 36 foot tree is broad spreading with a flat top. The bark is smooth and brown in color. Its ornamental values are its foliage, flower and suitability for landscaping ranch-type houses.

29. Thornless Honey Locust (Gleditsia triacanthos 'inermis') has a compound leaf which is alternately arranged. The leaf is fine-textured and ranges from 7 to 12 inches long. This broad and open tree grows to a height of 125 feet and is lacking in flowers and fruit. It is a good shade tree and is easily transplanted.

30. The three-foliated, compound leaf is characteristic of the Golden Chain (Laburnum anagyroides). These alternately arranged leaves have a gray-green upper surface, with a silky pubescence underside. The yellow flowers develop in late May to early June hanging from the green twigs. A 2 inch long pod will develop. This small weeping tree (25 feet high) has a smooth bark.

31. The Chinese Scholar Tree (Sophora japonica) has dark green compound leaves, which are alternately arranged. The fragrant white or yellow flowers bloom in August and develop into green pod fruits. The 75 foot tree is vase shaped, rounded, and wide branching. It is a good shade tree and one of the larger trees to bloom in the fall.

MAGNOLIACEAE:

32. Saucer Magnolia (Magnolia soulangeana) produces simple leaves which range from 6 to 18 inches long. These leaves develop alternately on densely pubescent twigs. The flowers are white with a purple base and are 5 to 10 inches across. They are borne terminally in mid April to early May before the leaves appear. The smooth bark is characteristic of this 25 foot tree.

OLEACEAE:

33. Forsythia is both the common and genius name of this ornamental shrub. Simple leaves develop with an opposite arrangement on the yellow-brown twigs. A yellow flower appears in April. Depending on the species, the height will vary from 2 to 9 feet.

34. Common Privet (Ligustrum vulgave) has a 1 to 2 inch oblong simple leaf. These are opposite and have pubescents on the under surface. The twigs also have pubescents in the juvenile stage. The fragrant white flowers appear in mid-June and develop into black berries by September or October. This 15 foot shrub is of value for formal hedges.

35. Common Lilac (Syringa vulgaris) has a simple leaf which is borne oppositely on the twigs with a waxy, glossy upper surface. The twig also bears a twin terminal bud. The lavender or white fragrant flowers appear in late May on this 20 foot upright shrub.

PINACEAE:

36. White Fir is an evergreen with needle-like leaves. The 1 to 2 inch needles are blue-green in color, longest of the firs, and have a spiral arrangement. The 120 foot conical tree has a smooth gray bark. The fruit of the (Abies concolor) is a 4 inch cone which is purple to brown when it breaks apart.

37. European Larch (Larix decidua) has a deciduous needle which clusters with the bud at the tip of the spurs. Thirteen or more leaves form each cluster. A 2 inch long cone will persist on this 100 foot tree for several years. The leaves have a yellow autumn coloration.

38. The deep green and glossy needle lacking a petiole is characteristic of the Norway Spruce. The needles, rarely flat, are four-sided in cross section. The twigs tend to droop on this 150 foot pyramidal tree. The (Picea abies) cone is the longest of the family (4 to 6 inches). The species is often used as Christmas trees.

39. Austrian Pine (Pinus nigra) has two needles in a bundle which are 3 1/2 to 6 inches long. They are stiff but not brittle. Resinous buds form on the gray-brown to black twigs. The cone is about 3 1/2 inches long on this species. The dense pyramidal shaped tree (90 feet high) makes it desirable for screening or windbreak plantings.

40. (Pinus strobus) has a 2 1/2 to 5 1/2 inch long, soft, flexible needle. These green-white needles are arranged five in a bundle. The cone of the White Pine is 5 inches long and the bark remains smooth for a number of years. This 100 to 150 foot tree has a broad pyramidal to flat-topped shape, which makes it suitable for background foliage and landscape planting.

41. Douglas Fir (Pseudotsuga taxifolia) is also a needle-leafed evergreen. Sharp pointed buds form on the brown twigs. The cone persists throughout the fall and winter. Irregular gray appearance of the bark is characteristic of this 300 foot, broad, conical tree. The persistence of the leaves make it an exceptionally good Christmas tree.

42. Canada Hemlock (Tsuga canadensis) has needles which are flat and tapered from the base to the apex. They are 1/2 to 3/4 inches in length. Twigs are pubescent when young. This 90 foot pyramidal tree produces small cones and the bark is deeply furrowed. The branches have a tendency to weep.

PLATANACEAE:

43. London Plane Tree (Platanus acerifolia) has simple leaves, which are alternately arranged. The leaf is 5 to 10 inches wide, oval or maple shaped. The petioles hide the buds. The fruit is a multiple of nutlets (achenes) which persist throughout the fall and winter. They are borne in two's and three's. The bark is smooth, but exfoliating, and is gray to white, with a greenish underbark. The pyramidal tree when mature is upright and spreading. It will reach 100 feet in height. It is a rapid growing tree and is suitable for street planting, shore areas, and cities.

ROSACEAE:

44. Chokeberry (Aronia arbutifolia) has simple leaves arranged alternately. The 2 inch eliptic - oblong leaf has small black glands along the midrib on the upper surface, tomentose on the underside. The buds are red in winter and the twigs have a light tomentose condition. The white flower with some red on its petals, blooms late in May. The fruit, a pome, is bright red and is predominant in fall and winter. The 9 foot shrub has a red autumn coloration.

45. Cotoneaster or Creeping Cotoneaster has simple leaves with the alternate arrangement. They are 1/2 inch long, with a glossy upper surface and pubescence on the under surface. Twigs are greenish with pubescence and the branching habit is regular. The (Cotoneaster horizontalis) has small pink flowers which form clusters and appear in mid June. The red pome fruit persists sometimes all winter. The 3 foot shrub is low spreading making it suitable for ground cover. It will also weep over low banks and stone walls.

46. (Malus floribunda), the Japanese Flowering Crabapple, has simple, elliptic leaves with the alternate arrangement. The fragrant flower is deep red in the bud stage, fading to pink and finally white as it blossoms. Flowering occurs in early May. This 30 foot tree is wide spreading with a flat top. It produces a red pome which is apparent from August to mid October.

47. Oriental Flowering Cherry (Prunus serrulata 'kwanzan') has a 4 inch long simple leaf. There are 2 to 4 glands present on the petiole. The 2 1/2 inch double pink flowers tend to form clusters of 3 to 4 flowers which bloom in early May. A black drupe is the fruit of this species. The tree reaches a height of 12 to 18 feet with a characteristic vase shape.

48. The semi-evergreen Laland Firethorn (Pyracantha coccina 'lalandi') has 1 1/2 inch leaves in the alternate arrangement. The twigs are small with pubescents and usually thorny. Small white flowers appear in mid June. The orange-red pome fruit is predominate during the fall and winter. The 6 foot sprawling shrub may be used for wall and foundation plantings.

SALICACEAE:

49. (Salix babylonica), Weeping Willow, has a simple leaf on an alternate arrangement. The 3 to 6 inch leaf has a grayish green underside. The twigs are yellow or green, slender and weeping. The broad columnar tree has grayish brown bark and reaches a height of 90 feet. The branches tend to shed. Plantings near drains should be avoided.

SAXIFRAGACEAE:

50. Slender Deutzia (Deutzia gracilis) has an oppositely arranged simple leaf. This 1 1/4 to 3 inch leaf has stellate hairs on the upper surface. Small buds are present on the yellow to gray twigs. White flowers 3/4 to 1 inch are present in late May to early June. These flowers develop into small capsule fruits. This 3 to 6 foot shrub has a graceful weeping habit.

51. Mock Orange (Philadelphus lemoinei) has a 3/4 to 2 inch long simple leaf, with an opposite arrangement. Chestnut or red-brown twigs are also common. The fragrant white flowers appear in mid June. These are single and double flowers. The 4 to 6 foot shrub is upright and spreading.

TAXACEAE:

52. Yew is a needle-like evergreen with a spiral arrangement. The leaf shape is linear. The buds and the height are variable on small trees and shrubs of the (Taxus species).

TILIACEAE:

53. Little Leaf Linden (Tilia cordata) has a simple leaf 1 1/2 to 3 inches long. Leaves have a heart-shaped base and are arranged alternately. The buds are lopsided and the twigs are green turning to red. The yellow to white flowers appear in July and later produce a nutlet fruit. The narrow pyramidal tree reaches a height of 90 feet and is suitable for street plantings in urban areas.

54. Silver Linden (Tilia tomentosa) has an alternately arranged simple leaf 2 to 4 inches long. Leaves are silvery with white tomentose present on the lower surface. The buds are lopsided with pubescents on the younger twigs. The small yellowish blossoms produce nutlets which have a tomentose covering. The compact and dense tree reaches a height of 90 feet. It has a broad pyramidal shape.

PART VI

PLANS FOR CONSTRUCTING AN ELECTRIC PANEL QUIZ BOARD

QUESTIONS AND ANSWERS ABOUT VOCATIONAL AGRICULTURE AND FFA HELPFUL IN DEVELOPING A RECRUITMENT BROCHURE

Teachers of agriculture are constantly aware of the fact that they must continually inform the public about their programs. One of a number of ways to promote vocational agriculture and the FFA is to prepare and distribute an attractive brochure which describes a practical and sound educational program.

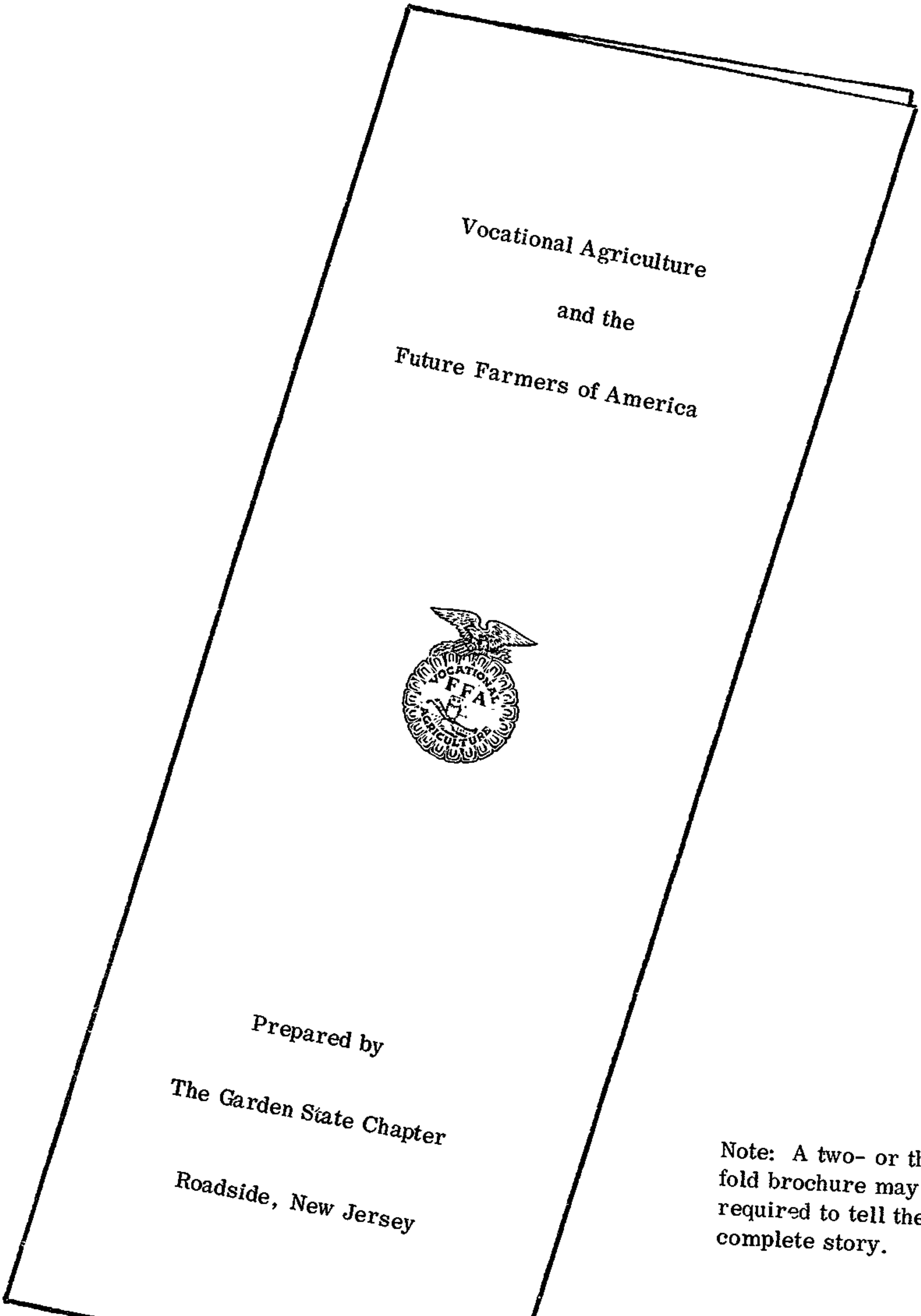
The questions and answers which follow were written to include in a brochure directed at potential vocational agriculture students and their parents. The brochure gives the future student and his parents tangible information to assess and evaluate the program.

The questions and answers were written to include both off-farm agricultural occupations and production agriculture. They are suggested as a guide for the teacher to prepare a brochure which will meet the needs of his own department.

To add appeal and interest, the brochure should contain pictures of successful students and outstanding graduates of the program engaged in agricultural pursuits. A total of four pictures appropriately placed in the brochure will tell the story. Suggested settings for the pictures are as follows:

1. In classroom or laboratory such as greenhouse
2. About supervised agricultural experience programs
3. In the agricultural mechanics shop
4. About a current or recent chapter FFA activity
5. The land laboratory, demonstration plot or school nursery.

Brochures are easy to distribute after they are prepared. They may be mailed, given as part of a packet during a recruitment visitation, or distributed at open house or other school, chapter and community functions.



Vocational Agriculture

and the

Future Farmers of America

Prepared by

The Garden State Chapter

Roadside, New Jersey

Note: A two- or three-fold brochure may be required to tell the complete story.

Questions and Answers About Vocational Agriculture and FFA

1. What is Vocational Education?

   Vocational education is preparation for employment in a useful occupation. It is practical instruction for a specific type of work usually offered as a part of the public school program.

2. What is Vocational Agriculture?

   It is an educational program in agricultural occupations conducted by public schools. It serves three general groups of people: high school students, out-of-school youths, and adults. It endeavors to help people solve their problems in agri-business, ornamental horticulture, conservation, agricultural mechanics, and all phases of local production agriculture.

3. What is Included in the High School Vocational Agriculture Program?

   The program includes scientific business, and agricultural mechanics instruction. Practical supervised agricultural experience and leadership training through the Future Farmers of America are integral parts of the program.

4. What is Included in Agricultural Mechanics?

   A portion of the student's in-school time is devoted to education in shop skills, power and equipment, structures, rural electrification and conservation practices. Mechanical skills and better judgment by students result from the training.

5. May I take Vocational Agriculture and Meet College Entrance Requirements?

   Yes. For students planning to enroll in college, there should be no difficulty in meeting requirements for college entrance. Students can complete vocational agriculture and the college required courses at the same time. Vocational education is not separate, but rather a part of general education. It should make your academic education more meaningful through practical application. Consult the school guidance counselor about your academic capabilities.

6. Can a Student Who Lives in Town Enroll in Vocational Agriculture?

   Yes. If he is interested in a future in agriculture, arrangements can be made to provide him with an adequate supervised agricultural experience program and guidance into the field of his selection.

7. Are Girls Permitted to Take Vocational Agriculture?

Sure. Many girls are interested in a future in agriculture. Girls are required to meet the requirements of the program. They are eligible to participate in FFA activities. Some agricultural opportunities are particularly adaptable to women.

8. What is a Supervised Agricultural Program?

It is a planned program of approved experiences in agricultural occupations. Each individual student plans his own program with the help of the teacher according to his needs and interests. Supervised programs may be in any of the following areas: production agriculture, cooperative occupational experience, farm and home improvement, and placement in the home farm business. Complete and accurate records on these programs are required annually.

The vocational agriculture instructor visits each student at his home, farm, or place of employment. The visit provides for individual instruction and guidance. By knowing the student, his parents, and his working environment, the teacher can adapt instruction to the needs, interests, and progress of the individual.

9. Why is a Supervised Agricultural Experience Program Needed?

It provides practical application to test those facts and concepts learned in the classroom. It is the "learning to do" part of the program.

10. Are Field Trips and Tours Included?

Yes. They create interest and are generally made to farms and agricultural businesses in the community. Educational tours are sometimes made to more distant points to study new developments in agriculture, and to attend state and National FFA leadership conferences and conventions.

11. What Opportunities are Open to Vocational Agriculture Graduates?

a. Continued education in Young Farmer Programs offered at the local high school.
b. Establishment in the business of farming or enterprises servicing agriculture.
c. Placement in an agricultural occupation other than farming--for example, government service.
d. Advancement to coursework in higher education and professional status.

12. What is the Future Farmers of America?

The Future Farmers of America is the largest agricultural youth organization in the world. Its 500,000 members are students who are enrolled in vocational agriculture in public schools. It is a non-sectarian, non-secret, and non-political organization designed to help the student develop his abilities as a member of an organized group. It develops leadership, initiative, integrity, responsibility, and cooperation. There are local chapters, state associations, and a National Organization.

13. What are Some of the Activities of the FFA?

There are chapter, regional, state, and National contests. These include public speaking, home and farm safety, agricultural mechanics, rural electrification, horticulture, crops, soil judging, conservation, livestock and others. Awards are provided by the Future Farmers of America Foundation, agricultural organizations, and individual doners. Members of the FFA may exhibit crops and livestock and in other ways participate in agricultural fairs and shows.

14. How May a Student Become a Member of the FFA?

Any vocational agriculture student may become a member by expressing a desire to join and by meeting the obligations set forth by the membership. Membership implies an obligation to attend chapter meetings and to participate in the activities of the chapter as a cooperative and responsible person.

YOUR LOCAL VOCATIONAL AGRICULTURE INSTRUCTOR AND SCHOOL ADMINISTRATORS WILL WELCOME THE OPPORTUNITY TO DISCUSS WITH YOU PERSONALLY THE LOCAL HIGH SCHOOL VOCATIONAL AGRICULTURE PROGRAM.

PART V

A DESCRIPTION FOR A SET OF 51 SLIDES USEFUL IN PROMOTING THE AGRICULTURE PROGRAM

A DESCRIPTION FOR A SET OF 51 SLIDES USEFUL IN PROMOTING THE AGRICULTURE PROGRAM

Fifty or a few more colored slides when carefully selected and placed in a logical sequence make an excellent fifteen to twenty minute program for promoting the agriculture program. A script of from two to four short, snappy sentences written about each slide adds to the effectiveness of the program. With a set of slides and an accompanying script, chapter officers are able to present an interesting program and answer questions following the presentation.

The set of slides with script may be used in the following situations:

1. Eighth grade introductory program
2. School assembly
3. FFA Week program
4. Agriculture I class
5. PTA, Grange, and other community organization meetings
6. Teachers' meetings
7. Service club meetings

Teachers and others cannot make an effective slide presentation unless they are intimately familiar with the slides they are using. For that reason it is suggested that slides for promoting a local agriculture program be about chapter activities, local department accomplishments, and outstanding students and graduates. The audience warms up quickly to familiar names and places.

The challenge here is not to create a general set of slides with script and have them reproduced for each chapter in the state, but rather to suggest descriptions for a set of slides which the teacher can take and discuss with authority and pride.

Suggestions for Slide Set

No. 1 - Title slide - The __________ High School Agriculture Program.

No. 2 - FFA slogan - such as: "Agriculture is more than farming."

No. 3) Facilities of the local agriculture department - classroom, agriculture
No. 4) mechanics shop, greenhouse, crop demonstration plot.
No. 5)

No. 6 - Classroom instruction - A typical classroom situation.

No. 7 - Laboratory work - Small group instruction in milk testing or soil testing laboratory.

No. 8 - Classroom demonstration - Demonstrate a manipulative skill which is pleasant to watch (not castration or docking).

No. 9 - Agriculture library - include books, magazines and other resource materials.

No. 10) Outdoor instructional activities - such as: pruning, land judging,
No. 11) weed identification, contour stripping, planting shrubs,
No. 12) fertilizing lawns, etc.

No. 13) Field trips - such as: milk plant, hatchery, farms and agricultural
No. 14) businesses, farm show, fair, nursery, State Department of
No. 15) Agriculture.

No. 16 - Agricultural shop program - A variety of shop projects.

No. 17 - A typical agriculture I shop project.

No. 18 - A student in the process of welding a project.

No. 19) Four slides illustrating the breadth of the shop program. Show
No. 20) projects in woodworking, tractor maintenance and repair,
No. 21) machinery repair, small engine reconditioning, concrete
No. 22) work, spray painting, etc.

No. 23 - Construction project - Major construction such as greenhouse construction or building a cinder block poultry house.

No. 24) Slides on plant propagation, greenhouse work, landscaping, nursery
No. 25) production, etc. Also slides illustrating the agri-business activities
No. 26) of boys in garden centers, floral shops and roadside stands.
No. 27)

No. 28) Depict some of the work the department of vocational agriculture has
No. 29) done for the school - such as maintaining the plantings, painting
No. 30) outdoor basketball bankboards and constructing fences.

No. 31) A community improvement project - The rat control campaign,
No. 32) landscaping the fire hall, building park picnic tables.

No. 33) Supervised agriculture experience program - Show the most common
No. 34) projects in your area relative to production projects, home improvement,
No. 35) and supervised occupational experience, animal projects, crop projects,
No. 36) home improvement projects, supplementary practices, and cooperative
No. 37) work experience programs.

No. 38 - Record keeping - A boy or group of boys working on record books.

No. 39) A minimum of ten slides are necessary to depict FFA activities.
No. 40) (Boys should wear jackets properly and white shirt and FFA tie
No. 41) when appropriate.) Suggested areas to depict are: crop demonstrations,
No. 42) cooperative chapter projects, community service activities, a chapter
No. 43) meeting, annual parent and son banquet, public speaking contest, typical
No. 44) committee at work, recreational activities, FFA judging contests, award
No. 45) programs, state FFA convention activities, FFA Week activities, National
No. 46) FFA convention activities, leadership training conferences, etc.
No. 47)
No. 48)
No. 49)
No. 50)

No. 51 - Closing slide - such as: FFA Motto.

PART IV

QUESTIONS AND ANSWERS ABOUT VOCATIONAL AGRICULTURE AND FFA HELPFUL IN DEVELOPING A RECRUITMENT BROCHURE

PLANS FOR CONSTRUCTING AN ELECTRIC PANEL QUIZ BOARD

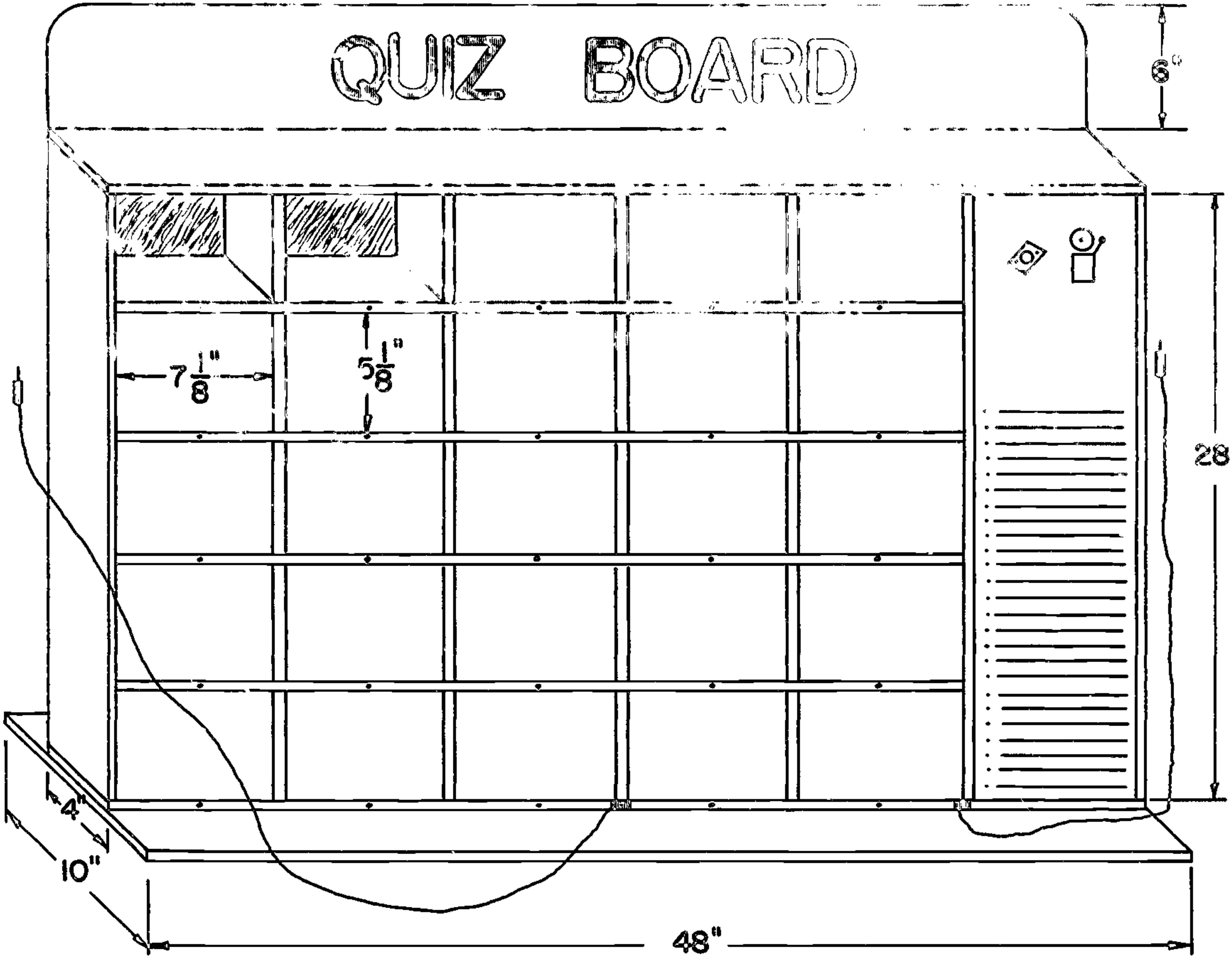
The electric panel quiz board is an instructional device which lends itself well to individual instruction. It may be used during the student's free time and he can proceed to learn at a rate he chooses. Like programmed instruction, the student is rewarded immediately for a correct answer by seeing a light or by hearing a bell ring.

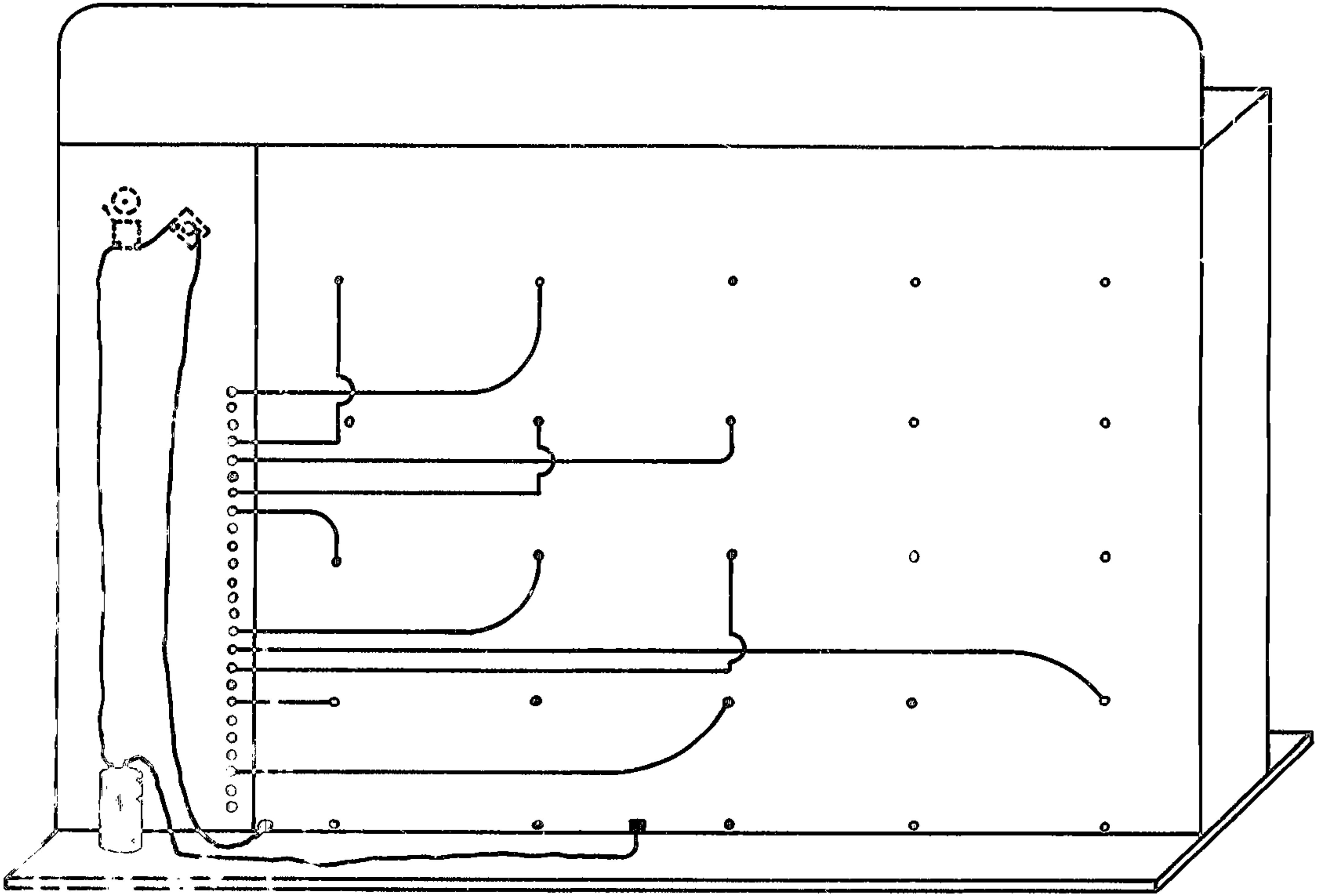
The electric panel quiz board appeals to the student who likes "gimmicks" and the one who enjoys manipulating machines.

Applications for use of the quiz board are numerous and limited only to the combined ingenuity of the teacher and his class. It may be used to identify plants, seeds, breeds of livestock, tools, weeds, insects, and varieties of vegetables, fruits, and field crops. Recognition of soil types, conservation practices, and plant deficiency symptoms may be learned by means of the quiz board.

The quiz board can be used at opportune times throughout the school year. It may be used just prior to introducing a new unit of instruction. On another occasion it may be used to supplement a unit of instruction. A student may be assigned the responsibility of setting it up to provide other students with a learning activity during those occasional idle moments before and after class.

The quiz board can be utilized effectively throughout the school and community. While it might be used primarily in the classroom and shop, teachers are encouraged to use it in school corridors, the library and study hall to acquaint the total school population with FFA or some other specially chosen agricultural topic. The panel board may be placed in a local farm supply store to inform the public. And, too, it may be taken to school sending districts after a recruitment presentation to stimulate potential vocational agricultural students to think further about the agriculture program.


QUIZ BOARD
6"
7 1/8"
5 1/8"
28 1/2"
4"
10"
48"



BACK VIEW

Bill of Materials

Lumber

1 pc. 1" x 10" x 4'	White Pine	Base
1 pc. 1" x 4" x 8'	White Pine	Top and Bottom
2 pcs. 1" x 4" x 8'	White Pine	Horizontal Members
2 pcs. 1" x 4" x 8'	White Pine	Vertical Members
5 pcs. 1/4" x 1-1/4" x 40"	Lath or plastic	Facing
1 pc. 3/8" x 3' x 4'	Plywood	Back and Legend Panel

Hardware

25 sets of electrical jacks

60 feet of bell wire

1 lamp socket and/or 1 door bell

25 brass wood screws (Contacts for each box)

2 telephone switchboard jacks (Contacts)

1 six-volt transformer or dry cell battery

A quantity of nails

Finishing Materials

For natural finish:

1 pint sander sealer

1 pint varnish

1 pint gloss lacquer

Assortment of sandpaper

Steel Wool

Optional Materials

Glass or plastic (Coverings for each box)

Spotlights (Lighting for the exhibit)

Four 8" to 10" removeable legs (To adjust height of Quiz Board)

VT003 268

VT 003 268
Mathematics I for Masons.

Heppa, Victor
New Jersey State Dept of Educ, Trenton. Vocational Div.
Rutgers State Univ., New Brunswick, N.J. Curric Lab.
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*STUDY GUIDES, TEXTBOOKS, *TRADE AND INDUSTRIAL EDUCATION, HIGH SCHOOLS, *BRICKLAYERS, *PRACTICAL MATHEMATICS, ASSIGNMENTS, *INDIVIDUAL INSTRUCTION,

This study guide-textbook was developed to direct the individual study of the vocational high school student in a 1-year course in mathematics related to masonry work. The material was prepared by a vocational-technical high school instructor and tested by classroom use. Units are Fractions, Decimal Fractions, Square Measure, and Cubic Measure. The lessons within each unit have information sheets and assignment sheets. Information sheets provide the student with the specific lesson objective, the related information, and sample problems. Assignment sheets present problems for student practice. A comprehensive test is provided for each unit. Answers to the assignment sheet problems and the unit tests are given in an answer section. The teacher should have a science and masonry background. This document is available for $1.50 from Vocational-Technical Curriculum Laboratory, Rutgers University, 10 Seminary Place, New Brunswick, New Jersey 08903. (HC)

STATE OF NEW JERSEY
DEPARTMENT OF EDUCATION
VOCATIONAL DIVISION

MATHEMATICS 1 - MASONS

PREPARED BY
VICTOR HERRA - INSTRUCTOR

BERGEN COUNTY VOCATIONAL AND TECHNICAL HIGH SCHOOL
HACKENSACK, NEW JERSEY

VOCATIONAL DIVISION - CURRICULUM LABORATORY
NEW BRUNSWICK, NEW JERSEY

94

State of New Jersey
Department of Education
Vocational Division

MATHEMATICS I - FOR MASONS

Prepared by
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Bergen County Vocational and Technical High School
Hackensack, New Jersey

Vocational Division - Curriculum Laboratory
Administration Building
College of Agriculture
New Brunswick, New Jersey

A.E. JOCHEN - Assistant Commissioner

BENJAMIN SHAPIRO - Curriculum Specialist

JULY, 1959

MEMORANDUM

TO: The ERIC Clearinghouse on Vocational and Technical Education
The Ohio State University
980 Kinnear Road
Columbus, Ohio 43212

FROM: (Person) Benjamin Shapiro (Agency) Vocational Div.-Curriculum Laboratory

(Address) 10 Seminary Place, New Brunswick, N J 08903; School of Education-Rutgers

DATE: August 29, 1967

RE: (Author, Title, Publisher, Date) Victor Heppa; MATHEMATICS #1 - MASONS; 1959

Supplementary Information on Instructional Material

Provide information below which is not included in the publication. Mark N/A in each blank for which information is not available or not applicable. Mark P when information is included in the publication. See reverse side for further instructions.

(1) Source of Available Copies:
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Address 10 Seminary Place, New Brunswick, N J 08903
Limitation on Available Copies as available Price/Unit $1.50
(quantity prices) same

(2) Means Used to Develop Material:
Development Group Author and related instructors
Level of Group County
Method of Design, Testing, and Trial Testing and trial within classroom

(3) Utilization of Material:
Appropriate School Setting Related classroom
Type of Program Vocational - High School
Occupational Focus Masonry
Geographic Adaptability Unlimited
Uses of Material Related classroom text
Users of Material Students

(4) Requirements for Using Material:
Teacher Competency Certification - science - masonry background preferred
Student Selection Criteria Student preference and guidance approval

Time Allotment One year

Supplemental Media -- N/A
Necessary ____ } (Check Which)
Desirable ____ }

Describe ____

Source (agency) ____
(address) ____

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UNIT I - FRACTIONS

UNIT II - DECIMAL FRACTIONS

UNIT III - SQUARE MEASURE

UNIT IV - CUBIC MEASURE

INTRODUCTION

Back in the beginning of brickmaking and bricklaying, when a builder had to make his own materials to build with, it was important that he know how many bricks and how much mortar he would need. The builder could not hop into his pick-up truck and go to the nearest supply yard when he ran short of material. He had to stop building and make more of the material he ran short of. If the builder made more than he needed, he was stuck with it. There were very few customers for masonry materials close by in those days, so whether he made too much or too little, the builder lost time and did extra work which he could have avoided.

Today in order to erect a building quickly, easily and economically we must know how to figure exactly how much material we will need. If we do not or cannot estimate our needs accurately, we will lose time and do extra work - which means losing money.

So you can see that even after thousands of years the only great change is money. Do you like to make money? You can make more money if you learn to figure accurately.

What you do with your head, you don't have to do with your back.

In the Masonry class you will work from individual lesson sheets. You will learn to do your work by following written instructions and explanations. No daily assignments will be made. As you complete each assignment you will start on the next one. There will be no waiting for some students in the class to learn a certain lesson before YOU can go ahead with a more advanced lesson. Each student can go ahead as rapidly as he is capable of going.

RULES

1. Be sure you read the instructions and explanations carefully and understand them completely.

2. Check with your instructor if you are not sure about how to do the problem. It is better to be sure and do it right than to do it wrong and have to unlearn the wrong way.
   CAUTION: Do not wear a path to the teacher's desk.
   Others need help also.

3. Be sure that you understand each step in a problem.

4. Do your own work. You cannot learn by copying. You only cheat yourself and keep yourself from learning as quickly as you are able.

5. All problems must be completely worked out on the work sheet which you turn in.

6. All work sheets will be graded for neatness as well as for accuracy. Those failing in neatness will be returned to be done over.

7. At the top of each work sheet you will write:

   Your Name Unit # Assignment # and the date.

UNIT I - FRACTIONS

Addition of Fractions | **Information Sheet No. 1**

OBJECTIVE: To learn the proper way of adding fractions.

INFORMATION:

You know that you cannot add things that are not alike. How would you add 10 bricks, 12 cinder blocks, and 3 bags of cement? You simply cannot combine these into any one figure.

Similarly, you cannot add fractions unless they are the same kind of fraction. You can add $\frac{1}{8}$, $\frac{3}{8}$ and $\frac{7}{8}$ (the answer is $\frac{11}{8}$ or $1\frac{3}{8}$). But you cannot add $\frac{1}{2}$, $\frac{2}{3}$, and $\frac{3}{8}$. However, in the case of fractions, it is possible to change the form of each one (without changing its value) so that they are all the same kind of fraction, and then they can be added.

To do this, you must first find the lowest common denominator (the denominator is the bottom figure of the fraction). This lowest common denominator is the smallest number that can be divided evenly by all the denominators. The denominators of $\frac{1}{2}$ and $\frac{3}{8}$ give us no trouble. Eight is a common denominator of both. But to get a common denominator with $\frac{2}{3}$, we multiply the denominators 8 x 3, giving us 24, which is evenly divisible by 2, 3, and 8.

PROBLEM: Add $1\frac{1}{2}$, $\frac{2}{3}$, $7\frac{3}{8}$.

1. List all the numbers to be added clearly and neatly. If you cannot list the numbers in straight columns, draw a straight line between them. Do not crowd the numbers. Leave a space between the column of whole numbers and the column of fractions.

$$\begin{array}{rr} 1 & \frac{1}{2} \\ & \frac{2}{3} \\ 7 & \frac{3}{8} \\ \hline \end{array}$$

2. Write your common denominator (24) to the right of the fraction column under a line. Do not list it opposite each fraction you are going to change.

$$\begin{array}{rrl} 1 & \frac{1}{2} & \\ & \frac{2}{3} & \\ 7 & \frac{3}{8} & \\ \hline & & \end{array}$$

(common denominator) -- $\overline{24}$

3. Change each fraction into an equal fraction having 24 as a denominator. In this case, $\frac{1}{2}=\frac{12}{24}$, $\frac{2}{3}=\frac{16}{24}$, $\frac{3}{8}=\frac{9}{24}$. List the top number only of the common fractions in a column alongside the original fractions.

$$\begin{array}{llcr} 1 & \frac{1}{2} & = & 12 \\ & \frac{2}{3} & = & 16 \\ 7 & \frac{3}{8} & = & 9 \\ \hline & & & \overline{24} \end{array}$$

4. Add the top numbers (numerators) of the common fractions and place the total above the common denominator. You now have an improper fraction $\frac{37}{24}$ which you must reduce to $1\frac{13}{24}$.

$$\begin{array}{llcrcl} 1 & \frac{1}{2} & = & 12 & & \\ & \frac{2}{3} & = & 16 & & \\ 7 & \frac{3}{8} & = & 9 & & \\ \hline & & & \frac{37}{24} & = & 1\frac{13}{24} \end{array}$$

5. Cross out the "1" and carry to the whole numbers column. Add the whole numbers. You get a total of 9.

Below the problem write the complete answer clearly.

$$\begin{array}{llcrcl} \overset{1}{1} & \frac{1}{2} & = & 12 & & \\ & \frac{2}{3} & = & 16 & & \\ 7 & \frac{3}{8} & = & 9 & & \\ \hline 9 & & & \frac{37}{24} & = & \cancel{1}\frac{13}{24} \end{array}$$

ANS. $9\frac{13}{24}$

No one can learn to add fractions quickly and accurately unless he practices. The following assignment sheets provide the practice problems to help you learn to add fractions.

List the numbers to be added clearly, neatly, and correctly.
Check to be sure that the numbers are listed properly.
Do all of your work on the work sheet.
Work carefully and accurately. Follow Information Sheet No. 1.

ADD:

1. $2\frac{1}{2} + \frac{3}{4} + 5\frac{1}{3} =$
2. $\frac{1}{4} + 11\frac{1}{2} + 3\frac{5}{8} =$
3. $2\frac{3}{8} + 18\frac{1}{3} + \frac{5}{6} =$
4. $\frac{3}{4} + \frac{1}{6} + \frac{2}{3} =$
5. $9\frac{2}{3} + 3\frac{7}{8} + 4\frac{1}{4} =$
6. $17\frac{1}{2} + 11\frac{3}{4} + 21\frac{7}{8} =$
7. $\frac{5}{8} + \frac{3}{4} + \frac{9}{16} =$
8. $49\frac{3}{8} + 26\frac{1}{4} + 67\frac{7}{16} =$
9. $37\frac{3}{4} + 75\frac{7}{8} + 9\frac{3}{16} =$
10. $\frac{15}{16} + 127\frac{3}{4} + 7\frac{7}{8} =$
11. $41\frac{1}{2} + 2\frac{7}{8} + 3\frac{3}{4} + 89\frac{9}{16} + 102\frac{5}{8} + 17\frac{1}{4} =$
12. $22\frac{2}{5} + 19\frac{3}{4} + 2\frac{5}{8} + 101\frac{1}{10} + 8\frac{3}{4} + 11\frac{1}{2} =$
13. $14\frac{2}{3} + 3\frac{3}{4} + 6\frac{7}{8} + 9\frac{1}{2} + 110\frac{5}{16} + 44\frac{1}{4} =$
14. $12\frac{1}{2} + 13\frac{1}{4} + 14\frac{5}{8} + 16\frac{1}{16} + 18\frac{1}{8} + 121\frac{3}{4} =$
15. $66\frac{2}{3} + 33\frac{1}{3} + 99\frac{9}{16} + 6\frac{7}{8} + 10\frac{2}{3} + 1\frac{1}{2} + 111\frac{1}{4} =$

REVIEW PROBLEMS:

16. How much would it cost to build a wall if you paid $375.50 for brick, $78.75 for concrete, $13.95 for sand, $21.25 for cement, and $195.45 for labor?

17. What is the total cost of the following equipment?
1 mixer $388.95, 1 mixing box $29.75, 6 mortar pans $5.50 each, 5 shovels $4.50 each, 1 mortar hoe $5.25.

18. How much is the total payroll if you paid $1,475.50 to bricklayers, $1,389.49 to carpenters, $1,187.28 to laborers, $169.75 to truck drivers, $642.75 to engineers, and $233.25 to timekeepers?

19. How much would a kit of tools cost if you spend $4.50 for a brick trowel, $1.75 for a pointing trowel, $1.15 for a jointer, $1.69 for a rule, $3.79 for a brick hammer, $2.75 for a brick set, $15.75 for a 4' level, $6.25 for a 2' level, and $4.99 for a tool bag?

20. How much is the total overhead if you paid $459.65 for compensation insurance, $265.00 for office rent, $27.59 for electricity, $35.50 for advertising, $215.50 for clerks, $17.75 for phone service, and $125.00 for legal fees?

ADD:

1. $1\frac{1}{2} + 15\frac{5}{8} + 86 + 23\frac{11}{16} + 8\frac{5}{8} + 10\frac{3}{4} =$
2. $101\frac{1}{16} + 2\frac{3}{4} + 7\frac{7}{8} + 46\frac{13}{16} + 211 + 9\frac{1}{2} =$
3. $\frac{3}{4} + \frac{1}{2} + \frac{9}{16} + \frac{15}{16} + \frac{7}{8} + \frac{1}{4} =$
4. $14\frac{3}{4} + \frac{7}{8} + 21\frac{15}{16} + 104\frac{1}{2} + 55\frac{5}{8} + 6\frac{9}{16} =$
5. $\frac{13}{16} + 121\frac{1}{2} + 32\frac{3}{4} + 3\frac{7}{3} + 19\frac{1}{4} + 1,019\frac{11}{16} =$
6. $196\frac{3}{4} + 2\frac{1}{2} + 48\frac{5}{8} + 67\frac{11}{16} + 99\frac{1}{4} + \frac{15}{16} =$
7. $1,848 + 123\frac{9}{16} + 7\frac{1}{2} + 86\frac{3}{4} + 27\frac{5}{8} + 12\frac{13}{16} =$
8. $18\frac{1}{4} + 96\frac{3}{4} + 1\frac{7}{8} + 206\frac{15}{16} + 45\frac{1}{2} =$
9. $2\frac{1}{2} + 4\frac{3}{4} + 6\frac{7}{8} + 8\frac{3}{8} + 10\frac{1}{2} + 2\frac{3}{8} =$
10. $\frac{1}{2} + \frac{3}{4} + \frac{5}{8} + \frac{13}{16} + \frac{19}{32} =$

11. How many cubic yards of concrete are needed for a job that requires $4\frac{1}{2}$ cu. yds. for column footings, $6\frac{3}{4}$ cu. yds. for step footings, $23\frac{5}{8}$ cu. yds. for foundation footings, $2\frac{2}{3}$ cu. yds. for areaways, and $7\frac{1}{2}$ cu. yds. for sidewalks?

12. How many cubic yards of sand are needed for a job that requires $12\frac{1}{4}$ cu. yds. for mortar for brick, $16\frac{3}{4}$ cu. yds. for mortar for block, $3\frac{1}{2}$ cu. yds. for concrete, $9\frac{2}{3}$ cu. yds. for plaster?

13. A truckman hauled $12\frac{1}{3}$ cu. yds. of sand, $17\frac{3}{4}$ cu. yds. of cinders, $9\frac{1}{2}$ cu. yds. of gravel, $6\frac{1}{4}$ cu. yds. of crushed stone, and $14\frac{2}{3}$ cu. yds. of fill. How many cu. yds. did the truckman haul altogether?

ADD:

14. $1\frac{1}{2} + 32\frac{7}{8} + 29\frac{3}{4} + 87\frac{1}{8} + 201\frac{5}{8} + 7\frac{1}{4} =$

15. $264\frac{3}{4} + 24\frac{5}{8} + 5\frac{11}{16} + 38\frac{1}{2} + 14\frac{7}{8} + 82\frac{13}{16} =$

16. $56\frac{7}{8} + 4\frac{3}{4} + 12\frac{1}{2} + 85\frac{5}{8} + 65\frac{3}{8} + 9\frac{7}{8} =$

17. $16\frac{1}{2} + 35\frac{7}{8} + 62\frac{5}{8} + 101\frac{7}{8} + 3\frac{3}{4} + 7 =$

18. $1{,}255\frac{3}{4} + 1\frac{9}{16} + 11\frac{15}{16} + 47\frac{7}{8} + 58\frac{7}{8} + 17\frac{1}{2} =$

REVIEW PROBLEMS:

19. A bricklayer spent $5.25 for overalls, $4.75 for a jumper, $11.95 for shoes, $4.39 for a shirt, and $1.99 for a cap. How much did his work clothes cost?

20. A contractor paid $4.30 per hr. for bricklayers, $3.45 per hr. for laborers, $4.05 per hr. for carpenters, $4.25 per hr. for waterproofers, $3.95 per hr. for roofers, $4.15 per hr. for ironworkers, and $4.30 per hr. for plasterers. How much was his total hourly cost for 1 man from each trade?

Dimensions - Addition of Feet, Inches and Fractions of an Inch

Information Sheet No. 2

OBJECTIVE: To learn how to add dimensions easily and accurately.

INFORMATION:

In the previous lesson you learned to add whole numbers and fractions. This was to prepare you to add dimensions. By following the information given below, you will learn to add dimensions easily and accurately.

PROBLEM: Add 7' $10\frac{3}{4}''$ + 3' $\frac{1}{2}''$ + $9\frac{3}{8}''$ =

1. List the dimensions to be added clearly and neatly. Each dimension must be listed in the 3 columns, feet, inches, and fractions of an inch.

Feet	Inches	Fractions of an Inch
7	10	$\frac{3}{4}$
3		$\frac{1}{2}$
	9	$\frac{3}{8}$

2. Find the common denominator. In the case of fractions of an inch, the lowest common denominator will always be the largest denominator (in this case, 8). Change the fractions to common fractions, then add the top numbers (numerators). You get $\frac{13}{8}$ inches, which you reduce to $1\frac{5}{8}$ inches.

7	10	$\frac{3}{4}$	=	6
3		$\frac{1}{2}$	=	4
	9	$\frac{3}{8}$	=	3
				$\frac{13}{8} = 1\frac{5}{8}$

3. Cross out the 1 inch and carry to the "inches" column. Add the inches column, which gives you 20 inches. You now reduce the 20 inches to feet and inches by dividing 20 inches by 12 inches (which equals 1 foot). This gives you 1 foot and 8 inches.

7	10	$\frac{3}{4}$	=	6
3		$\frac{1}{2}$	=	4
	9_1	$\frac{3}{8}$	=	3
	20	$\frac{13}{8}$	=	$1\frac{5}{8}$
	1' 8"			

4. Carry the 1 foot to the "feet" column and add up the number of feet. You get 11 feet for the total.

Now below the problem write the answer clearly and place the foot and inch symbols in their proper place.

7	10	$\frac{3}{4}$	=	6
3		$\frac{1}{2}$	=	4
1	1	$\frac{3}{8}$	=	3
11	$\cancel{2}\cancel{0}$"		$\frac{13}{8}$	= $\cancel{1}\frac{5}{8}$
	$\cancel{1}$' 8"			

ANS. 11' $8\frac{5}{8}$"

The lesson sheets which follow provide the necessary practice so you can learn to add dimensions easily and accurately.

List the dimensions to be added clearly and neatly. Make certain that the feet, inches and fractions of an inch are placed in the proper columns. Follow the instructions on Information Sheet No. 2 and solve the following problems.

ADD:

1. $42'\ \frac{1}{2}'' + 1{,}099'\ 6'' + 7'\ 3\frac{1}{8}'' =$
2. $6\frac{7}{8}'' + 1{,}000'\ 9'' + 9'\ 10\frac{3}{4}'' =$
3. $15'\ \frac{3}{4}'' + 11'\ 8\frac{1}{8}'' + 103'\ 6'' =$
4. $20'\ 5'' + 2{,}329' + 8\frac{1}{2}'' + 21'\ 7\frac{7}{8}'' =$
5. $29'\ 8\frac{1}{2}'' + 375'\ \frac{3}{8}'' + 4'\ 11\frac{3}{4}'' + 10'' =$
6. $7'\ \frac{1}{2}'' + 12'\ 8'' + 4'\ 6\frac{1}{8}'' + 33'\ 6\frac{1}{4}'' =$
7. $14' + 112'\ 6'' + 8'\ 9\frac{3}{8}'' + 8\frac{3}{4}'' =$
8. $9'\ 11\frac{5}{8}'' + 6\frac{3}{4}'' + 135'\ 2\frac{5}{16}'' + 78'\ 7'' =$
9. $102'\ 11\frac{9}{16}'' + 8\frac{1}{2}'' + 12'\ 3'' + 7'\ \frac{3}{4}'' + 4'\ 5'' =$
10. $8'\ \frac{1}{2}'' + 7'\ \frac{3}{4}'' + 201'\ 5\frac{7}{16}'' + 11'' + 9'\ \frac{5}{8}'' =$

11. What is the perimeter of a building whose dimensions are $29'\ 8\frac{1}{2}''$, $18'\ 6''$, $29'\ 8\frac{1}{2}''$, $18'\ 6''$?

12. The sidewalks around a building measure $21'\ 6\frac{1}{2}''$, $18'\ 10''$, $12'\ \frac{3}{4}''$, $43'\ 7\frac{1}{4}''$ and $9'\ 5''$. What is their total length?

13. An irregularly shaped patio has sides measuring $18'\ 3\frac{1}{2}''$, $20'\ \frac{3}{4}''$, $24'\ 6''$, $21'\ 2\frac{1}{4}''$, and $17'\ 11\frac{1}{4}''$. What is the distance around it?

14. A builder had to excavate $4\frac{1}{2}$ cu. yds. for column footings, $146\frac{2}{3}$ cu. yds. for the basement, $18\frac{1}{2}$ cu. yds. for the steps, $7\frac{3}{4}$ cu. yds. for areaways, $43\frac{1}{4}$ cu. yds. for the septic tank, $8\frac{1}{3}$ cu. yds. for sidewalks and $1\frac{3}{4}$ cu. yds. for the fireplace footing. How many cu. yds. did the builder have to excavate?

15. A mason worked $16\frac{1}{2}$ hours laying brick, $12\frac{3}{4}$ hours laying blocks, $8\frac{1}{3}$ hours on a sidewalk, $19\frac{1}{4}$ hours plastering, $5\frac{2}{3}$ hours putting in a tile drain, $7\frac{1}{2}$ hours pouring concrete, and $3\frac{3}{4}$ hours washing down the brickwork. How many hours did he work?

ADD:

16. $47'\ 8\frac{3}{4}'' + 7'\ \frac{1}{2}'' + 137'\ 6'' + 6'\ 6\frac{9}{16}'' + 8\frac{7}{8}'' =$

17. $6'\ \frac{1}{2}'' + 4\frac{3}{4}'' + 7'\ 11\frac{9}{16}'' + 5'\ 5'' + 22'\ 8\frac{5}{8}'' =$

18. $5'\ 8\frac{3}{4}'' + 129'\ 3'' + 15'\ 11\frac{5}{8}'' + 11\frac{13}{16}'' + 1{,}275'\ 4\frac{7}{8}'' =$

19. $625' + 2'\ 8\frac{3}{4}'' + 11\frac{1}{2}'' + 2{,}378'\ 9'' + 65'\ 7\frac{7}{16}'' =$

20. $16'\ 7\frac{11}{16}'' + 139'\ 10\frac{3}{4}'' + 278'\ 9\frac{7}{8}'' + 4{,}789'\ 1\frac{1}{2}'' + 2{,}865'\ 11\frac{15}{16}'' =$

Dimensions (Addition) Assignment Sheet No. 4

ADD:

1. $8\frac{1}{2}'' + 10'\ 5\frac{3}{4}'' + 72'\ 11\frac{13}{16}'' + 155'\ \frac{5}{8}'' + 29'\ 9\frac{3}{8}'' =$
2. $238'\ 4\frac{5}{16}'' + 7'\ \frac{3}{8}'' + 21'\ 9\frac{1}{4}'' + 145'\ \frac{7}{16}'' + 11\frac{1}{2}'' =$
3. $1{,}101'\ 4\frac{1}{4}'' + 7\frac{7}{16}'' + 247'\ \frac{13}{16}'' + 79'\ 11\frac{1}{2}'' + 33' =$
4. $8'' + 1{,}042'\ 6\frac{5}{16}'' + 198'\ \frac{5}{8}'' + 7'\ 3'' + 201'\ 11\frac{11}{16}'' =$
5. $141'\ 2\frac{3}{4}'' + 9\frac{9}{16}'' + 21' + 23'\ 11\frac{7}{8}'' + 7\frac{13}{16}'' =$
6. $7'\ 11'' + 100' + 42'\ 8\frac{15}{16}'' + 6\frac{7}{8}'' + 2'\ 9\frac{15}{32}'' =$
7. $627'\ 8\frac{5}{8}'' + 72'\ \frac{1}{2}'' + 9\frac{1}{4}'' + 17'\ \frac{7}{16}'' + 143'\ 7\frac{3}{8}'' =$
8. $569'\ \frac{3}{4}'' + 79'\ 6\frac{3}{16}'' + 125'\ \frac{9}{16}'' + 7'' + 47'\ 3\frac{7}{8}'' =$
9. $6'\ 8\frac{3}{4}'' + 257' + 32'\ \frac{13}{16}'' + 4'\ 11\frac{7}{8}'' + 11\frac{9}{16}'' =$
10. $11'' + 2'\ \frac{5}{8}'' + 826' + 9'\ \frac{9}{16}'' + 42'\ 11\frac{1}{2}'' =$
11. $16'\ 7\frac{3}{4}'' + 101'\ \frac{9}{16}'' + 1'\ 11\frac{1}{2}'' + 73'\ 3\frac{3}{4}'' + 8\frac{5}{8}'' =$
12. $112'\ \frac{1}{4}'' + 7'\ 6\frac{7}{8}'' + 122'\ \frac{7}{16}'' + 33'\ 9\frac{3}{4}'' =$
13. $8\frac{5}{8}'' + 100'\ \frac{1}{2}'' + 7'\ 6\frac{3}{4}'' + 1{,}018'\ 5\frac{7}{16}'' + 7'\ \frac{3}{8}'' =$
14. $12'\ 11\frac{5}{8}'' + 6\frac{3}{4}'' + 101'\ \frac{9}{16}'' + 3'\ 3'' + 17'\ \frac{7}{8}'' =$
15. $14'\ 10\frac{3}{4}'' + 6'\ \frac{7}{8}'' + 111' + 7'\ \frac{15}{16}'' + 18'\ 6\frac{5}{8}'' =$
16. $100'\ \frac{3}{4}'' + 5'\ \frac{9}{16}'' + 4'\ 9\frac{3}{4}'' + 7\frac{3}{8}'' + 6'\ 1\frac{3}{4}'' =$
17. $203'\ 5\frac{3}{4}'' + 23'\ \frac{9}{16}'' + 1'\ 3\frac{3}{8}'' + 15'\ 1\frac{11}{16}'' + 3'\ \frac{5}{8}'' =$

18. A builder installed 87' 6" of sidewalk on Monday, 136' $8\frac{1}{2}$" of sidewalk on Tuesday, 119' 7" of sidewalk on Wednesday, 93' 2" of sidewalk on Thursday, 158' $10\frac{3}{4}$" of sidewalk on Friday.
How many feet of sidewalk did the builder install?

REVIEW PROBLEMS:

19. A builder paid $879.75 for face brick, $426.95 for common brick, $179.38 for mortar cement, $88.57 for sand, $284.26 for concrete, $199.52 for blocks and $57.49 for gravel.
How much did the builder pay for the material?

20. A builder paid $4,753.69 for material, $1,926.87 for labor, $789.14 for overhead, $43.75 for advertising, $243.28 for trucking and $478.65 for scaffold rental.
How much did the job cost?

Subtraction of Fractions Information Sheet No. 3

OBJECTIVE: To learn the correct way of subtracting dimensions.

INFORMATION:

When you subtract dimensions, you must always start by subtracting the fractions of an inch first, next you subtract the inches, and last the feet.

List all numbers clearly and in neat columns. Cross out each number from which you borrow and write the correct number above it so that you do not make a mistake.

Do not crowd the figures. You will find it is much easier to work out a problem which is neatly and clearly written, with the numbers widely spaced.

PROBLEM: Subtract $127' \; 10\frac{5''}{8}$ from $168' \; 7\frac{5''}{16}$

1. Change the fractions of an inch so they both have the same common denominator.

$$\begin{array}{rrrl} & 168 & 7 & \frac{5}{16} = \frac{5}{16} \\ - & 127 & 10 & \frac{5}{8} = \frac{10}{16} \\ \hline \end{array}$$

2. Since you cannot subtract $\frac{10''}{16}$ from $\frac{5''}{16}$, you must borrow 1" from the 7". Cross out the 7 and write 6 above it. $1'' = \frac{16''}{16}$. You add $\frac{16''}{16}$ to the $\frac{5''}{16} = \frac{21''}{16}$. Cross out the $\frac{5''}{16}$ and write $\frac{21}{16}$ next to it. Then subtract $\frac{10''}{16}$ from $\frac{21}{16}$, giving $\frac{11''}{16}$. Write $\frac{11}{16}$ below the line.

$$\begin{array}{rrlcl} 168 & \overset{6}{\cancel{7}} & \frac{\cancel{5}}{\cancel{16}} = \frac{\cancel{5}}{\cancel{16}} & = & \frac{21}{16} \\ 127 & 10 & \frac{\cancel{5}}{\cancel{8}} = \frac{\cancel{10}}{\cancel{16}} & = & \frac{10}{16} \\ \hline & & & & \frac{11}{16} \end{array}$$

3. You cannot subtract 10" from 6" so you must borrow 1' from 168'. Cross out the 8 and write 7 above it. 1' = 12". Add 12 to 6" = 18". Cross out the 6 and write 18 above it. 18" - 10" = 8.

Write 8 below the line.

$$\begin{array}{rrlcl} 16\overset{7}{\cancel{8}} & \overset{\overset{18}{\cancel{6}}}{\cancel{7}} & \frac{\cancel{5}}{\cancel{16}} = \frac{\cancel{5}}{\cancel{16}} & = & \frac{21}{16} \\ 127 & 10 & \frac{\cancel{5}}{\cancel{8}} = \frac{\cancel{10}}{\cancel{16}} & = & \frac{10}{16} \\ \hline & 8 & & & \frac{11}{16} \end{array}$$

4. Subtract 127' from 167', giving 40. Write 40 below the line.

$$\begin{array}{cccc}
16\cancel{8}^{7} & \cancel{7}^{\overset{18}{\cancel{6}}} & \frac{\cancel{5}}{\cancel{16}} = \frac{\cancel{5}}{\cancel{16}} = & \frac{21}{16} \\
127 & 10 & \frac{\cancel{5}}{\cancel{8}} = \frac{10}{16} = & \frac{10}{16} \\
\hline
40 & 8 & & \frac{11}{16}
\end{array}$$

5. Write out the answer clearly with the foot and inch symbols in their proper places.

ANS. $40'\ 8\frac{11}{16}''$

Subtraction of Fractions (Dimensions) Assignment Sheet No. 5

SUBTRACT:

1. $6\frac{1}{2}'' - 3\frac{3}{4}'' =$
2. $1'\ 6'' - 8\frac{3}{8}'' =$
3. $7'' - 4\frac{1}{8}'' =$
4. $9\frac{1}{4}'' - 3\frac{5}{8}'' =$
5. $\frac{7}{8}'' - \frac{5}{16}'' =$
6. $1'\ \frac{5}{8}'' - 7\frac{1}{4}'' =$
7. $8\frac{1}{2}'' - 5\frac{3}{4}'' =$
8. $6\frac{7}{8}'' - 3'' =$
9. $2'\ 4\frac{1}{2}'' - 1'\ 9\frac{7}{8}'' =$
10. $1'\ 2'' - 6\frac{5}{8}'' =$
11. $2' - 1'\ 4\frac{3}{8}'' =$
12. $2'\ 5'' - 2'\ \frac{1}{4}'' =$
13. $11\frac{3}{4}'' - 5\frac{3}{8}'' =$
14. $1'\ \frac{5}{8}'' - 7'' =$
15. $2' - 1'\ 4'' =$
16. $201'\ 9\frac{9}{16}'' - 102'\ 5\frac{3}{8}'' =$
17. $1{,}987'\ 2\frac{1}{4}'' - 1{,}698'\ 6\frac{5}{8}'' =$
18. $583'\ \frac{7}{8}'' - 327'\ 4\frac{13}{15}'' =$
19. $246'\ 3\frac{3}{8}'' - 175'\ \frac{3}{4}'' =$
20. $10{,}\ 846'\ 5\frac{13}{32}'' - 2{,}679'\ 8\frac{3}{4}'' =$
21. $791' - 425'\ 5\frac{9}{16}'' =$
22. $155'\ \frac{1}{2}'' - 97'\ 5\frac{3}{8}'' =$
23. $369'\ 3\frac{5}{16}'' - 135'\ 7\frac{9}{32}'' =$
24. $263'\ 10\frac{11}{16}'' - 204'\ 8\frac{3}{4}'' =$
25. $444' - 279'\ 5\frac{9}{16}'' =$
26. $156'\ 9\frac{3}{8}'' - 102'\ 11\frac{13}{16}'' =$
27. $123'\ 4\frac{5}{8}'' - 121'\ \frac{7}{8}'' =$
28. $847'\ 10\frac{3}{4}'' - 637'\ 7\frac{11}{16}'' =$
29. $707'\ 9'' - 548'\ 6\frac{3}{16}'' =$
30. $154' - 79'\ \frac{9}{32}'' =$
31. $683'\ 5\frac{5}{8}'' - 479'\ 8\frac{27}{32}'' =$
32. $179'\ \frac{3}{4}'' - 123'\ 5\frac{3}{8}'' =$
33. $248'\ 2\frac{9}{16}'' - 147'\ 6'' =$
34. $671'\ 6\frac{3}{32}'' - 437'\ \frac{3}{4}'' =$
35. $1{,}367'\ \frac{1}{2}'' - 1{,}186'\ 3\frac{3}{4}'' =$
36. $555' - 369'\ 8\frac{9}{32}'' =$
37. $1{,}436'\ 5\frac{1}{4}'' - 558'\ 5\frac{3}{32}'' =$
38. $892'\ 6\frac{3}{4}'' - 279'\ 5\frac{24}{32}'' =$
39. $346'\ 8'' - 255'\ 10\frac{3}{8}'' =$
40. $5{,}148'\ \frac{5}{8}'' - 2{,}479'\ 6\frac{27}{32}'' =$

Addition and Subtraction of Fractions — Assignment Sheet No. 6

ADD:

1. $199'\ 11\frac{7}{8}'' + 16'\ \frac{1}{2}'' + 101'\ 9\frac{3}{4}'' + 8\frac{1}{16}'' + 5'\ \frac{5}{8}'' =$
2. $122'\ \frac{1}{2}'' + 71'\ 9\frac{3}{4}'' + 8'\ 11\frac{7}{8}'' + 45'\ 8\frac{9}{16}'' + 155'\ 11\frac{5}{8}'' =$
3. $5'\ 6\frac{3}{4}'' + 91'\ \frac{7}{8}'' + 15'\ 11\frac{1}{2}'' + 166'\ \frac{13}{16}'' + 4'\ 7\frac{3}{8}'' =$
4. $6\frac{7}{8}'' + 100'\ \frac{3}{4}'' + 7'\ 11\frac{1}{2}'' + 42'\ 8\frac{15}{16}'' + 9\frac{7}{32}'' =$
5. $41'\ \frac{3}{4}'' + 9\frac{9}{16}'' + 121'\ 2\frac{1}{2}'' + 23'\ 11\frac{7}{8}'' + 7\frac{13}{16}'' =$

SUBTRACT:

6. $175'\ \frac{3}{8}'' - 88'\ 6\frac{1}{2}'' =$
7. $1{,}895'\ 9\frac{5}{16}'' - 1{,}599'\ 10\frac{3}{4}'' =$
8. $225'\ 8\frac{9}{32}'' - 220'\ 9\frac{7}{8}'' =$
9. $115'\ 3\frac{3}{8}'' - 111'\ 7\frac{9}{16}'' =$
10. $1{,}435'\ \frac{1}{2}'' - 396'\ 10\frac{5}{8}'' =$
11. $69'\ 3\frac{1}{4}'' - 22'\ 8\frac{5}{8}'' =$
12. $4{,}270' - 1{,}485'\ 6\frac{5}{8}'' =$
13. $2{,}798'\ 6'' - 1{,}797'\ 7\frac{1}{2}'' =$
14. $2{,}059'\ 11\frac{13}{16}'' - 1{,}039'\ 6\frac{3}{4}'' =$
15. $298'\ \frac{3}{4}'' - 179'\ 4\frac{1}{2}'' =$
16. A builder ordered 293 cu. yds. of concrete. He used $201\frac{1}{4}$ cu. yds. for a foundation, $27\frac{1}{3}$ cu. yds. for column footings, $61\frac{1}{2}$ cu. yds. for the foundation footings, and $2\frac{3}{4}$ cu. yds. for areaways. How much concrete was left?

17. A builder was getting ready to pour a cellar floor.
When he checked, he found that the foreman had leveled the dirt at the finished floor height. He had to dig out $39\frac{1}{2}$ cu. yds. of dirt to get to the proper depth. He then filled in $19\frac{3}{4}$ cu. yds. of gravel and laid the concrete floor on top of the gravel.
How much concrete did the builder use for the floor?

REVIEW PROBLEMS:

18. A builder bought 58, 750 brick. He used 17, 850 on one job, 22,395 on a second job, and 18, 125 on the third job.
How many brick were left?

19. A builder had a total payroll of $3,989.68. The carpenters were paid $1,284.85, the bricklayers were paid $1,437.60, the laborers were paid $1,018.69.
How much were the timekeeper and superintendent paid?

20. A builder bought 389 bags of cement. He needed 108 bags on one job, 214 bags on the second job, 49 bags on the third job, and 47 bags on the fourth job.
How did he make out on the fourth job?

Addition and Subtraction of Fractions — Assignment Sheet No. 7

SUBTRACT:

1. $125'\ 4\frac{5}{8}'' \quad - \quad 67'\ 8\frac{1}{4}'' \quad =$
2. $79'\ 10\frac{1}{4}'' \quad - \quad 43'\ 5\frac{7}{16}'' \quad =$
3. $1{,}343'\ \frac{7}{8}'' \quad - \quad 391'\ 4\frac{9}{16}'' \quad =$
4. $234' \quad - \quad 87'\ 5\frac{1}{4}'' \quad =$
5. $352'\ 4'' \quad - \quad$ [illegible]$3'\ 1\frac{5}{8}'' \quad =$
6. $12'\ \frac{3}{4}'' \quad - \quad 7'\ 5'' \quad =$
7. $191'\ 7\frac{5}{8}'' \quad - \quad 90'\ 4\frac{7}{16}'' \quad =$
8. $57'\ 4\frac{3}{8}'' \quad - \quad 28'\ 8\frac{9}{16}'' \quad =$
9. $1{,}455'\ 6\frac{1}{2}'' \quad - \quad 444'\ 8'' \quad =$
10. $3{,}282'\ 5\frac{1}{4}'' \quad - \quad 2{,}879'\ 4\frac{9}{16}'' \quad =$

ADD:

11. $3' \quad + \quad 11\frac{1}{2}'' \quad + \quad 155'\ 6'' \quad + \quad \frac{3}{4}'' \quad + \quad 8'\ 8\frac{13}{16}'' \quad =$
12. $17'\ 2'' \quad + \quad 82' \quad + \quad 33'\ 5\frac{3}{4}'' \quad + \quad 11\frac{13}{16}'' \quad + \quad 14'\ \frac{7}{8}'' \quad =$
13. $92'\ 8\frac{5}{8}'' \quad + \quad 9\frac{3}{4}'' \quad + \quad 5'\ 6'' \quad + \quad 8'\ \frac{11}{16}'' \quad + \quad 16'\ 7\frac{7}{8}'' \quad =$
14. $2'\ 6\frac{1}{2}'' \quad + \quad 5'\ 9'' \quad + \quad 12\frac{1}{2}'' \quad + \quad 47'\ \frac{5}{8}'' \quad + \quad 3'\ \frac{15}{16}'' \quad =$
15. $88'\ 9'' \quad + \quad 1{,}459' \quad + \quad 32'\ \frac{3}{4}'' \quad + \quad 11\frac{7}{8}'' \quad + \quad 9'\ 9\frac{9}{16}'' \quad =$
16. The dimensions of the sides of an irregularly shaped building are $17'\ 9\frac{1}{2}''$, $21'\ 6''$, $6'\ \frac{1}{2}''$, $18'\ 5\frac{7}{8}''$, $4'$, $18'\ 11\frac{1}{2}''$.
    What is the perimeter of the building?
17. A builder ordered 67 cu. yds. of sand. He had $18\frac{1}{2}$ cu. yds. delivered to the first job, $23\frac{3}{4}$ cu. yds. delivered to the second job, $16\frac{2}{3}$ cu. yds. delivered to the third job.
    How much sand was left for job #4?

REVIEW PROBLEMS:

18. A builder drew $3,859.67 from the bank. He paid the masons $1,246.89, the laborers $1,045.28, and the carpenters $1,258.67. How much was left for himself?

19. A builder ordered 79,500 face brick, 28,750 common brick and 9,850 blocks in all. He had 26,500 face brick, 2,750 common brick and 2,910 blocks delivered to job #1; 8,750 face brick and 2,290 blocks delivered to job #2; 12,450 common brick and 1,350 blocks delivered to job #3.
How many face brick, common brick, and blocks were delivered to job #4?

20. A builder paid $1,296.59 to the masons, $1,188.48 to the carpenters, $946.79 to the laborers, and $678.50 to the clerks, superintendent, and engineer.
How much was his total payroll?

Next assignment will be Test No. 1.

Multiplication of Fractions — Information Sheet No. 4

OBJECTIVE: To learn the methods of multiplying fractions.

INFORMATION:

There are various kinds of problems in the multiplication of fractions. By following the explanation below, you should be able to solve the different types of problems.

Neatness and careful placing of numbers is very important.

PROBLEM: $\frac{1}{3} \times 7 =$ (a fraction times a whole number)

Write both the whole number and the fraction as fractions. $\frac{1}{3} \times \frac{7}{1} =$

Multiply the upper numbers (numerators).
Multiply the lower numbers (denominators).
Reduce to the lowest terms.

$$\frac{1}{3} \times \frac{7}{1} = \frac{7}{3}$$
$$= 2\frac{1}{3} \quad \text{ANS.}$$

PROBLEM: $6 \times 1\frac{1}{4} =$ (a whole number times a mixed number)

Change both numbers to improper fractions. $\frac{6}{1} \times \frac{5}{4} =$

Multiply the numerator; multiply the denominators. $\frac{6}{1} \times \frac{5}{4} = \frac{30}{4}$

Reduce to the lowest terms. $\frac{30}{4} = \frac{15}{2} = 7\frac{1}{2}$ ANS.

PROBLEM: $\frac{3}{4} \times \frac{1}{2} =$ (a fraction times a fraction)

Multiply the numerators; multiply the denominators. $\frac{3}{4} \times \frac{1}{2} = \frac{3}{8}$ ANS.

In order to reduce the size of the totals when you multiply fractions, use cancellation whenever possible. If a numerator will divide evenly into a denominator, or a denominator into a numerator, do so. When a number can be divided evenly into both a denominator and a numerator, do so.

PROBLEM: $\frac{3}{4} \times \frac{8}{9} =$

4 divides into 8 twice. Cross out the 4 and write 1 under it. Cross out the 8 and write 2 above it.
3 divides into 9 three times. Cross out the 3 and write 1 above it. Cross out the 9 and write 3 below it.
This changes the numerators and denominators. Now multiply the new numerators and denominators.

$$\begin{array}{ll} \text{numerators} & \multirow{2}{*}{} \\ \text{denominators} & \end{array} \quad \frac{\cancel{3}^{1}}{\cancel{4}_{1}} \times \frac{\cancel{8}^{2}}{\cancel{9}_{3}} = \frac{2}{3} \quad \text{ANS.}$$

PROBLEM: $123 \times 14\frac{1}{4}$

Change to improper fractions. $\frac{123}{1} \times \frac{57}{4} =$

No cancellation is possible. Multiply the numerators, then multiply the denominators. Divide the denominator into the numerator.

$$\frac{123}{1} \times \frac{57}{4} = \frac{7011}{4} = 1752\frac{3}{4} \quad \text{ANS.}$$

Alternate method:

Set up problem as an ordinary multiplication example.

Multiply $\frac{1}{4} \times 123 = 30\frac{3}{4}$

Then multiply 14×123

$$\begin{array}{r} 123\phantom{\frac{1}{4}} \\ \times\ 14\frac{1}{4} \\ \hline 30\frac{3}{4} \\ 492\phantom{\frac{1}{4}} \\ 123\phantom{0\frac{1}{4}} \\ \hline 1752\frac{3}{4} \end{array} \quad \text{ANS.}$$

PROBLEM: $56\frac{1}{3} \times 29\frac{1}{4} =$

Change to improper fractions. Cancel. Multiply.

$$\frac{169}{\cancel{3}} \times \frac{\overset{39}{\cancel{117}}}{4} = \frac{6591}{4} = 1647\frac{3}{4} \qquad \text{ANS.}$$

Alternate method:

Multiply $\frac{1}{4} \times \frac{1}{3} = \frac{1}{12}$

Multiply $\frac{1}{\cancel{4}} \times \frac{\overset{14}{\cancel{56}}}{1} = 14$

Multiply $\frac{29}{1} \times \frac{1}{3} = \frac{29}{3} = 9\frac{2}{3}$

Multiply 29 x 56

Common denominator of the fraction is 12

$$\begin{array}{rll}
 & 56\frac{1}{3} & \\
\times & 29\frac{1}{4} & \\
\hline
 & \frac{1}{12} & = 1 \\
 & 14 & \\
 & 9\frac{2}{3} & = 8 \\
 & 504 & \\
 & 112 & \\
\hline
 & 1647 \qquad \frac{9}{12} & = \frac{3}{4} \\
 & 1647\frac{3}{4} & \text{ANS.}
\end{array}$$

To multiply dimensions (feet and inches), first change the inches in each dimension to a fraction of a foot. Then multiply as you do mixed numbers.

PROBLEM: 16' 9" x 18' 3" =

Change to feet and fractions of a foot. $16\frac{3}{4}' \times 18\frac{1}{4}' =$

Change to improper fractions and multiply.

$$\frac{67'}{4} \times \frac{73'}{4} = \frac{4891'}{16} = 305\frac{11}{16} \text{ \underline{sq.} \underline{ft.}} \qquad \text{ANS.}$$

When you multiply feet x feet, the answer is always in <u>square feet.</u>

Alternate method:

Multiply $\frac{1}{4} \times \frac{3}{4} = \frac{3}{16}$

Multiply $\frac{1}{4} \times \frac{\overset{4}{\cancel{16}}}{1} = 4$

Multiply $\frac{\overset{9}{\cancel{18}}}{1} \times \frac{3}{\underset{2}{\cancel{4}}} = \frac{27}{2} = 13\frac{1}{2}$

Multiply 18 x 16

Common denominator = 16.

$$\begin{array}{rll}
 & 16\frac{3}{4}' & \\
\times & 18\frac{1}{4}' & \\
\hline
 & \frac{3}{16} & = 3 \\
 & 4 & \\
 & 13\frac{1}{2} & = 8 \\
 & 128 & \\
 & 16 & \\
\hline
 & 305 \qquad \frac{11}{16} & \text{sq. ft.} \\
 & 305\frac{11}{16} & \text{sq. ft.} \quad \text{ANS.}
\end{array}$$

Remember, when changing inches to a fraction of a foot, that there are 12" in 1'.

Make a rough check of the answer by multiplying the whole numbers and comparing the rough answer with the exact answer.

Multiplication of Fractions — Assignment Sheet No. 8

Follow the directions on Information Sheet No. 4 so you will learn to multiply fractions quickly and easily. Try both methods and adopt the method which is easier for you. Make your rough check.

Multiply:

1. $4\frac{1}{3} \times 3\frac{1}{4} =$
2. $5\frac{1}{2} \times 6\frac{1}{2} =$
3. $6\frac{2}{5} \times 5\frac{1}{4} =$
4. $\frac{1}{2} \times \frac{1}{2} =$
5. $\frac{3}{4} \times \frac{1}{2} =$
6. $\frac{1}{3} \times 7 =$
7. $20 \times \frac{1}{6} =$
8. $5\frac{1}{3} \times 6\frac{1}{3} =$
9. $8\frac{3}{4} \times 12\frac{1}{4} =$
10. $9\frac{1}{6} \times 11\frac{1}{4} =$
11. $4\frac{5}{6} \times 12\frac{1}{2} =$
12. $6\frac{1}{4} \times 7\frac{2}{3} =$
13. $102\frac{1}{2} \times 11\frac{1}{3} =$
14. $76\frac{1}{3} \times 6\frac{3}{4} =$
15. $88\frac{1}{6} \times 7\frac{1}{2} =$
16. $81\frac{3}{4} \times 5\frac{2}{3} =$
17. $\frac{1}{5} \times \frac{5}{6} =$
18. $1\frac{1}{4} \times 2\frac{1}{2} =$
19. $42\frac{1}{2} \times 8\frac{3}{14} =$
20. $36\frac{2}{3} \times 51\frac{5}{12} =$
21. $16\frac{1}{3} \times 15\frac{3}{4} =$
22. $17\frac{1}{2} \times 9 =$
23. $21 \times 12\frac{1}{4} =$
24. $6\frac{1}{3} \times 7\frac{3}{4} =$
25. $10\frac{3}{4} \times 11\frac{2}{3} =$
26. $18\frac{1}{2} \times 17\frac{3}{4} =$
27. $9\frac{3}{4} \times 17 =$
28. $33\frac{1}{3} \times 44\frac{1}{2} =$
29. $\frac{7}{8} \times 2\frac{2}{3} =$
30. $19\frac{3}{8} \times 8\frac{1}{2} =$
31. $5\frac{3}{4} \times 6\frac{2}{3} =$
32. $21\frac{1}{3} \times 23\frac{2}{3} =$
33. $11\frac{3}{4} \times 3\frac{1}{2} =$
34. $15\frac{3}{8} \times \frac{8}{9} =$
35. $21\frac{3}{4} \times 12\frac{2}{3} =$
36. $14\frac{1}{2} \times 9\frac{1}{4} =$
37. $7\frac{1}{4} \times 4\frac{2}{3} =$
38. $3\frac{5}{6} \times 2\frac{1}{2} =$
39. $\frac{5}{8} \times 5\frac{1}{3} =$
40. $122\frac{1}{3} \times 97\frac{2}{3} =$

Multiplication of Fractions (Feet and Inches) Assignment Sheet No. 9

Do the work as directed on Information Sheet No. 4. Remember to make a rough check.

Multiply:

1. $\frac{3}{4} \times 5\frac{1}{3} =$
2. $\frac{3}{8} \times 1\frac{1}{3} =$
3. $\frac{1}{6} \times 1\frac{1}{5} =$
4. $\frac{2}{3} \times 3\frac{3}{4} =$
5. $2\frac{1}{2} \times \frac{3}{10} =$
6. $4\frac{1}{2} \times \frac{2}{3} =$
7. $7\frac{1}{2} \times 3\frac{1}{3} =$
8. $2\frac{1}{7} \times 2\frac{1}{3} =$
9. $1\frac{1}{3} \times 2\frac{1}{2} =$
10. $12\frac{3}{8} \times 11\frac{3}{5} =$
11. $2\frac{2}{3} \times 3\frac{3}{4} =$
12. $1\frac{4}{5} \times 3\frac{1}{3} =$
13. $3\frac{1}{4} \times 2\frac{2}{3} =$
14. $3\frac{7}{8} \times 3\frac{1}{5} =$
15. $1\frac{3}{4} \times 2\frac{1}{3} \times 1\frac{1}{2} =$
16. $4\frac{1}{2} \times 4\frac{2}{3} \times 5\frac{1}{2} =$
17. $5\frac{1}{4} \times 2\frac{2}{3} \times 4\frac{1}{2} =$
18. $3\frac{1}{8} \times 2\frac{4}{5} \times 2\frac{1}{3} =$
19. $2\frac{5}{8} \times 2\frac{1}{3} \times 2\frac{2}{7} =$
20. $6\frac{2}{3} \times 3\frac{3}{4} \times 1\frac{1}{5} =$
21. $18\frac{1}{4} \times 42\frac{3}{8} =$
22. 55' 4" x 63' 8" =
23. 21' 3" x 43' 6" =
24. 37' 5" x 11' 8" =
25. 14' 6" x 21' 9" =
26. 33' 4" x 22' 3" =
27. 91' 2" x 7' 3" =
28. 77' x 21' 6" =
29. 147' x 15' 3" =
30. 36' x 21' 2" =
31. 63' x 31' 1" =
32. 29' 4" x 27' 4" =
33. 37' 9" x 33' 8" =
34. 72' 8" x 25' 3" =
35. 66' 9" x 21' 4" =
36. 189' 2" x 4' 9" =
37. 65' 3" x 27' 8" =
38. 57' 8" x 29' 3" =
39. 81' 6" x 37' 4" =
40. 55' 4" x 63' 8" =

Multiplication of Fractions
(Feet and Inches, Quantities, Costs)

Assignment Sheet No. 10

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1. How much is the total payroll for 11 men who worked 6 days each, 7 hours per day, and earned \$3.75 per hour?

2. A contractor built a foundation for \$7,865.75. He paid \$2,306.75 for labor, he bought 21,000 brick @ \$48.25 per 1,000, 225 bags of mortar cement @ \$1.11 per bag, 18 cu. yds. of sand @ \$3.75 per yard, and his overhead cost was \$927.50.
How much did he make?

3. It takes $6\frac{3}{4}$ brick to face 1 sq. ft. of wall. How many brick are needed to face a wall 73' 6" long and 6' high?

ADD:

4. $8\frac{1}{2}''$ + $10'\ 5\frac{3}{4}''$ + $72'\ 11\frac{13}{16}''$ + $155'\ \frac{5}{8}''$ + $29'\ 9\frac{3}{8}''$ =

5. $238'\ 4\frac{5}{16}''$ + $7'\ \frac{3}{8}''$ + $21'\ 9\frac{1}{4}''$ + $145'\ \frac{7}{16}''$ + $11\frac{1}{2}''$ =

SUBTRACT:

6. $2{,}059'\ 11\frac{3}{16}''$ - $1{,}039'\ 6\frac{3}{4}''$ =

7. $298'\ \frac{1}{8}''$ - $198'\ 6\frac{1}{2}''$ =

MULTIPLY:

8. 43' x 17' 4" =

9. 24' 4" x 18' 6" =

10. 36' 8" x 28' 9" =

11. 47' 3" x 32' 2" =

12. 19' 6" x 27' 4" =

13. 256' 2" x 11' 3" =

14. 79' 3" x 23' 9" =

15. 14' 8" x 13' 9" =

Multiplication of Fractions
(Feet and Inches, Quantities, Costs) Assignment Sheet No. 11

Make a rough check wherever appropriate in the following problems:

1. Nine men worked 5 days each, 8 hours per day, and earned a total of $1,350.00. How much did each man earn per hour?

2. A contractor built a foundation for $17,500.00. His labor cost $6,928.65, he bought 23 cu. yds. of concrete @ $13.95 per yard, 37,500 brick @ $42.75 per 1,000, 1,750 concrete blocks @ 29¢ per block, 294 bags of mortar cement @ $1.19 per bag, 29 cu. yds. of sand at $3.95 per yard; overhead cost was $2,826.50.
How much did he make?

3. It takes $6\frac{1}{2}$ brick to face 1 sq. ft. of wall. How many brick are needed to face a wall 288' long and 8' 8" high?

ADD:

4. 1,101' $4\frac{1}{4}''$ + $7\frac{7}{16}''$ + 247' $\frac{13}{16}''$ + 79' $11\frac{1}{2}''$ + 33' =

5. 8" + 1,042' $6\frac{5}{16}''$ + 198' $\frac{5}{8}''$ + 7' 3" + 201' $11\frac{11}{16}''$ =

SUBTRACT:

6. 795' 6" - 694' $\frac{1}{2}''$ =

7. 456' $9\frac{3}{8}''$ - 429' $8\frac{9}{16}''$ =

MULTIPLY:

8. 36' 8" x 39' 9" =

9. 27' 9" x 48' 8" =

10. 78' 3" x 26' 6" =

11. 127' 8" x 19' 9" =

12. 16' 4" x 21' 3" =

13. 37' 6" x 33' 8" =

14. 37' 2" x 21' 8" =

15. 14' 9" x 12' 4" =

Next try Test #2.

Multiplication of Fractions
(Feet and Inches, Quantities, Costs)

Assignment Sheet No. 12

Make a rough check wherever appropriate in the following problems:

1. Fifteen men laid 92,610 brick in 9 days, working 7 hours per day. How many brick did each man average in 1 hour?

2. A contractor built a foundation for \$13,500.00. His labor cost \$5,608.75. He bought 21 cu. yds. of concrete @ \$13.85 per yard, 16,000 brick @ \$47.25 per 1,000, 9,000 brick @ \$67.50 per 1,000, 295 bags of mortar cement @ \$1.07 per bag, 23 cu. yds. of sand @ \$3.95 per yard, and his overhead cost was \$796.85.
How much did the contractor make?

3. Nine men worked 7 days each, 8 hours per day, and earned \$13.45 per hour. How much was the total payroll?

ADD:

4. $141'\,2\frac{3}{4}'' + 9\frac{9}{16}'' + 21' + 23'\,11\frac{7}{8}'' + 7\frac{13}{16}'' =$

5. $7'\,11'' + 100' + 42'\,8\frac{15}{16}'' + 6\frac{7}{8}'' + 2'\,9\frac{15}{32}'' =$

SUBTRACT:

6. $1{,}468'\,\frac{3}{4}'' - 457'\,5\frac{1}{2}'' =$

7. $3{,}246'\,7\frac{1}{4}'' - 2{,}468'\,9'' =$

MULTIPLY:

8. 2' 6" x 3' 4" =

9. 5' 3" x 3' 4" =

10. 27' 3" x 16' 8" =

11. 89' x 23' 4" =

12. 32' 9" x 55' 8" =

13. 79' 3" x 23' 9" =

14. 36' 8" x 28' 9" =

15. 19' 6" x 27' 4" =

Multiplication of Fractions
(Feet and Inches, Quantities, Costs) — Assignment Sheet No. 13

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1. Seven men working 7 days each, 8 hours per day, averaged 117 brick per hour. How many brick did each man average per day?

2. It takes $6\frac{1}{2}$ brick to cover 1 sq. ft. of wall. How many brick are needed to cover the face of a wall 179' 6" long and 6' high?

3. A builder put up a foundation for $15,600.00. His labor cost was $5,896.25. He bought 32,500 brick @ $48.75 per 1,000, 1,250 block @ 30¢ each, 289 bags of mortar cement @ $1.13 per bag, 30 cu. yds. of sand @ $3.45 per yard and his overhead cost was $1,769.45. How much did he make?

ADD:

4. $627'\ 8\frac{5}{8}'' + 72'\ \frac{1}{2}'' + 9\frac{1}{4}'' + 17'\ \frac{7}{16}'' + 143'\ 7\frac{3}{8}'' =$

5. $569'\ \frac{3}{4}'' + 79'\ 6\frac{3}{16}'' + 125'\ \frac{9}{16}'' + 7'' + 47'\ 3\frac{7}{8}'' =$

SUBTRACT:

6. $789'\ 7'' - 279'\ \frac{5}{8}'' =$

7. $3{,}279'\ \frac{5}{16}'' - 1{,}378'\ 6\frac{3}{8}'' =$

MULTIPLY:

8. 2' 8" x 4' 9" =

9. 18' 4" x 17' 8" =

10. 14' 6" x 21' 9" =

11. 23' 8" x 19' 3" =

12. 77' 3" x 26' 8" =

13. 33' 4" x 22' 3" =

14. 47' 8" x 39' 9" =

15. 91' 2" x 7' 3" =

Multiplication of Fractions
(Feet and Inches, Quantities, Costs) Assignment Sheet No. 14

Make a rough check wherever appropriate in the following problems:

1. It takes 6$\frac{3}{4}$ brick to face 1 sq. ft. of wall. How many brick are needed to face a wall 245' 6" long and 7' high?

2. A builder put up a foundation for $15,750.00. His labor cost was $6,013.65. He bought 27 cu. yds. of concrete @ $13.75 per yard, 34,500 brick @ $39.50 per 1,000, 1,900 block @ 31¢ each, 269 bags of mortar cement @ $1.09 per bag, 27 cu. yds. of sand @ $3.95 per yard and his overhead cost was $1,985.75.
How much did the builder make?

3. What is the cost of an I-beam 27' 6" long which weighs 37$\frac{1}{4}$ lbs. per lineal foot and costs 19$\frac{1}{3}$¢ per lb.?

ADD:

4. 6' 8$\frac{3}{4}$" + 257' + 32' $\frac{13}{16}$" + 4' 11$\frac{7}{8}$" + 11$\frac{9}{16}$" =

5. 11" + 2' $\frac{5}{8}$" + 826' + 9' $\frac{9}{16}$" + 42' 11$\frac{1}{2}$" =

SUBTRACT:

6. 2,685' $\frac{5}{16}$" - 1,597' 11$\frac{3}{4}$" =

7. 196' 8$\frac{3}{8}$" - 89' 9$\frac{3}{16}$" =

MULTIPLY:

8. 37' x 21' 4" =

9. 3' 9" x 4' 4" =

10. 14' 6" x 21' 9" =

11. 43' 6" x 17' 4" =

12. 24' 4" x 18' 6" =

13. 15' 2" x 16' 3" =

14. 72' 9" x 27' 4" =

15. 188' 6" x 15' 3" =

16. 36' 8" x 14' 9" =

Next try Test #3.

Division of Fractions

Information Sheet No. 5

OBJECTIVE: To learn how to divide fractions.

INFORMATION:

When you divide a quantity, you separate it into portions which are the same size.

When you divide 6 by 2 $\left(\begin{array}{r}3\\ 2\overline{)6}\end{array}\right)$, you get the same answer as you do when you multiply

$$\frac{\cancel{6}^{3}}{1} \times \frac{1}{\cancel{2}} = 3.$$

This gives us another way of doing division problems, particularly convenient when we are dealing with fractions. In each case, this is what we do:

1. Change <u>both</u> numbers to fractions $(\frac{6}{1} \div \frac{2}{1})$.
2. <u>Invert</u> the divisor mentally $(\frac{1}{2})$.
3. <u>Multiply</u> the number by the inverted divisor $(\frac{\cancel{6}^{3}}{1} \times \frac{1}{\cancel{2}}) = 3$ ANS.

PROBLEM: $\frac{5}{8} \div 6$ (divisor) $=$

Change to fractions. $\frac{5}{8} \div \frac{6}{1} =$

Invert the divisor and multiply. $\frac{5}{8} \times \frac{1}{6} = \frac{5}{48}$ ANS.

PROBLEM: $7 \div 1\frac{3}{4}$ (divisor) $=$

Change to improper fractions. $\frac{7}{1} \div \frac{7}{4} =$

Invert the divisor and multiply, using cancellation. $\frac{\cancel{7}}{1} \times \frac{4}{\cancel{7}} = \frac{4}{1} = 4$ ANS.

PROBLEM: $5\frac{1}{3} \div 4 =$

Change to improper fractions. $\frac{16}{3} \div \frac{4}{1} =$

Invert the divisor, then multiply. Cancel. $\frac{\cancel{16}^{4}}{3} \times \frac{1}{\cancel{4}} = \frac{4}{3} = 1\frac{1}{3}$ ANS.

PROBLEM: $15\frac{7}{12} \div 3\frac{2}{3} =$

$$\frac{187}{12} \div \frac{11}{3} =$$

$$\frac{\overset{17}{\cancel{187}}}{\underset{4}{\cancel{12}}} \times \frac{\cancel{3}}{\cancel{11}} = \frac{17}{4} = 4\frac{1}{4} \quad \text{ANS.}$$

To divide dimensions (feet and inches) you change the inches to a fraction of a foot. Then solve the problem in the regular way. (You have not forgotten that 12" = 1' !)

PROBLEM: $10'\,6'' \div 4\frac{1}{2} =$

Change to feet and a fraction of a foot. $10\frac{1'}{2} \div 4\frac{1}{2} =$

Change to improper fractions. $\frac{21'}{2} \div \frac{9}{2} =$

Invert the divisor, then multiply. $\frac{\overset{7}{\cancel{21}}'}{\cancel{2}} \times \frac{\cancel{2}}{\underset{3}{\cancel{9}}} = \frac{7}{3} = 2\frac{1'}{3}$

Change the $2\frac{1'}{3}$ to feet and inches. $2\frac{1'}{3} = 2'\,4''$ ANS.

Make a rough check of your answer by multiplying the whole number of the answer by the whole number of the divisor. Or better still, multiply your entire answer by the divisor.

$$2'\,4'' = 2\frac{1'}{3} \times 4\frac{1}{2} = \frac{7'}{3} \times \frac{9}{2} = \frac{63'}{6} = 10\frac{3'}{6} = 10\frac{1'}{2} = \underline{\underline{10'\,6''}}$$

Division of Fractions **Assignment Sheet No. 15**

Be particularly careful when changing mixed numbers to improper fractions. Most errors are made at this point. Follow the directions of Information Sheet No. 5.

DIVIDE:

1. $\frac{9}{16} \div 3 =$
2. $\frac{15}{16} \div 5 =$
3. $\frac{3}{2} \div 3 =$
4. $\frac{27}{64} \div 9 =$
5. $\frac{63}{100} \div 9 =$
6. $\frac{48}{9} \div 4 =$
7. $\frac{56}{6} \div 4 =$
8. $\frac{72}{4} \div 6 =$
9. $10 \div 2\frac{1}{2} =$
10. $14 \div 3\frac{1}{3} =$
11. $21 \div 2\frac{2}{3} =$
12. $17 \div 1\frac{1}{4} =$
13. $18 \div 5\frac{1}{3} =$
14. $16 \div 1\frac{1}{2} =$
15. $9 \div 4\frac{1}{4} =$
16. $13 \div 1\frac{2}{3} =$
17. $27\frac{1}{2} \div 6\frac{1}{4} =$
18. $18\frac{3}{4} \div 2\frac{1}{2} =$
19. $22\frac{2}{3} \div 1\frac{3}{4} =$
20. $24\frac{3}{4} \div 8\frac{1}{4} =$
21. $16\frac{1}{2} \div 4\frac{1}{3} =$
22. $17\frac{1}{4} \div 2\frac{1}{2} =$
23. $15\frac{1}{3} \div 2\frac{2}{3} =$
24. $18\frac{1}{2} \div 4\frac{1}{2} =$

In the following problems, leave your answer in number of feet and fractions of a foot.

25. $16' \, 9'' \div 3\frac{1}{4} =$
26. $17' \, 6'' \div 2\frac{2}{3} =$
27. $18' \, 4'' \div 3\frac{1}{3} =$
28. $12' \, 9'' \div 2\frac{1}{2} =$
29. $24' \, 6'' \div 5\frac{2}{3} =$
30. $8' \, 8'' \div 2\frac{1}{2} =$

Division of Fractions (Feet and Inches)

Assignment Sheet No. 16

In solving the following problems, be particularly careful when dealing with fractions of a foot. Make a rough check.

Divide:

1. $9\frac{3}{8} \div 3\frac{3}{4} =$
2. $22\frac{2}{3} \div 4\frac{1}{4} =$
3. $7\frac{7}{12} \div 4\frac{1}{3} =$
4. $8\frac{3}{4} \div 2\frac{1}{2} =$
5. $15\frac{1}{2} \div 3\frac{1}{3} =$
6. $23\frac{3}{8} \div 4\frac{1}{4} =$
7. $94\frac{13}{16} \div 5\frac{1}{8} =$
8. $92\frac{1}{2} \div 7\frac{1}{2} =$
9. $32\frac{5}{8} \div 4\frac{1}{2} =$
10. $89\frac{1}{16} \div 6\frac{1}{4} =$
11. $28\frac{7}{8} \div 3\frac{1}{2} =$
12. $26\frac{1}{8} \div 5\frac{1}{2} =$
13. $19\frac{3}{8} \div 2\frac{1}{2} =$
14. $30\frac{3}{8} \div 6\frac{3}{4} =$
15. $55\frac{1}{4} \div 4\frac{1}{4} =$

In the following problems, work out your answer to feet and inches.

16. $110'\ 10'' \div 8\frac{3}{4} =$
17. $34'\ 10'' \div 4\frac{3}{4} =$
18. $55' \div 6\frac{2}{3} =$
19. $97'\ 6'' \div 4\frac{1}{2} =$
20. $87'\ 10'' \div 11\frac{1}{3} =$
21. $33'\ 3'' \div 7 =$
22. $39'\ 0'' \div 3\frac{1}{4} =$
23. $55'\ 3'' \div 4\frac{1}{3} =$
24. $42'\ 8'' \div 2\frac{2}{3} =$
25. $71'\ 9'' \div 3\frac{1}{2} =$
26. $14'\ 4'' \div 4 =$
27. $80'\ 6'' \div 6 =$
28. $63'\ 4'' \div 5 =$
29. $124'\ 3'' \div 7 =$
30. $189'\ 4'' \div 16 =$
31. $53'\ 4'' \div 4 =$
32. $78'\ 4'' \div 10 =$
33. $97'\ 3'' \div 3 =$
34. $88'\ 6'' \div 6 =$
35. $139'\ 7'' \div 5 =$

Division of Fractions
(Feet and Inches, Quantities) Assignment Sheet No. 17

OBJECTIVE: To learn to divide fractions and to divide quantities and areas into the standard units of measure used in the trade.

INFORMATION:

There are 9 square feet in 1 square yard. When you divide a given number of sq. ft. by 9, the answer is always square yards. All plastering is estimated by the square yard.

There are 27 cubic feet in 1 cubic yard. When you divide a given number of cu. ft. by 27, the answer is always cubic yards. Quantities of sand, gravel, concrete, and excavating are always estimated and paid for by the cubic yard.

In problems 1-20 and 36-40, give your answer in feet and inches. In problems 21-35, give your answer in square yards or cubic yards, as required. Make a rough check.

Divide:

1. 110' 10" ÷ $8\frac{3}{4}$ =
2. 34' 10" ÷ $4\frac{3}{4}$ =
3. 55' ÷ $6\frac{2}{3}$ =
4. 97' 6" ÷ $4\frac{1}{2}$ =
5. 87' 10" ÷ $11\frac{1}{3}$ =
6. 33' 3" ÷ 7 =
7. 69' 4" ÷ $3\frac{1}{4}$ =
8. 55' 3" ÷ $4\frac{1}{3}$ =
9. 42' 8" ÷ $2\frac{2}{3}$ =
10. 71' 9" ÷ $3\frac{1}{2}$ =
11. 14' 4" ÷ 4 =
12. 80' 6" ÷ 6 =
13. 63' 4" ÷ 5 =
14. 124' 3" ÷ 7 =
15. 189' 4" ÷ 16 =
16. 53' 4" ÷ 4 =
17. 78' 4" ÷ 10 =
18. 88' 6" ÷ 6 =
19. 139' 7" ÷ 5 =
20. 20' 2" ÷ $2\frac{3}{4}$ =
21. $139\frac{1}{2}$ sq. ft. ÷ 9 =
22. $114\frac{3}{4}$ sq. ft. ÷ 9 =
23. 201 sq. ft. ÷ 9 =
24. $160\frac{1}{2}$ sq. ft. ÷ 9 =
25. $262\frac{1}{2}$ sq. ft. ÷ 9 =

26. $465\frac{3}{4}$ cu. ft. ÷ 27 =
27. $1,282\frac{1}{2}$ cu. ft. ÷ 27 =
28. $535\frac{1}{2}$ cu. ft. ÷ 27 =
29. 1,071 cu. ft. ÷ 27 =
30. $388\frac{1}{8}$ cu. ft. ÷ 27 =
31. $178\frac{7}{8}$ sq. ft. ÷ 9 =
32. 231 sq. ft. ÷ 9 =
33. $87\frac{3}{4}$ sq. ft. ÷ 9 =
34. 1,812 cu. ft. ÷ 27 =
35. $1,300\frac{1}{2}$ cu. ft. ÷ 27 =
36. 31' 8" ÷ $6\frac{2}{3}$ =
37. 50' ÷ $7\frac{1}{2}$ =
38. 55' 7" ÷ $5\frac{3}{4}$ =
39. 25' 4" ÷ $5\frac{1}{3}$ =
40. 97' 6" ÷ $21\frac{2}{3}$ =

Division of Fractions
(Feet and Inches, Quantities, Costs) Assignment Sheet No. 18

ADD:

1. $238' \, 4\frac{5}{16}'' + 28' \, 9\frac{5}{8}'' + 145' \, \frac{7}{16}'' + 11\frac{1}{2}'' =$
2. $31' \, \frac{7}{8}'' + 47' \, 9\frac{3}{8}'' + 12' \, 2'' + 118' =$

SUBTRACT:

3. $2{,}059' \, 11\frac{3}{16}'' - 1{,}039' \, 6\frac{3}{4}'' =$
4. $298' \, \frac{3}{4}'' - 179' \, 4\frac{1}{2}'' =$

MULTIPLY:

5. $66' \, 8'' \times 17' \, 3'' =$
6. $65' \, 8'' \times 46' \, 9'' =$

DIVIDE:

7. $63' \, 4'' \div 5 =$
8. $11' \, 3'' \div 9 =$
9. $2' \, 3'' \div 3 =$
10. $42' \, 9'' \div 3 =$
11. $23' \, 4'' \div 4 =$
12. $337\frac{1}{2}$ cu. ft. $\div 27 =$
13. $506\frac{1}{4}$ cu. ft. $\div 27 =$
14. $1{,}246\frac{1}{2}$ sq. ft. $\div 9 =$
15. $807\frac{3}{4}$ sq. ft. $\div 9 =$
16. $18' \, 8'' \div 8 =$

17. Seven bricklayers worked 6 days each, 7 hours per day, and laid 32,046 brick. How many brick did each man average per hour?

18. Twelve bricklayers worked 14 days each, 7 hours per day, and earned a total of $4,410.00. How much did each man earn per day?

19. A builder put up a foundation for $19,800.00. His labor cost was $6,127.65. He bought 35 cu. yds. of concrete @ $13.85 per yard, 39,000 brick @ $67.75 per 1,000, 2,600 blocks @ 27¢ each, 358 bags of mortar cement @ $1.16 per bag, cu. yds. of sand @ $3.75 per yard, door bucks and window fram[illegible] cost $467.50, and his overhead cost was $2,369.75. How much profit did the builder make?

20. How much would a 24' long I-beam weighing $27\frac{1}{2}$ lbs. per lineal ft. cost if each lb. costs $19\frac{1}{2}$¢?

21. How many courses of brick are needed to build a wall 11' 11" high? The brick are to be laid 4 courses in 11".

Division of Fractions
(Feet and Inches, Quantities, Costs)

Assignment Sheet No. 19

You have reached the halfway mark in division of fractions. Cheer up, there is more to come. Remember to check your work.

ADD:

1. $133' + 8'' + 11'\,\frac{1}{2}'' + 89'\,6''$ =
2. $7' + 101'\,6'' + 8\frac{1}{2}'' + 92'\,11\frac{3}{4}''$ =

SUBTRACT:

3. $69'\,3\frac{1}{4}'' - 22'\,8\frac{5}{8}''$ =
4. $4{,}270' - 1{,}485'\,6\frac{5}{8}''$ =

MULTIPLY:

4. $129'\,3'' \times 38'\,8''$ =
6. $145'\,9'' \times 129'\,6''$ =

DIVIDE:

7. $124'\,3'' \div 7$ =
8. $88'\,6'' \div 6$ =
9. $154' \div 8$ =
10. $18'\,9'' \div 2\frac{1}{2}$ =
11. $17'\,4'' \div 4$ =
12. $4{,}079\frac{1}{4}$ sq. ft. $\div\ 9$ =
13. $3{,}989\frac{1}{4}$ cu. ft. $\div\ 27$ =
14. $841\frac{1}{2}$ sq. ft. $\div\ 9$ =
15. $2{,}139\frac{3}{4}$ cu. ft. $\div\ 27$ =
16. $51 \div 4\frac{1}{2}$ =

17. Seventeen men worked 15 days, 7 hours per day each, and laid a total of 156,485 brick. How many brick per day did each man average?

18. Fifteen men worked 9 days each, 7 hours per day and earned $4.05 per hour. How much is the total payroll for the men?

19. How much does an I-beam 54' 6" long, weighing 39 lbs. per lineal foot, cost @ 18¢ per lb.?

20. A builder did a job for $18,500.00. His labor cost was $6,015.00. He bought 37 cu. yds. of concrete @ $12.95 per yard, 37,500 brick @ $39.75 per 1,000, 2,550 blocks @ 27½% each, 269 bags of Portland cement @ $1.28 per bag, 179 bags of lime @ 98¢ per bag, 38 cu yds. of sand @ $3.87½ per yard, door bucks, window frames and lintels cost $347.65; he bought the I-beam in problem #19 and 4 lally columns 8' long @ 78¢ per foot, his overhead cost was $1,997.67. How much profit did the builder make?

Division of Fractions
(Feet and Inches, Quantities, Costs) Assignment Sheet No. 20

Check your answers to the following problems:

ADD:

1. 7' 6" + 2' $\frac{3"}{4}$ + $9\frac{1"}{2}$ + 11" + $3\frac{5"}{16}$ =

SUBTRACT:

2. 17' 5" - 9' $8\frac{1"}{4}$ =

MULTIPLY:

3. 17' 3" x 9' 6" =
4. 9' 8" x 15' 4" =
5. 73' 9" x 9' 8" =

DIVIDE:

6. 16' 4" ÷ $4\frac{2}{3}$ =
7. 10' 10" ÷ $2\frac{1}{2}$ =
8. 35' 9" ÷ $4\frac{1}{3}$ =
9. 25' 6" ÷ 6 =
10. 269 sq. ft. ÷ 9 =
11. $427\frac{1}{2}$ sq. ft. ÷ 9 =
12. 1,200 sq. ft. ÷ 9 =
13. $418\frac{1}{2}$ cu. ft. ÷ 27 =
14. $1,005\frac{3}{4}$ cu. ft. ÷ 27 =
15. 657 cu. ft. ÷ 27 =

16. How much does a 37' 6" long I-beam weighing 33 lbs. per lineal foot cost @ 22¢ per lb.?

17. A builder put up a foundation for $8,500.00. His overhead cost was $723.75. He bought 12,500 brick @ $56.50 per 1,000, 2,100 blocks @ 26¢ per block, 27 cu. yds. of concrete @ $18.75 per yard, 30 cu yds. of sand @ $5.50 per yard, 157 bags of mortar cement @ $1.27 per bag, and the I-beam in problem #16; his labor cost was $1,295.75.
How much did the builder make?

Division of Fractions
(Feet and Inches, Quantities, Costs **Assignment Sheet No. 21**

Check your answers to the following problems:

ADD:

1. $9'\,\frac{3}{4}'' + 11' + 12\frac{13}{16}'' + 4'\,5'' + 3'\,11\frac{7}{8}'' =$

SUBTRACT:

2. $72'\,8\frac{1}{4}'' - 27'\,10\frac{5}{8}''$

MULTIPLY:

3. 67' 8" x 34' 3" =
4. 8' 9" x 12' 4" =
5. 19' 6" x 17' 8" =

DIVIDE:

6. $18'\,1'' \div 3\frac{1}{2} =$
7. $13'\,9'' \div 3\frac{2}{3} =$
8. $25'\,4'' \div 5\frac{1}{3} =$
9. 19' 3" ÷ 7 =
10. 348 sq. ft. ÷ 9 = ÷
11. $787\frac{1}{2}$ sq. ft. ÷ 9 =
12. 1,400 sq. ft. ÷ 9 =
13. $1{,}282\frac{1}{2}$ cu. ft. ÷ 27 =
14. $1{,}052\frac{1}{4}$ cu. ft. ÷ 27 =
15. 723 cu. ft. ÷ 27 =

16. How much does 29' 6" long I-beam weighing 41 lbs. per lineal foot cost @ 26¢ per lb.?

17. A builder put up a foundation for $8,500.00. His overhead cost was $815.67. He bought 11,500 brick @ $57.50 per 1,000, 2,350 blocks @ 23¢ per block, 28 cu. yds. of concrete @ $18.25 per yard, 27 cu. yds. of sand @ $5.65 per yard, 179 bags of mortar cement @ $1.23 per bag and the I-beam in problem #16; his labor cost was $1,379.85.
How much did the builder make?

Division of Fractions
(Feet and Inches, Quantities, Costs) Assignment Sheet No. 22

Check your answers to the following problems:

ADD:

1. $7'\ 6'' + 12\frac{3}{4}'' + 2'\ \frac{7}{8}'' + 11' + 3'\ 9\frac{5}{6}'' =$

SUBTRACT:

2. $35'\ 8'' - 21'\ 9\frac{1}{4}'' =$

MULTIPLY:

3. $29'\ 8'' \times 35'\ 9'' =$

4. $9'\ 9'' \times 16'\ 4'' =$

DIVIDE:

5. $21'\ 8'' \div 6\frac{1}{2} =$

6. $19'\ 6'' \div 6 =$

7. $63'\ 9'' \div 5 =$

8. 423 sq. ft. $\div$ 9 =

9. $265\frac{1}{2}$ sq. ft. $\div$ 9 =

10. 1,250 cu. ft. $\div$ 27 =

11. 1,521 cu. ft. $\div$ 27 =

12. $985\frac{1}{2}$ cu. ft. $\div$ 27 =

13. How many lath are needed to cover 627 sq. yds. of wall if it takes 800 lath to cover 50 sq. yds. of wall?

14. A block 18" long and 8" high covers 1 sq. ft. of wall surface. How many block are needed for a wall 97' 6" long and 13' high?

15. How many sq. yds. are in a wall 83' long and 12' high?

16. Seventeen bricklayers, working 8 hours per day each, laid 100,912 brick in 7 days. How many brick did each man average per day?

17. A builder put up a foundation for $7,850.00. His overhead cost was $805.50. He bought 12,500 brick @ $57.50 per 1,000, 2,250 blocks @ 23¢ per block, 27 cu. yds. of concrete @ $18.25 per yard, 29 cu. yds. of sand @ $5.65 per yard, 189 bags of mortar cement @ $1.23 per bag and an I-beam 39 ft. long, weighing $27\frac{1}{2}$ lbs. per lineal foot, @ 24¢ per lb.; the labor cost was $1,425.75.
How much did the builder make?

Division of Fractions
(Feet and Inches, Quantities, Costs   Assignment Sheet No. 23

Remember to check your work in the following problems:

ADD:

1. $72'\ \frac{1}{2}'' + 2'\ 6'' + 9\frac{7}{8}'' + 11'' + 12'\ 1\frac{3}{4}'' =$

SUBTRACT:

2. $86'\ 9\frac{7}{16}'' - 47'\ 5\frac{3}{4}'' =$

MULTIPLY:

3. $17'\ 8'' \times 14'\ 6'' =$

4. $87'\ 8'' \times 17'\ 4'' =$

DIVIDE:

5. $43'\ 9'' \div 5\frac{1}{4} =$

6. $38'\ 9'' \div 5 =$

7. $12'\ 8'' \div 2\frac{2}{3} =$

8. 273 sq.ft. $\div$ 9 =

9. $337\frac{1}{2}$ sq. ft. $\div$ 9

10. 1,427 cu. ft. $\div$ 27

11. $1{,}167\frac{3}{4}$ cu. ft. $\div$ 27

12. $526\frac{1}{2}$ cu. ft. $\div$ 27

13. How much will an I-beam $27\frac{1}{2}''$ long cost? It weighs 42 lbs. per lineal foot and costs 23¢ per pound.

14. It takes 620 lath to cover 40 sq. yds. of wall. How many lath are needed to cover 519 sq. yds. of wall?

15. It takes $6\frac{1}{4}$ brick to face 1 sq. ft. of wall. How many brick are needed to face a wall 137' 6" long and 9' high?

16. Seven men worked 8 hours per day for 9 days and earned $2,167.20. How much did each man earn per hour?

17. A builder put up a foundation for $12,500.00. His overhead was $1,376.85. He bought 18,500 brick @ $55.50 per 1,000, 2,850 blocks @ 24¢ per block, 29 cu. yds. of concrete @ $1[illegible] per yard, 23 cu. yds. of sand @ $5.45 per yard, 217 bags of mor[illegible]ement @ $1.24 per bag, 3 lally columns 8' long @ $1.65 per foot, and the I-beam in problem #13. His labor cost was $2,874.50.
How much did the builder make?

Now go on to Test #4.

UNIT II - DECIMAL FRACTIONS

Review of Meaning of Decimals

Information Sheet No. 1

OBJECTIVES: To review the concept of decimal fractions.
To learn to convert common fractions to decimal fractions, and decimal fractions to common fractions.

INFORMATION:

A decimal fraction is one which has no written denominator. The denominator of a decimal fraction is understood to be 10, or 10 multiplied by itself one or more times. The denominator of a decimal fraction is given by the position of the decimal point. There are as many zeros in the denominator as there are numbers to the <u>right</u> of the decimal point. Numbers to the left of the decimal point are whole numbers.

Decimal Fraction		Common Fraction	
.2	=	$\frac{2}{10}$	Two tenths
1.06	=	$1\frac{6}{100}$	One and six hundredths
25.159	=	$25\frac{159}{1000}$	Twenty-five and one hundred fifty-nine thousandths

You will need to know how to add, subtract, multiply, and divide decimal fractions. You add, subtract, multiply and divide decimal fractions exactly as you do whole numbers, BUT you must be certain to put the <u>decimal point</u> in the right place throughout your work and in the answer.

Here is a list of some of the common fractions and their decimal equivalents. As you can see, the decimal equivalentscan be obtained by actually dividing the denominator of the fraction into the numerator.

$\frac{1}{2}$	=	.5	$\begin{array}{r} .5 \\ 2/\overline{1.0} \end{array}$	
$\frac{1}{4}$	=	.25	$\begin{array}{r} .25 \\ 4/\overline{1.00} \end{array}$	
$\frac{1}{5}$	=	.2	$\begin{array}{r} .2 \\ 5/\overline{1.0} \end{array}$	
$\frac{1}{6}$	=	.167	$\begin{array}{r} .166\frac{2}{3} \\ 6/\overline{1.000} \end{array}$	= .167
$\frac{1}{8}$	=	.125	$\begin{array}{r} .125 \\ 8/\overline{1.000} \end{array}$	
$\frac{1}{10}$	=	.1	$\begin{array}{r} .1 \\ 10/\overline{1.0} \end{array}$	

Decimal values:

.2	3	4	5	6
Tens	Hundredths	Thousandths	Ten Thousandths	Hundred Thousandths

Addition of Decimal Fractions — Information Sheet No. 2

OBJECTIVE: To learn how to add decimals.

INFORMATION:

Adding decimals is just like adding whole numbers except that you must keep all the decimal points directly under each other in a straight line. If you do not list each number properly you will arrive at the wrong answer.

ADD: 6.1 + 362.007 + 23.12 + .86

If you cannot keep the numbers in their proper places, draw a line as a guide.

Be sure to put the decimal point of your answer in the right place before you add.

6.	1	
362.	007	
23.	12	
.	86	
392.	087	ANS.

Subtraction of Decimal Fractions — Information Sheet No. 3

OBJECTIVE: To learn how to subtract decimals.

INFORMATION:

Subtracting decimals is just like subtracting whole numbers. BUT- be certain that the numbers are listed with the decimal points directly in line with each other.

SUBTRACT: 12.56 - 8.29 =

List correctly. Place decimal point of the answer in the proper place before subtracting.

$$\begin{array}{r} 12.56 \\ \underline{8.29} \\ 4.27 \\ \uparrow \end{array} \quad \text{ANS.}$$

SUBTRACT: 18.6 - 12.43 =

List correctly. Having only 1 decimal place in the top number you have nothing from which to subtract the 3. so you add a zero to the right of the .6 making it .60. This does not change the value of the decimal ($\frac{60}{100} = \frac{6}{10}$) and now you can subtract to get the correct answer.

$$\begin{array}{r} 18.6 \\ -\ \underline{12.43} \end{array}$$

$$\begin{array}{r} 18.60 \\ -\ \underline{12.43} \\ 6.17 \end{array} \quad \text{ANS.}$$

SUBTRACT: 21.58 - 14.7 =

List correctly. Having 2 decimal places in the top number and only one in the bottom number, subtract as though there were a zero after the 7. Watch the decimal point.

$$\begin{array}{r} 21.58 \\ -\ \underline{14.7} \\ 6.88 \end{array} \quad \text{ANS.}$$

Addition and Subtraction of Decimal Fractions — Assignment Sheet No. 1

Follow the directions on Information Sheets 1, 2, and 3. List all numbers clearly, neatly and correctly. Be sure the decimal point is in the right place.

ADD:

1. .97 + 8.5 + 12.06 + .469 =
2. 9 + 6.15 + 11.869 + .7 =
3. .6 + 9.07 + 2.4 + 12.156 =
4. 123.3 + .775 + 26.9 + 1.23 + 14.246 =
5. 1.587 + 201.6 + .075 + 2.67 + 101.369 =
6. .69 + 17.874 + 1,828.25 + 13.3 + 9.99 =
7. 3.6 + 137.586 + 6.459 + 32.2 + 2,658.877 =
8. 47.4 + 6.579 + 1,825.6 + 39.85 + 4.327 =
9. 152.3 + 7.355 + 18.7 + 3,429.86 + 76.59 =
10. .08 + 6.763 + 125.68 + 7.9 + 2.318 =

SUBTRACT:

11. 23.05 - 16.6 =
12. 71.6 - 14.74 =
13. 6.783 - 2.867 =
14. 125.4 - 10.689 =
15. 17.66 - 8.4 =
16. 23.845 - 16.5 =
17. 5.89 - 3.799 =
18. 1,447.62 - 758.673 =
19. 12.357 - 3.45 =
20. 16.791 - 6.26 =

Change the following fractions to decimals:

21. $\frac{1}{4}$

22. $\frac{1}{10}$

23. $\frac{2}{5}$

24. $\frac{1}{8}$

25. $\frac{9}{10}$

26. $\frac{1}{3}$

27. $\frac{7}{8}$

28. $\frac{2}{3}$

29. $\frac{3}{4}$

30. $\frac{1}{2}$

31. $\frac{7}{10}$

32. $1\frac{3}{5}$

33. $6\frac{1}{8}$

34. $3\frac{1}{3}$

35. $10\frac{3}{100}$

Change the following decimals to fractions. Reduce to lowest terms.

36. .5

37. .75

38. .06

39. .125

40. .6

41. .45

42. .07

43. .625

44. 1.68

45. .4

46. .65

47. 2.75

48. 13.05

49. 6.98

50. 10.15

Multiplication of Decimal Fractions — Information Sheet No. 4

OBJECTIVE: To learn the right way to multiply decimals.

INFORMATION:

To multiply decimals, again you must be careful to list your numbers neatly and correctly. You do not list the decimals so that the decimal points line up. Instead you place the numbers of the multiplier under the multiplicand starting at the right and working to the left.

2.895 x 3.2 is written:

$$\begin{array}{rrl} & 2.895 & \text{(multiplicand)} \\ \times & \underline{3.2} & \text{(multiplier)} \end{array}$$

17.2 x .46 is written:

$$\begin{array}{rrl} & 17.2 & \text{(multiplicand)} \\ \times & \underline{.4\ 6} & \text{(multiplier)} \end{array}$$

You multiply just as for whole numbers, and when you have the answer you must place the decimal point in the right place. The important point to learn in multiplication is to get the right number of decimal places in the answer.

PROBLEM: 2.895 x 3.2

To determine the number of decimal places in your answer, you add the number of decimal places in the multiplicand (3) and the multiplier (1). 3 + 1 = 4.

$$\begin{array}{rrl} & 2.895 & \text{(multiplicand)} \\ \text{X} & \underline{3.2} & \text{(multiplier)} \\ & 5790 & \\ & \underline{8685\ \ } & \\ & 9.2640 & \text{ANS.} \\ & \uparrow\ \ \ \ \ \ \ & \end{array}$$

Starting at the right in your answer, count off 4 places toward the left. Put the decimal point in front of the 4th number. To make a rough check on your answer, multiply the whole numbers in the problem and compare this with the answer. If the 2 results are reasonably close, you have the decimal point in the right place.

Multiplication of Decimal Fractions — Assignment Sheet No. 2

Follow the instructions on Information Sheet No. 4. List your figures neatly and clearly. Check each problem for accuracy. Be sure you place the decimal points properly and so that they can be seen easily.

MULTIPLY:

1. 1.47 x 7 =
2. 382 x .08 =
3. 840 x .005 =
4. .006 x .07 =
5. 1.56 x 7.2 =
6. 7.071 x 9 =
7. 12.4 x 3.5 =
8. 65.1 x 2.7 =
9. 3.08 x .45 =
10. 1.63 x 4.3 =
11. .6 x 5 =
12. .04 x .7 =
13. 875 x .016 =
14. 24.56 x 4.31 =
15. 17 x $40.83 =
16. 34 x $4.85 =
17. .41 x 51.2 =
18. 16 x $.79 =
19. .008 x 9.48 =
20. .512 x .305 =
21. $3.78 x 17.5 =
22. .9 x 3.33 =
23. 17.25 x $14.40 =
24. 238.5 x .12 =
25. 1.98 x 20.5 =

Division of Decimal Fractions — Information Sheet No. 5

OBJECTIVE: To learn the proper way to divide decimals.

INFORMATION:

In dividing decimals, it is most important to place the decimal point in the right place.

There are different kinds of division problems involving decimals, as you will see. But in all kinds, the most important point is the placing of the decimal point.

PROBLEM: 16.5 ÷ 6=

When you divide a decimal by a whole number, you place the decimal point in the answer directly above the decimal point in the dividend.

(Decimal point)
2.75 Answer
(Divisor) 6/16.5 Dividend

To check your answer you multiply your answer by the divisor. This should be the same as the dividend.

2.75 (Answer)
x 6 (Divisor)
16.50 (Dividend)

PROBLEM: 16.5 ÷ 4.4 =

(A decimal divided by a decimal). Move the decimal point to the right one place in both the dividend and the divisor. Your dividend will then be 165. The decimal point in your answer will be directly above the decimal point which you moved behind the 5. Since 44 will not divide evenly into 165, you add 0's to the right of the decimal point in the dividend to get your answer.

Decimal point)
3.75 (Answer)
(Divisor) 4‸4./16‸5.00 (Dividend)
13 2
3 3 0
3 0 8
2 2 0
2 2 0

Check your answer:

3.75 (Answer)
x 4.4 (Divisor)
150 0
150 0
16.50 0 (Dividend)

PROBLEM: 2.6 ÷ .08 =

The divisor has 2 decimal places and the dividend only 1. Before you can move the decimal point you must place a zero after the six. Then move the decimal point 2 places to the right in both the divisor and the dividend. In order to complete the division, you will find it necessary to add a zero to the right of the decimal point in the dividend. The decimal point in the answer is directly above the new position of the decimal point in the dividend.

```
                  ┌ (Decimal point)
                  ↓
                32.5        (Answer)
             ─────────
Divisor o08./2o60.0         (Dividend)
             2 4↓  |
             ───   |
              20   |
              16   ↓
              ──
               40
               40
               ──
```

Check your answer.

```
  32.5   (Answer)
x  .08   (Divisor)
──────
2.6 00   (Dividend)
↑
```

PROBLEM: .855 ÷ .05 =

Before you divide, you must move the decimal point in both divisor and dividend 2 places to the right. This changes .855 to 85.5, and .05 to 5. The decimal point in the answer is directly above the new position of the decimal point in the dividend.

```
                 ┌ (Decimal point)
                 ↓
               17.1   (Answer)
             ───────
Divisor o05./o85.5    (Dividend)
              5↓  |
              ──  |
              35  |
              35  ↓
              ─────
                  5
                  5
                  ─
```

Check your answer.

```
  17.1   (Answer)
x .0 5   (Divisor)
──────
  .85 5  (Dividend)
```

In all the sample problems, you will note that the same general procedure was followed. First the divisor was changed to a whole number. Then the decimal point in the dividend was moved to the right as many places as it was necessary to move the decimal point in the divisor. So long as you move both decimal points the same number of places to the right, you do not change the value of the division problem, and your answer should be correct.

Follow the directions on Information Sheet No. 5. Be sure the decimal point is in the right place. Carry out your answer to 3 decimal places where necessary. Remember to check your answers.

DIVIDE:

1. .72 ÷ .6 =
2. 2.55 ÷ 3 =
3. 16.75 ÷ .5 =
4. .9984 ÷ 3.84 =
5. 60.8 ÷ .008 =
6. 1.026 ÷ .19 =
7. 18.99 ÷ 1.5 =
8. 888 ÷ .048 =
9. 150 ÷ 5.5 =
10. 240 ÷ 6.75 =
11. 48 ÷ 2.5 =
12. 63 ÷ 4.25 =
13. 58 ÷ 1.8 =
14. 75.5 ÷ 6 =
15. 18.5 ÷ 2.25 =
16. 27 ÷ 1.5 =
17. 32 ÷ 3.8 =
18. 29 ÷ 2.3 =
19. 15.6 ÷ 1.4 =
20. 21.5 ÷ 2.25 =

OBJECTIVE: To learn the meaning of per cent and how to change per cents to common fractions and to decimals.

INFORMATION:

Per cents are fractions which are expressed in a different way from common fractions and decimal fractions. A per cent is a fraction with a denominator of 100. Instead of writing the complete fraction, only the numerator is written, with the % sign.

Per Cent		Common Fraction		Decimal Fraction
25%	=	$\frac{25}{100} = \frac{1}{4}$	=	.25
5%	=	$\frac{5}{100} = \frac{1}{20}$	=	.05
$3\frac{1}{2}$%	=	$\frac{3.5}{100} = \frac{35}{1000} = \frac{7}{200}$	=	.035
17.5%	=	$\frac{17.5}{100} = \frac{175}{1000} = \frac{7}{40}$	=	.175
100%	=	$\frac{100}{100} = 1$	=	1.00
150%	=	$\frac{150}{100} = 1\frac{50}{100} = 1\frac{1}{2}$	=	1.5

To change per cent to a fraction, you write it as the numerator of a fraction having a denominator of 100. $25\% = \frac{25}{100} = \frac{1}{4}$.

To change per cent to a decimal, multiply the per cent by .01.
$25\% = 25 \times .01 = .25$

When changing from per cent to a decimal or a fraction, you must drop the per cent sign. Here is what happens if you fail to drop the per cent sign after the change.

$$25\% = 25\% \times .01 = .25$$
$$.25\% = \frac{.25}{100} \quad \frac{25}{10{,}000} = \frac{1}{400}$$

You started with $25\% = \frac{25}{100} = \frac{1}{4}$. There is a big difference between $\frac{1}{4}$ and $\frac{1}{400}$. But, if you forget to drop the per cent sign, your answer will be only a hundredths of what it should be! So, be sure you do your work accurately, and don't forget to drop the per cent sign when changing a per cent to a fraction or a decimal.

Solve the problems below by following the instructions on Information Sheet No. 6.

Change the following per cents to common fractions. Reduce to lowest terms.

1. 6%
2. 10%
3. 25%
4. 30%
5. 40%
6. 75%
7. 60%
8. $33\frac{1}{3}\%$
9. $2\frac{1}{2}\%$
10. 12.5%
11. 125%
12. 250%

Change the following per cents to decimal fractions:

13. 5%
14. 15%
15. $12\frac{1}{2}\%$
16. 65%
17. 17.5%
18. $3\frac{1}{2}\%$
19. $7\frac{1}{2}\%$
20. 4%
21. $6\frac{3}{4}\%$
22. 78%
23. 100%
24. 175%
25. 1%

Change the following decimals to per cents:

26. .25
27. .50
28. .9
29. .85
30. 1.25
31. .06
32. .045
33. 2.5
34. .99
35. .375

Change the following fractions to per cents:

36. $\frac{1}{10}$
37. $\frac{3}{5}$
38. $\frac{1}{2}$
39. $\frac{1}{4}$
40. $\frac{1}{8}$
41. $\frac{7}{10}$
42. $\frac{1}{6}$
43. $\frac{2}{3}$
44. $\frac{4}{5}$
45. $\frac{1}{20}$

Multiplication and Division of Per Cents

Assignment Sheet No. 5

There will be a great many occasions when you will have to use per cents. Learning to work with per cents quickly and accurately will make your job easier. Follow the instructions on Information Sheets 7 and 8.

1. 5% of 275 =
2. 15% of 718 =
3. 25% of 15,894 =
4. $16\frac{2}{3}\%$ of 7,896 =
5. 6% of 15,275 =
6. $4\frac{1}{2}\%$ of 5,000 =
7. 7.5% of 4,270 =
8. $5\frac{1}{4}\%$ of 1,268 =
9. 10% of 15,789 =
10. 120% of 19,675 =
11. 6% of what number is 68?
12. 10% of what number is 27?
13. $12\frac{1}{2}\%$ of what number is 16%
14. 20% of what number is 49?
15. 77 is 40% of what number?
16. 126 is 8% of what number?
17. A man borrowed $2400, signing a promissory note to repay the money in a year at 6% interest. How much interest did he have to pay?
18. A contractor bought a truck listed at $3275, and was allowed a 7% discount from the list price. How much did he pay for the truck?
19. A contractor stated that 20% of his working capital was invested in a certain building project. If $13,500 was invested in it, what was the man's capital?
20. A salesman received a weekly salary of $85 and a commission of 2% on all his sales. His sales on Monday amounted to $510.50, on Tuesday, $740.15, on Wednesday, $315.80, on Thursday $418.00, and on Saturday, $1024.50. What were his total earnings for the week?

Review of Decimals and Per Cents

Assignment Sheet No. 6

ADD:

1. $2.70 + .063 + 79 + 8.1 + .8 =$
2. $125.06 + 12 + .12 + 1.2 + 11.2 =$
3. $7\% + 12\% + 5\frac{1}{2}\% + 40\% + 110\% =$

SUBTRACT:

4. $275.26 - 188.674 =$
5. $5.7382 - 2.687 =$
6. $23\% - 8\frac{1}{2}\% =$

MULTIPLY:

7. $6.528 \times 4.67 =$
8. $510.8 \times 6.72 =$
9. $16\frac{2}{3}\%$ of $7125 =$
10. $2.7 \times 61.82 =$
11. $6\frac{1}{2}\%$ of $428 =$
12. $17\frac{1}{2} \times \$4.50 =$
13. 120% of $345 =$
14. $218 \times .006 =$
15. $3\frac{1}{2}\%$ of $\$489.00 =$

DIVIDE:

16. $8.7 \div .03 =$
17. $.98 \div 4 =$
18. $326.4 \div .025 =$
19. 28 is 15% of what number =
20. $7\frac{1}{2}\% \div 3 =$
21. $.8946 \div 2.4 =$

CHANGE TO DECIMAL FRACTIONS:

22. $6\frac{1}{2}\%$
23. $12\frac{1}{2}\%$
24. 150%
25. $3\frac{3}{4}\%$

CHANGE TO COMMON FRACTIONS:

26. 5%
27. $7\frac{1}{2}$%
28. $12\frac{1}{2}$%
29. 75%
30. 140%

CHANGE TO DECIMALS:

31. $\frac{7}{10}$
32. $\frac{2}{3}$
33. $\frac{5}{8}$
34. $\frac{3}{20}$
35. $\frac{1}{100}$

CHANGE TO FRACTIONS AND REDUCE TO LOWEST TERMS:

36. .25
37. .35
38. .2
39. .125
40. .99

CHANGE TO PER CENTS:

41. .5
42. .333
43. .17
44. 1.5
45. 6.

CHANGE TO PER CENTS:

46. $\frac{3}{10}$
47. $\frac{4}{5}$
48. $\frac{1}{20}$
49. $\frac{3}{50}$
50. $2\frac{3}{4}$

Test #5 comes next.

OBJECTIVE: To learn how to multiply by per cents.

INFORMATION:

To multiply by a per cent, first you must change the per cent to a decimal or common fraction, then multiply.

PROBLEM: 25% of 160 =

A. Change to a fraction: $25\% = \frac{25}{100} = \frac{1}{4}$

$\frac{1}{4} \times 160 = 40$ ANS.

B. Change to a decimal: $25\% = .25$

$.25 \times 160 = 40.00$ ANS.

↑
decimal point

In solving the problems you will encounter in your work, you will find that sometimes it is easier to convert the per cent to a fraction, and sometimes to a decimal. You will naturally do whichever is simpler. But it is important to know and practice both ways.

OBJECTIVE: To learn when and how to divide by per cents.

INFORMATION:

To find a number when you know the per cent of the number, you must divide by the per cent. Proceed as in the problem below.

PROBLEM: 35% of a number is 7. Find the number.

$$35\% \times ? = 7$$

Change the per cent to a decimal fraction. $35\% = .35 \qquad .35 \times ? = 7$

Use the decimal fraction (.35) as the divisor. Use the number (7) as the dividend. Then divide.

$$\begin{array}{r} 20.\ \text{ANS.} \\ .35\overline{)7.00.} \\ \underline{7\ 0} \\ 00 \end{array}$$

Check the answer.

$$\begin{array}{r} 20 \\ \times\ \underline{.35} \\ 100 \\ \underline{60\ } \\ 7.00 \\ \uparrow \end{array}$$

decimal point

In some cases it is easier to convert the per cent to a common fraction rather than to a decimal before dividing.

PROBLEM: 25% of a number is 110. What is the number?

Changing to a common fraction, $25\% = \frac{25}{100} = \frac{1}{4}$

$$\frac{1}{4} \times ? = 110$$

Divide 110 by $\frac{1}{4}$: $110 \div \frac{1}{4} = \frac{110}{1} \times \frac{4}{1} = \frac{440}{1} = 440$ ANS.

Check the answer. $440 \times \frac{1}{4} = \frac{\overset{110}{\cancel{440}}}{1} \times \frac{1}{\cancel{4}} = 110$

UNIT III - SQUARE MEASURE

Areas of Perimeters of Squares,
Rectangles, Triangles, Circles

Information Sheet No. 1

OBJECTIVE: To learn how to find the area of the different shaped surfaces most often used in construction.

Think! What you can do with your brain you do not have to do with your back.

INFORMATION:

Square measure is the method of finding out how much space the surface of an object or building covers. This is done by figuring out how many squares of a certain size are needed to cover the surface. The size of the surface is called its area. The unit of measure used most often is 1 foot.

Surfaces have different shapes. Squares, rectangles, triangles, and circles are encountered most.

Surfaces have no depth or thickness. They have only 2 dimensions, length and width (or height).

Square: A square is a 4-sided figure whose sides are all the same length and are at right angles to each other. The sides of a square are known as the length and width (or height).

To find the area of a square, multiply the length by the width (or height).
Fig. 1:

Length 2'
Height 2'

2' x 2' = 4 sq. ft. area of Fig. 1

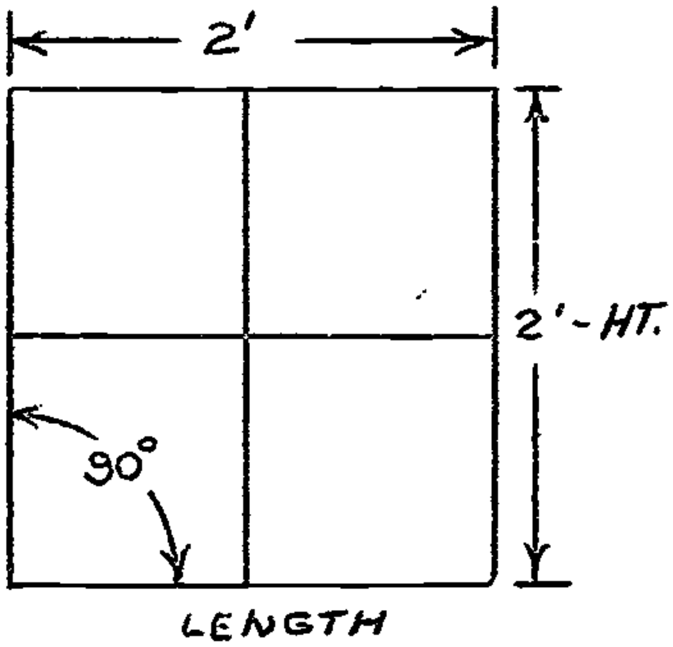


FIG. 1
SQUARE

Rectangle:
A rectangle is a 4-sided figure in which the sides opposite each other are the same size. The sides are at right angles to each other.

To find the area of a rectangle, multiply the length by the width (or height).
Fig. 2:

Length 3'
Height 2'

2' x 3' = 6 sq. ft. area of Fig. 2

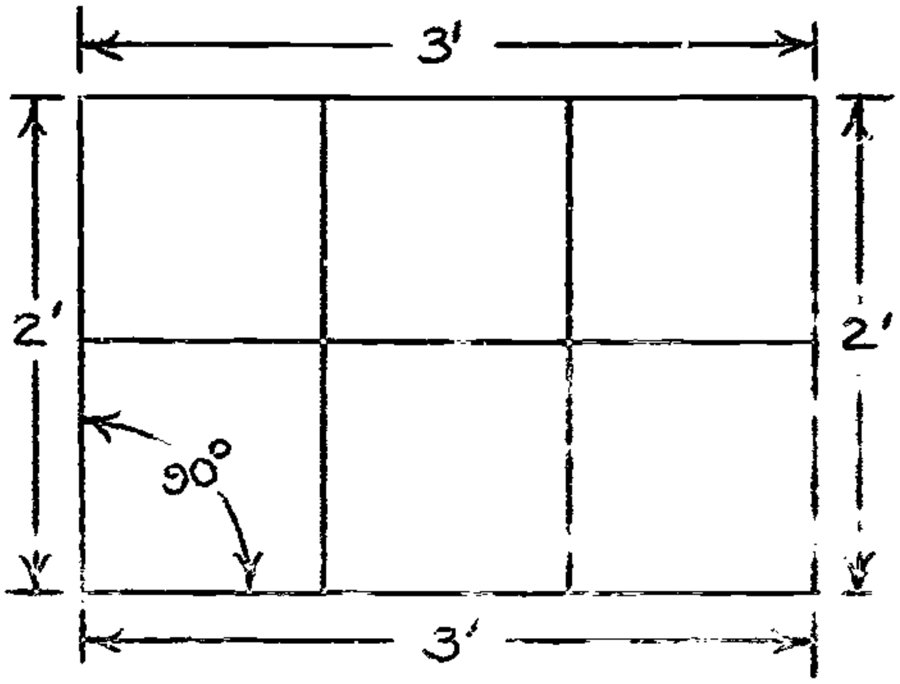


FIG. 2
RECTANGLE

Triangle: Triangles are 3-sided figures.

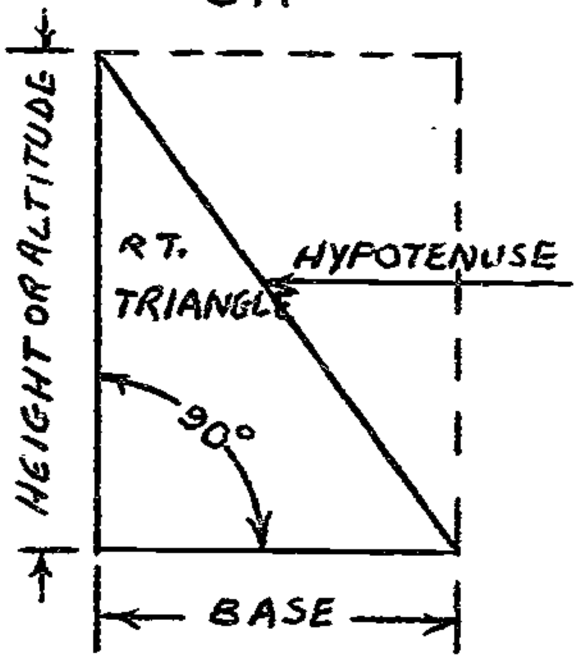
The bottom of the triangle is called the base.

The sides of the triangle are sometimes called legs.

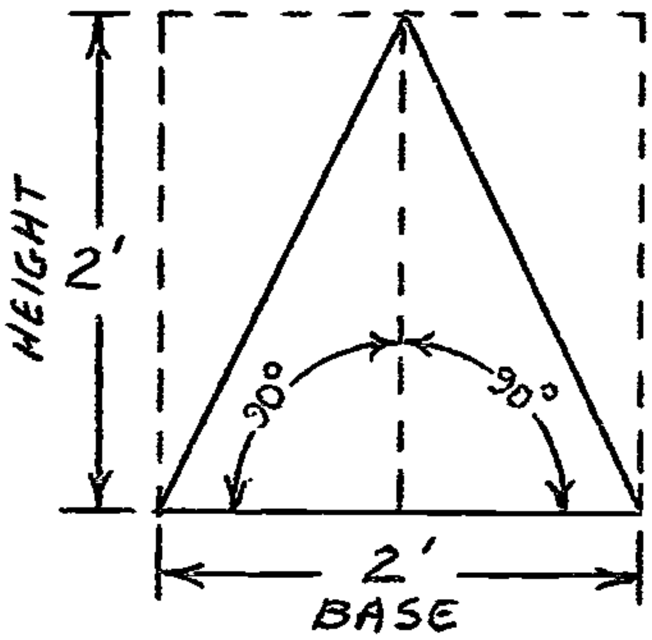
The distance from the base to where the other legs or sides meet is called the height or altitude.

The triangles which you will use in estimating will be right triangles. Right triangles are those triangles which have one angle which is 90°.

3A



3B



In Fig. 3A and Fig. 3B, you see that the triangles cover one half the area of the square and rectangle in which they have been drawn. The base of each triangle is the same size as the length of one side of both the rectangle and the square. The height of each triangle is the same as the length of the other side of the rectangle and square. Since the dimensions of the base and altitude (or height) of the triangles are the same as those of the square and rectangle, and since the triangles cover one half the area of the square and rectangle, to find the area of a triangle you multiply the base x height and divide the total by 2.

The standard formula is

Area = $\frac{1}{2}$ x Base x Height. Using the dimensions in Fig. 3B,
$\frac{1}{2}$ x Base x Height

$\frac{1}{\cancel{2}} \times \frac{\cancel{2}^{1}}{1} \times \frac{2^{1}}{1}$ = 2 sq. ft. area of Fig. 3B

In problems involving right triangles, many times you will have only 2 dimensions given. To find the third dimension you will use the "3-4-5" method.

In all right triangles, the square of the hypotenuse (the side opposite the right angle) is equal to the sum of the squares of the other 2 sides.

In Fig. 3C, the 2 sides are 3' and 4' long.

3 squared = 3 x 3 = 9
4 squared = 4 x 4 = $\underline{16}$
The sum of the squares of 3 and 4 = 25
5 squared = 5 x 5 = 25

When you multiply the 3-4-5 formula to increase the size of the sides, the results will be in the same proportion no matter what figure you use to multiply the sides by. Just be sure that you use the same multiplier for each side.

Let us increase a 3-4-5 right triangle so that each side will be 4 times this size.

3 x 4 = 12 12 squared = 12 x 12 = 144
4 x 4 = 16 16 squared = 16 x 16 = $\underline{256}$
the sum of the squares of 12 and 16 = 400
5 x 4 = 20 20 squared = 20 x 20 = 400

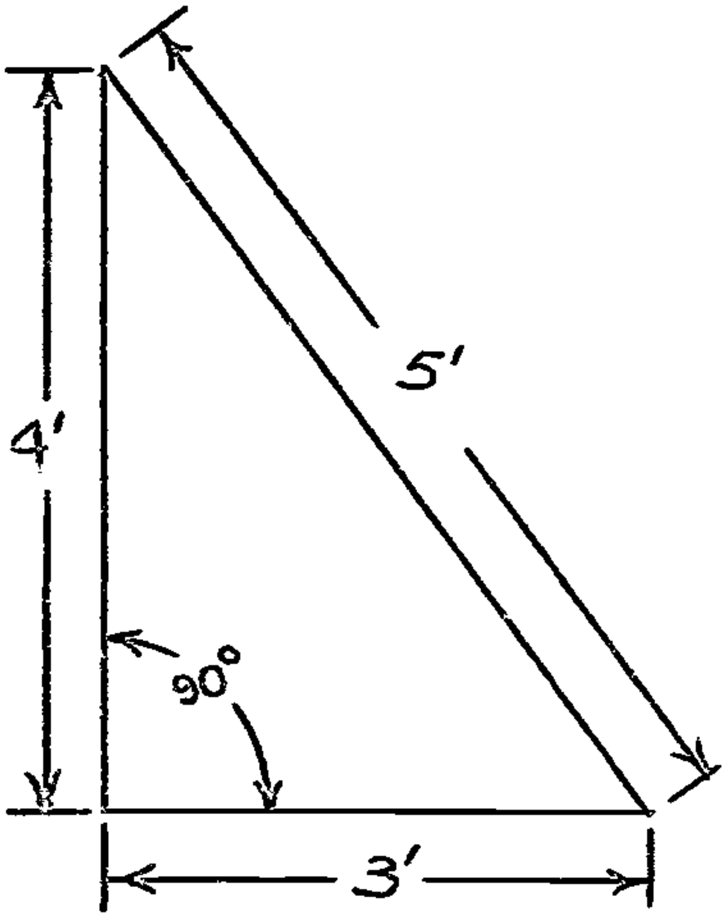


FIG. 3C

A <u>Circle</u> (Fig. 4) is a figure whose outside edge is the same distance from the center throughout its length. The outside edge of circle is a curve or arc. The entire curved edge of a circle is the circumference. The distance through the center of a circle is the diameter. The radius of a circle is the distance from the center of the circle to the circumference. The radius is $\frac{1}{2}$ the diameter.

To find the area of a circle, you must know the length of the radius, diameter, <u>or</u> circumference of the circle.

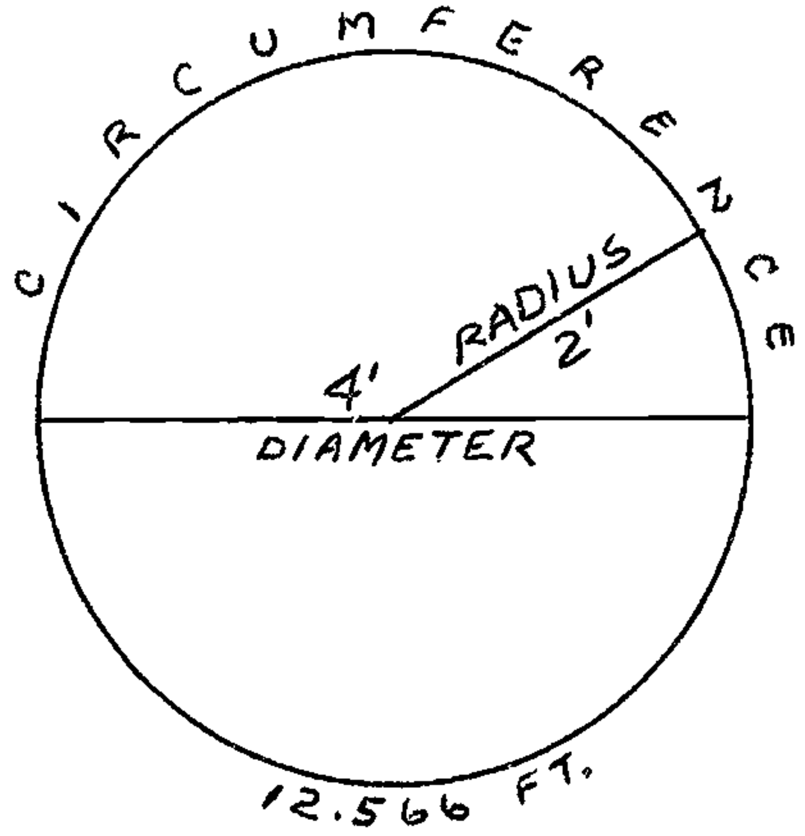


FIG. 4 - CIRCLE

If you were to measure the circumference of any circle and compare its length with the length of the diameter, you would find that the circumference is always a little over three times the length of the diameter. Mathematicians have calculated that the figure is actually 3.1416 and have given this the name <u>pi</u> (the Greek letter <u>p</u>, written π). In working with circles it is generally necessary to use π, which for rough work is sometimes approximated as 3.14 or even $3\frac{1}{7}$.

To find the <u>radius</u> of a circle, you divide the <u>diameter</u> by 2. In Fig. 4, <u>radius</u> = 4' ÷ 2 = 2' (<u>radius</u> of Fig. 4).

To find the <u>circumference</u>, you multiply the <u>diameter</u> by π, that is

circumference = 3.1416 x diameter

In Fig. 4, circumference = 3.1416 x 4' = 12.566 ft. (<u>circumference</u> of Fig. 4)

To find the <u>diameter</u> of a circle when you know the circumference, you divide the <u>circumference</u> by π

<u>diameter</u> = circumference ÷ 3.1416

In Fig. 4, diameter = 12.5664 ÷ 3.1416 = 4' (<u>diameter</u> of Fig. 4)

To find the area of a circle, you multiply π by the square of the radius (that is, π x radius x radius). This is written radius ^{2}.

$$\text{area} = 3.1416 \times \text{radius}^2$$

In Fig. 4, area = 3.1416 x 2' x 2' = 12.5664 sq. ft. (area of Fig. 4). This happens by coincidence to be the same numerical value as the circumference, but note that the area is always in square measure.

To summarize the above facts about a circle, we can let c stand for the circumference, d for the diameter, r for the radius, and A for the area.

Then: $r = \frac{d}{2}$ or $d = 2 \times r$

$c = \pi \times d$ or $c = \pi \times r \times 2$

$d = \frac{c}{\pi}$

$A = \pi \times r^2$

The perimeter is the distance around the outside edge of a surface or figure. (We have seen that the perimeter of a circle has a special name, circumference).

For a rectangle, the perimeter equals the sum of all four sides. But since the opposite sides are equal,

perimeter = 2 x length + 2 x width

In a square, all four sides are equal, so that

perimeter = 4 x length of a side

Follow the instructions on Information Sheet No. 1 to solve the problems in this assignment. If you study the instructions carefully you will have no trouble solving the problems quickly and accurately. Remember: Area is expressed in sq. ft.

1. Find the area of a 17' square.
2. Find the area of a rectangle 27' long and 19' wide.
3. Find the area of a rectangle 43' long and 29' high.
4. Find the perimeter of a rectangle 36' long and 27' wide.
5. Find the perimeter of a 28' square.
6. Find the area of a triangle whose base is 28' and whose height is 17'.
7. Find the area of a circle whose radius is 12'.
8. Find the circumference of a circle whose diameter is 12'.
9. Find the area of a circle whose diameter is 14'.
10. Find the area of a triangle whose base is 18' and whose altitude is 14'.
11. Find the perimeter of a right triangle whose base is 12' and height 16'. Use 3-4-5 method.
12. Find the area of a rectangle 27' 3" long and 14' 6" wide.
13. Find the area of a circle whose diameter is 17'.
14. Find the circumference of a circle whose radius is 19' 8".
15. Find the area of a triangle whose base is 13' and whose height is 13'.
16. Find the area of a 15' 4" square.
17. Find the radius of a circle whose circumference is 59.6904 feet.
18. Find the area of a circle whose circumference is 84.8232 feet.
19. Find the perimeter of a triangle whose base is 24' and height is 32'. Use 3-4-5 method.
20. Find the area of a triangle whose base is 19' 6" and whose height is 12'.
21. How many courses of brick are needed to build a wall 10' 1" high? The brick are to be laid 4 courses in 11".

In this assignment you will find the areas of irregularly shaped surfaces.

To find the areas of Fig. A and Fig. B, first find the areas of each section and then add them. For convenience, we shall combine the capital letters to indicate a portion of the figure. For example, AB will mean A + B, BCD (in Fig. D) will mean B + C + D, etc.

FIG. A

1. What is the length of dimension "X"?
2. What is the length of dimension "Y"?
3. What is the perimeter of Fig. A?
4. What is the area of A?
5. What is the area of C ?
6. What is the area of B ?
7. What is the area of AB?
8. What is the area of BC?
9. What is the area of ABC?

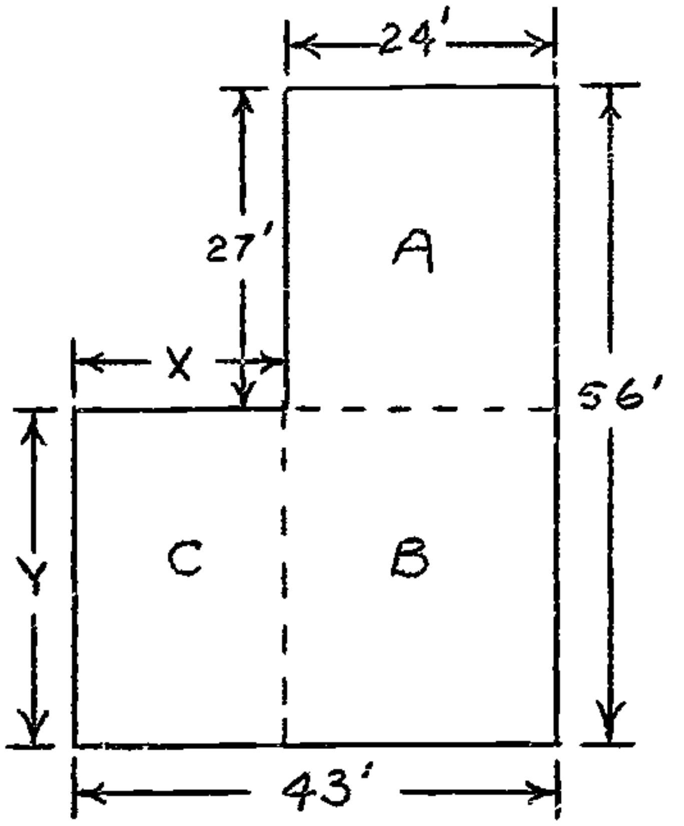


FIG. A

FIG. B

10. How long is dimension "Z"?
11. How long is dimension "Y"?
12. What is the perimeter of Fig. B?
13. What is the area of A?
14. What is the area of C ?
15. What is the area of AB?
16. What is the area of AC ?
17. What is the area of ABC?
18. What is the area of a triangle whose base is 17' and whose height is 13'?
19. What is the area of a circle whose circumference is 53.4072'?
20. What is the area of a 19' square?
21. How many courses of block are needed to build a wall 16' 6" high? Each block course is laid in $8\frac{1}{4}$".

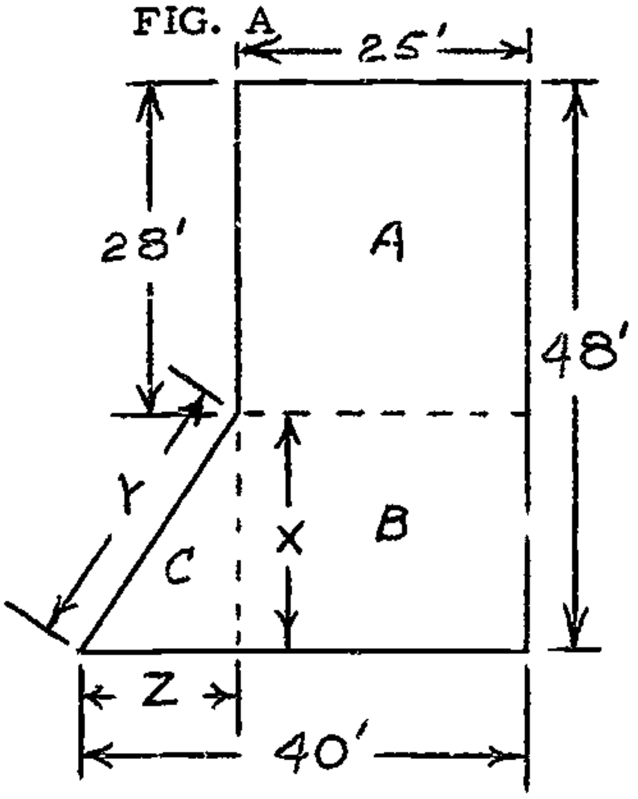


FIG. B

In working with Fic. C, note that A + C = a circle. B is a rectangle. To find the perimeter, add the circumference of AC and the 2 sides of B.

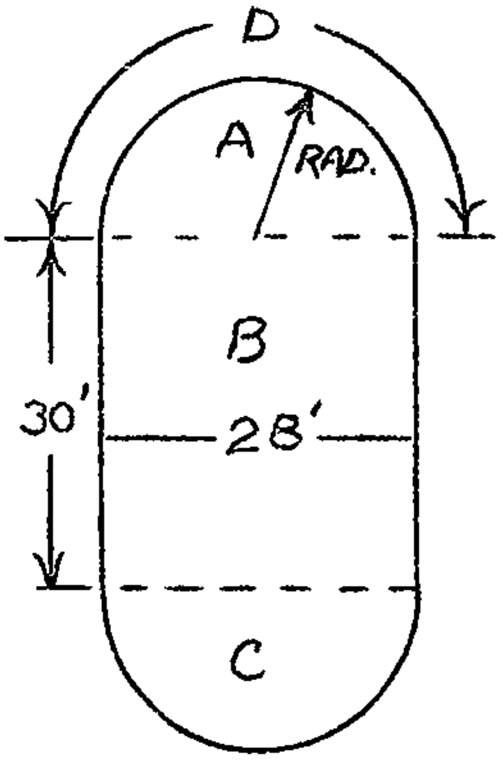


FIG. C

FIG. C

1. How long is the radius of A and C?
2. Find the area of AC.
3. Find the area of B.
4. Find the area of Fig. C.
5. How long is dimension D?
6. Find the perimeter of Fig. C.

FIG. D

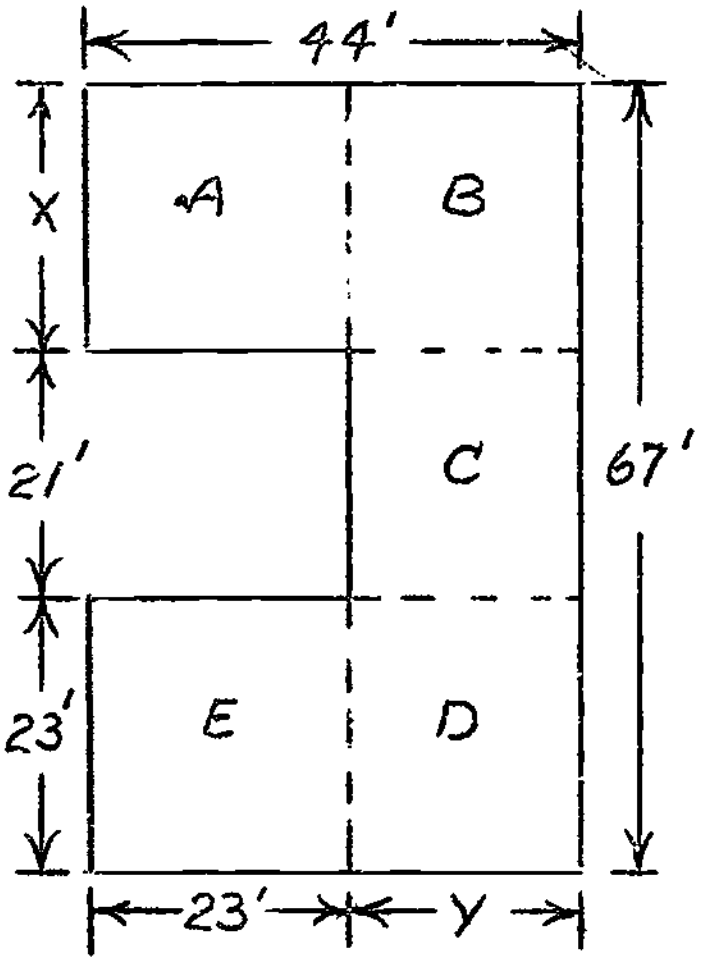


FIG. D

7. How long is dimension "X"?
8. Find the area of AB.
9. How long is dimension "Y"?
10. Find the area of BCD.
11. Find the area of Fig. D.
12. Find the perimeter of Fig. D.
13. Add:
    $345'\ 7\frac{1}{4}'' + 125'\ \frac{5}{8}'' + 6\frac{1}{2}'' + 8'\ 11\frac{7}{8}'' + 9'\ 11\frac{3}{16}''$
14. Multiply: 47' 8" x 39' 9" =
15. Divide: $36'\ 5'' \div 5\frac{3}{4}$ =
16. It takes $6\frac{1}{2}$ brick to cover 1 sq. ft. of wall. How many brick are needed to cover a wall 288' long and 8' 8" high?
17. A builder erected a foundation for $17,500.00. His labor cost was $6,928.65; he bought 23 cu. yds. of concrete @ $13.96 per yard, 37,510 brick @ $42.75 per 1,000, 1750 blocks @ 29¢ per block, 294 bags of mortar cement @ $1.17 per bag, and 29 cu.yds. of sand @ $3.95 per yard; his overhead was $2,826.50. How much did he make?
18. How many courses of brick are needed to build a wall 7' high? Brick are to be laid 4 courses in $10\frac{1}{2}$".

OBJECTIVE: To learn how to find the area of the walls and ceiling of a room.

INFORMATION:

It is necessary to know how to find the area of the walls and ceiling of a room, so that you can estimate the amount of plaster needed for the room. The area of a room is always given in square yards.

Square or rectangular rooms have 4 walls and a ceiling. You find the area of the walls just as you do for a square or rectangle. After you find the number of square feet in the room, you deduct the size of the openings (doors, windows, archways and all other parts of the wall which are not plastered). After you deduct the openings, you divide the remainder by 9 (1 sq. yd. = 9 sq. ft.) to get the number of square yards.

Think! Anyone can develop a strong back, even a mule.

If the numbers 1 and 3 are centered on the appropriate walls, and put into perspective, the diagram will be clearer. Also the words ceiling and floor.

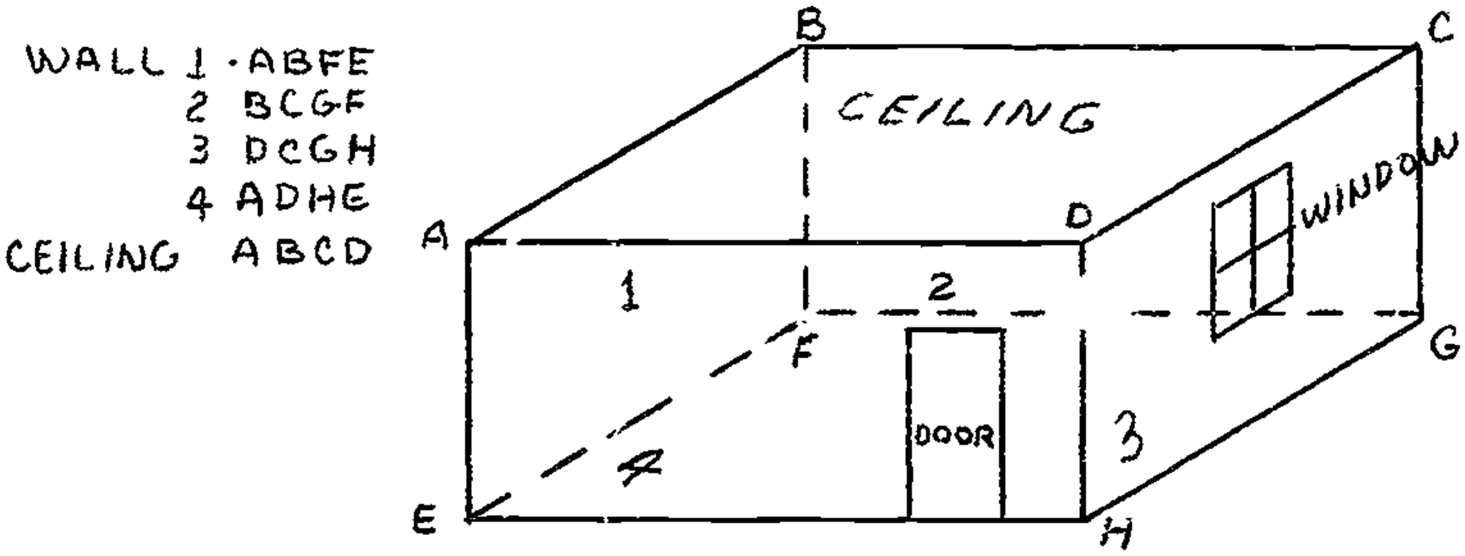


FIG. 5

Fig. 5 is a drawing of a room showing the walls and ceiling. In Fig. 6 we will take the walls and ceiling of a room apart and lay them out flat.

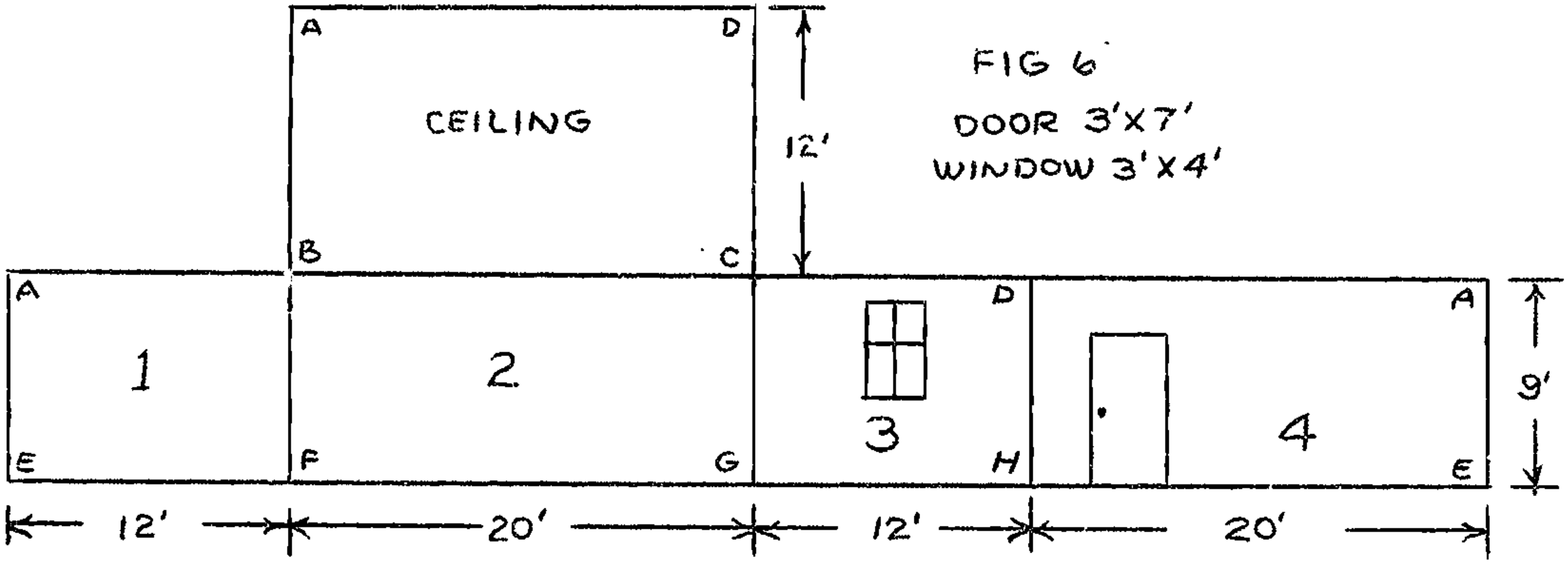


FIG 6

DOOR 3'X7'

WINDOW 3'X4'

PROBLEM: How many sq. yds. in the walls and ceiling of a room 20' long, 12' wide, and 9' high (dimensions of Fig. 6).

Fig. 6 shows that when you "flatten out" a room you will have 2 rectangular areas. One is the ceiling and the other is made up of the 4 walls.

First find the area of the ceiling by multiplying the length (20') by the width (12').

12' x 20' = 240 sq. ft. area of ceiling

All 4 walls are the same height, so instead of finding the area of each wall separately, add the lengths of the walls. (Wall 1 = 12'; wall 2 = 20'; wall 3 = 12'; wall 4 = 20'.)

12' + 20' + 12' + 20' = 64', length of walls (perimeter of the room).

length (64') x height (9') = area of walls.

64' x 9' = 576 sq. ft. area of walls.

Add area of ceiling + 240 sq. ft. area of ceiling.
816 sq. ft., total area of the room.

Remember you must deduct the size of the openings.

Openings: door: 3' x 7' = 21 sq. ft.
window: 3' x 4' = 12 sq. ft.
door and window = 33 sq. ft., total openings.

Subtract the total area of the openings from the total area of the room.

816 sq. ft., total area of room.
\- 33 sq. ft., total area of openings.
783 sq. ft. of walls to be plastered.

Plaster is always estimated in sq. yds., so divide the number of sq. ft. to be plastered by 9 (the number of sq. ft. in 1 sq. yd.)

9/783 sq. ft.
87 sq. yards in the walls and ceiling. ANS.

The above is not nearly so involved as it appears at first. Here is what we did:

Area of ceiling:	12' x 20' =	240 sq. ft.
Area of walls:	64' x 9' =	576 sq. ft.
Total area of room:		816 sq. ft. total
Deduct openings	-	33 sq. ft. openings
	9/	783 sq. ft. to be plastered
		87 sq. yds. ANS.

Solve the problems in this assignment by following the instructions in Information Sheet No. 2. Think a little; it doesn't hurt.

Find the number of sq. yds. in the walls and ceilings of the rooms listed below:

	Length	Width	Height	Doors	Windows
1.	15'	12'	8'	1-- 3' x 7'	2-- 3' x 5'
2.	29'	16'	8' 6"	1-- 3' x 6' 8"	4-- 2'6" x 4' 6"
3.	34'	19'	10' 6"	2-- 3' x 7'	7-- 3' x 5'
4.	22' 6"	16'	9'	2-- 3' x 6' 8"	5-- 3' x 4'
5.	17'	12' 6"	8' 6"	1-- 3' x 7'	3-- 2'8" x 4'
6.	21'	16' 4"	9'	3-- 2' 8" x 6' 8"	4-- 2'8" x 4' 6"

7. Find the area of a circle whose diameter is 23'.

8. Find the area of a triangle whose base is 17' and whose height is 14'.

9. Seven bricklayers worked 6 days, 7 hours per day and laid 32,046 brick. How many brick did each man average per hour?

10. Twelve bricklayers worked 14 days each, 7 hours per day and earned a total of $4,410.00. How much did each man earn per day?

11. A builder put up a foundation for $19,800.00. His labor cost was $6,127.65, he bought 35 cu. yds. of concrete @ $13.85 per yard, 39,000 brick @ $67.75 per 1,000, 2,600 blocks @ 27¢ each, 358 bags of mortar cement @ $1.16 per bag, 40 cu. yds. of sand @ $3.75 per yard; door bucks and window frames cost $467.50; overhead cost was $2,369.75. How much profit did the builder make?

12. How much would a 24' long I-beam, weighing $27\frac{1}{2}$ lbs. per lineal ft. cost, if each pound costs $19\frac{1}{2}$¢?

13. How many courses of block are needed to build a wall 22' $4\frac{1}{8}$" high? The block courses are laid in $8\frac{1}{8}$".

14. How many brick are needed for the first course of a foundation, 38' 6" long and 29' 6" wide? A brick with the cross joint measures $8\frac{1}{2}$".

Find the number of square yards in the walls and ceilings of rooms with the following dimensions:

	Length	Width	Height	Openings	
				Doors	Windows
1.	24' 6"	18'	9'	2-- 3' x 6' 8"	6-- 2'6" x 4'
2.	34'	21'	12' 6"	3-- 2'8" x 7'	8-- 3' x 5' 6"
3.	26'	19'	11'	2-- 2'8" x 6'8"	5-- 2 8" x 4' 6"
4.	45'	21'	13' 6"	3-- 2' 8" x 7'	6-- 2' 8" x 6'
5.	15' 6"	12'	9'	1-- 3' x 6' 8"	3-- 3' x 5'
6.	37'	22'	11' 6"	2-- 6' x 8'	9-- 2' 8" x 7'
7.	51'	26'	14'	6-- 2'8"x6'8"	12-- 2' 8" x 7' 6"

8. Seventeen men worked 14 days, 7 hours per day and laid 148,274 brick. How many brick did each man average per day?

9. It takes 720 lath to cover 40 sq. yds. of wall. How many lath are needed to cover 627 sq. yds. of wall?

10. A builder put up the walls of a building for \$18,600.00. His labor cost was \$7,425.50. He bought 31 cu. yds. of concrete @ \$15.75 per yard, 32,000 brick @ \$68.25 per 1,000, 8,000 blocks @ 24¢ per block, 415 bags of mortar cement @ \$1.17 per bag, and 53 cu. yds. of sand @ \$5.25 per yard; windows and door bucks cost \$529.89, lintels cost \$188.70, and his overhead was \$1,998.49. How much profit did the builder make?

11. A builder bought 136 ft. of 4" x 4" x $\frac{3''}{8}$ angle iron lintels. The angle iron weighed 7½ lbs. per lineal foot, and cost 18½¢ per lb. How much did the lintels cost?

12. It takes $6\frac{2}{3}$ brick laid with a $\frac{3''}{8}$ joint to face 1 sq. ft. of wall. How many brick are needed to face a wall 249' long and 8' 4" high?

13. How many porcelain glazed tile will it take to face a wall 33' 6" long and 8' high? Porcelain glazed tile cover 5¼" x 8" including the mortar joints

14. How many 16" long cinder blocks are needed to build a wall 38' long and 12' high? A 16" block covers $\frac{8}{9}$ sq. ft. of wall, including the mortar joints.

How many square yards are in the walls and ceilings of rooms having the following dimensions?

				Openings	
1.	Length	Width	Height	Doors	Windows
1.	21'	16'	9'	2-- 3' 7'	3-- 2' 8" x 5'
2.	47'	33'	11' 6"	3-- 2' 8" x 7'	10-- 3' x 5' 5"
3.	32' 6"	24'	10' 6"	2-- 6'6" x 8'	9-- 2' 8" x 6'
4.	25'	17'	8' 6"	2-- 3' x 6' 8"	4-- 3' x 4' 6"
5.	52'	27' 6"	12' 6"	3-- 7' x 8'	16-- 3' x 6' 6"
6.	19'	17'	9'	2-- 3' x 7'	3-- 2' 8" x 5'
7.	49' 6"	28'	13'	4-- 6' x 8'	16-- 2' 6" x 7'
8.	22'	17' 6"	8' 6"	2-- 3' x 6' 8"	6-- 2' 8" x 5'
9.	17'	13'	8'	2-- 2' 6" x 7'	3-- 2'6" x 4'

FIG. E

10. Find the area of BCD.

11. Find the area of F.

12. Find the area of FED.

13. Find the area of Fig. E.

14. Find the perimeter of Fig. E.

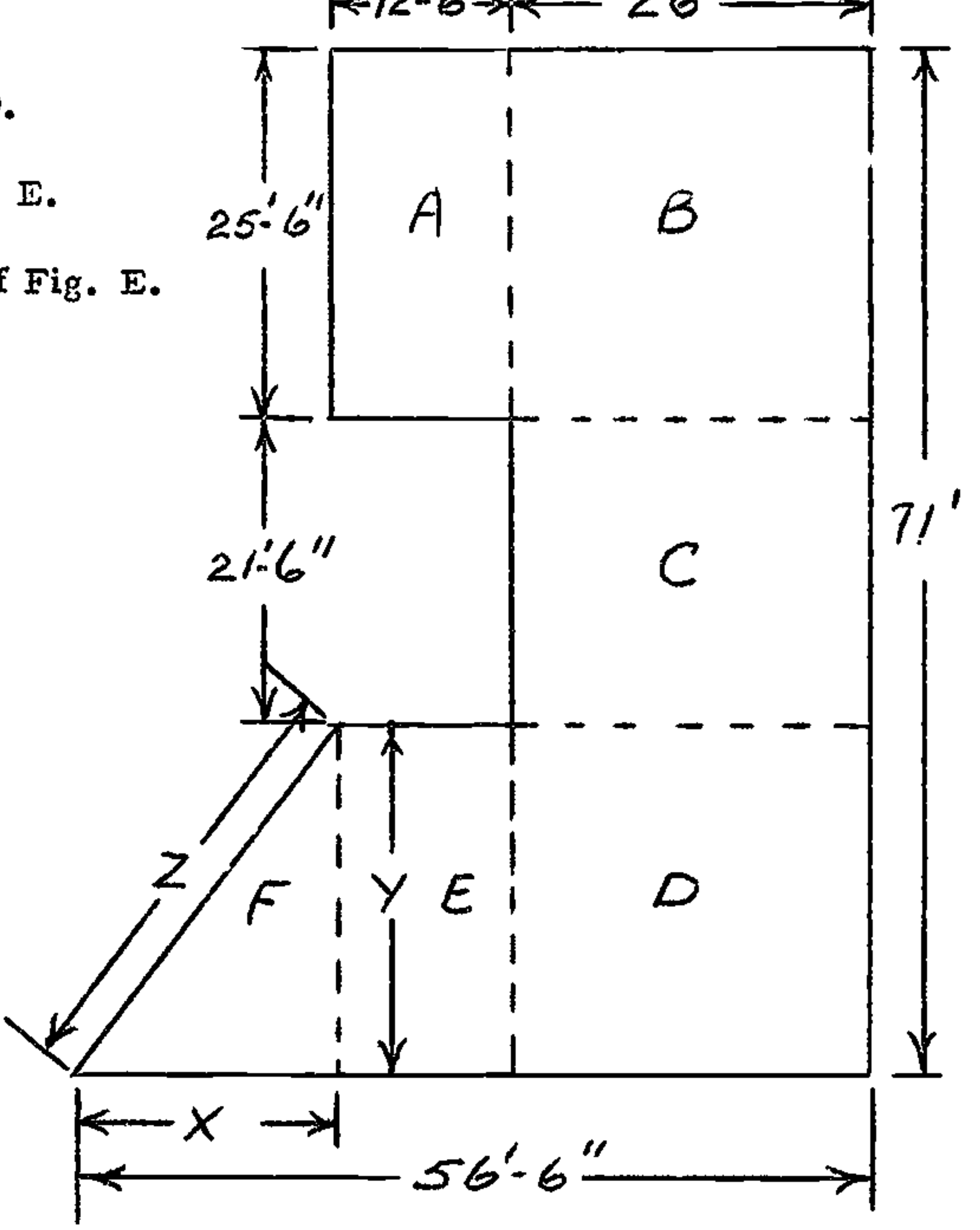


FIG. E

Next comes Test #6.

OBJECTIVE: To learn to find the surface area of a cube, rectangular prism, triangular prism, and cylinder.

INFORMATION:

1. To find the area of a cube:

A cube has 6 sides, all of which are equal squares. See Fig. 8. To find the area, you multiply the length (3') by the width (3') by the 6 sides.

3' x 3' x 6 = 54 sq. ft., area of Fig. 8.

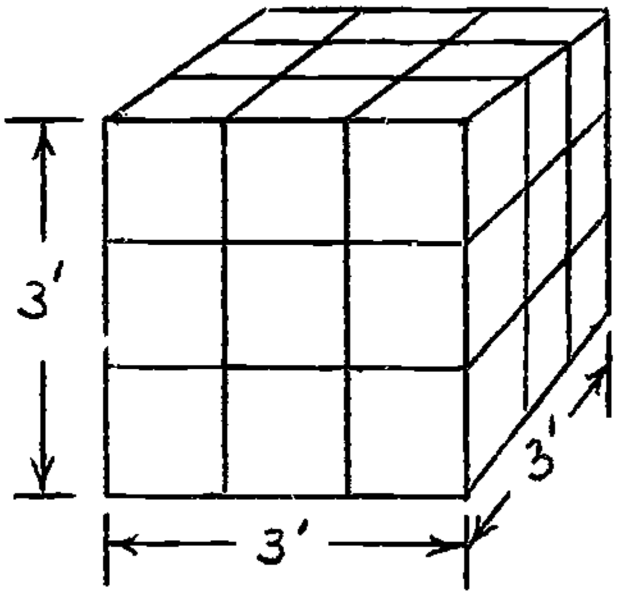


FIG. 8 - CUBE

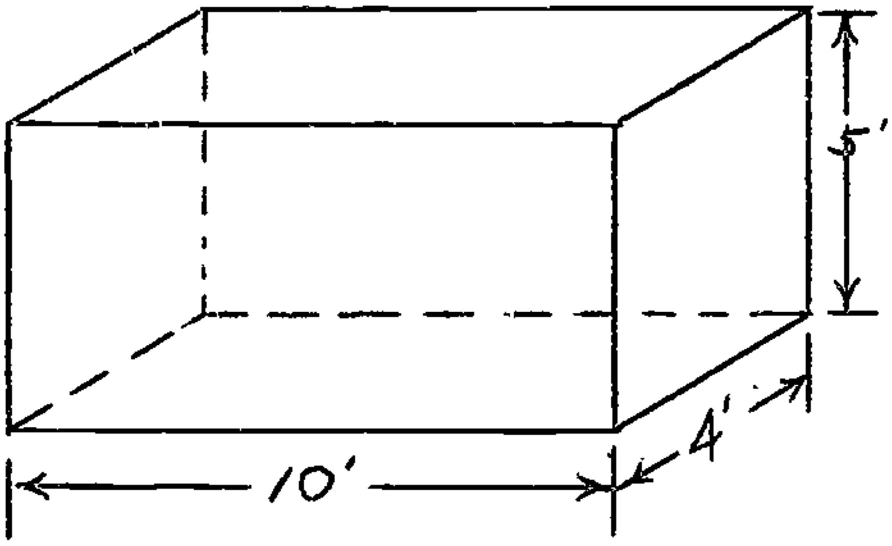


FIG. 9 - RECTANGULAR PRISM

2. To find the area of a rectangular prism (Fig. 9):

A rectangular prism has six sides. The sides opposite each other have the same dimensions.

Area of 2 sides (5' x 10') = 2 x 5' x 10' = 100 sq. ft.
Area of 2 sides (4' x 10') = 2 x 4' x 10' = 80 sq. ft.
Area of 2 sides (4' x 5') = 2 x 4' x 5' = 40 sq. ft.
220 sq. ft. area of Fig. 9.

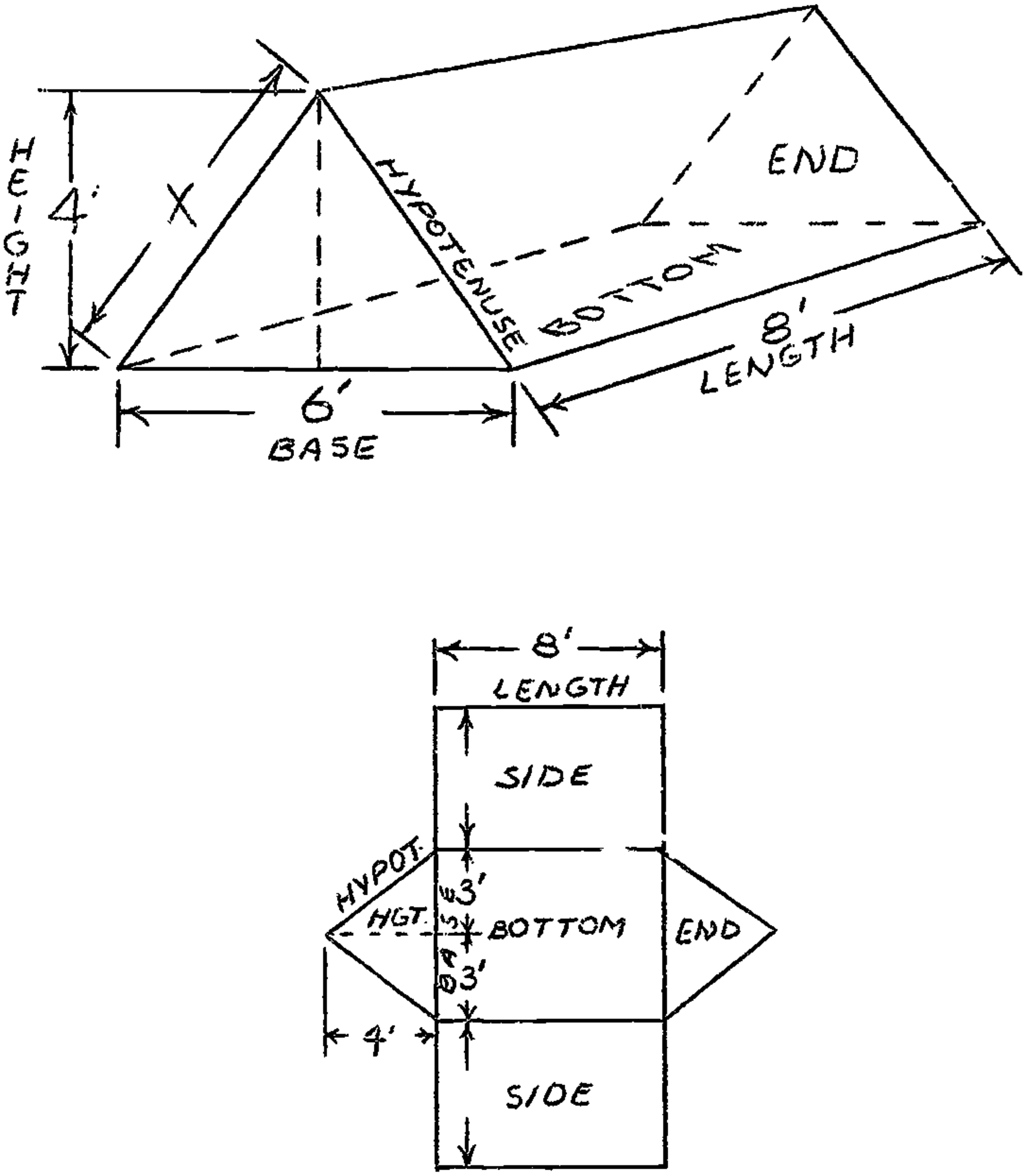


FIG. 10 - TRIANGULAR PRISM

3. To find the area of a triangular prism (Fig. 10):

A triangular prism has 2 triangular ends, a bottom and 2 sides.

Before you can find the area of Fig. 10, you must find the length of dimension "x". The dash line denoting the height of the triangle divides the triangle into 2 equal halves. Each half is a right triangle. Using the 3-4-5 method you find dimension x = 5'.

Area of 2 ends = $2 \times \frac{1'}{2} \times 6' \times 4'$ = 24 sq. ft.

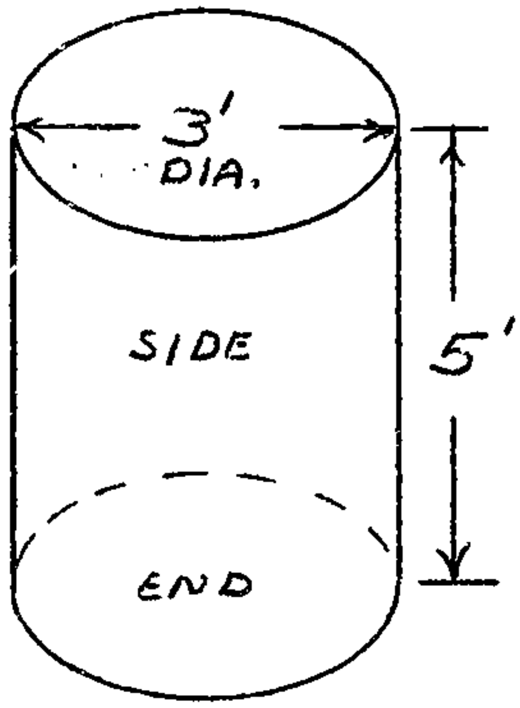
Area of bottom = $6' \times 8'$ = 48 sq. ft.

Area of sides = $2 \times 5' \times 8'$ = 80 sq. ft.

152 sq. ft., area of Fig. 10.

FIG. 11

CYLINDER



4. To find the area of a cylinder (Fig. 11):

A cylinder has 2 circular ends and 1 curved side which goes completely around it.

The cylinder ends in Fig. 11 have a radius of 1' 6".

Area of 2 circular ends = 2 x 1.5 x 1.5 x 3.1416 = 14.1372 sq. ft.

Circumference of an end = 3' x 3.1416 = 9.4248 ft.

Area of the curved side = circumference of the end x height
= 9.4248' x 5' = 47.1240 sq. ft.

$$
\begin{array}{lrl}
\text{Total area} = & 14.1372 & \text{sq. ft., area of ends} \\
+ & \underline{47.1240} & \text{sq. ft., area of curved side} \\
 & 61.2612 & \text{sq. ft., total area}
\end{array}
$$

To summarize:

1. Area of a cube = 6 x area of a side
2. Area of a rectangular prism = 2 x area of 1 pair of opposite sides
   \+ 2 x area of 2nd pair of opposite sides
   \+ 2 x area of 3rd pair of opposite sides
3. Area of a triangular prism = 2 x area of triangular ends
   \+ area of bottom
   \+ 2 x area of sides
4. Area of a cylinder = 2 x area of circular ends
   \+ area of curved side (equal to perimeter of end x height)

1. What is the area of a 7' 4" cube?

2. What is the area of a rectangular prism, 26' 6" long, 14' high, and 9' wide?

3. Find the area of a triangular prism whose base is 18', height is 12', and length is 19' 6".

4. Find the area of a cylinder whose diameter is 19' and height is 23'.

5. Find the area of Fig. F.

6. Find the perimeter of Fig. F.

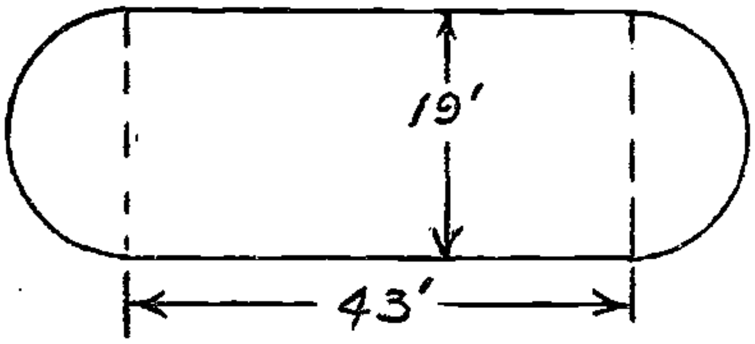


FIG. F

7. What is the area of a triangular prism whose base is 30', height is 20', and length is 26' 8"?

8. Find the area of a circle whose circumference is 72.2568'.

9. Find the area of a cylinder whose diameter is 24' and height is 18'.

How many sq. yds. are there in the walls and ceilings of rooms having the following dimensions:

	Length	Width	Height	Openings	
				Doors	Windows
10.	38'	29'	12'	2-- 3' x 7'	7-- 3' x 6'
11.	22'	14' 6"	9'6"	3-- 3' x 6' 8"	4-- 2' 6" x 4'

12. It takes $6\frac{1}{2}$ brick to face 1 sq. ft. of wall. How many brick are needed to face a wall 179' 6" long and 12' high?

13. It takes 728 lath to cover 52 sq. yds. of wall. How many lath are needed to cover 650 sq. yds. of wall.

14. If each bricklayer lays 445 brick per day, how long will it take 7 bricklayers to lay 59,185 brick?

1. Find the area of a rectangular prism which is 21' 6" long, 14' wide and 8' high.

2. Find the area of a 9' 6" cube.

3. Find the area of a cylinder which is 9' in diameter and 26' high.

4. Find the area of a triangle whose base is 36' and whose height is 27'.

5. Find the area of a circle 18' in diameter.

6. Find the area of a triangular prism with a 12' base, 8' altitude, and 39' length.

7. Find the area of Fig. G.

8. Find the perimeter of Fig. G.

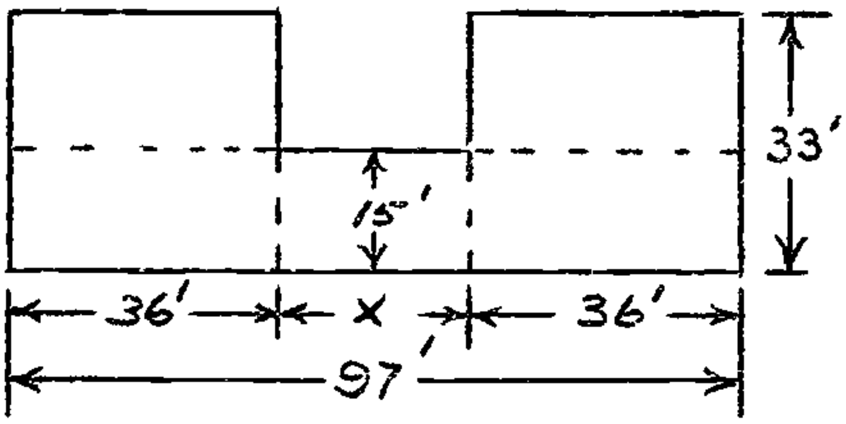


FIG. G

9. Find the area of Fig. H.

10. Find the perimeter of Fig. H.

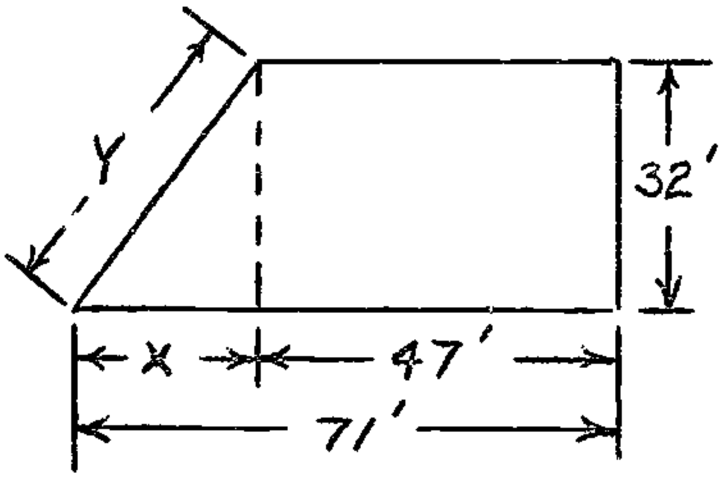


FIG. H.

How many square yards are there in the walls and ceilings of the following rooms?

				Openings	
	Length	Width	Height	Doors	Windows
11.	49' 6"	28'	13'	4-- 6' x 8'	16-- 2' 6" x 7'
12.	22'	17' 6"	8' 6"	2-- 3' x 6' 8"	6-- 2' 8" x 5'
13.	17'	13'	8'	2-- 2' 6" x 7'	3-- 2' 6" x 4'

14. How long will it take 3 bricklayers to face a wall 324' long and 7' 6" high? It takes $6\frac{1}{2}$ brick to face 1 sq. ft. of wall. Each bricklayer worked 7 hours per day and laid an average of 455 brick per day.

1. Find the area of a rectangular prism which is 33' 6" long, 9' wide, and 12' high.

2. Find the area of a 16' 6" cube.

3. Find the area of a cylinder which is 27' high and has a 13' diameter.

4. Find the area of a right triangle whose base is 47' and whose height is 35'.

5. Find the area of a circle which is 29' in diameter.

6. Find the area of a triangular prism whose base is 18', altitude is 12', and length is 47' 9".

How many sq. yds. are there in the walls and ceilings of rooms having the following dimensions?

	Length	Width	Height	Openings	
				Doors	Windows
7.	[illegible] 6"	24'	10' 6"	2-- 6' 6" x 8'	9-- 2' 8" x 5'
8.	49' 6"	28'	13'	4-- 6' x 8'	16-- 2' 6" x 7'

9. Find the area of Fig. I.

10. Find the perimeter of Fig. I.

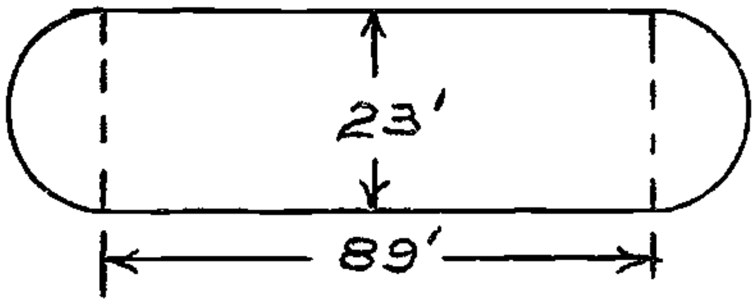


FIG. I

11. Deformed steel reinforcing rods cost 17$\frac{1}{2}$¢ per lb. Deformed steel reinforcing rods $\frac{5}{8}$" in diameter weigh 1.05 per lineal foot. How much will 1,989 lineal feet of $\frac{5}{8}$" deformed steel reinforcing rods cost?

12. How long will it take 7 men to veneer a wall 343' long and 9' high. It takes 7 brick to veneer 1 sq. ft. of wall. Each bricklayer worked 7 hours per day and laid an average of 441 brick per day.

13. How many courses of brick are needed to build a wall 10' 4$\frac{7}{8}$" high? The brick are to be laid 4 courses in 13$\frac{1}{2}$".

Now go on to Test #7.

UNIT IV - CUBIC MEASURE

Volumes of Cubes, Rectangular Prisms, and Walls Information Sheet No. 1

OBJECTIVE: To learn how to compute the cubic contents of solid objects, including cubes, rectangular prisms, and walls.

INFORMATION:

A solid object or figure is one which has 3 dimensions, variously known as length, width or height, and thickness or width.

A wall is referred to as having length, height, and thickness or width. For example, a wall may be said to be 12" wide or 12" thick.

A solid block is referred to as having length, width and height.

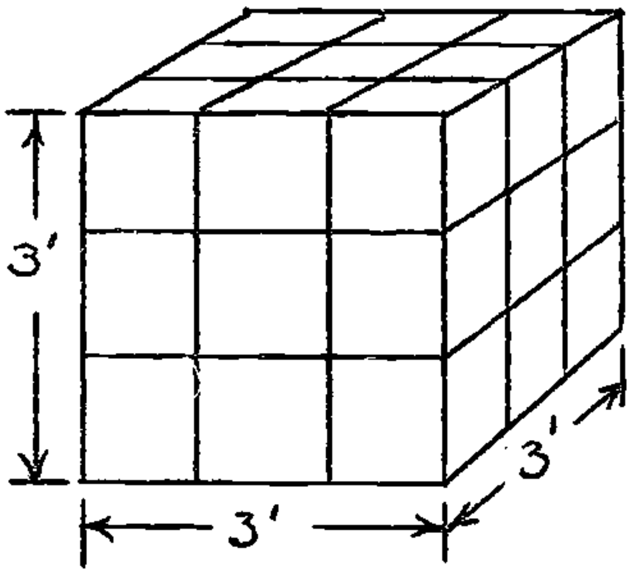


FIG. 12

CUBE

Cubic measure or volume tells how many cubic units of a certain size are needed to make a solid object. The units which you will be working with are cubic feet and cubic yards.

A cube is a solid object or figure which has all three dimensions the same length, for example, 3' long, 3' high, 3' wide.

Fig. 12 shows a cube which is 3' long, 3' high, and 3' wide. To find the cubic contents or volume of Fig. 12, you must multiply the length x the width x the height.

3' x 3' x 3' = 27 cubic feet

To understand better why this is true, divide the height into 3 layers of 1' each. Each layer is then divided into squares of 1' each. The surface of each layer has 9 squares of 1' each, so this gives you 9 one-foot cubes in the layer.

9 one-foot cubes in each layer multiplied by 3 layers = 27 one-foot cubes in a 3' cube.

One yard is 3' long, so a 3' cube equals 1 cubic yard.

The unit of cubic measure used to estimate excavating, or buy concrete, sand, and gravel is the cubic yard. So remember that 1 cubic yard is made up of 27 cubic feet. The solid figures which are used most in building are the cube, rectangular prism, triangular prism, and the cylinder. The estimating which you will do will deal mainly with rectangular prisms.

The footings and walls of a building are actually a series of connected rectangular prisms.

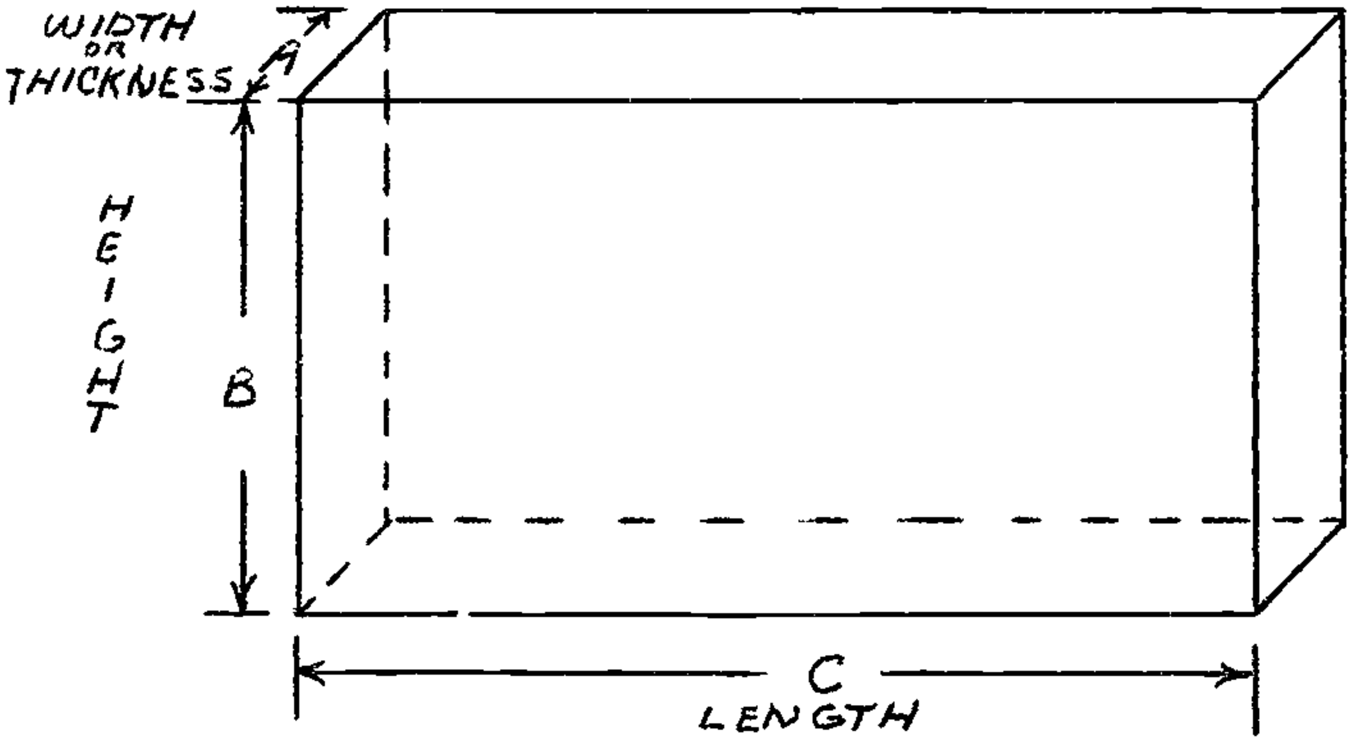


FIG. 13

To find the cubic contents or volume of Fig. 13, you do exactly as you did for Fig. 12.

Multiply: Length x Height x (Width or Thickness).
Dimensions: C x B x A

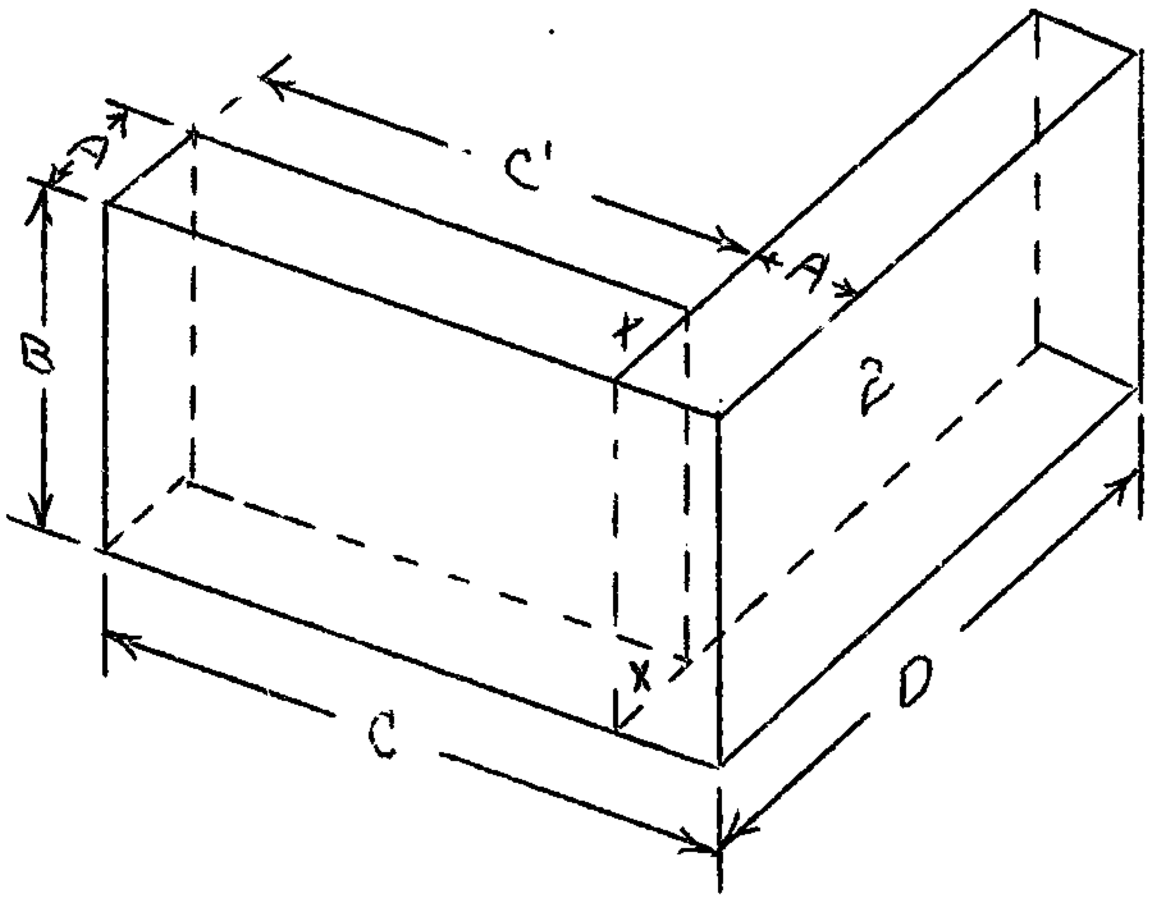


FIG. 14

Fig. 14 presents a different situation. On blueprints all dimensions for the outside walls of a building are given on the outside of the building. Fig. 14 is made up of 2 pieces of wall joined at right angles at point x - x. The length of piece 1 is C^1. On a blueprint you will not be given the dimension shown as C^1 in Fig. 14; instead you will be given dimension C. When you compare dimensions C and C^1, it is easy to see that they are not the same length. Dimension $C = C^1 + A$. Therefore, when you are taking your dimensions from a blueprint or sketch, you will add the dimensions and from this total you will subtract once the width of the wall (dimension A) for each corner. You can see that, if you did not subtract this width, when you multiplied the dimensions to get the cubic measure, you would be including the same corner twice. Therefore, for purposes of computing cubic measure, the <u>length</u> to be used in Fig. 14 is

$$C + D - A = \text{LENGTH}$$

To find the cubic contents, you do as you did for Fig. 12.

Multiply: Length x Height x Width

Let us give Fig. 14 numerical dimensions to better illustrate how you find the cubic contents.

Dimensions: A = 12", B = 4', C = 10', D = 8'.

First find the length: C + D - A. 10' + 8' - 1' = 17' LENGTH

Now multiply: Length x Height x Width. (Remember, you will get <u>cubic feet.</u>)

$$\begin{array}{rl} & 17' \text{ Length} \\ \times & \underline{4'} \text{ Height} \\ & 68 \text{ sq. ft.} \\ \times & \underline{1'} \text{ Width} \\ & 68 \ \underline{\text{cubic feet}} \end{array}$$

Divide the cubic feet by 27 to get <u>cubic yards</u>.

$$\begin{array}{r} 2 \\ 27\overline{)68} \\ \underline{54} \\ 14 \end{array}$$

$2\frac{14}{27}$ <u>cubic yards</u> ANS.

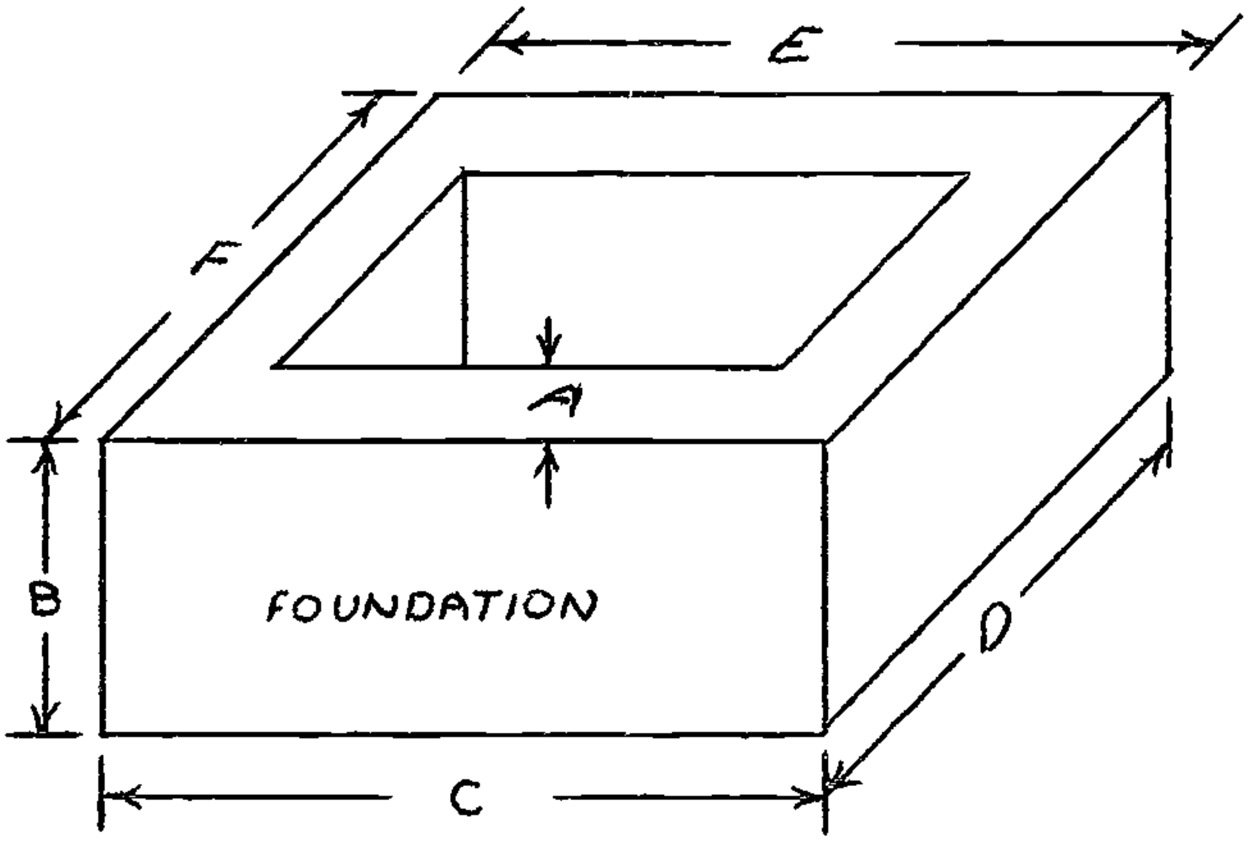


FIG. 15

Dimensions for Fig. 15: A = 12", B = 5', C = 16', D = 14', E = 16', F = 14'

To find the cubic contents of Fig. 15:

Find the length: C + D + E + F - (4 x A) = LENGTH

In Fig. 15 there are 4 corners and 4 sides. We have 4 sections of wall joined into one rectangular structure, so we must deduct the width of the wall once for each corner, or 4 times in all.

Add:	The dimensions of the 4 sides.	C		16'
		D		14'
		E		16'
		F		14'
				60' Perimeter
Subtract:	Once the width of the wall for each corner (4 x A)		-	4' Corners
				56' Length
Multiply:	Length x Height		x	5' Height
				280 sq. ft.
Multiply:	(Length x Height) x Width		x	1' Width
				280 Cubic Feet

Divide cubic feet by 27'

$$\begin{array}{r} 10 \\ 27\,\overline{)\,280} \\ -\;27 \\ \hline 10 \end{array}$$

$10\frac{10}{27}$ Cubic Yards

ANS.

The problems in this assignment are explained in Information Sheet No. 1. Check each problem to find out whether it refers to Fig. 12, 13, 14, or 15. Work carefully. Do not go ahead with your work unless you are certain that the work is being done correctly.

The estimating which you will do later is based on what you are learning to do now. Learning the right way now will save time and trouble later.

Label each step in every problem. You will have to refer back to parts of the work which you have finished, to get the information needed to estimate quantities of different materials. If you do not label your work, you cannot be sure that the figures you take are the correct ones. So, you either do the work over or take a chance that the figures are correct.

Estimating is way of figuring out the amounts of materials needed. You cannot afford to guess. Your estimate must be accurate.

PROBLEMS: How many cu. yds. are in the following walls?

		A	B	C	D	E	F
1.	(Fig. 13)	12"	10'	46'			
2.	(Fig. 15)	12"	9'	23'	47'	23'	47'
3.	(Fig. 14)	12"	6	42'	63'		
4.		16"	12'	46'	65'	46'	65'
5.		16"	11'	55'			
6.		8"	8'	73'			
7.		12"	9'	21'	27'	21'	27'
8.		9"	12'	45' 4"	48' 5"		
9.		16"	15'	38' 8"	45'	38' 8"	45'
10.		9"	12'	39'	60'	39'	60'

How many sq. yds. are in the walls and ceilings of the following rooms?

	Length	Width	Height	Doors	Windows
11.	52'	36' 6"	14' 6"	3-- 3' x 7'	7-- 4' x 6' 6"
12.	77' 6"	49'	16' 9"	2-- 7' x 8'	10-- 3' 6" x 7'

13. Three-quarter-inch round deformed reinforcing steel weighs 1.52 lbs. per lineal foot and costs $7\frac{1}{2}$¢ per lb. How much will 2,747 lineal feet cost?

14. It takes 19 brick laid with a $\frac{1}{2}$" mortar joint to build 1 cu. ft. of wall. How many brick are needed to build a wall 75' 8" long, 8' high, and 12" wide?

15. How long will it take 3 bricklayers to lay the brick in problem 14, if they lay an average of 426 brick each per day?

How many cu. yds. are there in the following walls and prisms?

	A	B	C	D	E	F
1. (Fig. 13)	9'	6'	47'			
2.	12"	18'	57'			
3. (Fig. 15)	18"	16'	39'	66'	39'	66'
4.	16"	15'	38' 8"	45'	38' 8"	45'
5. (Fig. 13)	9"	12'	36'			
6.	11'	4' 6"	38'			
7. (Fig. 15)	12"	9'	75'	56'	75'	56'
8.	18"	12'	28'	36' 6"	28'	36' 6"
9. (Fig. 14)	18"	8'	40'	75' 6"		
10. (Fig. 12)	11'	11'	11'			

11. It takes $6\frac{2}{3}$ brick to veneer 1 sq. ft. of wall. How many brick are needed to veneer a wall 162' 8" long and 9' 6" high?

12. It takes 19 brick laid with a $\frac{1}{2}$" mortar joint to build 1 cu. ft. of wall. How many brick are needed to build a wall 199' 8" long, 9' 6" high, and 12" wide?

13. It takes 15 cu. ft. of mortar to lay 1,000 brick with a $\frac{1}{2}$" mortar joint. How many cu. yds. of mortar are needed to lay the brick in problem 12?

How many sq. yds. are there in the walls and ceilings of the following rooms?

	Length	Width	Height	Openings	
				Doors	Windows
14.	48'	33' 6"	13'	4-- 3' x 7'	11-- 2'8" x 6'
15.	21' 6"	18'	10'	2-- 2'6" x 7'	6-- 2'6" x 3'

16. $5\frac{2}{3}$% of 17,988 = ?

17. How many courses of brick are needed to build a wall 9' $9\frac{7}{8}$" high? The brick are to be laid 4 courses in $11\frac{1}{2}$".

Cubic Measure — Assignment Sheet No. 3

How many sq. yds. are there in the walls and ceilings of the following rooms?

	Long	Wide	High	Openings	
				Doors	Windows
1.	89' 6"	46'	17' 6"	3-- 8' x 8'	17-- 3'6" x 7'
2.	27' 6"	23' 6"	9' 9"	2-- 3' x 6' 8"	7-- 2'6" x 5'

How many cu. yds. are there in the following foundation walls?

	A	B	C	D	E	F
3.	12"	10' 6"	43'			
4.	16"	11' 6"	57'			
5.	9"	9'	37' 4"			
6.	12"	11' 6"	55'	47' 6"	55'	47' 6"
7.	16"	13' 6"	47' 4"	33' 4"	47' 4"	33' 4"
8.	8"	7' 8"	32' 6"	28'	32' 6"	28'

9. It takes 20 brick laid with a $\frac{3}{8}$" mortar joint to build 1 cu. ft. of wall. How many brick are needed to build a wall 77' 6" long, 9' high, and 12" wide?

10. It takes 19 brick laid with a $\frac{1}{2}$" mortar joint to build 1 cu. ft. of wall. How many brick are needed to build a wall 98' long, 6' 6" high, and 8" wide?

11. It takes $13\frac{1}{2}$ cu. ft. of mortar to lay 1,000 brick with a $\frac{3}{8}$" mortar joint. How many cubic yards of mortar are needed to lay the brick in problem 9?

12. If a bricklayer averages 450 brick per day, how many working days will it take to build the wall in problem 9?

13. Three-eighths-inch deformed round reinforcing steel weighs .38 lbs. per lineal foot. Find the cost of 5,690 feet at $6\frac{3}{4}$¢ per lb.

14. It takes 1 cu. yd. of sand and 9 cu. ft. of cement paste or lime putty to make 1 cu. yd. of mortar. How much sand must you buy to make the mortar needed in problem 11?

15. Find the area of a cylinder whose diameter is 37', and whose height is 18'.

---

1. Find the area of a circle whose circumference is 53.4072'.

How many sq. yds. are there in the walls and ceilings of the following rooms?

	Length	Width	Height	Openings	
				Doors	Windows
2.	18'	12'	8' 6"	1-- 3' x 6' 8"	3-- 2' 6" x 4'
3.	28'	13' 6"	9'	2-- 3' x 7'	6-- 2' 8" x 5'

How many cu. yds. are there in the following foundations?

	A	B	C	D	E	F
4.	18"	18'	54'			
5.	16"	15'	63'			
6.	18"	12'	48'	54'	48'	54'
7.	12"	9'	39'	43'	39'	43'
8.	16"	15'	38' 8"	45'	38' 8"	45'
9.	9"	12'	39'	60'	39'	60'
10.	9"	18'	27'	75' 6"		
11.	17'	4' 6"	39'			

12. It takes 20 brick laid with a $\frac{3}{8}$" mortar joint to build 1 cu. ft. of wall. How many brick are needed to build a wall 164' long, 9' high, and 12" wide?

13. It takes 19 brick laid with a $\frac{1}{2}$" mortar joint to build 1 cu. ft. of wall. How many brick are needed to build a wall 259' 6" long, 7' 6" high, and 16" wide?

14. I-beams cost 18¢ per lb. Find the cost of an I-beam 27' 6" long, weighing 33 lbs. per foot.

15. Find the area of a triangular prism whose base is 18', whose height is 12', and whose length is 47' 6".

16. $16\frac{2}{3}\%$ of 49,305 = ?

Cubic Measure — Assignment Sheet No. 5

How many sq. yds. are there in the walls and ceilings of the following rooms?

	Length	Width	Height	Openings	
				Doors	Windows
1.	71'	46'	15' 6"	4 -- 3' x 7'	12-- 3' 6" x 8'
2.	47' 6"	54'	16'	3 -- 3' x 7'	9-- 4' x 8'

How many cu. yds. are there in the following foundations?

	A	B	C	D	E	F
3.	18"	12'	37' 6"	55' 6"	37' 6"	55' 6"
4.	12"	18'	49' 6"	43' 6"	49' 6"	43' 6"
5.	16"	15'	38' 8"	45'	38' 8"	45'
6.	9"	18'	36'	42'	36'	42'
7.	8"	13' 6"	47' 6"	38'	47' 6"	38'
8.	35'	2' 8"	48'			
9.	9"	11' 6"	56'			

10. It takes 19 brick laid with a $\frac{1}{2}$" mortar joint to build 1 cu. ft. of wall. How many brick are needed to build a wall 93' long, 9' 6" high, and 12" wide?

11. It takes 20 brick laid with a $\frac{3}{8}$" mortar joint to build 1 cu. ft. of wall. How many brick are needed to build a wall 156' 6" long, 12' high, and 16" wide?

12. It takes $13\frac{1}{2}$ cu. ft. of mortar to lay 1,000 brick with a $\frac{3}{8}$" mortar joint. How many cu. yds. of mortar are needed to lay the brick in problem 11?

13. Ten bricklayers working 7 hours per day, laid an average of 626 brick each per day. How long will it take them to lay the brick in problem 11?

14. $5\frac{2}{3}\%$ of 50,080 = ?

15. Find the area of Fig. A.

16. Find the perimeter of Fig. A.

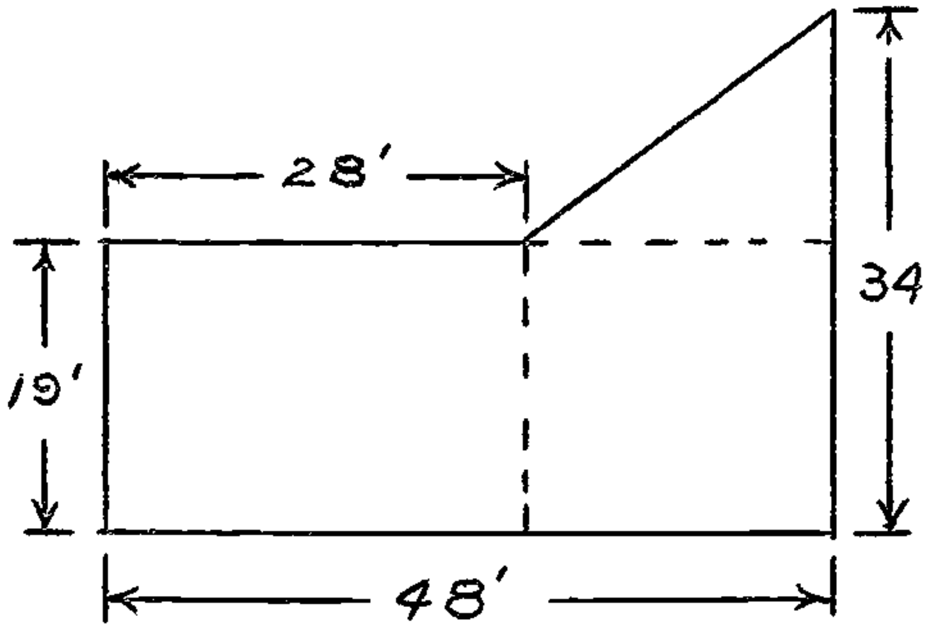


FIG. A

Quantities of Materials
(Brick, Mortar, Stone) Information Sheet No. 2

OBJECTIVE: To learn how to find the amounts of brick, mortar, and stone to build or veneer walls.

INFORMATION:

The following table will provide the information needed to estimate the amounts of materials needed to build walls. Remember, if you think first, you will save time and trouble.

Number of Brick Needed to Build 1 Cu. Ft. of Wall

Size of Mortar Joint	$\frac{1}{4}$"	$\frac{3}{8}$"	$\frac{1}{2}$"	$\frac{5}{8}$"
Number of Brick Needed	21	20	19	$18\frac{1}{4}$

Amount of Mortar Needed to Lay 1000 Brick

Size of Mortar Joint	$\frac{1}{4}$"	$\frac{3}{8}$"	$\frac{1}{2}$"	$\frac{5}{8}$"
Amount of Mortar Needed	9 cu. ft.	$13\frac{1}{2}$ cu. ft.	15 cu.ft.	18 cu. ft.

One Ton of Marble Veneer Covers 40 Sq. Ft. of Wall.

One Ton of Grained Stone Veneer Covers 44 Sq. Ft. of Wall.

To find the number of brick needed to build a wall:

First find the number of cu. ft. in the wall and label your work. Then multiply the number of cu. ft. of wall by the number of brick which are needed to build 1 cu. ft. of wall, using a certain size mortar joint.

Let us work it out in a problem. How many brick are needed to build a wall 15' long, 8' high, and 12" wide, using a $\frac{3}{8}''$ mortar joint?

Find the cu. ft. in the wall.
Length x Height x Width.
The table shows that it takes 20 brick laid with a $\frac{3}{8}''$ mortar joint to build 1 cu. ft. of wall.

$$\begin{array}{rl} 15' & \text{Length} \\ \times\ \underline{8'} & \text{Height} \\ 120 & \text{sq. ft.} \\ \times\ \underline{1'} & \text{Width} \\ 120 & \text{cu. ft. of wall} \end{array}$$

Therefore you multiply 120 cu. ft. of wall x 20 brick (in 1 cu. ft.)

$$\begin{array}{rl} 120 & \text{cu. ft. of wall} \\ \times\ \underline{20} & \text{brick per cu. ft.} \\ 2400 & \underline{\text{brick needed}} \end{array}$$

To find the amount of mortar needed to lay the brick, you check the table and find that, with a $\frac{3}{8}''$ mortar joint, you need $13\frac{1}{2}$ cu. ft. of mortar to lay 1,000 brick. So, divide the total number of brick into units of 1,000 brick each. To do this you start from the right and point off 3 decimal places.

2.400
decimal point

You now have 2.4 units of 1,000 brick each. Multiply the number of units of 1,000 brick each by the amount of mortar needed to lay 1,000 brick with a $\frac{3}{8}''$ mortar joint.

$$\begin{array}{rl} 2.4 & \text{units of 1,000 brick} \\ \times\ \underline{13\frac{1}{2}} & \text{cu.ft.of mortar needed to} \\ 12 & \text{lay 1,000 brick} \\ 72 & \\ \underline{24} & \\ 32.4 & \text{cu. ft. of mortar needed.} \end{array}$$

Always give the quantity of mortar in cu. yds. Divide 32.4 cu. ft. by 27.

$$\begin{array}{rl} \underline{1.2} & \text{cu. yds. of mortar needed} \\ 27/32.4 & \\ \underline{27} & \\ 54 & \\ 54 & \end{array}$$

ANS. 2,400 brick
1.2 cu yds. mortar

Stone veneer: To find the number of tons of stone veneer needed to veneer a house.

First find the number of sq. ft. of surface on the outside of the house.

Sq. ft. of surface = perimeter x height.

Then divide the sq. ft. of surface by the number of sq. ft. of wall covered by 1 ton of stone veneer.

Follow the instructions in Information Sheet No. 2. The work is not new; it is just being given you in a different way.

How many sq. yds. are there in the walls and ceilings of the rooms with the following dimensions?

	Length	Width	Height	Openings	
				Doors	Windows
1.	64' 6"	42'	15'	3-- 3' x 7'	11-- 4' x 7'
2.	33'	25' 4"	14' 6"	2-- 3' 6" x 7'	12-- 4' x 8'

How many cu. yds. are there in foundation walls having the following dimensions?

	A	B	C	D	E	F
3.	18"	18'	54'			
4.	16'	15'	63'			
5.	8"	15'	38' 8"	45'	38' 8"	45'
6.	12"	12'	42'	42'	42'	42'
7.	8"	9'	39'	43'	39'	43'
8.	16"	15'	60'	74' 8"	60'	74' 8"

9. It takes 1 ton of marble to veneer 40 sq. ft. of wall. Find the amount of marble needed to veneer a wall 192' long and 9' 8" high.

10. How many brick laid with a $\frac{3}{8}$" mortar joint are needed for the foundation walls in problem 5?

11. How many brick laid with a ½" mortar joint are needed for the foundation walls in problem 6?

12. How many cu. yds. of mortar are needed to lay the brick in problem 10?

13. How many cu. yds. of mortar are needed to lay the brick in problem 11?

14. How long will it take 8 bricklayers, working 7 hours per day, to lay the brick in problem 11 if the bricklayers average 389½ brick per day?

Quantities of Materials Assignment Sheet No. 7

---

1. Find the number of sq. yds. in the walls and ceilings of a room 31' long, 29' wide, and 12' high. There are two doors 3' 6" x 7' and 8 windows, 2' 8" x 6'.

foundation
How many cu. yds. are there in/walls having the following dimensions?

	A	B	C	D	E	F
2.	16"	12'	42'	42'	42'	42'
3.	12"	13' 6"	50'	38'	50'	38'
4.	8"	12'	39'	60'	39'	60'
5.	16"	18'	36'	42'	36'	42'
6.	8"	15'	48' 6"	68' 6"	48' 6"	68' 6"

7. How many brick laid with a $\frac{3}{8}$" mortar joint are needed for the foundation walls in problem #2?

8. How many brick laid with a $\frac{1}{2}$" mortar joint are needed for the foundation walls in problem #5?

9. How many cu. yds. of mortar are needed to lay the brick in problem #8?

10. How many cu. yds. of mortar are needed to lay the brick in problem #7?

11. How many tons of grained veneer stone are needed to face a house 48' 6" long, 28' 3" wide, and 9' high?

12. Find the area of a triangular prism whose base is 36', whose height is 24', and whose length is 58' 6".

13. How many cu. yds. of earth must be dug from an excavation which is 87' 6" long, 38' wide, and 7' 4" deep?

14. Find the cost of 4,650' of $\frac{1}{2}$" round, deformed reinforcing steel. Round, deformed reinforcing steel weighs .66 lbs. per foot and costs $6\frac{3}{4}$¢ per lb.

15. $5\frac{2}{3}$% of 52,054 = ?

16. $16\frac{2}{3}$% of 68,704 = ?

OBJECTIVE: To learn how to find the number of cu. yds. in a footing.

INFORMATION:

Because the footings of a building are the base which support the building, the footing is almost always wider than the foundation wall. On a blueprint, the length and width of a building are given on the outside of the foundation, but very rarely on the outside of a footing.

Figures 17 and 18, on the following page, show the dimensions necessary to compute a footing. The dimensions given are the width of the footing, A, and the height or depth, B. You use the same length to estimate both the footing and the foundation. To find the cu. yds. in a footing, you multiply the Length x Width x Height, just as you do to find the cu. yds. in a wall.

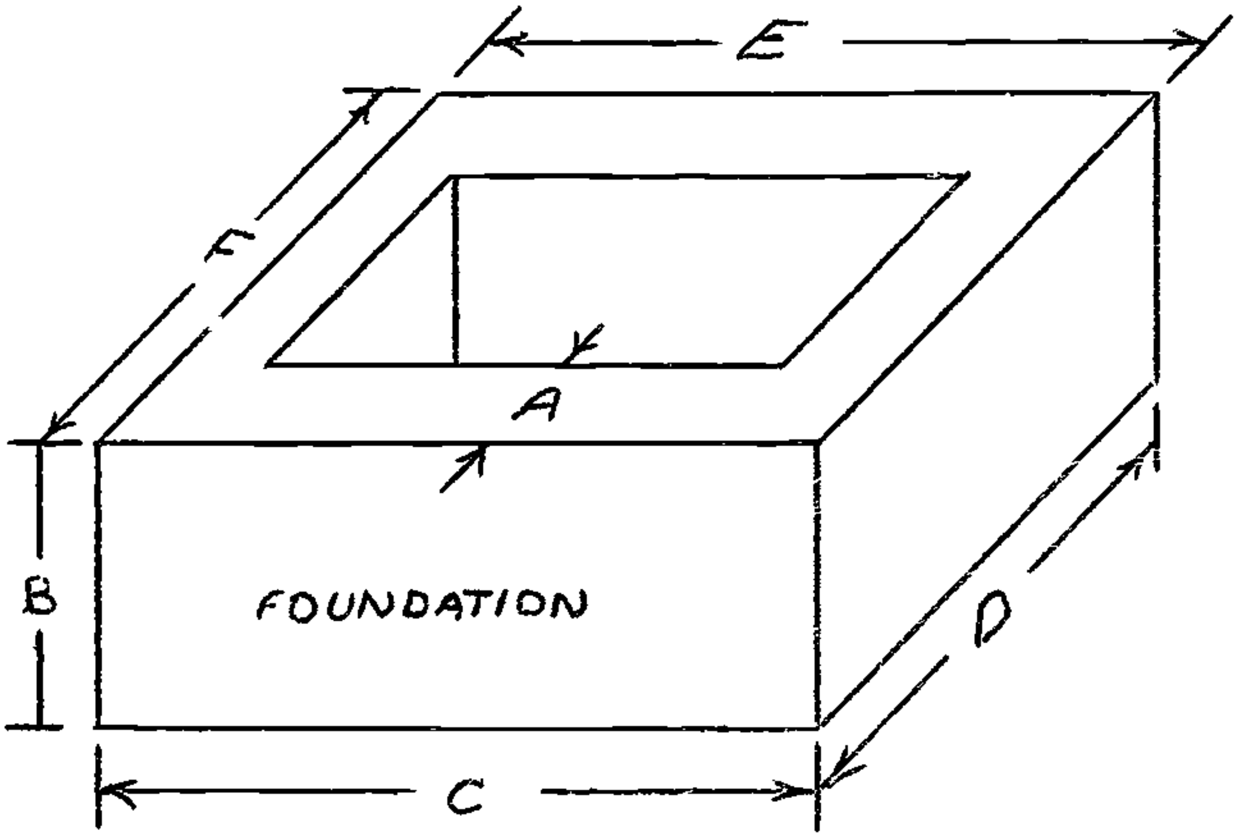


FIG. 16

FIG. 17

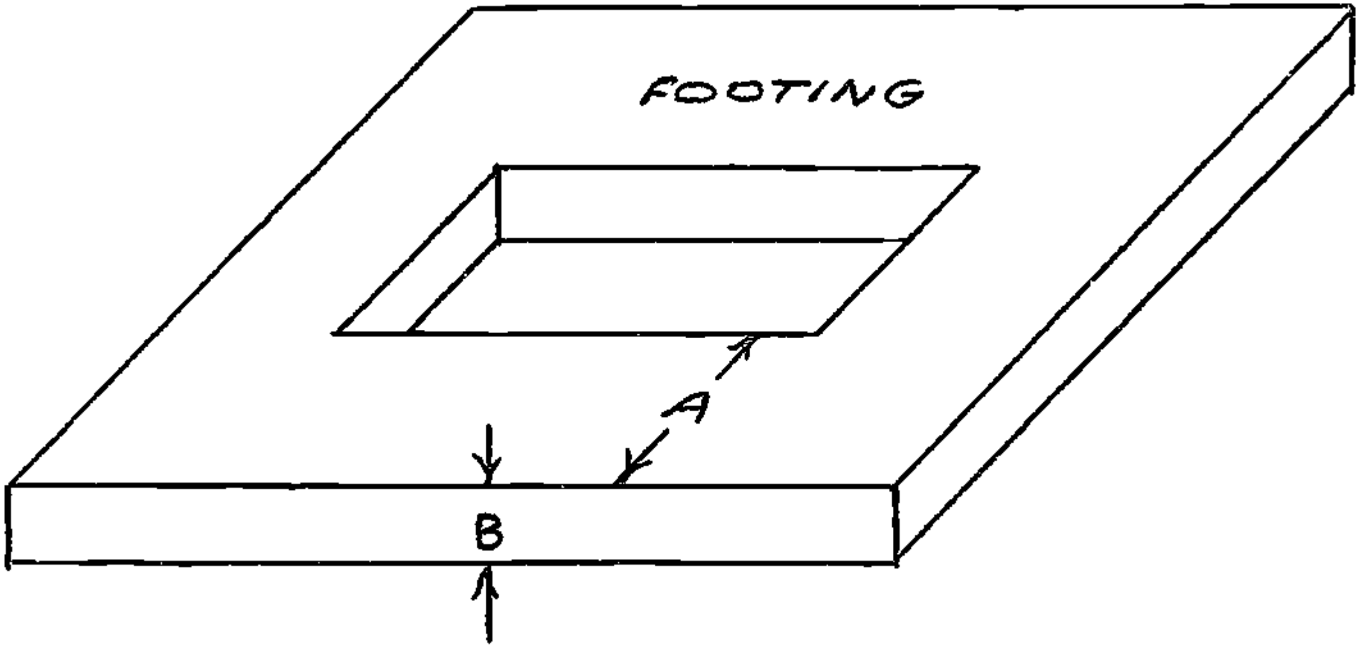
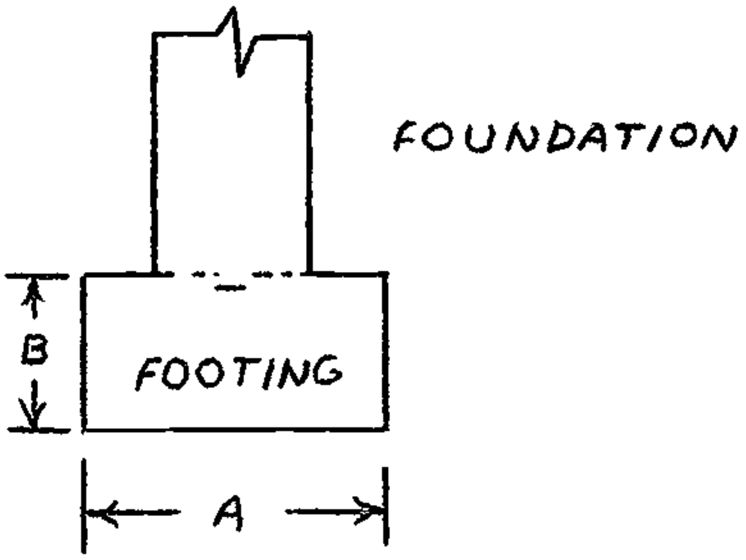


FIG. 18



Footings and Quantities of Materials — Assignment Sheet No. 8

Follow the instructions on Information Sheet No. 3. Read each problem carefully to see whether the answer is required for the foundation only; footing only, or foundation and footing combined.

1. How many sq. yds. are there in the walls and ceiling of a room which is 38' long, 29' wide, and 12' high? Openings are 2 doors 3' x 7', and 7 windows 3' x 6'.

How many cu. yds. are there in the footings and foundation walls having the following dimensions?

	A	B	C	D	E	F	
2.	12"	9'	34'	37'	34'	37'	Foundation
3.	12"	9'	75'	56'	75'	56'	Foundation
4.	2'	1'	Footing for foundation in problem 2				
5.	2'	1'	Footing for foundation in problem 3				
6.	(16" (2' 6"	15' 1' 4"	60'	74' 8"	60'	74' 8"	)Foundation)and Footing
7.	(12" (2'	9' 1'	37'	34'	37'	34'	)Foundation)and Footing

8. How many brick laid with a $\frac{3''}{8}$ mortar joint are needed for the foundation walls in problem 2?

9. How many brick laid with a $\frac{1}{2}$" mortar joint are needed for the foundation walls in problem 3?

10. How many cu. yds. of mortar are needed to lay the brick in problem 8?

11. How many cu. yds. of mortar are needed to lay the brick in problem 9?

12. How many working hours will it take to lay the brick in problem 9, if the bricklayers work 7 hours per day and average 378 brick per day?

13. How many tons of grained stone are needed to veneer a house 48' 8" long, 26' 4" wide, and 9' 8" high?

14. $5\frac{2}{3}$% of 44,118 = ?

How many cu. yds. are there in the footings and foundation walls having the following dimensions?

	A	B	C	D	E	F
1.	(12" (2'	13' 6" 1'	50'	38'	50'	38'
2.	15"	12'	38' 6"	48'	38' 6"	48'
3.	(16" (2' 8"	15' 1' 4"	60'	74' 8"	60'	74' 8"
4.	(16" (2' 8"	9' 1' 4"	45' 2"	39' 6"	45' 2"	39' 6"
5.	(12" (2'	9' 1'	45'	39'	45'	39'
6.	18"	12'	42'	63'	42'	63'

7. How many sq. yds. are there in the walls and ceiling of a room 31' long, 27' wide, and 10' 6" high?
Openings: 2 doors 3' x 7' and 8 windows 2' 6" x 4' 6".

8. How many brick laid with a $\frac{1}{2}$" mortar joint are needed for the foundation walls in problem 1?

9. How many brick laid with a $\frac{3}{8}$" mortar joint are needed for the foundation walls in problem 5?

10. How many cu. yds. of mortar are needed to lay the brick in problem 8?

11. How many cu. yds. of mortar are needed to lay the brick in problem 9?

12. How many tons of marble are needed to veneer a house 47' 8" long, 33' 6" wide, and 9' 6" high?

13. $16\frac{2}{3}\%$ of 29,520 = ?

14. $\frac{5}{8}$" round, deformed reinforcing steel weighs 1.05 lbs. per foot and costs $7\frac{3}{4}$¢ per lb. Find the cost of 3,985 feet of round deformed reinforcing steel.

How many cu. yds. are there in the following footings and foundation walls?

	A	B	C	D	E	F
1.	(16" (2' 8"	12' 6" 1' 4"	41'	57'	41'	57'
2.	8'	5'	169'			
3.	12"	13'	39'	43' 6"	39'	43' 6"
4.	(16" 2' 8"	12' 1' 4"	38' 8"	45'	38' 8"	45'
5.	(15" (2' 6"	12' 1' 3"	50' 6"	45'	50' 6"	45'

6. How many brick laid with a $\frac{5}{8}''$ mortar joint are needed for the foundation walls in problem 1?

7. How many brick laid with a $\frac{3}{8}''$ mortar joint are needed for the foundation walls in problem 3?

8. How many cu. yds. of mortar are needed to lay the brick in problem 6?

9. How many cu. yds. of mortar are needed to lay the brick in problem 7?

10. How many sq. yds. are there in the walls and ceiling of a room 41' long, 32' wide, and 12' 6" high? Openings: [illegible] doors 3' 6" x 7' and 12 windows 3' x 5' 6".

11. How many working days will it take to lay the brick in problem 7 if the bricklayers lay an average of 520 brick each per day?

12. $5\frac{2}{3}\%$ of 57,995 = ?

13. Find the area of a rectangular prism 26' 6" long, 14' 6" wide, and 9' high.

14. Find the area of a cylinder 19' high, which has a diameter of 19'.

15. How many tons of grained veneer stone are needed for the foundation in problem 3?

How many cu. yds. are there in the following footings and foundation walls?

	A	B	C	D	E	F
1.	9' 6"	5'	189'			
2.	(12" (2'	13' 6" 1'	27'	38'	27'	38'
3.	16"	12'	27' 2"	49'	27' 2"	49'
4.	(12" (2'	9' 1'	34'	37'	34'	37'
5.	(18" (3'	12' 1' 6"	29'	42'	29'	42'
6.	(8" (1' 4"	9' 8"	78' 4"	47' 6"	78' 4"	47' 6"

7. How many brick laid with a $\frac{1}{4}$" mortar joint are needed for the foundation walls in problem 6?

8. How many brick laid with a $\frac{1}{2}$" mortar joint are needed for the foundation walls in problem 3?

9. How many cu. yds. of mortar are needed to lay the brick in problem 7?

10. How many cu. yds. of mortar are needed to lay the brick in problem 8?

11. How many sq. yds. are there in the walls and ceiling of a room 29' 6" long, 24' wide, and 11' 6" high?
Openings: 2 doors 3' x 7', and 8 windows 3' x 4' 6".

12. Find the area of a triangular prism whose base is 28', whose height is 17', whose sides are 21', and whose length is 46' 6".

13. Find the area of Fig. A.

14. Find the perimeter of Fig. A.

15. $16\frac{2}{3}\%$ of 44,688 = ?

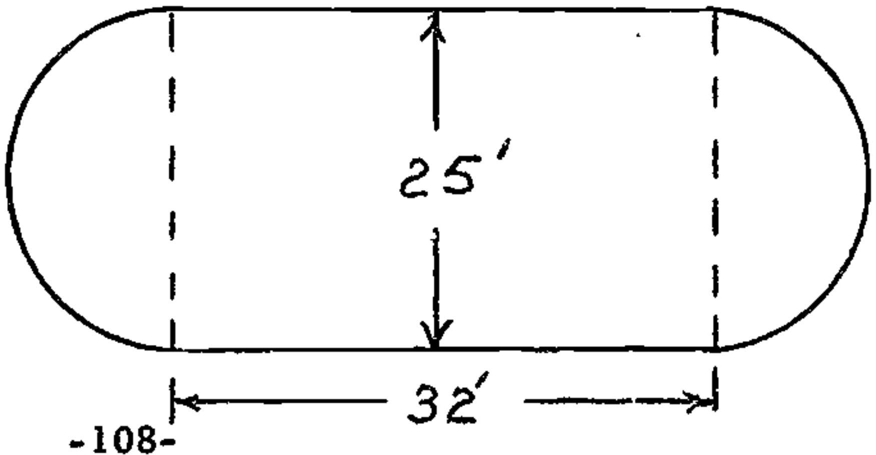


FIG. A

OBJECTIVE: To learn how to find the cubic contents of cylinders and triangular prisms.

INFORMATION:

In construction today, many round columns of concrete are used. Also many concrete walls have slanting sides. In the assignments which follow you will learn how to compute the cubic contents (volume) of both cylinders and triangular prisms.

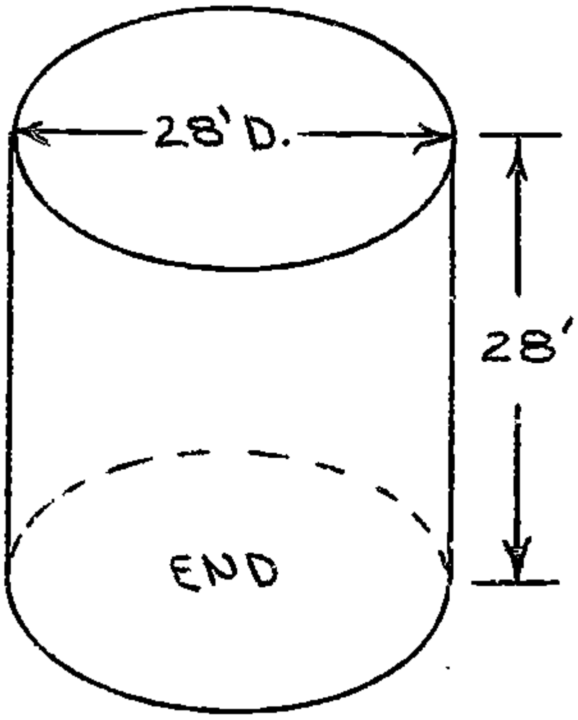


FIG. 19

CYLINDER

Fig. 19 is a round column or cylinder. To find the number of cu. yds. in Fig. 19:

First, you must find the area of one of the circular (ends either the top or the bottom). To find the area of a circle, you recall, you multiply the radius x radius x 3.1416.

The radius is $\frac{1}{2}$ of the diameter.
$\frac{1}{2}$ x 28' = 14'

$$\begin{array}{lr} \text{radius} & 14' \\ \text{radius} \times & \underline{14'} \\ & 56 \\ & \underline{14} \\ & 196 \text{ sq. ft.} \end{array}$$

$$\begin{array}{rl} & 3.1416 \\ \times & \underline{196} \text{ sq. ft.} \\ & 188496 \\ & 282744 \\ & \underline{31416} \\ & 615.7536 \text{ sq. ft. area of the end of Fig. 19.} \end{array}$$

Next, you multiply the area of the end of Fig. 19 by the height. You now have the number of cubic feet in Fig. 19.

$$\begin{array}{rl} & 615.7536 \text{ sq. ft. area} \\ \times & \underline{28} \text{ ft. high} \\ & 49260288 \\ & \underline{12315072} \\ & 17{,}241.1008 \text{ cubic ft. in Fig. 19.} \end{array}$$

Divide by 27 to get cubic yards.

$$\begin{array}{r} 638.55+ = \\ 27/\overline{17{,}241.1008} \\ \underline{162} \\ 1\,04 \\ \underline{81} \\ 231 \\ \underline{216} \\ 151 \\ \underline{135} \\ 160 \\ \underline{135} \end{array}$$

638.56 cu. yds in Fig. 19. ANS.

Summarizing, to find the cubic contents of a cylinder, multiply the area of the end x height.

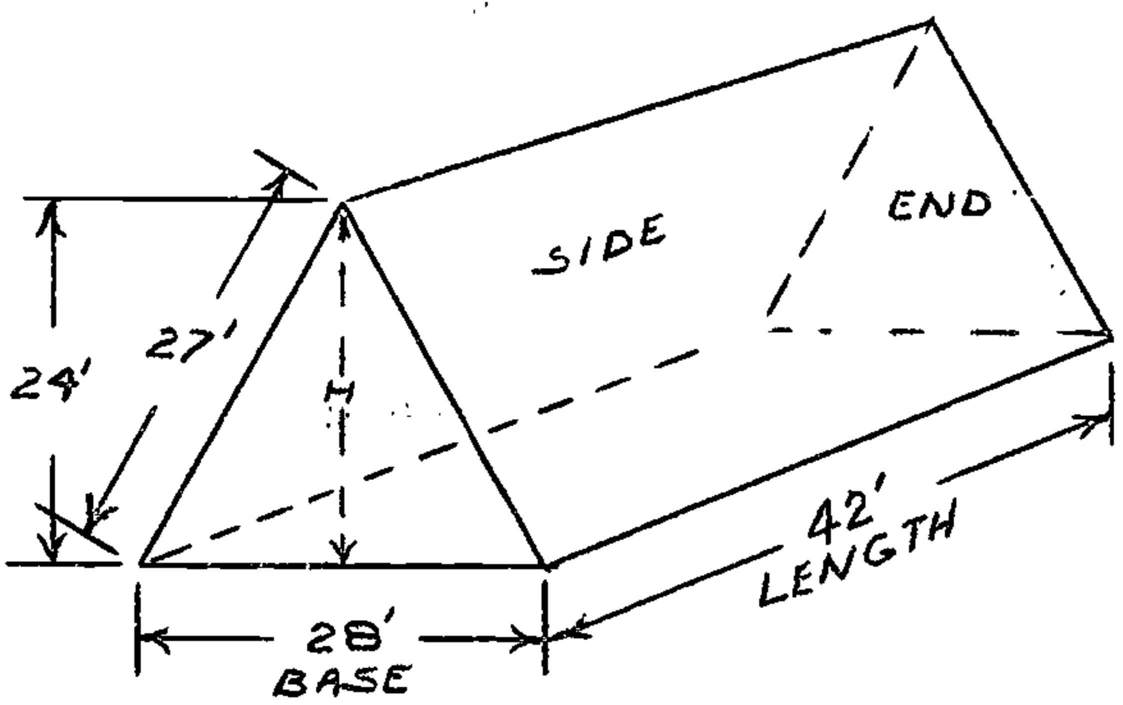


FIG. 20

TRIANGULAR PRISM

Fig. 20 is a triangular prism. To find the number of cubic yards in Fig. 20:

First, you must find the area of one end. To find the area of one end, which is a triangle, we multiply:

$\frac{1}{2}$ base x the height

$\frac{1}{2}$ x 28' = 14'

$\frac{1}{2}$ base 14'
x height x 24'
56
28
336 sq. ft. area of end of Fig. 20

Next, multiply the area of the end of Fig. 20 by the length.

336 sq. ft. of end of Fig. 20
x 42' length
672
1344
14,112 cubic feet in Fig. 20

Divide by 27 to get cubic yards.

$522\frac{2}{3}$ cu. yds. in Fig. 20
27/14112
135
61
54
72
54
$\frac{18}{27} = \frac{2}{3}$

$522\frac{2}{3}$ cu. yds. ANS.

Summarizing, to find the cubic contents of a triangular prism, multiply the area of the end x length.

1. Find the number of cu. yds. in a cylinder which has a diameter of 11' and which is 17' high.

2. Find the number of cu. yds. in a triangular prism which has a base of 15', sides 18', height 12', and which is 27' 6" long.

3. Find the number of cu. yds. in a cylinder whose radius is 15' and whose height is 23'.

4. Find the number of cu. yds. in a triangular prism whose base is 18', whose height is 12', and whose length is 27' 9".

5. Find the area of a cylinder which is 4' in diameter and 18' high.

6. Find the number of cubic yards in a column whose circumference is 10.2102' and whose height is 29' 9".

7. Find the area of a triangular prism which has a base 12' wide, whose sides are 10', whose height is 8', and which is 25' 4" long.

8. Find the number of cu. yds. in a triangular prisms whose base is 9', height is 6', and length is 18' 6".

9. Find the number of cu. yds. in a column 3' in diameter and 19' 6" high.

10. How many cu. yds. are there in the following footing and foundation walls?

A	B	C	D	E	F
(12"	9' 6"	32' 2"	47' 4"	32' 2"	47' 4"
(2'	1'				

11. How many brick laid with a $\frac{5}{8}$" mortar joint are needed for the foundation walls in problem 10?

12. How many cu. yds. of mortar are needed to lay the brick in problem 11?

13. $16\frac{2}{3}\%$ of 26,670 = ?

14. How many cu. yds. are there in a slanted wall (section view) Fig. A, which is 57' long?

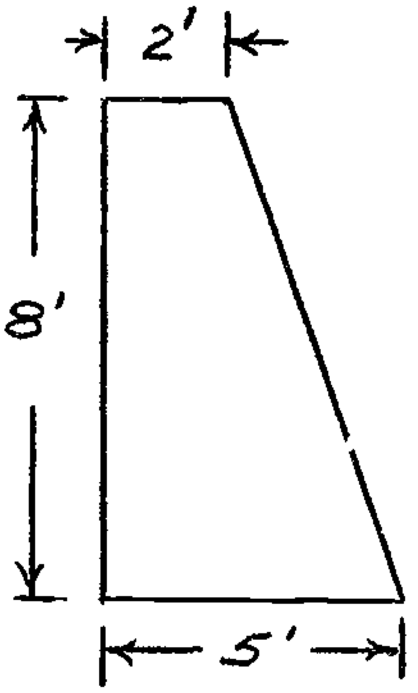


FIG. A
SECTION VIEW

1. Find the number of cu. yds. in 12 columns each of which has a circumference of 9.4248' and a height of 18'.

2. How many cu. yds. are there in a triangular prism (section view, Fig. A) whose length is 19' 6"?

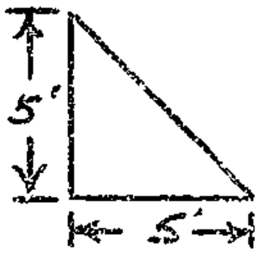


FIG. A
SECTION VIEW

3. How many cu. yds. are there in a slanted wall (section view, Fig. B) whose length is 88' 9"?

FIG. B
SECTION VIEW

4. Find the number of cu. yds. in a column whose radius is 1' and whose height is 21'.

5. Find the number of sq. yds. in the walls and ceiling of a room 21' long, 14' wide, and 8' 6" high.
Openings: 1 door 2' 8" x 7' and 5 windows 2' 6" x 4'.

6. How many cu. yds. are there in 8 columns 18" square and 18' high?

7. How many cu. yds. are there in the following footing and foundation walls?

A	B	C	D	E	F
(12"	8' 8"	43' 6"	29'	43' 6"	29'
(2'	1'				

8. How many brick laid with a $\frac{3}{8}''$ mortar joint are needed for the foundation walls in problem 7?

9. How many cu. yds. of mortar are needed to lay the brick in problem 8?

10. $5\frac{2}{3}\%$ of 24,440 = ?

11. How many tons of marble veneer are needed to veneer the foundation walls in problem 7?

OBJECTIVE: To learn how to compute the number of cubic yards of concrete needed for sidewalks, basement floors, and patios.

INFORMATION:

In square measure, you learned how to find the area of different shaped surfaces. Floors, walks, and patios are surfaces which have depth. To find the number of cubic yards of concrete needed for a floor, walk, or patio, you must first find the area of the surface to be covered, then multiply that area by the specified depth or thickness of the concrete.

The concrete for basement floors, garage floors, walks, and patios is usually 4'' thick.

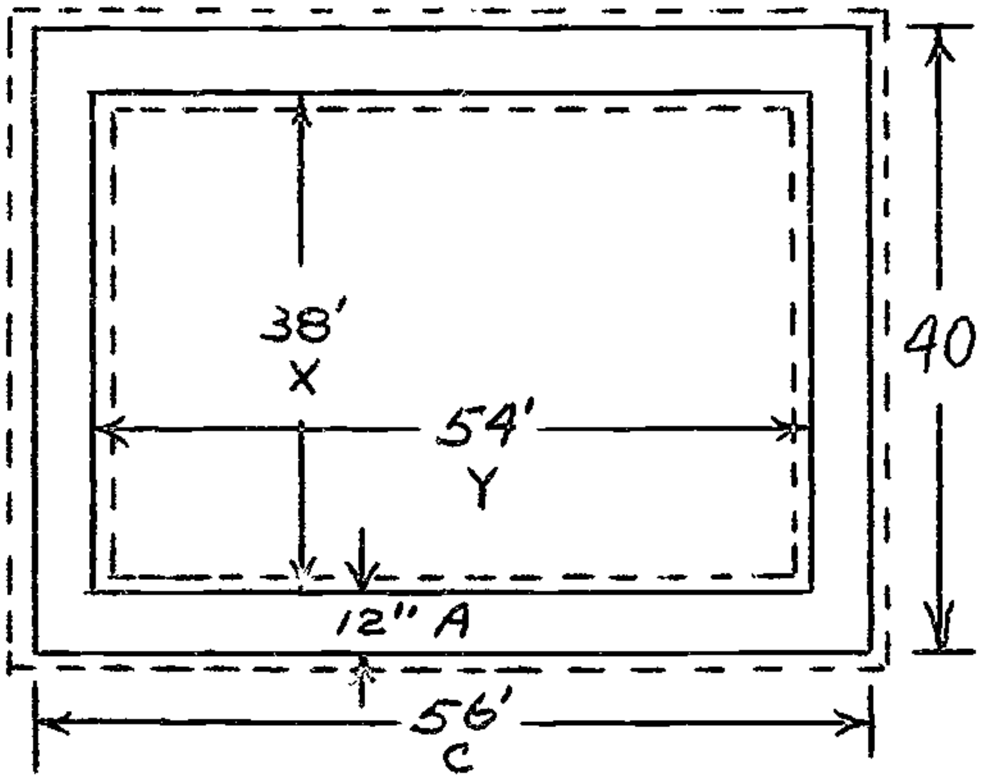
Basement floors are poured inside the walls of a building. On the plan (see Fig. 21) dimensions are always given on the <u>outside</u> of the building, as dimensions C & D. The dimensions you need in order to estimate the amount of concrete required are dimensions X & Y. To find dimension X, you subtract the width of the wall from each end of dimension D.

$$X = 40' - (1 + 1) = 38'$$

To find dimension Y, you subtract the width of the wall from each end of dimension C.

$$Y = 56' - (1 + 1) = 54'$$

$$Y = 54' \text{ (length)}; \quad X = 38' \text{ (width}$$



Note: Floor 4" thick

FIG. 21

To get the area of the floor, multiply the length by the width.

length (Y) 54'
width (X) x 38'
432
162
2052 sq. ft. area of floor

To find the number of cu. yds. of concrete needed, multiply the area by the thickness (change 4" to $\frac{1}{3}$ of a foot).

Note that the number of <u>cu. ft.</u> is <u>less</u> than the number of <u>sq. ft.</u>

$\overset{684}{\cancel{2052}} \times \frac{1}{\cancel{3}}$ = 684 cu. ft. in floor

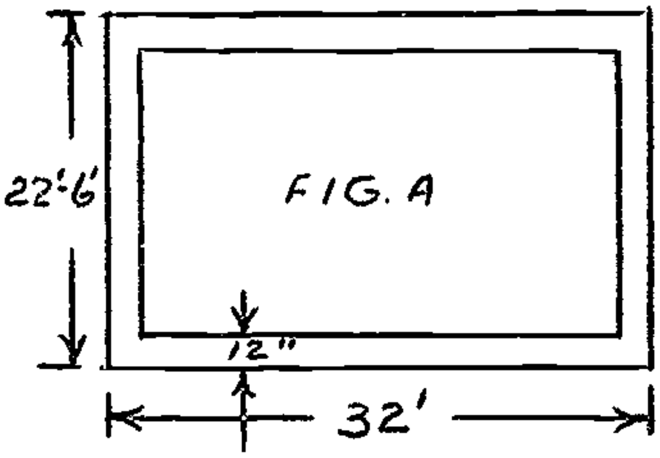
Divide by 27 to change the cu. ft. to cu. yds.

$25\frac{1}{3}$ cu. yds. of concrete needed
27/684 for the floor of Fig. 21
54
144
135
$\frac{9}{27} = \frac{1}{3}$

Sidewalks and patios cover the entire area given by the dimensions.

Follow the instructions on Information Sheet No. 5. Think before you work, it will save you time and effort.

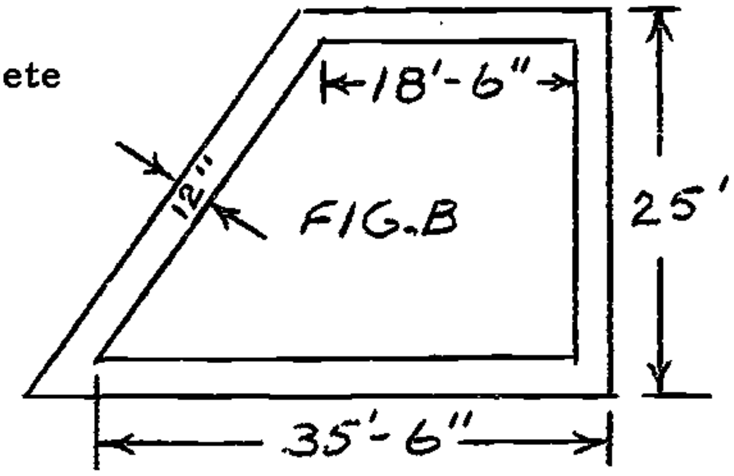
1. How many cu. yards of concrete are needed for the floor in Fig. A? Floor is 4" thick.



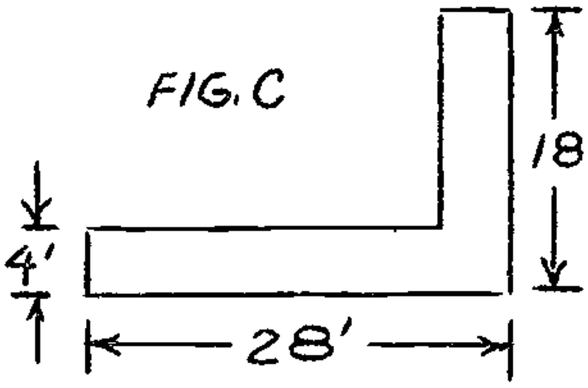
2. How many cubic yards of concrete are needed for a sidewalk 4' wide, 62' 6" long and 4" thick?

3. How many cubic yards of concrete are needed for a patio 23' long, 16' wide, and 4" thick?

4. How many cubic yards of concrete are needed for the floor in Fig. B? Floor is 6" thick.

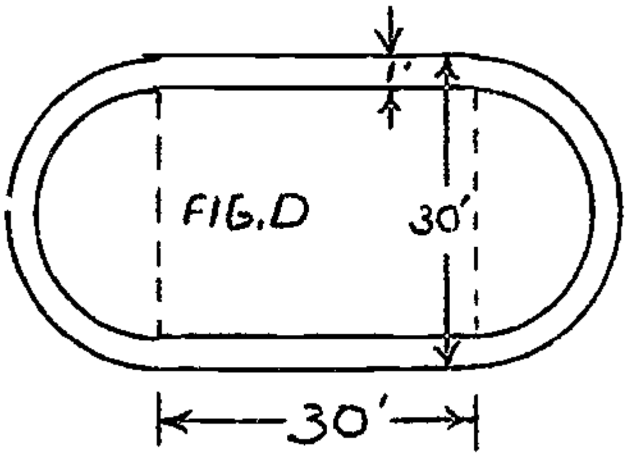


5. How many cubic yards of concrete are needed for the walk in Fig. C? Walk is 4" thick.



6. How many cubic yards of concrete are needed for a patio 29' long, 14' wide, and 4" thick?

7. How many cubic yards of concrete are needed for the floor of Fig. D? Floor is 8" thick.



8. How many cu. yds. are there in the following footing and foundation walls?

A	B	C	D	E	F
(8" (1' 4"	8' 6" 8"	33' 2"	27' 2"	32' 2"	27' 2"

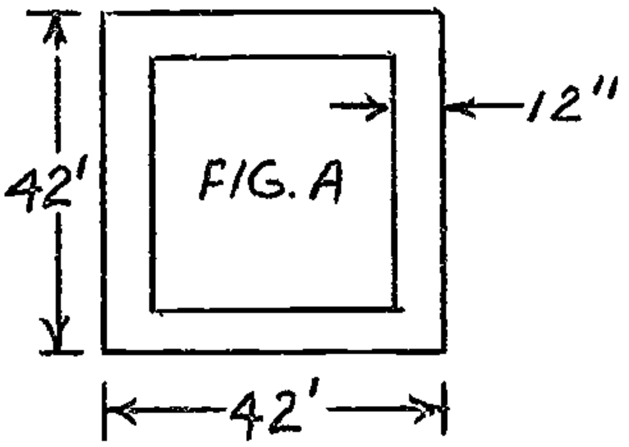
9. How many brick laid with a $\frac{1}{2}$" mortar joint are needed for the foundation walls in problem 8?

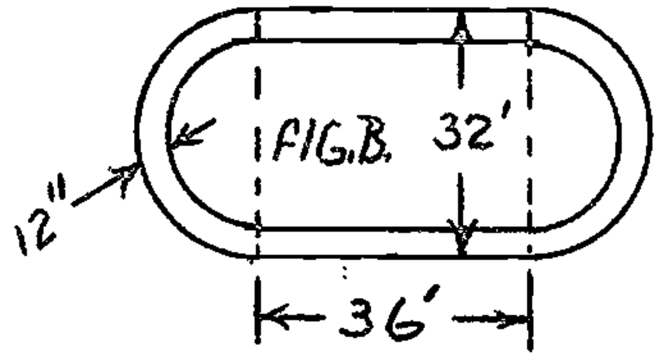
10. How many cubic yards of mortar are needed to lay the brick in problem 9?

11. How many cubic yards of concrete are needed for the floor in problem 8? Floor is 4" thick.

Concrete Floors, Walks, Patios — Assignment Sheet No. 15

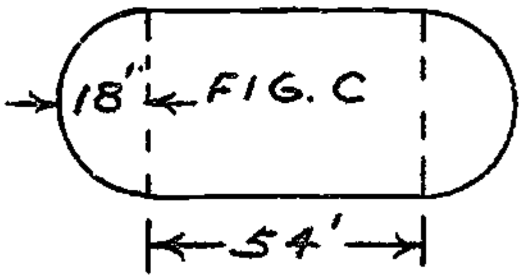
1. How many cu. yds. of concrete are needed for the floor in Fig. A? Floor is 6" thick.

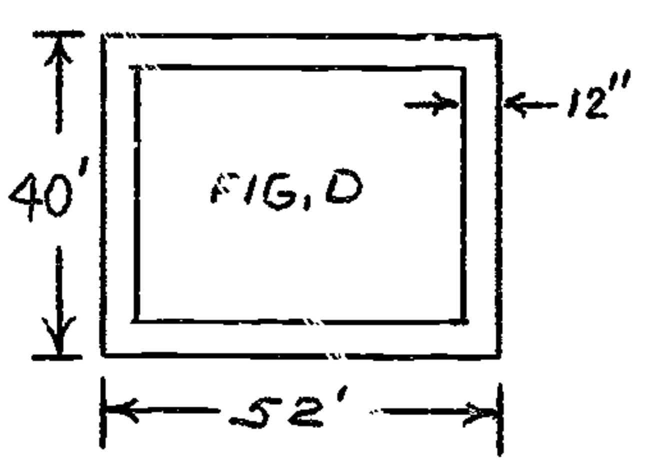




2. How many cu. yds. of concrete are needed for the floor in Fig. B? Floor is 8" thick.

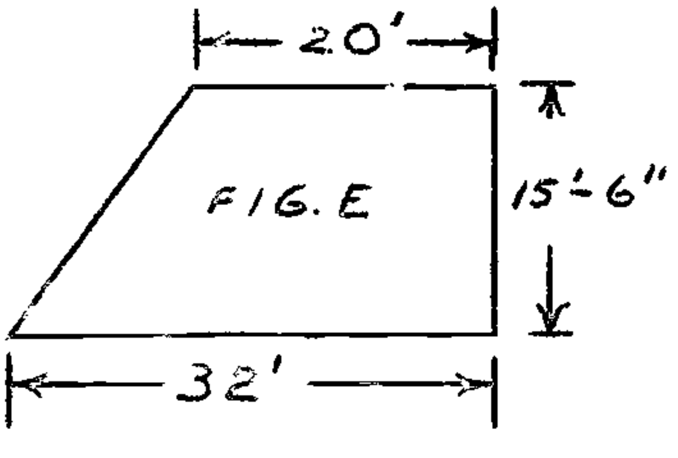
3. How many cu. yds. of concrete are needed for the patio in Fig. C? Concrete is 6" thick.





4. How many cu. yds. of concrete are needed for the floor in Fig. D? Floor is 4" thick.

5. How many cu. yds. of concrete are needed to cover Fig. E? Concrete is 4" thick.



6. How many cu. yds. of concrete are needed for a walk 39' 9" long, 4' 6" wide, and 4" thick?

7. How many cu. yds. of concrete are needed for the walk in Fig. F? Walk is 4" thick.

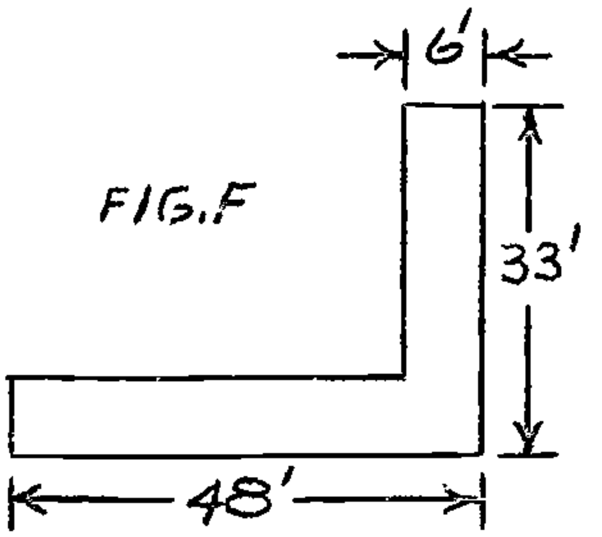


FIG.F

8. How many cu. yds. of concrete are needed for 18 columns 18' high and 2' 6" in diameter?

9. How many sq. yds. are there in the walls and ceiling of a room 26' 6" long, 19' wide, and 9' 6" high?
Openings: 2 doors 3' x 6' 8"; 8 windows 2' 6" x 5'.

10. How many cu. yds. are there in the following footing and foundation walls?

A	B	C	D	E	F
(12"	10' 6"	67' 6"	52'	67' 6"	52'
(2'	1'				

11. How many brick laid with a $\frac{5''}{8}$ mortar joint are needed for the foundation walls in problem 10?

12. How many cu. yds. of mortar are needed to lay the brick in problem 11?

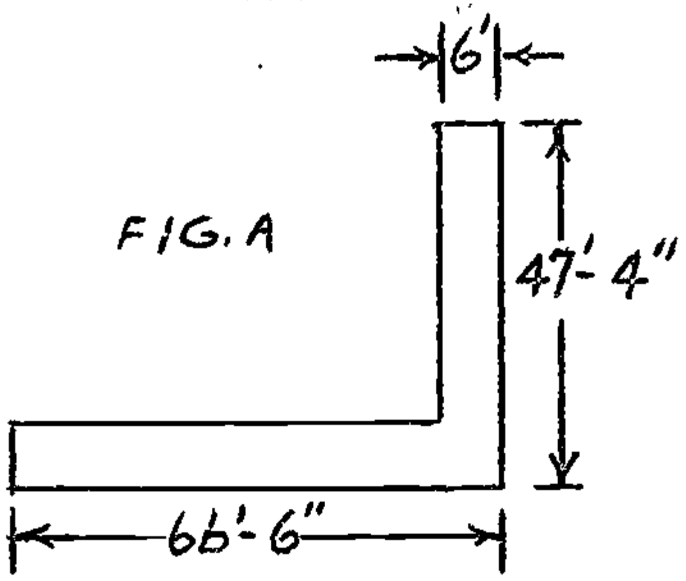
13. How many cu. yds. of concrete are needed for the floor in problem 10? Floor is 4" thick.

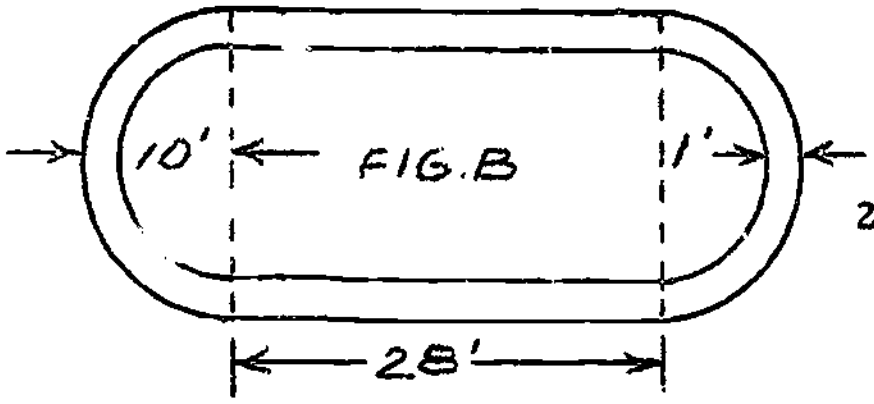
14. How long will it take 16 men, working 7 hours per day, to lay the brick in problem 11, if they lay an average of 433 brick each per day?

15. How many tons of grained veneer stone are needed for the foundation walls in problem 10?

16. How many sq. ft. of slate are needed to cover the surface of the patio in problem 3?

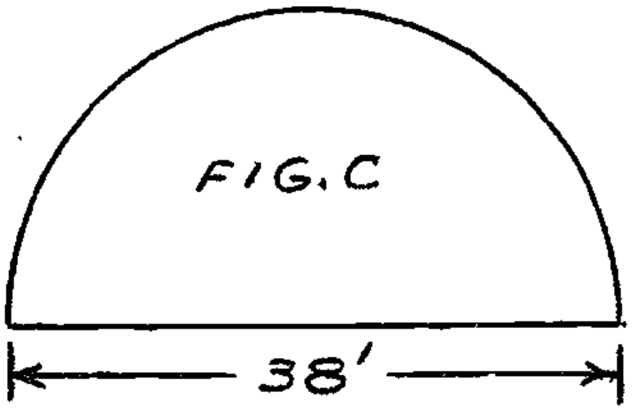
1. Find the number of cu. yds. of concrete needed for the walk in Fig. A. Walk is 4" thick.





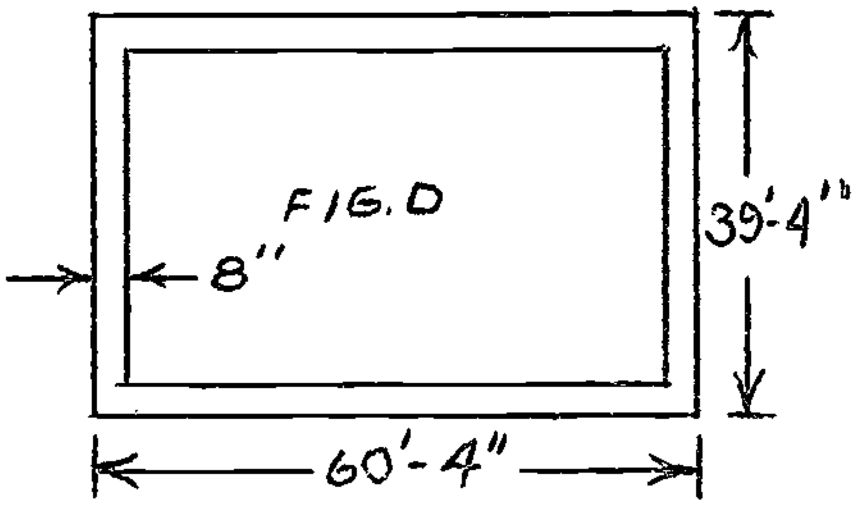
2. How many cu. yds. of concrete are needed for the floor in Fig. B? Floor is 6" thick.

3. How many cu. yds. of concrete are needed for the patio in Fig. C? Concrete is 4" thick.



4. How many sq. yds. are there in the walls and ceiling of a room 35' long, 26' wide, and 9' 6" high?
Openings: 3 doors 2' 8" x 6' 8" and 12 windows 2' 8" x 5' 6".

5. How many cu. yds. of concrete are needed for the floor in Fig. D? Floor is 4" thick.



6. How many cu. yds. are there in 18 columns 17' high and 2' 9" in diameter?

7. How many cu. yds. of concrete are needed for the patio in Fig. E? Concrete is 4" thick.

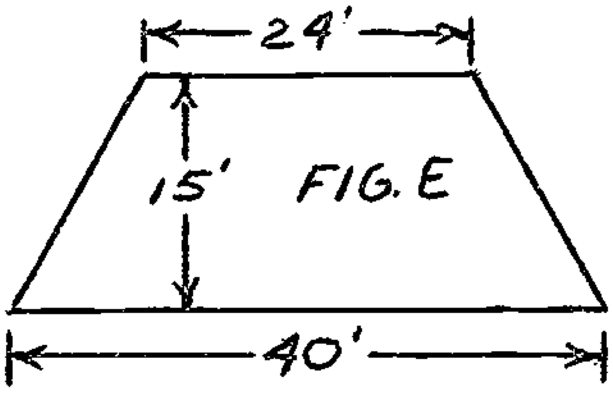


FIG. E

8. How many cu. yds. are there in the following footing and foundation walls?

A	B	C	D	E	F
(12"	8' 4"	46' 6"	58'	46' 6"	58'
(2'	1'				

9. How many brick laid with a $\frac{1}{4}$" mortar joint are needed for the foundation walls in problem 8?

10. How many cu. yds. of mortar are needed to lay the brick in problem 9?

11. How many cu. yds. of concrete are needed for the floor in problem 8? Floor is 6" thick.

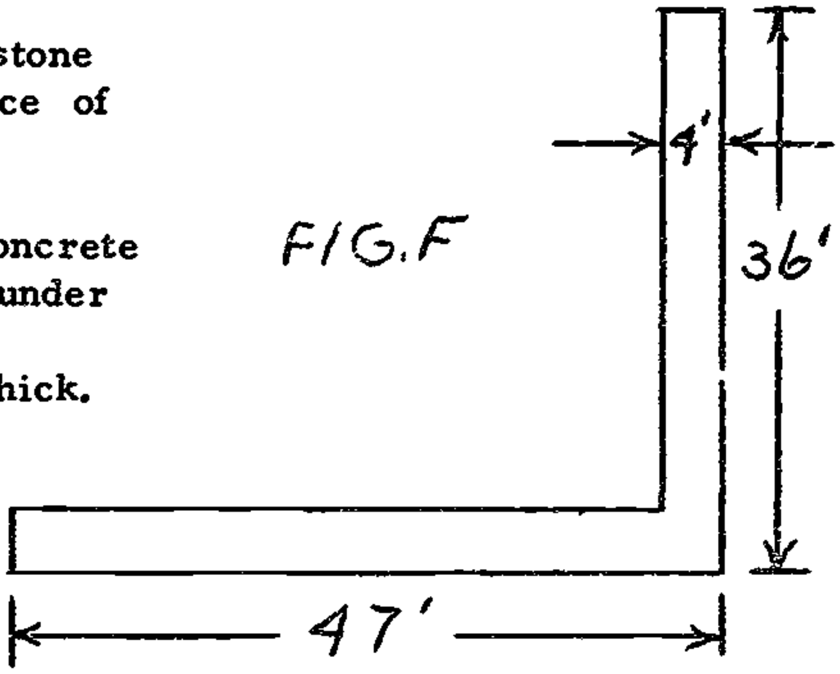
12. $16\frac{2}{3}\%$ of 35,875 = ?

13. How many tons of marble veneer are needed to veneer the foundation walls in problem 8?

14. How many sq. ft. of flagstone are needed for the surface of the walk in Fig. F?

15. How many cu. yds. of concrete are needed for the base under the flagstone in Fig. F? Concrete base to be 3" thick.

FIG. F



UNIT I

Addition and Subtraction of Fractions — Test No. 1 - A

Add:

1. $275'\ 6\frac{1}{4}'' + 1'\ 11\frac{3}{8}'' + 72'\ \frac{1}{2}'' + 1{,}429'\ 10\frac{13}{16}' + 14'\ 2\frac{5}{8}'' =$
2. $115'\ \frac{3}{8}'' + 29'$ [illegible]$\frac{1}{4}'' + 8\frac{9}{16}'' + 140'\ \frac{5}{8}'' + 56'\ 9\frac{1}{2}'' =$
3. $121'\ \frac{3}{4}'' + 8\frac{7}{8}'' + 10' + 41'\ 11\frac{9}{16}'' + 8'\ \frac{1}{2}'' =$
4. $196'\ 7\frac{7}{8}'' + 7' + 132'\ \frac{1}{2}'' + 8\frac{1}{2}'' + 17'\ \frac{3}{4}'' =$
5. $18'\ \frac{9}{16}'' + 21'\ 10\frac{3}{4}'' + 155'\ 2\frac{7}{8}'' + 11\frac{5}{8}'' + 34' =$
6. $121'\ \frac{3}{4}'' + 10\frac{3}{8}'' + 41'\ 11\frac{9}{16}'' + 6'\ \frac{1}{2}'' + 12' =$
7. $199'\ 11\frac{7}{8}'' + 16'\ \frac{1}{2}'' + 101'\ 9\frac{3}{4}'' + 8\frac{11}{16}'' + 5'\ \frac{5}{8}'' =$
8. $122'\ \frac{1}{2}'' + 71'\ 9\frac{3}{4}'' + 8'\ 11\frac{7}{8}'' + 45'\ 8\frac{9}{16}'' + 155'\ 11\frac{5}{8}'' =$

Subtract:

9. $1{,}895'\ 9\frac{5}{16}'' - 1{,}599'\ 10\frac{3}{4}'' =$
10. $1{,}435'\ 11\frac{1}{2}'' - 396'\ 10\frac{5}{8}'' =$
11. $165'\ \frac{3}{8}'' - 156'\ 10\frac{9}{16}'' =$
12. $271' - 159'\ 9\frac{3}{4}'' =$
13. $194'\ 11'' - 95'\ \frac{1}{2}'' =$
14. $3{,}795'\ 2\frac{1}{4}'' - 2{,}694'\ 2\frac{5}{8}'' =$
15. $3{,}689'\ 11\frac{7}{16}'' - 1{,}792'\ 4\frac{5}{8}'' =$
16. $1{,}435'\ \frac{1}{2}'' - 396'\ 10\frac{5}{8}'' =$

Addition and Subtraction of Fractions — Test No. 1 - B

Add:

1. $41'\ 2\frac{3}{4}'' + 9\frac{9}{16}'' + 121' + 23'\ 11\frac{7}{8}'' + 7'\ \frac{13}{16}'' =$
2. $42'\ 8\frac{15}{16}'' + 100' + 6\frac{7}{8}'' + 7'\ 11'' + 9\frac{15}{32}'' =$
3. $245'\ 6\frac{1}{4}'' + 11'\ 11\frac{3}{8}'' + 8\frac{9}{16}'' + 72'\ \frac{1}{2}'' + 56'\ 9\frac{1}{2}'' =$
4. $123'\ 6\frac{13}{16}'' + 45' + 8'\ \frac{7}{8}'' + 8\frac{3}{4}'' + 31'\ 11\frac{13}{16}'' =$
5. $7'\ 5\frac{3}{4}'' + 18'\ \frac{7}{8}'' + 11\frac{1}{2}'' + 45'\ 10\frac{15}{16}'' + 155'\ \frac{5}{8}'' =$
6. $132'\ \frac{1}{2}'' + 8\frac{1}{2}'' + 7' + 196'\ 7\frac{7}{8}'' + 17'\ \frac{3}{4}'' =$
7. $41'\ 11\frac{9}{16}'' + 21' + 110'\ \frac{3}{4}'' + 8\frac{7}{8}'' + 8'\ \frac{1}{2}'' =$
8. $155'\ 2\frac{7}{8}'' + 11\frac{5}{8}'' + 34' + 18'\ \frac{9}{16}'' + 21'\ 10\frac{3}{4}'' =$

Subtract:

9. $2{,}279'\ \frac{5}{16}'' - 1{,}378'\ 6\frac{3}{8}'' =$
10. $1{,}895'\ 10\frac{5}{16}'' - 796'\ 11\frac{7}{8}'' =$
11. $559'\ 6'' - 359'\ 7\frac{3}{8}'' =$
12. $191' - 159'\ 9\frac{3}{4}'' =$
13. $156'\ \frac{3}{4}'' - 49'\ 10\frac{7}{8}'' =$
14. $335'\ \frac{1}{2}'' - 316'\ 8'' =$
15. $189'\ 3\frac{3}{16}'' - 92'\ 8\frac{1}{8}'' =$
16. $875'\ 11\frac{3}{4}'' - 687'\ 7\frac{13}{16}'' =$

Addition, Subtraction and Multiplication of Fractions

Test No. 2A

Add:

1. $9\frac{5}{8}'' + 115'\frac{3}{16}'' + 7'\ 10\frac{3}{4}'' + 4'\frac{9}{16}'' =$

Subtract:

2. $298'\ 7\frac{7}{8}'' - 198'\ 6\frac{1}{2}'' =$

Multiply:

3. 66' 8" x 17' 3" =

4. 29' x 27' 4" =

5. Nine men worked 7 days each, 7 hours per day, and earned $3.45 per hour. How much was the total payroll?

6. Fourteen bricklayers worked 6 days each, 7 hours per day, and laid 64,092 brick. How many brick did each man average per hour?

7. A builder put up a wall for $11,500.00. His labor cost was $4,765.50. He bought 23,500 brick @ $46.50 per 1,000, 275 bags of mortar cement @ $1.09 per bag, 19 cu. yds. of sand @ $3.65 per yard, and his overhead cost was $969.50. How much did he make?

8. If it takes $6\frac{1}{2}$ brick to cover 1 sq. ft. of wall, how many brick are needed for a wall 185' long and 9' high?

Addition, Subtraction and Multiplication of Fractions

Test No. 2 - B

Add:

1. $229'\ 8'' + 1\frac{3}{4}'' + 17' + 125'\ 8\frac{1}{2}'' =$

Subtract:

2. $234'\ \frac{5}{8}'' - 133'\ 3\frac{1}{2}'' =$

Multiply:

3. $47'\ 8'' \times 39'\ 9'' =$

4. $23' \times 18'\ 8'' =$

5. Nine men worked 8 days each, 7 hours per day and earned a total of $1,839.60. How much did each man earn per hour?

6. Seven laying brick averaged 117 brick each per hour. How many brick did they lay in 7 days, working 8 hours per day?

7. A builder put up a wall for $12,200.00. His labor cost was $4,763.55. He bought 22,500 brick @ $46.25 per 1,000, 279 bags of mortar cement @ $1.09 per bag, 21 cu. yds. of sand @ $3.85 per yard, and his overhead cost was $983.25. How much did he make?

8. If it takes $6\frac{1}{2}$ brick to cover 1 sq. ft. of wall, how many brick are needed for a wall 173' long and 7' high?

Addition, Subtraction, and Multiplication of Fractions

Test No. 3 - A

Add:

1. $115'\ \frac{3}{8}'' + 29'\ 6\frac{1}{4}'' + 8\frac{9}{16}'' + 140'\ \frac{5}{8}'' + 56'\ 9\frac{1}{2}'' =$

2. $159'\ \frac{3}{4}'' + 7\frac{9}{16}'' + 81'\ 6\frac{5}{8}'' + 265'\ 4\frac{1}{4}'' + 2'\ \frac{1}{2}'' =$

Subtract:

3. $3{,}795'\ 4\frac{1}{4}'' - 2{,}694'\ 4\frac{5}{8}'' =$

4. $1{,}286'\ 3'' - 285'\ 4\frac{3}{4}'' =$

Multiply:

5. 19' 3" x 18' 4" =

6. 18' 4" x 17' 8" =

7. 39' 3" x 18' 9" =

8. Nine men worked 8 days each, 7 hours per day, and earned a total of $1,839.60. How much did each man earn per hour?

9. A builder put up a foundation for $15,600.00. His labor cost was $5,896.25. He bought 32,500 brick @ $48.75 per 1,000, 1,250 blocks @ 30¢ each, 289 bags of mortar cement @ $1.13 per bag, 30 cu. yds. of sand @ $3.45 per yard, and his overhead cost was $1,679.45. How much did he make?

10. It takes $6\frac{1}{2}$ brick to face 1 sq. ft. of wall. How many brick are needed to face a wall 298' 6" long and 8' 6" high?

Addition, Subtraction and Multiplication of Fractions

Test No. 3 - B

Add:

1. $125'\ 6\frac{3}{4}'' + 27'\ 2\frac{1}{8}'' + 4'\ \frac{1}{2}'' + 133'\ 11\frac{1}{4}'' + 22'\ 2\frac{9}{16}'' =$

2. $1{,}350'\ 5\frac{1}{2}'' + 35'\ 6\frac{3}{4}'' + 21'\ 11\frac{3}{8}'' + 131'\ \frac{1}{2}'' + 71'\ 10\frac{1}{4}'' =$

Subtract:

3. $385'\ 6\frac{1}{4}'' - 279'\ 8\frac{9}{16}'' =$

4. $1{,}784'\ \frac{1}{2}'' - 998'\ 4\frac{7}{8}'' =$

Multiply:

5. 48' 8" x 29' 9" =

6. 96' 4" x 32' 3" =

7. 33' 4" x 28' 9" =

8. It takes $6\frac{3}{4}$ brick to face 1 sq. ft. of wall. How many brick are needed to face a wall 319' long and 8' 6" high?

9. A builder put up a foundation for $15,750.00. His labor cost was $6,013.65, he bought 27 cu. yds. of concrete @ $13.75 per yard, 34,500 brick @ $39.50 per 1,000, 1,900 block @ 31¢ each, 269 bags of mortar cement @ $1.09 per bag, 27 cu. yds. of sand @ $3.95 per yard, and his overhead cost was $1,895.75. How much did the builder make?

10. What is the price of an I-beam 27' 6" long, which weighs $37\frac{1}{4}$ lbs. per lineal foot and cost $19\frac{1}{3}$¢ per lb.?

Addition, Subtraction, Multiplication, and Division of Fractions

Test No. 4 - A

Add:

1. $4'\ 6\frac{1}{8}'' + 12'\ 8'' + 7'\ \frac{1}{2}'' + 33'\ 6\frac{1}{4}'' =$
2. $14' + 112'\ 6'' + 8'\ 9\frac{3}{8}'' + 8\frac{3}{4}'' =$

Subtract:

3. $155'\ \frac{1}{2}'' - 97'\ 5\frac{3}{8}'' =$
4. $201'\ 9\frac{9}{16}'' - 102'\ 5\frac{3}{8}'' =$

Multiply:

5. $19' \times 29'\ 3'' =$
6. $18'\ 3'' \times 42'\ 8'' =$

Divide:

7. $21'\ 4'' \div 8 =$
8. $9'\ 6'' \div 1\frac{1}{2} =$
9. $607\frac{1}{2}$ sq. ft. ÷ 9 =
10. $1{,}019\frac{1}{4}$ cu. ft. ÷ 27 =

11. A contractor built a foundation for $9,465.00. His labor cost was $2,248.65. He bought 25,000 brick @ $49.50 per 1,000, 175 bags of mortar cement @ $1.15 per bag, 15 cu. yds. of sand @ $5.25 per yard, 69 cu. yds. of concrete @ $18.25 per yard, and his overhead cost was $1,105.75. How much did the contractor make?

12. It takes $6\frac{1}{2}$ brick to face 1 sq. ft. of wall. How many brick are needed to face a wall 157' long and 7' high?

Addition, Subtraction, Multiplication and Division of Fractions

Test No. 4 - B

Add:

1. $6' \, 6'' + 17' \, \frac{3}{4}'' + 8\frac{3}{8}'' + 36' \, 4\frac{9}{16}'' =$
2. $8\frac{1}{2}'' + 12' \, 3'' + 7' \, \frac{3}{4}'' + 102' \, 11\frac{9}{16}'' =$

Subtract:

3. $175' \, \frac{3}{8}'' - 88' \, 6\frac{1}{2}'' =$
4. $115' \, 3\frac{3}{8}'' - 111' \, 2\frac{9}{16} =$

Multiply:

5. $27' \times 37' \, 4'' =$
6. $14' \, 6'' \times 21' \, 9'' =$

Divide:

7. $15' \, 9'' \div 7 =$
8. $16' \, 3'' \div 4\frac{1}{3} =$
9. $717\frac{3}{4}$ sq. ft. ÷ 9 =
10. $1,248\frac{3}{4}$ cu. ft. ÷ 27 =

11. A contractor built a foundation for $9,645.00. His labor cost was $2,268.45. He bought 23,000 brick @ $49.50 per 1,000, 165 bags of mortar cement @ $1.15 per bag, 65 cu. yds. of concrete @ $18.50 per yard, 15 cu. yds. of sand @ $5.35 per yard, and his overhead cost was $1,205.75. How much did the contractor make?

12. It takes $6\frac{1}{2}$ brick to face 1 sq. ft. of wall. How many brick are needed to face a wall 169' long and 7' high?

Addition, Subtraction, Multiplication and Division of Fractions and Decimals

Test No. 5 - A

Add:

1. $4'\,4\frac{1}{8}''$ + $12'\,8''$ + $2'\,\frac{1}{2}''$ + $33'\,6\frac{1}{4}''$ =

2. .5 + 261.058 - 1. + 1.1 + .067 =

3. $5\frac{1}{2}\%$ + $16\frac{2}{3}\%$ + $3\frac{1}{3}\%$ + $4\frac{1}{4}\%$ + 25% =

Subtract:

4. $155'\,\frac{1}{2}''$ - $97'\,5\frac{2}{3}''$ =

5. 16.05 - 9.073

Multiply:

6. $18'\,3''$ x $42'\,8''$

7. $28\frac{3}{4}$ x 7.396 =

8. $5\frac{2}{3}\%$ of 26,988 =

Divide:

9. $9'\,6''$ ÷ $1\frac{1}{2}$ =

10. 164.2733 ÷ 25.39 =

11. It takes $6\frac{1}{2}$ brick to cover 1 sq. ft. of wall How many brick are needed for a wall 12' long and 8' 6" high?

12. It takes 600 lath to cover 40 sq. yds. of wall. How many lath are needed to cover 518 sq. yds. of wall?

13. Seventeen men worked 9 days each, 7 hours per day, and laid a total of 103,887 brick. How many brick did each man average per day?

14. A contractor built a foundation for $9,265.00. His overhead was $1,123.75. He bought 14,500 brick @ $37.50 per 1,000, 2,450 blocks @ 24¢ per block, 26 cu. yds. of concrete @ $18.75 per yard, 27 cu. yds. of sand @ $4.75 per yard, 197 bags of mortar cement @ $1.19 per bag, and a 27' long I-beam weighing 27 lbs. per lineal foot and costing 23¢ per lb.; his labor cost was $2,648.60. How much did the contractor make?

Change to decimals:

15. 15%
16. $28\frac{1}{2}\%$
17. 6%
18. $4\frac{1}{2}\%$
19. 76%
20. 137%
21. $14\frac{1}{4}\%$
22. $\frac{2}{5}$
23. $\frac{1}{3}$
24. $3\frac{1}{4}\%$
25. $12\frac{1}{2}\%$
26. 200%
27. $\frac{2}{3}$
28. $\frac{1}{2}$
29. $\frac{1}{2}\%$
30. 3%
31. $\frac{7}{8}$
32. 1%

Change to fractions, reducing to lowest terms:

33. .75
34. .6
35. .04
36. 1.8
37. .35
38. .333
39. .09
40. 1.16

Change to per cents:

41. .18
42. .125
43. 1.
44. 2.25
45. $\frac{3}{4}$
46. $\frac{2}{3}$
47. $\frac{1}{5}$
48. $\frac{1}{100}$
49. $\frac{7}{8}$
50. $\frac{1}{6}$

Addition, Subtraction, Multiplication and
Division of Fractions and Decimals

Test No. 5 - B

Add:

1. $8\frac{1}{2}''$ + 12'3" + $7'\frac{3}{4}''$ + $102'\ 7\frac{9}{16}''$ =

2. .005 + 3.2 + 11 + 267.19 + 4.627 =

3. $5\frac{1}{4}\%$ + $16\frac{1}{3}\%$ + 4% + $3\frac{2}{3}\%$ + 35% =

Subtract:

4. $115'\ 3\frac{3}{8}''$ - $111'\ 2\frac{9}{16}''$ =

5. 27.03 - 18.246 =

Multiply:

6. 14' 6" x 21' 9" =

7. $26\frac{1}{4}$ x 8.487 =

8. $16\frac{2}{3}\%$ of 42,789 =

Divide:

9. 16' 3" ÷ $4\frac{1}{3}$ =

10. 210.1248 ÷ 27.36 =

11. It takes 560 lath to cover 40 sq. yds. of wall. How many lath are needed to cover $768\frac{1}{2}$ sq. yds. of wall?

12. It takes $6\frac{3}{4}$ brick to face 1 sq. ft. of wall. How many brick are needed to face a wall 245' 6" long and 7' high?

13 A builder put up a foundation for $15,700.00. His labor cost was $6,013.65. He bought 27 cu. yds of concrete @ $13.75 per yard, 34,500 brick @ $39.50 per 1,000, 1,900 blocks @ 31¢ each, 269 bags of mortar cement @ $1.09 per bag, and 27 cu. yds of sand @ $3.95 per yard.; his overhead cost was $1,985.75. How much did the builder make?

14. What is the price of an I-beam 27' 6" long which weighs $37\frac{1}{4}$ lbs. per lineal foot and costs $19\frac{1}{3}$¢ per lb.?

15. Twelve boys in the senior class were planning to become masons. If this represented 15% of the class, how many seniors were there in all?

16. Compute a year's interest on a government bond of $5,000 at $4\frac{3}{4}$%.

17. By building his own house, a mason estimated that he had saved himself 45% of its market value. If the house was estimated to be worth $19,500, what did it actually cost the mason?

18. A mason averaged 630 brick per day; the apprentice working with him averaged $\frac{2}{3}$ as many. How many bricks did the two men lay, working together?

19. How much of a saving is represented by a discount of 3% on materials costing $1428.10?

20. A mason bought a ladder marked $29.98 at a $12\frac{1}{2}$% discount. What did he pay for it?

UNIT III

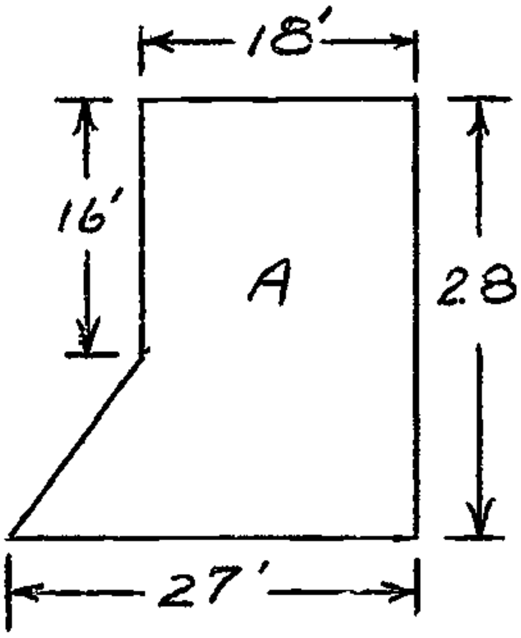
Test No. 6 - A

1. Find the area of a triangle which has a base 17' and is 12' high.
2. Find the area of a circle whose diameter is 27'.
3. Find the perimeter of a 21' 6" square.
4. Find the area of a circle whose circumference is 28.2744'.
5. Find the area of a triangle whose base is 24' and whose height is 16'.
6. Find the perimeter of a triangle whose base is 24' and whose height is 16'. The two other sides of the triangle are equal.
7. Find the circumference of a circle whose radius is 13' 4".

How many sq. yds. are there in the walls and ceilings of rooms having the following dimensions?

	Length	Width	Height	Openings	
				Doors	Windows
8.	32' 6"	18'	12'	2-- 3' x 6' 8"	5-- 3' 6" x 6'
9.	44'	31'	14' 6"	3-- 6' x 8'	4-- 4' x 5' 6"
10.	82'	46'	15' 6"	4-- 8' x 8'	12-- 3' x 6'

11. Find the area of Fig. A.
12. Find the perimeter of Fig. A.



13. How many courses of brick are needed to build a wall 14' $2\frac{1}{2}$" high? The brick are to be laid 4 courses in 11".
14. How many courses of block are needed to build a wall 29' $1\frac{3}{8}$" high? The block are laid in $8\frac{1}{8}$" for each course.

Test No. 6 - B

---

1. Find the area of a triangle which has a base 19', and is 14' high.

2. Find the area of a circle whose diameter is 29'.

3. Find the area of a 23' 6" square.

4. Find the area of a circle whose circumference is 21.9912'.

5. Find the area of a triangle whose base is 15' and whose height is 10'.

6. A triangle's sides are in the ratio of 3-4-5. If the smallest side is 15', what is the perimeter of the triangle?

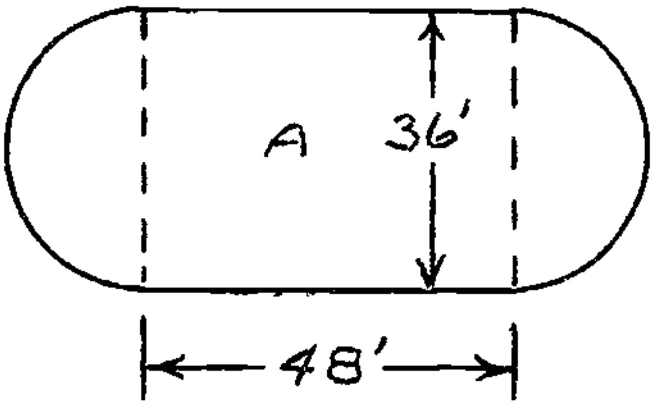
7. Find the circumference of a circle whose radius is 14' 4".

How many sq. yds. are there in the walls and ceilings of rooms having the following dimensions?

				Openings	
	Length	**Width**	**Height**	**Doors**	**Windows**
8.	21' 6"	18'	10'	2-- 2' 6" x 7'	6-- 2' 6" x 3'
9.	17'	13'	8' 6"	2-- 3' x 6' 8"	4-- 2' 8" x 3'
10.	72'	45' 6"	16'	4-- 7' x 8'	14-- 3' x 7' 6"

11. Find the area of Fig. A.

12. Find the perimeter of Fig. A.



13. How many courses of brick are needed to build a wall 14' $10\frac{1}{2}$" high? The brick are to be laid 4 courses in $10\frac{1}{2}$".

14. How many brick are needed for the first course of a building, 147' $6\frac{1}{2}$" long and 106' 6" wide? A brick with the cross joint measures $8\frac{3}{8}$".

Test No. 7 - A

---

1. How many sq. yds. are there in the walls of a room, 37' 6" long, 29' 9" wide, and 11' high?

2. Find the area of a triangular prism whose base is 24', whose height is 16', and whcse length is 37'.

3. What is the area of a rectangular prism, 32' 6" long, 17' wide, 11' high?

4. It takes $6\frac{3}{4}$ brick to cover 1 sq. ft. of wall. How many brick are needed for a wall 259' long and 9' high?

5. Find the area of a 7' 6" cube.

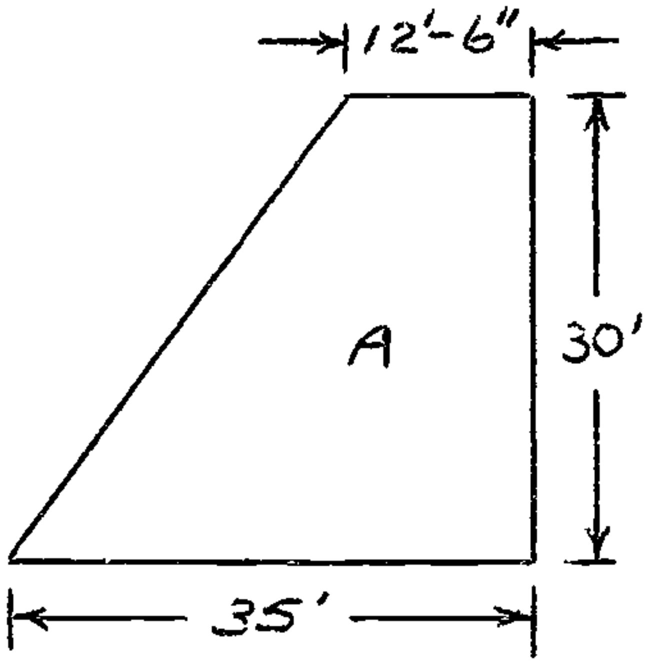
6. Find the area of a circle whose circumference is 26.7036'.

7. Find the area of a cylinder whose diameter is 24', and whose height is 18'.

8. How many sq. yds. are there in the walls and ceiling of a room 30' long, 20' wide, and 9' 6" high?
   Openings: 2 doors 3' x 7' and 6 windows 4' x 4'.

9. Find the area of Fig. A.

10. Find the perimeter of Fig. A.



Test No. 7 - B

---

1. How many sq. yds. are there in the walls of a room 37' 6" long, 27' 6" wide, and 11' high?

2. Find the area of a triangular prism whose base is 24', whose height is 16', and whose length is 37' 9".

3. Find the area of a rectangular prism, 32' long, 11' wide and 17' high.

4. It takes $6\frac{1}{4}$ brick to cover 1 sq. ft. of wall. How many brick are needed for a wall 259' long and 9' high?

5. Find the area of a 9' 6" cube.

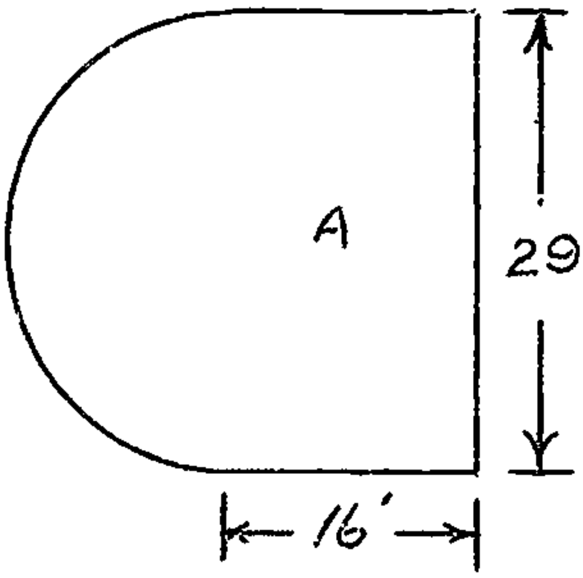
6. Find the area of a circle whose circumference is 32.9868'.

7. Find the area of a cylinder whose diameter is 24' and whose height is 16'.

8. How many sq. yds. are there in the walls and ceiling of a room 50' long, 25' wide, and 12' 6" high?
   Openings: 3 doors 2' 8" x 7' and 12 windows 3' x 4' 6".

9. Find the area of Fig. A.

10. Find the perimeter of Fig. A.



UNIT IV

Test No. 8 - A

1. How many sq. yds. are there in the walls and ceiling of a room 25' long, 15' wide, and 9' high?
Openings: 3 doors 3' x 7' and 6 windows 2' 8" x 5'.

How many cu. yds. are there in the following foundation walls?

	A	B	C	D	E	F
2.	12"	12'	89' 6"			
3.	12"	13' 6"	50'	38'	50'	38'
4.	16"	18'	36'	42'	36'	42'

5. How many brick laid with a $\frac{1}{4}$" mortar joint are needed to build the foundation walls in problem 3?

6. How many cu. yds. of mortar are needed to lay the brick in problem 5?

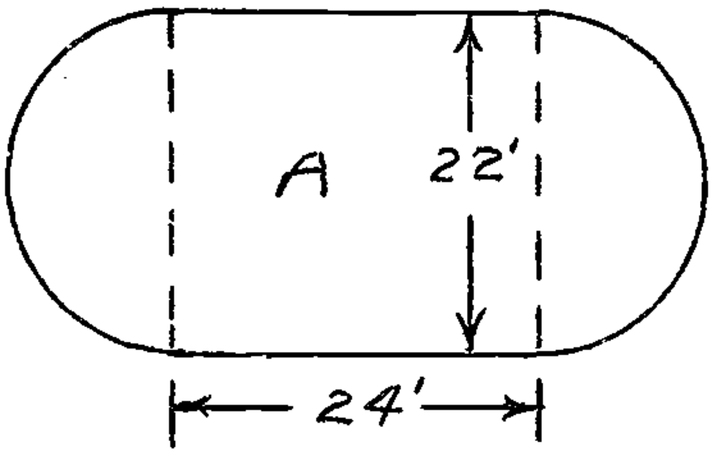
7. Find the area of a rectangular prism 27' long, 14' high, and 4' 6" wide.

8. Find the area of a cylinder whose diameter is 12' and whose height is 19'.

9. $5\frac{2}{3}$% of 48,762 = ?

10. Find the area of Fig. A.

11. Find the perimeter of Fig. A.



12. How many tons of marble veneer are needed to veneer the foundation walls in problem 3?

Test No. 8 - B

---

1. How many sq. yds. are in the walls and ceiling of a room 30' long, 22' wide, and 11' high? Openings: 3 doors 2'8" x 7' and 10 windows 3' x 5'.

How many cu. yds. are there in the following foundation walls?

	A	B	C	D	E	F
2.	12"	14'	79' 6"			
3.	12"	11' 6"	37'	29'	37'	29'
4.	16"	15'	38' 8"	45'	38' 8"	45'

5. How many brick laid with a $\frac{1}{2}$" mortar joint are needed to build the foundation walls in problem 3?

6. How many cu. yds. of mortar are needed to lay the brick in problem 3

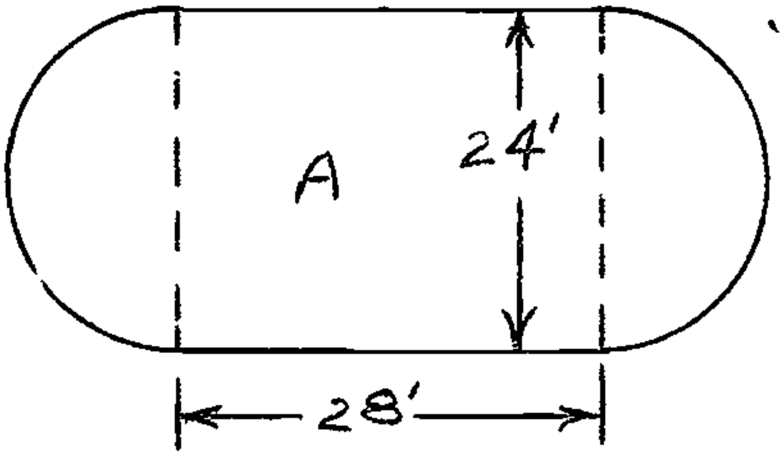
7. Find the area of a triangular prism whose base is 18', height is 12', and length is 29' 9".

8. Find the area of a cylinder whose diameter is 6' and whose height is 18'.

9. $16\frac{2}{3}\%$ of 27,968 = ?

10. Find the area of Fig. A.

11. Find the perimeter of Fig. A.



12. How many tons of grained stone veneer are needed to veneer the foundation walls in problem 3?

Test No. 9 - A

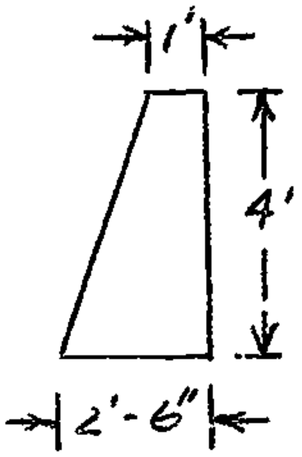
---

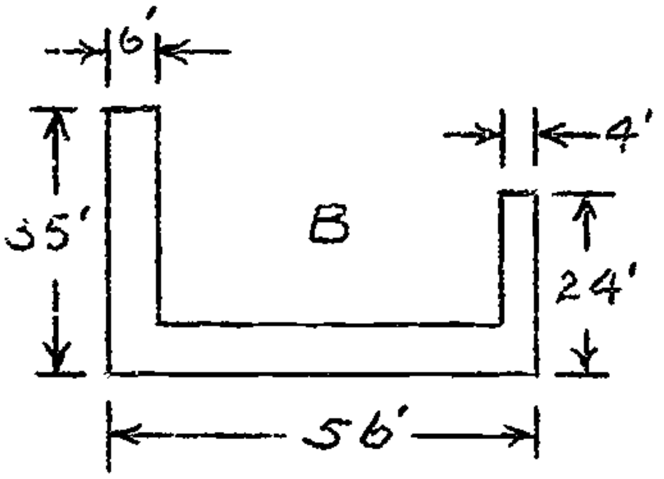
1. How many sq. yds. are there in the walls and ceiling of a room 18' 6" long, 14' wide, and 10' high? Openings: 2 doors 3' x 6' 8" and 4 windows 2' 6" x 4'.

2. Find the number of cu. yds. in 12 columns, 2' in diameter and 17' 6" high.

3. How many cu. yds. are there in a slanted wall which is 79' 6" long? See section view, Fig. A, for width and height.

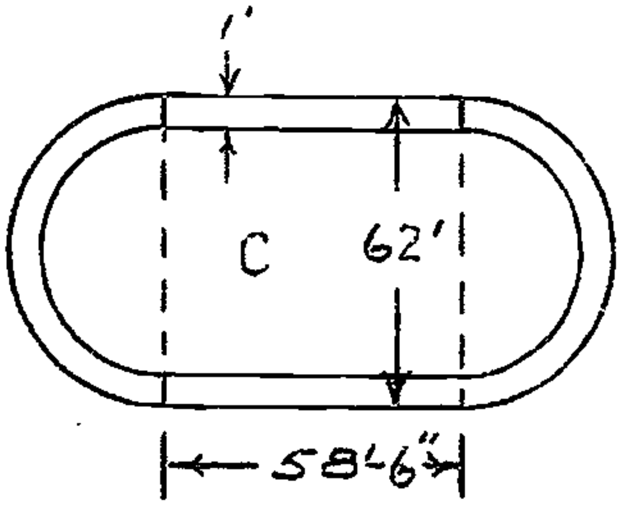
FIG. A
Section View





4. How many cu. yds. of concrete are needed for the walk, Fig. B? Walk is 4" thick.

5. How many cu. yds. of concrete are needed for the floor of Fig. C? Concrete is 6" thick.



6. How many cu. yds. are there in the following footing and foundation walls?

A	B	C	D	E	F
(12"	8' 6"	43' 6"	71" 6"	43' 6"	71" 6"
(2'	1'				

7. How many brick laid with a $\frac{1}{2}$" mortar joint are needed for the foundation walls in problem 6?

8. How many cu. yds. of mortar are needed to lay the brick in problem 7?

9. How many cu. yds. of concrete are needed for the floor in problem 6? Floor is 6" thick.

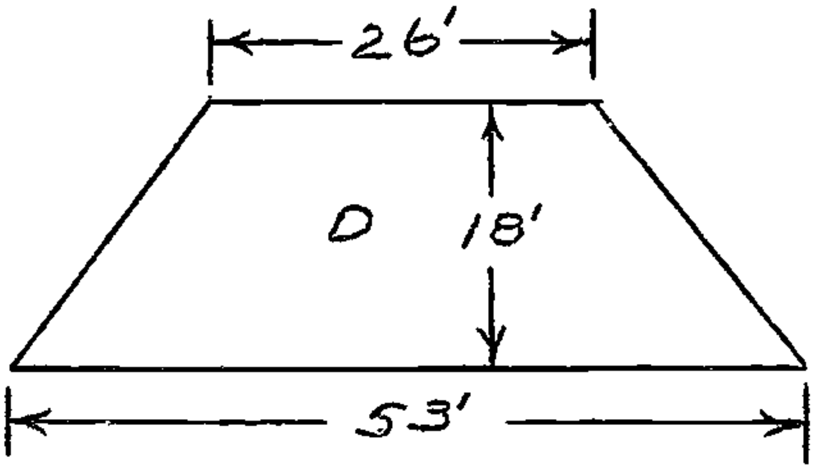
10. How many tons of grained stone veneer are needed to veneer the foundation walls in problem 6?

11. Find the area of a cylinder 3' in diameter and 16' 6" high.

12. How many cu. yds. of concrete are needed for 18 columns 18" square and 16' high?

13. How many cu. yds. of concrete are needed for the patio in Fig. D? Concrete is 4" thick.

14. Find the perimeter of Fig. D.



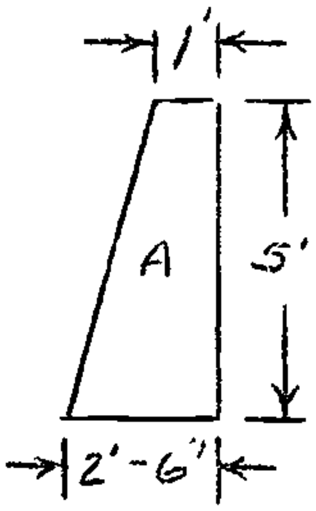
15. How many days will it take 6 bricklayers to lay the brick in problem 7, if they work 7 hours per day and lay an average of 56½ brick each per hour? Give the answer to the nearest half or full day.

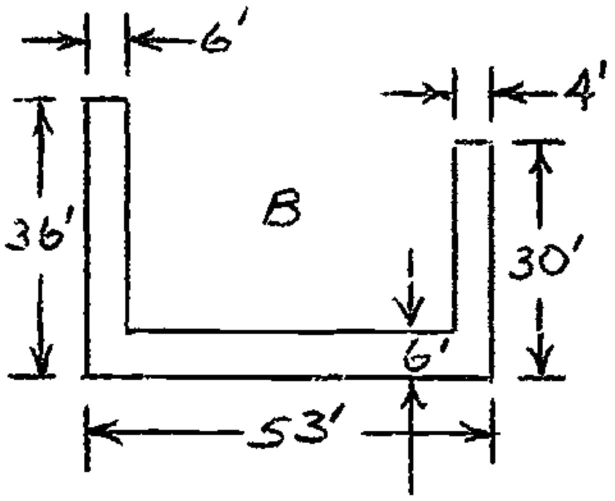
Test No. 9 - B

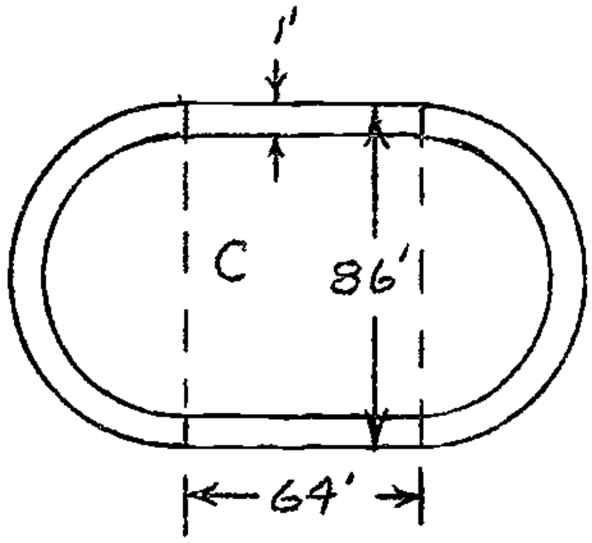
1. How many sq. yds. are there in the walls and ceiling of a room 29' long, 21' wide, and 12' 6" high?
Openings: 2 doors 2' 6" x 7' and 2 windows 3' x 5'.

2. Find the number of cu. yds. in 12 columns, 4' in diameter and 17' 6" high.

3. How many cu. yds. are there in a slanted wall which is 89' 6" long? See section view, Fig. A, for width and height.







4. How many cu. yds. of concrete are needed for the walk, Fig. B? Walk is 4" thick.

5. How many cu. yds. of concrete are needed for the floor of Fig. C? Concrete is 8" thick.

6. How many cu. yds. are there in the following footing and foundation walls?

A	B	C	D	E	F
(12"	9' 6"	54' 9"	61' 9"	54' 9"	61' 9"
(2'	1'				

7. How many brick laid with a $\frac{1}{2}$" mortar joint are needed for the foundation walls in problem 6?

8. How many cu. yds. of mortar are needed to lay the brick in problem 7?

9. How many cu. yds. of concrete are needed for the floor in problem 6? Floor is 6" thick.

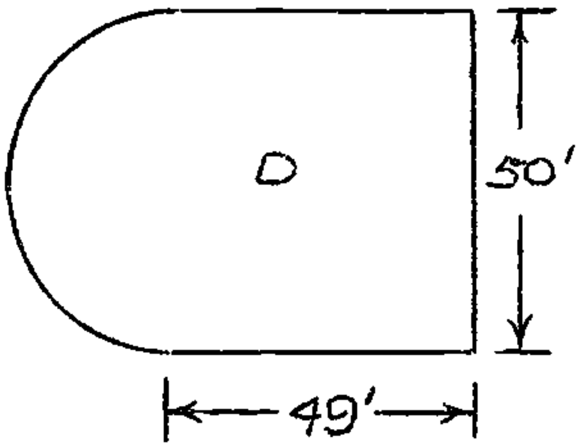
10. How many tons of marble veneer are needed to veneer the foundation walls in problem 6?

11. Find the area of a cylinder 6' in diameter and 16' 6" high.

12. How many cu. yds. of concrete are needed for 24 columns 18" square and 16' high?

13. How many cu. yds. of concrete are needed for the patio in Fig. D? Concrete is 4" thick.

14. Find the perimeter of Fig. D.



15. How many days will it tak 7 bricklayers to lay the brick in problem 7, if they work 7 hours per day and lay an average of $57\frac{1}{2}$ brick each per hour? Give the answer to the nearest half or full day.

ANSWERS

UNIT I

ASSIGNMENTS

	1.		2.		3.
1.	$8\frac{7}{12}$	1.	$146\frac{3}{16}$	1.	$1{,}148'\ 9\frac{5}{8}''$
2.	$15\frac{3}{8}$	2.	379	2.	$1{,}011'\ 2\frac{5}{8}''$
3.	$21\frac{13}{24}$	3.	$3\frac{7}{8}$	3.	$222'\ 2\frac{7}{8}''$
4.	$1\frac{7}{12}$	4.	$204\frac{1}{4}$	4.	$2{,}371'\ 9\frac{3}{8}''$
5.	$17\frac{19}{24}$	5.	$1{,}197\frac{7}{8}$	5.	$410'\ 6\frac{5}{8}''$
6.	$51\frac{1}{8}$	6.	$415\frac{3}{4}$	6.	$57'\ 8\frac{7}{8}''$
7.	$1\frac{15}{16}$	7.	$2{,}106\frac{1}{4}$	7.	$136'\ \frac{1}{8}''$
8.	$143\frac{1}{16}$	8.	$369\frac{5}{16}$	8.	$224'\ 3\frac{11}{16}''$
9.	$122\frac{13}{16}$	9.	$35\frac{3}{8}$	9.	$127'\ 4\frac{13}{16}''$
10.	$136\frac{9}{16}$	10.	$3\frac{9}{32}$	10.	$226'\ 6\frac{5}{16}''$
11.	$257\frac{9}{16}$	11.	$45\frac{1}{24}$ cu. yds.	11.	96' 5"
12.	$166\frac{1}{8}$	12.	$42\frac{1}{6}$ cu. yds.	12.	$105'\ 5\frac{1}{2}''$
13.	$189\frac{17}{48}$	13.	$60\frac{1}{2}$ cu. yds.	13.	$101'\ 11\frac{3}{4}''$
14.	$196\frac{5}{16}$	14.	$360\frac{1}{8}$	14.	$230\frac{3}{4}$ cu. yds.
15.	$329\frac{41}{48}$	15.	$431\frac{1}{4}$	15.	$73\frac{3}{4}$ hrs.
16.	\$684.90	16.	235	16.	$199'\ 6\frac{11}{16}''$
17.	\$479.45	17.	$227\frac{5}{8}$	17.	$42'\ 6\frac{7}{16}''$
18.	\$5,098.02	18.	$1{,}393\frac{1}{2}$	18.	$1{,}427'\ 4\frac{1}{16}''$
19.	\$42.62	19.	\$28.33	19.	$3{,}073'\ \frac{11}{16}''$
20.	\$1,145.99	20.	\$28.45	20.	$8{,}090'\ 5\frac{3}{4}''$

ASSIGNMENTS

4.

1. $269'\ \frac{1}{16}''$
2. $413'\ 1\frac{7}{8}''$
3. 1,462'
4. $1{,}450'\ 5\frac{5}{8}''$
5. 187' 8''
6. $154'\ \frac{9}{32}''$
7. $861'\ 2\frac{3}{16}''$
8. $821'\ 6\frac{3}{8}''$
9. 301' 9''
10. $880'\ 11\frac{11}{16}''$
11. $193'\ 8\frac{3}{16}''$
12. $275'\ 5\frac{5}{16}''$
13. $1{,}133'\ 9\frac{11}{16}''$
14. $134'\ 10\frac{13}{16}''$
15. $157'\ 7\frac{3}{16}''$
16. $116'\ 8\frac{3}{16}''$
17. 246'
18. $595'\ 10\frac{1}{4}''$
19. \$2,115.92
20. \$8,235.38

5.

1. $2\frac{3}{4}''$
2. $9\frac{5}{8}''$
3. $2\frac{7}{8}''$
4. $5\frac{5}{8}''$
5. $\frac{9}{16}''$
6. $5\frac{3}{8}''$
7. $2\frac{3}{4}''$
8. $3\frac{7}{8}''$
9. $6\frac{5}{8}''$
10. $7\frac{3}{8}''$
11. $7\frac{5}{8}''$
12. $4\frac{3}{4}''$
13. $6\frac{3}{8}''$
14. $5\frac{5}{8}''$
15. 8''
16. $99'\ 4\frac{3}{16}''$
17. $288'\ 7\frac{5}{8}''$
18. $255'\ 8\frac{1}{16}''$
19. $71'\ 2\frac{5}{8}''$
20. $8{,}166'\ 8\frac{21}{32}''$
21. $365'\ 6\frac{7}{16}''$
22. $57'\ 7\frac{1}{8}''$
23. $233'\ 8\frac{1}{32}''$
24. $59'\ 1\frac{15}{16}''$
25. $164'\ 6\frac{7}{16}''$
26. $53'\ 9\frac{9}{16}''$
27. $2'\ 3\frac{3}{4}''$
28. $210'\ 3\frac{1}{16}''$
29. $159'\ 2\frac{13}{16}''$
30. $74'\ 11\frac{23}{32}''$
31. $203'\ 8\frac{25}{32}''$
32. $55'\ 7\frac{3}{8}''$
33. $100'\ 8\frac{9}{16}''$
34. $234'\ 5\frac{11}{32}''$
35. $180'\ 8\frac{3}{4}''$
36. $185'\ 3\frac{23}{32}''$
37. $878'\ \frac{5}{32}''$
38. 613' 1''
39. $90'\ 9\frac{5}{8}''$
40. $2{,}668'\ 5\frac{25}{32}''$

ASSIGNMENTS

6.

1. 323' $7\frac{7}{16}$"
2. 404' $6\frac{5}{16}$"
3. 283' $3\frac{5}{16}$"
4. 152' $1\frac{9}{32}$"
5. 187' $8\frac{1}{2}$"
6. 86' $5\frac{7}{8}$"
7. 295' $10\frac{9}{16}$"
8. 4' $10\frac{13}{32}$"
9. 3' $7\frac{13}{16}$"
10. 1,038' $1\frac{7}{8}$"
11. 46' $6\frac{5}{8}$"
12. 2,784' $5\frac{3}{8}$"
13. 1,000' $10\frac{1}{2}$"
14. 1,020' $5\frac{1}{16}$"
15. 118' $8\frac{1}{4}$"
16. $\frac{1}{6}$ cu. yd. conc.
17. $19\frac{3}{4}$ cu. yds. conc.
18. 380 brick
19. $248.54
20. 29 bags (<u>short</u>)

7.

1. 57' $8\frac{3}{8}$"
2. 36' $4\frac{13}{16}$"
3. 951' $8\frac{5}{16}$"
4. 146' $6\frac{3}{4}$"
5. 99' $2\frac{3}{8}$"
6. 4' $7\frac{3}{4}$"
7. 101' $3\frac{3}{16}$"
8. 28' $7\frac{13}{16}$"
9. 1,010' $10\frac{1}{2}$"
10. 403' $\frac{11}{16}$"
11. 168' $3\frac{1}{16}$"
12. 147' $8\frac{7}{16}$"
13. 123' $8\frac{15}{16}$"
14. 59' $5\frac{9}{16}$"
15. 1,590' $7\frac{3}{16}$"
16. 86' $9\frac{3}{8}$" perimeter
17. $8\frac{1}{12}$ cu. yds. for job #4
18. $308.83 left
19. 44,250 face brick
    13,550 common brick
    3,300 blocks
20. $4,110.36

TEST #1

ADDITION AND SUBTRACTION OF FRACTIONS

	A		B
1.	$1{,}793'\ 7\frac{9''}{16}$	1.	$194'\ 1''$
2.	$342'\ 1\frac{5''}{16}$	2.	$152'\ \frac{9''}{32}$
3.	$181'\ 9\frac{11''}{16}$	3.	$387'\ \frac{3''}{16}$
4.	$353'\ 5\frac{5''}{8}$	4.	$209'\ 4\frac{1''}{4}$
5.	[illegible]$'\ 1\frac{13''}{16}$	5.	$227'\ 5\frac{11''}{16}$
6.	$181'\ 11\frac{3''}{16}$	6.	$353'\ 5\frac{5''}{8}$
7.	$323'\ 7\frac{7''}{16}$	7.	$181'\ 9\frac{11''}{16}$
8.	$404'\ 6\frac{5''}{16}$	8.	$230'\ 1\frac{13''}{16}$
9.	$295'\ 10\frac{9''}{16}$	9.	$900'\ 5\frac{5''}{16}$
10.	$1{,}039'\ \frac{7''}{8}$	10.	$1{,}098'\ 10\frac{7''}{16}$
11.	$8'\ 1\frac{13''}{16}$	11.	$199'\ 10\frac{5''}{8}$
12.	$111'\ 2\frac{1''}{4}$	12.	$131'\ 2\frac{1''}{4}$
13.	$99'\ 10\frac{1''}{2}$	13.	$106'\ 1\frac{7''}{8}$
14.	$1{,}100'\ 11\frac{5''}{8}$	14.	$18'\ 4\frac{1''}{2}$
15.	$1{,}897'\ 6\frac{13''}{16}$	15.	$96'\ 7\frac{1''}{16}$
16.	$1{,}038'\ 1\frac{7''}{8}$	16.	$188'\ 3\frac{15''}{16}$

ASSIGNMENT 8

1. $14\frac{1}{12}$
2. $35\frac{3}{4}$
3. $33\frac{3}{5}$
4. $\frac{1}{4}$
5. $\frac{3}{8}$
6. $2\frac{1}{3}$

7 $3\frac{1}{3}$

8. $33\frac{7}{9}$
9. $107\frac{3}{16}$
10. $103\frac{1}{8}$
11. $60\frac{5}{12}$
12. $47\frac{11}{12}$
13. $1,161\frac{2}{3}$
14. $515\frac{1}{4}$
15. $661\frac{1}{4}$
16. 545
17. $\frac{1}{6}$
18. $3\frac{1}{8}$
19. $349\frac{3}{28}$
20. $1,885\frac{5}{18}$
21. $257\frac{1}{4}$
22. $157\frac{1}{2}$
23. $257\frac{1}{4}$
24. $49\frac{1}{12}$
25. $125\frac{5}{12}$
26. $328\frac{3}{8}$
27. $165\frac{3}{4}$
28. $1,483\frac{1}{3}$
29. $2\frac{1}{3}$
30. $164\frac{11}{16}$
31. $38\frac{1}{3}$
32. $504\frac{8}{9}$
33. $41\frac{1}{8}$
34. $13\frac{2}{3}$
35. $275\frac{1}{2}$
36. $134\frac{1}{8}$
37. $33\frac{5}{6}$
38. $9\frac{7}{12}$
39. $3\frac{1}{3}$
40. $11,947\frac{8}{9}$

ASSIGNMENT 9

1. 4
2. $\frac{1}{2}$
3. $\frac{1}{5}$
4. $2\frac{1}{2}$
5. $\frac{3}{4}$
6. 3
7. 25
8. 5
9. $3\frac{1}{3}$
10. $143\frac{11}{20}$
11. 10
12. 6
13. $8\frac{2}{3}$
14. $12\frac{2}{5}$
15. $6\frac{1}{8}$
16. $115\frac{1}{2}$
17. 63
18. $20\frac{5}{12}$
19. 14
20. 30
21. $773\frac{11}{12}$
22. $3,522\frac{8}{9}$ sq. ft.
23. $921\frac{3}{8}$ " "
24. $436\frac{19}{36}$ " "
25. $315\frac{3}{8}$ " "
26. $741\frac{2}{3}$ " "
27. $660\frac{23}{24}$ " "
28. $1,655\frac{1}{2}$ " "
29. $2,241\frac{3}{4}$ " "
30. 762 " "
31. $1,958\frac{1}{4}$ " "
32. $801\frac{7}{9}$ " "
33. $1,270\frac{11}{12}$ " "
34. $1,834\frac{5}{6}$ " "
35. 1,424 " "
36. $898\frac{13}{24}$ " "
37. $1,805\frac{1}{4}$ " "
38. $1,686\frac{3}{4}$ " "
39. $3,042\frac{2}{3}$ " "
40. $3,522\frac{8}{9}$ " "

ASSIGNMENTS

	10.	11.
1.	\$1,732.50	\$3.75 per hour
2.	\$3,301.00	\$4,854.84
3.	2,976$\frac{3}{4}$ brick	16,224 brick
4.	269' $\frac{1}{16}$"	1,462'
5.	413' $4\frac{7}{8}$"	1,450' $5\frac{5}{8}$"
6.	1,020' $4\frac{7}{16}$"	101' $5\frac{1}{2}$"
7.	99' $5\frac{5}{8}$"	27' $\frac{13}{16}$"
8.	745$\frac{1}{3}$ sq. ft.	1,457$\frac{1}{2}$ sq. ft.
9.	450$\frac{1}{6}$ " "	1,350$\frac{1}{2}$ " "
10.	1,054$\frac{1}{6}$ " "	2,073$\frac{5}{8}$ " "
11.	1,519$\frac{7}{8}$ " "	2,521$\frac{5}{12}$ " "
12.	533 " "	347$\frac{1}{12}$ " "
13.	2,881$\frac{7}{8}$ " "	1,262$\frac{1}{2}$ " "
14.	1,882$\frac{3}{16}$ " "	805$\frac{5}{18}$ " "
15.	201$\frac{2}{3}$ " "	181$\frac{11}{12}$ " "

TEST 2

	A	B
1.	127' $9\frac{1}{8}$"	372' $6\frac{1}{4}$"
2.	100' $1\frac{3}{8}$"	100' $9\frac{1}{8}$"
3.	1,150 sq. ft.	1,894$\frac{3}{4}$ sq. ft.
4.	792$\frac{2}{3}$ sq. ft.	429$\frac{1}{3}$ sq. ft.
5.	$1,738.80	$3.65 per hr.
6.	109 brick	45,864 brick
7.	$4,303.15	$5,027.61
8.	10,822$\frac{1}{3}$ brick	7,871$\frac{1}{2}$ brick

ASSIGNMENTS

	12.	13.	14.
1.	98 brick	936 brick	$11,599\frac{7}{8}$ brick
2.	\$5,033.55	$7,000\frac{1}{2}$ brick	\$5,027.74
3.	\$1,738.80	\$5,544.85	\$198.05
4.	187' 8"	861' $2\frac{3}{16}$"	301' 9"
5.	154' $\frac{9}{32}$"	821' $6\frac{3}{8}$"	880' $11\frac{11}{16}$"
6.	1,010' $7\frac{1}{4}$"	510' $6\frac{3}{8}$"	1,087' $\frac{9}{16}$"
7.	777' $10\frac{1}{4}$"	1,900' $5\frac{15}{16}$"	106' $11\frac{3}{16}$"
8.	$8\frac{1}{3}$ sq. ft.	$12\frac{2}{3}$ sq. ft.	$789\frac{1}{3}$ sq. ft.
9.	$17\frac{1}{2}$ " "	$323\frac{8}{9}$ " "	$16\frac{1}{4}$ " "
10.	$454\frac{1}{6}$ " "	$315\frac{3}{8}$ " "	$315\frac{3}{8}$ " "
11.	$2,076\frac{2}{3}$ " "	$455\frac{7}{12}$ " "	754 " "
12.	$1,823\frac{1}{12}$ " "	2,060 " "	$450\frac{1}{6}$ " "
13.	$1,882\frac{3}{16}$ " "	$741\frac{2}{3}$ " "	$246\frac{11}{24}$ " "
14.	$1,054\frac{1}{6}$ " "	$1,894\frac{3}{4}$ " "	$1,988\frac{1}{2}$ " "
15.	533 " "	$660\frac{23}{24}$ " "	$2,874\frac{5}{8}$ " "
16.			$540\frac{5}{6}$ " "

TEST 3

	A		B
1.	$342'\ 1\frac{5}{16}''$	1.	$312'\ 11\frac{3}{16}''$
2.	$508'\ 7\frac{11}{16}''$	2.	$1,610'\ 10\frac{3}{8}''$
3.	$1,100'\ 11\frac{5}{8}''$	3.	$105'\ 9\frac{11}{16}''$
4.	$1,000'\ 10\frac{1}{4}''$	4.	$785'\ 7\frac{5}{8}''$
5.	$352\frac{11}{12}$ sq. ft.	5.	$1,447\frac{5}{6}$ sq. ft.
6.	$323\frac{8}{9}$ " "	6.	$3,106\frac{3}{4}$ " "
7.	$735\frac{15}{16}$ " "	7.	$958\frac{1}{3}$ " "
8.	$3.65 per hr.	8.	$16,302\frac{5}{8}$ brick
9.	$5,634.85	9.	$5,117.74
10.	$16,492\frac{1}{8}$ brick	10.	$198.05

ASSIGNMENT 15

1. $\frac{3}{16}$
2. $\frac{3}{16}$
3. $\frac{1}{2}$
4. $\frac{3}{64}$
5. $\frac{7}{100}$
6. $1\frac{1}{3}$
7. $2\frac{1}{3}$
8. 2
9. 4
10. $4\frac{1}{5}$
11. $7\frac{7}{8}$
12. $13\frac{3}{5}$
13. $3\frac{3}{8}$
14. $10\frac{2}{3}$
15. $2\frac{2}{17}$
16. $7\frac{4}{5}$
17. $4\frac{2}{5}$
18. $7\frac{1}{2}$
19. $12\frac{20}{21}$
20. 3
21. $3\frac{21}{26}$
22. $6\frac{9}{10}$
23. $5\frac{3}{4}$
24. $4\frac{1}{9}$
25. $5\frac{2'}{13}$
26. $6\frac{9'}{16}$
27. $5\frac{1'}{2}$
28. $5\frac{1'}{10}$
29. $4\frac{11'}{34}$
30. $3\frac{7'}{15}$

ASSIGNMENTS

16.

1. $2\frac{1}{2}$
2. $5\frac{1}{3}$
3. $1\frac{3}{4}$
4. $3\frac{1}{2}$
5. $4\frac{13}{20}$
6. $5\frac{1}{2}$
7. $18\frac{1}{2}$
8. $12\frac{1}{3}$
9. $7\frac{1}{4}$
10. $14\frac{1}{4}$
11. $8\frac{1}{4}$
12. $4\frac{3}{4}$
13. $7\frac{3}{4}$
14. $4\frac{1}{2}$
15. 13
16. 12' 8"
17. 7' 4"
18. 8' 3"
19. 21' 8"
20. 7' 9"
21. 4' 9"
22. 12'
23. 12' 9"
24. 16'
25. 20' 6"
26. 3' 7"
27. 13' 5"
28. 12' 8"
29. 17' 9"
30. 11' 10"
31. 13' 4"
32. 7' 10"
33. 32' 5"
34. 14' 9"
35. 27' 11"

17.

1. 12' 8"
2. 7' 4"
3. 8' 3"
4. 21' 8"
5. 7' 9"
6. 4' 9"
7. 21' 4"
8. 12' 9"
9. 16'
10. 20' 6"
11. 3' 7"
12. 13' 5"
13. 12' 8"
14. 17' 9"
15. 11' 10"
16. 13' 4"
17. 7' 10"
18. 14' 9"
19. 27' 11"
20. 7' 4"
21. $15\frac{1}{2}$ sq. yds.
22. $12\frac{3}{4}$ " "
23. $22\frac{1}{3}$ " "
24. $17\frac{5}{6}$ " "
25. $29\frac{1}{6}$ " "
26. $17\frac{1}{4}$ cu. yds.
27. $47\frac{1}{2}$ " "
28. $19\frac{5}{6}$ " "
29. $39\frac{2}{3}$ " "
30. 14.38 "
31. $19\frac{7}{8}$ sq. yds.
32. $25\frac{2}{3}$ " "
33. $9\frac{3}{4}$ " "
34. $67\frac{1}{9}$ cu. yds.
35. $48\frac{1}{6}$ " "
36. 4' 9"
37. 6' 8"
38. 9' 8"
39. 4' 9"
40. 4' 6"

ASSIGNMENTS

	18.	19.	20.
1.	$413'\,2\frac{1}{2}''$	$224'\,1\frac{1}{2}''$	$11'\,6\frac{9}{16}''$
2.	$209'\,\frac{1}{4}''$	$202'\,2\frac{1}{4}''$	$7'\,8\frac{3}{4}''$
3.	$1,020'\,4\frac{7}{16}''$	$46'\,6\frac{5}{8}''$	$163\frac{7}{8}$ sq. ft.
4.	$118'\,8\frac{1}{4}''$	$2,784'\,5\frac{3}{8}''$	$148\frac{2}{9}$ " "
5.	1,150 sq. ft.	$4,997\frac{2}{3}$ sq. ft.	$712\frac{11}{12}$ " "
6.	$3,069\frac{11}{12}$ sq. ft.	$18,874\frac{5}{8}$ " "	3' 6"
7.	12' 8"	17' 9"	4' 4"
8.	1' 3"	12' 9"	8' 3"
9.	9"	19' 3"	4' 3"
10.	14' 3"	7' 6"	$29\frac{8}{9}$ sq. yds.
11.	5' 10"	4' 4"	$47\frac{1}{2}$ " "
12.	12.5 cu. yds.	$453\frac{1}{4}$ sq. yds.	$133\frac{1}{3}$ " "
13.	18.75 " "	$147\frac{3}{4}$ " "	$15\frac{1}{2}$ cu. yds.
14.	138.5 sq. yds.	$93\frac{1}{2}$ " "	$37\frac{1}{4}$ " "
15.	89.75 " "	$79\frac{1}{4}$ " "	$24\frac{1}{3}$ " "
16.	2' 4"	$11\frac{1}{3}$	$272.25
17.	109 brick	$613\frac{2}{3}$ brick	$4,095.36
18.	$26.25	$3,827.25	
19.	$6,440.82	$382.59	
20.	$128.70	$6,394.11	
21.	52 courses		

ASSIGNMENTS

	21.	22.	23.
1.	$29'\ 6\frac{7}{8}''$	$25'\ 5\frac{9}{16}''$	$88'\ 5\frac{1}{8}''$
2.	$44'\ 9\frac{5}{8}''$	$13'\ 10\frac{3}{4}''$	$39'\ 3\frac{11}{16}''$
3.	$2,317\frac{7}{12}$ sq. ft.	$1,060\frac{7}{12}$ sq. ft.	$256\frac{1}{6}$ sq. ft.
4.	$107\frac{11}{12}$ " "	$159\frac{1}{4}$ " "	$1,519\frac{5}{9}$ sq. ft.
5.	$344\frac{1}{2}$ " "	3' 4"	8' 4"
6.	5' 2"	3' 3"	7' 9"
7.	3' 9"	12' 9"	4' 9"
8.	4' 9"	47 sq. yds.	$30\frac{1}{3}$ sq. yds.
9.	2' 9"	$29\frac{1}{2}$ " "	$37\frac{1}{2}$ " "
10.	$38\frac{2}{3}$ sq. yds.	$46\frac{8}{27}$ cu. yds.	$52\frac{23}{27}$ cu. yds.
11.	87.5 " "	$56\frac{1}{3}$ " "	$43\frac{1}{4}$ " "
12.	$155\frac{5}{9}$ " "	$36\frac{1}{2}$ " "	$19\frac{1}{2}$ " "
13.	47.5 cu. yds.	10,032 lath	$265.65
14.	38.97 " "	$1,267\frac{1}{2}$ blocks	$8,044\frac{1}{2}$ lath
15.	$26\frac{7}{9}$ " "	$110\frac{2}{3}$ sq. yds.	$7,734\frac{3}{8}$ brick
16.	$314.47	848 brick	$4.30 per hr.
17.	$3,904.54	$3,236.03	$5,297.37

TEST 4

	A.		B.
1.	57' 8$\frac{7}{8}$"	1.	60' 7$\frac{11}{16}$"
2.	136' $\frac{1}{8}$"	2.	122' 11$\frac{3}{16}$"
3.	57' 7$\frac{1}{8}$"	3.	86' 5$\frac{7}{8}$"
4.	99' 4$\frac{3}{16}$"	4.	4' $\frac{13}{16}$"
5.	555$\frac{3}{4}$ sq. ft.	5.	1,008 sq. ft.
6.	778$\frac{2}{3}$ " "	6.	315$\frac{3}{8}$ sq. ft.
7.	2' 8"	7.	2' 3"
8.	6' 4"	8.	3' 9"
9.	67$\frac{1}{2}$ sq. yds.	9.	79$\frac{3}{4}$ sq. yds.
10.	37$\frac{3}{4}$ cu. yds.	10.	46$\frac{1}{4}$ cu. yds.
11.	\$3,333.85	11.	\$3,559.80
12.	7,143$\frac{1}{2}$ brick	12.	7,689$\frac{1}{2}$ brick

UNIT II

ASSIGNMENTS

1.

1. 21.999
2. 27.719
3. 24.226
4. 166.451
5. 307.301
6. 1,870.104
7. 2,838.722
8. 1,923.756
9. 3,684.805
10. 142.741
11. 6.45
12. 56.86
13. 3.916
14. 114.711
15. 9.26
16. 7.345
17. 2.091
18. 688.947
19. 8.907
20. 10.531
21. .25
22. .1
23. .4
24. .125
25. .9
26. .333
27. .875
28. .667
29. .75
30. .5
31. .7
32. 1.6
33. 6.125
34. 3.333
35. 10.03
36. $\frac{1}{2}$
37. $\frac{3}{4}$
38. $\frac{3}{50}$
39. $\frac{1}{8}$
40. $\frac{3}{5}$
41. $\frac{9}{20}$
42. $\frac{7}{100}$
43. $\frac{5}{8}$
44. $1\frac{17}{25}$
45. $\frac{2}{5}$
46. $\frac{13}{20}$
47. $2\frac{3}{4}$
48. $13\frac{1}{20}$
49. $6\frac{49}{50}$
50. $10\frac{3}{20}$

2.

1. 10.29
2. 30.56
3. 4.2
4. .00042
5. 11.232
6. 63.639
7. 43.4
8. 175.77
9. 1.386
10. 7.009
11. 3
12. .028
13. 14
14. 105.8536
15. $694.11
16. 164.90
17. 20.992
18. $12.64
19. .07584
20. .15616
21. $66.15
22. 2.997
23. $248.40
24. 28.62
25. 40.59

ASSIGNMENTS

3.

1. 1.2
2. .85
3. 33.5
4. .26
5. 7,600
6. 5.4
7. 12.66
8. 18,500
9. 27.2727
10. 35.555
11. 19.2
12. 14.823
13. 8.529
14. 12.583
15. 8.222
16. 18
17. 8.421
18. 12.608
19. 11.142
20. 9.555

4.

1. $\frac{3}{50}$
2. $\frac{1}{10}$
3. $\frac{1}{4}$
4. $\frac{3}{10}$
5. $\frac{2}{5}$
6. $\frac{3}{4}$
7. $\frac{3}{5}$
8. $\frac{1}{3}$
9. $\frac{1}{40}$
10. $\frac{1}{8}$
11. $1\frac{1}{4}$
12. $2\frac{1}{2}$
13. .05
14. .15
15. .125
16. .65
17. .175
18. .035
19. .075
20. .04
21. .0675
22. .78
23. 1.00
24. 1.75
25. .01
26. 25%
27. 50%
28. 90%
29. 85%
30. 125%
31. 6%
32. $4\frac{1}{2}$%
33. 250%
34. 99%
35. $37\frac{1}{2}$%
36. 10%
37. 60%
38. 50%
39. 25%
40. $12\frac{1}{2}$%
41. 70%
42. $16\frac{2}{3}$%
43. $66\frac{2}{3}$%
44. 80%
45. 5%

ASSIGNMENTS

5.

1. 13.75
2. 107.7
3. 3,973.5
4. 1,316
5. 916.5
6. 225
7. 320.25
8. 66.57
9. 1,578.9
10. 23,610
11. 1,133.333
12. 270
13. 128
14. 245
15. 192.5
16. 1,575
17. $144.00
18. $3045.75
19. $67,500.00
20. $145.18

6.

1. 90.663
2. 149.58
3. 1.745
4. 86.586
5. 3.0512
6. $14\frac{1}{2}\%$
7. 30.48576
8. 408.576
9. $1,187\frac{1}{2}$
10. 166.914
11. 27.82

p2. $78.75

13. 414
14. 1.308
15. $17.12
16. 290
17. .245
18. 13,056
19. $186\frac{2}{3}$
20. $2\frac{1}{2}\%$
21. .37275
22. .065
23. .125
24. 1.5
25. .0375
26. $\frac{1}{20}$
27. $\frac{3}{40}$
28. $\frac{1}{8}$
29. $\frac{3}{4}$
30. $1\frac{2}{5}$
31. .7
32. .667
33. .625
34. .15
35. .01
36. $\frac{1}{4}$
37. $\frac{7}{20}$
38. $\frac{1}{5}$
39. $\frac{1}{8}$
40. $\frac{99}{100}$
41. 50%
42. $33\frac{1}{3}\%$
43. 19%
44. 150%
45. 600%
46. 30%
47. 80%
48. 5%
49. 6%
50. 275%

TEST 5

A.

1. 57' $6\frac{7}{8}$"
2. 272.725
3. $54\frac{3}{4}$%
4. 57' $7\frac{1}{8}$"
5. 6.977
6. $778\frac{2}{3}$ sq. ft.
7. 212.635
8. 1,529.32
9. 6' 4"
10. 6.47
11. 7,016$\frac{3}{4}$ brick
12. 7,770 lath
13. 679 brick per day
14. $2,988.05
15. .15
16. .285
17. .06
18. .045
19. .76
20. 1.37
21. .1425
22. .4
23. .333
24. 3.25
25. .125
26. 2.
27. .667
28. .5
29. .005
30. .03
31. .875
32. .01
33. $\frac{3}{4}$
34. $\frac{3}{5}$
35. $\frac{1}{25}$
36. $1\frac{4}{5}$
37. $\frac{7}{20}$
38. $\frac{1}{3}$
39. $\frac{9}{100}$
40. $1\frac{4}{25}$
41. 18%
42. $12\frac{1}{2}$%
43. 100%
44. 225%
45. 75%
46. $66\frac{2}{3}$%
47. 20%
48. 1%
49. $87\frac{1}{2}$%
50. $16\frac{2}{3}$%

B.

1. 122' $7\frac{13}{16}$"
2. 286.022
3. $64\frac{1}{4}$%
4. 4' $\frac{3}{16}$"
5. 8.784
6. $315\frac{3}{8}$ sq. ft.
7. 222.78375
8. 7,131$\frac{1}{2}$
9. 3' 9"
10. 7.68
11. 10,759 lath
12. 11,599$\frac{7}{8}$ brick
13. $4,977.74
14. $198.05
15. 80 seniors
16. $237.50
17. $10,725
18. 1,050 bricks
19. $42.84
20. $26.23

UNIT III

ASSIGNMENTS

	1.		2.		3.
1.	289 sq. ft.	1.	19 ft.	1.	14 ft.
2.	513 sq. ft.	2.	29 ft.	2.	615.7536 ft.
3.	1,247 sq. ft.	3.	198 ft.	3.	840 sq. ft.
4.	126 ft.	4.	648 sq. ft.	4.	1,455.7536 sq. ft.
5.	112 ft.	5.	551 sq. ft.	5.	43.9824 ft.
6.	238 sq. ft.	6.	696 sq. ft.	6.	147.9648 ft.
7.	452.3904 sq. ft.	7.	1,344 sq. ft.	7.	23 ft.
8.	37.6992 ft.	8.	1,247 sq. ft.	8.	1,012 sq. ft.
9.	153.9384 sq. ft.	9.	1,895 sq. ft.	9.	21 ft.
10.	126 sq. ft.	10.	15 ft.	10.	1,407 sq. ft.
11.	48 ft.	11.	25 ft.	11.	2,465 sq. ft.
12.	$395\frac{1}{8}$ sq. ft.	12.	166 ft.	12.	268 ft.
13.	226.9806 sq. ft.	13.	700 sq. ft.	13.	490' $1\frac{7}{16}$"
14.	123.5696 ft.	14.	150 sq. ft.	14.	$1,894\frac{3}{4}$ sq. ft.
15.	$84\frac{1}{2}$ sq. ft.	15.	1,200 sq. ft.	15.	6' 4"
16.	$235\frac{1}{9}$ sq. ft.	16.	850 sq. ft.	16.	16,224 brick
17.	9' 6"	17.	1,350 sq. ft.	17.	$4,854.84
18.	572.5566 sq. ft.	18.	$110\frac{1}{2}$ sq. ft.	18.	32 courses
19.	96 ft.	19.	226.9806 sq. ft.		
20.	117 sq. ft.	20.	361 sq. ft.		
21.	44 courses	21.	24 courses		

ASSIGNMENTS

	4.		5.		
1.	$62\frac{1}{3}$ sq. yds.	1.	$122\frac{8}{9}$ sq. yds.	1.	$102\frac{2}{9}$ sq. yds.
2.	$129\frac{1}{3}$ " "	2.	$211\frac{2}{9}$ " "	2.	$352\frac{2}{9}$ " "
3.	$179\frac{1}{9}$ " "	3.	154.28 sq. yds.	3.	193.62 sq. yds.
4.	$105\frac{8}{9}$ " "	4.	$286\frac{1}{9}$ sq. yds.	4.	$116\frac{1}{9}$ sq. yds.
5.	$73\frac{4}{9}$ " "	5.	$68\frac{4}{9}$ " "	5.	326.39 sq. yds.
6.	101.52 sq. yds.	6.	$211\frac{8}{9}$ " "	6.	$98\frac{7}{9}$ sq. yds.
7.	415.4766 sq. ft.	7.	348.37 sq. yds.	7.	$325\frac{4}{9}$ " "
8.	119 sq. ft.	8.	623 brick	8.	104.06 sq. yds.
9.	109 brick	9.	11,286 lath	9.	$70\frac{2}{3}$ sq. yds.
10.	$26.25 per day	10.	$3,101.37	10.	1,846 sq. ft.
11.	$6,440.82	11.	$188.70	11.	216 " "
12.	$128.70	12.	$13,833\frac{1}{3}$ brick	12.	1,140 " "
13.	33 courses	13.	$918\frac{9}{13}$ P.G. tile	13.	$2,680\frac{3}{4}$ " "
14.	192 brick	14.	513 blocks	14.	268 ft.

TEST 6

	A.		B.
1.	102 sq. ft.	1.	133 sq. ft.
2.	572.5566 sq. ft.	2.	660.5214 sq. ft.
3.	86'	3.	$552\frac{1}{4}$ sq. ft.
4.	63.6174 sq. ft.	4.	38.4846 sq. ft.
5.	192 sq. ft.	5.	75 sq. ft.
6.	64'	6.	60'
7.	83.776'	7.	90.0592'
8.	$183\frac{5}{9}$ sq. yds.	8.	$121\frac{8}{9}$ sq. yds.
9.	$367\frac{4}{9}$ " "	9.	$73\frac{2}{9}$ " "
10.	$807\frac{5}{9}$ " "	10.	$721\frac{8}{9}$ " "
11.	558 sq. ft.	11.	2,745.8784 sq. ft.
12.	104'	12.	209.0976'
13.	62 courses	13.	78 courses
14.	43 courses	14.	728 brick

ASSIGNMENTS

	7.		8.		9.
1.	$322\frac{2}{3}$ sq. ft.	1.	1,170 sq. ft.	1.	1,623 sq. ft.
2.	1,471 sq. ft.	2.	$541\frac{1}{2}$ sq. ft.	2.	$1,633\frac{1}{2}$ " "
3.	1,152 " "	3.	862.3692 sq. ft.	3.	1,368.1668 sq. ft.
4.	1,939.938 sq. ft.	4.	486 sq. ft.	4.	$822\frac{1}{2}$ sq. ft.
5.	1,100.5294 sq. ft.	5.	254.4696 sq. ft.	5.	660.5214 sq. ft.
6.	145.6904 ft.	6.	1,344 sq. ft.	6.	2,508 sq. ft.
7.	$2,733\frac{1}{3}$ sq. ft.	7.	2,751 sq. ft.	7.	193.62 sq. yds.
8.	415.4766 sq. ft.	8.	296 ft.	8.	$325\frac{4}{9}$ sq. yds.
9.	2,261.952 sq. ft.	9.	1,888 sq. ft.	9.	2,462.4766 sq. ft.
10.	$282\frac{4}{9}$ sq. yds.	10.	190 ft.	10.	250.2568 ft.
11.	101.39 sq. yds.	11.	$325\frac{4}{9}$ sq. yds.	11.	$365.48
12.	4,225 brick	12.	104.06 " "	12.	7 days
13.	9,100 lath	13.	$70\frac{2}{3}$ " "	13.	37 courses
14.	19 days	14.	11 days 4 hrs.		

TEST 7

	A.	B.
1.	164.39 sq. yds.	$158\frac{8}{9}$ sq. yds.
2.	2,752 sq. ft.	2,800 sq. ft.
3.	2,194 sq. ft.	2,166 sq. ft.
4.	$15,734\frac{1}{4}$ brick	$14,568\frac{3}{\text{[illegible]}}$ brick
5.	$337\frac{1}{2}$ sq. ft.	$541\frac{1}{2}$ sq. ft.
6.	56.74515 sq. ft.	86.59035 sq. ft.
7.	2,261.952 sq. ft.	2,111.1552 sq. ft.
8.	$156\frac{8}{9}$ sq. yds.	323 sq. yds.
9.	$712\frac{1}{2}$ sq. ft.	794.2607 sq. ft.
10.	115 ft.	106.5532 ft.

UNIT IV

ASSIGNMENTS

1.	2.	
1. $17\frac{1}{27}$ cu. yds.	1. 94 cu. yds.	1. $916\frac{7}{9}$ sq. yds.
2. $45\frac{1}{[illegible]}$ " "	2. 38 " "	2. 168.14 sq. yds.
3. $23\frac{1}{9}$ " "	3. $181\frac{1}{3}$ " "	3. 16.73 cu. yds.
4. 128.1 " "	4. 120 " "	4. $32\frac{10}{37}$ " "
5. 29.88 " "	5. 12 " "	5. $9\frac{1}{3}$ " "
6. 14.42 " "	6. $69\frac{2}{3}$ " "	6. 85.62 " "
7. $30\frac{2}{3}$ " "	7. 86 " "	7. 104 " "
8. 31 " "	8. 82 " "	8. 22.41 " "
9. 120 " "	9. $50\frac{2}{3}$ " "	9. 13,950 brick
10. 65 " "	10. $49\frac{8}{27}$ " "	10. $8,068\frac{2}{3}$ brick
11. 468.84 sq. yds.	11. $10,302\frac{2}{9}$ brick	11. 6,98 cu. yds.
12. 853.14 " "	12. 36,040 "	12. 31 days
13. $313.16	13. 20.03 cu. yds.	13. 1,459.49
14. $11,501\frac{1}{3}$ brick	14. $385\frac{2}{9}$ sq. yds.	14. 7 cu. yds.
15. 9 days	15. $121\frac{8}{9}$ " "	15. 4,242.7308 sq. ft.
	16. 1,019.32	
	17. 41 courses	

ASSIGNMENTS

4.

1. 226.9806 sq. ft.
2. $75\frac{1}{9}$ sq. yds.
3. $111\frac{4}{9}$ " "
4. 54 cu. yds.
5. $46\frac{2}{3}$ " "
6. 132 " "
7. $53\frac{1}{3}$ " "
8. 120 " "
9. 65 " "
10. 50.88 " "
11. $110\frac{1}{2}$ " "
12. 29,520 brick
13. 49,305 "
14. $163.35
15. 2,496 sq. ft.
16. 8,217.5

5.

1. $719\frac{2}{9}$ sq. yds.
2. $606\frac{8}{9}$ " "
3. 120 cu. yds.
4. $121\frac{1}{3}$ " "
5. 120 " "
6. $76\frac{1}{2}$ " "
7. $56\frac{1}{9}$ " "
8. $165\frac{25}{27}$ " "
9. $17\frac{8}{9}$ " "
10. 16,787 brick
11. 50,080 "
12. 25.04 cu. yds.
13. 8 days
14. 2,837.87
15. 1,062 sq. ft.
16. 154'

6.

1. $614\frac{7}{9}$ sq. yds.
2. 232.75 sq. yds.
3. 54 cu. yds.
4. 560 " "
5. 60.99 " "
6. $72\frac{8}{9}$ " "
7. $35\frac{23}{27}$ " "
8. $195\frac{5}{9}$ " "
9. $46\frac{2}{5}$ tons
10. 32,934 bricks
11. 37,392 "
12. 16.47 cu. yds.
13. 20.78 " "
14. 12 days

ASSIGNMENTS

	7.		8.		9.
1.	$281\frac{4}{9}$ sq. yds.	1.	$282\frac{4}{9}$ sq. yds.	1.	$98\frac{20}{27}$ cu. yds.
2.	96.4 cu. yds.	2.	46 cu. yds.	2.	$93\frac{1}{3}$ " "
3.	86 " "	3.	86 " "	3.	230.33 " "
4.	57.88 cu. yds.	4.	$10\frac{2}{9}$ " "	4.	94.49 " "
5.	$133\frac{25}{27}$ " "	5.	$19\frac{1}{9}$ " "	5.	$66\frac{22}{27}$ " "
6.	85.68 " "	6.	$228\frac{4}{27}$ " "	6.	136 " "
7.	52,054 brick	7.	$56\frac{2}{9}$ " "	7.	$213\frac{2}{3}$ sq. yds.
8.	68,704 "	8.	24,840 brick	8.	44,118 brick
9.	38.18 cu. yds.	9.	44,118 "	9.	29,520 "
10.	26.03 " "	10.	12.42 cu. yds.	10.	24.52 cu. yds.
11.	31.4 tons	11.	24.52 " "	11.	14.76 " "
12.	6,480 sq. ft.	12.	817 hours	12.	38.56 tons
13.	903.09 cu. yds.	13.	32.96 tons	13.	4,920
14.	$207.16	14.	2,500.02	14.	$324.28
15.	2,949.73				
16.	$11,450\frac{2}{3}$				

ASSIGNMENTS

	10.		11.
1.	142.81 cu. yds.	1.	332.5 cu. yds.
2.	$250\frac{10}{27}$ " "	2.	$72\frac{1}{3}$ " "
3.	$77\frac{14}{27}$ " "	3.	$87\frac{1}{9}$ " "
4.	$117\frac{1}{3}$ " "	4.	$56\frac{2}{9}$ " "
5.	124.87 " "	5.	$113\frac{1}{3}$ " "
6.	57,995 brick	6.	63.54 cu. yds.
7.	41,860 "	7.	31,374 brick
8.	$38\frac{2}{3}$ cu. yds.	8.	44,688 "
9.	20.93 cu. yds.	9.	10.46 cu. yds.
10.	318.39 sq. yds.	10.	24.82 " "
11.	$80\frac{1}{2}$ days	11.	198.73 sq. yds.
12.	3,286.39	12.	3,731 sq. ft.
13.	$1,506\frac{1}{2}$ sq. ft.	13.	1,290.875 sq. ft.
14.	1,701.1764 sq. ft.	14.	142.54 ft.
15.	$48\frac{3}{4}$ tons	15.	7,448

TEST 8

	A.	B.
1.	$105\frac{7}{9}$ sq. yds.	$177\frac{5}{9}$ sq. yds.
2.	$39\frac{7}{9}$ cu. yds.	$41\frac{2}{9}$ cu. yds.
3.	86 " "	$54\frac{14}{27}$ cu. yds.
4.	$133\frac{25}{27}$ " "	120 " "
5.	48,762 brick	27,968 brick
6.	16.26 cu. yds.	15.54 cu. yds.
7.	1,125 sq. ft.	1,644 sq. ft.
8.	942.48 sq. ft.	395.8416 sq. ft.
9.	2,763.18	4,662
10.	908.1336 sq. ft.	1,124.3904 sq. ft.
11.	117.1152 ft.	131.3984 ft.
12.	58.05 tons	$33\frac{5}{11}$ tons

ASSIGNMENTS

	12.		13.		14.
1	59.84 cu. yds.	1.	56.55 cu. yds.	1.	$7\frac{16}{27}$ cu. yds.
2.	$91\frac{2}{3}$ " "	2.	9.03 " "	2.	3.09 " "
3.	602.14 " "	3.	51.78 " "	3.	4.55 " "
4.	111 " "	4.	2.45 " "	4.	11.29 " "
5.	25..328 sq. ft.	5.	91.15 sq. yds.	5.	$2\frac{2}{27}$ " "
6.	9.15 cu. yds.	6.	12 cu. yds.	6.	5.02 " "
7.	$906\frac{2}{3}$ sq. ft.	7.	$55\frac{19}{27}$ cu. yds.	7.	35.95 " "
8.	18.5 cu. yds.	8.	24,440 brick	8.	28.17 " "
9.	5.11 " "	9.	12.22 cu. yds.	9.	12,490 brick
10.	$65\frac{16}{27}$ " "	10.	1,384.94	10.	6.94 cu. yds.
11.	26,670 brick	11.	31.42 tons	11.	9.84 " "
12.	17.78 cu. yds.				
13.	4,445				
14.	$599\frac{1}{9}$ cu. yds.				

ASSIGNMENTS

	15.	16.
1.	$29\frac{17}{27}$ cu. yds.	7.99 cu. yds.
2.	44.12 " "	14.05 " "
3.	54.85 " "	7.01 " "
4.	23.46 " "	204.41 sq. yds.
5.	4.98 " "	27.68 cu. yds.
6.	2.21 " "	67.31 " "
7.	$5\frac{5}{9}$ " "	$5\frac{25}{27}$ " "
8.	58.91 " "	78.46 " "
9.	$136\frac{4}{9}$ sq. yds.	35,875 brick
10.	108.8 cu. yds.	11.96 cu. yds.
11.	45,032 brick	$46\frac{4}{27}$ " "
12.	30.03 cu. yds.	5,979.17
13.	40.44 " "	43.55 tons
14.	$6\frac{1}{2}$ days	316 sq. ft.
15.	57.04 tons	$2\frac{25}{27}$ cu. yds.
16.	2,962 sq. ft.	

TEST 9

	A.		B.
1.	$92\frac{1}{9}$ sq. yds.	1.	$199\frac{1}{3}$ sq. yds.
2.	24.44 cu. yds.	2.	97.75 cu. yds.
3.	20.62 " "	3.	12.44 " "
4.	$7\frac{5}{27}$ " "	4.	$7\frac{1}{3}$ " "
5.	117.36 " "	5.	276.17 " "
6.	$87\frac{8}{9}$ " "	6.	97.54 " "
7.	36,499 brick	7.	41,335 brick
8.	20.28 cu. yds.	8.	22.97 cu. yds.
9.	53.42 " "	9.	58.37 " "
10.	44.44 tons	10.	55.34 tons
11.	169.6464 sq. ft.	11.	367.5672 sq. ft.
12.	24 cu. yds.	12.	32 cu. yds.
13.	$8\frac{7}{9}$ " "	13.	42.37 cu. yds.
14.	124 ft.	14.	226.54 ft.
15.	$15\frac{1}{2}$ days	15.	15 days

VT003 269

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Auto Body Repair, I.

Radvany, John E.
New Jersey State Dept of Educ, Trenton. Vocat Div.
Rutgers State Univ., New Brunswick, N.J. Curric Lab.
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*STUDY GUIDES, TEXTBOOKS, *TRADE AND INDUSTRIAL EDUCATION, *AUTO BODY REPAIRMEN, *MOTOR VEHICLES, HIGH SCHOOLS, *INDIVIDUAL INSTRUCTION,

This study guide-textbook was developed to direct individual student study in a 1-year course and serve as a reference manual and handbook for persons interested in learning the automotive body repair trade. It was prepared by the principal especially for the students at the New Jersey School for the Deaf and has been tested in the classroom. Various phases of the automotive trade which are closely allied to body repairing and found to be important to the overall development of the skilled craftsman are presented. The units are (1) Shop Orientation, (2) Care of Shop and Tools, (3) Materials and Parts of the Automobile, (4) Removal and Assembly, (5) Refinishing, (6) Care of the Finish, (7) Metal Repair, and (8) Acetylene Welding. Each unit contains lesson assignment sheets with the specific lesson objective, the related information with illustrations, and assignments. A test is provided at the end of each unit. To be most helpful, this material should be combined with teacher demonstration and supervision of the manipulative skills required by the trade. The teacher should have a science and automobile body repair background. A glossary of trade terms with phonetic spelling is given. Suggested classroom references are listed. This document is available for $1.50 from Vocational-Technical Division Curriculum Laboratory, Rutgers University, 10 Seminary Place, New Brunswick, New Jersey 08903. (HC)

STATE OF NEW JERSEY
DEPARTMENT OF EDUCATION
VOCATIONAL DIVISION

AUTO BODY REPAIR - 1

PREPARED BY
JOHN E. RADVANY - PRINCIPAL, DEPARTMENT OF BOYS' VOCATIONAL EDUCATION
NEW JERSEY SCHOOL FOR THE DEAF

VOCATIONAL DIVISION - CURRICULUM LABORATORY
NEW BRUNSWICK, NEW JERSEY

State of New Jersey
Department of Education
Vocational Division

AUTO BODY REPAIR - I

Prepared by
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ALBERT E. JOCHEN, Assistant Commissioner

BENJAMIN SHAPIRO, Curriculum Specialist

JANUARY, 1962

INTRODUCTION

The purpose of this book is to serve as a text, reference manual, or handbook for persons interested in learning the Automotive Body Repair Trade. Especially prepared for the students at the New Jersey School for the Deaf, it is the first of two books designed to make the trade experience more meaningful. This book will deal with the various phases of the automotive trade, which are closely allied to body repairing and found to be important with regard to the overall development of the skilled craftsman.

The Auto Body Trade calls for a combination of skills requiring knowledge in removal and assembly, metal straightening, oxy-acetylene welding, electric arc welding, painting and upholstering. It is intended that, to be most helpful, this text be combined with instructor demonstration and supervision of the manipulative skills required by the trade. Information that is contained in this book is of necessity general in nature. It will be important for the instructor to bring out and develop special applications.

In vocational work it is an accepted fact that we learn best by doing. It is hoped that as a student is encouraged to read the factual information, which interests him in learning the skills, he can also attain a greater understanding of language and vocabulary.

J. E. RADVANY

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(Address) 10 Seminary Place, New Brunswick, N J 08903; School of Education-Rutgers

DATE: August 29, 1967

RE: (Author, Title, Publisher, Date) John Radvany; AUTO BODY REPAIR 1; 1962

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(3) Utilization of Material:
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Type of Program Vocational - High School
Occupational Focus Auto body repairman
Geographic Adaptability Unlimited
Uses of Material Related classroom text
Users of Material Students

(4) Requirements for Using Material:
Teacher Competency Certification - science - auto body repair background preferred
Student Selection Criteria Student preference and guidance approval

Time Allotment One year

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JOHN E. RADVANY

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UNIT V - REFINISHING (Cont'd)

UNIT I - SHOP ORIENTATION

Rules and Procedures Lesson 1

OBJECTIVE: To learn the rules and procedures used in the Auto Body shop.

INFORMATION:

Before a person starts to play a game, whether it be football, basketball, checkers, or dominoes, the first thing he must do is to learn the rules.

Learning the rules will help you play the game with confidence and prevent your being penalized and possibly losing the game through ignorance of the rules.

In the world of work, many of the same principles are used as in sports, with a big difference. In sports, if you don't know the rules, you may lose the game, or you may have to play much harder to win. In the world of work you may lose something much more precious, your job. Ignorance of the rules can cause injury to you or someone else.

Read and study the following basic rules, which must be followed at all times.

1. NEVER TOUCH ANY TYPE OF EQUIPMENT OR MACHINE until you have been instructed in its use by the teacher.

2. PAY STRICT ATTENTION when the teacher is showing you an operation. If you do not understand, ask questions before you start your job.

3. FOLLOW DIRECTIONS CAREFULLY when you start your job and do only that which was told to you.

4. ALWAYS DO YOUR BEST. Do not hurry. The most important thing is to do your part correctly so that you can be proud of your work. Speed will come later.

5. KEEP YOUR WORK AREA CLEAN as you work. This is one way to cut down accidents and do a better job.

6. PUT YOUR TOOLS AWAY after your job is finished. This will prevent your losing tools which are expensive, and the wasting of time which is very valuable to you.

7. DO NOT LEAVE YOUR JOB AND DISTURB OTHERS. When you are working you are learning, but when you stop you are merely wasting time.

ASSIGNMENT:

1. Name a game which has no rules.
2. Why must you be taught how a machine operates before you can use it?
3. When the teacher is demonstrating something, what should you be doing? Why?
4. Do you know why tools must be put into their proper place?
5. Is it a good practice to talk to the other boys after you are finished with your job? Why?
6. There are some underlined words in the lesson. Find them and give their meanings. Use each of these words in a sentence.

Safety Precautions Lesson 2

OBJECTIVE: To learn what safety precautions must be taken in the Auto Body shop.

INFORMATION:

Above all, in the shop, the first consideration is safety. To each one of us, work means the earning of a livelihood. The earning of this livelihood depends upon our ability to perform the tasks that are expected of us. We must be alert in order to compete with others and do a satisfactory job. To protect our lives and limbs, the watchword is always "CAUTION AND CARE." Do not take chances when you are not sure of what you are doing. Remember, "AN OUNCE OF PREVENTION IS WORTH A POUND OF CURE."

In addition to your own safety and welfare, there is another consideration. This is the fact that you will be working on property that does not belong to you. You will be entrusted with a valuable piece of another person's property, which must be given better care than even your own.

Automobile work is interesting and even fascinating, but at the same time you will be working with hazardous materials under hazardous circumstances.

There will be times when it is necessary for you to work with fire and flammable materials, operate power tools under pressure, and operate electrical power tools. Hazards can be created by your failure to follow the correct procedure.

FIG. 1

FIRE in the body shop is always a potential danger. Know where all the fire extinguishers are located; also know the location of sand buckets and water outlets. Your instructor will demonstrate the use of different types of extinguishers. Read the directions on the extinguisher and if you do not understand how they work, ask the instructor to explain it to you again. When working with flame, always keep the area clean and free of paper and rags. Place all discarded paper and rags into waste containers. Spontaneous combustion means a fire that starts by itself because of too much heat.

For this reason, oily and paint-soaked rags should always be put into safety cans. Be careful of the welding torch and where you point it. Treat the burning torch like a loaded gun. Never point it at anyone or anything that might catch fire.

POWER TOOLS operating under high pressure, such as hydraulic jacks or lifts, can be very dangerous if they are not handled properly. Make sure that jacks are always in proper position so that they will not slip out of place. If high pressure is being used, try to anticipate what will happen if something slips and stand clear to avoid such accidents.

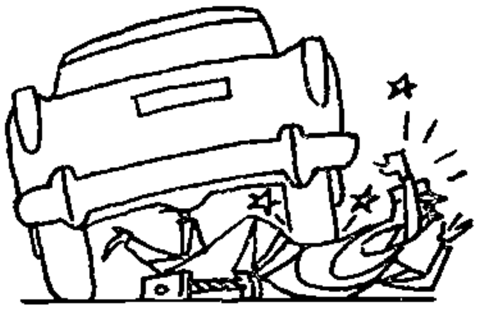


FIG. 2

ELECTRICAL TOOLS are commonly used in the shop, yet they present a very serious problem to those who will be careless. Most of the electrical tools are portable and have no safety guards on them. Tools such as sanders, grinders, drills, buffers, have spinning surfaces which are exposed. The best safety guard against accidents on this type of equipment is COMMON SENSE. Do not hurry with your work. Look for ways to avoid coming in contact with moving parts of the machine and getting caught in them. ELECTRICITY AND WATER NEVER MIX so never stand in water when using an electrical tool. If you must work in an area where there is water on the floor, be sure to place a piece of wood under your feet. This will act as an insulator and prevent a serious electrical shock.

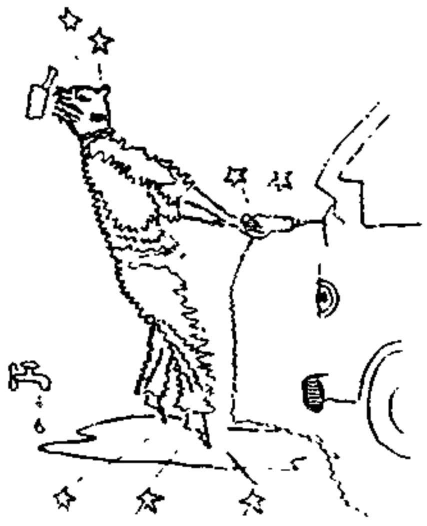


FIG. 3

SOLVENTS AND THINNERS are commonly used in the body shop. Always be sure that there are windows open for ventilation purposes when you use them.

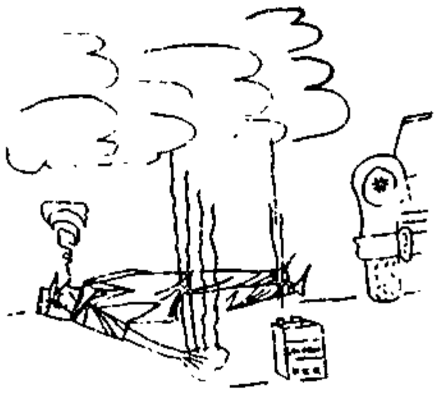


FIG. 4

If you are working in an area without windows, such as a spray booth, be sure the exhaust fan is operating so that obnoxious fumes can be drawn out. If you are working with solvents inside the car, do not close the doors and windows, but keep them open to give you better ventilation.

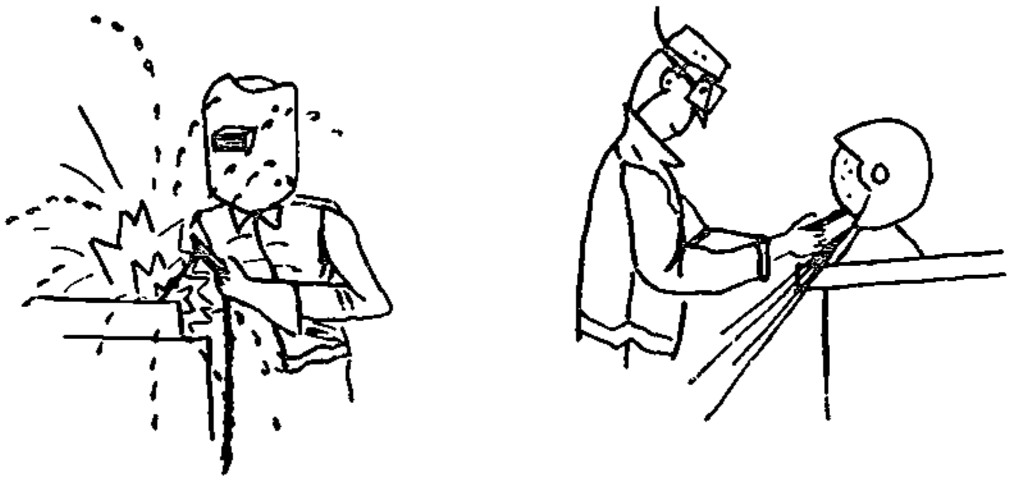


FIG. 5

PROTECTION OF YOUR BODY must always be uppermost in whatever you do. Your eyes are one of your most precious senses. Take every step to protect them. Use safety goggles whenever you are working with tools that give off flying chips, splinters, or sparks. If you must work under a car, wear goggles to protect your eyes from falling dirt. When welding always use welding goggles. NEVER LOOK AT THE ARC in the electric welding operation, for this arc is so brilliant that it can have a blinding effect on your eyes.

The floor in an auto body shop is generally constructed of concrete, because of its durability. There are times when a serious injury can come from a fall. Spilled oil or grease, tools and parts left in the middle of the floor, can be the cause of this type of accident. ALWAYS BE ALERT as you walk around the shop and look for these thing to prevent your falling.

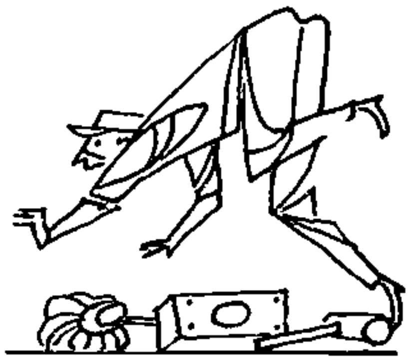


FIG. 6

Do your part in keeping the floor free from this hazard. If your work involves grease and oil, place something under the job so that the grease can be picked up and discarded. Do not leave extension cords and air hoses lying on the floor after you have finished with them. When you have removed parts from the car, do not leave them in the middle of the floor, but store them in a good place. A good rule is the slogan used by the New Jersey Bell Telephone Company, "No job is so urgent or important that we cannot take time to do it safely."

In the shop, it is best to use coveralls at all times. First of all they protect your good clothing, but more important they protect exposed parts of the body from things being spilled, flying particles and sparks. The coveralls eliminate loose clothing which may catch in machines which have exposed spinning parts on them.

FIG. 7

ASSIGNMENT:

1. List as many reasons as you can for being interested in safety.
2. List some ways of preventing fires.
3. What must you do when operating power tools under pressure?
4. List some of the dangers in using electrical tools. How can they be overcome?
5. What is the best guard for a portable machine?
6. What should you do when you work with solvents in a closed spray booth?
7. How can you protect your eyes from injury?
8. Is it wise to look at the electric arc for even a short time? Why?
9. Why is it important to wear coveralls in the shop?
10. What is meant by "an ounce of prevention is worth a pound of cure"?
11. There are some underlined words in the lesson. Find them and give their meanings. Use each one of these in a sentence.

UNIT I - SHOP ORIENTATION

ACHIEVEMENT TEST

1. Write three rules which must be followed in the school shop.

2. Name three general groups of hazards in the body shop.

3. What is the basic rule to use in any shop?

4. Name three protective devices that are available in the shop.

5. What is spontaneous combustion? How can it be prevented?

6. List five new words that you have learned in this unit.
   Use each one in a sentence.

UNIT II - CARE OF SHOP AND TOOLS

Shop Area   Lesson 1

OBJECTIVE: To learn how to keep the shop area clean.

INFORMATION:

In order for you to work efficiently and safely, your first important need is a clean shop. The dirty shop can be the cause of poor workmanship due to poor standards. It can also contribute to the loss of valuable tools. A great deal of time is required to find tools that are misplaced. This time could be spent on more productive work. The clean and neat appearance of a work area shows the work habits of the mechanic. If a shop looks dirty and untidy, more than likely the work done will be of the same type.

One big asset to the repairman is natural light, so be sure that windows are kept clean and unobstructed.

It is understood that the nature of automobile work is dirty. Therefore, a broom is an essential part of the shop equipment. When you are finished with your job, sweep around your area and place the dirt in a waste can. If you are working with oil and grease, be sure to place something under your job to catch any that is spilled. This in turn then, can easily be picked up and disposed of, leaving the floor as you found it.

When placing things on the floor, do not drop them, as this will chip the concrete, which only gets worse later.

Remember, the shop you work in, is in part, a reflection of your ability. Always do your best to keep it looking neat and tidy.

ASSIGNMENT:

1. What is the first thing we learn about the shop?

2. Why is it important to clean windows?

3. How can you prevent oil and grease from building up on the floor?

4. Who, do you think, should clean the shop?

5. What happens when objects are dropped on the floor? Why is this serious?

6. How does the appearance of the shop affect you? Why must you do your part?

7. There are some underlined words in the lesson. Find them and give their meanings. Use each of these words in a sentence.

UNIT II - CARE OF SHOP AND TOOLS

Basic Hand Tools — Lesson 2

OBJECTIVES: To learn the names of the basic tools used.
To learn to identify basic tools used.

INFORMATION:

To list all the tools in the body shop and expect you to remember them is very impractical unless you have the opportunity to work with them.

There are, however, some basic hand tools which are common to most shops and these are the ones you will use most often. Hand tools are those that have no machinery attached to drive them. They are operated by the hands of the mechanic.

Study the picture carefully and learn all the different names so that when you are asked to use a certain tool you will understand the directions given. (Fig. II-1)

1. straight screwdriver
2. Phillips head screwdriver
3. clutch head screwdriver
4. aviation snips
5. metal shears
6. hacksaw
7. tire hammer
8. ball pein hammer
9. bolt cutter
10. Allen wrench
11. vise grip pliers
12. straight pliers
13. open end wrench
14. box wrench
15. center punch
16. pin punch
17. cold chisel

Tools help the mechanic work better and faster. They must always be kept in good operating condition. Parts that move should receive a drop of light oil to keep them moving freely. Frequently check the cutting edges of all the tools and make sure they are sharp before a job is started.

Tools that are not used often may be coated with a thin film of machine oil to keep them from rusting.

Above all, small hand tools must be stored in their proper places so that they can be found when needed without wasting valuable shop time.

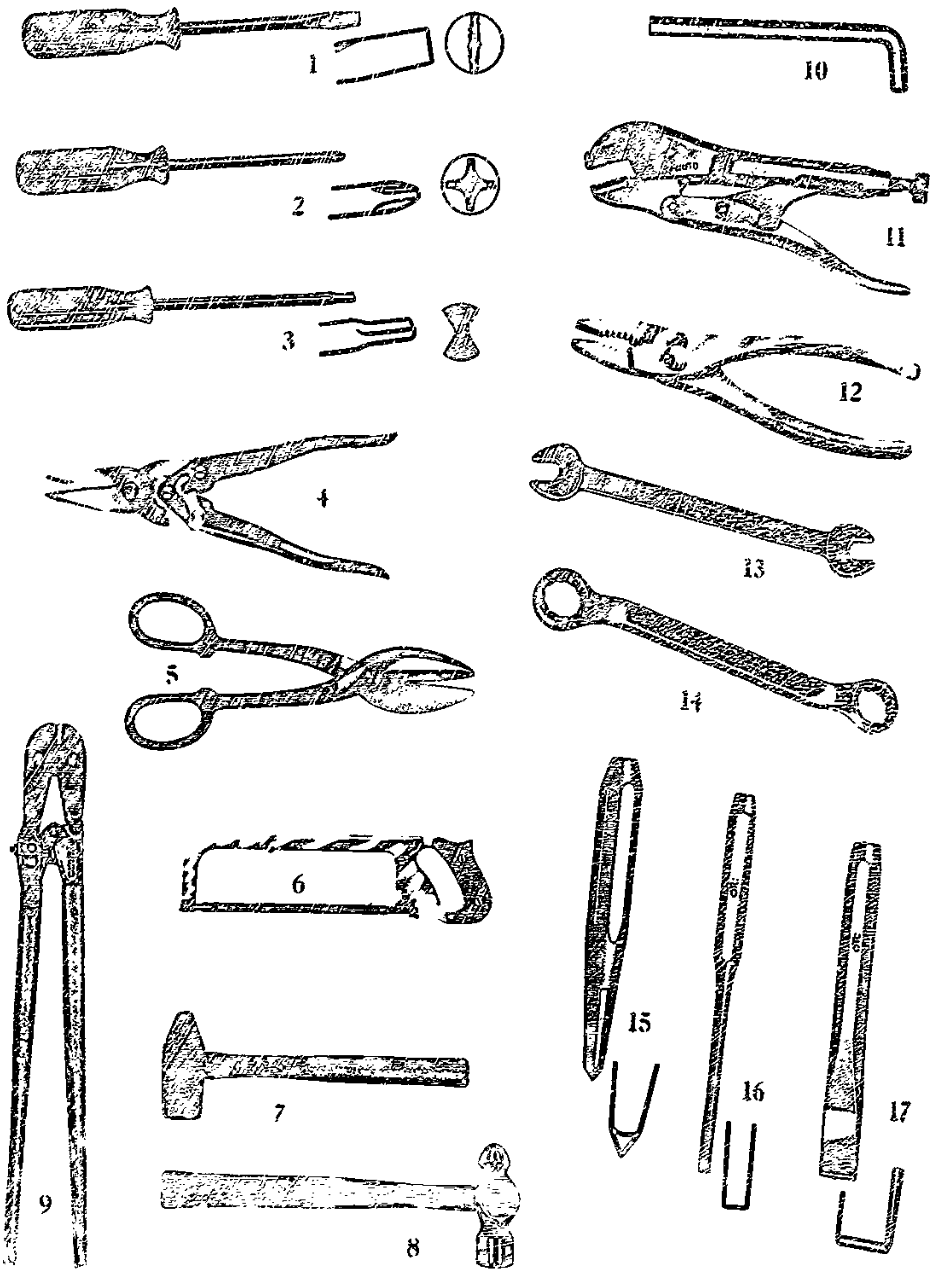


FIG. II-1

ASSIGNMENT:

1. Is it important to oil tools? Why?

2. What should you do with tools that have cutting edges? Why?

3. Do you think that storing tools on a tool board is a good idea? How can this help you?

4. What should be done with tools that are not used often?

5. Match the following names of tools with the correct numbers in the diagram. (Fig. II-1)

( ) ball pein hammer
( ) tire hammer
( ) straight screwdriver
( ) clutch head screwdriver
( ) Phillips head screwdriver
( ) center punch
( ) cold chisel
( ) pin punch
( ) hacksaw
( ) open end wrench
( ) box wrench
( ) pliers
( ) bolt cutter
( ) metal shear
( ) vise grip pliers
( ) Allen wrench
( ) aviation snips

6. There are some underlined words in the lesson. Find them and give their meanings. Use each of these words in a sentence.

UNIT II - CARE OF SHOP AND TOOLS

ACHIEVEMENT TEST

1. Explain why you think a clean shop is important.

2. How can clean windows help you?

3. What kind of accident can you prevent by keeping the floor clean?

4. What are hand tools?

5. What should you do with moving parts? cutting edges?

6. Name five basic hand tools that you have learned about in this unit.

7. List five new words that you have learned in this unit.
   Use each one in a sentence

UNIT III - MATERIALS AND PARTS OF THE AUTOMOBILE

Metals Lesson 1

OBJECTIVES: To learn about some of the different types of metal that go into the manufacture of an automobile.

To learn the reasons why so many different metals are used.

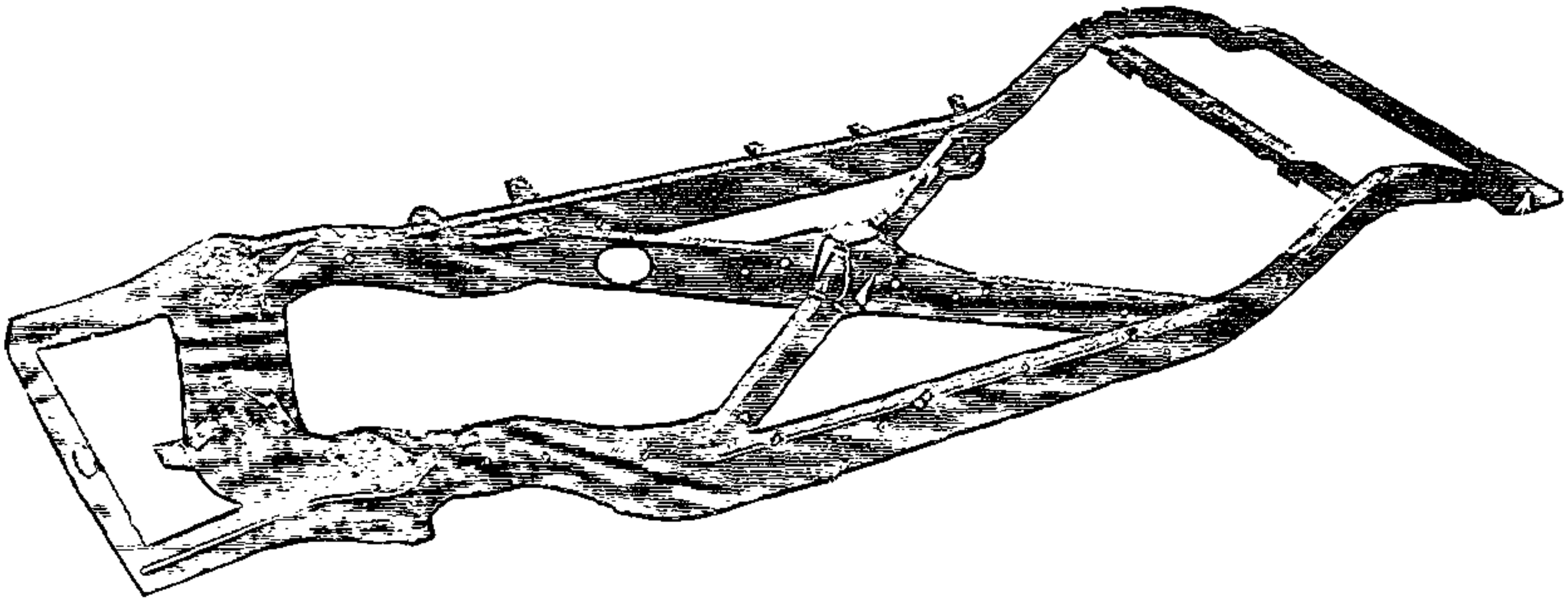
INFORMATION:

In order to learn how a part is to be repaired, we must first know what the part is made of. The automobile is a combination of many materials and each must be treated differently.

First let us look at the metals. In the manufacture of a car, a company uses steel, aluminum, chrome, brass, copper, nickel, cast iron, and white metal.

You may wonder why it is necessary to make use of so many different kinds of metal in one car, but let us look at some examples of the uses and the reasons they are used.

STEEL

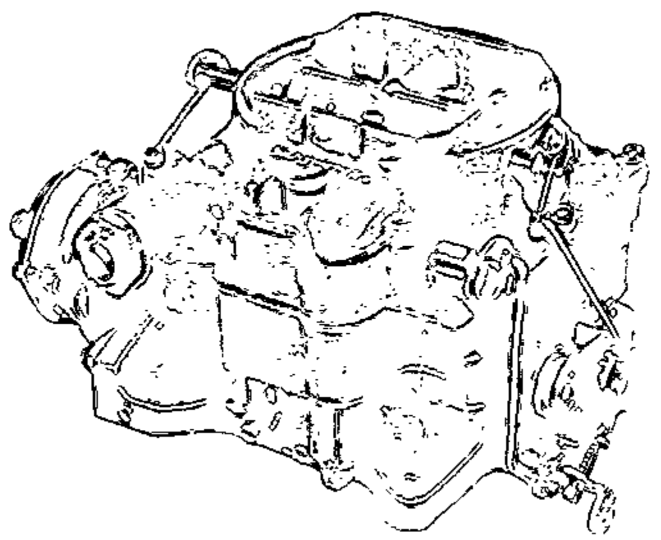


CHASSIS

FIG. III-1

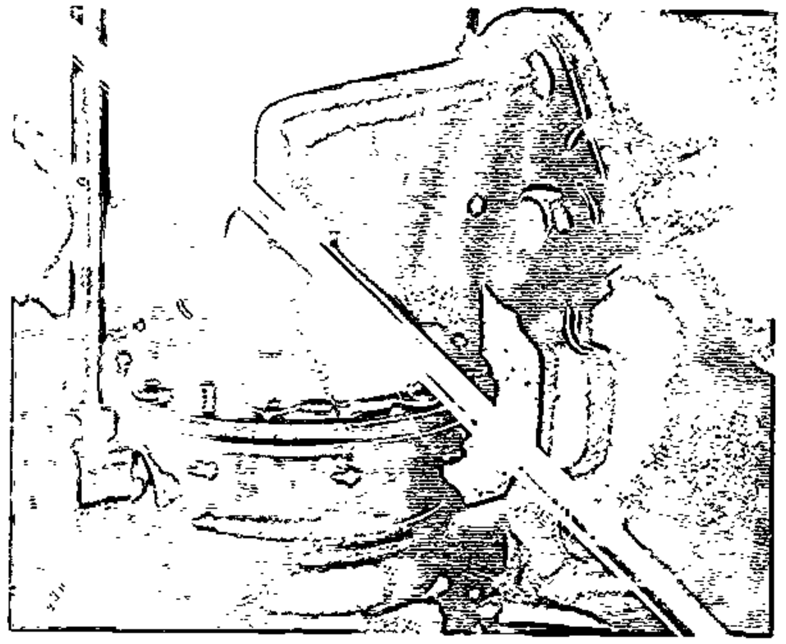
The body and chassis of the automobile are generally constructed of steel because steel is strong, long lasting, and reasonably economical. It can be bent or welded into almost any shape, resists the impact from a collision, and yet still is flexible enough to protect the people of the car from shock during an accident.

ALUMINUM



CARBURETOR

FIG. III-2

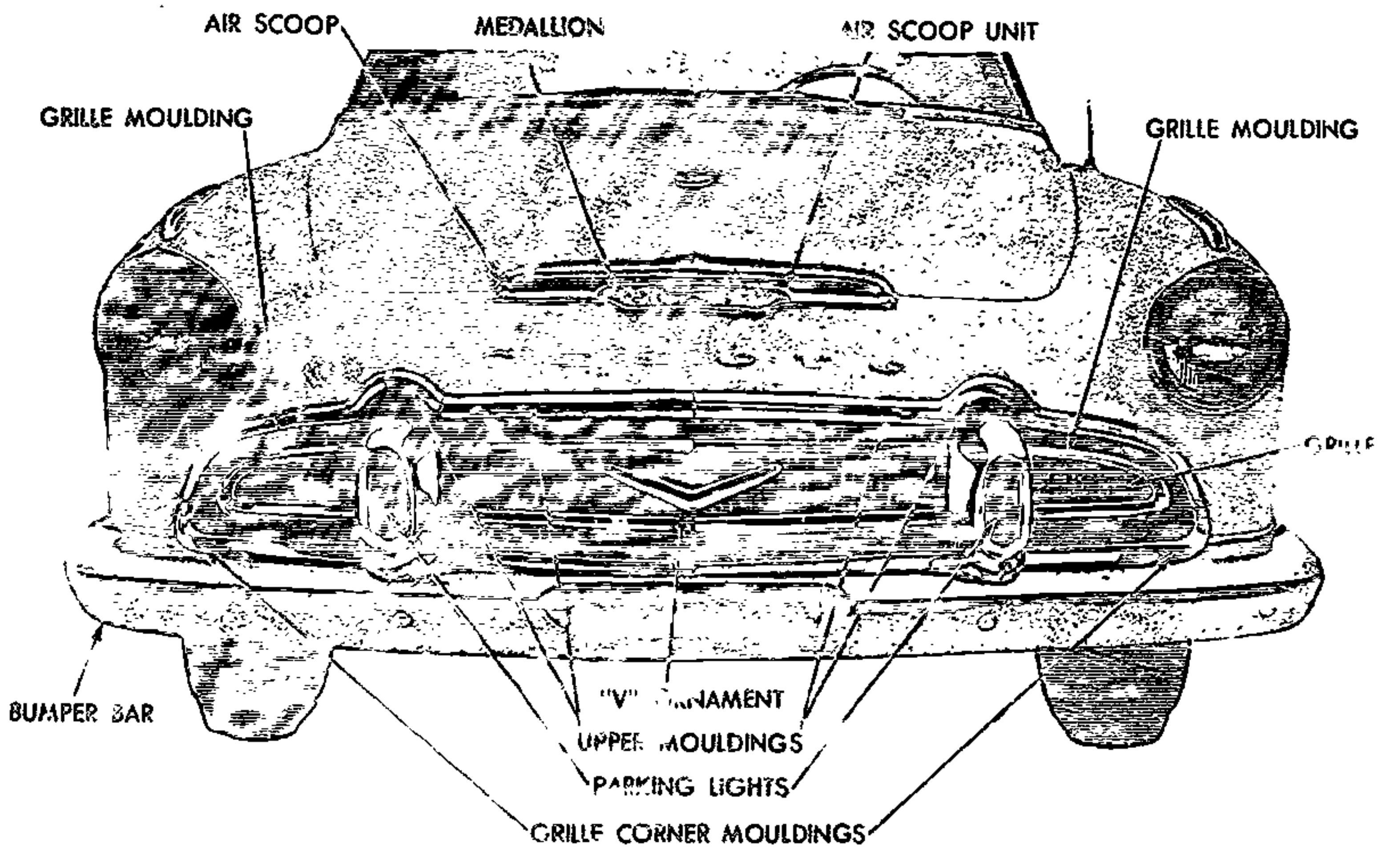


FUEL PUMP

FIG. III-3

Many parts of the car require little strength, but need durability and lightness. Aluminum is used for these parts. Engine parts such as carburetors and fuel pumps are made of aluminum because they add very little weight to the total weight of the engine and are long lasting because they do not rust. They are strong enough to withstand ordinary wear.

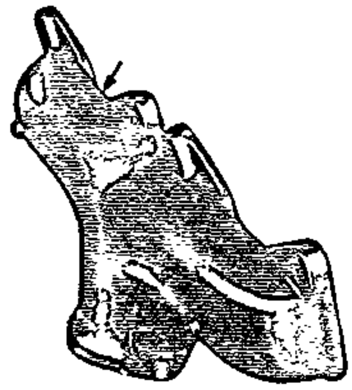
CHROME, NICKEL AND COPPER



GRILLE
FIG. III-4

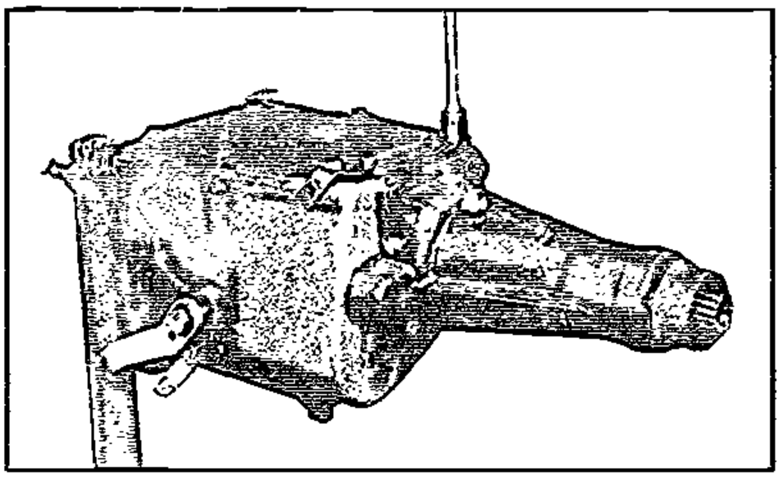
One of the most attractive parts of the car is the trim. In order to keep certain parts shiny and attractive they are coated with copper, nickel and chrome through the process of electroplating. This is a rather expensive process, therefore it is used mainly for trim which improves the appearance of the car.

CAST IRON



MANIFOLD

FIG. III-5



TRANSMISSION HOUSING

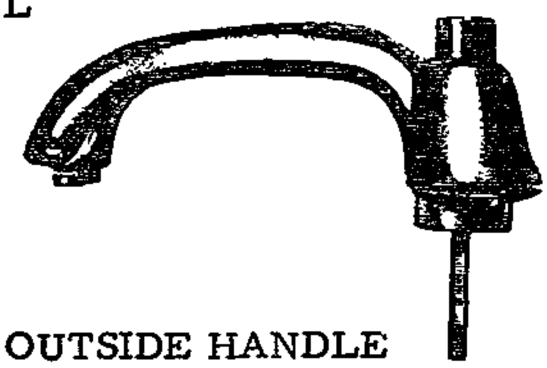
FIG. III-6

Parts such as the motor block, rear, and transmission housing are constructed of cast iron. This is a very heavy and strong material, which will resist heat, cold and shock from both ordinary use and the shock of accident. This resistance is very important for protecting the vital working mechanism of the automobile.

WHITE METAL

INSIDE HANDLE

FIG. III-7

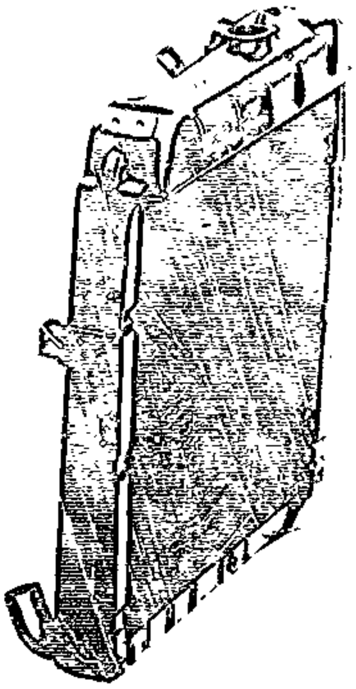


OUTSIDE HANDLE

FIG. III-8

Much of the hardware on the car is constructed of white metal. This is an alloy which is very light in spite of the thickness in which it is used. It will not rust and receives chrome plating very well. Due to its thickness it can be used for handles, headlight rims, taillight rims, and ornaments. It is very brittle and can break very easily if struck.

BRASS



RADIATOR

FIG. III-9

The heart of the cooling system on the automobile is the radiator. Without the radiator the car will overheat and be impossible to run. Most manufacturers use a combination of copper and brass for constructing a radiator. These materials are ideal because they do not rust and are excellent conductors of heat, which is the principle of the radiator - to release heat. Both metals are tinned easily and can be soldered.

We have mentioned only a few of the basic metals used on the car. These are the ones used most commonly and the ones you will be learning more about. There are also many other alloys used for special reasons, which we will omit at this time.

ASSIGNMENT:

1. What is the most common metal used on the automobile? Why?

2. Why is aluminum used on some parts of the car?

3. What is the reason for using cast iron?

4. Why are copper and brass used on the radiator of the car?

5. Why not use aluminum for the body instead of steel?

6. Why not use cast iron for the chassis instead of steel?

7. There are some underlined words in the lesson. Find them and give their meanings. Use each of these words in a sentence.

UNIT III - MATERIALS AND PARTS OF THE AUTOMOBILE

Body Parts Lesson 2

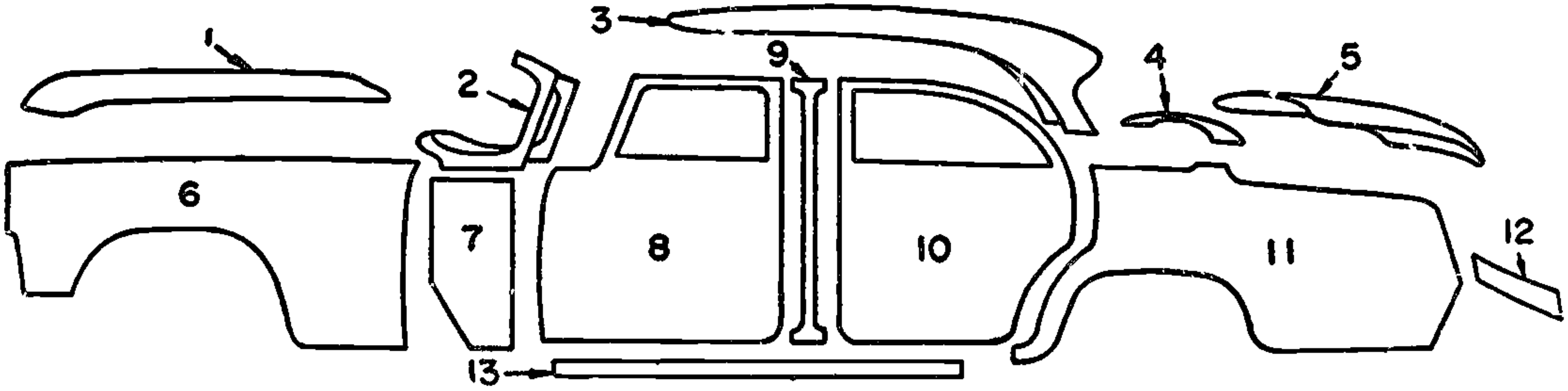
OBJECTIVE: To learn the basic body parts of the automobile.

INFORMATION:

From pictures of the early automobile you can see that there were very few parts as compared to the modern auto. The reason for the added parts on the modern car is the desire of the manufacturer to increase the sale of his product by providing added protection, convenience and appearance to the finished product. The modern automobile of today contains thousands of parts. In this section we will begin by studying the major body sections and those parts that are visible.

Study the picture carefully and identify the name of the part with a numbered section of the car. (Figs. III-10 and III-11)

97

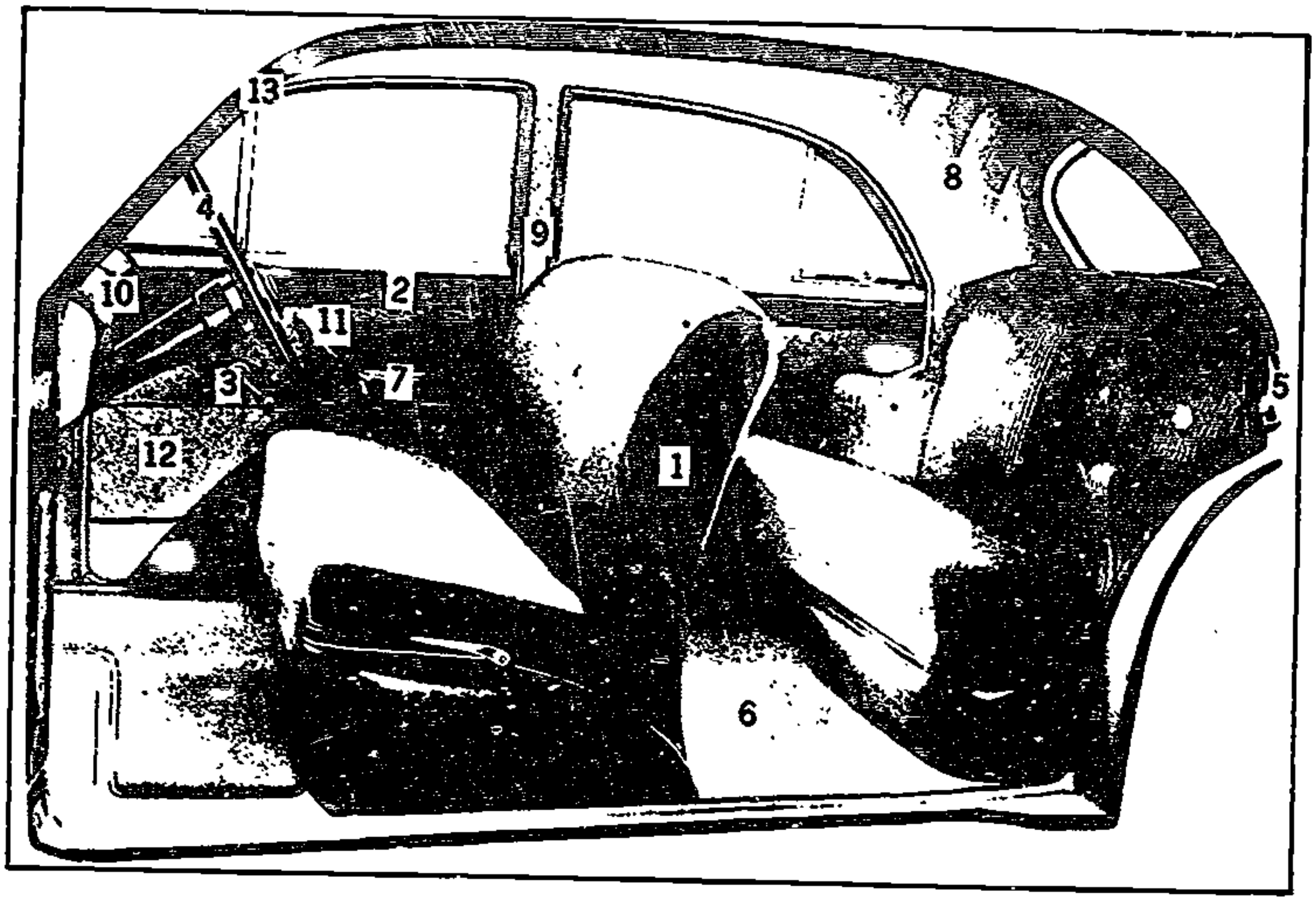


EXTERIOR PARTS

FIG. III-10

Exterior Parts

1. hood
2. cowl upper panel
3. roof panel
4. trunk upper panel
5. trunk lid
6. front fender
7. cowl side panel
8. front door
9. center pillar
10. rear door
11. quarter panel
12. trunk lower panel
13. rocker panel



INTERIOR BODY

FIG. III-11

Interior Parts

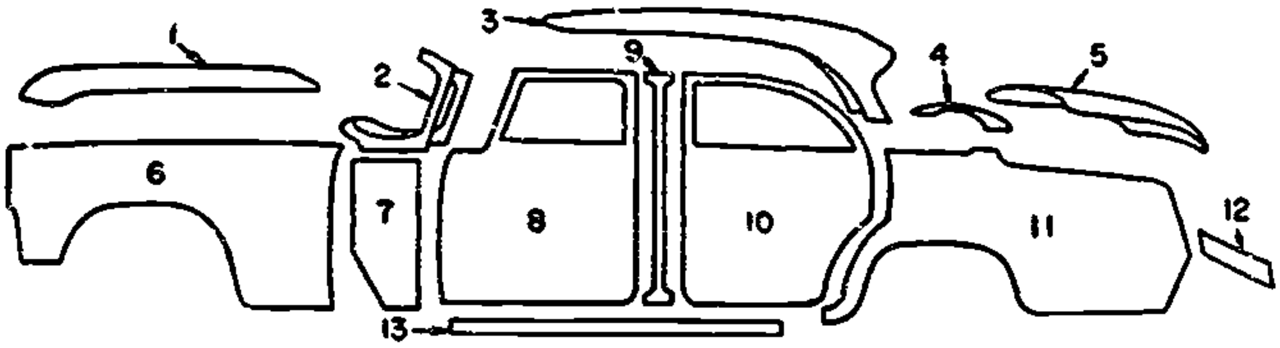
1.	seats	7.	arm rest
2.	garnish moulding	8.	headlining
3.	window regulating handle	9.	center post
4.	steering wheel	10.	instrument panel
5.	door jamb	11.	door handle
6.	rugs	12.	trim panel
		13.	sun visor

ASSIGNMENT:

1. Using the picture below and the following names, write the correct number of the part in front of the word which names that part.

( ) hood
( ) trunk upper panel
( ) cowl side panel
( ) rear door
( ) rocker panel
( ) cowl upper panel

( ) trunk lid
( ) front door
( ) quarter panel
( ) roof panel
( ) front fender
( ) center pillar
( ) trunk lower panel



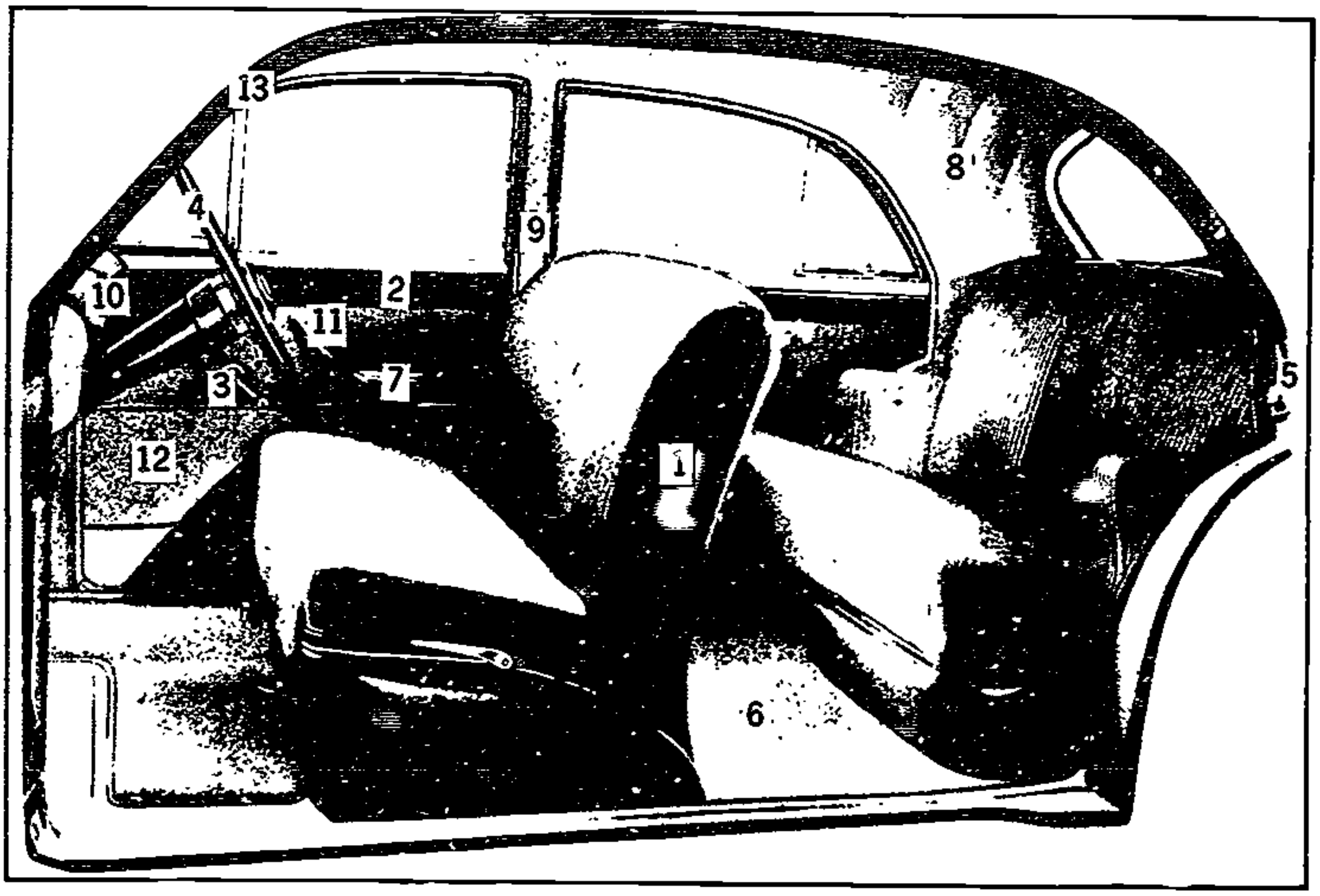
EXTERIOR BODY

FIG. III-10

2. Using the picture below and the following names, write the correct number of the part in front of the word which names the part.

(   ) seats
(   ) steering wheel
(   ) arm rest
(   ) instrument panel
(   ) sun visor
(   ) garnish moulding

(   ) door jamb
(   ) headlining
(   ) door handle
(   ) window regulating handle
(   ) rugs
(   ) center post
(   ) trim panel



INTERIOR BODY

FIG. III-11

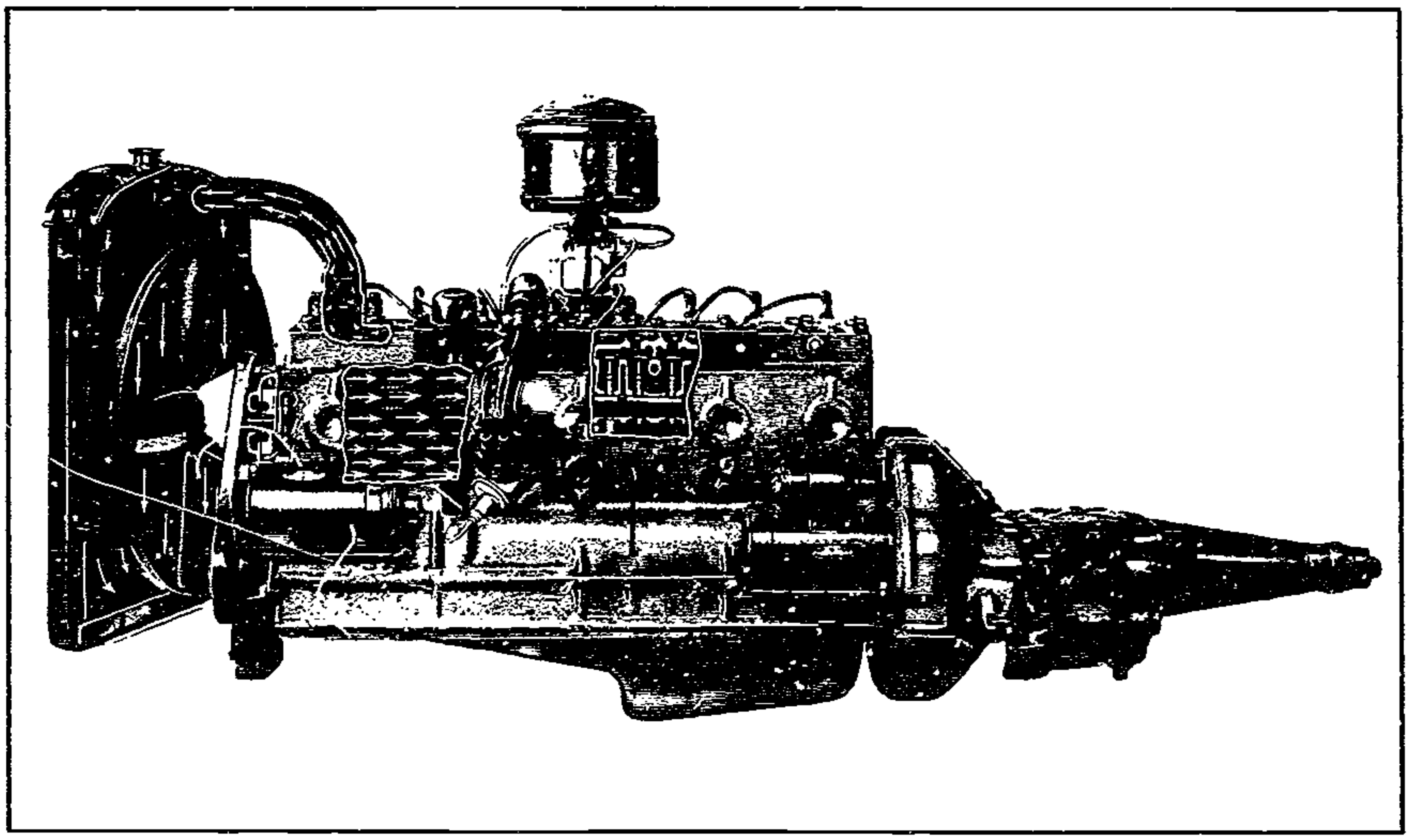
3. There are some underlined words in the lesson. Find them and give their meanings. Use each of these words in a sentence.

OBJECTIVES: To learn the purpose of the cooling system.
To learn the parts of the cooling system.
To learn how to drain the cooling system.

INFORMATION:

One of the most important parts on the car is the cooling system. The motor cannot run when it becomes overheated. The job of the cooling system is to keep the engine cool.

The cooling system is made up of the radiator, water pump, fan assembly, the water jacket of the engine, and the hoses. (Fig. III-12)



COOLING SYSTEM

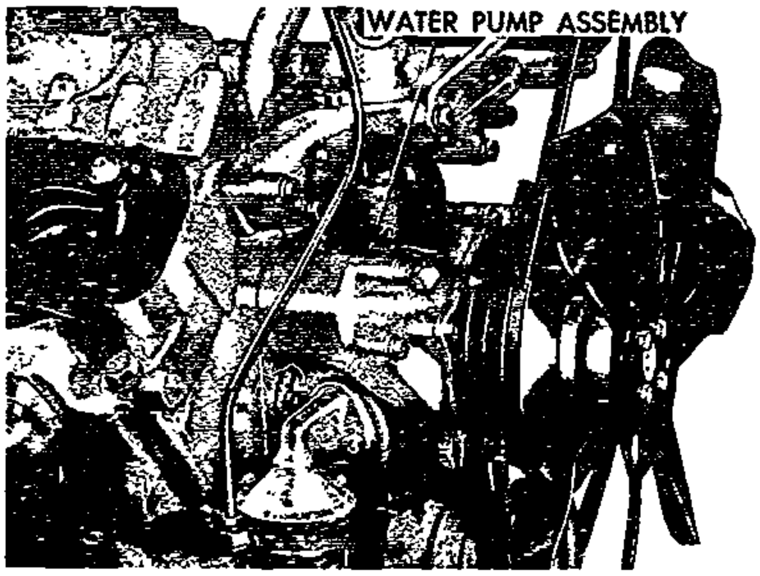
FIG. III-12

Merely placing water into the water jacket of the engine is not enough to cool the motor as it runs. More water is required, plus circulation by which the hot water leaves the engine, is cooled off, and then re-enters the engine

The RADIATOR, which is the heart of the cooling system, serves two purposes. It is a reservoir for more water and is the means for cooling off the hot water as it comes from the engine. Generally the radiator is made of brass and copper and made up of the upper and lower tank and a series of tubes and fins.

RADIATOR

FIG. III-13



WATER PUMP AND FAN ASSEMBLY

FIG. . I-14

The WATER PUMP is the part that circulates the water through the cooling system. Mounted on the shaft of the water pump is the FAN BLADE ASSEMBLY (Fig. III-14) which is driven by the engine by means of the fan belt. The blades are bent, so that as it runs, it draws air through the radiator, cooling off the water which is being pumped through the tubes of the radiator. The cooled water is then pumped back into the water jacket of the engine which thereby can maintain an even temperature and overheating is prevented. The HOSES are used to carry the water from the engine to the radiator and back again.

The cooling system must always be tight. By this we mean that it must not have any leaks, for if the water is lost, the motor will overheat. In the winter when temperatures drop to freezing, it is necessary to place into the cooling system a material which will not freeze. This is called anti-freeze. Consult the charts which give you the correct amount of anti-freeze to be added to the different size cooling systems. To drain the cooling system you will need the following:

drain pan
pliers
extension light

Place the drain pan on the floor under the radiator.

ALWAYS BE CAREFUL WHEN THE MOTOR IS HOT. Most cooling system are under pressure. To release this pressure, first VERY SLOWLY loosen the radiator filler cap. STAND BACK, so that if the pressure blows the cap off, you will not be burned. With the cap removed, loosen the petcock, which is found at the bottom of the radiator, by turning it to the left. To determine right and left, picture yourself in the driver's seat. Use the pliers to loosen the winged part of the petcock. After the water has been drained, close the petcock by turning it to the right and tightening it slightly with the pliers. Do not tighten it too much for the petcock can be broken.

CAUTION: Always check to see if you have drained out plain water or anti-freeze. If it is plain water, always replace it with fresh water. If it is anti-freeze, find out if it is to be put back or replaced with new solution.

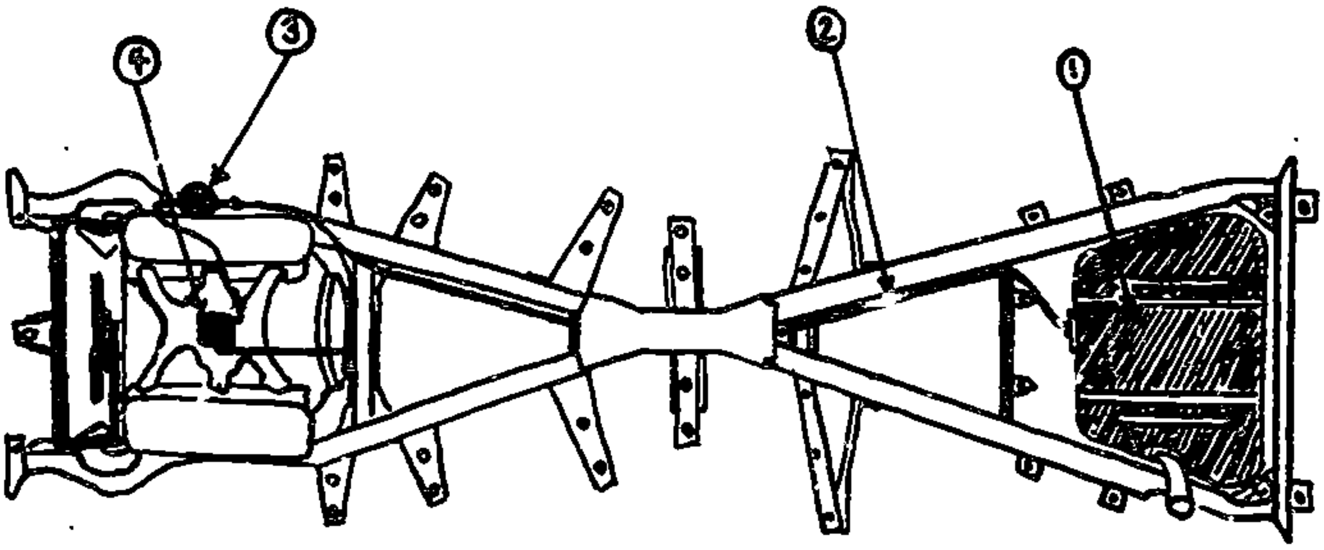
ASSIGNMENT:

1. Name the major parts of the cooling system.
2. How is the water pump operated? What does it do?
3. What is the radiator for?
4. What is the radiator made of? Why?
5. Why must we have a cooling system?
6. How does the fan help to cool the water?
7. What must be true about a cooling system?
8. Demonstrate to your instructor the way you would drain the cooling system.
9. There are some underlined words in the lesson. Find them and give their meanings. Use each of these words in a sentence.

OBJECTIVES: To learn the main parts of the fuel system.
To learn how they function.
To learn how to drain the gas tank.

INFORMATION:

We all know that the automobile is powered by the gasoline engine. Just how is the gasoline stored, and how does it get into the motor? First let us look at the picture and locate the parts and identify them. (Fig. III-15)



FUEL SYSTEM

FIG. III-15

The gasoline is stored in the GAS TANK (1) which is located under the floor of the trunk (for cars with front engines). From the tank there is the FUEL LINE (2) which carries the gas to the FUEL PUMP (3), which is located on the side of the motor. The motor drives the fuel pump and creates a suction which draws the gas from the tank. The gas is taken from the fuel pump by another fuel line and is directed into the CARBURETOR (4) which in turn feeds it to the engine as it is needed.

One of the most important things about the fuel system is that it must not leak. Any leaks which may develop must be repaired immediately.

To drain the gas tank we will need the following tools:

drain pan
set of open end wrenches

The instructor will have the car placed on a hydraulic lift and raise it to its proper height. On the bottom of the gas tank you will notice a plug. Some plugs are in the center while others are in one corner toward the front of the car. Place the drain pan under the plug and remove the plug carefully. Allow the gas to drain completely into the pan. Remove the gas cap from the filler neck so that air can enter the tank to help the gas drain out more quickly. (CAUTION: Be sure windows are open for ventilation to remove some of the fumes as the gas is being drained. Check with the instructor as to the place to store the gas.) Generally gasoline is not stored in the shop because of the fire hazard. The can should be covered and placed outside the shop in a cool place until needed.

To refill the tank, replace the plug and tighten securely. Pour the gas back into the tank through the filler neck. AGAIN, whenever working with gasoline, always make sure that windows are open for ventilation.

ASSIGNMENT:

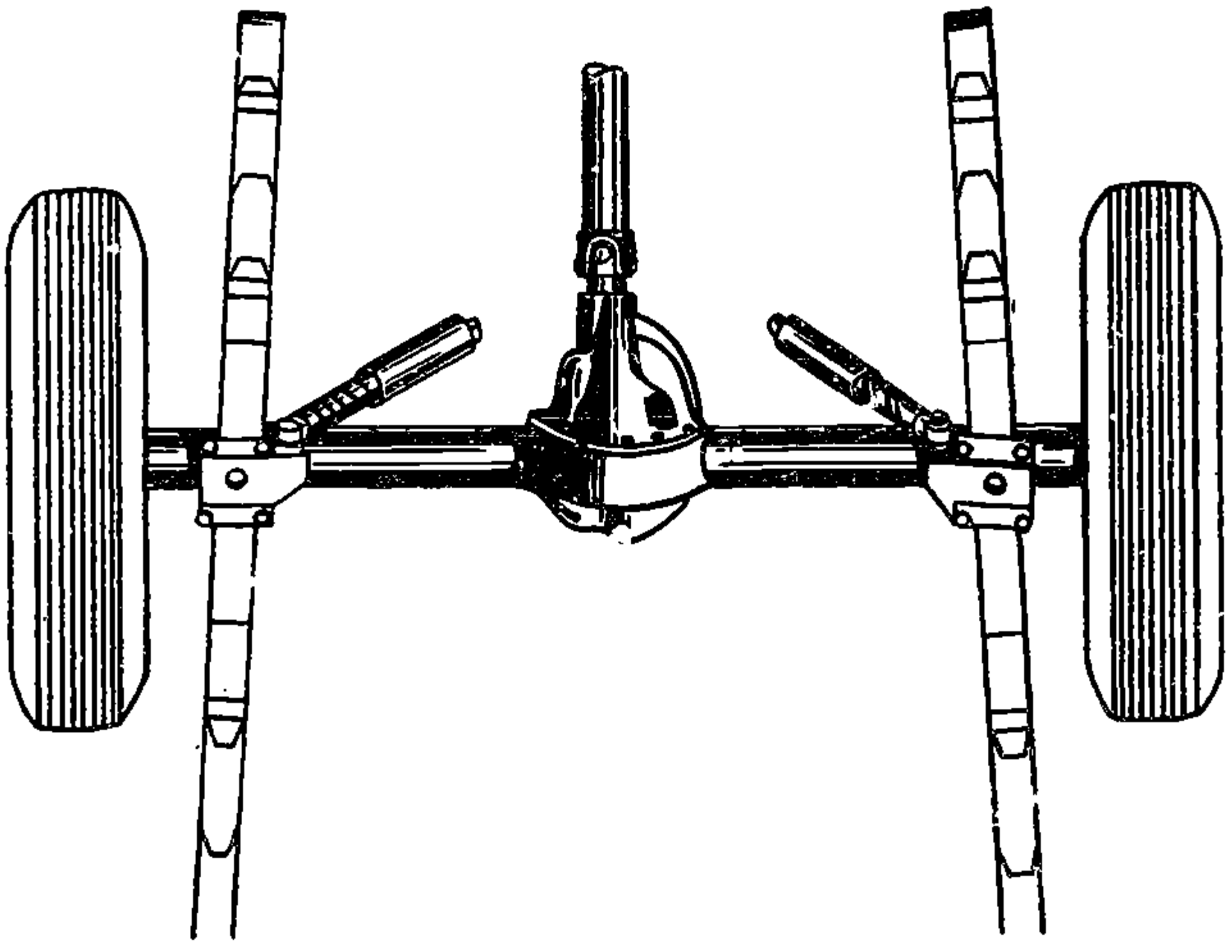
1. Where is the gasoline stored?
2. Which part takes the gas out of the tank? How?
3. How is the gasoline fed into the engine?
4. What connects the major parts of the fuel system together?
5. Are all gas tanks located in the back of the car?
6. Demonstrate to the instructor how you would drain the tank. What tools are required? What safety precautions must be taken while draining and after the tank is emptied?
7. There are some underlined words in the lesson. Find them and give their meanings. Use each of these words in a sentence.

OBJECTIVES: To become familiar with the different types of suspension systems.
To learn some of the basic parts and their function.

INFORMATION:

As a boy you must have played with a wagon the wheels and axle of which were fastened directly to the body. Perhaps you will remember that it rode very rough and inside, all the bumps could be felt. Another feature of the wagon that you probably recall was that it tipped over very easily when it hit a bad bump or was turned too sharply.

The original horse-drawn wagons were built much the same as the toy wagons. As horse-drawn carriages developed, springs were placed between the axle and the body to help make rides smoother and cut down on the chance of upsetting. As the automobile was introduced, the same principles carried through with regard to the suspension. The most conventional type of suspension uses the leaf spring. (Fig. III-16)

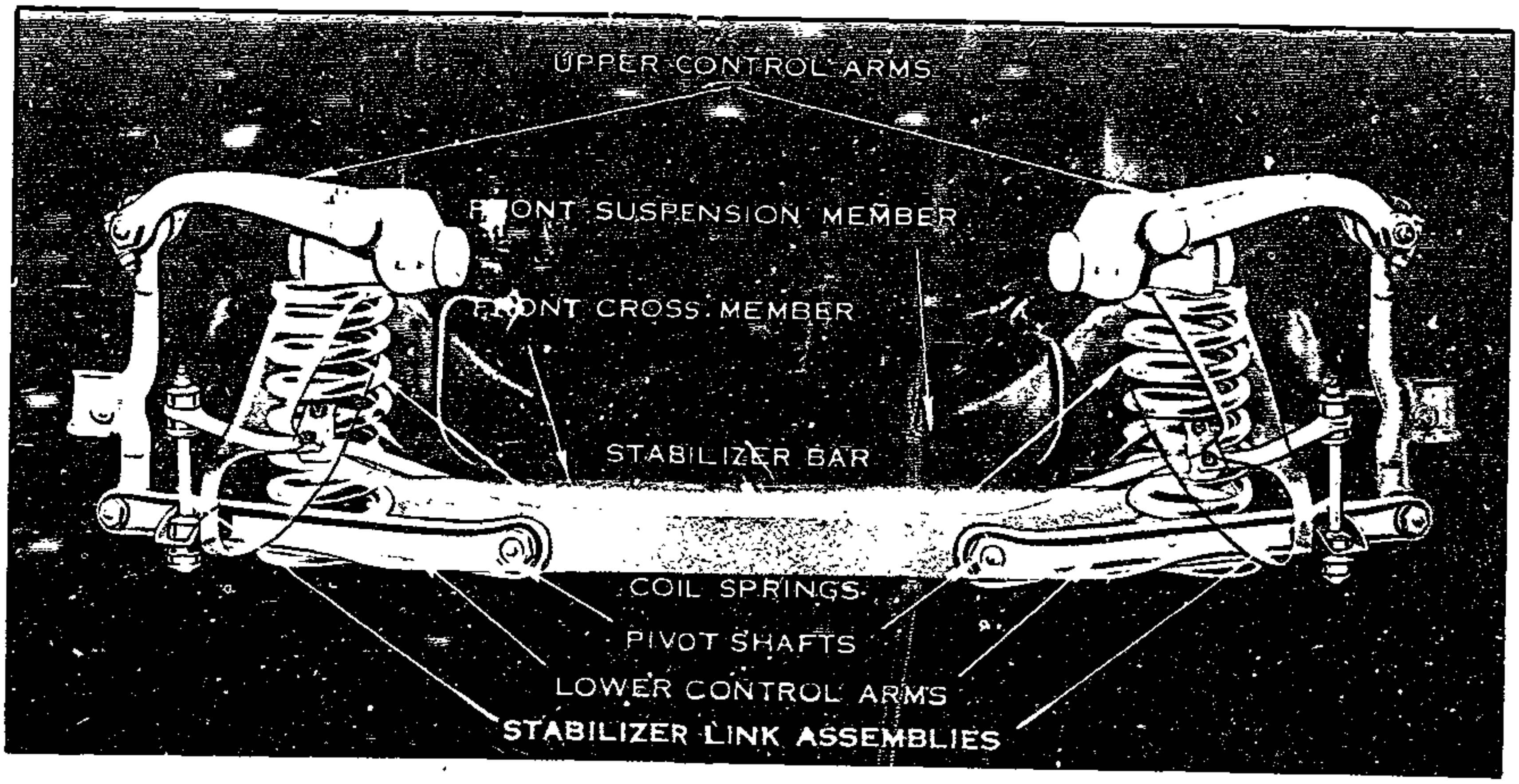


LEAF SPRING

FIG. III-16

The leaf spring system has been with us for many years; some cars still use it.

As the automobile companies looked for ways to improve the suspension system so that a smoother ride could be accomplished, they developed what is known as the knee action or coil spring suspension. (Fig. III-17)

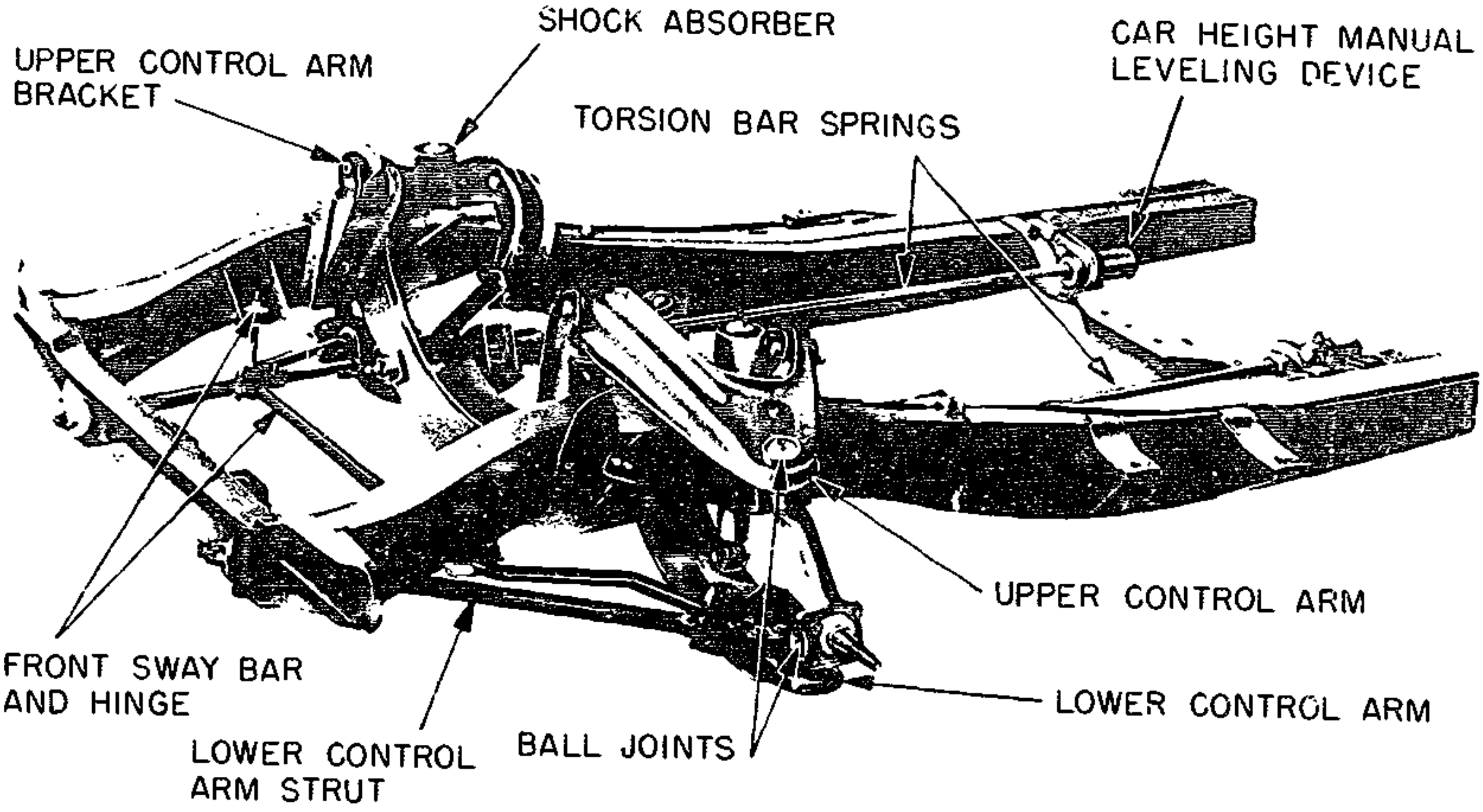


COIL SPRING

FIG. III-17

This system, instead of using the leaf spring, makes use of the coil spring. Most American autos today use the coil spring system because of the smoother ride it affords. Some cars use coil springs in the front and leaf springs in the rear.

The latest change in the suspension system is the elimination of the coil spring and the introduction of the torsion bar type of spring. (Fig. III-18)



TORSION BAR

FIG. III-18

Regardless of the type of suspension system used, all must have other parts such as shock absorbers, stabilizers, and bushings.

The shock absorbers help to prevent bounce. The stabilizer keeps the car from leaning to one side, especially when making turns. The bushings are used at pivot points where one section is fastened to another and motion takes place. Bushings are made so that they can be replaced as they become worn.

ASSIGNMENT:

1. What type of suspension system did the original wagons use?
2. What is the most conventional type of spring?
3. Name two other types of springs used on autos today.
4. Is the shock absorber necessary? Why?
5. What is the purpose of the stabilizer?
6. Why is the suspension system important?
7. There are some underlined words in the lesson. Find them and give their meanings. Use each of these words in a sentence.

Bolts, Nuts and Fasteners

Lesson 6

OBJECTIVE: To become familiar with the different types of fastening devices available.

INFORMATION:

You can see that the automobile is not made of one piece. It is made up of thousands of separate parts, that are put together or assembled. One of the major problems faced by the auto manufacturer is determining the way the various parts are fastened together. The company must keep in mind that its fasteners must be strong, economical to buy or produce and must be easy to install so that time is saved in production. The earliest cars used the bolt and nut method of fastening parts together. (Fig. III-19) This was very good because it was strong and long lasting.

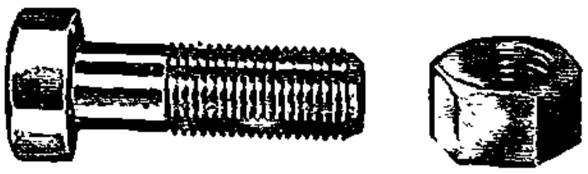


FIG. III-19

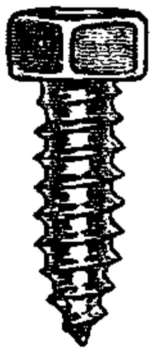


FIG. III-20

In certain places where the nut could not be reached, the nut was clamped inside the body. As the cars changed their shape and design, it became difficult to use bolts and nuts in certain places. Also the auto producers were looking for ways by which the cars could be assembled more quickly and easily. One variation of the bolt and nut method was the metal screw (Fig. III-20). This method eliminated the need for the nut as this screw was self tapping and could be screwed through a piece of metal with a hole in it. It was found, however, that when these screws were taken out and replaced they would not hold well. A clip of spring steel was then developed. The metal screw goes through the two pieces to be fastened and into the spring clip. This method has proved very effective and is used widely today.

In the early days there was very little chrome trim on the car. As the chrome was added, there had to be found ways of fastening these parts to the car. The "T" bolt is the most common of these. (Fig III-21) This bolt is inserted in the moulding or trim and the nut is placed on the underside where it does not show. Where it was difficult to put a nut, a spring was developed which could be snapped into place. (Fig. III-22)

"T" BOLTS

FIG. III-21

SPRING CLIP

FIG. III-22

There is now a great variety of clips and fastening devices in use in the automotive field. Each year as the mouldings and trim are changed, new clips are developed to suit the needs of production. Each company uses the type which it feels is best for the purpose, so there is no universal type of fastening device. Pictured are some of the different types of clips and devices for holding things together. Familiarize yourself with them. (Fig. III-23)

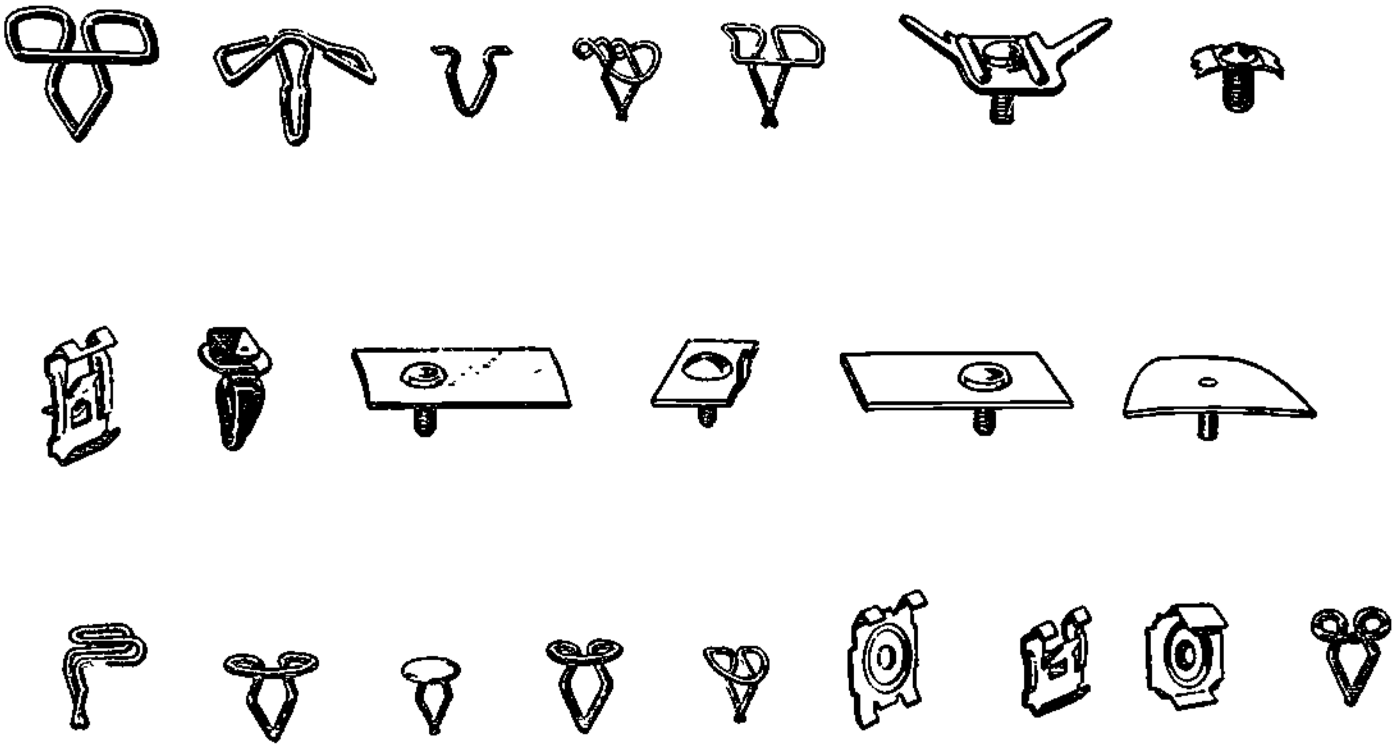


FIG. III-23

ASSIGNMENT:

1. Why are bolts, nuts, and clips important?

2. What are the most common ways of holding two things together?

3. What is a metal screw? How does it differ from a bolt?

4. What are clips generally made of?

5. There are some underlined words in the lesson. Find them and give their meanings. Use each of these words in a sentence.

UNIT III - MATERIALS AND PARTS OF THE AUTOMOBILE

Materials in an Automobile (Non-Metal) Lesson 7

OBJECTIVES: To learn about the various products that go into the automobile.
To learn where such products are used.

INFORMATION:

When thinking about automobiles, people generally think in terms of metals such as steel, aluminum, copper, brass, lead, white metal and their related alloys, but actually an automobile is made up of a combination of many products which contribute to the American economy.

The modern auto includes such items as: glass, plastics, rubber, felt, upholstery fabrics (wool, cotton, nylon), leather, leatherette, asbestos, insulating materials such as rockwool or spun glass, tar, ceramics, adhesives, greases and oils, and paints. It may seem unbelievable to have so many things in one automobile, but let us look at some of the parts of the car carefully.

Very evident of course is the glass in the windows. However, glass is also used in lights for bulbs and lenses, and covers for instruments.

Plastics are used more and more. For example, trim on the instrument panel, steering wheel, lenses on some lights are plastics, as are parts of door locks and on some cars the whole body, although this is still mostly experimental.

Rubber is widely used on the automobile. There are tires, radiator hoses, fuel and hydraulic hoses, weatherstripping, floor mats, rubber bumpers on the body between the doors, and rubber shackles in the suspension system. These are only a few uses.

The upholstery on the car is made up of various types of cloth or material such as wool, nylon, cotton, leather, leatherette, and felt. Felt is also used in the window channels to guide the glass.

The brake linings are made of a composition consisting mainly of asbestos. Asbestos is also used in the making of engine gaskets and insulation in the firewall. Insulators of rock wool and spun glass are used under the turret tops and hood and firewall to keep the heat out of the car. Tar is used as a protective coating and sound deadener throughout the entire car.

Ceramics are found in the spark plugs, and electric switches and controls. Adhesives are used to hold many things such as weatherstripping and upholstery, in place.

The motor, transmission, rear, and steering column use grease and oil for lubrication purposes, and of course, the car cannot run without gasoline. The finish on the car is a result of paint and its various products.

No doubt you will find many more places where these basic materials are used on the car. It is interesting to see how many people are employed because of the American automobile.

ASSIGNMENT:

1. List the basic materials that were covered and under each one list as many items as you can think of that use this basic material.

2. Can you think of reasons why each of these is used? Discuss this with your teacher.

3. There are some underlined words in the lesson. Find them and give their meanings. Use each of these words in a sentence.

UNIT III - MATERIALS AND PARTS OF THE AUTOMOBILE

ACHIEVEMENT TEST

1. Name three basic metals used in an automobile.

2. Name as many exterior parts of the car as you can.

3. Name as many interior parts of the car as you can.

4. Why does a car have a cooling system?

5. Name three parts of the fuel system.

6. What is the suspension system? Name the main part of the suspension system.

7. Name as many different types of fasteners as you can.

8. Name five basic non-metal products used in an automobile.

9. List five new words that you have learned in this unit. Use each one in a sentence.

UNIT IV - REMOVAL AND ASSEMBLY

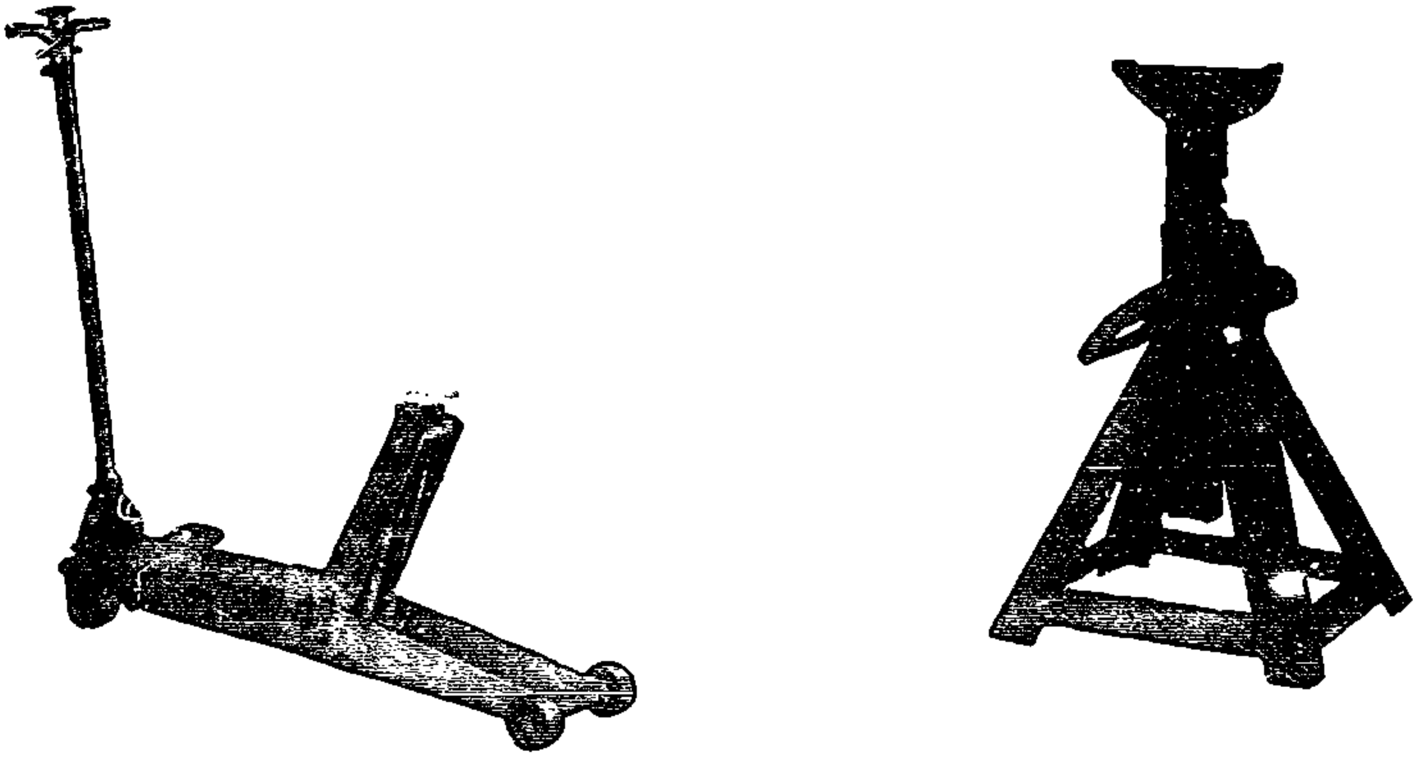
Wheels Lesson 1

OBJECTIVES: To learn how to remove and replace wheels.
To learn what precautions must be taken in doing this job.

INFORMATION:

The removal and replacement of wheels is one of the basic jobs in the body shop. It is not difficult, yet the safety of the passengers in the car depends upon the person who does this job. Care must be used, because there are dangers if safety procedures are not followed in any work on wheels.

EQUIPMENT: Hydraulic jack, lug wrench, standing jacks, and a screwdriver (Fig. IV-1)



HYDRAULIC JACK STANDING JACK

FIG. IV-1

PROCEDURE:

Begin with the rear wheel. Roll the hudraulic jack under the rear of the car and center it under the differential housing. (Fig. IV-2)

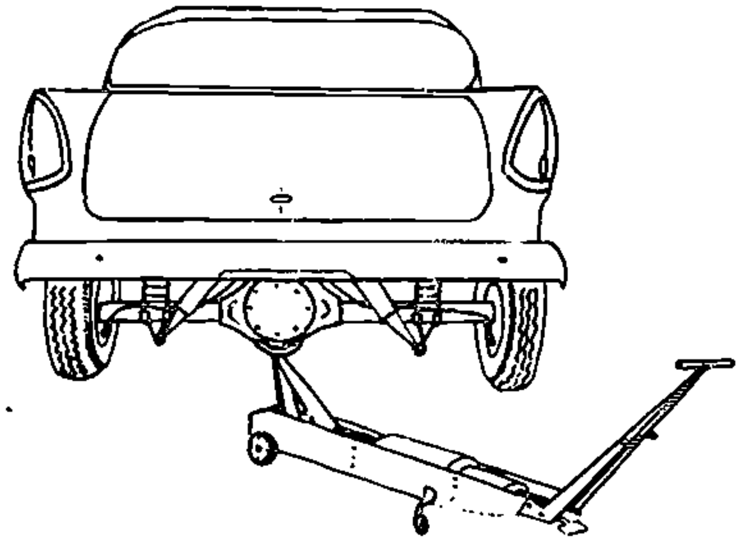


FIG. IV-2

Raise the car by pumping the handle of the jack up and down. To prevent the car from slipping off the hydraulic jack you must now place standing jacks under the housing. (Fig. IV-3)

Adjust the jack so that when the weight is lowered the wheel does not touch the floor.

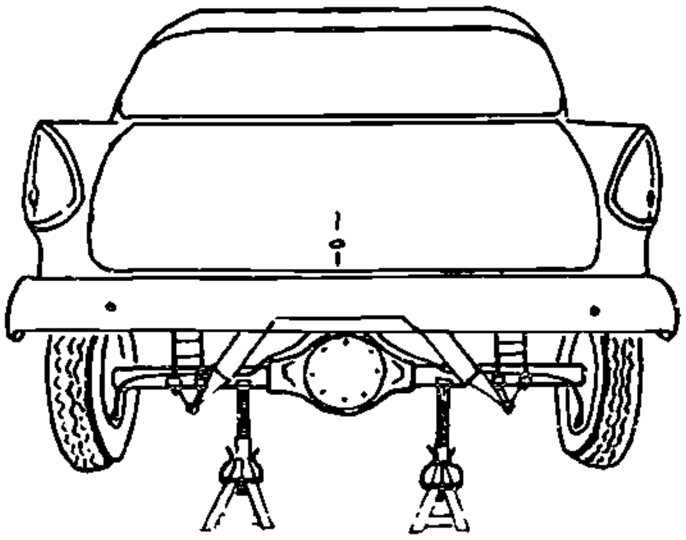


FIG. IV-3

Slowly lower the hydraulic jack so that the rear housing will rest on the jack stand. Next look at the wheel and see if the wheel will clear the fender or the quarter panel. If the quarter panel has a large overhang, then the standing jack must be moved to the chassis just forward of the rear wheel. (Fig. IV-4)

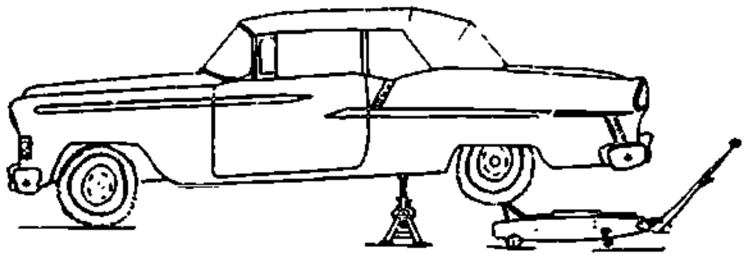
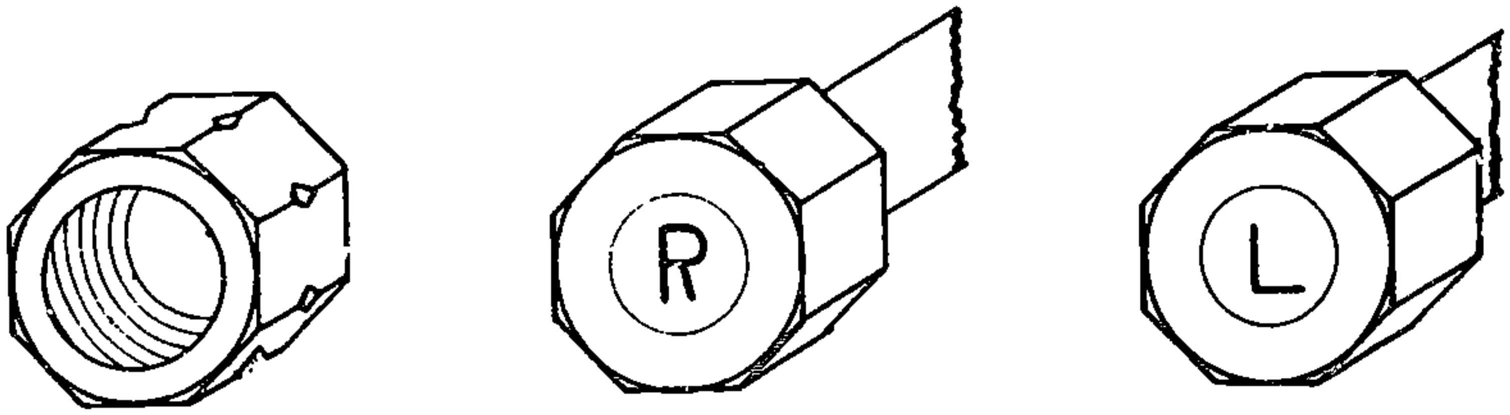


FIG. IV-4

With the screwdriver remove the hubcap or wheelcover. With the lug wrench loosen all the lugs, then remove them. You must look at the lug very carefully to determine which way to turn it. If there are no marks or letters of any kind, then it it counter-clockwise (this is called right-handed thread). If there are small notches on the side of the nut, then turn the nut clock-wise (this is called left-handed thread). (Fig. IV-5) Certain cars have the letters "L" or "R" stamped on the lugs. (Fig. IV-5) The letter means left or right-handed thread. REMEMBER, when we speak of left and right-handed thread we mean the way it is turned to tighten it. therefore to remove the lug reverse this direction.



NOTCHED NUT

LUG
"R"

LUG
"L"

FIG. IV-5

After all the nuts or lugs have been removed, lift the wheel off the car and put it in a safe place.

To replace the wheel, merely lift the wheel into place and replace the nuts or lugs and tighten them evenly, a little at a time until they are all equally tight. Replace the wheel cover by pushing it into place, but make sure that the valve stem is centered.

Finally, raise the hydraulic jack, remove the standing jacks, and lower the car to the floor.

To remove the front wheels, follow the same procedure, but be sure that when you put the hydraulic jack into place, you raise the car by either the coil spring or the center of the cross frame. NEVER ALLOW THE JACK TO COME IN CONTACT WITH THE MOTOR, RADIATOR OR TIE RODS. If you do, this could cause a great deal of damage to the car. The standing jack can be placed under the coil spring or the chassis, whichever seems to be better.

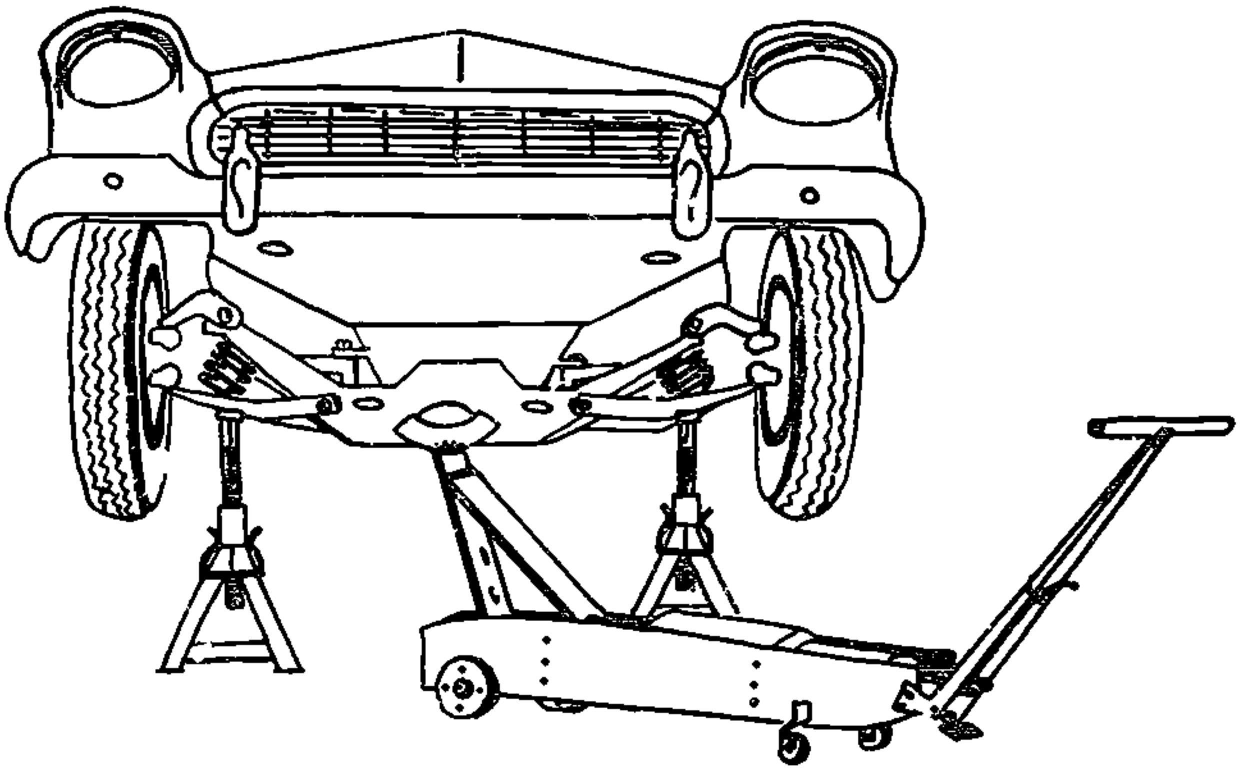


FIG. IV-6

ASSIGNMENT:

1. When raising the rear of the car, where is the best place to position the hydraulic jack?

2. Why must standing jacks be used at all times?

3. If the quarter panel has a large overhang, where should the standing jack be placed?

4. Name the threads of the following nuts and lugs.

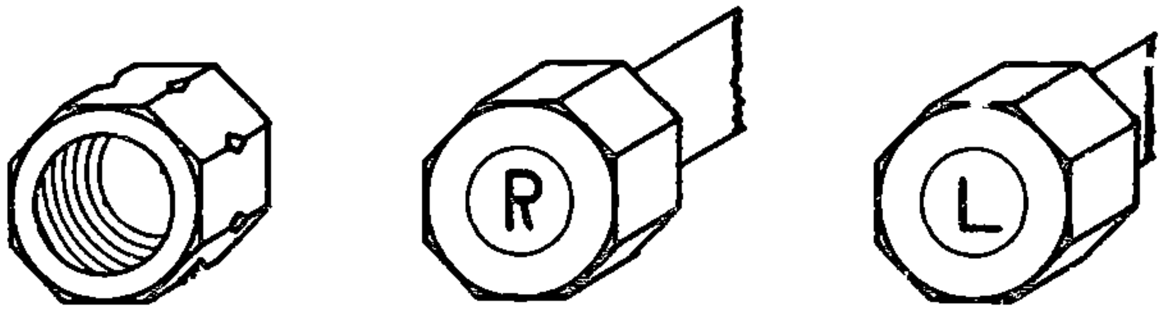


FIG. IV-6A

5. When we say right-handed thread, what do we mean?

6. Demonstrate to the instructor how you would remove and replace a wheel.

7. There are some underlined words in the lesson. Find them and give their meanings. Use each of these words in a sentence.

UNIT IV - REMOVAL AND ASSEMBLY

Seats (Front) Lesson 2

OBJECTIVE: To learn the correct procedure in the removal of the front seat and back rest.

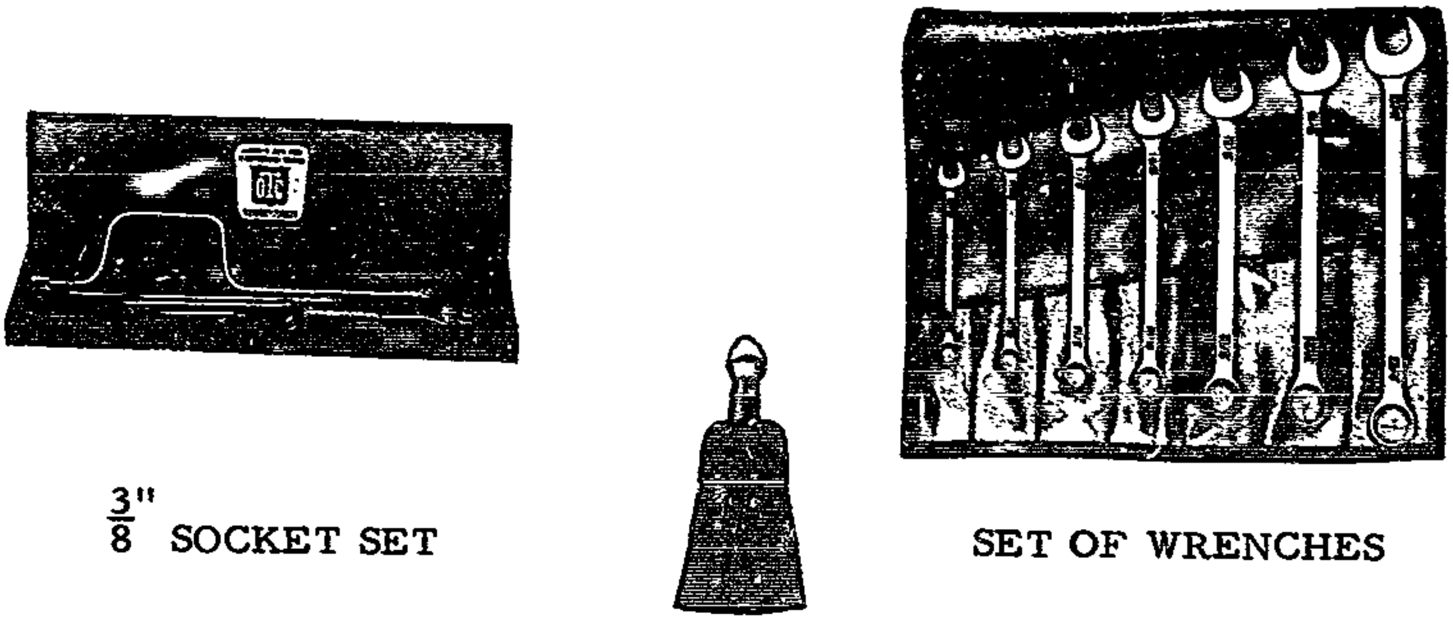
INFORMATION:

As you begin your work on automobiles you will notice that for each car you may need to have a different method of assembling parts. Basically, they all use the same principles, but they may vary in types of clips or fasteners used, and their location. The best rule to remember is always to note the way that something comes apart, and usually it can be reassembled in the opposite order.

The front seat assembly is a movable unit. All front seats move back and forth, some even move up and down. To permit this, the seat is fastened to a track which is fastened to the floor.

TOOLS AND EQUIPMENT:

$\frac{3}{8}$" socket set, set of wrenches, screwdriver, extension light, and a whisk broom. (Fig. IV-7)



$\frac{3}{8}$" SOCKET SET

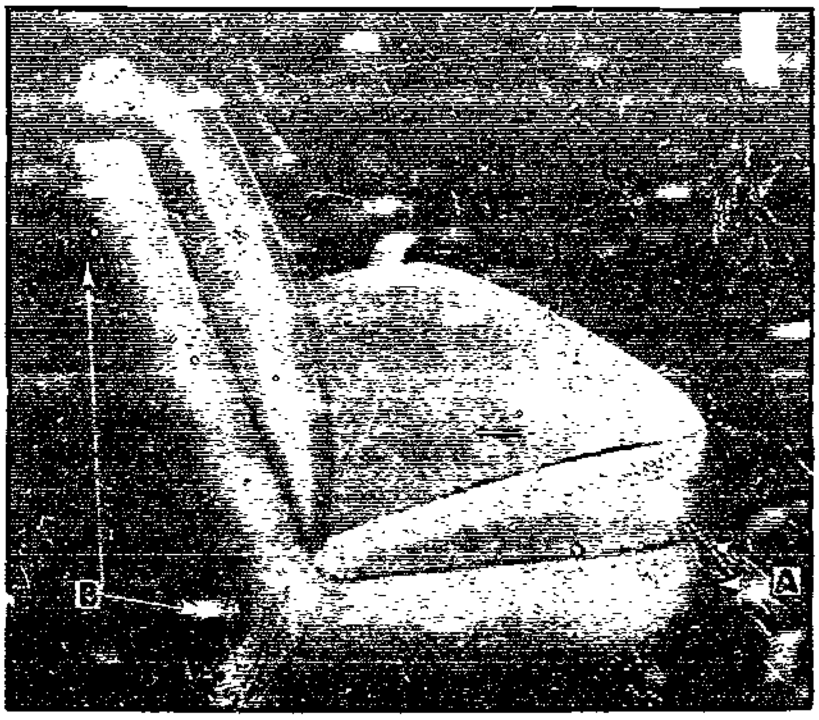
WHISK BROOM

SET OF WRENCHES

FIG. IV-7

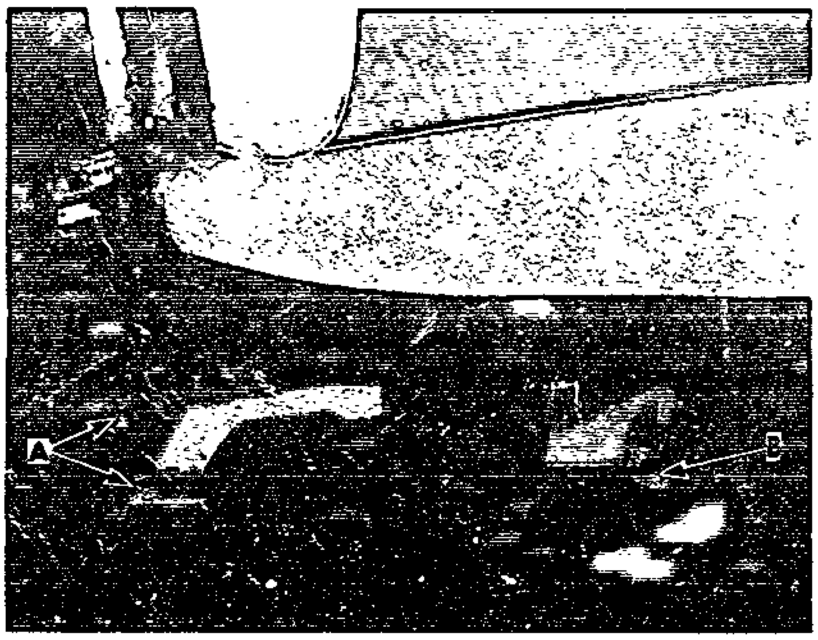
PROCEDURE:

All seat tracks are fastened to the floor by bolts. If you cannot reach them, then the trim cover on the side of the seat must be removed first. (Fig. IV-8) You will see chrome screws which must be removed with a screwdriver. Now the bolts that hold the seat track to the floor are visible. (Fig. IV-9)



SEAT ASSEMBLY

FIG. IV-8



ASSEMBLY WITH SIDE REMOVED

FIG. IV-9

Remove these bolts on both sides, being sure to place the parts into the can that you have provided. (Approximately four bolts on each side.)

The seat is now ready to be lifted out of the car. DO NOT TRY TO DO THIS BY YOURSELF. Front seats are heavy and two people are needed to lift them out of the car. Place the seat in a safe place and cover it with a clean cloth to protect it against soiling.

To replace the seat assembly, follow the same procedure in reverse. Place the seat in the car, replace the bolts in the floor, and replace the side trim panels. BE SURE TO TIGHTEN ALL BOLTS SECURELY.

On some older cars, the front seat cushion can be lifted out by raising the front and pulling forward. You will then see the bolts that hold the seat track to the floor.

ASSIGNMENT:

1. What allows the front seats to move?

2. Where do you place all bolts and screws?

3. When you cannot reach the bolts that hold the track to the floor, what must you do?

4. What do you do with the seats after they are taken out of the car?

5. Demonstrate to the instructor the proper way to remove the front seat.

6. There are some underlined words in the lesson. Find them and give their meanings. Use each of these words in a sentence.

Seats (Rear) **Lesson 3**

OBJECTIVE: To learn the correct procedure in the removal and assembly of rear seats.

INFORMATION:

The rear seat and back rest differs from the front in the way it is fastened to the body because it is in a fixed position and is not adjustable as is the front seat.

TOOLS AND EQUIPMENT:

Screwdriver, socket set (¼"), extension light, and a whisk broom

PROCEDURE:

Place your fingers under the front of the rear seat cushion. Raise it up and pull forward slightly. Remove the cushion from the car and put it in a safe place. (Fig. IV-11)

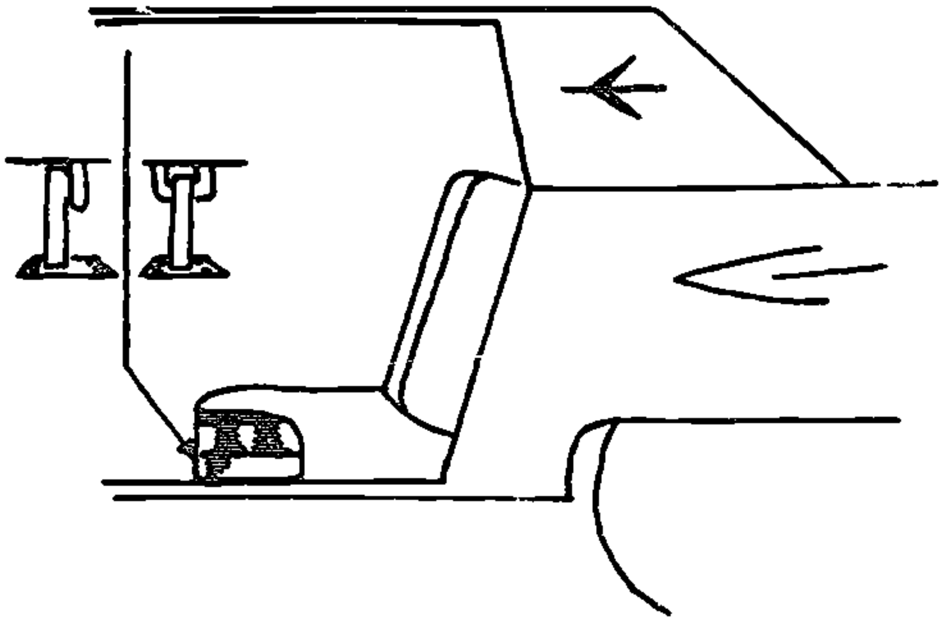


FIG. IV-11

Next look under the back rest with the extension light and you will see two little tabs hanging down from the back rest. Some cars have a bolt or screw holding the tabs to the body, while others have a piece of metal bent over. Remove the screws or straighten the metal that is bent over. Place your fingers under the bottom of the back rest and slowly pull forward, then raise the entire back rest off the hooks that are located at the top of the back rest. (Fig. IV-12) Remove the back rest from the car and store with the seat. BE SURE TO COVER THE SEAT WITH A CLEAN CLOTH.

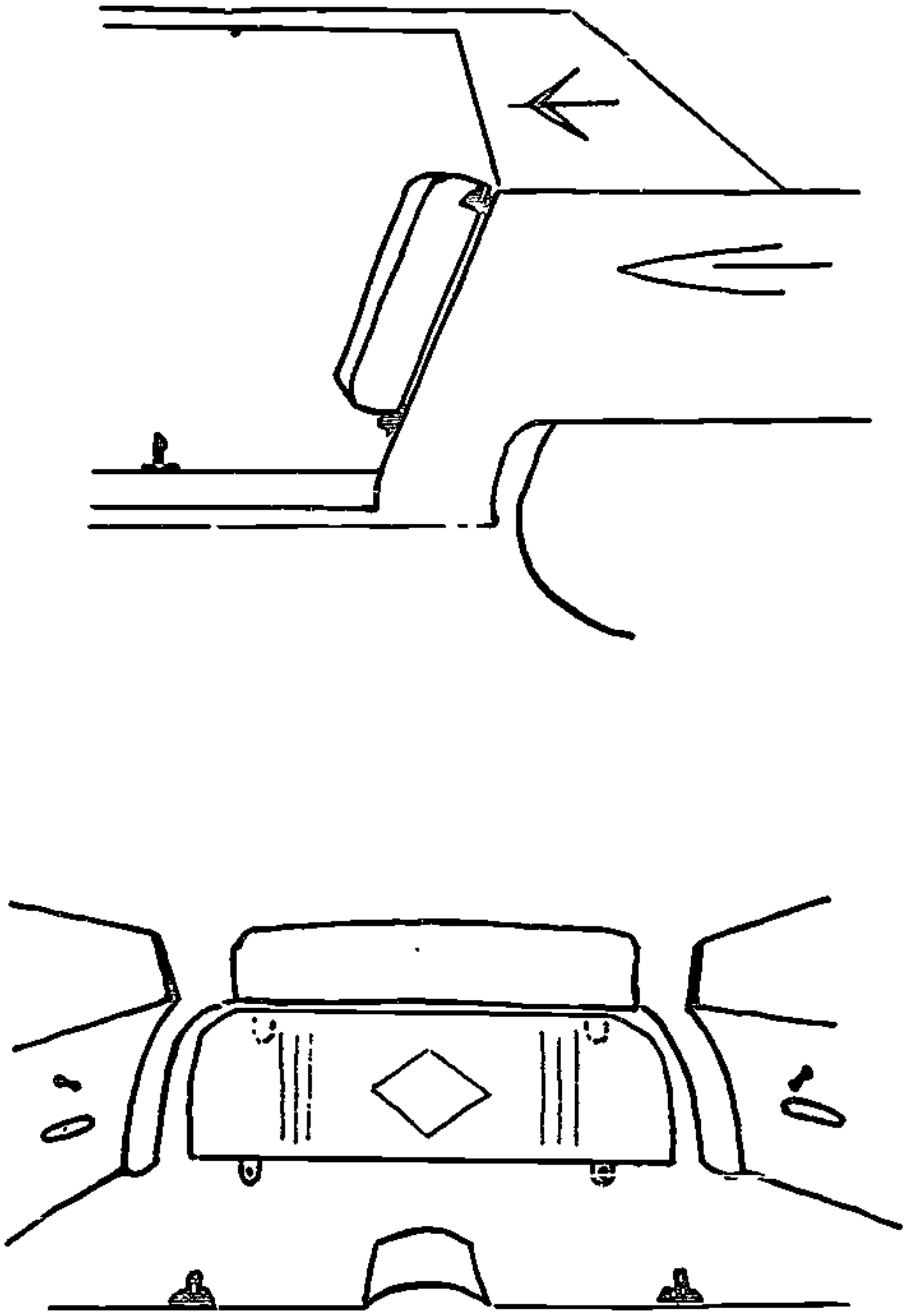


FIG. IV-12

To replace the rear seat, begin with the back rest and place it in the car. Hook the top of the back rest on the hooks that you will see on the body and <u>gradually</u> push the back rest into place. (Be sure the hooks are caught.)

Replace the screws or bend over the metal tabs that hang down from the back rest. Now place the rear seat cushion into place by pushing towards the back. Then raise it slightly and make sure it is caught on the small brackets that stand up from the floor.

When you have finished, use a whisk broom and clean out the rear seat area.

ASSIGNMENT:

1. What is the main difference between the front and back seats?
2. Why is the rear seat fastened in a different manner from the front seat?
3. What prevents the rear seat cushion from moving forward?
4. What prevents the top of the back rest from falling forward?
5. Show how you would remove the rear seat cushion and back rest from the car.
6. There are some underlined words in the lesson. Find them and give their meanings. Use each of these words in a sentence.

Upholstery Panels

Lesson 4

OBJECTIVE: To learn how to remove and replace upholstery trim panels.

INFORMATION:

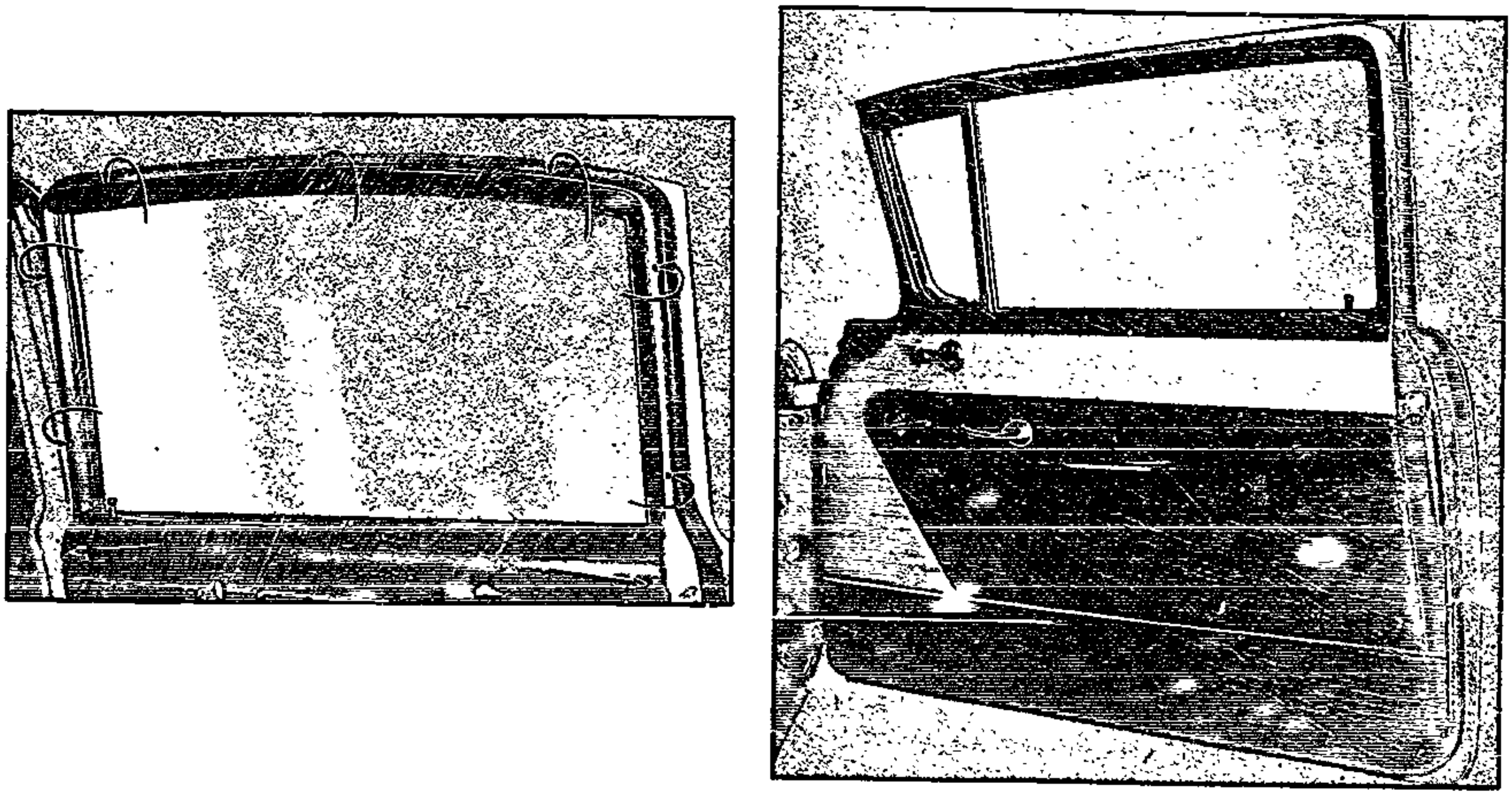
Whenever you begin to work with upholstery of any kind, remember that it was put there to make the inside of the car more attractive. CLEAN HANDS are one of the most important things to remember. Even though your hands may look clean, wash them before you begin. In this way you will be sure that the upholstery will not become soiled. There are many special tools that are available for use in trim work in order to simplify the operation. However, we will start with the basic ones and others will be introduced as needed.

TOOLS AND EQUIPMENT:

Small and medium screwdrivers (straight and Phillips head), mallet, door handle removing tool, pick or awl, and a whisk broom

PROCEDURE:

Begin by removing the screws that hold the garnish moulding in place. There are two types, one has screws through the face of the moulding, the other has the screw head coming through the door jamb. (Fig. IV-13)



TWO TYPES OF GARNISH MOULDINGS

FIG. IV-13

Look under the arm rest, if there is one. You will notice two screws which hold it in place. (If none are visible, then the arm rest is built into the trim panel.) Remove the two screws and place the screws and arm rest in a clean container.

Door handles are fastened in several ways. When removing the door handles, we must remember that there are two spring types and one that uses a pin. All General Motors cars and most Ford products use a horseshoe clip. (Fig. IV-14) Chrysler Corporation cars use another type of spring which requires a special tool. (Fig. IV-15) Whenever you use tools of this type remember that great force is not necessary. You must feel your way along. Some of the older cars have a straight pin through the handle, which is pushed out with a pin pick.

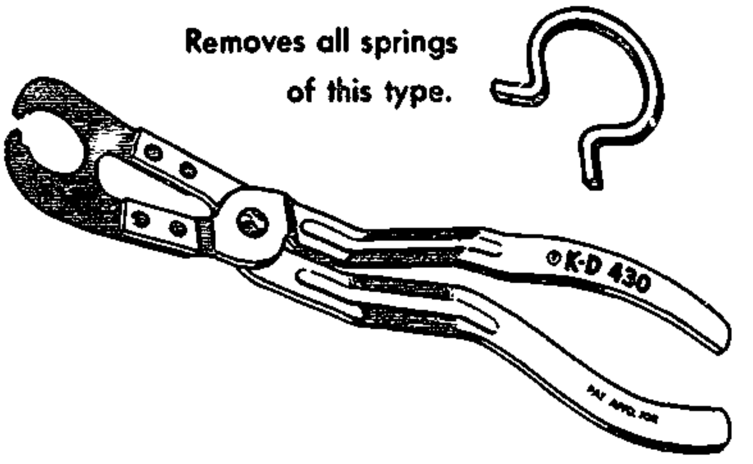


FIG. IV-14

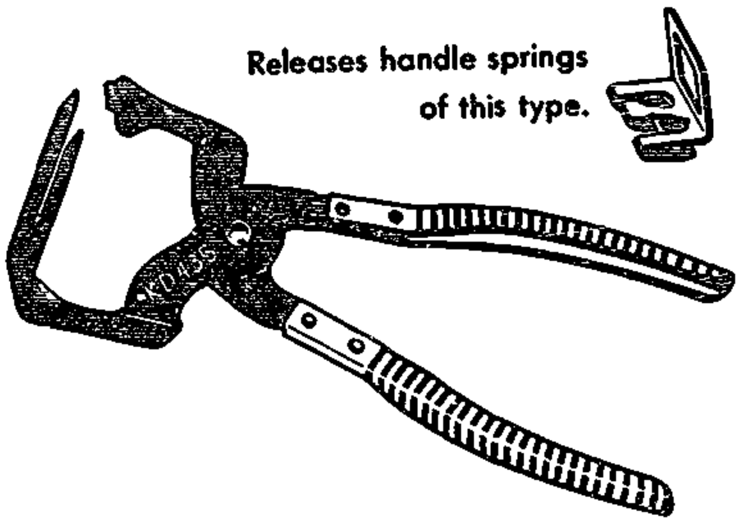


FIG. IV-15

TWO TYPES OF SPRING REMOVING TOOLS

Next, look for screws in the face of the trim panel, and remove any which are visible. Observe the length of the screws as you remove them. Some are made shorter to prevent glass breakage.

Insert a medium sized screwdriver or other tool with a wide face between the trim panel and the door shell. Gently pry the panel away from the door (keep the tool as close to the nail or clip as possible to prevent tearing it away from the trim panel). Pry on both sides, but not on the bottom, because some cars have a metal guide instead of clips or nails. Pull the panel slightly away from the door to check this. If it is the guide type, then merely raise the trim panel to unhook it; if it does have clips, then use your tool to release them. As the trim panel is removed, look for springs that may be under the handles. Be sure to PLACE ALL THE PARTS IN A CONTAINER. Store the trim panel in a safe place and cover it with a clean cloth to prevent soiling.

To replace the trim panel, first bring all the parts to the job and lay them out on a clean flat surface. Try to identify each part and its location. If you have forgotten, you can check yourself by looking at the door panel and locating the parts in this manner. Particularly with regard to screws, you can count the holes in the door and observe the size, thereby identifying the hole in which each belongs. Be sure that you know where all the parts belong before you begin the job. When replacing the trim panel, use a mallet to tap the clips back into place, using care not to break them. Next replace the handles by inserting the springs into the handle and pushing them into place. Follow this with the arm rest and the garnish moulding, making sure that no screws are left out.

ASSIGNMENT:

1. What is the purpose of the upholstery?
2. What must be done before starting a job with upholstery?
3. What must be done with the parts as they are removed?
4. How would you find out if the bottom of the trim panel has a metal guide or clips?
5. Demonstrate the proper way of removing the trim panel.
6. There are some underlined words in the lesson. Find them and give their meanings. Use each of these words in a sentence.

Bumpers (Front and Rear) Lesson 5

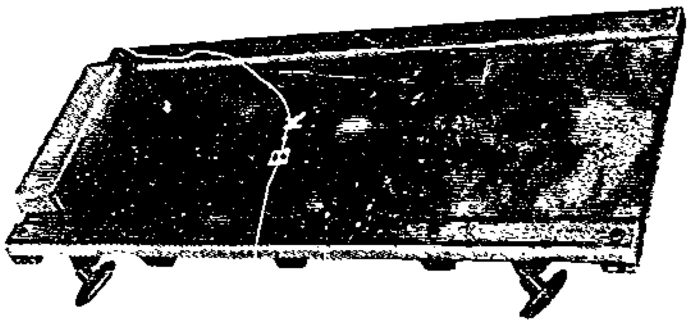
OBJECTIVE: To learn how to remove the bumper from the car in one unit.

INFORMATION:

On most cars you will find that to remove the bumper <u>assembly</u> you must work from underneath the car. To do this, follow the same procedure as used when removing wheels. Raise the car with the hydraulic jack, place the jack stands into position, and lower the car on the stands. Have the stands adjusted so that the car is high enough for you to slide under with a creeper. If a hoist is <u>available</u>, then you can work standing up. DO NOT operate the hoist until you have been instructed in its use.

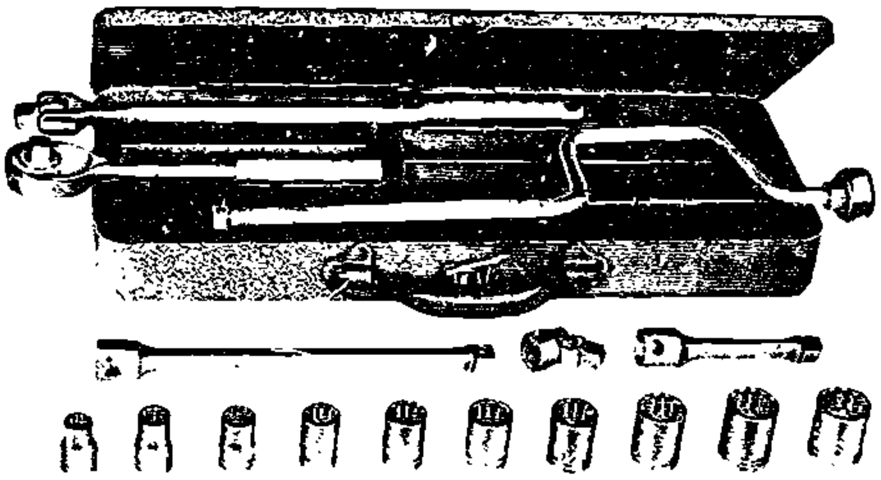
TOOLS AND EQUIPMENT:

Floor jack and stands, extension light, set of ½" drive sockets, set of wrenches, creeper and a can of penetrating oil



CREEPER

FIG. IV-16



½" DRIVE SOCKETS

FIG. IV-17

The first thing you must do when using the creeper, is to look under the car and examine it carefully for bolts that hold the bumper to the car. Do not lie on the floor. Always use a creeper as it protects your clothes and keeps your body off the damp floor. The best way to do this job is by starting at the bumper face bar and following the back bars to the chassis. Do not remove the bolts in the face bar. Remove only those that hold the bumper to the chassis.

Place a few drops of oil on each bolt on the nut side. Proceed to loosen all the bolts that you have located. Remove the nuts, but leave the bolts in place as this will keep the bumper from falling off. If there are only bolts that are threaded into the chassis, then leave at least two bolts to hold the bumper (one on each side).

Now you will need someone to help you to keep the bumper from falling as you remove the final bolts. Most of the new bumper assemblies are large and heavy and you should not attempt to do this by yourself. Carefully remove the bumper and store it in a place where it will not become scratched or damaged. If necessary, cover it.

On some cars, the grilles and parking lamps are fastened to the bumper. If such is the case, be sure that all wires are disconnected and remove the assembly in one piece. (Fig. IV-18)

Bumper Assembly including Grille and Lamps

FIG. IV-18

To replace the bumper assembly, bring all the parts to the car and make sure you know where each part belongs. Lift the bumper into place (someone must help you with this) and insert the bolts, but do not tighten them, just draw them up snug.

It is now important that you look at the assembly from the top and check it for level and for equal spacing on the ends. Once the bumper is set into its proper place, tighten all bolts securely.

With a soft, clean, cloth remove all smudges and finger prints from the area where you were working.

ASSIGNMENT:

1. Why should you place oil on the bolts and nuts?

2. Give some reasons for using a creeper.

3. What must be done before you slide under a car that is jacked up?

4. What must you do before you tighten the bumper securely?

5. Demonstrate the proper procedure to follow in the removal and assembly of the bumper.

6. There are some underlined words in the lesson. Find them and give their meanings. Use each of these words in a sentence.

UNIT IV - REMOVAL AND ASSEMBLY

Hardware and Trim — Lesson 6

OBJECTIVES: To learn to identify some of the hardware and trim.
To learn how to remove and replace some of the basic pieces of hardware and trim.

INFORMATION:

The hardware and trim of a car serves two purposes. First, it is useful and second, it adds beauty to the car. The hardware that is useful we call functional, because it is used to assist another part of the car. Such items may be hinges, regulators, handles, locks. The hardware which is visible is chrome-plated most of the time to give long wear and additional beauty.

The trim of the car is primarily used for adding attractiveness to the final product. It can be used to hide seams, edges, openings in construction and for ornamental purposes. Generally, the trim is also chrome-plated for lasting beauty.

Since there are so many different types of hardware and trim, there are many different ways of holding them to the body. One rule we should remember is always to look in the service manuals which cover that particular car and model. If manuals are not available, then see if you can reach behind the part to be removed and look for a nut or screw. If it is impossible to get to the back of a part, then it is correct to assume that a clip of some type is used.

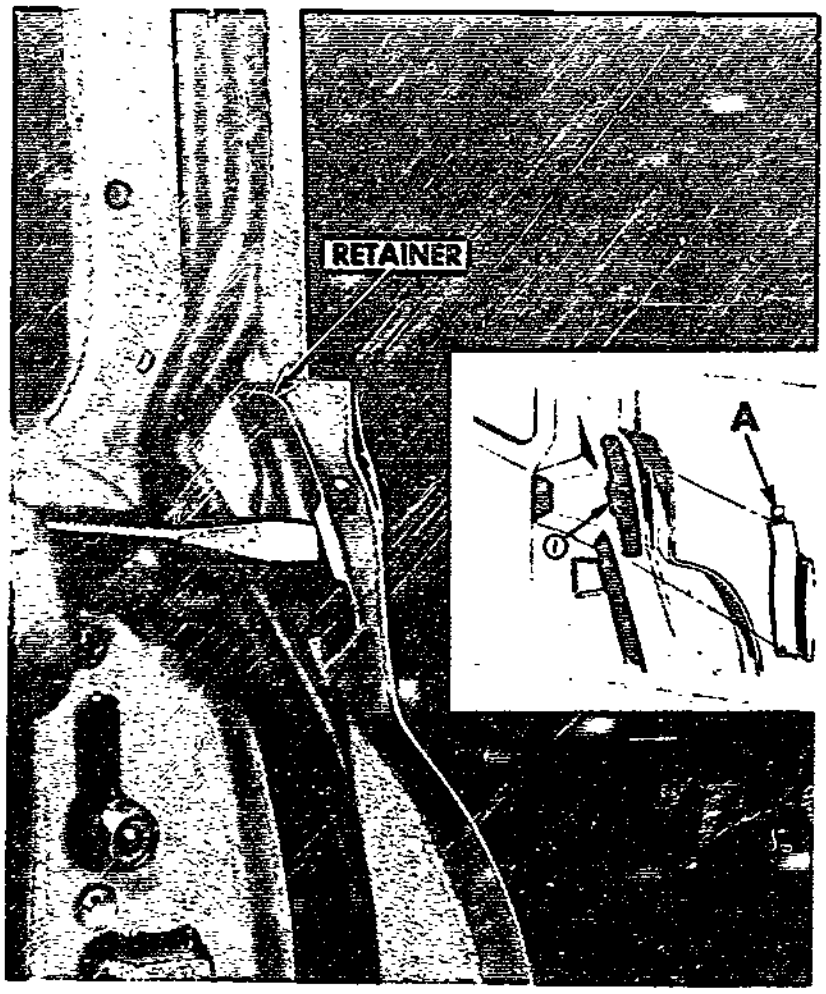
TOOLS AND EQUIPMENT:

There are many special tools which are devised for special fastening devices, but most of the time if care is used, a screwdriver, $\frac{1}{4}$" socket set, and pliers, are all that will be required.

Let us take for example the door handles which are to be removed. Most late model General Motors cars have a spring clip which holds the door handle in place. (Fig. IV-19) Carefully loosen the weather-stripping on the door jamb near the handle. You will see a small tab, about $\frac{1}{4}$" wide and 1" long. Place a screwdriver under this tab and pry outward evenly until it is out about $\frac{1}{2}$". Now remove the handle from the outside.

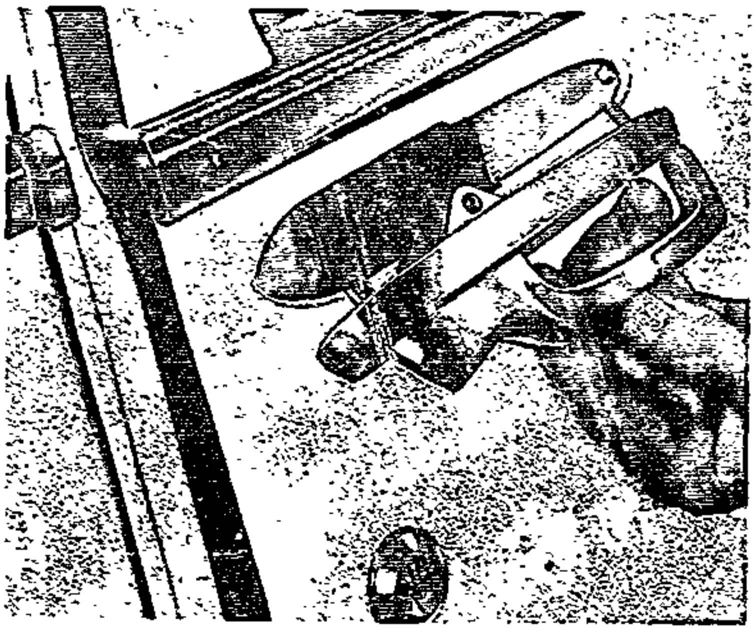
On Chrysler Corporation cars it is necessary to remove the upholstery trim panel in order to reach the screws from the inside of the door. (Fig. IV-20) Remember, if there is any question, refer to the service manual that is put out by the manufacturer.

To replace hardware, generally use the reverse procedure of the removal. It is a good idea to lubricate moving parts when they are apart before you proceed to reassemble them.



G. M. HANDLE

FIG. IV-19



CHRYSLER HANDLE

FIG. IV-20

Each car has its own type and style of mouldings and ornaments. One good rule is to look in the service manuals for the method used to fasten a part to the car. If this cannot be done, always look behind the part to see if there are nuts or screws which can be removed. If you cannot reach behind the part then probably clips are used to fasten it.

Some clips are fastened to the body and the moulding is snapped on (Fig. IV-21). Some clips are put into the moulding and snapped into the body (Fig. IV-22). In prying a moulding off a clip, always use great care, for the moulding can be bent or the surface of the body can be scratched, or nicked with the prying tool.

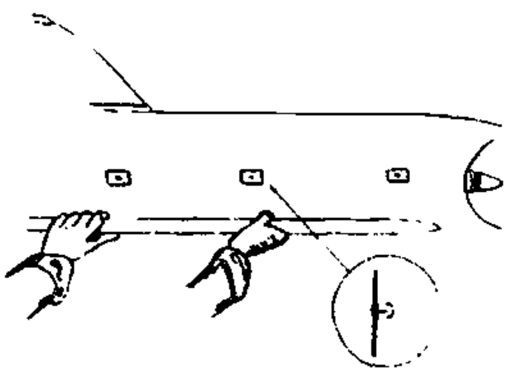


FIG. IV-21

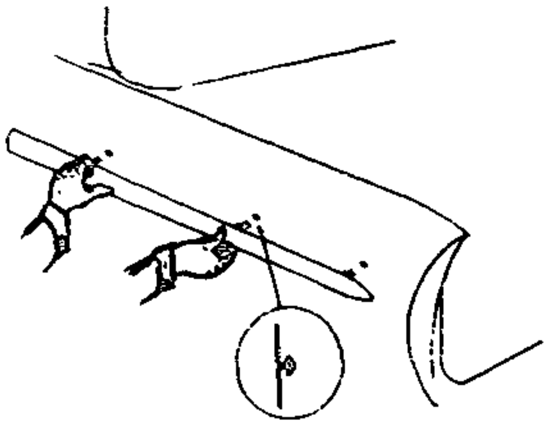


FIG. IV-22

TWO TYPES OF MOULDING CLIPS

You must also be very careful on some mouldings as they have clips in the middle but a bolt and nut on the end. Here the nut or screw must be removed first. Whenever trim is removed, always store it in a safe place, so that it does not get damaged.

To replace trim, make sure you know where all the parts go and reverse the removal procedure, always being careful not to scratch or mar the paint, or chrome.

After you have finished installing a part, wipe off the area that you have worked on with a clean, soft cloth.

ASSIGNMENT:

1. List some examples of hardware on the automobile.

2. Why is trim used on the automobile?

3. What is the first rule when you are not sure of how a piece is fastened?

4. How would you find out how a piece is fastened to the car?

5. What do you do with chrome parts when they are removed?

6. Demonstrate how you would remove the handle of a General Motors car and a Chrysler Corporation car.

7. Demonstrate how you would remove the hood ornament from a car.

8. There are some underlined words in the lesson. Find them and give their meanings. Use each of these words in a sentence.

OBJECTIVE: To learn how to remove and replace the radiator.

INFORMATION:

Radiators are made of a combination of copper and brass (Fig. IV-23). This makes the radiator one of the most expensive single pieces on the car, therefore extra care must be used whenever you work on this section.

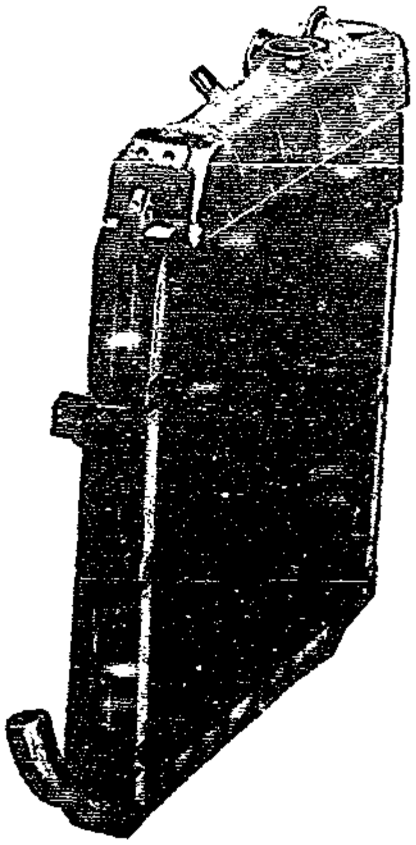


FIG. IV-23

There are many reasons why radiators must be removed. Many times the radiator is damaged in an accident and must be replaced. There are times when radiators develop leaks. These radiators should be removed, repaired, tested, and replaced. There are times when work is required on the motor or chassis which can only be done after the radiator is removed.

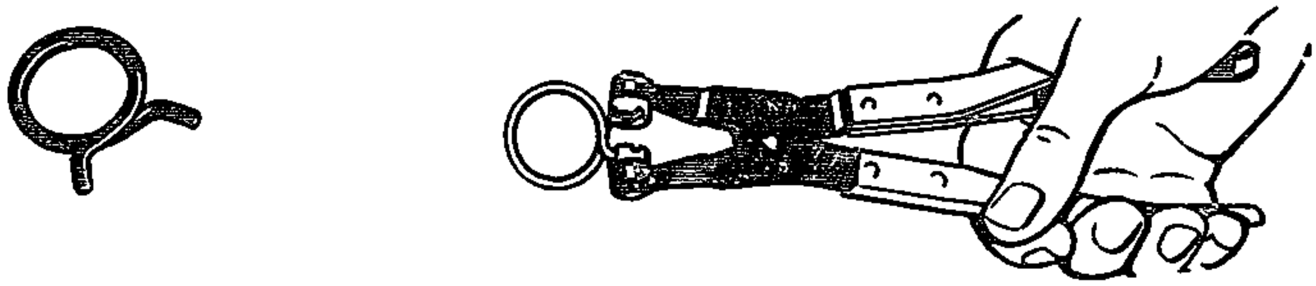
TOOLS AND EQUIPMENT:

3/8" socket set, straight screwdriver, pliers, drain pan, extension light, and possibly a creeper.

PROCEDURE:

First, place the drain pan on the floor under the radiator and position it under the drain plug or petcock. Remove the radiator cap with caution. Most radiators operate under pressure. Therefore, the cap must be removed very slowly when the radiator is hot. Loosen the drain plug. On some cars this can be done by reaching down in front of the motor. On others it may be necessary to use a creeper and loosen the drain from the bottom of the car. After all the water has drained into the pan, check the color for the presence of anti-freeze. If it is only water, it may be disposed of. Anti-freeze should be poured into a container and stored in a safe place. To be absolutely sure of the contents of the radiator, use a hydrometer.

Loosen the screws that hold one end of the radiator hoses. One end should be left tight. There are different types of hose clamps. Most of them have screws which tighten them, but some now use a spring type clamp (Fig. IV-24) which requires a special tool for removal.



SPRING TYPE HOSE CLAMP

FIG. IV-24

It does not make much difference which end is removed, but always pick the end which you can reach more easily. With the clamps loosened, begin to twist the hoses off, with a back and forth twisting motion. Often these can be very stubborn, so be careful not to damage the hoses.

Remove all the bolts that are found on both sides of the radiator (generally there are from two to four on one side). The radiator is now ready to be lifted out of the car. You must use care so that the radiator is not damaged by scraping it against the fan blade. On some cars there is a large round pan that covers the fan blade. This must be removed before you attempt to remove the radiator.

When replacing the radiator, bring all the parts to the car and make sure that you identify and locate all the parts. Lower the radiator into place and insert all the bolts but do not tighten them. Next, hook up the hoses and tighten them securely. Now tighten the bolts on the side of the radiator. Replace the pan if there is one. Check the drain plug and make sure that it is shut off. Proceed to refill the radiator. Check for leaks around the hoses and the drain. When you are finished with your job, wipe up the area in which you were working to remove dirt, grease, and hand marks.

ASSIGNMENT:

1. Why must the radiator cap be loosened slowly when the radiator is hot?

2. How are the radiator hoses removed after the clamps are loosened?

3. Where is the radiator drain plug located?

4. What are most radiators made of?

5. Demonstrate the way to remove the radiator from the automobile.

6. There are some underlined words in the lesson. Find them and give their meanings. Use each of these words in a sentence.

UNIT IV - REMOVAL AND ASSEMBLY

ACHIEVEMENT TEST

1. Demonstrate the following operations. All involve removal and replacement.

    a. front and rear wheel
    b. front seat assembly
    c. rear seat
    d. trim panel
    e. rear bumper
    f. front bumper
    g. outside door handle
    h. radiator

2. List ten new words that you have learned in this unit. Use each in a sentence.

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   f. front bumper
   g. outside door handle
   h. radiator

2. List ten new words that you have learned in this unit. Use each in a sentence.

UNIT V - REFINISHING

Enamels and Lacquers Lesson 1

OBJECTIVES: To learn about the different types of paint.
To learn how to identify paint.
To learn why finishes were developed.

INFORMATION:

Painting something, whether it be a car, refrigerator, toys or furniture, is done for two reasons. First of all paint protects the surface, and second, it adds beauty to the finished product. For automobile paint, the weather is the chief enemy. Cars are exposed to sun, rain, snow, wind, heat and cold with little or no protection. The major part of the automobile is made of steel. Steel, as you know, is strong and very useful in the auto, but a disadvantage is that it will rust when exposed to the weather. So then, the primary purpose of using paint is to protect the steel from rusting and make it last longer.

The automobile of today is made more beautiful by the wide range of colors that are available. Therefore, the automobile is not only a useful means of taking you from place to place, but becomes something which you can enjoy looking at and be proud to own.

In the beginning, automobile makers used the slow drying varnishes and paints which we call ENAMELS. These are satisfactory, but they had one big disadvantage, they dried too slowly. Because of its slow drying, the paint would accumulate a great deal of dust and dirt while it was tacky. In addition a long time was needed to complete one job.

The paint companies then began to develop a paint which would be just as good as the enamel, but would dry faster. This fast drying paint we now know as LACQUER. Now we have a paint which can be sprayed on the car and in a few minutes is dry enough to touch. But it differs from enamel in that it must be polished and waxed in order to make it shine.

Now let us look at each one a little more closely. The enamels are slow drying paints which develop a hard glaze on the surface. This hard glaze is the heart of the finish. If the surface wears off, there is very little possibility of regaining the original shine and lustre. The lacquers on the other hand are uniform throughout the entire paint film. The shine and brilliance, however, is acquired through rubbing, polishing, and waxing If the color goes dull from the weather, it can readily be polished and waxed to its original color and brilliance.

The various paints are made heavy in form. For this reason paint must be reduced in order to be usable in a spray gun. This reduction is made possible by the use of lacquer thinners and enamel reducers. On each can, you will see the directions for mixing the paint. Follow these directions carefully and NEVER mix enamel and lacquer products together. Each product is made up of its own special ingredients and the inter-mixing of them will result in curdling or jelling of the paint.

ASSIGNMENT:

1. What are two reasons for painting something?

2. Name the two basic types of auto paint. Which was used first?

3. Why was the second paint developed?

4. Give some of the differences between the two basic types of paint.

5. What must be done to paint before it can be sprayed? What products are used?

6. Is it permissible to mix the different types of paint together? Why?

7. There are some underlined words in the lesson. Find them and give their meanings. Use each of these words in a sentence.

Materials for Undercoating Lesson 2

OBJECTIVES: To learn the reason for using undercoating materials. To learn how to identify different paint products and their uses.

INFORMATION:

When we speak of materials for undercoating, we mean primers, surfacers, sealers, and putties. At first it was required to apply a coat of PRIMER to all bare metal. The primer is the bonding agent that holds all the other coats of paint in place. This operation was followed by at least two or three coats of SURFACER to fill in all the scratches and imperfections on the surface of the metal. Generally, surfacers are heavier and fill more readily than any other material. Now if there were still spots which had scratches or nicks, it became necessary to apply GLAZING PUTTY with a rubber squeegee or a flexible putty knife. By this time the surface was well prepared for the finish color. However, in order to prevent the color coats from sinking into the undercoats, a SEALER is used. This seals the surface so that the color will not penetrate and also acts as a bonding agent between the color and the primers

As new paints and products were developed, the manufacturers combined the primer and surfacer into one paint. We now have what is called PRIMER SURFACER. In most instances this can be used on bare metal or old paint to act as a bonding agent. It can also be used to fill in the scratches and imperfections.

It must be remembered that there are many different kinds of paint products being made for various uses. One type of primer or primer surfacer may not be good for all types of jobs. It is important that we refer to the catalogues from the paint company to learn about each type of paint. We want to know what it was developed for, and which of our needs will it meet. Each paint manufacturer has his own brand names and numbers by which their paints can be identified.

The reduction of primers is very important. Always read the label on the can thoroughly. Usually primer surfacers are made heavier than the color coats. This is done so that there will be more body to the paint for filling purposes. Some primers which are meant for bare metal are thinned more than usual. This is merely to allow them to act as a bonding agent. Some sealers require no reduction at all, so be sure always to refer to the label for instructions on reduction.

ASSIGNMENT:

1. What is meant by the word primer?

2. What is meant by the word, surfacer?

3. Why is glazing putty used?

4. Why are sealers used?

5. What is the best way to find out what a certain paint is meant to do?

6. Are primers reduced in the same way as colors? Why?

7. There are some underlined words in the lesson. Find them and give their meanings. Use each of these words in a sentence.

OBJECTIVES: To become familiar with the different types of solvents available.
To learn the purposes of these products.

INFORMATION:

In painting, one problem with which you will be faced from now until you complete your last paint job is cleanliness. This is a never-ending problem. Without cleanliness you can never be successful. It applies to everything in the paint field: the job, the shop, tools, equipment, materials, and you. Paint manufacturers have developed materials called solvents to help you maintain this cleanliness. Here again we must refer to the manufacturers' catalogues to see what types of solvents have been developed to do certain things.

WAX AND GREASE REMOVERS

Let us begin with wax and grease removers. Some of the biggest enemies of the painter are wax, oil, or grease. Paint that is applied over any one of these agents will not stick to the surface. One sure indication of this is the failure of the paint to dry. Generally, the first thing a good painter will do before he starts sanding, is to use a good cleaner and wash the entire surface to remove any trace of wax, grease, or oil.

METAL ETCH

Another common enemy of the painter is the formation of rust on the metal surface to be painted. In certain kinds of repair work, solder is used, with acid as a flux. This acid must be neutralized or rust will begin to form under the painted surface. To neutralize this acid there are many metal cleaners on the market which will dissolve rust, neutralize acid, and etch the metal to be painted. Remember to refer to the catalogues, because there are different cleaners for steel, aluminum, and galvanize.

GUN CLEANERS

Your spraying equipment must always be kept clean and in good operating condition if you expect to do a good job. Right after you have finished spraying, is the best time to clean the gun. If you put the gun down and allow the paint to dry on the gun, it will be much harder to do a good cleaning job on it.

In some shops, thinners are used in place of a gun cleaner. This is acceptable practice, but it is recommended that for best results a gun cleaner be used.

It might be mentioned here that there are many cleaners for other purposes which are not in the refinishing line. For example, if upholstery is soiled by grease and dirt, carbon-tetrachloride is very helpful in removing stains. If paint happens to get on the upholstery, clean it immediately with the proper thinner (if the paint is lacquer, use lacquer thinner; if it is enamel, use reducer).

One word of caution about using solvents. Many solvents are highly flammable. This material must be kept away from fire and stored properly when not in use. Also, many of the solvents of today are highly asphyxiating and injurious to the skin. Whenever solvents are used there must be sufficient ventilation. Never close yourself into a room when using solvents. Always open doors and windows to allow air to circulate around you. When solvents are spilled on some part of your body, always wash immediately with soap and warm water.

ASSIGNMENT:

1. What is the first thing you must do before starting to sand a job?

2. How can rust be removed from the metal surface?

3. When is the best time to clean a spray gun?

4. What can you use to clean a spray gun?

5. Name two common hazards in using solvents.

6. There are some underlined words in the lesson. Find them and give their meanings. Use each of these words in a sentence.

UNIT V - REFINISHING

Sanding Materials Lesson 4

OBJECTIVES: To learn the reasons for sandpapering a surface.
To learn the different types of sandpaper.

INFORMATION:

After we are sure that the surface of the job is thoroughly cleaned, our next problem is to prepare the surface for the first coat of primer surfacer. This is done by sandpapering. In the sanding operation there are two things that must be done. First, we must sand all rough spots smooth and eliminate imperfections as much as possible. This will reduce the amount of filling that must be done. Second, we must take a smooth painted surface and provide tiny scratches for the paint to grab into and thus make a perfect bond between the old and new paint.

These two steps can be accomplished best through the wise choice of sandpaper. The grit of the paper means the roughness of the abrasive. The thing to remember is that we are trying to make less work and not more. If we use a sandpaper that is too coarse, the result will be unnecessary scratches which must be filled in with paint. On bare metal the average grit that is used is 180 or 100. This will cut fast and yet leave the surface smooth. When working with painted surfaces we must consider the condition of the old finish. If it is a new car with a good finish then we can sand with #320 grit paper. If the finish is old and has many defects which must be eliminated, then we must use a coarser paper, perhaps #220 or $180. On very bad surfaces sometimes we use #100 grit paper. Another important thing to remember is that there are two types of paper, the wet or dry type. The wet paper should be used with water. This helps to keep the abrasive in the sandpaper from becoming clogged with the paint that has been sanded off. By flushing water with a sponge over the sandpaper the particles of paint that have been sanded off are washed away. With the use of water, the sandpaper can be used much longer. Usually dry paper is used on bare metal. However, sometimes when the old paint is very bad it is faster to use dry paper instead of wet.

ASSIGNMENT:

1. Give two reasons for using sandpaper.

2. What are the two types of sandpaper?

3. What does grit mean in relation to sandpaper?

4. Name four different grit sandpapers.

5. Why is water used with sanding?

6. There are some underlined words in the lesson. Find them and give their meanings. Use each of these words in a sentence.

Sanding

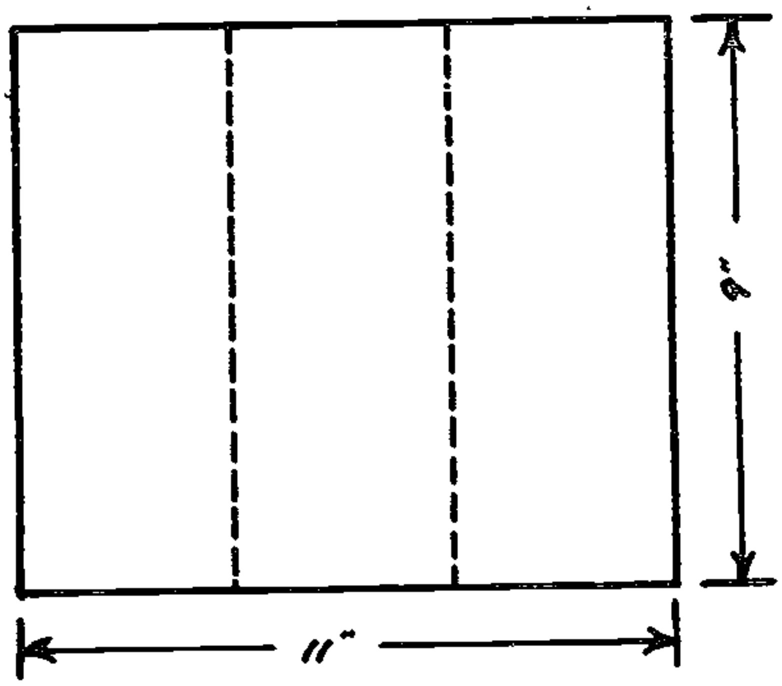
Lesson 5

OBJECTIVE: To learn how to sand a job properly by hand or with a machine.

INFORMATION:

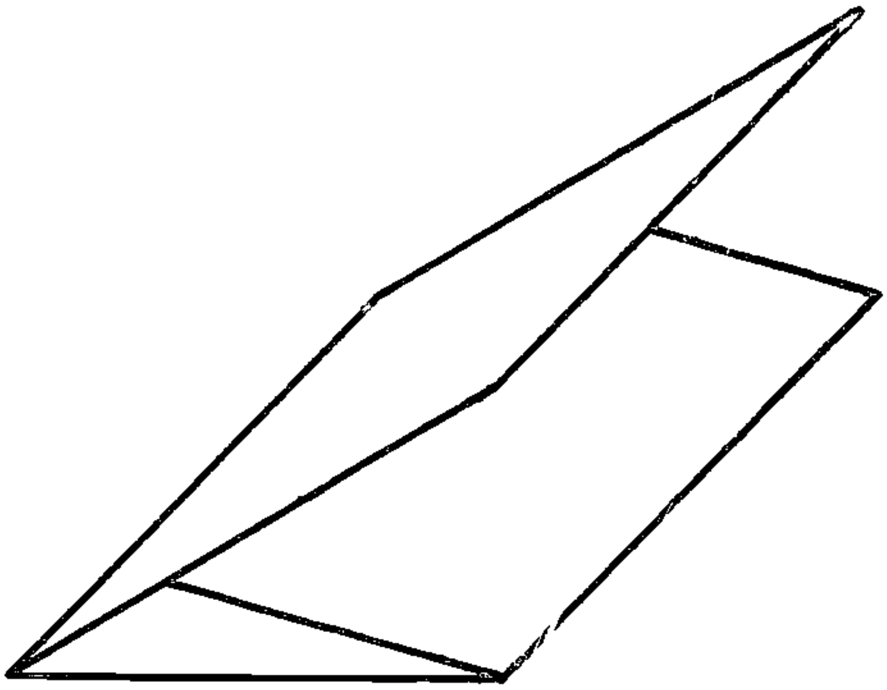
After you have selected the proper sandpaper grit to use, the next thing is to cut the sheet so that there is no waste. Divide it into three sections and cut evenly (Fig. V-1). Sometimes an old paper cutter is good for this purpose.

Cut on dotted lines



CUTTING THE SANDPAPER

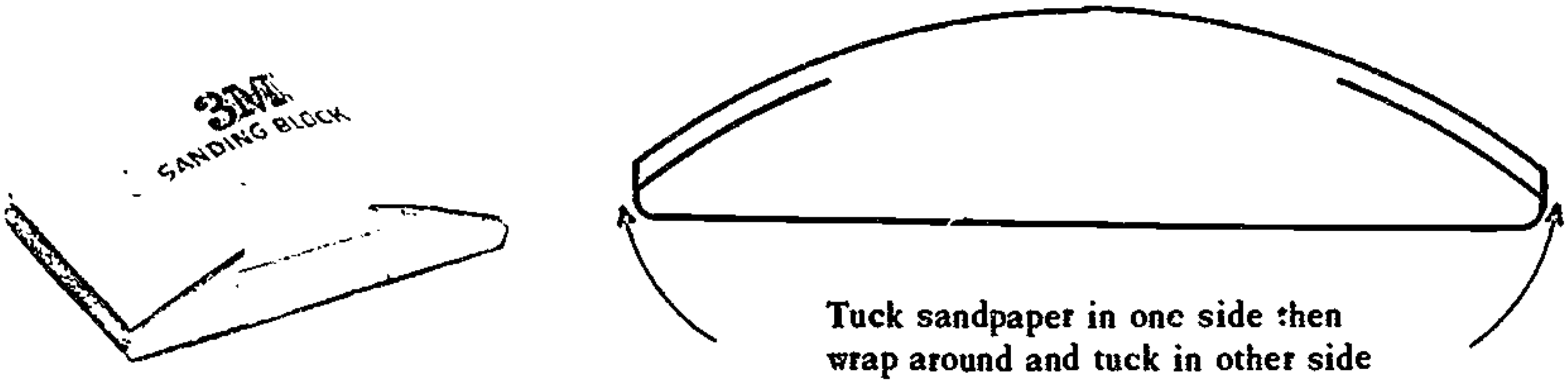
FIG. V-1



FOLDING THE SANDPAPER

FIG. V-2

By cutting the paper in this method, you will find that it can be used for both hand and machine sanding. When doing hand sanding, fold the paper into three sections (Fig. V-2). If you use a block sander, attach the ends of the sandpaper in the block as shown (Fig. V-3).



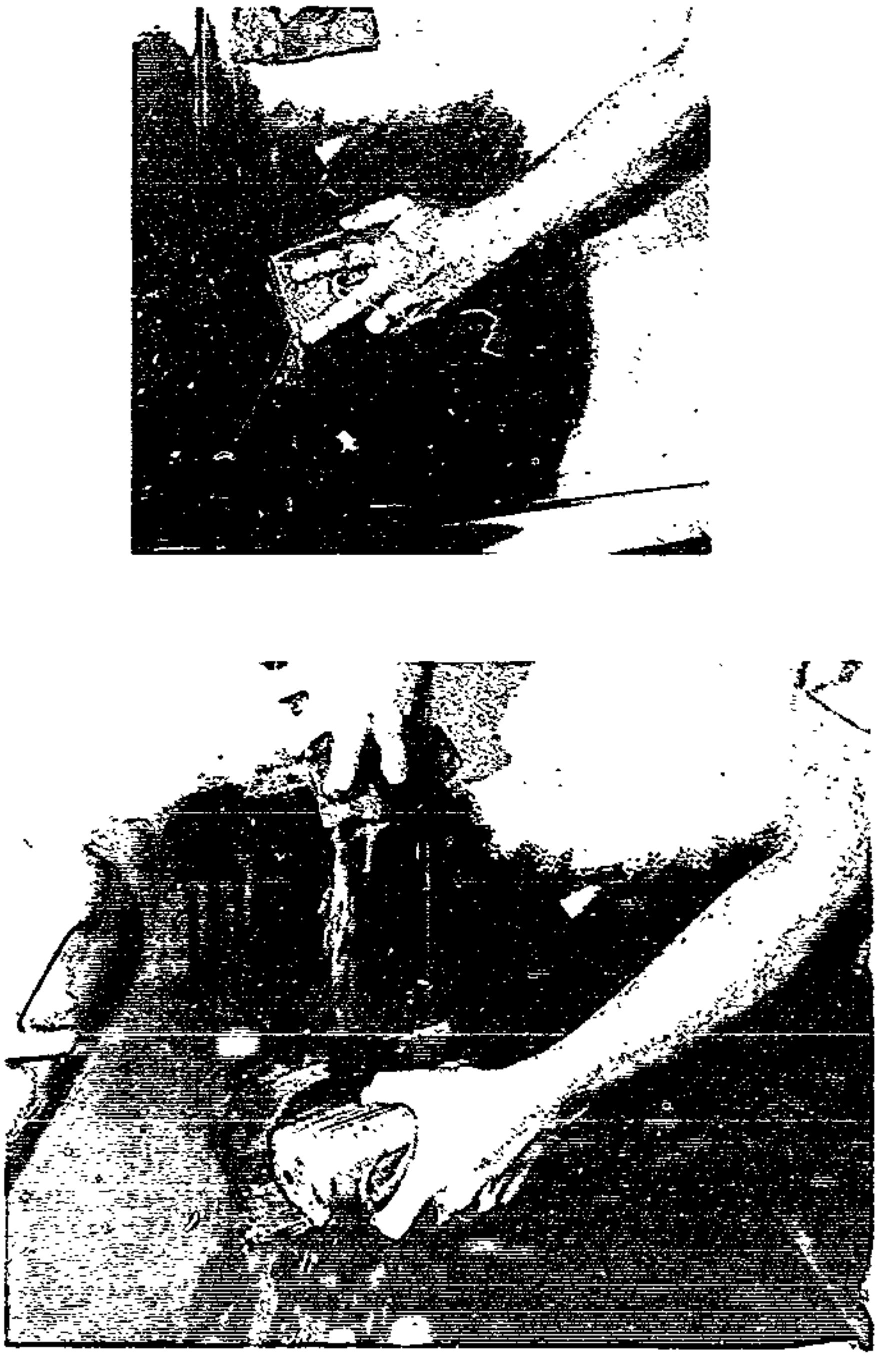
Tuck sandpaper in one side then
wrap around and tuck in other side

FIG. V-3

When sanding by hand grasp the corner of the sandpaper between the thumb and the index finger and lay the fingers flat on the sandpaper (Fig. V-4). Apply a slight pressure as you sand and always sand in the longest direction. This will help you sand faster and more evenly. NEVER, NEVER sand with the finger tips. Always use the palm of the hand. This will give you a smooth and level surface when you are finished. The use of the finger tips will cause small holes to show through the finish. See example of sanding with block and machine (Fig. V-5).

HAND SANDING

FIG. V-4



BLOCK AND MACHINE SANDING

FIG. V-5

Feather edging is a term applied to the tapering off of an edge of paint where you have a chip or a repair spot (Fig. V-6). The amount of feather edging is determined by the condition of the surface. If there are only a few coats of paint, then you do not have to sand very far from the bare metal area. If there are many coats of paint, then it becomes necessary to sand a larger area. On the average, to feather edge you will sand away from the metal from 1" to 3". Feather edging can be done by hand, with a block, air sander, or electric sander (Fig. V-7).

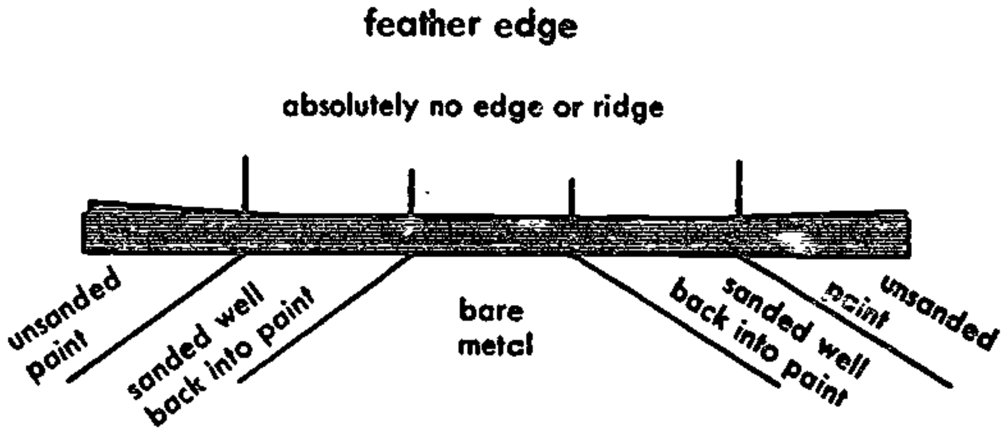


FIG. V-6

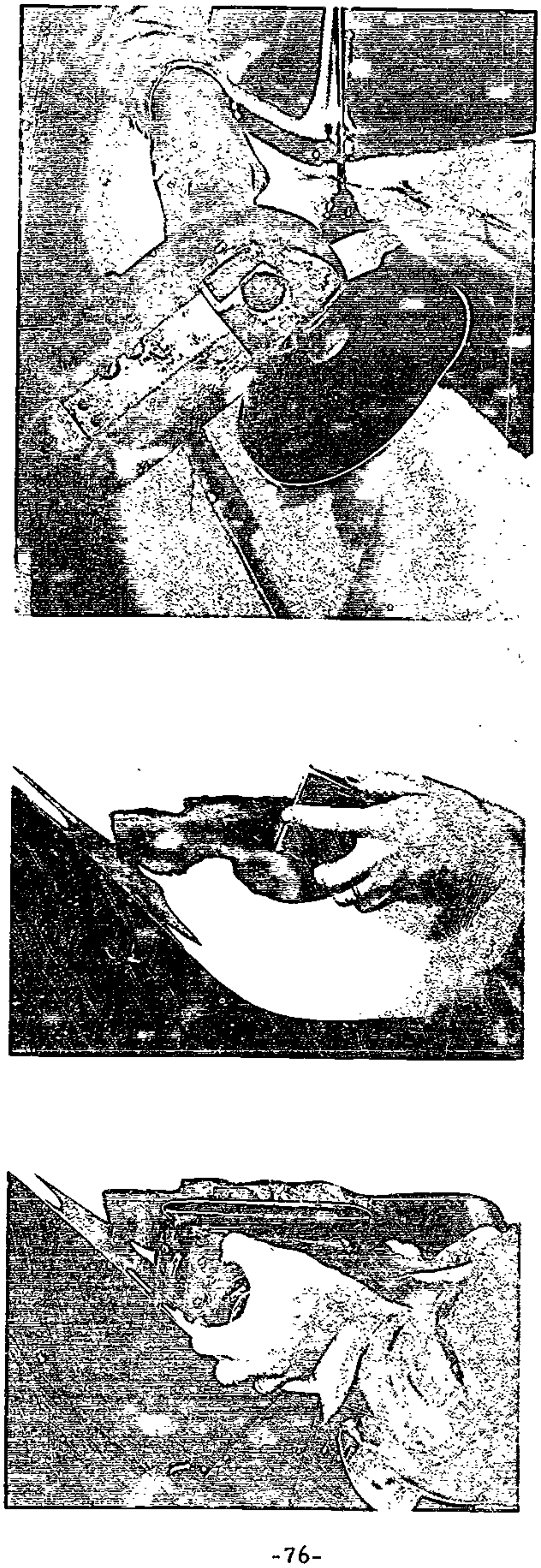
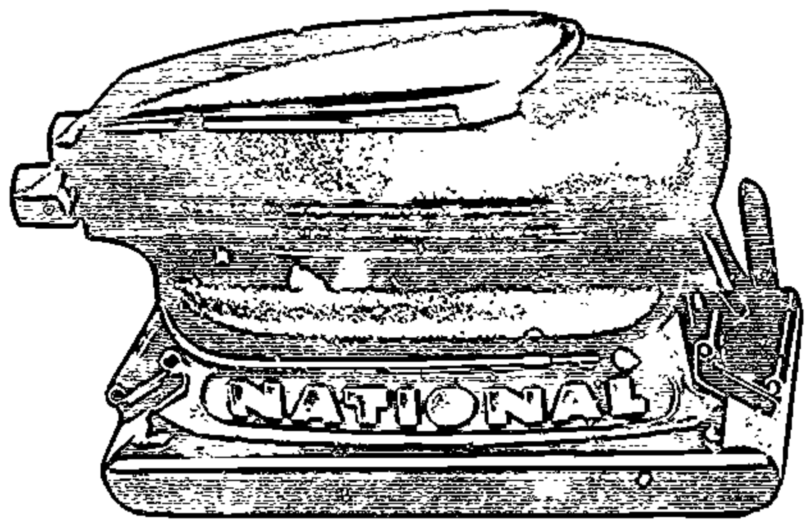


FIG. V-7



AIR SANDER

FIG. V-8

When using a machine sander (Fig. V-8), the same basic principles apply as do to hand sanding. Always use the longest stroke and hold the machine flat on its pad. The air pressure that is required to operate a pneumatic sander should be from 65 to 80 pounds. Be sure that all connections are tight because the vibration of the sander will tend to loosen the connections. One thing to remember is not to inter-mix hoses between the spray gun and the sander. The sander uses oil through the hose for lubrication and generally the hose has an accumulation of oil which could get into the spray operation.

To operate the sander, hook up the connections securely to the main line of the regulator and sander and turn on the air. IMPORTANT - never lay the sander on a bench or table with the hoses hanging over. It is very possible for someone to trip over the hose and knock the sander off causing it to break. Always hold the sander by the body of the machine and not the hoses. It is very possible for the connector to break off if a strain is put on it by holding it by the hose connection.

Holding the machine in one hand, squeeze the handle at the top to start the machine. If you are using water, hook up the water line to the outlet next to the air outlet. This will operate at the same time that the air goes on.

You will have to use your own judgment as to which method would be the best to use. If the spot is small or curved, then the hand method is the best. If you have a panel that is not too large, then perhaps the block sander is the best. If the area to be sanded is larger, then perhaps the machine sander would be better to use.

Whether sanding by hand, machine or block, always be careful of glass and chrome parts. They can become scratched very easily and are very expensive to replace.

ASSIGNMENT:

1. Show the instructor how you would divide and cut a sheet of sandpaper for use.

2. Show the instructor how you would fold the piece of sandpaper to sand a job.

3. What is feather edging?

4. Where would you use a block sander?

5. What must you be careful of when using the machine sander?

6. There are some underlined words in the lesson. Find them and give their meanings. Use each of these words in a sentence.

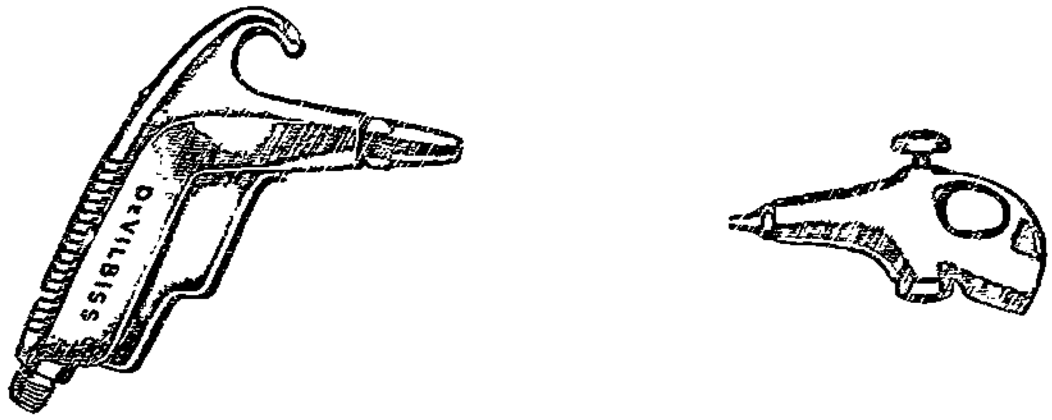
UNIT V - REFINISHING

Use of the Dusting Gun — Lesson 6

OBJECTIVES: To learn the proper method of dusting.
To learn the reasons for using the dusting gun.

INFORMATION:

Whenever we discuss any part of refinishing we must emphasize cleanliness. This lesson deals directly with the cleaning of particles of dirt from the painted surface. You can wash and wipe over and over again and clean the surface, but there are some places where your cloth will never reach. These are in the openings, cracks, and joints. The dusting gun is the only way to clean these places. You will need the dusting gun, air hose, and a clean piece of cloth (Fig. V-9).



DUSTING GUNS

FIG. V-9

The following procedure applies, whether you are preparing a small touch-up job or a complete refinishing project. Always remember where you start, and work in a pattern. Do not go from place to place without a definite pattern, as there will be places that you may miss and these will show up when it is too late.

Let us start with the refinishing of the front fender. Starting between the hood and the front fender, put the point of the dusting gun between the opening of these two parts, and with full force blow the air and move the gun towards the back of the car. (The higher the pressure the better - 60-80 lbs.) Now do the same thing between the door and the fender, working from the top down. Be sure that the air is being forced into the opening with full force, and hold the gun as close to the opening as possible.

Next start at one point between the headlight rim and the fender and work around the rim. This spot might take more than one operation as a great deal of dirt is caught there. Next work around the grille and here again thoroughly clean this area. If there are any mouldings or trim on the fender, do this last. To test to see if you are actually blowing something out or not, place your hand in front of the dusting gun as you move it along and you will feel the dust and dirt coming out. If this operation is not done properly, later as you are spraying with paint, the pressure of the spray gun will blow the dirt out and it will settle on the fresh paint. Remember, always follow a pattern so that you can remember what has been done and what remains to be done.

When preparing for a complete paint job, start at one point on the car and move systematically around the car until all joints, openings, and cracks have been cleaned thoroughly. Be sure to do all trim and mouldings. If once is not enough, then go over it until you can feel that there is no dirt coming out in front of the gun.

ASSIGNMENT:

1. Why is it necessary to use a dusting gun?

2. How much pressure should be used with the dusting gun?

3. Show the instructor how you would blow the areas around the front fender.

4. There are some underlined words in the lesson. Find them and give their meanings. Use each of these words in a sentence.

Masking

Lesson 7

OBJECTIVE: To learn the methods of masking.

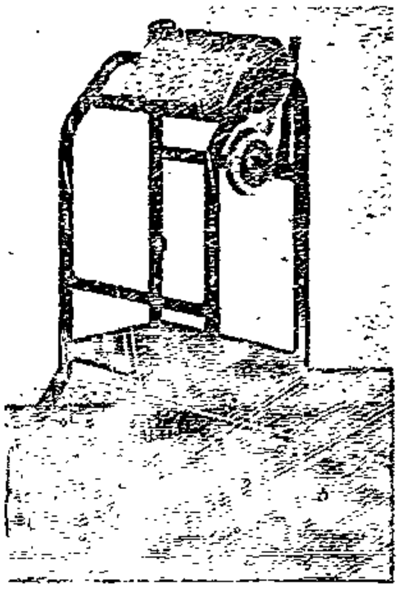
INFORMATION:

Included in the program of cleanliness is the covering of the parts of the car that are not to be refinished. This is called MASKING. It is done with masking tape and paper. The masking tape is available in sizes from ½" to 2" wide. It is a waterproof paper with a gum adhesive on one side.

Masking paper is available in 3", 6", 12", 24" and 36" widths. Pictured is a typical type of masking machine in common use (Fig. V-10). If masking paper is not available, then ordinary newspaper will do.

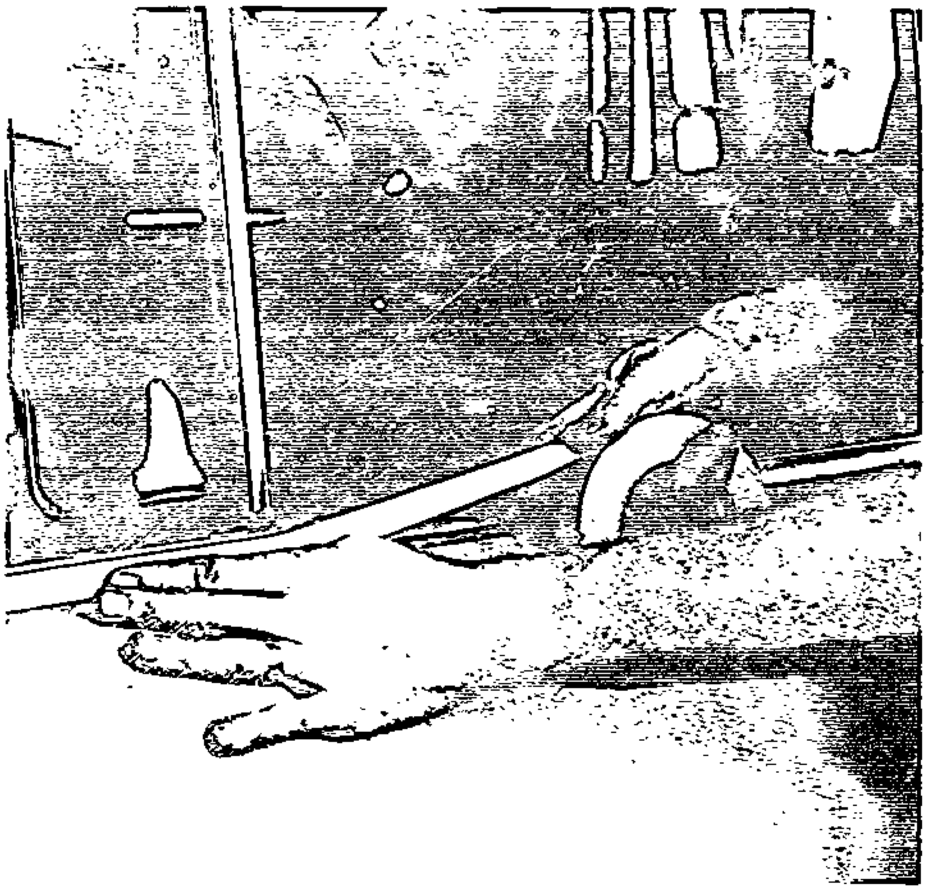
Before starting to mask a job, see how much area needs to be covered. This will tell you what size tape and paper to use.

Follow the pictures of various parts being masked and notice the size of the tape and paper, as well as the method used.



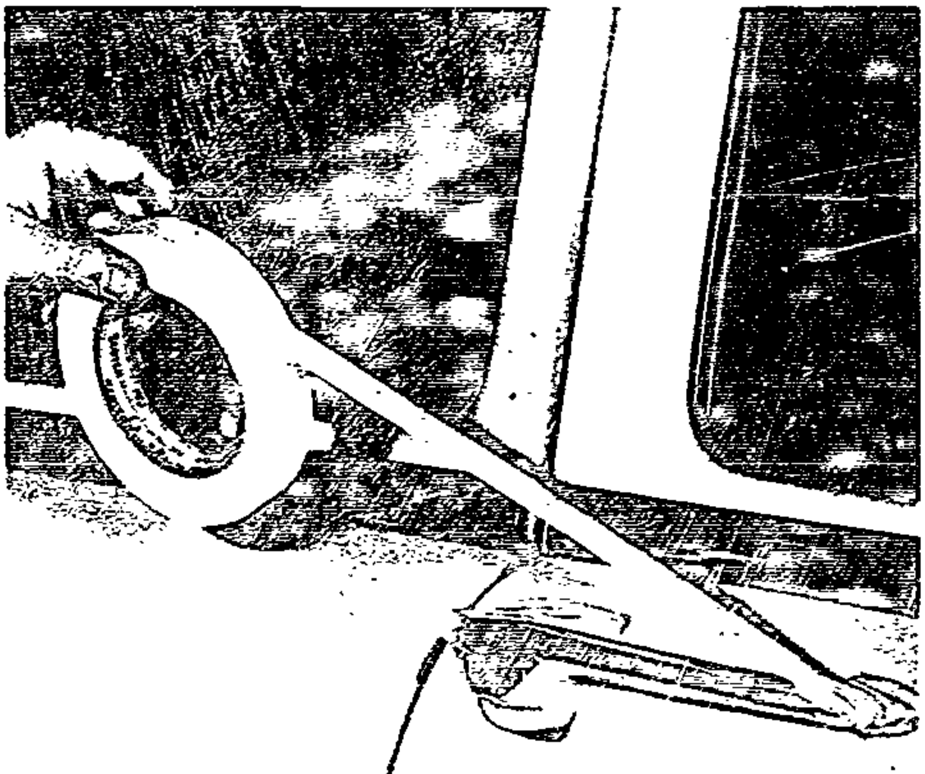
MASKING MACHINE

FIG V-10



MOULDINGS

FIG. V-11



HANDLES

FIG. V-12

When masking, NEVER STRETCH the tape. Lay it on as it comes off the roll. Hold the roll of tape in one hand and guide the strip of tape with the other hand. Always mask the edges first and fill in the spaces in the center last.

When masking windows or areas where there are many curves, always use $\frac{1}{4}$" masking tape on the edge first. This is easier to maneuver. Then proceed to use the tape and paper. Going around curves, the tape or paper should always be held loosely, pressing it down with one hand and steering it with the other hand. Always tape down all edges of the paper, as this will prevent paint from being blown under the paper.

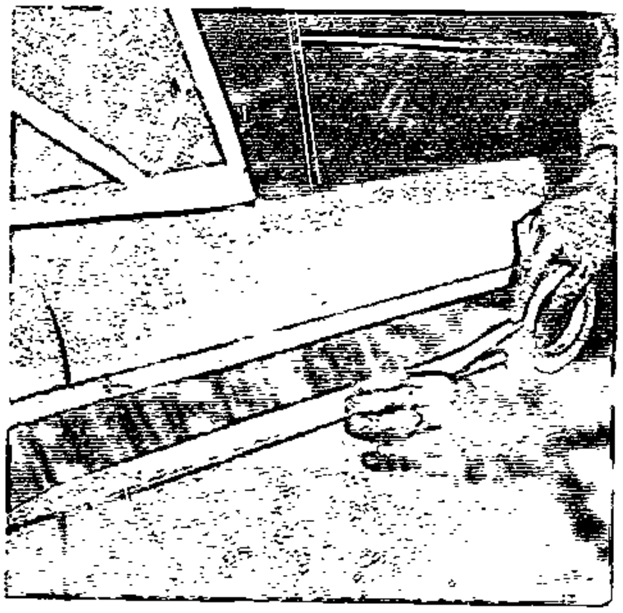


FIG V-13

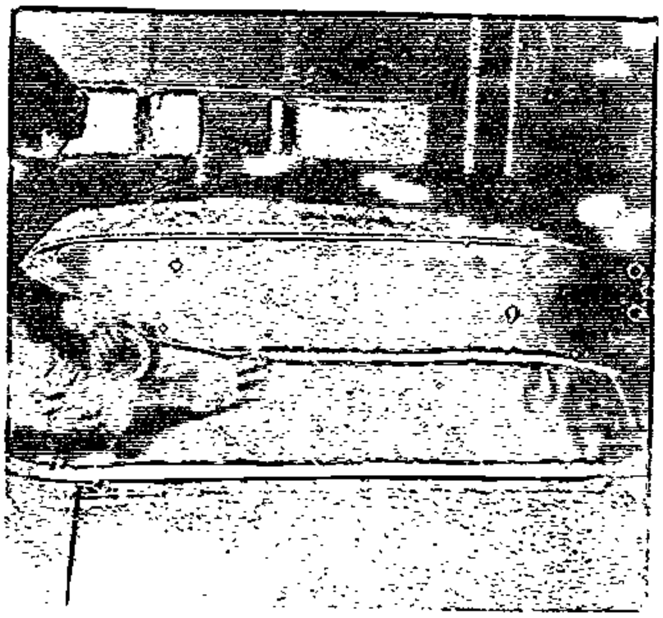


FIG. V-14

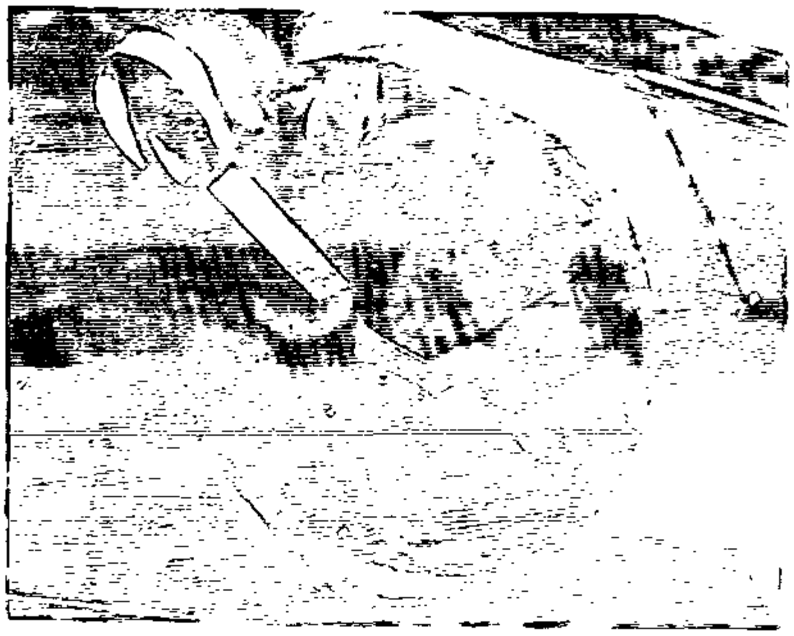


FIG. V-15

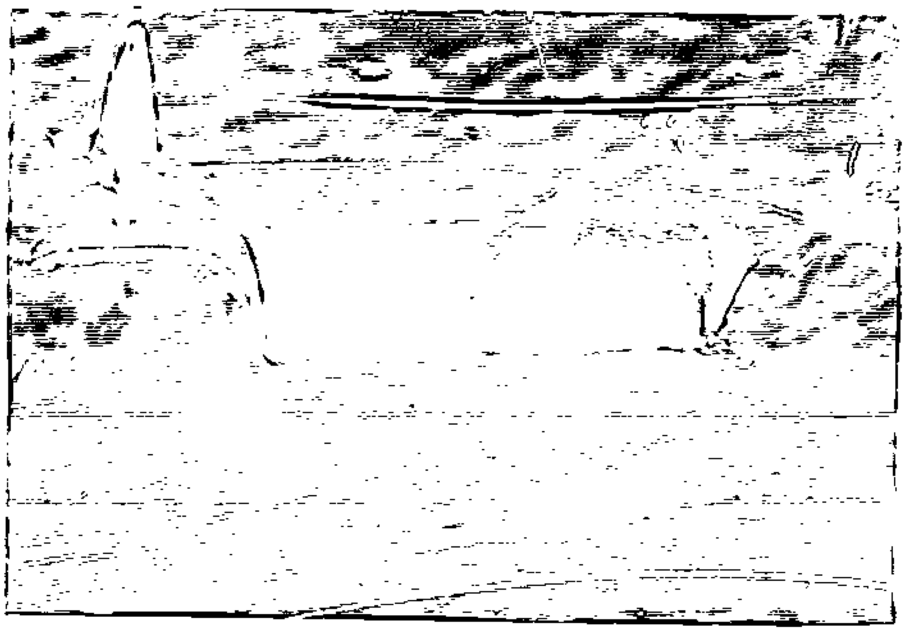


FIG. V-16

TYPES OF MASKING JOBS

When there is a continuous curve to be taped, it is helpful to pleat the paper every 4" to 6". This will help the tape and paper to fit the curve tightly (Fig. V-17). Note how door jams are masked (Fig. V-18).

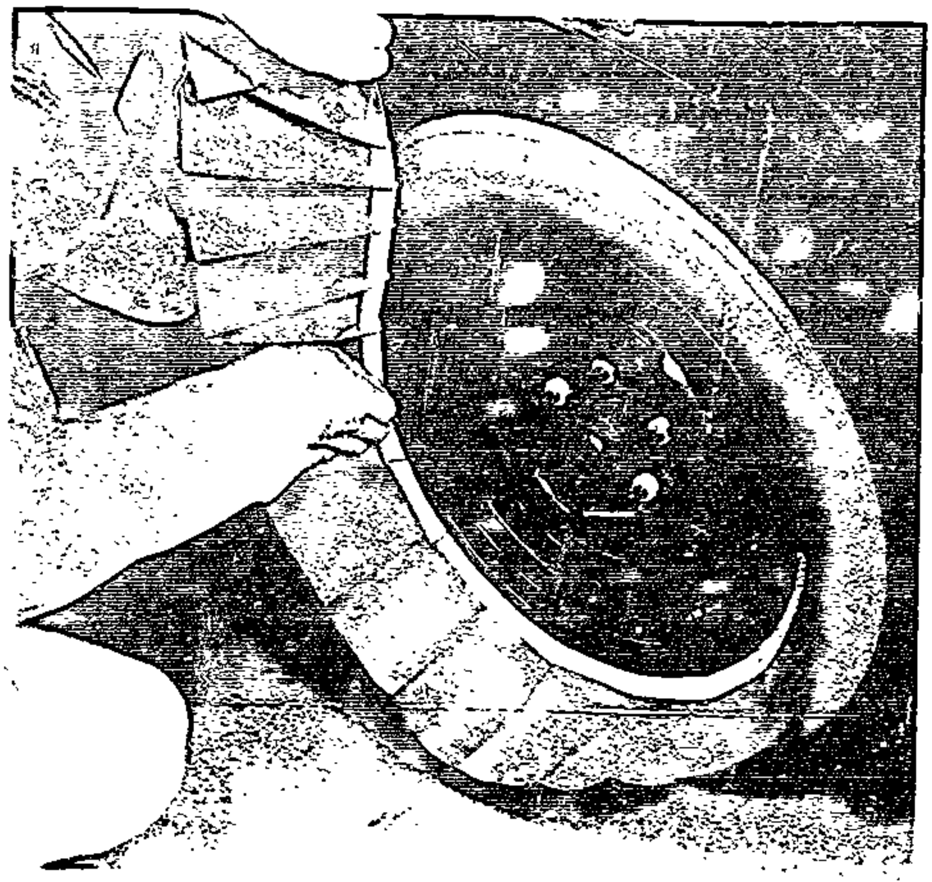


FIG. V-17

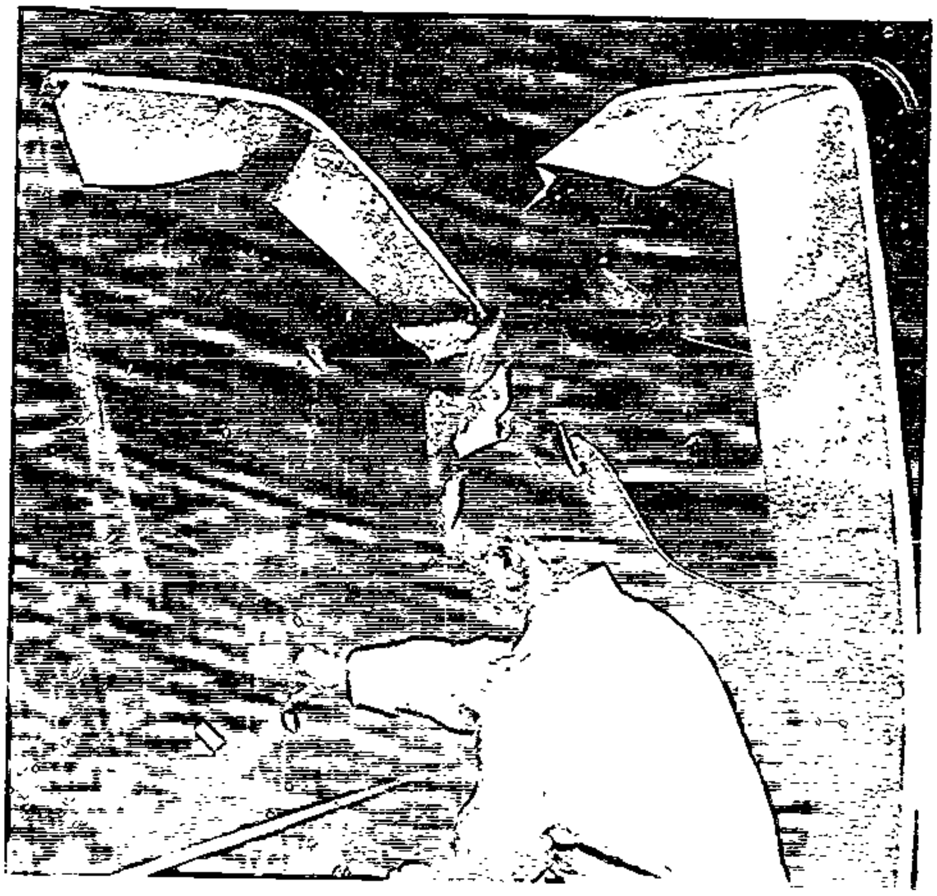


FIG. V-18

Masking in preparation for a two-tone job can be very easily done with the use of a large piece of clean soft cloth. The cloth is draped over the general area and the edges folded under near the edge (Fig. V-19). The edge is then masked with tape and paper over the cloth (Fig. V-20).

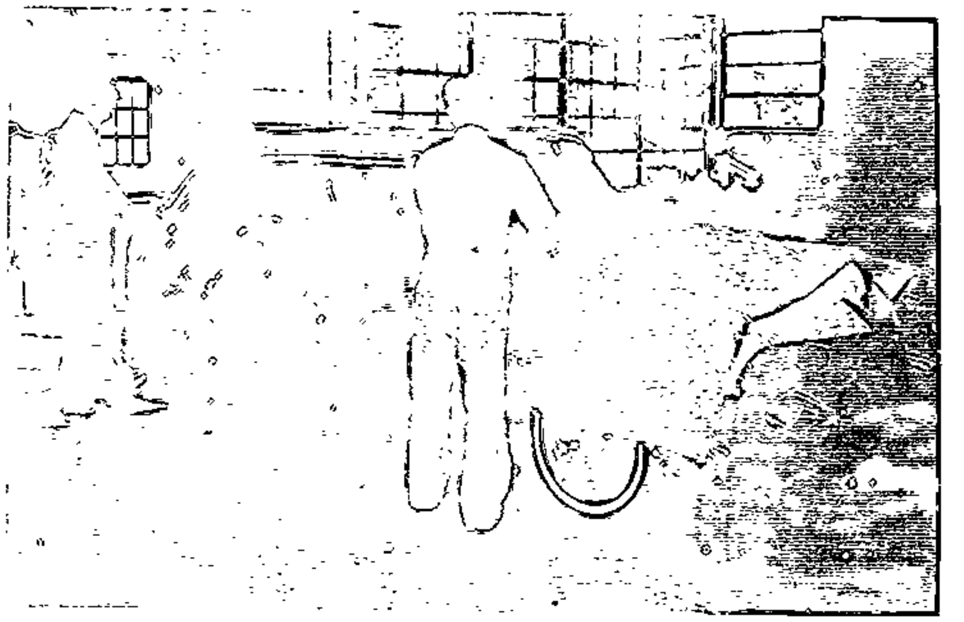


FIG. V-19

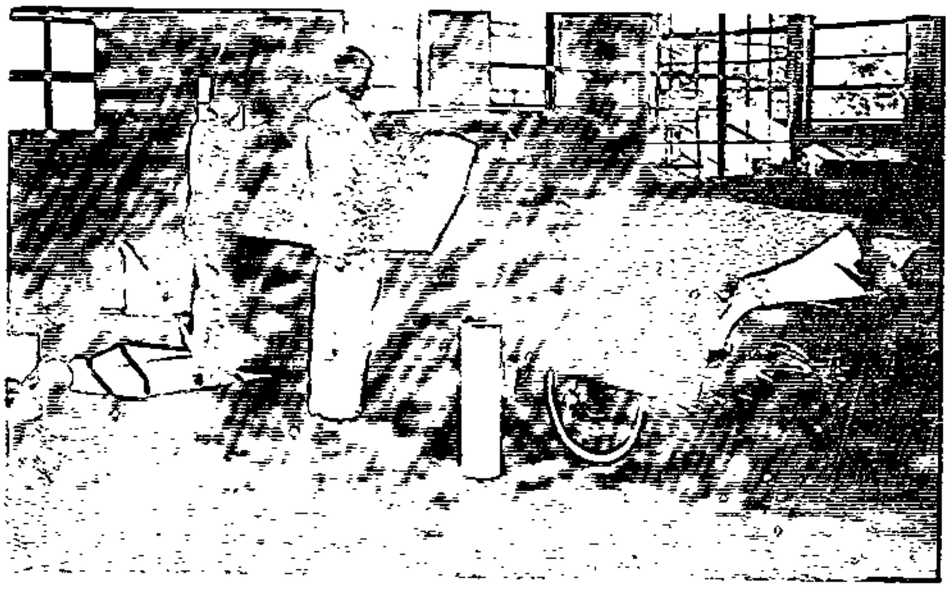


FIG. V-20

The important thing to remember is that it is always easier and better to mask properly, than to remove the paint after the job is finished.

ASSIGNMENT:

1. What is masking? Why is it done?

2. What materials are used in masking?

3. Where should you always begin to mask a part?

4. As you are masking, how should you hold the tape?

5. What is the best method of masking long curves?

6. How can two-tone jobs be masked quickly and easily?

7. Demonstrate to the instructor how you mask the following parts:

    mouldings
    handles
    windows
    windshields
    bumper
    grille
    tires
    two-tone (top covered)
    two-tone (bottom covered)

8. There are some underlined words in the lesson. Find them and give their meanings. Use each of these words in a sentence.

OBJECTIVE: To learn the proper method of metal conditioning.

INFORMATION:

Earlier we spoke about metal conditioning. Now we will go into a little more detail and actually prepare a job. Let us assume we are going to repaint a fender or a quarter panel. The repairs are finished, the job has been washed to remove wax and grease and has been sanded and masked off. Now take some form of metal-etch (metal prep or something similar) and mix it following the directions on the label. Generally this material comes full strength and must be reduced with water before using.

With the reduced solution, soak a piece of cloth and rub the metal vigorously. Do not allow it to dry, but wipe it off immediately with a clean dry cloth (Fig. V-21). If you are working with a metal other than steel, follow the same procedure, but be sure to refer to the materials catalogue, which tells you what kind of cleaner to use. Each type of metal has its own cleaner.

If you are preparing the car for complete refinishing, always start at the top and work down. First, complete the turret top on both sides, then do one half of the hood, cowl, front fender, doors on one side, rear quarter panel, trunk and trunk panels, the opposite quarter panel, doors, front fender and the remaining half of the hood.

FIG. V-21

REMEMBER, always wipe the metal etch off while it is still wet; it will be much easier to remove then, than after it has dried. You will have to use your own judgment as to how much you can do at one time. It is not necessary to wash the painted part of the surface, only the bare metal must be etched.

ASSIGNMENT:

1. Why is it important to condition the metal before applying the paint?
2. Do you use the same kind of cleaner on all kinds of metal?
3. When should you wipe off the metal etch? Why?
4. If you are cleaning the whole car, in what order should you proceed?
5. There are some underlined words in the lesson. Find them and give their meanings. Use each of these words in a sentence.

Cleaning with Solvents

Lesson 9

OBJECTIVE: To learn the proper procedure for doing the final washing before refinishing.

INFORMATION:

Again we are dealing primarily with cleanliness. This cleaning operation is the final one and it is important that no spot be overlooked. The materials needed are: can of cleaning solvent (you will have to learn the trade names as each company makes its own), and two pieces of lint free cloth about eighteen inches square.

Soak one of the cloths well with the solvent and work from the top of the section to the bottom. Before the solvent has had time to dry, wipe it off with the second cloth. This operation must be done quickly, because solvents generally evaporate very fast. Remember, wipe it off while the surface is still wet. As in the dusting operation, always follow a pattern so that you will not miss a section. If the whole car is to be cleaned, start with the turret top and do one side, follow around the quarter panel, trunk, the other side, and finish with the front end. You will have to use your own judgment as to how big a section to wash at one time. Generally the top can be done in four sections, the hood in two, fenders and quarter panel in two or three depending on their size and the trunk in about two. If you notice that the solvent is drying before you have time to wipe it off, then you are trying to do too much at one time, so you must try a smaller section.

Study the diagram (Fig. V-22) which shows you the order to follow in washing the entire car.

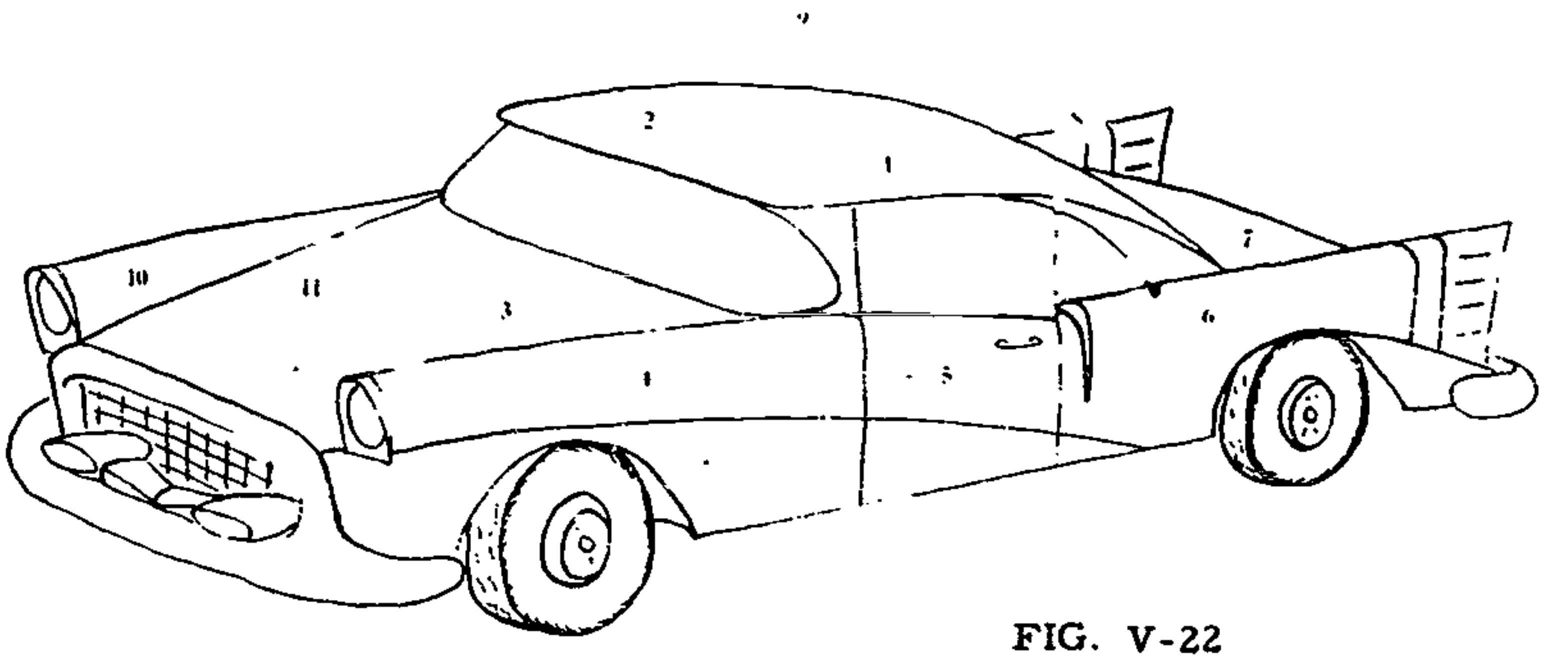


FIG. V-22

ASSIGNMENT:

1. What are the brand names of solvents used in your shop?
2. Do you have to follow a pattern when you clean the car? Why?
3. What must you do if the solvent begins to dry before you can wipe it off?
4. There are some underlined words in the lesson. Find them and give their meanings. Use each of these words in a sentence.

Equipment - Compressor Lesson 10

OBJECTIVES: To understand the importance of a compressor.
To learn to take care of a compressor.

INFORMATION:

What is an air compressor and why do we need it? This machine takes air out of the room and forces it into a tank under pressure. Once we have air in the tank we can use it for many things, dusting under pressure, spraying paint, or operating power equipment.

A good compressor must not have any leaks and it should be large enough to provide all the air that is needed in the shop. Study the different parts which are shown in the photograph (Fig. V-23).

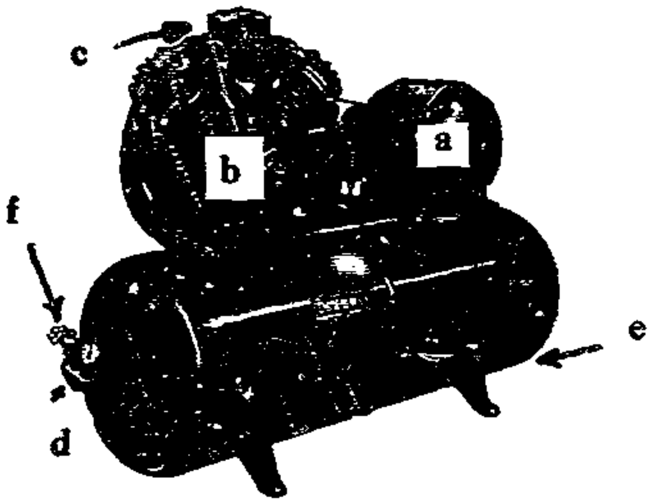


FIG. V-23

a. the motor which drives the machine.

b. the compressor unit, which pumps air into the tank.

c. the air intake where the machine draws air from the room.

d. the pressure gauge which tells how much air pressure is in the tank.

e. the drain cock which allows water to be drained.

f. the shut off valve which stops air from leaving the tank.

Generally the compressor unit has an oil gauge which should be checked regularly. This tells us whether or not there is oil in the pump. Some machines have motors that are packed in grease; others have fittings which need regular greasing. The air intake has a screen which needs cleaning regularly, and finally the water in the tank must be drained, usually each morning before the machine is started.

ASSIGNMENT:

1. What does an air compressor do?

2. What can you do with compressed air?

3. List some of the points on the compressor which require care and tell what you must do.

4. There are some underlined words in the lesson. Find them and give their meanings. Use each of these words in a sentence.

Equipment - Air Transformer Lesson 11

OBJECTIVES: To learn why the transformer is used.
To learn to maintain the transformer.

INFORMATION:

The air that is stored in the tank of the air compressor is piped into the air transformer (Fig. V-24). Some people refer to this as the air regulator or separator. This piece serves two purposes; first it separates moisture and oil from the air; and second, it regulates the amount of air pressure that goes into the spray gun.

Most transformers have two sets of gauges and outlets. One set is called the regulated line while the other is the main line. The regulated line is used for all spraying operations, and the main line is used for operating air equipment. The part of the transformer that separates the moisture and oil from the air is connected only with the regulated line, so for this reason these are the only outlets which should be used for spraying.

In order to do good painting, it is necessary to use different pressures for different types of materials. This can be done on the regulated line only. We have already learned that the major enemies of a good paint job are oil and grease. The next major problem is moisture or water. Water is formed when air is taken from the room and compressed into a tank. This water can be carried from the tank to the spray gun by the hose, and later cause the paint to peel. These destructive substances are eliminated by the use of the transformer.

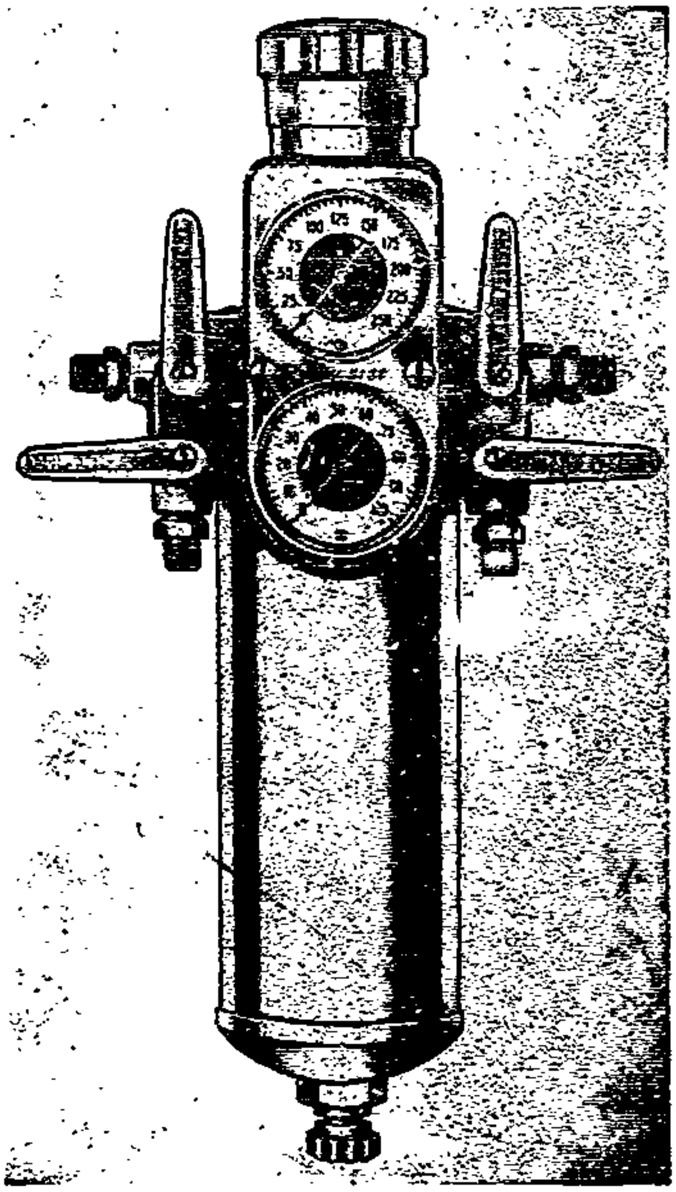
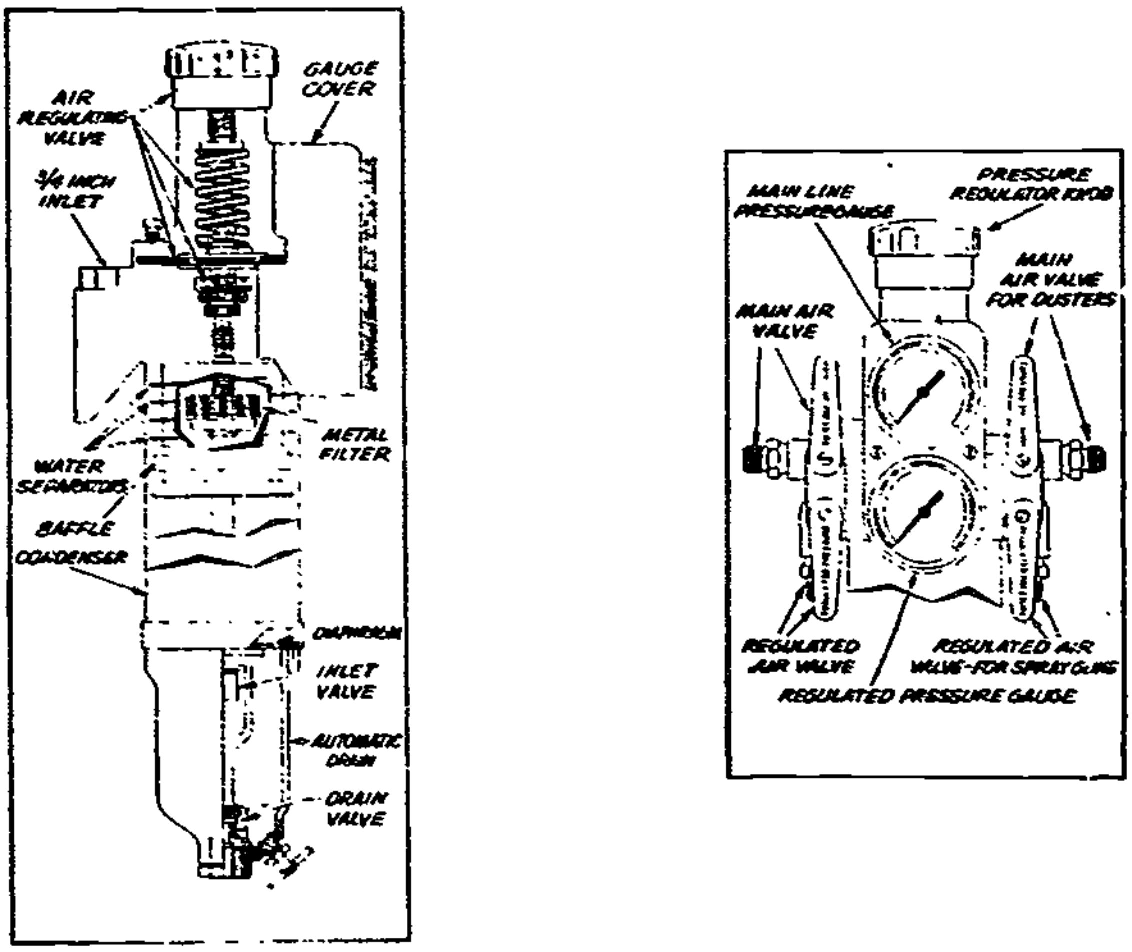


FIG. V-24

Periodically the transformer must be cleaned. This can be done by taking it apart, cleaning it, and replacing the element. Some are merely cleaned by draining at the bottom of the transformer (Fig. V-25). The best time to drain the transformer is in the morning before the air compressor is turned on. Generally this is done at the same time that the compressor is drained. When hooking up for spraying, REMEMBER, always use the regulated line.



AIR TRANSFORMER

FIG. V-25

ASSIGNMENT:

1. Where is the air transformer located?

2. What does the transformer do?

3. What are two other names commonly used for the transformer?

4. When should the transformer be drained? Why?

5. Which line should be used for spraying?

6. What is the other line for?

7. There are some underlined words in the lesson. Find them and give their meanings. Use each of these words in a sentence.

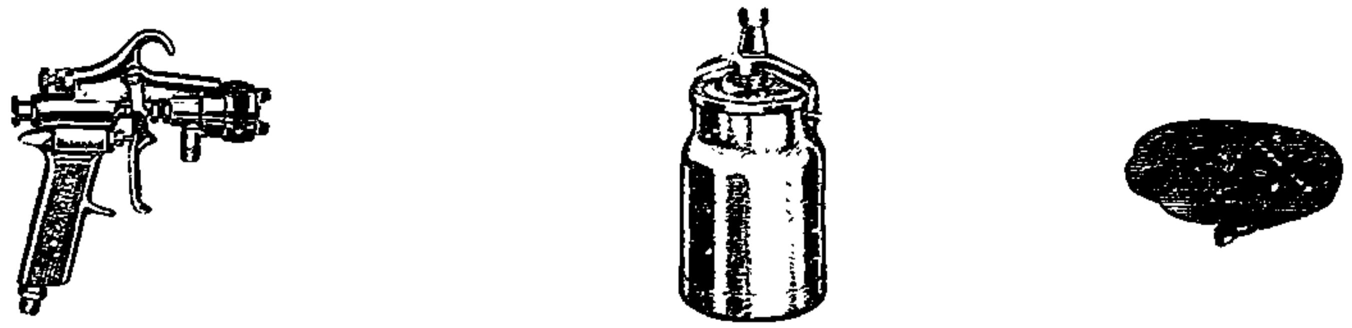
UNIT V - REFINISHING

Equipment - Air Hose and Spray Gun — Lesson 12

OBJECTIVES:
- To learn the use of the hose and gun assembly.
- To learn the parts of the spray gun (general).
- To learn the care necessary with a spray gun.

INFORMATION:

After the air has been compressed, stored, cleaned and regulated, it must be combined with paint to give us the desired finish. This is done by using the air hose and the spray gun (Fig. V-26).



SPRAY GUN — PAINT CUP — AIR HOSE

FIG. V-26

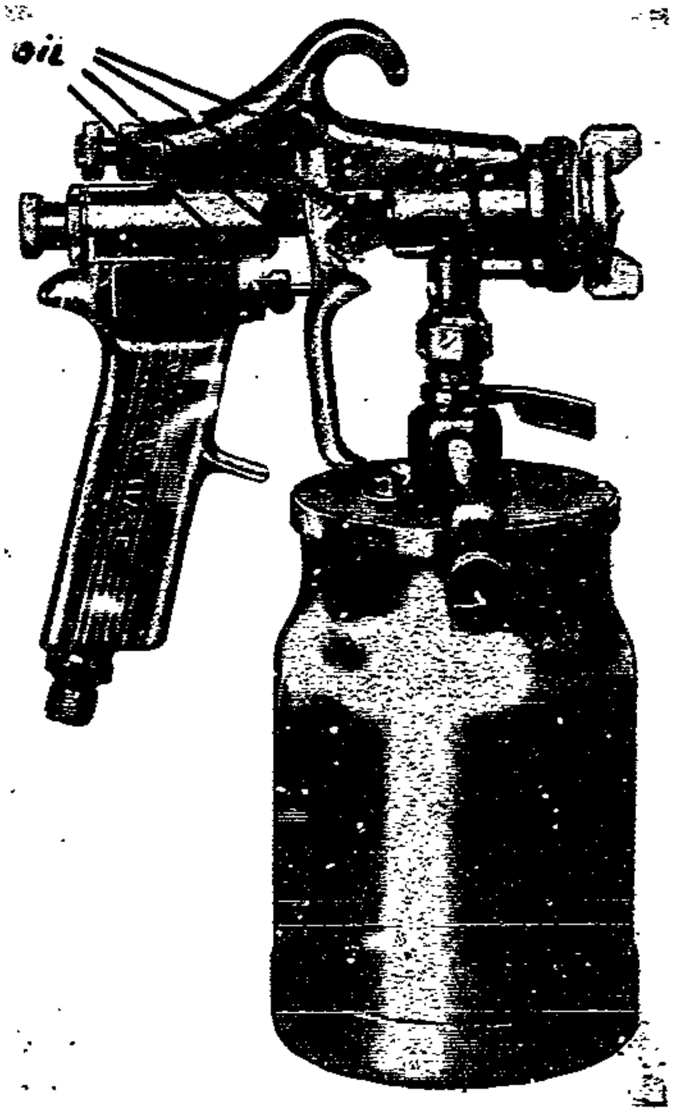
First of all, the hose that is used for spraying must never be used for any other purpose. Pneumatic machines use oil for lubrication. This oil gets into the hose. It can get into the spray gun and mix with the paint and cause many headaches. For the best results the hose size should be at least $\frac{5}{16}$" inside diameter.

The guns that are used in most body shops are the syphon or suction feed guns. There is another type used in factories called the pressure feed. (Fig. V-27)

FIG. V-27

The spray gun is a precision tool and must be treated carefully because a good spray job depends upon a good gun. The most important care which must be given the gun is proper cleaning.

As soon as you are finished painting, remove the paint that is left and pour about a half pint of gun cleaner into the cup. Move the gun in a swirling motion so that the cleaner will remove the paint from the walls of the cup, then spray some of the cleaner through the gun by pulling the trigger. Wipe off the outside of the gun and cup, then remove the cup and clean the inside by wiping. Next pour a little more cleaner into the cup and spray again. This time leave a little in the cup. Remove the air cap and, holding it up to an air outlet, blow it out thoroughly and replace it on the gun. NEVER dip the gun into the cleaner, because of the leather washers which will then dry out and leak. Occasionally a few drops of oil should be placed on the leather washers in order to keep them soft. Use light oil and follow the diagram for lubrication points (Fig. V-28).



LUBRICATION POINTS OF A SPRAY GUN

FIG. V-28

ASSIGNMENT:

1. What type of gun is used in most body shops?
2. What type of gun is used in factories?
3. When should a gun be cleaned?
4. Is it a good idea to dip the gun into cleaner? Why?
5. Should a spray gun be oiled? Where?
6. There are some underlined words in the lesson. Find them and give their meanings. Use each of these words in a sentence.

UNIT V - REFINISHING

Equipment - Respirators and Spray Booths — Lesson 13

OBJECTIVES: To learn the reasons for using a spray booth and respirator. To learn how to use and care for this equipment.

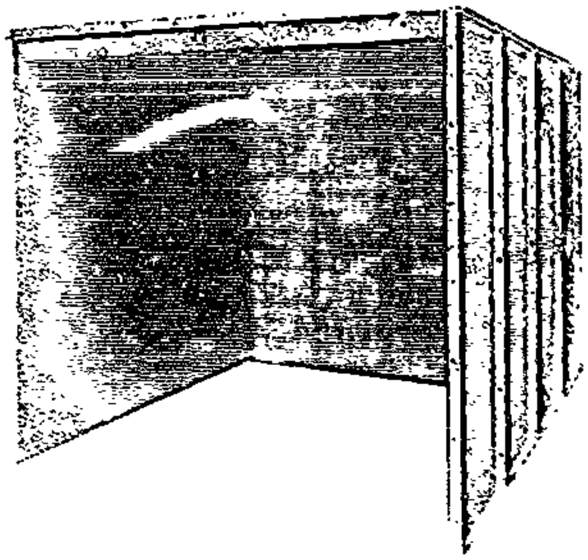
INFORMATION:

The respirator is a safety device that was developed to protect the painter from inhaling fumes while working. The mask, as it is called, must be worn whenever spraying is being done. There are many different types used. Some are pictured here (Fig. V-29).

TYPES OF RESPIRATORS

FIG. V-29

Respirators should be kept in a clean place when not in use and should be cleaned right after using, by wiping with a clean cloth. The replaceable filters should be changed whenever necessary to make them most effective. The respirator is a very personal tool and each person should have his own. If properly used it should have a long life.



FLOOR TYPE BOOTH

TYPE V-30

The spray booth is an ideal place of equipment for use by the painter (Fig. V-30). By placing a job in a booth, much dust and dirt can be prevented from settling on the freshly painted job. The booth also keeps the paint fumes from annoying other workers. There are many different types of booths, but all must have a good exhaust system, lighting, and a system for purifying the air that enters the booth (this applies to the closed booth). The most important care that is required is cleanliness. When necessary the booth should be washed down from top to bottom, so that there will be no accumulation of dust and dirt inside it. The air filters which purify the air that comes into the booth must be cleaned or replaced regularly. If the air filters become too dirty, dust and dirt particles will be drawn into the booth by the fan. This can ruin the paint job. The important thing to remember is to keep it clean. The inside of the spray booth should be painted a light color so that the light is reflected onto the job.

ASSIGNMENT:

1. What is a respirator? What does it do?

2. Should a respirator be shared with others? Why?

3. Give two reasons for using a spray booth.

4. What is the most important thing to do with a spray booth in order to have good results?

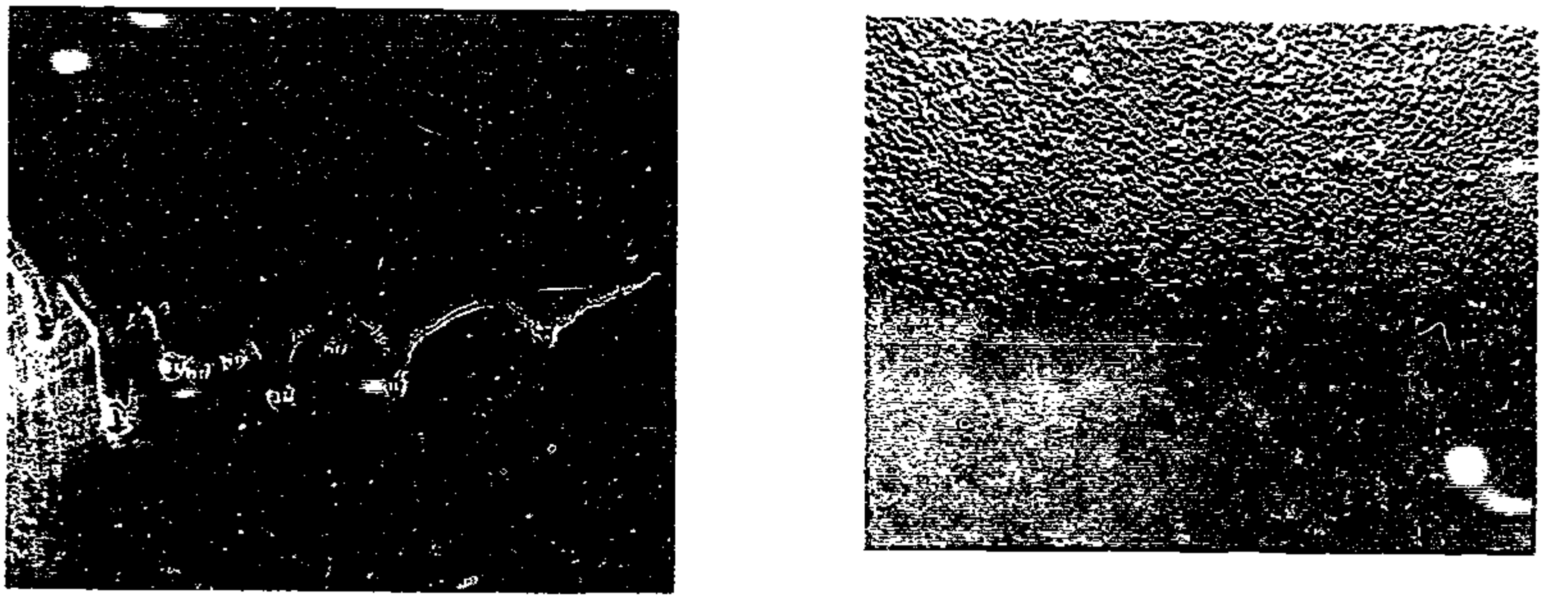
5. How often should air filters be changed?

6. There are some underlined words in the lesson. Find them and give their meanings. Use each of these words in a sentence.

OBJECTIVE: To learn the proper procedure in spraying various shapes.

INFORMATION:

When spraying, whether it be a car, filing cabinet, box or a cylinder, the same basic principles apply. First, mix the paint thoroughly, following the directions on the can, and fill the paint cup. Set the air pressure as recommended on the paint can. There are certain ways to spray different shapes to avoid runs, sags, and dry spots. If the gun is moved too slowly, then runs and sags will appear. If the gun is moved too fast, then dry spots will result (Fig. V-31).

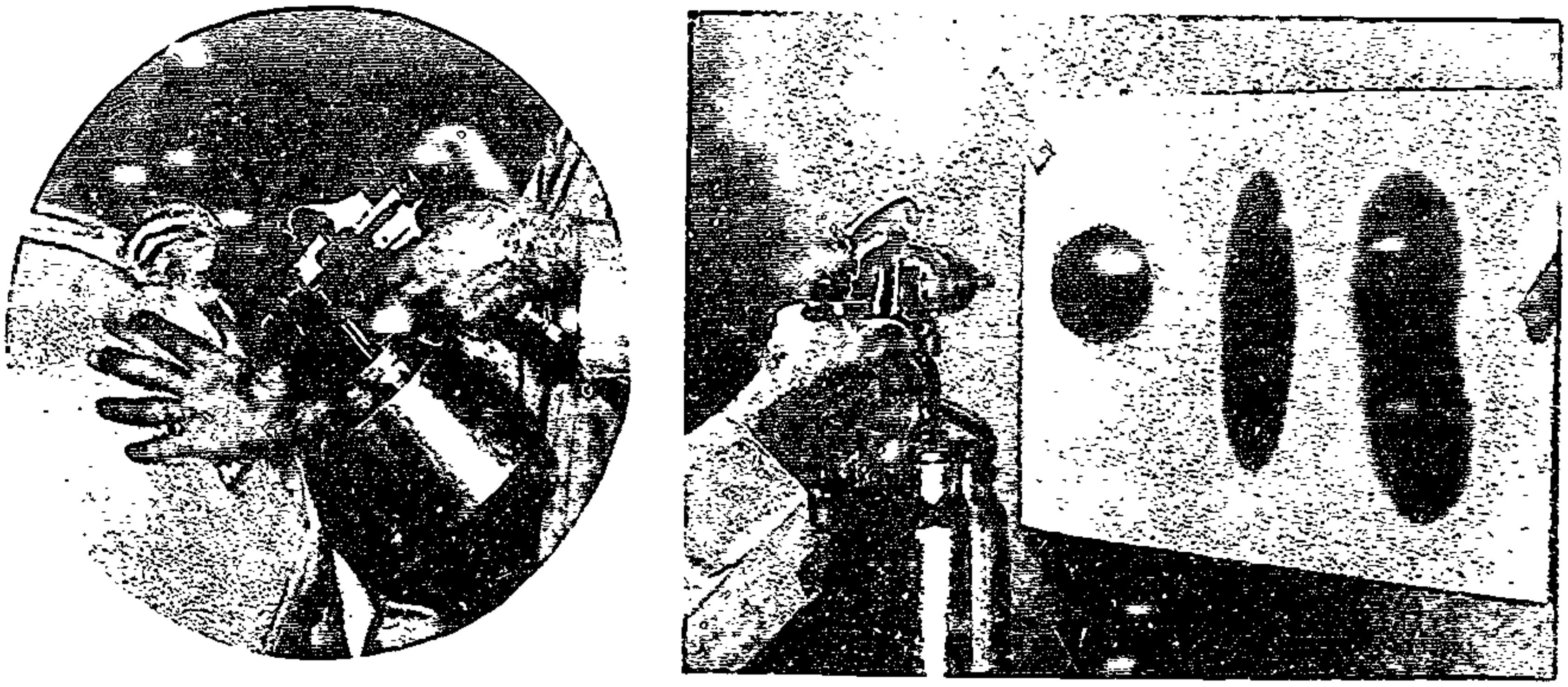


RUNS OR SAGS

DRY SPRAY

FIG. V-31

The spray gun must always be held level, about 6-8 inches away from the job, and must be moved at a moderate rate of speed. The spray gun must be set to the job that you are doing (Fig. V-32).



DISTANCE FROM JOB

SPRAY PATTERN

FIG. V-32

If your project is a flat, wide surface, then you must use the fan spray. This can be done by opening the air regulating knob (A) wide (Fig. V-33).

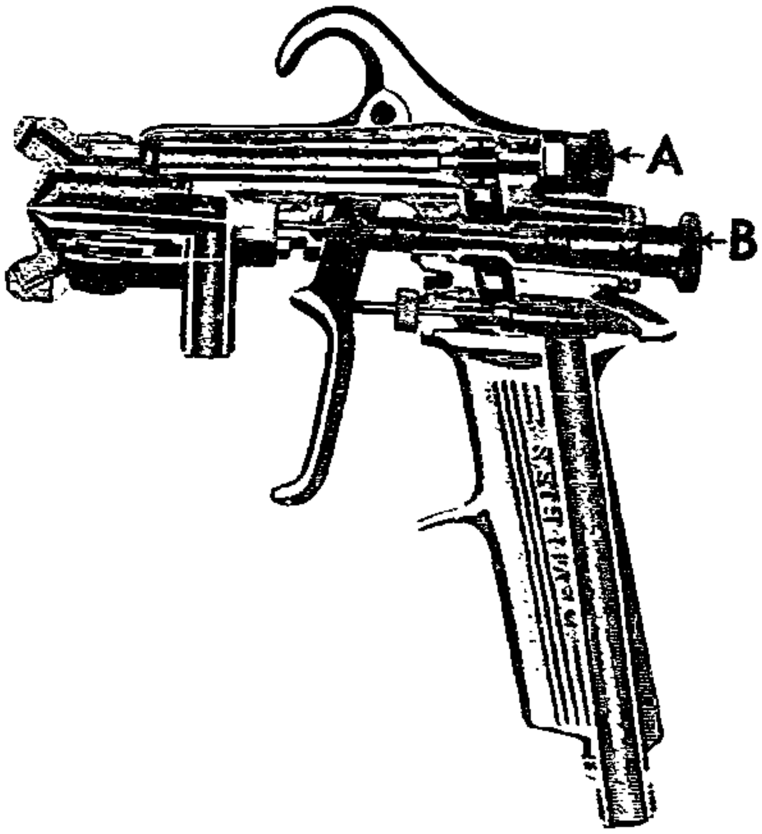


FIG. V-33

If your project is a long, narrow shaped object, then you should you use the round spray. This can be done by closing the air regulating knob (A). By doing this you will cover all that is necessary and yet save paint and reduce overspray. By adjusting the air regulating knob you can obtain the proper spray pattern for the job.

The paint that leaves the gun is regulated by the fluid control knob (B), (Fig. V-33). By turning the knob clockwise you can reduce the amount of paint that comes out of the gun. This is generally done when using the round spray. Turning the knob counter-clockwise will cause more paint to leave the gun. This is generally used when the fan pattern is desired. Study the diagrams carefully with regard to different shapes and methods of procedure (Fig. V-34).

Another small but important detail in spraying is the TRIGGERING of the gun. This means that every time the gun reaches the end of a panel or section, the trigger must be released. When starting on the next stroke, pull the trigger to start spraying again. This is very important to stop runs at the end of a section and also save a great deal of paint. Get into the triggering habit early and your paint jobs will turn out much better.

ASSIGNMENT:

1. What are the two adjustments which control your spraying?

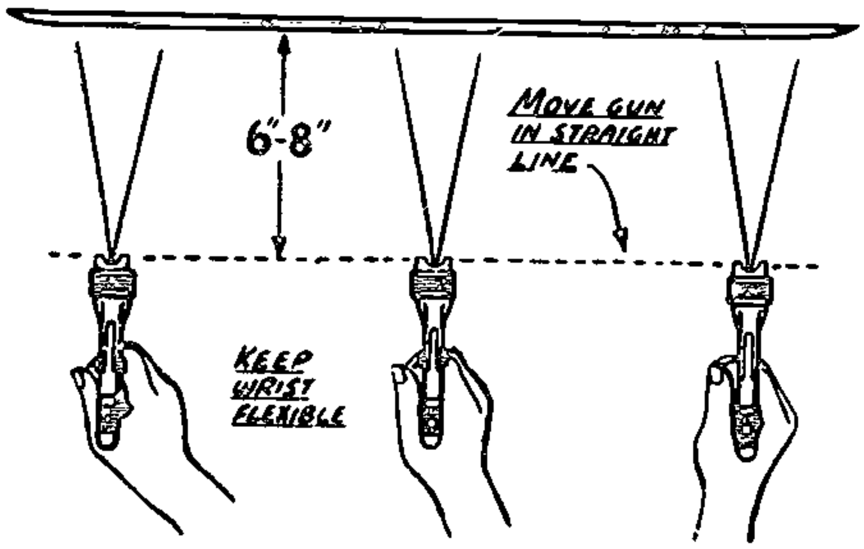
2. How far should the gun be held from the job?

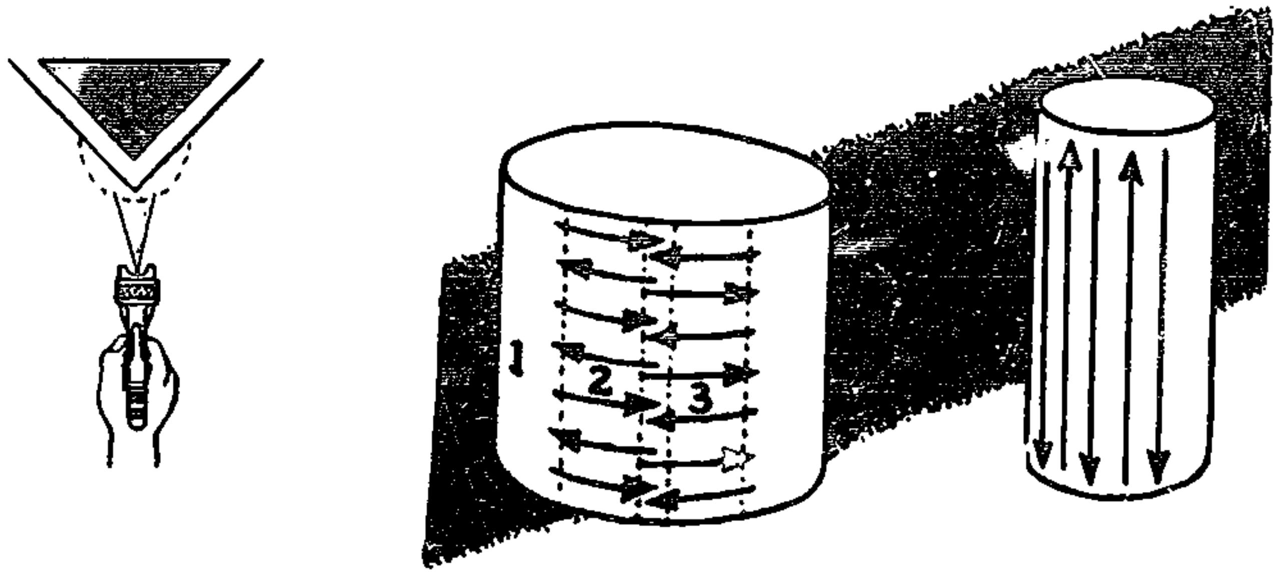
3. When should you use the fan spray pattern?

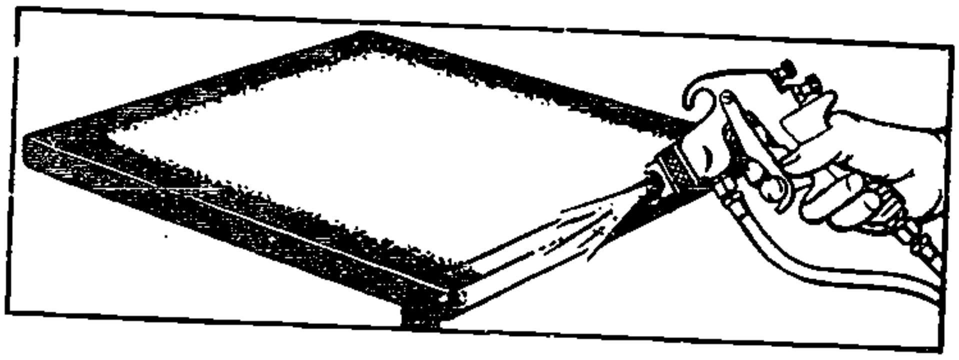
4. When should you use the round spray pattern?

5. What does it mean to trigger the gun?

6. There are some underlined words in the lesson. Find them and give their meanings. Use each of these words in a sentence.







SPRAY DIFFERENT SHAPES

FIG. V-34

Lacquer Spraying (Primer) Lesson 15

OBJECTIVES: To learn the proper procedure in spraying lacquer primers. To review the steps of preparation.

INFORMATION:

You have covered the lesson on how the spray gun works and what you must do to produce satisfactory results. This lesson deals with the specific job of applying the lacquer primer in preparation for the color coats. Be sure that you are familiar with all the material in Lessons #1, 5, 6, 7, 8 and 9.

MATERIALS AND EQUIPMENT:

All the necessary materials and equipment are the same as those for Lessons #1, 5, 6, 7, 8 and 9.

Briefly, let us review the steps of preparation. First, begin by de-waxing the area to be painted by using a solvent which is meant for this purpose. Wash and wipe off with a clean cloth, making sure that more surface is cleaned than the part to be painted. Always clean well into the surrounding areas. Sandpaper the job well, making sure that broken paint areas are feather-edged. Clean the entire area by blowing with the dusting gun and wiping with a clean cloth.

The masking operation is next. All areas that are next to the painted panel, whether they be chrome, glass or other painted panels should be covered. (When spraying lacquer, it is not necessary to cover the whole car.) Wash the bare metal with a metal conditioner (e. g., metal prep) and allow it to dry. Blow out all the corners with the dusting gun and again wash the whole area to be painted with a cleaning solvent (e. g., prep-sol, or klix), and dry off with a clean cloth. The surface is now ready to be sprayed with primer surfacer.

The next step is the preparation of the paint for spraying. Probably the best rule to remember is to read the directions on the can and mix the paint and thinner according to the factory recommendations. With the paint properly mixed, pour it into the cup through a strainer. ALWAYS USE A STRAINER. It is inexpensive and will stop dirt or lumps of pigment from being sprayed on your job. Lock the gun body on the cup and you are ready to begin. Connect the air hose on the gun and to the regulated line on the air transformer, adjusting the pressure for 45 lbs. If you have properly mixed the paint and the temperature is normal in the room (approximately 70°), this is the proper pressure to use with lacquers.

Follow the instructions given in Lesson 14 on the proper adjustment of the gun. Spray the first coat light and allow it to dry. The drying time will depend on the temperature and humidity in the room. When the first coat is dry to the touch, apply a second coat. This time spray it medium and allow it to dry. When the second coat is dry to the touch, apply the third coat (medium) and allow to dry.

Finally, clean the gun as instructed in Lesson #12.

ASSIGNMENT:

1. List the steps in the preparation of the surface.

2. How can you find out about paint reduction?

3. What pressure is generally used for lacquers?

4. What should you do when pouring paint into the cup?

5. When you have finished spraying, show the instructor what you should do.

6. There are some underlined words in the lesson. Find them and give their meanings. Use each of these words in a sentence.

Application of Glazing Putty

Lesson 16

OBJECTIVES: To learn the reason for applying putty.
To learn the proper method of application.

INFORMATION:

After the surface has been coated with primer-surfacer and allowed to dry, it is necessary to look it over carefully. You must look for deep scratches or imperfections in the surface. If such spots show, then we must use a glazing putty to fill them in. Actually putty is a heavy surfacer and is used in place of spraying many coats on the job. Also the putty can be applied to a small spot to eliminate the need for spraying a large area.

MATERIALS AND EQUIPMENT:

Can of putty, flexible steel putty knife (approximately 4" wide), or a rubber squeegee.

The putty can be applied with a steel knife or a rubber squeegee. If the surface is flat, the steel knife is probably better. However, if the surface is curved, a squeegee should be used.

Never apply too much putty at one time. It is better to apply two light coats than one heavy one. It should be remembered that only enough putty should be used to fill the imperfections. If too much is applied, the excess must be removed in order to make it smooth, so remember, apply only as much as is necessary. If you use a steel knife, hold it as shown in the diagram (Fig. V-35).

KNIFE APPLICATION OF PUTTY

SQUEEGEE APPLICATION OF PUTTY

FIG. V-35

First, lay the putty on heavy in one spot with a corner of the knife, then use a wiping motion with the knife to spread and to remove the excess. Do not go over the material more than two or three times, as this material dries fast and it will get rougher each time you go over it. If the surface is curved and you use a squeegee, use the same procedure as with the knife (Fig. V-35).

Immediately after you are finished, wash the knife or the squeegee with thinner so that the putty will not dry on it.

ASSIGNMENT:

1. What is putty?
2. Why is it used?
3. Name two tools for applying putty.
4. How should putty be applied for best results?
5. There are some underlined words in the lesson. Find them and give their meanings. Use each of these words in a sentence.

OBJECTIVES: To learn how to prepare the surface for color spraying.
To learn the proper procedure in spraying lacquer colors.

INFORMATION:

Before the color operation can begin, we must be sure that the primer surfacer is thoroughly dry. The tools and equipment needed are: pail of clean water, sponge, squeegee, sandpaper grit #320, cut and folded as previously shown, and a tack rag.

Sand the entire surface to be painted using parallel strokes in one direction (Fig. V-36). ALLOW THE SANDPAPER TO DO THE WORK. Do not apply too much pressure on the sandpaper and constantly use the water and sponge to flush away the paint particles that have been sanded off. Do not attempt to sand all the primer off. The idea is to leave the primer on, so that the scratches are filled in.

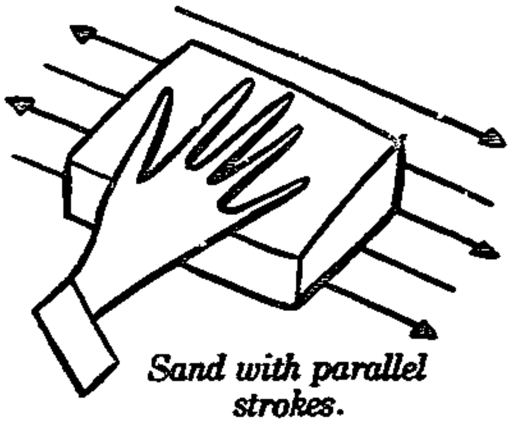

Sand with parallel strokes.

FIG. V-36

After sanding about four to six strokes on one spot, check the area by pulling the squeegee over the sanded part and look at it very carefully. If no scratches appear, then move on to the next spot. If you see scratches, then you must sand a few more strokes and check again, doing this until the whole area is smooth.

When you are satisfied that the sanding is finished, wash the area with the sponge and dry it off. Using the dusting gun, blow out all the joints, especially around mouldings, for this is where water is trapped. Now check the masking to see that it is still in good condition and re-tape where necessary. The surface is now ready to receive the color coats.

Open the can of paint and stir it vigorously until there are no solids remaining on the bottom of the can. Reduce the paint according to the instructions on the can and strain the reduced paint into the spray cup, then lock the cup into place. Hook up the air hose to the gun and the regulated line and set the pressure for 45 lbs. The gun is now ready for use.

Just before spraying, take the tack rag and unfold it. Then make a loose ball and holding it in your hand, wipe off the whole area to be painted. Do not miss any spots as this will show later. The tack rag will pick up all dust and lint leaving the surface perfectly clean. After using the tack rag, do not touch the part that is to be painted.

Use the same procedure as in applying primers and first apply a light coat. Be sure that you do not spray dry as this will leave a rough finished job. After the first coat has set for a few minutes, begin to apply the second coat (medium) and allow time to set. After a few minutes, apply the third coat (medium). Finally, mix about ten parts thinner and one part paint and again coat the entire area with a full wet coat. This will bring a gloss to the area, but be careful not to make runs by applying too much. It will take a little practice to get the feel of the paint and to know how much to apply.

ASSIGNMENT:

1. What grit sandpaper is generally used before applying the color?

2. Why is water used with sandpaper?

3. How is the squeegee used when sanding a job?

4. Why is it important to use a tack rag?

5. How much pressure do you use when spraying lacquer colors?

6. Why do you thin out the last coat?

7. There are some underlined words in the lesson. Find them and give their meanings. Use each of these words in a sentence.

Spraying - Enamel Colors on Panels Lesson 18

OBJECTIVE: To learn the proper procedure in spraying enamels.

INFORMATION:

In order to spray enamels, the same basic preparation holds true as in lacquer spraying. The equipment will be the same as for lacquer work. The surface must be clean, well sanded and masked properly. With regard to masking, however, there is a different pattern which must be followed. The reason for this is that lacquers dry in the air before they land on another surface. Thus they do not stick. However, enamels are slow driers and the paint particles in the air are wet, and as they settle on another surface, they stick and dry. This presents a major problem of removal. The best policy to follow when spraying enamel is to use a large cloth to cover an area, so that the whole car can be covered, leaving only the area to be refinished exposed. Most important, put the cloth on first and use the masking paper on the edge and over the cloth. Cloths must be kept in a clean place when not in use.

With respect to paint preparation, be sure to follow the instructions on the can. Generally the reduction is one part of reducer to three or four parts of paint. Some of the more modern enamels are reduced 50%. Therefore, it is important to read the directions on the paint can. The air pressure is important again; usually the pressure that is recommended is from 45 to 55 lbs. Some enamels are heavier than others and thus need more pressure. It must be remembered, however, that the higher the pressure, the more overspray and the greater the loss of paint. Use only as much pressure as is necessary.

Again, the use of the tack rag is emphasized to eliminate the dust and dirt problem. Always unfold the tack rag and hold it loosely. Wipe in a pattern so that no area is missed.

The application of most enamels require one medium coat and a sufficient amount of time to become tacky. You can tell by touching the paint in a place where it will not show. When the paint does not stick to the finger, it is ready for re-coating. Some of the new enamels require a medium wet coat, which is followed immediately with another medium wet coat.

Always clean the equipment, such as the spray gun and cup, immediately after the spray operation is completed. Do not allow time for it to dry on the gun as this makes it more difficult to clean off.

ASSIGNMENT:

1. What is the difference when masking for enamels and lacquers? Why is there a difference?
2. Are all enamels reduced in the same way?
3. What is the best way to cover a large area on the car?
4. How much air pressure is generally used on enamels?
5. How many coats of enamel do you generally apply?
6. There are some underlined words in the lesson. Find them and give their meanings. Use each of these words in a sentence.

UNIT V - REFINISHING

Brush Painting — Lesson 19

OBJECTIVE: To learn the proper procedure in brush painting.

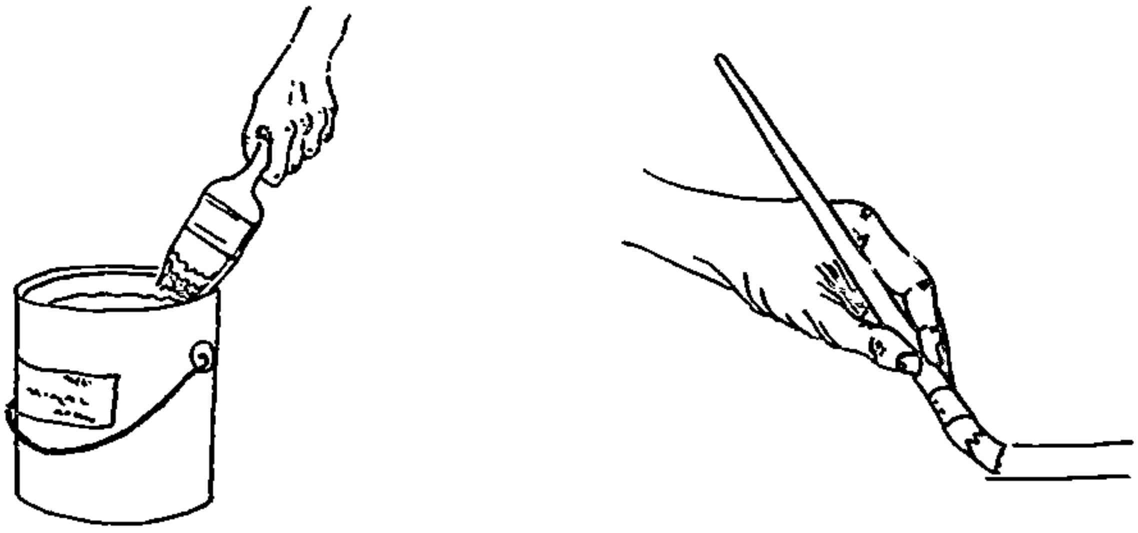
INFORMATION:

When automobiles were first built, they were made of wood. After the car was built, it was taken to the paint shop to be painted. In the early days, there were no spray guns and all the painting was done by hand brush. In fact, there was very little color used. Most of the car was shellacked and varnished. As paints were developed and improved, the makers began to apply color to cars, but still by using the hand brush method. There were very few chrome parts on the car so most of the trim was done by striping with a bright color. This, too, was done by hand.

Today, the brush is used sparingly because of the time involved. However, some paint shops use the brush for door jambs, cowl sections under the hood, or underneath the trunk section. The small camel hair striping brush is used for touching up some small nicks which do not require spray painting.

When used for brushing, the paint must have the proper viscosity. It should be heavier than when being sprayed, but not as heavy as when it comes in the can from the factory. Use your own judgment on the reduction, but generally the amount of thinner used is only half of what is required in the spray operation. Dip the brush into the paint so that half the brush is covered with paint. Then wipe off one side on the inside edge of the can. Place the side of the brush with more paint on it, against the surface and without pushing too hard, pull the brush slowly along the surface and then work it back and forth about three or four times. The brush should be held at a 45° angle to the surface being painted (Fig. V-37). When the paint has been worked out of the brush, dip it into the paint as before and proceed until the entire surface is finished.

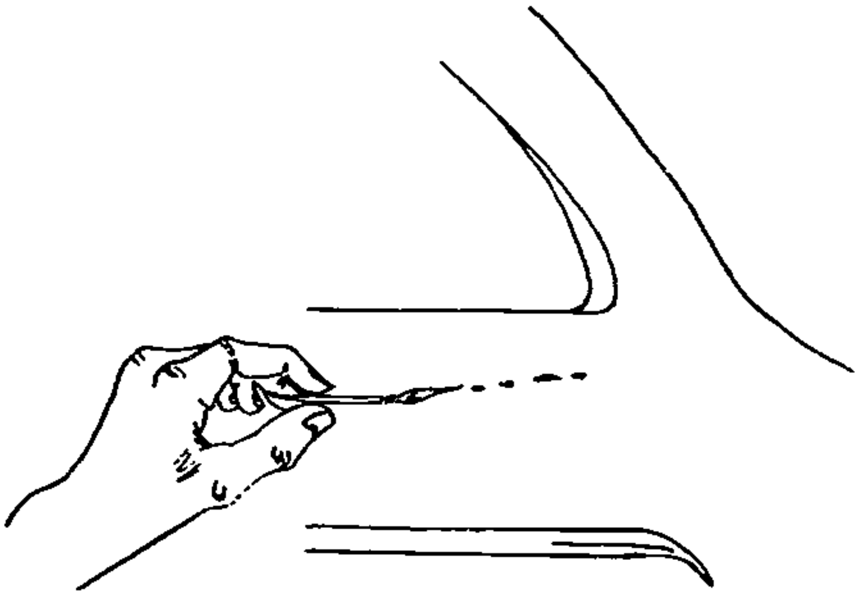
Always be careful not to put paint on any chrome part or upholstery. A little practice and you will be able to work to the edge without any trouble. At first, however, take your time and stay away from the edge. Gradually work over to it, until you feel confident that you will not smear the other parts. As in spraying, when you are finished with your job, always clean the brush immediately with thinner or reducer.



PAINTING WITH A BRUSH

FIG. V-37

When doing touch-up work, use a camel hair striping brush and work with the tip of the brush, applying only enough paint to cover the spot. Do not use a brush motion on small chips. Just dab it lightly with the tip and if too much paint is applied, wipe it off and do it again (Fig. V-38).



TOUCHING UP CHIPS

FIG. V-38

ASSIGNMENT:

1. How were cars painted before the spray gun was invented?

2. Where is the brush used today?

3. At what angle should the paint brush be held when painting?

4. What kind of brush do you use for touch-up work?

5. What part of the brush is used for touch-up work?

6. There are some underlined words in the lesson. Find them and give their meanings. Use each of these words in a sentence.

UNIT V - REFINISHING

ACHIEVEMENT TEST

1. Name the fast drying paint. slow drying paint.

2. Name three materials that are put under the color coat.

3. Name three solvents used in automobile refinishing.

4. Give two reasons for sandpapering.

5. Demonstrate to the instructor the following operations:

   Cutting and folding a sheet of sandpaper
   Feather-edging
   Using a dusting gun
   Masking a front fender
   Masking a door window
   Masking a chrome trim
   Metal conditioning

6. Name the three most important parts of the spray outfit.

7. Give some reasons for using a spray booth and respirator.

8. Demonstrate to the instructor the following operations:

   Spray a square box or cabinet
   Spray a cylindrical object
   Spray primer on a fender
   Apply glazing putty on a small area
   Wet-sandpaper a primed area
   Spray a small area using lacquer color
   Spray a small area using enamel color

9. Give ten new words that you have learned in this unit.
   Use each in a sentence.

UNIT VI - CARE OF THE FINISH

Polishing — Lesson 1

OBJECTIVES: To learn the reasons for polishing.
To learn the proper method to use in polishing.

INFORMATION:

The automobile and paint manufacturers realize the amount of time and money that is spent on the preservation of the finish and are constantly trying to perfect finishes which will eliminate the need for polishing.

The enamels used today on most cars require little or no polishing. However, as the car is exposed to weather and road conditions, a haze forms over the surface which must be removed periodically. This can best be done by using a non-abrasive polish (e.g., liquid). Abrasive polishes will tend to dull the finish of enamels and should not be used.

The lacquers that are used today on most General Motors cars require some polishing in order to brighten the finish. As lacquer is exposed to the weather, the surface tends to become chalky. This condition must be removed with abrasive polish (e.g., rubbing compound).

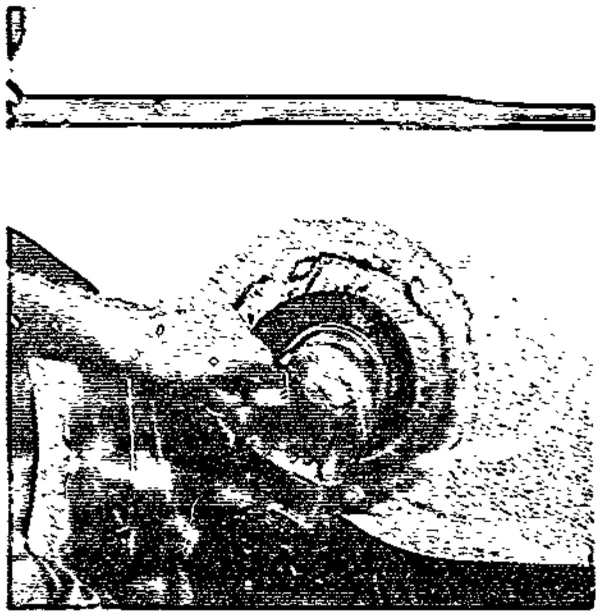
The latest type of paint, the acrylic lacquers, supposedly need very little polishing. However, here again as the finish is exposed, it will tend to dull. A cleaning with a good grade of polish will restore its original appearance.

The materials and equipment needed for this operation are: an abundant supply of soft, clean rags; a good grade of polish or compound, and an electric buffer.

When using compound always work from the top down. Do only a small section at one time so that the polish will not dry too soon (approximately two to three feet square). Apply polish to the cloth and rub it on the surface in one direction only. At all times be sure that the cloth does not become wrinkled. If you have wrinkles on the cloth, as you rub, marks will appear in the finish. Rub evenly all over, but stay away from the edges and corners as a very small amount of rubbing at these points will take the paint off and then the primer will show through. You must continue to rub and burnish until most of the polish has been worked off, then you will see a shine building up on the paint. Next, turn your cloth over or take a clean piece and wipe it clean, always rubbing in one direction. Proceed in this manner until the entire surface has been completed.

To complete the job, use the buffer with a lamb's wool bonnet and shine the whole car working from top to bottom following the directions given next. (Fig. V-39)

When using liquid polish it is much faster to use an electric buffer.



ELECTRIC BUFFER

FIG. V-39

First, fill the machine with a machine polish and plug it in. (Machine switch must always be off.) Make sure that there is no water on the floor when using an electric tool. If you stand in water you can get a severe shock. Always hold the buffer securely with two hands and keep your attention on the job. Apply the polish and spread it over the section. Keep the bonnet flat until all the polish has been rubbed off. Then tilt the buffer slightly so that the clean part of the bonnet will shine the paint. As you use the buffer, remember to stay away from corners as at these points the buffer can very quickly remove the paint. Follow the same pattern as with hand rubbing, working from the top down and doing a small section at a time. When the whole car is finished, wipe it off with a clean soft cloth.

ASSIGNMENT:

1. What is the difference between a rubbing compound and a liquid polish?
2. Which polish do you use for enamels?
3. Which polish do you use for lacquers?
4. Why should you stay away from corners and edges?
5. When polishing, where should you start?
6. What must you be careful of when using the buffer?
7. There are some underlined words in the lesson. Find them and give their meanings. Use each of these words in a sentence.

UNIT VI - CARE OF THE FINISH

Waxing Lesson 2

OBJECTIVES: To learn the reason for waxing.
To learn the proper procedure when waxing.

INFORMATION:

After a car has been thoroughly cleaned and polished, it is best to preserve the finish by applying a coat of wax. If you were to look at the finish under a microscope, you would see that some paint surfaces are porous. In order to seal this type of surface and protect it from the elements, wax should be used.

There are many types of auto wax on the market. Some are liquids, some are in a paste form, some are sprayed on while others are applied with a piece of cheesecloth. Whichever type is to be used, be sure to follow the directions on the can. You will need a good grade of wax and a good supply of cheesecloth or other soft rags.

Perhaps it might be mentioned here that the car should be examined carefully and all nicks and chips in the paint should be touched up with a camel hair brush before the waxing is started. Follow the same procedure as in polishing and work from the top down and do a small section at one time (approximately two to three feet square). If a paste wax is used, first apply the wax in a circular motion (approximately 6" circles) and cover the section you are working on. Then without waiting, wipe it off with a clean soft rag. After you have most of the wax off, take another piece of soft rag and finish wiping and shining. Proceed in this manner until the whole car has been waxed. Be sure not to miss any spots. As you wax, coat the chrome mouldings, too. Finally, clean the windows with clean water and rags, being careful not to smear the waxed surface.

ASSIGNMENT:

1. What does wax do to the finish?

2. When should the chips and nicks be touched up?

3. Where should you start to wax a car?

4. When should you clean the windows?

5. There are some underlined words in the lesson. Find them and give their meanings. Use each of these words in a sentence.

UNIT VI - CARE OF THE FINISH

Interior Care Lesson 3

OBJECTIVES: To learn what care is to be given to the interior.
To learn the proper procedure for cleaning the interior.

INFORMATION:

The interior of an automobile contains many different types of basic materials. The floor rugs are made of rubber or wool, the seats are covered with fabric or plastic, the instrument panel is primarily steel with some plastic and leather, the trim panels on the doors are fabric, plastic, or leatherette, and the garnish mouldings are generally steel.

All of these materials require different care. The painted steel can be cleaned and waxed. The leather should be cleaned with a mild soap and warm water, the fabric upholstery and rugs can be brushed or vacuumed.

Generally we begin by brushing and vacuuming the seats and upholstery thoroughly. Next we wash the leatherette with mild soap and warm water, clean and wax the instrument panel and garnish mouldings, and finally clean the glass with clean water and rags.

For grease stains on the upholstery, probably the best cleaner is carbon-tetrachloride. If you use this cleaner, be sure that the doors of the car are open for ventilation. The fumes of carbon-tetrachloride can overcome you if you are in a closed car. When you are working on the inside of the car, always be sure that your clothes and hands are clean. . It is wise always to use a cover over the seats so that the upholstery is not stained.

ASSIGNMENT:

1. Name some of the basic materials used in the interior of an automobile.
2. What can you use to remove grease stains from upholstery?
3. Why must you open doors of the car when using this cleaner?
4. There are some underlined words in the lesson. Find them and give their meanings. Use each of these words in a sentence.

UNIT VI - CARE OF THE FINISH

ACHIEVEMENT TEST

1. Name examples of abrasive and non-abrasive polishes.

2. What kind of polish is used on lacquers? enamels?

3. Why is wax used on the automobile?

4. Demonstrate to the instructor the following operations:

   Polish a fender with a lacquer surface

   Polish a fender with an enamel surface

   Polish a fender using a buffer and liquid polish

   Clean the interior of a car

   Remove spots from trim panel

5. List five new words that you have learned in this unit. Use each of these words in a sentence.

UNIT VII - METAL REPAIR

Basic Body Repair Tools — Lesson 1

OBJECTIVES: To identify the basic tools used in the auto body shop.
To learn how to care for hand tools.

INFORMATION:

The tools of the modern body repair shop have been developed over the years to meet the needs of collision work. From year to year, changes in the design of the auto make it necessary for new tools to be developed which will suit the needs of the body repairman. Actually there is no set of tools which can be considered essential. A great deal depends upon the mechanic and how much he can do. This will determine how many tools he should have. You will find listed here the most common tools and the ones used most often. As operations become more complex, additional tools will be introduced (Fig. VII-1).

1. dinging hammer
2. pick hammer
3. combination spoon
4. bumping hammer
5. spoon dolly
6. combination dolly
7. heel dolly
8. toe dolly
9. body file (flat)
10. body file (convex)

With respect to the care of hand tools, the most important item is the proper storage when they are not in use. Hand tools have a long life if they are used properly. Most of the time small hand tools become lost or are misplaced. You will find that tools are expensive and replacement is an expense. The working surfaces of metal repair tools are the most important parts. They must be kept smooth and shiny at all times. If there are any marks or nicks on the face of the hammer or dolly, these will be transferred to the metal that is being hammered. You must constantly check the face of the dinging hammer and dolly blocks to see if any marks are apparent. The best way to remove these marks is to use a piece of 100C sandpaper. Holding it in the palm of your hand, rub the face of the hammer against the paper with a circular motion. You must try to keep rust from forming on the steel faces of the tools as it will cause pits in the steel and leave marks on the surface that is being straightened.


1
2
3
4
5
6
FAIRMOUNT
7
8
9
FAIRMOUNT NO.1120
FAIRMOUNT NO.1127
10

FIG. VII-1

The body file is another important tool which must be handled very carefully. NEVER drop the file, for if it is dropped small chips will be knocked out of the teeth and then scratches will be made on the metal as you are filing. On tools that are not used frequently, a thin film of oil will protect the steel from rusting.

ASSIGNMENT:

1. Match the following names with the tools that are pictured:

   ( ) body file (convex)
   ( ) dinging hammer
   ( ) bumping hammer
   ( ) combination dolly
   ( ) pick hammer
   ( ) spoon dolly
   ( ) combination spoon
   ( ) body file (flat)
   ( ) heel dolly
   ( ) toe dolly

2. What is most important with regard to hand tools?

3. How can nicks be removed from the face of the hammer and dolly?

4. What damages the body file more than any other thing?

5. How do you prevent rust from forming on tools?

6. There are some underlined words in the lesson. Find them and give their meanings. Use each of these words in a sentence

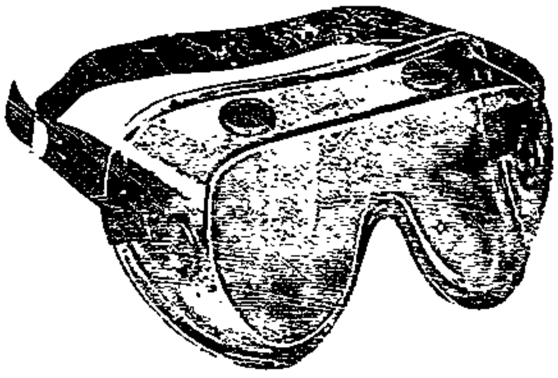
UNIT VII - METAL REPAIR

Operation of the Electric Sander — Lesson 2

OBJECTIVES: To learn the proper method of using the electric sander. To learn the safety procedures to follow when using the sander.

INFORMATION:

One of the most dangerous machines in the shop is the one that you will use the most often. This is the electric sander. Do not be afraid of this tool, but at the same time never become overconfident and careless. Whenever you use a sander you must wear safety goggles (Fig. VII-2). The machine must be held firmly but not so tight that you are tense. When using the sander never allow yourself to become distracted, for it takes only a fraction of a second to have an accident. Observe the illustration showing you how to hold the sander at all times (Fig. VII-3).



SAFETY GOGGLES

FIG. VII-2

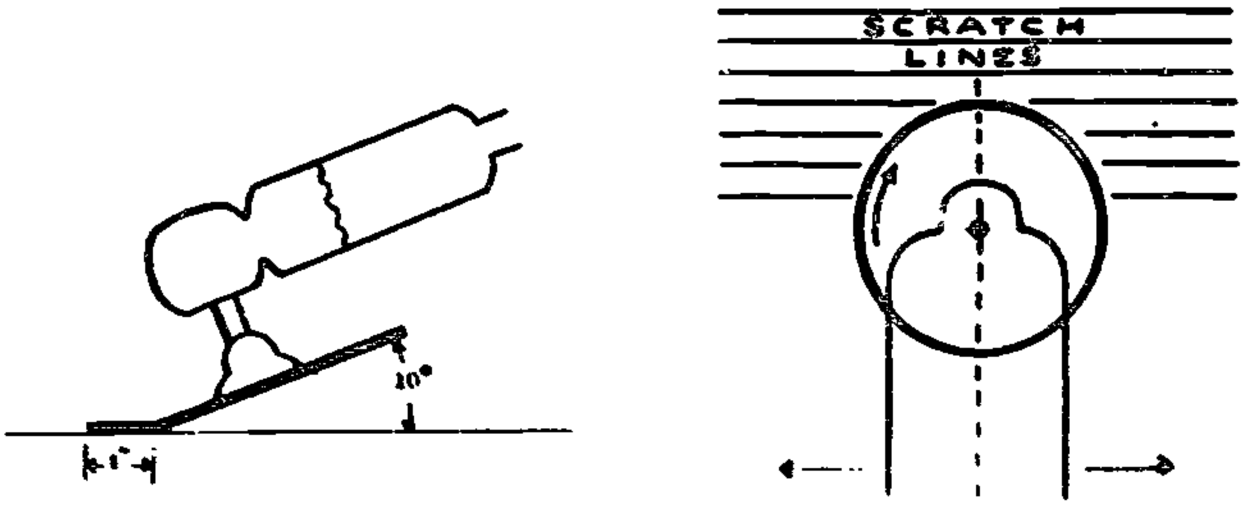
USING THE ELECTRIC SANDER

FIG. VII-3

You must always be conscious of the electrical wire and never allow it to become entangled with the disc. NEVER stand in water when using the sander, as you can receive a severe electrical shock if you do.

The discs that are available for the electric sander must be selected to suit the job that you are doing. The most common grits used are the #24, #36, and #50. After an average repair job you should start with a #24 or #36 and finish off with a #50 disc to give your job a smooth finish. If you are trying to remove paint from a surface, use open coat discs made for this purpose. Open coat discs will not clog as easily as will the metal cutting discs. These also come in various grits. Study the books and pamphlets issued by the manufacturers and they will tell you what discs are sold and the way they are to be used.

As in filing, always use a long stroke and never cross the stroke unless the shape of the panel makes it necessary. Look at the illustration which shows you the proper method of sanding. Also be very careful of any glass or chrome parts that may be near. If the disc strikes any of these parts, they can be ruined (Fig. VII-4).



PROPER METHOD OF SANDING

FIG. VII-4

When sanding, always stand behind the machine so that the sparks will fly away from your body. Remember, the main purpose of the sanding operation is to remove deep scratches and slight irregularities in the metal so that the surface may be prepared for painting more easily and more quickly.

ASSIGNMENT:

1. What must you always wear when using the electric sander?
2. Why must you always be careful of the wire?
3. Should you use the electric sander if you are standing in water? Why?
4. Name some of the grits and discs used in the shop.
5. Which way should the sparks be going if you hold the machine properly?
6. What is the main purpose of sanding?
7. There are some underlined words in the lesson. Find them and give their meanings. Use each of these words in a sentence.

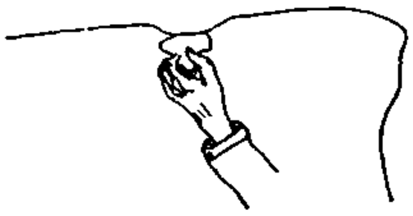
Fenders (Curved Surfaces) Lesson 3

OBJECTIVE: To learn the proper way to remove a small dent in a fender with a curved surface.

INFORMATION:

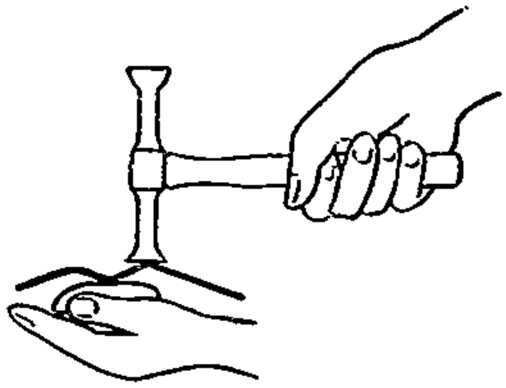
Probably the most important phase in automotive collision work is the proper technique applied to the straightening of dents in the metal. The rule that should never be forgotten is that we should remove the dent with as little hammering as possible. The more times the surface is hammered, the more chance there is that stretching will take place. Before starting to hammer a dent, always study it and try to determine how the dent went in. This is very important because it should be removed in the reverse way from which it went in. The tools that you will need are: dinging hammer, the three basic dolly blocks (combination, flat, and heel), body file, scraper, and wire brush.

With the help of the wire brush and scraper, clean the underside of the dent to be straightened. Now take the combination dolly and hold it at its smallest end and slowly tap out the dent with the flattest side of the dolly from underneath (Fig. VII-5). Do not try to knock it all out at one time, but tap it gently at first and if it does not move, then tap it harder until it comes out. Be careful not to put more dents into the metal because every dent will tend to stretch the metal. With the dent roughed out, take the dinging hammer and lightly begin to tap the high spots, while you hold the dolly under the low spots (Fig. VII-6).



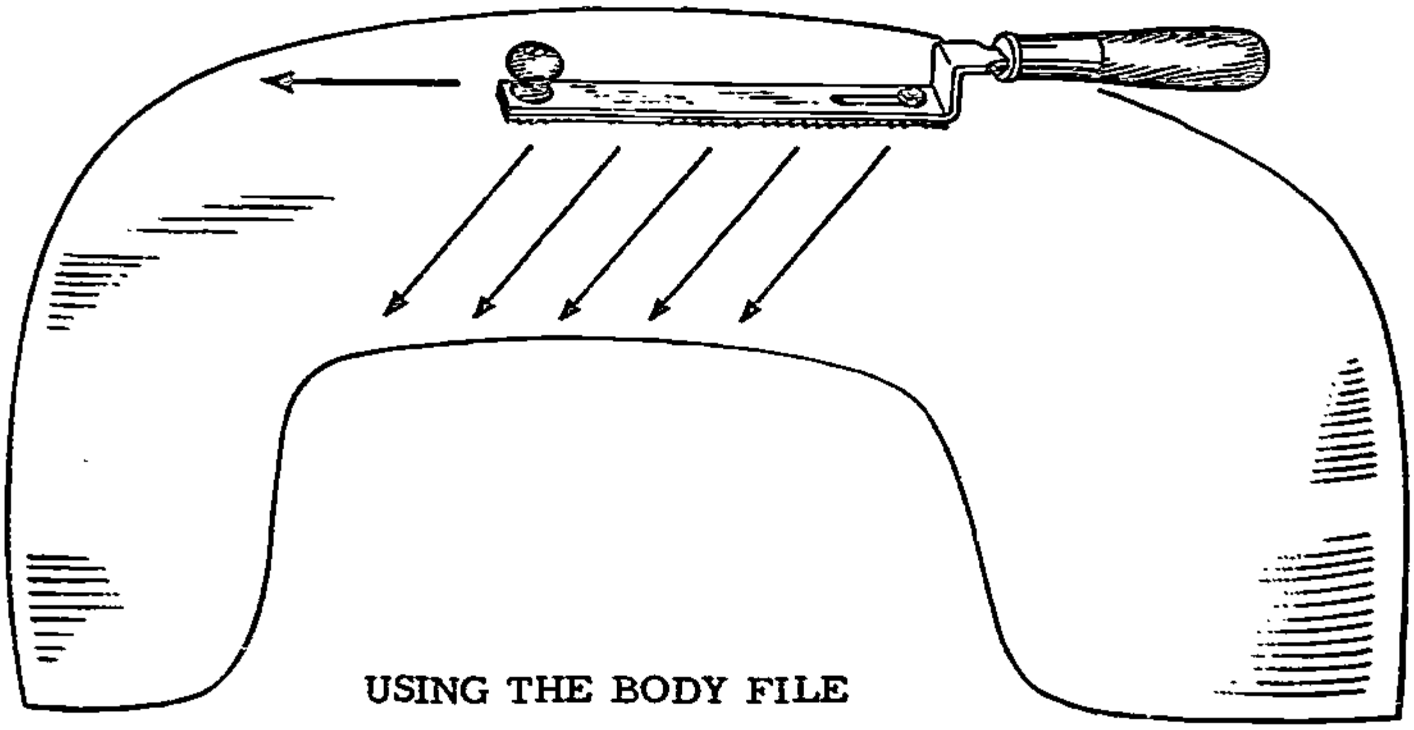
ROUGHING OUT THE DENT

FIG. VII-5



EQUALIZING THE DENT

FIG. VII-6



USING THE BODY FILE

FIG. VII-7

The hammer must always hit the surface squarely so that nicks are avoided. Doing this will equalize the surface to a minimum of high and low spots. Next select the dolly that best fits the surface in its original form and slowly begin to tap with the dinging hammer, holding the dolly directly under it. As has been mentioned, do not hammer too much or too hard because every blow of the hammer will stretch the metal more and more. Continue tapping directly over the dolly until the surface feels reasonably smooth in your hands. In checking the surface with your hands, always use the palm of the hand and not the finger tips. Keep checking frequently and tap more as it is needed. REMEMBER, the secret lies in how little you hammer, not how much.

When the surface feels fairly smooth, take the flat body file and begin to file in long, even strokes, filing only once in each spot (Fig. VII-7).

When the whole dented area has had a once over, look at it carefully. The places where the paint has been taken off are the high spots and the areas where paint remains are the low spots. Take one of the dolly blocks and using one of the corners or points, gently tap up on the low spots. How hard you must strike it, depends upon the depth of the low spot. Obviously, if the low spot is slight, a mere tap will be enough. This can be checked by running the file over the adjusted spot. If the paint comes off then it is just right. If the paint still remains, then you must tap and file again. Be very careful on this operation as it is very easy to stretch the metal by hitting it too hard. Proceed with this process until the dented area has had all its paint removed. Now you have equalized the high and the low spots. CAUTION: Do not file repeatedly in one spot. It is possible to file a hole in the metal quite quickly.

After the metal has been filed, it is ready to be sanded with the electric sander. First, use a #36 disc and follow the directions in the previous lesson. When you have done this, go over the area with a #50 disc. Remember to hold the sander in the proper manner and always use safety goggles.

ASSIGNMENT:

1. Is it true that the more you hammer on the job the better it will be? Why?
2. Before you start to straighten a dent, what should you do?
3. Which hammer do you use to remove dents?
4. After knocking out the dent, where do you hold the dolly in order to equalize the dent?
5. After knocking out the dent, where do you strike the hammer in order to equalize the dent?
6. What does the file tell you?
7. How do you correct the high and low spots?
8. Which disc would you use first on the sander? Which second, and why?
9. There are some underlined words in the lesson. Find them and give their meanings. Use each of these words in a sentence.

Fender (Flat Surface)

Lesson 4

OBJECTIVE: To learn the proper way to remove small dents in a fender with a flat surface.

INFORMATION:

After you have repaired a dent in a curved surface, you will be given a dent to repair in a flat surface. The same basic principles apply. However, with a flat surface you must be extra careful because of the stretching. A flat surface will stretch much more easily than a curved surface, and more important, it is more noticeable.

The same tools will be required as in the previous lesson: dinging hammer, three basic dolly blocks, scraper and wire brush, body file, and the electric sander. Start by cleaning off the underneath side of the surface to be straightened. Begin to bump out the area as shown in the diagram (Fig. VII-8). When the dent has been roughed out, proceed to tap down the high spots with the hammer while you hold the dolly underneath the low spots (Fig. VII-9). You must always select the dolly that fits the shape of the panel because as you hammer the surface, it will take the shape of the dolly.

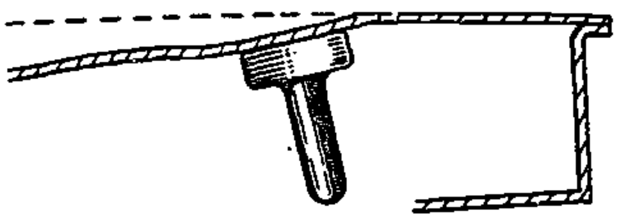


FIG. VII-8

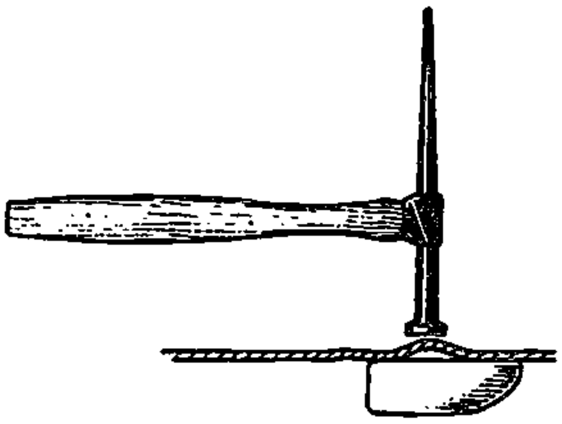
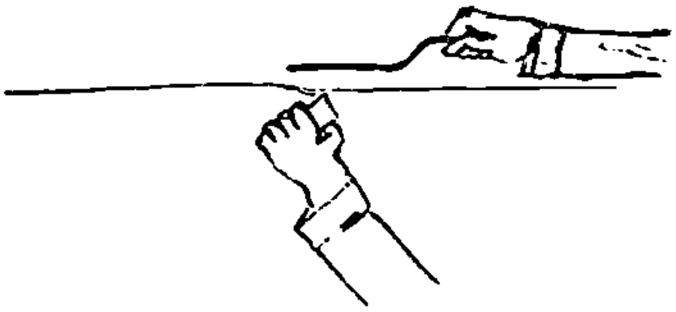


FIG. VII-9

Check the surface with your hands often, and when you feel that it is smooth, begin to use the body file and find all the low spots. Now you must adjust the low spots and re-file until all of the low spots have been eliminated. On flat areas you may prefer to use the fender slapper. This can be used for raising low spots instead of tapping them up with a dolly or hammer. Hold the point of a dolly block under the low spot and tap the top with a fender slapper once or twice.

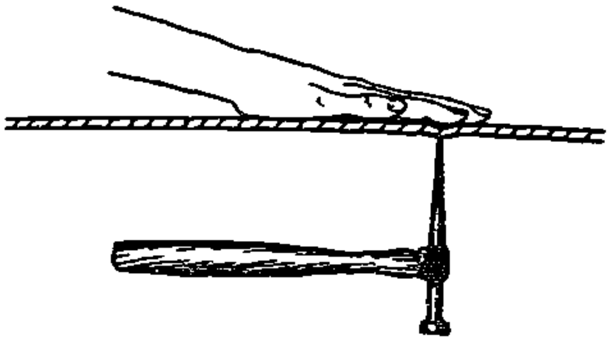
Upon checking with the file you will see that this raises the low spot (Fig. VII-10).



RAISING A LOW SPOT WITH THE SLAPPER

FIG. VII-10

Another method of raising low spots is to use the pick hammer. By lightly tapping the surface underneath the low spot, it can be raised easily (Fig. VII-11).



RAISING A LOW SPOT WITH A PICK HAMMER

FIG. VII-11

When you have finished filing, follow the directions given in the preceding lesson and use the electric sander until the area is smooth. Again, be careful with the sander and do not bump into chrome, glass, or painted area which does not need painting.

ASSIGNMENT:

1. Is the flat surface easier or harder to repair than a curved surface?

2 Name three ways of raising a low spot.

3. How do you select the proper dolly?

4. What can happen if you file in one spot too much?

5. Name two new tools introduced in this lesson.

6. There are some underlined words in the lesson. Find them and give their meanings. Use each of these words in a sentence.

Use of Hydraulic Jack Lesson 5

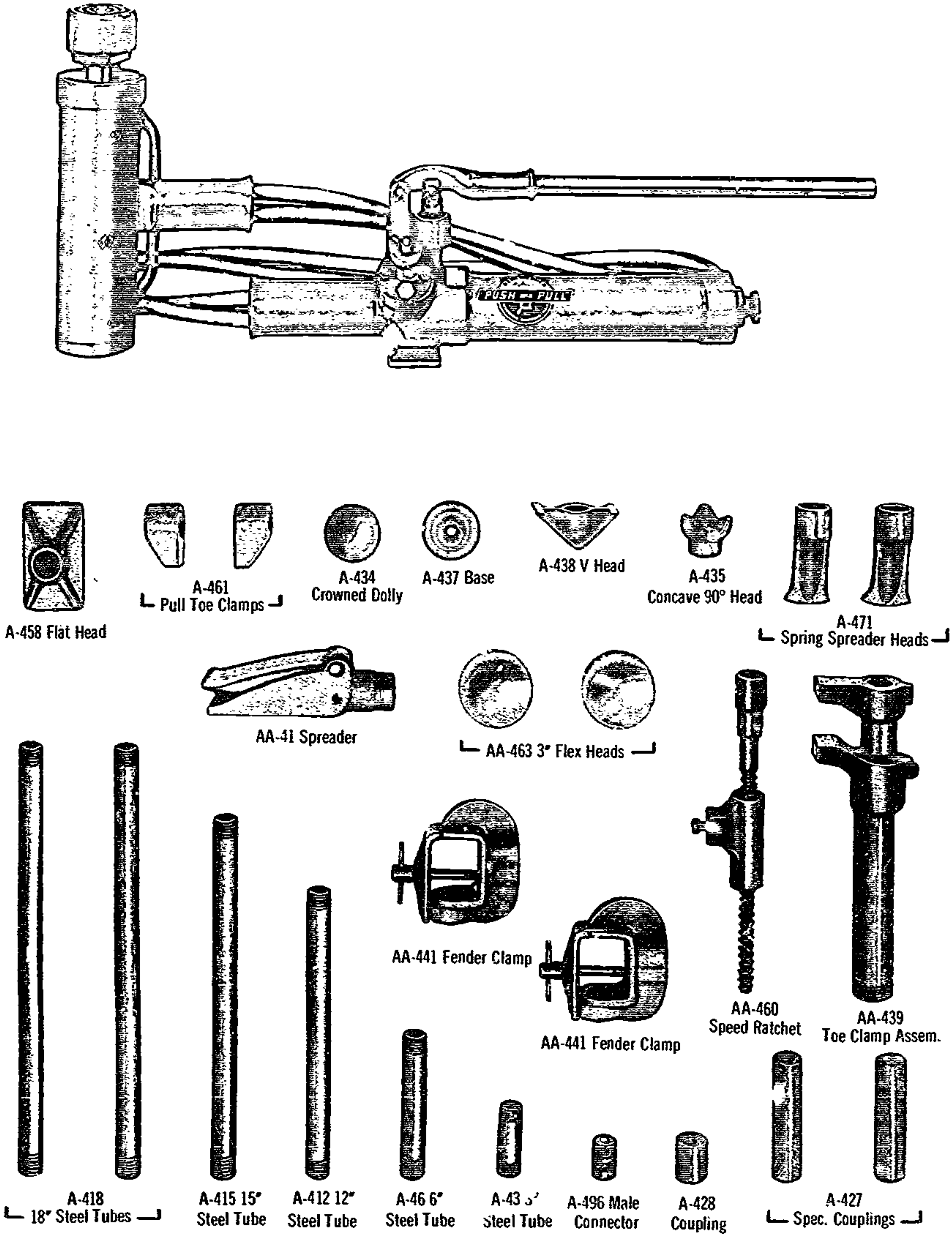
OBJECTIVES: To learn why hydraulic jacks are used in repair work.
To learn how to operate the hydraulic jack.
To learn how to care for this piece of equipment.

INFORMATION:

As collision repair jobs become more difficult, it is necessary to use tools which can help the body man to do things which ordinarily would be extremely difficult by hand. The hydraulic jack is this type of tool (Fig. VII-12).

It is an expensive tool and must receive careful use. The most important thing to remember about a hydraulic jack is not to overload it. This means that if a jack is a three ton type, you cannot expect to move ten tons with it. There are heavier duty jacks which can do bigger and heavier jobs. Another important thing to remember when using the jack, is to be sure that the pipes and attachments are screwed together all the way. If this is not done, when strain is applied it is possible that the threads will become stripped. Careful storage is another important factor. When the tool is not being used, all the parts should be put into the stand and put into the storeroom. Periodically the oil level should be checked and refilled with hydraulic jack oil if necessary.

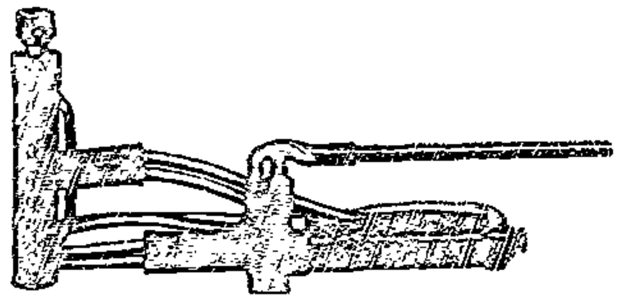
As you can see in the picture, there are many parts to the hydraulic jack assembly. Basically, however, the major parts are: the pump, ram, and connecting hose (Fig. VII-13). All of the other parts help to make it fit a special need. The pipes, nipples and couplings make the jack longer. There are different types of ends that can be used to make it fit against the job better. All the threads are right hand and the jack is assembled by screwing the parts together. The jack that is illustrated is a push-pull type. This means that it can be hooked up to push against something or pull it together.



HYDRAULIC BODY JACK SET

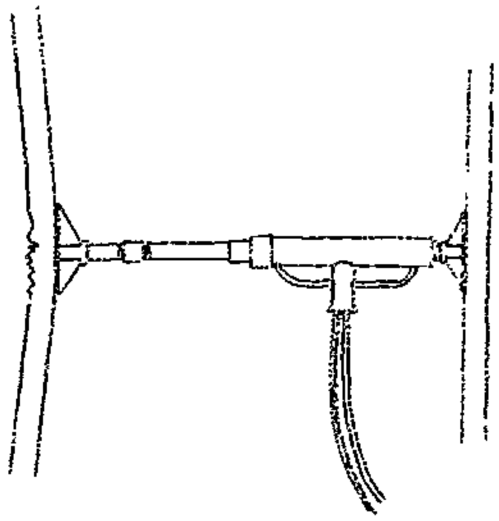
FIG. VII-12

It will take practice to know exactly what to use, where, and how, but the way to learn is by beginning with the most simple pushing operation, which requires little extending. When selecting the end, always select the piece that best fits the surface you are jacking against without doing damage to it. When pumping the ram out in a pushing operation, first close the valve all the way. (Turn it in a clockwise direction (Fig. VII-14).) Then proceed to pump as much as is needed.



HYDRAULIC, PUMP, RAM AND HOSE

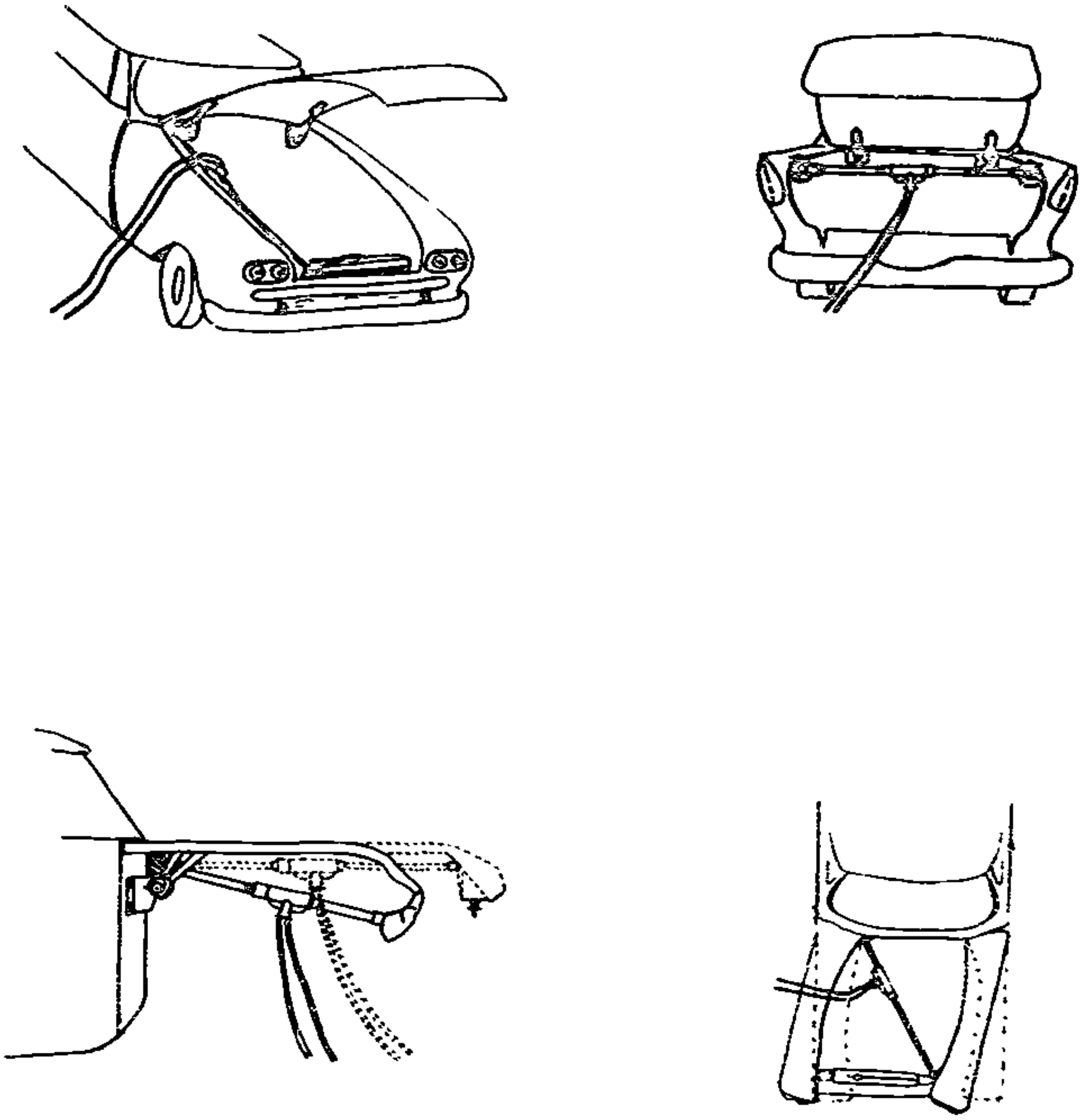
FIG. VII-13



A SIMPLE PUSH OPERATION

FIG. VII-14

In order to pull the jack together again when you are finished, first turn the valve all the way in a counter-clockwise direction and pump until the cylinder has returned inside the ram. Study the picture of all the parts and familiarize yourself with the names of the pieces. Also study the pictures which show some sample hookups which illustrate the ways it can be used. Study these carefully and when doing the next job requiring the hydraulic jack, refer to this page (Fig. VII-15).



SAMPLE HYDRAULIC JACK HOOKUPS

FIG. VII-15

ASSIGNMENT:

1. Name the three most important parts of the hydraulic jack.

2. What are all the pipes, nipples, and couplings for?

3. How is the jack assembled for use?

4. What kind of thread does the jack have?

5. Which way do you turn the valve in order to push the cylinder out of the ram?

6. Which way do you turn the valve in order to pull the cylinder back into the ram?

7. There are some underlined words in the lesson. Find them and give their meanings. Use each of these words in a sentence.

Fenders (Flanges) Lesson 6

OBJECTIVE: To learn the proper way to repair damage to the flanged edge of a fender.

INFORMATION:

When a fender receives a hard blow, usually the edge buckles and is knocked out of shape. This rolled edge is called a flange and is designed to give strength to the fender. If put back into the proper position, strength can be regained, as can the proper shape of the fender.

The tools that are required are the same as listed for Lessons #1 and #2, plus the small hydraulic jack.

Begin the job by scraping off the dirt and tar from the underside of the fender and bump out the worst of the impact point. Next place the hydraulic jack between the fender and a solid part of the car. By a solid part of the car we mean either the frame or some part of the front system or section of the body which is stronger than the fender. There are many parts and attachments to the hydraulic jack from which you must select the proper hook up. Refer to Lesson #5 for some sample hook ups.

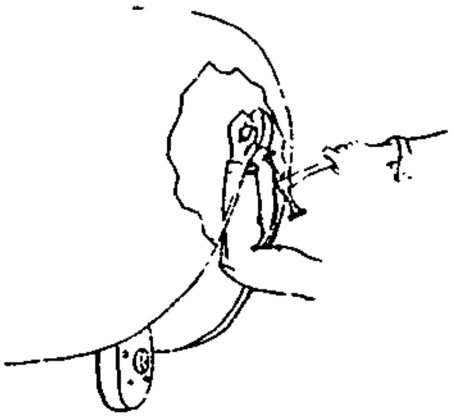
Slowly pump the cylinder out of the ram until the fender moves forward pulling in the side of the fender and the flanged edge (Fig. VII-16).

DAMAGED FLANGE

HYDRAULIC JACK HOOK UP FOR REPAIRING FLANGE DAMAGE

FIG. VII-16

Leave the jack in position and begin to straighten the flange with the dinging hammer and dolly that best fits the shape of the flange. First rough out the area and then hammer it smooth as in previous operations (Fig. VII-17).



STRAIGHTENING THE FLANGE WITH HAMMER AND DOLLY

FIG. VII-17

After the flange has been repaired, slowly release the pressure of the hydraulic jack and remove it. If the flange has been properly straightened, it will hold in place after the jack has been removed. Now proceed to repair the rest of the damage as you have been previously taught; file and sand with the electric sander.

ASSIGNMENT:

1. What is the flange? Draw a sketch of a flange.
2. Why is the flange used?
3. Where should the jack be placed when straightening a flange? Draw a sketch.
4. When do you remove the hydraulic jack?
5. There are some underlined words in the lesson. Find them and give their meanings. Use each of these words in a sentence.

UNIT VII - METAL REPAIR

Soldering Iron   Lesson 7

OBJECTIVES: To learn the materials that are used in soldering with coppers.
To learn how to solder with coppers.

INFORMATION:

In the automotive trade, soldering is done with both copper and the torch. In order to learn the principles of soldering we will first use the copper. In most shops the soldering copper is commonly called the soldering iron. The tools that are needed are: gas furnace, soldering coppers, wire brush, muriatic acid, killed acid, acid brushes, and sal-ammoniac.

When working with acid, it is most important to remember not to splash, as this can cause a burn on the skin. Be especially careful of your eyes. Acid in the eye can cause blindness. Acid can also ruin your clothes. If some is spilled on a piece of cloth a hole through the fabric will result. If, at any time, acid is spilled or splashed, use large amounts of water to wash the area.

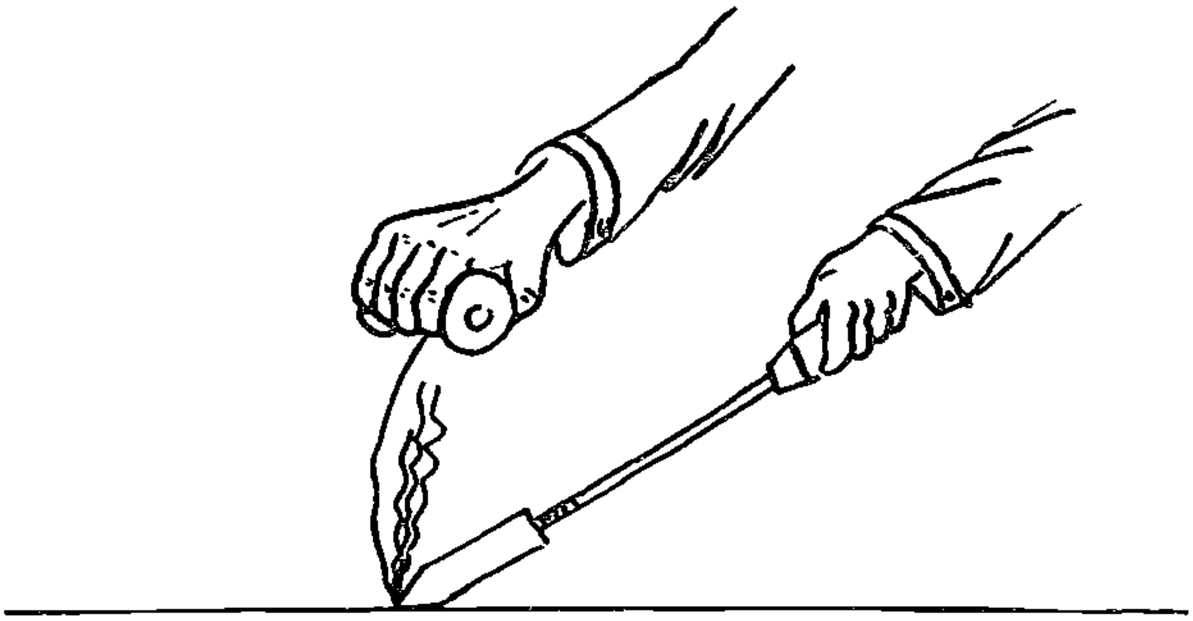
The secret of good soldering is the proper preparation of the surface. This operation is called "tinning." First of all thoroughly clean the area to be soldered. There should be no paint, dirt or scale present. If there is, remove it with a wire brush, or sandpaper. Next we must light the furnace to heat the coppers. Using a flint lighter, first open the top of the furnace, then as you turn the jet on, squeeze the lighter. If you use a match, be sure to strike the match first, and then turn on the gas jet.

Place the coppers into the burning furnace and let them heat. The amount of heat can be tested by dipping the copper into a jar of killed acid for a second. When you remove the copper it should have a small amount of solder added to the tip. If it sticks and flows, then the iron is the proper temperature. You will have to experiment with this until you can tell whether the heat is enough.

When the iron is hot, apply some killed acid to the surface to be soldered with an acid brush. Killed acid is muriatic acid that has been neutralized by adding zinc.

Now lay the hot copper or iron on the surface to be soldered and allow the surface to become heated. Add a small amount of wire solder, slowly moving the iron and adding solder at the same time. This is the tinning operation and the <u>object</u> is to leave a thin film of solder on the surface. As the copper begins to cool, replace it in the furnace and reheat it. Never allow the copper to become red hot as this will burn it. When the surface has been tinned properly, you may begin to solder. Be sure that both surfaces have been tinned and coated with killed acid.

Dip the hot copper into the killed acid and lay it on the surfaces to be soldered together and allow it to heat the area (don't hurry this) and gradually add a little solder. This time move the copper slowly and allow a bead of solder to be built up (Fig. VII-18).



SOLDERING WITH A COPPER

FIG. VII-18

To keep the tip of the copper clean, rub the hot iron on a sal-ammoniac block and add a little solder. When you are finished with your job, very carefully wire-brush the copper to remove any burnt particles and allow the copper to cool before storing.

ASSIGNMENT:

1. What are two ways of soldering?

2. What types of acid are used in soldering?

3. What does tinning mean?

4. Where do you heat the irons or coppers?

5. What happens when a copper becomes red hot?

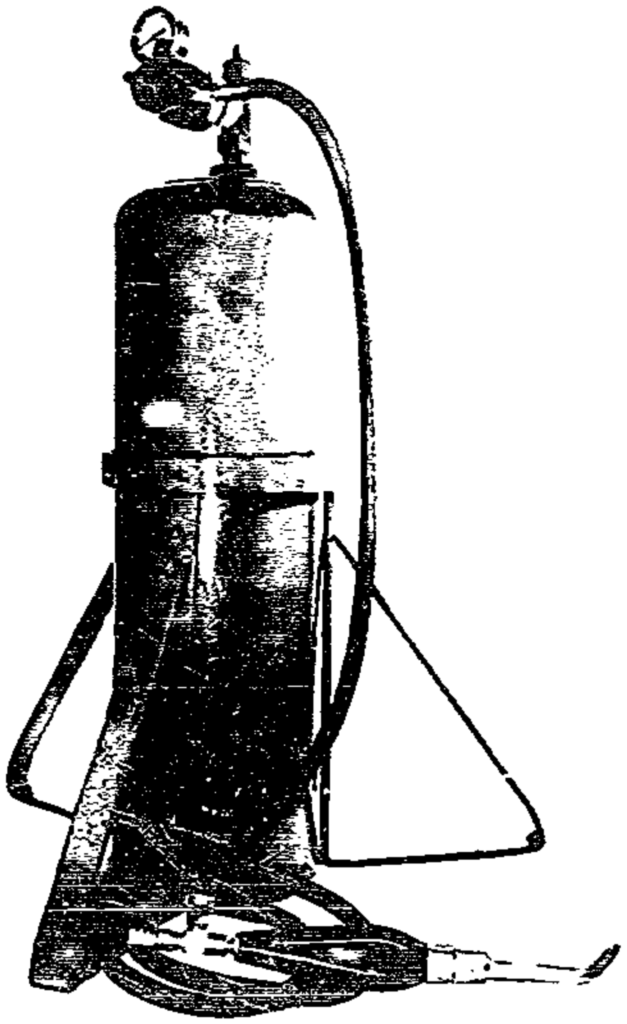
6. There are some underlined words in the lesson. Find them and give their meanings. Use each of these words in a sentence.

Soldering (Torch) Lesson 8

OBJECTIVES: To learn what equipment is used in torch soldering.
To learn what care is required by this equipment.
To learn how to solder small dents.

INFORMATION:

You have done some soldering with the copper. The basic principles of torch soldering are the same as with the copper. The main difference is the sending of heat through a flame instead of a heat conducting metal. The equipment that is needed is the Prest-O-Lite tank unit, soldering paddle, beeswax, wire brush, a flint lighter, and steel wool (Fig. VII-19).



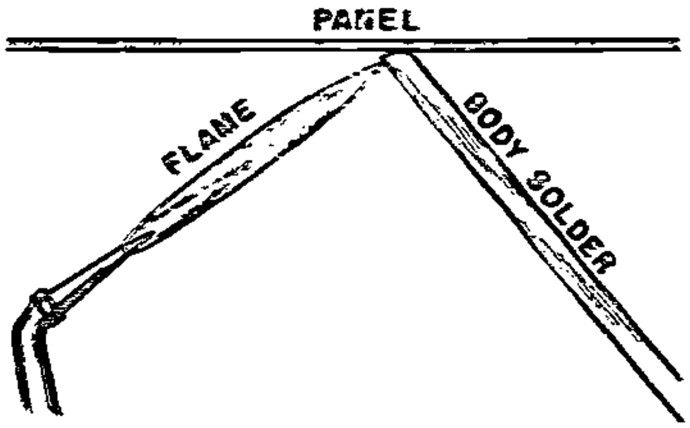
PREST-O-LITE TORCH UNIT

FIG. VII-19

The surface must be prepared in the same way as for soldering with a copper. Remove paint, dirt and scale so the bare metal shows.

Let us begin with the lighting of the torch. Open the regulator at the top of the tank with one or two turns. Hold the torch in the left hand and open the valve with the thumb and first finger of the left hand. Strike the lighter with your right hand. Adjust the flame so that it is about 6" long. Pre-heat the section to be done and apply killed acid or flux with an acid brush. As the surface becomes warm, add a little wire solder (50-50) by playing the flame on the metal and the wire solder. Now rub vigorously with steel wool while the surface is hot. When the metal cools off reheat it again with the torch and again rub it with the steel wool until the whole area has a thin film of solder on it. This is called the tinning operation. Always tin more than the actual spot that is to be soldered.

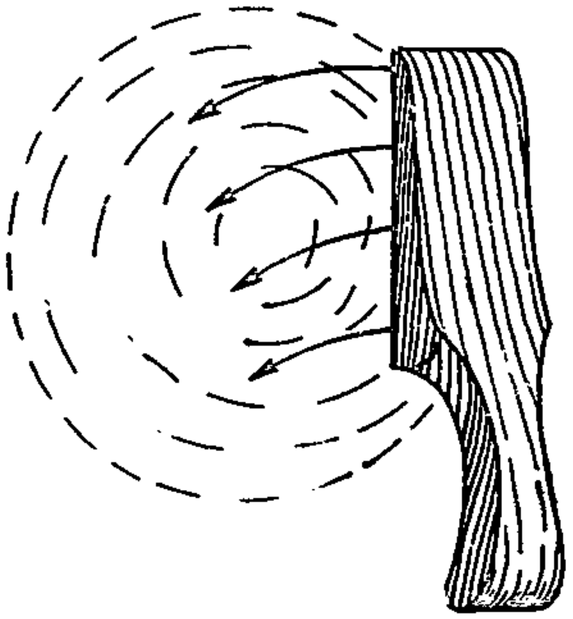
Now you will need the bar of body solder (60-40) (this is 60% lead and 40% tin). Slowly heat the panel, then add the solder to the panel by heating both the metal and the solder bar (Fig. VII-20).



ADDING BAR SOLDER

FIG. VII-20

Add enough solder to fill the dent. Coat the soldering paddle with beeswax. This is done by heating the wax with the flame of the torch and dipping the face of the paddle into it. With the coated paddle in the right hand, heat the solder and the metal until it becomes soft. This you can tell by the color. Do not overheat as all the solder will run off. When the solder is soft, press the paddle against it pushing it into the dent. Then gradually using a circular motion, even it off (Fig. VII-21).



SMOOTHING THE SOLDER WITH A PADDLE

FIG. VII-21

If the solder cools, re-heat it and keep working it until it is fairly smooth. You will have better results if you do not let the metal and solder cool. Keep it warm. When you are finished, the solder should be a little higher than the surface to allow for filing and sanding. Flush off the area with clean water and dry off the water. This will neutralize the acid on the surface.

ASSIGNMENT:

1. What kind of a torch do you use for torch soldering?
2. What is the paddle used for? beeswax?
3. What kind of wire solder is used for tinning?
4. What kind of solder is best for body work?
5. Why is it necessary to flush off the surface of the solder job with water?
6. There are some underlined words in the lesson. Find them and give their meanings. Use each of these words in a sentence.

UNIT VII - METAL REPAIR

ACHIEVEMENT TEST

1. Show the instructor where the wire hangs when you use the electric sander.

2. Demonstrate to the instructor the following types of jobs:

    a. straighten a small dent on a curved surface.

    b. straighten a small dent on a flat surface.

    c. eliminate a side buckle on a fender.

    d. solder together two pieces of metal using the soldering copper.

    e. tin and fill in a dent on a curved surface using the Prest-O-Lite torch.

3. Review with your instructor the names of the basic tools used in the above operations.

4. List five new words that you have learned in this unit. Use each in a sentence.

UNIT VIII - ACETYLENE WELDING

Equipment

Lesson 1

OBJECTIVES: To become familiar with the different parts of the welding unit.
To learn how to care and operate the equipment.

INFORMATION:

Welding is the joining together of two pieces of similar metal with heat and a rod. On some occasions two pieces of metal can be fused together with heat alone, but most of the time for a strong job a filler rod should be used. The equipment involved in acetylene welding is the tanks (one for oxygen, and one for acetylene), the regulators, the hoses, the torch unit, tips, lighter, wrench, and the goggles. Study the picture and learn to identify the various parts of the welding unit (Fig. VIII-1).

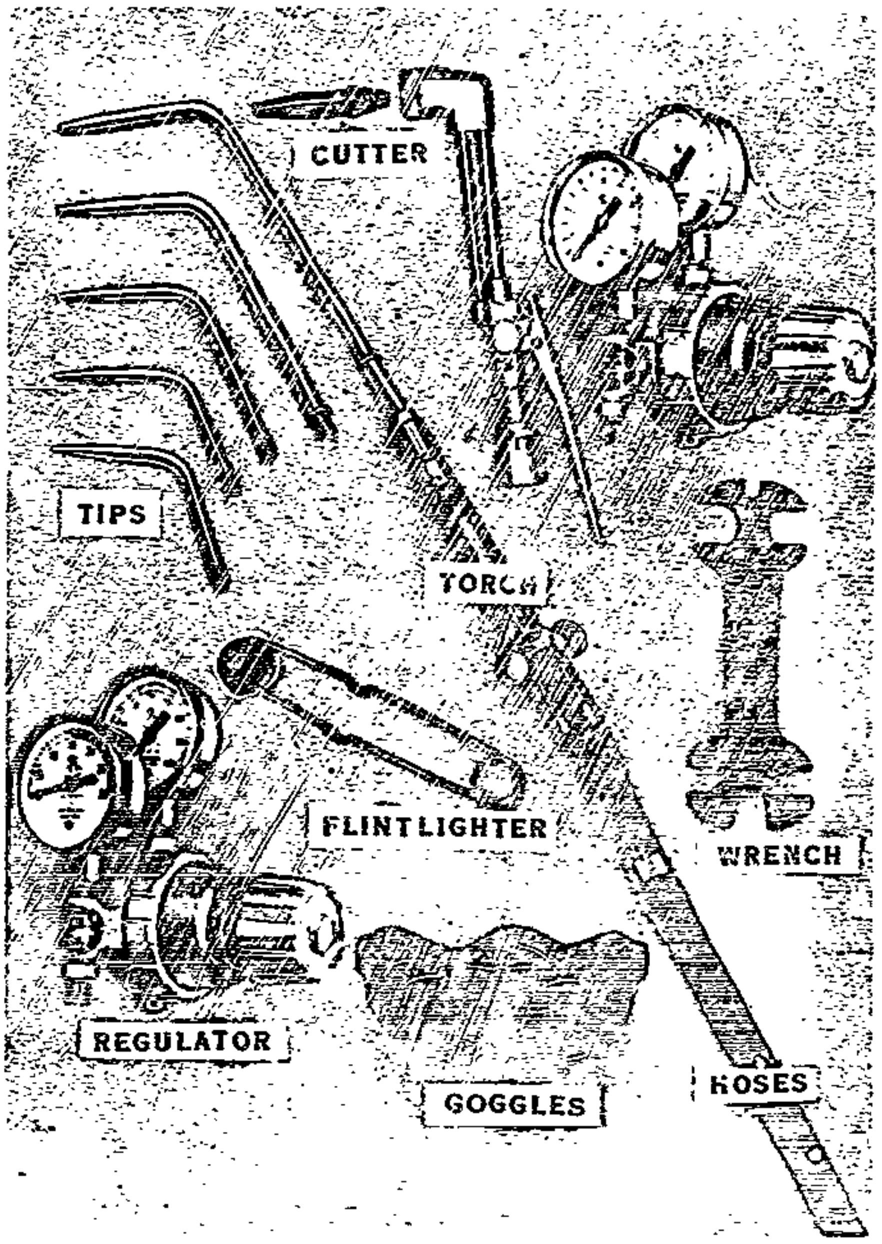


FIG. 8-1

Let us look at the basic principles that make the acetylene unit work. In order to produce a flame we must first have acetylene or gas. This is always in the tank that has the red markings on it. At the top of the tank is the acetylene regulator which is painted red. This controls the pressure of the gas leaving the tank. From the regulator, a hose carries the gas to the torch. This hose is also red. On the torch the left hand valve is the one that controls the amount of gas that leaves the torch. This takes care of one side of the welding unit. Remember, the gas side is indicated in red, which means danger. This gas is highly flammable and care must be used so that the hose is not broken or punctured.

With the gas we now have a flame, but in itself it is not usable, so we add air or oxygen to blow the flame and increase the intensity of the torch. The air is stored in the oxygen tank which is painted green or blue. At the top of the tank is the air regulator which is usually painted green. The hose which carries the air to the torch is also green or black. The valve on the torch controls the amount of air that leaves the tip.

It is the combination of the acetylene and oxygen passing through the tip which enables the flame to be used to fuse metal together.

You should always use goggles when welding to protect your eyes from injury. When they are not in use, be sure to hang the goggles in a place where they will not be broken. Usually the best place to hang them is on the regulator of the torch unit.

Remember, the torch is a dangerous tool. It must never be pointed at anyone or anything that can burn. A lighted torch must always be treated like a loaded gun (Fig. VIII-2).

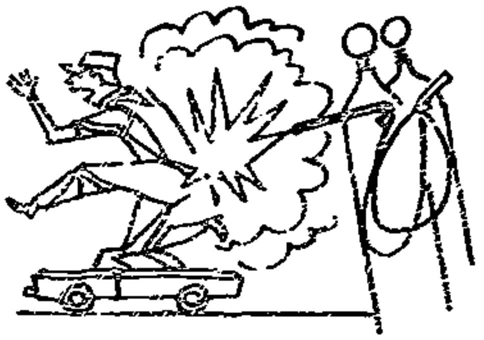


FIG. VIII-2

ASSIGNMENT:

1. What are the two types of tanks used in a welding outfit?

2. Why is the acetylene side always marked in red?

3. Which valve on the torch controls the air?

4. What is the reason for the regulator at the top of the tank?

5. How are your eyes protected from the welding operation?

6. There are some underlined words in the lesson. Find them and give their meanings. Use each of these words in a sentence.

UNIT VIII - ACETYLENE WELDING

Steel (Without Rod) Lesson 2

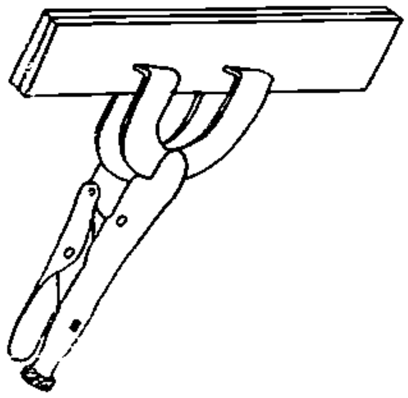
OBJECTIVE: To learn how to weld steel without using a filler rod.

INFORMATION:

In order to gain an understanding of what welding involves, we will begin to weld without the filler rod. This will give us an opportunity to master the torch and to see how metals are fused together.

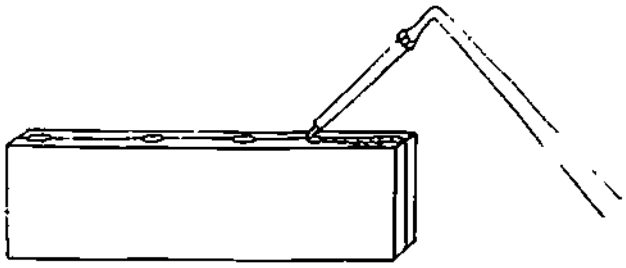
The equipment that will be needed is the welding torch with the smallest tip, #1 or #2, welding goggles, flint lighter, two pieces of 20 gauge steel (approximately 6" x 2").

Begin by clamping together two pieces of steel (Fig. VIII-3).



CLAMPING THE METAL TOGETHER

FIG. VIII-3



FUSING METAL TOGETHER

FIG. VIII-4

Light the torch and adjust the flame so that the deep blue portion of the flame is about $\frac{1}{4}$" long. Now lower the goggles over your eyes and lay the flame next to the edges of the two pieces of metal (Fig. VIII-4).

Apply the heat to both pieces of metal evenly, holding the tip of the flame about $\frac{1}{8}$" away until the metal begins to turn red. If one turns red before the other, then you are applying too much heat to one side. Move the tip a little so that they will both turn red evenly. Very quickly after the metal turns red you will notice that it turns white in color and the steel will start to melt together. Slowly move the torch forward and keep melting the two pieces together as you move, trying to make it as smooth as possible. At first you will not be able to do the entire length of the metal, but this is what you should strive for.

When finished, turn the metal over and begin to fuse together the opposite edge, following the same directions. Complete the project by fusing together the ends in the same manner. The idea is to melt together the two pieces of metal into one, with a smooth edge.

When leaving the welding outfit for any length of time, it is best to release the tank pressure on the gauges by closing the tank with the special wrench kept on the torch, and by unscrewing the regulator until it is free. This will keep the tank from leaking when the torch is not in use. The instructor will tell you when this should be done.

ASSIGNMENT:

1. How long should the deep blue portion of the flame be for proper welding of 20 gauge steel?

2. How far away from the metal should the tip be?

3. What are you doing when you weld without a filler rod?

4. What color is steel at its melting point?

5. There are some underlined words in the lesson. Find them and give their meanings. Use each of these words in a sentence

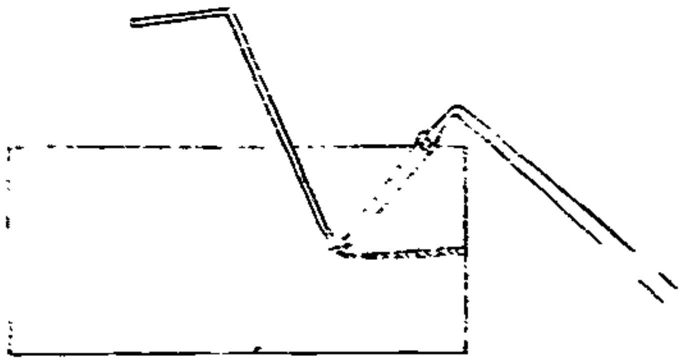
OBJECTIVE: To learn how to puddle with the use of the filler rod.

INFORMATION:

Welding skill rests on a basic understanding of temperature control and manipulation of the rod and flame. With the basic principles in mind, you must practice in order to be able to weld quickly and leave a weld that is smooth and strong.

The equipment necessary for this lesson is the welding unit, goggles, flint lighter, one piece of 20 gauge steel and some $\frac{1}{16}$" copper-coated steel rod.

Lay the steel on a fire brick. Light the torch and adjust the flame so that the tip of the flame is about $\frac{1}{4}$" long. Take the rod in one hand and the torch in the other as shown (Fig. VIII-5), and at the same time lay the rod close to the piece of steel.



ACETYLENE PUDDLING

FIG. VIII-5

Hold the tip of the flame about $\frac{1}{8}$" away from the metal and be sure the rod is the same distance from the tip of the flame. Begin to heat them and carefully watch the color. This will tell you where to concentrate the flame. When they both begin to turn white and melt, lightly touch the rod against the metal and then raise the rod slightly. Keep adding the rod and moving the torch in a forward position until you have left a bead on the metal. This will help you to learn how to add wire to the job to be welded.

The object of this lesson is to learn to lay a bead on the piece of metal and make a weld which is uniform and has no holes in it. If the rod sticks to the metal, then you are not applying enough heat to the wire. Merely turn the torch slightly toward the rod. This will burn it away and release it from the metal. This will require practice, so keep laying beads one after the other until you can go the entire length of the metal without burning holes through it.

ASSIGNMENT:

1. What are the basic principles of welding?

2. What happens if you hold the torch too far away from the job?

3. What are you doing when you puddle?

4. If the rod sticks to the job, what is wrong?

5. What must you do to eliminate sticking of the wire?

6. There are some underlined words in the lesson. Find them and give their meanings. Use each of these words in a sentence.

UNIT VIII - ACETYLENE WELDING

Acetylene Welding Steel With Filler Rod — Lesson 4

OBJECTIVE: To learn how to weld with steel filler rod.

INFORMATION:

After you have had a considerable amount of practice in fusing two pieces of metal together and puddling, you will be ready to add another piece of metal. This time you will weld two pieces of steel together with the help of a steel filler rod. The principle is the same as before. Remember, the secret is melting both pieces of steel and the wire at the same time.

The equipment needed is the same as before: welding unit, welding goggles, flint lighter, two pieces of steel (20 gauge) approximately 6" x 2", and some $\frac{1''}{16}$ copper coated steel welding rod. Set up the project as shown in the diagram (Fig. VIII-6).

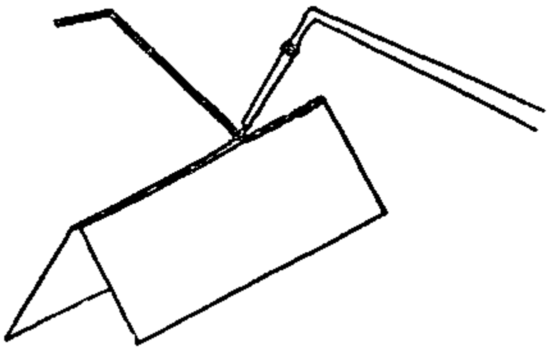


FIG. VIII-6

Light the torch and adjust the flame. Lower the goggles over your eyes. Lay the tip of the flame near the edges of the metal. At the same time, with your other hand, add the rod so that it is about the same distance away from the flame as the two pieces of metal. Watch the color very carefully and make sure that the two pieces of metal and the rod all turn red at the same time. As all three pieces begin to turn white, touch the filler rod to the two pieces of metal and move it slightly away. Then touch again and take away again. This is the procedure that must be followed on the entire length of the metal. If the wire sticks to the metal, merely turn the torch and point it at the wire and this will burn it loose. You will see that a slight touch of the wire on the metal leaves a small amount of molten metal on the job and this fuses the two together.

When you have completed this project, add another piece of metal (Fig. VIII-7) and begin to weld again.

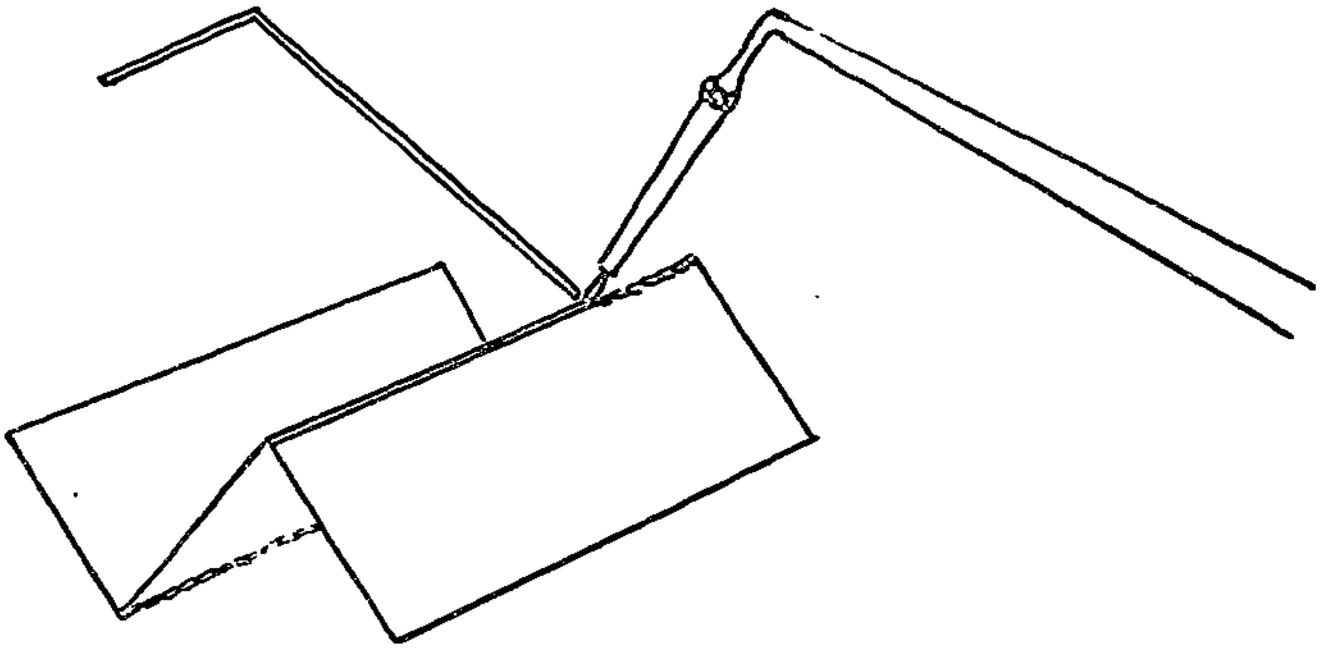


FIG. VIII-7

ASSIGNMENT:

1. Demonstrate to the instructor how to adjust the regulators on the two tanks for welding 20 gauge steel.

2. Show the instructor the proper way of lighting the torch.

3. Set up a project using two pieces of 20 gauge metal and weld together using a piece of $\frac{1''}{16}$ rod.

4. There are some underlined words in the lesson. Find them and give their meanings. Use each of these words in a sentence.

UNIT VIII - ACETYLENE WELDING

ACHIEVEMENT TEST

1. Name and point out the principal parts of the acetylene welding outfit.

2. Show the instructor the proper way to light and adjust the torch.

3. Demonstrate to the instructor the following projects:

   a. Fuse together two pieces of 20 gauge metal without welding rod.

   b. Using a piece of 20 gauge steel, puddle a uniform bead.

   c. Weld together two pieces of 20 gauge steel using a $\frac{1}{16}$" mild steel rod.

4. How do you leave the torch when leaving the shop for the day?

5. List five new words you have learned in this unit. Use each in a sentence.

assembly	-	ă sĕm′ blĭ	a group of parts put together
assist	-	ă sĭst′	to help or aid
assure	-	ă shŏŏr′	make sure, tell positively, make safe against loss
attach	-	ă tăch′	to fasten, to join together
attachment	-	ă tăch′ mĕnt	a thing added to the main part
attempt	-	ă tĕmpt′	to try, an effort
attractive	-	ă trăk′ tĭv	nice or pretty
available	-	ȧ vāl′ ȧ bl	usable; at hand
avoid	-	ă void′	to keep away from
basic	-	bās′ ĭk	fundamental, something important in the beginning; a foundation
bonding agent	-	bŏnd′ ing ā′ jĕnt	something that holds one thing to another
brand	-	brănd	a certain kind
brilliance	-	brĭl′ yăns	brightness, shine
brittle	-	brĭt′ l	something that will break easily
buckle	-	bŭk′ l	a bend or a wrinkle
careless	-	kâr′ lĕs	not careful, sloppy, inexact
catalog	-	kăt′ ȧ lŏg	a book showing pictures or describing something; tells you about something
caution	-	kô′ shŭn	carefulness
circular	-	sûr′ kū lẽr	round
circulation	-	sûr′ kū lā shŭn	the act of going or moving around
circumstance	-	sûr′ kŭm stăns	the way things are
clockwise	-	klŏk′ wīz	the direction in which the hands of the clock move

assembly	-	ă sĕm′ blĭ	a group of parts put together
assist	-	ă sĭst′	to help or aid
assure	-	ă shŏŏr′	make sure, tell positively, make safe against loss
attach	-	ă tăch′	to fasten, to join together
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circulation	-	sûr′ kū lā shŭn	the act of going or moving around
circumstance	-	sûr′ kŭm stăns	the way things are
clockwise	-	klŏk′ wīz	the direction in which the hands of the clock move

clog	-	klŏg	to become filled up, or choked (stops something from working)
collision	-	kŏ lĭzh′ ŭn	coming together with force; accident
combine	-	kŏm bīn′	to join together
combination	-	kŏm′ bĭ nā shŭn	something made of more than one thing
complex	-	kŏm plĕks′	hard to understand, difficult, containing many parts
composition	-	kŏm pȯ zĭsh′ ŭn	the union of more than one thing
compressor	-	kŏm prĕs′ ẽr	a machine that pushes air together, gives force to air
concentrate	-	kŏn′ sĕn trāt	pay attention; to bring together
concern	-	kŏn sûrn′	to have to do with, belong to
condition	-	kŏn dĭsh′ ŭn	the way something is, its present state
conditioning	-	kŏn dĭsh ŭn′ ĭng	preparing or getting ready
confident	-	kŏn′ fĭ dĕnt	sure, certain
connection	-	kŏ nĕk′ shŭn	a way of fastening things together
considerable	-	kŏn sĭd′ ẽr ȧ bl	important, not a little, much
consideration	-	kŏn sĭd ẽr ā′ shŭn	careful thought
consistency	-	kŏn sĭs′ tĕn sĭ	the amount of firmness
constant	-	kŏn′ stănt	the same
constantly	-	kŏn′ stănt lĭ	always the same, not changing
constructed	-	kŏn strŭkt′ ĕd	made or built
contain	-	kŏn tān′	to hold something, to hold
container	-	kŏn′ tān′ ẽr	a box, can, or jar used to hold something
contents	-	kŏn′ tĕnts	that which is inside something
continuous	-	kŏn tĭn′ ū ŭs	connected; without a stop; unbroken

contribute	kŏn trĭb′ ū̇t	to give to
control	kŏn trōl	to have the power to do something; to be able to handle something
convenience	kŏn vēn′yĕns	comfort; advantage
conventional	kŏn vĕn′ shŭn ăl	ordinary; usual
correct	kŏ rĕkt′	right
counter clockwise	koun′ tẽr klŏk′wīz	opposite from the direction in which the hands of the clock move
curdling	kûrd′lĭng	thickening
cylinder	sĭl′ĭn dẽr	a hollow or solid body shaped like a roller
depend	dē̇ pĕnd′	to rely on
depth	dĕpth	distance from the top to the bottom
design	dē̇ zīn′	a certain style
desire	dē̇ zīr′	a strong wish, something you want
deteriorate	dē̇ tē′rĭ ō̇ rāt	become worse; spoil
determine	dē̇ tûr′mĭn	to find out; to decide
develop	dē̇ vĕl′ŭp	to grow; to make; become better, bigger, or more useful
device	dē̇ vīs′	a tool or machine
differ	dĭf′ẽr	not the same; to vary
difficult	dĭf′ĭ kŭlt	hard to do or understand
directly	dĭ rĕkt′lĭ	exactly, straight
dispose	dĭs pōz′	to get rid of; give away; throw away
dissolve	dĭ zŏlv′	to do away with; break up
distance	dĭs′tăns	space between
discard	dĭs kärd′	to throw away

distract	dĭs trăkt′	to disturb or bother someone so that he takes his mind off his work
drain	drān	to take out or remove liquids
durability	dū′rȧ bĭl′ĭ tĭ	lasting a long time
economical	ē kŏ nŏm′ĭ kăl	not too expensive
effective	ĕ fĕk′tĭv	the way we want it; acting the way it is supposed to
efficiently	ĕ fĭsh′ĕnt ly	quickly, without wasting time
eliminate	ē lĭm′ĭ nāt	to get rid of; leave out; omit
elimination	ē lĭm ĭ nā′shŭn	removing; getting rid of
entangle	ĕn tăng′gl	to wrap up in, to get mixed and caught
entire	ēn tīr′	the whole; everything
equal	ē′kwăl	the same
equalize	ē′kwăl īz	to make the same
essential	ĕ sĕn′shăl	needed; important; necessary
evaporate	ē văp′ō rāt	disappear; turn into vapor; turn to gas
evident	ĕv′ĭ dĕnt	easy to see or understand; plain; clear
experience	ĕks pēr′ĭ ĕns	practice; what we learn by doing; what happens to a person
expose	ĕks pōz′	uncover
extensive	ĕks tĕn′sĭv	large; far reaching
factor	făk′tẽr	a thing, a cause, something that must be considered
familiar	fȧ mĭl′yẽr	well known, something which a person knows or recognizes

familiarize	fȧ mĭl′yẽr īz	make well known; to get to know about something
fascinating	făs′ĭ nāt ĭng	very interesting
fasten	fȧs′n	to attach, lock, connect or tie
feature	fē tūr	a special part, whatever makes one thing different from another
final	fī′năl	the last, end, closing
firmly	fûrm′li	solidly, strongly
flammable	flăm′ȧ bl	burns easily; able to catch on fire easily
flexible	flĕk′sĭ bl	bends without breaking
flux	flŭks	a material used to help metals stick together when welded
form	fôrm	a shape; to shape or make something
formation	fôr mā′shŭn	a structure; the act of making or shaping
frequently	frē kwĕnt li	happens often; many times
functional	fŭngk′shŭn ăl	acting, operating
furnish	fûr′nĭsh	to give; provide, or supply
fuse	fūz	to join together by melting as in welding
generally	jĕn′ẽr ăl ĭ	most of the time; usually
gently	jĕnt′tlĭ	softly, or easily
glaze	glāz	a smooth covering; a shiny coating
gradually	grăd′ū ă li	slowly, easily
grasp	grȧsp	to grab or hold
guide	gīd	to direct, lead, help, show the way

hazardous	-	hăz′ẽr dŭs	dangerous
humidity	-	hŭ mĭd′ĭ tĭ	dampness, amount of water in the ai
ideal	-	ī dē′ăl	perfect; just the way you would like it
identify	-	ī dĕn′tĭ fī	to recognize something or someone
ignorance	-	ĭg′nō răns	lack of knowledge
illustrate	-	ĭ′lŭs trāt	to explain by using pictures or drawings
immediately	-	ĭ mē′dĭ ĭt li	right away, without delay
impact	-	ĭm păkt′	the hitting of one thing against another; the coming together; striking
impractical	-	ĭm prăk′tĭ kăl	not very useful, not commonly used
imperfection	-	ĭm′pẽr fĕk shŭn	something wrong; a defect
include	-	ĭn klōōd′	to count in the total; contain
ingredient	-	ĭn grē′dĭ ĕnt	one of the parts of a mixture
inhaling	-	ĭn hāl′ĭng	breathing in
injurious	-	ĭn jo͝o′rĭ ŭs	harmful
injury	-	ĭn′jẽr ĭ	harm, hurt, or damage
insert	-	ĭn sûrt′	to put in, set into place
install	-	ĭn stôl′	to put on
instance	-	ĭn′stăns	an example
instructor	-	ĭn strŭkt′tẽr	teacher
intensity	-	ĭn tĕn′sĭ tī	amount of strength; amount of concentration
interior	-	ĭn tēr′ĭ ẽr	inside, inner side
introduce	-	ĭn trō dūs	to bring in, insert, put in
involve	-	ĭn vŏlv′	to include or take in

irregularity	ĭ rĕg ū lăr′ ĭ tĭ	lack of evenness or smoothness
item	ī′tĕm	a thing, a piece, an article
jelling	jĕl′ĭng	becoming lumpy and turning into a solid mass
judgment	jŭj′mĕnt	the way you think is best; good sense, common sense
knowledge	nŏl′ĕj	what someone knows
lint	lĭnt	tiny bits of thread from cloth
livelihood	līv′lĭ hŏŏd	a way of making a living
locate	lō′kāt	find, to show where something is
lubrication	lū brĭ kā shŭn	oiling, greasing
major	mā′jĕr	greater; large; most
maneuver	ma noo ver	a movement; a way of moving; to steer; to move
manipulation	mȧ nĭp ū lā shŭn	handling something with skill; doing something with your hands
master	mȧs′tẽr	to be skillful; an expert
material	mȧ tēr′ĭ ăl	what something is made of
means	mēnz	a way of doing something
mention	mĕn′shŭn	to talk or speak about
mere	mēr	nothing else than, only, something slight
method	mĕ th′ŭd	a way of doing something
moisture	mois′tūr	dampness, water in the air

molten	-	mōl′tĕn	melted through heat
motion	-	mō′shŭn	movement, a change of position
moderate	-	mŏd′ẽr ĭt	not too fast, not too slow; in between; fair
movable	-	mo͞ov′a bl	something that can be moved or carried
necessary	-	nĕs′ĕ sĕr ĭ	needed, important
neutralize	-	nū′trăl īz	to make neutral, counter balance
noted	-	nōt ed	specially noticed
notice	-	nō′tĭs	give attention to; take heed
noticeable	-	nō′tĭs ȧ bl	easily seen
object	-	ŏb′jĕkt	a thing or a part
obnoxious	-	ŏb nŏk′shŭs	harmful; unpleasant
observe	-	ŏb zûrv′	to see and notice, examine, study
obtain	-	ŏb tān′	to get
occasionally	-	ŏ kā′zhŭn ăl lĭ	once in a while, sometimes, not regularly
operation	-	ŏp ẽr ā′shŭn	the way something works, movement, doing; an act
opportunity	-	ŏp ŏr tū′nĭ tĭ	a chance; possibility of doing something
ordinarily	-	ôr′dĭ nĕr ĭ lĭ	most of the time; usually
original	-	ō rĭj′ĭ năl	the first; earliest; new
ornamental	-	ôr nȧ mĕn′tăl	something which adds beauty; decorative; for show
outlet	-	out′lĕt	a way of letting something out; a place for plugging in an electric wire
over-confident	-	ō′vẽr kŏn′fĭ dĕnt	too sure of oneself, too certain of oneself.

parallel	-	păr′ă lĕl	two lines exactly the same distance apart at all points (like two pieces of railroad track)
particle	-	pär′tĭ kl	a very little piece of something
particular	-	pẽr tĭk′ú lẽr	different from other; unusual; something special
particularly	-	pẽr tĭk′u̇ lẽr lĭ	especially
passenger	-	păs′ĕn jẽr	rider in a vehicle
pattern	-	păt′ẽrn	a model, guide, example
perfect	-	pûr′fĕkt	just right, no mistakes
periodically	-	pēr ĭ ŏd′ĭ kăl lĭ	every now and then; once in a while; with regularity
permanent	-	pûr′má nĕnt	something that lasts a long time
permit	-	pûr′mĭt	to let or allow
personal	-	pûr′sŭn ăl	something that belongs to a person
phase	-	fāz	one part (of a job)
pivot	-	pĭv′ŭt	the spot on which something turns
pliable	-	plī′ȧ bl	bendable; flexible
pneumatic	-	nū̇ măt′ĭk	worked by air; filled with air
position	-	pō zĭsh′ŭn	a place where something or someone is
potential	-	pō̇ tĕn′shăl	something which could be; not actual
precious	-	prĕsh′ŭs	something very dear; of great value
precision	-	prē̇ sĭzh′ŭn	exactness; accuracy
preparation	-	prĕp ȧ rā′shŭn	getting ready
presence	-	prĕz′ĕns	being present; being in a place
present	-	prĕz′ĕnt	not absent; now
preservation	-	prĕz ẽr vā shŭn	keeping safe

preserve	-	prē zûrv	to protect; to keep from harm or change
preferably	-	prĕf′ẽr ȧ bli	by choice, what you think is best
pressure	-	prĕsh′ẽr	force
prevent	-	prē vĕnt′	to stop from happening
previous	-	prē′vĭ ŭs	comes before; first; happened earlier
primarily	-	prī′mĕr ĭ lĭ	at first, originally
primary	-	prī′mĕr ĭ	first in importance, time, and order
principle	-	prĭn′sĭ pl	an important idea
probably	-	prŏb′ȧ blĭ	maybe; likely to happen
proceed	-	prō sēd	to go ahead, continue
procedure	-	prō sē′dūr	a way of doing things
process	-	prŏs′ĕs	a special way; a set of actions
product	-	prŏd′ŭkt	something which is made
project	-	prō jĕkt′	a job, plan; to stick out
properly	-	prŏp′ẽr lĭ	the right way, correctly
protective	-	prō tĕk′tĭv	serving to keep safe
provide	-	prō vīd′	to supply or furnish, take care of
puncture	-	pŭngk′tūr	to make a hole; a hole made by something sharp
purify	-	pū′rĭ fī	to make clean or pure
purpose	-	pûr′pŭs	a plan; aim; intention
quantity	-	knŏn′tĭ tĭ	amount

readily	-	rĕd′ĭ lĭ	quickly or easily
realize	-	rē′ăl īz	to understand
reasonably	-	rē′zn ȧ blĭ	in a sensible way; not foolishly
reassemble	-	rē ă sĕm′ bl	put back together again
recommend	-	rĕk ŏ mĕnd′	advise; speak in favor of; suggest
reduce	-	rḗ dūs′	to make less or smaller
reduction	-	rḗ dŭk′shŭn	a decrease; a cutting down
reflection	-	rḗ flĕk′shŭn	shine or image, as in a mirror
regain	-	rḗ gān′	to get back again
regard	-	rḗ gärd′	look closely at; to think of
regularly	-	rĕg′ū̇ lẽr lĭ	over and over, at the same time, steady
regulate	-	rĕg′ū̇ lāt	to control
regulator	-	rĕg′ū̇ lā tẽr	a part that controls something, (on a welding torch it controls air and gas)
refer	-	rḗ fûr′	turn for information or help; look for help (from a book)
related	-	rḗ lāt′ẽd	belonging to the same family
release	-	rḗ lēs′	to let go
remain	-	rḗ mān′	to stay in same place
remaining	-	rḗ mān′ĭng	what is left; not used
removal	-	rḗ mo͞ov′ăl	taking off or taking away
remove	-	rḗ mo͞ov	to take off or take away
replace	-	rḗ plās′	to put back in place again
replaceable	-	rḗ plās′ă bl	something that can be changed or re-newed
replacement	-	rḗ plās′mĕnt	a new part
require	-	rḗ kwīr′	need, demand

requisite	rĕk′wĭ zĭt	needed
reservoir	rĕz′ẽr vwôr	a place where something is stored
respect	rē̇ spĕkt′	show honor for; show care for someone or something
respirator	rĕs′pĭ rā tẽr	a tool used to stop a person from breathing harmful fumes, cleans the air we breathe
return	rē̇ tûrn′	to put back; go back; or reply
reverse	rē̇ vûrs′	backwards; opposite; to turn the other way
rough	rŭf	not smooth; not level or straight
ruin	rōō′ĭn	to spoil or destroy
section	sĕk′shŭn	a part or piece of something
secure	sē̇ kūr′	to fasten firmly
select	sē̇ lĕkt′	to pick, choose
separate	sĕp′ȧ rāt	keep apart; not together
serve	sûrv	be useful; satisfy
severe	sē̇ vēr′	very bad; difficult or serious
similar	sĭm′ĭ lẽr	almost the same, alike
slightly	slīt′lĭ	a little; very little
solid	sŏl′ĭd	not a liquid; not hollow; hard or firm
solvent	sŏl′vĕnt	a liquid that dissolves other materials, often used for washing surfaces
sparingly	spâr′ĭng lĭ	very lightly, without using too much
specific	spē̇ sĭf ĭk	exact, definite, particular
spread	sprĕd	to lay out, or stretch or move apart
storage	stōr′ĭj	keeping safe, a place to keep things

strive	strīv	to try, attempt
suction	sŭk′shŭn	drawing up liquids (as through a straw)
sufficient	sŭ fĭsh′ĕnt	enough; as much as is needed
suit	sūt	to make fit, to agree with
surface	sûr′fĭs	the outside of anything; a face or side of a thing
surroundings	sŭ round′ingz	things around you
suspension	sŭs pĕn′shŭn	holding something in place as if by hanging
swirling	swûrl′ĭng	a circular motion; moving in a circle quickly
syphon	sī′fŏn	to draw up a liquid through a hose
systematically	sĭs tĕm ăt′ĭk lĭ	according to plan

tab	tăb	a small piece; flap or loop
technique	tĕk nēk′	a special way or skill in doing something
temperature	tĕm′pẽr á tūr	amount of heat or cold measured in degrees
transmit	trăns mĭt′	to pass along; to send; or let through
thorough	thûr′ō	complete, everything that is needed

uniform	ū′nĭ fôrm	the same; not different; all alike
universal	ū nĭ vûr săl	general
unnecessary	ŭn nĕs′ĕ sĕr ĭ	not needed
unobstructed	ŭn ŏb strŭkt′ĕd	not blocked; clear
usable	ūz′ă bl	can be used

valuable	-	văl′ū̇ ȧ bl	worth a great deal
variation	-	vâr ĭ ā′shŭn	change, a different way
variety	-	vȧ rī′ĭ tĭ	different kinds
various	-	vâr′ĭ ŭs	different
vibration	-	vī brā′shŭn	rapid motion to and fro
vigorous	-	vĭg′ẽr ŭs	forceful; strong; active
viscosity	-	vĭs kŏs ĭ tĭ	thickness of a liquid such as paint
visible	-	vĭz′ĭ bl	can be seen
vital	-	vī′tăl	important, necessary

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A Guide for Use in Developing Training Programs in Vocational Automotive Mechanics.

Mississippi State Univ., State College. Curriculum Lab.
Mississippi State Dept. of Vocat. Educ. State College

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*CURRICULUM GUIDES, *TRADE AND INDUSTRIAL EDUCATION, *AUTO MECHANICS (OCCUPATION), *MOTOR VEHICLES, HIGH SCHOOLS,

The purpose of this curriculum guide is to encourage the development of a more efficient instructional program in automobile mechanics for the secondary school by assisting the instructor in making lesson plans for lectures and demonstrations and in planning shop activities. A statewide curriculum committee of trade instructors used findings from a trade analysis as a basis for developing the materials. The purpose of the course is to prepare the student to meet beginning employment standards. The major divisions are (1) Orientation, Basic Operations, Welding, (2) Engine Rebuilding, (3) Electrical System, (4) Fuel System, (5) Cooling System, (6) Power Train, (7) Suspension System, (8) Steering System, (9) Brakes, and (10) Heating and Air Conditioning. Each division includes a topical outline of trade principles, selected descriptions of trade practice, an equipment list, and a supplies list. The course is designed for a 2-year program with 1,080 hours of group instruction and with time designations for group shop activity within each division. The teacher should be occupationally up-to-date with at least 2 years of work experience beyond the learner's level. The students should have made a definite vocational choice for the trade. Topic outlines are included for related mathematics and science. The appendixes contain a bibliography, trade analysis, student rotation plan, and proficiency chart. This document is available for $2.00 from Curriculum Laboratory, Box NU, State College, Mississippi 39762. (HC)

A GUIDE
in
VOCATIONAL AUTOMOTIVE MECHANICS

first draft for discussion only

Prepared and Issued by the
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STATE DEPARTMENT OF VOCATIONAL EDUCATION
Jackson, Mississippi

Located in the
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MEMORANDUM

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DATE: June 16, 1967

RE: (Author, Title, Publisher, Date) Curriculum Laboratory

A GUIDE IN VOCATIONAL AUTOMOTIVE MECHANICS, Curriculum Laboratory

August 1966

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FOREWORD

Because the modern automobile is a highly complex machine resulting from our most advanced engineering and manufacturing skills, both routine and major services must be performed by knowledgeable, skilled, trained personnel. There is no reason to believe that automobiles, or other private transportation vehicles, which the beginning mechanic will find in his work life, will present simple problems or can be serviced by any but a well-trained, capable person.

Accordingly, the course of study presented here for the vocational automotive mechanic has several characteristics. First, the automobile chassis is studied as a series of systems. Each system has a purpose and operates according to certain physical science fundamentals. It is a complex of component parts, each of which performs a given function and is serviced in a specific fashion. The outline is designed to encourage teaching that employs a systems analysis approach.

Second, skill in the use of basic hand tools, special-purpose tools, and precision instruments is required for repair and overhaul. While most automobiles have similar components, each manufacturer uses some variation. Therefore, frequent reference is made to the manufacturer's manual and specifications.

Third, accurate diagnosis is the hallmark of the competent mechanic. It comes with knowledge of the fundamentals of the physical sciences as applied in the automotive systems. The outline which follows identifies many of these diagnostic measures. The instructor is encouraged to involve advanced students in these activities.

Fourth, the future promises more change. However, whatever the nature of the change, it will be based on present knowledges and practices. Innovations will consist of new applications and extensions of presently known fundamentals. This fact re-emphasizes the need for strong instructional sessions in basic science in addition to skill-building activities.

Finally, the major areas of instruction, or systems, carry time designations. These are not to be taken literally, but are listed as a guide to the relative emphasis placed on each system and to encourage planning and scheduling by the instructor.

ACKNOWLEDGMENTS

A Curriculum Committee for the development of instructional materials in vocational automotive mechanics convened on March 10, 11, 12, 1966. The members developed a job analysis and a basic course of study, which includes a topical outline of trade principles, selected descriptions of trade practices, an equipment list, and a supplies list. The following men and their institutions are to be commended for contributing their efforts, abilities, and time in initiating this this basic program.

Gerd Beetz	Northwest Mississippi Junior College
William A. Bowman	East Central Junior College
Jesse Lee Boyd	Temple High School, Vicksburg
C. Rex Coker	Ross Collins High School, Meridian
Jesse C. Davis	Hunt High School, Columbus
Dwight A. Harris	Copiah-Lincoln Junior College
Richard Jeansonne	Jones County Junior College
Hoyt B. Phillips	Iuka High School, Iuka
Houston Richey	Northeast Mississippi Junior College
Clarence E. Smith	Lanier High School, Jackson
Elwyn Wheat	Biloxi High School
Bondy A. Welch	Gulf Coast Junior College District

Also in attendance and making significant contributions were Roy C. Watson and F. O. Woodard of the State Department of Vocational Technical Education, Trade and Technical Section.

Following the conference, the staff of the Curriculum Materials Laboratory compiled, edited, and duplicated the materials developed. The staff added the portions on instructional materials, characteristcs of trade training, the rotation plan, and the progress chart.

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TO THE INSTRUCTOR

Introduction

The purpose of trade training is to prepare persons for entry into a specific trade. To accomplish this, the instructor guides each trainee in the development of knowledges and skills of his trade. The instructor uses teaching methods and instructional materials as tools, much as he uses the tools of his trade to perform specific tasks. His skill as a teacher and as a tradesman depends upon his ability to use these tools.

A full treatment of the role of the Curriculum Materials Laboratory in implementing the foregoing process is contained in the Operational Plan. Simply stated, the Laboratory provides technical assistance to state and local educators in improving instruction through the development of instructional materials, and communicates with industry about training being offered.

The first step

Since the accepted practice in trade training is the identification of the knowledges and the skills of the trade, the Laboratory asked Mississippi trade instructors to supply information. The process described in the FOREWORD was used in arranging the information in a teachable form. It is an instructional base and is usually referred to as a course outline or guide. Its proper use requires skillful applications of teaching methods as tools in presenting the content of the outline. The end result is a trainee who is skilled and knowledgable.

Since this publication is the instructional base for the teaching of a specific trade, all future work will be planned around this base. Workshops will be held to develop supplementary insstructional materials for use by the trade instructor in enriching his program.

Characteristics of this publication

First, its scope, in terms of content, is broad and applicable in all parts of the state. The instructor, who directs his class in becoming proficient with each of these knowledges and skills, assists each student in meeting beginning employment standards. The student is prepared to take advantage of opportunities for gainful employment in any part of the state.

Second, while the scope of the program is broad and there is depth, an effort was made to confine the content of the outline to those knowledges and skills essential to occupational entry. This policy allows the local instructor to supplement his program with additional experiences. By identifying only essentials, this publication encourages local institutions to seek and to offer the special instruction which will meet regional industrial needs.

Third, a serious effort has been made to arrange the content in a usable form. The elementary knowledges and easiest tasks precede more difficult ones. Assignments are written in a step-by-step fashion. All content has been carefully sequenced. Time for instruction in class and in shop is listed in approximate terms.

Fourth, as indicated by certain items in the format, this publication is designed for the Type B Shop found in Mississippi secondary schools. However, it should not be inferred that this is its only valid use. The content and sequence are equally applicable to trade training in junior colleges and in MDTA programs or in any preparatory program.

The impact of this publication

What then should be the impact of this publication on the local program? Since the purpose is to encourage a planned, orderly, more efficient instructional program, it must be used and evaluated by the instructor. He should give this publication his best efforts in light of the principles and practices of trade training. Examination, evaluation, and recommendation during preparation of instructional materials and while teaching from them will assist in continued program development. Using this publication as a guide, the instructor should make lesson plans for lectures and demonstrations and should prepare shop activities. In some instances, the instructor will likely find more information and greater detail than he is presently using. There may be more than one job assignment. In other instances, the development of an idea may appear too shallow or a job may be absent. It is at this time that the instructor can be most helpful in the following ways: (1) by suggesting which areas can be effectively covered in a shorter time, (2) by identifying areas requiring greater emphasis which would involve additional detail and an extended-time allocation, (3) by extending the instructional content to reinforce or clarify ideas, (4) by preparing additional or alternate jobs, (5) by listing references, texts, and instructional aids at appropriate places, and (6) by suggesting additions and deletions. Some of the suggestions listed above may require only marginal notes, others may call for development of completely new and more comprehensive materials. The result will be realistic evaluation of content, organization, and time allotment for each unit.

Purposes and characteristics not inferred

As previously stated, this publication is intended to assist in improving instruction. It is planned, items are sequenced, and time limits are set because these characteristics are the heart of a strong instructional program, and for no other purpose. Consequently, it should not be inferred that this publication is an exact image of any given program. As noted earlier, local institutions go well beyond these minimum requirements to enrich their programs.

Also, it is not expected that every institution's program be exactly like every other program, that hour allotments be rigidly adhered to, or that students be rotated on a clockwork or calendar basis. On the contrary, the emphasis is on individual proficiency. It is likely that students of lesser ability will require longer periods in certain areas. These students may gain only the minimum proficiencies while more able students will progress rapidly and engage in many enriching experiences. Consequently, the planning, sequencing, and allotting are not designed to standardize programs, but to assist local teachers in planning more carefully and conducting their instruction more effectively.

Evaluation

Finally, recent vocational-technical legislation contains provision for follow-up and program evaluation. The day is coming when vocational-technical education will be held accountable for its actions in training youth and adults and for the millions of dollars it has spent. The Curriculum Materials Laboratory will, no doubt, be involved in developing suitable instruments and evaluative criteria at that time. This publication, representing the combined efforts of Mississippi education and industry and containing the material these groups feel is appropriate, may well serve as one basis for making such a study.

DESCRIPTION OF THE AUTOMOTIVE MECHANIC

The all-around automotive mechanic is highly capable in two areas: he is knowledgeable in the diagnosis of malfunctions within the automobile chassis; he is skilled in the repair and overhaul of all chassis components. To provide these services, he examines the vehicle and discusses the nature and extent of the malfunction or damage with customers and other service men. He may assist in further diagnosis and planning.

His diagnostic abilities require keen insight into electrical and mechanical fundamentals as applied to the automobile chassis. He understands each system, such as the electrical, fuel, suspension, etc., the role of each component in the system, and the contribution of each system to the total chassis. He makes audio and visual inspection as well as precision measurements with gages, such as the micrometer, calipers, depth gages, and dial indicators, and with instruments, such as the ammeter, voltmeter, and oscilloscope.

His skill as a repair man is extensive. He disassembles, cleans, inspects, and repairs or replaces as judgment dictates. He rewires lighting circuits, panels, and ignition circuits. He relines and adjusts brakes, aligns suspension members, and repairs or replaces carburetors, generators, distributors, starters, and pumps. He installs accessories, such as heaters.

CHARACTERISTICS OF TRADE TRAINING

Introduction

Training for various trades without on-the-job experience can be and is being given effectively by simulating, in locales other than industrial plants, an on-the-job environment. The industrial environment is achieved in an educational institution by performing jobs of fabrication and service using industrial techniques and industrial-type equipment and facilities. The additional requirements placed upon the training as a result of its operating within an institution have been successfully met. It has proved advantageous to all concerned to provide preparatory training to qualified students and extension training to employed tradesmen.. Characteristics of institutional training are briefly described in the following paragraphs.

Physical Facilities, Equipment, and Supplies

As previously stated, trade training facilities must be designed and constructed so that they lend themselves to fabrication and service operations found in industry. Built-ins are provided with adequate floor space, lighting, climate control, power sources, entrances, equipment, storage for supplies, finished-product handling, waste-disposal systems, etc.--each of which is duty-rated to serve its purpose in an industrial manner. That costs and floor-space requirements per pupil are higher than those for general education are facts that must be recognized because they are intrinsic in the nature of the training and cannot be side-stepped. Equipment and supplies must meet the standards of quality and variety used in industry, and they must be maintained and replenished.

Instructor Qualifications

Of equal importance is the caliber of the instructor. Past experience has assisted in establishing the requirement of at least two years of work experience beyond the learner's level, in the specific training being given, and of broad experience in the major areas of the industrial occupation. The instructor must be adept in selecting, organizing, and presenting trade information and skills--a fuller treatment of which may be found in later paragraphs. The trade teacher must also keep himself occupationally up to date through study and association with industrial activities.

Student Screening and Selection

The State Plan states that any student who wants, needs, and is able to profit by instruction is eligible for enrollment in vocational training. His ability to profit by the instruction depends, in large measure, on his making a definite vocational choice, his desire to gain the knowledges and skills of the trade, and his educational background. These qualifications are evaluated, insofar as is possible, by a vocational-guidance process which includes an examination of the applicant's school record, a personal interview, a check of references, and tests for interests, motivations, and learning rates; and, in the absence of adequate guidance facilities and a screening process, it is reasonable to expect that a considerable number of those accepted for training will need remedial instruction in science, mathematics, and communication skills.

In Mississippi, preparatory training is offered in the Type B Shop located in the comprehensive high school. Trade training is carried on 180 days per year. Normally, the course is elected for both the junior and the senior years. In two years a student receives 1080 hours of instruction. However, some students enroll for the senior year only. Although these students receive no more than minimal experiences, instruction on a planned rotational basis will provide them with knowledges and skills in the basic blocks of the trade and will render them employable.

Teaching Techniques

Trade training uses most, if not all, of the conventional teaching techniques and adapts them to the information to be presented. The "tell-show-do-check" method has been found highly effective and is the one most commonly used. The instructor "tells" by informally lecturing on a given topic. Open periods of discussion allow the student to clarify points not initially grasped. The instructor may choose to stimulate thought or to spot-check comprehension by questioning. The "show" method is employed when a demonstration can more vividly present a principle or the steps of trade procedure. Specially prepared audio-visual aids may be involved to "show". The major investment of time is on the "do", where the student is engaged in useful and productive work in typical trade jobs. He uses tools, equipment, and materials common to the trade. Thus he learns by doing. At predetermined intervals, a "check" of the student's progress serves to evaluate command of knowledge and skill learned to date. Deficiencies identified are retaught through additional, individual instruction, through reading, shop practice, etc., until an acceptable level of learning and performance is reached.

Related Instruction

The value of scientific principles and mathematical applications for the tradesman is unquestioned. Indeed the caliber of his work in these areas is determined by the quality of his foundation and his ability to apply and adapt the principles. However, trade trainees, characteristically, react to mathematics and science with disinterest when these subjects are presented on the academic level with the usual academic approach. But these subject areas become much more acceptable when they are applied to the job in which the trainee expects to develop skill and earn a living.

In the Type B Shop, no outside instruction related to the trade is given. The shop teacher is expected to meet the need. Upon him rests the responsibility of supplying any and all necessary teaching of trade mathematics, trade science, trade drafting, etc. This information is also correlated with trade practice and given as needed by the student.

Group instruction and group shop activity are encouraged when space and equipment are available, for it is generally conceded that instruction of the typical class as a group is an advantage for the progress of the class. Extensive preparation prior to group instruction and keen observation of individual behavior are necessary to meet the variety of need and speeds in a heterogeneous class. The volume of trade tools, equipment, and materials, as well as adequate space and shop facilities, required for the instruction of large groups, makes the costs prohibitive in many instances; and a scheduled rotational process must be employed. A suggested plan is found in the appendix.

Instructional Content

The source of the instructional content of a given trade program can come only from the trade itself, from the knowledges and the skills of the master. Usually the trade analysis is used to identify this content. Following the analysis, there is much need for proper organization and preparation prior to presentation of the material. An extension of this characteristic of the program is the establishment and maintenance of an up-to-date reference library in the classroom-shop. Materials housed here would be in many forms, such as textbooks, technical manuals, trade periodicals, manufacturer's catalogs, safety bulletins, etc. All of them would be shelved in a systematic arrangement with a careful record kept for ready reference.

Safety Instruction

The place and value of safety instruction cannot be over emphasized. The instructor is morally and legally responsible for introducing safety instruction prior to performance, for using safe techniques in demonstrations, and for tactfully, but firmly, pointing out each violation.

Summary

In summary, trade training can be characterized as instruction in trade practices given by an occupationally competent teacher. Related information is carefully correlated with shop activities and is given by the trade teacher as it is needed by the trainee. Students who have made a vocational commitment, and who are able to profit by the instruction are engaged in productive learning experiences. Successful completion of such a program prepares a student for employment at an advanced-learner level.

COURSE OF STUDY

INTRODUCTION

The content of this course of study for vocational automotive mechanics was developed for use in the Type B Shop as found in the secondary school. A student having average mental and manipulative abilities should develop proficiency in all the blocks, or major divisions, in the allotted 1080 hours. The blocks, or major divisions, listed below carry varying emphasis as indicated by the contact time.

MAJOR DIVISIONS

	Contact Hours
Orientation; Basic Operations; Welding	90
Engine Rebuilding	210
Electrical System	108
Fuel System	102
Cooling System	30
Power Train	180
Suspension System	150
Steering System	75
Brakes	75
Heating and Air Conditioning	60
Total Contact Hours	1080

I. ORIENTATION; BASIC OPERATIONS; ACETYLENE & ELECTRIC ARC WELDING

General Safety

1. Treat all injuries regardless of how small
2. Clean up all spills as quickly as possible
3. Maintain orderly work and storage areas
4. Avoid rushing: work at your own best speed
5. Use the proper tool for each job
6. Use care and proper technique when lifting
7. Wear appropriate safety clothing and use safety equipment
8. Gather and study safety information on each job
9. Examine each job for potential hazards
10. There is no substitute for: information, judgement, action!

Contact hours <u>90</u>

Trade principles	Trade practice
1. Orientation a. School requirements b. Occupational requirements c. Occupational opportunities	Tour the shop; identify areas; emphasize order and cleanliness; point out hazards; indicate lines of travel.
2. Basic tools and operations a. Cutting b. Holding c. Measuring d. Layout e. Fastening f. Marking g. Other	Demonstrate the correct use and care of the basic hand tools. Demonstrate the procedure for performing basic operations and explain the reasons for each step. Assign jobs to each trainee and distribute appropriate instructional sheets.
3. Acetylene welding a. Types of joints b. Equipment c. Position d. Procedures e. Hazards	Light and adjust a torch. Run a fusion bead; run a bead using filler rod; run a bead using a filler rod and join two pieces of heavy gage sheet metal. Give special attention to safe practices in use of equipment.

4. Arc welding a. Types of joints b. Equipment c. Positions d. Procedures e. Hazards	Strike an arc and maintain the proper arc length. Run beads in downhand position using mild steel plate and small electrode. Give special attention to safe practices. Use proper rod and machine setting on an arc welder to build up worn parts.

II. THE AUTOMOTIVE ENGINE

Trade principles	Trade practices Contact hours: 210
A. The four-stroke cycle 1. Intake stroke 2. Compression stroke 3. Power stroke 4. Exhaust stroke	
B. General description of the engine 1. Block and head assembly 2. Electrical system 3. Fuel system 4. Cooling system 5. Lubricating system	
C. Block and head assembly	
1. Components a. Head b. Block c. Piston d. Valves e. Spark plug f. Rods g. Crankshaft h. Camshaft	Remove and replace a broken stud. "Back out" and clean old threads or drill out and tap new threads. Apply thread lubricant and install new stud.
2. Combustion chamber configurations a. Wedge b. Hemisphere c. Other	Clean carbon deposits from combustion chamber; inspect all head surfaces
D. The head 1. Metal composition 2. Types by valve location a. L b. I c. F	

3. Types by service

   a. Removable
   b. Nonremovable

Replace a head gasket. Refer to appropriate shop manual. Drain coolant if necessary. Remove, clean, and inspect cylinder head(s) using special tools such as carbon scrapers, carbon brushes, straight edges, magnaflux, etc. Remove old head gasket, clean cylinder surface, install new gasket, re-install cylinder head observing proper torque procedures. Replenish oil and coolant as necessary.

4. Sealing techniques

   a. Gaskets
   b. O-rings

5. Specification

   a. Gasket surface condition
   b. Combustion chamber
   c. Tightening sequence
   d. Torque specs

E. The valves

1. Location
2. Types

   a. Poppet
   b. Sleeve
   c. Other

3. Valve train components

   a. Valve
   b. Seat
   c. Spring
   d. Seal
   e. Retainer
   f. Rocker arm
   g. Pushrod
   h. Tappet
   i. Cam

4. Metal composition

5. Valve specifications

   a. Face and seat angles
   b. Spring tension and height
   c. Valve length
   d. Tappet clearance
   e. Allowable wear on stem

Position vehicle properly in bay, cover finders, and drain coolant. Refer to shop manual. Use hand tools and special tools to remove, inspect, and clean the head(s). Grind valves and seats. Reassemble making necessary inspection, replacements, measurements, and adjustments.

6. Cooling techniques

    a. Metal-to-metal conduction
    b. Sodium filled stems
    c. Water cooling of seats and guides

F. The block

1. Metal composition

    a. Cast iron
    b. Aluminum

2. Block features

    a. Head surface
    b. Water passages
    c. Core holes
    d. Cylinders
    e. Valve chamber
    f. Main bearing surfaces
    g. Cam bearing surfaces
    h. Oil pan surface
    i. Accessory mounting

3. Cylinder layout

    a. In-line
    b. Vee
    c. Opposed
    d. Other

4. Cylinder features

    a. Bore
    b. Length
    c. Wall thickness
    d. Metal composition
    e. Alignment

Remove oil pan and cylinder head(s). Cut cylinder ridge using ridge reamer. Remove connecting rod and piston assembly. Clean cylinder bore. Check for wear according to specifications. Bore if necessary

5. Main bearings

    a. Function
    b. Number
    c. Composition

6. Oil pump

G. The crankshaft assembly

1. Components

    a. Crankshaft
    b. Pistons and rod assembly
    c. Bearings

2. Crankshaft features
    a. Bearing surfaces
    b. Counterweight
    c. Oil passages
    d. Flywheel flange
    e. Nose

3. Metal composition
    a. Cast iron
    b. Cast steel
    c. Forged steel

4. Specifications
    a. Sizes and important dimensions
    b. Clearances
    c. Alignment

H. The piston and rod assembly

1. Piston, pin, rings
    a. Function
    b. Features
    c. Metal composition

2. Rod and bearing
    a. Function
    b. Features
    c. Metal composition

3. Alignment of rod and piston: specifications
    a. Sizes and important dimensions
    b. Clearances

4. Alignment technique

After piston and connecting rod assemblies have been removed, they are disassembled for cleaning, inspection, and repair or replacement. Remove old rings, clean, inspect, and repair if necessary the pistons, including ring grooves. Inspect, bore, ream, or rebush piston pin boss. Reassemble connecting rod, pistons, piston pins. Check ring gap clearance. Install rings on piston and check the assembly for alignment using rod-aligning jig. Using ring compressor, reinstall assembly in cylinder bore. Fasten rod to crankshaft. Replace cylinder head and oil pan. Refill engine with proper oil and coolant.

I. The camshaft

1. Function and features
2. Types by location
    a. In the block
    b. In the head

3. Metal composition

4. Drive mechanism a. Chain b. Gear	Referring to appropriate shop manual, remove radiator, lower fan pulley and timing gear cover. Remove gear(s) or chain, clean and inspect all components as necessary. Align timing marks when installing new gear and/or chain. Install new oil seal and gasket in cover. Replace cover pulley, fan belt and radiator. Replenish coolant.
5. Timing techniques a. Aligning mark or dots b. Strobe light c. Degree wheel	Referring to appropriate manufacturers literature, remove all components necessary to give access to the camshaft. Inspect camshaft and bearings for wear. Replace camshaft bearings if necessary, using special bearing remover and replacer tool. Replace camshaft and all components previously removed.
6. Camshaft and valve train parts a. Camshaft b. Camshaft bushings c. Tappets: solid and hydraulic d. Pushrods e. Rocker arms f. Valve assembly	Refer to manufacturer's specifications to adjust value tappets or rocker arms using feeler gage or dial indicator.
J. Oil pump 1. Location 2. Function 3. Replacement techniques	Securely place vehicle on stands or lift. Consult shop manual. Drain oil and remove oil pan. Remove oil pump assembly from engine for cleaning and inspection. Determine wear and repair or replace oil pump as applicable. Thoroughly clean oil pan and oil lines. Replace pan gasket and pan. Refill crankcase with oil. Start engine and test oil pressure.
K. Engine-chassis connections 1. Electrical connections a. Primary ignition b. Generator or alternator c. Dash gages d. Starting circuit e. Other	

2. Mechanical connections	
a. Motor supports	Remove engine hold-down bolts and nuts on old supports. Raise engine high enough to provide sufficient space to remove supports. Blocking engine securely in place, remove and replace supports as necessary. Lower engine; tighten all nuts and bolts.
b. Throttle linkage	
c. Engine to clutch	
d. Transmission linkage	
e. Exhaust	Check the exhaust manifold butterfly for free and proper movement; lubricate if necessary. Replace faulty unit.
	Replace any part of the exhaust system as required (manifold, header pipe, resonator, muffler, tailpipe.
3. Fluid connections	
a. Fuel lines	
b. Oil lines	
c. Other	
	Depending upon type of automobile, and consulting appropriate shop manual, remove necessary accessories to provide safe working conditions. Remove power plant as outlined in manual by using overhead hoist or shop crane with proper sling firmly secured. Replace engine mounts, clean chassis, and install new power-plant. Reconnect cables, wires, hoses, and lines. Make necessary adjustments and test run.
L. Diagnostic methods	Use appropriate tools to make diagnostic tests. Check compression, cylinder pressure, manifold vacuum, oil pressure, etc. Determine nature of malfunction such as faulty rings, valves, bearings, gaskets, etc.

III. THE FUEL SYSTEM

Trade principles	Trade practices Contact hours <u>114</u>
A. Principle: To supply clean fuel and to mix for optimum combustion B. System components 1. Tank 2. Lines 3. Filters, fuel 4. Pumps 5. Carburetor 6. Filters, air 7. Manifolds: intake, exhaust	
C. Fuel tank 1. Location and mounting 2. Features a. Filler b. Outlet c. Drain d. Filter element e. Baffles f. Sending unit g. Coating 3. Repair techniques	Prepare automobile on jack stands, disconnect sending unit wire and filler tube; remove fuel tank. Remove sending unit and test for open circuit, test float. Inspect tank for cracks, dents, and rust. Replace tank, inspect fuel cap gasket and vent hole.
D. Fuel lines 1. Composition a. Steel b. Copper c. Neoprene 2. Fittings a. Compression b. Flared 3. Repair and replacement technique	Repair or replace fuel lines and hoses. 1. Replace: Remove damaged line. Install new line and connect fittings . 2. Repair: Cut out damaged piece and install a compression fitting and sleeve on each end of the line. Connect the fitting together with a coupling. Repeat for a flared-type fitting.
E. Fuel filters 1. Principle of operation 2. Types	Replace fuel filter on line between fuel pump and carburetor. Disconnect clamps at each end of filter with clamp pliers. Remove filter and install new filter in reverse operation.

    a. Porous bronze
    b. Disc, metal
    c. Ceramic
    d. Other

  3. Cleaning and replacement techniques

F. Fuel pumps

  1. Principle of operation and fuel flow
  2. Types

    a. Mechanical-diaphragm
    b. Electric-diaphragm
    c. Electric-bellows

  3. Fuel-vacuum pump combination
  4. Disassembly technique

Make sure that the fuel tank has sufficient amount of fuel. Check pump pressure. Check lines for loose connections. If the fuel supply is satisfactory, disconnect fuel line at carburetor, crank engine with switch off, allowing fuel to go into a small container. If the pump is in good condition, strong spurts will flow out. If not, the pump is probably defective. Remove and replace new or rebuilt pump.

G. Carburetor

  1. Operating principle

    a. Venturi effect
    b. Fuel atomization
    c. Mixture ratio

  2. Types by flow direction

    a. Updraft
    b. Downdraft
    c. Side draft

  3. Types by valve

    a. Vane or butterfly
    b. Rotary
    c. Other

  4. Systems

    a. Float system
    b. Idle system
    c. Main system
    d. Power system

  5. Disassembly, cleaning and reassembly

Service or replace carburetor.

Remove and disassemble carburetor; clean all parts and repair or replace as necessary; make adjustments specified; complete assembly and install carburetor.

6. Adjustments

a. Float level
b. Main meter jets
c. Accelerator pump
d. Idle mixture
e. Idle speed
f. Centering butterflies
g. External throttle linkage
h. Other

7. Choke

a. Components

(1) Butterfly
(2) Piston
(3) Bimetal spring
(4) Fast idle cam
(5) Heating tube
(6) Linkage

H. Intake manifold

1. Passages

a. Fuel-air
b. Water
c. Vacuum
d. Exhaust heat

2. Other features

Inspect manifold for cracked, warped, or broken studs. Clean surface on manifold and on block, install gasket required

a. Carburetor pad
b. Head-to-manifold mating surface
c. Other

(1) Distributor
(2) Fuel pump
(3) Generator pad
(4) Power-steering pump pad

d. Types of gaskets

I. Air cleaner

1. Purpose and operation

a. Filter incoming air
b. Direct cool air
c. Silence

2. Types by service a. Oil bath b. Oil dip c. Paper element	Remove air cleaner from carburetor, service according to type oil bath, wet or dry.
J. Positive crankcase ventilation systems 1. Types of systems 2. Types of valves a. Metering valve b. Flow restricting valve c. Closed d. Dual action	Refer to manufacturer's handbook to service the major types of PCV systems. Inspect all valves, hose, and connections.
IV. ELECTRICAL SYSTEM	
A. Fundamental electrical data	Contact hours <u>120</u>
1. The electron theory and the structure of the atom a. Electron b. Proton c. Neutron 2. Current flow in a conductor: the flow of electrons 3. Characteristics of conductors and insulators 4. Principles of magnetism	
a. Types of magnets	Examine several types of permanent and nonpermanent, natural and artificial magnets
b. Polarity of magnets	Make artificial magnets by rubbing iron and steel bars against strong magnets, by striking with a hammer, and by electrical induction. Demagnetize in a similar manner.
c. Attraction and repulsion of poles	Use iron filings and magnets to show the lines of force around magnetic poles. Note the effect of changing position of like and unlike poles. Note the effect on filings of strong and weak magnets.

d. Simple magnetic induction	Set up a galvanometer to record induced current and direction of current flow when a conductor cuts the lines of force of a magnet. Note the variation in strength of current flow caused by speed of cutting lines of force and strength of magnet.
5. Basic electrical terms	
a. Volt b. Ampere c. Ohm d. Watt	
6. The use of instruments in making simple measurements	
a. The voltmeter	Connect electrical instruments into circuits in proper manner. Make measurements of volts, amps, and ohms.
b. The ammeter c. The ohmmeter d. The wattmeter	
7. Electrical circuits	
a. Series b. Parallel c. Series-Parallel	
8. Ohm's law	Apply Ohm's law to simple circuits. Note the effect on circuit values caused by varying each of the following: voltage, amperage, and resistance.
9. Kirchhoff's law	Apply Kirchhoff's law to simple parallel circuits. Explain "splitting" effect.
10. The electric storage cell: the conversion of chemical to electrical energy	
a. The primary cell b. The secondary cell	Make electrical measurements of single primary and secondary cells. Combine cells in series and parallel fashion and make electrical measurements. Explain readings.

B. The Starting circuit

1. Components
    - a. Battery
    - b. Starting motor
    - c. Starting solenoid
    - d. Starting switch
    - e. Ignition switch
    - f. Wiring

2. Major parts of the battery
    - a. Cell
    - b. Case
    - c. Cell connectors
    - d. Terminate posts
    - e. Vent cap
    - f. Electrolyte

3. Principles and operation of the battery
    - a. Energy conversion
    - b. Volts available
    - c. Amperes available
    - d. Typical types

4. Tests for operation
    - a. Electrolyte gravity
    - b. Light load
    - c. Full load

Use a hydrometer and a voltammeter to gage the condition of fully charged, partially charged, and discharged batteries. Slowly charge a discharged cell while taking hydrometer and voltammeter reading. Make similar measurements for cells under warm and cold conditions.

5. Maintenance and service
    - a. Cleaning
    - b. Discharge and slow charge
    - c. Proper connections

Develop a procedure for servicing a battery including charging, cleaning poles and cable ends and battery case, and fastening in position.

6. Major parts of the starter
    - a. Case
    - b. Field coils
    - c. Armature
    - d. Brushes
    - e. Drive mechanism

Disassemble and reassemble a starter and solenoid for cleaning and inspection. Identify points of wear and parts requiring frequent replacement.

7. Operating principle
8. Typical internal arrangements

   a. Four-pole, two-field
   b. Four-pole, four-field
   c. Six-pole, six-field

9. Starter motor service

   a. Disassembling and cleaning
   b. Replacing brushes
   c. Checking armature with growler
   d. Turning commutator
   e. Making continuity check of field coils

Examine a wiring diagram of a starter and circuit. Make continuity checks according to the diagram.

10. Starter motor switches

    a. Manual-operated
    b. Vacuum-operated
    c. Solenoid-operated
    d. Solenoid-and-relay-operated

11. Solenoid test techniques
12. Solenoid repair methods
13. Control switches and circuit

    a. Ignition switch
    b. Starter button
    c. Wiring in circuit

Use a kit to repair a faulty solenoid. Explain operation.

14. Battery-solenoid-starter circuit analysis

    a. Ignition switch
    b. Starter button
    c. Wiring in circuit

Make an electrical analysis and diagnosis of a faulty starter on a live automobile. Make the necessary repairs.

C. The charging system

1. Introduction

   a. Description: a mechanically driven electro-magnetic device used to generate electricity

   b. Principles

      (1) Generation of a magnetic field
      (2) Cutting of lines of force by conductors

2. D-C generators

   a. Principles of operation

      (1) Rotating conductors
      (2) Fixed magnetic field

   b. Construction features

      Disassemble a generator. Identify each part, its function, and its proper operation. Reassemble and note any special adjustments

      (1) Housing
      (2) Field coil
      (3) Pole shoes
      (4) Armature
      (5) End plates
      (6) Brushes
      (7) Pulley
      (8) Fan

   c. Circuits

      (1) Externally grounded
      (2) Internally grounded

   d. Service techniques

      Disassemble a starter for overhaul and inspection. Replace the brushes and check holder spring tension. Turn the commutator. Check the armature with a growler. Make electrical checks of circuit.

      (1) Replacing bearings and brushes
      (2) Testing and or replacing the armature
      (3) Turning the commutator
      (4) Replacing field coils
      (5) External electrical
      (6) Adjusting the belt

      Adjust the drive belt to manufacturer's specifications on a generator.

3. D-C regulators

   a. Principle: vary resistance in the field circuit
   b. Methods

      (1) Externally-grounded field
      (2) Internally-grounded field
      (3) Cutout relay

   c. Circuits

      Use a schematic diagram to explain the paths of current and operation of the mechanisms within a regulator.

      (1) Cutout relay
      (2) Current regulation
      (3) Voltage regulation

   d. Temperature compensation

e. D-C regulator checks

(1) Cutout relay
(2) T-C regulator
(3) Current-and-voltage regulator

(a) Autolite
(b) Delco-Remy
(c) Ford

Test cutout relay closing voltage, test current relay and voltage relay, if not satisfactory remove for servicing and adjusting service points with proper tools, replace on automobile, start engine, run until normal operating temperature. Using tester adjust to manufacturer's specifications.

4. A-C generator: alternator

a. Principles of operation

(1) Rotating magnetic field
(2) Fixed conductors

b. Construction features

Disassemble an alternator. Test the parts, explain the function of each, and describe the proper operation. Reassemble and note special precautions or adjustments.

(1) Rotor

(a) Field winding
(b) Pole pieces
(c) Slip rings and brushes
(d) Shaft

(2) Stator

(a) Winding
(b) Laminations

(3) Housing

(a) Mounting lugs
(b) Heat sink
(c) Diodes
(d) Capacitor
(e) Through bolts

c. Circuit within alternator

(1) Within rotor
(2) Within stator

(a) Delta connected
(b) Wye connected

d. Service techniques

  (1) External checks

    (a) Adjusting drive belt
    (b) Checking output

  (2) Internal checks

Disassemble an alternator for rebuilding. Check all windings in stator for opens, grounds, and excessive resistance. Turn slip rings in a lathe; replace brushes, check diodes. Reassemble, install, and check.

    (a) Turning slip rings and replacing brushes
    (b) Checking the field rotor
    (c) Checking the stator
    (d) Checking diodes
    (e) Checking bearings

5. A-C regulators

  a. Principle: varying resistance in field circuit
  b. Types

    (1) Conventional

      (a) Single-unit
      (b) Two-unit
      (c) Three-unit

    (2) Transistorized

      (a) Partially
      (b) Fully

6. Testing techniques for the charging circuit

  a. Polarity check

    (1) Positive-ground systems
    (2) Negative-ground systems

  b. Mechanical contact check of terminals and connections
  c. Electrical checks of the charging circuit using meters

    (1) Excessive resistance
    (2) Grounds
    (3) Open circuit

Test armature and field circuits for grounded or open circuits.

D. Ignition system

1. Introduction
   - a. Purpose: to ignite the fuel-air charge at a predetermined moment
   - b. Principles of operation
     - (1) Generation of a high-voltage charge
     - (2) Timed sequence for discharge
     - (3) Spark gap in cylinder

2. Ignition coil
   - a. Construction

     Test the coil for proper output.

     - (1) Primary windings
     - (2) Laminated core
     - (3) Secondary winding
     - (4) Case
   - b. Operational principles
     - (1) Electromagnetism
     - (2) Mutual induction
     - (3) Self-induction
     - (4) Build-up time

3. Condenser
   - a. Construction

     Test the capacitance of the condenser.

     - (1) Sheet foil
     - (2) Insulating sheets
     - (3) Case
     - (4) Lead
   - b. Operating principle: storage of electrons

4. Distributor
   - a. Operational principles

     Examine distributor points for color and pitting. Check lubricant and condition of rubbing block.

     - (1) Closes primary circuit to charge coil
     - (2) Opens primary circuit to discharge secondary voltage

(3) Properly sequences and directs secondary voltage

(4) Varies the above with engine conditions

b. Construction

(1) Drive mechanism
(2) Cam
(3) Points
(4) Breaker plate
(5) Rotor button
(6) Cap
(7) Advance mechanisms

(a) Centrifugal
(b) Vacuum

Use a dwell meter to set the points in the distributor while installed in the car.

Remove the distributor from the car and place in a test and adjustment stand. Check the advance curve and modify as necessary to meet manufacturer's specifications.

Use a timing light to set ignition in correct time sequence with a running engine.

5. Spark plugs

a. Purpose: To maintain a set gap for secondary discharge and ignition

b. Construction

(1) Electrodes
(2) Insulators
(3) Seals
(4) Shell

c. Features

(1) Thread
(2) Reach
(3) Heat range
(4) Gap adjustment

d. Cleaning techniques

(1) Abrasive
(2) Solvent

Remove a set of spark plugs. Inspect for proper heat range and engine condition. Clean, gap, and reinstall or replace.

6. High-tension leads

Examine all secondary wiring for damage and shorts.

a. Purpose: Transport high voltages

b. Construction

- (1) Center lead
    - (a) Solid
    - (b) Strand
    - (c) Other
- (2) Insulator
- (3) Terminals

Comprehensive test

Use an oscilloscope to analyze the entire ignition system. Match images on the screen with those in manual. Explain deviations observed from the pattern, and recommend corrective steps.

E. ELECTRICAL ACCESSORIES

1. Manual switches
    - a. Head light
    - b. Dimmer
    - c. Directional signal
    - d. Backup light
    - e. Windshield wiper
2. Fuses and circuit breakers
    - a. Cartridge fuses
    - b. Fuse panel
    - c. Bimetallic breaker
3. Relays
    - a. Current limit
    - b. Horn
    - c. Light
    - d. Telltale

File the points, adjust the gap, and check the closing voltage on each type of relay.

4. Sending units and gages
    - a. Fuel units and gages
        - (1) Electromagnetic-type
        - (2) Bimetallic-type

Make electrical tests on an electromagnetic unit using grounding methods and continuity checks.

- b. Temperature units and gages
    - (1) Bourdon-type
    - (2) Temperature-sensing-type

c. Oil pressure units and gages

(1) Bourdon type
(2) Diaphragm-type
(3) Bimetallic-type
(4) Indicator light

d. Ammeters

(1) D'arsonval-type
(2) Other types

5. Horns

a. Major components

(1) Driver
(2) Diaphragm
(3) Horn

b. Operation

(1) Electromagnetically-driven diaphragm
(2) Compression and rarefaction of air

Use a voltmeter to determine the potential delivered to an automobile horn. Refer to manufacturer's specifications

c. Adjustment of the contact point air-gap

Adjust the air-gap between the contact points on a horn. Use a feeler gage for the proper gap and a screw driver on the adjusting screw

6. Windshield wiper assembly

a. Components

Check the electrical requirements of a windshield wiper switch and examine the circuit breaker

(1) Switch
(2) Wiper motor
(3) Linkage
(4) Blade

b. Adjustments

7. Interior lights

a. Types

Run a new wire to an interior light. Use both solder and solderless connections. Note the grounding technique on the light fixture. Replace the bulb according to manufacturer's specifications.

(1) Dash
(2) Dome
(3) Courtesy
(4) Other

b. Replacement

8. Headlights

    a. Components

        (1) Sealed beam unit
        (2) Mounting body
        (3) Adjusting screws
        (4) Wiring

    b. Aiming and adjusting

        Use available equipment to properly adjust headlights

        (1) One unit per side
        (2) Two units per side

    c. Voltage and current requirements

        (1) Single units
        (2) Dual units

    d. Causes of poor lighting

        (1) Low battery
        (2) Poor connection
        (3) Faulty or wrong size wire
        (4) Cracked sealed-beam
        (5) Improper adjustment

9. Directional signals

    a. Components

        (1) Selector
        (2) Blinker unit
        (3) Wiring
        (4) Light: front or rear

    b. Operation

        (1) Selector
        (2) Blinker

        Analyze problems in a directional indicator system by checking the bulbs, wiring connections, flasher, and selector

10. Other lighting circuits

    a. Light units
    b. Wiring
    c. Switches

V. COOLING SYSTEM

A. Purpose: to maintain engine temperature at an acceptable level

B. Principles of operation

1. Properties of liquids
   - a. As a coolant
   - b. As a lubricant
   - c. As a corrosive agent
   - d. As a volatile agent
2. Heat transfer
   - a. Conduction
   - b. Convection
   - c. Radiation
3. Circulation
   - a. Thermo-syphon
   - b. Forced
4. Other
   - a. Pressurized system
   - b. Cold-weather protection

C. Service of major components

1. Coolant a. Water b. Alcohol c. Air d. Other	Test freezing point of coolant using a hydrometer.
2. Coolant pump	Consult manufacturer's shop manual. Drain coolant, remove fan belt, fan, and waterpump. Inspect water pump and rebuild or replace waterpump assembly. Replace fan, fan belt, and hoses. Adjust belt tension, replace coolant.
3. Radiator	Drain coolant, remove radiator hoses; transmission cooling lines if applicable; radiator mounting bolts, remove radiator. Replace radiator, reconnect hoses, refill cooling system with proper coolant, pressure test.

	Locate leak either by visual inspection or by immersion method. Minute leaks may be corrected with liquid compounds. Larger leaks should be soldered. After radiator has been replaced in car, it should be pressure tested.
4. Thermostat a. Bellows b. Bimetallic	Refer to manufacturers shop manual. Drain coolant, remove thermostat. Inspect visually and by hot water immersion method if necessary. Reinstall or replace as required. Replenish coolant.
5. Connecting hoses	Inspect waterhoses visually for cracks, leaks, cuts, and wear. Replace if necessary.
6. Pressure cap	
7. Fan	Consult appropriate shop manual. Inspect, repair, or replace fan unit as required.
8. Fan belt	Consult manufacturers shop manual for specifications. Using straight edge and ruler or tension gage, check for proper tension and adjust if necessary. Inspect for cracks, wear, etc., and replace if necessary.
9. Heat indicator	Consult applicable shop manual and/or wiring diagram. Check vapor pressure sending unit for overheated tube. Check electric sending unit for shorts and/or grounds. Replace sending unit, gage and/or wiring as needed.
D. System service	Consult manufacturers shop manual. Prepare vehicle for reverse flushing procedure. Use specified cleaning agent. Clean and flush system. Inspect all components and replace if needed. Pressure test the system using pressure tester.
E. Comparison of water-cooled and and air-cooled engines	Consult appropriate manufacturer's shop manual. Visually inspect blowers, belts, air ducts, and thermostatic controls for wear, proper adjustment and proper operation. Check for obstruction of fins due to foreign matter, cleaning them with compressed air if necessary.

VI. POWER TRAIN

A. Components

1. Clutch
2. Transmission
   - a. Manual
   - b. Automatic
3. Overdrive
4. Propeller shaft
5. Differential
   - a. Housing
   - b. Gears
   - c. Axles

B. The clutch

1. Purpose: to engage and disengage engine to drive train
2. Types
   - a. Positive
   - b. Friction
     - (1) Dry
     - (2) Wet

3. Components in a dry-clutch a. Clutch pedal	Disassemble a good clutch and examine position and operation of each part. Check the spring pressure of a good pressure plate and note the movement of centrifugal weights.
b. Linkage a. Manual b. Hydraulic	Examine clutch pedal play. Check for excessive wear in countershaft, outer bracket, pedal rod, clevis pin, clutch fork. Replace worn parts.
	Remove slave cylinder from automobile. Disassemble; inspect for wear and pits in cylinder wall.
	Hone cylinder. Do a thorough cleaning job after honing. Assemble in reverse order. Replace cylinder on vehicle and fill unit with brake fluid. Bleed air from cylinder. The same operations apply to master cylinder

c. Throwout fork
d. Throwout bearing
e. Pressure plate assembly
f. Flywheel
g. Clutch disc

Use a dial indicator to check runout of a clutch disc.

4. Operation

a. Spring action
b. Centrifugal weight action
c. Disengaging mechanism

Diagnose clutch malfunctions [illegible] binding, chatter, slipping, harsh operation, and lack of operation. Disassemble and replace faulty parts or adjust, as necessary.

C. Syncromesh transmission

1. Purpose: To provide a selection of gears to multiply engine torque

2. Types

a. Three speeds forward; one reverse
b. Four speeds forward; one reverse
c. Three speeds forward with overdrive; one reverse

3. Components

Disassemble a good standard transmission and identify the components. Reassemble. Make each gear shift by hand and explain the flow of power and torque multiplication.

a. Case
b. Gears

(1) Drive pinion (input)
(2) Main shaft (output)
(3) Others

c. Shift linkage

Examine the shift linkage on a manual transmission for excessive wear and slack; check bushings and lubricate and/or replace; operate linkage to assure proper selection of all four in-gear positions, as well as neutral position; adjust linkage as required by lengthening, bending, or shortening.

4. Operation

a. Alignment of gears with shift mechanism
b. Synchronization of rotational speed of gears to be meshed

c. Multiplication of torque

5. Power flow and gear position

   a. Reverse
   b. Low
   c. Intermediate
   d. High

D. Overdrive

1. Purpose: To reduce engine to drive ratio
2. Types

   a. Transmission-mounted
   b. Differential-mounted

3. Components

   a. Case
   b. Transmission mainshaft (input)
   c. Planetary gear
   d. Freewheeling mechanism
   e. Overdrive mainshaft (output)
   f. Shifting mechanism

4. Power flow

   a. In direct drive
   b. In overdrive

Diagnose malfunctions of a transmission in a car. Identify the nature of the problem (for example: hard shifting, gear clash, slipping out of gear, no power transmission, noisy gears, etc.) and reason for problem (for example: improperly adjusted linkage; worn bearing, gears, or linkage; broken gears; lubricant leaks, etc.).

Make an electrical check of the overdrive circuit. Prepare the overdrive for removal from car by disconnecting speedometer cable, electrical wires, and propeller shaft; drain lubricant. Remove from car and place on work bench. Disassemble and inspect for wear and breaks. Clean thoroughly with solvent. Reassemble using new parts and gaskets as required. Reinstall.

E. Automatic transmissions

1. Purpose: automatic selection of gearing to meet automobile load and speed requirements
2. Principles

    a. Incompressibility of fluids
    b. Fluid transmission of force
    c. Planetary gear operation
    d. Clutch disk operation

3. Major components

    a. Fluid pump(s)
    b. Fluid coupling
    c. Drive clutches
    d. Planetary gear system
    e. Final drive or output shaft
    f. Hydraulic control mechanism or body
    g. External linkage

4. Fluid couplings and torque converters

    a. Drive member
    b. Driven member
    c. Stator (optional)

5. Fluid or oil pumps

    a. Engine driven
    b. Propeller shaft driven

6. Drive clutches

    a. Servo-engaged
    b. Spring-released

7. Planetary gear system

    a. Sun gear
    b. Planetary gears
    c. Ring gear

8. Final drive or output shaft

9. Hydraulic control mechanism or valve body

10. External linkage a. Mechanical b. Vacuum c. Fluid	Adjust the linkage on each type of automatic transmission. Make electrical check of circuitry; vacuum check of lines, and linkage position check. Adjust to manufacturer's specifications for idle, slow, road, and stall.
11. Power flow a. Low b. Intermediate(s) c. Direct or final d. Reverse	
12. In-car transmission service	
a. Diagnostic testing	Check fluid for proper level and for foaming. Try transmission in all shift lever positions to determine whether or not the car moves. Drive car over road of varying terrain and check behavior of transmission. Lift car and go underneath and make a close visual check. Effect one or more pressure gages as required. Consider evidences to determine whether an adjustment, in car repair or removal for complete overhaul, is in order.
b. Linkage adjustment	Adjust automatic transmissions external linkage. Apply parking brake and place selector lever in neutral. Adjust the engine idle speed to specifications with a tachometer. With the engine hot, adjust the anti-stall dashpot clearance. Check the starter circuit in all selector lever positions, the circuit must be open in all positions except N. & P. apply parking brake to prevent operation of the rear pump and install pump pressure gage. Check pressure adjustment at idle and stall speeds. Adjust the throttle linkage, selector lever and starter neutral switch. Follow manufacturer's specifications

c. Replace gaskets and seals	Place car on stands as high as possible. Replace rear seal by removing drive shaft as directed. Use suitable puller. Remove old seal and drive in new seal with proper driving tool. Replace drive shaft as directed.
	Remove governor housing, retainer bolts and gaskets. Replace gaskets, reinstall cover and bolts.
	Remove oil pan and filler tube retaining bolts. Replace old gaskets and filler tube seal, reinstall filler tube and oil pan retaining bolts.
d. Other	
(1) Band adjustment (2) Valve body replacement (3) Governor replacement	Make external adjustment of bands on automatic transmissions of this design; use manufacturer's specifications.
	Place car on high lift for easy access to underside of car. Clean area along gasket joint of pan or cover to be removed. (Scrape with putty knife, wash, and blow off with compressed air as required to thoroughly clean; or steam clean). Remove pan or cover from opening where work is to be done. Clean all parts removed by submerging (when allowable) in a clean solvent. Do not wipe any internal parts with a cloth. Make repair. Reassemble and fill with new fluid as recommended. Pressure test after any jobs involving the governor, valves, body pressure, regulator, or other hydraulic control mechanisms.
13. Out-of-car transmission service	
a. Front seal replacement	Remove dust covers from torque converter housing and take out torque converter to flywheel bolts. Remove linkage and wiring. Remove motor supports and rear cross members where required. Remove drive shaft as directed.

Lower transmissions to floor with transmissions jack. Remove torque converter from housing. Remove and replace front seal with proper tools; replace torque converter in housing slowly to prevent damage to front seal. Raise transmission into place and replace housing to engine bolts. Replace torque converter to fly wheel bolts and dust covers. Reinstall [illegible], linkage, etc. Reinstall filler tube and drive shaft.

Check oil level, fill if necessary. Operate and check for leaks, lower car and road test.

b. Minor or major rebuild

F. Propeller shafts

1. Purpose: connect transmission to differential
2. Types

   a. Enclosed or open
   b. One-piece or two-piece
   c. Hollow or solid

3. Features

   a. Drive angle
   b. Concentric running
   c. Balance
   d. Slip joints

Raise the automobile on a lift. Start engine, place in high gear, and run at highway speed (note: rear tires must be in balance). Check the propeller shaft for running concentric and for balance. Refer to manufacturer's manual for corrective action.

G. Universal joints

1. Purpose: to transmit motion between two parts without a common center line
2. Types

   a. Cross
   b. Ball-and-trunnion

3. Features

Place vehicle on safety stands or lift. Remove propeller shaft and universal joint assembly. Remove old U joint using arbor or hydraulic press. Clean, lubricate, and install universal joint or constant velocity joint. Replace transmission output seal and differential pinion seal if necessary. Re-install propeller shaft assembly, and test drive vehicle.

4. Lubrication requirements	Refer to manufacturer's manual to select proper lubricant in servicing both types of universal joints.
H. Rear axles	
1. Purposes	
a. Support automobile weight b. Support the rear brakes, wheels, and tires c. House the differential	
2. Types	
a. Full-floating b. Three-quarter-floating c. Semi-floating	
3. Components	
a. Axle housing	
(1) Brakes	
(2) Seals and gaskets	Place vehicle securely on stands. Refer to shop manual. Remove wheel, brake, drum, and anchor plate assembly. Remove axle using slide-hammer puller. Remove bearing using hydraulic press. Clean and inspect rear axle. Install new bearing on axle shaft. Replace axle shaft in housing. Install new axle seal. Replace anchor plate, brake drum, and wheel. Refill differential with lubricant, adjust brakes. Test drive vehicle.
(3) Bearings	
b. Axle shafts	
c. Differential carrier	Referring to shop manual, place vehicle on safety stands. Place stands under frame, let axle assembly rest on floor jack. Remove shock absorbers, U bolts, and torque bars when required. Disconnect brake line. Remove axle assembly. Clean and inspect all U-bolts, etc. Install new axle assembly. Connect all lines, hoses, and suspension components. Check differential lubricant, bleed and adjust brakes. Install wheels and test drive.

I. Differential, standard

1. Purposes:
    - a. To multiply torque of the engine
    - b. To change direction of motion
    - c. To permit variation between the speed of the rear wheels
2. Types
    - a. Spur
    - b. Spur bevel
    - c. Hypoid
    - d. Other
3. Components
    - a. Pinion gear
    - b. Ring gear
    - c. Differential case
        - (1) Spider gears
        - (2) Bearings
        - (3) Case
    - d. Differential carrier
4. Action of the differential

Refer to applicable shop manual. Remove drive shaft and rear axles. Drain differential housing and remove differential assembly for cleaning and inspection. Replace worn components and adjust clearances using dial indicator and feeler gage. Reinstall differential in axle housing, install new seals and gaskets. Refill differential with lubricant. Install axles and drive shaft. Test drive.

VII. SUSPENSION SYSTEM

A. Introduction

1. Purposes
    - a. To absorb road shock
    - b. To maintain contact between road and tire
    - c. To maintain alignment with the chassis

2. Requirements
    a. Elasticity: to flex and to return to original state
    b. Flexibility: to be adaptable to many road conditions
    c. Acceptable ride: to have a favorable sprung-to-unsprung-weight ratio
    d. Strength: to be able to carry overloads on rough surfaces

3. Components
    a. Wheels and tires
    b. Axles or A-arms
    c. Springs
    d. Shock absorbers
    e. Control members

4. Lubrication of chassis suspension components

Follow a lubrication guide to select proper lubricant type and application point. Lubricate the front and rear suspension on an automobile chassis

B. Tires

1. Construction
    a. Cord body
    b. Rubber tread
    c. Wire bead

2. Types
    a. Tube
    b. Tubeless

3. Balance
    a. Static
    b. Dynamic

Balance tires both statical and dynamically. Give a full explanation of the need for both types of balance

C. Wheels

1. Features
    a. Offset
    b. Drop center
    c. Bead-lock flange

- d. Flange width
- e. Bolt patterns

2. Tolerance

   - a. Lateral runout
   - b. Radial runout

Measure the runout of both a wheel and a tire; compare with manufacturer's allowable tolerances

D. Springs

1. Purposes

   - a. To absorb road shock
   - b. To align axle-to-frame

2. Types

   - a. Leaf
   - b. Coil
   - c. Torsion bar

3. Mounts

   - a. Rigid
   - b. Shackles

4. Service

   - a. Lubrication of spring
   - b. Lubrication of mount
   - c. Replace one leaf or entire unit

Replace rear coil springs. Jack up car and support front or rear end at the frame side rails. Remove front wheels, stabilizer, shock absorber, lower control arm to floor and remove coil spring. CAUTION: clean and inspect all parts for damage and replace worn or broken parts. Reassemble using proper spring for specific automobile.

E. Shock absorbers

1. Purpose: to absorb and dissipate road shock
2. Types

   - a. Direct acting
   - b. Cam-operated piston
   - c. Rotary vane

3. Mounting methods

   - a. Position
   - b. Brackets and bushings

Place stands under lower suspension arms or axle. Remove retaining nuts or bolts at upper end of shock absorber. Remove bolts at lower end, then lower the shock absorber. Lubricate rubber bushings with rubber lube to prevent squeaks. Remount and torque nuts to specifications.

F. Other control members

1. Purpose: to maintain alignment of the chassis in reaction to unequal road conditions, crosswinds, etc.

2. Types

   a. Stabilizer bars

   Place car carefully onto stands. Disconnect strut and bar mounts in a safe manner. Replace worn and broken metal and rubber bushings. Apply rubber lubricant to all rubber parts to prevent squeaks. Do not try to weld.

   b. Anti-sway bars
   c. Others

   Place car carefully onto suitable hoist such as a twin post, or drive on ramp-type lift. Lift car and support to relieve the pressure at the control arm pivots. Remove control arm pivot attaching bolts in a safe manner and in the sequence that facilitates easy removal. When replacing arm, first assemble all pivots loosely. Then with everything in place, tighten securely. Check drive line angle to be certain of alignment.

G. Rear suspension

1. Types

   a. One piece axle housing
   b. Independent

2. Components

   a. Axle housing or control arm
   b. Spring
   c. Shock absorbers
   d. Others

3. Service

   a. Checking alignment

   Check the alignment of the rear suspension. Make recommendation for adjustment and proceed under instructor's supervision.

   b. Replacing spring, shock absorber, control arm, etc.

H. Front suspension

1. Features

   a. Beam axle

b. Independent

(1) Kingpin
(2) Ball-joint

2. Components

a. Axle or A-arms
b. Springs
c. Shock absorbers
d. Stabilizer bar

3. Replacement of components
4. Alignment by adjustment

a. Caster
b. Camber
c. Toe-in

Lift car from floor; support on stands at outer end of lower control arms. Check ball joints and/or kingpins and bushing for wear, replace if necessary. Adjust front wheel bearings and equalize pressure in front and rear tires. Check tie rod ends, tie rods, front and rear control arms and other components, repair or replace it if needed. Lower car to floor and position on wheel alignment rock. Balance front and rear wheels. Adjust caster, camber, toe-in and rear wheel alignment. Follow manufacturer's procedures and instructions for car involved.

5. Alignment by bending

VIII. STEERING SYSTEM

A. Introduction

1. Purpose: to direct the travel of an automobile

2. Components

a. Steering gear
b. Linkage
c. Spindles

3. Operation

a. Mechanical advantage of steering box and linkage
b. Steering geometry
c. Hydraulic power assist

B. Steering gears or boxes

- 1. Manual
  - a. Components
    - (1) Steering shaft
    - (2) Coupling
      - (a) Worm and roller
      - (b) Recirculating ball
      - (c) Cam and lever
    - (3) Sector shaft
    - (4) Pitman arm
    - (5) Box, housing, bearings, etc.
  - b. Operation
    - (1) Reduces turning effort
    - (2) Multiplies turning force
    - (3) Change plane of motion
  - c. Adjustments
    - (1) Worm bearing pre-load
    - (2) Sector shaft end play
    - (3) Center load adjustment

Place stands under car and cover fenders. Remove pitman arm and loosen sector lash adjusting screw. Adjust worm bearing to specific clearance. With steering at center position, make sector lash adjustment and replace arm. Lower car and test.

- 2. Integral-type power-steering boxes
  - a. Components
    - (1) Hydraulic pump
    - (2) (a) Vane-type
      - (b) Rotor-type
    - (2) Relief valve
    - (3) Lines
      - (a) Delivery
      - (b) Return
    - (4) Integral-type steering box
      - (a) Constant-control
      - (b) Coaxial

      - (c) Saginaw
  - b. Operation
    - (1) Hydraulic pressure assist
    - (2) Precaution: avoid entry of dirt
  - c. Adjustments
    - (1) Thrust-bearing preload
    - (2) High-point

C. Steering linkage

- 1. Components of typical system
  - a. Pitman arm
  - b. Relay rod
  - c. Idler arm
  - d. Tie rods and adjustment sleeves
  - e. Pivot joints
    - (1) Ball-and-socket
    - (2) Tie-rod ends
- 2. Variant linkages
  - a. Drag link and intermediate steering arm
  - b. Center pitman
- 3. Linakge-type power steering: power cylinder
- 4. Spindles and steering arms
  - a. Kingpin type
  - b. Ball-joint type
- 5. Adjustments
  - a. Manual
    - (1) Pitman arm
    - (2) Adjusting sleeves
    - (3) Ball-and-socket joints
  - b. Power: control valve

D. Hydraulic pumps and lines

  1. Hydraulic pumps

    a. Vane-type
    b. Rotary-type
    c. Other

  2. Hydraulic lines

    a. Pressure delivery
    b. Return

E. Lubrication

  1. Manual- and power-steering boxes
  2. Hydraulic pumps and power cylinders
  3. Linkage pivot points

Place stands under car and cover fenders. Remove small hose from gear housing and start engine. Turn steering wheel from lock to lock until all fluid is removed from system. Replace hoses and tighten nuts. Refill reservoir and bleed system by starting engine and turning steering wheel from one extreme to the other. Check and test for leaks (pressure test).

F. Service

  1. Rebuilding steering boxes

Remove, rebuild, and replace steering box. With car on stands, disconnect steering coupler and pitman arm. Remove steering box and place on a clean work surface. Disassemble box and clean, air dry and inspect all parts. Use a magnifying glass where needed for a minute inspection. Replace worn bushings and seals. Reassemble, using lubricants to hold parts in position and lubricate as required. Adjust and remount box. Reconnect coupler and pitman arm.

Remove, rebuild, and replace power steering unit. Remove power steering unit in same manner as conventional box. Overhaul procedures vary greatly. Always refer to shop manual. Place unit on a work bench having a large clean work space. To keep parts in proper reassembly order, lay them out as in an exploded view. Clean parts of one subassembly at a time. Air dry (no rags). Inspect parts for wear,

	straightness, interfering nicks, and breakage. Do not attempt to straighten or weld any steering parts. Reassemble, using recommended special tools, fluid to coat internal parts, sequence and work practices. Adjust to proper torque and clearance specifications. Remount unit and reconnect hoses. Refill with new fluid and recheck for safety.
2. Replacing pivot points	Position car in bay and place on jack stands so that all steering linkage may turn free. Replace complete idler arm or use kit as needed. Draw nuts to specified torque and replace cotter pins. Inspect, remove, and replace tie rods and tie rod ends as needed. Remove tie rods with suitable puller. Note overall length and manufacturer's specifications. Replace, using lock nut or puller.
3. Rebuilding hydraulic pumps	Drain all fluid from pump and reservoir. Disconnect hoses from pump and plug to prevent drainage of hoses. Remove pump belt pivot bolt and mounting bolt and lift off pump and reservoir. Clean pump and reservoir and install repair kit following manufacturer's schematics and instructions for type of pump being repaired. Replace pump on engine; install and adjust pump belt. Check for leaks and check pump pressure.
4. Rebuilding power cylinders	Remove the two hydraulic lines connected to the power cylinder and drain fluid into a container. Remove the power cylinder from the vehicle and inspect seals, brass fitting, hose, and other parts. Remove piston and rod. Reassemble by reversing the disassembly procedure
5. Adjusting the pitman arm and the adjusting sleeves	
6. Replace kingpin and bush spindles	Lift car so as to remove weight from front wheels and spindles. Check kingpins for wear and replace if necessary.

7. Replace ball joints

Remove ball joints as in directions. Service or replace spindle as required. Reinstall components as directed in applicable section.

IX. BRAKING SYSTEM

A. Introduction

1. Purpose: to slow or stop vehicle
2. Principles

    a. Friction; conversion of force to heat
    b. Mechanical advantages of levers
    c. Relationship of pressure, volume, and force of cylinder of various sizes
    d. Characteristics of fluids

        (1) Incompressibility
        (2) Force and pressure transmission
        (3) Corrosiveness
        (4) Lubrication
        (5) Coolant

3. Requirements

    a. Dependability
    b. Duty-rated for overload
    c. Heat dissipation
    d. Ease of operation
    e. Low maintenance

4. Types

    a. Bendix duo-servo
    b. Lockheed
    c. Chrysler centerplane
    d. Disk
    e. Other

5. Major components of the system

    a. Individual wheel brakes
    b. Master cylinder and distribution lines
    c. Emergency brake and linkage
    d. Power booster

B. Drum-type brake

1. Components

a. Drum
b. Backing plate
c. Shoes
d. Wheel cylinder
e. Shoe return spring
f. Wear-adjustment mechanism

2. Operation

a. Hydraulic pressure in wheel cylinder
b. Shoe action against drums
c. Self-energization
d. Return action

3. Adjustment

a. Lockheed-type
b. Bendix-type
c. Chrysler-type

Adjust the brakes on all wheels on each type of drum brake. Evaluate the life remaining before relining.

4. Service

a. Replace shoes
b. Repair cylinders
c. Turn drums

Rebuild the brake on a wheel by replacing shoes, repairing the wheel cylinder, and turning the drum.

C. Disk-type brake

1. Components

a. Pressure plates
b. Wheel cylinders
c. Lining or pucks
d. Housing or brake disk

2. Operation

a. Disk-and-housing type
b. Disk-and-puck type

3. Adjustment

a. Disk-and-housing type
b. Disk-and-puck type

D. Master cylinder

1. Components

- a. Housing
  - (1) Cylinder chamber
  - (2) Reservoir chamber
- b. Piston
- c. Cup and spring
- d. Pedal rod
- e. Boot

2. Operation
   - a. Foot pedal activated
   - b. Pressure developed in the master cylinder
   - c. Equal distribution
   - d. Effect of varying size wheel cylinders

3. Service
   - a. Maintaining fluid level
   - b. Replacing boot
   - c. Rebuilding the master cylinder

Rebuild a master cylinder. Hone the cylinder, measure for wear tolerance, install a repair kit, and remount on the chassis. Fill with fluid and adjust the pedal-to-cylinder linkage.

E. Emergency brake

Adjust the linkage and/or replace the brake band or shoes on an emergency brake.

1. Purpose: to provide an independent, mechanically accentuated brake for parking and emergencies
2. Types by operation
   - a. Externally contracting
   - b. Internally expanding
3. Adjustment
   - a. External
   - b. Internal

F. Vacuum booster

1. Purpose: to reduce pedal effort and raise braking force
2. Types by manufacturer
   - a. Bendix
   - b. Kelsey-Hayes
   - c. Other

3. Sources of trouble

   a. Leakages
   b. Clogged filter
   c. Linkage maladjustment or wear

X. HEATING AND AIR CONDITIONING

A. Introduction

1. Purpose: temperature and humidity control of passenger compartment
2. Types of control

   a. Heaters
   b. Air conditioners

B. Heaters

1. Purpose: elevate temperature for passenger comfort
2. Operation: absorption of heat from engine coolant; blow heated air throughout passenger compartment
3. Components

   a. Heater core
   b. Heater hoses and clamps
   c. Blower fan
   d. Defroster hoses
   e. Radiator
   f. Engine coolant pump
   g. Heater controls

4. Service

   a. Repair or replace heater core
   b. Replacement of heater hose
   c. Replacement of defroster hose
   d. Check and repair electrical circuit and blower motor
   e. Change engine thermostat

C. Air conditioning

1. Purpose

completely disassemble and rebuild a vacuum-boost unit. Carefully follow manufacturer's literature and use recommended procedures, specifications, and parts.

Troubleshoot inoperative heater.

Install a heater in a car. Remove plugs from firewall or drill holes. Mount heater unit; insert fitting on water pump and block; run water line and electrical circuit with switch. Fill with coolant and check for leaks and proper operation.

   - a. To reduce air temperature in passenger compartment
   - b. To reduce humidity in passenger compartment

2. Operation
   - a. Absorption of heat from air and direct a flow of cooled air
   - b. Transport heat to the outside where it is dissipated
   - c. Reduction of moisture by cooling, then heating the air to be circulated

3. Service of system components

a. Condenser	Discharge system of replacement, disconnect and plug hoses, remove and replace condenser and connect hoses. Evacuate the system and recharge with freon 12. Test the system for leaks and check for proper operation.
b. Compressor	Replace or repair air conditioning compressor unit. Discharge system of refrigerant. Disconnect and plug lines. Remove compressor belt and mounting bolts. Disassemble compressor being careful with the valve plates. Determine worn parts and reassemble. Evacuate and recharge system; check evaporator temperature for proper operation.
c. Expansion valve	Discharge refrigerant from system, disconnect hoses, remove and replace expansion valve, being careful with capillary tube. Connect hoses, insulate capillary bulb; evacuate and charge system, check for leaks and proper operation.
d. Evaporator core	Discharge system of refrigerant. Disconnect and plug hoses; remove and replace evaporator. Connect hoses. Evacuate and charge system with Freon 12. Test for leaks, check compression oil and check system for proper operation.

e. Heating core	Discharge refrigerant from system, disconnect hoses, remove and replace dehydrator being careful of sight glass when applicable. Connect hoses, evacuate and charge system with Freon 12. Test compression oil for leaks and check for proper operation.
f. Blower and motor	Disconnect motor to switch wire connection. Remove and replace or repair heater motor following specific manufacturer's service manual.
g. Sight glass	
h. Pressure relief valve	Discharge system of freon, disconnect hoses, vacuum hose and manual control cable. Remove and replace manual control valve or diaphragm. Connect hoses, manual control cable and vacuum hose. Evacuate and recharge system. Check for leaks and proper operation of system.
i. Filter	
j. High-pressure lines and hoses	
k. Air hoses and outlets	

APPENDIX

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AUTOMOTIVE MECHANICS

JOB ANALYSIS OF THE TRADE

Automotive mechanics is a service trade, and the services rendered include both the diagnosis of automotive malfunctions and the repair, overhaul, or replacement of components. These components may be major units such as engines and transmissions, or they may be minor ones such as electrical solenoids and mechanical linkages. Furthermore, adequate service may range from engine replacement to linkage adjustment. Almost all services involve inspection.

The following job analysis of the automotive mechanics trade may appear repetitious because the terms "inspect", diagnose", "repair", or "replace" occur frequently. The use of these terms may seem to convey the idea that the trade is one of limited scope; this is not the case. Each of the jobs listed is distinctive because its makeup consists of numerous operations, some of which are found in no other trade, and all of which are sequenced exactly like no other job. In addition, the ability to know what to look for and when to do things contributes to the uniqueness of each job. For these reasons, automotive mechanics is a complex, multiskilled, knowledgeable trade. It cannot be successfully pursued by those whose only assets are procedural abilities.

TRADE ANALYSIS

AUTOMOTIVE MECHANICS

I. BASIC SHOP PROCESSES

1. Layout patterns with straight edges, scribes, center punches, combination sets, rules, etc.
2. Make non-precision, semi-precision, and precision measurements
3. Cut stock with acetylene torch
4. Cut stock and parts with saws, snips, chisels, files, etc.
5. Hold materials with vises, pliers, wrenches, clamps, etc.
6. Join similar metals with acetylene torch
7. Join similar metals with electric welder
8. Join dissimilar metals with brass
9. Fasten materials with bolts, nuts, screws, rivets, etc.
10. Drill stock with hand drill, drill bits, drill press, etc.
11. Thread stock with tape and dies

II. ENGINE

A. Head assembly

   1. Replace head gaskets
   2. Grind valves and seats
   3. Repair valve train (except camshaft)
   4. Diagnose valve train and head malfunctions

B. Block assembly

   1. Fit and install pistons, pins, and rings
   2. Inspect the crankshaft and connecting rod assembly
   3. Replace timing chains and gears
   4. Replace camshaft and/or camshaft bushings

5. Replace engine and/or transmission supports

6. Service the engine breathing system

7. Diagnose malfunctions in the block assembly for each of the above

III. ELECTRICAL SYSTEM

A. Cranking system

1. Service the battery

2. Repair cables, wiring, switches, relays, and solenoids

3. Repair the cranking motor and/or solenoid

4. Analyze malfunctions in the cranking system

B. Charging system

1. Service the generator

2. Repair wiring

3. File points within the regulator and make necessary adjustments

4. Analyze malfunctions in the charging system

C. Ignition system

1. Inspect and repair the switch, resistor, wiring, coil, points and condenser of the primary circuit

2. Inspect secondary circuit leads, distributor, cap and/or rotor

3. Clean and test spark plugs

4. Test ignition timing and advance units on a test stand

5. Set the timing of the ignition to the engine

6. Determine the reasons for weak or no spark at the plug.

D. Accessories

1. Clean and adjust horns and switches

2. Inspect and test windshield-wiper motors, blades, and arms

3. Test and repair turn-signal units

4. Diagnose and repair lighting circuits

5. Test and rewire dash units

IV. FUEL SYSTEMS

A. Tank and lines

1. Inspect, service, or replace gas tank, cap, and sending unit
2. Repair or replace fuel lines and hoses

B. Pumps and filters

1. Test and repair fuel pump vacuum
2. Clean or replace filter units
3. Measure fuel flow and pressure

C. Carburetors

1. Test and clean choke unit (automatic and manual)
2. Inspect, service, or replace carburetor air cleaner
3. Clean and/or adjust the carburetor

D. Exhaust

1. Service heat-control valve on exhaust manifold
2. Replace exhaust manifold header pipe, muffler, tail pipe, and brackets

V. COOLING SYSTEM

A. Water-cooled engines

1. Test thermostat
2. Adjust fan belt
3. Chemically clean and flush cooling system
4. Replace expansion plugs
5. Inspect water hoses
6. Test antifreeze
7. Test heat-gage sending unit
8. Replace water-distribution tubes
9. Inspect and replace variable-speed fan
10. Replace water pump

    11. Remove and install radiator
    12. Solder minor leaks in radiator
  - B. Air-cooled engines
    1. Adjust fan or blower belt
    2. Test heat-gage sending unit
    3. Clean oil and dirt accumulations on engine

VI. POWER TRAIN

- A. Manual clutch
  1. Replace and or adjust mechanical-type clutch linkage
  2. Repair hydraulic-type clutch bearing
  3. Replace clutch assembly and pilot bearing
  4. Replace flywheel
- B. Conventional transmission
  1. Adjust external shift linkage
  2. Replace gaskets and seals (in-car repairs)
  3. Lubricate and/or replace speedometer cable, drive gear and housing
  4. Rebuild manual transmission (major repairs)
- C. Automatic transmission
  1. Adjust linkage from steering column to transmission
  2. Adjust linkage from engine to transmission
  3. Replace external seals, gaskets, and lines
  4. Make external adjustment of bands
- D. Overdrives
  1. Analyze and repair electrical control circuit and components
  2. Rebuild overdrive unit
- D. Propeller shaft
  1. Replace universal joint

    2. Balance drive shaft (in-car)
    3. Test and replace out-of-round shaft
  - F. Differential and housing
    1. Replace pinion seal
    2. Replace rear-axle shaft, bearing and/or seal
    3. Rebuild differential

VII. SUSPENSION SYSTEM

  - A. Component service
    1. Lubricate the front and rear suspension
    2. Replace shock absorbers and/or mounting
    3. Replace stabilizer bars and/or mounting
    4. Replace springs and/or mountings
    5. Replace control arms and/or bushings
    6. Replace ball joints
  - B. Alignment service
    1. Check frame and axle alignment
    2. Adjust caster
    3. Adjust camber
    4. Adjust toe-in

VIII. STEERING SYSTEM

  - A. Manual
    1. Adjust worm and sector
    2. Rebuild manual steering box
    3. Replace pivot points on steering linkage
    4. Lubricate the steering box and linkage

B. Power-assist

1. Rebuild power-steering box

2. Replace hoses

3. Rebuild power cylinder

4. Rebuild pump

5. Replace pivot points on linkage

6. Lubricate the power steering

IX. BRAKING SYSTEM

A. Hand brake

1. Adjust and/or replace linkage

2. Adjust and/or replace exteraal band

B. Foot brake

1. Replace brake-shoe lining and/or shoes

2. Repair wheel cylinder

3. Re-flare or replace line and/or hose

4. Repair master cylinder

5. Replace grease seal (front)

6. Adjust wheel bearing (front)

7. Replace stop-light switch

8. Rebuild vacuum-assist unit

9. Replace pucks (disc-type brake)

10. Repair disc brake

11. Bleed and adjust brakes

12. Diagnose improper brake operation or leakage.

X. HEATING & AIR CONDITIONING

A. Heating

1. Check coolant temperature
2. Inspect and replace defroster hose
3. Remove/replace heater core
4. Service heater controls
5. Install hot-water heater
6. Analyze heating system malfunction

B. Air Conditioning

1. Repair and/or replace compressor
2. Replace condenser
3. Replace evaporator
4. Replace dehydrator
5. Replace expansion valve
6. Replace freon control valve and/or diaphragm
7. Service control cables and switches
8. Replace fan motor
9. Diagnose air conditioning malfunction

ROTATION PLAN

The rotation plan presented on the following pages is premised on the assumption that first year students will be scheduled in separate classes from second year students. The instructor will then teach the fundamentals of automotive mechanics to the first year students as a group, both in class and in shop. Students successfully completing the first year may be enrolled in second year.

The class is broken into two or more subgroups, depending on the enrollment and nature of the trade. At any given time, each subgroup is engaged in a different block of the trade; the instruction is unique for that block; the jobs are a part of that specific block. During rotation, all subgroups are routed through all blocks and perform all jobs before their training is completed. This teaching technique makes use of instructional sheets such as job sheets, information sheets, operation sheets, and assignment sheets. Records of progress and proficiency are kept for each student.

The following page is an example of the rotation plan as it may apply to the teaching of automotive mechanics. Strict adherence to the plan will likely be difficult, and rigid compliance with it is not recommended. The hours assigned to each automotive system indicate the relative emphasis given to each by the curriculum committee. Preplanning is encouraged for the entire training period. On the other hand, preplanning for the entire training period, with due consideration of student loads; of space, equipment, and supplies capabilities; of unscheduled interruptions; and of the content of the trade program, will result in an improved and more effective learning environment. Such planning assists the teacher in being aware of the proficiency and progress of each student. It also promotes teacher direction of individual activities.

VOCATIONAL AUTOMOTIVE MECHANICS ----

15. SMITH, VIRGIL 14. ROBERTS, ROY 13. QUINCY, CARL 12. PUGH, JOHN 11. OWENS, TED	10. NEWBY, NED 9. MORRIS, JACK 8. LANE, BOB 7. KNIGHT, RAY 6. JOHNSON, JOE	5. HOLLIS, TOM 4. ELLIS, SAM 3. DRAKE, JOHN 2. CARTER, JIM 1. BROWN, BILLY
ORIENTATION (15 hours)		
GAS WELDING (25 hours)	ARC WELDING (25 hours)	HAND TOOLS (25 hours)
HAND TOOLS (25 hours)	GAS WELDING (25 hours)	ARC WELDING (25 hours)
ARC WELDING (25 hours)	HAND TOOLS (25 hours)	GAS WELDING (25 hours)
PRINCIPLES OF THE AUTOMOTIVE ENGINE (15 hours)		
FUEL SYSTEM (102 hours)	ELECTRICAL SYSTEM (108 hours)	ENGINE REBUILDING (200 hours)
COOLING SYSTEM		

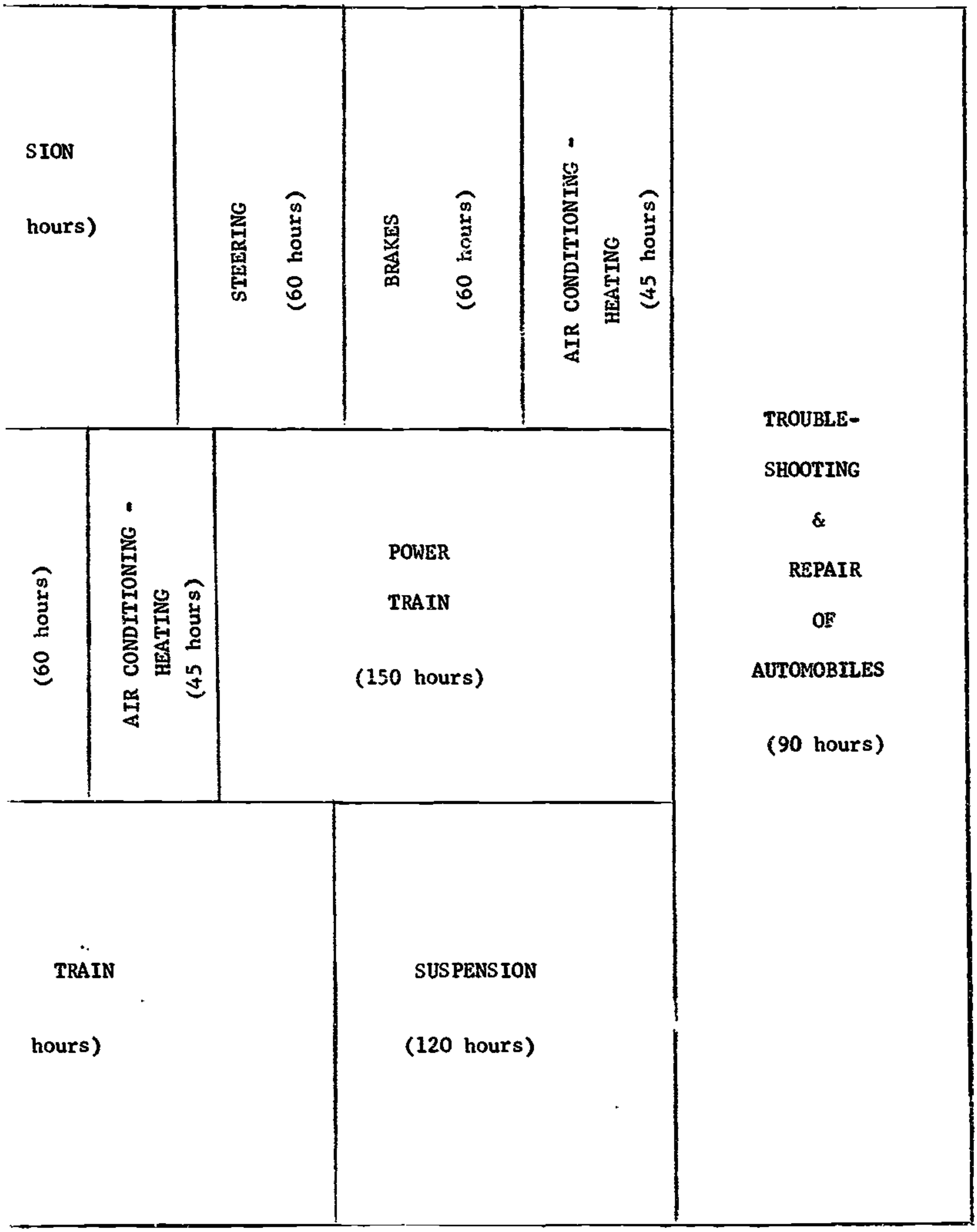
ROTATION PLAN ---- FIRST YEAR STUDENTS

	ELECTRICAL SYSTEM (108 hours)	FUEL SYSTEM (102 hours)	COOLING SYSTEM (30 hours)
FUEL SYSTEM (102 hours)	COOLING SYSTEM (30 hours)	ENGINE REBUILDING (200 hours)	
(30 hours)	ENGINE REBUILDING (200 hours)	ELECTRICAL SYSTEM (108 hours)	

VOCATIONAL AUTOMOTIVE MECHANICS ----

1. BROWN, BILLY 2. CARTER, JIM 3. DRAKE, JOHN 4. ELLIS, SAM 5. HOLLIS, TOM	POWER TRAIN (150 hours)	SUSPEN (120		
6. JOHNSON, JOE 7. KNIGHT, RAY 8. LANE, BOB 9. MORRIS, JACK 10. NEWBY, NED	SUSPENSION (120 hours)	STEERING (60 hours)	BRAKES	
11. OWENS, TED 12. PUGH, JOHN 13. QUINCY, CARL 14. ROBERTS, ROY 15. SMITH, VIRGIL	STEERING (60 hours)	BRAKES (60 hours)	AIR CONDITIONING - HEATING (45 hours)	POWER (150

ROTATION PLAN ---- SECOND YEAR STUDENTS



PROGRESS CHART

Progress in trade training is based on proficiency in knowledges and skills, not on hours or days of exposure in class or shop. For this reason, a progress chart is found on the following page. When the student begins a given task, the instructor places a diagonal in the block corresponding to the task and the student's name. For example: ⧄ When the student evidences proviciency in a given task, the instructor places a second diagonal in the block corresponding to the task and the student's name. For example: ☒ The student is then directed into the next task.

While the chart shown lists only manipulative tasks, the instructor will find it advantageous to prepare similar charts for reading assignments, tests, and other shop activities.

VOCATIONAL AUTOMOTIVE MECHANICS

STUDENT	JOB ASSIGNMENT	ENGINE REBUILDING											ELECTRICAL							
		Replace head gaskets	Grind valves and seats	Repair valve train (except camshaft)	Diagnose valve train and head malfunctions	Fit and install pistons, pins, and rings	Inspect the crankshaft and connecting rod assembly	Replace timing chains and gears	Replace camshaft and/or camshaft bushings	Replace engine and/or transmission supports	Service the engine breathing sys	Diagnose malfunctions in the block assembly	Service the battery	Repair cables, wiring, switches, relays, and solenoids	Repair the cranking motor and/or solenoid	Analyze malfunctions in the cranking system	Service the generator	Repair wiring	File points within the and make necessar	An
1. BROWN, BILLY																				
2. CARTER, JIM																				
3. DRAKE, JOHN																				
4. ELLIS, SAM																				
5. HOLLIS, TOM																				
6. JOHNSON, JOE																				
7. KNIGHT, RAY																				
8. LANE, BOB																				
9. MORRIS, JACK																				
10. NEWBY, NED																				
11. OWENS, TED																				
12. PUGH, JOHN																				
13. QUINCY, CARL																				
14. ROBERTS, ROY																				
15. SMITH, VIRGIL																				

BASIC APPLIED MATHEMATICS

I. INTRODUCTION

  1. The study of applied mathematics

  2. Application of applied mathematics

II. ARITHMETIC

  A. Whole numbers

    1. Addition

    2. Subtraction

    3. Multiplication

    4. Division

  B. Common fractions

    1. Interpreting common fractions

    2. Defining parts of fractions

    3. Reducing common fractions

    4. Operations involoving common fractions

      a. Addition

      b. Subtraction

      c. Multiplication

      d. Division

    5. Practical problems involving common fractions

  C. Improper fractions

    1. Interpreting imporper fractions

    2. Reducing improper fractions

    3. Operations involving improper fractions

      a. Addition

      b. Subtraction

      c. Multiplication

- d. Division
- 4. Practical problems involving improper fractions
- D. Decimal fractions
  - 1. Interpreting decimal fractions
  - 2. Expressing decimal values
    - a. Reading
    - b. Writing
  - 3. Conversion of decimal fractions
    - a. Fractions to decimals
    - b. Decimals to fractions
  - 4. Operations involving decimal fractions
    - a. Addition
    - b. Subtraction
    - c. Multiplication
    - d. Divisions
  - 5. Table of decimal equivalents
  - 6. Practical problems involving decimal fractions
- E. Measurement
  - 1. Standard basic units of measurement
  - 2. Types of measurement
    - a. Direct
    - b. Indirect
    - c. Linear
    - d. Angular
    - e. Circular
    - f. Volume
    - g. Metric

3. Measuring instruments
   a. Scales
   b. Micrometers (inside and outside)
   c. Gages
4. Practical problems involving the different types of measurements

F. Percentage and averages
1. Form for expressing percent
2. Finding any percent of a number
3. Changing percent to decimals and fractions
4. Application of percentage
   a. Interest
   b. Discounts
   c. Payrolls and taxes
   d. Efficiency
   e. Anti-freeze solutions

G. Graphs
1. Types of graphs
   a. Bar
   b. Sine
   c. Circular
   d. Picto-graphs
2. Use of graphs
3. Development of graphs
4. Practical problems involving interpretation and the plotting of different types of graphs

III. FUNDAMENTALS OF APPLIED MATHEMATICS

A. Symbols
1. Concept of symbols

2. Application of symbols in
    a. Addition
    b. Subtraction
    c. Multiplication
    d. Division

B. Equations
    1. Concepts of equations
    2. Defining equations
    3. Parts of an equation
    4. Positive and negative quantities
    5. Solving equations
        a. Addition
        b. Subtraction
        c. Multiplication
        d. Division
    6. Mixed equations
    7. Use of equations in solving practical problems

C. Ratio and proportion
    1. Concepts of proportion
    2. Application of direct proportion
    3. Application of direct inclined proportion
    4. Practical problems involving ratio and proportion

D. Exponents and radicals
    1. Concepts of exponents and radicals
    2. Use of exponents with numerical values
    3. Use of exponents with letters
    4. Multiplication and division of like factors with exponents

- 5. Square root of whole numbers
- 6. Square root of fractions and algebraic numbers
- 7. Use of tables to obtain the power or square root of a number
- 8. Practical problems involving the use of exponents and radicals

E. Formulas

- 1. Concepts and use of formulas
- 2. Application of formulas to
    - a. Squares
    - b. Rectangles
    - c. Regular solids
    - d. Circles
    - e. Parts of circles
    - f. Handbook data
- 3. Special formulas
- 4. Practical problems involving formulas

IV. APPLIED GEOMETRY

A. Introduction

- 1. Relationships and measurement of common shapes and solids
- 2. Solids and solid geometry
- 3. Planes and plane geometry

B. Lines

- 1. Types
    - a. Straight
    - b. Curved
    - c. Parallel
    - d. Horizontal
    - e. Vertical
    - f. Perpendicular

  - 2. Construction
    - a. Perpendicular
    - b. Parallels
    - c. Dividing
  - 3. Linear measurements
- C. Angles
  - 1. Types
    - a. Right
    - b. Acute
    - c. Obtuse
    - d. Complementary
    - e. Supplementary
  - 2. Sum of angles
  - 3. Pythagorean theorem
  - 4. Similarity
  - 5. Construction
  - 6. Area and perimeter calculations
- E. Quadrilaterals
  - 1. Types
    - a. Rectangle
    - b. Square
    - c. Parallelogram
    - d. Trapezoid
  - 2. Construction
  - 3. Area and perimeter calculations
- F. Regular polygons
  - 1. Types
    - a. Pentagon

        - b. Hexagon
        - c. Octagon
    - 2. Construction
    - 3. Area and perimeter calculations
- G. Circles
    - 1. Part of circle
        - a. Radius
        - b. Diameter
        - c. Arcs
        - d. Chords
        - e. Tangent
        - f. Central angle
        - g. Sector
        - h. Segment
    - 2. Circumference and area calculations
- H. Solids
    - 1. Basic concepts relating to common solids
        - a. Rectangular solids and cubes
        - b. Prisms
        - c. Cylinders
        - d. Cones
        - e. Spheres
        - f. Pyramids
    - 2. Lateral-area calculations

V. APPLIED TRIGONOMETRY AND LOGARITHMS

- A. Trigonometry
    - 1. Description of functions

  - 2. Sine, cosine, tangent
  - 3. Co-functions
  - 4. Use of table
  - 5. Interpolation
  - 6. Applied problems
    - a. Angle and side given
    - b. Angle and hypotenuse
    - c. Isosceles triangles
    - f. Equilateral triangles
    - g. Dividing circumference of a circle
  - 7. Oblique triangles
    - a. Laws of sines
    - b. Laws of cosines
  - 8. Functions of any angle
- B. Logarithms
  - 1. General description
  - 2. Use of tables
    - a. Multiplication
    - b. Division
    - c. Powers and roots
- C. Applied problems
  - 1. Installation diagrams
  - 2. Front end adjustment
  - 3. Cam problems
  - 4. Crankshaft problems
  - 5. Timing
  - 6. Power cycle
  - 7. Headlights adjustment
  - 8. Gears and pulleys
  - 9. Tapers of pins and shafts

AUTOMOTIVE MECHANICS

APPLIED SCIENCE

Objectives

1. To develop an interest in science and its role in the metal trades
2. To learn basic scientific facts and principles as they apply to the automotive mechanics area
3. To solve problems encountered in automotive mechanics practices, as they are related to scientific facts and principles

UNIT I. SCIENCE, MATTER, AND MEASUREMENTS

A. Basic principles
    1. Science and the scientific method
    2. Matter
        a. Properties of solids
        b. Properties of liquids
        c. Properties of gases

B. Measurements
    1. English
    2. Metric
    3. Linear
    4. Area
    5. Volume

UNIT II. USE OF PRECISION INSTRUMENTS

A. Combination square

B. Calipers
    1. Inside
    2. Outside
    3. Hermaphrodite

- C. Micrometers
  - 1. Inside
  - 2. Outside
  - 3. Depth
- D. Verniers

UNIT III. SIMPLE MACHINES

- A. Levers
- B. Inclined plane and wedge
- C. Wheel and axle
- D. Screw threads
- E. Speed and force as related to gear trains

UNIT IV. FRICTION

- A. Causes of friction
- B. Types of friction
  - 1. Starting
  - 2. Sliding
  - 3. Rolling
- C. Principles of reducing friction
  - 1. Types of bearings
    - a. Roller
    - b. Ball
    - c. Needle

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Simplifying Farm Work.

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*WORK SIMPLIFICATION, *TEXTBOOKS, REFERENCE BOOKS, UNITS OF STUDY (SUBJECT FIELDS), *VOCATIONAL AGRICULTURE, *FARM MANAGEMENT,

Textual and reference material is provided on the simplification of farm work for high school vocational agriculture and adult farmer classes. It was prepared by a teacher educator in consultation with subject matter specialists, teacher educators, supervisors, and teachers. The material covers (1) reasons for simplifying farm work, (2) the work simplification procedure, (3) illustration of farm work simplification, (4) labor reduction in silage feeding and egg production, and (5) investment in labor-saving equipment. The material is to be used for 1-4 hours by teachers with agricultural competency and students who have average ability, agricultural interest, and occupational goals in production agriculture. Concepts are illustrated with graphs, tables, and photographs. Copies are available for 20 cents from the Vocational Agriculture Service, 434 Mumford Hall, Urbana, Illinois 61801. (JM)

SIMPLIFYING FARM WORK

1. Why Are We Interested in Simplifying Farm Work?
2. What Is the Work Simplification Procedure?
3. Illustrations of Farm Work Simplification.
4. Reducing Labor in Silage Feeding and Egg Production.
5. When Does It Pay to Invest in Labor-Saving Equipment?

In the preceding unit, we discussed the problem of balancing the labor supply and the farm business. Farm labor, an important resource in any business, is a costly agent of production. We must use it effectively in carrying out farm operations.

Considerable emphasis has been placed on getting jobs done with less effort, increasing the productivity of workers, and reducing the labor cost per unit of product. This procedure is referred to as work simplification. We shall discuss its advantages, the procedure to follow, its application to farm jobs, and a method of determining whether the purchase of labor-saving equipment is economical.

1. WHY ARE WE INTERESTED IN SIMPLIFYING FARM WORK?

Most of us are interested in taking advantage of ways of reducing labor or making work easier to do. The final results of effective work simplification may show up as lower costs, greater labor accomplishments, or higher earnings. Any or all of these are worthwhile goals.

A means of reducing costs

Costs in farming have increased ever since the depression of the 1930's. The increase was very great during and following World War II. Labor is an important cost item because the value of the operator's labor, unpaid family labor, and hired labor must all be included.

Farm costs have increased. Total costs have increased greatly since 1940. These costs, including cash operating expenses, new machinery purchases, unpaid labor, and interest on investment, amounted to about $27 an acre on northern Illinois farms in 1940. Hog farms of about 220 acres in northern Illinois had total costs of $64 per acre in 1951 and $85 per acre in 1960. These figures indicate that total costs per acre were about 3 times as high in 1960 as in 1940.

Prices paid for farm-cost items also show large increases since 1940 (Fig. 1). Wage rates were 4.9 times as high in 1960 as in 1940. Farm machinery was 2.5 times as high, farm supplies were 1.8 times as high, and fertilizer 1.5 times as high in 1960 as compared with 1940. With costs increasing over a period of time, it is very important that we keep them at reasonable levels without decreasing production.

Labor is a major farm cost. In all the common systems of farming in Illinois, labor is one of the three major cost items. The data in Table 1 indicate its importance for four systems in northern Illinois.

Labor makes up about 17 to 22 percent of the total farm costs in most of the common systems of farming. It is exceeded in importance by only the interest charge on the investment and by machinery and equipment costs. Work simplification deals with an important phase of the cost side of the farm business.

Labor accomplishment varies. The higher your labor costs in relation to production, the more important it is for you to use methods that will reduce these costs. The variations in labor accomplishments from farm to farm are so great that they are almost amazing,

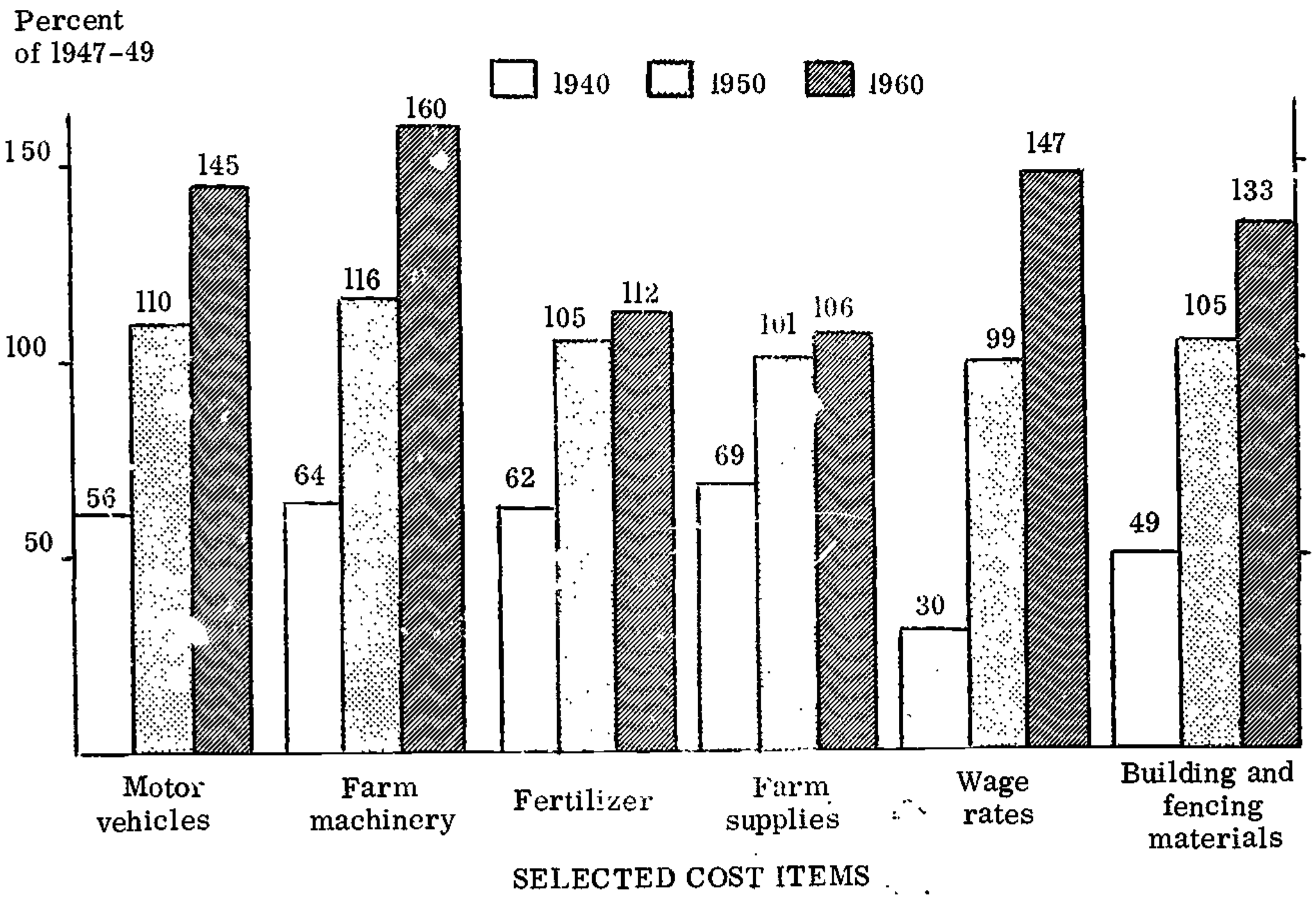

Fig. 1. Cost rates of selected items used by farmers in 1940, 1950, and 1960 (Reported by U.S. Dept. Agr.).

Table 1. Costs Other Than Feed on 180-259 Acre Northern Illinois Account Keeping Farms, 1960

	Systems of Farming							
	Grain		Hog		Beef		Dairy	
No. of farms		99		65		65		32
Av. size (acres)		226		219		221		213
Soil rating		86		82		74		66
	Cost	Percent of total	Cost	Percent of total	Cost	Percent of total	Cost	Percent of total
Costs:								
Machinery & equip.	$4332	25	$5010	26	$5324	25	$5376	27
Labor	3007	17	3630	18	3640	17	4222	22
Soil fertility	1241	7	1066	5	1244	6	759	4
Buildings & fences	1059	6	1605	8	2025	9	2002	10
Taxes	1441	8	1384	7	1449	7	1268	7
Interest charges	5416	31	5658	29	6307	29	4590	23
Seed & crop	725	4	675	3	760	4	6[illegible]	3
Livestock & misc.	318	2	814	4	623	3	832	4
Total	$17539	100	$19842	100	$21372	100	$19650	100

MEMORANDUM

TO: The ERIC Clearinghouse on Vocational and Technical Education
The Ohio State University
980 Kinnear Road
Columbus, Ohio 43212

FROM: (Person) J. W. Matthews (Agency) Vocational Agriculture Service

(Address) 434 Mumford Hall, Urbana, Illinois 61801

DATE: September 7, 1967

RE: (Author, Title, Publisher, Date) Simplifying Farm Work, VAS 2036. Urbana, Illinois: Vocational Agriculture Service, University of Illinois. 16 p., 1963.

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Users of Material Students

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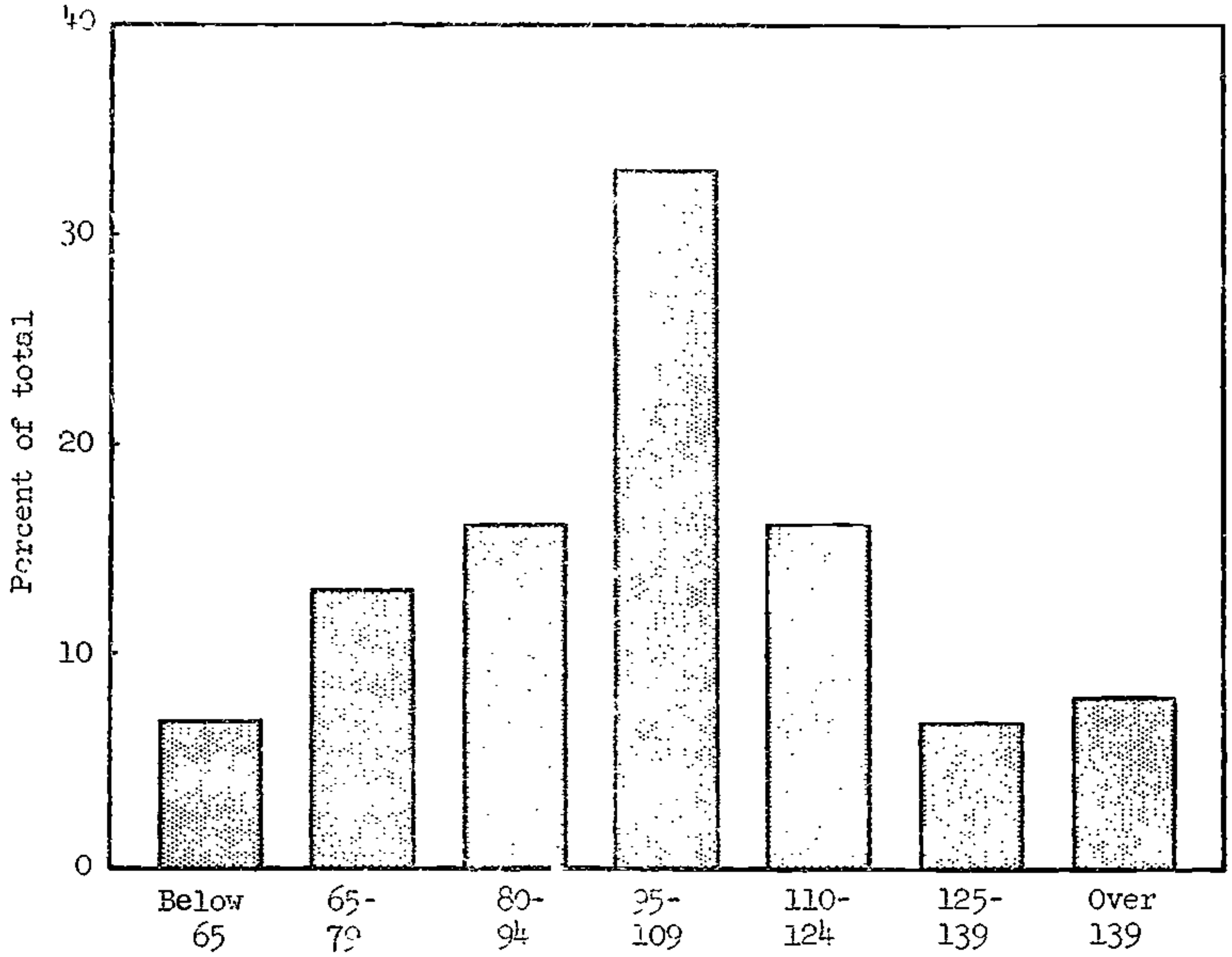

Fig. 2. Index of labor accomplishment on 45 Illinois farms on which hogs were produced in confinement, 1959-60.

but they show up every year. The data in Fig. 2 give an indication of the amount of variation in labor costs on a sample of 45 hog farms on which the hogs were produced in confinement. The indexes of labor accomplished were based on labor standards for pasture production.

The figures show that these farmers as a group did not use labor more efficiently than the standards for pasture production; thus most of those farmers should be able to improve their labor efficiency. An index of 100 indicates the same accomplishment as indicated by the pasture production standards. Notice th-, there was a great deal of difference between the top group and the bottom group. The top group accomplished over twice as much as the bottom group, as shown by an index of 139 as compared with an index of 65.

In any study of farm records, great differences show up. Many farms using labor inefficiently could surely simplify their jobs and work methods to either reduce labor costs or to produce more with the same labor.

Good hired farm workers are scarce. The importance of high labor accomplishment is further emphasized when a farmer tries to hire a worker. High wages paid by industry, shorter work days, and modern conveniences have drawn large numbers of farm workers away from farms.

Good farm workers must possess many skills. They must be good mechanics in order to operate and adjust farm machinery and equipment; they must be able to feed, manage, and care for livestock on livestock farms: they must understand crop production; and they must be able to do a host of other miscellaneous jobs. Then they must be willing to work long hours when it is necessary.

Farm workers who possess the necessary skills and are willing to work for farm wages are becoming harder and harder to find. Most workers prefer industry and the city in spite of certain benefits of living in the country. The trend in sources of farm workers is indicated in Table 2.

During the 1949-1961 period total farm employment in the United States decreased 30 percent. The number of hired workers declined 16 percent while the number of operators and family workers declined 34 per-

Table 2. Farm Employment: Average Number of Persons Employed in the United States for Selected Years, 1949-1961 1/

Year	Total employment	Operators and family workers	Hired workers
		(1,000 persons)	
1949	9,964	7,712	2,252
1951	9.546	7,310	2,236
1953	8,864	6,775	2,059
1955	8,364	6,347	2,017
1957	7,577	5,682	1,895
1959	7,384	5,459	1,925
1961	6,990	5,104	1,886
Decrease from 1949 to 1961	2,974	2,608	364
Percent decrease	30	34	16

1/ From the Farm Cost Situation, November 1962, U.S.D.A.

cent. If farmers are going to maintain production with a smaller labor force and higher wages for hired workers, work simplification will continue to be important to them.

A means of increasing production and earnings per worker

The value of work simplification as a means of increasing the productivity of farm workers has been mentioned several times. Let us consider this in more detail.

Large variations in production per worker. We have examined and compared farm labor costs and showed that there were great variations in these costs from farm to farm. These costs, however, do not necessarily reflect the amount of production or the labor accomplishments per worker.

The variations in labor accomplishment are probably as great as the variations in costs. Labor accomplishment is illustrated in Table 3 with figures taken from "Planning Your Farm Business." The standards shown were based primarily on results obtained from groups of farms keeping detailed labor records.

Notice that even within the same enterprise size group, the number of hours per unit was doubled in comparing low mechanization and poor work methods with high mechanization and efficient work methods. Only about one-third as much labor per unit is needed on the average for the larger enterprises with high mechanization and efficient work methods as compared with smaller enterprises carried on with poor work methods and low mechanization. These figures were based on averages of groups of farms. Individual farm situations would show still more variation. Truly there are large variations in work accomplishment per worker. Simplifying farm work can help farmers make more efficient use of their time.

Greater production per worker usually means higher earnings. The wage a farmer can afford to pay depends on the work accomplished by the employee. Simplifying work makes greater accomplishment possible and a farmer can pay a higher wage without decreasing his earnings. He can then better compete with industry in keeping hired workers. Another important consideration is that the hired worker receives higher wages and improves his economic position.

Most of the labor in farming is furnished by farm operators and members of their families. These persons are unpaid workers in the sense that they do not receive a check every month. At the end of the year the earnings remaining after paying all other costs

Table 3. Annual Direct Labor Requirements for Crop and Livestock Enterprises

Enterprise	Unit	Annual hours of labor per unit		
		Average	High mechanization, efficient work methods	Low mechanization, poor work methods
Dairy herd:				
1-10 cows	1 cow	140	110	200
10-24 cows	1 cow	110	80	160
25 cows or more	1 cow	100	70	140
Hogs:				
1-14 litters	1 litter	35	25	50
15-29 litters	1 litter	25	18	35
30 litters or more	1 litter	20	15	27

of production are considered to be earnings of unpaid labor. The production per worker is an important item affecting the earnings that will remain for the unpaid workers.

Besides having higher earnings, workers may have more leisure time if they are able to maintain their earnings with less physical effort or by working fewer hours.

2. WHAT IS THE WORK SIMPLIFICATION PROCEDURE?

The primary objective of work simplification is to accomplish more with less effort during a given period of time. Farmers often overlook some simple things they can do to reduce labor needs on the farm. Using a little time to plan will frequently save time. Machines often substitute for labor but sometimes the investment in machinery is too large for the size of business. You may be able to reduce considerably the amount of labor needed by replanning the work operations without much additional investment in equipment.

A standard procedure for simplifying farm work has been worked out. It is applicable to many farm jobs varying from very simple tasks to complicated ones.

Break the job down into parts. Analyze the particular job to be studied. List every phase in detail, step by step, so you can get a picture of all the things you do in completing the job.

Compare your methods and accomplishments with others. Compare methods and results with those of your neighbors or friends. It often pays well to visit several farms to observe how others are doing the farm jobs you have to do. The average time requirements for various enterprises are available in such publications as Planning Your Farm Business.

Question the details of your work methods. Be critical of your own methods. Can parts of the job be eliminated? Can certain operations be changed or combined to save time and effort? Can travel be reduced? Can better tools and equipment be used? Can someone else do the job to better advantage? These questions indicate the purpose of this step.

Develop an improved method. Use the ideas you have gathered, along with the analysis of your work methods, to develop an improved method of doing the job. The improved plan should make more effective use of your labor.

Use the improved method. Put the new, improved plan into effect. Only then will you reap the benefits of lower costs, greater accomplishments, less exertion, and higher profits.

3. ILLUSTRATIONS OF FARM WORK SIMPLIFICATION

We will review an actual case to illustrate the procedure used in work simplification. You can follow this same general procedure for numerous jobs on your farm and reap the benefits of reduced labor and higher earnings. We will also give examples of some of the benefits that have resulted. The job illustrated is the one of getting water to hogs on pasture. The following material is adapted from a study made by Purdue University.

Step 1. Break the job down into parts.

A detailed outline of everything done from beginning to end of the job is illustrated in Table 4. In this particular study the distance traveled and the minutes required were recorded.

What impresses you when you read through the list of operations performed? Several operations are repeated a number of times. How many times did the farmer mount and dismount his tractor or open and close the gate? The job routine sounds rather ridiculous as you read it, but you may find something just as ridiculous on your own farm.

How do you compare with others who have the same jobs to do? Do the methods differ?

Do you accomplish more or less than they in the same time? How does the quality of work compare? Make a habit of observing how other farmers do field and chore work, arrange buildings, and care for livestock. It may be easier to find workable ideas already in use than to develop your own.

Several other methods of watering the hogs could be suggested for the job breakdown shown in Table 4. Alternatives include the use of permanent pipe lines, field well with automatic engine shut-off, field well without automatic engine shut-off, water hauled in tank wagon, and water hauled by two rather than one 100-gallon fountain.

Step 3. Question the details of your work methods.

Be critical of your operation performed. Ask yourself the following questions and relate them to the job breakdown (Table 4).

Can the job be done in fewer steps, leaving out some of the details? Is this part of the job absolutely necessary? Is it necessary to make two trips to and two trips from the field? Can it be arranged so the tractor does not have to be mounted and dismounted so many times? If some of the trips could be eliminated, travel, mounting and dismounting, and opening and closing of gates would be greatly reduced. Perhaps other methods and devices could be used to eliminate some of these details of the operations.

Can some of the details or parts of a job or jobs be combined? In our illustration there is little that can be done along this line. There may be opportunity for combining other jobs with watering the hogs. Can feed be taken to the hogs at the same time? Could the fountain be filled with a hose so the farmer could be doing something else while it is being filled?

Can the chore routine be changed? Is the order in which things are done the most logical or can the procedure be reversed to save time and travel? For the single job we are considering and the equipment used, not much improvement can be accomplished. The order of doing the operations is pretty much dictated by the job itself. If more than one job were considered, it is entirely possible that the procedure could be changed.

Are feeds, supplies, and equipment so located that foot travel as well as machine travel is kept at a minimum? In this illustration the location of the water supply is a limiting factor. Can water be made available from a field well, stream or pond? If so, labor requirements may be greatly reduced.

Can buildings, lots, doors, or gates be rearranged for greater convenience? This is an extremely important consideration for livestock operations. Building rearrangement sometimes becomes a major expense. As agriculture has progressed, many farm buildings have become out-of-date. They need to be remodelled if they are to be used in the future. In our illustration, opening and closing gates uses up a considerable amount of time and effort.

Is the equipment adequate and suitable for the job? Proper machines and equipment substitute for labor. Can more equipment be used on the hog watering job to reduce labor? Can another fountain be used to save time? How much would it cost?

Can hand jobs be made less tiring? Some farm jobs such as harvesting fruits and vegetables are repetitive hand jobs. They may become very monotonous and tiring. Methods of doing hand jobs are important in determining how much time is required and how tiring the job becomes. There is little hand work in the job of watering hogs in our illustration.

Step 4. Work out an improved method of doing the job.

After analyzing the job, comparing your methods and results with those of others, and questioning the details of your methods, you should be ready to work out an improved method for doing the job to save labor and cost. You may wish to test the method on paper first.

The operator of the farm used in our illustration decided to change to a method that requires very little purchase of additional equipment but reduces time and travel. He considers the permanent pipe lines and a field well impractical for his conditions.

His decision is the very simple change of buying an additional water fountain. One fountain will be kept in the field and one at the water tank. This reduces the number of round trips to the field from two to one. He

Table 4. A Breakdown of the Job of Hauling Water to Hogs on Summer Pasture. Original Method -- One 100-gallon Fountain Used.

Order of operations	Operations performed	Feet traveled	Minutes required
1	Mount tractor		
2	Start tractor		
3	Drive to field	1370	3.2
4	Dismount		
5	Open gate		
6	Mount		
7	Drive through		
8	Dismount		
9	Close gate		1.2
10	Mount		
11	Drive to water fountain	100	0.6
12	Dismount		
13	Hitch to fountain		0.4
14	Mount		
15	Drive to gate	100	0.8
16	Dismount		
17	Open gate		
18	Mount		
19	Drive through		
20	Dismount		
21	Close gate		1.2
22	Mount		
23	Drive to stock tank	1320	4.2
24	Dismount		
25	Fill water fountain		3.1
26	Mount		
27	Drive to field	1320	4.2
28	Dismount		
29	Open gate		
30	Mount		
31	Drive through		
32	Dismount		
33	Close gate		
34	Mount		1.2
35	Drive to fountain location	100	0.8
36	Dismount		
37	Unhitch		0.4
38	Mount		
39	Drive to gate	100	0.6
40	Dismount		
41	Open gate		
42	Mount		
43	Drive through		
44	Dismount		
45	Close gate		
46	Mount		1.2
47	Drive to farmstead	1320	3.2
	TOTAL	5730	26.3

Summary: Requires 2 trips to field, 47 steps, 5730 feet of travel, and 26.3 minutes per 100 gallons of water.

will simply take a full fountain to the field and bring the empty one to the tank each time he waters the hogs.

Step 5. Put your plan into use.

The advantages of a new or improved plan mean nothing until it is put into effect. The job breakdown for watering hogs for the new plan is shown in Table 5.

This new plan involves purchasing a second 100-gallon fountain and using an electric motor and a piece of hose on the pump so he can be doing other chores while the water fountain is being filled.

Table 5. A Job Breakdown of an Improved Method of Hauling Water to Hogs on Summer Pasture -- Two 100 Gallon Fountains Used.

Order of Operations	Operations performed	Feet traveled	Minutes required
1	Turn on electric pump		
2	Adjust hose to fill fountain while doing other chores		0.5
3	Mount tractor		
4	Start tractor		
5	Drive to filled fountain	50	0.8
6	Dismount		
7	Hitch to fountain		0.4
8	Mount		
9	Drive to field	1320	4.2
10	Dismount		
11	Open gate		
12	Mount		
13	Drive through		
14	Dismount		
15	Close gate		1.2
16	Mount		
17	Drive to fountain location	100	0.8
18	Dismount		
19	Unhitch		0.4
20	Mount		
21	Drive to empty fountain	10	0.4
22	Dismount		
23	Hitch to empty fountain		0.4
24	Mount		
25	Drive to gate	100	0.8
26	Dismount		
27	Open gate		
28	Mount		
29	Drive through		
30	Dismount		
31	Close gate		1.2
32	Mount		
33	Drive to stock tank	1320	3.2
34	Dismount		
35	Unhitch		0.4
	TOTAL	2900	14.7

Results of Applying Work Simplification

We will show some of the savings in time, effort, and costs made possible by work simplification.

Improved method of watering hogs. Summaries and comparisons of the old and the new method of watering hogs are shown in Table 6.

Table 6. Comparison of the Original and the Improved Method of Watering Hogs

	No. of operations	No. of trips	Time (min.)	Travel (ft.)
Original method	47	2	26.3	5730
Improved method	35	1	14.7	2900
Savings	12	1	11.6	2830

The savings shown are for one watering only. If it were necessary to water the hogs twice a day while on pasture for 140 days there would be a total saving of 54 hours of time and 150 miles of travel---all as a result of the purchase of an inexpensive fountain and a change in the method of filling the fountains.

Alternative methods of watering hogs. Purdue University reported time, travel, and estimated costs for six methods of watering and inspecting 100 hogs on summer pasture 80 rods from the farmstead. The data, adjusted for changes in price levels, are shown in Table 7.

Table 7. Time, Travel, and Costs of Watering Hogs on Pasture

Method of watering	Seasonal requirements (140-days)			
	Man hours	Miles walking	Miles riding	Labor and equip. cost[1/]
1. Permanent pipe lines	14.0	40.3	--	$67
2. Field well, engine, automatic shut-off	15.1	40.3	--	49
3. Field well, engine, no automatic shut-off	27.5	75.3	--	61
4. Haul in tank wagon	36.3	2.6	42.9	101
5. Haul in one 100-gallon fountain	94.4	8.0	225.8	210
6. Haul in two 100-gallon fountains	65.3	8.0	115.1	157

1/ Costs recalculated at $1.00 per hour for labor and 30 percent increase since 1949 in costs of machinery, equipment, and supplies

From Table 7 we can see that the use of two fountains is cheaper than one when we consider labor cost. The table also shows that some other methods are still more economical when labor costs are considered.

Work simplification in dairy production

Work simplification has an important place in dairy production. Studies of labor used show a great deal of variation, even among dairy herds grouped according to size. Records of 105 herds in Indiana showed the following results:

Average number of cows	Hours of labor per cow	
	Average	Range
10	132	75-307
16	115	65-300
23	96	48-235

Even though the labor needed per cow was lower for the larger herds, the work method on individual farms was a much more important factor than size of herd in determining unit labor needs. The range in the data give us that information.

Some dairy farmers cut down substantially on the labor needed per cow by carefully studying the entire job of feeding, milking, and handling the milk. You may be interested to know that the study previously reported was made before pipeline milking and bulk tanks came into general use. Studies showed even then that farmers were able to reduce labor requirements by changing the internal arrangement of the barn to improve efficiency; using improved equipment, even a simple grain cart; improving the work routine, such as using rapid milking practices; and improving the positioning of equipment and supplies, such as establishing a work center for milking separate from the one used for general dairy chores.

Some farmers were able to care for, milk, and feed a cow with 75 hours of labor per year without pipelines and bulk tanks when now we still consider 100 hours per cow to be a reasonably good average! By careful planning and the use of better equipment, we should be able to reduce labor needs substantially from today's averages on many dairy farms.

After observing the variations in time and travel for accomplishing certain jobs, it is not surprising that many farmers complain about long hours and hard work. Farm jobs, even though they are small, should be given thought in an effort to improve them and thereby save time, travel, and expense. The procedure outlined is applicable to jobs on all farms. Your farm is no exception.

4. REDUCING LABOR IN SILAGE FEEDING AND EGG PRODUCTION

You should have many opportunities to reduce labor spent in livestock feeding and egg production. Labor efficiency has not increased as much in livestock operations as in crop production. Output per man hour in crop production was about 4 times as high in 1960 as in 1930 but only twice as high in livestock production.

Dairy cattle and poultry require a large amount of labor. This often amounts to 18 or 20 percent of total feed, labor, and capital inputs for these enterprises. Labor in beef production is usually less but silage feeding can consume a great deal of time.

Labor in feeding silage

In the past this job has required a great deal of labor. Several tons of silage may be fed per animal; this means that the total weight of material will be quite high for a medium or large herd of cattle. The method of handling the silage can be very important in determining the total hours required.

According to methods of removal, silage is stored in two major types of silos, vertical silos and horizontal silos.

Vertical silos. Three methods of silage removal will be considered: hand forking, mechanical unloading from the bottom, and mechanical unloading from the surface.

An Illinois study showed the time required for hand forking to be about 190 pounds per minute or 11 minutes per ton, plus any time required to climb up and down the silo and to unloosen frozen silage. Of course, no special equipment is needed with this method. If you have no alternative use for your labor, hand forking may be your most economical method. However, if your labor has value in another use, you may be able to justify spending money for mechanical equipment. The mechanical equipment may also enable you to handle more animals and increase gross income. If the annual cost of the additional equipment is less than the increase in gross income, you will have a higher net income by adding the equipment.

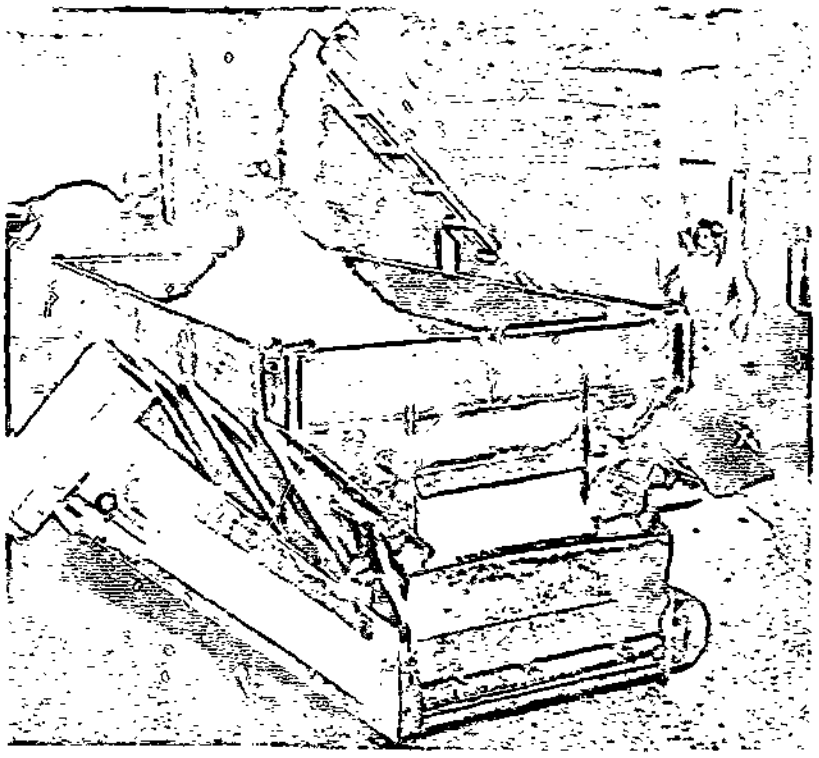

Fig. 3. Self-unloading wagon being filled with silage by a mechanical silo unloader and elevator.

Fig. 3 shows a self-unloading wagon being filled with silage by the use of a mechanical silo unloader and elevator. Such equipment removes corn silage at the rate of 170 pounds per minute or about 12 minutes per ton. The rate of removal may be no greater than for hand forking but the operator is usually free to do something else during part of the time that the machinery is running. Also, considerable back-breaking work is saved. Equipment costs, including fixed costs, spread out over 300 tons of silage, plus operating costs are usually about $1.25 per ton by this method.

Fig. 4 shows a mechanical surface unloader. This equipment unloads silage at the rate of about 200 pounds per minute and requires an attendant for only a few minutes per day. Here again, the operator is usually free to do something else during part of the time that the machinery is running. The costs may be somewhat less than for the equipment shown in Fig. 3.

Sometimes augers or other mechanical devices carry the silage to the feed bunks. Even when such equipment is not used, careful planning in arranging feed bunks can reduce time required in feeding. Arranging feed bunks along the fence and using a self-unloading wagon can contribute to labor efficiency. Such an arrangement is shown in Fig. 5.

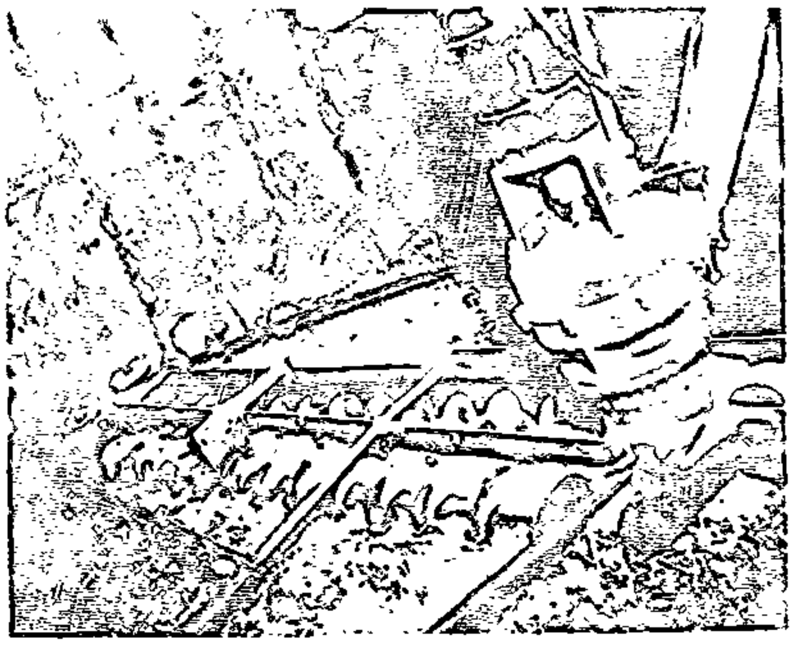

Fig. 4. Mechanical surface unloader for unloading silage.

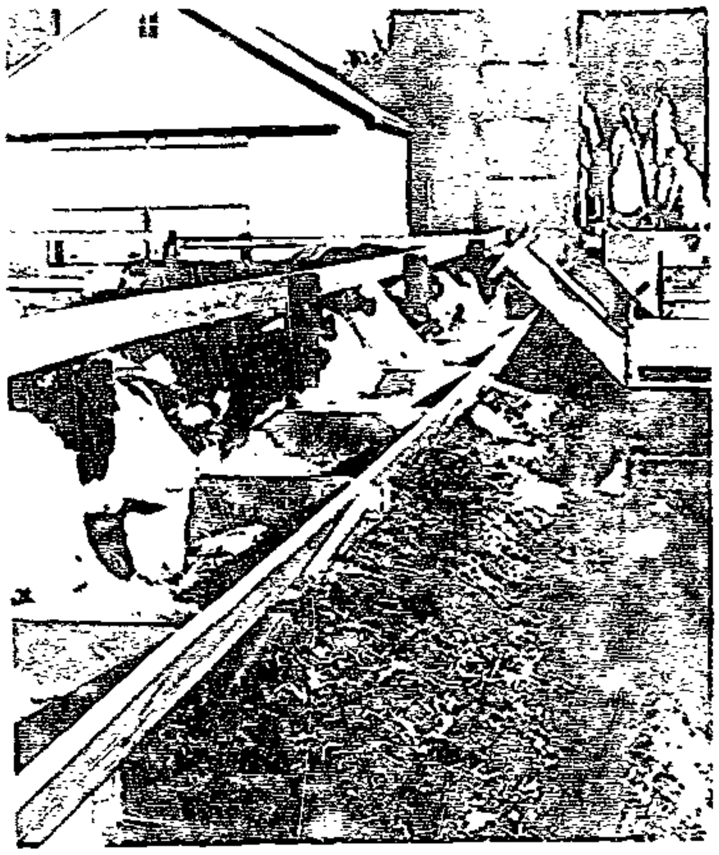

Fig. 5. Arrangement which enables self-unloading wagon to deliver feed into the fence bunks from outside the lot.

Horizontal silos. Removing silage by hand forking from a horizontal silo requires a lot of hard work. A power scoop can be used to much advantage when you move silage to the feeding area. Spreading the cost of such equipment over 200 tons of silage, for example, can keep the removal cost low on the basis of a ton handled. Then, too, the equipment can be used for other farm jobs.

You can save still more time and expense if you construct the silo in such a location that the animals can be self-fed directly from the silo. Fig. 6 shows a movable gate that

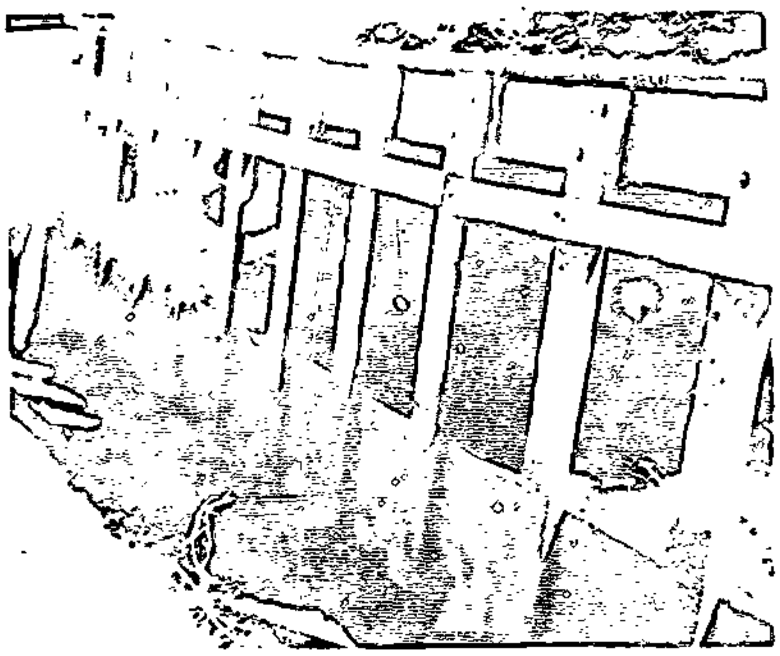

Fig. 6. Movable gate with individual feeding partitions and a solid-panel base.

can be used to allow the animals to eat with a minimum of waste. The time spent in building the gate is not very great and the time required for maintaining and moving it is very small.

A suspended gate, such as shown, is usually built of 2" by 6" material; bolts are recommended for fastening. Poles or iron pipe with the equivalent strength of a 6-inch wooden pole should be satisfactory for suspending the gate from the side walls of silos up to 30 feet wide. Steel cables, chains, or tripled strands of No. 9 wire can be used to attach the gate to the support pole. Gates are usually 5 or 6 feet high and are hung so the bottom just clears the silo floor.

Labor in egg production

The laying flock enterprise serves as another excellent example of possibilities in reducing labor. Some of the jobs that will be considered are: feeding and feed processing; watering; gathering, cleaning, and processing eggs; and cleaning the house.

Feeding and feed processing. Each 100 hens requires that about 5 tons of feed be distributed per year; this job often affords an opportunity to save labor. The labor needed will depend on the number of feedings and different kinds of feed, storage of feed, arrangement of the feeders, and the use of mechanical equipment.

Some poultrymen feed as often as 5 times per day; others fill self-feeders only once a week. Some feed several kinds of feed; others feed an all-mash ration handled in bulk. Scratch grain may be fed in addition but this does not require much time if the feed is conveniently stored and if done during a trip to the henhouse to gather eggs. Oyster shell and grit can be fed by using large capacity hoppers that do not need to be filled often.

Feed should be stored inside the henhouse, especially when hand-feeding is practiced. The storage volume should be large enough that the feed does not have to be brought in too often. A bin with a volume of 90 cubic feet holds a 10-day supply for 1,000 hens. Overhead storage permits quick and easy filling of hoppers or the supply bin of a mechanical feeder (Fig. 7).

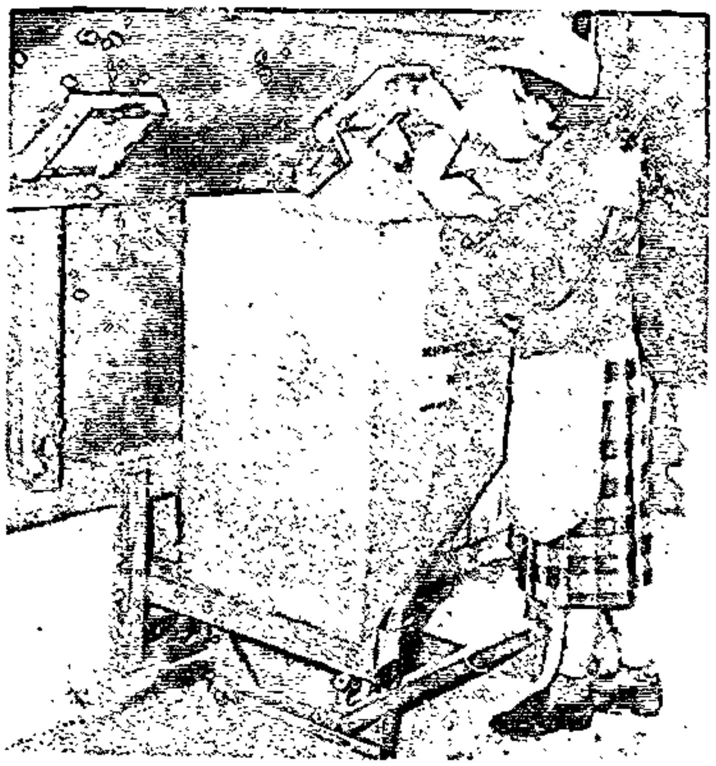

Fig. 7. Supply bin of a mechanical feeder being filled from an overhead bin.

With hand-feeding, careful planning in arrangement of hoppers and in working out the feeding routine is important. Self-feeders reduce feeding time considerably even though checked daily. Self unloading wagons or carriers on an overhead track may be used to carry feed to the hoppers.

A mechanical feeder should be a paying proposition for a larger operation. Fig. 8 shows that a mechanical feeder costs only a few dollars more than hand-feeding for 500 hens but almost twice as much as hand-feeding for 250 hens. (Labor was charged at $.90 an hour and interest at 5 percent.) The cost of mechanical feeding was the same as the cost of hand-feeding at a flock size of 650 hens. With labor at $2.00 an hour, mechanical feeding would cost the same as hand-feeding for a flock size of 350 hens.

Watering. Each 100 hens requires 6 to 9 gallons of water per day. An Illinois study showed that poultrymen who did this job by hand worked 27 hours and walked an additional 28 miles per year.

Piping water to the henhouse and carrying it to the fountain reduced labor to about 8 hours per 100 hens. A few extra feet of pipe and automatic fountains reduced labor for watering to a little more than one-half hour per year. The use of shallow waterers can reduce the time required for cleaning watering equipment.

Equipment for automatic watering is very inexpensive. If you already have a water system of adequate capacity, the added equipment for automatic watering will be economical even if the flock is small and labor is valued at only 25 cents an hour.

Gathering, cleaning, and processing eggs. Studies show that it pays to gather eggs three times a day in commercial flocks. However, proper arrangement of the nests and planning the travel routes can keep the time required to a minimum.

The use of clean nests means less time spent in cleaning eggs. Placing soiled eggs in a separate portion of the container saves time in sorting. If the eggs are cleaned by hand, you can save time by cleaning only the soiled areas of the egg.

Machines for washing eggs save considerable time and are considered economical for

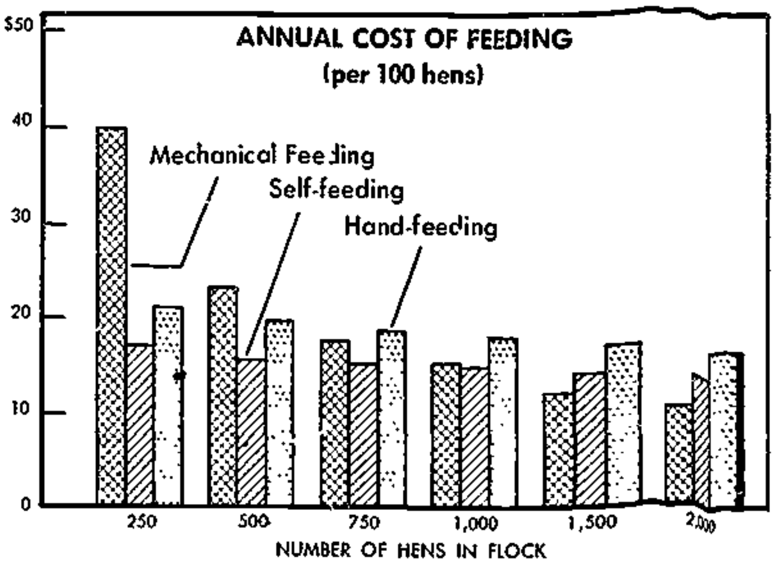

Fig. 8. Annual cost of feeding hens.

flocks of 300 hens or more. Cleaning should be done carefully and according to the manufacturer's recommendations. Hand-cleaned eggs must be packed one at a time because the cleaning and packing jobs are combined. Several machine-washed eggs may be packed at one time, speeding up the job of packing.

Time can be saved in candling or grading eggs by providing plenty of work space and keeping materials in a convenient location.

Cleaning the henhouse. Modern methods of cleaning reduce the time spent on this job. With a deep litter system, the house may be cleaned only once a year if the dropping pits are cleaned two or three times. Cleaning may be done with the use of tractor equipment. Mechanical cleaners are used in some hen houses to simplify the cleaning job.

A recent development on a very few poultry farms is the use of lagoons to collect the manure, thus reducing the cleaning job to a minimum. Time will tell how satisfactory this method is over a period of years.

Other examples

We have shown how labor can be reduced in hauling water to hogs, in dairying, in feeding silage, and in producing eggs. You can undoubtedly think of other ways of reducing labor on your farm.

The use of pipelines for transporting milk from the cows to a bulk tank is a good example. The use of a proper work routine is also important. We touched briefly on these items earlier in the unit.

When individual hog houses are used, the proper arrangement of the houses is important In confinement feeding, the arrangement of the farrowing and feeding quarters and provisions for disposal of manure are all important. Mechanical feeding of concentrates to cattle and hogs saves much labor.

A large increase in labor efficiency has already occurred in crop production. Minimum tillage can reduce further the hours required in producing crops.

Think of methods you can use to reduce the labor needed on your farm. Some methods may require little, if any, new investment in equipment. Planning, as explained in Sections 2 and 3, is very important.

5. WHEN DOES IT PAY TO INVEST IN LABOR-SAVING EQUIPMENT?

We will discuss the items to consider in making the decision and then give an example of the use of a partial budget as an aid in doing so.

Points to consider

Some of the items that should be considered are: 1) fixed costs of the equipment, 2) operating costs, 3) added returns, and 4) other uses for your labor and capital.

Fixed costs. The annual fixed costs are those costs that remain the same, regardless of the amount of use you have for the equipment. Fixed costs are sometimes referred to as "overhead" costs. Depreciation is usually considered to be a fixed cost, along with interest, taxes, insurance, and sometimes shelter. (Depreciation is not entirely a fixed cost if the machine is used so much each year that it wears out more rapidly and needs to be replaced sooner as a result of its use.)

The fixed cost per unit of use depends on the amount of use you have for the equipment and on its initial cost. You determine the fixed cost of handling a ton of feed by dividing the annual fixed costs by the tons of feed handled during the year.

For example, a silage unloader costs $1,500 and is expected to last for 10 years. Interest amounts to 3 percent of the new cost (the same as 6 percent of the remaining cost in the equipment at the beginning of each year); and other fixed costs, such as taxes and insurance, amount to about 2 percent of the new cost. The total fixed cost per year then is 15 percent: 10 percent for depreciation, 3 percent for interest, and 2 percent for other items. The total fixed costs of the silage unloader amount to $225 per year (15 percent of $1,500).

If the silage unloader is used for 100 tons of silage per year, the fixed cost per ton will be $2.25; if used for 200 tons it will be $1.12.

Operating costs. The annual operating costs vary in proportion to the amount of use for the equipment; thus the operating cost per unit of use will be the same regardless of the amount of use. The operating costs per ton handled by the silage unloader will be the same, regardless of whether we handle 100 tons, 200 tons, or some other amount.

The fuel or electricity needed to operate a piece of equipment is an excellent example of an operating cost. We use the same amount per hour, no matter how many hours we operate the equipment. The greater the use per year, the higher will be the annual operating cost.

Repairs are usually thought of as an operating cost because the greater the use, the higher will be the repairs. Sometimes rusting calls for repairs even though the equipment is not used; however, here we will think of repairs as being in proportion to the amount of use.

Labor is sometimes thought of as an operating cost in connection with equipment. However, you may be able to do other work while labor-saving equipment is in operation. You probably have less total work as a result of having the equipment and may want to consider the reduction in total labor rather than the amount or cost of labor needed to operate the equipment. We will do so in this example.

We will assume that operating costs, including repairs and electricity, will amount to 20 cents per ton for the silage unloader, regardless of the amount of use per year.

Added returns from the equipment. Sometimes new equipment will result in extra gross returns. An example is equipment that permits a dairy farmer to sell Grade A milk. For a small herd of 20 cows producing 10,000 pounds of milk per cow, 65 cents more per hundred for Grade A milk amounts to added returns of $1,300. In our first example about deciding on the purchase of a silage unloader, we will not figure any added returns from the use of the equipment.

It is possible that some equipment could reduce gross returns. If the quantity or quality of the product would be lower with the use of the equipment, this would, of course, result in reduced returns. We would need to consider this item in our decision regarding purchases even though the equipment would save much labor. We will assume here that most equipment to reduce labor will not reduce the value of production.

Other uses for your labor and capital. Other uses for labor and capital will determine the value you should place on them in making the decision to purchase equipment. Of course, you may want to place a value on time you could use for leisure, even though you have no other use for your labor. In other words, you may feel that it is worth $1 an hour not to have to work!

If no value is assigned to leisure time and you have no other use for your labor, you should figure its value at zero when deciding whether the purchase of labor-saving equipment is economical. On the other hand, if the saved labor will return $2 an hour in another use, that figure is valid in figuring the value of labor saved by the machine.

In our example we will first assume labor to be worth the same as the prevailing wage rate for hired farm workers in Illinois, or about $1 an hour. We will assume that the silage unloader saves about 25 minutes of labor for each ton of silage removed; thus .4 hour of labor, or 40 cents worth, is saved for every ton of silage handled with that equipment. If the equipment handles 100 tons per year, you save $40 worth of labor; if it handles 200 tons, you save $80 worth, and so on. If we assume that the labor saved is worth $2 an hour, the silage unloader will save $80 for every 100 tons of silage handled.

Other uses for your capital are also important. For example, you can invest money in fertilizer, in breeding stock, in buildings, or in off-farm investments. We figured interest at the rate of 6 percent of the average remaining cost at the beginning of each year, or 3 percent of the new cost of the equipment. If you have another use for your money that will return more than 6 percent, you should allow a higher percentage of the new cost as interest. The same is true if you have to pay more than 6 percent for borrowed money.

Use of a partial budget

A partial budget will help determine whether it will pay you to make a change in a part of the farm business. Such a budget is helpful in deciding whether the purchase of an item of labor saving equipment is economical.

We will work out a partial budget based on preceding information about the use of a silage unloader. First, we will add the additional costs and any reduced returns that will result from the purchase of the equipment. Second, we will add any additional returns (increase in gross income) and reduced costs that will result. Then we will subtract the first figure from the second to determine whether there is an advantage in buying the equipment. We will assume that 200 tons of silage will be handled and that labor is worth $1.00 per hour. The budget is shown as Table 8.

Table 8 Partial Budget to Determine Whether to Buy Equipment

	Item	Value
1.	Additional costs	
	Fixed costs of the silage unloader, 15% of $1,500	$225
	Operating costs, 20 cents per ton times 200 tons	40
	Total annual additional costs	$265
2.	Reduced returns (assume none in this example)	0
3.	Total annual additional costs and reduced returns	$265
4	Additional returns (assume none in this example)	0
5.	Reduced costs	
	Saving of labor, 80 hours at $1.00 per hour	$80
6.	Total annual additional returns and reduced costs	$80
7.	Net change in income with new equipment (6 - 3)	-$185

According to the budget, it will not pay to buy the additional equipment because the added annual costs will be higher than the labor saved, the difference amounting to $185 per year. If we value labor at $2 an hour, the silage unloader would still cost $105 more per year ($265 - $160) than the value of labor saved. It would take about 370 tons of silage, with labor valued at $2 an hour, before the use of the unloader would be economical.

With 370 tons of silage and labor worth $2.00 an hour, the budget would appear as follows:

Additional costs

Fixed costs	$225
Operating costs 370 x .20	74
Total costs	$299

Reduced costs

370 tons x .4 = 148 hours 148 hours labor @ $2	$296
Net change in income	-$3

Additional returns made possible by equipment can have an important effect on the outcome of the partial budget. Let us assume, for example, that we have the buildings, equipment, and funds needed for extra steers for which labor is now available. With the 200 tons handled by the silo unloader in Table 8, 80 hours of labor will be saved. At 8 hours of labor for each additional steer, we can now feed 10 more steers. If each steer returns $30 above feed and purchase costs, we will have additional returns of $300 after buying the silage unloader (Table 9). The annual additional returns are $35 more than the annual costs of the equipment.

Table 9 Partial Budget Showing Additional Returns After Purchase of Equipment

	Item	Value
1	Additional costs	
	Fixed costs of the silage unloader, 15% of $1,500	$225
	Operating costs, 20 cents per ton times 200 tons	40
	Total annual additional costs	$265
2	Reduced returns (assume none in this example)	0
3	Total annual additional costs and reduced returns	$265
4	Additional returns	
	Income above feed and purchase costs, $30 times 10 steers	$300
5.	Reduced costs (The labor saved was used to feed steers to bring in additional returns)	0
6	Total annual additional returns and reduced costs	$300
7	Net change in income with new equipment	+$35

You can adapt this illustration to your own situation to help determine whether new equipment is likely to pay for itself. Compare the total of the "additional costs and reduced returns" portion of the budget with the total of the "additional returns and reduced costs" portion to find whether the equipment will return more than its cost. A form you can use for your partial budget is shown on page 16 of this unit.

Partial Budget

Additional costs	$	Additional returns	$
Reduced returns	$	Reduced costs	$
A. Total annual additional costs and reduced returns	$	B. Total annual additional returns and reduced costs	$

Net change in income (B minus A) $________

R. N. Van Arsdall, Farm Production Economics Division, Economic Research Service, U. S. Dept. of Agr., gave assistance with this unit.

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Pruning and Training Bramble Fruits and Highbush Blueberries.

Illinois Univ., Urbana. Vocat Agriculture Service
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*TEXTBOOKS, REFERENCE BOOKS, *VOCATIONAL AGRICULTURE, *PRUNING, *FRUITS, UNITS OF STUDY (SUBJECT FIELDS),

The purpose of this document is to provide high school vocational agriculture and adult farmer students with textual and reference material on the training and pruning of small fruits. It was developed by a teacher educator in consultation with subject matter specialists, teacher educators, supervisors, and teachers. The sections are (1) Pruning Tools, (2) Supporting the Canes, (3) Pruning Red and Yellow Raspberries, (4) Pruning Black and Purple Raspberries and Erect Blackberries, (5) Pruning Semi-Erect and Trailing Blackberries, and (6) Pruning Highbush Blueberries. Photographs and drawings illustrate the textual material. Teachers with agricultural competency and students of average ability with interest in production agriculture may use the material over a period of 1 to 2 hours. This document is available from Vocational Agriculture Service, 434 Mumford Hall, University of Illinois, Urbana, Illinois 61801. (JM)

PRUNING AND TRAINING BRAMBLE FRUITS AND HIGHBUSH BLUEBERRIES

1. Pruning Tools
2. Supporting the Canes
3. Pruning Red and Yellow Raspberries
4. Pruning Black and Purple Raspberries and Erect Blackberries
5. Pruning Semi-Erect and Trailing Blackberries
6. Pruning Highbush Blueberries

In order to intelligently prune any plant, it is essential to understand its growth and fruiting habits. Bramble fruits (raspberries and blackberries) have biennial canes and perennial roots and crowns. All brambles send up new shoots during each growing season from the crown and some (erect blackberries and red or yellow raspberries) develop new shoots from both the crown and roots. These shoots, regardless of origin, grow vigorously during the summer, initiate flower buds in the fall, over-winter, and bear fruit the following season. The fruit is borne terminally on leafy shoots arising from lateral buds on one-year-old canes. The canes then gradually dry up and die shortly after harvest while new shoots are developing to repeat the cycle, thus providing fruiting canes each year.

Fig. 1. Typical purple raspberry plant properly trained.

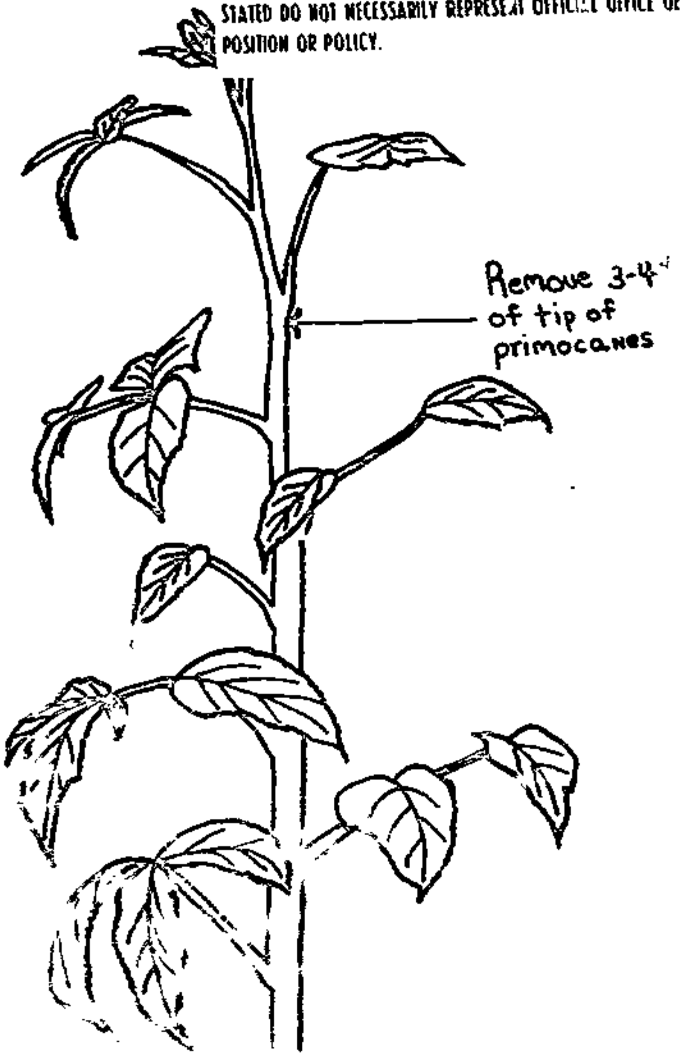

Fig. 2. Black and purple raspberries and erect blackberries should be pinched or topped during the growing season.

The everbearing types bear fruit twice on the same cane. The new shoots bear a crop at the tips in the fall and again the next season farther down on the canes. The fruited canes of such types should not be pruned after the fall crop since this would remove the fruiting wood for the spring crop. However, since the everbearing varieties produce fruit abundantly on primocanes (canes of the current season's growth), it is possible to grow them solely for the fall crop by mowing all of the canes to within 2-3 inches of the ground in the spring before growth begins. Then only the abundant crop on the primocanes is harvested in the fall. This practice eliminates all labor of hand pruning and the problems associated with winter injury to the overwintered canes. Common fungus diseases may also be held to a minimum.

Variation in the development of lateral branches must also be considered in order to properly prune the bramble fruits. Black raspberries, purple raspberries, and erect blackberries usually develop strong lateral branches if the new shoots are headed back early in the growing season. This characteristic is responsible for the practice of pinching or summer topping which consists of snapping off or cutting with shears the top 3 to 4 inches of the new shoots at the proper time (Fig. 2). This practice has no advantages and may be detrimental when used on red raspberries, yellow raspberries, semi-erect blackberries, and trailing blackberries. With red and yellow raspberries the resulting new laterals are generally weak, often break away from the cane when fruiting the following year, and are easily winterkilled. Topping also tends to induce more sucker plants than desired.

1. PRUNING TOOLS

The tools needed for training and pruning the brambles are neither expensive nor complex (Fig. 3). The three types generally used are the small hand pruning shears, the long-handled or lopping shears, and the bramble hook The small shears are used for cutting back the laterals and summer topping. Either the lopping shears or the bramble hook may be used to remove entire canes at the ground level in thinning or removing fruited canes. Care must be taken not to pull or break the cane out of the crown when using the hook.

Maintaining pruning tools in good cutting condition is an essential part of pruning. After use, all tools should be cleaned and their cutting surfaces wiped with an oily cloth to retard rust Cutting surfaces must be kept sharp to make smooth, rapid-healing cuts.

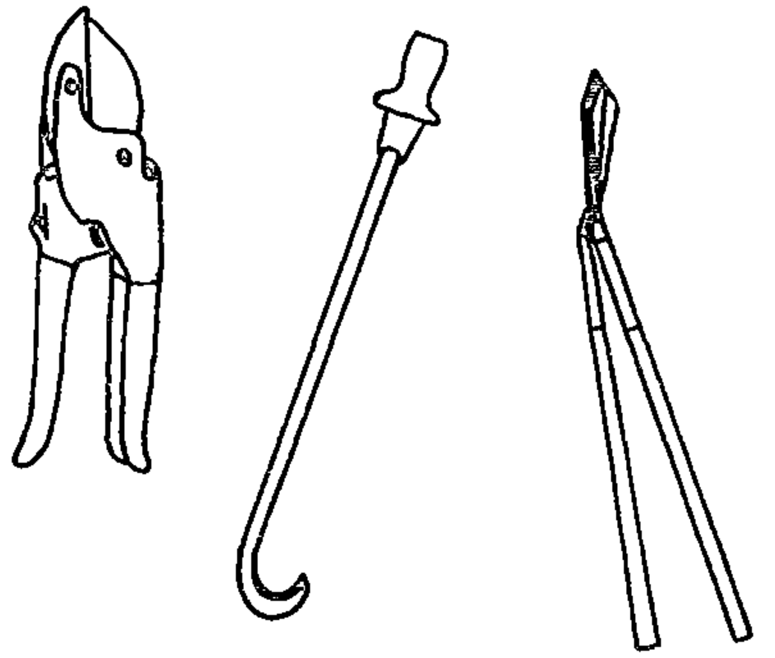

Fig 3. Pruning tools include (A) hand pruning shears, (B) bramble hook, and (C) long-handled or lopping shears.

2. SUPPORTING THE CANES

Although all brambles, except possibly the trailing blackberries may be grown without support, some type of trellis is desirable. Fruit on supported canes is clean and a minimum of the crop is lost due to breakage of the canes by wind, cultivation, and picking. Supports also facilitate harvesting and other cultural practices and in the long run will pay for themselves.

Many types of trellises and methods of training are in use by bramble growers. The following are some of the simplest methods of satisfactory trellis construction.

MEMORANDUM

TO: The ERIC Clearinghouse on Vocational and Technical Education
The Ohio State University
980 Kinnear Road
Columbus, Ohio 43212

FROM: (Person) J. W. Matthews (Agency) Vocational Agriculture Service

(Address) 434 Mumford Hall, Urbana, Illinois 61801

DATE: September 7, 1967

RE: (Author, Title, Publisher, Date) Pruning and Training Bramble Fruits and Highbush Blueberries, VAS 4048. Urbana, Illinois: Vocational Agriculture Service, University of Illinois. 8 p., 1965.

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Level of Group State: R. L. Courson, Asst. Prof. of Vocational Agriculture
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The hill system of culture may be used for any of the bramble fruits (Fig. 4). Support is provided by a single stake, 2 to 4 inches in diameter, driven into the ground close to the plant. Five to eight fruiting canes are tied in one or two places to the stake each spring following dormant pruning. This system is most useful in home garden plots where a small power cultivator can be used. The plants are usually set 6 feet apart each way and restricted to a clump. Very little hand hoeing is needed and the fruit is easy to pick.

Wire trellising systems are the most practical for large scale plantings (Fig. 5). Posts may be either metal or wood. If wood posts are used, the underground parts should be treated with a wood preservative to extend their life. Pentachlorophenol, one gallon (50%) in 10 gallons of kerosene, stove oil, diesel oil (#400), or other light oil is a satisfactory preservative. The posts should be soaked for as long as seven days in a 50-gallon drum containing enough of this solution to cover 3 or 4 inches of the post above ground level. Posts should be spaced 25 to 30 feet apart in the row with the end posts braced or anchored. The wire supports to which the canes are tied are 12-gauge galvanized wires attached to the posts or to the cross-arms. Wire clips used between the posts in the horizontal-type trellis will keep the wires from spreading.

The horizontal-type trellis is used with the hedgerow system, the most common system of training. The plants form a solid row that is kept about 18 inches wide. Each spring the canes within the row are thinned to about 4-8 inches apart. No tying of canes is necessary with this system.

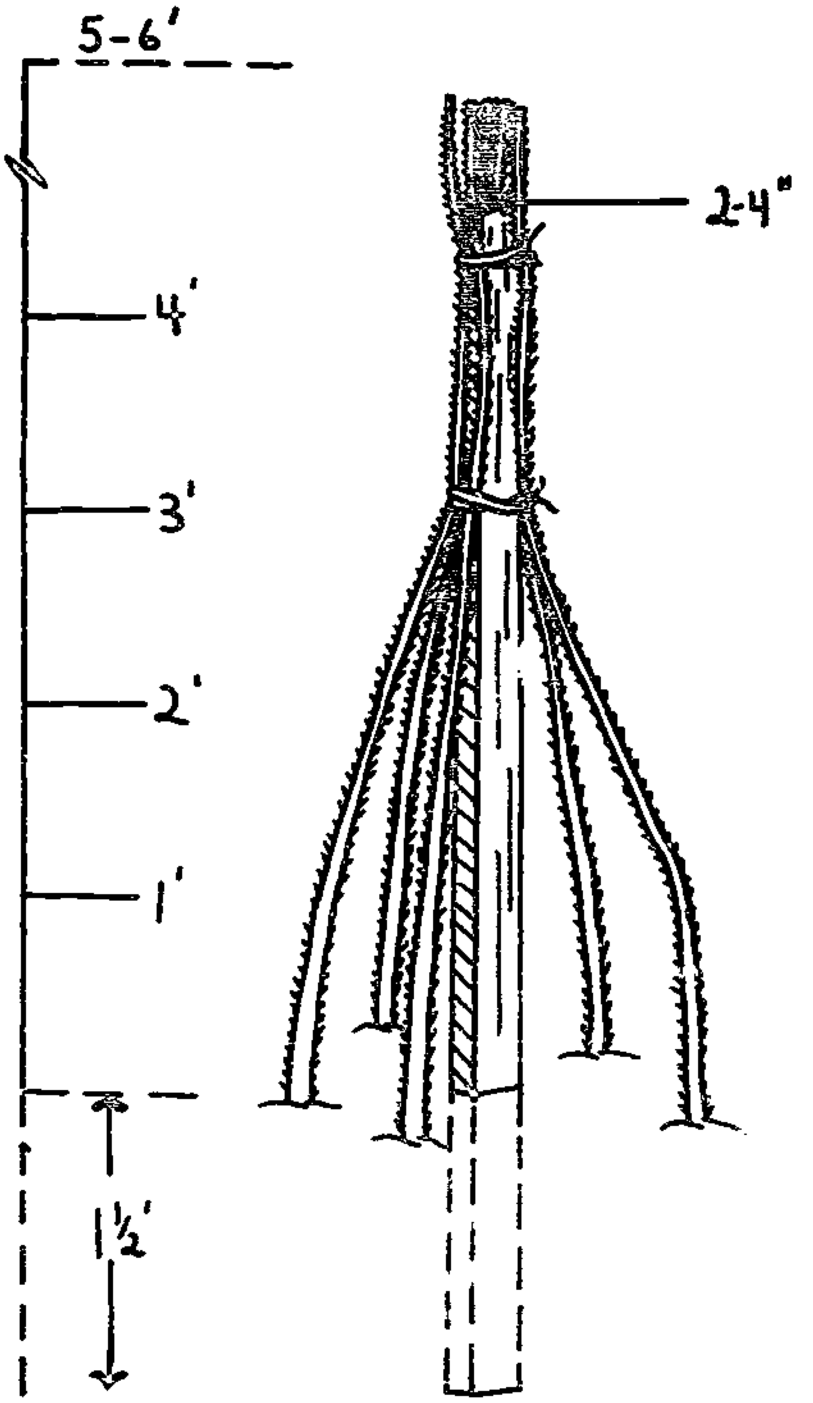

Fig. 4. Red raspberries trained and pruned to the staked-hill system.

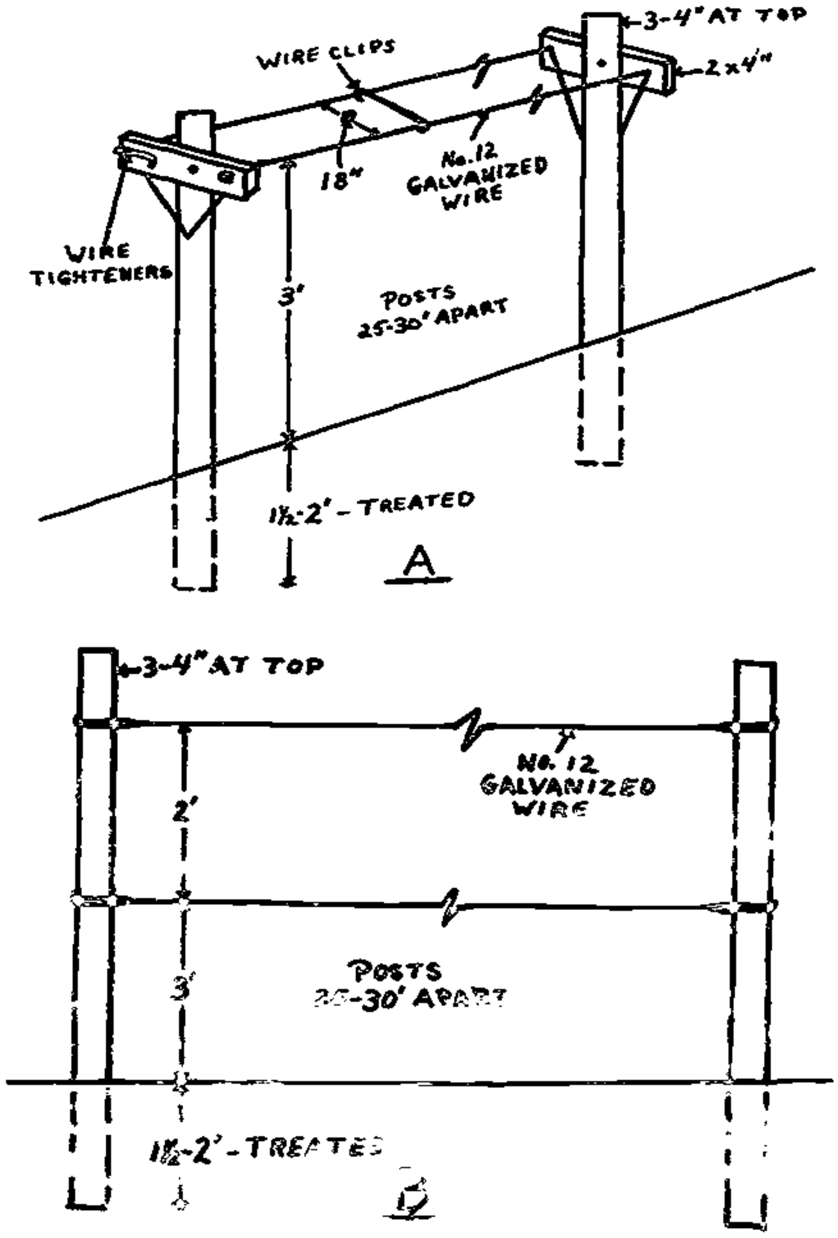

Fig. 5. Trellises are desirable. (A) Horizontal type, no tying necessary. (B) Vertical type, canes tied to each wire.

The vertical-type trellis is used with the linear system, a modification of the hedgerow system that allows better control of weeds, diseases, and insects. Plants are maintained in a narrow row and are tied to the wires. This system is most useful with red or yellow raspberries and trailing blackberries.

3. PRUNING RED AND YELLOW RASPBERRIES

Regardless of the training system being used, these types should be pruned twice each year, once in early spring and again as soon as possible after fruiting. New shoots of red and yellow raspberries should not be summer topped.

Spring pruning should be done early before the buds begin to swell but after danger of severe cold is past. All short and weak canes should be removed and the remaining healthy, vigorous canes should be thinned to 5-8 canes per stake in the hill system (Fig. 4), or spaced 4-8 inches apart in other systems (Fig. 6). Only the largest canes as indicated by diameter and length should be saved as these are the most fruitful. The remaining canes should be headed back moderately to 5-6 feet from the ground level. Canes shorter than 5-6 feet should not be headed back unless winter injury extends below this height. Where no support is provided, canes should be cut to about 3-4 feet regardless of original height.

Fruited canes may be removed any time after harvest since they die soon after fruiting. Although this pruning may be delayed until the following spring, cutting these canes off at the ground level as soon as possible after harvest is preferred since their removal at this time facilitates growth of the new shoots and reduces possible infestation of diseases and insects. These prunings should be removed from the planting and burned.

The canes of the everbearing varieties are pruned the same way as ordinary varieties in the spring and following the summer harvest. The shoots that fruit in the fall at the tip bear fruit again the next spring farther down, thus these canes should not be removed after the fall harvest.

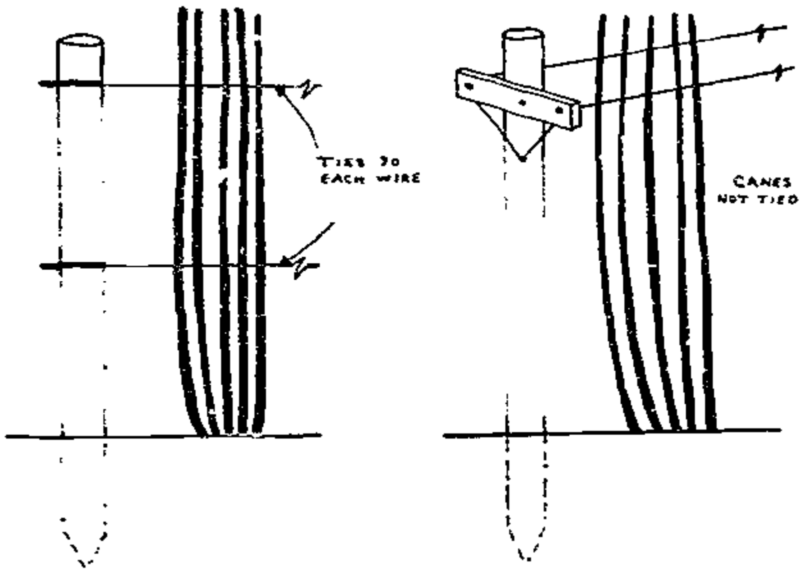

Fig. 6. Dormant pruned red raspberries. Vertical trellis left and horizontal trellis right. Canes should be 4-8" apart.

4. PRUNING BLACK AND PURPLE RASPBERRIES AND ERECT BLACKBERRIES

These brambles should be pruned three times each year, during the summer, early spring, and after fruiting.

Summer pruning is an essential step in the production of these brambles. All new shoots should be pinched back 3 to 4 inches as they develop (Fig. 2). If grown without supports, black raspberries are pinched when the new shoots are about 24 inches high while purple raspberries and erect blackberries are pinched when they reach 30-36 inches. If grown with supports, the shoots may be allowed to grow 6 to 8 inches more before pinching. This operation usually coincides with harvest and the plantings should be gone over several times as the new canes develop over a period of several weeks.

Dormant pruning is best done in early spring before the buds begin to swell. All weak canes should be cut out at the ground level leaving 4 or 5 of the most vigorous canes (at least half an inch in diameter) per plant (Fig. 7). The lateral branches on the remaining canes are thinned out and shortened. All weak or dead laterals (usually 1/4-inch diameter or less) should be removed and the remaining ones shortened. With black raspberries, the laterals are shortened to 8-10 inches of growth or 8-12 buds per lateral. Purple raspberries and erect blackberries are more vigorous, thus the laterals may be left 12-18 inches long or about 15 buds per lateral.

Erect blackberries send up root suckers in addition to the new canes that grow from the crown. If these have all been allowed to grow during the previous season, they should be thinned out during the dormant pruning to about 3 or 4 canes per lineal foot of row. A better practice is to remove the excess suckers during the summer between and in the rows, leaving only those desired for fruiting next season. The suckers should be pulled out if possible since they do not regrow as quickly as those that are cut off at the ground level.

Fruited canes of black and purple raspberries and erect blackberries are handled the same way as red raspberries.

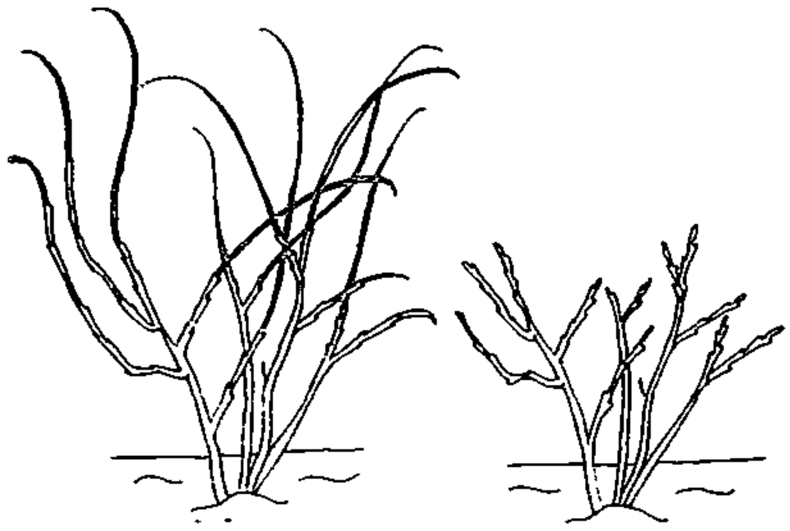

Fig. 7. Dormant pruning black and purple raspberries and erect blackberries. The number of buds to leave on laterals depends upon the vigor of the plants.

5. PRUNING SEMI-ERECT AND TRAILING BLACKBERRIES

These brambles are pruned twice, once in early spring and again after harvest. Pinching the new shoots as they develop is not practical.

Spring pruning these brambles consists of selecting the best canes for tying to some support and removing the remaining ones. The best 4 to 8 canes of semi-erect varieties and 8 to 16 canes of trailing varieties are selected. If stakes are used for support, the selected canes are wound around the stake, tied at two or three places, and cut to about the height of the stakes. On a horizontal trellis the canes are wound around the wires and tied at intervals. On vertical trellises the canes are tied to the wires without being wound around them (Fig. 8).

Fruited canes are handled as described for red raspberries.

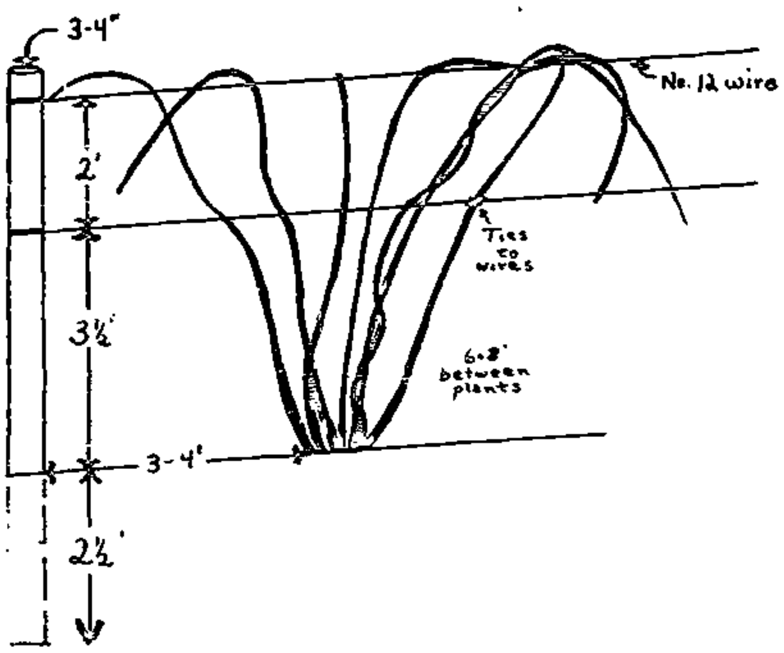

Fig. 8. Dormant pruned trailing blackberries.

6. PRUNING HIGHBUSH BLUEBERRIES

Highbush blueberries are woody perennial shrubs that produce fruit clusters from lateral and terminal buds located on the previous season's growth. This type of fruiting habit requires rather moderate annual pruning of mature plants to maintain an adequate fruiting surface, namely, the vigorous new growth produced each year. Although considerable variation in growth habit occurs among varieties, none require support.

The plants are usually 2 or 3 years old when planted and have several branched stems. At planting time, any broken roots should be cut off and the top reduced to two or three of the most vigorous stems. All fruit buds (Fig. 9) should be removed. The objective at this time is to produce a strong bush and the development of a fruit crop will be at the expense of vigorous shoot development. Following this initial pruning, the plants need not be pruned until the end of the third year in the field except for removal of dead and broken branches and the small bushy growth near the base of the plant.

At the end of the third year in the field and annually thereafter, the blueberry plants should be pruned moderately to maintain a vigorous and productive bush (Fig. 10). This annual pruning may be done any time during the dormant season, but early spring just before

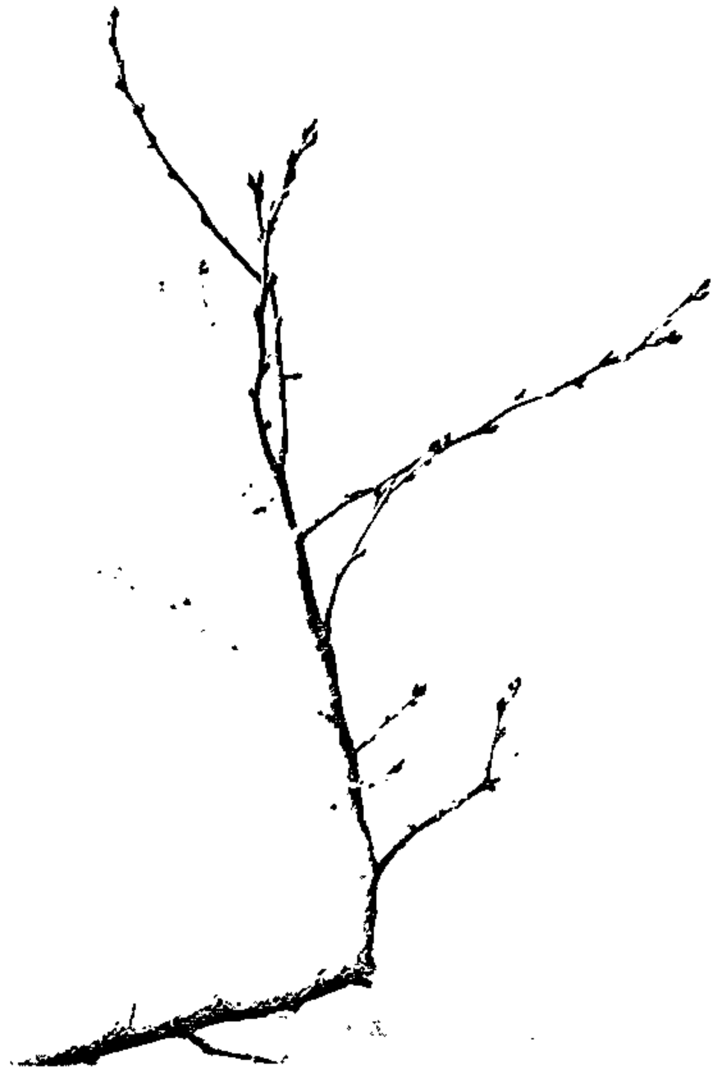

Fig. 9. Branch of the highbush blueberry as it looks during the dormant season. Note plump fruit buds on twigs produced the previous season.

Fig. 10. Highbush blueberry plant before pruning (A) and after pruning (B). Oldest stems have been removed at the crown and remaining ones thinned to 8 of the most desirable in regard to age, vigor, and spacing. Bushy growth also thinned out. This plant was not pruned for two years so pruning was more severe than normal for a plant pruned annually as recommended.

growth starts is preferred in order to avoid possible injury from extreme cold.

Varietal and individual plant differences require some adjustment in the pruning of mature plants but the following may be used as a general guide:

1. Remove bearing branches near the ground. Berries produced on these branches usually get dirty and are in an inconvenient position for harvesting.

2. Remove any old stems in excess of 3 or 4 by cutting them off at the crown. These older stems have grayish-black bark and are easy to identify. Remove the ones that have the fewest fruit buds.

3. Remove the weaker younger stems and suckers arising from the crown, leaving a total of 6 to 8 stems per plant. The objective is to replace the old, less productive stems systematically with vigorous younger ones, maintaining 6 to 8 of the best available on each plant. Some of the new vigorous stems grow very rapidly in a single season and remain unbranched. Such stems should be headed back, removing about the terminal 1/4 to 1/3 to induce branching.

4. Thin out the fruiting branches on the 6 to 8 stems selected. Remove a large part of the very thin, bushy wood that accumulates in mature plants. The aim is to remove about 50% of the fruit buds by taking off the weaker shoots, those less than 3 inches long which generally make poor fruiting wood. A general rule is to leave one fruit bud for each 3 inches of new shoot growth formed during the previous season.

5. Keep this basic principle in mind when pruning mature blueberry plants: The heavier the pruning the lower the yields, the larger the berries, and the higher the percentage of berries maturing early. Thus pruning should be heavy enough to obtain large-sized berries, light enough to provide a good crop the current year, and heavy enough to stimulate the growth of new fruiting wood for the next crop year.

This unit was prepared by C. C. Zych, Assistant Professor of Pomology, Department of Horticulture, University of Illinois.
Illustrations, courtesy of C. C. Zych, Jr

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Producing Oats.

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*TEXTBOOKS, REFERENCE BOOKS, *VOCATIONAL AGRICULTURE, UNITS OF STUDY (SUBJECT FIELDS), *OATS, *AGRICULTURAL PRODUCTION,

Textual and reference material on producing oats is provided for high school vocational agriculture and adult farmer students. It was developed by a teacher educator in consultation with subject matter specialists, supervisors, teacher educators, and teachers. Sections are What Variety of Spring Oats Should I Grow, What Practices Are Recommended for Growing Spring Oats, Can Winter Oats be Grown Successfully in Illinois, and What Diseases Attack Oats. Photographs and drawings illustrate the textual material. Interested high school and adult students of average ability will need 1 to 3 hours for use of the material. This document is available for 15 cents from Vocational Agriculture Service, 434 Mumford Hall, University of Illinois, Urbana, Illinois 61801. (JM)

ED020442

PRODUCING OATS

1. What Variety of Spring Oats Should I Grow?
2. What Practices Are Recommended for Growing Spring Oats?
3. Can Winter Oats Be Grown Successfully in Illinois?
4. What Diseases Attack Oats?

Of all farm crops grown in Illinois, oats rank fourth in acreage, with corn first, soybeans second, and wheat third. The number of acres of oats harvested in Illinois has steadily decreased from 3,708,913 acres in 1950 to 1,413,000 acres in 1963.

Oat yields, however, have shown just the opposite trend. The average yield was 43 bushels per acre for 1951-1956; 48 bushels for 1957-1961; and 57 bushels in 1963 (Fig. 1).

Fig. 1. Oats continues to be an important farm crop in Illinois.

1. WHAT VARIETY OF SPRING OATS SHOULD I GROW?

Improved varieties of oats are continuously being developed and tested by plant breeders and research workers. They prepare a list of recommended varieties and their characteristics. From this list you can select a variety that is best adapted to your farm.

Observation of variety demonstration plots in your area will also help you to decide which of the recommended varieties to grow. Results from these demonstrations may be found in the "Oat Yield and Variety Trials" report published annually by the Agronomy Department of the University of Illinois. If you do not have a copy, your agriculture instructor may have one available or you may obtain one from the College of Agriculture.

When selecting a variety of oats, take into account climate, farm management practices, market acceptability, and seed supplies, as well as plant characteristics. Each variety has its strong and weak points, but you will need to select the variety which best meets your farming conditions.

The most common oat varieties of Illinois, as reported by the Illinois Cooperative Crop Reporting Service, are listed in Table 1.

Table 1. Percent of Spring Oat Varieties Seeded in Illinois

Variety	1963
Newton	42
Clintland	10
Nemaha	10
Goodfield	9
Clintland 60	6
Minhafer	5
Shield	2
Others	16

Newton has been the most popular variety for the past few years. Varieties mentioned in the table for "others" include Beedee, Putnam 61, Clinton, Garland, Dodge, Bonham, and a number of other varieties reported in small amounts.

Most farmers when selecting a variety look for the following characteristics:

1. High yielding
2. Suitable maturity
3. Heat tolerance
4. Strong, stiff straw
5. Disease resistance
6. High-quality grain

High yielding

Oat varieties should be selected primarily on their ability to yield well on your particular soil type, climatic conditions, and management practices (Table 2). Varieties listed in Fig. 2 have proven their ability to yield well and are currently recommended for Illinois.

Table 2. Possible Yield of Recommended Varieties

Variety	Yield
Brave	Exc.
Beedee	Good
Clintland 64	Good
Dodge	Good
Garland	Exc.
Goodfield	Good-Fair
Minhafer	Good
Newton	Good
Putnam 61	Fair
Shield	Exc.

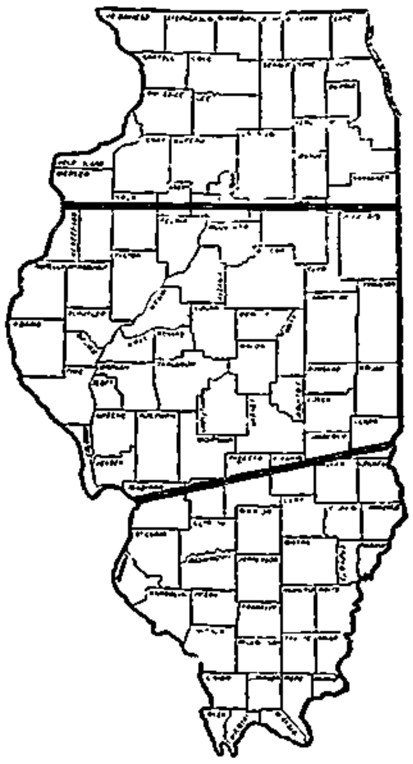

Fig. 2. Recommended varieties for Illinois in 1965 are: Northern -- Beedee, Brave, Clintland 64, Dodge, Garland, Goodfield, Minhafer, Newton, and Shield. Central -- Brave, Clintland 64, Garland, Goodfield, Minhafer, Newton, and Putnam 61. Southern -- Brave, Minhafer, Newton, and Putnam 61.

It is usually advisable to obtain new pure seed every 2 or 3 years to maintain high yields. Be sure to store seed oats in a clean bin separate from other varieties. Seed kept year after year tend to decrease in yield. This decline in yield may be due to mixing of varieties in storage or to such factors as variations in soil fertility, climate, diseases, or insects. Reduction in yield of a variety is rarely due to hereditary changes occurring naturally, since oats are self pollinated.

Suitable maturity

In southern Illinois use only varieties like Putnam 61, or Newton that will usually fill and mature in time to escape hot, dry weather. In central Illinois varieties like Newton and Garland are recommended. In northern Illinois Shield and Garland have made top yield records for the past several years. They have a chance to mature normally before hot weather which aids in producing good yields. Table 3 illustrates the usual maturity of the recommended varieties.

Table 3. Normal Maturity of the Recommended Varieties

Variety	Maturity
Brave	Early
Beedee	Medium
Clintland 64	Medium
Dodge	Medium
Garland	Medium
Goodfield	Medium
Minhafer	Early
Newton	Medium
Putnam 61	Very Early
Shield	Early

Heat tolerance

Although heat tolerance and early maturity are two separate characteristics, use of a variety which will tolerate heat may help to avoid heat damage especially in southern and central Illinois.

Some varieties such as Putnam 61 or Newton are better than others in being able to tolerate heat and finish filling the kernels in hot weather.

Strong, stiff straw

A stiff straw as shown in Fig. 3 is becoming increasingly important, especially in

MEMORANDUM

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The Ohio State University
980 Kinnear Road
Columbus, Ohio 43212

FROM: (Person) J. W. Matthews (Agency) Vocational Agriculture Service

(Address) 434 Mumford Hall, Urbana, Illinois 61801

DATE: September 7, 1967

RE: (Author, Title, Publisher, Date) Producing Oats, VAS 4023a. Urbana, Illinois: Vocational Agriculture Service, University of Illinois. 12 p., 1964.

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cropping systems with legumes, because the legumes increase the available nitrogen, which in turn, tends to increase lodging (Fig. 4).

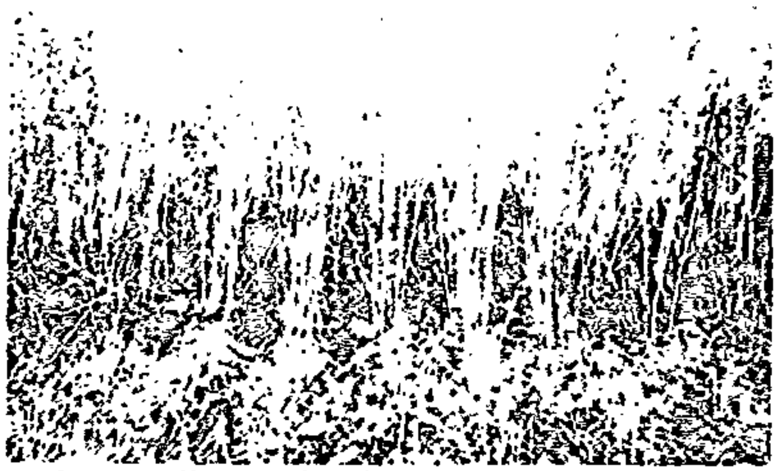


Fig. 3. A stiff-strawed early-maturing variety, is easy to harvest, high yielding, and an excellent nurse crop for clovers.

Fig. 4. A variety that lodges, yields low, and is difficult to harvest. It also tends to smother the clover when it is used as a nurse crop.

When oats lodge before the grain is filled, the supply of moisture and nutrients going through the conducting system of the plant to the top is shut off (as in the case of bending a drinking straw) and the grain is not filled normally.

Considerable loss of grain also occurs in a field where the oats are down because of the inability to harvest all of the seed. Oats which are lodged also tend to smother the young growing legumes. Table 4 shows the normal straw strength of the recommended varieties. If you have lodging problems, stiff-strawed Goodfield may be your choice.

Table 4. Normal Straw Strength of the Recommended Varieties

Variety	Straw Strength
Brave	Fair
Beedee	Fair
Clintland 64	Good
Dodge	Good
Garland	Good
Goodfield	Exc.
Minhafer	Good
Newton	Good
Putnam 61	Fair
Shield	Fair

Disease resistance

For highest yields, the oats you select should be resistant to diseases. Four of the most important diseases of oats in Illinois are: crown rust, stem rust, Septoria disease, and yellow dwarf. These diseases will be discussed in greater detail later in this unit. Information in Table 5 will aid in selection of disease resistant varieties.

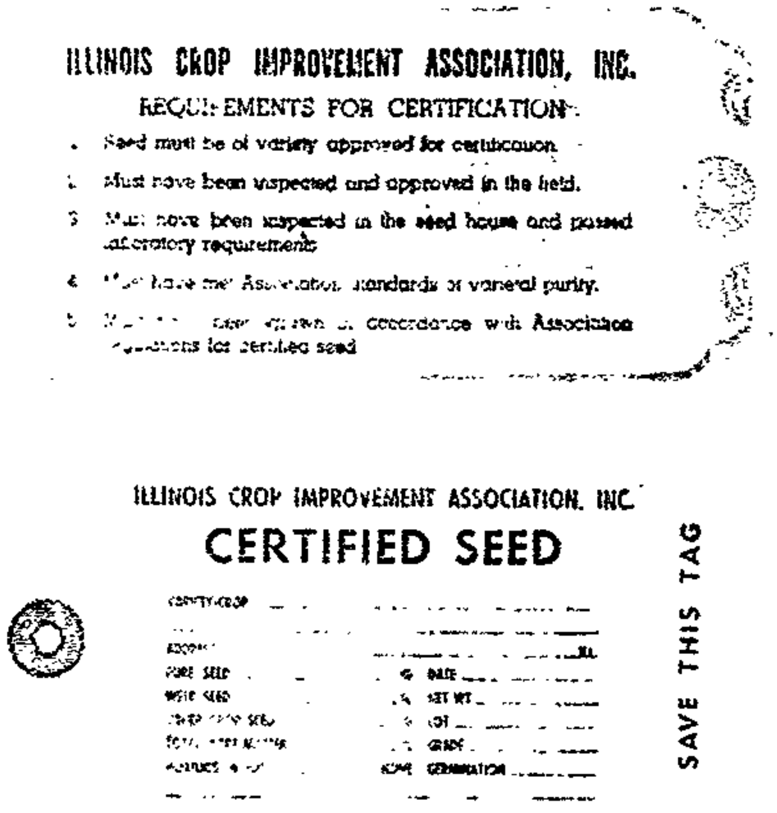
Table 5. Normal Disease Resistance of the Recommended Varieties

Variety	Crown Rust	Stem Rust	Septoria Disease	Yellow Dwarf
Brave	Good	Good	Good	Tolerant
Beedee	Fair	Fair	Fair	Susc.
Clintland 64	Exc.	Exc.	Good	Susc.
Dodge	Exc.	Exc.	Fair	Susc.
Garland	Good	Exc.	Fair	Susc.
Goodfield	Good	Exc.	Fair	Susc.
Minhafer	Good	Exc.	Fair	Susc.
Newton	Fair	Fair	Poor	Tolerant
Putnam 61	Good	Exc.	Fair	Tolerant
Shield	Fair	Good	Fair	Susc.

High-quality grain

The variety of oats selected should have bright, plump, uniform kernels and a high feeding value. Oats with excessive hulls usually have a low test weight (below 32 pounds per bushel) and do not make high-quality feed. Table 6 will aid in selecting a variety with a high test weight. Brave and Clintland 64 are not included in this table because seed will not be available to farmers until 1965.

Buying and handling seed. High prices and unknown varieties and sources should be avoided when buying seed oats. A good motto is, "if you do not know your seeds, know your seedsman." Certified seed gives the best results. A high germination rate is characteristic of good seed. It should be free of weed seed, other varieties of oats, other grains, and inert material. See Fig. 5 for a sample certified seed tag. Cleaning and treating seed oats are profitable practices. Seed treatment of smut-free seed will increase yields from 3 to 5 bushels over untreated seed (see VAS Unit 4021). You can afford to pay more for seed which has been cleaned and treated. Remember, certified seed is your best guarantee that you are getting what you pay for. Buy from a reputable seed dealer, one who takes pride in the quality of his seed, not in its low price.



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2. Must have been inspected and approved in the field.
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4. Must have met Association standards of varietal purity.
5. [illegible] in accordance with Association [illegible] for certified seed

ILLINOIS CROP IMPROVEMENT ASSOCIATION, INC.

CERTIFIED SEED

PURE SEED %

WEED SEED %

DATE

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LOT

GRADE

GERMINATION

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Fig. 5. The certified seed label, together with the reputation of the seedsman, is your best assurance of getting good quality seed.

Table 6. Test Weights of Oat Varieties in Illinois Trials

Variety	Test weights Dekalb 1963	 Urbana 1963	 Brownstown 1963
		lb. per bushel	
Beedee	39	35	---
Clintland 60	39	33	33
Dodge	40	35	31
Garland	39	35	39
Goodfield	40	35	34
Minhafer	39	35	28
Newton	40	33	34
Putnam 61	39	34	31
Shield	39	35	33

2. WHAT PRACTICES ARE RECOMMENDED FOR GROWING SPRING OATS?

Preparing the seedbed

Spring oats usually follow corn in the cropping system. While the seedbed is normally prepared by disking, plowing usually increases yields about 3 bushels per acre. This increase in yield may not pay for the additional cost of plowing, but the difference in cost may be justified by the better control of insects and diseases. If plowing is not practical, you'll get better oat yields by shredding the stalks before disking the ground. Where oats follow soybeans, the land need not be plowed for oats.

The number of times the seedbed is disked will depend on the residue on the field, the condition of the soil, and the method of seeding. Usually one to three diskings are necessary.

When to sow

Seed spring oats early, as soon as the ground is dry enough in the spring to be worked properly. Oats are a cool-weather crop. Spring oats do well in northern Illinois when seeded any time during the last half of March to April 20. In central and southern Illinois, spring oats should be seeded in March or early April. Seeding too late usually reduces yields and quality more than seeding too early. Fig. 6 shows yield trend curves taken from many years of experience in seeding spring oats in central Illinois. Tests in several states show that you may lose roughly one bushel per acre for every day that you delay seeding.

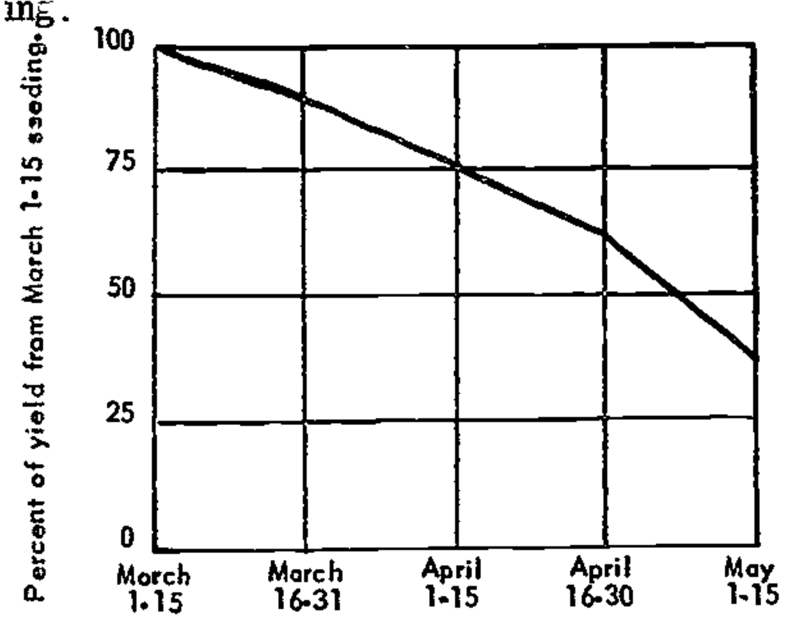

Fig. 6. Early planting of spring oats increases yields considerably.

Fertilizing

Too often oats get only the leftovers. They have to live on plant food left by the corn crop -- or by soybeans. However, there is no prescription for fertilizing oats that will fit every situation. Reliable soil tests show which nutrients and how much are needed for high yields. Establishing good stands of forage grasses and legumes in oats depends on having adequate amounts of phosphate and potash in the soil and liming if the soil is acid. Basic amounts of phosphate, potash, and limestone, indicated as being necessary by soil tests, may be plowed down or disked in. In addition to these basic requirements, starter fertilizer may be used to meet maintenance requirements and at the same time provide nutrients for getting seedlings off to a good start. Oats need phosphorus early. They can use soluble phosphorus to insure a faster start in the spring (Fig. 7).

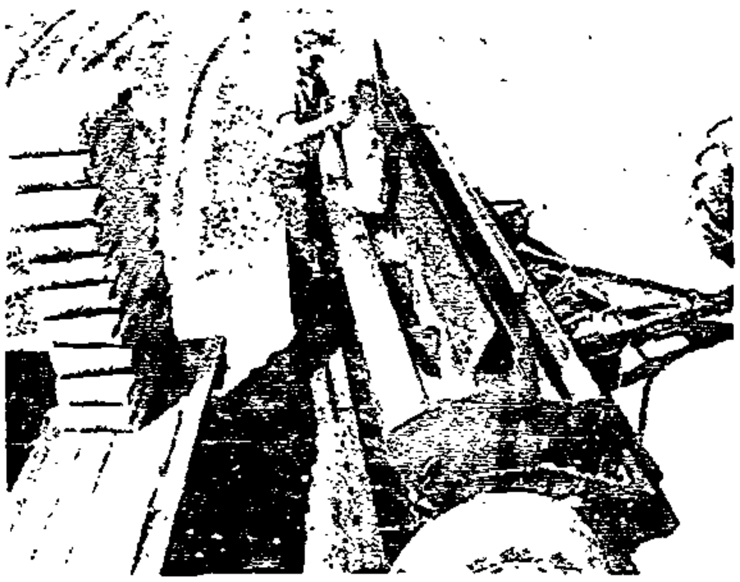

Fig. 7. Starter fertilizer helps insure a faster start, if applied at seeding time (courtesy International Harvester Co.).

If oats follow corn which received heavy applications of fertilizer, residual effects will usually reduce the amount needed for the oats. Excessive applications usually do not pay. In fact too much nitrogen is likely to cause severe lodging or excessive straw growth at the expense of seed production. However, moderate amounts of nitrogen often boost your returns. New varieties have stiffer straw, stand better, and respond more to nitrogen than the older varieties.

As mentioned previously, it is always best to use soil-test results as a basis for deciding what and how much fertilizer to apply. However, if you don't make any soil tests, the following may serve as a guide. A 60-bushel oat crop, where only the grain is removed, would remove roughly 37 pounds nitrogen, 15 pounds of P_2O_5, and 11 pounds of K_2O. (One bushel of grain removes - .61 lb. N., .25 lb. P_2O_5, and 18 pounds of K_2O.)

Nitrogen. Apply 20 to 30 pounds of actual nitrogen per acre on dark-colored, fertile soils. On lighter-colored and less fertile soils, use 30 to 50 pounds of nitrogen. If you are farming timber soils and have applied little or no manure, then 40 to 60 pounds of nitrogen should give you a profitable yield boost. However, if you are on a prairie soil, have included legumes in your cropping system, and have used manure continuously, then it is doubtful if nitrogen will pay.

Where oats follow heavily fertilized corn, you probably should use the 20- to 30-pound rate. When only a moderate application or no nitrogen has been applied to corn, use 30 to 50 pounds. Where oats follow a legume in the cropping system, such as soybeans, use about 20 pounds less than you would if they followed corn.

Phosphorus. As mentioned previously, oats need phosphorus in a hurry, and soluble forms are more readily available than rock phosphate. A minimum of 25 to 35 pounds of soluble phosphate will probably satisfy the requirements for the oat crop. In most cases, however, a legume is seeded with oats; therefore, an application of 55 to 60 pounds of P_2O_5 may be more realistic.

Potassium. Potash levels in most Illinois soils are usually adequate, except on poorly drained soils, for high oat yields. However, you may wish to apply at least 20 to 30 pounds for the new legume seeding.

Remember the above are to be used only as a guide. There's no substitute for soil test.

Amount to sow

The recommended rate of seeding is: 2 to 2 1/2 bushels of well-cleaned seed per acre when drilled and 2 1/2 to 3 1/2 bushels when broadcast. The lower rate (2 bushels for drilling and 2 1/2 bushels for broadcasting) should be used when oats are used as a nurse crop for grasses and legumes. These lower rates will give the grass and legume seedlings a better start.

Plant treated seed

As mentioned previously, seed treatment is a recommended practice in growing oats. Chemical seed treatment not only helps to kill off diseases carried on the seed, but they also protect the germinating seed in the soil. Tests show that you may get better stands from treated seed and may expect an average of three bushels per acre more grain than untreated plots.

Method of seeding

Drilling. Seed with a drill if possible (Fig. 8). A drill puts the seed in the ground at a uniform depth and allows the plants to establish good root systems. The plants grow more evenly and therefore mature more evenly, resulting in higher yields and higher-quality grain.

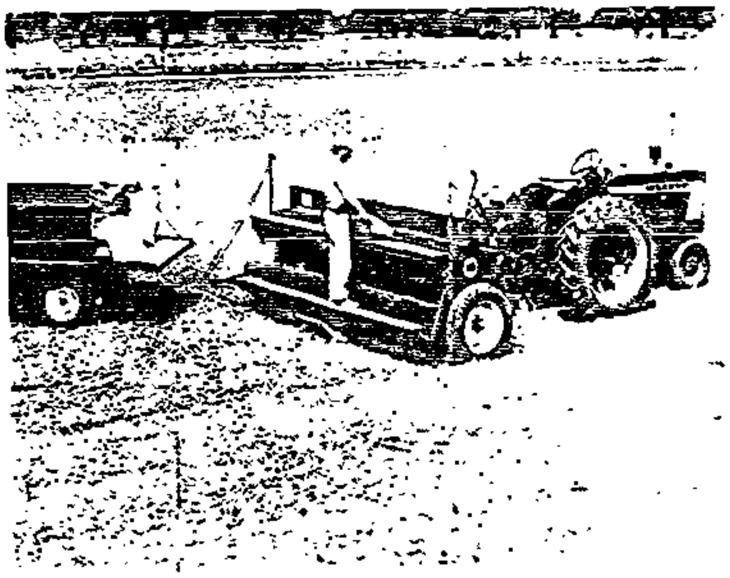

Fig. 8. Seed with a drill if possible (courtesy International Harvester Co.).

Using a grain drill with a fertilizer attachment as shown in Fig. 9 makes possible efficient use of fertilizer, placing it down in the furrow near the seed, which cannot be accomplished in broadcast seedings. Drilling with a drill as in Fig. 10 also permits seeding of the grass-legume crop at the same time as the oats and no further working of the seedbed is necessary.

Broadcasting. If legumes and grasses are not to be seeded with the oats, the oats may be broadcast in the corn stalks or soybean stubble with a broadcast seeder and the seed covered by double disking and harrowing. When legumes and grasses are to be seeded, the oats should be broadcast and disked in first, then the legumes and grasses broadcast and covered lightly with the use of a harrow or roller (Fig. 11).

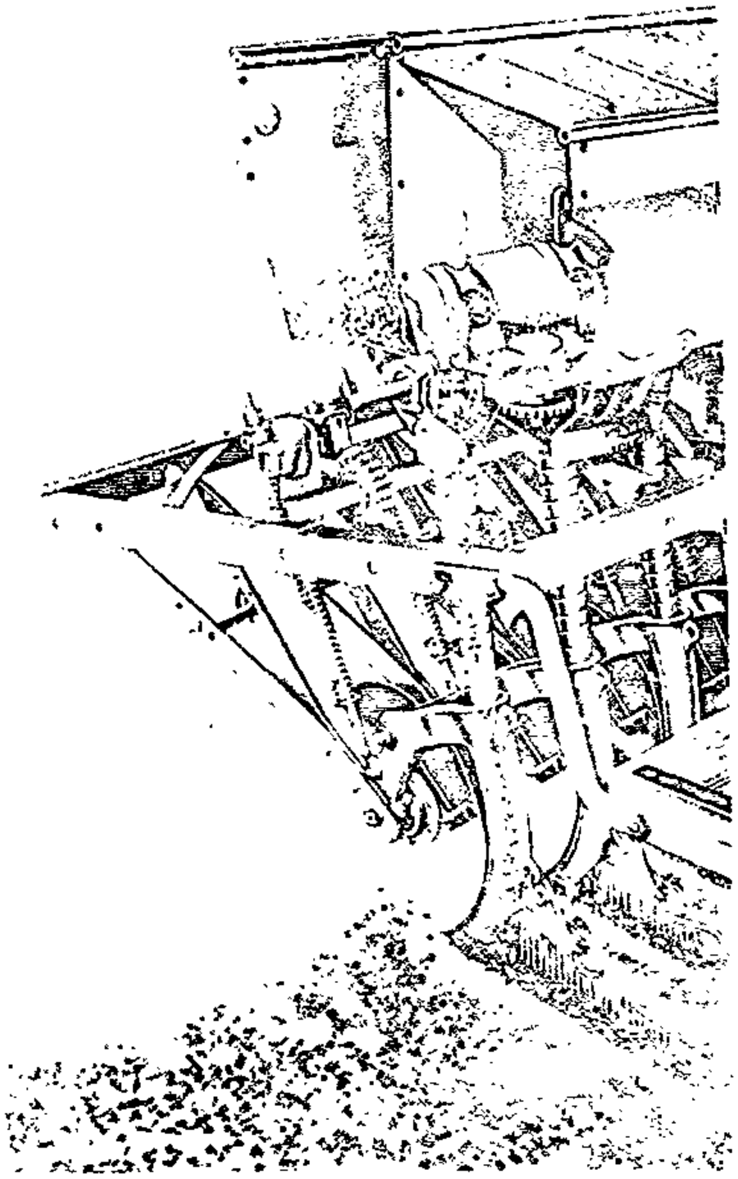

Fig. 9. Drilling in the fertilizer, with the seed oats, gives more efficient use of the fertilizer than just broadcasting it on top of the ground.

Oats should be planted deep enough to be covered with moist soil, but not too deep--3/4 to 1 1/2 inches is usually adequate.

The major advantage of broadcast seeding is the lower investment in machinery. In tests at the Illinois Station, drilled oats outyielded broadcast oats by 5 to 10 bushels per acre. Whether the advantages of drilling will justify the investment in a drill will depend largely upon the acreage of small grain on the farm. For example, if a grower averaged 40 acres of oats and the price averaged 60 cents

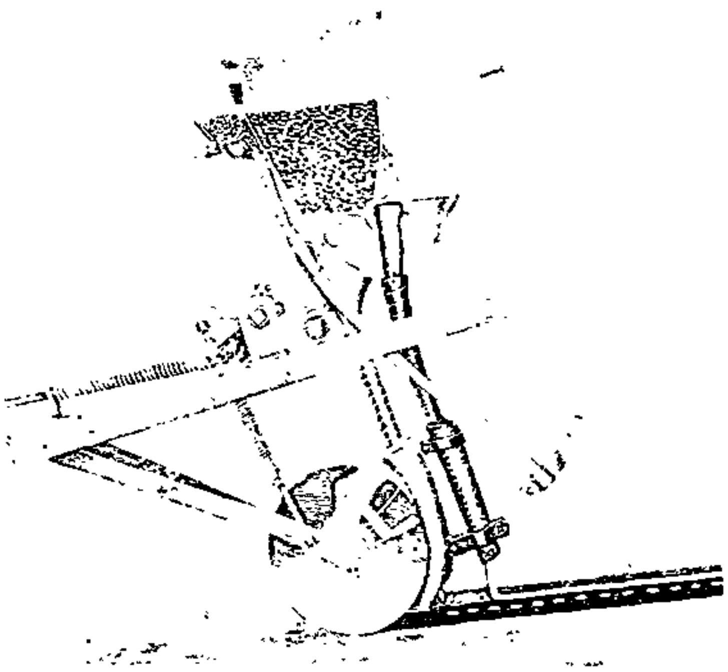

Fig. 10. This type of drill may be used to seed oats, sow the grass-legume seed, and apply the fertilizer in one operation.

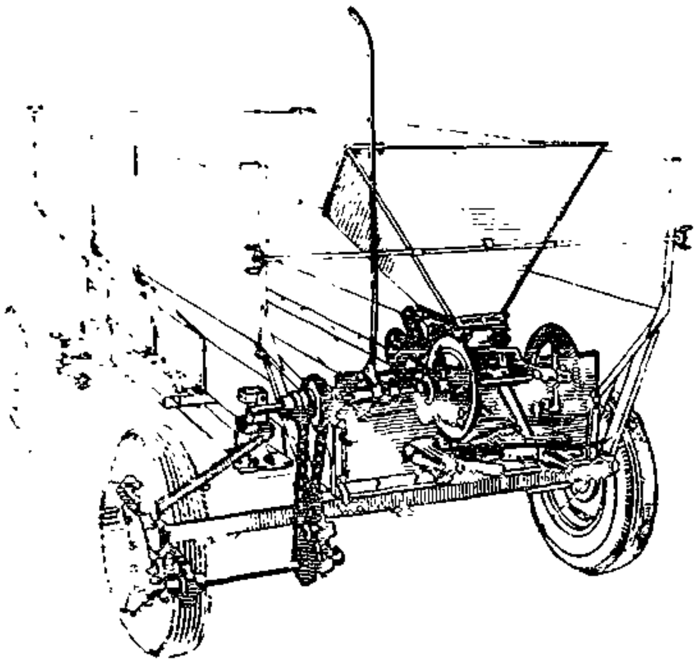

Fig. 11. Broadcast endgate seeder.

a bushel, he would have approximately 200 extra bushels, or $120, to apply to the cost of a drill each year.

40 acres x 5 bu. per acre increase=
200 bushel extra yield

200 bu. x 60¢ = $120.00

Weed control

Weeds may be pulled by hand or hoed off to remove them from the grain field if they are not too widely distributed over the field. If they are widely distributed, spraying with chemicals may be necessary or preferable.

Two chemicals--2,4-D and MCP are recommended for use in small grains. MCP is not as effective as 2,4-D in controlling some weeds, but is less injurious to legume seedings. Both chemicals, however, may seriously damage legumes, and should not be used where there are legume seedings unless the weed hazard is serious.

Apply the amine type of either 2,4-D or MCP. If there are no legumes in the oats, use up to 1/2 pound of acid per acre, although this maximum amount should be used only when necessary as it may reduce grain yields somewhat. Where there are legumes, do not use more than 1/4 pound per acre. Apply after the grain has passed the five-leaf stage, but before the plants get over 5 to 8 inches tall. This is after the grain tillers and before the boot stage, but after small grain and weeds form a canopy over the legumes. An application of either spray to small grains with legumes may reduce the legume stands.

Harvesting

Oats are usually harvested for grain with the combine (Fig. 12) although an occasional field may still be cut with a binder and threshed. Oats are less suited for harvesting with the combine than other small grains because they lodge and shatter badly once the crop is ripe. Most of the newer recommended varieties have stiffer straw and will stand longer after ripe than the older varieties, but even these newer varieties will shatter if harvesting is delayed very long. Losses can easily range up to 10 to 12 bushels per acre.

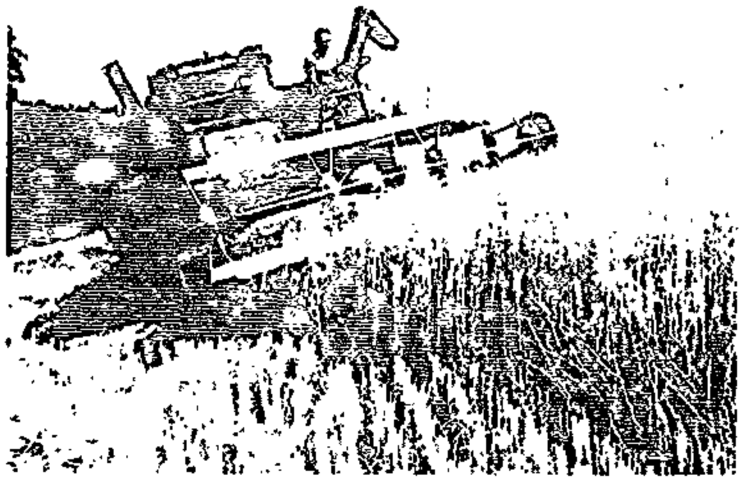

Fig. 12. Oats being harvested with the combine.

Much of the loss from lodging and shattering may be avoided by cutting and windrowing the oats and allowing them to dry before combining them (Fig. 13). This practice is also profitable when the field is heavily infested with weeds, or if there is a vigorous growth of the new seeding. Otherwise, the weed seeds and succulently green material may provide sufficient moisture for the grain to heat excessively during storage. The moisture content of the grain may also be excessive if it is combined too early in the morning or too late in the day.

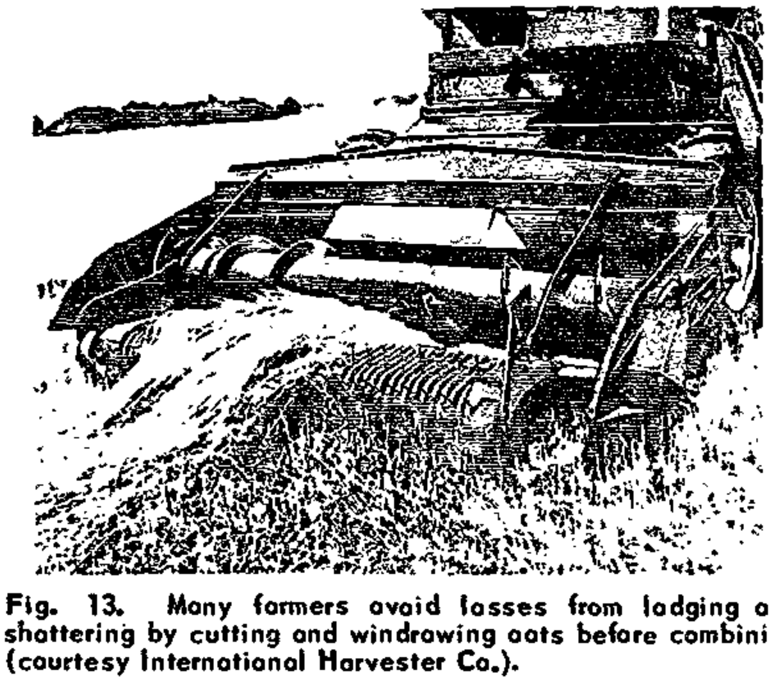

Fig. 13. Many farmers avoid losses from lodging and shattering by cutting and windrowing oats before combining (courtesy International Harvester Co.).

Harvesting oats as silage rather than as grain has shown some promise in recent tests. You may be able to increase your returns from oats by harvesting them for forage and improve your legume seeding. In 1963, Illinois agronomists harvested nearly 10 tons of oat silage--cut in the early dough stage. This silage produced almost twice as much TDN per acre as oats from nearby plots that averaged 110 bushels of grain per acre. With oats cut this early, the alfalfa came on despite dry weather and gave a fine hay cutting in September. In addition, the alfalfa stands appeared better where the oats were cut for forage than where they were left for grain.

3. CAN WINTER OATS BE GROWN SUCCESSFULLY IN ILLINOIS?

Data from variety tests conducted at the Illinois Station indicate that winter oats can be grown successfully south of highway U. S. 50, which runs from St. Louis, Missouri, to Vincennes, Indiana. North of that they are very dependent on a mild winter. However, if winter oats fail, a spring-seeded crop like spring oats or soybeans can be seeded in the same field.

Advantages of winter oats in southern Illinois

1. When winter oats survive the winter, they can be expected to give higher yields than the spring varieties.
2. Winter oats mature several weeks earlier than spring oats and usually escape many oat diseases and the hot, dry weather.
3. Winter oats can serve as late-fall pasture, as a companion crop for legumes and grasses, and as an erosion-control crop.
4. Winter oats may be used to replace winter wheat when this is desirable for compliance with government programs.

Disadvantage of winter oats

1. Winter oats are more susceptible to winter injury than winter wheat, rye, or barley.

Date of seeding

Late seeding is often the cause of failure of winter oats. The crop must be planted early enough to become well established before freezing weather. This is normally in early September, about one week earlier than winter barley seeding and about three weeks earlier than winter wheat. If the area is to be grazed, the seedings may be made during the latter part of August. Most of the adapted varieties of winter oats can be fall grazed. Since Hessian fly does not readily attack winter oats, seedlings need not be delayed to conform with the fly-free date for winter wheat. An early-planted, well-established seeding of winter oats will often ripen two or three weeks earlier than spring oats.

Rate of seeding

Two bushels of winter oats per acre, drilled, seems to be the minimum seeding rate for Illinois. Three bushels per acre may be better toward the northern limit of adaptation. Experimental data indicate that early seeding is more important than seeding rate. Seeding with a grain drill will give a uniform depth and covering for the seed and thereby insure a uniform stand. Broadcasting the seed is not recommended.

Seedbed preparation

The seedbed should be prepared in the same way as for spring oats.

Varieties

Winter hardiness is the most important characteristic to be considered in choosing a winter-oat variety. The recommended variety is Norline.

4. WHAT DISEASES ATTACK OATS?

Rusts

There are two common types of rusts that attack oats in Illinois — crown rust, with a hundred different races, and stem rust, with twenty different races. Crown rust is the most prevalent and causes a greater loss of yield and grain quality over a period of years than any other oat disease. It appears as small, dusty orange-yellow pustules (blister-like lesions) mainly on the leaves and leaf sheaths (Fig. 14). Stem rust produces reddish-brown, ragged looking, elongated pustules on most any part of the plant above the ground.

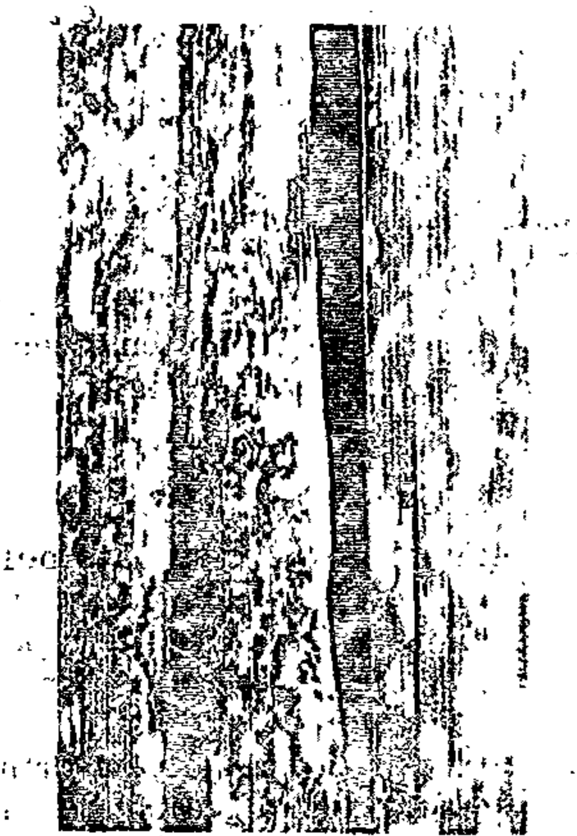

Fig. 14. Crown rust on oats; winter spore stage, left; summer spore stage, right (courtesy Illinois Experiment Station).

The number and size of the pustules vary greatly, depending on the susceptibility of the oat variety and the severity of infection. If weather is favorable for infection (high humidity, fogs, frequent heavy dews or light rains, and a temperature of about 70° F. or above), the pustules become numerous and may grow together as the season progresses. Rust may appear on oats in southern Illinois as early as late April. A new generation of summer spores may be produced every seven to fourteen days. These spores in turn are blown about by air currents to spread the disease from plant to plant and from field to field during the remainder of the growing period.

The rust diseases produce a rust colored, dusty material which may be seen on the plant. This "dust" rubs off onto your clothes as you walk through an infested field.

When attacks are severe, rust causes premature ripening, lowering of test weight, and lodging. In years of heavy attacks, 90 to 100 percent of all oat plants growing in the state become diseased, and the food-manufacturing ability of the leaves reduced up to 30 percent. In years unfavorable to rust infection, less than 5 percent of the oat plants develop any rust at all.

As oats mature, black overwintering spores (teliospores) are formed. These spores also may form during periods of adverse weather, such as extreme drought, excessive moisture, or excessively high temperatures.

The black, overwintering spores cannot infect oats the following year, so all infection must come from outside sources. One such source is spores from the common barberry plant that has been infected by the overwintering spores and the other from summer spores blown in from southern states.

Most prevention and control measures must be the eradication of any common barberry plants or buckthorn shrubs in the community and the development of resistant oat varieties. The latter is a continuing process, because the different races of rust cross with each other giving them hybrid vigor. Then oats varieties that have been resistant to rust may not be very resistant to some of the crosses.

Other management practices may also help prevent infection or reduce losses from infection. One is plant oats as early in the spring as practical. This helps the crop to escape much of the rust damage. Also, if the disease is present and building up rapidly — especially in late-maturing varieties— you may wish to harvest the crop for silage. Cutting in the soft dough stage usually makes the best quality silage.

Septoria disease

Septoria disease is a fungus disease of oats that attacks the leaves, stem, or head of a plant. For our discussion here, we will divide it into three phases, namely the leaf-blotch phase, the black-stem phase, and the kernel-blight phase.

The leaf-blotch phase appears in the early spring as small yellowish to light brown or chocolate-brown spots on the leaves (Fig. 15). As the spots enlarge, the infected leaf tissue dies. In severe cases the spots may fuse and cause the entire leaf to die prematurely. Infection usually starts on the leaves and then spreads upward on the plant.

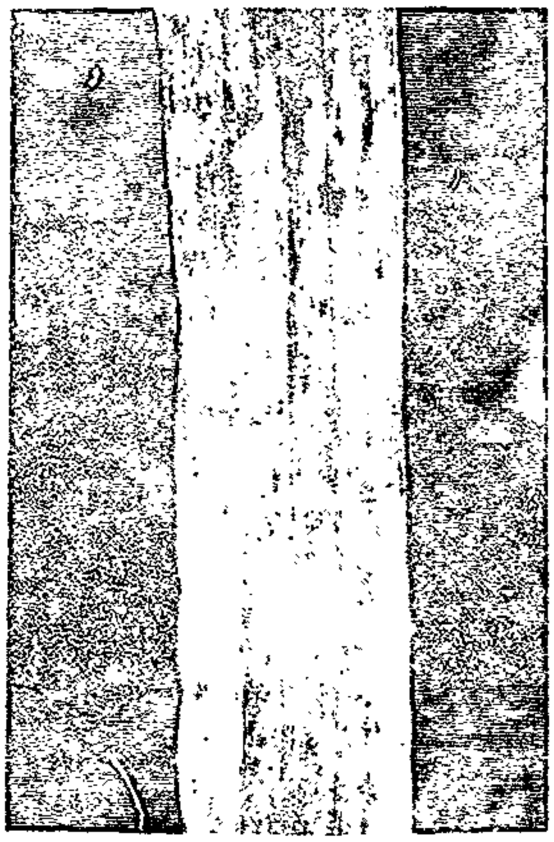

Fig. 15. Leaf phase of Septoria disease. In early spring the disease appears as small yellowish to light brown or chocolate-brown spots on the leaves (courtesy Illinois Experiment Station).

The black-stem phase of the disease is the most destructive (Fig. 16). Some time after the plant heads out, the symptoms begin to appear, usually first on the leaf sheath around the point where the leaf is attached to the sheath. From here it spreads to the stem of the plant where it forms grayish-brown to shiny black lesions, mostly above the upper two joints. Plants of varieties susceptible to this disease will lodge considerably at the points where the lesions occur.

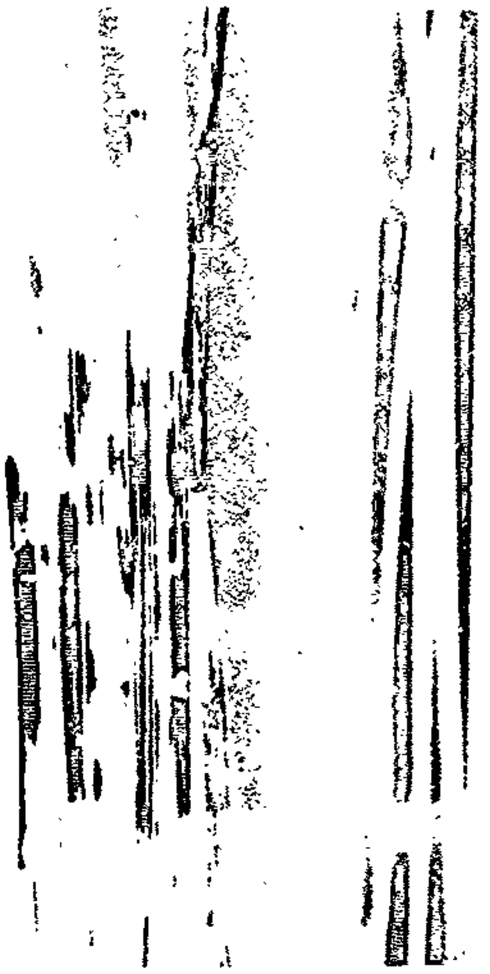

Fig. 16. Black stem phase of Septoria disease with leaf sheaths removed (courtesy Illinois Experiment Station).

The kernel-blight phase of the disease occurs in prolonged cool, wet weather (Fig. 17). Irregular yellow to brown blotches occur on the outer glumes. Black or dark brown lesions may later extend to the lemma and palea and even to the oat kernel. The disease is ordinarily not transmitted by infected seed.

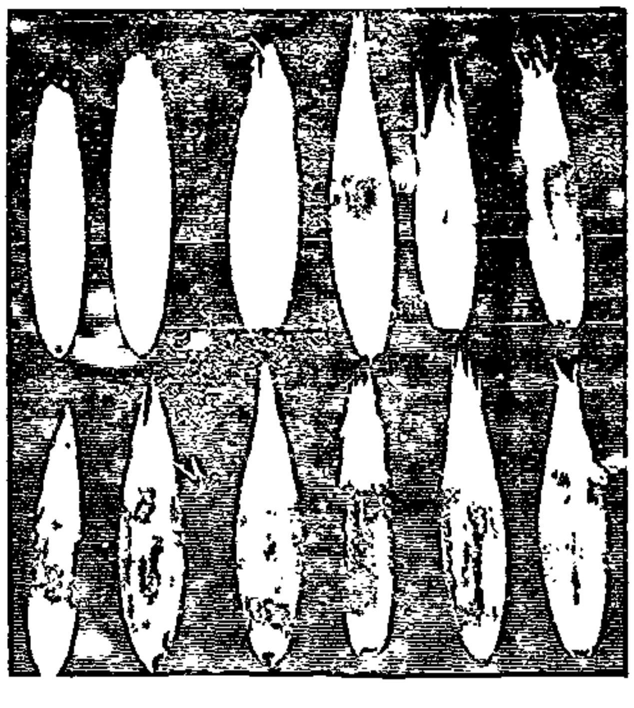

Fig. 17. Kernel phase of the Septoria disease, showing various degrees of infection. Healthy kernels at upper left (courtesy Illinois Experiment Station).

Control

Where feasible, plant tolerant or resistant oat varieties. Unfortunately, resistance of most varieties is low at present. Early varieties tend to be more susceptible. Tall, late varieties are generally more resistant or escape infection. More resistant oat varieties should be available in the future but the plant breeding program in this area is very difficult.

If possible, plant certified seed that has been thoroughly cleaned and treated with a recommended mercury-containing fungicide. Where practical, rotate crops for three or four years between oat crops. Do not apply manure containing known Septoria-infected straw on fields to be planted to oats within the next year or two.

Yellow dwarf

Yellow dwarf (also called red leaf) is recognized by the reddening, bronzing, and yellowing of the leaves. The color may vary from a yellow-red to a red to a reddish-brown, depending somewhat on the variety infected and the time of infection.

At the present the disease is known to be transmitted by more than ten different species of aphids that commonly infest small grains and grasses. In many instances, however, the aphids leave before the symptoms appear. Plants infected early in the seedling stage become stunted and in extreme cases die or fail to head. Severe blasting of the floral parts (seed fail to form) is associated with the infection. This blasting may involve a few florets or the entire head. The basal florets are usually the most severely affected. The intensity of the symptoms is directly correlated with the age of the plant at the time of infection.

The world oat collection of 5,000 different varieties of oats has been tested at the Illinois Station in a search for resistance to this disease. Brave, Newton, and Putnam 61 were found to have tolerance. At present early planting and high soil fertility also appear to aid in controlling it. This is because vigorously growing plants are able to tolerate the disease better than smaller ones, and large populations of aphids usually do not appear in Illinois oat fields until sometime in May. Applying contact insecticides in localized areas to control yellow dwarf does not appear to be effective. Continued research is needed before a more complete control can be recommended.

This unit was prepared in cooperation with the Agronomy and Plant Pathology Departments.

VT003 381

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Small Engines, Repair and Overhaul.

Illinois Univ., Urbana. Vocational Agriculture Service
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*TEXTBOOKS, REFERENCE BOOKS, *VOCATIONAL AGRICULTURE, *ENGINES, *REPAIR,

This document provides textual and reference material on small engine repair for high school vocational agriculture and adult farmer students. It was developed by a techer educator in consultation with subject matter specialists, teacher educators, supervisors, and teachers. Sections are (1) tools and equipment needed, (2) engine disassembly, (3) cylinder, piston, and ring wear measurement, (4) crankpin and bearing checking, (5) piston replacement, (6) valve servicing, (7) engine head replacement, (8) carburetor and fuel system repair, (9) ignition system servicing, and (10) engine operation and checking. The document is illustrated with photographs and drawings designed to emphasize key procedures. Students with average ability and interest would use the material for 2 to 6 hours. This document is available for 25 cents from Vocational Agriculture Service, 434 Mumford Hall, University of Illinois, Urbana, Illinois 61801. (JM)

SMALL ENGINES - REPAIR AND OVERHAUL

1. Special Tools and Equipment Needed for Small Engine Repair
2. Disassembling the Engine
3. Measuring Cylinder, Piston, and Ring Wear
4. Checking Crankpin and Bearing
5. Replacing the Piston
6. Servicing the Valves
7. Replacing the Engine Head
8. Repairing the Carburetor and Fuel System
9. Servicing the Ignition System
10. Operating and Checking the Engine

Small internal combustion engines are mass produced at low cost. It is often more economical to purchase a new engine than to pay for an extensive overhaul. However, if the owner has access to the proper tools and knows how to use them properly, he can often purchase needed parts and recondition an engine with a reasonable cash outlay.

A thorough program of maintenance, following the recommendations in the operator's manual, will greatly prolong the useful life of an engine. Eventually, normal wear of internal moving parts will make overhaul or replacement necessary.

1. SPECIAL TOOLS AND EQUIPMENT NEEDED FOR SMALL ENGINE REPAIR

The special tools and equipment listed and described here are in addition to standard mechanic's tools, such as socket wrenches, open-end wrenches, box-end wrenches, pliers, screwdrivers, hammers, and punches. It is assumed that these will be available in any good school or home shop.

Tools for disassembly and reassembly

Flywheel holder. Some device is necessary for holding the flywheel while the nut or recoil mechanism is unscrewed. Fig. 1 shows a shop-made tool for this purpose. Fig. 2 shows a special flywheel wrench which can be purchased from an engine manufacturer but this wrench is designed to fit one make of engine only.

Recoil mechanism wrench. Fig. 3 shows two shop-made wrenches with notches cut to fit the projections on one type of recoil mechanism. They can also be purchased from the engine manufacturer.

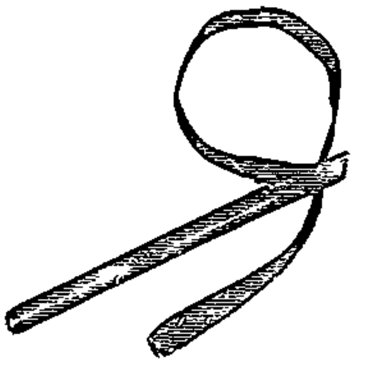

Fig. 1. This shop-made flywheel holder fits a variety of engines.

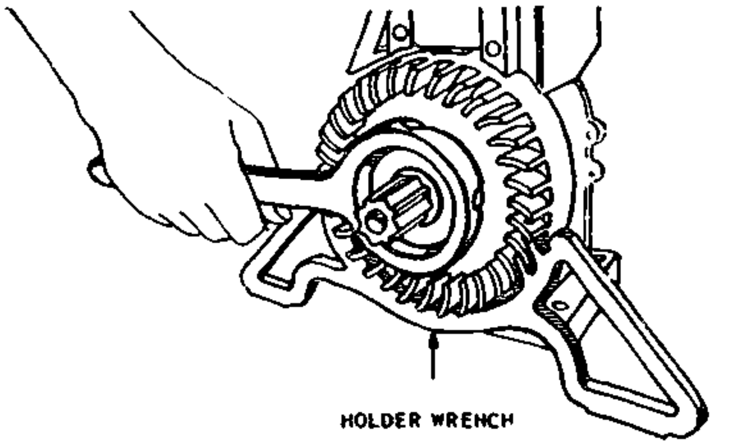

Fig. 2. This special flywheel holder wrench fits between the flywheel fins.

Fig. 3. These wrenches were made to remove the recoil mechanism.

Flywheel puller. Fig. 4 shows a special flywheel puller that is available from one engine manufacturer. This tool is not absolutely necessary as the flywheel can be removed with ordinary tools as explained later.

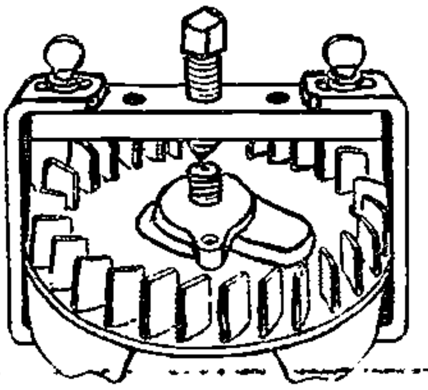

Fig. 4. A special puller may be used to remove a flywheel.

Valve spring compressor. Fig. 5 shows a special valve spring compressor for small engines. This tool is useful in controlling valve springs when removing and replacing valves.

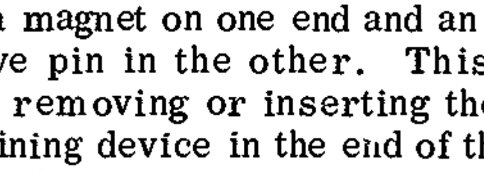

Fig. 5. Valve spring compressor.

Valve key inserter. Fig. 6 shows a device with a magnet on one end and an opening for a valve pin in the other. This tool is useful for removing or inserting the pin or other retaining device in the end of the valve stem while the spring is compressed.

Piston ring expander. This device (Fig. 7) is made both for removing and replacing piston rings. Using this tool properly will avoid breaking rings.

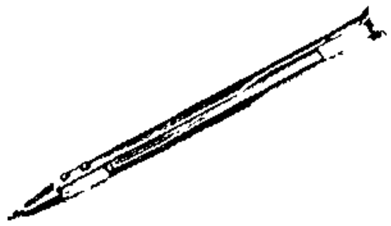

Fig. 6. Valve key inserter.

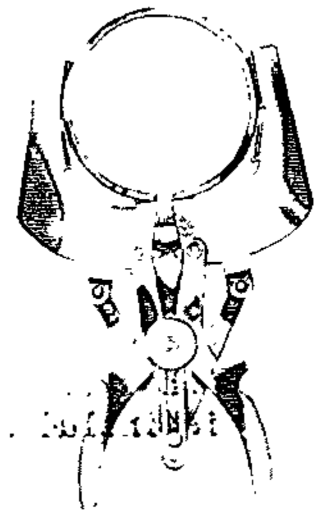

Fig. 7. Piston ring expander.

Piston ring compressor. Fig. 8 shows a piston ring compressor that is special for the small size piston found in a small engine. It is used for replacing the piston in the cylinder of a 4-cycle engine.

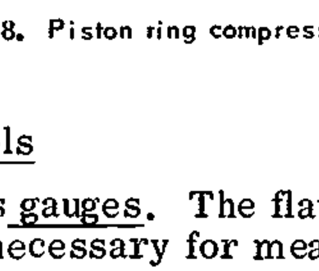

Fig. 8. Piston ring compressor.

Measuring tools

Thickness gauges. The flat feeler gauge (Fig. 9A) is necessary for measuring clearance between the piston and cylinder wall, piston ring gap, breaker point clearance,

MEMORANDUM

TO: The ERIC Clearinghouse on Vocational and Technical Education
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FROM: (Person) J. W. Matthews (Agency) Vocational Agriculture Service

(Address) 434 Mumford Hall, Urbana, Illinois 61801

DATE: September 7, 1967.

RE: (Author, Title, Publisher, Date) Small Engines - Repair and Overhaul, VAS 3019. Urbana, Illinois: Vocational Agriculture Service, University of Illinois. 20 p., 1965.

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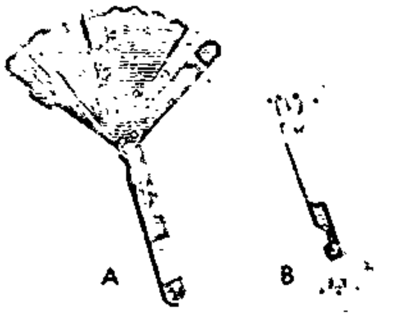

Fig. 9. Thickness gauges may be (A) flat-type for general use or (B) wire-type for measuring spark plug gap.

etc. The wire-type gauge (Fig. 9B) is preferred for measuring spark plug gap. It also has a notched lever for bending the flat terminal in setting spark plug gap.

Micrometers. Fig. 10 shows a set of three outside micrometers that are needed for measuring pistons, crankpin bearings, and other external diameters. One micrometer measures from 0 to 1 inch, one from 1 to 2 inches, and the third from 2 to 3 inches, all in thousandths of an inch.

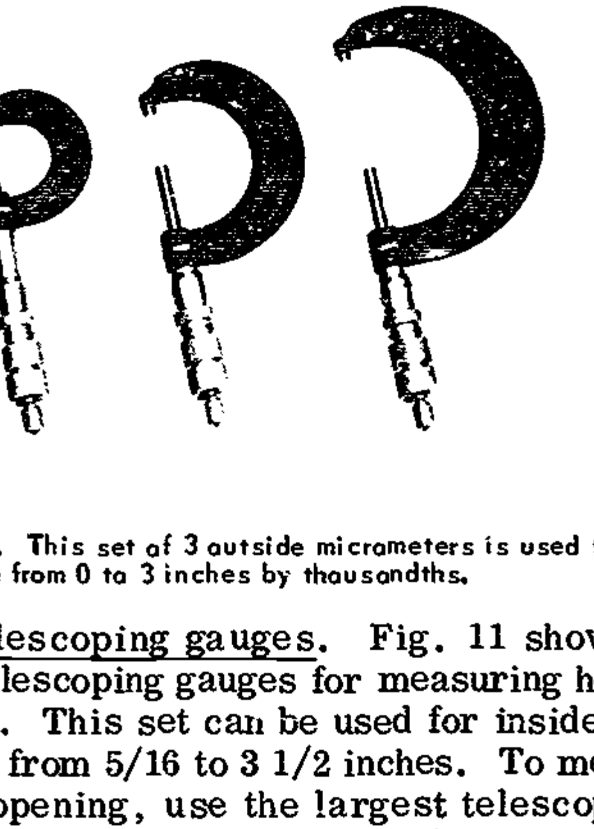

Fig. 10. This set of 3 outside micrometers is used to measure from 0 to 3 inches by thousandths.

Telescoping gauges. Fig. 11 shows a set of telescoping gauges for measuring holes or slots. This set can be used for inside diameters from 5/16 to 3 1/2 inches. To measure an opening, use the largest telescoping gauge that will go in when the plunger is depressed and locked. The plunger is spring-loaded so it expands against the sides of the opening when unlocked. Lock it in this position. Then remove the gauge and measure it with an outside micrometer to determine the exact diameter of the opening. When used this way, the telescoping gauge substitutes for an inside micrometer.

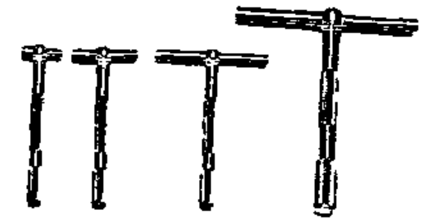

Fig. 11. This set of telescoping gauges is used to measure inside diameters from 5/16" to 3 1/2".

Miscellaneous tools

Torque wrench. The torque wrench, shown in Fig. 12, measures the torque applied in tightening a stud or nut. Its range is from 0 to 600 inch-pounds. It has a 3/8-inch square drive and is used with a standard set of sockets for tightening head bolts, bearing cap studs, spark plugs, etc. Most large torque wrenches read in foot-pounds and are not suitable for small engine work.

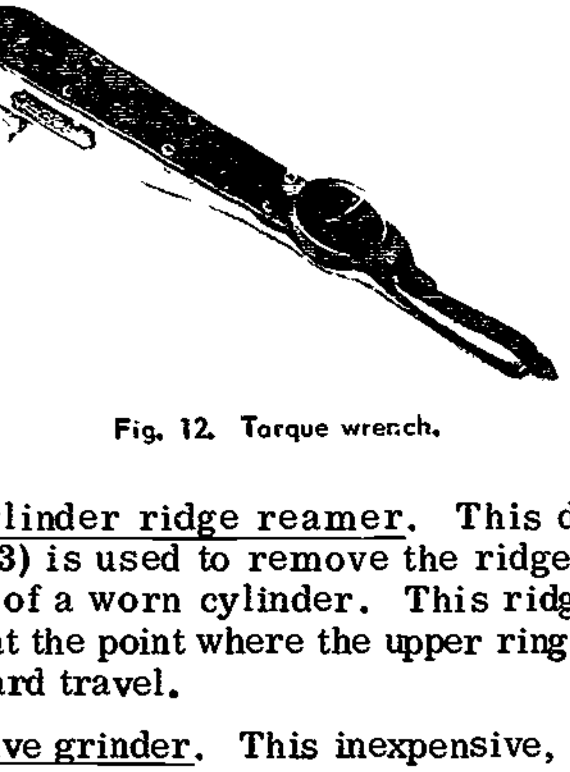

Fig. 12. Torque wrench.

Cylinder ridge reamer. This device (Fig. 13) is used to remove the ridge from the top of a worn cylinder. This ridge develops at the point where the upper ring stops its upward travel.

Valve grinder. This inexpensive, hand-

Fig. 13. Cylinder ridge reamer.

operated device (Fig. 14) may be used for light grinding of valve seats. It is of doubtful value if valves are in need of reconditioning.

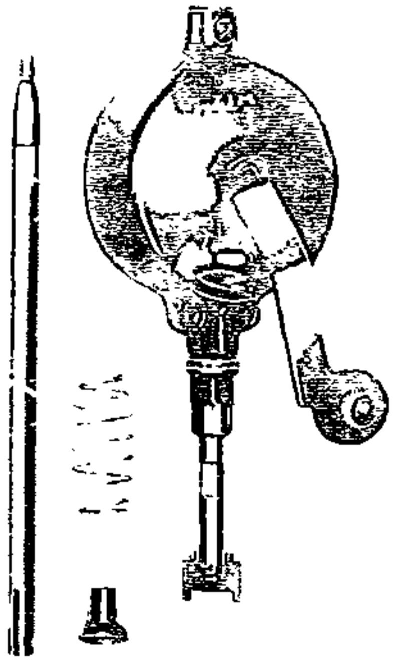

Fig. 14. Hand valve grinder.

Valve facing machine. This is an item of precision equipment (Fig. 15) that is not often available in a school or home shop. Unless a considerable amount of valve work is done, it may be more economical to have valves refaced at an implement dealer's shop or a commercial garage.

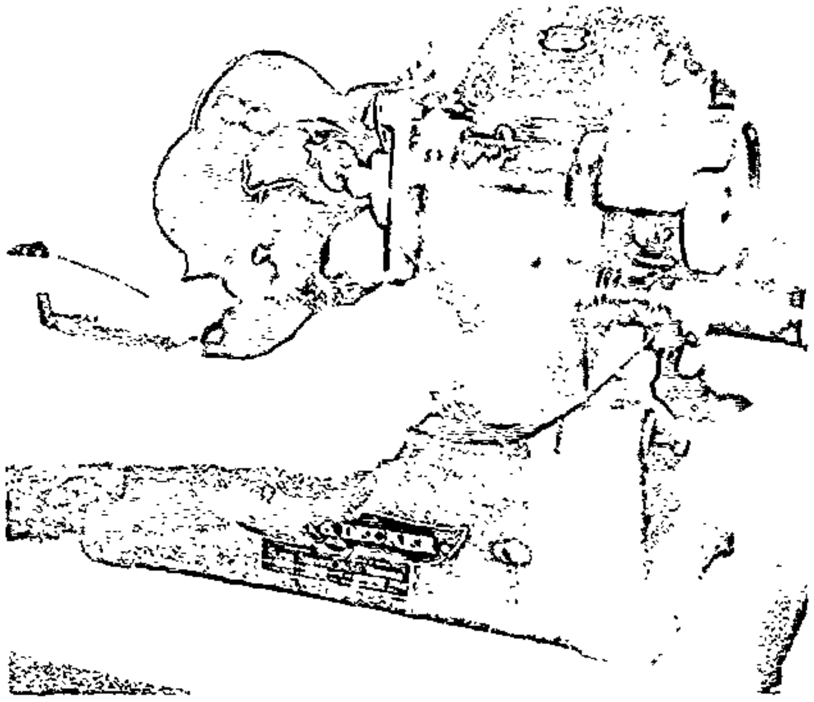

Fig. 15. Valve facing machine.

Valve seat grinder. This tool (Fig. 16) is the counterpart to the valve facing machine. It is advisable to have the valve seats reground when the valves are refaced in order to obtain a precise fit.

Fig. 16. Valve seat grinder.

2. DISASSEMBLING THE ENGINE

Preparing for disassembly

Before taking the engine apart, clean it thoroughly to avoid getting dirt into the internal parts. Loosen dry dirt with a putty knife and a stiff brush. Then blow it off with an air hose.

Clean off oil and grease with a safe solvent (not gasoline) and wipe parts dry with rags. It is generally necessary to remove the flywheel shield and other sheet metal parts to complete the cleaning.

Drain the fuel from the tank and the oil from the crankcase (4-cycle engine).

Remove air cleaner, carburetor, and fuel tank

Remove the air cleaner assembly. If it is an oil-bath type, drain and discard the old oil.

Unless you have a manual that shows a detailed picture of throttle linkage, attachment of springs, etc., draw a sketch of these parts before you disconnect them from the carburetor. It is difficult to get them hooked up again properly without a drawing or picture.

If the engine has a gravity fuel system, remove the fuel tank, disconnect the fuel lines, and remove the carburetor. If the engine has a suction system, remove the carburetor and fuel tank together. Place these parts in a box or other container and set it aside.

Remove the flywheel

Examine the threaded end of the flywheel shaft carefully to determine whether it has a right-hand or left-hand thread. You may also find this information in the manual.

Hold the flywheel with the shop-made tool shown in Fig. 1 or with a special wrench. Do not attempt to hold it with a screwdriver or a pry bar wedged between the flywheel fins. These fins break off easily and this throws the flywheel out of balance. On some rope-start engines, you can use a socket wrench to remove the flywheel nut, but if it has a recoil mechanism, a special wrench may be required as described previously. Use a sharp blow on the wrench with your hand to loosen the nut.

The flywheel is usually keyed on to a tapered shaft. To remove the flywheel, have a helper hold the engine up by the flywheel an inch or two above the bench. Hit the end of the shaft a sharp blow with a lead hammer or protect the threads with a hardwood block and strike the block with a hammer. The weight of the engine together witn the impact of the hammer will loosen the flywheel (Fig. 17).

Remove the engine head (4-cycle engine)

Remove the spark plug from the head first. Use a spark plug wrench that fits to avoid damage to the porcelain of the plug.

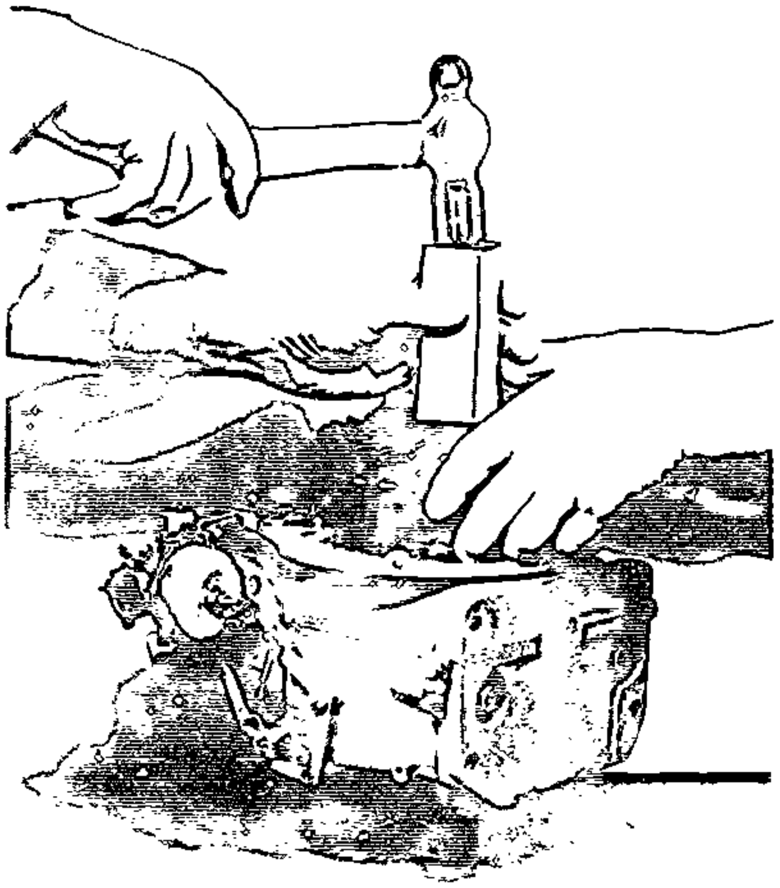

Fig. 17. Hold the engine by the flywheel and strike the end of the shaft a sharp blow, using a wood block to protect the threads.

Loosen and remove the head bolts. Note any difference in length of these bolts so you can properly reassemble the head later. Also note if a brace support or a spark plug shorting device is held in place by any of the head bolts.

Clean the carbon off the head, the top of the piston, and around the valves. If any of these parts are made of soft metal, be careful to avoid scratching them. Place the spark plug, engine head, and head bolts in a container so they will not be misplaced.

Open the crankcase

Note carefully how the engine is put together. To open the crankcase on some engines, you must remove the entire engine base. On others, one side of the engine comes off. If the engine is of the latter type, determine whether its main bearings are ball bearing or sleeve bearing type. You may find this in the manual. Type of bearings is often coded in the engine model number.

If the engine has ball bearings, it is usually necessary to remove the grease seal and a bearing locking ring before the side can be taken off. You have to destroy this seal to remove it. Drive a scratch awl or other sharp tool into the seal and pry it out (Fig. 18). Then remove the bearing locking ring (Fig. 19).

Before you remove the side of the crankcase, check for burrs or roughness on the exposed end of the crankshaft. If necessary use a fine file or emery cloth to smooth the shaft. Remove the bolts and slide off the side of the engine, exposing the crankcase.

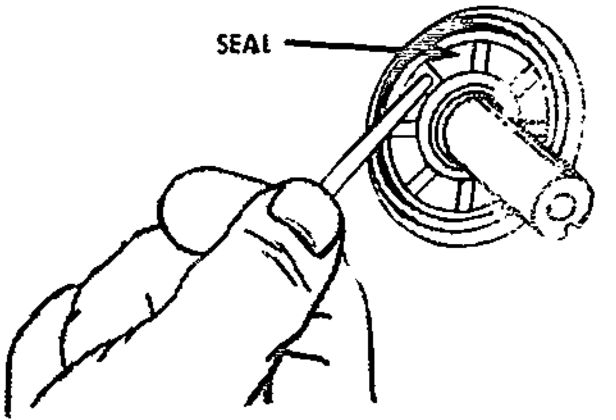

Fig. 18. Drive a sharp tool into the seal and pry it out.

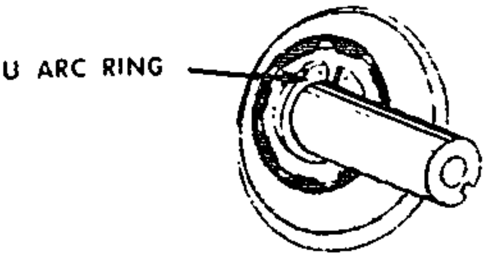

Fig. 19. The bearing is held on the shaft by a locking ring.

Be careful at this point not to let the timing gear fall out. It may be removed after you have noted the timing marks (Fig. 20). If you cannot find these marks, make them yourself with a sharp center punch before the gears are unmeshed.

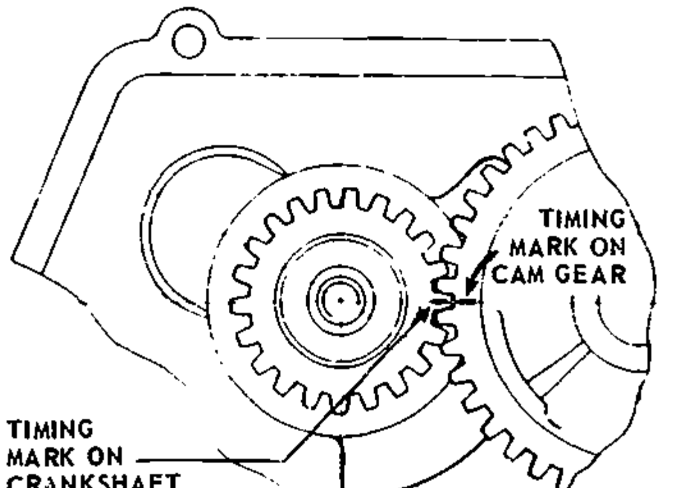

Fig. 20. Note timing marks on crankshaft and cam gears before unmeshing them.

VAS 3019

Remove the piston

Examine the upper end of the cylinder. If a noticeable sharp ridge is present, turn the engine so the piston is down out of the way. Remove the ridge with the ridge reamer. Unless you remove this ridge, the top ring may catch on the ridge and damage the piston when you force it out of the cylinder.

Before removing the crankpin bearing cap, note any marks on the cap and the connecting rod. It helps to write these things down. If no marks can be identified, mark these parts with a center punch so you can be ure to get them back in their original position.

Unscrew the studs holding the bearing cap and remove the piston from the cylinder. With a 4-cycle engine, push the piston out the top. Most 2-cycle engines do not have a removable head so the piston must be pulled out the bottom. Replace the bearing cap and keep all parts together.

Remove the piston rings

Use the piston ring expander to remove the rings from the piston (Fig. 21). Do not expand them more than necessary to free them from the grooves and slip them off the piston. Note any differences between the rings so they can be put back in the proper grooves and right side up.

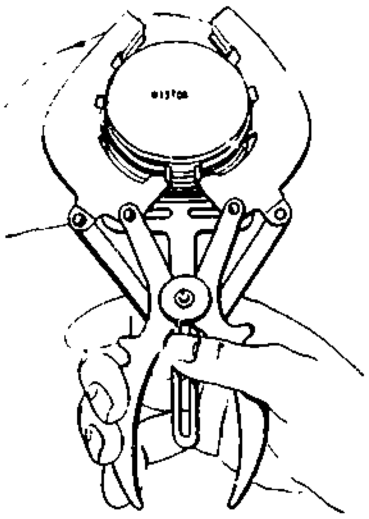

Fig. 21. Remove piston rings carefully to avoid breaking them.

Remove the valves

Four-cycle engine. Remove the valve cover, being careful to avoid injuring the gasket if possible. Adjust the jaws of the valve spring compressor so they are the right distance apart to engage the full length of the valve spring. Force the jaws onto the spring and tighten the compressor until the spring is fully compressed. This should free the pin or other retainer so it can be removed. Remove the valve, noting whether it is intake or exhaust. The valves may be marked or you can tell by their position relative to the intake and exhaust manifolds. The exhaust valve generally shows the effect of greater heat.

The valve springs may be removed or they may be left in place by releasing the valve spring compressor. If you remove the springs, tag them so they can be replaced in the proper position.

Two-cycle engine. Most two-cycle engines have a reed-type intake valve. Remove this and examine it carefully (Fig. 22). The reed is made of spring steel. It opens by suction and is supposed to spring shut to prevent loss of pressure back through the intake port. Hold the reed valve up to the light. If it is not light tight, it should be replaced before the engine is reassembled.

Remove the muffler and exhaust manifold. Clean the carbon out of the exhaust port with a hardwood scraper.

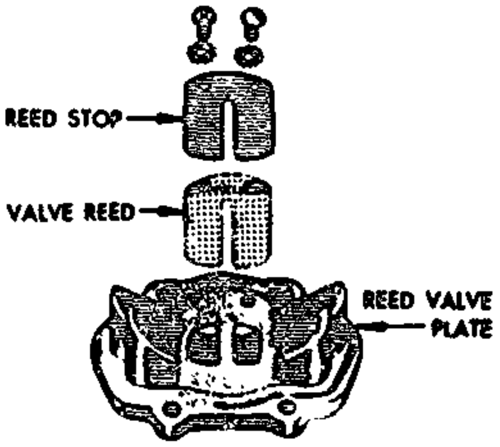

Fig. 22. The intake system on a two-cycle engine usually has a reed-type valve.

3. MEASURING CYLINDER, PISTON, AND RING WEAR

This is an important step in small engine repair. Unless you determine accurately the condition of these parts, you cannot be sure what should be done to restore the engine to good operating condition. Make all measurements carefully and check them with the manufacturer's standard for minimum, maximum, and reject dimensions. The figures quoted in this publication are for one model engine only and are given as examples. Consult repair manuals and other references to find corresponding figures for your engine.

Determining condition of cylinder

It is important first to determine the type and amount of wear that has taken place in the cylinder. If this is beyond acceptable limits, your choice is between having the cylinder rebored and fitted with an oversize piston and rings, or replacing the engine.

Cylinders may wear in three ways and usually in all three ways at once. They are (1) oversize in diameter; (2) out-of-round; and (3) taper. Following are the limits for our example engine:

	Minimum	Maximum	Reject
Cylinder diameter	2.3115	2.3125	2.3145
Out-of-round			
Cast iron			.0015
Lightweight			.0025
Taper			.006

Measuring diameter. Select the largest telescoping gauge that will fit inside the cylinder. Place it crossways in the center of the cylinder down about an inch from the top. Release the lock and let it expand against the cylinder walls. Be sure the plunger and stationary leg are held exactly perpendicular to the cylinder wall. Lock the gauge, remove it carefully, and measure with the micrometer. If your reading is between the maximum and minimum, wear in cylinder diameter has not been excessive. If it exceeds the reject dimension, you should conclude that the engine cannot be put in good working condition without being rebored. Repeat your measurement several times to be sure you are right.

Measuring for out-of-round. Repeat the diameter measurement first with the telescoping gauge held parallel to the crankshaft and then at a right angle to it. Compare these measurements. If they differ by more than the allowable amount, reject the engine as being worn too much out-of-round. The measurement taken at a right angle to the crankshaft is usually the larger one as the cylinder tends to wear more in the path of crank travel.

Measuring for taper. Take measurements near the top and bottom of the cylinder with the telescoping gauge held at a right angle with the crankshaft. If these measurements differ by more than the allowable amount, reject the engine on the basis of too much taper. Cylinders normally wear faster near the top than near the bottom because of greater heat and consequent poorer lubrication.

Taper can be measured in another way with no special equipment except a piston ring and a feeler gauge. Place a piston ring in the cylinder near the top. Use the piston upside down to position the ring exactly straight in the cylinder. Measure the ring gap with a feeler gauge (Fig. 23).

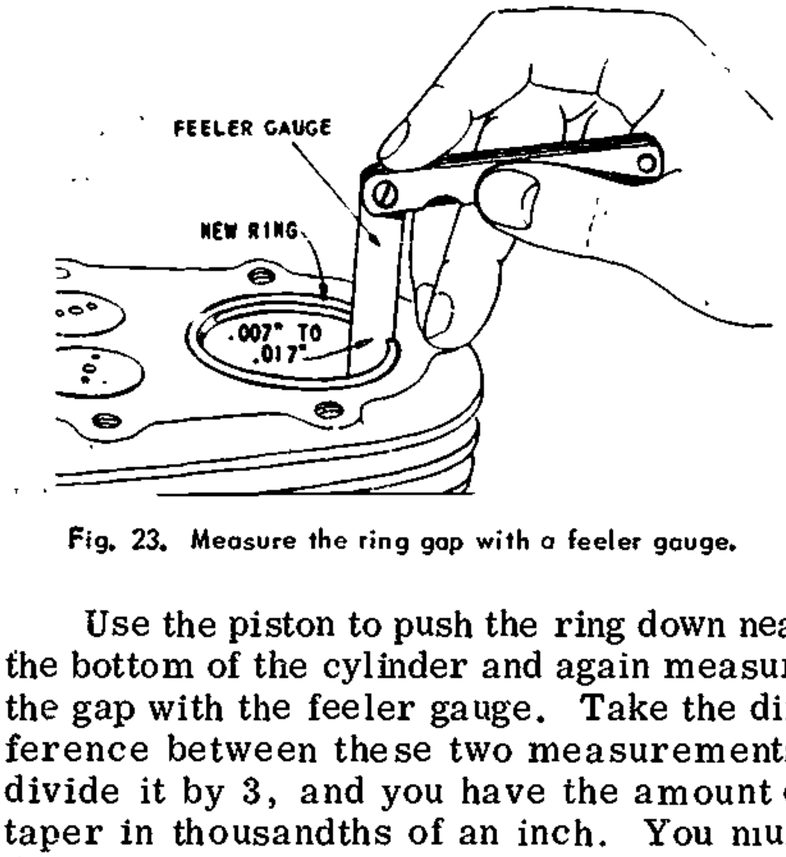

Fig. 23. Measure the ring gap with a feeler gauge.

Use the piston to push the ring down near the bottom of the cylinder and again measure the gap with the feeler gauge. Take the difference between these two measurements, divide it by 3, and you have the amount of taper in thousandths of an inch. You must divide by 3 (actually by pi or 3.1416) because taper is expressed in diameter and you were measuring difference in circumference. Circumference is pi X diameter, or diameter is circumference ÷ pi.

This simple test for taper is often enough to help you make a fairly good estimate of cylinder condition. If it causes you to reject the cylinder on the basis of taper, the other measurements are not necessary. If no serious taper is found, it is reasonable to assume that the cylinder is not badly worn in diameter or out-of-round.

Determining condition of the piston

If none of the cylinder measurements indicate rejection, the next step is to determine if the piston is suitable for reuse. First clean the carbon out of the ring grooves. A good tool for this purpose may be made by grinding a sharp edge on a broken piston ring (Fig. 24). Avoid cutting any metal out of the groove, particularly if the piston is made of lightweight, soft metal.

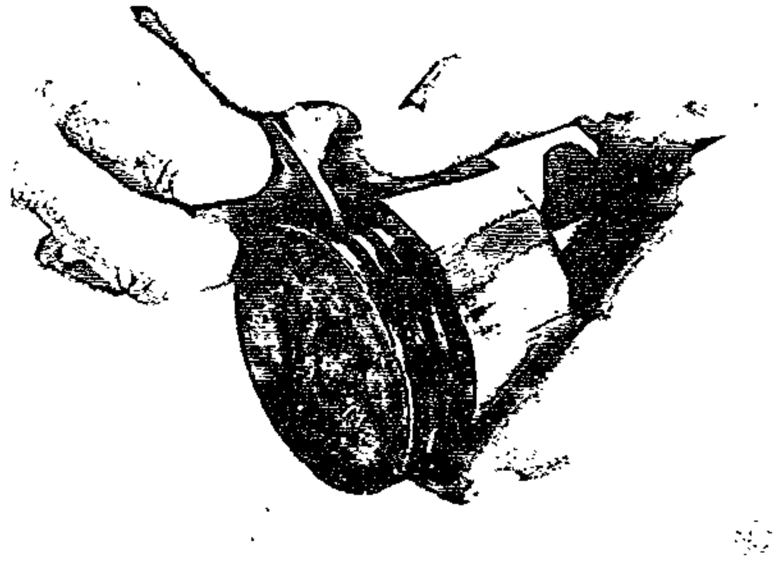

Fig. 24. Clean the carbon out of the piston ring grooves with a broken ring, ground to a sharp edge.

Two common reasons for rejecting a piston are (1) excessive wear in the upper ring groove; and (2) excessive piston skirt clearance. Manufacturer's recommendations for our example engine are:

	Minimum	Maximum	Reject
Ring groove side clearance			.007
Piston skirt clearance	.005	.007	.008

To determine wear in the upper ring groove, place a new ring on the piston and measure the clearance between the side of the ring and the groove with a flat feeler gauge (Fig. 25). Replace the piston if it exceeds the reject figure.

To measure piston skirt clearance, remove the ring and place the piston in the cylinder upside down and measure the clearance

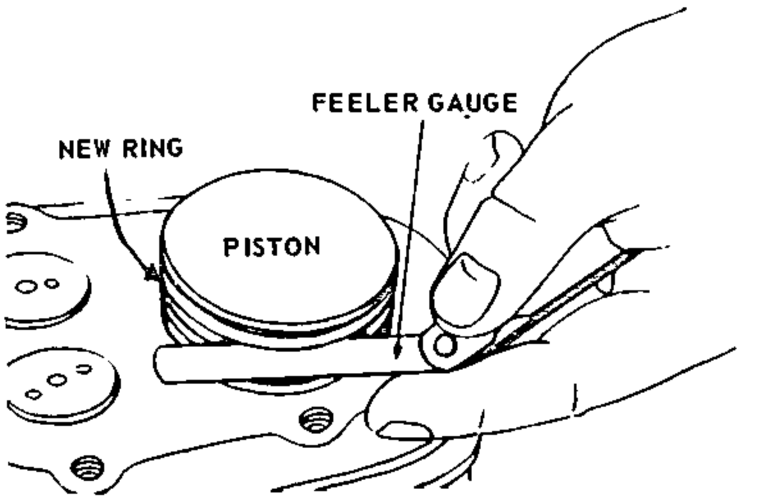

Fig. 25. Measure clearance between a new ring and the upper piston ring groove.

between the piston skirt and the cylinder wall (Fig. 26). Make this measurement at a right angle to the piston pin. You may find it easier to push the piston and a leaf of the feeler gauge down into the cylinder together. You have the right thickness leaf when it requires about a 5 pound pull to remove the feeler gauge.

Determining condition of piston rings

Piston ring end gap should be measured for each compression ring and the oil ring. To measure the end gap, place the ring inside the cylinder near the top of its working range and use the piston to true it up. Determine the amount of gap between the ends of the ring with a flat feeler gauge.

Manufacturer's recommendations for the example engine are:

	Minimum	Maximum	Reject
Compression ring	.007	.017	.035
Oil ring	.007	.017	.045

If your measurement of ring end gap exceeds the allowable amount, the rings should be rejected. Bear in mind, however, that it is not worthwhile to install new rings in an engine if either the piston or cylinder is beyond the reject point in wear.

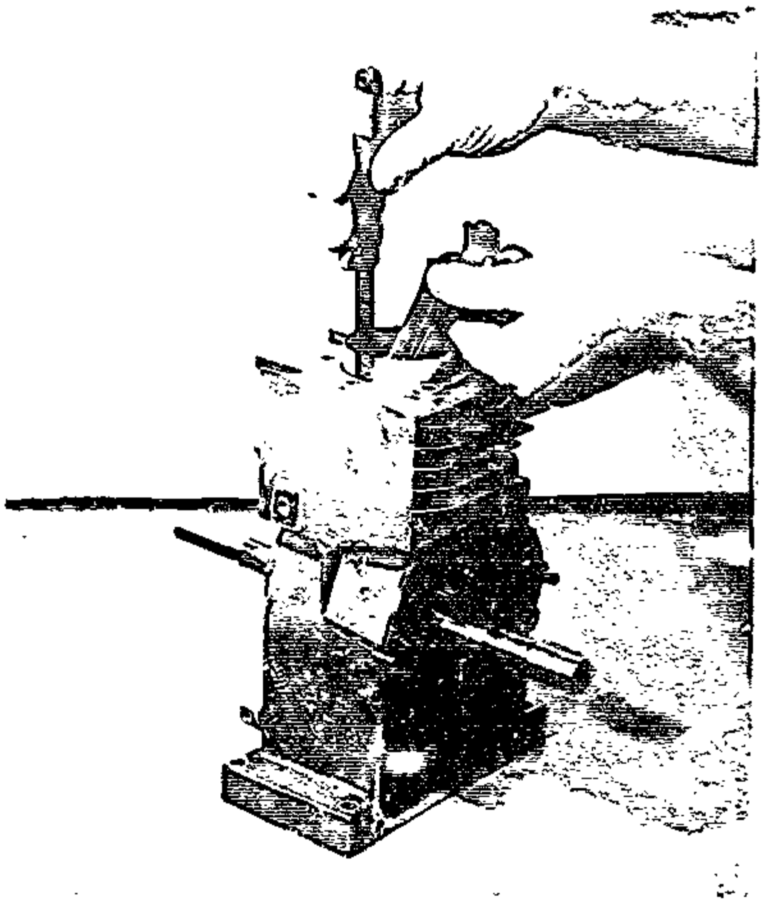

Fig. 26. Measure piston skirt clearance with a flat feeler gauge.

4. CHECKING CRANKPIN AND BEARING

Crankpin

The crankpin, or part on the crankshaft to which the connecting rod bearing is attached, should be checked for three things -- (1) scoring; (2) diameter wear; and (3) out-of-round. If the crankpin is badly scored due to poor lubrication or bearing disintegration, the crankshaft should be rejected.

Consult manufacturer's recommendations for minimum diameter and maximum out-of-round. For our example engine they are:

	Reject
Crankpin diameter	.867 or less
Out-of-round	.0007 or more

Measure the diameter of the crankpin with a small micrometer. Measure it several times in several places to determine actual diameter and differences in diameter or out-of-round. If either of these measurements indicate rejection, it will be impossible to fit the connecting rod bearing properly. Crankpins can be built up and reground or the crankshaft can be replaced, but either of these alternative may be so expensive you will decide to replace the engine.

Crankpin bearing

Again the manufacturer specifies a minimum, maximum, and reject bearing clearance. For our example engine, they are:

	Minimum	Maximum	Reject
Crankpin bearing clearance	.0015	.0045	.0095

A convenient way to measure bearing clearance is to use a plastic thread (Plastigage) made by a leading manufacturer of automotive and engine parts. Place a piece of the plastic thread about as long as the width of the bearing on the crankpin and tighten the bearing cap over it. Use the torque wrench and tighten the studs to the recommended torque. For our example engine this is 70 to 80 inch-pounds. Without turning the engine, remove the bearing cap carefully and measure the width of the flattened plastic with the paper gauge furnished with the material (Fig. 27). You read this gauge directly in thousandths of an inch of bearing clearance.

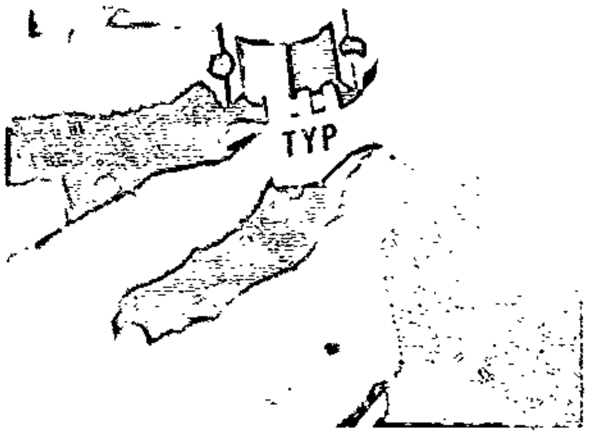

Fig. 27. Measure bearing clearance with Plastigage.

The plastic thread comes in different sizes. For small engine work, two sizes are generally sufficient -- .001 to .003, and .002 to .006. If you place the piece of plastic parallel to the crankshaft, your measurement will indicate bearing clearance. If you place it at a right angle to the crankshaft and use a piece long enough to extend about half way around the bearing, your measurement will give some indication of out-of-round.

If the crankpin is not too badly worn but bearing clearance is beyond the rejection point, you may correct the problem by replacing the connecting rod.

5. REPLACING THE PISTON

Having made the measurements on the cylinder, piston, rings, and crankpin bearing and having determined what parts should be replaced, you are ready to install these parts. Let us assume that the only parts you found necessary to replace were the piston rings.

Clean the cylinder wall thoroughly, first with an oil-soaked rag and then with a clean white rag. Continue until the clean rag shows no dirt. Do not use solvent as this would remove the protective oil film that has penetrated into the pores of the cylinder-wall surface.

Checking new rings

Place each new ring in the cylinder, true it up with the piston and check the ring end gap. If your cylinder measurements have been accurate, ring gap will probably be satisfactory. If the gap is found to be too small, file off the end of the ring carefully, holding it in a vise.

Installing new rings on the piston

Use the piston ring expander to install the rings on the piston. The oil ring is usually put on first and it can be either side up. The compression rings may be different. The center compression ring may have a slight recess on one outside edge, called a scraper groove. This scraper groove goes down. The upper compression ring may have a recess on one inside edge. This recess goes up. Fig. 28 shows the various rings and the proper position of each.

The piston of a 2-cycle engine may have a small pin or knob in each ring groove to keep the ring from turning (Fig. 29). The ring must be installed so this pin comes in the ring gap. These knobs are to prevent the ends of the rings from catching in the cylinder ports. If you install these rings improperly, they are likely to be broken when you force the piston into the cylinder.

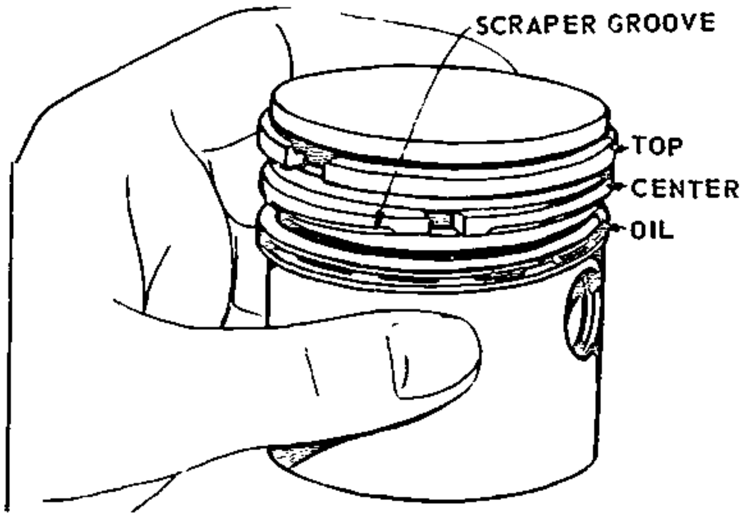

Fig. 28. Rings should be installed in correct position on the piston.

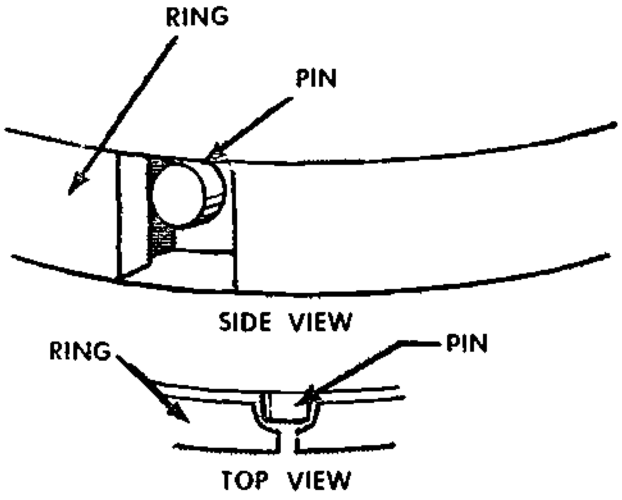

Fig. 29. Some pistons have a pin in each ring groove that fits in the ring gap.

Installing the piston in the cylinder

Squirt some oil on the piston and around the rings. Then lower the piston into the cylinder with the connecting rod bearing turned the right way until the projecting oil ring is in contact with the engine block. Place the ring compressor over the piston and tighten it to squeeze the rings into their grooves. Then push the piston down until all rings are inside the cylinder.

Oil the crankpin bearing surface, put on the bearing cap, and tighten the studs to specified tension with a torque wrench (70-80 inch-pounds). Turn the engine over to be sure it moves freely. If not, you may have the piston in backwards as some engines have a slightly offset connecting rod which binds if it is not installed in correct position. If the engine turns freely, lock the studs, and close up the crankcase.

In a 2-cycle engine, the piston is usually put in from the bottom. Be sure you have it turned correctly (Fig. 30). It is not necessary to use a ring compressor since the bottom of the cylinder has a chamfer which compresses each ring into its groove as the piston is pushed up.

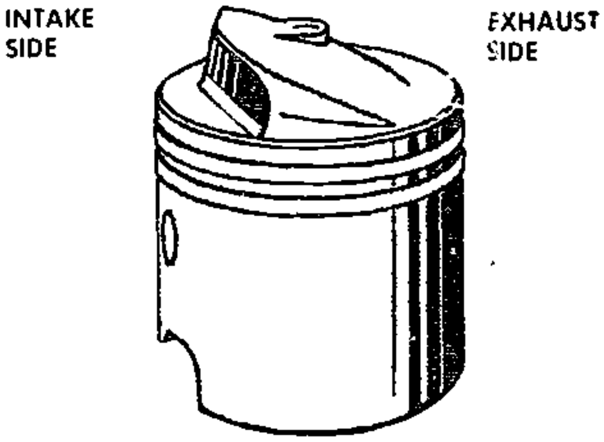

Fig. 30. Note the correct position of the piston in a 2-cycle engine.

6. SERVICING THE VALVES

Inspect the valves and valve seats carefully for evidence of improper contact and leakage. The mark of contact on both the valve and its seat should be clean and continuous. Since valve condition is so important in maintaining good compression, it is usually advisable to reface the valves when overhauling an engine.

Refacing valves

As mentioned previously, this is done on a special valve facing machine. The following suggestions are made in case you have access to a facing machine. Otherwise the valves can be taken to a repair shop for this work.

Dress the wheel lightly with the special diamond dressing tool before you use it to be sure the wheel is clean and true. Check the angle setting of the machine to be sure it is the same as your valves. For most small engines this angle is 45° but you should verify this from your manual.

Place the valve stem in the chuck and tighten securely. Start the machine and slowly move the valve up to the face of the wheel, moving it across the wheel steadily when it begins to cut. Take light cuts and continue only until the cutting is continuous around the entire valve face. You can tell this by the sound.

It is not until facing has been completed that you can tell for sure if the valve can be reused. The width of the valve margin on a new valve is usually about 1/32 inch (Fig. 31). If this margin is less than 1/64 inch wide after refacing, the valve should be rejected. Without this minimum width, the valve will overheat and warp or burn.

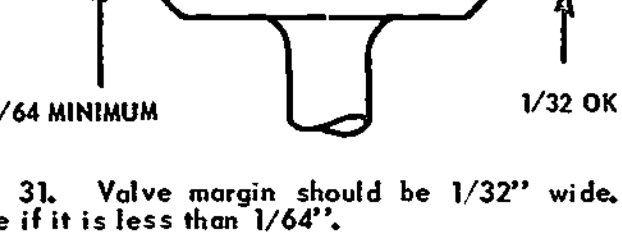

Fig. 31. Valve margin should be 1/32" wide. Reject valve if it is less than 1/64".

Servicing valve seats

If the valve seat is in bad condition, it may be reseated with the special reseating tool. Select the right size pilot to fit tightly in the valve guide and use a stone of proper diameter and angle. Dress the stone each time before using it. Grind the seat lightly until a clean, continuous line is formed.

Some engines have valve seat inserts made of hard alloy steel. These can be replaced but a special tool is required for removing the old seat (Fig. 32). Prepare the new insert by placing it in a freezer for several hours to shrink it so you can press it into the recess in the engine block. Then you peen the area around it with a ball peen hammer to hold it in place. A new insert should be lightly ground with the reseating tool to true it up.

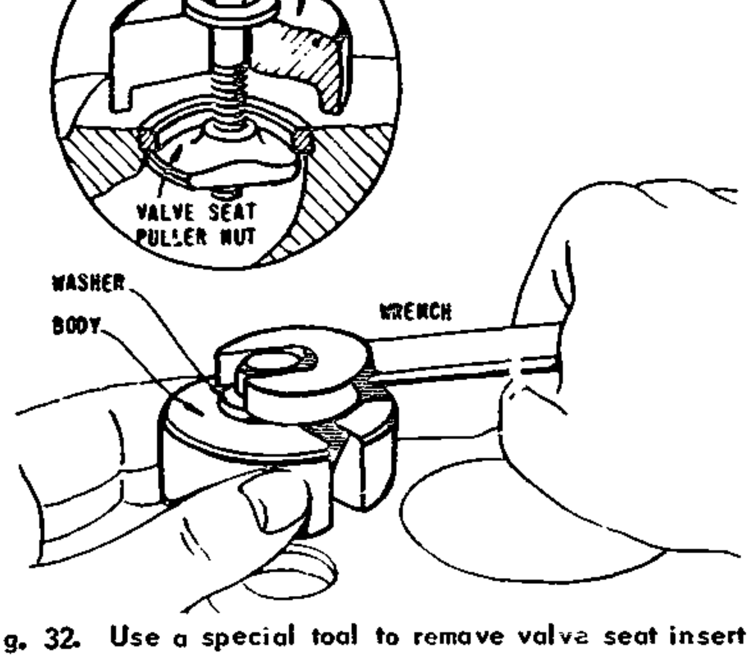

Fig. 32. Use a special tool to remave valve seat inserts.

Replacing the valves

After the valves have been refaced or replaced, they may be ground lightly with the hand grinding tool. Use fine valve grinding compound and grind only until a continuous mark shows around the valve face and seat. Too much hand grinding will destroy the effect of refacing because the valve may not seat where you ground it when the engine gets hot.

Wipe all traces of valve grinding compound off the valve faces, stems, valve seats, and guides. This material is very abrasive and will cause rapid wear if left on any moving parts.

Replace the valve springs and keepers, using the valve spring compressor and the pin inserter. Turn the engine over to be sure the valves are opening and closing properly.

Checking and adjusting tappet clearance

Be sure the valves are in fully closed position when you measure tappet clearance. Turn the engine over until the intake valve starts to open. The piston should be going down on the intake stroke at this time. Keep turning until the piston reaches the top again. This is the end of the compression stroke and both valves should be fully closed.

Measure the gap between the end of the valve stem and the tappet with a flat feeler gauge. This gap should be between the minimum and maximum prescribed by the manufacturer. For our example engine, these figures are:

	Minimum	Maximum
Intake valve	.005	.007
Exhaust valve	.009	.011

Too little clearance is very serious as it will not allow the valve to close fully when the stem has expanded with the heat. If a valve does not close and seat properly, it overheats and burns rapidly. Too much clearance makes a valve open a little too late. It also opens less than the full amount. Both of these things cause some loss of power.

Refacing and reseating causes the valves to seat deeper so tappet clearance is generally reduced. The only way to restore proper clearance on most small engines is to grind off the end of the valve stems. The valves must be removed from the engine for this operation.

If valve stems are ground off by trial and error, it is usually necessary to put them in and take them out of the engine several times in order to get the clearance just right. The valve springs must be secured to the valve each time before an accurate measurement can be taken. To avoid this repetition, note the first time how many thousandths of an inch must be removed from each valve stem. Take the valves out and measure the length of each with the large micrometer before you start grinding off the stems (Fig. 33). By alternate grinding and measuring, you can take off the desired amount.

Replace the valves, make a final check of tappet clearance and replace the valve cover.

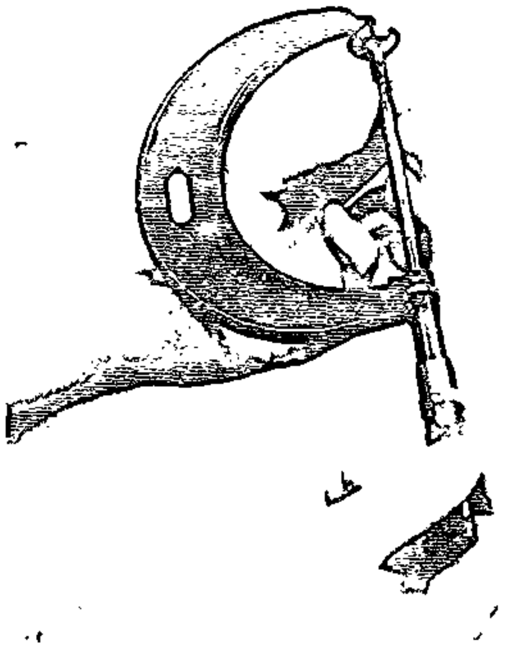

Fig. 33. Measure the length of the valve with a micrometer.

7. REPLACING THE ENGINE HEAD

After the valves have been serviced, you are ready to replace the engine head. It is advisable to obtain and use a new head gasket. Place the head in position and insert the head bolts. Draw them up evenly until they are snug.

Use the torque wrench to finish tightening the head bolts after determining the proper torque from the manual. For our example engine it is 125 to 150 inch-pounds. Alternately tighten bolts on one side and the other so that the head is drawn down evenly.

Do not replace the spark plug at this time. It will be easier to turn the engine over while servicing the ignition system if you do not have to work against compression.

8. REPAIRING THE CARBURETOR AND FUEL SYSTEM

Two types of fuel systems are common on small engines. They are the gravity system in which the tank is elevated above the carburetor and the suction system in which the tank is below the carburetor. With either type, clean out the tank thoroughly and rinse it with gasoline. Blow fuel lines clear with compressed air.

Servicing the float-type carburetor

The gravity system has a float-type carburetor which is quite similar to that of a large engine. It should be disassembled for checking, cleaning, and replacement of parts.

If the main fuel jet adjustment is on the side of the carburetor as in Fig. 34, remove the

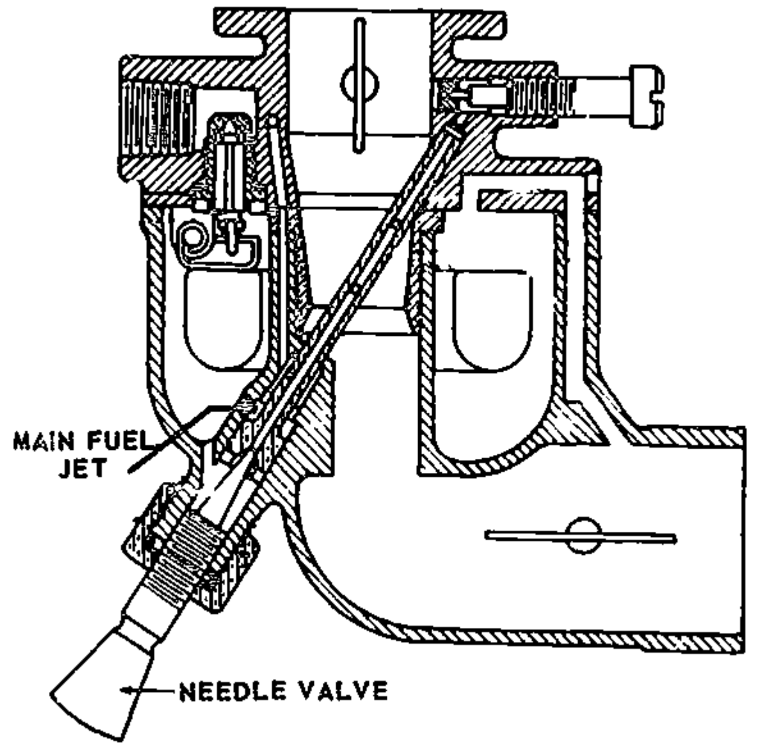

Fig. 34. Remove the main fuel adjusting needle valve and jet before disassembling the carburetor.

main fuel jet before taking the carburetor apart. This jet extends up through both halves of the carburetor and may be damaged if it is not removed first. Loosen the needle valve packing nut and remove the needle valve and nut together. Unscrew and remove the main fuel jet using a screwdriver that has been ground to the proper width and thickness to fit the slot in the jet. You can see this slot if you look inside the opening from which the needle valve has been removed.

Remove the screws and open up the carburetor, noting how all parts fit together. Remove the float and float valve. Remove the idle jet needle valve.

Clean the carburetor bowl and all parts with special gum solvent or lacquer thinner. Wipe parts dry and lay them out so you can examine them.

If the float valve has a groove around it that you can feel with your finger nail, replace it and its seat. Do the same with the two needle valves. Shake the float to see if there is any fuel inside it. If so, this indicates that the float has a hole in it and should be replaced.

Reassemble the float valve seat, float valve, and float. Check the float position when the valve is fully closed. In most cases the float should be at right angles to the carburetor body when the valve is closed (Fig. 35).

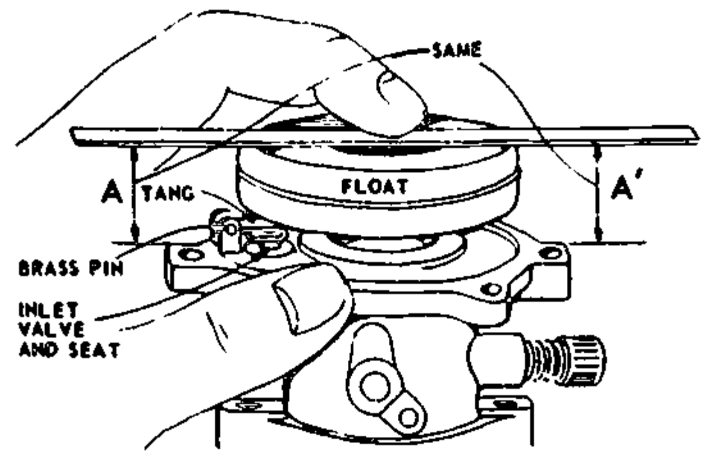

Fig. 35. Float position is correct when A and A' are the same.

If necessary, adjust by bending the projection that presses against the float valve.

Check the throttle shaft for wear and replace if there is noticeable looseness between the shaft and bearings. If the bearings are not replaceable, the entire carburetor should be replaced.

Reassemble the carburetor using new gaskets. Reconnect the fuel line and the linkage between the throttle, governor, and manual controls.

Servicing the suction-type carburetor

Remove the fuel tank from the carburetor, being careful not to damage the fuel tube. In the suction system the fuel tank corresponds to the carburetor bowl. The tank is generally made broad and shallow so that the variation in height of fuel level between a full and empty tank is held to a minimum.

Remove the fuel tube from the carburetor. This is generally a press fit and the tube may be held in a vise for removal as shown in Fig. 36. Test the ball check in the bottom of the fuel tube by blowing through it both ways. It should be air tight when blown from the

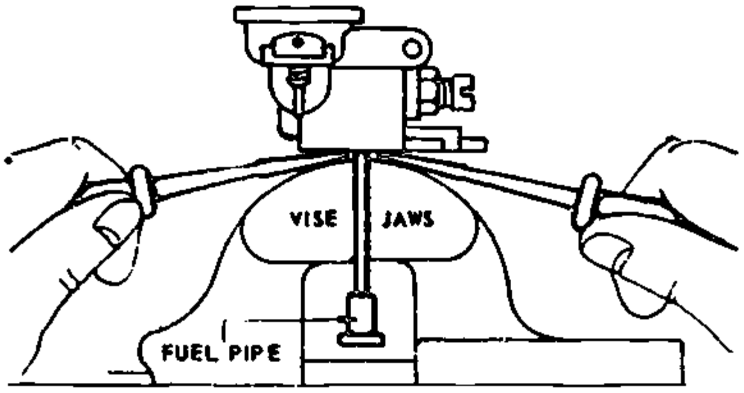

Fig. 36. Hold fuel pipe in a vise and pry it out of carburetor body with two screwdrivers.

top but the ball should open when you blow through the screen end.

If the ball is stuck or grimy, soak it in gum solvent or lacquer thinner until it is clean and free. Clean the screen also and replace the entire fuel tube assembly if it cannot be put in good condition by cleaning.

This type carburetor usually has only a main fuel jet. Remove the needle valve so you can check it and its seat for wear. Replace these parts if they show wear as described previously. Open up the carburetor, clean, and inspect all parts before reassembling. Press the fuel tube into the bottom of the carburetor, using a bench vise as shown in Fig. 37. Reconnect the fuel tank.

Mount the carburetor on the engine, using a new manifold gasket, and reconnect the throttle linkage. Service the air cleaner according to manufacturer's recommendations and mount it in place.

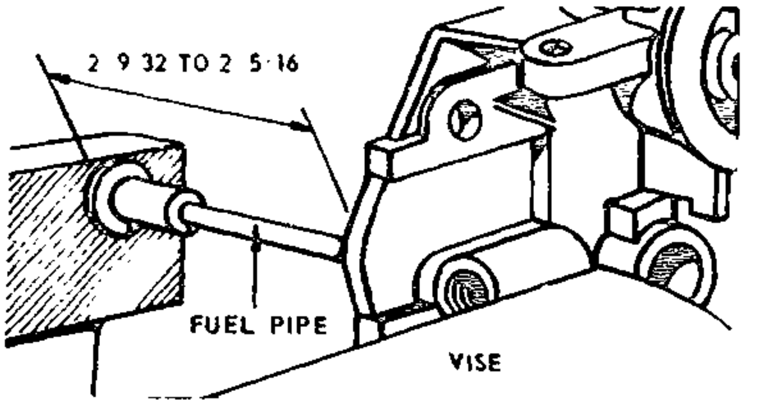

Fig. 37. Press new fuel pipe into carburetor body with a vise.

9. SERVICING THE IGNITION SYSTEM

Breaker points

Remove the breaker point cover and examine the condition of the points. If they are burned or pitted, they should be replaced. If you replace the points, have the condenser tested or replace it too.

Adjust the clearance between the breaker points when fully open to that recommended. For our example engine this clearance is .020. Wipe the blade of your feeler gauge clean of oil or grease before you use it to check point setting.

Spark plug

Inspect the spark plug for fouling, wide gap, or burned condition. Cleaning a dirty plug is a questionable practice. If in doubt, it is best to replace it with a new plug of the proper number as specified by the engine manufacturer.

Adjust the plug gap to the recommended clearance. For the example engine this is .025.

Coil and ignition wiring

The coil and ignition circuit can be tested with a 6-volt lantern battery as shown in Fig. 38. It is convenient to have a clip on the end of one battery wire and a test prod on the end of the other.

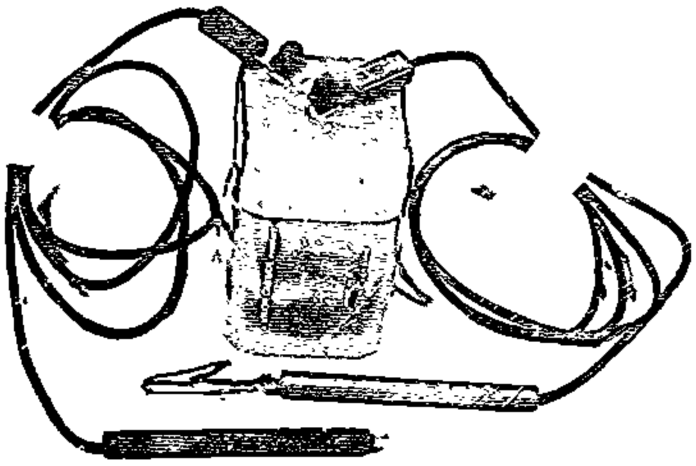

Fig. 38. A coil and ignition circuit tester.

Connect the spark plug wire to the plug and lay the base of the plug in contact with the engine head. Clip one battery wire to the engine frame. Turn the engine until the points are fully open and scratch the insulated part of the breaker point assembly with the test prod (Fig. 39). A spark should jump the gap at the plug. The spark is most intense when you touch the prod to the insulated point for a moment and then break contact quickly. This simulates the action of the breaker points when the engine is running.

If you get no spark at the plug, do not conclude immediately that the coil is defective. The trouble may be in the points, in the

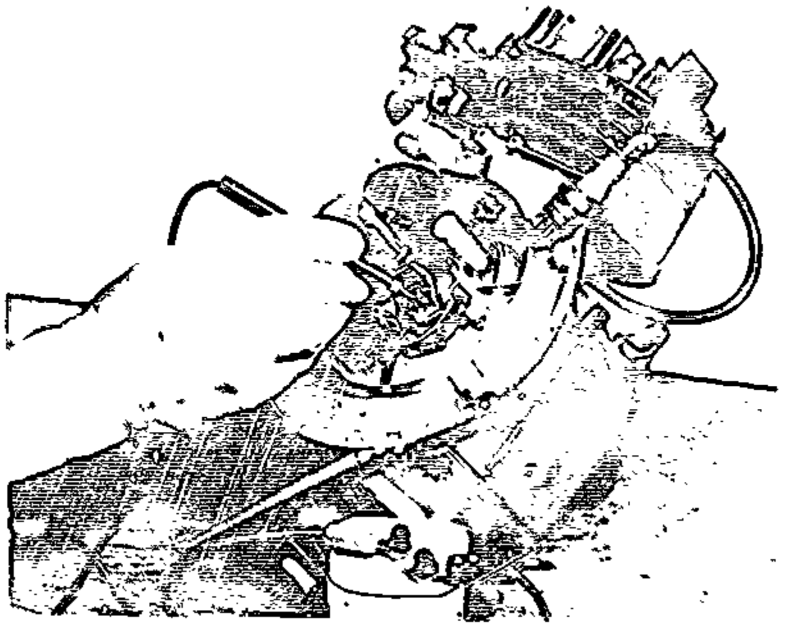

Fig. 39. Clip one battery wire to the engine frame. Scratch the insulated breaker point with the prod and a spark should jump the plug gap.

primary wire leading from the points to the coil, in the coil grounding wire, or in the secondary wire leading from the coil to the plug.

Note what kind of a spark, if any, occurs when you scratch the insulated point with the battery prod.

No spark. This means that the current is not going through the primary ignition circuit. Look for a poor connection or a break in the wire leading from the point assembly to the coil. A loose connection at the point where the coil winding is grounded will also cause this fault (Fig. 40).

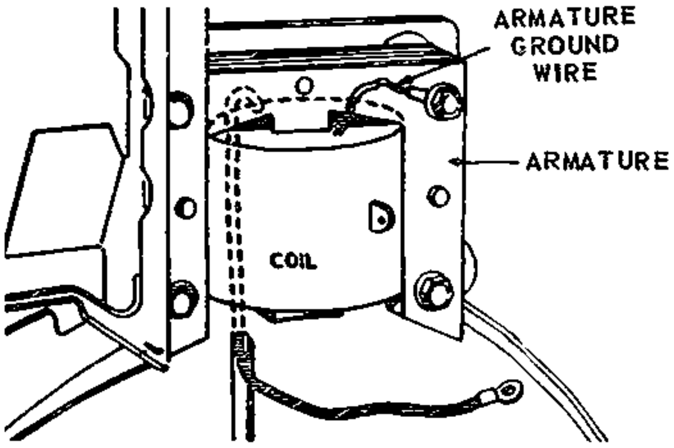

Fig. 40. The armature ground wire must be tight.

Small spark. A small spark of the same intensity that you get when you scratch the prod on the engine frame indicates that the insulated breaker point assembly is grounded somewhere. This may be due to the lug on the wire attached to the insulated point touching the frame, or to a break in the insulation on the wire leading from the point to the coil. Do not overlook the shorting mechanism that may be used to stop the engine. If your engine has a switch to turn it off, or if you close the throttle to stop it, this mechanism may be shorting out the points continuously.

Bright spark. This indicates that the primary circuit of the coil is probably all right. When you energize the primary circuit, a magnetic field builds up in the coil. When you break this circuit, the primary field collapses, giving a momentary surge of fairly high voltage back through the primary circuit. This causes a bright blue spark at your prod.

If you still get no spark at the plug and you are sure the plug base is making good contact with the engine head, look for trouble in the secondary circuit. Check the connection of the spark plug wire to the coil. It should be pinched tight as shown in Fig. 41 but not soldered.

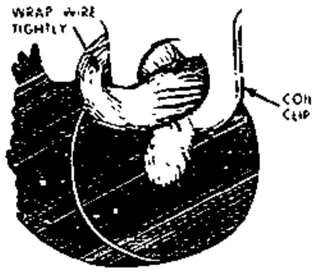

Fig. 41. The spark plug wire should be pinched tight but not soldered.

Look next for worn insulation on the spark plug wire, particularly where it passes through openings in the frame or under metal clips. High-voltage current may be shorting to the frame at these points. There may also be a break in the wire somewhere between the coil and the plug. To check these possibilities, disconnect the spark plug wire from the coil and connect a new piece of wire directly to the coil and plug.

If the plug still fails to fire, you may conclude that the coil is defective and should replace it with a new one.

Check magneto air gap

Magneto air gap is the distance between the rotating magnets in the flywheel and the stationary laminations of the coil. The closer these two come together without rubbing, the stronger the current produced by the magneto will be. Manufacturer's recommendations for magneto air gap for our example engine are:

	Minimum	Maximum
Magneto air gap		
Zinc flywheel	.008	.011
Aluminum flywheel	.018	.022

Coil and armature outside flywheel. If the coil and armature are outside the flywheel, checking and adjusting the magneto air gap is a simple procedure. Replace the flywheel. If the flywheel key is worn or partly sheared, use a new one. This is a special soft key supplied by the manufacturer which is meant to shear in case the engine jams or locks to avoid damage to the internal parts. Do not use a hardened steel key.

Check magneto air gap with a flat feeler gauge as shown in Fig. 42. If this gap is less than the minimum, or greater than the maximum, loosen the armature mounting screws. Adjust the armature to the proper gap and retighten the screws.

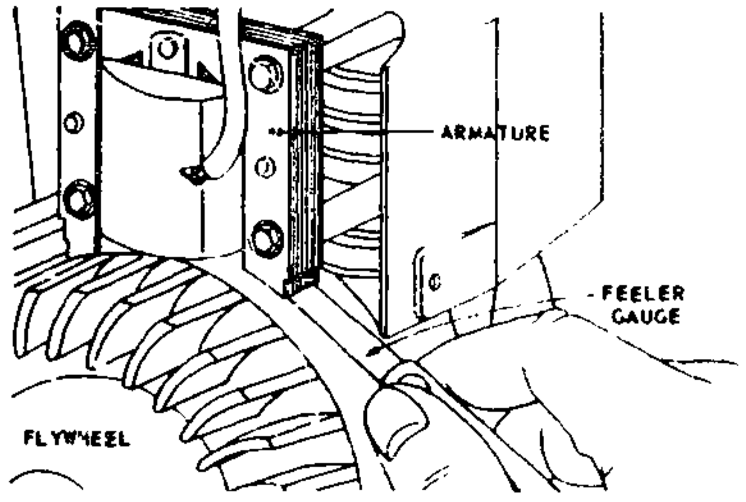

Fig. 42. Check magneto air gap with a flat feeler gauge.

An alternate method of setting magneto air gap if the coil and armature are outside the flywheel is to use special tag or a government postal card as shown in Fig. 43. A postal card is about .010 inches in thickness. Rotate the flywheel until the magnet pole pieces are opposite the stationary laminations of the coil. Place the card in the gap, loosen the screws holding the laminations, and allow the magnetic pull to draw the laminations down against the card. Tighten the screws and withdraw the card, leaving the proper air gap. Use two thicknesses of card for an aluminum flywheel.

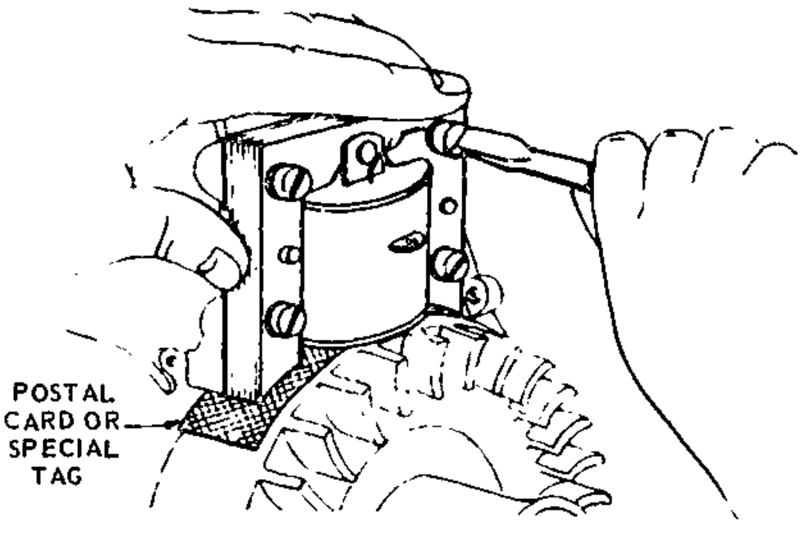

Fig. 43. Set magneto air gap with a postal card or special tag as the thickness gauge.

Coil and armature inside flywheel. If the coil and armature are inside the flywheel on your engine, it is somewhat more difficult to measure magneto air gap. One method is to wrap one thickness of electrician's plastic tape over the armature laminations as shown in Fig. 44. Replace the flywheel and tighten down the nut that holds it. Turn the engine over about twice and remove the flywheel, turning the magnets away from the armature before you disturb the wheel.

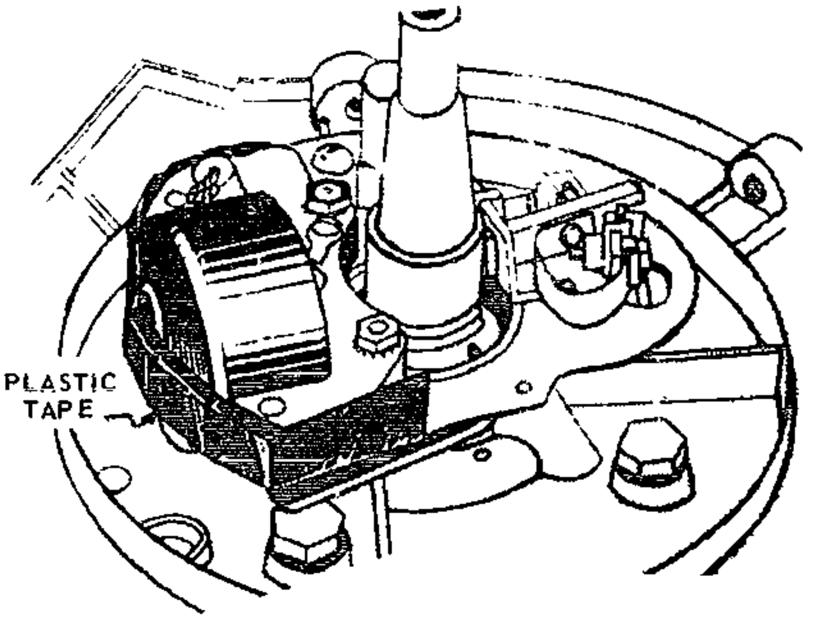

Fig. 44. If the coil and armature are inside the flywheel, use plastic tape to measure magneto air gap.

If the tape has been scuffed, it indicates the clearance is probably too small as the thickness of one layer of plastic tape is about .008. If the tape is not scuffed, apply a second layer, put the flywheel back on, tighten it, and again turn the engine two turns. If the tape is not scuffed this time, you have too much magneto air gap.

To adjust the air gap loosen the armature mounting screws and move the armature slightly. If there is no play in the holes, you can redrill them slightly oversize. After adjusting the armature, you should repeat the checks with tape as before.

Final check of ignition system

An ignition system in proper working order will produce a spark sufficient to jump a gap much larger than a normal spark plug setting. Specified magneto output should jump a gap of .166 for our example engine.

To check magneto output, open the point setting on a spark plug to .166. Connect it to the spark plug wire and lay it with its base in contact with the engine head. Crank the engine in the regular way as though you were trying to start it. At this speed a strong spark should jump this wide gap at regular intervals.

10. OPERATING AND CHECKING THE ENGINE

Put on the flywheel shield and any other remaining parts. Replace the spark plug, tightening it with the torque wrench to a torque of 250 to 275 inch pounds. Attach the spark plug wire.

Refill the crankcase (4-cycle engine) with new oil of proper type and viscosity. Fill the fuel tank with clean gasoline or with the proper mixture of gasoline and oil (2-cycle engine). If your engine has an oil-bath air cleaner, fill it with clean oil to the proper level.

Open the main fuel jet needle valve on the carburetor 1 to 1 1/2 turns from closed position. Open the idle jet needle valve a like amount if your engine has an idle jet. Close the choke and start the engine.

With the throttle in about half open position, adjust the main fuel jet to the position where the engine runs fastest and smoothest. Then hold the throttle shut and adjust the idle screw until the engine runs fastest and smoothest. Set the idle speed adjusting screw so that the engine idles at recommended speed.

Allow the engine to warm up and then readjust both carburetor jets until the engine accelerates smoothly and runs properly at all speeds.

The reconditioned engine is now ready to be put back into service. After 8 or 10 hours of use, retighten the head bolts with the torque wrench and check it over once more for any parts that have not been tightened properly.

Most of the illustrations were supplied by Briggs & Stratton Corp., Milwaukee, Wisc., Clinton Engines Corp., Maquoketa, Iowa, Perfect Circle Corp., Hagerstown, Ind., and Zim Manufacturing Co., Chicago, Ill.

SMALL ENGINE REPAIR CHART

Engine Make________________ Model____________ Serial No.____________

ITEM		MIN.	MAX.	REJECT	ACTUAL	RECOMMENDATION
Cylinder	- Diameter					
	- Out of round					
	- Taper					
Ring groove side clearance						
Piston skirt clearance						
Ring end gap	- Compression					
	- Oil					
Crankpin	- Diameter					
	- Out of round					
Crankpin bearing clearance						
Valve margin						
Tappet clearance	- intake					
	- exhaust					
Carburetor float level						
Breaker point gap						
Spark plug gap						
Magneto air gap						
Magneto output gap						

VT003 388

VT 003 388
Radio and Television Servicing, A Course of Study Designed for Cooperative Part-Time Students Employed in Radio and Television Servicing.

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Missouri Univ., Columbia. Dept. of Industrial Education
Missouri State Dep of Educ, Jefferson City. Ind Educ Sect

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*STUDY GUIDES, *TRADE AND INDUSTRIAL EDUCATION, *TELEVISION REPAIRMEN, *RADIO, TELEVISION, HIGH SCHOOLS, POST SECONDARY EDUCATION, *COOPERATIVE EDUCATION, OCCUPATIONAL CLUSTERS,

This study guide is for student use in the related instruction phase of high school or post-secondary cooperative or preparatory trade and industrial education programs with a job cluster focus in radio and television servicing. It was developed by a statewide committee of subject matter specialists and teacher educators and has been periodically revised during several years of field use. The content objective is to provide a guide for the study of the technical and related occupational information basic to an intelligent understanding to the trade. The 216 job skills and procedures and technical and related information topics are correlated in parallel columns with 37 assignment sheets which provide the student with the assignment, reference, and a series of true-false, completion, multiple choice, and listing or problem-type questions. The material is to be used by individual students under teacher direction for 180 hours. The teacher should be a qualified coordinator or trade instructor, and the students must be juniors in high school with a basic course in electricity and electronics. Supplementary materials include a list of references keyed to the assignment sheets and a training plan and progress record. An answer key for the instructor is available as VT 003 387. This document is available for $1.50 from Industrial Education, 103 Industrial Education Building, University of Missouri, Columbia, Missouri 65201. (HC)

RADIO AND TELEVISION SERVICING

A Course of Study

Designed for
Cooperative Part-time Students
Employed In Radio and Television Servicing

Issued by

Department of Industrial Education
College of Education
University of Missouri
Columbia, Missouri

In Cooperation with

Industrial Education Section
State Department of Education
Jefferson City, Missouri

MEMORANDUM

TO: The ERIC Clearinghouse on Vocational and Technical Education
The Ohio State University
980 Kinnear Road
Columbus, Ohio 43212

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(Address) 103 Industrial Education Bldg., Columbia, Missouri

DATE: August 5, 1967

RE: (Author, Title, Publisher, Date) Industrial Education Dept., Univ. of Mo. at Columbia.
RADIO & TV SERVICING, cooperatively with Indus. Educ. Dept.,
(U. of Mo. at Columbia) and Missouri State Dept. of Education (1967)

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instructor's key $ .50

(2) Means Used to Develop Material:
Development Group subject matter specialists; teacher educators, developmental committee
Level of Group State
Method of Design, Testing, and Trial Subject matter specialists; teacher educators; periodic revisions over several years of use in field.

(3) Utilization of Material:
Appropriate School Setting High school and Post-secondary
Type of Program cooperative or preparatory trade & industrial
Occupational Focus job cluster
Geographic Adaptability United States
Uses of Material study guide for related instruction
Users of Material students

(4) Requirements for Using Material:
Teacher Competency Qualified coordinator or qualified trade instructor
Student Selection Criteria Junior in high school with basic course in electricity and electronica.
Time Allotment 180 hours related instruction only.

Supplemental Media --
Necessary XX)
Desirable ____) (Check Which)

Describe P Instructor's key; reference material

Source (agency) see attached list
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REFERENCES FOR RADIO AND TELEVISION SERVICING

A. Marcus, Abraham, Radio Servicing: Theory & Practice, Prentice-Hall, Inc., Englewood Cliffs, N.J., 1960, $6.00

B. Radio Corporation of America, RCA Receiving Tube Manual Technical Series RC-25, Tube Department, Harrison, N.J., 1966, $1.25

C. Marcus, William and Levy, Alex, Elements of Radio Servicing, McGraw-Hill Book Co., New York, 1967.

D. Mandl, Matthew, Mandl's Television Servicing, The Macmillan Company, 60 Fifth Ave., New York 11, New York, 1965, $8.95

FOREWORD

This course of study, consisting of an analysis of the work of the radio and television serviceman, together with assignment sheets covering the related (occupational) information to be taught by the school, has been prepared for teaching radio and television servicing on an individual basis in a part-time cooperative occupational education program.

The original course of study for radio servicing was prepared by Mr. Charles See, B.S. in Electrical Engineering, University of Missouri, and formerly a student in the Diversified Occupations class at Hannibal High School, Hannibal, Missouri. The 1955 and the 1961 revisions of this course of study were prepared by Dr. Thomas R. Gaines and Dr. B. Wesley Brown, respectively, both former research assistants at the University of Missouri. The present revision was prepared by Mr. B. H. Campbell and Mr. Vincent Oxley, research assistants in Industrial Education at the University of Missouri.

We wish to acknowledge our indebtedness to Dr. H. H. London, Professor of Industrial Education at the University of Missouri, for the direction and administration of the Curriculum Materials Laboratory in which this material was prepared, and to Dr. James B. Karnes, Assistant Professor of Industrial Education at the University of Missouri, who supervised the preparation of the material and edited the manuscript. Credit is due to Mr. B. W. Robinson, Assistant Commissioner of Education, Mr. Merton Wheeler, Director of Industrial Education, and to other staff members of the State Department of Education for their efforts in the development of the Industrial Education Curriculum Series of which this course of study is a part.

HUBERT WHEELER

Commissioner of Education

June, 1967
1000

TABLE OF CONTENTS

Assignment Sheets:

INTRODUCTION

In preparing this course of study, it has been assumed that the attainment of occupational competency in any type of work involves three different, yet closely related, types of learning. They are:

1. Mastery of the practical job skills and procedures performed by the worker in the occupation.

2. Comprehension of the technical and related information basic to an intelligent understanding and practice of the occupation.

3. Development of those personal-social traits which are essential for the successful worker.

The first group of these "learning units," the job skills and procedures, has been arranged in the analysis under the heading of "Job Training." The second group of "learning units," the technical and related information, has been arranged under the heading of "Related Information." And the third group, the personal-social traits, has been listed in the introductory section addressed to the student-worker.

In a cooperative educational program it is necessary for both cooperating agencies, the school and the employer, to understand clearly just what each is to be responsible for in the training of the student worker. Experience has shown that most of the practical job skills and procedures of an occupation can best be learned through supervised work on the job. Experience has shown also that the school can best teach most of the technical and related occupational information needed by young student workers. This division of responsibility has been made in the arrangement of this course of study; that is, it is expected that the student-worker will master the job skills and procedures through practical work on the job under the immediate supervision of the employer, and that he will receive instruction in related occupational information in the school under the direction of the coordinator.

Skills and related information are matters for direct instruction, but personal-social traits are acquired only through practicing them during the process of acquiring skills and information and in one's daily conduct. Therefore, both the employer and the school, as well as the home, must assume responsibility for developing in the student-worker those habits, attitudes, and character traits which are essential for success in his occupation and in life. Both the employer and the school should be constantly on the alert to see that the student-worker places desirable interpretations on his experiences and that he does not practice habits and exhibit character traits detrimental to his success.

Since the coordinator's class will be made up of fifteen or more students, each differing from the other significantly, studying a dozen or more occupations which differ markedly in their requirements, it follows that it will be impossible for him to teach, through the group method, the occupational information which relates to the <u>specific job</u> of each student-worker. In order to be effective, this type of instruction must be individualized. There is, of course, some related information such as occupational health and safety, workmen's compensation, wage-hour laws, fair labor standards, unemployment compensation, and the like, which is of common interest and concern to all student-workers, and may be effectively taught by the group method. But if the coordinator is to make a real contribution to the in-service vocational education of his students, he must devote a major portion of his classroom instruction to content which deals specifically with the work of each boy and girl enrolled.

With this requirement in mind, and in order to facilitate individual instruction, this series of assignment sheets has been prepared. Each contains certain record data as to number and range of units covered, introductory paragraphs designed to develop interest, explain the importance of the assignment, and to convey to the student what he is expected to learn, specific assignments including reading, learning activities, and a series of new-type questions designed to check his attainment.

It is usually desirable to teach the related information in school at the time it will be used most advantageously on the job. However, in the case of radio and television servicing the theory related to this subject is best learned in a certain order, each assignment being a building block upon which to add later assignments. Therefore, there will be occasions when the related classwork for this course will need to be presented in a logical, progressive order and may not coincide exactly with the job training.

In selecting instructional materials for this course, an effort has been made to restrict the number to those including information considered to be most important for the radio-television servicemen to know, and to those of recent publication. It is recommended that copies of these materials be secured and kept in the coordinator's classroom for ready use by the student.

In several of the assignments, "closed book exercises" have been suggested. These usually consist of drawing schematic circuit diagrams. They may either be used as examinations or the student may be given the assignment in advance so that he can practice drawing the prescribed circuit diagram. The important point is that if he fails to draw the diagram properly, he should not be allowed to go on to the next assignment until he has demonstrated that he can make the drawing without reference to any books or notes.

The key sheets, available in a separate pamphlet, have been prepared to enable the coordinator to score quickly the objective tests which are a part of each assignment sheet. These key sheets give the correct answers to the questions, as well as the reference and page on which each answer can be found. The key sheets should be kept in the coordinator's possession.

TO THE STUDENT-WORKER

The day of the "screwdriver radio mechanic" is past. To be successful today a radio or television serviceman must not only be familiar with the techniques of servicing but also must have a thorough understanding of the fundamentals and theory behind the work.

Radio and television servicing offers many things besides an occupation. It is an open door to many fields involving electricity, electronics, communications, and picture production. Further training may also lead to openings in physics, atomic research, or industrial electronic controls. Broadcast and telecast station technicians and operators often start as radio or television servicemen. Amateur radio operation, set-building, and radio and television experimenting offer possibilities for interesting hobbies.

The expansion of home television and radio, both AM and FM and the introduction of color television, closed circuit television, stereophonic radio, and miniature transistorized circuitry with its many uses have opened up many new possibilities in the field. According to the U.S. Department of Labor, Occupational Outlook Handbook, 1966-67, in 1964, more than nine out of ten households had one or more television receivers and those having two or more are expected to increase rapidly over the next decade. Much of the increase will be in the form of color and portable receivers. There will be a substantial increase in the use of stereophonic radios and phonographs, AM-FM radios, portable transistor radios, home tape recorders for home use and closed circuit television, two-way radios and many other electronic devices in business, industry, and the professions.

According to the Statistical Abstract of the U. S. 1966, which is published by the U.S. Department of Commerce, Bureau of the Census, of the households in the United States in 1965, 73 per cent had one television receiver, 20 per cent had two or more sets, and 7 per cent had no sets. Also, there are more radios of all types in the United States than there are people. In 1963, there were over 43,000 television and radio repair shops in our nation with an annual payroll of $8,700,000. This clearly indicates the unusual opportunities for those planning to enter the field of television and radio repair.

One of the most important phases of your training in this course should be that relating to the reading and drawing of circuit diagrams, especially schematic circuit diagrams. Throughout the course you will be asked to draw these diagrams, because the ability to draw a schematic diagram of a typical receiver shows a great deal of understanding of radio and television principles. You are urged, therefore, to practice drawing the schematic diagrams without referring to books or notes.

There are some personal traits which are necessary for success in most occupations, such as good health, cooperation with fellow employees and with customers, honesty, and a willingness to assume responsibility and to work hard.

Honesty probably deserves special consideration. In a technical occupation, when dealing with the public, it is very easy to develop dishonest practices with the mistaken idea that the people whom you are serving will not know the difference. Some people will soon suspect thay are being overcharged. After a time these dissatisfied customers will add up to a considerable number. You will then find that you have very few customers, or if you are working for someone else, your employer will become suspicious and will discharge you. It cannot be over-emphasized that honesty is of great importance in any undertaking.

Good health and personal appearance are also very important in any occupation in which the worker deals with the public. You should always present a neat and clean appearance, and your shop should be kept in the same manner. Although good health is important, it should be stressed that greater than average physical strength is seldom required, and average vision and hearing are sufficient.

Personal interests are of importance for the prospective radio and television serviceman. This occupation seldom involves vigorous exercise, it is generally indoor work with a small amount of outdoor activity. The hours are usually regular and the working day is the same as in other occupations of this nature; ordinarily this is eight hours per day. Any student who is interested in scientific and theoretical subjects which must be analyzed to be understood, should find radio and television servicing an interesting vocation. This interest should be deep enough to enable him to study radio and television theory and new developments without any feeling of boredom, because this knowledge is necessary for success.

REFERENCES FOR RADIO AND TELEVISION SERVICING

A. Marcus, Abraham, Radio Servicing: Theory and Practice, Prentice-Hall, Inc., Englewood Cliffs, N. J., 1960, $6.00** (26)*

B. Radio Corporation of America, RCA Receiving Tube Manual Technical Series RC-25, Tube Department, Harrison, N. J., 1966, $1.25** (4)

C. Marcus, William, and Levy, Alex, Elements of Radio Servicing, McGraw-Hill Book Co., New York, 1967, $6.50** (5)

D. Mandl, Matthew, Mandl's Television Servicing, The Macmillan Company, 60 Fifth Ave., New York 11, N. Y., 1965, $8.95** (9)

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*Frequency of use in assignments
**Subject to educational discount

ANALYSIS FOR RADIO AND TELEVISION SERVICING

JOB TRAINING: What the Worker Should be Able to Do	Assign. No.	RELATED INFORMATION: What the Worker Should Know
Fundamental Radio and Electrical Theory		
	1	1. The nature of radio waves
	1	2. The electron theory
3. Read resistor color codes	2	3. Direct current circuits; batteries voltage, current, power, and resistance
4. Calculate resistance voltage, and current	2	4. The use of Ohm's Law
	2	5. Series and parallel circuits and their solution
	2	6. Magnetism in radio
	2	7. Elementary alternating current theory
	2	8. Explanation of phase and power factor
9. Calculate impedances	2	9. Ohm's Law in AC circuits
10. Read modern receiver schematic diagrams	2	10. Factors in reading circuit schematic diagrams
	3	11. Induced voltages in generators
	3	12. Theory and construction of transformers
13. Read capacitor color codes	3	13. Coils, reactance, and impedance in radio circuits
	4	14. The construction of capacitors
	4	15. The use of capacitors for radio and television circuits
	5	16. Theory of tuned circuits

JOB TRAINING: What the Worker Should Be Able to Do	Assign. No.	RELATED INFORMATION: What the Worker Should Know
	6	17. How coupled circuits are used to transfer energy from one resonant circuit to another
	6	18. How filters are used to separate currents of different frequencies
19. Recognize and correct troubles in the filter	6	19. Power supply filter construction
	7	20. General characteristics of radio waves as they relate to generation, transmission and reception
21. Design and replace parts in the voltage divider	7	21. Construction and design of the voltage divider

Theory and Design of Radio and Television Components

JOB TRAINING: What the Worker Should Be Able to Do	Assign. No.	RELATED INFORMATION: What the Worker Should Know
	8	22. The use of resistors in radio and television circuits
	8	23. The use of inductors in radio and television circuits
	8	24. The use of reproducers in radio and television circuits
	8	25. The use of switches in radio and television circuits
	8	26. How loop antennas function
	9	27. Advantages of the tetrode tube
	9	28. Superiority of the pentode tube
	9	29. Advantages of the beam power tube
	9	30. Uses of multi-unit tubes

JOB TRAINING: What the Worker Should Be Able to Do	Assign. No.	RELATED INFORMATION: What the Worker Should Know
31. Ascertain tube characteristics from tube manual	9	31. The meanings of tube characteristics
32. Check tubes	9	32. How tube checkers operate
	9	33. Tube numbering system and ratings
	9	34. Transistor theory and construction

Theory and Servicing of Amplifiers

JOB TRAINING: What the Worker Should Be Able to Do	Assign. No.	RELATED INFORMATION: What the Worker Should Know
35. Install universal output transformer	10	35. How impedance matching is accomplished
	10	36. Typical circuits for first audio stages
37. Determine if first audio stage is normal	10	37. Normal voltage and resistance readings in first audio stages
38. Read and interpret RC amplifier design tables	10	38. Typical RC amplifier circuit design
	10	39. Classification of amplifiers
	10	40. R.F. power amplifier design
	10	41. Characteristics of video-frequency amplifiers
42. Correct troubles in push-pull stages	11	42. Troubles typical of push-pull stages
43. Correct common troubles in the first audio stage	11	43. Typical troubles of the first audio stage
	11	44. Typical I.F. stage circuits
45. Determine if I.F. stage operation is normal	11	45. Normal voltage and resistance readings for IF stages
46. Shoot trouble in the I.F. stage	11	46. Typical troubles in I.F. stages

JOB TRAINING: What the Worker Should Be Able to Do	Assign. No.	RELATED INFORMATION: What the Worker Should Know
	11	47. Function and typical circuits of R.F. stages
48. Determine if the R.F. stage is normal	11	48. Normal voltage and resistance readings for the R.F. stages
49. Shoot trouble in R.F. stages	11	49. Typical troubles in R.F. stages
	The Superheterodyne Circuit	
	12	50. Theory of the superheterodyne circuit
	12	51. Mixer circuits in superheterodynes
	12	52. AC-DC superheterodyne circuits
	12	53. Theory involved in alignment of superheterodyne receiver
54. Align a modern superheterodyne receiver	12	54. Alignment procedures for superheterodynes
55. Repair defective volume controls	12	55. Volume controls commonly used in superheterodynes
	Power Supplies	
56. Replace batteries in portable and farm receivers	13	56. How A, B, and C batteries are used in battery-powered receivers
	13	57. How an AC power supply operates
	13	58. The function of the rectifier tube
59. Replace a faulty power transformer	13	59. Power transformer construction and connection
	13	60. Purpose of the low-voltage power supply

JOB TRAINING: What the Worker Should Be Able to Do	Assign. No.	RELATED INFORMATION: What the Worker Should Know
61. Diagnose and remedy trouble in low-voltage power supplies	13	61. Types of low-voltage power supplies
	13	62. Combined low-high-voltage power supply
63. Diagnose and remedy trouble in high-voltage power supplies	13	63. Flyback high-voltage power supply
	13	64. Voltage doubling in flyback power supplies
	13	65. Direct drive flyback power supply system
	13	66. R-f high voltage power supply system
67. Diagnose and remedy trouble in AC-DC hi-low voltage power supplies	13	67. AC-DC hi-low voltage power supply systems
68. Remedy hum in an AC receiver	14	68. Causes of hum in an AC receiver
69. Correct troubles peculiar to AC-DC power supplies	14	69. Peculiarities of the AC-DC power supply circuit
70. Correct hum in AC-DC receivers	14	70. Causes of hum in AC-DC receivers

Test Equipment for Radio and Television Servicing

71. Read DC voltage and current	15	71. Direct current meter theory and construction
72. Read AC voltage and current	15	72. AC meter theory and construction
	15	73. Theory of the signal generator
	15	74. Uses of the signal generator

JOB TRAINING: What the Worker Should Be Able to Do	Assign. No.	RELATED INFORMATION: What the Worker Should Know
	15	75. Construction of a typical signal generator
76. Measure AC and DC voltages, resistances, and direct current in milliamperes	15	76. Theory of the volt-ohm-milliameter multimeter
77. Measure AC and DC voltages, resistances, and alternating current in milliamperes	15	77. Theory of the vacuum-tube voltmeter
	15	78. Theory of the television alignment generator
	15	79. Uses of separate sweep and marker generators
	15	80. Uses of the cross batch generator
	15	81. Principles and uses of the CRT oscilloscope
	15	82. Use of the field strength meter

General Service Techniques

83. Lay out the radio service bench	16	83. Tools and equipment needed for the workbench
	16	84. Outline of the servicing procedure
85. Service a dead receiver	16	85. An outline for service procedure for a dead receiver
86. Correct noisy reception	16	86. Service technique for noisy reception
87. Correct distortion	16	87. Service technique for distortion
88. Correct oscillation and "motorboating"	16	88. Service technique for oscillation and "motorboating"

JOB TRAINING: What the Worker Should Be Able to Do	Assign. No.	RELATED INFORMATION: What the Worker Should Know
89. Correct weak reception	16	89. Service technique for weak reception
90. Remedy hum	16	90. Service technique for hum
91. Make the converter stage track	17	91. Need for proper alignment of the converter
92. Service the push-button tuner	17	92. Push-button tuner construction and alignment
93. Service permeability tuners	17	93. Permeability tuner construction
	18	94. Techniques involved in repair and replacement of inductors
	18	95. Techniques involved in repair and replacement of transformers

Characteristics and Uses of Electron Tubes

JOB TRAINING: What the Worker Should Be Able to Do	Assign. No.	RELATED INFORMATION: What the Worker Should Know
	19	96. How the vacuum tube acts as a rectifier
	20	97. How the electron tube acts as a detector
	20	98. The regenerative triode detector circuit
	20	99. Theory of radio wave propogation
	20	100. Transmitting antenna theory
	20	101. Vacuum tube characteristic definitions
102. Read and interpret tube characteristic curves	20	102. Construction and use of characteristic curves and data
	21	103. The electrode tube as an audio frequency amplifier

JOB TRAINING: What the Worker Should Be Able to Do	Assign. No.	RELATED INFORMATION: What the Worker Should Know
	21	104. The triode tube as a radio frequency amplifier
	21	105. Power audio stage circuits
106. Determine quickly if the power audio stage is active	21	106. Quick check for the power stage
107. Localize power stage trouble	21	107. Functions of typical components in power stages
108. Determine if power stage voltage and resistance readings are normal	21	108. Typical voltage and resistance readings in the power stage
109. Correct common power stage troubles	21	109. Commonly encountered power audio stage troubles
	22	110. Typical oscillator circuits
	22	111. Typical mixer-converter circuits
112. Determine if converter stage operation is normal	22	112. Normal voltage and resistance readings in the converter stage
113. Shoot trouble in the converter stage	22	113. Typical troubles in the converter stage
	22	114. Modern variations of mixer converter circuits
	22	115. How the electron tube acts as an oscillator
	Control Circuits	
	23	116. Commonly used noise-suppression circuits
117. Correct troubles on the AVC circuit	23	117. How automatic volume control works
118. Recognize and correct troubles in tone control circuits	23	118. Commonly used tone control circuits
	23	119. How automatic frequency control circuits operate

JOB TRAINING: What the Worker Should Be Able to Do	Assign. No.	RELATED INFORMATION: What the Worker Should Know
	23	120. Operation of tuning indicators
	23	121. Typical second detector AVC stage circuits
122. Recognize and correct troubles in the second detector-AVC stage	23	122. Typical troubles of the second detector-AVC stage
	23	123. Types and comparison of r-f tunes
	Antennas	
	24	124. Theory of antenna design
125. Recognize antenna troubles	24	125. Troubles in the antenna system
126. Install an outdoor antenna properly	24	126. Proper antenna installation
127. Install and repair F.M. antennas	24	127. Common antenna troubles
	24	128. Theory of the dipole and folded dipole antennas
129. Select the best antenna for the requirements of the area	24	129. Theory of stacked and arrayed antennas
	24	130. Types of indoor and built-in antennas
	24	131. Types of transmission lines
	24	132. Tools and equipment necessary for receiver and antenna installation
133. Install television antennas and receivers	24	133. Methods and techniques of antenna and receiver installation
	24	134. Antenna orientation

JOB TRAINING: What the Worker Should Be Able to Do	Assign. No.	RELATED INFORMATION; What the Worker Should Know
Theory and Servicing of Frequency-Modulation Receiver		
	25	135. Comparison of amplitude frequency and phase modulation
	25	136. Fundamentals of frequency modulation
137. Analyze F.M. receivers, using methods similar to A.M.	25	137. Comparison of A.M. and F.M. receivers
	25	138. Fundamental F.M. receiver circuits
	25	139. Various types of F.M. detectors compared
140. Install F.M. tuners	25	140. F. M. tuner circuits
141. Apply certain A.M. receiver servicing techniques to F.M. receiver servicing	25	141. Comparison of F.M. and A.M. receiver servicing
	26	142. Comparative advantages of the meter method and the visual method of alignment
143. Align a discriminator and a limiter	26	143. F.M. receiver alignment procedure
144. Align the R.F. and oscillator stages		
145. Align the I.F. stages		
146. Align receivers using the ratio detector		
147. Align receivers using the oscillator detector		
148. Locate troubles in F.M. receivers	26	148. Troubles peculiar to F.M. receivers

JOB TRAINING: What the Worker Should Be Able to Do	Assign. No.	RELATED INFORMATION: What the Worker Should Know
Loudspeakers		
	27	149. Principles of the headphone
	27	150. Magnetic speaker operation
	27	151. Theory of the dynamic speaker
152. Recognize a faulty output transformer	27	152. Function of the output transformer
153. Correct field coil troubles	27	153. The field coil as a filter choke
154. Recognize and repair common speaker troubles	27	154. Troubles often found in the speaker
Cathode-Ray Tubes		
	28	155. Theory of the cathode-ray tube
	28	156. Use of cathode ray tube in oscillograph to show pictures of current
157. Replace CRT	28	157. Types of cathode ray tubes
158. Adjust ion trap magnet	28	158. Function of ion trap
159. Adjust focus for CRT	28	159. Focusing devices for CRT
	29	160. How television picture tubes operate
	29	161. Typical picture tube troubles
Theory and Servicing of Television Receivers		
	30	162. Theory and design of the tuner

JOB TRAINING: What the Worker Should Be Able to Do	Assign. No.	RELATED INFORMATION: What the Worker Should Know
163. Correct troubles in the tuning indicator	30	163. Tuning indicator circuits
	30	164. Types of tuners
	30	165. Typical tuner troubles
	31	166. Types and comparison of video i-f amplifiers
	31	167. Types of video detectors
	31	168. Types and comparison of video amplifiers
	31	169. RC and direct coupling of video amplifiers
	31	170. Theory of AGC
	31	171. Typical DC restoration circuits
172. Check vertical system with oscillator	32	172. Theory and design of the vertical sweep system
173. Adjust vertical system	32	173. Typical troubles in vertical sweep systems
174. Check and adjust horizontal system	32	174. Types of circuits employed in horizontal sweep systems
	32	175. Typical troubles in horizontal sweep systems
176. Adjust operating controls	33	176. Function and operating characteristics of operating controls
177. Adjust pre-set controls	33	177. Function and operating characteristics of the pre-set controls
	33	178. Theory of sync pulse separation
	33	179. Theory of differentiating and integrating circuits
	33	180. Typical sync separator circuits

JOB TRAINING: What the Worker Should Be Able to Do	Assign. No.	RELATED INFORMATION: What the Worker Should Know
	33	181. Typical differentiating and integrating circuits
	33	182. Typical vertical oscillator sweep circuits
	33	183. Typical horizontal oscillator sweep circuits and AFC sync systems
184. Align AFC-sync systems	33	184. Alignment procedures for typical AFC-sync systems
185. Diagnose and remedy television interference	33	185. Causes of TVI and their elimination or reduction
186. Trouble shoot television receiver	33	186. Trouble shooting hints for "touch" sets
	33	187. The nature of video waves
	34	188. Separation of sight and sound signals.
	34	189. Function of limiter and discriminator circuits
190. Align the Foster-Seeley sound discriminator	34	190. Alignment procedure for television sound sections
191. Sweep align the sound I-F stage		
192. Align the ratio detector		
193. Align intercarrier sound system		
194. Align stager tuned video i-f stage	34	194. Alignment procedure for video i-f stages
195. Align wide band transformer i-f stages		
196. Align band-pass filter i-f stages		
197. Align intercarrier video i-f stages		

JOB TRAINING: What the Worker Should Be Able to Do	Assign. No.	RELATED INFORMATION: What the Worker Should Know
198. Align single-end r-f tuner	34	198. Alignment procedure for r-f and oscillator sections
199. Align balanced-line tuner		
200. Align 12 channel turret tuner		
201. Align inputuner		
202. Align permeability tuner		
203. Align variable-condenser tuner		
Color Television		
204. Check phase relation between I and Q signals with color-bar generator	35	204. Theory of color transmission
	35	205. Troubles peculiar to color television (or troubles typical of color television)
	35	206. Circuits peculiar to color television
	35	207. Test equipment peculiar to color television
Record Changers		
208. Correct troubles peculiar to radio-phonograph combinations	36	208. Typical troubles of radio-phonograph combinations
209. Repair and adjust turntables and record changers	36	209. Typical commercial turntables and record changers
210. Trouble shoot combination receivers	36	210. Typical commercial radio-television-phonograph combination receivers

JOB TRAINING: What the Worker Should Be Able to Do	Assign. No.	RELATED INFORMATION: What the Worker Should Know
Automobile Radio Installation and Servicing		
	37	211. Auto and home radio compared
212. Eliminate noise in auto radios	37	212. Causes of motor and ignition noise
	37	213. Auto radio power supply circuits
214. Recognize vibrator troubles	37	214. Function and construction of the vibrator
215. Shoot trouble in auto radios	37	215. Troubles peculiar to auto radios
216. Install and remove auto radios	37	216. Auto radio installation

Assignment
Sheet No. 1

Covering
Units 1-2

ELECTRICAL THEORY

In this first assignment you will learn the fundamental facts which experience has proved are necessary for later understanding of more advanced radio and television principles.

Future progress will be determined largely by your mastery and understanding of basic concepts as outlined in this unit and expanded upon in the study assignments.

If you enjoy working with abstract ideas, electrical theory is a rewarding and fascinating study.

Assignment:

1. Read the reference listed below.
2. Work several of the exercises on your own.
3. Answer the following questions and turn in this assignment by ______________________________.

Reference:

A. Marcus Radio Servicing, pp. 1-9.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T". If it is false, draw a circle around the letter "F".

T F 1. The electric charges of the electron and proton are equal.

T F 2. The nucleus of an atom is always electrically negative.

T F 3. An atom of uranium contains ninety-two planetary electrons.

T F 4. Concentric circles are circles which have a common center.

T F 5. According to Marcus, a piece of glass has very few free electrons, while aluminum has a great many free electrons.

T F 6. Even though molecules in a gas collide with each other, since the molecules are very light, the collisions do not amount to anything.

T F 7. The prefix meg or mega means that the unit of measurement involves thousandths.

T F 8. Adding an electron to a neutral atom gives it a negative charge.

T F 9. In an electrical formula such as E = I x R, the I stands for voltage.

T F 10. Different substances offer different amounts of resistance to the flow or pressure of electricity.

T F 11. All substances, being matter, offer the same amount of resistance to the flow of electricity.

T F 12. In an electrical formula such as E = I x R, the E stands for voltage.

T F 13. When electrons are moved from the negative to the positive end of a conductor, work is done.

T F 14. Temperature of a substance will not be a factor to consider in determining resistance.

T F 15. The cross-sectional area and length of a wire are both important factors to be considered in determining resistance.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. Certain substances such as ______________, ______________, and ______________, when exposed to light, will give off or "emit" electrons.

2. The prefix ______________ means "a thousand".

3. Metals generally offer higher resistance at ______________ temperatures.

4. The unit of resistance is the ______________.

5. The unit of conductance is the ______________.

6. The mathematical shorthand 10^6 is the same as ______________.

7. The unit of electrical power is the ______________.

8. Energy is the capacity for doing ______________.

9. The ______________ is an instrument used for measuring emf.

10. The electrical symbol for resistance is ______________.

11. If an electron is removed from a neutral atom, this atom becomes ______________ charged.

12. Electrical energy travels at 186,000 mps (miles per second) which is the same rate of speed as ____________________.

13. The rate at which electrons flow past a given point is called ________________. In your house, the measuring point in your electrical circuit is called the ____________________.

Multiple-Choice

Directions: In the space at the left of each statement, write the letter of the item which will provide the correct answer to complete the statement.

_____ 1. An ion is a particle that is (A) always electrically positive; (B) always electrically negative; (C) always electrically neutral; (D) always charged.

_____ 2. Free electrons in motion are present in (A) most substances; (B) all non-metallic substances; (C) all conductors; (D) all resistors.

_____ 3. If a substance is heated the movement of free electrons is (A) increased; (B) not affected; (C) decreased; (D) impossible to predict

_____ 4. The prefix <u>milli</u> means (A) 1,000,000; (B) 1,000; (C) 1/1,000; (D) 1/100,000

_____ 5. The prefix <u>micro</u> means (A) 1,000,000; (B) 1,000; (C) 1/1,000; (D) 1/1,000,000.

_____ 6. When dealing with extremely small units of electrical charge (the electron) the unit of measurement is the (A) volt; (B) watt; (C) erg; (D) coulomb.

_____ 7. When dealing with units of electrical energy, the unit of measurement is the (A) volt; (B) amp; (C) erg; (D) resistance.

_____ 8. An ammeter is an electrical device to measure (A) amperage; (B) voltage; (C) resistance; (D) capacitance.

_____ 9. In an electrical formula the R stands for (A) voltage; (B) amperage; (C) conductance; (D) resistance.

_____ 10. The unit of measurement of EMF is called the (A) volt; (B) amp; (C) capacitance; (D) coulomb.

Problems

Directions: Read each of the following problems carefully. Do the specific operations which each question requires for proper solution. You may wish to refer to the reading assignment before proceeding with the problems.

1. Natural gas, such as is used daily in the home and industry, is made up of molecules and atoms, which in turn are made up of electrical charges. In a short paragraph, explain why there is not a flow of electricity in an ordinary gas pipe.

2. In a short paragraph, describe the basic principle upon which most of our radio tubes operate.

3. How much work is done if an appliance which is rated at 15.5 amps operates one hour on a voltage of 120.5?

Assignment
Sheet No. 2

Covering
Units 3-10

ELECTRICAL CIRCUITS

In the preceding unit you have learned much of the language and terminology of radio and television repairmen.

In this assignment you will put your new knowledge to work. You will add new phrases and concepts to your radio and TV vocabulary, especially as they apply to electrical theory and circuits.

Assignment:

1. Read the reference listed below.
2. Answer the questions below and turn in this assignment by ______________________________.

Reference:

A. Marcus, Radio Servicing, pp. 9-33.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T". If it is false, draw a circle around the letter "F".

T F 1. Because of the peculiar characteristics of electrons, the electrons in a conductor flow from a point of low potential to a point of high potential.

T F 2. One of the difficulties in tracing the flow of electricity in a circuit is a result of electrons moving in unpredictable paths.

T F 3. In a series circuit, the electrons can follow only one path from the high potential to the low potential.

T F 4. In a series circuit, the current is the same in all parts of the circuit.

T F 5. In a series circuit, the total resistance is equal to the sum of the separate resistances.

T F 6. Electrons will flow more readily through a high resistance than through a low resistance.

T F 7. In a parallel circuit, electrons can follow only one path from the high potential to the low potential.

T F 8. The permeability of all substances is calculated as unity or one

T F 9. Before a current carrying wire can become a magnet, the wire must be coiled.

T F 10. The number of cycles per second is commonly called frequency.

T F 11. Phase refers to the physical nearness of two or more conductors.

T F 12. It is not possible for two emf's to be phase-related.

T F 13. Rules and formulas which apply to DC circuits need not be changed when working with AC circuits.

T F 14. A conductor (wire) moves through a magnetic field of a permanent magnet and induces electricity. Since the magnetism continues indefinitely, we refute the law of physics which says you cannot get something for nothing.

T F 15. A wire that has an electrical current sent through it also has a magnetic field about it.

T F 16. Magnetism, being a separate physical science, has no discernable effect on electrons.

T F 17. Magnetic lines of force are thought to extend out from a permanent magnet at all times.

T F 18. Magnetic lines of force are thought to exist around a magnet at all times; therefore by placing a permanent magnet <u>beside</u> a copper wire, electricity will be induced in the wire <u>continuously</u>.

T F 19. Current that flows from a chemical cell is called AC or alternating current.

T F 20. It is impossible to have "mixed" AC and DC on one line at the same time.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. Electric power is the product of ________________ and ______________.

2. The magnetic field around a conductor extends outward at _________ from the conductor.

3. Iron and steel have a permeability of about _________ to more than ________________.

4. The source of emf is the _____________________.

5. Current that flows from a dry cell is called ______________ or ____________________.

6. The amplitude of a 120 volt AC line is ________ volts.

7. Phase angle actually indicates a ___________ interval between two or more quantities.

8. The total opposition to the flow of alternating current in a circuit is called _______________.

9. When the voltage and current are out of phase, the impedance is always greater than the _________________.

Multiple-Choice

Directions: In the space at the left of each statement, write the letter of the item which will provide the correct answer to complete the statement.

_____ 1. The voltage drop across each of three resistors (R_1 = 15 ohms, R_2 = 30 ohms, R_3 = 45 ohms) in a parallel circuit is (A) the same; (B) R_1 lower voltage drop; (C) R_2 lower voltage drop; (D) R_3 lower voltage drop.

_____ 2. In drawing and reading circuit diagrams, it is well to remember that two wires which cross each other and have no electrical connection are shown with (A) a dot; (B) an "X"; (C) a loop; (D) a broken line.

_____ 3. Electrical power is usually expressed in (A) voltage; (B) watts; (C) amperage; (D) resistance.

_____ 4. An electromagnet always has at least (A) 1; (B) 2; (C) 3; (D) 4 poles

_____ 5. The unit of magnetic flux is called the (A) ohm; (B) gauss; (C) maxwell; (D) einstein.

_____ 6. The unit of magnetomotive force is called the (A) gauss; (B) einstein; (C) maxwell; (D) gilbert.

_____ 7. When discussing magnetism, reluctance has a similar meaning to what term in electricity: (A) voltage; (B) resistance; (C) amperage; (D) wattage.

_____ 8. A wire is passed through a strong magnetic field, thereby inducing a current. This wire, as it is being passed through the magnetic field, now (A) has a separate magnetic field of its own; (B) has no magnetic field of its own; (C) has a magnetic field equal in strength to the original strong field; (D) has split-phased magnetism.

_____ 9. A complete circle has (A) 180°; (B) 90°; (C) 360°; (D) 270°.

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_____ 10. Alternating current supplied to dwelling houses generally has a frequency of (A) 60 CPS; (B) 90 CPS; (C) 120 CPS; (D) 180 CPS.

_____ 11. The DC formula for Ohm's Law may be used with AC circuits only when (A) the circuit is out of phase; (B) the circuit is in phase; (C) the circuit is dual-phased; (D) the Z factor is used.

_____ 12. The term "cycle" means nearly the same as (A) sickle; (B) circle; (C) snorkle; (D) snaffle.

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. Three pieces of electrical equipment which use the heating effect of electricity to good advantage are:

(A) ______________________ (C) ______________________

(B) ______________________

2. Five different ways in which electricity may by generated are:

(A) ______________________ (D) ______________________

(B) ______________________ (E) ______________________

(C) ______________________

3. The strength of the magnetic field around a coil depends upon the:

(A) ______________________ (B) ______________________

4. The basic parts of an electric motor are:

(A) ______________________ (C) ______________________

(B) ______________________ (D) ______________________

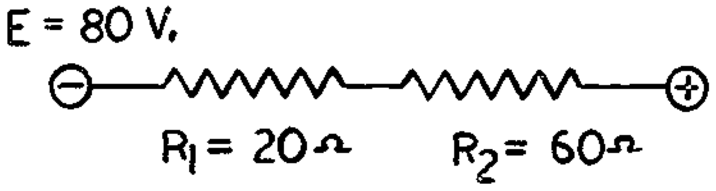
5. The basic parts of an electromagnet are:

(A) ______________________ (B) ______________________

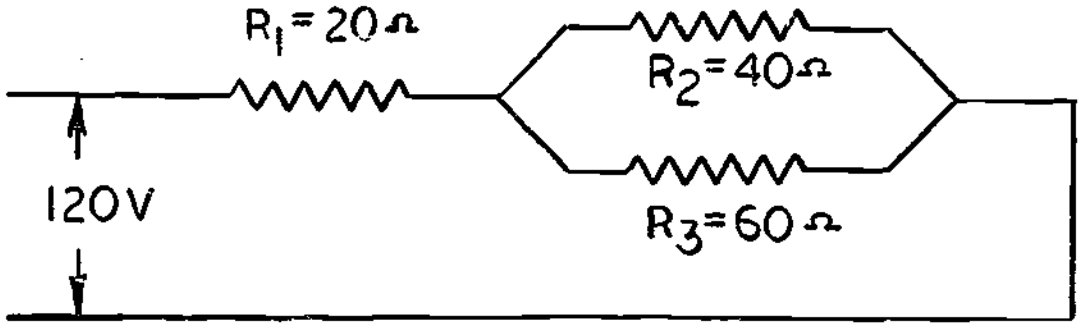
Problems

Directions: Read each of the following problems carefully. Do the specific operations which each question requires for proper solution. You may wish to refer to the reading assignment before proceeding with the problems.

1. What is the voltage drop across R_2?



2.



_____ A. What type circuit is this: (A) series; (B) parallel; (C) series-parallel; (D) shunt.

B. What is the combined resistance of the circuit?

C. According to Ohm's Law, how much current is passing through R_1? ______________

3. What is the essential difference between a primary cell and a "B" Battery?

4. Draw the symbol for:

a. resistor

b. cell

c. battery

5. What determines the charge or emf of a dry cell?

6. How is it possible to measure the electrical charge of a secondary cell with a hydrometer?

7. State the "law" of magnetism.

8. How is it possible to determine the polarity of an electromagnet by "hand"?

9. Basically, what is a generator?

10. Why is "peak value" of voltage not the same as effective value?

11. What conditions must exist, for an emf and current to be in phase?

Assignment
Sheet No. 3

Covering
Units 11-13

INDUCTANCE

Making further use of the materials we have studied thus far, we now approach the study of a highly important electrical characteristic called inductance.

As you progress still further in the radio-TV field, this term will occur with ever increasing frequency.

In this assignment you will learn the place of inductance as it applies to circuits.

Assignment:

1. Read the reference listed below.
2. Answer the questions below and turn in this assignment by ______________________________.

Reference:

A. Marcus, Radio Servicing, pp. 34-44.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T". If it is false, draw a circle around the letter "F".

T F 1. The ability of a circuit to set up a current which reinforces the applied emf is called inductance.

T F 2. The unit of measure of inductance is the gilbert.

T F 3. Counter emf is voltage generated by one of a series of devices such as the geiger counter.

T F 4. The symbol for inductance is "L".

T F 5. The inductance of a straight wire is, except in unusual cases, rather low.

T F 6. Inductors, because of their extremely high potential, are never hooked up in series, parallel or series-parallel.

T F 7. The impedance of an AC circuit is considered only as that resistance to current offered by components such as resistors and capacitors.

T F 8. It is possible to connect inductors so as to complement or to oppose each other's magnetic field.

T F 9. The greatest transfer of power takes place when the impedance of the load is equal to that of the source.

T F 10. Eddy current and hysteresis loss are one and the same.

T F 11. In operating a step-up transformer, the voltage is stepped up and the amperage is stepped down.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. When considering inductance, we uaually think of ________________ lagging behind the voltage.
2. The symbol for impedance is __________.
3. The symbol for reactance is __________.
4. It is theoretically possible to have a circuit with ___________ resistance.
5. The _______________ is the unit of measure of mutual induction.
6. A transformer always has at least ________________ windings or coils.
7. Energy loss in a transformer due to the changing of polarity as a result of AC frequency is called ________________ ___________.
8. The inductive reactance depends upon the ________________ of the induced voltage.
9. When an induced voltage in one circuit is the result of current changes in another circuit, the term _________ _______________ is used to describe the relationship.
10. When two coils are wound on the ____________ iron core, the coupling approaches __________ per cent.

Multiple-Choice

Directions: In the space at the left of each statement, write the letter of the item which will provide the correct answer to complete the statement.

_____ 1. Mutual inductance is one of those factors in radio and TV which is generally (A) undesirable; (B) screened out; (C) desirable; (D) screened in.

_____ 2. The core of a transformer is uaually a (A) closed square or ring; (B) hexagon; (C) triangle; (D) none of these.

_____ 3. Eddy current losses are reduced by using (A) solid construction; (B) plastic insulators; (C) lead insulators; (D) laminated construction.

_____ 4. The transfer of energy from the primary to the secondary winding of the transformer depends mainly upon (A) a wire connecting the two; (B) magnetic lines of force of the primary winding cutting across the secondary winding; (C) an extremely high voltage; (D) a direct current.

_____ 5. A transformer which has achieved its maximum magnetic capacity is said to have reached the point of (A) impedance; (B) reluctance; (C) saturation; (D) no return.

_____ 6. An inductor is usually constructed in the form of a (A) capacitor; (B) resistor; (C) coil; (D) filament.

_____ 7. Inductance is a property of a circuit which (A) reinforces an applied emf; (B) opposes an applied emf; (C) transforms an applied emf; (D) rectifies an applied emf.

_____ 8. The symbol for inductive reactance is (A) X_L; (B) X; (C) Z; (D) Z_L.

_____ 9. The unit for measuring inductive reactance is (A) henry; (B) gilbert; (C) einstein; (D) ohm.

_____ 10. The current lag in a circuit is caused by (A) reactance; (B) inductance; (C) impedance; (D) resonance.

Discussion

Directions: Answer each of the following questions with a brief, clearly worded paragraph.

1. When is it possible for the impedance of a circuit to be greater than the resistance of that circuit?

2. How is it possible to transfer energy from one circuit to another without running a wire between them?

3. Describe reflected impedance.

4. Describe a step-up transformer.

Problems

Directions: Read each of the following problems carefully. Do the specific operations which each question requires for proper solution. You may wish to refer to the reading assignment before proceeding with the problems.

1. A transformer has a primary winding with 500 turns. With 110 volts AC across the primary, how many turns on the secondary will we need to have 11 AC volts output? (Assume a perfect transformer with unity coupling.)

2. Three inductors of 3,4, and 6 henries are connected in series. What is the total inductance if their magnetic fields do not interact?

3. What is the total inductance of two inductors of 5 and 2 henries connected in parallel, if their fields do not interact?

Assignment
Sheet No. 4

Covering
Units 14-15

CAPACITANCE

Capacitors play an increasingly important role in radio and television circuitry.

In this assignment, you will learn how capacitors are constructed, used, and specified for radio and television circuits.

Assignment:

1. Read the reference listed below.
2. Answer the questions below and turn in this assignment by ____________________.

Reference:

A. Marcus, Radio Servicing, pp. 44-49.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T". If it is false, draw a circle around the letter "F".

T F 1. One device used to store electrical energy is the capacitor.

T F 2. The amount of electrical energy which can be stored between the two ends of a wire alone is very large.

T F 3. Electrical energy may be stored in a capacitor for short periods of time only.

T F 4. The dielectric constant (K) of air is 10.

T F 5. Generally speaking, metallic dielectrics have a higher K than non-metallic.

T F 6. The unit of capacitance is the ohm.

T F 7. All capacitors are harmless when charged and make amusing party tricks possible.

T F 8. Generally speaking, the smaller (actual physical size) the capacitor, the smaller the capacitance.

T F 9. The farad is an extremely small unit of capacitance.

T F 10. Ideal capacitors (one with no power consumption), much like our present atomic "breeder" reactors, are now available.

T F 11. The microfarad is a smaller unit than the farad.

T F 12. The symbol for micromicrofarad is mf.

T F 13. Capacitance, since it "stores" electrical energy, decreases the impedance of an AC circuit.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. The ______________ the area of the dielectric, the greater the capacitance.

2. The _______ the dielectric, the greater the capacitance.

3. In circuits with very high frequencies, ______________ or ______________ capacitance must be taken into account.

4. The amount of capacitive reactance depends on the value of ______________ and the ______________ of the current.

5. When calculating capacitive reactance, the ______________ the frequency, the ______________ the Xc.

6. The symbol for capacitance is __________.

7. The _____________ the phase difference, the closer the capacitor approaches the ideal.

8. The ________________ the frequency, the smaller the capacitive reactance.

9. In a purely capacitive circuit, the ____________ would be equal to the capacitive reactance.

10. In an AC circuit, when capacitance and resistance are in series, the impedance is equal to the ______________ effect of the resistance and the capacitive reactance (Xc).

Multiple-Choice

Directions: In the space at the left of each statement, write the letter of the item which will provide the correct answer to complete the statement.

_____ 1. In early literature, the following term was used to describe what we know as a capacitor today (A) resistor; (B) rheostat; (C) condenser; (D) cathode.

_____ 2. The dielectric constant of mica is (A) 1; (B) 3; (C) 5; (D) 7.

______ 3. The unit of capacitance is the (A) ohm; (B) farad; (C) amp; (D) volt.

______ 4. When K is being discussed, unity is the same as (A) copper; (B) mica; (C) titanium dioxide; (D) air.

______ 5. When a resistor is placed across a circuit that has a charged capacitor, we (A) discharge the capacitor; (B) burn up the capacitor; (C) burn up the resistor; (D) receive an electric shock.

______ 6. The excellence of a capacitor is expressed as a (A) power factor; (B) analysis factor; (C) farad factor; (D) phase factor.

______ 7. Current in a capacitive circuit may lead the voltage by (A) 360°; (B) 270°; (C) 180°; (D) 90°.

Listing

Directions: List the items called for in each of the following; Select your answers carefully.

1. Five substances from which most dielectrics are manufactured are:

(A) ______ (D) ______

(B) ______ (E) ______

(C) ______

2. The capacitance of a given capacitor is determined by what characteristics?

(A) ______ (C) ______

(B) ______

3. The plates of a capacitor are commonly made of:

(A) ______ (B) ______ (C) ______

4. Three factors which prevent a capacitor from being "ideal" are:

(A) ______

(B) ______

(C) ______

Problems

Directions: Read each of the following problems carefully. Do the specific operations which each question requires for proper solution. You may wish to refer to the reading assignment before proceeding with the problems.

1. Two capacitors of 5 and 2 microfarads are connected in parallel. What is their total capacitance?

2. What is the capacitance of the above two capacitors connected in series?

Assignment
Sheet No. 5

Covering
Unit 16

RESONANCE

Selectivity, one of the ever-present problems which confront the electrical design engineer, the manufacturer of electrical components and the radio-television repairman, is one of the most interesting phases of electrical theory. In resonant circuits we take the inherent characteristics, both good and bad, of certain electrical parts and put them to work for us.

In this assignment you will learn how resonance is a very essential part of the "internal" controls for radio and television circuits.

Assignment:

1. Read the reference listed below.
2. Answer the questions below and turn in this assignment by ________________________.

Reference:

A. Marcus, Radio Servicing, pp. 49-54.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T". If it is false, draw a circle around the letter "F".

T F 1. At resonance, the inductive and capacitive reactances are both equal to zero (series circuit).

T F 2. When resonance is under consideration, "Q" is the same as the quantity of electrical charge.

T F 3. Generally speaking, we desire a circuit to have a high "Q".

T F 4. A signal which is caused to pass through a number of successive circuits, all tuned to the same resonant frequency, becomes progressively less selective.

T F 5. It is possible, under certain conditions, for voltage drops at resonance to be greater than the applied voltage of the generator (series circuit).

T F 6. If the frequency in a resonant circuit is reduced below resonance, the capacitive reactance becomes larger than the inductive reactance (series circuit).

T F 7. A parallel-resonant circuit has perfect or infinite capacitance.

T F 8. In a series-resonant circuit, the resistance affects the amplitude and the sharpness of the plotted curve.

T F 9. In a parallel-resonant circuit, the resistance affects the amplitude and the sharpness of the plotted curve.

T F 10. Amplification of resonant circuits causes distortion of the signal and is seldom, if ever, used.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. The resonant frequency of a circuit depends upon the values of ___ ________________ and ________________________.

2. The inductive and capacitive reactances cancel each other out at resonance, leaving only __________________ to oppose the flow of current.

3. In a resonant circuit, where resistance alone opposes the flow of current, the flow of current may be very _________________.

4. We use the opposition to current flow by the inductive reactance and the opposition to current flow by the capacitive reactance to ______________ an _______________ ____________________.

5. The greater the ___________________, the lower the resonant peak and the flatter the curve.

Multiple-Choice

Directions: In the space at the left of each statement, write the letter of the item which will provide the correct answer to complete the statement.

_____ 1. The ability of a resonant circuit to discriminate against currents of non-resonant frequency is called (A) adaptability; (B) regeneration; (C) selectivity; (D) oscillation.

_____ 2. Essentially, the tuning of an antenna circuit is accomplished by (A) accepting one frequency and rejecting all others; (B) rejecting one frequency and accepting all others; (C) accepting the number of frequencies desired and rejecting all others; (D) rejecting the number of frequencies desired and accepting all others.

______ 3. In a working antenna system, the generator of our laboratory experiments is replaced by (A) a capacitor hooked up in a series with a resistor; (B) an emf induced in the antenna circuit as radio waves cut across the antenna; (C) a capacitor hooked up to the tank circuit by a coupling device; (D) an emf produced by a wet-cell.

______ 4. In a parallel-resonant circuit, the greater current will flow through path of (A) negative impedance; (B) positive impedance; (C) higher impedance; (D) lower impedance.

______ 5. In a parallel-resonant circuit, once oscillation has started, it is theoretically possible for it to continue indefinitely. The reason it does not is due to (A) wattage; (B) amperage; (C) resistance; (D) voltage.

Assignment
Sheet No. 6

Covering
Units 17-19

COUPLED AND FILTERED CIRCUITS

The process of transferring energy from one resonant circuit to another is a good example of how we put theory to work for us. Without the theoretical base of induction, coupled circuits could not be.

In this assignment you will learn how various electrical components and parts are hooked "together" and made to work as a unit rather than working separately.

Assignment:

1. Read the reference listed below.
2. Answer the questions below and turn in this assignment by
   ________________________.

Reference:

A. Marcus, Radio Servicing, pp. 49-54.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T". If it is false, draw a circle around the letter "F".

T F 1. In the direct-coupled method of coupling, a component common to both circuits is inserted between the two resonant circuits.

T F 2. The capacitive-coupling method is essentially a parallel rather than series hook-up.

T F 3. A transformer is a good example of inductive-coupling.

T F 4. Reflected resistance tends to cause a voltage drop at the original resonant frequency.

T F 5. Coupling between inductors can be varied by placing the windings closer or further apart.

T F 6. In inductive coupling, the step-up and step-down effects rising out of turn ratios are still usable.

T F 7. At resonance, the inductive reactance cancels out the capacitive reactance.

T F 8. Filters are used to separate AC from DC.

T F 9. The higher the frequency, the less the impedance in an Xc circuit.

T F 10. A resistor in series will filter only high frequency currents.

T F 11. Fluctuating or pulsating direct current is a theoretical assumption and never really takes place.

T F 12. A band-pass filter is used to pass only current of a single frequency (or a narrow band of frequencies.)

T F 13. In some cases, a resonant circuit acts as a filter.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. When considering inductive-coupling at resonant frequency the reflected resistance from each circuit reduces the ___________ of the other.
2. Generally speaking, when the energy transfer is low, the output voltage is _______________.
3. The point of maximum energy transfer is called _________________ coupling.
4. As the coupling is increased, the reflected impedance becomes ____________________.
5. An example of a band-stop filter is the _____________ ____________.
6. The series-resonant circuit offers relatively high ________________ to currents of other than resonant frequencies.
7. Sometimes it is possible to use a __________________ instead of the choke coil in a filter circuit.
8. The capacitor-resistor type of filter is used only where the current requirements of the power supply are ______________.
9. In a capacitive coupled circuit, the inductors are placed so there is no _______________ coupling between them.
10. An inductive-coupled transformer is usually a __________________ frequency transformer.

Multiple-Choice

Directions: In the space at the left of each statement, write the letter of the item which will provide the correct answer to complete the statement.

_____ 1. In the direct coupled method, current flows in the secondary circuit because of a (A) voltage increase across the common component; (B) voltage drop across the common component; (C) voltage which remains constant across the common component; (D) voltage which drops to zero across the common component.

_____ 2. The flow of current in the secondary circuit depends on the output voltage and on the (A) type of the load; (B) location of the load; (C) resistance of the load; (D) Q of the load.

_____ 3. If we assume DC = 0 frequency, the most logical component for complete filtering of DC is the (A) capacitor; (B) resistor; (C) inductor; (D) rheostat.

_____ 4. If we wish to filter a high frequency current, we should use a/an (A) capacitor; (B) resistor; (C) inductor; (D) rheostat.

_____ 5. If we wish to filter a low frequency current, we should use a/an (A) capacitor across the load; (B) resistor across the load; (C) inductor across the load; (D) rheostat across the load.

_____ 6. A high pass filter passes high frequencies on to the (A) transformer; (B) load; (C) inductor; (D) capacitor.

_____ 7. An example of a band-stop filter is a (A) sine wave; (B) wave trap; (C) sinusoidal wave; (D) wave form.

Assignment
Sheet No. 7

Covering
Units 20-21

TIME CONSTANTS, VOLTAGE DIVIDERS AND RADIO WAVES

The precise definition of just what a radio wave consists of is perhaps not nearly so important as what a radio wave can do.

In this assignment you will study certain general characteristics of radio waves, especially as they relate to generation, transmission and reception.

Assignment:

1. Read the reference listed below.
2. Answer the questions below and turn in this assignment by ________________________.

Reference:

A. Marcus, Radio Servicing, pp. 63-69.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T". If it is false, draw a circle around the letter "F".

T F 1. Theoretically, a capacitor never succeeds in becoming fully charged.

T F 2. The time constant of a circuit is equal to 100 per cent of the time for full-charge value of the capacitor.

T F 3. When alternating current flows through a conductor of any size, radio waves are sent out.

T F 4. Electric waves travel at the speed of sound.

T F 5. Radio waves travel at the speed of light.

T F 6. A meter is approximately equal to one foot.

T F 7. The frequency-modulation band lies between 88 and 108 megacycles.

T F 8. Radio waves bounced back to earth by the Kennelly-Heaviside layer are usually distorted beyond use.

T F 9. The Kennelly-Heaviside layer is usually called the ionosphere.

T F 10. Transmission of low frequency radio waves must always be by line of sight.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. Frequencies of ________________ cycles per second are usually considered as the minimum of the high range.

2. The wave form of a radio wave resembles that of the ________________ ________________ producing it.

3. A radio wave with a uniform amplitude and constant frequency is called a ________________ ________________.

4. A given wave length may be calculated by dividing the speed of travel of the radio wave by the ________________ of the radio wave.

5. The standard broadcast band lies between ___________ and ___________ kilocycles per second.

6. A transmitter's antenna usually radiates ___________ types of radio waves.

7. One type radio wave radiated by a transmitter's antenna is the ground wave; another is called the ___________ wave.

8. Ground waves which are expected to travel any appreciable distance must be radio waves of ______________ frequency.

9. The ________________________ often reflects some radio waves back to earth.

10. The ionosphere often varies in height from _____________ to __________ miles above the earth.

Multiple-Choice

Directions: In the space at the left of each statement, write the letter of the item which will provide the correct answer to complete the statement.

_____ 1. When a capacitor is fully charged the back emf will equal the (A) resistance; (B) wattage; (C) emf; (D) amperage.

_____ 2. Voltage dividers are often used to (A) obtain various voltages; (B) route electricity; (C) separate electrons from protons; (D) separate AC from DC.

_____ 3. A radio wave of a constant frequency and variable amplitude is said to be a/an (A) carrier wave; (B) amplitude-modulated wave; (C) frequency-modulated wave; (D) saw-tooth wave.

_____ 4. A radio wave of constant amplitude and variable frequency is called a/an (A) carrier wave; (B) amplitude-modulated wave; (C) frequency-modulated wave; (D) saw-tooth wave.

_____ 5. The wave length is best described as the distance (A) between the transmitter and receiver; (B) between the top and bottom of the antenna; (C) between the amplifier and the voltage divider; (D) between two adjacent peaks of a radio wave.

_____ 6. A meter is approximately equal to one (A) inch; (B) foot; (C) yard; (D) rod.

_____ 7. Cycles per second (CPS) of some radio waves may go as high as (A) billions of cps; (B) millions of cps; (C) thousands of cps; (D) hundreds of cps.

_____ 8. Common house current usually is (A) 50 cps; (B) 60 cps; (C) 70 cps; (D) 80 cps.

_____ 9. The minimum CPS of radio waves which can be sent out readily are (A) 10,000; (B) 15,000; (C) 20,000; (D) 25,000.

_____ 10. At very high frequencies there are (A) no ground waves; (B) many ground waves; (C) absorbed ground waves; (D) reflected ground waves.

Assignment
Sheet No. 8

Covering
Units 22-26

COMPONENTS

It is quite obvious that the proper functioning of a radio or television set must depend upon the proper application of scientific principles (theory), acting upon and through (circuits) many dependent and related parts (components).

In this unit you will become more familiar with many radio and television parts, their use and design.

Assignment:

1. Read the reference listed below.
2. Answer the questions below and turn in this assignment by ______________________.

Reference:

A. Marcus, Radio Servicing, pp. 71-112.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T". If it is false, draw a circle around the letter "F".

T F 1. Capacitors should be placed near heat-producing components in order to get maximum performance.

T F 2. The working voltage of a capacitor is also the maximum voltage.

T F 3. In capacitors peak voltages may exceed working voltages without damaging the capacitor.

T F 4. Wax-impregnated capacitors may be used in circuits where the DC working voltages do not exceed about 600 volts.

T F 5. Generally speaking, capacitors with a small physical bulk (size) can be expected to have a small capacitance.

T F 6. Oil-impregnated capacitors stand up better under higher operating temperatures than do wax-impregnated capacitors.

T F 7. An electrolytic capacitor cannot be used across an AC source.

T F 8. A lower than normal capacitive leaking indicates a partially opened circuit.

T F 9. The dielectric for a variable capacitor is usually made of aluminum.

T F 10. A variable capacitor is at maximum capacitance when the plates are open as far as possible.

T F 11. It is usually good practice to connect the rotor plates of a variable condenser to ground.

T F 12. A trimmer capacitor is simply a small semi-variable capacitor used for fine adjustment.

T F 13. Resistance is seldom, if ever, desirable in radio-television circuitry.

T F 14. The wattage of a tapped resistor is based upon that part of the resistor being used.

T F 15. A rheostat is a variable resistor.

T F 16. A potentiometer is a variable resistor.

T F 17. The essential difference between a rheostat and a potentiometer is in the number of leads present.

T F 18. Inductors are usually classified into two general categories, depending upon the frequencies at which they operate.

T F 19. Filter choke coils are used in power supplies to smooth out the ripples of rectified AC and to convert it into steady DC.

T F 20. Filter choke coils usually have heavy cores to prevent saturation.

T F 21. The current flowing through the primary windings of an inter-stage transformer is usually quite large.

T F 22. A loop antenna such as found on the portable receivers is actually one form of inductor.

T F 23. FM receivers use transformers which are usually tuned to 3 megacycles and higher.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. In the audio-frequency section of a receiver, currents whose frequencies lie between __________ cycles and ____________ kilocycles are encountered.

2. In the filter circuit of the power supply, frequencies of __________ and ____________ cycles are common.

3. The ________ of a capacitor is sometimes used to express its merit.

4. Variable capacitors are used where changes in capacitance are needed to vary ______________ circuits.

5. When a capacitor is heated, its capacitance is generally __________________.

6. The dielectric for a variable capacitor is usually made of ____________________.

7. It is usually a good idea to allow a safety factor of__________ per cent when specifying watts for resistors.

8. Resistors used in ordinary recievers range from ________ to _______ watts.

9. Wire-wound resistors above __________ watts are generally not color-coded.

10. Inductors which operate at frequencies below 15,000 cps are called __________________________ inductors.

11. When discussing inductors, direct current may be considered as alternating current at _______________ frequency.

12. A step-up transformer is called a ______________ transformer.

13. A step-down transformer is called a ________________ transformer.

14. Generally, receivers employ a rectifier tube that requires ________ volts at __________ or _________ amps.

15. The dynamic loudspeaker operates on the principle of ____________ magnetic fields.

16. The field excitation for the electrodynamic loudspeaker usually comes from the ____________ ______________ of the ___________.

17. Toggle switches are rated by their ______ ___________ carrying capacity and _________________ that can be safely applied.

Multiple-Choice

Directions: In the space at the left of each statement, write the letter of the item which will provide the correct answer to complete the statement.

_____ 1. Inductors which operate at frequencies above 15,000 cps are called (A) audio frequency inductors; (B) fixed inductors; (C) radio-frequency inductors; (D) variable inductor.

_____ 2. The dynamic loudspeaker operates on the principle of (A) opposing magnetic fields; (B) a single magnetic field; (C) equal but opposite magnetic fields; (D) interacting magnetic fields.

_____ 3. A higher than normal capacitive leaking indicates (A) a partially opened circuit; (B) a defective dielectric; (C) too much voltage; (D) the electrolyte is drying out.

_____ 4. Trimmers and padders are semivariable because (A) they can rotate a full 360^{o}; (B) they are both auxiliary; (C) the distance between plates can be changed; (D) the distance between gangs can be changed.

_____ 5. Resistors are usually made of (A) brass; (B) aluminum; (C) iron; (D) carbon.

_____ 6. The potentiometer is usually used as a (A) volume control; (B) capacitor; (C) transformer; (D) fixed resistor.

_____ 7. Single-coil inductors are usually called (A) potentiometers; (B) transformers; (C) choke coils; (D) fixed capacitors.

_____ 8. Multi-coil inductors are usually called (A) potentiometers; (B) transformers; (C) choke coils; (D) fixed capacitors.

Listing

Directions: List tht items called for in each of the following. Select your answers carefully.

1. Two places where currents applied to capacitors require high frequency are:

(A) ______________________________

(B) ______________________________

2. The voltage at which a capacitor's dielectric will break down depends upon the:

(A) ______________________________

(B) ______________________________

(C) ______________________________

3. Fixed capacitors are used in the following circuits:

(A) __________ (B) __________ (C) __________

4. There are two general types of dynamic loudspeakers (according to the method used to obtain the field. They are:

(A) ______________ (B) ______________

5. Two switches which are in general use today:

(A) ______________ (B) ______________

6. Rotary switches may be either of the:

(A) ______________________________

(B) ______________________________

Assignment
Sheet No. 9

Covering
Units 27-34

THE ELECTRON TUBE AND TRANSISTOR

High on the list of memorable inventions in the history of mankind must be placed the invention and development of the vacuum tube.

The vacuum tube, long the workhorse of the radio and television industry, now has a smaller helpmate, the transistor. The transistor has had wide application in military and civilian components, especially where size, weight and low power drain are critical design factors.

In this unit you will study the vacuum tube and transistor so as to gain a fuller understanding and appreciation of their role in the electronics industry.

Assignment:

1. Read the references listed below.
2. Answer the questions listed below and turn in your work by ______________________.
3. Draw the symbols and label the various electrodes for the following:

    A. Tetrode
    B. Pentode
    C. Power beam tube

References:

A. Marcus, Radio Servicing, pp. 114-167.
B. Radio Corporation of America, RCA Receiving Tube Manual, pp. 3-12.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T". If it is false, draw a circle around the letter "F".

T F 1. It is possible to heat the cathode by one of three different methods.

T F 2. The voltage at which the filament or heater operates does not determine the character or nature of the tube.

T F 3. The simplest electron tube is called the diode.

T F 4. The basic principle of all electron tubes is that a cathode emits a stream of electrons which are attracted to a positively charged plate.

T F 5. The space charge repels electrons which are emitted by the cathode and limits the space current.

T F 6. In a gas-filled tube, such as a tungar rectifier, current flow in the tube will be greatest when the larger electrode is positive.

T F 7. A certain amount of ionization is always present in any gas.

T F 8. It is impossible for the triode tube to function as a rectifier.

T F 9. The currents which flow in the plate circuit have both direct and alternating components.

T F 10. In the grid circuit, only DC is present.

T F 11. Characteristic curves of radio-television tubes are of little value to radio-television repairmen.

T F 12. It is impractical to use a triode as a power tube.

T F 13. The suppressor grid in a pentode prevents secondary emission.

T F 14. A pentode is a five-element tube.

T F 15. The third portion of a tube designation number consists of a single number which may be from 1 to 8.

T F 16. Crystal diodes are studied today only for historical background.

T F 17. An N-P transistor may either aid or impede the flow of electrons, depending upon the battery connections.

T F 18. Defects in electron tubes are usually checked by one or both of two general methods.

T F 19. Loose connections furnish a major source of noise in a radio receiver.

T F 20. A tube that tests <u>above</u> normal is quite satisfactory for continued use.

T F 21. In view of recent developments, namely the development of the transistor, the future of the electron tube is one of limited use.

T F 22. The space charge in a tube tends to retard the movement of other electrons.

T F 23. When a triode is used as an amplifier, a negative DC voltage is usually applied to the grid.

T F 24. An electron gun is a device which works on the principle of radar and which has an effective killing range of 1,000 yards.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. The evaporation of electrons, called ______________ ______________ is the starting point of the action of nearly all our electron tubes.

2. The most commonly used emitter in the tubes of radio receivers is made of ________________, coated with oxides of _______________ and ___________________.

3. The external circuit from plate to cathode is called the ___________ ________________.

4. The internal flow of electrons from the cathode to the plate is called the __________________ current.

5. The battery that maintains the plate positive is called the ______________ battery or _____________ battery.

6. The battery that heats the cathode is called the __________________ battery or _______________ battery.

7. In a tungar rectifier tube, the envelope is evacuated, and a small amount of ________________ gas in inserted.

8. In a triode, if the grid is negative with respect to the cathode, the grid tends to ________________ the emitted electrons.

9. In a triode, a _________________ variation of the input voltage produces a _________________ variation in the output voltage.

10. A tetrode is a ___________-element tube.

11. In a tetrode, the screen grid by capacitive action will pass _________ voltage but will hold back the __________ voltage.

12. Tubes that have more than five electrodes are called _______________ tubes.

13. Tube envelopes are usually made of ________________ or _____________.

14. In a tube-numbering system, the first number or set of numbers indicates the approximate ______________ ________________ used.

15. The crystal triode is commonly called a __ __________________.

16. A negative type crystal triode is produced by adding a small impurity of ___________________ to the germanium.

17. A positive-type crystal diode is produced by adding a small amount of _________________ to the germanium.

18. Electron tubes are the most ____________________ parts of a reciever.

19. Failure of a tube to light up indicates an open__________________ or ______________________ circuit.

20. Short circuits in a tube which "come and go" with expansion and contraction are known as ____________________ short circuits and are usually difficult to isolate.

21. The importance of the electron tube lies in its ability to ___________________ almost __________________ the flight of millions of electrons supplied by the cathode.

22. The grid, plate, and cathode of a triode tube usually form what is essentially a ________________ between them.

23. Focusing of the electron beam in a television picture tube is accomplished _________________________ or _________________________.

Multiple-Choice

Directions: In the space at the left of each statement, write the letter of the item which will provide the correct answer to complete the statement.

_____ 1. The symbol for an instantaneous value of voltage is (A) E; (B) e; (C) I; (D) i.

_____ 2. Referring to the graph on page 129 of Reference A and assuming a plate voltage of 210 volts, what is the plate current when the grid voltage is -8? (A) .04 milliamperes; (B) .4 milliamperes; (C) 4. milliamperes; (D) 40. milliamperes.

_____ 3. The amplification factor of a 24-A tetrode compared with that of a 6J5 triode is (A) the same; (B) much lower; (C) much higher; (D) slightly less.

_____ 4. When the letters U, V, W, X, Y, and Z appear as the second portion of a tube-identification code, the tube is a/an (A) rectifier; (B) amplifier; (C) vibrator; (D) glass-envelope type.

_____ 5. The third portion of the tube designation indicates the (A) number of amps between anode and cathode; (B) number of volts between anode and cathode; (C) number of useful elements to terminals; (D) number of screen mesh of the grid.

_____ 6. That portion of the tube which furnishes escaping electrons is the (A) base; (B) anode; (C) grid; (D) cathode.

_____ 7. The anode or plate of the ordinary receiver-type tube is usually made of (A) aluminum; (B) strontium; (C) uranium; (D) nickel or iron.

_____ 8. If a negative voltage is placed on the plate, emitted electrons are (A) repelled, no plate current flows; (B) repelled, increasing plate current; (C) attracted, no plate current flows; (D) attracted, increasing plate current.

_____ 9. One of the chief functions of the diode in a radio receiver is that of (A) modulation; (B) rectification; (C) amplification; (D) oscillation.

_____ 10. Mercury vapor in a diode tends to (A) decrease electron flow; (B) increase electron flow; (C) decrease operating temperature; (D) increase operating temperature.

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. Two advantages of enclosing the cathode in a vacuum are:

(A) ____________________ (B) ____________________

2. The four characteristics of an electron tube which distinguish one tube from another are:

(A) ____________________ (C) ____________________

(B) ____________________ (D) ____________________

3. The three essential (electrical) parts of a triode tube are:

(A) ____________________ (C) ____________________

(B) ____________________

4. Triode circuits are of three general types. They are:

(A) ____________________ (C) ____________________

(B) ____________________

5. In the triode, three factors control the flow of electrons from the cathode to the plate. They are:

(A) ____________________ (C) ____________________

(B) ____________________

6. The dynamic characteristics of the triode, known as the tube parameters, are:

(A) ____________________ (C) ____________________

(B) ____________________

7. Tube bases are usually made in three different types. They are:

(A) ________ ________________ (C) ____________________________

(B) ____________________________

8. Tube manufacturers usually include "ratings" of their products. These tube ratings may include:

(A) ____________________________

(B) ____________________________

(C) ____________________________

(D) ____________________________

(E) ____________________________

9. With the advent of the transistor, it was demonstrated that a crystal could function not just one, but in three ways: They are:

(A) ____________________________ (C) ____________________________

(B) ____________________________

Assignment
Sheet No. 10

Covering
Units 35-41

AMPLIFIERS

The process of changing weak signals to audible or usable signals is known as amplification. In your previous readings you have noted that in some rare instances, amplification is not needed. For many purposes, however, a high-quality amplifier is a must.

In this lesson you will have the opportunity to learn about the characteristics of the various kinds of amplifiers.

Assignment:

1. Read the references listed below.
2. Answer the questions listed below and turn in your work by ____________________.

3. Check with your coordinator relative to closed book exercise 1. He will give you an assignment from the coordinator's "Key to Radio and Television Servicing" which you should be able to complete without referring to any books or notes. If you fail the first time, study the appropriate chapter of the text and ask your coordinator to let you try again.

References:

A. Marcus, Radio Servicing, pp. 238-277.
B. Radio Corporation of America, RCA Receiving Tube Manual, pp. 25-27.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T". If it is false, draw a circle around the letter "F".

T F 1. A given amplifier will be one of several classes, depending upon the fraction of input cycle during which plate current is expected to flow under rated full-load conditions.

T F 2. All tubes contain a minute amount of residual gas which may lead to the ultimate destruction of the tube.

T F 3. One classification of amplifiers is based upon the frequencies at which they operate.

T F 4. In the radio receiver, amplifiers, both audio and radio-frequency types, generally are used in single stages.

T F 5. The impedance-coupled amplifier is frequently used in radio receivers.

T F 6. Modern receivers do not generally use transformer-coupled amplifiers because of the weight and cost factor.

T F 7. The impedance of the average voice coil is 2 to 30 ohms.

T F 8. Oneof the criteria for a push-pull amplifier is evenly matched tubes.

T F 9. One advantage of a push-pull amplifier is that the separate DC components are not cancelled out.

T F 10. In an ordinary amplifier where the grid is always negative, very few electrons coming from the cathode reach the grid.

T F 11. The signal currents flowing in a Class A amplifier are heavier than those in a Class B push-pull amplifier.

T F 12. One method of equalizing signal voltages in a push-pull amplifier is by resistance coupling.

T F 13. It is possible to obtain "two" tubes in one envelope, such as the 6V8.

T F 14. The r-f amplifier differs from the a-f amplifier in that the former is required to amplify only a single frequency, and the latter is required to amplify the entire audio band.

T F 15. Resistance coupling is generally used for r-f amplification.

T F 16. Radio-frequency transformers generally are of the air-core type.

T F 17. One advantage of powdered iron-core r-f transformers is the increased inductance without excessive eddy-current losses.

T F 18. Essentially, the i-f lies between the frequency of the carrier and the frequency of the signal used to modulate that carrier.

T F 19. The v-f (video-frequency) signal range is about 30 to 4,000,000 cycles per second.

T F 20. Generally speaking, DC amplifiers are in wide use in receivers today.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. The suffix ________ may be added to the letter(s) of the class identification to denote that grid current does not flow during any part of the input cycle.

2. A remote cut off amplifier tube is a modified construction of a _______________ or a ________________ type designed to reduce modulation-distortion and cross-modulation in r-f stages.

3. A __________ ___________ is inserted to provide a path whereby trapped electrons may be drained off slowly.

4. Coupling capacitors generally run from ______________ to _________ microfarad.

5. ___________________ are generally used in resistance-coupled amplifiers.

6. A sharp rise in signal strength takes place at about _____________ cycles in a transformer-coupled amplifier.

7. In the push-pull circuit, the primary winding of the output transformer must match the _______________-_________-_____________ resistance of the two tubes.

8. In a DC amplifier, the plate current is measured by a _____________.

9. The direct-coupled amplifier may be used to amplify signals containing very ________________ ______________.

Multiple-Choice

Directions: In the space at the left of each statement, write the letter of the item which will provide the correct answer to complete the statement.

_____ 1. A Class A amplifier is one with (A) multiple channels; (B) two 6L6 tubes in push-pull at all times; (C) the grid bias and alternating grid-voltages so designed that the plate current in a specific tube flows at all times; (D) the grid bias greater than the cut-off value, so that the plate current is zero.

_____ 2. The suffix 2, such as A_2 denotes an amplifier where (A) the grid current flows during some part of the cycle; (B) the grid bias is greater than the cut-off value; (C) the grid current is completely cut off; (D) the plate current is zero.

_____ 3. In a resistance-coupled amplifier, the component used to prevent a large positive voltage from appearing upon the grid of the second tube is a/an (A) resistor; (B) capacitor; (C) inductor; (D) transformer.

_____ 4. A grid leak is a (A) resistor; (B) capacitor; (C) inductor; (D) transformer.

_____ 5. In a push-pull circuit, the signal voltages must be 180 degrees out of phase with each other. This is accomplished by (A) using a converter tube; (B) using a ± 1% resistor and ± 1% capacitor in parallel; (C) using the center-tapped-secondary-winding input transformer; (D) using matched resistors only.

______ 6. The device most commonly used to couple stages of r-f amplification is the (A) tuned r-f transformer; (B) resistance coupling; (C) iron-core transformers; (D) mica capacitor.

______ 7. One use of the DC amplifier is in the (A) receivers general; (B) VTVM; (C) T-V; (D) transistor receiver.

______ 8. The frequency of a DC amplifier is (A) 0; (B) 10; (C) 100; (D) 1000.

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. The four classes of amplifiers are:

(A) ______ (B) ______ (C) ______ (D) ______

2. The input impedance of an electron tube consists of:

(A) ______

______

(B) ______

______

(C) ______

______

3. The system of amplifier classification which is based upon the frequency at which the amplifier will operate also has four classes. They are:

(A) ______ (C) ______

(B) ______ (D) ______

4. The speed with which electrons trapped on the grid will leak off will depend on the values of the:

(A) ______ (B) ______

5. In the ordinary receiver, the r-f amplifier serves a double purpose of:

(A) ______ (B) ______

6. Three cures for "feedback" are:

(A) ______

(B) ______

(C) ______

7. Radio frequency amplifiers have a number of advantages over a-f amplifiers:

(A) ______________________________

____

(B) ______________________________

____

(C) ______________________________

____

Diagrams

Directions: In the space provided, draw the following diagrams:

1. Two-stage resistance-coupled audio frequency amplifier employing pentodes.

2. A typical R. F. stage schematic diagram employing a pentode.

Assignment
Sheet No. 11

Covering
Units 42-49

SERVICING AMPLIFIERS AND RECEIVERS

As the previous unit made clear, the amplifier is often the "heart" of many electronics devices. Knowing how to repair an amplifier that is not functioning properly is an essential part of the radio-TV repairman's skills and knowledge.

In this unit you will have the opportunity to learn servicing techniques to go with your previously learned information about amplifiers.

Assignment:

1. Read the references listed below.
2. Answer the questions listed below and turn in your work by ________________________.
3. Draw the circuit of a single tube used as an audio-frequency amplifier and phase inverter and explain its operation.

References:

A. Marcus, Radio Servicing, pp. 283-291.

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T". If it is false, draw a circle around the letter "F".

T F 1. In general, most of the defects that cause trouble in the detector stage will do the same for the amplifier stage.

T F 2. If the receiver operates from the power main, the power transformer should be tested for short and open circuits.

T F 3. Short-circuited by-pass capacitors in the plate and screen circuits may cause an inoperative receiver.

T F 4. Reversed "B" or "C" battery should cause no operating difficulties in an amplifier.

T F 5. It is possible for a short-circuited grid leak to short-circuit the signal.

T F 6. The chief cause of distortion in an amplifier is overloading of the tubes.

T F 7. Grid and plate leads, if too close together, can cause distortion.

T F 8. In an inverse-feedback arrangement, too little feedback will cause distortion.

T F 9. Weak signal strength may cause feedback.

T F 10. One of the chief causes of oscillation howls, clicks, and whistles is unwanted feedback.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. If the amplifier produces no output, the first check should be for ______________ or ________________ power.

2. When trying to determine the cause of weak output from the amplifier stage, the grid circuit should be checked for any __________-________________ contacts which may have developed.

3. A major sourse of weak output in r-f and i-f amplifiers is __________________ of ____________________ ____________________.

4. In the push-pull a-f amplifier, any ______________________ may produce distortion.

5. Hum in an amplifier is usually caused by stray ____________________ or ___________________ pickup from the AC power lines or failure of the ________________ circuits designed to keep it out.

6. The r-f amplifier ____________ ____________ amplify 60 cycle hum.

7. The ____________ ____________ is a major source of hum in a receiver.

8. It is sometimes possible to eliminate hum by ______________________ either the primary or the secondary winding of the a-f transformers.

9. Twisting the leads carrying AC to the filaments or heaters of the tubes will _____________________ unwanted magnetic fields.

10. A _________________ _________________ between the heater and the cathode of a tube may cause hum.

Multiple-Choice

Directions: In the space at the left of each statement, write the letter of the item which will provide the correct answer to complete the statement.

_____ 1. When the amplifier produces no output, one should check the voltages at the plates and screen of the tube. Generally, the plates should operate at (A) 50 volts; (B) 100 volts; (C) 200 volts; (D) 250 volts.

_____ 2. The chief sources of weak output are (A) tubes; (B) resistors; (C) capacitors; (D) transformers.

_____ 3. In a-f amplifiers using inverse feedback, too much feedback will cause a (A) dead receiver; (B) weak output; (C) burned-out r-f transformer; (D) tube failure

_____ 4. Defective shielding of plate and grid leads may produce (A) a dead receiver; (B) neutralization; (C) feedback; (D) regeneration.

_____ 5. Audio howling is a special type of oscillation caused by some component (A) vibrating; (B) degenerating; (C) regenerating; (D) chopping.

_____ 6. Hum current is usually of the following frequency: (A) 30 cps; (B) 60 cps; (C) 90 cps; (D) 120 cps.

_____ 7. Audio-frequency transformers are a source of hum, largely due to (A) oscillation(internal); (B) magnetic field; (C) capacitance; (D) reactance.

_____ 8. All AC leads should be (A) as short as possible; (B) placed near plate or grid leads; (C) shielded; (D) grounded.

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. Defects which usually occur in the amplifier stage are:

(A) _______________ (C) _______________

(B) _______________ (D) _______________

2. When checking for weak output, the power supply should be tested to see that it is delivering the correct voltage to the:

(A) _______________ (C) _______________

(B) _______________

3. Intermittent output from an amplifier stage is usually caused by:

(A) _______________ (C) _______________

(B) _______________

4. Marcus lists four steps that should be taken before starting a service procedure. These are:

(A) _______________

(B) _______________

(C) _______________

(D) _______________

5. If a receiver is "dead", but the tubes light up, the sources of trouble could be:

(A) ____________________

(B) ____________________

(C) ____________________

6. There are two checks to make if a receiver is "dead", but the tubes light up. These are:

(A) ____________________

____

(B) ____________________

____

7. Some common causes of hum in a receiver are:

(A) ____________________

(B) ____________________

(C) ____________________

(D) ____________________

8. Common causes of noise within a superheterodyne are:

(A) ____________________

(B) ____________________

(C) ____________________

(D) ____________________

(E) ____________________

9. The grid bias voltage on the r-f, mixer, or i-f amplifier tubes of an AM receiver is composed of two components. These are:

(A) ____________________

(B) ____________________

10. Intermittent operation of a receiver may be caused by such troubles as:

(A) ____________________

(B) ____________________

(C) ____________________

(D) ____________________

(E) ____________________

(F) ____________________

Assignment
Sheet No. 12

Covering
Units 50-55

THE SUPERHETERODYNE CIRCUIT

One of the most common circuits around which receivers are designed and built is the superheterodyne circuit. In such a receiver, the incoming modulated radio-frequency (RF) signal is amplified a small amount in the pre-selector section and then fed into the frequency converter section, where the RF signal is converted into a fixed and usually lower frequency called the intermediate frequency (IF) of the receiver. In the IF stage, the modulated IF signals are highly amplified and then fed into the second detector for demodulation. The resultant (relatively weak) audio signals are then amplified in the conventional manner by the audio amplifier, then reproduced as sound by the loudspeaker.

In this unit you will study the principles of the superheterodyne receiver in detail, inasmuch as modern radio and television receivers still rely heavily on these principles.

Assignment:

1. Read the references listed below.
2. Answer the questions listed below and turn in your work by ______________________________.
3. Draw the block diagram for a five-tube AC-DC superheterodyne receiver using miniature-type tubes.

References:

A. Marcus, Radio Servicing, pp. 419-432.
B. Radio Corporation of America, RCA Receiving Tube Manual, pp. 75-77.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T". If it is false, draw a circle around the letter "F".

T F 1. The carrier current is generated at a constant radio frequency.

T F 2. Radio vacuum tubes, having no moving parts, are "electronically noiseless".

T F 3. Most home receivers have three stages of RF amplification.

T F 4. A rough estimate of the selectivity of a receiver may be obtained from the number of tuned circuits appearing before the detector--the greater the number, the more selective the receiver.

T F 5. A preselector is a device for always tuning in a given station at peak efficiency.

T F 6. The tuned RF receiver generally has replaced the superheterodyne receiver today.

T F 7. One of the distinct disadvantages of the tuned RF receivers is its lack of selectivity.

T F 8. Modulation is a changing or varying of the frequency, amplitude, or phase of a signal and passing on the "change" to the new signal.

T F 9. The local oscillator is important in that we can have, at all times, a constant IF regardless of the incoming signal.

T F 10. In this country, the frequency separation between adjacent stations generally is about ten kilocycles.

T F 11. Image frequency of a superheterodyne circuit refers only to the sound components of television receivers.

T F 12. Preselectors are absolutely necessary as a functioning part of the IF stage.

T F 13. A local oscillator is, in reality, a transmitter.

T F 14. A capacitor called a padder is a fixed capacitor.

T F 15. Most present-day superheterodyne receivers employ three or more stages of IF amplification.

T F 16. Misalignment of tuned circuits may be due to normal aging.

T F 17. A good indicating instrument for realignment is the VTVM equipped with a high-frequency probe.

T F 18. Manufacturers' service data should be disregarded since the principles of radio and television apply to all makes, not just a particular brand.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. Frequency conversion is used in superheterodyne receivers to change the frequency of the rf signal to an ____________________ ____________________.

2. Because of the great sensitivity of the superheterodyne receiver a(n) ________________ antenna is not required.

3. The standard IF for AM broadcast and short-wave receivers is ________ kc.

4. When a pentagrid mixer tube is used for frequency conversion, variations in plate current are due to the combination of the ______________ and ______________ frequencies.

5. In the superheterodyne receiver, one of the mixing voltages is produced by the ________________ signal.

6. The lower the IF, the greater the percentage of ________________ ______________ between adjacent stations.

7. A large number of ___________-_____________ receivers do not use a preselector.

8. IF transformers operate at ______________ frequencies.

Multiple-Choice

Directions: In the space at the left of each statement, write the letter of the item which will provide the correct answer to complete the statement.

_____ 1. The frequency of the incoming signal is determined by the (A) IF transformer; (B) broadcasting station; (C) dummy antenna; (D) local oscillator.

_____ 2. In superheterodyne receivers for use in the broadcast band, it is usual to employ oscillators that are tuned (A) higher than the signal frequency; (B) lower than the signal frequency; (C) the same as the signal frequency; (D) none of the above.

_____ 3. The chief function of a preselector is to (A) reduce tube noise; (B) change stations automatically; (C) eliminate antenna systems; (D) eliminate signals from unwanted stations before they reach the converter stage.

_____ 4. The small capacitor usually connected in parallel with the main tuning capacitor and used mainly to obtain proper tracking, especially at the high-frequency end of the band is called a (A) trimmer; (B) tracker; (C) triad; (D) tetrode.

_____ 5. Most superheterodyne receivers employ a (A) triode type of second detector; (B) hexode type of second detector; (C) diode type of second detector; (D) pentode type of second detector.

______ 6. To minimize the undesirable effects caused by interaction between the oscillator and signal sections of the tube as the frequency increases, several pentagrid-converter tubes are designed so that (A) only one of the electrodes function alone as the oscillator anode; (B) two of the electrodes function alone as the oscillator anode; (C) three of the electrodes function alone as the oscillator anode; (D) none of the electrodes function alone as the oscillator anode.

______ 7. An example of a tube as discussed in the previous question is a (A) 12AT5; (B) 6BE6; (C) 6V3A (D) 6SH7.

______ 8. Virtually all receivers having automatic volume control (avc) are (A) t-r-f; (B) superheterodyne; (C) Williamson; (D) Miller.

______ 9. In realignment, the signal generator should be set at which of the following for best results? (A) weakest signal possible; (B) moderate signal; (C) strongest signal possible; (D) none of these.

______ 10. In servicing superheterodyne receivers, it is well to remember that (A) the chassis may be connected to both power leads; (B) the chassis may be connected to the antenna; (C) the chassis may be connected to the speaker, (D) the chassis may be connected to one lead of the power source.

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. Three important advantages gained in a receiver by the conversion of signal frequency to a fixed intermediate frequency are:

(A) ______________________ (C) ______________________

(B) ______________________

2. The action of a mixer hexode in converting a R-F signal to an IF depends on:

(A) ____

(B) ____

(C) ____

____

3. In the superheterodyne receiver, one finds voltages and currents of four different frequencies. They are:

(A) ______________________________

(B) ______________________________

(C) ______________________________

(D) ______________________________

4. Small semivariable trimmers, used for tuning I-F transformers, generally have dielectrics made of:

(A) ________________ (C) ________________

(B) ________________

5. Three disadvantages of the tuned R-F receiver are:

(A) ______________________________

(B) ______________________________

(C) ______________________________

6. Several advantages of the superheterodyne receiver over the tuned R-F receiver are:

(A) ________________ (C) ________________

(B) ________________ (D) ________________

Assignment
Sheet No. 13

Covering
Units 56-67

POWER SUPPLIES

All the various components and stages of radio and television receivers depend upon the power supply for energy. As you will find in your study, receivers cannot use AC or DC as it is produced, except in certain instances. The power supply furnishes the type energy needed.

In this unit you will have the opportunity to learn the characteristics and design features of power supplies.

Assignment:

1. Read the references listed below.
2. Answer the questions listed below and turn in your work by ______________________________.
3. Check with your coordinator relative to a closed-book exercise. He will give you an assignment which you should be able to complete without referring to any books or notes. If you fail the first time, study the appropriate chapter of the text and ask your coordinator to let you try again.

Reference:

A. Marcus, Radio Servicing, pp. 372-407.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T". If it is false, draw a circle around the letter "F".

T F 1. Pilot lamps will operate on AC or DC current.

T F 2. The electrodynamic speaker requires AC for best operation.

T F 3. An AC power transformer usually is a combination of step-up and step-down transformers.

T F 4. It is not necessary to filter the output of the rectifier.

T F 5. The filter choke coil may be placed in either the positive or negative leg of the power supply.

T F 6. Most home receivers employ a resistor-capacitor filter.

T F 7. Half-wave rectifiers are generally used because it is easier to filter their output.

T F 8. A choke-input filter will produce better regulation than a capacitor-input type.

T F 9. A voltage divider is used to obtain lower voltages which may be required.

T F 10. Most receivers employ an electromagnetic-dynamic speaker.

T F 11. In most receivers operating from house current or storage batteries, the cathode-resistor method for obtaining grid bias is used.

T F 12. The voltage output of the ordinary power supply is quite constant.

T F 13. Most AC-DC receivers employ a series of tubes, the sum of whose heater voltages add up to the line voltage, and, therefore, do not need a voltage regulator.

T F 14. Most receivers use miniature (pilot) lamps rated at 6 to 8 volts and operated at about 4.25 volts to prolong life.

T F 15. The greater the potential difference between the cathode and the heater of a tube, the greater is the possibility for hum.

T F 16. Tubes employed in portable receivers are of the filament type and require AC.

T F 17. The tuning capacitor in the secondary circuit is called a buffer capacitor.

T F 18. One of the chief difficulties encountered in the vibrator power supply is that of eliminating R-F interference (hash) from the receiver.

Completion

<u>Directions</u>: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. Most portable receivers use small ________________ volt batteries for ____________________ and screen supply.

2. Alternating current receivers usually employ a __________-__________ transformer to obtain the low potential needed for the tube filaments and heaters and a ___________-________ transformer for the high plate and screen potentials.

3. Current for the filament of the rectifier tube is provided by a third ____________________ __________________ of the ___________ ______________________.

4. High-frequency disturbances, usually originating in sparks in other appliances on the line, may be minimized by inserting _____________________ in the _______________ circuit of the power transformer.

5. Most filter capacitors have values of __________ to _________ mfds and working voltages of about ____________ to __________ volts.

6. Filter choke coils used in most AC receivers have inductances ranging from about _________ to ___________ henries.

7. The operation of the voltage-multiplier circuit depends upon alternating charging two or more capacitors to a value close to the peak ____________ _______________ and then permitting them to discharge in _________________.

8. Glow tubes, operating in voltage regulating circuits, have limited use because they can operate only on a fixed ________________ and a limited ________________.

9. A higher output can be obtained when the AC-DC power supply is used on _______________.

Multiple Choice

Directions: In the space at the left of each statement, write the letter of the item which will provide the correct answer to complete the statement.

_____ 1. Plate and screen voltages must be (A) AC; (B) DC; (C) AC or DC; (D) mixed AC,DC.

_____ 2. Grid-bias voltage must be (A) AC; (B) DC; (C) AC or DC; (D) mixed AC, DC.

_____ 3. Most portable receivers do not use <u>one</u> of the following battery voltages for heating the filaments: (A) 1½; (B) 3; (C) 7½; (D) 9.

_____ 4. Power transformers used in present-day AC receivers have a secondary winding which supplies the heaters with (A) 1.5 V.; (B) 3.1 V.; (C) 6.3 V.; (D) 12.6 V.

_____ 5. The rectifier-filament winding of modern AC power transformers is usually designed to furnish (A) 5 volts at 2 to 3 amps; (B) 5 volts at 4 to 6 amps; (C) 10 volts at 2 to 3 amps; (D) 10 volts at 4 to 6 amps.

_____ 6. Power transformers are usually enclosed in shields of (A) aluminum; (B) copper; (C) alnico; (D) iron.

_____ 7. Capacitors used in power-supply filter circuits are called (A) brute-strength capacitors; (B) variable capacitors; (C) filter capacitors; (D) choking capacitors.

_____ 8. The inductors used in power-supply filter circuits are called (A) transformers; (B) artichokes; (C) filter choke coils; (D) inducers.

_____ 9. The AC-DC power supply is quite common because it eliminates the need for a (A) rectifier tube; (B) paired capacitors; (C) power transformer; (D) matched resistors.

_____ 10. A spark plate is a (A) capacitor; (B) resistor; (C) transformer; (D) tube.

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. The power supply must furnish energy for the following purposes:

(A) ______________________________

(B) ______________________________

(C) ______________________________

(D) ______________________________

2. The electric energy for the power supply originally comes from one or more of the following three sources:

(A) ______________________________

(B) ______________________________

(C) ______________________________

3. The power-supply filter called the resistor-capacitor is not used in high-powered sets for the following reasons:

(A) ______________________________

(B) ______________________________

(C) ______________________________

4. Four advantages of the p-m dynamic speaker over the electromagnetic type are:

(A) ______________________________

(B) ______________________________

(C) ______________________________

(D) ______________________________

5. Often it is desirable to operate a radio receiver from storage batteries whose voltages may be:

(A) __________ (B) __________ (C) __________ (D) __________

6. Higher voltages than those listed in the previous question are often needed to activate plates and screens. This higher potential is obtained from:

   (A) ______________________ (C) ______________________

   (B) ______________________

7. Some advantages of the dynamotor power supply over the vibrator power supply are:

   (A) ______________________ (C) ______________________

   (B) ______________________ (D) ______________________

Problems

Directions: Solve the problems below using the information given.

1. Assume the following tube lineup in an AC-DC receiver: 6SA7, 6SK7, 6SQ7, 25L6, 25Z6. The line voltage is 117 volts. Find:
   a. the value of the filament-dropping resistor.
   b. the power dissipated in this resistor

2. Assume the following tube line-up in an AC-DC receiver: 6SA7, 63Q7, 6SK7, 25Z5, 35L6.
    a. Which tubes should have their heaters shunted?
    b. What value of shunting resistance is required?

Assignment
Sheet No. 14

Covering
Units 68-70

SERVICING POWER SUPPLIES

As is true for all other portions of the receiver, faults in the power supply may be due to open circuits, short circuits, accidental grounding, and the like.

The alert technician will be alert for these defects, as well as many others when the trouble is known to be in the power supply.

In this unit you will have the opportunity to learn servicing techniques for defective power supplies.

Assignment:

1. Read the references listed below.
2. Answer the questions listed below and turn in your work by ______________________________.

References:

A. Marcus, Radio Servicing, pp. 407-418.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T". If it is false, draw a circle around the letter "F".

T F 1. A faulty power supply may result in a dead or weak receiver.

T F 2. Run-down batteries tend to produce a noisy output.

T F 3. Electrolytic capacitors are quite critical as to their working voltages and polarity.

T F 4. Semiconductor rectifiers must be replaced quite frequently.

T F 5. The first a-f stage of the receiver is particularly sensitive to strong magnetic influences.

T F 6. The filter-choke coil is another major source of trouble.

T F 7. It is good practice to place all the power supply components as far as possible from the receiver proper.

T F 8. If an electrodynamic speaker is receiving excitation, a screw driver blade will be attracted to its center pole piece, whether the set is on or off.

T F 9. Generally speaking, AC-DC receivers run hotter than power-transformer receivers.

T F 10. Rectifier tube failure is greater in AC-DC receivers.

T F 11. Reversing the live plug with an AC-DC receiver operating on AC seldom, if ever, results in better reception.

T F 12. It is not generally advisable to try to repair a defective vibrator.

T F 13. If a receiver is dead and the tubes do not light, the first thing to check is the voltages at the plate and screen grid.

T F 14. A voltage-doubler system will operate on DC power source.

T F 15. The "dry" type of filter capacitor is commonly used in power supplies.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. The chief source of trouble in a power supply operated from AC are the ________________ ______________________.

2. A ruined rectifier tube is generally associated with a short-circuited __________________ ________________.

3. In an AC-DC receiver an (a) ________________________ circuit in the heater circuit will extinguish all the tubes.

4. Electrolytic capacitors tend to ________________________ when not in use.

5. A ruined rectifier tube is often associated with a short-circuited ____________________ __________________.

6. The most common sources of trouble in a power supply are the ________________ _________________.

7. If the bypass capacitor across the grid bias resistor is short-circuited, ______________________ will set in and the volume of the receiver will decrease.

Multiple-Choice

Directions: In the space at the left of each statement, write the letter of the item which will provide the correct answer to complete the statement.

_____ 1. In a battery-operated power supply, if the B battery is connected in reverse, the set (A) remains operative, same strength; (B) remains operative, weaker; (C) gradually becomes inoperative: (D) immediately goes dead.

_____ 2. If the A battery in a battery-operated power supply is connected in reverse, the set (A) remains operative, same strength; (B) may become weaker or inoperative; (C) gradually becomes inoperative; (D) immediately goes dead.

_____ 3. Next to filter capacitors, most of the trouble in power supplies arise in the (A) transformer; (B) resistors; (C) rectifier; (D) choke coil.

_____ 4. If the shield around the power transformer is poorly grounded, the following will result: (A) intermittent howl; (B) short circuit; (C) hum; (D) sparking.

_____ 5. If the laminations of the power transformer are not tightly clamped, the following will result; (A) a tunable hum; (B) a sparking; (C) mechanical hum; (D) intermittent howl.

_____ 6. An automobile radio may draw (A) 2 amps; (B) 3 or more amps; (C) 4 amps; (D) 5 or more amps.

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. A transformer that has burned out has the following characteristics:

(A) ______________________ (C) ______________________

(B) ______________________ (D) ______________________

2. Seven factors which can cause no B+ output from the power supply in an AC power supply are:

(A) ______________________

(B) ______________________

(C) ______________________

(D) ______________________

(E) ______________________

(F) ______________________

(G) ______________________

3. Six factors which may cause the B+ from the power supply to be too low are:

(A) ______

(B) ______

______

(C) ______

(D) ______

(E) ______

______

(F) ______

______

4. Five causes of a B+ output from the power supply that is too high are:

(A) ______

(B) ______

______

(C) ______

(D) ______

______

(E) ______

Assignment
Sheet No. 15

Covering
Units 71-82

SERVICE INSTRUMENTS

The increasing complexity of home receivers has taken the repair of such out of the hands of the "handyman" and placed it squarely in the hands of the fully qualified technician.

The fully qualified technician understands and uses the best test equipment available to diagnose, and therefore repair a defective receiver.

In this section you will have an opportunity to learn about the basic kinds of test equipment and their uses.

Assignment:

1. Read the reference listed below.
2. Answer the questions listed below and turn in your work by ______________________________.

Reference:

A. Marcus, Radio Servicing, pp. 487-547.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T". If it is false, draw a circle around the letter "F".

T F 1. The most commonly used servicing instrument is the meter.

T F 2. The most common type of meter movement is the d'Arsonval or moving-coil type.

T F 3. The moving-vane type meter movement is as sensitive as the d'Arsonval type.

T F 4. The d'Arsonval movement-type meter can be used to measure AC.

T F 5. The range of some meters is increased by placing a shunt in series with the moving coil.

T F 6. The minus terminal of the voltmeter should be connected to the positive side of the circuit.

T F 7. The multimeter will measure DC voltage only.

T F 8. The AC - VTVM is essentially a device for rectifying the alternating voltage and increasing the resulting DC pulses.

T F 9. The ohmmeter cannot be used to test for open and short circuits.

T F 10. The scale of the VTVM may be calibrated to read resistance.

T F 11. A certain amount of leakage is normal in all electrolytic capacitors.

T F 12. Signal generators are used to reproduce signals normally encountered in the equipment under test.

T F 13. The desired wave form of the output of the signal generator used for ordinary servicing work is the sine curve.

T F 14. Transconductance tube checkers closely simulate actual operating conditions of tubes in the receiver.

T F 15. Fluctuations in line voltage are not considered serious enough to warrant attention when operating the tube checker.

T F 16. Short circuits existing within a tube may cause damage to the tube checker when the tube is placed under test.

T F 17. The neon-lamp test will show up leakage that may exist between the various electrodes.

T F 18. In reality the oscilloscope is a kind of voltmeter.

T F 19. Generally, the horizontal deflecting plates are reserved for the output of the sweep oscillator.

T F 20. Most amplifiers used in oscilloscopes consist of a single stage.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. The divisions of a meter scale may be ____________________ or ____________________.

2. A meter used to measure the current flowing in a circuit is called an ____________________.

3. A voltmeter must be connected ____________________ or ____________________ with the circuit being tested.

4. When testing a circuit whose current or voltage is unknown, start with the ____________________ range and work ____________________ to the proper one.

5. In a DC VTVM, ____________________ tends to protect the meter from burn-out resulting from overload.

6. Most AC VTVM are of the ____________ type, with their scales usually calibrated in ____________ values.

7. Where direct voltages are to be measured across a high impedance circuit, it is customary to build into the probe a ____________ ____________ isolating resistor.

8. The measurement of resistance is based upon ____________ flowing through the resistor under test and the ____________ ____________ across the resistor produced by that current.

9. One of the most accurate devices for measuring ____________ is the Wheatstone ____________.

10. A multimeter is several meters combined in one using a common ____________ ____________ ____________ as an ____________ device.

11. The ____________ test is used to check diodes and rectifier tubes.

12. Heater-to-cathode electrode leakage is a major source of ____________ in a receiver.

13. To test for gas in a vacuum tube, place a resistor between the ____________ ____________ and cathode. The ____________ ____________ should be observed while the ____________ is shorted.

14. In the cathode-ray tube, a stream of electrons is emitted by a ____________ ____________.

15. If an alternating voltage is applied to the plates of an oscilloscope, the electron beam will form a ____________ ____________.

Multiple-Choice

Directions: In the space at the left of each statement, write the letter of the item which will provide the correct answer to complete the statement.

_____ 1. If a current is sent through a d'Arsonval meter, in the opposite direction, the pointer will (A) do nothing; (B) indicate a normal reading; (C) burn up; (D) move backward.

_____ 2. The electrodynamometer-type indicating meter will measure (A) AC only; (B) DC only; (C) AC-DC; (D) none of the above.

_____ 3. A meter with hot-wire movement is frequently used to measure (A) r-f output of radio transmitters; (B) AC only; (C) DC only; (D) none of the above.

_____ 4. An ammeter must be connected in (A) series; (B) parallel; (C) series-parallel; (D) none of the above.

_____ 5. The meter used to measure the difference of potential between two points is called a (A) voltmeter; (B) ammeter; (C) ohmmeter; (D) wattmeter.

_____ 6. A multiplier is a (A) voltage doubler; (B) power transformer; (C) large resistor; (D) large capacitor.

_____ 7. Output meters are used to measure (A) antenna currents; (B) power supply output; (C) loudspeaker-power output; (D) power-transformer output.

_____ 8. A phrase that means the same as frequency deviations is (A) sweeps per second; (B) heat frequency; (C) zero frequency; (D) metered frequency.

_____ 9. With no voltage applied to any of the plates of an oscilloscope, the electron beam produces a (A) sine wave; (B) spot of light in the exact center of the screen; (C) saw tooth; (D) vertical line.

_____ 10. If direct voltage is applied to the top vertical deflecting plate which is positive of an oscilloscope, the electron beam will move (A) up; (B) down; (C) right; (D) left.

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. The indicating meter may be calibrated to indicate:

(A) ______________ (B) ______________ (C) ______________

2. Generally, a meter consists of a:

(A) ______________________ (C) ______________________

(B) ______________________ (D) ______________________

3. Meters may indicate from one of three directions. They are:

(A) ______________ (B) ______________ (C) ______________

4. The VTVM has several advantages over other voltmeters. They are:

(A) ____

____

(B) ____

(C) ____

(D) ____

(E) ____

5. A signal generator must be able to reproduce the following signals:

(A) ______________________________

(B) ______________________________

(C) ______________________________

6. Commercial tube checkers are of two types. They are:

(A) ______________ (. ______________

7. Damaged tube electrodes, leads, or supports may cause the following:

(A) ______________ (C) ______________

(B) ______________ (D) ______________

8. The two parts of a cathode-ray oscilloscope power supply are:

(A) ______________________________

(B) ______________________________

Problems

Directions: Read each of the following problems carefully. Do the specific operations which each question requires for proper solution. You may wish to refer to the reading assignment before proceeding with the problems.

1. Diagram: Make a clear, accurate schematic diagram of a Wheatstone Bridge. Label all the parts.

2. Make a clear, accurate schematic diagram of an R-F oscillator and output circuit. Label all the parts.

Assignment
Sheet No. 16

Covering
Units 83-90

GENERAL SERVICING PROCEDURES

The chief purpose of radio servicing is to locate and remedy defects in a faulty receiver.

As in all fields of endeavor, a book cannot be a substitute for experience. Although there are many servicing techniques in use today, the basic principles which underlie all these techniques are the same.

In this unit you will have the opportunity to learn these basic techniques. As your experience becomes broader, several short cuts will present themselves.

Assignment:

1. Read the references listed below.
2. Answer the questions listed and turn in your work by ________________________.
3. Check with your coordinator relative to a closed-book exercise. He will give you an assignment which you should be able to complete without referring to any books or notes. If you fail the first time, study the appropriate chapter of the text and ask your coordinator to let you try again.

References:

A. Marcus, Radio Servicing, pp. 548-601.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T". If it is false, draw a circle around the letter "F".

T F 1. Successful servicing must be conducted in accordance with a systematic plan.

T F 2. One of the first steps in servicing a receiver is to clean it of dust, dirt, drops of solder, etc.

T F 3. During the preliminary examination, nuts and screws that control trimmers and padders should be tightened.

T F 4. Static servicing procedure assumes that defects in radio receivers are cause, or are accompanied by, a change in the operating voltages on the various tube elements or in the resistances of the various components and circuits.

T F 5. The best way to measure tube-pin voltage is to remove the tube and insert it in a tube checker.

T F 6. Once the danger of a short circuit has been eliminated and the power of a receiver is turned on, the line voltage or battery voltage should be checked.

T F 7. A capacitor to be checked must be removed from the receiver.

T F 8. In signal injection you should use as low an output from the signal generator as will give positive results.

T F 9. If the receiver is defective, some component must be defective.

T F 10. Voltage of the AVC circuit must be measured with a VTVM.

T F 11. The voltage at the control grid is always positive.

T F 12. Realignment should be a last resort when it has been proved there are no other defects.

T F 13. If a receiver fails to operate, the tubes should be tested.

T F 14. In a superheterodyne receiver, a non-operating oscillator will stop the receiver from functioning.

T F 15. A major source of trouble is the misalignment of tuned circuits.

T F 16. Noises heard in the loudspeaker always originate within the receiver.

T F 17. Hum heard in the speaker is usually due to poor ground connections.

T F 18. The chief cause of distortion is a defect that prevents an amplifier tube from operating on the linear portion of its characteristic curve

T F 19. The transistor must be removed when making resistance measurements in the transistor receiver.

T F 20. Stray capacitance which may be negligible at AM frequencies may become quite large at FM frequencies.

Completion

<u>Directions:</u> Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. While cleaning the receiver, it should be examined for ______________ ____________________

2. The chief weakness of the static-servicing procedure is that many defects are possible in a radio receiver which will not show up on a ____________ or __________________ test.

3. Tube-pin voltage tests are usually made with the __________________ control of the __________________ turned to maximum and the ________________ controls of the receiver so adjusted that no signal is tuned in.

4. Dynamic testing consists of two general categories: signal ____________________ and signal _________________.

5. Low B+ voltages may be due to a weak __________________-____________ or semiconductor _________________ which should be replaced.

6. In its simplest form, the output indicator (for dynamic testing) may be the ______________________ of the receiver.

7. For the signal injection procedure, the "cold" lead of the signal generator is connected to the _________________ of the receiver.

8. If the tubes and the power supply of a superheterodyne receiver have been cleared of any defects and no note is heard when the signal is injected, a defect in the _____________ _________________ or _____________________ is indicated.

9. The signal-tracing procedure is similar to the signal-injection method, except that it is __________________.

10. A major cause of weak signals is ________________________ of the __________________ ____________________.

11. Distrubances in the loudspeaker may enter the receiver through the ______________ or through the _____________________ _________________ ______________.

12. The chief cause of oscillations is ________________________ produced by feedback from the ________________ to the _____________ circuits of a single stage or from stage to stage.

13. The heart of a "high-fidelity" system is the __________ ______________.

14. The voltage measured across a short-circuited plate bypass capacitor would be _____________ volts.

15. The voltmeter most often used in service work is a vacuum-tube voltmeter or a _____________________________ voltmeter.

Multiple-Choice

Directions: In the space at the left of each statement, write the letter of the item which will provide the correct answer to complete the statement.

_____ 1. After all visible defects of a receiver have been repaired, the next step is to (A) return the set to the owner; (B) test the tubes; (C) test power supply; (D) test amplifier.

_____ 2. Tube-pin voltages may normally vary from chart values (A) ± 10%; (B) ± 20%; (C) ± 30%; (D) ± 40%.

_____ 3. In most receivers, the resistors have a tolerance of (A) ± 10%; (B) ± 20%; (C) ± 30%; (D) ± 40%.

_____ 4. With the power on an AC receiver, should the power-output tube be removed and a "click" heard, this would indicate that all except one of the following are operating: (A) audio-output stage; (B) antenna system; (C) power supply; (D) loudspeaker.

_____ 5. The converter tube of the three-way portable receiver is best checked by (A) feeling it for warmth; (B) a tube checker; (C) visual inspection to see if its filament lights; (D) substitution.

_____ 6. The chief cause of weak output in transistor receivers is (A) a weak battery; (B) the i-f section; (C) the r-f section; (D) in the audio section.

_____ 7. The i-f frequency of FM receivers is (A) 1.7 megacycles; (B) 7.1 megacycles; (C) 10.7 megacycles; (D) 17.5 megacycles.

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. Systematic servicing procedure may be divided into two general classifications. They are:

(A) ______________________ (B) ______________________

2. Defects which will not show up on a voltage or resistance test are:

(A) ______________________ (B) ______________________

3. A defective receiver presents one of two symptoms; these are:

(A) ____

(B) ____

4. If the output of a receiver is defective, it may exhibit a number of symptoms, which fall into the following general categories:

(A) ____________________ (C) ____________________

(B) ____________________ (D) ____________________

5. When using an ohmmeter there are certain precautions to be observed. These are:

(A) ____

(B) ____

(C) ____

____

(D) ____

6. Most multimeters have the following ranges:

(A) ____________________ (C) ____________________

(B) ____________________ (D) ____________________

7. Common sources of defects in transistor radios are:

(A) ____

(B) ____

(C) ____

8. Three main pieces of test equipment which may be used in alignment procedures are:

(A) ____________________ (C) ____________________

(B) ____________________

Problems

Directions: Read the following problem carefully. Do the specific operations which the question requires for proper solution. You may wish to refer to the reading assignment before proceeding with the problems.

1. Diagram a typical AVC circuit showing points to check for voltage readings. Label all parts.

Assignment
Sheet No. 17

Covering
Units 91-93

REPLACEMENT, REPAIR, AND READJUSTMENT OF COMPONENTS

Once the defect of a receiver has been isolated, it must be repaired, replaced, and possibly readjusted.

The skills involved in this phase of radio and TV repair are as important as any learned up to this time.

In this unit you will have the opportunity to learn the skills and techniques necessary for this phase of radio and TV repair.

Assignment:

1. Read the reference listed below.
2. Answer the questions listed below and turn in your work by ______________________________.
3. Using a signal generator and the speaker of the set, describe how you would align the i-f section of an AM AC-DC receiver.

Reference:

A. Marcus, Radio Servicing, pp. 602-619.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T". If it is false, draw a circle around the letter "F".

T F 1. The ability to solder properly is a prerequisite to successful servicing.

T F 2. As the material to be soldered is heated, it tends to form a coat of oxide, which makes soldering difficult.

T F 3. A mica capacitor can be replaced with an electrolytic capacitor of the same ratings.

T F 4. Receivers that employ only one i-f stage generally use high-gain input and output transformers.

T F 5. Any change in the position of wiring may result in misalignment.

T F 6. Realignment should be carried out on a metal-topped table.

T F 7. All shields normally found in a receiver should be in place before realignment takes place.

T F 8. Realignment tools should be made of high-carbon steel.

T F 9. Alignment consists of making adjustments in each tuned circuit to compensate for the various small discrepancies that exist between them.

T F 10. It is not necessary to allow a receiver to be aligned time to warm up.

T F 11. In most multiband receivers, one set of transformers, trimmers, and padders serves all bands.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. A soldered joint must be strong ____________________ and should make perfect ________________ contact.

2. The tip of the soldering iron should be kept clean and free from ____________________.

3. A replacement resistor should have the same ____________________ and also be able to carry the same ________________ as the original.

4. When replacing fixed capacitors, the new should have both the same ____________________ and the same or higher __________ ____________ ________________ as the old.

5. When replacing potentiometers, one of the same ____________________ and ______________ of ______________ should be used.

6. As a preliminary to realignment procedures, the dial should be checked to see that it is synchronized with the ________________ ________________. When these capacitors are fully meshed, the pointer should be on the ________________ frequency marking of the dial.

7. The ____________________ - ____________________ section should be aligned first, since the proper operation of the other sections depends upon that stage for proper functioning.

8. In some modern receivers ________________ ____________ ____________ may be employed for tuning the i-f transformers instead of trimmers.

9. If signals from a powerful station blanket out all other signals, a __________ ________________ may be installed in the antenna circuit to cut out or reduce the interfering signal.

Multiple-Choice

Directions: In the space at the left of each statement, write the letter of the item which will provide the correct answer to complete the statement.

_____ 1. A soldering iron suitable for most repair work would have a wattage of about (A) 50; (B) 100; (C) 150; (D) 200.

_____ 2. The purpose of a flux is to (A) hold the wires together; (B) conduct heat; (C) prevent oxidation; (D) none of the above.

_____ 3. When replacing a field coil loudspeaker, the ohmic resistance should be the same and also the (A) physical size; (B) power-handling ability; (C) frequency response; (D) none of these.

_____ 4. After the i-f section has been aligned, the next adjustment should be on the (A) antenna system; (B) heater-cathode string; (C) speaker system; (D) oscillator and r-f sections.

_____ 5. At the high-frequency end of the band, the oscillator-tuning capacitor is (A) completely meshed; (B) meshed to the first segment; (C) open half way; (D) completely unmeshed.

_____ 6. In most FM receivers, the tuned circuits are required to pass a band of frequencies that is about (A) 50 KC; (B) 100 KC; (C) 150 KC; (D) 200 KC.

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. In order to do a good job of soldering, the following three rules must be observed:

(A) ______________________________

(B) ______________________________

(C) ______________________________

____

2. Faults which may be symptoms of misalignment are:

(A) ______________________________

(B) ______________________________

(C) ______________________________

(D) ______________________________

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3. We may align FM receivers by either of two methods with what devices?

(A) ____

(B) ____

Assignment
Sheet No. 18

Covering
Units 94-95

RADIO FREQUENCY AND INTERMEDIATE FREQUENCY INDUCTORS AND TRANSFORMERS

Tuning coils and power transformers each fulfill extremely important functions in the proper functioning of the television receiver.

One inductor may aid in the control of energy in one circuit, while another may furnish the low or high power needed for effective component operation.

In this unit you will have the opportunity to learn the techniques involved in repair and replacement of inductors and transformers.

Assignment:

1. Read the referenceslisted below.
2. Answer the questions listed below. Turn in your work by ________________________.

References:

A. Marcus, Radio Servicing, pp. 40-44. 99-104, 318-320.
C. Marcus & Levy, Elements of Radio Servicing, pp. 152-167, 187-200, 365.
D. Mandl, Mandl's Television Servicing, p. 325.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T". If it is false, draw a circle around the letter "F".

T F 1. It is permissible to remove one turn of wire to effect a repair of a defective interstage r-f transformer.

T F 2. The placement of leads is not critical when replacing an r-f transformer.

T F 3. The probable cause of a faulty oscillator coil is an open winding.

T F 4. It is always necessary to obtain an exact replacement when installing a new oscillator coil.

T F 5. The single, most important specification to be met in replacing an i-f transformer is the proper intermediate frequency to which the transformer windings must resonate.

T F 6. Interstage transformers couple successive i-f amplifier stages together.

T F 7. I-f transformers for FM receivers differ from the AM type in that the FM has a large number of turns.

T F 8. Color coding of i-f output transformer leads have not yet been standardized.

T F 9. Color coding of input i-f transformer leads have been standardized.

T F 10. Laminated cores are frequently used in the construction of r-f inductors.

T F 11. Inductances of a-f inductors are greater than inductances of r-f inductors.

T F 12. Windings of r-f inductors are sometimes arranged in sections called "pies" to reduce distributed capacitance.

T F 13. Radio frequency coils are always shielded.

T F 14. A loop antenna is an a-f inductor.

T F 15. Permeability tuning is used in some recievers.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. High gain r-f transformers have ____________ turns on the primary winding and ____________ impedance.
2. The inductance of r-f choke coils usually is from ____________ to ____________ millihenrys.
3. The frequency band of i-f transformers may be ______________, ______________ or _______________________.
4. Frequency modulation receivers use transformers tuned to _________________ megacycles.
5. The symbol for an air-core inductor is _______________________.
6. The movable-iron slug symbol is _________________________.
7. A two-stage i-f stage may use a _______________ gain transformer.
8. The oscillator output voltage should be relatively free from ___________________ frequencies.
9. Fundamental and harmonic oscillations beat together to produce __________________ frequencies.

10. Incorrect operating potentials in an oscillator may cause ________________ oscillations.

11. Blocking is a tendency for an oscillator to operate ____________.

12. The output voltage of an oscillator should display a good ________________ curve on an oscilloscope.

13. At frequencies above 15 K cycles ____________________ or ______________________ transformers are used.

14. The condition of maximum magnetization of a transformer coil is called ____________________.

15. The impedance of a primary winding should be equal to the impedance of the ________________.

16. The impedance of the secondary winding should be equal to the impedance of the ______________.

17. Oscillator transformers used in superheterodyne receivers may be tuned by ______________ ____________ ________________ or ________________ ____________________.

18. Improper placement of r-f transformer leads may cause ____________________________ .

19. If an r-f transformer is replaced in a receiver circuit, the receiver should be ______________________.

20. Coupling between the primary and secondary coils of an i-f transformer may be increased by the addition of a ________________ coil.

Multiple-Choice

Directions: In the space at the left of each statement, write the letter of the item which will provide the correct answer to complete the statement.

_____ 1. Radio receivers use inductors which are constructed of (A) one coil; (B) two or more coils independent of each other; (C) two or more coils inductively coupled to each other; (D) A or B; (E) A or C.

_____ 2. The intermediate-frequency transformer is so named because it is used with currents whose frequencies lie between those frequencies handled by the a-f inductor and the r-f inductor. This implies that (A) the intermediate frequencies are low; (B) the intermediate frequencies are lower than the audio-frequencies; (C) the intermediate frequencies are lower than the signal frequency; (D) the intermediate frequencies are lower than the a-f and the r-f frequencies; (E) the intermediate frequencies are really a-f and r-f frequencies mixed.

_____ 3. Audio-frequency inductors generally have (A) relatively low inductance compared to those of radio frequency; (B) relatively high inductance compared to those of radio frequency; (C) fluctuations of inductance which is sometimes higher and sometimes lower than those of radio-frequency; (D) same inductance as those of radio-frequency; (E) no relation to those of radio frequency.

_____ 4. Inductance is measured in (A) henrys; (B) millihenrys; (C) microhenrys; (D) all of these; (E) none of these.

_____ 5. The output of the final a-f amplifier must be coupled to the (A) 50L6 tube; (B) one of the 6K6-GT tubes; (C) the 6K6-GT tubes in parallel; (D) the voice coil of the loud speaker; (E) audio-frequency transformer.

_____ 6. Radio-frequency inductors are usually constructed so as to have a core of (A) air; (B) laminated iron; (C) powdered iron; (D) wood; (E) ceramic.

_____ 7. Transformer designs have been limited to (A) 2 to 4 styles; (B) 10 to 12 styles; (C) 14 to 16 styles; (D) 18 to 20 styles.

_____ 8. An AC receiver has a heater winding with 2.4 amps flowing. The defective power transformer should be replaced with a minimum (A) 1 amp transformer; (B) 2 amp transformer; (C) 3 amp transformer; (D) 4 amp transformer.

_____ 9. Current rating of the plate secondary winding of a power transformer is ordinarily given in terms of the current (A) from the output circuit of the filter; (B) drain of the primary winding; (C) of the line; (D) consumed in the a-f section.

_____ 10. In a typical 300-v power supply the peak voltage between high voltage secondary and leads is about (A) 100-300 v; (B) 500-600 v; (C) 800-900 v; (D) 1000-1100 v.

_____ 11. When the leads of a transformer must pass through a hole in the chassis, it is good policy to protect them by (A) replacing with heavier gauge wire; (B) replacing with heavier insulated wire; (C) replacing with stranded wire; (D) using a grommet in the hole.

_____ 12. Filament-heater windings can usually be distinguished from primary or high voltage secondary windings in that filament-heater windings are usually (A) lighter; (B) heavier; (C) stronger; (D) weaker.

_____ 13. The maximum temperature rise allowed for a transformer is (A) 42° F.; (B) 52° F.; (C) 62° F.; (D) 72° F.

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. Four important factors to be observed when replacing a coil in a television-frequency circuit are:

   a ____________________

   b ____________________

   c ____________________

   d ____________________

2. The three windings in an intermediate frequency transformer are named:

   a __________ c __________

   b __________

3. Troubles often encountered in the pentagrid converter tube are:

   a ____________________

   b ____________________

   c ____________________

   ____

4. If an oscillator is not functioning, the fault may be in one of its component parts. These parts are:

   a ____________________

   b ____________________

   c ____________________

   d ____________________

   e ____________________

5. The two types of built-in antennas are the:

   a ____________________

   b ____________________

6. Some common mechanical faults which occur in built-in antennas are:

(A) ______________________________

(B) ______________________________

(C) ______________________________

7. The three types of r-f coupling units are:

(A) ______________________________

(B) ______________________________

(C) ______________________________

8. Miniature types of tubes are employed in television receivers because they have:

____

Assignment
Sheet No. 19

Covering
Unit 96

THE VACUUM TUBE AS A RECTIFIER

The diode is generally used as a rectifier to change AC to DC which the plates of the rest of the tubes need.

In this unit you will have the opportunity to learn the operating characterisitics of a diode vacuum tube functioning as a rectifier.

Assignment:

1. Read the references listed below.
2. Answer the questions listed below and turn in your work by ______________________________.

References:

A. Marcus, Radio Servicing, pp. 168-182.
B. Radio Corporation of America, RCA Receiving Tube Manual, pp. 17-18.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T". If it is false, draw a circle around the letter "F".

T F 1. Most radio receivers require a plate supply of about 300 volts and up to approximately 100 milliamperes of current.

T F 2. The maximum peak plate current is the maximum instantaneous current that can safely flow through the tube.

T F 3. The voltage drop of a mercury-vapor rectifier tube will never exceed the ionization potential of the mercury vapor which is about 15 volts.

T F 4. The mercury-vapor type, as well as the vacuum type, has a "built-in" degree of overload protection.

T F 5. The characteristic curves of the high-vacuum rectifier tube (type 83) and its mercury-vapor counterpart are essentially the same.

T F 6. The half-wave rectifier is generally used for low-current circuits.

T F 7. One advantage of the full-wave rectifier over the half-wave is lack of core saturation of the transformer.

T F 8. The bridge rectifier delivers about twice the voltage of a center-tapped full-wave rectifier.

T F 9. Bridge-type rectifiers are frequently used in radio receivers.

T F 10. Loose connections within the tube can be detected by fluctuations of the meter of the tube checker.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. Most public address systems (and receivers with a large power output) require voltages of about ____________ volts and currents up to ______________ milliamperes.

2. Rectifier tubes should be operated so that the ____________________ voltage and peak ______________ current are not exceeded.

3. The peak value of sine wave AC is equal to _____________ times the rms value.

4. In a half-wave rectifier tube, the ________________ is _____________ with respect to the cathode during one-half of the AC cycle; during the next half of the AC cycle, the ______________ is positive with respect to the cathode.

5. If the input voltage has a frequency of 60 cycles per second, the frequency of the pulses of direct output voltage will be ________ pulses per second.

6. To obtain output voltages that are larger than the 117 volts of the AC supply, a step-up transformer is used ____________ the rectifier tube.

7. When two diodes are used for full-wave rectification, their ____________________ are hooked together and go to the _____________ side of the load resistor.

8. If the input voltage of a full-wave rectifier has a frequency of 60 cycles per second, the ripple frequency of the output voltage would be ___________ pulses per second.

9. One advantage of the full-wave rectifier over the half-wave rectifier is that the full-wave carries __________ the load ____________, whereas the half-wave carries ___________ the load.

10. If the safe peak inverse voltage of the rectifier tube is exceeded, the current may arc over from the ________________ to the ______________________.

Multiple-Choice

Directions: In the space at the left of each statement, write the letter of the item which will provide the correct answer to complete the statement.

_____ 1. When a rectifier tube plate is negative with respect to the cathode, it is (A) conducting; (B) not conducting; (C) overloaded; (D) probably arcing over.

_____ 2. The voltage drop of a rectifier tube is the (A) actual line voltage less line resistance; (B) difference between line and plate voltage; (C) difference between line and cathode voltage; (D) difference in potential between the plate and cathode as the tube is conducting.

_____ 3. In the vacuum-type rectifier, an increase in plate current causes a corresponding increase in (A) plate voltage; (B) maximum instantaneous current; (C) voltage drop; (D) minimum instantaneous current.

_____ 4. The output of a half-wave rectifier is called (A) pulsating direct voltage; (B) ripple-free direct voltage; (C) pure direct voltage; (D) AC.

_____ 5. The output of a full-wave rectifier is called (A) pulsating direct voltage; (B) ripple-free direct voltage; (C) pure direct voltage; (D) AC.

_____ 6. To obtain the same output that the half-wave transformer produces, the full-wave transformer must supply (A) twice the voltage that the half-wave produces; (B) three times the voltage that the half-wave produces; (C) four times the voltage that the half-wave produces; (D) five times the voltage that the half-wave produces.

_____ 7. A typical arrangement for converting AC to DC includes all but one of the following: (A) a rectifier tube; (B) a filter; (C) a capacitor in series with the load; (D) a voltage divider.

_____ 8. The function of a filter is to (A) smooth out the ripple or the tube output; (B) convert DC to AC; (C) act as a voltage divider; (D) replace resistors needed in the r-f stage.

_____ 9. When mercury-vapor rectifier tubes are connected in parallel in order to be sure that each tube will carry an equal share of the load, stabilizing resistors of the following size should be connected to each plate lead: (A) 50-100 ohms; (B) 500-1000 ohms; (C) 2000-4000 ohms; (D) 5000-6000 ohms.

_____ 10. When vacuum-type tubes are connected in parallel, stabilizing resistors (A) must be used; (B) must not be used; (C) may or may not be used; (D) none of the above.

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. The full-wave rectifier is often used in receivers and small public-address systems because:

(A) ____________________ (C) ____________________

(B) ____________________

2. Defects in the rectifier tube may be spotted by:

(A) ____________________ (C) ____________________

(B) ____________________

3. Defects in rectifier tubes may show up in the receiver in the following ways:

(A) ____________________ (D) ____________________

(B) ____________________ (E) ____________________

(C) ____________________

4. If the output is distorted, the following tube defects are likely:

(A) ____________________ (C) ____________________

(B) ____________________ (D) ____________________

5. If the output is noisy, the following tube defects are likely:

(A) ____________________ (D) ____________________

(B) ____________________ (E) ____________________

(C) ____________________ (F) ____________________

Problems

Directions: Read each of the following problems carefully. Do the specific operations which the question requires for proper solution. You may wish to refer to the reading assignment before proceeding with the problems.

1. Make a schematic diagram of a rectifier circuit using two diodes. Indicate the direction of electron flow during one-half a cycle by arrows. Label all the parts.

Assignment
Sheet No. 20

Covering
Units 91-102

THE ELECTRON TUBE AS A DETECTOR

The carrier component of the alternating current flowing in the receiver must be separated from the sound component. Since only the sound component is wanted, it must be carried through to the reproducer, and the carrier component must be blocked and dissipated. This process is called demodulation or detection.

In this unit you will have the opportunity to learn the operating characteristics of various methods of detection.

Assignment:

1. Read the references listed below.
2. Answer the questions listed below and turn in your work by ______________________.
3. Check with your coordinator relative to a closed book exercise. He will give you an assignment which you should be able to complete without referring to any books or notes. If you fail the first time, study the appropriate chapter of the text and ask your coordinator to let you try again.

References:

A. Marcus, Radio Servicing, pp. 183-210.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T". If it is false, draw a circle around the letter "F".

T F 1. A radio wave takes the wave form and frequency of the AC producing it.

T F 2. Rectification is the first step in detection.

T F 3. There is an increasing tendency to use the crystal diode as a detector in AM, FM, and TV receivers.

T F 4. The capacitor in parallel with the load resistor in a diode detector circuit must be large enough to by-pass the r-f component, but not large enough to allow the a-f component to flow through it.

F T 5. The diode detector is seldom used today.

T F 6. In the triode we have a sensitive detector capable of operating on weak signals.

T F 7. Detection may take place in the grid circuit of a triode.

T F 8. The major problem of a regenerative detector is to control regeneration, that is, to bring the detector up to, but not beyond oscillation.

T F 9. It is not possible to use a pentode as a detector.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. Carrier currents in the ordinary broadcast band have frequencies of ____________ KC to _______________ KC.

2. The r-f carrier current and the _______________ - __________________ sound current are mixed to produce the r-f ________________________ carrier current.

3. In most commercial receivers, the _________________-_________________ method for obtaining grid bias is used.

4. The diode detector requires only __________________ power.

5. The grid-circuit detector tends to ________________ all signals except _______________ ones.

Multiple-Choice

Directions: In the space at the left of each statement, write the letter of the item which will provide the correct answer to complete the statement.

_____ 1. As the radio wave strikes the antenna of the receiver, the following type current is set up in the antenna: (A) AC; (B) DC; (C) pulsating DC; (D) FM DC.

_____ 2. The fixed-negative voltage on the grid of a triode is called (A) grid negative; (B) grid bias; (C) grid screen; (D) grid damping.

_____ 3. The diode detector (A) amplifies the signals; (B) does not amplify the signal; (C) modulates the signal; (D) none of these.

_____ 4. Plate voltages in the detector stage should be about (A) 25 volts; (B) 50 volts; (C) 75 volts; (D) 100 volts.

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. The crystal detector has several advantages over other detectors. They are:

(A) ______________________________ (C) ______________________________

(B) ______________________________

2. Two types of plate-circuit detectors are the:

(A) ______________________________ (B) ______________________________

3. Most of the defects encountered in the detector circuits fall into three categories:

(A) ______________________________ (C) ______________________________

(B) ______________________________

4. Current leak between two points which are otherwise insulated can be caused by:

(A) ________________ (B) ________________ (C) ________________

Problems

Directions: Read each of the following problems carefully. Do the specific operations which each question requires for proper solution. You may wish to refer to the reading assignment before proceeding with the problems.

1. Make a schematic diagram of a circuit of the diode-detector. Label all the parts.

2. Make a schematic diagram of a circuit of a triode-detector. Label all the parts.

Assignment
Sheet No. 21

Covering
Units 118-119

THE ELECTRON TUBE AS AN AMPLIFIER

Mere amplification of a received signal is not the sole purpose of an amplifier. The sound must be reproduced as closely as possible in all ways.

In this unit you will have the opportunity to study the electron tube as it functions as an amplifier in various circuits.

Assignment:

1. Read the reference listed below.
2. Answer the questions listed below and turn in your work by ____________________.
3. Draw a graph showing the fundamental, second harmonic, and third harmonic of a sine curve.

Reference:

A. Marcus, Radio Servicing, pp. 211-237.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T". If it is false, draw a circle around the letter "F".

T F 1. It is possible for a detector stage to drive a pair of headphones or a loudspeaker, making the rest of a receiver unnecessary.

T F 2. The current flowing in the plate circuit is pure DC, having no AC component present.

T F 3. The grid and plate are precisely in phase.

T F 4. The grid and the cathode are in phase.

T F 5. The signal input and output voltages are out of phase.

T F 6. Frequency distortion results when the amplifier does not amplify currents of different frequencies to the same degree.

T F 7. Frequency distortion may be corrected by tone control.

T F 8. In the voltage amplifier, as we increase the load resistance we decrease the amplification of the stage.

T F 9. The power output from an electrical device is greatest when the resistance of the load is equal to that of the device.

Completion

Directions: Fill in the blank s in each statement with the word s required to complete the sentence correctly.

1. The function of an amplifier is to ____________ the signal either before it reaches the ____________ or after it passes through it, or both.

2. The radio-wave coming across the ____________ causes ____________ ____________ of very low power to flow through the antenna ____________ system.

3. The intensity of the plate current will depend upon the ____________ on the ____________.

4. Generally, we seek to amplify the signal with as little ____________ as possible.

5. When screen-grid tubes are used, the current flowing through the cathode resistor is not only the ____________ ____________, but also the ____________ ____________.

6. Frequency distortion originates chiefly in the components of the amplifier stage, such as ____________ and ____________ rather than in the tube.

7. The chief type of distortion in an amplifier is ____________ distortion.

8. A ____________ of either side of the output curve results in the production of harmonics.

9. Distortion of the wave form of the output of the amplifier may produce ____________ harmonics.

10. ____________ generally suffer from second-harmonic distortion; ____________ usually have third harmonics.

11. In the radio receiver, all amplifiers except the last or power amplifiers generally are ____________ amplifiers.

12. In the pentode, the plate current is dependent chiefly on the ____________ rather than on the ____________ voltage.

13. Tubes used as voltage amplifiers usually have ____________ amplification and ____________ transconductances.

Multiple-Choice

Directions: In the space at the left of each statement, write the letter of the item which will provide the correct answer to complete the statement.

_____ 1. Generally, amplifier tubes in radio receivers operate with a plate voltage of (A) 100; (B) 150; (C) 200; (D) 250.

_____ 2. To prevent degeneration and subsequent loss of amplification, the cathode-resistor is generally by-passed by a (A) capacitor; (B) resistor; (C) potentiometer; (D) variable capacitor.

_____ 3. The phase difference between the signal input and output voltages is with a resistive load (A) 90 degrees; (B) 180 degrees; (C) 270 degrees; (D) 360 degrees.

_____ 4. Radio-frequency amplifiers in radio receivers are almost always of the following type: (A) A; (B) A_1; (C) A_2; (D) AB.

_____ 5. We have maximum power output when the plate resistance is (A) matched; (B) zero; (C) equal to load resistance; (D) made up of one per cent components.

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. The grid bias of an amplifier tube may be obtained by:

(A) ______________________________

(B) ______________________________

(C) ______________________________

2. Three general types of distortion found in amplifiers are:

(A) ______________________________

(B) ______________________________

(C) ______________________________

3. Amplifiers, according to function, are of two types. They are:

(A) _______________ (B) _______________

Assignment
Sheet No. 22

Covering
Units 110-115

THE ELECTRON TUBE AS AN OSCILLATOR

The production of very high-frequency currents by mechanical devices is next to impossible. These very high frequencies can be produced, with help from certain other devices, with electron tubes.

In this unit you will have the opportunity to learn how the vacuum tube serves this function.

Assignment:

1. Read the reference listed below.
2. Answer the questions listed below and turn in your work by ________________________.

Reference:

A. Marcus, Radio Servicing, pp. 292-321.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T". If it is false, draw a circle around the letter "F".

T F 1. In a simple L-C (L = coil; C = capacitor) oscillating circuit, the resistance in the circuit would soon stop the oscillations.

T F 2. In an oscillating circuit, the feedback of energy must take place during the entire cycle.

T F 3. Oscillators are generally operated as Class B or C amplifiers.

T F 4. A Hartley oscillator used two inductively coupled coils.

T F 5. Crystal oscillators are now considered obsolete and seldom, if ever, used.

T F 6. L-C oscillators are equally effective as r-f and a-f oscillators.

T F 7. The R-C oscillator works on exactly the same principle as that of the L-C oscillator.

T F 8. Unwanted frequencies in the output of the oscillator are produced by harmonics.

T F 9. In general, harmonic output is reduced by operating the oscillator with the least feedback which will maintain oscillations.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. If an L-C oscillatory (tank) circuit were connected to the input of an electron tube, the amplified energy would appear in the ______________ ______________ ____.

2. Increasing the grid voltage beyond the saturation point will produce little, if any, increase in ______________ ______________.

3. In a tank circuit, B battery in series-feed a ______________ must be connected ______________ the battery so that the ______________ components of the plate current may pass around and not through the battery.

4. In a shunt (parallel-feed) circuit, the ________ ______________ is connected in parallel with the remainder of the plate circuit.

5. A regenerative oscillator is also called a ____________ - __________ oscillator.

6. In the Colpitts oscillator, instead of using a tapped tank coil, the ______________ ______________ is tapped.

7. The beat-frequency oscillator consists of ____________ r-f oscillators whose outputs are ___________ to produce beat-frequency currents.

8. The ______________-______________ oscillator is designed to reduce the generation of harmonics.

9. The sweep-circuit oscillator is sometimes called a ______________-______________ oscillator.

10. Any relaxation oscillator is one in which the frequency is controlled by the charge or discharge of an ______________ or ______________ through a ______________.

11. Instantaneous changes in frequency of an oscillator are known as ______________ ______________.

12. Sometimes a tube that will work satisfactorily as an ______________ will fail as an ______________.

13. ______________ oscillators produce outputs of exceptionally high stability.

Multiple-Choice

Directions: In the space at the left of each statement, write the letter of the item which will provide the correct answer to complete the statement.

_____ 1. The input voltage of a Class C amplifier tube, which is applied to the grid of the tube, is developed by the (A) plate to cathode; (B) L-C tank; (C) grid bias; (D) grid capacitor.

_____ 2. Oscillations in a tank circuit are prevented from "building up" by (A) the characteristic curve of the tube; (B) grid capacitor; (C) grid resistor; (D) plate-to-cathode short.

_____ 3. In a shunt (parallel-feed) tank circuit, the AC is kept out of the B battery by a (A) capacitor; (B) resistor; (C) RFC; (D) diode.

_____ 4. In a Meissner oscillator, the tank circuit is (A) in the grid circuit; (B) in the plate circuit; (C) done away with; (D) a separate circuit inductively coupled to the grid and plate circuits.

_____ 5. The main advantage an R-C oscillator enjoys over an L-C oscillator is that it (A) is cheaper; (B) is lighter; (C) has wider frequency range; (D) has fewer components.

_____ 6. The most serious defect of a multivibrator oscillator is that it has an output which (A) is rich in harmonics; (B) has a narrow-frequency range; (C) has a low amplification factor; (D) is degenerative.

_____ 7. In the L-C oscillator, the Q of the tank circuit must be (A) high; (B) low; (C) non-existent; (D) none of these.

_____ 8. If good frequency stability is desired, the oscillator should be called on to furnish (A) a large output; (B) very little output; (C) no output; (D) maximum output.

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. Oscillators may be classified according to the type of oscillating circuit they employ. These are:

(A) ______________ __________ (B) ______________________

2. In an L-C oscillator, the B battery can be connected two ways. They are:

(A) ______________________ (B) ______________________

3. R-C oscillators are usually used in:

(A) ______________________ (C) ______________________

(B) ______________________

4. Two methods for coupling the load to an L-C oscillator are:

(A) ______________________________ (B) ______________________________

5. Drift (gradual change of frequency of an oscillator) is generally caused by:

(A) ______________________________

(B) ______________________________

6. Oscillator defects generally fall into one of the following groups:

(A) ______________________________

(B) ______________________________

(C) ______________________________

7. Unstable output of an oscillator may be caused by:

(A) ______________________________

(B) ______________________________

(C) ______________________________

8. The frequency of an oscillator may vary three ways. They are:

(A) ______________________________ (C) ______________________________

(B) ______________________________

Problems

Directions: Read each of the following problems carefully. Do the specific operations which each question requires for proper solution. You may wish to refer to the reading assignment before proceeding with the problems.

1. Make a schematic diagram of an L-C oscillator circuit showing the B battery in series-feed. Label all the parts.

2. Make a schematic diagram of an L-C oscillator circuit showing the B battery connected by the shunt of parallel-feed method. Label all the parts.

Assignment
Sheet No. 23

Covering
Units 116-123

CONTROL CIRCUITS

The station received, volume of signal, and quality of tone may suit the owner of one receiver, while the same results would never be acceptable to the owner of another receiver. Most modern receivers, therefore, come equipped with several control circuits to allow for the wishes of the individuals who may purchase the sets and then who later become your customers as these same sets need repair.

In this unit you will have the opportunity to learn about the basic control circuits, how they are "hooked-up" with the other circuits, and about the things that can go wrong with them.

Assignment:

1. Read the reference listed below.
2. Answer the questions listed below and turn in your work by ______________________.
3. Check with your coordinator relative to a closed book exercise. He will give you an assignment which you should be able to complete without referring to any books or notes. If you fail the first time, study the appropriate chapter of the text and ask your coordinator to let you try again.

Reference:

A. Marcus, Radio Servicing, pp. 336-371.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T". If it is false, draw a circle around the letter "F".

T F 1. One condition required for AVC is that the original signal must be amplified until it is large enough to produce several volts of rectified voltage.

T F 2. One condition required for AVC is that the grid-biasing voltage must be steady and reflect the strength of the incoming signal.

T F 3. The AVC voltage is AC.

T F 4. Under certain conditions, it is desirable to apply different AVC voltages to different stages of the receiver.

T F 5. The AVC system tends to level off the output from the detector stage.

T F 6. Delayed AVC pulls very weak stations in.

T F 7. Generally, when there is no incoming signal, the receiver with AVC is at maximum sensitivity.

T F 8. One of the simplest tuning indicators is a milliammeter connected in series with the plate circuits of the tubes controlled by the AVC circuit.

T F 9. The indicator discussed in the previous question (No. 8) should show maximum deflection for perfect tuning.

T F 10. We can vary the tone of a receiver by dissipating some of the high-frequency audio currents.

T F 11. All tone control must be accomplished by attenuation and not by amplification of the high or low-frequency audio currents.

T F 12. The superheterodyne receiver may be too selective with a resultant loss of a-f currents.

T F 13. Some receivers are designed to operate on five or more bands.

T F 14. Generally, provision is made to silence a push-button receiver while the buttons are pushed.

T F 15. The chief cause of too much AVC is a defective AVC tube.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. The ________________ control must not permit the tubes to become overloaded by strong signals.

2. The simplest type volume control is a manually operated ______________ ________________ inserted in the circuit to vary the gain of one or more stages of the receiver.

3. The controlled tubes in AVC are generally of the ________________ (________________ - ______________, ______________________-______________) type.

4. At low-signal levels the ratio between noise and signal may be quite ______________, and, therefore, reception may be noisy.

5. To obtain quiet reception, the AVC voltage can be used to block the action of the last _________-_________________ tube.

6. Circuits that control the tone will generally be found in the _____________ __________________ of the receiver.

7. We may attenuate the low-frequency audio currents by reducing the value of the _________-_____________ by-pass capacitor.

8. The selectivity of a receiver enables it to tune in the desired station and ______________ all others.

9. Selectivity-control circuits are used so that selectivity can be increased when ___________________ from adjacent stations becomes too great, and the selectivity decreased when the _____________-___________ tones are desired.

10. The process of changing the receiver operation from one band to another is called _____________________________.

11. Band spread is a process whereby the band is spread out so that each division of the dial covers a _______________ frequency range.

12. Compared with incoming signals impluse noise is of extremely short duration and extremely ___________ amplitudes.

Multiple-Choice

Directions: In the space at the left of each statement, write the letter of the item which will provide the correct answer to complete the statement.

_____ 1. In filtering out the a-f component in a diode detector with an R_1 of 2 megohms and a C_3 of 0.05 microfarad, the time constant of this filter circuit would be (A) 1.0 second; (B) 0.5 second; (C) 0.3 second; (D) 0.1 second.

_____ 2. In order to apply different AVC voltages to different stages of the reciever, we use (A) a tapped load resistor; (B) two manual volume controls; (C) two resistors in series; (D) two capacitors in parallel.

_____ 3. Tuning indicators are used to give a visual signal when (A) the grid-bias drops to zero; (B) the Q tube is driven to cutoff; (C) the set is tuned accurately to the incoming signal; (D) the signal-to-noise ratio is greatest.

_____ 4. Bandswitching is usually accomplished by (A) cutting out one tuned circuit (by means of a switch)and substituting another with a different L-C constant; (B) dropping resistors; (C) matching capacitors (fixed); (D) two antenna systems.

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. A potentiometer can act as a volume control in any one of the following ways:

(A) ______

(B) ______

(C) ______

2. In the modern receivers which use a 6SQ7 in AVC, what function does each of the three "tubes" actually serve?

(A) Diode: ______

(B) Diode: ______

(C) Triode: ______

3. When the signal becomes strong enough in a "quiet-reception" AVC, so that the AVC voltage exceeds the predetermined squelch level, the blocking action is removed, allowing the receiver to operate normally. Circuits of this type are known as:

(A) ______ (C) ______

(B) ______ (D) ______

4. Control of selectivity is generally accomplished by one of the following two methods:

(A) ______

(B) ______

5. Push-button tuning may operate on one of two general principles. They are:

(A) ______

(B) ______

6. Defects in AVC may be placed in four categories:

   (A) ____________________ (C) ____________________

   (B) ____________________ (D) ____________________

7. Defects in band-switching circuits manifest themselves by:

   (A) ____

   (B) ____

   (C) ____

8. Failure of the noise-suppression circuit may produce:

   (A) ____________________ (C) ____________________

   (B) ____________________

Problems

Directions: Read each of the following problems carefully. Do the specific operations which each question requires for proper solution. You may wish to refer to the reading assignment before proceeding with the problems.

1. Make a schematic diagram of an AVC circuit showing how low and high AVC voltages are obtained. Label all parts.

7. Make a schematic diagram of an AVC circuit showing the first and second i-f tubes and a milliammeter connected as a tuning indicator. Label all parts.

Assignment
Sheet No. 24

Covering
Units 124-134

ANTENNAS

The present developmental stage of radio and television engineering and design make some kind of antenna system mandatory for most receivers.

As distance and certain obstructions become factors in reception, a well-designed and maintained antenna system becomes extremely important for good results.

In this unit you will have the opportunity to learn some of the theory and service techniques which apply to receiver antenna systems.

Assignment:

1. Read the reference listed below.
2. Answer the questions listed below. Turn in your work by ________________________.

Reference:

D. Mandl, Mandl's Television Servicing, pp. 284-303.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T". If it is false, draw a circle around the letter "F".

T F 1. Antenna troubles are immediately recognizable as such because the signal received is unlike that recieved when other components are faulty.

T F 2. Disconnecting one side of the antenna causes immediate loss of sound and picture.

T F 3. An increase in antenna height or the erection of a stacked array will invariably increase the signal-to-noise ratio.

T F 4. Wavelength of antennas are always expressed in terms of the physical length of the antenna.

T F 5. Even though an antenna may be cut for a specific frequency, it may reasonably be expected to give adequate reception for all channels, a range of 162 megacycles.

T F 6. The folded dipole, biconical, and fanned types of antennas have more desirable pickup patterns than the simple dipole.

T F 7. Antennas become better performers as wide-band types if they are deliberately mismatched to the transnission line.

T F 8. Antennas should be placed to favor the weakest stations.

T F 9. Tilting antenna elements slightly forward increases the gain for the higher channels in the direction of the tilt.

T F 10. Directors are four per cent shorter than the antenna element.

T F 11. Two reflectors are more efficient than one.

T F 12. Ghost images are a result of a reflected signal arriving at a slightly later time than the main signal.

T F 13. Not all common antennas lend themselves to stacking.

T F 14. A mismatch between the transmission line and the receiver, as was the case between the transmission line and the antenna, is not too important and may, in fact, be beneficial.

T F 15. Unused energy reflected back up the line combined with signals traveling down the line is called standing waves.

T F 16. Impulse noise caused by such devices as automobile ignition and other electrical devices can be reduced by giving the twin lead type of transmission line a twist every foot or so from the antenna to the receiver.

T F 17. Any increase in singal-to-noise ratio by putting up a higher antenna, a stacked array, or a Yagi will materially aid in diminishing all types of interference.

T F 18. Stubs function more effectively with ends shorted together.

T F 19. Standoff insulators are used to keep the line away from metal objects.

T F 20. A good lightning arrestor installation is to a water-pipe.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. The field strength meter gives an indication of signal strength received at the end of the transmission line in ________________.

2. With an imporperly tracked tuner the low signal output would cause the a-g-c to decrease ____________ and thus increase ________ beyond where it should be for a normal signal.

3. Readings of ______________ microvolts or more are usually indications of a good signal strength in a locality.

4. In the absence of a field-strength meter, an _______________ _____________ may be used for test purposes.

5. Most single antennas such as the dipole or folded dipole have been cut to a ______________ wavelength of a certain frequency.

6. A reflector will _______________ signals from the rear and _______________ pickup from the front.

7. Reflectors are ______ per cent longer than the antenna elements and if spaced 0.15 wavelength from the antenna, they will result in more ____________, but with a decided loss in antenna _______________

8. Overall dimensions of an antenna for Channel 13 should include a length of _______ inches, a reflector length of _________ inches and a director length of ____________ inches.

9. In areas where there are considerable reflection problems, excellent results can be obtained by using an ________________ ________________.

10. When one or more directors are used in combination with a reflector, the antenna system is called a __________________.

11. Spacings for all folded dipoles between their elements may be anywhere from __________ to ____________ of a wavelength.

12. When antennas are stacked and properly hooked up to the transmission line, an increase in ____________ results.

13. In television reception, the antenna acts as a ___________________.

14. Twin-lead cable has a rating of __________ ohms, while coaxial cable has a rating of __________ ohms.

15. If the picture quality increases when the hand grips the lead-in, this indicates ___________________ ________________ reduced by __________________ change.

16. A stub consists of about 30 inches of ______________ _______________ transmission _________________.

17. It is possible that a director for channel two can act as a __________________ for channel three.

18. A convenient and practical way to adjust loose antenna guy wires is to use a _____________________ in each guy wire section.

19. A common trouble is the breaking off of the _____________ ____________ at the point on the antenna where the line is attached.

20. A twin lead should never be installed by __________________ it to the antenna mast.

Multiple-Choice

Directions: In the space at the left of each statement, write the letter of the item which will provide the correct answer to complete the statement.

_____ 1. The chief value of the field strength meter lies in (A) the technician having an instrument to keep the customer in the dark on true service charges; (B) determining whether the tuner is functioning properly; (C) determining whether the oscillator is functioning properly; (D) determining whether a weak signal or a defective receiver is present.

_____ 2. When an indoor antenna is used for test purposes, the built-in antenna of the receiver should be (A) disconnected completely; (B) left connected; (C) connected with one lead only; (D) connected for maximum capacitive coupling.

_____ 3. The physical dimensions of an antenna are always (A) the same as the electrical dimensions; (B) smaller than the electrical dimensions; (C) larger than the electrical dimensions; (D) unimportant for considering electrical dimensions.

_____ 4. A space loop is (A) a portable antenna; (B) an antenna suspended in space; (C) an antenna within an antenna; (D) an area with higher than usual signal strength.

_____ 5. Reflectors and directors are referred to as (A) extenders; (B) dividers; (C) band spreaders; (D) parasitics.

_____ 6. Standard twin-lead impedance is a minimum of (A) 100 ohms; (B) 200 ohms; (C) 300 ohms; (D) 400 ohms.

_____ 7. Ghost images usually appear in relation to the main image (A) to the left; (B) to the right; (C) up; (D) down.

_____ 8. Spacings between stacked antennas usually run (A) 1/4 wavelength; (B) 1/2 wavelength; (C) 3/4 wavelength; (D) 1 wavelength.

_____ 9. Stubs can be used to trap out (A) spark-generated disturbances; (B) extra-high and prolonged voltages; (C) ghost images; (D) unwanted frequencies.

_____ 10. Additional lightning protection is obtained by grounding the antenna mast with size (A) 14 wire; (B) 10 wire; (C) 8 wire; (D) 6 wire.

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. The appearance of retrace lines could easily be due to:

(A) ______________________ (C) ______________________

(B) ______________________

2. Symptoms which indicate that the gain of the antenna system is insufficient are:

(A) ______________________ (C) ______________________

(B) ______________________

3. If an antenna cannot be moved in order to obtain an improved signal, the technician can:

(A) ______________________ (B) ______________________

4. Ghost reception can be decreased by:

(A) ____

(B) ____

(C) ____

5. The two most widely used types of lead in lines for television reception are:

(A) ______________________ (B) ______________________

6. A theoretical antenna system would have mounting hardware consisting entirely of:

(A) ________________ (B) ________________ (C) ________________

Assignment
Sheet No. 25

Covering
Units 135-141

THE FREQUENCY-MODULATION RECEIVER

At the present time there is a widespread interest in the "hi-fi" record field. Music is recorded with as little background and component noise as the electrical engineers can devise. FM radio is to the radio listener as hi-fi is to the record listener.

The present method of FM transmission limits the listening range to about 75 to 80 miles from the transmitter. Even at this range, other stations "creep" in and reception is usually poor.

The technician will be called upon to service some FM receivers. More likely, he will have a combination AM-FM set to repair.

In this unit you will have the opportunity to learn about FM receivers, AM-FM combinations, and how to repair them.

Assignment:

1. Read the reference listed below.
2. Answer the questions listed below and turn in your work by ______________________.

Reference:

A. Marcus, Radio Servicing, pp. 452-480.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T". If it is false, draw a circle around the letter "F".

T F 1. The greater the intensity of the sound, the greater the amplitude of the sound current.

T F 2. The radio wave is actually produced by the modulated carrier current.

T F 3. The intensity of the sound will vary the amplitude of the envelope of the modulated carrier current, and the pitch of the sound determines the number of such variations per second.

T F 4. The function of the oscillator in producing r-f carrier currents varies with AM and FM.

T F 5. When the sound current of an FM receiver is impressed on the carrier current, the intensity of the sound varies the amplitude of the carrier current.

T F 6. The standard broadcast band is often used for FM purposes.

T F 7. Tuned circuits in an FM set are usually made to pass bands of 100 KC or less.

T F 8. One disadvantage of the ratio detector is that it requires at least one limiter stage.

T F 9. One advantage of the FM system is that an efficient antenna system can be used.

T F 10. A radio receiver which is designed to pick up FM stations only is called an FM tuner.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. The average human ear can hear sounds that range in frequency from about __________ to ______________ vibrations per second.

2. The tonal quality of sound is a function of its frequency and is determined by the intensity of the ______________-______________ and ______________-___________________ vibrations present in a given sound.

3. When sound strikes a microphone and related components, it is converted into an electric current having a ____________________-wave form.

4. At the receiver, the carrier current is separated from the sound current at the _________________ stage.

5. In FM, the intensity of the sound determines the amount of ________________-_____________________ of the carrier current from its normal value and the _______________ determines the number of same.

6. The demodulator of an FM set differs from the detector of an AM set in that the detector is sensitive to changes in the ___________________ of the signal, and the demodulator is sensitive to changes in the ____________________ of the signal.

7. Because of the high frequencies involved, _________________ of an FM receiver is of prime importance.

8. Noise and static are essentially ______________ phenomena.

9. Although FM has a limited range, greater __________________ may be used without fear of interference.

10. An FM antenna is called a ___________________.

Multiple-Choice

Directions: In the space at the left of each statement, write the letter of the item which will provide the correct answer to complete the statement.

_____ 1. The range of frequencies which the human ear can hear is called the (A) sonic range; (B) audio range; (C) visual-acuity range; (D) tonal-quality range.

_____ 2. The frequency (cps) of a sound current is determined by the (A) tonal quality of the sound; (B) intensity of the sound; (C) overtones of the sound; (D) pitch of the sound.

_____ 3. Present regulations state that sounds of maximum intensity will cause the frequency of the carrier current to vary above and below the central carrier frequency by (A) 25 KC; (B) 50 KC; (C) 75 KC; (D) 100 KC.

_____ 4. FM stations are usually separated by (A) 100 KC; (B) 200 KC; (C) 300 KC; (D) 400 KC.

_____ 5. The i-f stages of an FM set usually operate at (A) 10.7 mc; (B) 12.7 mc; (C) 14.7 mc; (D) 16.7 mc.

_____ 6. Amplitude variations present in an FM signal are eliminated by the (A) discriminator; (B) limiter stage; (C) central-carrier frequency; (D) 6AC7 in the r-f stage.

_____ 7. A ratio detector is one form of (A) FM demodulator; (B) amplifier; (C) AFC; (D) oscillator.

_____ 8. More "noise" is present when the carrier wave is modulated by a-f signals lying between (A) 5-15 KC; (B) 15-20 KC; (C) 15-30 KC; (D) 20-30 KC.

_____ 9. An FM antenna consists of a metal rod whose actual physical length is equal to approximately (A) 1/4 the wave length of the desired signal; (B) 1/2 the wave length of the desired signal; (C) 3/4 the wave length of the desired signal; (D) the full wave length of the desired signal.

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. Sound has two main characteristics. They are:

(A) ______________________ (B) ______________________

Assignment
Sheet No. 26

Covering
Units 142-148

REALIGNING FM RECEIVERS

Realignment of radio or television receivers actually may involve knowing how and why to adjust components, rather than actual repair or replacement of defective parts. Realignment of a receiver may well follow the repair and replacement of parts which through age, heating, and other reasons have become defective.

In this unit you will have the opportunity to learn realignment procedures, especially as they apply to FM receivers.

Assignment:

1. Read the reference listed below.
2. Answer the questions listed below and turn in your work by __________________________.

Reference:

C. Marcus and Levy, Elements of Radio Servicing, pp. 161; 355-403.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T". If it is false, draw a circle around the letter "F".

T F 1. Most manufacturers' service notes confine visual-alignment procedures to the oscillator and r-f stages.

T F 2. The name f-m signal generator is often used for the sweep frequency signal generator.

T F 3. The superheterodyne principle is used in the f-m receiver circuit.

T F 4. The basic difference between f-m and a-m carriers is the strength of the signal.

T F 5. The servicing of a combined a-m and f-m receiver is more complicated than for a simple f-m receiver.

T F 6. The intermediate frequency for all f-m receivers is 10.7 mc.

T F 7. The function of the f-m ratio detector is the same as that of the discriminator.

T F 8. The outdoor dipole antenna is used most often for f-m receivers.

T F 9. Voltage checking in a defective stage is a poor means of locating defective components.

T F 10. "Hum" defects in an f-m receiver are resolved in the same manner as for a-m receivers.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. The two basic alignment techniques for the f-m section of an a-m/f-m receiver are the ____________________ and ____________________.

2. When aligning an f-m receiver, connect the set to the power source through an ____________ transformer.

3. When using a 20,000-ohms-per-volt meter as an output indicator, connect a resistor of approximately ______________ ohms resistance in series with the hot lead.

4. The r-f carrier frequency for f-m broadcasting is __________ megacycles.

5. The intensity control on an oscilloscope makes the image ______________ or ______________.

6. The warm-up time for a receiver under test should be about ______ minutes.

7. Capacitors used in f-m receivers often have additional specification such as ______________ ________________.

8. The f-m limiter is simply the last _______ stage of the receiver.

9. The signal-to noise ratio for monaural reception is ________ than that for stereo reception.

10. Misalignment in an f-m demodulator causes poor ________ quality and a __________ signal.

Multiple-Choice

Directions: In the space at the left of each statement, write the letter of the item which will provide the correct answer to complete the statement.

____ 1. The i-f frequency for f-m receivers is: (A) 455 KC; (B) 10.7 KC; (C) 108 MC; (D) 10.7 MC.

____ 2. The i-f frequency for a-m receivers is (A) 455 KC; (B) 10.7 KC; (C) 108 MC; (D) 10.7 MC.

______ 3. Zero voltage for any plate or screen when all other tubes have the correct voltages indicates: (A) a short circuit in the plate circuit of that tube; (B) the meter is not recording properly; (C) that the resistance in that tube's screen circuit is too high; (D) there is an open in the screen or plate supply of that tube.

______ 4. If the signal in the receiver under test was found to drift, the trouble may be caused by: (A) open or short circuited components in the afc line; (B) faulty oscillator circuit; (C) defective afc circuit; (D) all of these.

______ 5. To match most f-m receivers, the impedance of the antenna system (dipole) should be: (A) 3000 ohms; (B) 300 ohms; (C) 10.7 ohms; (D) 455 ohms.

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. Circuits to be checked in an f-m receiver are:

   (A) ______________________________

   (B) ______________________________

   (C) ______________________________

2. If an f-m receiver is found to be "dead" the trouble may be due to:

   (A) ______________________________

   (B) ______________________________

   (C) ______________________________

3. Troubles in the r-f stage of an a-m f-m receiver are often caused by:

   (A) ______________________________

   (B) ______________________________

4. Two advantages of an f-m receiver over an a-m receiver are:

   (A) ______________________________

   (B) ______________________________

5. The main types of f-m demodulators are:

   (A) ______________________________

   (B) ______________________________

8. Better quality AM-FM receivers separate some of the AM and FM stages. These stages are:

   1 ______________________________ 2 ______________________________

   3 ______________________________

Problems

Directions: Read each of the following problems carefully. Do the specific operations which each question requires for proper solution. You may wish to refer to the reading assignment before proceeding with the problems.

1. Make a drawing of a ratio-detector circuit showing how and where the VTVM is connected to indicate the condition of alignment of the transformer secondary winding.

Assignment
Sheet No. 27

Covering
Units 149-154

REPRODUCERS

With the expansion of interest in high fidelity reproduction of music on various kinds of sound equipment, much has been done in the field of loudspeaker design and construction.

In many instances a defective "speaker" may simply be discarded, while in many other cases the investment of the individual customer in a truly fine speaker, involving many dollars, may dictate repair if possible.

In this unit you will have the opportunity to learn how to test, replace, and repair defective speakers.

Assignment:

1. Read the references listed below.
2. Answer the questions listed below and turn in your work by ____________________.

References:

A. Marcus, Radio Servicing, pp. 104-109.
C. Marcus and Levy, Elements of Radio Servicing, pp. 93-103.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T". If it is false, draw a circle around the letter "F".

T F 1. Loose or cracked parts on a receiver cabinet may cause interference in the function of the radio speaker.

T F 2. The most frequent speaker defect is an open i-f coil.

T F 3. A shorted field coil may be the cause of a faulty P-M dynamic speaker.

T F 4. It is possible to vary the volume of auxiliary speakers and the receiver speaker by means of the volume control on the receiver.

T F 5. All spiders are cemented into place in the speaker assembly.

T F 6. It is never economically sound to replace a damaged voice coil in a speaker.

T F 7. Generally the modern tendency is toward the use of P-M dynamic speakers.

T F 8. It is often better to replace a damaged inexpensive speaker than try to repair it.

T F 9. An auxiliary speaker should never be wired in parallel with the receiver's speaker.

T F 10. The voice coil is fixed rigidly to the metal frame of the speaker.

T F 11. The paper cone causes the air at its surface to vibrate, thus producing audible sound.

T F 12. The function of the reproducer is to change radio-frequency sound into audio-frequency sound.

T F 13. There is an EIA color code for transformer windings.

T F 14. The diaphragm in a headphone serves the same function as the paper cone in a loudspeaker.

T F 15. The headphones have a fairly low impedance.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. The headphones are usually connected into the ________________ circuit of an audio-frequency amplifier.

2. The impedance of a voice coil usually is between ___________ and _______________ ohms.

3. The receiver's power supply provides the current for the field excitation of the _____________________ loudspeaker.

4. To reduce hum some loudspeakers have _________________ coils.

5. The symbol for a pair of headphones is ______________________.

6. The common symbol for a permanent-magnet dynamic type loudspeaker is ___________________.

7. The colors for the winding leads on the voice coil are ___________ and ______________.

8. Loudspeaker leads are frequently ________________________ coded.

9. A common solvent for the cement used on the cone assembly is __________________________.

10. The varying magnetic field surrounding the voice coil is caused by _________________ frequency current.

Multiple-Choice

Directions: In the space at the left of each statement, write the letter of the item which will provide the correct answer to complete the statement.

_____ 1. The best way to test for a defective speaker is to (A) take it apart to determine the precise trouble; (B) turn the volume control to a low signal in order to reduce the defect; (C) replace the electromagnet with a PM known to be good; (D) replace the suspected speaker with one known to be good.

_____ 2. Power ratings in ordinary home-receiver loudspeakers generally run from (A) 1 to 10 watts; (B) 1 to 20 watts; (C) 3 to 10 watts; (D) 5 to 20 watts.

_____ 3. Since the input impedance of a voice coil is low, an output transformer is required to match it with the (A) input impedance of the receiver; (B) output of the i-f stage; (C) plate circuit of the power output stage; (D) grid circuit of the power output stage.

_____ 4. Practically all permanent magnets in PM speakers are of a special alloy called (A) Alnico V; (B) aluminum; (C) manganese; (D) manganese-dioxide.

_____ 5. The voice coil consists of (A) a great many turns of wire; (B) a few turns of wire around the voice coil form; (C) the entire speaker assembly; (D) the inductor only.

_____ 6. In applying the quick check for loudspeaker operation, one first (A) disconnects the AC from receiver output transformer; (B) disconnects field coil from DC; (C) grounds voice coil; (D) unseats a-f tube.

_____ 7. The quick check tells us(A) how well the speaker is functioning; (B) whether the voice coil is open or short circuited; (C) whether the field coil is faulty or good; (D) whether the cone is functioning or not.

_____ 8. The terminal wires of a loudspeaker voice coil may be identified by the colors: (A) finish-green and start-black; (B) finish-black and start-green; (C) finish-yellow and red and start-black and red; (D) finish-black and red and start-yellow and red.

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. A visual and manual test of a loudspeaker will reveal defects such as the following:

(A) ______ (D) ______

(B) ______ (E) ______

(C) ______ ______

2. When replacement speakers are being purchased, the factors to be considered are:

(A) ______

(B) ______

(C) ______

(D) ______

3. If a speaker indicates no reception and there is no B+ voltage or click on the quick check test, the faults to look for are:

(A) ______

(B) ______

(C) ______

4. If strange rattles are observed, some of the faults to look for in the speaker are:

(A) ______

(B) ______

(C) ______

(D) ______

(E) ______

5. There are two common methods of securing the spider to the voice-coil form and the pot. These are:

(A) ______ (B) ______

Assignment
Sheet No. 28

Covering
Units 155-159

THE CATHODE-RAY TUBE

Special tubes have been developed to serve a particular function. Once the basic principles of such devices as electron tubes were made known to men of vision and perception, the applications and uses of the tubes increased many times, especially so as modifications of earlier inventions evolved. One such of these modifications is the C-R tube.

In this unit you will have the opportunity to learn about the C-R tube as it operates in modern oscilloscopes and television receivers.

Assignment:

1. Read the reference listed below.
2. Answer the questions listed below and turn in your work by ____________________.

Reference:

A. Marcus, Radio Servicing, pp. 328-332.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T". If it is false, draw a circle around the letter "F".

T F 1. In the electron gun, the heater heats the cathode, causing it to emit electrons.

T F 2. The control grid of an electron gun is negative with respect to the cathode and thus tends to repel the electrons that are emitted by the cathode.

T F 3. The effect of the control grid of an electron gun is to control the amount of emission from the cathode and to concentrate these electrons into a beam.

T F 4. The second anode of an electron gun has a high negative voltage.

T F 5. Phosphorescence and fluorescence are two words which mean the same.

T F 6. The electron beam is extremely light and may be moved with great rapidity without running into problems of inertia.

T F 7. The aquadag coating carries a negative voltage.

T F 8. If the aquadag coating were omitted, interference could result.

T F 9. Magnetic deflection is used in some TV receivers.

T F 10. Some C-R tubes use both electrostatic and magnetic deflection.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. The operation of an electron-ray tube depends upon the fact that if a phosphor is struck by an electron beam, the phosphor will ______________ or ______________.

2. In the C-R tube, the electron beam is produced by an ______________ ______________.

3. The control grid of an electron gun is a metal tube having a small ______________ in one end and enclosing the ______________.

4. The purpose of the first anode of an electron gun is to reduce the spreading effect of the ______________ and to ______________ them to a certain degree.

5. Before the beam of electrons reaches the screen, it must pass between two sets of ______________ ______________.

6. Since the electrons of the beam carry a negative charge, they will be attracted to a ______________ charged plate, and repelled by a ______________ charged plate.

7. The aquadag coating is a deposit of ______________ on the inside of the C-R tube.

8. The electrostatic-deflection type is so-called because of ______________ ______________ on the deflection plates.

9. In the magnetic-deflection type, deflection of the electron beam is accomplished by means of ______________ ______________.

10. Since the electron beam constitutes a flow of current, it is surrounded by a ______________ ______________.

Problems

Directions: Read each of the following problems carefully. Do the specific operations which each question requires for proper solution. You may wish to refer to the reading assignment before proceeding with the problems.

1. Make a clear line diagram of an electron gun. Show the path of the beam. Label all the parts.

2. Make a clear line diagram of a cathode-ray tube. Show the path of the beam. Label all the parts.

Assignment
Sheet No. 29

Covering
Units 160-161

THE PICTURE TUBE

The picture tube is one of many cathode-ray tubes. Design engineers are constantly experimenting with and finding new uses for special types of cathode-ray tubes.

In this unit you will have the opportunity to learn the operating theory and service techniques that apply to television picture tubes.

Assignment:

1. Read the reference listed below.
2. Answer the questions listed below. Turn in your work by ____________________.

Reference:

D. Mandl, Mandl's Television Servicing, pp. 55-79.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T". If it is false, draw a circle around the letter "F".

T F 1. The modern television picture tube has an indirectly heated cathode.

T F 2. The control grid of a television tube functions in precisely the same way that a conventional tube works; it acts as a valve.

T F 3. Magnetic deflection is accomplished by a single coil.

T F 4. When picture-signal amplitude is low, a high current will flow and a bright spot or section will appear on the screen.

T F 5. In order to give the electron stream sufficient velocity to reach the screen material with proper force to cause it to fluoresce, a second anode is included within the tube upon which a very high voltage is impressed.

T F 6. Beam velocity within the picture tube depends directly on the amount of high voltage applied to the second anode.

T F 7. In a given magnetic field a high-velocity beam is influenced to a greater extent than a low-velocity beam.

T F 8. All picture-tubes have the same deflection angles.

T F 9. When the cathode of the picture tube is heated suffiecintly to permit electron flow, ions are released; these ions will damage the screen area if permitted to reach the phosphor coating of the tube.

T F 10. An ion has a greater mass than an electron.

T F 11. If the picture tube is defective and the scanning beam is not perfectly round but has an oval shape, good focusing will be impossible to achieve without picture-tube replacement.

T F 12. Practically all modern picture tubes have the built-in ability to give a sharp focus unless they have been damaged by improper ion-trap setting.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. The grid structure of a television picture tube is unlike that of a conventional tube in that instead of a wire mesh it consists of a ______________ with a small ______________ ______________ to keep the electron stream down to a small size.

2. An ______________ grid follows the control grid and a voltage of approximatley ______________ volts is applied to it.

3. The first-lens system reduces the stream of electrons into a tiny spot called the ______________.

4. The second-lens system consists of the ______________ ______________.

5. The phosphorescent characteristic of the chemically treated glass front of the tube has an afterglow called ______________.

6. The influence on the beam by the magnetic fields of both focus coil and deflection coils is at ______________ ______________.

7. When negative-signal amplitude to the grid increases, the beam current ______________ and a ______________ section will appear on the screen.

8. The operating bias for the picture tube is set by adjusting a ______________ which controls the amount of screen illumination desired by the viewer.

9. Magnetically deflected picture tubes are coated on the inside with ______________ ______________.

10. Beam velocity depends directly on the amount of high voltage applied to the second ______________, and such voltage may vary from ______________ volts for small tube sizes to well over ______________ volts for the larger sizes.

11. A decline in either high voltage or beam velocity will lower ________________ to a subnormal level.

12. Adjustments on the yoke are primarily for correcting ___________.

13. Beam-bending coils are sometimes referred to as ______________ ________________.

14. One method of preventing ion damage to the screen is to ______________ the phosphor screen material.

15. A voltmeter placed across the grid and cathode of the picture tube should always indicate a __________________ voltage.

16. The yoke should be as close to the tube __________________ as possible for maximum efficiency.

17. If a receiver is in need of alignment or if the video amplifier does not pass frequencies up to 4 megacycles, the _______________ wedge in a test pattern will not be clearly defined.

18. Most later types of television receivers use _____________________ ________________ for both focusing and picture positioning.

Multiple-Choice

Directions: In the space at the left of each statement, write the letter of the item which will provide the correct answer to complete the statement.

_____ 1. The cathode of a picture tube has for an emitting element (A) uranium; (B) phosphorus; (C) barium; (D) radium.

_____ 2. The accelerating grid, together with the cathode and control grid, forms an initial focusing of the beam referred to as a (A) first-lens system; (B) second-lens system; (C) third-lens system; (D) fourth-lens system.

_____ 3. The most widely used type of deflection in modern receivers is the (A) swinging; (B) electrostatic; (C) mechanical; (D) magnetic.

_____ 4. Some glass-walled picture tubes have an inside and outside coating of aquadag which acts as a (A) resistor; (B) variable resistor; (C) capacitor; (D) variable capacitor.

_____ 5. A tube with a deflection angle of 60 degrees has a maximum swing on either side of center of (A) 30°; (B) sine 30°; (C) 60°; (D) sine 60°.

_____ 6. Tubes having a larger deflection angle require a somewhat (A) stronger deflection field; (B) weaker deflection field; (C) wider deflection field; (D) more narrow deflection field.

_____ 7. Combined vertical and horizontal deflection coil sections are referred to as the (A) ion trap; (B) focus coil; (C) beam bender; (D) yoke.

_____ 8. The most probable defect in a television set that suddenly develops poor focus is (A) poor alignment; (B) poor tracking; (C) aging components; (D) defective component in the focus circuit.

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. The raster is formed by the combination of the:

(A) ____________________

(B) ____________________

2. Aquadag has the dual purpose of:

(A) ____________________

(B) ____________________

____

3. A clear picture in a television receiver depends on any one or more of the following factors:

(A) ____________________

(B) ____________________

(C) ____________________

(D) ____________________

(E) ____________________

(F) ____________________

____

4. If the horizontal wedges of a test pattern cannot be clearly defined, the trouble will be found in one or more of the following:

a ______________________________

b ______________________________

c ______________________________

d ______________________________

____

5. If the focus unit is not in the proper place along the neck of the picture tube, the result will likely be:

a ______________________________

b ______________________________

Assignment
Sheet No. 30

Covering
Units 162-165

RF MIXER-OSCILLATOR STAGES

When television repair technicians refer to the "front end" of a receiver, they are usually referring to the tuner. The tuner is composed of several main stages, each having a particular function to fulfill.

Tuners may vary in mechanical appearance and construction, but electronically they all meet the same requirements.

In this assignment you will have the opportunity to learn the operating theory of the tuner with special consideration for its repair and service.

Assignment:

1. Read the reference listed below.
2. Answer the questions and problems listed below. Turn in your work by ______________________.

Reference:

D. Mandl, Mandl's Television Servicing, pp. 85-107.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T". If it is false, draw a circle around the letter "F".

T F 1. The tuner works at much higher frequencies than the rest of the receiver.

T F 2. The purpose of the tuner is to select the desired station; amplification and signal mixing are functions of other components.

T F 3. The two types of tuners are the turret type and the drum type.

T F 4. Oscillator coils for VHF tuners are usually wound with a few turns of wire for the lower channels, and progressively less turns for the higher channels.

T F 5. The fewer grids in a tube, the less will be the objectionable noise.

T F 6. Because of che load placed on pentodes with wide-band television usage, their final gain is approximatley equal to that of a triode.

T F 7. The tube capacity of a triode is large, making it easy for interfering signals to pass through it.

T F 8. Cascade tuners have the disadvantage of using tubes with strong tendencies to grid absorption of cathode coatings.

T F 9. Some tubes in use today contain neither mica nor glass and utilize ceramic materials.

T F 10. Even though an open circuit develops in the tuner, the raster will appear on the picture-tube screen.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. A relatively new type of r-f amplifier being used is the neutrode which has been made possible by newer design in ________________.

2. A tuner which is used by many manufacturers of television receivers carries the manufacturer's name of ____.

3. A tuner should not be operated with the shields ________________.

4. Defective sockets of miniature size found in tuners usually must be ____________________ when found to be defective.

5. An open circuit in the tuner will have ____________________ effect on the power supplies.

6. Microphonics are usually caused by loose ________________ elements.

7. If the oscillator is functioning, the rectification of the feedback will produce a ___________ ____________ across the grid leak.

8. When any capacitor in the local oscillator circuit is replaced, care must be exercised that a __________________ __________________ type is not replaced with an ordinary one designed for general replacement in other circuits.

9. The initial warmup period of the receiver will cause the _______________ to drift lower in frequency because of expanding coils and other parts.

10. A common trouble of many tuners is failure of the __________________ associated with the selector shaft.

Multiple-Choice

Directions: In the space at the left of each statement, write the letter of the item which will provide the correct answer to complete the statement.

_____ 1. If the converter in a VHF-UHF set has its own power supply, any troubles which occur in the unit will usually manifest themselves by (A) loss of both UHF reception and VHF reception in the receiver; (B) loss of VHF reception in the receiver without loss of UHF reception; (C) loss of UHF reception without any influence on the VHF reception of the receiver; (D) loss of UHF reception and poor reception from VHF receiver.

_____ 2. Some UHF strips in tuners incorporate a minimum of parts and these tuners will require (A) no servicing since the complete strip must be replaced when it malfunctions; (B) little servicing other than initial peak-tuning adjustments; (C) frequent servicing to insure peak performance; (D) little servicing but required servicing must be performed by one specializing in UHF tuners.

_____ 3. The cleaning agent to use when switching contacts are to be cleaned is (A) a mild salt solution; (B) kerosene; (C) H_2SO_4; (D) carbon tetrachloride.

_____ 4. If the sound or picture is missing from only one or two channels, this indicates (A) improper tracking; (B) an open circuit in the tuner; (C) a defective capacitor; (D) a defective resistor.

_____ 5. Many receivers use negative-coefficient-type capacitors to minimize (A) oscillator drift; (B) harmonies; (C) reflected images; (D) interference.

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. The purpose of the r-f mixer and oscillator stages is to:

(A) ____

(B) ____

(C) ____

____

2. Two design requirements for tuners are:

(A) ______________________________

____

(B) ______________________________

____

3. Two basic categories of tuners are:

(A) ______________ (B) ______________

4. Common troubles of television tuners include:

(A) ______________ (D) ______________

(B) ______________ (E) ______________

(C) ______________ (F) ______________

5. Oscillator drift may be caused by a:

(A) ______________ (B) ______________

6. Defective tubes can:

(A) ______________________________

(B) ______________________________

(C) ______________________________

7. Noisy contacts can originate in the following places:

(A) ______________________________

(B) ______________________________

(C) ______________________________

(D) ______________________________

8. Poor gain may be due to:

(A) ______________________________

(B) ______________________________

(C) ______________________________

9. Loss of picture and sound may result from open circuits in:

(A) ______________ (C) ______________

(B) ______________ (D) ______________

Assignment
Sheet No. 31

Covering
Units 166-171

VIDEO INTERMEDIATE-FREQUENCIES, VIDEO AMPLIFIERS, VIDEO DETECTORS AND DC RESTORERS

The signal as it passes or is impelled through the various stages and sections of the television receiver must be within certain tolerances of strength and frequency.

In this assignment you will have the opportunity to trace the video signal to the cathode or grid of the picture tube, to determine how defects in video i-f, video amplifiers, the video detector, and the DC restorer will affect reception, and what the technician can do to remedy poor reception.

Assignment:

1. Read the reference listed below.
2. Answer the questions listed below. Turn in your work by ______________________.

Reference:

D. Mandl, Mandl's Television Servicing, pp. 134-178.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T". If it is false, draw a circle around the letter "F".

T F 1. It is well for the technician to remember that as the i-f signals are passed through i-f stages for gain, both the audio and video signals are impressed upon a single detector and demodulated.

T F 2. If a receiver is to be used in an area when adjacent channels cannot be received, sound traps need not be adjusted.

T F 3. For those receivers which have a more narrow bandpass than the standard 4 megacycles, adjacent channel traps are often omitted.

T F 4. If symptoms seem to indicate trouble in the i-f stages, tubes should be checked first.

T F 5. A fast and effective way of servicing a defective coupling capacitor is to simply bridge the old one with a new one.

T F 6. A burned-out decoupling resistor should not be replaced without first determining the cause for the burnout.

T F 7. If the sound is functioning, the tuner and the first video i-f stage must be functioning.

T F 8. The capacitor in a diode tube detector should always be large enough to pass voltage changes below 4 megacycles.

T F 9. Except for tube failure, little trouble is experienced with the video detector stage of a television receiver.

T F 10. If capacitors are used across cathode resistors, they are made large enough in value to prevent degeneration of low frequencies.

T F 11. Failure of either or both video amplifier stages will result in no picture.

T F 12. The leads of a new peaking coil should be cut as short as possible.

T F 13. Signal-tracing procedures can be used to locate a dead or defective stage.

T F 14. Some modern television receivers no longer have DC restorers.

T F 15. In a three-gun color television receiver, three separate video amplifiers are used.

T F 16. The a-g-c tube functions at all times in order to properly control the video signal.

T F 17. A lack of bias applied to the r-f/i-f stages is a positive indication of a-g-c circuit failure.

T F 18. Filter capacitors are a common source of trouble in an a-g-c circuit because of the low-to-high pulses in DC voltage they must handle.

T F 19. Receivers with an adjustable control for proper setting of the a-g-c bias level should have the control set for a stable picture on the weakest station in the area.

T F 20. Intercarrier buzz may result from improper i-f alignment.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. The video and sound i-f signals derived from the tuner are passed through i-f amplifier stages for further ______________ and in order to secure the required _________________ characteristics.

2. The interference from maladjusted traps takes the form of _________________ lines if the spill-over is from a channel _________ in frequency than the one being received.

3. If the receiver's own sound i-f traps are not properly adjusted, the sound bars will vary in ________________ and _________________ as the sound frequencies from the station being received change.

4. If spill-over occurs due to interference from an upper adjacent channel, _________________ will be visible on the screen.

5. Misalignment of the intercarrier type of i-f stages will result in excessive __________________ ______________ which must be corrected by proper alignment of the common _____________ and _____________ i-f stages so that the sound i-f signal is set below the response curve at the proper level.

6. A bias check with a VTVM between grid and cathode should indicate a _____________ potential on the grid.

7. The video detector of a television receiver has the same general function as the _______________ _______________ in the AM superheterodyne radio.

8. The signal must be _____ __________-going at the picture-tube grid.

9. If shunt peaking coils open, it would mean loss of ____ ___ power with a resultant loss of ___________________.

10. Direct-current restoration is the process where the DC level of the signal is restored after it has been upset by ________________-_______________ between video amplifier stages.

11. The bias-clamp tube should be checked in a tube-tester which is capable of testing the _____________ as well as the triode section.

12. Rapid and repeated blanking of the horizontal trace which occurs at a fixed rate will give the appearance of _______________ bars.

13. Correct adjustment of the fine-tuning control, the a-g-c system, and ________________ ___________________ are all effective in reducing intercarrier buzz.

Multiple-Choice

Directions: In the space at the left of each statement, write the letter of the item which will provide the correct answer to complete the statement.

_____ 1. The intensity of spill-over interference will vary as the (A) volume is adjusted; (B) fine tuning is adjusted; (C) vertical-hold is adjusted; (D) lower adjacent channel sound trap is adjusted.

_____ 2. If the receiver's own sound i-f traps are not properly adjusted, sound bars will appear as (A) evenly spaced horizontal bars; (B) unevenly spaced horizontal bars; (C) evenly spaced vertical bars; (D) unevenly spaced vertical bars.

_____ 3. Poor and distorted amplification as a result of defective components which permit the minus bias on the grids of the amplifier tubes to be overcome can be caused by a (A) leaky coupling capacitor; (B) defective bleeder resistor; (C) poor antenna system; (D) defective variable capacitor.

_____ 4. In the intercarrier type of receiver, failure of any of the i-f stages following the tuner would result in (A) loss of sound; (B) loss of picture; (C) loss of sound and picture; (D) picture tube burn-out.

_____ 5. If a germanium crystal diode is defective, the picture will (A) not be present; (B) have a washed-out appearance; (C) have diagonal bars; (D) have a herringbone effect.

_____ 6. The distortion of a leaky coupling capacitor will show up as (A) a washed-out picture; (B) no picture; (C) no sound; (D) a dark picture.

_____ 7. Vertical sync pulses occur at (A) 30-cycle intervals; (B) 60-cycle intervals; (C) 90-cycle intervals; (D) 120-cycle intervals.

_____ 8. Hum introduced by a 60-cycle power supply will produce (A) one dark hum bar; (B) 20 dark hum bars; (C) 40 dark hum bars; (D) 60 dark hum bars.

_____ 9. The reduction of impulse noise and diathermy interference at the receiver can always be obtained by (A) increasing the signal-to-noise ratio; (B) decreasing the signal-to-noise ratio; (C) increasing the line voltage; (D) decreasing the line voltage.

_____ 10. Impulse noises may be effectively reduced with a (A) 0.02 capacitor; (B) 0.06 capacitor; (C) 0.08 capacitor; (D) 0.10 capacitor.

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. In review, the technician should recall that the i-f stages he may have to work with may be one of two types:

   (A) ____________________ (B) ____________________

2. The video detector of a television receiver usually is a diode-type detector and can be either of two types:

   (A) ____________________ (B) ____________________

3. In order that the a-g-c tube will function properly, the following two conditions must exist:

   (A) ____

   (B) ____

4. When direct coupling is used, two requirements are:

   (A) ____

   (B) ____

   ____

5. Pulse-type interference in the video-stage may be caused by:

   (A) ____

   (B) ____

   (C) ____

   (D) ____

   (E) ____

Assignment
Sheet No. 32

Covering
Units 172-175

VERTICAL AND HORIZONTAL SWEEP SYSTEMS

Many of the circuits which are used in television receivers have similar circuits in radio receivers. Vertical and horizontal sweep circuits are circuits found in television and cathode-ray tubes only.

In this unit you will have the opportunity to learn about sweep systems, especially as the received picture is affected. with proper steps for the technician to take to correct defects.

Assignment:

1. Read the reference listed below.
2. Answer the questions listed below. Turn in your work by ______________________.

Reference:

D. Mandl, Mandl's Television Servicing, pp. 193-259.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true draw a circle around the letter "T". If it is false, draw a circle around the letter "F".

T F 1. Six equalizing pulses are transmitted in order to keep the horizontal oscillator in sync during the initial vertical blanking.

T F 2. After the initial six equalizing pulses the vertical pulse is transmitted.

T F 3. Failure in one sweep system never influences the other sweep system.

T F 4. A noise pulse of sufficient amplitude which arrives at the sweep oscillator just prior to the time when tube conduction takes place could also trigger the vertical sweep oscillator, causing loss of vertical synchronization.

T F 5. A separate tube is usually used for sawtooth formation.

T F 6. A decrease in the vertical output tube emission or a decrease in plate voltage will result in a reduction of picture height.

T F 7. On rare occasions, television transmitting stations may lose interlace.

T F 8. The horizontal hold control normally has sufficient range so the viewer can compensate for ordinary line voltage variations.

T F 9. When the synchroguide system is operating normally, it should be impossible to turn the horizontal hold control fully counterclockwise without losing horizontal synchronization.

T F 10. Fold-over can be caused by defective tubes or bad parts in any of the sweep circuits from the sync locking stages to the damping circuits.

Completion

Directions: Fill in the blank(s) in each statement with the word s required to complete the sentence correctly.

1. After sync pulses have been removed from the composite video signal by the sync separator circuits previously discussed, they are used to __________ in the vertical and horizontal sweep oscillator.

2. Each sweep oscillator must be continuously kept locked in by the sync pulses; for if they are removed for only a fraction of a second, the __________ will __________ off frequency and thereby shift the picture information.

3. The effect of equalizing pulses on the vertical system can be minimized by a __________ __________ having a long time-constant.

4. The keystone effect will result when one-half of the __________ __________ coils has a short out, or has a short across it because of a defective resistor.

5. Most of the linearity controls and other controls which the viewer does not normally adjust are called __________ controls.

6. Poor linearity which cannot be corrected by adjustment of the vertical controls is usually the result of discharge circuit of the __________ __________ system.

7. Loss of __________ __________ causes the picture to roll vertically.

8. Poor interlace is usually caused by a defect in the __________ circuit.

9. Fold-over indicates improper __________ __________ __________.

10. Newer versions of the synchroguide system are superior to the older types because the new circuits include a stabilizing __________ __________ capacitor.

Multiple-Choice

Directions: In the space to the left of each statement, write the letter of the item which will provide the correct answer to complete the statement.

_____ 1. The horizontal oscillator sweep causes the picture-tube beam to trace across the tube for A. [illegible] lines; B. [illegible] lines; C. [illegible] lines; D. [illegible] lines.

_____ 2. Equalizing pulses occur at a rate of A. [illegible] pulses per second; B. [illegible] pulses per second; C. 31,500 pulses per second; D. [illegible] pulses per second.

_____ 3. The hold control component of a vertical or horizontal hold is a A. variable resistor; B. variable capacitor; C. choke coil; D. fixed capacitor.

_____ 4. The blocking oscillator is one type of A. free-running oscillator; B. multivibrator; C. signal generator; D. sweep frequency generator.

_____ 5. A decrease in height indicates trouble in the A. resistive network in the B+ part of the power supply as applied to the plate; B. picture tube; C. antenna network; D. deflection yoke.

_____ 6. If vertical sweep is lost entirely, the result will be a bright A. vertical line; B. horizontal line; C. herringbone pattern; D. diagonal line.

_____ 7. The multivibrator is a two-tube type oscillator which A. vibrates mechanically in a sustained and free-running manner; B. vibrates electronically in a sustained and free-running manner; C. vibrates mechanically to supply power to the sweep circuitry; D. vibrates electronically to supply power to the sweep circuitry.

_____ 8. Barkhausen oscillations are visible on the screen as A. one or more black vertical lines near the center of the screen; B. one or more white vertical lines near the center of the screen; C. one or more black horizontal lines near the top of the screen; D. one or more white horizontal lines near the top of the screen.

_____ 9. A [illegible] horizontal output stage which is operating at [illegible] the tube will show A. horizontal sync instability at the top of the picture; B. horizontal sync instability at the bottom of the picture; C. horizontal sync stability but poor detail; D. horizontal sync stability but poor contrast.

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. A well-formed sawtooth is a result of:

(A) ____________________ (C) ____________________

(B) ____________________

2. The combined functioning of the vertical and horizontal sweep systems will determine:

(A) ______________________________

(B) ______________________________

(C) ______________________________

3. Lack of vertical sweep is due to complete failure of either the:

(A) ____________________ (B) ____________________

4. If the vertical hold control is totally ineffective in stopping picture roll, it would indicate:

(A) ______________________________

(B) ______________________________

(C) ______________________________

5. The three signal waveforms involved in the synchroguide circuit are:

(A) ______________________________

(B) ______________________________

(C) ______________________________

6. Troubles which are common in the horizontal sweep system of television receivers are:

(A) ______________________________

(B) ______________________________

(C) ______________________________

7. When horizontal sweep is lost entirely, localization becomes difficult, as the trouble may lie in the:

(A) ____________________ (D) ____________________

(B) ____________________ (E) ____________________

(C) ____________________

8. Symptoms of horizontal sweep failure are:

(A) ____

(B) ____

9. Fold-over can be caused by defective components in any of the following circuits:

(A) ____________________ (C) ____________________

(B) ____________________ (D) ____________________

10. Horizontal lock circuits can be checked with the:

(A) ____________ (B) ______________ (C) ________________

Assignment
Sheet No. 33

Covering
Units 176-187

TROUBLESHOOTING TELEVISION RECEIVERS

Troubleshooting television receivers must follow a sequence, just as a sequence for troubleshooting radio receivers has been established. The procedures follow certain fundamentals, sometimes complicated by the additional components which form a part of video portion of the television receiver.

In this unit you will have the opportunity to learn some trouble-shooting techniques which will apply to basic television circuits.

Assignment:

1. Read the reference listed below.
2. Answer the questions listed below and turn in your work by ____________________.
3. Check with your coordinator relative to a closed book exercise. He will give you an "assignment" which you should be able to complete without referring to any books or notes. If you fail the first time, study the appropriate chapter of the text and ask your coordinator to let you try again.

Reference:

D. Mandl, Mandl's Television Servicing, pp. 2-26, 53-83, 109, 139-175, 188, 271, 337, 429.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T". If it is false, draw a circle around the letter "F".

T F 1. The electron stream produced by the picture tube produces a bright white glow upon reaching the phosphorus coating inside the picture tube only if the negative potential is high.

T F 2. Side bands are produced by distortion of the pure sine-wave formation of the carrier waves by frequency-modulation and amplitude modulation.

T F 3. Video and sound arrive in the receiver on the same carrier to provide "interlocking synchronization."

T F 4. In order to obtain sharp, clear pictures, the video carrier is frequency-modulated.

T F 5. Shorted plate coils are a common source of trouble in the video I-F stages.

T F 6. In a TV receiver, high degrees of modulation correspond to the blackest parts of the picture.

T F 7. Blanking pulses, which cause the screen to darken 15,750 times per second, are really a series of sudden lowering of carrier amplitude.

T F 8. Horizontal retrace takes place 60 times per second.

T F 9. The first vertical sweep motion fills only the odd lines of the total picture.

T F 10. Since the i-f of the sound and video carriers are 4.5 mc apart, they can be made to heterodyne and produce a beat signal of 4.5-mc frequency.

T F 11. Echoes or overshoots may result from improper alignment of the video i-f where the high frequency end of the bandpass rises above normal.

T F 12. By far the biggest factor in video amplifier failure is tube and components failure.

T F 13. The video amplifier stages of all television receivers are designed to include D-C restoration.

T F 14. Picture brilliancy may be affected by a leaking coupling capacitor between the video amplifier and the picture tube grid.

T F 15. Transistor video i-f and video amplifier stages perform the same functions as their vacuum tubes counterparts but present different trouble symptoms than do the vacuum-tube components when affected by similar failures.

T F 16. All FM stations utilize 25 KC for their carrier swing and the other 175 KC is to prevent side b and interaction between adjacent stations.

T F 17. Interfering sine wave signals and square wave signals cause identical types of picture interference as long as the interfering signals are 60 cps.

T F 18. Oscilloscopes utilize the electrostatic type of sweep.

T F 19. If a filament cathode short occurs in the video amplifier (or the DC restorer), no voltage will be impressed across the picture-tube input.

T F 20. Light on the screen is produced by the flow of current in the electron beam causing fluorescing of chemical coating.

T F 21. One of the first things to do is adjust the ion-trap magnet on the neck of the picture tube.

T F 22. The purpose for A.G.C. systems in television receivers is to maintain a constant audio level.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. The 12 standard VHF channels represent spectrum assignments from ________ to __________ mc called the "low band", and ___________ to ________ mc called the "high band".

2. The video carrier is transmitted on a frequency of __________ mc inside the low-frequency edge of the channel.

3. The sound carrier in a standard TV signal is _____________-_________________ with a deviation of ± ____________KC.

4. The video signal contains frequency components from about ________ cps to ___________ mc.

5. The picture-tube beam at the receiver sweeps across the picture ____________ times for each complete picture scan.

6. The downward motion of the horizontal trace and retrace is called _____________ _________________.

7. For one vertical sweep motion, the picture is divided into ________ lines.

8. The sound signals in a TV receiver pass through an i-f amplifier, limiter, detector, and a-f amplifier sections which are almost the same as those in standard ____________ broadcast receivers.

9. The video i-f signals pass through the video i-f amplifier, are demodulated in the video detector and amplified in the video amplifier to actuate the ____________ of the cathode-ray picture tube and produce the picture.

10. The sound and video carriers are transmitted on frequencies exactly ________ mc apart.

11. Because simple synchronizing systems are subject to interference from ignition and other noises, ________________ ________________ __________________ is now always used for the horizontal-deflection system.

12. The horizontal deflection coil which sweeps the ______________ across the face of the tube from ______________ to _______________ is split into two sections.

13. The signal information from the last video amplifier is applied to the __________________ __________________ of the picture tube.

14. Vertical and horizontal wedges of a test pattern are used to adjust the ____________________.

15. The shaded circles in the center of a test pattern are used for adjusting the ____________________ control.

16. The manner in which the circuit is wired depends on the type of ________________ used between the last video amplifier stage and the picture tube grid, as well as the ________________ of the signal.

17. In areas where signal strength is exceptionally strong a ____________________ picture may result.

18. If a negative picture is always present for each station in the area, and if A.G.C. circuits are functioning properly, the ________________ ________________ will have to be replaced.

19. When a defective picture tube cannot be replaced by an identical one, ____________________ _ __________________ available from the manufacturer should be consulted.

20. Manufacturers recommend the use of ________________________ ____________________ and ____________________ whenever picture tubes are handled.

Multiple-Choice

Directions: In the space at the left of each statement, write the letter of the item which will provide the correct answer to complete the statement.

_____ 1. The complete width of a single v-h-f channel is (A) 3 mc; (B) 6 mc; (C) 9 mc; (D) 12 mc.

_____ 2. TV receivers are properly tuned when the response to the picture carrier is (A) 25% of maximum response; (B) 50% of maximum response; (C) 75% of maximum response; (D) 100% of maximum response.

_____ 3. In an a-m signal which is modulated 100% the sidebands each have an intensity equal to what per cent of the carrier? (A) 25%; (B) 50%; (C) 75%; (D) 100%.

_____ 4. Complete picture scans (frames) recur (A) 20 times per second; (B) 30 times per second; (C) 40 times per second; (D) 50 times per second.

_____ 5. The process of returning the beam from the bottom to the top of the picture is known as (A) vertical retrace; (B) horizontal trace; (C) horizontal retrace; (D) vertical trace.

_____ 6. The system of fitting together two alternate sets of lines is known as (A) synchronization; (B) traversing; (C) panning; (D) interlaced scanning.

_____ 7. Poor high frequency responses due to open peaking coils or improperly alinged i-f system will (A) obscure the horizontal wedge and decrease its contrast with respect to the vertical; (B) obscure the horizontal wedge but increase its contrast with respect to the vertical; (C) obscure the vertical wedge and decrease its contrast with respect to the horizontal; (D) obscure both the vertical and horizontal wedges.

_____ 8. In signal tracing of video i-f stages, if the signal generator can be internally modulated by a 400-cycle note, (A) the VTVM can be used and sound bars noted on the screen; (B) the VTVM can be dispensed with and a raster noted on the screen; (C) the VTVM can be dispensed with and sound bars noted on the screen; (D) the VTVM can be used to detect the sound bars.

_____ 9. With direct coupling, or when a DC restorer is used with capacity coupling, the background illumination of the picture tube will be (A) in proportion to the signal strength of the station; (B) in proportion to the intensity picked up by the camera at the television studio; (C) dependent on the setting of the "contrast" control knob; (D) dependent on the quality of the antenna.

_____ 10. In the high-voltage supply, the voltage may reach (A) 5,000 volts; (B) 10,000 volts; (C) 15,000 volts; (D) 30,000 volts.

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. Television broadcasting requires two carriers. They are:

(A) ______________________________

(B) ______________________________

2. Two types of modulation are used in television receivers. They are:

(A) ______________________________

(B) ______________________________

3. A 100 mc FM carrier modulated by a 400-cycle per second tone would have twelve significant side bands (6 lower and 6 upper). They are:

(A) ________________

(B) ________________

(C) ________________

(D) ________________

(E) ________________

(F) ________________

(G) ________________

(H) ________________

(I) ________________

(J) ________________

(K) ________________

(L) ________________

4. Some of the advantages of FM over AM might be summarized as follows:

(A) ________________________________

(B) ________________________________

(C) ________________________________

(D) ________________________________

(E) ________________________________

5. Three advantages of transistors over vacuum tubes are:

(A) ________________________________

(B) ________________________________

(C) ________________________________

6. The triode type transistor has one lead known as the emitter, one known as the base, and one known as the collector which compare to the following parts of a vacuum tube of the same function respectively:

(A) ________________

(B) ________________

(C) ________________

7. Three basic circuits, irrespective of transistor types are:

(A) ________________________________

(B) ________________________________

(C) ________________________________

8. A number of troubles of an elementary nature common to both television and radio receivers are:

(A) ______________________________________

(B) ______________________________________

(C) ______________________________________

(D) ______________________________________

9. Most noise suppression circuits consist of a diode, a triode, or a transistor, and may be referred to as:

(A) ______________________________________

(B) ______________________________________

(C) ______________________________________

(D) ______________________________________

10. When repairing a completely dead receiver, the technician should look in one of the following two sections:

(A) ______________________________________

____

(B) ______________________________________

11. Virtually all receivers have a separately shielded high-voltage compartment which houses the:

(A) ______________________________________

(B) ______________________________________

(C) ______________________________________

(D) ______________________________________

12. Distortions of received picture may be divided into the following three classes:

(A) ____________________ (C) ____________________

(B) ____________________

13. The types of picture interference are:

(A) ______________________________

(B) ______________________________

(C) ______________________________

(D) ______________________________

14. If the picture is present with no sound, possible defects or trouble may be in the:

(A) ______________ (C) ______________

(B) ______________ (D) ______________

15. The oscilloscope is a useful and informative instrument for:

(A) ______________________________

(B) ______________________________

(C) ______________________________

(D) ______________________________

Problems

Directions: Read each of the following problems carefully. Do the specific operations which each questions requires for proper solution. You may wish to refer to the reading assignment before proceeding with the problems.

1. Make a block diagram of a conventional TV receiver. Label all the parts.

2. Make a block diagram of the various controls of a TV receiver, showing the section to which each is most closely related. Label all the parts.

Assignment
Sheet No. 34

Covering
Units 188-203

TELEVISION REALIGNMENT

In order that the various sections of the television receiver function according to specifications, realignment of one or all of various stages may be necessary.

In this unit you will have the opportunity to learn about the various techniques and procedures of television realignment.

Assignment:

1. Read the reference listed below.
2. Answer the questions listed below and turn in your work by ____________________.

Reference:

D. Mandl, Mandl's Television Servicing, pp. 363-378.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T". If it is false, draw a circle around the letter "F".

T F 1. Front ends of television sets differ to a considerable extent and no two receivers are aligned in exactly the same sequence or procedure.

T F 2. The general rule to follow is: If in doubt, realign.

T F 3. The experienced technician has little difficulty in determining whether a receiver needs realignment procedures instead of other troubleshooting techniques.

T F 4. Many times technicians fail to achieve desired results in aligning even though they follow the manufacturer's service notes in detail.

T F 5. Servicemen should remember that needed alignment is always obvious and that other circuit defects cannot cause symptoms of misalignment.

T F 6. Tracking of television receiver front ends can be done successfully with the average television repair equipment.

T F 7. The marker generator is really a single signal generator.

T F 8. Sweep generators may overload circuits being tested but markers have a built-in overload protector circuit.

T F 9. Improper setting of traps may result in trapping out frequencies which are part of the desired response curve.

T F 10. The Simpson VOM has DC and AC ranges from 5000 volts to 30,000 volts to take care of the high voltage circuits.

T F 11. To check the frequency of the marker generator for accuracy, one must have it tested by the Bureau of Standards.

T F 12. The alignment procedures for various sets differ, but certain precautions apply to any alignment or tracking procedures involving sweep and marker generators.

T F 13. The National Bureau of Standards operates a radio station.

T F 14. A television serviceman cannot procure an actual visual indication of amplifier response.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. The sweep generator alone is ____________ ____________ ____________ the strict frequency requirements encountered in television and FM work.

2. The marker generator is really a ____________ ____________ ____________.

3. To prevent interaction between the marker generator and the sweep generator it is better to inject the marker signal--preferably a ____________ ____________ of the sweep generator.

4. Marker generators have ____________ adjustments by which the frequency indicated on the dial can be accurately adjusted and calibrated.

5. The process of calibration of a marker generator is to ____________ the marker signal generator with another generator of known accuracy.

6. The marker generator can also be calibrated against the transmission sent out by station ____________ or any ____________ ____________ ____________ of known frequency.

7. The grounding of all test equipment is a necessity for good results but precautions must be observed with respect to ____________ chassis.

8. Make sure test equipment has been turned on from ____________ to ____________ minutes before being put to actual use.

9. Commercial linearity adjustment generators use two oscillators, one below the ______________ sweep to produce a series of ______________ bars and one above ________________ to produce the ________________ bars.

10. ________________ effect and ________________ effect are defects caused by shorted turns in the yoke or by an improperly designed or matched yoke.

Multiple-Choice

Directions: In the space at the left of each statement write the letter of the item which will provide the correct answer to complete the statement.

_____ 1. The essential differences between the marker generator and the single signal generator are: (A) the single signal generator has a lower frequency and thereby, accuracy of a higher order than does the marker generator; (B) the marker generator has a much higher frequency range and accuracy of a higher order than does the single signal generator; (C) the single signal generator has a much higher frequency range and accuracy of a higher order than does the marker generator; (D) the marker generator has a much higher frequency range than the single signal generator but the accuracy of both are of equally high order.

_____ 2. At those places where the trap circuits of the receiver are giving spots of decreased gain, the marker indication will be (A) much larger in amplitude than on the normal portion of the response curve; (B) missing from the normal portion of the response curve; (C) visible intermittently on either end of the response curve; (D) much smaller in amplitude than on the normal portion of the response curve.

_____ 3. Excessive marker signal amplitude will (A) give a sharp response curve and very accurate band-pass indications; (B) give a ghost response curve and incorrect band-pass indications; (C) break up the response curve and give incorrect band-pass indications; (D) break up the response curve but will not affect the accuracy of the band-pass indications.

_____ 4. When using the "sweep sync" output of the sweep generator to sweep the horizontal trace of the oscilloscope, be sure to (A) shut off the internal sweep of the scope but not the horizontal sweep amplifier; (B) shut off both the internal sweep of the scope and the horizontal sweep amplifier; (C) shut off the horizontal sweep amplifier but not the internal sweep of the scope; (D) shut off the internal sweep of the scope for 3 minutes then turn on again.

_____ 5. For television servicing it is desirable to use meters which have (A) high input impedance to load circuits under test to prevent blooming; (B) low input impedance to avoid loading down the circuits under test; (C) high output impedance to avoid loading down the circuits under test; (D) high input impedance to avoid loading down the circuits under test.

_____ 6. The pincushioning effect can be produced when the corrector magnets (A) are out of adjustment on those sets which use them; (B) are properly adjusted on those sets which use them; (C) are grounded to the yoke housing; (D) are in phase with the raster.

_____ 7. To adjust the pincushion magnets (A) reduce the raster size and adjust to obtain pincushioning; (B) reduce the raster size until all 4 sides are visible then adjust for slight barrel effect; (C) reduce the raster size until all 4 sides are visible then adjust to straighten the raster sides and eliminate pincushioning; (D) increase raster size until barrel effect is obtained then adjust to straighten the raster and eliminate the barrel effect.

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. Three resonant circuits which can be used to give marker indications on the response curves traced on the oscilloscope screen are:

(A) ____________________ (C) ____________________

(B) ____________________

2. The types of markers which are incorporated within sweep generators may be:

(A) ____

(B) ____

3. Some important factors often overlooked when aligning i-f stages and which because of this, cause much difficulty are:

(A) ____

(B) ____

____

(C) ____

(D) ____

____

4. When aligning video on FM i-f stages, two precautions should be observed:

(A) ____

____

(B) ____

____

5. A general rule to follow is to use the sweep generator, marker, and scope in the following sequence for tracking and alignment procedures:

(A) ____

(B) ____

(C) ____

(D) ____

(E) ____

____

Assignment
Sheet No. 35

Covering
Units 204-207

COLOR TELEVISION

After much experimentation a system of color television transmission and reception has been designed which the FCC has approved. One of the main problems involved was designing a system which would permit the reception of black and white transmissions when color transmissions were not scheduled.

As manufacturing processes and methods bring color television sets within the present market of black and white receivers, more and more of the technician's work will involve the service and repair of color television receivers.

In this unit you will have the opportunity to learn the theory of the present system of color transmission and reception as the theory applies to service techniques and knowledge.

Assignment:

1. Read the reference listed below.
2. Answer the questions listed below. Turn in your work by ____________________.

Reference:

D. Mandl, Mandl's Television Servicing, pp. 380-415.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T". If it is false, draw a circle around the letter "F".

T F 1. Color transmissions, in respect to bandwidth, separation between video and sound carriers, and the scanning process, are quite different from those used in black and white sets.

T F 2. The color subcarrier is modulated by the color components to form the sidebands, but the carrier itself is not transmitted.

T F 3. The Q signal is transmitted as a double-sideband signal, each sideband 500 kilocycles distant from suppressed subcarrier frequency.

T F 4. On a monochrome reciever, the color signal becomes the conventional black-and-white picture.

T F 5. Color television receivers use a separate detector to take the sound off prior to the video detector.

T F 6. The color receiver uses the conventional sync-separator and syn-amplifier stages as black-and-white receivers.

T F 7. In color television receivers it is necessary to take the 3.58-mc burst frequency which occurs during the back porch of a horizontal blanking and apply this to the proper a-f-c circuit.

T F 8. Resistors used at the grid of the demodulators minimize parasitic oscillations.

T F 9. The color and black and white receivers have the same type and number of circuits.

T F 10. A subcarrier used in color sets is an odd multiple of one half the horizontal sweep frequencies.

T F 11. Tolerances for resistors in the matrix circuits should be five per cent or less.

T F 12. To reduce the number of color signals necessary for modulating the carrier, the individual color singals are then changed to I and Q signals with definite phase relationships relating to color hues.

T F 13. The bandpass amplifier is employed between the audio amplifier section of a color TV receiver and the demodulators.

T F 14. A sweep generator with a flat output and an accurate marker generator are essential for color television servicing.

T F 15. The absence of raster but presence of sound indicates lack of high voltage.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. Color transmission uses ______________________ for the horizontal scan frequency.

2. The color television camera at the transmitting station uses an optical system which filters from a televised scene the three primary colors of _____________, ______________, and _______________.

3. The color receiver must have an adequate bandpass to accomodate the flat portion of the signals which extend to _________megacycles.

4. Following the video detector, a __________-band ___________ amplifier is used.

5. The matrix circuits are composed of ____________________ which mix each of the color signal components in proper proportions with the luminance signals in order to derive the individual red, blue, and green signals.

6. A gating circuit tube acts as a gate for permitting the ____________ ________________ to be transferred across the tube and also ________________ the burst signal.

7. The 3.58-mc oscillator of a color television receiver may be checked by means of the bias which exists between _____________ and ___________________.

8. Inability of the reactance tube to hold the 3.58-mc oscillator may be caused by insufficient _____________ ___________________ from the video amplifier.

9. The demodulators must mix the chrominance signals with the generated _____________________, and for this reason it is essential that their conversion gain be at a _____________level.

10. The green color is restored by mixing the Q and I signals with the Y signals in a resistive network called a ________________.

11. The phosphor on the inside of a 3-gun color tube is made up of a _____________ pattern.

12. A phase detector, or ________________________ compares the phase of the __________________ burst frequency with that from the 3.58-mc oscillator.

Multiple-Choice

Directions: In the space at the left of each statement, write the letter of the item which will provide the correct answer to complete the statement.

_____ 1. Color information is added to the regular carrier as a subcarrier with a frequency of (A) 1.58 mc; (B) 2.58 mc; (C) 3.58 mc; (D) 4.58 mc.

_____ 2. The color receiver has an oscillator which generates a precise frequency in synchronization with the sub-carrier generators at the transmitter. This precise frequency is (A) 1.58 mc; (B) 2.58 mc; (C) 3.58 mc; (D) 4.58 mc.

_____ 3. The most common trouble which will be experienced in both the burst amplifier and the band pass amplifier are (A) losing sync; (B) losing alignment: (C) tube failures; (D) capacitor failures.

_____ 4. Low emission from the Q demodulator affects the rendition of (A) red; (B) blue; (C) green (D) all of the above.

_____ 5. The instrument to use in checking relative polarities of signals at each individual matrix circuit is the (A) VTVM; (B) ohmmeter; (C) signal generator; (D) oscilloscope.

_____ 6. If the beam from one color gun is permitted to strike a phosphor dot of a different color, (A) the signal voltage will drop; (B) polarity will change; (C) parasitic oscillations will increase; (D) incorrect color rendition will result.

_____ 7. Because both the burst amplifier and the bandpass amplifier have applied to them gating pulses for periodic tube cutoff, failure of the keying or blanking pulses will cause the circuit to (A) overheat; (B) remain in oscillation; (C) oscillate intermittently; (D) be inoperative.

_____ 8. A VTVM used in color television servicing must be capable of measuring a potential of (A) 0-5,000 volts; (B) 5,000-10,000 volts; (C) 20,000-30,000 volts; (D) 40,000-50,000 volts.

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. The wide-band video amplifier installed after the video detector has two primary functions. They are to handle the:

(A) ______________________________ (B) ______________________________

2. There are two basic commercial color demodulator systems in general usage. They are:

(A) ____

(B) ____

3. Use of a cathode resistor in the color demodulator without an accompanying bypass capacitor results in:

(A) ______________________________ (B) ______________________________

4. The outputs of the demodulators provide signals which indicate:

(A) ____

(B) ____

Assignment
Sheet No. 36

Covering
Units 208-210

RECORD CHANGERS

The recent upswing in popular interest for high fidelity reproduction has centered manufacturers' attention on the production of many types and styles of record changers. If the technician is to keep on top of his job, he must be aware of these manufactured changes almost as they occur.

In this unit you will have the opportunity to learn some of the basic servicing techniques that apply to record changers.

Assignment:

1. Read the reference listed below.
2. Answer the questions listed below and turn in your work by _________________.
3. Prepare a record changer troubleshooting chart in which you list the trouble, possible causes of the trouble, and remedies.

Reference:

C. Marcus and Levy, Elements of Radio Servicing, pp. 248-279.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T". If it is false, draw a circle around the letter "F".

T F 1. High fidelity reproduction of music has led to a refinement of standard radio receivers.

T F 2. Record changer motors are so designed that they must be operated only on the voltage indicated on the service plate.

T F 3. The cutting stylus used in cutting records is forced, by electric currents that pass through an a-f amplifier, to vibrate vertically at the varying audio frequencies as it cuts the record.

T F 4. Magnetic pickups exert a very light pressure on records.

T F 5. A stroboscope disc is used for determining whether a record changer is level.

T F 6. Changer base plates and pickup arms must be insulated from common negative to avoid shock hazard.

T F 7. Only the more expensive phonographs are equipped with tone controls.

T F 8. The servicing of phonograph motors and record changers is a field in itself.

T F 9. When replacing shielded cable, be sure to solder the shielding in the middle of the lead to the chassis.

T F 10. When it becomes necessary to flip the radio-phonograph switch two or three times before positive contact takes place, a worn out switch is indicated.

T F 11. A characteristic of the push-pull stage is that it may increase even-harmonic distortion if it is not damped.

T F 12. An open output-transformer primary is a common trouble of the push-pull amplifier.

T F 13. An ordinary phonograph may be converted to high-fidelity by adding one or more speakers of the type found in the set.

T F 14. It is much easier to determine the faulty channel on a stereo amplifier with a center speaker than on one with a central speaker.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. In phonograph playback, the vibrating needle acts on a ________________, ________________, or ________________ cartridge.

2. The crystal and the ceramic pickup cartridges of the phonograph produce an average audio signal output of about ________ volt(s).

3. Needle scratch is in the __________ audio-frequencies; therefore, in one-stage phonographs, turning the control knob toward __________ reduces scratch noise.

4. The light source to be used in conjunction with the stroboscope disc can be either the ________________ or ____________ types.

5. When using the stroboscopic disk, if the proper circle of dots remains stationary for the most part but shows a periodic jump for some of the dots, erratic action of the _____________ or ________________ ________________ is indicated.

6. Rumble may be caused by inadequate ________________ or ____________ ________________.

7. The last audio or power stage in high-fidelity home audio systems is generally a ________________ ________________.

8. The push-pull stage amplifies at ______________ frequencies with a ______________ power output and with little ______________________ and __________________.

9. Because ____________________________ distortion is reduced or eliminated in a push-pull stage, the tubes may be overloaded somewhat without ________________________.

10. Transformer-coupled push-pull amplifiers are very common in ______________ receivers and are still used in _____________________ receivers.

11. In order to get the 180-degree phase difference of signal voltage fed to the push-pull grids, in sets where resistance-capacitance couplings are used in place of transformers, a tube known as the _____________________________ is used.

12. For a defective output transformer, an exact replacement is recommended but when such a replacement is not possible, a ___________________ ___________________ output transformer may be used.

13. The only cause for trouble in the inverter is a _______________ __________ __________________ ___________________.

14. In replacing a speaker in a single speaker set, the polarity of the speaker is ______________________.

15. Connecting a multispeaker system correctly is known as _____________.

16. Tone controls are generally placed between a ___________ of ______________ in the amplifier.

17. When the balance control must be reset for every position of the loudness control on stereo systems, the problem almost always is due to ________________ _______________ in the loudness control.

18. The best position for a listener when listening to stereo-phonic recordings is between the ____________________ _________________ and ____________ the ________________ from them.

19. Low-frequency sounds are not ____________________ and do not require ______________________ to obtain the stereophonic effect.

20. Large AM/FM radio-stereo-phono combinations are generally built up of several individual chassis interconnected by ________________ __________________ and __________________ ________________.

Multiple-Choice

Directions: In the space at the left of each statement, write the letter of the item which will provide the correct answer to complete the statement.

_____ 1. The turn table in most common use in inexpensive players is the (A) manual; (B) semi-automatic; (C) fully automatic; (D) combination.

_____ 2. There are special high-output crystal cartridges which produce up to (A) 3 volts of audio output; (B) 6 volts of audio output; (C) 110 volts of audio output; (D) 220 volts of audio output.

_____ 3. For better hum elimination, practically all phonographs use at least a (A) one-section filter; (B) two-section filter; (C) three-section filter; (D) four-section filter.

_____ 4. When a phonograph motor fails to operate, the serviceman should check the (A) line switch and wiring; (B) field and armature windings; (C) brushes; (D) motor for dust and dirt.

_____ 5. With a push-pull amplifier, a simple method of obtaining the 180 degree phase difference for the two grids, as well as equal voltage, is by means of a(n) (A) i-f stage; (B) phase inverter; (C) phase detector; (D) center-tapped transformer.

_____ 6. If the output of the record changer seems very low or there is no output at all, the (A) motor should be checked; (B) line-cord should be checked; (C) drive mechanism should be checked; (D) pickup operation should be checked.

_____ 7. Four-unit speaker systems generally consist of (A) two "woofers" and two "tweeters"; (B) one "woofer", one "tweeter", and two mid-range speakers; (C) two "woofers", one "tweeter", and one mid-range speaker; (D) one "woofer", one mid-range speaker, and two "tweeters".

_____ 8. If a stereo set is dead, the trouble is almost sure to be in (A) the common power supply; (B) the switch; (C) the speakers; (D) one of the tubes.

_____ 9. When servicing an AM/FM stereo phonograph combination, which is dead on all functions, one should first (A) check pickup and input circuit; (B) check power supply; (C) check tuner; (D) check amplifier and speaker.

_____ 10. When servicing an AM/FM monaural combination which is exhibiting distortion on all functions, one should first (A) check power supply, amplifier, and patch cords for open; (B) check pickup and input circuit; (C) check tuner; (D) check amplifier and speaker.

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. Two classifications of phongraph players and home audio systems according to types of records are:

(A) ______________________ (B) ______________________

2. A monaural phonograph consists basically of:

(A) ______________________________

(B) ______________________________

(C) ______________________________

(D) ______________________________

3. Most record changers operate at speeds of:

(A) ______________ (C) ______________

(B) ______________ (D) ______________

4. Common troubles to be considered when servicing phonographs and radio-phonograph combinations are troubles with the:

(A) ______________ (C) ______________

(B) ______________ (D) ______________

5. When flexible shielded cable is found to be defective, it is best to replace the cable by making up a new cable in the following manner:

(A) ______________________________

(B) ______________________________

(C) ______________________________

(D) ______________________________

____

____

(E) ______________________________

____

(F) ______________________________

(G) ______________________________

(H) ______________________________

6. When a radio phonograph switch needs cleaning, one may do so effectively by:

(A) ______________________________

(B) ______________________________

7. The push-pull amplifier generally performs the following functions:

(A) ____

____

(B) ____

(C) ____

Assignment
Sheet No. 37

Covering
Units 213-218

AUTOMOBILE RECEIVERS

With many new model cars being manufactured with radios as standard equipment, plus the many older model cars which have had radios installed sometime in the past, a large proportion of the automobiles today now are equipped with radios.

The technician will do well to know the various service techniques and skills which apply specifically to automobile receivers.

Assignment:

1. Read the reference listed below.
2. Answer the questions listed below. Turn in your work by ________________________.

Reference:

C. Marcus and Levy, Elements of Radio Servicing, pp. 319-350.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T". If it is false, draw a circle around the letter "F".

T F 1. In all cars the negative terminal of the storage battery is grounded.

T F 2. If a fuse which has been replaced also burns out, this indicates a fuse of a higher amperage should be used.

T F 3. The all-transistor auto radio is a superheterodyne circuit.

T F 4. Since auto radios operate on battery power and these batteries are of either 6 volts or 12 volts, there is no need for a fuse between the battery-plus lead and the battery.

T F 5. The spark plate is a choke that serves to filter out ignition noise.

T F 6. To compensate for different antenna installations with different antenna capacitances, there is an adjustment in the radio cabinet.

T F 7. Resistors which are added to the vibrator circuit to prevent voltage peaks in the primary are, as a result of the sudden changes of current in the inductance, subject to frequent replacement.

T F 8. The case of the transistor of the r-f amplifier stage is grounded in transistorized auto radios.

T F 9. A frequent service problem is the replacement of the buffer capacitor.

T F 10. Vibrators are seldom a source of trouble in car receivers.

T F 11. Generally speaking, resistances are larger and capacitances are smaller in transistor circuits than in tube circuits.

T F 12. Because of the expense involved, it is almost always better to repair a vibrator rather than replace it.

T F 13. A good vibrator will start only at the voltage specified, never lower.

T F 14. Push-button tuning systems employ a tuning stage with a special capacitor and tube or transistor for immediate selection of a desired station.

T F 15. The general procedure in alignment of auto radios is to begin with the i-f circuit and work back to the antenna.

T F 16. In checking to see if the vibrator power supply is working normally, if we have all tubes lit, a B+ voltage of 150 to 250 and no vibrator buzz, we may logically suspect the hash-suppression circuits.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. In addition to the newer 12-volt systems presently used in new cars, many older model cars will have receivers with a low voltage of ___________ volts.

2. The first possibility of trouble in an antenna input circuit is that the antenna becomes grounded to the ___________ ___________ through its ____________________.

3. Because of the relatively low out-put impedance of the transistors, there is no out-put ________________________.

4. If it should become necessary to replace the speaker on a transistor auto radio, it is important to use a similar one for proper ________________ ________________ and ________________ operation.

5. The vibrator of a car radio acts as a _____________.

6. Most vibrators are designed so that the vibration takes place at about _____________cps.

7. When a receiver is dead and the trouble is traced to the output stage, a likely cause is a(n) ____________________ __________ ______ ____________________________.

8. Two devices for noise pick-up reduction which may be employed by service men, other than those devices incorporated in the receiver, are _______________ _______________ _____________ and ____ ____.

9. Cars that use alternators, instead of generators, do not require a __________________ across the alternator.

10. When trouble shooting the vibrator in older-style sets, the rectifier tube may exhibit the usual malfunctions of _________________ ___ _________________________________and/or ______________________ leakage.

11. Leakage of the cathode-heater is definitely indicated when there is no _____________________, the _________________ is working, there is a heavy _________________current drain, but there is some ______ voltage at the ___________________ plates.

12. If the search tuner searches but fails to bring in any station, yet the receiver works manually, the trouble probably is in the _____________________ ____________________.

Multiple-Choice

Directions: In the space at the left of each statement, write the letter of the item which will provide the correct answer to complete the statement.

_____ 1. The device which is first used to filter out generator interference is a (A) spark-plate capacitor; (B) paper-type capacitor; (C) dry-plate rectifier; (D) variable capacitor.

_____ 2. The primary purpose of the vibrator is to (A) convert AC to DC; (B) convert DC to AC; (C) provide a sound check for the technician to determine if voltage is present; (D) act as a filter choke.

_____ 3. Buffer capacitors, because of their use, may be replaced by (A) components of a higher value; (B) components of a lower value; (C) components of the same value; (D) a spark-plate capacitor.

_____ 4. Most intermittent conditions in car receivers arise from (A) a weak battery; (B) loose wires; (C) defective capacitors or resistors; (D) poor starting of the vibrator.

_____ 5. If a normal amount of hash and no signals are heard from the speaker and random noise is present, the trouble is likely to be in the (A) vibrator; (B) speaker; (C) a-f circuit; (D) antenna.

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. The design of parts for auto and home radios which are the same are:

(A) ________________ (D) ________________

(B) ________________ (E) ________________

(C) ________________ (F) ________________

2. List 4 problems encountered when considering the design of the antenna input circuit to a car radio.

(A) ________________________________

(B) ________________________________

____

(C) ________________________________

(D) ________________________________

____

3. Distortion may occur in the receiver from the driver stage as a result of:

(A) ________________________________

(B) ________________________________

(C) ________________________________

4. When all voltages are low or at zero, the hot battery line is open or has developed a resistance. The service man should check for:

(A) ________________ (D) ________________

(B) ________________ (E) ________________

(C) ________________

5. The purpose of the buffer capacitor is to:

(A) ________________________________

(B) ________________________________

____

6. The best points for bonding ground straps to insure good electrical bonding are from the:

(A) ______________________________

(B) ______________________________

(C) ______________________________

(D) ______________________________

____

7. Vibrators may usually fail for either of two reasons:

(A) ______________________________

(B) ______________________________

Information
Sheet No. 1

THE RADIO-TELEVISION TECHNICIAN AND HIS JOB

One of the most important factors which will contribute to your success or failure as a beginning radio-television technician will be your ability to locate a defect in the quickest possible time. The actual time you spend in repairing or replacing the defect will often be much shorter than the time spent in finding it.

Once a receiver has been repaired or put back in top-notch condition, a fair and just customer-cost will have to be calculated, keeping in mind wages, shop overhead, wear on equipment, etc. Customers will soon know that your charges are fair or unfair, and your business will prosper accordingly. The radio-television technician must also, in addition to being a serviceman, be a businessman.

Generally speaking, the technician may work an eight-hour day in the shop or on "house calls". It may well be, however, that night service calls will have to be made when the occasion arises.

The financial return which a radio-television technician may expect will vary greatly with locality and type of employment. You may be starting work in a one-man shop where your salary is all that is left after rent, materials, supplies, insurance, new test equipment, advertising, and the like are paid for; or, you may begin work in a large repair house where your work hours and salary are fairly stable.

The working conditions which the radio-television technician has are generally good. Since there is a danger of high and low voltage shock, the experienced technician should not become too complacent about working with such voltages. Generally, heating and lighting are adequate.

Good health and personal appearance are also very important in any occupation in which the worker deals with the public. You should always present a neat and clean appearance, and your shop should be kept in the same manner. Although good health is important, it should be stressed that greater than average physical strength is seldom required, and average vision and hearing are sufficient.

Personal interests are of importance for the prospective radio and television serviceman. This occupation seldom involves vigorous exercise; it is generally indoor work with a small amount of outdoor activity. The hours are usually regular and the working day is the same as in other occupations of this nature; ordinarily, this is eight hours per day. Any student who is interested in scientific and theoretical subjects which must be analyzed to be understood should find radio and television servicing an interesting vocation. This interest should be deep enough to enable him to study radio and television theory and new developments without any feeling of boredom, because this knowledge is necessary for success.

TRAINING PLAN AND PROGRESS RECORD
for
RADIO AND TELEVISION SERVICING

Employer's Copy

JOB TRAINING: What the Worker Should Be Able to Do	Proficiency Shown	RELATED INFORMATION: What the Worker Should Know
Fundamental Radio and Electrical Theory		
Read resistor and capacitor codes, calculate resistance, voltage, current, and impedance, read schematic diagrams, and replace parts in the voltage divider Time in hours ________	☒	The nature of radio waves, the electron theory, alternating current theory, series and parallel circuits, and magnetism
Theory, Design, and Servicing of Radio and Television Components		
Ascertain tube characteristics from tube manual, check tubes, replace batteries in portable receivers, diagnose and remedy troubles in power supplies, recognize and repair common speaker troubles Time in hours ________	☒	The use of resistors, reproducers, inductors, transistors, and switches in radio and television circuits, how tube checkers operate, tube numbering system and ratings, power supplies used in radio and television receivers, and theory of loudspeakers
Test Equipment and General Servicing Techniques for Radio and Television		
Install output transformer, determine if first audio stage is normal, read and interpret RC amplifier design tables, and correct troubles in various stages Time in hours ________	☒	Typical circuits for first audio stages, amplifier circuits and design and typical troubles of push-pull, R.F., and audio stages
Characteristics and Uses of Electron Tubes		
Read and interpret tube characteristic curves, identify and correct power stage troubles and troubles in the converter stage Time in hours ________	☒	The characteristics and uses of electron tubes, functions of typical components in power stages, and commonly encountered power audio stage troubles

Control Circuits

Recognize and correct troubles in control circuits and in the second detector AVC stage

Time in hours ___________

☒

Theory, design and typical troubles of control circuits

Theory and Servicing of FM Receivers

Analyze FM receivers, install FM tuners, make alignments, and locate and correct troubles in FM receivers

Time in hours ___________

☒

Fundamentals of frequency modulation, fundamental FM receiver circuits, and FM receiver alignment procedure

Theory and Servicing of Television Receivers

Correct troubles in the tuning indicators, check and adjust vertical and horizontal systems, adjust controls, make alignments, and diagnose and remedy television interference

Time in hours ___________

☒

Theory and design of television components, types of circuits employed in television receivers, typical troubles in sweep systems, functions and operating characteristics of controls, alignment procedures, the nature of video waves, and general trouble shooting techniques

Color Television

Check phase relation between I and Q signals with color-bar generator

Time in hours ___________

☒

Theory of color transmission, troubles typical of color television, circuits and test equipment peculiar to color television

Record Changers

Correct troubles peculiar to radio-phonograph combinations, and repair and adjust turntables and record changers

Time in hours ___________

☒

Typical troubles of radio-phonograph combinations

Code for employer's use in marking student's progress:

Performed some operations in area ◩

Performed some operations with reasonable proficiency ⬒

Performed most operations in area ◪

Performed most operations satisfactorily ■

TRAINING PLAN AND PROGRESS RECORD
for
RADIO AND TELEVISION SERVICING

Student's Copy

<table>
<tr><th>JOB TRAINING: What the Worker Should Be Able to Do</th><th>Proficiency Shown</th><th>RELATED INFORMATION: What the Worker Should Know</th></tr>
<tr><td colspan="3">Fundamental Radio and Electrical Theory</td></tr>
<tr><td>Read resistor and capacitor codes, calculate resistance, voltage, current, and impedance, read schematic diagrams, and replace parts in the voltage divider
Time in hours ________</td><td>☒</td><td>The nature of radio waves, the electron theory, alternating current theory, series and parallel circuits, and magnetism</td></tr>
<tr><td colspan="3">Theory, Design, and Servicing of Radio and Television Components</td></tr>
<tr><td>Ascertain tube characteristics from tube manual, check tubes, replace batteries in portable receivers, diagnose and remedy troubles in power supplies, recognize and repair common speaker troubles
Time in hours ________</td><td>☒</td><td>The use of resistors, reproducers, inductors, transistors, and switches in radio and television circuits, how tube checkers operate, tube numbering systems and ratings, power supplies used in radio and television receivers, and theory of loudspeakers</td></tr>
<tr><td colspan="3">Test Equipment and General Servicing Techniques for Radio and Television</td></tr>
<tr><td>Install output transformer, determine if first audio stage is normal, read and interpret RC amplifier design tables, and correct troubles in various stages
Time in hours ________</td><td>☒</td><td>Typical circuits for first audio stages, amplifier circuits and design and typical troubles of push-pull, R.F., and audio stages</td></tr>
<tr><td colspan="3">Characteristics and Uses of Electron Tubes</td></tr>
<tr><td>Read and interpret tube characteristic curves, identify and correct power stage troubles and troubles in the converter stage
Time in hours ________</td><td>☒</td><td>The characteristics and uses of electron tubes, functions of typical components in power stages, and commonly encountered power audio stage troubles</td></tr>
</table>

Control Circuits

Recognize and correct troubles in control circuits and in the second detector-AVC stage Time in hours ________	☒	Theory, design and typical troubles of control circuits

Theory and Servicing of FM Receivers

Analyze FM receivers, install FM tuners, make alignments, and locate and correct troubles in FM receivers Time in hours ________	☒	Fundamentals of frequency modulation, fundamental FM receiver circuits, and FM receiver alignment procedure

Theory and Servicing of Television Receivers

Correct troubles in the tuning indicators, check and adjust vertical and horizontal systems, adjust controls, make alignments, and diagnose and remedy television interference Time in hours ________	☒	Theory and design of television components, types of circuits employed in television receivers, typical troubles in sweep systems, functions and operating characteristics of controls, alignment procedures, the nature of video waves, and general trouble shooting techniques

Color Television

Check phase relation between I and Q signals with color-bar generator Time in hours ________	☒	Theory of color transmission, troubles typical of color television, circuits and test equipment peculiar to color television

Record Changers

Correct troubles peculiar to radio-phonograph combinations, and repair and adjust turntables and record changers Time in hours ________	☒	Typical troubles of radio-phonograph combinations

---

Code for employer's use in marking student's progress:

Performed some operations in area	☒	Performed some operations with reasonable proficiency	▨
Performed most operations in area	▨	Performed most operations satisfactorily	▨

TRAINING PLAN AND PROGRESS RECORD
for
RADIO AND TELEVISION SERVICING

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Performed most operations in area	◪	Performed most operations satisfactorily	■

VT003 491

VT 003 491
A Guide for Use in Developing Training Programs in Vocational Welding (Combination).

Mississippi State Univ., State College. Curriculum Lab.
Mississippi State Dept. of Vocat. Educ., State College
Pub Date - Feb67
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*CURRICULUM GUIDES, *TRADE AND INDUSTRIAL EDUCATION, *WELDERS, *WELDING, HIGH SCHOOLS, POST SECONDARY EDUCATION, EQUIPMENT,

This curriculum guide was prepared to assist the trade instructor in planning and developing a welding course to prepare high school vocational students for entry-level occupation as a combination welder. The material was developed by a curriculum committee from a trade analysis involving welded joints, welding positions, and types of metals to be joined. Instructional blocks are (1) Layout, (2) Oxyacetylene, (3) Burning (Oxyacetylene Cutting), (4) Brazing and Soldering, (5) Manual Metal Arc, (6) Heliarc (Tig), (7) Manual Inert Gas, and (8) Short Arc. Job sheets within each block include (1) a job assignment, (2) references, (3) trade principles, (4) equipment, (5) tools and supplies, (6) safety, and (7) trade practices. Related instruction outlines cover (1) Introduction to Welding, (2) Oxyacetylene Welding, (3) Basic Metallurgy, (4) Welds, Joints, and Positions, and (5) Blueprint Reading. The course is designed as a 2-year program with 1,080 hours of training to be taught by a teacher with at least 2 years of work experience beyond the learner's level. The program is for students who want, need, and are able to profit from instruction and who have made a definite vocational choice. Equipment and consumable supplies are listed, and a bibliography contains instructor's references, recommended textbooks, and reference books. This document is available for $2.00 from Curriculum Laboratory, Box NU, State College, Mississippi 39762. (HC)

A Guide
in

VOCATIONAL WELDING
-Combination-

PRELIMINARY DRAFT -- FOR DISCUSSION ONLY

Prepared and Issued by the
CURRICULUM LABORATORY
TRADE AND TECHNICAL EDUCATION
STATE DEPARTMENT OF VOCATIONAL AND TECHNICAL EDUCATION
Jackson, Mississippi

Located in the
DEPARTMENT OF INDUSTRIAL EDUCATION
MISSISSIPPI STATE UNIVERSITY
State College, Mississippi

A GUIDE

For Use in Developing Training Programs

in

VOCATIONAL WELDING (COMBINATION)

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MISSISSIPPI STATE UNIVERSITY
State College, Mississippi

MEMORANDUM

TO: The ERIC Clearinghouse on Vocational and Technical Education
The Ohio State University
980 Kinnear Road
Columbus, Ohio 43212

FROM: (Person) Robert D. Sartin (Agency) Curriculum Laboratory

(Address) P. O. Drawer NU, State College, Mississippi 39762

DATE: September 11, 1967

RE: (Author, Title, Publisher, Date) Mississippi Curriculum Laboratory,

A GUIDE IN VOCATIONAL WELDING - (COMBINATION)

State College, Miss: Curriculum Laboratory of the State Department of Vocational and Technical Education, Mississippi State University, 1967

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DEPARTMENT OF INDUSTRIAL EDUCATION
MISSISSIPPI STATE UNIVERSITY
State College, Mississippi

FOREWORD

Training for a trade has come to be a practice in which a qualified instructor (1) presents to the trainee special information (related instruction) and (2) directs the trainee in applying the information (skill building) to jobs performed in a shop. The development of skills is given the major emphasis as reflected by the large percentage of total training time devoted to shop work. During this time, every effort is made to provide trainees with assignments identical with on-the-job responsibilities in the trade or resembling those of actual employment as closely as possible. Since the combination welder is a very highly skilled tradesman, skill building is doubly important. Many hours must be invested in repetitive practice to develop satisfactory technique. The correct balance between these two types of instruction is important. Authorities in the field recommend that about one hour in five be devoted to related instruction. This 20 percent figure means that a little over 200 clock hours of total training time is considered adequate.

The decision as to exactly when to make the presentation of related instruction is another problem. Ideally, related information should be given at that point where it is of greatest benefit. Generally, this is immediately prior to application. However, much of the related instruction is not immediately applicable, but is of a broad nature and designed to give the trainee a strong foundation. Care should be taken to avoid lengthy lecture sessions when presenting this type of information. Experience has shown that trade trainees neither respond to nor profit from lengthy lectures nor to information far removed from its application. Some of the related information can be given in an orientation period, prior to any skill development. Other parts can then be intermittently dispersed as shop work progresses.

To encourage and support an organized instructional program, the staff of the Laboratory has invested considerable time in locating and indexing sources of information and technical data. These sources may be used by the trade instructor to supplement his daily instruction. In the left-hand column under the heading REFERENCES, fourteen sources have been indexed and keyed to be easily located by the instructor. Some of these sources will contain a type of information which the instructor will want to use in his related instruction. Other sources are developed around a job-sheet format. The instructor may want to use these as a guide in making up his own job sheets.

Summarizing, trade training for the welder requires extensive periods of repetitive practice in developing technique. Related instruction, while of equal value, requires fewer clock hours but greater effort by the instructor to effectively work it in. Related instruction is generally given immediately prior to application. When this practice is inadvisable or impractical, related instruction should be broken into teachable units and given by the instructor as his judgment dictates.

ACKNOWLEDGMENTS

The Curriculum Committee for welding met at the Holiday Inn, Starkville, Mississippi, on November 3, 4, and 5. The work of the committee included an analysis involving welded joints, welding positions, and types of metals to be joined. From the analysis, basic instructional units were developed which included steps of procedure in welding; knowledges required for intelligent job performance; equipment, tools, and supplies necessary for training; references or sources of trade information; and an estimate of training time. Members of the committee are to be commended for their effort in the initial development of instructional materials. Special thanks is to be given to the industry and the institutions which made these people available. The members of the committee and their organizations are as follows:

Jack Burt	Copiah-Lincoln Junior College
Donald M. Dexter	Hinds Junior College
B. B. Jones	Amory High School
Howard Little	Ross Collins Vocational School
Kenneth E. Matheiu	Northeast Mississippi Junior College
H. A. Murray	Ingalls Shipbuilding Corporation
Walter H. Moak	Southwest Mississippi Junior College
G. A. Parnell	Gulf Coast Junior College District
Reggie Roy Polk	Columbia Training School
D. J. Sims	Parchman Vocational School

Also in attendance, and making a significant contribution, was Mr. Charles W. Roye, Itinerant Teacher Trainer, State Department of Vocational and Technical Education, Trade and Technical Section.

Following the meeting, the staff of the Curriculum Materials Laboratory compiled the work of the committee for editing, extending, and duplicating. Additions to the material included all introductory material preceding the course content; a bibliography, a progress chart, and an equipment list.

Special recognition is given to Mr. Roy Morton, National Cylinder Gas, who was largely responsible for the original preparation of the equipment list as contained in the Appendix, and for checking the accuracy of the draft from which this copy was made.

TABLE OF CONTENTS

* Omitted: to be completed at a later date.

TO THE INSTRUCTOR

Introduction

The purpose of trade training is to prepare persons for entry into a specific trade. To accomplish this, the instructor guides each trainee in the development of knowledges and skills of his trade. The instructor uses teaching methods and instructional materials as tools, much as he uses the tools of his trade to perform specific tasks. His skill as a teacher and as a tradesman depends upon his ability to use these tools.

A full treatment of the role of the Curriculum Materials Laboratory in implementing the foregoing process is contained in the Operational Plan. Simply stated, the Laboratory provides technical assistance to state and local educators in improving instruction through the development of instructional materials, and communicates with industry about training being offered.

The first step

Since the accepted practice in trade training is the identification of the knowledges and the skills of the trade, the Laboratory asked Mississippi trade instructors to supply information. The process described in the FOREWORD was used in arranging the information in a teachable form. It is an instructional base and is usually referred to as a course outline or guide. Its proper use requires skillful applications of teaching methods as tools in presenting the content of the outline. The end result is a trainee who is skilled and knowledgable.

Since this publication is the instructional base for the teaching of a specific trade, all future work will be planned around this base. Workshops will be held to develop supplementary instructional materials for use by the trade instructor in enriching his program.

Characteristics of this publication

First, its scope, in terms of content, is broad and applicable in all parts of the state. The instructor, who directs his class in becoming proficient with each of these knowledges and skills, assists each student in meeting beginning employment standards. The student is prepared to take advantage of opportunities for gainful employment in any part of the state.

Second, while the scope of the program is broad and there is depth, an effort was made to confine the content of the outline to those knowledges and skills essential to occupational entry. This policy allows the local instructor to supplement his program with additional experiences. Although identifying only essentials, this publication encourages local insitiutions to seek and to offer the special instruction which will meet regional industrial needs.

Third, a serious effort has been made to arrange the content in a usable form. The elementary knowledges and easiest tasks precede more difficult ones. Assignments are written in a step-by-step fashion. All content has been carefully sequenced. Time for instruction in class and in shop is listed in approximate terms.

Fourth, as indicated by certain items in the format, this publication is designed for the Type B Shop found in Mississippi secondary schools. However, it should not be inferred that this is its only valid use. The content and sequence are equally applicable to trade training in junior colleges and in MDTA programs or in any preparatory program.

The impact of this publication

What then should be the impact of this publication on the local program? Since the purpose is to encourage a planned, orderly, more efficient instructional program, it must be used and evaluated by the instructor. He should give this publication his best efforts in light of the principles and practices of trade training. Examination, evaluation, and recommendation during preparation of instructional materials and while teaching from them will assist in continued program development. Using this publication as a guide, the instructor should make lesson plans for lectures and demonstrations and should prepare shop activities. In some instances, the instructor will likely find more information and in greater detail than he is presently using. There may be more than one job assignment. In other instances, the development of an idea may appear to shallow or a job may be absent. It is at this time that the instructor can be most helpful in the following ways: (1) by suggesting which areas can be effectively covered in a shorter time, (2) by identifying areas requiring greater emphasis, which would involve additional detail and an extended time allocation, (3) by extending the instructional content to reinforce or clarify ideas, (4) by preparing additional or alternate jobs, (5) by listing references, texts, and instructional aids at appropriate places, and (6) by suggesting additions and deletions.

Some of the suggestions listed above may require only marginal notes; others may call for development of completely new and more comprehensive materials. The result will be realistic evaluation of content, organization, and time allotment for each unit.

Purposes and characteristics not inferred

As previously stated, this publication is intended to assist in improving instruction. It is planned, items are sequenced, and time limits are set because these characteristics are the heart of a strong instructional program, and for no other purpose. Consequently, it should not be inferred that this publication is an exact image of any given program. As noted earlier, local institutions go well beyond these minimum requirements to enrich their programs.

Also, it is not expected that every institution's program be exactly like every other program, that hour allotments be rigidly adhered to, or that students be rotated on a clockwork or calendar basis. On the contrary, the emphasis is on individual proficiency. It is likely that students of lesser ability will require longer periods in certain areas. These students may gain only the minimum proficiencies, while more able students will progress rapidly and engage in many enriching experiences. Consequently, the planning, sequencing, and allotting are not designed to standardize programs, but to assist local teachers in planning more carefully and conducting their instruction more effectively.

Evaluation

Finally recent vocational-technical legislation contains provision for follow-up and program evaluation. The day is coming when vocational-technical education will be held accountable for its actions in training youth and adults and for the millions of dollars it has spent. The Curriculum Materials Laboratory will, no doubt, be involved in developing suitable instruments and evaluative criteria at that time. This publication, representing the combined efforts of Mississippi education and industry and containing the material these groups consider appropriate, may well serve as one basis for making such a study.

VOCATIONAL WELDER (COMBINATION)

The vocational welder fuses metal parts according to layouts, blueprints, and work orders. He may use a variety of welding processes that include manual metal arc welding, inert gas welding, oxyacetylene welding, and any other of a number of special processes.

The welder must set up and adjust equipment, estimate and order supplies, and often plan his work. He may find his work previously positioned, or be required to clamp together components himself. In smaller plants and companies he will be required to perform layout, fitting, and aligning with various degrees of difficulty. He repairs broken or cracked parts, fills holes, fills up worn parts. For these tasks, he must be familiar with fabricated, cast, and forged parts in structural forms which make up frames, tanks, pressure vessels, and shelves. Proper layout, fitting and alignment require a knowledge of geometry, the special properties of metals, effects of temperature variations, and standard fabrication techniques.

A more detailed job description of each specialty area may be found in the Dictionary of Occupational Titles, third edition. See WELDER, COMBINATION, 812.884; WELDER, ARC, 180.884; WELDER, GAS, 811.884; and WELDER-FITTER, 819.381.

CHARACTERISTICS OF TRADE TRAINING

Introduction

Training for various trades without on-the-job experience can be and is being given effectively by simulating, in locales other than industrial plants, an on-the-job environment. The industrial environment is achieved in an educational institution by performing jobs of fabrication and service using industrial techniques and industrial-type equipment and facilities. The additional requirements placed upon the training as a result of its operating within an institution have been successfully met. It has proved advantageous to all concerned to provide preparatory training for qualified students and extension training for employed tradesmen. Characteristics of institutional training are briefly described in the following paragraphs.

Physical Facilities, Equipment, and Supplies

As previously stated, trade-training facilities must be designed and constructed so that they lend themselves to fabrication and service operations found in industry. Built-ins are provided with adequate floor space, lighting, climate control, power sources, entrances, equipment, storage for supplies, finished-product handling, waste-disposal systems, etc. --each of which is duty-rated to serve its purpose in an industrial manner. That costs and floor-space requirements per pupil are higher than those for general education are facts that must be recognized because they are intrinsic in the nature of the training and cannot be side-stepped. Equipment and supplies must meet the standards of quality and variety used in industry, and they must be maintained and replenished.

Instructor Qualifications

Of equal importance is the caliber of the instructor. Past experience has assisted in establishing the requirement of at least two years of work experience beyond the learner's level, in the specific training being given, and of broad experience in the major areas of the industrial occupation. The instructor must be adept in selecting, organizing, and presenting trade information and skills--a fuller treatment of which may be found in later paragraphs. The trade teacher must also keep himself occupationally up to date through study and association with industrial activities.

Student Screening and Selection

The State Plan states that any student who wants, needs, and is able to profit by instruction is eligible for enrollment in vocational training. His ability to profit by the instruction depends, in large measure, on his making a definite vocational choice, his desire to gain the knowledges and skills of the trade, and his educational background. These qualifications are evaluated, insofar as is possible, by a vocational-guidance process which includes an examination of the applicant's school record, a personal interview, a check of references, and tests for interests, motivations, and learning rates; and, in the absence of adequate guidance facilities and a screening process, it is reasonable to expect that a considerable number of those accepted for training will need remedial instruction in science, mathematics, and communication skills.

In Mississippi, preparatory training is offered in the Type B Shop located in the comprehensive high school. Trade training is carried on 180 days per year. Normally, the course is elected for both the junior and the senior years. In two years a student receives 1080 hours of instruction. However, some students enroll for the senior year only. Although these students receive no more than minimal experiences, instruction on a planned rotational basis will provide them with knowledges and skills in the basic blocks of the trade and will render them employable.

Teaching Techniques

Trade training uses most, if not all, of the conventional teaching techniques and adapts them to the information to be presented. The "tell-show-do-check" method has been found highly effective and is the one most commonly used. The instructor "tells" by informally lecturing on a given topic. Open periods of discussion allow the student to clarify points not initially grasped. The instructor may choose to stimulate thought or to spot-check comprehension by questioning. The "show" method is employed when a demonstration can more vividly present a principle or the steps of trade procedure. Specially prepared audio-visual aids may be involved to "show". The major investment of time is on the "do", where the student is engaged in useful and productive work in typical trade jobs. He uses tools, equipment, and materials common to the trade. Thus he learns by doing. At predetermined intervals, a "check" of the student's progress serves to evaluate command of knowledge and skill learned to date. Deficiencies identified are retaught through additional, individual instruction, through reading, shop practice, etc., until an acceptable level of learning and performance is reached.

Related Instruction

The value of scientific principles and mathematical applications for the tradesman is unquestioned. Indeed the caliber of his work in these areas is determined by the quality of his foundation in these principles and his ability to apply and adapt them. However, trade trainees, characteristically, react to mathematics and science with disinterest when these subjects are presented on the academic level with the usual academic approach. But these subject areas become much more acceptable when they are applied to the job in which the trainee expects to develop skill and earn a living.

In the Type B Shop, no outside instruction related to the trade is given.

The shop teacher is expected to meet the need. Upon him rests the responsibility of supplying any and all necessary teaching of trade mathematics, trade science, trade drafting, etc. This information is also correlated with trade practice and given as needed by the student.

Group instruction and group shop activity are encouraged when space and equipment are available, for it is generally conceded that instruction of the typical class as a group is an advantage for the progress of the class. Extensive preparation prior to group instruction and keen observation of individual behavior are necessary to meet the variety of need and speeds in a heterogeneous class. The volume of trade tools, equipment, and materials, as well as adequate space and shop facilities required for the instruction of large groups, makes the costs prohibitive in many instances; and a scheduled rotational process must be employed. A suggested plan is found in the Appendix.

Instructional Content

The source of the instructional content of a given trade program can come only from the trade itself; that is, from the knowledges and the skills of the master. Usually a trade analysis is used to identify this content. Following the analysis, there is much need for proper organization and preparation prior to presentation of the material. An extension of this characteristic of the program is the establishment and maintenance of an up-to-date reference library in the classroom-shop. Materials housed here are found in many forms, such as textbooks, technical manuals, trade periodicals, manufacturers' catalogs, safety bulletins, etc. All of them should be shelved in a systematic arrangement with a careful record kept for ready reference.

Safety Instruction

The place and value of safety instruction cannot be overemphasized. The instructor is morally and legally responsible for introducing safety instruction prior to performance, for using safe techniques in demonstrations, and for tactfully, but firmly, pointing out each violation.

Summary

In summary, trade training can be characterized as instruction in trade practices given by an occupationally competent teacher. Related information is carefully correlated with shop activities and is given by the trade teacher as it is needed by the trainee. Students who have made a vocational commitment, and who are able to profit by the instruction are engaged in productive learning experiences. Successful completion of such a program prepares a student for employment at an advanced-learner level.

COURSE OF STUDY

COURSE OBJECTIVES

PURPOSE OF THE TRAINING

To develop entry-level knowledges and skills as a combination welder.

CONTENT OF THE COURSE

Systematic and purposeful presentation of the following information:

1. Detailed and thorough coverage of the following welding processes: manual metal arc, oxyacetylene manual inert gas, tungsten inert gas, and short arc or microwire
2. Broad coverage of brazing, soldering, cast iron welding and brazing, and burning
3. An introduction to these additional welding processes: atomic hydrogen, explosive, friction, laser, plasma, resistance, stud, thermit, ultrasonic, and underwater; and to natural gas burning
4. A strong emphasis on safety practices, processes, and work hazards
5. An explanation of joint design and preparation
6. An examination of filler rods, their uses, and their AWS numbers
7. The reading of blueprints for the metal trades with emphasis on welding symbols and structural shapes
8. The fundamentals of measurement and layout of plate and pipe
9. The use, adjustment, and care of the equipment, tools, and supplies for the welding processes contained in a. and b. above
10. An explanation of basic metallurgy
11. The definitions and spellings of trade terms
12. A description of the weldability of metals
13. The purpose and use of soldering, welding, and brazing fluxes
14. A discussion of shielding gases
15. An examination of destructive and nondestructive testing methods

SKILLS TO BE DEVELOPED

1. Immediately marketable skills in the welding of both plate and pipe with the manual metal arc and the oxyacetylene processes
2. Basic manipulative skills in brazing, burning, layout, manual inert gas, short arc or microwire, tungsten inert gas, and soldering

NATURE OF THE TRAINING:

1. Duration is three hours per day, five days per week, thirty-six weeks per year for two years; or, six hours per day, five days per week, thirty-six weeks per year for one year -- total of 1080 clock hours of training.
2. Related instruction by lecture, demonstration, use of audio-visuals, etc. immediately precedes application by the trainee (a high degree of correlation between presentation and application) with the major emphasis in time on development of manipulative skills.
3. No instruction directly related to the trade is offered outside the shop.

ASSUMPTIONS:

That those enrolling in training have had no previous training in welding principles or practices; that they have a general science background of a non-technical nature; and that they are in need of additional instruction in the fundamentals of arithmetic.

COURSE DESCRIPTION

Vocational Welding (Combination) is designed to develop marketable skills in the learner in the oxyacetylene and the manual metal arc methods of welding. In addition, basic manipulative skills are developed in brazing, burning, layout, manual inert gas, short arc or microwire, tungsten inert gas, and soldering. The information related to the intelligent application of these processes is presented by the trade instructor on a one-to-five ratio with skill-building job assignments. Major topics covered are basic metallurgy, the weldability of various metals, shielding coatings and gases, filler rods, safe working practices, blueprint reading, layout techniques, and the use of brazing fluxes.

INSTRUCTIONAL BLOCKS

		Contact Hours
I.	Layout	20
II.	Oxyacetylene	180
III.	Burning (oxyacetylene Cutting)	45
IV.	Brazing and Soldering	90
V.	Manual Metal Arc	500
VI.	Heliarc (Tig)	120
VII.	Manual Inert Gas	30
VIII.	Short Arc	70
	Total Contact Hours	1080

I. LAYOUT

A. Lay out straight lines

Job

Lay out a straight line which is parallel to a straight edge of a piece of metal

References

Trade Principles

1. Basic layout tools and their uses
   a. Straight edge
   b. Steel rule
   c. Scratch awl
   d. Scriber
   e. Soapstone
   f. Prick punch
   g. Center punch
   h. Hammer
2. Degree of accuracy required for welding layouts
3. Measuring with a rule
4. Measuring distance on a perpendicular line

Equipment, Tools, Supplies

1 Straight edge
1 Prick punch
1 Scratch awl
1 Hammer, ball peen; #1
1 Piece of soapstone
1 Steel rule
1 Piece of 1/4" mild steel plate large enough for a simple layout
1 Wire brush

Safety

Keep sharp points on the scratch awl and the prick punch; sharp tools are safe tools!

Trade Practices

1. Clean surface to be laid out, using a wire brush and/or the oxyacetylene welding torch
2. Examine the shape to be laid out and the stock with which you are working; determine the best layout position to make best use of the material
3. Select one edge as the starting point
4. Use a ruler to measure several points which are equal in distance from the edge
5. Use a prick punch and hammer, or soapstone to mark the points laid out
6. Lay a straight edge along these points and mark with a scratch awl or soapstone

B. Lay out angles

Job

Lay out several acute, obtuse, and right angles using both a plain protractor and the protractor head of a combination set

References

Trade Principles

1. Parts of an angle
    - a. Initial sides
    - b. Origin
    - c. Terminal side
    - d. Vertex
2. Types of angles
    - a. Acute
    - b. Right
    - c. Obtuse
    - d. Straight
3. Angular measure
    - a. Degrees
    - b. Minutes
    - c. Seconds
4. Measuring tool: the protractor
5. Tools for layout of angles
    - a. Protractor
    - b. Trammel points and bar
    - c. Compass

Equipment, Tools, Supplies

1	Straight edge
1	Prick punch
1	Scratch awl
1	Hammer, ball peen; #1
1	Piece of soapstone
1	Protractor, plain
1	Combination set with protractor head and a blade
1	Wire brush
1	Piece of unlined paper, $8\frac{1}{2}$ X 11"

Safety

Avoid "horseplay" with all tools, particularly with sharp ones such as scratch awls, dividers, and the like

Trade Procedure

(Layout with a plain protractor)

1. Use a piece of unlined paper
2. Determine which position makes for the best layout
3. Use a straight edge and a pencil to draw a base line
4. Select a point on this line as the origin and mark it
5. Properly position a protractor on the line and at the origin, use a pencil to mark a 30° angle
6. Place the straight edge along the two marks; draw a line which is the terminal side
7. Repeat the above for angles of 90°, 135°, and 200°

(Layout with a combination set)

8. Select a piece of 1/4" stock which must have one straight edge; this edge will act as the base line

d. Combination set with a dividing head

9. Clean the surface to be laid out
10. Mount the blade in the protractor head of a combination set and adjust it for an angle of 45°
11. Position the protractor head on the edge of the stock with the blade passing through a point chosen as the origin; use a scratch awl or soapstone to mark the terminal side
12. Repeat the above for angles of 60°, 90°, 120°, and 165°

C. Lay out circles and arcs

Job

Lay out circles and arcs using both dividers and trammel points

References

Equipment, Tools, and Supplies

1 Pair of dividers
1 Compass
1 Scratch awl
1 Straight edge
1 Hammer, ball peen; #1
1 Pair of trammel points and a bar
1 Piece of soapstone
1 Piece of 1/2" mild steel plate

Safety

Trade Principles

1. Circle: a curved line having all points of equal distance from the center

Trade Procedure

1. Select a piece of stock
2. Clean it with a wire brush and an oxyacetylene welder's torch if necessary
3. Lay out hole a given distance from the edge of the piece of stock
4. Use a center punch and a hammer to center-punch the location
5. Use dividers or trammel points and bar to scribe an arc or circle
6. Use a prick punch to clearly identify the circumference; mark every two inches

D. Basic Exercises

Job

Transfer angles from one layout to another

References

Trade Principles

Equipment, Tools, Supplies

Safety

Trade Procedure

1. Select a second piece of stock which has one straight edge
2. Clean by brushing and burning if necessary
3. Prepare to transfer the 45° angle from the previous layout; mark a point on the edge of the clean stock, using a scratch awl; remember to plan the spacing since several angles will be laid out along this edge
4. Use dividers or trammel points: place one point on the origin of the previously laid out 45° angle and scribe an arc along the base line at about 4-6" distance
5. Repeat this same procedure on the new piece of stock which has only the origin marked
6. Use the dividers or trammel points: place one point on the origin of the previously laid out 45° angle and scribe an arc along the terminal side at a convenient distance
7. Repeat this same procedure on the new piece of stock; be careful not to change the setting on the dividers while doing this
8. Use the dividers to measure by setting one point on the places where the arcs cross the base line and the terminal side on the 45° angle
9. Without changing the setting, transfer this measurement to the new workpiece by placing one point on the intersection of the previously made arc, and the making of a scratch with the other point on the arc above the base line
10. Use a straight edge to draw a line from the origin to the intersection of these arcs

II. OXYACETYLENE WELDING

A. Equipment setup

Job

Set up acetylene welding equipment and check for leaks

Equipment, Tools, Supplies

1 Complete oxyacetylene welding outfit (see Page 43)
1 Set of oxyacetylene welder's tools (see Page 43)
1 Welding torch

References

(1) Chapter 2
(2) pp 212-215
(4) Unit 8, p 23
(7) pp 17-22
(9) pp 1-8
(10) pp 75-83
(11) pp 497-498
(12) Unit I, Job 1

Safety

1. Secure bottles in an upright position
2. Do not use lubricants on the connections of the bottle, gage or line

Trade Principles

1. A brief history of oxyacetylene welding
2. Basic equipment
    - a. Gas supply: oxygen and acetylene
    - b. Gas regulators
    - c. Hose
    - d. Torch
3. Typical gas supplies
    - a. Acetylene
        - (1) Generator
        - (2) Cylinder
    - b. Oxygen: cylinder
        - (1) Pressurized gas
        - (2) Pressurized liquid
4. Regulators: purpose and construction
    - a. Single-stage
    - b. Two-stage
5. Hose
    - a. Types of connections
    - b. Types of hose

Trade Procedure

1. "Crack" the cylinder valves slightly to remove foreign matter; close valves
2. Attach regulators to bottles, using the proper wrench
3. Attach hose to regulators
4. Back off regulator-adjusting screws
5. Turn regulator-adjusting valve
6. Select the proper tip for the job and attach it to the torch; tighten with proper wrench
7. Insert oxygen hose on torch tip or head to clear torch; close oxygen
8. Attach hose to torch, using the proper wrench
9. Adjust the acetylene pressure to 5 psi; adjust the oxygen pressure to 10 psi
10. Check for leaks, using soapsuds

6. Gas manifolds
    a. Purpose
    b. Typical arrangements
    c. Construction techniques
    d. Fire regulations
7. Torch and tip construction
8. Procedure for hooking up equipment

B. Lighting and adjusting the torch

Job

Light an oxyacetylene torch and adjust it through the carburizing, neutral, and oxidizing flame

Tools, Equipment, Supplies

1 Complete oxyacetylene welding outfit
1 Set of oxyacetylene welder's tools
1 Welding tip, NCG #63 or equal

References

(1) Chapter 1, pp 10-20.
(2) pp 215-220
(4) Unit 7, pp 20-22; Unit 8, pp 23-25
(7) pp 22-25
(9) pp 1-9
(10) pp 85, 86
(11) p 497

Safety

Do not use matches or open flame to ignite the acetylene; use a spark lighter only

Trade Principles

1. Oxyacetylene welding tools and clothes
    a. Cap
    b. Safety goggles (#5 lens)
    c. Leather gloves
    d. Spark lighter
    e. Shirt with long sleeves or welder's "leathers"
    f. Apron
    g. Heavy trousers with no cuffs
    h. High-top shoes (preferably with safety toes)
    i. Tip cleaners
    j. Cylinder or utility wrench
2. The oxyacetylene flame
    a. Parts
    b. Temperature
    c. Colors

Trade Procedure

1. Set up the oxyacetylene equipment
2. Attach a welding torch and tip
3. Make initial regulator settings for oxygen and acetylene
4. "Crack" oxygen valve and add as necessary
    a. For carburizing flame
    b. For neutral flame
    c. For oxidizing flame

   - d. Percentages of each gas used
   - e. Chemical composition

3. Uses of each flame
   - a. Carburizing
   - b. Neutral
   - c. Oxidizing

C. Fusion Bead

Job

Run a fusion bead on a piece of 16-gage sheet

Equipment, Tools, Supplies

1 Complete oxyacetylene welding outfit
1 Set of oxyacetylene welder's tools
1 Piece of mild steel sheet, 16-gage x 4" x 6"

References

(1) Chapter 1, pp 21-23
(2) pp 221-222
(4) pp 24-28
(7) pp 26-29
(9) pp 15-18
(10) pp 170-172
(11) p 310
(12) Unit II, Job 1

Safety

Do not use acetylene at pressures 15 psi

Trade Principles

1. Method of selecting tip to match the job
2. Swirling technique of moving torch
3. Shape and size of the fusion puddle
4. Rate of travel
5. Characteristics of a good fusion weld
   - a. Fusion
   - b. Penetration
   - c. Bead size

Trade Procedure

1. Set up equipment
2. Set acetylene at 5 psi and oxygen at 10 psi
3. Use a #4 tip on the torch
4. Hold the torch in the right hand like a pencil if sitting down, or like a fishing pole if standing up; practice shifting the torch until the balance point is found
5. Hold the torch at an angle of about 45° off vertical and with the cone about 1/8" away from the metal
6. When a puddle forms, move the torch slightly in the direction it is pointed; continue until the workpiece has been crossed
7. Examine the weld

D. Flange weld

Job

Make a fusion weld on a flange joint

Equipment, Tools, Supplies

1 Complete oxyacetylene welding outfit
1 Set of oxyacetylene welder's tools
1 Welding tip, NCG #63 or equal
1 Pair tongs
2 Pieces of mild steel sheet, 16-gage x 4" x 6"

References

(1) Chapter 1, p 22
(2) p 227
(9) pp 19-22
(11) p 300

Safety

Trade Principles

1. Purpose: to develop puddling technique without using filler rod

Trade Procedure

1. Take two pieces of sheet and bend a 1/8" flange along the long side of each
2. Set up and adjust the welding equipment
3. Place the two pieces on the worktable with the flanges aligned
4. Tack at each end and at $1^1/2$" intervals in between
5. Start the puddle at the right end and weld out to the left
6. Make a visual examination and a bend test on the completed weld
7. Determine reasons for weld failures and method of improving technique
8. Repeat the exercise until good penetration and good bead are made

E. Bead with a filler rod

Job

Run a bead with a 1/16" filler rod on 16-gage mild steel

Equipment, Tools, Supplies

1 Complete oxyacetylene welding outfit
1 Set of oxyacetylene welder's tools
1 Welding tip, NCG #63 or equal
1 Piece of mild steel, 16-gage x 4 x 6
1 Filler rod, 1/16" AWS GB 45

References

(1) Chapter 1, pp 23-25
(2) pp 222-224
(4) pp 39-41
(7) pp 31-36
(9) pp 27-29
(10) pp 172-275
(12) Unit II, Job 2

Safety

Wear goggles and other safety clothing and equipment

Trade Principles

1. Method of selecting size and type of filler rod
2. Use of the AWS comparison chart for iron and steel gas welding rod
3. Technique of adding filler rod
    a. Dipping motion
    b. Keeping in flame at all times
4. Weld preparation
    a. Cleaning
    b. Spacing
    c. Beveling

Trade Procedures

1. Set up the equipment
2. Adjust acetylene to 5 psi; oxygen to 10 psi
3. Place the workpiece on the table
4. Attach an oxweld 29 (or equivalent) tip to the torch
5. Light the torch and adjust to a neutral flame
6. Start the puddle at the right edge
7. As the puddle forms, add filler rod
8. Maintain a rate of travel which gives good penetration and evenly spaced ripples
9. Examine the finished bead

F. Tack weld

Job

Tack-weld two pieces of 16-gage mild steel having a 1/16" gap

Equipment, Tools, Supplies

1 Complete oxyacetylene welding outfit
1 Set of oxyacetylene welder's tools
1 Welding tip; NCG #63 or equal
2 Pieces of mild steel, 4" x 6" x 16-gage
Filler rods, 1/16 AWS GB 45

References

(1) Chapter 1, p 26
(2) p 225
(4) pp 42-44

Safety

Remove all combustible materials from the welding area

Trade Principles

1. Reason for tacking plates together
2. Reason for leaving 1/16" gap between plates

Trade Procedures

1. Set up equipment including tanks, lines, torch
2. Select two pieces of 16-gage, 4" x 6", and clean the edges to be tacked

a. Permits penetration
b. Allows for expansion

3. Procedure for cleaning areas to be welded

3. Place two pieces side by side; the long sides should have a 1/16" gap between them
4. Make 1/4" tack welds at each end, then at $1\frac{1}{2}$" intervals in between

G. Butt weld

Job

Butt-weld two pieces of 16-gage mild steel

Equipment, Tools, Supplies

1 Complete oxyacetylene welding outfit
1 Set of oxyacetylene welder's tools
1 Welding tip, NCG #63 or equal
2 Pieces of mild steel; 4" x 6" x 16-gage
Filler rods, 1/16 AWS GB 45

References

(1) Chapter [illegible], pp 26-27
(2) pp 226-[illegible]
(4) pp 42-44
(7) pp 49-50
(9) pp 29-34
(10) pp 175-179
(11) p 135, 382
(12) Unit II, Job 4

Safety

Trade Principles

1. Appearance of a good weld
   a. Beads even in width
   b. Fine, regularly spaced ripples
   c. Slight convex above joint
   d. Good penetration
2. Reasons for poor weld
   a. Puddle varied in size
   b. Irregular speed along joint
   c. Not enough filler rod added
   d. Torch improperly adjusted
   e. Torch improperly held

Trade Procedures

1. Set up and adjust equipment
2. Clean pieces to be welded back 1/2" from the edge
3. Clamp one piece of 16-gage, 4" x 6" mild steel sheet in place; position second sheet with long side at a distance of 1/16"
4. Light torch and adjust it to a neutral flame
5. Make 1/4" tack welds at either end and at $1\frac{1}{2}$" intervals in between
6. Begin weld at right end of joint; carefully observe puddle, add filler as necessary, and move at best speed
7. When weld is complete, pick up joined sheets with tongs and cool by immersing in water
8. Make a visual examination of the weld
9. Test quality of weld by bending

H. Outside corner

Job

Make an outside corner weld

Equipment, Tools, Supplies

1 Complete oxyacetylene welding outfit
1 Set of oxyacetylene welder's tools
1 Welding tip, NCG #63 or equal
2 Pieces of mild steel sheet, 16-gage x 4" x 6"

References

(1) Chapter 1, p 29
(2) pp 227-228
(4) pp 45-48
(9) pp 23-26
(10) pp 181-182
(11) p 193
(12) Unit II, Job 3

Safety

Trade Principles

Trade Procedure

1. Set up and adjust the equipment
2. Select sheet stock and clean the edges to be welded
3. Place the sheet stock over a firebrick and in an inverted V position
4. Select the proper gas welding rod
5. Light the torch and adjust it to a neutral flame
6. Tack the pieces together
7. Begin at the right and weld to the left; maintain a good puddle and add rod as necessary
8. Test the completed weld by flattening the pieces
9. Visually examine the quality of the weld

I. Lap weld

Job

Make a lap weld

Equipment, Tools, Supplies

1 Complete oxyacetylene welding outfit
1 Set of oxyacetylene welder's tools
2 Pieces of mild steel sheet, 16-gage x 4" x 6"
[illegible] Filler rods [illegible] 1/16" AWS [illegible]

References

(1) Chapter 1, pp 27-28
(2) p 228
(4) p 49-52
(7) pp 41-44
(10) pp 182-183

Safety

Trade Principles

1. Compare the relative strength of various joints
2. Describe the grain structure and stress lines in a lap joint
3. Explain the technique of making a fillet weld for a lap joint
4. Show the method of making a destructive test for a lap weld
5. Review the reasons for weld failure and the technique of correcting welder's errors

Trade Procedure

1. Set up and adjust equipment
2. Select stock, clean edges, and lap one piece 2" over the other
3. Select a welding rod
4. Light and adjust the torch
5. Tack the plates at the outside edge on both ends
6. Begin the weld at the right end and travel to the left
7. Concentrate the heat on the lower plate
8. Add filler rod at the top of the puddle; add enough filler rod to make the bead a little thicker than the top plate
9. Make a visual examination of the weld
10. Make a destructive test of the joint

J. Tee joint

Job

Make a tee joint

Equipment, Tools, Supplies

1 Complete oxyacetylene welding outfit
1 Set of oxyacetylene welder's tools
1 Welding tip, NCG #63 or equal
2 Pieces of mild steel sheet, 16-gage x 4" x 6"
Filler rod, 1/16 AWS GB 45

References

(1) Chapter 1, pp 29-30
(2) pp 228-229
(4) pp 53-57
(7) pp 45-48
(9) pp 35-38
(11) p 728

Safety

Trade Principles

Technique of making a tee weld

1. Concentrate over half the heat on the base
2. Preheat base plate to white-hot state
3. Undercutting of upright piece indicates too much heat
4. Add filler rod at the top of the puddle
5. Use crisscross motion of torch rather than circular
6. Hold tip at about 45° to the base and upright
7. Point tip about 30° off vertical from the base
8. Base piece should not rest on metal table top

Trade Procedure

1. Set up and adjust the equipment
2. Select the stock, welding tip, and rod
3. Position the two pieces to form a tee; use firebrick to support the pieces and to form a trough
4. Light the torch and adjust a neutral flame; then add a little extra oxygen
5. Tack the pieces at either end
6. Begin welding at right end and weld out to the left
7. Cool the finished weld and make a visual examination (naturally and artificially)
8. Make a bend test

K. Tack and weld plate

Job

Tack and weld a closed, square butt joint

Equipment, Tools, Supplies

1 Complete oxyacetylene welding outfit
1 Set of oxyacetylene welder's tools
1 Welding tip, NCG #54 or equal
2 Pieces of mild steel plate, 3/16" x 4" x 6"
1 Filler rod, 3/32 AWS GB 45

References

(4) pp 62-64
(9) pp 29-34

Safety

Trade Principles

A good job of tacking avoids much warping

Trade Procedure

1\. Set up and adjust the equipment
2\. Select two pieces of mild steel and prepare one long side on each piece
3\. Place the pieces with the prepared edges in contact over the entire length
4\. Select a gas welding rod
4\. Select a welding tip and attach it to the torch
6\. Light the torch and adjust it to a neutral flame

7. Make deep, strong tack welds 1/4" long at each end and at 1$\frac{1}{2}$" intervals along the joint
8. Start the weld at the right and weld out to the left; give special attention to forming a good puddle to get penetration
9. Cool the completed joint
10. Make a visual examination; give special attention to penetration
11. Make a guided bend test

L. Single-bevel butt joint

Job

Make a single-bevel butt joint on mild steel plate

Equipment, Tools, Supplies

1	Complete oxyacetylene welding outfit
1	Set of oxyacetylene welder's tools
1	Welding tip, NCG #48 or equal
3	Filler rods, 1/8 AWS GB 45
2	Pieces of mild steel plate, 3/8" x 4" x 6"

References

(4) pp. 58-61
(10) pp 515-516

Safety

Trade Principles

1. Types of bevels and vees
    a. Square-nose
    b. Feather-edge
2. Common angles for bevels and vees
    a. 45°
    b. 37°
    c. 30°
3. Method of selecting the proper tip and gas pressure for a given weld
4. Use of "Equivalent" chart in selecting tips of equal capacity

Trade Procedure

1. Select two pieces of mild steel plate, one of which has been beveled; or, bevel one piece at 45° along the long edge
2. Place the plates on a firebrick table top with the beveled edge forming one half the joint; there should be a gap of 1/8" between the two pieces
3. Set up and adjust the oxyacetylene welding equipment
4. Select a #2 welding tip and attach it to the torch
5. Light the torch and adjust a neutral flame
6. Make a 1/4" tack weld at either end and at 1$\frac{1}{2}$" intervals
7. Hold the torch with the tip more nearly horizontal to get more preheating

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8. Begin the weld at the right end by forming a puddle in the tack; add rod until the bevel is filled and has a slight convex shape
9. Move the puddle to the tack in the bevel; repeat the above process of adding rod while maintaining a puddle
10. When the puddle is again built to a convex shape above the joint, move the puddle back to the tack in the root
11. Continue this technique until the entire joint has been made with a good quality weld

M. Single-vee butt joint

Job

Make a single-vee butt joint on mild steel plate

Equipment, Tools, Supplies

1 Complete oxyacetylene welding outfit
1 Set of oxyacetylene welder's tools
1 Welding tip, NCG #48 or equal
3 Filler rods, 1/8 AWS GB 45
2 Pieces of mild steel plate, 1/4" x 4" x 6"

References

(2) pp 234-236
(7) pp 71-73
(10) pp 188-195
(12) Unit II, Job 9

Safety

Trade Principles

Trade Procedure

1. Select two pieces of stock each of which has a 30° bevel on one long edge, or cut a bevel if this has not been done
2. Place these pieces with the beveled edges facing each other at about 1/16-inch distance
3. Set up and adjust the oxyacetylene welding equipment
4. Select a welding tip and attach it to the torch
5. Light the torch and adjust it to a neutral flame
6. Tack-weld the plates together
7. Preheat the right end of the joint until it is almost dull red

8. While forming a puddle at the right end, preheat the rod in the edge of the flame
9. Add rod and increase the size of the puddle
10. When the puddle has filled the vee, move the flame to the left and into the vee
11. Begin another puddle and repeat the above steps

N. Strapped, vee-butt joint

Job

Make a strapped, vee-butt joint on a mild steel plate

Equipment, Tools, Supplies

1 Complete oxyacetylene welding outfit
1 Set of oxyacetylene welder's tools
1 Welding tip, NCG #48 or equal
2 Pieces of mild steel plate, 1/4" x 4" x 6"
1 Piece of mild steel plate, 1/8" x 2" x 6"
1 Pound of filler rod, 1/8 AWS GB 45

References

(11) p 696

Safety

Trade Principles

1. Method of determining the proper root gap
2. Technique of getting penetration and fusion with backing strap

Trade Procedure

1. Select stock with bevel, or make a square-nose bevel along one long side of the two pieces of plate
2. Position beveled edges 1/8" apart, centered over the backing strap
3. Set up and adjust the oxyacetylene welding equipment
4. Attach a #5 Airco tip to the torch
5. Light the torch and adjust a neutral flame
6. Tack the ends of the plates and at 1½" intervals along the joint; use a high torch angle to get penetration and a full puddle to join both beveled edges
7. Begin the weld at the right end by building a puddle in the root and adding rod as necessary; continue to build the puddle until a convex bead is above the joint

8. Move the puddle to the root and begin to build it again
9. Repeat this technique until the entire length is welded
10. Cool the weld and inspect it

O. Butt joint in the horizontal position

Job	Equipment, Tools, Supplies
Make a single-bevel butt joint in the horizontal position	1 Complete oxyacetylene welding outfit 1 Set of oxyacetylene welder's tools 1 Welding tip, NCG #63 or equal 1 Pair of tongs 2 Pieces of mild steel sheet, 16-gage x 4" x 6" 2 Filler rods, 1/16" AWS GB 45

References	Safety
(1) Chapter 1, p 32 (2) p 232 (7) pp 39-41 (10) pp 208-209 (11) p 353	Position the work at about eye level; do not get any part of the body or equipment directly under the weld

Trade Principles

1. Definition and description of a horizontal weld
2. Technique of mounting work
   a. Clamp
   b. Tack weld
3. Technique of horizontal welding
   a. Point torch slightly upward; heat entire puddle
   b. Avoid overheating upper piece
   c. Add rod at top of puddle

Trade Procedure

1. Select workpieces and prepare edges to be welded
2. Set up and adjust equipment
3. Place the workpieces in a flat position, 1/16" gap, and tack them together
4. Mount the workpieces at about eye level; either joint should be in a horizontal position by clamping or tacking
5. Begin weld at right end and weld out to the left
6. Remove the piece and cool it
7. Make a visual examination and a test bend on the complete weld
8. Repeat the job until good penetration and a good bead are made

P. Lap joint in the horizontal position

Job	Equipment, Tools, Supplies
Make a lap joint in the horizontal position	1 Complete oxyacetylene welding outfit

1 Set of oxyacetylene welder's tools
1 Welding tip, NCG #63 or equal
1 Pair tongs
2 Pieces of mild steel sheet, 16-gage x 4" x 6"
2 Filler rods, 1/16" AWS GB 45

References

Safety

Trade Principles

Trade Procedure

1. Select two pieces of mild steel sheet
2. Set up and adjust equipment
3. Clamp pieces at about eye level height with the joint in a horizontal position; lap one piece over the other about 1"
4. Light and adjust the torch; tack the joint at the ends and the middle
5. Begin the weld at the right end and weld out to the left
6. Remove the joint and cool it
7. Make a visual examination and a bend test

Q. Inside corner weld in the vertical position

Job

Make an inside corner weld on two pieces of 16-gage mild steel

Equipment, Tools, Supplies

1 Complete oxyacetylene welding outfit
1 Set of oxyacetylene welder's tools
1 Welding tip, NCG #63 or equal
2 Pieces of mild steel, 16-gage x 4" x 6"
2 Filler rods, 1/16 AWS GB 45

References

(1) Chapter 1, p 29-31

Safety

Trade Principles

1. Additional oxygen necessary to replace natural oxygen which is excluded
2. Filler rod added to top of puddle

Trade Procedures

1. Set up equipment and make necessary adjustments
2. Select two pieces of mild steel, 1/16 x 4" x 6" and clean for welding

3. Position pieces in an L-shape over a fire brick
4. Light the torch and adjust to a neutral flame
5. Tack weld ends
6. Reposition pieces for making an inside corner weld in a vertical direction
7. Add a little extra oxygen to the flame
8. Tack weld inside at 1½" intervals
9. Make inside fillet weld beginning at the bottom and moving to the top
10. Add filler rod to the <u>top</u> of the puddle
11. Cool the newly formed joint; inspect visually and by bending

R. Square butt joint in the vertical position

<u>Job</u>

Make a square butt joint in the vertical position

<u>Equipment, Tools, Supplies</u>

1 Complete oxyacetylene welding outfit
1 Set of oxyacetylene welder's tools
1 Welding tip, NCG #58 or equal
2 Pieces of mild steel, 1/8" x 4" x 6"
4 Filler rods, 3/32 AWS GB 45

<u>References</u>

(9) Part 2, Unit 14

<u>Safety</u>

Check goggle lens for proper shade

<u>Trade Principles</u>

1. Angles of intersection for the torch and the filler rod
2. Size of puddle for vertical welding

<u>Trade Procedure</u>

1. Set up the equipment
2. Select stock
3. Tack pieces with a 1/16" gap between two long edges
4. Clamp or tack in vertical position
5. Begin weld at bottom and build the weld toward the top
6. Use the torch and the rod to move the puddle to get proper penetration or to avoid blow-through and sags
7. Cut off the equipment and cool the joint
8. Examine the weld and make a bend test

S. Single-vee butt weld in the vertical position

Job

Make a single-vee butt weld in the vertical position

Equipment, Tools, Supplies

1 Complete oxyacetylene welding outfit
1 Set of oxyacetylene welder's tools
1 Welding tip, NCG #48 or equal
1 Piece of mild steel stock, 1/4" x 4" x 6"
1 Lb. of filler rod, 1/8 AWS GB 45

References

Safety

Wear protective clothing such as a leather jacket or leather sleeves when making out-of-position welds

Trade Principles

Trade Procedure

1. Set up equipment
2. Select two pieces of stock and bevel the edge at a 45° angle
3. Light the torch and adjust a neutral flame
4. Tack the two pieces together with a 1/16" gap
5. Clamp in a vertical position
6. Begin welding at the bottom by starting a small puddle; hold the torch at a 5° - 30° angle and move the tip in a tight circle
7. Move the puddle into the bottom of the vee to get penetration
8. Move the puddle back onto the old weld to chill it and to avoid a blowthrough
9. Use the force of the flame and the tip of the filler rod to control the position and the shape of the puddle
10. Complete the weld by moving from the bottom to the top
11. Shut off the equipment and cool the workpiece
12. Make a visual examination and a bend test
13. Repeat the job until a satisfactory weld has been made

T. Fillet, lap, and butt welds in the overhead position

Job

Make three acceptable joints of each of the following types of welds in the overhead position; fillet, lap, square butt

Equipment, Tools, Supplies

1	Complete oxyacetylene welding outfit
1	Set of oxyacetylene welder's tools
1	Welding tip, NCG #55 or equal
2	Pieces of mild steel plate 3/16" x 4" x 6" (for each joint)
1	Lb. of filler rod, 1/8 AWS GB 45

References

(1) Chapter 1, p 33
(2) pp 232-233
(10) p 204
(11) p 487
(12) Unit II; Job 10, Job 11

Safety

1. Wear leather sleeves or a leather jacket and a cap when welding overhead
2. Keep cuffs and collars buttoned

Trade Principles

1. Keeping puddle small and avoiding drops
2. Maintaining a high torch angle; 60° plus
3. Directing flame at the intersection of the two pieces
4. Using extra care in developing a puddle <u>before</u> adding filler

Trade Procedure

1. Set up the equipment
2. Select workpieces and make the setup
3. Light the torch and adjust a neutral flame
4. Tack-weld in the downhand position with a 1/16" gap
5. Clamp or tack-weld the pieces in overhead position
6. Begin the weld at the right by building a small puddle
7. Concentrate the flame and building the puddle at the intersection of the pieces
8. Weld out to the left
9. Cut off the torch and cool the weld
10. Make a visual examination and a bend test

U. Pipe welding in the vertical position

Job

Butt-weld short sections of pipe of 1" diameter in the vertical position

Equipment, Tools, Supplies

1	Complete oxyacetylene welding outfit
1	Set of oxyacetylene welder's tools
1	Welding tip, NCG #55 or equal
2	Pieces of pipe, 1" dia. x 6" long
2	Pieces of pipe, 2" dia. x 6" long
3	Filler rods, 3/32 AWS GB 45

References

(1) Chapter 1, p 33
(2) pp 232-233
(10) p 204
(11) p 487
(12) Unit II; Job 10, Job 11

Safety

Trade Principles

Trade Practice

1. Set up the equipment
2. Select two pieces of 1" diameter pipe; align on a jig in vertical position; leave a 1/32" gap
3. Light the torch and adjust a carburizing flame
4. Tack-weld at four evenly spaced places; remove the jig
5. Use the same welding technique as applied to horizontal welding of plate
6. Cut off the torch and cool the weld
7. Make visual examination and a destructive test
8. Repeat, using 2" pipe

V. Pipe welding in the horizontal position

Job

Butt-weld short sections of pipe of 1" diameter; repeat, using 2"-diameter pipe

Equipment, Tools, Supplies

1 Complete oxyacetylene welding outfit
1 Set of oxyacetylene welder's tools
2 Pieces of pipe, 1" dia. x 6" long
2 Pieces of pipe, 2" dia. x 6" long
3 Filler rods 3/32 AWS GB 45

References

(1) Chapter 18, pp 44-48
(2) pp 265-267
(9) Part 2, p 29-32
(10) pp 204-207, 211-233
(11) pp 511-539
(12) Unit 2, Job 17, 18, 19

Safety

Trade Principles

1. Clocked positions as they refer to the points on a circle
2. Rules governing the spacing of pipe joints

Trade Procedure

1. Set up equipment
2. Select two pieces of 1" dia. pipe, align on a jig, leave about 1/32" gap

3. Rules governing the angle of bevel on pipe joints
4. Reason for using carburizing flame in welding pipe
5. Proper torch angle and use of filler rod

3. Light the torch and adjust a carburizing flame
4. Tack-weld at four evenly spaced places
5. Begin the weld at the 2 o'clock position and weld up to 12 o'clock position; use a high torch angle and observe closely for good penetration
6. Rotate the pipe so that the weld end is moved from 12 o'clock to 2 o'clock. Resume welding and continue to the 12 o'clock position
7. Rotate the pipe again and continue this procedure until the weld is complete
8. Cut off the torch and cool the joint
9. Make a visual examination and a destructive test of the joint

A WORD OF EXPLANATION

One of the major purposes of this publication is the identification of the content of the trade. To this end, an analysis is contained in the appendix which lists the welds and joints to be made. The greater portion of this publication is a detailed treatment of the principles and practices of the welding trade. An examination will reveal that the treatment of these principles and practices, called a course outline, carefully parallels the analysis.

Due to time limitations, the course outline is only partially complete. The instructor is encouraged to carefully examine the completed portion and to develop his own course of study, using the analysis as a guide.

At a later date, the Laboratory will schedule workshops and lend technical assistance to instructors in developing additional instructional materials. All materials developed in the future will use this publication as a starting point.

RELATED INSTRUCTION

RELATED INSTRUCTION

I. INTRODUCTION TO WELDING

A. A brief description of the most widely used processes

1. Oxyacetylene welding
2. Oxyacetylene burning
3. Soldering and brazing
4. Manual metal arc welding
5. Tungsten inert gas welding
6. Manual inert gas welding
7. Micro-wire welding

B. A brief description of other processes and special techniques

1. Atomic hydrogen welding
2. Carbon arc welding
3. Cast iron welding
4. Explosive welding
5. Friction welding
6. Laser welding
7. Natural gas burning
8. Plasma welding
9. Resistance welding
10. Stud welding
11. Thermit welding
12. Ultrasonic welding
13. Underwater burning and welding

C. Major classes of welding processes

1. Arc welding
2. Brazing
3. Flow welding
4. Forge welding
5. Gas welding
6. Induction welding
7. Resistance welding
8. Thermit welding

II. OXYACETYLENE WELDING

A. The process

1. Definition: The heating of metals to be joined to their melting point; thus, a fusion process
2. History

   a. Development of process for making acetylene cheaply -- 1895
   b. Development of oxyacetylene torch -- 1900
   c. Introduction of the torch to the United States -- 1906

3. Combustion gases, their temperatures, and their products

   a. Gases for combustion

      (1) Acetylene: C_2H_2
      (2) Oxygen: O_2

b. Temperatures

(1) Luminous cone: 5800° - 6300°F.
(2) Envelope or outer cone: approximately 3800°F.
(3) Outer tip of the flame: approximately 2300°F.

c. Products

(1) First reaction: carbon monoxide plus hydrogen plus heat
(2) Second reaction: carbon dioxide and water vapor

4. The types of flames

a. Carburizing

(1) Ratio: 0.8 parts oxygen to 1.0 parts acetylene
(2) Temperature: 5550° - 5700°F.+
(3) Use: case harden

b. Neutral

(1) Ratio: 1.0 part oxygen to 1.0 part acetylene
(2) Temperature: 5850°F. approximately
(3) Use: welding

c. Oxidizing

(1) Ratio: 1.5 oxygen or more to 1.0 part acetylene
(2) Temperature: 6000° - 6300°F.
(3) Use: weld in an oxygen-starved atmosphere

B. Equipment

1. Combustion gases: the oxygen supply

a. Production

(1) By liquidation and distillation
(2) By electrolysis

b. Cylinders of compressed oxygen

(1) Construction

(a) Wall material: high carbon steel
(b) Wall thickness: 3/8"
(c) Neck ring
(d) Open center: no filler present

(2) Content

(a) Pressure: psig
(b) Volume: cu. ft.
(c) Calculation: Boyle's law

(3) Sizes

(a) Typical: 110, 220
(b) Other: 55, 80, 125, 250, 300

(4) Cylinder valves

(a) Back-seating seal
(b) Safety disc

    - (5) Safety cap
    - (6) Demurrage charge
  - c. Low-pressure, liquid oxygen cylinders
    - (1) Construction
      - (a) Double wall
      - (b) Filler and bleed lines
    - (2) Content and sizes
  - d. Oxygen manifold system
    - (1) Arrangement or construction
    - (2) Lines
    - (3) Regulator(s)
- 2. Combustion gases: the acetylene supply
  - a. Chemical composition: C_2H_2
  - b. Sources
    - (1) Generation by combining calcium carbide and water
    - (2) Purchase in storage cylinders
  - c. Acetylene cylinders: construction and content
    - (1) Wall: composition and thickness
    - (2) Cylinder valve
    - (3) Fuse plug
    - (4) Filler: pith and acetone
  - d. Cylinder discharge rates
  - e. Calculation of content: subtraction of tare weight from filled weight
  - f. Sizes from suppliers
    - (1) Typical: 130, 290, 300
    - (2) Other: 75, 190, 360
  - g. Acetylene generators
    - (1) Types
      - (a) Low-pressure
      - (b) Medium-pressure
    - (2) Adjustments and regulation
    - (3) Maintenance
    - (4) Safety precautions
  - h. Acetylene manifold systems
    - (1) Lines
      - (a) Size
      - (b) Metal composition
    - (2) Regulators
    - (3) Flash arrestor

3. Pressure regulators
    a. Purposes
        (1) To reduce storage pressure to a working level
        (2) To maintain a constant working pressure
    b. Types by valving
        (1) Nozzle-type
        (2) Stem-type
    c. Types by the number of stages
        (1) Single-stage
        (2) Two-stage
    d. Types used in manifold systems
        (1) Master service
        (2) Line station
    e. Safety precautions
4. Pressure gages
    a. Operation
        (1) Bourdon tube
        (2) Linkage
        (3) Pointer and dial
    b. Scales
        (1) For oxygen
        (2) For acetylene
        (3) Other: Nitrogen, Argon, CO_2, Hydrogen
    c. Types
        (1) High-pressure
        (2) Low-pressure
5. Hose: lines, connections, clamps
    a. Line diameters: 3/16", 1/4", 3.8", 1/2"
    b. Line composition: fabric and rubber
    c. Line connections: all female
        (1) Oxygen: right-hand thread
        (2) Acetylene: left-hand thread
    d. Line care and cleaning
        (1) Attaching connections
        (2) Work precautions
            (a) Avoid grease, acid, flame
            (b) Avoid abrasion, kinks, etc.
            (c) Check for leaks
6. Welding torches (blow pipes)
    a. Types

- (1) Injector type: use low pressure acetylene
- (2) Medium-pressure type

b. Acetylene sources used

- (1) Injector type
  - (a) Low-pressure generators
  - (b) Medium-pressure generators
  - (c) Cylinders
- (2) Medium-pressure type
  - (a) Medium-pressure generators
  - (b) Cylinders

c. Construction and operation

- (1) Injector type
  - (a) Body and handle with valves
  - (b) Welding head with injector
  - (c) Tip with removable or integral nozzle
- (2) Medium-pressure type
  - (a) Body and handle with valves
  - (b) Head with mixing chamber
  - (c) Tip with removable or integral nozzle

d. Care and cleaning

- (1) Tip and/or nozzle replacement
- (2) Tip and/or nozzle cleaning: selection and use of tip drills

III. BASIC METALLURGY

A. Basic definitions and explanations

1. Metallurgy
   - a. Extractive
   - b. Physical
2. Ore
3. Element
4. Metal
   - a. Properties, structure, characteristics
   - b. Base or parent
   - c. Filler
5. Alloys
   - a. Composition
   - b. Types

B. Properties of metals

1. Chemical
2. Electrical

- a. Conductors
  - (1) Good
  - (2) Poor
- b. Nonconductors

3. Thermal

4. Mechanical
   - a. Stress and strain
   - b. Tensile strength
     - (1) Yield point
     - (2) Yield strength
     - (3) Elastic limit
   - c. Elasticity
   - d. Ductility
   - e. Brittleness
   - f. Toughness
   - g. Hardness
     - (1) Brinell
     - (2) Rockwell
   - h. Corrosion resistance

C. Basic physics

1. The structure of matter
   - a. Compounds
   - b. Elements
   - c. Atoms
     - (1) Neutrons
     - (2) Protons
     - (3) Electrons
2. The table of the elements
   - a. Inert gases
   - b. Metals
   - c. Nonmetals
3. The states of matter
   - a. Gas
   - b. Liquid
   - c. Solid

D. Structure of metals

1. Grains: space-lattice type
   - a. Body-centered cubic

    - b. Hexagonal close-packed
    - c. Face-centered cubic
  - 2. Allotropic change
  - 3. Temperature range
    - a. Upper critical temperature
    - b. Transformation temperature
    - c. Lower critical temperature
  - 4. Iron-carbon structure
    - a. Pearlite
    - b. Austenite
    - c. Cemetite
    - d. Ferrite
    - e. Eutectoid mixture

- E. Extracting and forming metals
  - 1. Mining
  - 2. Smelting
    - a. Blast furnace
    - b. Bessemer process
    - c. Open hearth
    - d. Electric furnace
    - e. Other
  - 3. Casting
    - a. Pure iron
    - b. Iron-carbon and steel
    - c. Nonferrous
  - 4. Other metal forming
    - a. Cold rolling
    - b. Extruding
    - c. Hot rolling
    - d. Forging
  - 5. Heat treating
    - a. Annealing
    - b. Quenching
    - c. Carburizing
    - d. Spheroidizing
    - e. Hardening
    - f. Tempering
    - g. Flame hardening
    - h. Other

- F. Weldability
  - 1. Definitions and explanations of types
    - a. Practical weldability
    - b. Metallurgical weldability
    - c. Technical weldability

2. Factors to be considered in determining weldability
    a. Type of parent metal: its content
    b. Type of filler metal
    c. Influence of atmospheric gases
    d. Influence of shielding material
    e. Speed of weld
    f. Physical size of the object
    g. Need for pre- or post-processing: heat treat, anneal, preheat etc.

G. Types of metals and their weldability
  1. General
      a. Ferrous: iron is the main ingredient
      b. Nonferrous: nonmagnetic
  2. Ferrous
      a. Steel with carbon
          (1) Low-carbon: .05 -.30% carbon
          (2) Medium-carbon: .30 -.35% carbon
          (3) High-carbon: .45 - .75% carbon
          (4) Very high-carbon: .75 - 1.5% carbon
      b. Other alloying metals with steel
          (1) Nickel
          (2) Chromium
          (3) Molybdenum
          (4) Tungsten
          (5) Silicon
          (6) Manganese
          (7) Other: aluminum, copper
      c. Cast iron
          (1) Gray cast iron
          (2) Alloy cast iron
          (3) White cast iron
          (4) Malleable cast iron
          (5) Nodular
      d. Wrought iron
      e. Cast steel
      f. Stainless steel
          (1) Chromium-nickel: Group I
          (2) Hardenable chromium: Group II
          (3) Nonhardenable
  3. Nonferrous metals
      a. Copper and its alloys
          (1) Copper
          (2) Brass
          (3) Bronze

- b. Aluminum and its alloys
    - (1) Aluminum
    - (2) Wrought aluminum alloy
    - (3) Cast aluminum alloys
- c. Magnesium and its alloy
    - (1) Magnesium
    - (2) Alloying metals: aluminum, manganese, zinc
- d. Zinc and its alloys
    - (1) Zinc
    - (2) Alloying metals: copper, tin
- e. Nickel and its alloys
    - (1) Nickel
    - (2) Nonel: K, H, S, R, N
    - (3) Inconel
- f. Lead: grades
    - (1) Antimonial
    - (2) Corroding
    - (3) Common
    - (4) Chemical

H. Metal identification

1. Visual and manual examination of color, texture, and weight (an estimate)
2. Spark test
3. Chip test
4. Magnetic test
5. Hardness test

IV. WELDS, JOINTS, AND POSITIONS

A. Types of welds

1. Butt
2. Fillet

B. Fundamental types of joints and their variations

1. Butt (either open or closed)
    - a. Square butt
    - b. Bevel: single, double
    - c. Vee: single, double
    - d. J: single, double
    - e. U: single, double
2. Tee (either open or closed)
    - a. Plain
    - b. Vee: single, double
    - c. J: single, double
    - d. U: single, double

3. Lap
    a. Single-bead
    b. Double-bead
4. Corner
    a. Flush
    b. Half-open
    c. Full-open
5. Edge
6. Other
    a. Plug
    b. Slot

C. Positions for welding
1. Downhand
2. Horizontal
3. Vertical
4. Overhead

V. BLUEPRINT READING

A. Fundamentals
1. Basic lines
    a. Object line
    b. Hidden line
    c. Center line
    d. Dimension
    e. Extension
    f. Leaders
    g. Cutting plane
    h. Section
    i. Irregular break
        (1) Long
        (2) Short
2. Principal views (orthographic projection)
    a. Front
    b. Top
    c. Side, right
    d. Side, left
    e. Bottom
    f. Rear
3. Other representations
    a. Oblique
    b. Isometric
    c. Perspective

4. Dimensions
    a. Purpose
    b. Types
        (1) Location
        (2) Size
    c. Systems
        (1) Aligned
        (2) Unidirectional
    d. Methods
        (1) Fractions, decimals, and degrees
        (2) Chamfers and bevels
        (3) Radius, arc, and curves
        (4) Drilled holes
        (5) Other holes
        (6) Tolerances
        (7) Scale
        (8) Threads

7. Structural shapes and conventional representation
    a. Geometric solids
        (1) Square
        (2) Rectangular
        (3) Round
        (4) Hexagonal and octagonal
    b. Beams
        (1) Angles: equal and unequal, L-shape
        (2) Tees
        (3) Channels
        (4) I's
        (5) Irregular
    c. Cylinders
        (1) Thin-wall
        (2) Standard
        (3) Heavy
        (4) Extra-heavy

8. Auxiliary views
    a. Primaries
    b. Secondaries

9. Abbreviations and symbols
    a. Abbreviations
        (1) Standards
            (a) ASA - American Standards Association
            (b) AWS - American Welding Society
            (c) BWG - Birmingham Wire Gage

        - (d) SAE - Society of Automotive Engineers
        - (e) Others
    - (2) Metals
        - (a) br - brass
        - (b) bro - bronze
        - (c) CI - Cast Iron
        - (d) CRS - Cold Rolled Steel
        - (e) Others
    - (3) Geometry
        - (a) D - diameter
        - (b) R - radius
        - (c) Hex - hexagonal
        - (d) P - pitch
        - (e) Other
    - (4) Measurement
        - (a) ft. or ' - foot, feet
        - (b) in. or " - inch(es)
        - (c) deg. or ° - degrees
        - (d) lb. or # - pound(s)
        - (e) Other
    - (5) Process
        - (a) D - drill
        - (b) chfr - chamfer
        - (c) c'bore - counterbore
        - (d) ox - oxidize
        - (e) Other
- b. Symbols
    - (1) Reference line
    - (2) Arrowhead
    - (3) Element(s)
        - (a) Finish symbol
        - (b) Contour symbol
        - (c) Root opening: depth for plug and slot
        - (d) Size or strength for resistance welds
        - (e) Groove angle
        - (f) Length of weld
        - (g) Pitch
        - (h) Field weld symbol
        - (i) Weld all-around symbol
        - (j) Number of spot or projection weld
        - (k) Specification, process, or other
        - (l) Tail (when specification used)
        - (m) Basic weld symbol
            - (aa) Square
            - (bb) V
            - (cc) Bevel
            - (dd) U
            - (ee) J
            - (ff) Other

APPENDIX

OXYACETYLENE WELDING OUTFIT

Each work station for oxyacetylene welding shall be designed to perform all jobs identified in the course outline. The following pieces of equipment are recommended; any items substituted must have the same capabilities.

1	Cylinder of acetylene
1	Cylinder of oxygen
1	Oxygen cylinder valve
1	Acetylene cylinder valve
1	Single-stage oxygen regulator with gages
1	Single-stage acetylene regulator, with gages
10 ft.	Oxygen-acetylene hose, two-color, dual-type hose with female fittings attached
1	Welding torch, combination-type with gas nozzle and gooseneck

OXYACETYLENE WELDER'S TOOLS

Each trainee shall wear clothing appropriate to the welder's trade, such as heavy duck trousers, a long-sleeve shirt, high-top shoes, and a cap. In addition, each trainee shall have the following items:

1	Cylinder wrench
1 pr.	Welding goggles, #5 shade lens
1	Spark lighter
1	Wire brush
1 set	Tip cleaners
1 pr.	Welder's gloves

INSTRUCTOR'S REFERENCES

The following books have been chosen as being especially valuable to the instructor. It is recommended that he establish a reference library and draw heavily on these sources as he prepares for each day's teaching. To assist the instructor, considerable time has been invested in keying the instructional units in this guide to the particular book and page number.

Key
Number

1. Althouse, Andrew D., Carl H. Turnquist, and William A. Bowditch. Modern Welding, Homewood, Illinois: The Goodheart-Willcox Company, Inc., 1965.

2. Giachino, J. W., William Weeks, and Elmer Brune. Welding Skills and Practices. Chicago, Illinois: American Technical Society, 1965.

3. Griffin, Ivan, and Edward M. Roden. Basic Arc Welding. Albany, New York: Delmar Publishers, Inc., 1960.

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11. The Welding Encyclopedia, 15th ed. Morton Grove, Illinois: Monticello Books, 1964.

12. Welding: Unit I - Oxyacetylene Cutting; Unit II - Oxyacetylene Welding. Natchitoches, Louisiana: Louisiana State Vocational-Technical Curriculum Laboratory, 1963.

13. Welding: Unit III - Arc Welding; Unit IV - Inert Gas Welding. Natchitoches, Louisiana: Louisiana State Vocational-Technical Curriculum Laboratory, 1962.

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either

Althouse, Andrew D., Carl H. Turnquist, and William A. Bowditch. Modern Welding. Homewood, Illinois: The Goodheart-Willcox Company, Inc., 1965.

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No. 2, Water Supply, Drainage, Rough Work, Fixtures;
No. 3, Pipe Fitting, Heating, Ventilation, Air Conditioning;
No. 4, Gas Appliances, Sheet Metal Work, Welding.
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TRAINING ANALYSIS

for the

COMBINATION WELDER

I. LAYOUT

- A. Fundamental operations
    1. Lay out straight lines
    2. Lay out angles
    3. Lay out circles and arcs
- B. Basic exercises

II. OXYACETYLENE WELDING

- A. Downhand position
    1. Fundamental operations
        - a. Set up the equipment
        - b. Light the torch and adjust it for a carburizing, a neutral, and an oxidizing flame
        - c. Run a fusion bead
        - d. Run a bead with a filler rod
    2. Light sheet (under 1/8")
        - a. Make a tack weld
        - b. Make a butt weld
        - c. Make an outside corner weld
        - d. Make lap welds
        - e. Make tee welds
        - f. Make flange welds with and without filler rods
    3. Heavy stock
        - a. Tack a square-butt weld
        - b. Make a square-butt weld
        - c. Make a single-bevel-butt weld

    - d. Make a single vee-butt weld
    - e. Make a strapped square butt weld

- B. Horizontal position

    - a. Make a single-bevel butt weld
    - b. Make a lap weld

- C. Vertical position

    - a. Run a filler bead in an inside corner
    - b. Make a square butt weld
    - c. Make a single-vee butt weld

- D. Overhead position

    - a. Make a fillet weld
    - b. Make a lap weld
    - c. Make a square butt weld

- E. Pipe welds (up to 2" diameter)

    - a. Make a butt weld in the vertical position
    - b. Make a butt weld in the horizontal position

III. SOLDERING

- a. Properly clean ferrous and nonferrous materials
- b. Make a lap joint on flat stock
- c. Make a strapped butt joint
- d. Make a sweated pipe joint

IV. BRAZING

- a. Braze a lap joint on sheet steel
- b. Join dissimilar metals by brazing
- c. Build up cast iron by brazing
- d. Braze a single-vee butt joint (heavy plate)
- e. Braze a tee joint

V. OXYACETYLENE CUTTING

- a. Make straight line cuts
- b. Cut arcs and circles

        - c. Pierce heavy stock
        - d. Bevel plate and pipe
        - e. "Wash" a weld
        - f. Set up and operate an automatic cutting machine

VI. MANUAL METAL ARC

A. Flat position

1. Use 6010 or 6011 electrode

    - a. Set up and adjust MMA equipment
    - b. Strike and maintain an arc
    - c. Run a stringer bead
    - d. Make a single-pass fillet joint
    - e. Make a multiple-pass fillet joint
    - f. Make a multiple-pass tee joint

2. Use a 7016 or 7018 electrode

    - a. Set up and adjust MMA equipment
    - b. Strike and maintain an arc
    - c. Run a stringer bead
    - d. Make a single-pass fillet joint
    - e. Make a multiple-pass fillet joint
    - f. Make a multiple-pass tee joint

3. Use a Jet 6024 electrode

    - a. Make a fillet joint

B. Vertical position

    - a. Make a single-pass tee joint
    - b. Make a multiple-pass tee joint
    - c. Make a strapped vee-butt joint
    - d. Make an open vee-butt joint
    - e. Make a vertical-down, single-pass fillet joint

C. Overhead position

1. Use 6010 or 6011 electrode

    - a. Run stringer beads

        - b. Run weave beads
        - c. Make an open vee-butt joint
    - 2. Use 7016 or 7018 electrode
        - a. Run stringer beads
        - b. Run weave beads
        - c. Make an open vee-butt joint
- D. Pipe welding
    - 1. Horizontal position (6010 electrode)
        - a. Make an open vee-butt weld (with a chill ring)
        - b. Make an open vee-butt weld (without a chill ring)
    - 2. Vertical position
        - a. Make an open vee-butt weld (with a chill ring)
        - b. Make an open vee-butt weld (without a chill ring)
        - c. Join standard pipe to a 90° elbow (a socket weld)

VII. TUNGSTEN INERT-GAS WELDING

- A. Fundamentals
    - 1. Downhand position
        - a. Run a fusion bead
        - b. Make a fillet weld on a tee joint
        - c. Make a square-butt joint
        - d. Make a single vee-butt joint
        - e. Make a lap weld
        - f. Make a corner weld

VIII. METAL INERT-GAS WELDING

- a. Set up the equipment
- b. Run a stringer bead
- c. Make a square-butt joint
- d. Make a corner weld
- e. Make a tee joint
- f. Make a lap joint
- g. Make a single vee-butt weld

EQUIPMENT LIST

for

VOCATIONAL WELDING (COMBINATION)

Oxyacetylene welding and cutting equipment

Quantity	Item
7	Combination outfit for welding, cutting, brazing, heating, and soldering
	Or, the contents may be purchased separately to include:
7	Welding torches
7	Gooseneck extensions:
21	Welding tips: 7 each of sizes 62, 55, 42
7	Gas mixers
7	Cutting attachments, with 90° head
7	Cutting tips: Size 53,
7	Acetylene regulators, two-gage type
7	Oxygen regulators, two-gage type
175 ft.	Welding and cutting hose, dual-type with two hoses permanently bonded together, 1/4" diameter, with appropriate female connections on all ends
7 pairs	Welding goggles with #5 lens
7	Spark lighters, with round file lighter
7	Torch wrenches:
15	Manuals, welding and cutting (optional item)
	Additional pieces not in the outfit:
7	Welding tips, tip size 50 27 or equal
7	Welding tips: Series 170, tip size 58
1	Cutting outfit, hand operated, heavy-duty, for cutting only
	Or, the contents may be purchased separately to include:
1	Cutting torch; brass head set at 90°:
3	Cutting tips, acetylene, Sizes 62, 53, and 46:

Quantity	Item
1	Regulator, acetylene, two-gage type with gages
1	Regulator, oxygen, two-gage type with gages
25 ft.	Cutting hose; dual-type with two hoses permanently bonded together; 1/4" diameter with appropriate female connections on all ends
	Additional pieces not in the outfit:
2	Cutting tips for rivets; size 53
2	Gouging tips, with tip orifice 1/8"
1 pair	Goggles, welding; with #5 lens
1	Spark lighter with round file lighter
1	Wrench, torch
1	Portable flame-cutting machine, with torch, torch-holder, cutting tip for acetylene, torch wrench, machine-to-torch hose assembly (with connections and hose connection block having double action cutoff), machine track, 115-volt motor with three-wire cord

<u>Gas manifold system to include the following:</u>

Quantity	Item
1	Manifold for oxygen, 4-on/4-off type with nonautomatic (manual) control having two gages; master shut-off valve for each bank (2); 8 header fittings; 8 pigtails
1	Line delivery system for oxygen to include the following:
	Oxygen station valves with check valves with chain and dust cap
8	Oxygen line regulators with chain and dust cap:
1	Manifold for acetylene, 4-on/4-off type with single regulator having two gages, nonautomatic (manual) control; flash arrestor; master shut-off valve for each bank (2); 8 header fittings; 8 pigtails, each with flash arrestors

Quantity	Item
1	Line delivery system for acetylene to include the following:
8	Acetylene station valves with check valves, with chain and dust cap
8	Acetylene line regulator, with chain and dust cap:

NOTE: Most local building regulations require installation of manifold and distribution systems by a licensed plumber; manufacturers and distributors are restricted to a consulting role only.

Manual metal arc welding equipment

Quantity	Item
3	Welding machines, arc (manual metal); a-c transformer type, 250-amp output, 230-volt, 60-cycle input, with pigtail and 2 cable plugs:
	Accessories for the above welder:
75 ft.	Cable; 12 1/2 ft. lead, 12 1/2 ft. ground for each machine, #2/0 gage:
3	Electrode holders, with replaceable tip insulators
3	Ground clamps
6	Welding machines, arc (manual metal), 250-amp, a-c/d-c transformer-rectifier-type, with reverse polarity switch and a-c or d-c selector; current selector; current valve control, with pigtail
150 ft.	Cable; 12 1/2 ft. lead, 12 1/2 ft. ground for each machine; #2/0 gage:
6	Electrode holders, with replaceable tip insulators
6	Ground clamps
1	Welding machine, arc (manual metal); 300-amp, motor-generator type d-c; current valve control; pigtail
25 ft.	Cable; 12 1/2 ft. lead, 12 1/2 ft. ground for each machine; #2/0 gage:
1	Electrode holder, with replaceable tip insulators
1	Ground clamp

Manual inert gas welding

Quantity	Item
1	Welder (manual inert gas) d-c: constant-potential type; 300-amp rating at 100% duty factor; 220-volt, 60-cycle, 3-phase input
1	Wire drive and dispenser, for 1/16" wire; 115-volt a-c, 60-cycle, 1/6-hp, high torque drive motor, with empty reel
1 set	Drive rolls for 1/16" wire (spare), for wire drive
1	Welding gun, arc (manual metal); air-cooled, adjustable handle or grip, min. 300-amp rating
1	Ground clamp
1	Regulator, argon
1	Flowmeter, for argon

Tungsten inert gas welding

Quantity	Item
1	Welding machine, arc (manual metal); a-c/d-c transformer-type with rectifier for straight and reverse polarity equal
1	Torch, TIG; water-cooled, 350-amp capacity with short and long back cap
12 1/2 ft.	Torch lead (connecting cable)
10 ft. (Per machine)	Ground cable; #1 gage
1	Ground clamp
1	Water coolant system, 10 gallon capacity, with 115-volt, 60-cycle pump motor
25 ft.	Coolant hose
1	Argon regulator
1	Argon flowmeter
12 ft.	Connecting hose, single; for Argon

Diptransfer equipment

Quantity	Item
1	Welding machine, constant-potential type, for mild steel only. 250-amp, 100% duty cycle, 220/440, 3-phase
	Accessory pieces required:
1	Wire drive, with burn-back control, 115-volt, a-c, 60-cycle, 1/10-hp motor
1	Gun, with stop-start trigger in the handle; 360° swivel gooseneck with 60°-angle offset; 100% duty cycle, 200-amp to accommodate .025 - .045 diameter wire
4	Nozzles
4	Contact tips
1	Regulator, argon, and flowmeter
10 ft.	Hose, single
10 ft.	Cable, ground, #1 gage
1	Clamp, ground.

Equipment and tools for the shop and for trainee protection

Quantity	Item
2	Grinders, heavy-duty, on pedestal; push-button switch; sealed ball-bearings; enclosed, adjustable wheel guards; adjustable safety-shields; tool tray and lift-out water pot, mounted on base; 200-volt, three-phase motor, fully enclosed, 1-hp, 1800 r.p.m., with two grinding wheels, 6" in diameter
2	Grinders, portable, with 36" flexible shaft and 1/4" chuck
1	Cylinder truck, with tool box and 10" rubber wheels (min)
10	Welding helmets, vulcanized fiber construction with fixed glass holder, complete with ratchet adjustment headband, cover lens, and #10 welding lens
4	Hand shields, vulcanized fiber construction with aluminum handle and fixed glass holder cover lens, and #10 welding lens

Quantity	Item
4 pairs	Welding goggles (for persons wearing prescription glasses), with #54 clear cover lens, and #74, shade 5 welding lens
15 pairs	Safety glasses, with folding temples and hardened lens of medium shade
15 pairs	Goggles, chipping and grinding goggles, with insulated ball chain bridge
4	Faceshield visors, with light green tint, .040 thick visor
10 pairs	Welding gloves, regular
4 pairs	Welding gloves, inert arc
15	Welder's coats, leather, with collar, snap fasteners down front and on sleeves, sized to fit student
10 sets	Tip cleaners in a case, standard range of drill size, 51-74
1 dozen	Chipping hammers, combination cone and chisel point

<u>Consumable supplies</u>

Quantity	Item
4	Brazing flux, 1-lb cans
4	Brazing flux, 1-lb. cans
4	Aluminum welding flux, 1-lb. jars
4	Cast iron welding flux, 1-lb. cans
2 dozen	Soldering paste, 2-oz. cans
2 dozen	Bars of solder, 1-lb., 40/60
50 pounds	Brazing rod, 1/8" - 36": AWS A5.7T, Class RCuZn-B
25 pounds	Aluminum rod, 3/32-36"

Quantity	Item
pounds	Welding rod, oxyacetylene, mild steel, copper coated, 1/16-36": AWS-ASTM A251-46T, Grade GA-50
pounds	Welding rod, oxyacetylene, mild steel, copper coated, 3/32-36": AWS-ASTM A251-46T, Grade GA-50
pounds	Welding rod, oxyacetylene, mild steel, copper coated, 1/8-36": AWS-ASTM A251-46T, Grade GA-50
pounds	Welding rod, oxyacetylene, medium carbon, high strength, 3/32-36": AWS-ASTM A251-46T, Grade GA-60, GB-60
	Electrode, tungsten, 2% thorium 3/32-6":
	Electrode, tungsten, 2% thorium; 1/16-6"
spools	Welding wire, diptransfer-type, .035 diameter, 25-pound spool: AWS GB 45
spools	Welding wire, metal-inert-gas-type, 1/16" diameter
pounds	Welding electrodes, arc (manual metal); mild steel, coated: 1/8-AWS-E6010 or 6011
pounds	Welding electrodes, arc (manual metal); mild steel, coated: 1/8-AWS-E7016 or 7018
pounds	Welding electrodes, arc (manual metal); mild steel, coated: 5/32-AWS-E7016 or 7018
pounds	Welding electrodes, arc (manual metal; mild steel, coated: 1/8-AWS-E6013
pounds	Welding electrodes, arc (manual metal); mild steel, coated: 1/8-AWS met 6024
2 dozen	Flints, renewal
1 dozen boxes	Headbands for welding goggle replacement, 4 per box
4 dozen	Cover lens, replacement
2 dozen	Welding lens, replacement, shade 5
	Cylinder(s) of acetylene, 30/mo. x 18 mo.

Quantity	Item
	Cylinder(s) of argon, 5 per mo. x 18 mo.
	Cylinder(s) of carbon dioxide; argon 75-57 premix, 12 per mo.
	Cylinder(s) of oxygen, 65/mo. x 18 mo.
500	Cover plates for welding helmet, clear glass 2 x 4 1/2"
2 dozen	Filter plates, for welding helmet, 2 x 4 1/2", shade 10
3 each	Filter plates, for welding helmet, 2 x 4 1/2", shade 8 and shade 12

NOTE: Schools using electric power from REA sources should specify equipment with power factor correction, and should contact their local power company about installation.

VT003 492

VT 003 492

A Basic Plan for the Organization and Management of Instruction in Vocational Metal Trades.

Mississippi State Univ., State College. Curriculum Lab.
Mississippi State Dept. of Vocat. Educ., State College.
Pub Date - Apr67
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*CURRICULUM GUIDES, *TRADE AND INDUSTRIAL EDUCATION, *METAL MACHINING OCCUPATIONS, SHEET METAL WORKERS, WELDERS, OCCUPATIONAL CLUSTERS, HIGH SCHOOLS, POST SECONDARY EDUCATION, EQUIPMENT,

This curriculum guide was prepared to assist the trade instructor in planning and developing instructional materials for a high school metal trades course organized on the occupational cluster concept and encompassing the basic knowledge and skills of the metal machining, sheet metal, and welding trades. A curriculum committee developed the material by identifying operations and informational topics within each field. The objectives of the course are to develop entry-level knowledge and skills in one of the specific occupations or to develop knowledge and skills basic to the metal trades occupational cluster. Job procedures for the instructional blocks of sheet metal, welding, and machine shop, and related instruction for applied mathematics, applied physical science, basic metallurgy, and blueprint reading are outlined. This course is designed for a 2-year program with 1,080 hours of training. Instructional procedures are recommended for the trade competent teacher. Students should have a definite vocational committment to one of the specific trades or to the metal trades occupational cluster. Necessary equipment and consumable supplies are listed, and a bibliography contains recommended textbooks and reference books for each field. This document is available for $1.00 from Curriculum Laboratory, Box NU, State College, Mississippi 39762. (HC)

BASIC PLAN
for the
Organization and Management of Instruction
in
VOCATIONAL METAL TRADES

PRELIMINARY DRAFT — FOR DISCUSSION ONLY

Prepared and Issued by the
CURRICULUM LABORATORY
TRADE AND TECHNICAL EDUCATION
STATE DEPARTMENT OF VOCATIONAL AND TECHNICAL EDUCATION
Jackson, Mississippi

Located in the
DEPARTMENT OF INDUSTRIAL EDUCATION
MISSISSIPPI STATE UNIVERSITY
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MEMORANDUM

TO: The ERIC Clearinghouse on Vocational and Technical Education
The Ohio State University
980 Kinnear Road
Columbus, Ohio 43212

FROM: (Person) Robert D. Sartin (Agency) Curriculum Laboratory

(Address) P. O. Drawer [illegible] State College, Mississippi 39762

DATE: September 11, 1967

RE: (Author, Title, Publisher, Date) Mississippi Curriculum Laboratory

A BASIC PLAN FOR VOCATIONAL METAL TRADES
State College, Miss: Curriculum Laboratory of the State Department of Vocational and Technical Education, Mississippi State University, 1967

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(2) Means Used to Develop Material:
Development Group P
Level of Group P
Method of Design, Testing, and Trial This is a preliminary draft which is being reviewed by metal trades instructors; at a later date it will be evaluated by these two groups

(3) Utilization of Material:
Appropriate School Setting Vocational (trade) Training
Type of Program Preparatory
Occupational Focus P
Geographic Adaptability Normally found in the secondary schools, but believed to
Uses of Material be applicable at post secondary level; for use by instructo
Users of Material in planning daily teaching activities

(4) Requirements for Using Material:
Teacher Competency Trade competent, with teaching skills
Student Selection Criteria Those who want, need, and are able to profit from the training; recommend screening by testing, by examination of school records, and by personal interview
Time Allotment P

Supplemental Media --
Necessary X
Desirable
(Check Which)

Describe This is a guide for use in planning instruction; it is in outline form; thus it requires supplementary references which are listed and carry bibliographical citation
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Inquiries should be directed to:

CURRICULUM LABORATORY
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ACKNOWLEDGMENTS

The Curriculum Committee for the Metal Trades met on the campus of Mississippi State University on March 10 and 11. After a brief orientation, the members agreed upon the trades contained in the cluster, as well as the opportunities for employment. Using the traditional approach, skills and knowledges were then identified as operations and informational topics essential to successful entry into and progress within each trade. Following this, jobs were listed as suggested teaching vehicle. Finally, an equipment list was reviewed and modified which would adequately support the training activities.

Following the work of the Committee, the staff of the Curriculum Laboratory compiled, edited, duplicated, and distributed the material. This publication, which is the first step, will be the base for further development. A definite part of the developmental process is an evaluation and authentication by a representative industrial committee.

The members of the committee are commended for their efforts and their cooperative spirit in developing this material. The staff of the Curriculum Laboratory also wishes to acknowledge the continued support of Mississippi schools and their administrators who make their staff available. The members of the committee and their schools are:

James W. Bishop	Forest High School
George L. Curtin	Northeast Mississippi Junior College
Reo J. Grover	St. Martin High School
Glenn D. Millis	R. H. Watkins High School
Neil E. Wrenn	East Tallahatchie High School

FOREWORD

The Basic Plan for the Organization and Management of Instruction for Vocational Metal Trades is a departure from traditional trade training. Rather than confining itself to a single trade, the plan follows the "cluster" concept and encompasses the basic knowledges and skills of three trades: machinist, sheet-metal worker, and combination welder.

Trainees in a cluster program gain insight into a broader range of occupational requirements, than they could acquire in training for a single trade. Consequently, they enjoy a wider choice upon entry into the world of work. They have also the advantage of greater mobility as a tradesman, geographically as well as occupationally.

Institutions offering training in a cluster program must recognize and point out to trainees that this greater scope of occupational training can be gained only by limiting in-depth experiences. Administrators of these institutions must maintain communication with industry to insure that employment opportunity is available for the cluster graduate.

Only a carefully planned and executed series of activities can produce an orderly, well-balanced program of instruction. The following procedure is recommended to the instructor in a cluster program.

Group I. Trainees who have a definite vocational commitment to one specific trade within the cluster should be allowed to work in jobs of this trade for the full training time.

Group II. Trainees who are not committed to a specific trade at the time of entry should be systematically involved in basic knowledges and skills of all three trades during the first half of their training time

Group IIa. At the end of the first half of their training time, those trainees who have developed a definite trade objective should be allowed to invest the remainder of their training time in the knowledges and skills of that chosen trade

Group IIb. Trainees who have still not developed a definite trade objective should be systematically involved in activities designed to give the knowledges and skills of greater depth in *each* of the three trades of the cluster

As previously stated, the above program will require a high level of planning by the instructor. The use of job sheets and progress charts is strongly recommended as a time-proven method. Furthermore, it is recommended that the instructor make all decisions as to the activities of the trainee. Finally, the instructor should immediately modify the training plan of any trainee in accord with an identifiable vocational interest.

HOW TO USE THIS PUBLICATION

As a tool for teaching, this publication is primarily designed for use in planning, preparing, presenting, and evaluating instruction. As a tool, it lists operations, jobs, and informational topics--with the job as the focal point. Each job should be assigned to students, either as a group, a subgroup, or individually. The following procedure is recommended as an effective teaching sequence.

Step I. -- Tell how the job is done.
Give a full explanation of the steps necessary to perform the job. Emphasize the proper sequence; stress techniques requiring special care; point out the hazards to persons and the equipment.

Step II. -- Show how the job is done.
Demonstrate the proper procedure for performing the job. Re-emphasize the sequence, techniques, and hazards. Make sure each student can see what is being done and understands the steps.

Step III. -- Have the student do the job.
Assign each student the task of applying what he has just learned. Supervise his work; correct any variation from proper procedure or any hazardous techniques. Re-explain when necessary.

Step IV. -- Check the student for proficiency.
Assign a similar job to the student to be performed independently. Observe his work and examine the completed product or service. He is proficient when he can perform the job without supervision in a prescribed length of time.

Students who have demonstrated proficiency in one job move to the next job. The teaching steps *tell, show, do, check* are used again. Students who are not proficient perform additional jobs of a similar nature and are retaught in weak areas.

Additionally, this publication can be used (1) by the director and the instructor in a local program in communicating with their craft committee, (2) by the local director in supervising instruction and program operation, and (3) by the state supervisory staff in communicating with local school administrators and in supervising the operation of local programs.

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JOB DESCRIPTION

It is neither possible nor desirable to identify a single trade as the employment goal of all trainees enrolled in a cluster program. Conversely, several employment opportunities exist, and four of these are briefly described below. Each of these descriptions is given a fuller treatment in the Dictionary of Occupational Titles, third edition.

MACHINIST. 600.280. Machinist, all-around; machinist, first class; machinist, general; machinist, journeyman; machinist, precision.

The machinist works from blueprints, sketches, and descriptions of parts or assemblies to be made. He plans the sequence of operations and sets up and operates machine tools such as engine lathes, shapers, milling machines, drill presses, and grinders. He may fit and assemble parts, mechanisms, tools, or machines. He may also use a broad range of precision measuring and gaging instruments as an inspector.

SHEET-METAL WORKER (any ind.) 804.281. Sheet-metal journeyman; sheet-metal man; sheet-metal mechanic.

The sheet-metal man works from a job order or blueprint and selects metal according to the product being fabricated. He lays out a pattern or works directly on metal by locating and marking dimensions and reference lines while using such tools as rules, calipers, scribes, squares, and punches. He sets up and operates cutting, folding, and fastening machines to shear, brake, roll, and punch metal to specified shape. Additionally, he uses hand tools such as hammers, snips, and clamps. He joins parts, using rivets and screws as well as soldering and welding equipment. He inspects assemblies and installations for conformance to specifications.

WELDER, COMBINATION (Welding) 812.884.

The combination welder joins parts together, using gas welding (WELDER, GAS) or brazing (BRAZER-ASSEMBLER) and any combination of welding processes, such as manual metal arc, tungsten inert gas, carbon arc, and others. He works from layouts, blueprints, and work orders, and uses a variety of clamping and holding devices as well as the welding equipment unique to the process being employed at the time. Extensive involvement in fit-up of parts, or inspection of final welds depends upon advancement in the trade.

MAINTENANCE MECHANIC (any ind.) II. 638.281. Fixer; machine adjuster; machine-maintenance man; machine overhauler; machine repairman; mechanical handyman; repair mechanic; tool-and-machine maintenance man.

The maintenance mechanic repairs and maintains equipment in accordance with diagrams, sketches, operation manuals, and manufacturers' specifications. The range of machinery and mechanical equipment, such as cranes, pumps, engines, motors, pneumatic tools, conveyor systems, production machines, and automotive and construction equipment. The mechanic uses hand tools and power tools, such as wrenches, hammers, and drills, as well as precision and nonprecision measuring instruments. He troubleshoots malfunctions by listening, observing, inspecting, and testing, and disassembling. He repairs and replaces defective parts, as well as lubricates and cleans. He may set up and operate lathes, drill presses, grinders, and other metal-working tools.

A person desiring or accepting employment as a maintenance mechanic must recognize gaps in his preparation in the areas of power mechanics and basic electricity. Such gaps must be filled after employment by trade extension training.

COURSE DESCRIPTION

ALTERNATIVE OBJECTIVES

Either

1. To develop entry-level knowledges and skills in those trainees having an identifiable occupational goal in machine shop, or sheet metal, or combination welder

Or

2. To develop knowledges and skills which are basic to the metal trades occupational cluster, namely machinist, sheetmetal worker, and combination welder

ASSUMPTIONS

1. That trainees have had no previous experience in metalworking
2. That trainees have a nontechnical background in general science
3. That trainees need additional instruction in the fundamentals of mathematics

DESIRABLE PREREQUISITES

1. That trainees have a vocational commitment to one of the three trades (preferable)
2. That trainees have a vocational interest in the metal trades area
3. That trainees have a mechanical aptitude
4. That they have had or are currently taking a course in applied mathematics including arithmetic, simple algebra, plane geometry, and elementary trigonometry
5. That they have had or currently are taking a course in mechanical drawing
6. That they will have a course in applied physical science before completion of their training

NATURE OF THE TRAINING

1. The duration of the training is normally three hours per day, five days per week, thirty-six weeks per year for two years; or, six hours per day,

five days per week, thirty-six weeks per year for one year -- a total of 1080 clock hours of training

2. Related instruction by lecture, demonstration, the use of audiovisuals, and others immediately precedes application by the trainee in shop practice; instruction and its application are correlated as closely as possible at all times; and the major allotment of time is given to the development of manipulative skills.

3. No instruction directly related to the trade is offered outside the shop

CONTENT OF RELATED INSTRUCTION

Systematic and purposeful presentation of topics of related instruction to all trainees is strongly recommended. The instructor in Metal Trades is faced with a diversity of needs on the part of the trainees. The following is a suggested procedure:

1. Trainees with identifiable vocational goals in either sheet metal, machine shop, or combination welding are to receive related instruction appropriate to that trade. The content is identified in detail in the Curriculum Laboratory publications, Vocational Sheet Metal, Vocational Machine Shop, and Vocational Welding.

2. Trainee with a general vocational interest in the metal trades are to be given a broader background in the composition, processing, and fabrication of metals. A detailed identification of this content is contained elsewhere in this publication and is titled "Related Instruction Topics".

TYPES AND LEVELS OF SKILLS TO BE DEVELOPED

1. Immediately marketable skills for those trainees electing to train in a specific trade

2. Basic manipulative skills of the metal trades cluster for those trainees electing broader training

INSTRUCTIONAL BLOCKS

The following blocks are the major areas of instruction. Each has been assigned a number of hours for the purpose of indicating the relative amount of emphasis it is to receive in the total training period. Instructors are urged to plan training carefully, to select, sequence, and assign learning experience, thus making maximum use of available time. It should not be inferred that hour allotments be rigidly adhered to or that students be rotated on a clockwork or calendar basis. On the contrary, the emphasis is on individual proficiency. It is likely that students of lesser ability will require longer periods in certain areas. These students may gain only the minimum proficiencies while more able students will progress more rapidly and engage in many enriching experiences. Consequently, the planning, sequencing, and allotting are not designed to standardize programs, but to assist local teachers in planning more carefully and in conducting their instruction more carefully.

I. SHEET METAL

Scale and precision measurement	15	
Geometric construction and layout	150	
Bench work: mark out, cut out, form, fasten	90	
Form with sheet metal equipment	105	
Subtotal		360

II. WELDING

Oxyacetylene welding, cutting, brazing	90	
Manual metal arc	150	
Tungsten inert gas	120	
Subtotal		360

III. MACHINE SHOP

Engine lathe	150	
Drill press	15	
Shaper	45	
Mill	90	
Surface grinder	45	
Power saws	15	
Subtotal		360
TOTAL TRAINING TIME		1080

ANALYSIS OF OPERATIONS

I. MEASUREMENT

A. Scale Measurement

1. Measure with a steel tape or rule
2. Measure with a steel square
3. Measure diameter and circumference with a circumference rule
4. Measure angles with a semicircular protractor
5. Measure angles with a swing-blade protractor
6. Measure angles with the protractor head and the blade of a combination set
7. Measure ferrous metal with a sheet metal gage
8. Measure nonferrous metal with a sheet metal gage
9. Transfer measurements with dividers or calipers
10. Measure threads with a screw pitch gage
11. Check twist-drill points with drill-point gage
12. Measure holes and recesses with a (scaler) depth gage
13. Measure with a hook rule

B. Precision Measurement

1. Measure with an outside micrometer
2. Measure with an inside micrometer
3. Measure with a vernier caliper
4. Measure with a dial indicator
5. Measure angles with a vernier bevel protractor
6. Measure with a sine bar
7. Measure with a micrometer depth gage
8. Transfer measurements with a telescoping gage
9. Measure with a vernier depth gage
10. Measure with a vernier height gage
11. Measure gaps with a feeler gage
12. Measure with gage blocks

II. LAYOUT

A. Sheet Metal: operations performed with a compass, dividers, rule, straight edge, and pencil or scribe

1. Bisect a line
2. Erect a perpendicular from a point on a line
3. Erect a perpendicular from a point off a line
4. Bisect an arc
5. Bisect an angle
6. Transfer an angle
7. Construct a line parallel to a given line, passing through a given point
8. Construct a line parallel to a given line, at a given distance
9. Divide a line into a given number of equal parts
10. Divide a line into proportional parts
11. Divide a surface into any given number of equal parts
12. Construct a triangle with all sides given
13. Construct a triangle with the hypotenuse and one side given
14. Construct an equilateral triangle
15. Construct a square
16. Construct a regular pentagon
17. Construct a regular hexagon
18. Construct a regular octagon
19. Find the center of a circle with a right triangle
20. Construct a circle tangent to a line at a given point
21. Construct a tangent to a circle through a point on the circle
22. Construct a tangent to a circle through a point off the circle
23. Construct a line tangent to two circles
24. Construct a circle through three points
25. Divide a circle into any number of equal parts
26. Construct an arc tangent to two intersecting lines
27. Construct an arc tangent to both an arc and a straight line
28. Construct an ogee curve

B. Precision: with a surface plate and precision measuring tools; repeat the above operations

III. MARKOUT

A. Scribe a line with a scratch awl or scribe and a straight edge
B. Mark a location with a prick punch and a hammer
C. Mark centers with a center punch and a hammer
D. Mark centers with an automatic center punch
E. Scribe arcs and circles on flat or sheet stock with dividers
F. Scribe arcs with trammel points and bar
G. Scribe parallel lines with a tinner's file
H. Scribe parallel lines with a marking gage or a scratch gage
I. Scribe parallel lines with a scratch awl or scribe and the square head and the blade of a combination set
J. Scribe irregular arcs with a french curve and a scribe or a scratch awl
K. Sharpen a scratch awl, center punch, prick punch, or scribe
L. Scribe arcs and circles with a hermaphrodite caliper
M. Scribe lines with a surface gage mounted on a surface plate
N. Locate centers with a scribe and the center head and blade of a combination set
O. Mark centers with a bell punch
P. Locate the center of round stock with dividers
Q. Locate the center of round stock with a hermaphrodite caliper

IV. CUTOUT

A. Sheetmetal

1. Cut along a straight line with straight-pattern snips
2. Cut along a straight line with combination-pattern snips
3. Cut heavy sheet with combination-lever snips
4. Cut along a curved line with aviation snips
5. Cut pieces which are held in a vise, with a flat chisel
6. Cut a starting slit with a flat chisel
7. Cut pieces lying flat, with a chisel
8. Cut along layout lines, with an electric nibbler
9. Punch holes with a solid punch and a hammer
10. Punch holes with a hollow punch and a hammer
11. Punch holes along an edge, with a hand punch
12. Cut rivets with a chisel

B. Heavy Stock

1. Cut flat and round stock with a chisel
2. Cut flat and round stock with a hand hacksaw
3. Cut angle iron with a hacksaw
4. Cross-file for rapid stock removal, with a mill bastard file

C. Other

1. Drill holes with a hand drill and a twist drill
2. Countersink holes with a hand drill and a countersink bit
3. Ream holes with a hand reamer
4. Cut internal threads in a drilled hole, with a tap and T handle
5. Cut external threads on round stock with a die and diestock
6. Cut a groove with a cape chisel or diamond-point chisel
7. Move a drilled hole which is improperly started with a diamond-point chisel

V. FORM WITH HAND TOOLS

A. Sheetmetal

1. Set down an edge or flatten seams with a tinner's hammer
2. Form sheet metal with a wood, rubber composition, or rawhide mallet
3. Form a square piece on the breakdown or needlecase stake with a mallet
4. Form a round piece on the conductor stake with a mallet
5. Form a round piece on the needlecase stake with a mallet
6. Form a conical piece on the blowhorn stake with a mallet
7. Form a conical piece on the candlemold stake with a mallet
8. Brake a piece of sheet metal at 90° angle, with a piece of angle iron, C clamp, and mallet
9. Brake pieces to form boxes with hand tongs or handy seamer
10. Form a radius in a piece held over a pipe with a clamp, using a mallet
11. Form a single hem with hand tongs or handy seamer
12. Form a double hem with hand tongs or handy seamer
13. Prepare an edge for grooved seams with hand tongs or handy seamer
14. Form a radius bend with a conductor stake
15. Finish an outside grooved seam, using a hollow or solid mandrel stake
16. Form a plain dovetailed seam, using straight-cutting aviation snips

17. Flange an edge on a stake with a tinner's hammer
18. Shrink an edge on a stake with a tinner's hammer
19. Flange an edge with a hand dolly and a tinner's hammer
20. Fit a tee, using hand snips
21. Wire straight edges before a piece is formed
22. Wire an inside or outside radius on a flat piece
23. Wire a square or rectangular piece after it is formed
24. Wire a tapered piece after it is formed
25. Double-seam corners on a square or rectangular piece with handy seamer and stakes

B. Heavy sheet and bar stock

1. Make angular bends in a piece held in a vise by striking with a hammer
2. Form a curve in a piece, with an anvil and a hammer
3. Twist a piece held in a vise, with a monkey wrench
4. Form an eye in a piece of flat stock over a short pipe held in a vise
5. Form irregular curves, with a wooden jig
6. Heat a piece for forming, with an oxyacetylene torch

VI. FORM WITH SHOP EQUIPMENT

A. Bar folders

1. Fold a single hem
2. Fold a double hem
3. Form the folds for a grooved seam
4. Form the fold for an edge to be wired
5. Form a 45°, 90°, or a special angle
6. Form a double right-angle brake

B. Box and pan brake

1. Sharp brake thin sheet metal
2. Form a mold
3. Form the pocket for a Pittsburgh lock
4. Form a lock seam

C. Slip rolls

1. Roll cylindrical shapes

2. Remove buckles (brake tin)
3. Roll tapered shapes
4. Roll a cylindrical piece with wired edges

D. Squaring shears

1. Cut marked sheet metal
2. Cut a sheet against the front gage
3. Cut a sheet against the back gage
4. Cut a sheet at an angle

E. Combination rotary machine for turning, burring, wiring, elbow edging, flanging, and flattening operations

1. Beading
    a. Form a single bead
    b. Form an ogee bead
    c. Form a triple bead
2. Crimping
    a. Crimp round pipe
    b. Crimp and bead cylindrical-shaped objects
3. Turning
    a. Form an edge for wiring
    b. Score or crease an edge, using a gage
    c. Turn edges for elbows
4. Burring
    a. Burr a disc
    b. Burr an edge on a cylinder
5. Elbow: form an elbow

F. Ring and circle shears

1. Cut a circle
2. Cut a ring
3. Cut a sheet of metal

G. Setting down machine: set down flanges and seams

H. Spot welder

   1. Spotweld ferrous sheet (3/16" thick capacity)
   2. Spot weld nonferrous sheet

I. Notcher: Notch the edge of sheet metal (up to 16 gage)

J. Throatless shear

   1. Make straight cuts along marked lines
   2. Make curved cuts along contours

VII. FASTEN WITH HAND TOOLS

A. Tighten or loosen screws with a flat-blade screw driver
B. Tighten or loosen screws with a Phillips screwdriver
C. Tighten or loosen nuts and bolts with hand wrenches
D. Drive, set, and flange rivets with a riveting hammer and a rivet set
E. Hold a piece in place by applying a C clamp
F. Hold a pattern in place by applying parallel clamps
G. Forge a soldering copper
H. File a soldering copper
I. Tin a soldering copper
J. Apply soft solder with a soldering copper
K. Apply soft solder with a propane torch
L. Apply soft solder with an oxyacetylene torch
M. Rivet with pop rivets

VIII. WELDING

A. Oxyacetylene welding

   1. Install a cylinder valve and a regulator on a cylinder
   2. Assemble a welding torch
   3. Assemble a cutting torch
   4. Attach a welding torch or a cutting torch to a regulator, using dual-type hose
   5. Light a welding torch and adjust it for a carburizing, a neutral, and an oxidizing flame

6. Light and adjust a cutting torch
7. Form a puddle, using an acetylene torch
8. Add filler rod to a puddle
9. Change the tip on a welding or a cutting torch
10. Change the lens in welding goggles

B. Manual metal arc

1. Plug the pigtail into an outlet (CAUTION!)
2. Attach a lug, ground clamp, or electrode holder to a lead cable
3. Attach the welding lead and the ground lead to the welding machine
4. Attach the ground lead to the work or to the worktable
5. Put an electrode in the holder
6. Put on and adjust a welding helmet
7. Change a cover plate and/or lens in a helmet
8. Strike an arc and hold it
9. Adjust the current controls

C. Tungsten inert gas

1. Install a cylinder valve and argon regulator-flowmeter on a cylinder
2. Assemble a TIG torch
3. Attach a TIG torch to a power supply, water supply, and gas supply
4. Insert a tungsten electrode and adjust the collet cap assembly
5. Turn on and adjust the cooling water supply
6. Select the type of current and the polarity; set the current flow
7. Turn on and adjust the flow of argon
8. Strike an arc and hold it
9. Add filler rod
10. Change nozzles on the torch

IX. ENGINE LATHE

A. Setup

1. Set the speed on a belt-drive lathe
2. Set the speed on a gear-drive lathe
3. Set the feed on a quick change
4. Mount a faceplate or chuck on a threaded spindle nose

5. Mount a taper shank tool or workpiece in a collet
6. Mount a taper shank tool in a standard-taper headstock
7. Remove a taper shank tool from a standard-taper headstock
8. Mount a taper shank tool in a tailstock
9. Remove a taper shank tool from a tailstock
10. Mount work in a universal chuck
11. Mount work in an independent chuck
12. Mount work in a headstock
13. Mount work in a taper-shank drill chuck
14. Mount work in a faceplate by bolting, etc.
15. Mount work in a faceplate for turning between centers with a lathe dog
16. Mount work on a mandrel
17. Sharpen tool bits on a bench or pedestal grinder
18. Mount a tool bit and holder in the tool-post holder
19. Set a tool bit for cutting to the left
20. Set a tool bit for cutting to the right
21. Set a tool bit for thread cutting
22. Mount a taper attachment on the carriage and bed
23. Offset the tailstock for taper turning
24. Set the compound feed for taper turning
25. Support work with a steady rest
26. Support work with a follower rest
27. Mount a tool-post grinder

B. Operation

1. Turn on the lathe
2. Engage or disengage the back gear
3. Engage the power cross feed
4. Manually cross-feed
5. Manually feed the compound
6. Engage the longitudinal feed (power); reverse the feed
7. Engage the half nut on the lead screw
8. Feed manually (longitudinally); reverse the feed
9. Feed a tool held in the tailstock
10. File on a lathe
11. Polish with emery cloth

X. HOLDING WORK

- A. Vises
  - 1. Hold work in a vise
  - 2. Hold work in a vise, using a wedge
  - 3. Hold work in a vise, supporting with parallels or rest blocks
- B. Clamps and others
  - 1. Clamp work to a table with a C clamp
  - 2. Clamp work to a table with hold-down clamps, T bolts, and step plates
  - 3. Support work with jack screws
  - 4. Position work with angle plates and C clamps
  - 5. Hold round stock in V blocks

XI. DRILL PRESS

- A. Sharpen a twist drill
- B. Mount a taper shank tool or toolholder in the spindle
- C. Remove a taper shank tool or toolholder from the spindle
- D. Mount a tool or workpiece in a drill chuck
- E. Set the speed on a drill press
- F. Feed the tool manually
- G. Adjust the feed stop
- H. Adjust the table height
- I. Center work, using a wiggler

XII. SHAPER

- A. Set up
  - 1. Adjust the travel of the ram
  - 2. Adjust the position of the ram
  - 3. Adjust the speed of the ram
  - 4. Sharpen a tool bit
  - 5. Mount the tool bit in a toolholder
  - 6. Mount a toolholder in the tool post
  - 7. Mount a tool bit for a horizontal cut

8. Mount a tool bit for a vertical cut
9. Mount a tool bit for a regular angular cut
10. Mount a tool bit for an inside angular cut
11. Secure or loosen the clapper
12. Set the toolhead at an angle
13. Adjust the height of the table and set the slide

B. Operation

1. Power-feed the toolhead vertically
2. Manually feed the toolhead down
3. Power-feed the table horizontally
4. Manually feed the table horizontally
5. Power-feed the table
6. Manually feed the table in a vertical direction

XIII. MILL

A. Table

1. Set the height of the table
2. Manually, feed the table vertically
3. Power-feed the table vertically
4. Set the horizontal position of the table
5. Manually feed the table horizontally (laterally)
6. Power-feed the table horizontally
7. Manually cross-feed the table
8. Power cross-feed the table
9. Set the table-feed rate when using power

B. Spindle

1. Set the spindle speed
2. Mount a taper shank tool or an adapter in a spindle, using a draw bar
3. Mount a taper shank tool or an adapter in a spindle having a drive-fit-type taper
4. Mount a straight shank tool in a drill chuck
5. Bolt a cutting tool to the spindle or to an adaptor (eg. shell-type mills)
6. Mount a cutter on an arbor (horizontal mill only)

7. Mount an arbor in the spindle, support it with the overarm and adjust the brass collet (horizontal mill only)

C. Indexing

1. Mount an indexing head having a live center and a dead center on the table
2. Set the index wheel and the work piece for straight cuts
3. Attach and engage the index-drive gears for power feed from the table
4. Set the table at an angle cut

D. Coolant

1. Check the composition of the cutting fluid
2. Set the coolant flow rate

XIV. SURFACE GRINDER (VERTICAL SPINDLE)

A. Setup

1. Mount a grinding wheel in the spindle
2. Set the wheel speed
3. Set the coolant-flow rate

B. Operation

1. Face a grinding wheel
2. Form-shape a grinding wheel
3. Manually feed the table down
4. Manually cross-feed the table
5. Power cross-feed the table
6. Manually traverse-feed the table
7. Power traverse-feed the table

XV. BENCH GRINDER

A. Mount a grinding wheel
B. Face a grinding wheel
C. Form-shape a grinding wheel
D. Adjust the guard and the tool rest
E. Set the coolant-flow rate

XVI. POWER SAWS

A. Reciprocating hacksaw
   1. Clamp stock for a straight cut
   2. Clamp stock for an angular cut
   3. Adjust and/or change a blade
   4. Change cutting speed
   5. Adjust cutting pressure

B. Band saw
   1. Cut, weld, and anneal a blade
   2. Cut along straight lines with the table in the horizontal position
   3. Cut along curved lines with the table in the horizontal position
   4. Cut along straight lines with the table in an inclined position
   5. Cut along curved lines with the table in an inclined position

XVII. HEAT TREATING

A. Anneal a nonferrous metal by heating, then cooling rapidly
B. Anneal a ferrous metal by heating, then cooling slowly
C. Harden a nonferrous metal by heating, then cooling slowly
D. Harden a ferrous metal by heating and tempering
E. Surface-harden a ferrous metal by heating in the presence of a carbon compound

XVIII. FINISH

A. Draw-file a piece of flat or round stock
B. Finish-file edges and corners
C. Wire brush a surface
D. Clean a surface with steel wool or abrasive cloth
E. Degrease a surface with a solvent
F. Etch a surface with an acid
G. Blue a finished piece
H. Apply enamel to a finished piece
I. Apply lacquer to a finished piece
J. Hand-buff a finished surface, using polish or wax

SUGGESTED JOBS IN THE METAL TRADES

I. SHEETMETAL: LAYOUT AND FABRICATION

A. Elementary layout

1. Lay out patterns and construct simple rectangular boxes and pans
2. Lay out patterns and construct rectangular flaring pans
3. Lay out patterns and construct multipiece boxes and pans
4. Lay out patterns and construct circular pipe
5. Lay out patterns and construct circular pans and pails
6. Lay out patterns and construct rectangular duct cleats and seams
7. Lay out patterns and construct rectangular duct ells and angles with square throat and heel
8. Lay out patterns and construct 90° Y and branch in a rectangular duct
9. Lay out patterns for rectangular duct-change elbows
10. Lay out patterns for rectangular duct-change angles

B. Parallel-line layout

1. Lay out stretchout patterns and construct parallel line profiles
2. Lay out patterns and construct two-piece 90° elbows and angles of round pipe
3. Lay out patterns and construct two-piece elbows of any profile
4. Lay out patterns and construct 90° T's of equal-diameter round pipe
5. Lay out patterns for angle T's of unequal diameter pipe
6. Lay out patterns and construct multipiece elbows
7. Lay out patterns and construct round pipe offsets
8. Lay out patterns, using 90° round elbow patterns for elbows with angles of less than 90°.
9. Lay out patterns, using multipiece elbows to construct round-pipe offsets
10. Lay out patterns and construct an oblong 90° angle
11. Lay out patterns and construct square-face miters
12. Lay out patterns and construct ogee return miters
13. Lay out patterns and construct butt miters
14. Lay out patterns and construct return miters other than right angles
15. Lay out patterns and construct butt miters against oblique surfaces in the plan
16. Lay out patterns and construct eaves-trough miters

17. Lay out patterns and construct oblique-face miters
18. Lay out patterns and construct a range hood
19. Lay out patterns, using the three-point method; 90° transition elbows
20. Lay out patterns of 90° transition elbows, using three-line method
21. Lay out patterns and construct 90° transition elbows with vanes
22. Lay out patterns and construct molded conductor heads
23. Lay out patterns and construct octagonal roof finals

C. Radial line development

1. Lay out patterns and construct cones and frustums
2. Lay out patterns and construct funnels
3. Lay out patterns and construct round ventilator heads
4. Lay out patterns and construct square pyramids
5. Lay out patterns and construct irregular frustums
6. Lay out patterns and construct irregular frustums of hexagonal pyramids
7. Lay out patterns and construct conical outlet for 1/2-round gutter
8. Lay out patterns and construct collars on double-pitched roofs
9. Lay out patterns and construct rectangular pyramids
10. Lay out patterns and construct oblong raised covers
11. Lay out patterns and construct frustum of cone intersected by cylinder obliquely
12. Lay out patterns and construct a cone intersecting a cone obliquely

D. Triangulation

1. Develop patterns and construct a square-to-square transition piece
2. Develop patterns and construct a square-to-round
3. Develop patterns and construct a round reducer
4. Lay out patterns and construct round-to-oblong transitions
5. Lay out patterns and construct drop-cheek elbows
6. Lay out patterns and construct twisted rectangular pipes
7. Lay out patterns and construct rectangular-to-round fittings, vertical on two sides
8. Lay out patterns and construct irregular oblong-to-round fittings
9. Lay out patterns and construct irregular T joints
10. Lay out patterns and construct square-to-round roof collars for pitched roofs

11. Lay out patterns and construct a round-to-rectangular, 90° furnace boot
12. Lay out patterns and construct scalene cones
13. Lay out patterns and construct a three-piece, square-to-round elbow
14. Lay out patterns and construct a three-piece, round reducing elbow
15. Lay out patterns and construct a tapering Y branch
16. Lay out patterns and construct three-branch fittings
17. Lay out patterns and construct a two-way elbow intersection
18. Lay out patterns and construct ship ventilator with a round base and mouth

II. MACHINE SHOP

A. Engine Lathe

1. Plain turn (rough, finish, polish)
    a. Between centers
    b. With chuck
2. Bore
    a. Straight holes
    b. Angular holes
    c. Taper holes
    d. Multi-diameter (concentric) holes
    e. Bore and face blind holes
    f. Recess and groove inside diameters
3. Face
    a. In a chuck
    b. Between centers
    c. To radii and fillets
4. Drill
    a. Straight drill
    b. Ream
    c. Countersink
    d. Drill and countersink
    e. Counterbore

5. Thread
    a. Chase external threads
    b. Chase internal threads
    c. Chase taper threads
6. Taper turn
    a. Using compound rest
    b. Using taper attachment
    c. Using offset tail stock
7. Grind, using tool post grinder
    a. External grinding
    b. Internal grinding
8. Use accessories
    a. Faceplate turning
    b. Use of steady rest

B. Drill press

1. Straight-drill flat stock
2. Straight-drill round stock
3. Countersink
4. Counterbore
5. Ream
6. Tap
7. Spot-face

C. Shaper

1. Shape horizontal surfaces
2. Shape angular surfaces
3. Shape vertical surfaces
4. Shape grooves and external keyways
5. Shape internal keyways
6. Serrate

D. Mill

1. Horizontal
   - a. Plain-mill a horizontal surface
   - b. Plain-mill a vertical surface
   - c. Cut a slot
   - d. Cut a keyseat
   - e. Make an angular cut
   - f. Drill and ream holes
   - g. Enlarge holes by boring and counterboring
   - h. Cut spur gears
   - i. Cut helical gears
2. Vertical
   - a. Plain-mill a surface with an end mill
   - b. Drill and ream holes
   - c. Enlarge holes by boring and counterboring
   - d. Cut a slot; cut a T slot
   - e. Set up and cut flues and splines

E. Bench grinder

1. Sharpen hand tools
2. Form grind

F. Surface grinder (vertical spindle)

1. Grind a plain surface
2. Grind an edge or end
3. Step-grind an edge, end, or face
4. Form-grind an edge or end

G. Power saws

1. Reciprocal hacksaw: cut off ferrous and nonferrous metals
2. Band saw
   - a. Straight-cut single pieces of stock
   - b. Contour-cut single pieces of stock
   - c. Cut internal contours of single pieces
   - d. Make straight and contour cuts of stacked, multiple pieces

III. WELDING

- A. Oxyacetylene welding
  - 1. Downhand position
    - a. Fundamental operations
      - (1) Run a fusion bead
      - (2) Run a bead with a filler rod
    - b. Light sheet (under 1/8")
      - (1) Make a tack weld
      - (2) Make a butt weld
      - (3) Make an outside corner weld
      - (4) Make lap welds
      - (5) Make tee welds
      - (6) Make flange welds with and without filler rods
    - c. Heavy stock
      - (1) Tack a square-butt weld
      - (2) Make a square-butt weld
      - (3) Make a single-bevel butt weld
      - (4) Make a single-vee butt weld
      - (5) Make a strapped square-butt weld
  - 2. Horizontal position
    - a. Make a single-bevel butt weld
    - b. Make a lap weld
  - 3. Vertical position
    - a. Run a filler bead in an inside corner
    - b. Make a square butt weld
    - c. Make a single-vee butt weld
  - 4. Overhead position
    - a. Make a fillet weld
    - b. Make a lap weld
    - c. Make a square butt weld

5. Pipe welds (up to 2" diameter)
    a. Make a butt weld in the vertical position
    b. Make a butt weld in the horizontal position

B. Brazing
  1. Braze a lap joint on sheet steel
  2. Join dissimilar metals by brazing
  3. Build up cast iron by brazing
  4. Braze a single-vee butt joint (heavy plate)
  5. Braze a tee joint

C. Cast iron
  1. Weld cast iron with oxyacetylene

D. Oxyacetylene cutting
  1. Make straight line cuts
  2. Cut arcs and circles
  3. Pierce heavy stock
  4. Bevel plate and pipe
  5. "Wash" a weld
  6. Set up and operate an automatic cutting machine

E. Manual metal arc
  1. Flat position
    a. Use 6010 or 6011 electrode
      (1) Set up and adjust MMA equipment
      (2) Strike and maintain an arc
      (3) Run a stringer bead
      (4) Make a single-pass fillet joint
      (5) Make a multiple-pass fillet joint
      (6) Make a multiple-pass tee joint
    b. Use a 7016 or 7018 electrode
      (1) Set up and adjust MMA equipment
      (2) Strike and maintain an arc
      (3) Run a stringer bead
      (4) Make a single-pass fillet joint

        - (5) Make a multiple-pass fillet joint
        - (6) Make a multiple-pass tee joint

2. Vertical position: 6010 or 6011

    a. Make a single-pass tee joint
    b. Make a multiple-pass tee joint
    c. Make a strapped vee-butt joint
    d. Make an open vee-butt joint
    e. Make a vertical-down, single-pass fillet joint

3. Horizontal (6010 electrode)

    a. Make a single pass tee joint
    b. Make a multiple pass butt joint

4. Overhead position

    a. Use 6010 or 6011 electrode

        - (1) Run stringer beads
        - (2) Run weave beads
        - (3) Make an open vee-butt joint

    b. Use 7016 or 7018 electrode

        - (1) Run stringer beads
        - (2) Run weave beads
        - (3) Make an open vee-butt joint

5. Pipe welding

    a. Horizontal position (6010 electrode): Make an open vee-butt weld (without a chill ring)

    b. Vertical position

        - (1) Make an open vee-butt weld (without a chill ring)
        - (2) Join standard pipe to a 90° elbow (a socket weld)

F. Tungsten inert-gas welding on ferrous stainless, and nonferrous aluminum

1. Downhand position

    a. Run a fusion bead
    b. Make a fillet weld on a tee joint

c. Make a square-butt joint

d. Make a single vee-butt joint

e. Make a lap weld

f. Make a corner weld

2. Horizontal position

    a. Make a single-pass tee joint
    b. Make a multiple-pass butt joint

3. Vertical position

    a. Make a single-pass tee joint
    b. Make a multiple-pass butt joint

4. Overhead position:

    a. Make a multiple-pass butt joint

TOPICS OF RELATED INSTRUCTION

I. APPLIED MATHEMATICS

A. Whole numbers
   1. Addition of whole numbers
   2. Subtraction of whole numbers
   3. Multiplication of whole numbers
   4. Division of whole numbers

B. Fractions
   1. Addition of common fractions
   2. Subtraction of common fractions
   3. Multiplication of common fractions
   4. Division of common fractions

C. Decimal fractions
   1. Addition of decimal fractions
   2. Subtraction of decimal fractions
   3. Multiplication of decimal fractions
   4. Division of decimal fractions

D. Measurements
   1. Linear measure
   2. Angular measure
   3. Circular measure
   4. Area
   5. Volume

E. Percentage
   1. Finding the percent of numbers
   2. Application of percentage
   3. Averages
   4. Estimates
   5. Percentage of simple finance
   6. Use of percentage in manufacturing and cost

F. Graphs

   1. Bar graphs
   2. Line graphs
   3. Circle graphs

G. Symbols

   1. Addition of symbols
   2. Subtraction of symbols
   3. Multiplication of symbols
   4. Division of symbols

H. Equations

   1. Concept of positive and negative numbers
   2. Solving equations by addition
   3. Solving equations by subtraction
   4. Solving equations by multiplication
   5. Solving equations by division

I. Formulas - application as applied to

   1. Rectangles
   2. Squares
   3. Circles

J. Geometry of lines and shapes

   1. Lines
   2. Angles
   3. Circles
   4. Basic solid and flat shapes

K. Trigonometry

   1. Description of functions

      a. Sine
      b. Cosine
      c. Tangent

   2. Description of cofunctions

3. Trigonometric tables
    a. Use
    b. Interpolation
4. Applied problems

L. Logarithms

1. Description
2. Use of tables
    a. Multiplication
    b. Division
    c. Roots and powers

II. APPLIED PHYSICAL SCIENCE

A. The composition of matter

1. Structure
    a. Compounds, mixtures
    b. Molecules
    c. Atoms
    d. Protons, neutrons, electrons
2. Physical states
    a. Solid
    b. Liquid
    c. Gas

B. Measurement

1. English system
    a. Linear: inches, feet, miles, etc.
    b. Area: square inches, feet, miles, etc.
    c. Volume: cubic inches, feet, volume
2. Metric system
    a. Linear: milli-centi-, meter
    b. Area: square milli-,centi-, meter
    c. Volume: cubic milli-, centi-, meter

C. Simple machines

    1. Levers
        a. Mechanical advantage
        b. Hand tools
        c. Industrial machines
    2. Incline planes
        a. Mechanical advantage
        b. Wedges
    3. Wheels and axles
        a. Mechanical advantage
        b. Gears
    4. Screw threads
        a. Mechanical advantage
        b. Transmission of motion
        c. Torque: nuts, bolts, screws
    5. Pulleys
        a. Mechanical advantage
        b. Simple
        c. Compound

D. Friction

    1. Cause
    2. Types
        a. Rolling
        b. Sliding
    3. Effects
        a. Heat
        b. Wear

E. Heat

    1. Sources
        a. Solar
        b. Electrical

- c. Atomic
- d. Friction
- e. Other

2. Measurement
    - a. Specific
    - b. Latent
3. British thermal unit (Btu)
4. Transfer of heat
    - a. Radiation
    - b. Conduction
    - c. Convection

F. Chemical reactions

1. Acids
    - a. Sulfuric
    - b. Muratic
    - c. Acetic
2. Bases
    - a. Sodium hydroxide
3. Salts
    - a. Sodium chloride
    - b. Other
4. Corrosion of metals
    - a. Chemical
    - b. Electrical
    - c. Electrolysis

III. BASIC METALLURGY

A. Definitions and explanations

1. Metallurgy
    - a. Extractive
    - b. Physical

2. Ore
3. Element
4. Metal
    a. Properties, structure, characteristics
    b. Base or parent
    c. Filler
5. Alloys
    a. Composition
    b. Types

B. Properties of metals
1. Chemical
2. Electrical
    Conductors
        (1) Good
        (2) Poor
    b. Nonconductors
3. Thermal

4. Mechanical
    a. Stress and strain
    b. Tensile strength
        (1) Yield point
        (2) Yield strength
        (3) Elastic limit
    c. Elasticity
    d. Ductility
    e. Brittleness
    f. Toughness
    g. Hardness
        (1) Brinell
        (2) Rockwell

        - h. Corrosion resistance

- C. Basic physics
    - 1. The structure of matter
        - a. Compounds
        - b. Elements
        - c. Atoms
            - (1) Neutrons
            - (2) Protons
            - (3) Electrons
    - 2. The table of the elements
        - a. Inert gases
        - b. Metals
        - c. Nonmetals
    - 3. The states of matter
        - a. Gas
        - b. Liquid
        - c. Solid
- D. Structure of metals
    - 1. Grains: space-lattice type
        - a. Body-centered cubic
        - b. Hexagonal close-packed
        - c. Face-centered cubic
    - 2. Allotropic change
    - 3. Temperature range
        - a. Upper critical temperature
        - b. Transformation temperature
        - c. Lower critical temperature
    - 4. Iron-carbon structure
        - a. Pearlite
        - b. Austenite
        - c. Cemetite

    - d. Ferrite
    - e. Eutectoid mixture

- E. Extracting and forming metals
  - 1. Mining
  - 2. Smelting
    - a. Blast furnace
    - b. Bessemer process
    - c. Open hearth
    - d. Electric furnace
    - e. Other
  - 3. Casting
    - a. Pure iron
    - b. Iron-carbon and steel
    - c. Nonferrous
  - 4. Other metal forming
    - a. Cold rolling
    - b. Extruding
    - c. Hot rolling
    - d. Forging
  - 5. Heat treating
    - a. Annealing
    - b. Quenching
    - c. Carburizing
    - d. Spheroidizing
    - e. Hardening
    - f. Tempering
    - g. Flame hardening
    - h. Other
- F. Weldability
  - 1. Definitions and explanations of types
    - a. Practical weldability
    - b. Metallurgical weldability
    - c. Technical weldability

2. Factors to be considered in determining weldability

a. Type of parent metal: its content
b. Type of filler metal
c. Influence of atmospheric gases
d. Influence of shielding material
e. Speed of weld
f. Physical size of the object
g. Need for pre- or post-processing: heat treat, anneal, preheat,etc.

G. Types of metals and their weldability

1. General

a. Ferrous: iron is the main ingredient
b. Nonferrous: nonmagnetic

2. Ferrous

a. Steel with carbon

(1) Low-carbon: .05 - .30% carbon
(2) Medium-carbon: .30 - .35% carbon
(3) High-carbon: .45 - .75% carbon
(4) Very high-carbon: .75 - 1.5% carbon

b. Other alloying metals with steel

(1) Nickel
(2) Chromium
(3) Molybdenum
(4) Tungsten
(5) Silicon
(6) Manganese
(7) Other: aluminum, pper

c. Cast iron

(1) Gray cast iron
(2) Alloy cast iron
(3) White cast iron
(4) Malleable cast iron
(5) Nodular

- d. Wrought iron
- e. Cast steel
- f. Stainless steel
    - (1) Chromium-nickel: Group I
    - (2) Hardenable chromium: Group II
    - (3) Nonhardenable

3. Nonferrous metals
    - a. Copper and its alloys
        - (1) Copper
        - (2) Brass
        - (3) Bronze
    - b. Aluminum and its alloys
        - (1) Aluminum
        - (2) Wrought aluminum alloy
        - (3) Cast aluminum alloys
    - c. Magnesium and its alloy
        - (1) Magnesium
        - (2) Alloying metals: aluminum, manganese, zinc
    - d. Zinc and its alloys
        - (1) Zinc
        - (2) Alloying metals: copper, tin
    - e. Nickel and its alloys
        - (1) Nickel
        - (2) Monel: K, H, S, R, N
        - (3) Inconel
    - f. Lead: grades
        - (1) Antimonial
        - (2) Corroding
        - (3) Common
        - (4) Chemical

H. Machinability

1. Definition
2. Factors influencing machinability
    a. Hardness
    b. Alloys
    c. Processing and heat treatment
3. Relation between cast-iron hardness and machinability
4. Relation between tensile strength and hardness

I. Machinability of metals

1. Classes: ferrous, nonferrous
2. Cast-iron
    a. Gray
    b. White
    c. Malleable
3. Wrought iron
4. Steel
    a. Carbon: low, medium, high
    b. High speed
    c. Tool
    d. Alloys: nickel, manganese, chromium, molybdenum, tungsten, vinadium sillite, tungsten carbide
5. Base metals: lead, copper, zinc, tin, nickel, aluminum
6. Alloys: Bar-alloy, pewter, brass, bronze, nickel silver
7. Precious metals: sterling silver, gold, platinum

J. Metal identification

1. Visual and manual examination: color, texture, weight
2. Spark test
3. Chip test
4. Magnetic test
5. Hardness test

IV. BLUEPRINT READING

- A. Fundamentals
  - 1. Basic lines
    - a. Object line
    - b. Hidden line
    - c. Center line
    - d. Dimension
    - e. Extension
    - f. Leaders
    - g. Cutting plane
    - h. Section
    - i. Irregular break
      - (1) Long
      - (2) Short
  - 2. Principal views (orthographic projection)
    - a. Front
    - b. Top
    - c. Side, right
    - d. Side, left
    - e. Bottom
    - f. Rear
  - 3. Other representations
    - a. Oblique
    - b. Isometric
    - c. Perspective
  - 4. Dimensions
    - a. Purpose
    - b. Types
      - (1) Location
      - (2) Size
    - c. Systems

        - (1) Aligned
        - (2) Undirectional
    - d. Methods
        - (1) Fractions, decimals, and degrees
        - (2) Chamfers and bevels
        - (3) Radius, arc, and curves
        - (4) Drilled holes
        - (5) Other holes
        - (6) Tolerances
        - (7) Scale
        - (8) Threads
- 7. Structural shapes and conventional representation
    - a. Geometric solids
        - (1) Square
        - (2) Rectangular
        - (3) Round
        - (4) Hexagonal and octagonal
    - b. Beams
        - (1) Angles: equal and unequal, L-shape
        - (2) Tees
        - (3) Channels
        - (4) I's
        - (5) Irregular
    - c. Cylinders
        - (1) Thin-wall
        - (2) Standard
        - (3) Heavy
        - (4) Extra-heavy
- 8. Auxiliary views
    - a. Primaries
    - b. Secondaries

9. Abbreviations and symbols

a. Abbreviations

(1) Standards

(a) ASA - American Standards Association
(b) AWS - American Welding Society
(c) BWG - Birmingham Wire Gage
(d) SAE - Society of Automotive Engineers
(e) Others

(2) Metals

(a) br - brass
(b) bro - bronze
(c) CI - Cast Iron
(d) CRS - Cold Rolled Steel
(e) Others

(3) Geometry

(a) D - diameter
(b) R - radius
(c) Hex - hexagonal
(d) P - pitch
(e) Other

(4) Measurement

(a) ft. or ' - foot, feet
(b) in. or " - inch(es)
(c) deg. or ° - degrees
(d) lb. or # - pound(s)
(e) Other

(5) Process

(a) D - drill
(b) chfr - chamfer
(c) c'bore - counterbore
(d) ox - oxidize
(e) Other

b. Symbols

- (1) Reference line
- (2) Arrowhead
- (3) Element(s)
  - (a) Finish symbol
  - (b) Contour symbol
  - (c) Root opening: depth for plug and slot
  - (d) Size or strength for resistance welds
  - (e) Groove angle
  - (f) Length of weld
  - (g) Pitch
  - (h) Field weld symbol
  - (i) Weld all-around symbol
  - (j) Number of spot or projection weld
  - (k) Specification, process, or other
  - (l) Tail (when specification used)
  - (m) Basic weld symbol
    - (aa) Square
    - (bb) V
    - (cc) Bevel
    - (dd) U
    - (ee) J
    - (ff) Other

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EQUIPMENT LIST
for the
METAL TRADES

<u>Sheet metal equipment</u>

Quantity	Description
2 sets	Stakes: one set for bench plate mounting; one set with revolving stand Candlemold Beakhorn Blowhorn Needlecase Creasing Hollow Mandrel Solid mandrel Bottom Double seaming Conductor Bevel edge Common square Teakettle Hatchet Coppersmith Double seaming with four heads
1	Bar folder; including stand; 36"
1	Rotary machine, combination; A, B, C, D rolls; 22-gage capacity; including standard
1	Rotary machine, combination; 7" throat; with rolls A, B, C, D, E, F; 3/4" ogee rolls; elbow edging rolls; including stand; 24-gage capacity
1	Setting down machine; with standard; 1/2" seam, 18-gage capacity
1	Slip roll; 16-gage capacity 3" roll diameter; including stand; 42" length
1	Shears, squaring: foot-operated; 48" capacity
1	Bench brake, universal box and pan; 36-1/4" bench model; 22-gage capacity
1	Cornice brake; 16-gage capacity; 5' length
2	Gas bench furnaces; double burner
1	Bevel shear
1	Unishear: 16-gage capacity

Machine shop equipment

Quantity	Description
1	Lathe, engine; 16" swing, 48" between centers; gear-drive head; quick-change gear box; long-nose, taper spindle; 2-speed, reversing-type motor; coolant pump
	ACCESSORIES, to fit the above lathe
1	Collet attachment; with collets range 1/16 - 1", by 1/16" increments; with collet rack
1	Chuck, 3-jaw universal; 10" diameter
1	Drill chuck; 1/4" - 3/4" capacity
2	Chucks, 4-jaw independent; 10" diameter (1); 14" diameter (1)
2	Face plates; 1 large, 1 small
1	Taper attachment, telescoping
1	Steady rest
1	Follower rest
1 set (3)	Tool holders; left, right, straight
1	Boring bar set
1	Thread dial
1	Micrometer stop
1 set (3)	Parting tools;left, right, straight
1 set	Knurling tools
1	Live center; heavy-duty
1 set (3)	Tool holders, carbide; left, right, straight
1 set	Adaptor sleeve; for headstock
1 set	Lathe dogs; safety-type
1	Taper arbor; for tailstock
1 set	Pipe centers
1 set	Hollow centers
6	Combination center drill and countersink
2	Lathes, engine; 13" swing, 42" between center; gear head, quick-change gear box; long-nose taper spindle; 2-speed, reversing-type motor; coolant pump

Machine shop equipment

Quantity	Description
	ACCESSORIES, to fit the above lathe
1	Collet attachment; with collets range 1/16 - 1", by 1/16" increments; with collet rack
1	Chuck, 3-jaw universal; 10" diameter
1	Drill chuck; 1/4" - 3/4" capacity
2	Chucks, 4-jaw independent; 10" diameter (1); 14" diameter (1)
2	Face plates; 1 large, 1 small
1	Taper attachment, telescoping
1	Steady rest
1	Follower rest
1 set (3)	Tool holders; left, right, straight
1	Boring bar set
1	Thread dial
1	Micrometer stop
1 set (3)	Parting tools; left, right, straight
1 set	Knurling tools
1	Live center; heavy-duty
1 set (3)	Tool holders, carbide; left, right, straight
1 set	Adaptor sleeve; for headstock
1 set	Lathe dogs; safety-type
1	Taper arbor; for tailstock
1 set	Pipe centers
1 set	Hollow centers
6	Combination center drill and countersink
2	Milling machines, vertical; table size minimum 9" x 46" longitudinal travel minimum 32". Machine to have power feed to table (longitudinal only); head to rotate 360° on ram, turret to rotate 360° on column, head to tilt 45° backward on ram; power-feed head with independent motor drive.
	ACCESSORIES, to fit the above mill
1 set	Parallels
1	Vise, swivel base
1	Dividing head and accessories

Machine shop equipment

Quantity	Description
1	Rotary table
8	Cutters, woodruff key seat; high speed steel; two each of the following: 3/8 x 1/8, 5/8 x 3/16, 3/4 x 1/4, 1 x 3/8
6	Cutters, plain milling; high-speed steel; one each of the following sizes: 2-1/2 x 1/4 x 1, 2-1/2 x 3/8 x 1, 2-1/2 x 1/2 x 1; 2-1/2 x 5/8 x 1-1/4, 3 x 3/4 x 1-1/4, 3 x 1 x 1-1/4
4	Cutters, slitters (saws); hollow-ground, high-speed steel; two each of the following sizes: 1-1/4 x 1/16 x 1/2; 3-1/2 x 1/8 x 1/2
1 set (8)	Cutters, involute spur gear; high-speed steel; for 14-1/2° pressure angle; numbers 1 through 8 for a 16 diametral pitch, 2-1/8 diameter, 7/8" arbor
6	Cutters, side milling; high-speed steel; one each of the following sizes: 3 x 1/4 x 1, 3 x 3/8 x 1, 3 x 1/2 x 1, 5 x 5/8 x 1, 4 x 3/4 x 1, 4 x 7/8 x 1
8	End mills, 2-flute, single end; high-speed steel; hollow-ground, fast spiral flutes; right-hand spiral, right-hand cut, two each of the following sizes: 1/4 x 3/8, 3/8 x 3/8, 1/2 x 3/8, 5/8 x 3/8
12	End mills, 4-flute, single end; high-speed steel; hollow-ground, fast spiral flutes; right-hand spiral, right-hand cut, three each of the following sizes: 1/4 x 3/8, 3/8 x 3/8, 1/2 x 3/8, 5/8 x 3/8
4	End mills, 2-flute double end; high-speed steel; hollow-ground, fast spiral flutes; right-hand spiral; right-hand cut; standard length; one each of the following: 1/2 x 1/2, 5/8 x 5/8, 3/4 x 3/4, 1 x 1
6	End mills, 2-flute single end; high-speed steel; hollow-ground; right-hand spiral; right-hand cut; two each of the following: 1/4 x 3/8, 3/8 x 3/8, 1/2 x 1/2
2	End mills, shell; high-speed steel with mandrell; 3/4 - 1-1/2 by 1/8" increments
1	Shaper, horizontal 16" hydraulic, universal table, with swivel vise, with standard tool holders; one set hold-downs, 220 volt, 3-phase motor with magnetic switches. Power feeds, 360° head swivel accessories to include centers, rotary lathe, automatic oiler; extended tool holder; angle plate and all necessary wrenches, keys, bolts, and nuts

Machine shop equipment

Quantity	Description
2	Surface grinders, hydraulic, 8" x 24" minimum work capacity, 220 volt, 3-phase motor with automatic lubrication system. Hardened longitudinal ways, dust collector, permanent magnet chuck, wet-grind attachment with pulp and splash guards, hydraulic crossfeed, mounted diamond wheel dresser and all necessary wrenches, keys, and bolts
1	Reciprocating power saw; 6-3/4" x 6-3/4" with automatic lift, 1/2 hp motor, 115 volt, 60 cycle; with wetcutting attachment
1	Cut-off band saw
1	Tool grinder; 17" between tail stocks; 3-5/8 x 22-1/2 table working surface; 4-3/4" crossfeed; 10" table travel; with all attachments for cutter grinding; 1 hp, 220 volt, 3-phase motor
1	Drill press, floor model: 20"; min. 4" dia. colum; tapping attachment; with reducing sleeves for spindle; 3-phase preferred, single-phase acceptable; 1 hp motor, step pulley
1	Press, hydraulic, arbor; heavy-duty, structural steel frame, 50-ton capacity; hand operated; handwheel and screw for quick adjustment; automatic ram return; adjustable table
1	Power saw 20", 220 volt, 3-phase motor; with table tilt, welder, grinder, variable speed drive, and blade shear, disc cutting attachment, etching pencil, work light, illuminated magnetic attachment, mist coolant, band polishing attachment, long file, guide mitering attachment assembly, power feed, metal supply cabinet, kip fence; angle guide blocks

Oxyacetylene welding and cutting equipment

Quantity	Description
2	Combination outfits for welding, cutting, brazing, heating, and soldering
	Or, the contents may be purchased separately to include:
2	Welding torches
2	Gooseneck extensions
6	Welding tips: 2 each of sizes 62, 55, 42
2	Gas mixers
2	Cutting attachments, with 90° head
2	Cutting tips: Size 53
2	Acetylene regulators, two-gage type

Oxyacetylene welding and cutting equipment

Quantity	Description
2	Oxygen regulators, two-gage type
50 ft	Welding and cutting hose, dual-type with two hoses permanently bonded together, 1/4" diameter, with appropriate female connections on all ends
2 pairs	Welding goggles; with #5 lens, monogoggle-type
2	Spark lighters, with round file lighter
2	Torch wrenches
	Additional pieces not in the outfit:
2	Welding tips, tip size 50
2	Welding tips: size 58
1	Cutting outfit, hand operated, heavy-duty, for cutting only
	Or, the contents may be purchased separately to include:
1	Cutting torch; brass head set at 90°
3	Cutting tips, acetylene, sizes 62, 53, and 46
1	Regulator, acetylene, two-gage type with gages
1	Regulator, oxygen, two-gage type with gages
25 ft	Cutting hose; dual-type with two hoses permanently bonded together; 1/4" diameter with appropriate female connections on all ends
	Additional pieces not in the outfit:
2	Cutting tips for rivets; size 53
2	Gouging tips, with tip orifice 1/8"
1 pair	Goggles, welding; with #5 lens
1	Spark lighter with round file lighter
1	Wrench, torch
1	Circle cutting attachment
1	Portable flame-cutting machine, with torch, torch-holder, cutting tip for acetylene, torch wrench, machine-to-torch hose assembly (with connections and hose connection block having double action cutoff), machine track, 115-volt motor with three-wire cord

Manual metal arc welding equipment

1	Welding machine, arc (manual metal); a-c transformer type, 250-amp output, 230-volt, 60-cycle input, with pigtail and 2 cable lugs
	Accessories for the above welder:
25 ft	Cable; 12-1/2 ft. lead, 12-1/2 ft. ground for each machine, #2/0 gage
1	Electrode holder, with replaceable tip insulators
1	Ground clamp
1	Welding machine, arc (manual metal); a-c transformer type; 300-amp output; 230-volt, 60-cycle input; with pigtail and 2 cable lugs
	Accessories for the above welder:
25 ft	Cable; 12-1/2 ft. lead, 12-1/2 ft. ground for each machine #2/0 gage
1	Electrode holder, with replaceable tip insulators
1	Ground clamp
1	Welding machine, motor-generator type; 300-amp output, 230-volt, 60-cycle input; with pigtail and 2 cable lugs
	Accessories for the above welder:
25 ft	Cable; 12-1/2 ft. lead, 12-1/2 ft. ground for each machine, #2/0 gage
1	Electrode holder, with replaceable tip insulators
1	Ground clamp

Tungsten inert gas welding equipment

1	Welding machine, arc (manual metal); a-c/d-c transformer-type with rectifier for straight and reverse polarity
1	Torch, TIG; water-cooled, 350-amp capacity; with short and long back cap, end with ceramic tip
2	12-1/2 ft. Torch lead (connecting cable)
2	10 ft. Ground cable; #1 gage
1	Remote control switch, either hand or foot operated
1	Ground clamp
1	Water coolant system, 10-gallon capacity, with 115-volt, [illegible] 60-cycle pump motor
25 ft	Coolant hose
1	Argon regulator

Tungsten inert gas welding equipment

1	Argon flowmeter
12 ft	Connecting hose, single; for Argon; work-rated capacity and necessary fittings

Drafting equipment

5*	Drawing tables; 23" x 31" top
5*	Stools; 24" high
1	Chalkboard, green; reversible board on stand; 4' x 6'
1	Compass, chalkboard; 16"
1	Protractor, chalkboard; 15-1/2"
1	T-square, chalkboard; 6' long
5*	Scales, architect's (Plastic); 12"
5*	Triangles, 30°, 60°; 10"
5*	Triangles, 45°, 45°; 10"
5*	Irregular curves; 10"
1	Draftsman pencil sharpener
5*	T squares, wood or metal or plastic

* This quantity is dependent on the number of beginning students in the class.

Equipment and tools for the shop and for trainee protection

1	Grinder, heavy-duty, on pedestal; push-button switch; sealed ball-bearings; enclosed, adjustable wheel guards; adjustable safety-shields; tool tray and lift-out water pot, mounted on base; 220 volt, three-phase motor, fully enclosed, 1-hp, 1800 rpm, with two grinding wheels, 6" in diameter
1	Grinder, heavy-duty, bench mounted; push-button switch; sealed ball-bearings; enclosed, adjustable wheel guards; adjustable safety shields; lift-out water pot; 220 volt, three-phase motor, fully enclosed; 3/4 hp, 1800 rpm, with two grinding wheels, 6" in diameter
1	Hand grinder, for 4" grinding wheel
1	Disc sander
1	Air compressor, horizontal; 2-stage, 10 hp, 220 volt, 60 cycle, 3-phase motor, delivery 42 cu. ft. per minute, horizontal tank, 4 cylinder 120 gallon capacity, with enclosed belt guard
1	Furnace, for reprocessing aluminum

Quantity	Description
2	Grinders, portable, with 36" flexible shaft and 1/4" chuck
2	Cylinder trucks, with tool box and 10" rubber wheels (min) (purchase only if manifold system is not used)
10	Welding benches; 5 for oxyacetylene which must have firebrick top; 5 for electric welding, firebrick top optional; 24" x 24" top
5	Welding booths; for electric welding; with overhead clamp in each
1	Welding booth; for electric welding under handicap
1	Drying box for welding rod
5	Welding helmets, vulcanized fiber construction with fixed glass holder, complete with ratchet adjustment headband, cover lens, and #10 welding lens
4	Hand shields, vulcanized fiber construction with aluminum handle and fixed glass holder cover lens, and #10 welding lens
4 prs.	Welding goggles, nonogoggle-type, with #54 clear cover lens, and #74 shade 5 welding lens
4 prs.	Safety glasses, with folding temples and hardened lens of medium shade
2	Faceshield visors, with light green tint, .040 thick visor
4 prs.	Welding gloves, regular
2 prs.	Welding gloves, inert arc
4	Welder's coats, leather, with collar, snap fasteners down front and on sleeves, sized to fit student
3 sets	Tip cleaners in a case, standard range of drill size, 51-74
1 set	Tip drills
6 doz.	Chipping hammers, combination cone and chisel point

Hand Tools

15	Awls, scratch 6-1/2" long
8	Dividers, wing 8"
6	Dividers, wing 10"
6	Dividers, wing 12"
4	Square, steel framing: body 24" x 2", tongue 16" x 1-1/2"; 1/16" graduations
6	Squares, steel, with numbers on throat, 1/16" graduations 12"
6	Squares, combination 12"
4	Squares, combination 6"
1	Rule, zigzag, wood 6'

Quantity	Description
1	Rule, zigzag, metal 6'
6	Rules, circumference 36"
2 sets	Trammel points; 1 point adjustable in each set; 1 bar per set
6	Punches, center, hex 6"
6	Punches, automatic 4"
12	Punches, prick 6"
2 sets	Drive pin punches, 4" long, 1/16", 3/32", 1/8", 5/32", 3/16", 7/32". 1/4", 5/16", to include box
2 each	Cold chisels, cutting edge 1/4", 3/8", 1/2", 5/8", 3/4"; hex body
2 each	Chisels, round-nose, 1/4", and 1/2" cutting edge
2 each	Chisels, cape 1/4", 1/2", 3/8" cutting edge
1	Chisel, diamond point, 1/2" cutting edge
2 sets	Hand groovers 00, 0, 1, 2, 3, 4, 5, 6, 7, 8
6	Hammers, tinners riveting 12 oz.
4	Hammers, tinners riveting 8 oz.
1	Hammer, machinist's ball peen 8 oz.
1	Hammer, machinist's ball peen 12 oz.
1	Hammer, machinist's ball peen 16 oz.
1	Hammer, machinist's ball peen 24 oz.
3	Hammers, machinist's riveting 12 oz.
2	Hammers, brass faces or solid brass head, 16 oz.
2	Hammers, raising 16 oz.
4	Mallets, rubber 16 oz.
4	Mallets, wooden tinner's 3" x 6"
4	Mallets, rawhide 2" x 3-1/2"
4	Mallets, plastic 8 oz.
4	Snips, aviation left-cut
4	Snips, aviation right-cut
4	Snips, aviation straight-cut
1	Snip, aviation double-cut
6	Snips, straight 6-1/2"
6	Pliers, combination 8"
6	Pliers, straight-nose
4	Pliers, side cutting 7"
2	Pliers, needlenose; medium length nose 6"

Quantity	Description
6	Pliers, vise grip 10"
2	Coppers, soldering 1 lb.
2	Coppers, soldering 2 lbs.
2	Coppers, soldering 3 lbs.
1	Torch kit, propane, B-tank with hose and hand torch
6	Hacksaw frames, pistol grip handle, 10" - 12" adjustable
1 kit	Hole saws, 7/8", 1-1/8", 1-1/2", 1-3/4", 2", 2-1/2"
4	Files, mill, bastard 10"
4	Files, mill, smooth 10"
4	Files, flat, bastard 10"
4	Files, hand, smooth 10"
4	Files, square, bastard 8"
4	Files, three-corner, bastard 8"
4	Files, half-round, bastard 10"
4	Files, half-round, smooth 10"
4	Files, round, bastard 10"
4	Files, round, smooth 10"
6	File card and brush 1-1/2" x 5" x 9-1/2"
4	Files, knife, smooth 10"
4	Files, square, bastard 10"
36	File handles
1	Gage, size from 0 to 36 US Standard
1	Wire gage, 0 to 36 American Standard
1	Thickness gage, .002 to .025, 22 leaves
1	Rule, hook; 6"
1	Rule, hook; 12"
1	Rule, flexible steel 8'
4	Calipers,outside 8"
4	Calipers, inside 8"
2	Calipers, hermaphrodite, 6"
1	Grinding wheel dressers, spur type
2	Oil stones 6" x 2" x 1"
2	Oil cans, pump type, 1/2 capacity
1	Grease gun, lever type
2	Screw pitch gages, (1) ACME; (1) square

Quantity	Description
12	C clamps 2" opening
12	C clamps 6" opening
12	C clamps 8" opening
12	Bench clamps (spring-loaded type for sheet metal work)
4	Screwdrivers, flat blade 4" shank
4	Screwdrivers, flat blade 6" shank
2	Screwdrivers, flat blade 8" shank
1	Screwdriver, flat blade 12" shank
2	Screwdrivers, Phillips head #1 6-3/4"
2	Screwdrivers, Phillips head #2 6-3/4"
1	Screwdriver, Phillips head #3 8"
1	Screwdriver, Phillips head #4 9"
2	Screwdrivers, offset, 1/4" stock 4"
2	Screwdrivers, offset, 5/16" stock 5"
2 each	Wrenches, pipe, straight 8", 12", 18"
1	Wrench, pipe, stillson 12"
1	Wrench, adjustable 6"
1	Wrench, adjustable 8"
1	Wrench, adjustable 10"
1	Wrench, adjustable 12"
2 sets	Wrenches, Allen: #4 to 1/2" inclusive in pouch

Precision measuring tools

4	Micrometers, outside: 0-1" range
2	Micrometers, outside: 1-2" range
1	Micrometer, outside: 2-3" range
1	Micrometer, outside; 3-4" range
1	Micrometer, outside: 4-5" range
1	Micrometer, outside: 5-6" range
1 set	Inside micrometers: 2-8" range
1 set	Telescoping gages: six piece; with 5/16"-6" range
1	Micrometer depth gage: 0-3" range
1 set	Clamps, toolmakers: parallel, 3/4- 3-1/2" range

Quantity	Description
1 set	V blocks (2) and clamp (1); case hardened steel; 1-1/4" max. stock diameter; for general use
1 set	V blocks (2) and clamp (1): hardened and ground; 1" max. stock diameter; for precision layout and machining
1	Vernier caliper; 12", decimal
1	Height gage, vernier; 24", decimal
1 set	Gage blocks; grade B; 81 pieces
1 set	Dial indicator; .001-.125 range; continuous dial type with a wobbler, jeweled bearings; with magnetic base, post, sleeve, and indicator attachment; in a box
3	Dial indicators, 1" travel
1	Dial indicator, .030" travel
1	Surface plate; 18" x 24"; class B; for checking tools
1	Surface plate; 36" x 48"; class B; for layout
1	Universal surface gage with base hardened; ground and polished; 9" x 12" spindles
1	Surface gage, 12" and 18" spindles
1 set	Small-hole gages
1	Level, machinists precision; 15" overall length; 0.0005" or 10-second graduations
1	Square, steel; precision, certified; 8"

Consumable supplies

2	Brazing flux, 1-lb. cans for copper, brass, and bronze
2	Brazing flux, 1-lb. cans for cast iron
2	Stainless steel welding flux, 1-lb jars
2	Aluminum welding flux, 1-lb. jars
	Muratic acid, industrial grade
	Acid swab
1 doz.	Soldering paste, 2-oz cans
1 doz.	Bars of solder, 1-lb., 50/50
50 lbs.	Brazing rod, 1/8" - 36": AWS A5.7T, Class RCuZn-B
25 lbs.	Aluminum rod, 3/32-36"
	Welding rod, oxyacetylene, mild steel, copper coated, 1/16-36": AWS-ASTM A251-46T, Grade GA-50
	Welding rod, oxyacetylene, mild steel, copper coated, 3/32-36": AWS-ASTM A251-46T, Grade GA-50

Quantity	Description
	Welding rod, oxyacetylene, mild steel, copper coated, 1/8-36" AWS-ASTM A251-46T, Grade GA-50
	Welding rod, oxyacetylene, medium carbon, high strength, 3/32-36": AWS-ASTM A251-46T, Grade GA-60
	Electrode, tungsten, 2% thorium 3/32-6"
	Electrode, tungsten, 2% thorium: 1/16-6"
	Welding electrodes, arc (manual metal); mild steel, coated: 1/8-AWS-E6010 or 6011
	Welding electrodes, arc (manual metal); mild steel, coated: 1/8-AWS-E7016 or 7018
	Welding electrodes, arc (manual metal); mild steel, coated: 5/32-AWS-E7016 or 7018
	Welding electrodes, arc (manual metal) mild steel, coated: 1/8-AWS-E6013
	Welding electrodes, arc (manual metal); mild steel, coated: 1/8-AWS met 6024
2 doz.	Flints, renewal
2 bxs.	Headbands for welding goggle replacement, 4 per box
2 doz.	Cover lens, replacement; for oxyacetylene-type goggles
1 doz.	Welding lens, replacement, shade 5
	Cylinder (s) of acetylene
	Cylinder (s) of argon
	Cylinder (s) of carbon dioxide; argon 75-57 premix
	Cylinder (s) of oxygen
100	Cover plates for welding helmet, clear glass 2 x 4-1/2"
1 doz.	Filter plates, for welding helmet, 2 x 4-1/2", shade 10
3 ea.	Filter plates, for welding helmet, 2 x 4-1/2", shade 8 and shade 12
	30 gage, galvanized, 3 x 8 sheets
	26 gage, galvanized, 3 x 8 sheets
	22 gage, galvanized, 3 x 8 sheets
	18 gage, galvanized, 3 x 8 sheets
	16 gage, sheets of black iron, 3 x 8 sheets
	16 oz. copper sheets
	26 gage, stainless, type 304, #4 finish, 3 x 8 sheets

Quantity	Description
	20 gage, aluminum #.032, half hard, 3 x 8 sheets
	Bar stock: cold rolled, drawn steel; aluminum; brass
	Flats: 1/2 x 2"
	Square: 1" x 1"
	2" x 2"
	3" x 3"
	4" x 4"
	Rounds: 1/4"; 1/2"; 3/4"; 1"; 2"; 3"; 4"; 5"
	Steel plate: 1/4"; 1/2"; 3/4"
	Rivets, 1-5 lbs., galvanized
	Rivets, 1-5 lbs., copper
	Rivets, 1-5 lbs., aluminum
	Rivets, pop
	Screws, #4 x 1/2"
	Screws, #6 x 1/2"
	Screws, #8 x 1/2"
	Screws, #10 x 3/4"
	Screws, #12 x 3/4"
	Screws, #14 x 3/4"
	Bolts, 3/16" x 1/2"
	Bolts, 1/4" x 1/2"
	Bolts, 3/16" x 1/2"
	Bolts, 1/4" x 3/4"
	Angle iron, 1" x 1" x 1/8" x 20-ft. lengths
	Angle iron, 1-1/2" x 1-1/2" x 1/8", 20-ft. lengths
	Band iron, 1/8" x 1", 20-ft. lengths
	Band iron, 3/16" x 1"
	Band iron, 1/4" x 2"
	Sanding disc, 80 grit, 7" diameter
	Drawing paper: 11 x 17"
	Drawing pencils: F, 2H, 4H
	Stainless steel flux
	Cover plates for welding shields

VT003 493

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A Basic Plan for the Organization and Management of Instruction in Vocational Sheet Metal.

Mississippi State Univ., State College. Curriculum Lab.
Mississippi State Dept. of Vocat. Educ., State College
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*CURRICULUM GUIDES, *TRADE AND INDUSTRIAL EDUCATION, *SHEET METAL WORKERS, *SHEET METAL WORK, HIGH SCHOOLS, POST SECONDARY EDUCATION, EQUIPMENT,

This curriculum guide was prepared to assist the trade instructor in planning and developing instructional materials for a sheet metal course for training high school students for employment at a beginner's level. The material was developed by a group of instructors and tradesmen by systematically grouping the major segments of a trade analysis into instructional blocks and then into basic manipulative tasks and informational topics. The instructional blocks are (1) Measurement, (2) Layout, (3) Hand Processes, (4) Machine Processes, and (5) Welding. Each block contains an outline of operations and jobs for group, subgroup, or individual performance. Related instruction outlines are presented. The course is designed for a 2-year program with 1,080 hours of training. Instructional procedures are recommended for the trade competent teacher. Students should have a vocational committment to the sheet metal trade, a general mechanical aptitude, a course in general mathematics, and a course in mechanical drawing. Necessary equipment is listed and a bibliography contains recommended texts and suggested references. This document is available for $1.00 from Curriculum Laboratory, Box NU, State College, Mississippi 39762. (HC)

BASIC PLAN

for the

Organization and Management of Instruction

in

VOCATIONAL SHEET METAL

Prepared and Issued by the
CURRICULUM LABORATORY
TRADE AND TECHNICAL EDUCATION
STATE DEPARTMENT OF VOCATIONAL AND TECHNICAL EDUCATION
Jackson, Mississippi

Located in the
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MEMORANDUM

TO: The ERIC Clearinghouse on Vocational and Technical Education
The Ohio State University
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Columbus, Ohio 43212

FROM: (Person) Robert D. Sartin (Agency) Curriculum Laboratory

(Address) P. O. Drawer NU, State College, Mississippi 39762

DATE: September 11, 1967

RE: (Author, Title, Publisher, Date) Mississippi Curriculum Laboratory

A BASIC PLAN IN VOCATIONAL SHEET METAL
State College, Miss: Curriculum Laboratory of the State Department of
Vocational and Techical Education, Mississippi State University, March, 1967

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(2) Means Used to Develop Material:
Development Group P
Level of Group P
Method of Design, Testing, and Trial - this is a preliminary draft which has been distributed to sheet metal instructors; at a later date it will be evaluated by an industrial committee; the published form will contain the revisions recommended by these two groups

(3) Utilization of Material:
Appropriate School Setting Vocational (trade) training
Type of Program Preparatory
Occupational Focus P
Geographic Adaptability - Normally found in the secondary schools but believed to
Uses of Material be applicable at the post-secondary level; for use by
Users of Material instructors in planning daily teaching activities

(4) Requirements for Using Material:
Teacher Competency - trade competent, with teaching skills
Student Selection Criteria - those who want, need, and are able to profit from the training; recommend screening by testing, by examination of school records, and by personal interview
Time Allotment P

Supplemental Media --
Necessary X
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Describe This is a guide for use in planning instruction; it is in outline form; thus it requires supplementary references which are listed and carry bibliographical citation
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CURRICULUM LABORATORY
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State College, Mississippi

ACKNOWLEDGMENTS

This publication was developed by a group of instructors and tradesmen attending a workshop held on the campus of Mississippi State University on March 3 and 4, 1967. The group, called a Curriculum Committee, took the traditional approach and developed an analysis for the trade. The trade was systematically broken into its major segments, called blocks, and then into the basic manipulative tasks, called operations. Next, typical on-the-job activities, which contained the operations, were listed to involve the trainee in useful and productive work. Also, the committee identified those informational topics which, when understood by the tradesman, would contribute to the intelligent use of his skills. Finally, the equipment, tools, and supplies necessary for training were listed.

The members of the Curriculum Committee are to be commended for their efforts and their cooperative attitude in the development of this basic plan. The Committee was composed of:

J. L. Brown, Owner, Brown's Sheet metal Works, Greenville
Donald Carter, Instructor, Sheet Metal, Pascagoula High School, Pascagoula
Carl Hedglin, Owner, Carl's Sheet Metal Shop, Jackson
W. J. Stuart, Instructor, Sheet Metal, Parchman Vocational School, Parchman

This publication will serve as the starting point for the development of instructional materials to be used by the trade instructor.

HOW TO USE THIS PUBLICATION

As a tool for teaching, this publication is primarily designed for use in planning, preparing, presenting, and evaluating instruction. As a tool, it lists operations, jobs, and informational topics—with the job as the focal point. Each job should be assigned to students, either as a group, a subgroup, or individually. The following procedure is recommended as an effective teaching sequence.

Step I. -- Tell how the job is done.
Give a full explanation of the steps necessary to perform the job. Emphasize the proper sequence; stress techniques requiring special care; point out the hazards to persons and the equipment.

Step II. -- Show how the job is done.
Demonstrate the proper procedure for performing the job. Re-emphasize the sequence, techniques, and hazards. Make sure each student can see what is being done and understands the steps.

Step III. -- Have the student do the job.
Assign each student the task of applying what he has just learned. Supervise his work; correct any variation from proper procedure or any hazardous techniques. Re-explain when necessary.

Step IV. -- Check the student for proficiency.
Assign a similar job to the student to be performed independently. Observe his work and examine the completed product or service. He is proficient when he can perform the job without supervision in a prescribed length of time.

Students who have demonstrated proficiency in one job move to the next job. The teaching steps *tell, show, do, check* are used again. Students who are not proficient perform additional jobs of a similar nature and are retaught in weak areas.

Additionally, this publication can be used (1) by the director and the instructor in a local program in communicating with their craft committee, (2) by the local director in supervising instruction and program operation, and (3) by the state supervisory staff in communicating with local school administrators and in supervising the operation of local programs.

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SHEET METAL WORKER

A sheet metal worker lays out, fabricates, assembles, and repairs sheet metal products and equipment, such as control boxes, drain pipes, ventilators, and ducts.

Working from a job order or blueprint, the sheet metal worker selects sheet metal of the proper gage and type according to the product being fabricated. He lays out a pattern or works directly on the metal by locating and marking dimension and reference lines. He uses measuring instruments, such as rules, scales, calipers, and micrometers. He sets up and operates fabricating machines, such as shears, brakes, bending rolls, punch presses, and drill presses to cut, bend, and straighten to specified shapes. The worker also uses hand tools such as hammers, snips, and clamps to shape metal over anvils, blocks, and forms. He sets up and operates soldering and welding equipment to join sheet metal parts. Upon completion, he inspects assemblies and installations for conformance to specifications.

Sheet metal workers are employed by plants fabricating and installing heating, air-conditioning and refrigeration equipment, and by contractors engaged in residential, industrial, and commercial work. Others may be self-employed, and their work consists mainly of repair work or smaller types of installations. Some craftsmen are employed in small shops manufacturing specialty products, and others in plants, such as aircraft and shipbuilding companies.

A further description can be found in the <u>Dictionary of Occupational Titles</u>, third edition, under SHEET METAL WORKER (any ind.) 804,281.

COURSE DESCRIPTION

GENERAL OBJECTIVES

To develop knowledges and skills that make the trainee a sheet metal worker employable on a beginner's level.

ASSUMPTIONS

1. That those enrolling in training have had no previous experience in sheet metal work.
2. That trainees have a nontechnical background in general science.
3. That they need additional instruction in the fundamentals of mathematics.

DESIRABLE PREREQUISITES

1. That trainees have a vocational committment to the sheet metal trade.
2. That trainees have a general mechanical aptitude.
3. That they have had a course in general mathematics or shop mathematics but need additional instruction in arithmetic, simple algebra, and plane geometry.
4. That they have had or are presently taking mechanical drawing.

NATURE OF TRAINING

1. The duration of training is normally three hours per day, five days per week, thirty-six weeks per year for two years; or, six hours per day, five days per week, thirty-six weeks per year for one year -- a total of 1080 clock hours of training.
2. Related instruction by lecture, demonstration, the use of audiovisuals, etc. immediately precedes application by the trainee in shop practice; instruction and its application are correlated as closely as possible at all times; and the major allotment of time is given to the development of manipulative skills.
3. No instruction directly related to the trade is offered outside the shop.

CONTENT OF THE RELATED INSTRUCTION

Systematic and purposeful presentation of the following:

1. Detailed coverage of the following sheet metal processes: measurement, layout, hand processes, and machine processes.
2. Broad coverage of soldering, riveting, welding, brazing, bending, and forming of sheet metal.
3. A strong emphasis on safety practices and processes, and on work hazards.
4. An explanation of fundamental information about metals, such as gages, types of metals, basic use of each metal in the sheet metal trade, oxidation of metals, and protective coatings.
5. The reading of blueprints for the metal trades with emphasis on the use of blueprints, elevation views, scales and dimensions, structural details, shop drawings, blueprint specifications, symbols for the sheet metal trade and for electricians, plumbers, etc.
6. Information in drawing, such as care and use of drawing equipment, geometric construction, orthographic projection, parallel and radial line development, triangulation, and layout procedures.
7. The use, adjustment, and care of the equipment, tools, and supplies for sheet metal trade.
8. The definitions and spellings of trade terms.
9. The purpose and use of soldering, welding, and brazing fluxes as they pertain to the metals used in the sheet metal trade.
10. Instruction in mathematics, such as arithmetic, simple algebra, and plane geometry as they are applicable to the sheet metal trade.

TYPES AND LEVELS OF SKILLS TO BE DEVELOPED

1. Immediately marketable skills in the layout and fabrication of sheet metal.
2. Basic manipulative skills in brazing, welding, cutting with torch, and working with heavier metals.

INSTRUCTIONAL BLOCKS

		Contact Hours
I.	Measurement	30
II.	Layout	525
III.	Hand Processes	280
IV.	Machine Processes	170
V.	Welding	75
	Total Hours	1080

ANALYSIS OF OPERATIONS

I. MEASUREMENT

- A. Measure with a steel rule
- B. Measure with a steel square
- C. Measure with a circumference rule
- D. Measure with semicircular protractors
- E. Measure with a swing-blade protractor
- F. Measure angles with the protractor head and the blade of combination set
- G. Measure with a micrometer caliper
- H. Measure ferrous metal with sheet metal gages
- I. Measure nonferrous metals with sheet metal gages
- J. Transfer measurements with dividers

II. LAYOUT

- A. Layout operations performed with a compass, dividers, rule, straight edge, and pencil or scribe
    1. Bisect a line
    2. Erect a perpendicular from a point on a line
    3. Erect a perpendicular from a point off a line
    4. Bisect an arc
    5. Bisect an angle
    6. Transfer an angle
    7. Construct a line parallel to a given line and passing through a given point
    8. Construct a line parallel to a given line and at a given distance
    9. Divide a line into a given number of equal parts
    10. Divide a line into proportional parts
    11. Divide a surface into any number of equal parts
    12. Construct a triangle with all sides given
    13. Construct a triangle with the hypotenuse and one side given
    14. Construct an equilateral triangle
    15. Construct a square
    16. Construct a regular pentagon
    17. Construct a regular hexagon
    18. Construct an octagon
    19. Find the center of a circle with a right triangle
    20. Construct a circle tangent to a line at a given point

21. Construct a tangent to a circle through a point on the circle
22. Construct a tangent to a circle through a point off the circle
23. Construct a line tangent to two circles
24. Construct a circle through three points
25. Divide a circle into any number of equal parts
26. Construct an arc tangent to two intersecting lines
27. Construct an arc tangent to both an arc and a straight line
28. Construct an ogee curve

III. HAND PROCESSES

A. Operations using markout tools

1. Scribe a line with a scratch awl and a straight edge
2. Mark a location with a prick punch and a tinner's hammer
3. Mark centers with a center punch and a tinner's hammer
4. Mark centers with an automatic center punch
5. Scribe arcs with dividers
6. Scribe arcs with trammel points
7. Scribe parallel lines with a tinner's file
8. Scribe parallel lines with a marking gage
9. Scribe parallel lines with a combination square
10. Scribe irregular arcs with french curves
11. Sharpen a scratch awl, center punch, or prick punch

B. Cutout

1. Cut wire with pliers or side cutters
2. Cut along a straight line on sheet metal with straight snips
3. Cut along a straight line with combination snips

. Cut along a straight line with compound-lever shears

5. Cut an outside curve with aviation snips
6. Cut light sheet metal in a vise with flat chisel
7. Cut a starting slit with a chisel
8. Cut flat stock with a chisel
9. Cut sheet metal with an electric nibbler
10. Punch holes with a solid punch and a hammer
11. Punch holes with a hollow punch and a hammer
12. Punch holes with a hand punch

13. Drill holes in flat stock with a hand drill
14. Cut flat stock with a hacksaw
15. Cut round stock with a hacksaw
16. Cut angle iron with a hacksaw
17. Cut rivets with a chisel
18. Drive out rivets with a punch

C. Forming

1. Set down an edge or flatten seams with a tinner's hammer
2. Form material with a wood, rubber composition, or rawhide mallet
3. Form a square piece on the breakdown or needlecase stake with a mallet
4. Form a round piece on the conductor stake with a mallet
5. Form a round piece on the needlecase stake with a mallet
6. Form a conical piece on the blowhorn with a mallet
7. Form a conical piece on the candlemold stake with a mallet
8. Brake a piece of sheet metal at 90° angle, with a piece of angle iron, C clamp and mallet
9. Brake pieces to form boxes with hand tongs or handy seamer
10. Brake heavy metals in a vise with ball peen hammer
11. Form a single hem with hand tongs or handy seamer
12. Form a double hem with hand tongs or handy seamer
13. Prepare an edge for grooved seams with hand tongs or handy seamer
14. Form a radius bend with a stake
15. Finish an outside grooved seam, using a hollow or solid mandrel stake
16. Form a plain dovetailed seam, using straight-cutting aviation snips
17. Flange an edge on a stake with a tinner's hammer
18. Shrink an edge on a stake with a tinner's hammer
19. Flange an edge with a hand dolly and a tinner's hammer
20. Fit a tee, using hand snips
21. Wire straight edges before a piece is formed
22. Wire an inside or outside radius on a flat piece
23. Wire a square or rectangular piece after it is formed
24. Wire a tapered piece after it is formed
25. Double seam corners on a square or rectangular piece with handy seamer and stakes

D. Fastening

1. Assemble or disassemble with a flat-blade screwdriver
2. Assemble or disassemble with a flat-blade Phillips screwdriver
3. Use a Phillips screwdriver
4. Drive, set, and flange rivets with a riveting hammer and a rivet set
5. Rivet a seam, using rivet set and riveting hammer
6. Hold a pattern in place by applying C clamps
7. Hold a pattern in place by applying parallel clamps
8. Solder a lap seam with soldering copper
9. Forge a soldering copper
10. Solder a groove seam with a soldering copper
11. Solder a seam with soft solder and an oxyacetylene torch
12. Solder a seam with soft solder and a propane torch

E. Finishing

1. Finish file a rough edge
2. Finish an inside grooved seam
3. Finish corners and edges with a file

IV. MACHINE PROCESSES

A. Bar Folders

1. Fold a single hem
2. Fold a double hem
3. Form the folds for a grooved seam
4. Form the fold for an edge to be wired
5. Form a 45°, 90°, or a special angle
6. Form a double right angle brake

B. Hand brake

1. Sharp brake thin sheet metal
2. Form a mold
3. Form the pocket for a Pittsburgh lock
4. Form a lock seam

C. Slip rolls

1. Roll cylindrical shapes

2. Form tin plates
3. Roll tapered shapes
4. Roll a cylindrical piece with wired edges

D. Squaring shears

1. Cut marked sheet metal
2. Cut a sheet against the front gage
3. Cut a sheet against the back gag

E. Combination rotary machine for turning, burring, wiring, elbow edging, flanging, and flattening operations

1. Beading

a. Form a single bead
b. Form an ogee bead
c. Form a triple bead

2. Crimping

a. Crimp round pipe
b. Crimp and bead cylindrical-shaped objects

3. Turning

a. Form an edge for wiring
b. Score or crease an edge, using a gage
c. Turn edges for elbows

4. Burring

a. Burr a disc
b. Burr an edge on a cylinder

5. Elbow: form an elbow

F. Ring and circle shears

1. Cut a circle
2. Cut a ring
3. Cut a sheet of metal

G. Drill press

1. Drill flat plates
2. Drill round stock

H. Bench or floor grinders

1. Grind flat stock
2. Grind round stock
3. Grind points and edges on tools

I. Disc sanders and buffers

1. Grind welds
2. Buff aluminum
3. Buff stainless steel

J. Box and pan brake

1. Form rectangular pans
2. Form a radius bend

K. Pittsburgh machine

1. Form a Pittsburgh lock
2. Form an Acme lock

L. Spot welder

1. Spot-weld galvanized iron
2. Spot-weld black iron
3. Spot-weld aluminum

M. Unishears

1. Cut along a straight line on metal
2. Cut inside and outside curves

N. Band saw

1. Cut straight lines in flat sheet metal
2. Cut arcs and circles in flat sheet metal
3. Cut angle iron

O. Throatless shears

1. Cut along a straight line
2. Cut along an arc
3. Cut along a zigzag line

P. Setting down machine: set down flanged and burred seams

V. WELDING, CUTTING, AND BRAZING

A. Manual metal arc: 14- and 16-gage material

1. Set up and adjust manual metal-arc equipment
2. Strike and maintain an arc
3. Run a stringer bead
4. Weld a single-pass fillet joint
5. Weld a single-pass butt join with a 1/16" gap

B. Oxyacetylene welding: 14- and 16-gage metal (black iron)

1. Set up oxyacetylene welding equipment
2. Light the torch and adjust it for a carburizing, a neutral, and an oxidizing flame
3. Run a fusion bead
4. Tack-weld two pieces of plate
5. Weld a butt joint with a 1/16" gap
6. Weld in outside corner joint
7. Weld a lap joint
8. Weld a tee joint
9. Weld flange joints with a filler rod
10. Weld flange joints without a filler rod

C. Brazing

1. Braze a lap joint on sheet steel
2. Braze a tee joint

D. Oxyacetylene cutting: light and heavy metals

1. Attach a cutting torch; light and adjust a cutting flame
2. Cut along straight lines
3. Cut arcs and circles

SUGGESTED JOBS IN LAYOUT AND FABRICATION

A. Elementary layout

1. Lay out patterns and construct simple rectangular boxes and pans
2. Lay out patterns and construct rectangular flaring pans
3. Lay out patterns and construct multipiece boxes and pans
4. Lay out patterns and construct circular pipe
5. Lay out patterns and construct circular pans and pails
6. Lay out patterns and construct rectangular duct cleats and seams
7. Lay out patterns and construct rectangular duct ells and angles with square throat and heel
8. Lay out patterns and construct 90° Y and branch in rectangular duct
9. Lay out patterns for rectangular duct change elbows
10. Lay out patterns for rectangular duct change angles

B. Parallel line layout

1. Lay out stretchout patterns and construct parallel line profiles
2. Lay out patterns and construct two-piece 90° elbows and angles of round pipe
3. Lay out patterns and construct two-piece elbows of any profile
4. Lay out patterns and construct 90° T's of equal-diameter round pipe
5. Lay out patterns for angle T's of unequal diameter pipe
6. Lay out patterns and construct multipiece elbows
7. Lay out patterns and construct round pipe offsets
8. Lay out patterns, using 90° round elbow patterns for elbows with angles of less than ninety degrees
9. Lay out patterns, using multipiece elbows to construct round pipe offsets
10. Lay out patterns and construct an oblong 90° angle
11. Lay out patterns and construct square face miters
12. Lay out patterns and construct ogee return miters
13. Lay out patterns and construct butt miters
14. Lay out patterns and construct return miters other than right angles
15. Lay out patterns and construct butt miters against oblique surfaces in the plan
16. Lay out patterns and construct eaves-trough miters
17. Lay out patterns and construct oblique face miters
18. Lay out patterns and construct range hood
19. Lay out patterns, using the three-point methods, 90° transition elbows

20. Lay out patterns, using three-line method, of 90° transition elbows
21. Lay out patterns and construct 90° transition elbows with vanes
22. Lay out patterns and construct molded conductor heads
23. Lay out patterns and construct octagonal roof finals

C. Radial line development

1. Lay out patterns and construct cones and frustrums
2. Lay out patterns and construct funnels
3. Lay out patterns and construct round ventilator heads
4. Lay out patterns and construct square pyramids
5. Lay out patterns and construct irregular frustrums
6. Lay out patterns and construct irregular frustrums of hexagonal pyramids
7. Lay out patterns and construct conical outlet for 1/2 round gutter
8. Lay out patterns and construct collars on double pitched roofs
9. Lay out patterns and construct rectangular pyramids
10. Lay out patterns and construct oblong raised covers
11. Lay out patterns and construct frustrum of cone intersected by cylinder obliquely
12. Lay out patterns and construct a cone intersecting a cone obliquely

D. Triangulation

1. Develop patterns and construct a square-to-square transition piece
2. Develop patterns and construct a square-to-round
3. Develop patterns and construct a round reducer
4. Lay out patterns and construct round-to-oblong transitions
5. Lay out patterns and construct drop cheek elbows
6. Lay out patterns and construct twisted rectangular pipes
7. Lay out patterns and construct rectangular-to-round fittings, vertical on two sides
8. Lay out patterns and construct irregular oblong-to-round fittings
9. Lay out patterns and construct irregular T joints
10. Lay out patterns and construct square-to-round roof collars for pitched roofs
11. Lay out patterns and construct a round-to-rectangular 90° furnace boot
12. Lay out patterns and construct scalene cones

13. Lay out patterns and construct a three-piece, square-to-round elbow

14. Lay out patterns and construct a three-piece, round reducing elbow

15. Lay out patterns and construct a tapering Y branch

16. Lay out patterns and construct three-branch fittings

17. Lay out patterns and construct a two-way elbow intersection

18. Lay out patterns and construct ship ventilator with a round base and mouth

RELATED INSTRUCTION TOPICS

I. ARITHMETIC

- A. Whole numbers
- B. Fractions
- C. Decimal fractions
- D. Measurements
- E. Percentage
- F. Graphs
- G. Symbols
- H. Equations
- I. Formulas - application as applied to sheet metal trade
- J. Problems - application as applied to sheet metal trade

II. APPLIED GEOMETRY

- A. Construction
- B. Straight line figures (rectangles, triangles, polygons)
- C. Areas
- D. Circles
- E. Volumes

III. BLUEPRINT READING

- A. Use of blueprints
- B. Interpretation of shape
- C. Identification of lines
- D. Basic views
- E. Scales and dimensions
- F. Elevation views
- G. Structural details
- H. Building specifications
- I. Interpretation of symbols

IV. DRAWING

- A. Use of drawing equipment
- B. Constructive geometry
- C. Orthographic projection

E. Radial line development
F. Triangulation
G. Ductwork

V. SAFETY

A. Personal
B. Hand tools and materials
C. Welding
D. Machine operation
E. Administering first aid

VI. FASTENING METHODS

A. Soldering
B. Oxyacetylene welding
C. Manual metal arc welding
D. Brazing
E. Riveting

VII. PROPERTIES OF METALS

A. Classes: ferrous and nonferrous
B. Strengths and applications
C. Forming and fastening methods
D. Protective coatings

VIII. METALS AND MATERIALS

A. Galvanized iron
B. Tin
C. Black iron
D. Copper
E. Lead coated
F. Aluminum
G. Stainless steel
H. Minor nonferrous metals

EQUIPMENT LIST FOR SHEET METAL

Designed for a group of 15 students

Item No.	Quantity	Description	Capacity or Size
1.	15	Awls, scratch	6-1/2" long
2.	8	Dividers, wing	8"
3.	6	Dividers, wing	10"
4.	6	Dividers, wing	12"
5.	4	Square, steel framing: body 24" x 2", tongue 16" x 1-1/2"; 1/16" graduations	
6.	6	Squares, steel, with numbers on throat, 1/16" graduations	12"
7.	6	Squares, combination	12"
8.	4	Squares, combination	6"
9.	1	Rule, zigzag, wood	6'
10.	1	Rule, zigzag, metal	6'
11.	6	Rules, circumference	36"
12.	2 sets	Trammel points; 1 point adjustable in each set; 1 bar per set	
13.	6	Punches, center, hex	6"
14.	6	Punches, automatic	4"
15.	12	Punches, prick	6"
16.	2 sets	Drive pin punches, 4" long, 1/16", 3/32", 1/8", 5/32", 3/16", 7/32", 1/4", 5/16", to include box	
17.	2 each	Cold chisels, cutting edge 1/4", 3/8", 1/2", 5/8", 3/4"; hex body	
18.	2 each	Chisels, round-nose, 1/4", and 1/2" cutting edge	
19.	2 each	Chisels, cape 1/4", 1/2", 3/8" cutting edge	

Item No.	Quantity	Description	Capacity or Size
20.	1	Chisel, diamond point, 1/2" cutting edge	
21.	2 sets	Hand groovers 00, 0, 1, 2, 3, 4, 5, 6, 7, 8.	
22.	6	Hammers, tinners riveting	12 oz.
23.	4	Hammers, tinners riveting	8 oz.
24.	1	Hammer, machinist's ball peen	8 oz.
25.	1	Hammer, machinist's ball peen	12 oz.
26.	1	Hammer, machinist's ball peen	16 oz.
27.	1	Hammer, machinist's ball peen	24 oz.
28.	3	Hammers, machinists' riveting	12 oz.
29.	2	Hammers, raising	16 oz.
30.	4	Mallets, rubber	16 oz.
31.	4	Mallets, wooden tinner's	3" x 6"
32.	4	Mallets, rawhide	2" x 3-1/2"
33.	4	Mallets, plastic	8 oz.
34.	4	Snips, aviation left-cut	
35.	4	Snips, aviation right-cut	
36.	4	Snips, aviation straight-cut	
37.	1	Snips, aviation double-cut	
38.	6	Snips, straight	6-1/2"
39.	6	Pliers, combination	8"
40.	6	Pliers, straight-nose	
41.	4	Pliers, side cutting	7"
42.	2	Pliers, needlenose medium length nose	6"
43.	6	Pliers, vise grip	10"
44.	4	Coppers, soldering	1 lb.

Item No.	Quantity	Description	Capacity or Size
45.	4	Coppers, soldering	2 lbs.
46.	4	Coppers, soldering	3 lbs.
47.	1	Torch kit, propane, B-tank with hose and hand torch	
48.	6	Hacksaw frames, pistol grip handle, adjustable	10" - 12"
49.	1 kit	Hole saws, 7/8", 1-1/8", 1-1/2", 1-3/4", 2", 2-1/2"	
50.	4	Files, mill, bastard	10"
51.	4	Files, mill, smooth	10"
52.	4	Files, flat, bastard	10"
53.	4	Files, hand, smooth	10"
54.	4	Files, square, bastard	8"
55.	4	Files, three-corner, bastard	8"
56.	4	Files, half-round, bastard	10"
57.	4	Files, half-round, smooth	10"
58.	4	Files, round, bastard	10"
59.	4	Files, round, smooth	10"
60.	6	File card and brush 1-1/2" x 5" x 9-1/2"	
61.	4	Files, knife, smooth	10"
62.	4	Files, square, bastard	10"
63.	36	File handles	
64.	1	Gage, size from 0 to 36 US Standard	
65.	1	Wire gage, 0 to 36 American Standard	
66.	1	Thickness gage, .002 to .025, 22 leaves	
67.	1	Micrometer, outside	0-1"
68.	1	Rule, flexible steel	8'
69.	1	Caliper, outside	6"

Item No.	Quantity	Description	Capacity or Size
70.	2	Calipers, inside	6"
71.	1	Grinding wheel dressers, spur type	
72.	2	Oil stones	6" x 2" x 1"
73.	1	Bench oiler	3" spout
74.	1	Grease gun, lever type	
75.	12	C clamps	6" opening
76.	12	C clamps	2" opening
77.	12	C clamps	8" opening
78.	12	Bench clamps (spring-loaded type for sheet metal work)	
79.	4	Screwdrivers, flat blade	4" shank
80.	4	Screwdrivers, flat blade	6" shank
81.	2	Screwdrivers, flat blade	8" shank
82.	1	Screwdriver, flat blade	12" shank
83.	2	Screwdrivers, Phillips head #1	6-3/4"
84.	2	Screwdrivers, Phillips head #2	6-3/4"
85.	1	Screwdriver, Phillips head #3	8"
86.	1	Screwdriver, Phillips head #4	9"
87.	2	Screwdrivers, offset, 1/4" stock	4"
88.	2	Screwdrivers, offset, 5/16" stock	5"
89.	2 each	Wrenches, pipe, straight	8", 12", 18"
90.	1	Wrench, pipe, stillson	12"
91.	1	Wrench, adjustable 6"	6"
92.	1	Wrench, adjustable	8"
93.	1	Wrench, adjustable	10"
94.	1	Wrench, adjustable	12"
95.	2 sets	Wrenches, Allen: #4 to 1/2" inclusive in pouch	

Item No.	Quantity	Description	Capacity or Size
96.	1	Level, aluminum frame	24" long
97.	1	Gage, drill point	
98.	1 set (6)	Bits, countersink, high-speed steel	
99.	1 set	Drills, twist, high-speed steel; straight shank, fractional sizing 1/32" - 15/64" graduated in 64ths with drill index	
100.	12 each	Drills, twist, high-speed steel: straight shank, fractional sizing 1/8", 5/32", 3/16", 1/4"	
101.	2	Drills, twist, high-speed steel; straight shank, fractional sizing 1/16" - 1/2" with drill index	
102.	1 set	Hollow punches, 1/4", 3/8", 1/2", 5/8", 3/4", 7/8", 1", 1-1/4", 1-1/2", 1-3/4", 2".	
103.	1	Metal punch, 3/32", 1/8", 5/32", 3/16", 7/32", 1/4", 9/32", including metal box and bench mounting base	
104.	1	Hand punch, capacity, 9/32" hole through 23" length	
105.	1 set	Steel figures and letters 3/16" size	
106.	2 sets	Handy seamers, 3-1/2" blade, range 1/4" to 1"	8" overall
107.	2	Handy seamers, 6-7/8" blade, range 1/4" to 1"	10-1/4" overall
108.	2 sets	Bench stakes: Candlemold Beakhorn Blowhorn Needlecase Creasing Hollow mandrel Solid mandrel Double seaming with four heads Double seaming Conductor Bevel edge Common square Teakettle	

Item No.	Quantity	Description	Capacity or Size
		Hatchet	
		Bottom	
		Coppersmith	
109.	1 set	Cast stakes	
110.	1	Bench plate including stand	37-1/2" x 8"
111.	1	Bench plate including stand	30" x 8"
112.	1	Bar folder, including stand	36"
113.	2	Rotary machines, combination A, B, C, D rolls 22-gage capacity, including standard	
114.	2	Rotary machines, combination 7" throat, with rolls A, B, C, D, E, F, 3/4" ogee rolls, elbow edging rolls, including stand	24-g. capacity
115.	1	Setting down machine with standard	1/2" seam, 18-g. capacity
116.	1	Slip roll, 22-gage capacity, 2" roll including stand	36" length
117.	1	Slip roll, 16-gage capacity 3" roll including stand	42" length
118.	1	Shears, squaring: foot-operated	36"
119.	1	Bench brake, universal box and pan, 36-1/4" bench model, 22-gage capacity	
120.	1	Cornice brake, 16-gage capacity	5' length
121.	3	Gas bench furnaces, double burner	
122.	1	Bevel shear	
123.	1	Unishear, 16-gage capacity	
124.	3	Electric hand drills, heavy duty	1/4"
125.	1	Table, octagon 56" diameter, 32" high	
126.	6	Work benches, laminated maple top, including stake plate	120" x 40"
127.	8-15*	Drawing tables	23" x 31" top

* This quantity is dependent on the number of beginning students in the class.

Item No.	Quantity	Description	Capacity or Size
128.	8-15*	Stools	24" high
129.	1	Chalkboard, green; reversible board on stand	4' x 6'
130.	1	Compass, chalkboard	16"
131.	1	Protractor, chalkboard	15-1/2"
132.	1	T-square, chalkboard	6' long
133.	8-15*	Scales, architect's (Plastic)	12"
134.	8-15*	Triangles, 30°, 60°	10" base
135.	8-15*	Triangles, 45°, 45°	10" base
136.	8-15*	Irregular curves	10"
137.	1	Draftsman pencil sharpener	
138.	8-15*	T squares, wood or metal or plastic	
139.	2	Protector shields	2-6"
140.	6	Monogoggles, for grinding and buffing	
141.	1	Welding machine, arc (manual metal); a-c transformer type, 250-amp output, 230-volt, 60-cycle input, with pigtail and two cable plugs	
		Accessories for the above welder:	
	75 ft.	Cable; 12-1/2 ft. lead, 12-1/2 ft. ground for each machine, #2/0-gage	
	3	Electrode holders, with replaceable tip insulators	
	3	Ground clamps	
142.	4	Welding helmets, vulcanized fiber construction with fixed glass holder, complete with ratchet adjustment headband, cover lens, and #10 welding lens	
143.	2	Hand shields, vulcanized fiber construction with aluminum handle and fixed glass holder, cover lens and #10 lens	
144.	1	Welding screen, collapsible and portable 6' x 6' book size 3' wing size	

* This quantity is dependent on the number of beginning students in the class.

Item No.	Quantity	Description	Capacity or Size
145.	2 pr.	Welder's gloves, leather	
146.	2	Aprons and sleeves, leather	
147.	1	Complete oxyacetylene outfit, combination torch, dolly	
148.	1	Spot welder 230-volt, 30-amp, water-cooled	
149.	1	Drill press, 15" utility model, floor model 1/2" key chuck, 5-speed, pushbutton switch, 1/2" hp, 1725 rpm	
150.	24 (2 boxes)	Tips, spot welder; replacement: 3/4" bottom, straight; 30° angle tip	
151.	2	Machinist's vise, swivel base, 4-1/2" jaw width, 7" jaw opening, 4-1/8" throat depth	
152.	1	Bench drill vise, 2-3/8" jaw width, 2-5/8" jaw opening	
153.	1	Railroad iron	6'
154.	1	Square stock, 2 x 2	6'
155.	1	Pedestal grinder, with rough and fine grinding wheels	
156.	1	Pittsburgh lock machine, with Acme locks, 24-gage capacity	
157.	1	Band saw, 14" throat	
158.	1	Ring and circle shears, rotary-type: 42" throat	
159.	1	Easy edge, hand model	

SUPPLIES

Sheet Metal

26 gage	Galvanized	3 x 8 sheets
24 gage	Galvanized	3 x 8 sheets
22 gage	Galvanized	3 x 8 sheets
20 gage	Galvanized	3 x 8 sheets
18 gage	Galvanized	3 x 8 sheets
16 gage	Sheets of black iron	
16 oz.	Copper sheets	
26 gage	Stainless, type 304, #4 finish	
	Aluminum #.032, half hard	

Solderer, 50/50
Muratic acid, industrial
Acid swab

Rivets, 1 - 5 lbs	Galvanized
Rivets, 1 - 5 lbs	Copper
Rivets, 1 - 5 lbs	Aluminum

Screws, #8 x 1/2"
Screws, #10 x 3/4"

Bolts, 3/16" x 1/2"
Bolts, 1/4" x 1/2"
Bolts, 3/16" x 1/2"
Bolts, 1/4" x 3/4"

Angle iron, 1" x 1" x 1/8", 20-ft. lengths
Angle iron, 1-1/2" x 1-1/2" x 1/8", 20-ft. lengths
Band iron, 1/8" x 1", 20-ft. lengths
Band iron, 3/16" x 1"
Band iron, 1/4" x 2"

Sanding disc, 80 grit 7" diameter
Welding rod, 3/32 electric
Welding rod, 1/8" gas, copper coated
Brazing rod
Drawing paper
Drawing pencils
Copper flux
Stainless steel flux
Cover plates for welding shields

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*CURRICULUM GUIDES, *TRADE AND INDUSTRIAL EDUCATION, *AUTO BODY REPAIRMEN, *MOTOR VEHICLES, HIGH SCHOOLS, POST SECONDARY EDUCATION, EQUIPMENT,

This curriculum guide was prepared to assist the trade instructor in planning and developing instructional materials for an automobile body repair course to train high school students for employment at the advanced beginner's level. The material was developed by trade instructors by systematically grouping the major segments of a trade analysis into instructional blocks and then into basic manipulative tasks. A committee identified related informational topics. Instructional blocks include (1) Welding, (2) Body Alignment and Repair, (3) Special Body Jobs, (4) Frames, and (5) Painting. Each block contains an outline of operations and jobs for group, subgroup, or individual performance. Related instruction outline topics are included for each instructional block and for applied science and mathematics. The course is designed for a 2-year program with 1,080 hours of training. Instructional procedures are recommended for the trade competent teacher. Students should have a vocational commitment to the trade and general mechanical aptitudes. Equipment and consumable supplies are listed, and a bibliography contains recommended textbooks and suggested references. This document is available for $1.00 from Curriculum Laboratory, Box NU, State College, Mississippi 39762. (HC)

BASIC PLAN

for the

Organization and Management of Instruction

in

VOCATIONAL

AUTOMOBILE-BODY REPAIR

PRELIMINARY DRAFT --FOR DISCUSSION ONLY

Prepared and Issued by the
CURRICULUM LABORATORY
TRADE AND TECHNICAL EDUCATION
STATE DEPARTMENT OF VOCATIONAL AND TECHNICAL EDUCATION
Jackson, Mississippi

Located in the
DEPARTMENT OF INDUSTRIAL EDUCATION
MISSISSIPPI STATE UNIVERSITY
State College, Mississippi

A Basic Plan
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MEMORANDUM

TO The ERIC Clearinghouse on Vocational and Technical Education
The Ohio State University
980 Kinnear Road
Columbus, Ohio 43212

FROM (Person) Robert D. Sartin (Agency) Curriculum Laboratory

(Address) P.O. Drawer NU, State College, Mississippi 39762

DATE: September 11, 1967

RE (Author, Title, Publisher, Date) Mississippi Curriculum Laboratory
A BASIC PLAN FOR VOCATIONAL AUTOMOBILE-BODY REPAIR
State College, Miss: Curriculum Laboratory of the State Department of Vocational and Technical Education, Mississippi State University, 1967

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(2) Means Used to Develop Material·
Development Group P
Level of Group P
Method of Design, Testing, and Trial This is a preliminary draft which is being reviewed by automobile-body repair instructors; at a later date it will be evaluated by an industrial committee; the published form will contain the revisions recommended by these two groups

(3) Utilization of Material·
Appropriate School Setting Vocational (trade) training
Type of Program Preparatory
Occupational Focus P
Geographic Adaptability Normally found in the secondary schools, but believed
Uses of Material to be applicable at post secondary level; for use by
Users of Material instructor in planning daily teaching activities

(4) Requirements for Using Material.
Teacher Competency Trade competent, with teaching skills
Student Selection Criteria Those who want, need, and are able to profit from the training; recommend screening by testing, by examination of school records, and by personal interview
Time Allotment P
Supplemental Media -- Necessary X)
Desirable) (Check Which)
Describe This is a guide for use in planning instruction; it is in outline form thus it requires supplementary references which are listed and carry bibliographical citation
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DEPARTMENT OF INDUSTRIAL EDUCATION
MISSISSIPPI STATE UNIVERSITY
State College, Mississippi

ACKNOWLEDGMENTS

This publication was developed by instructors attending a workshop held on the campus of Mississippi State University on July 10 and 11, 1967. Mr. Herbert Burk of Itawamba Junior College and Mr. Grover Shoemaker of East Central Junior College, working with Laboratory personnel, took the traditional approach and developed an analysis for the trade. The trade was systematically broken into its major segments, called blocks, and then into the basic manipulative tasks, called operations. Next, typical on-the-job activities, which contained the operations, were listed to involve the trainee in useful and productive work. Also, the committee identified those informational topics which, when understood by the tradesman, would contribute to the intelligent use of his skills. Finally, the equipment, tools, and supplies necessary for training were listed. Mr. Burk and Mr. Shoemaker are to be commended for their efforts and contributions.

Following the work of the committee, the staff of the Curriculum Laboratory compiled, edited, duplicated, and distributed the material. This publication, which is the first step, will be the base for further development. A definite part of the developmental process is an evaluation and authentication by a representative industrial committee.

HOW TO USE THIS PUBLICATION

As a tool for teaching, this publication is primarily designed for use in planning, preparing, presenting, and evaluating instruction. As a tool, it lists operations, jobs, and informational topics--with the job as the focal point. Each job should be assigned to students, either as a group, a subgroup, or individually. The following procedure is recommended as an effective teaching sequence.

Step I. -- Tell how the job is done.
Give a full explanation of the steps necessary to perform the job. Emphasize the proper sequence; stress techniques requiring special care; point out the hazards to persons and the equipment

Step II. -- Show how the job is done.
Demonstrate the proper procedure for performing the job. Re-emphasize the sequence, techniques, and hazards. Make sure each student can see what is being done and understands the steps.

Step III. -- Have the student do the job.
Assign each student the task of applying what he has just learned. Supervise his work; correct any variation from proper procedure or any hazardous techniques. Re-explain when necessary.

Step IV. -- Check the student for proficiency.
Assign a similar job to the student to be performed independently. Observe his work and examine the completed product or service. He is proficient when he can perform the job without supervision in a prescribed length of time.

Students who have demonstrated proficiency in one job move to the next job. The teaching steps *tell, show, do, check* are used again. Students who are not proficient perform additional jobs of a similar nature and are retaught in weak areas.

Additionally, this publication can be used (1) by the director and the instructor in a local program in communicating with their craft committee, (2) by the local director in supervising instruction and program operation, and (3) by the state supervisory staff in communicating with local school administrators and in supervising the operation of local programs.

TABLE OF CONTENTS

AUTOMOBILE BODY REPAIRMAN

The automobile body repairman repairs or replaces damaged automobile body parts. He hammers out or fills in dents and welds broken surfaces. He removes old paint from the vehicle, or from damaged and repaired parts of the vehicle, using abrasives (he may use liquid paint remover). He primes and paints the vehicle.

He may remove upholstery, accessories and trim in preparation for actual repair. Major damage is roughed out with hydraulic jacks and other equipment. Dents are removed by placing a dolly block on one side and tapping with a hammer on the other. Dents may be filled with solder or other plastic material. The repairman smoothes repaired surfaces by using grinders, files, and sandpaper.

Frames may be straightened with hydraulic jacks and pulling devices.

He must cover bumpers, windows, and trim with paper and masking tape to protect them during painting. The repairman mixes paints to obtain the desired results and spray-paints the automobile or repaired portions.

A detailed description of this occupation may be found in the Dictionary of Occupational Titles, third edition, under AUTOMOBILE-BODY REPAIRMAN (auto. ser.) 807.381, and PAINTER, AUTOMOBILE (auto. ser.) 845.781.

COURSE DESCRIPTION

GENERAL OBJECTIVE

To help the trainee develop knowledges and skills which prepare him to enter the automobile repair trade on the advanced learner's level

ASSUMPTIONS

1. That those enrolling in training have had no previous experience in automobile body repair
2. That trainees have a background in basic mathematics and general science

DESIRABLE PREREQUISITES

1. That trainees have a vocational commitment to the automobile body repair trade
2. That trainees have general mechanical aptitudes

NATURE OF TRAINING

1. The duration of training is normally three hours per day, five days per week, thirty-six weeks per year for two years; or six hours per day, five days per week, thirty-six weeks per year for one year--a total of 1080 clock hours of training.
2. Related instruction by lecture, demonstration, the use of audiovisuals, etc. immediately precedes application by the trainee in shop practice; instruction and its application are correlated as closely as possible at all times; and the major allotment of time is given to the development of manipulative skills.
3. No instruction directly related to the trade is offered outside the shop.

CONTENT OF RELATED INSTRUCTION

Systematic and purposeful presentation of the following:

1. A detailed explanation of fundamental information about metals, such as grain structure, corrosion resistance, weldability, effects of stresses, etc.
2. Instruction in types of abrasives, their construction, and characteristics
3. An explanation of the types of fasteners used in auto bodies
4. A discussion of fiber glass bodies, their qualities and construction
5. Instruction in inspection and planning of repair procedures
6. Information on the types of electrical controls and switches
7. Broad coverage of upholstery materials, cleaners, and stains
8. Detailed information on primers, sealers, color coats and their properties and uses

9. Information on methods of checking frame alignment
10. Broad coverage of welding processes and techniques
11. Instruction in mathematics, such as arithmetic and percentages
12. Instruction in general science as it relates to the body repair trade

TYPES AND LEVELS OF SKILLS TO BE DEVELOPED

1. Immediately marketable skills enabling the trainee to handle extensive body repairs under minimum supervision

2. Immediately marketable skills in minor frame-straightening under minimum supervision

3. Basic skills in masking, priming, and painting; additional training after employment would be necessary to develop a production painter

4. Basic skills in oxyacetylene welding, brazing, and cutting, as well as manual metal arc welding

INSTRUCTIONAL BLOCKS

The following blocks are the major areas of instruction. Each has been assigned a number of hours for the purpose of indicating the relative amount of emphasis it is to receive in the total training period. Instructors are urged to plan training carefully, to select, sequence, and assign learning experience, thus making maximum use of available time. It should not be inferred that hour allotments be rigidly adhered to or that students be rotated on a clockwork or calendar basis. On the contrary, the emphasis is on individual proficiency. It is likely that students of lesser ability will require longer periods in certain areas. These students may gain only the minimum proficiencies while more able students will progress more rapidly and engage in many enriching experiences. Consequently, the planning, sequencing, and alloting are not designed to standardize programs, but to assist local teachers in planning more carefully and in conducting their instruction more carefully.

INSTRUCTIONAL BLOCKS		Contact Hours
I.	Welding	150
II.	Body alignment and repair	480
III.	Special body jobs	180
IV.	Frames	90
V.	Painting	180
	Total Hours	1080

ANALYSIS OF OPERATIONS

I. WELDING AND CUTTING EQUIPMENT

A. Oxyacetylene welding

1. Install a cylinder valve and regulator on a cylinder
2. Assemble a welding torch
3. Assemble a cutting torch
4. Attach a welding torch or a cutting torch to a regulator, using dual-type hose
5. Light a welding torch and adjust it for a carburizing, a neutral, and an oxidizing flame
6. Light and adjust a cutting torch
7. Form a puddle, using an acetylene torch
8. Add filler rod to a puddle
9. Change the tip on a welding or a cutting torch
10. Change the lens in welding goggles

B. Manual metal arc

1. Plug the pigtail into an outlet (CAUTION!)
2. Attach a lug, ground clamp, or electrode holder to a lead cable
3. Attach the welding lead and the ground lead to the welding machine
4. Attach the ground lead to the work or to the worktable
5. Put an electrode in the holder
6. Put on and adjust a welding helmet
7. Change a cover plate and/or lens in a helmet
8. Strike an arc and hold it
9. Adjust the current controls
10. Spotweld with an arc-spot welding gun

II. HAND TOOLS

A. Hammering

1. Repair damage with a rawhide or rubber mallet
2. Raise low spots with a pick hammer
3. Raise low spots with a pick tool
4. Repair dents by direct hammering
5. Repair dents by indirect hammering
6. Repair dents by spring hammering
7. Repair dents with a roughing dolly

8. Repair dents with a low-crown spoon and a hammer
9. Repair dents with a high-crown spoon and a hammer
10. Repair dents with a dinging hammer
11. Cold-shrink with a dolly and hammer
12. Hot-shrink with a dolly, a hammer and an acetylene torch
13. Sink a weld with a dolly and a hammer

B. Surface finishing

1. Smooth a surface with a body file
2. Smooth a surface with sandpaper
3. Featheredge a section of paint with water-proof paper
4. Tin a surface with an acetylene torch and solder
5. Work solder with heat and a solder paddle
6. Apply plastic body filler to a surface
7. Establish a contour by filing and sanding
8. Remove dust and lint from body with a tack rag

C. Fastening

1. Loosen and tighten nuts with open-end and box-end wrenches
2. Loosen and tighten nuts with sockets and attachments
3. Loosen and tighten screws with a standard blade screwdriver
4. Loosen and tighten screws with a Phillip's screwdriver
5. Loosen and tighten screws with a clutch-head screwdriver
6. Loosen and tighten nuts with an allen wrench

D. Miscellaneous

1. Hold materials with vise-grip pliers
2. Cut metal with a cold chisel
3. Mark a surface with a scratch awl
4. Measure with a steel tape
5. Remove a door handle with a special tool
6. Thread a drilled hole with a tap
7. Thread a rod with a die

III. POWER TOOLS AND EQUIPMENT

A. Remove material with a disk-type portable sander
B. Remove material with a portable belt sander
C. Remove material with an air orbital sander
D. Polish a surface with a portable polisher

E. Remove paint with a sandblaster

F. Set up a jack with the various attachments

G. Straighten members with a remote-controlled jack

H. Straighten material in an arbor press

I. Mount a door in a holding unit

J. Mount a hood in a holding unit

K. Mount a deck lid in a holding unit

L. Lift an automobile with a floor jack

M. Lift an automobile with a twin-saddle hydraulic jack

N. Support an automobile with jack stands

O. Drill a hole with an electric drill

P. Remove a nut with an air-drive wrench

Q. Sharpen a chisel on a bench grinder

R. Sharpen a drill bit on a bench grinder

S. Hold materials with a vise

T. Clean a dusty surface with an air dusting gun

U. Dry a surface with an infrared light panel

V. Clean a surface with a steam cleaner

IV. REFINISHING EQUIPMENT

A. Assemble and fill a spray gun

B. Adjust an air transformer to the proper pressure

C. Spray paint with a spray gun

SUGGESTED JOBS IN AUTOMOBILE BODY REPAIR

The following is a list of the different types of jobs the automobile body repairman will be required to complete. On inspection it will be found that the term "repair or replace" has been used often. The two words signify two separate and distinct jobs. They were used together here to avoid repetition.

I. BODY ALIGNMENT AND REPAIRS

A. Repair or replace a quarter panel
B. Repair a front fender
C. Repair a rear fender (truck)
D. Repair a hood
E. Replace a hood hinge and spring
F. Replace and align a hood
G. Repair a deck lid
H. Replace a deck-lid hinge and spring
I. Replace and align a deck lid
J. Replace or repair a top panel
K. Repair or replace a cowl
L. Repair or replace a floor panel
M. Repair or replace a rocker panel
N. Repair or replace a lower deck-lid panel
O. Repair or replace a center pillow
P. Replace a door panel
Q. Repair or replace a door
R. Repair or replace a dash
S. Repair or replace front inner panel
T. Repair a fiber glass panel
U. Adjust convertible-top mechanism
V. Repair top rails on a convertible

II. SPECIAL BODY JOBS

A. Replace a door latch, key cylinder, and/or striker plate
B. Replace a door glass and a manual glass regulator
C. Replace electric glass-regulating mechanism, motor, and switch
D. Replace quarter glass and/or glass regulator
E. Replace vent glass and/or vent glass mechanism

F. Replace a windshield
G. Replace a rear glass
H. Replace windshield and rear glass rubber
I. Replace a headliner
J. Replace a windlace
K. Replace door trim pads
L. Replace garnish molds
M. Replace weather stripping
N. Replace a sun visor
O. Replace a rear-view mirror
P. Replace carpets
Q. Replace seats
R. Replace a power-seat motor
S. Replace a power-seat switch
T. Repair bumpers and bumper arms
U. Replace chrome trim and clips
V. Replace a grill assembly
W. Replace manual and power radio antennae
X. Replace a headlamp and headlamp assembly
Y. Repair or replace a gravel deflector

III. PAINTING

A. Prepare a bare ferrous metal surface for painting
B. Prepare an aluminum surface for painting
C. Prepare an old surface for painting
D. Mask glasses and trim
E. Apply lacquer by spraying
F. Apply enamel by spraying
G. Buff out and wax lacquer

IV. FRAME

A. Replace body-to-frame grommets, pads, shims, etc.
B. Check a frame for alignment with tape, trammels, and gages
C. Align frame extensions
D. Repair or replace front and rear frame extensions
E. Replace damaged front-suspension components and rough-set caster, camber, and toe-in

V. WELDING

A. Join two pieces of sheet metal by oxyacetylene welding

B. Joint two pieces of sheet metal by brazing

C. Cut sheet metal with an oxyacetylene cutting torch

D. Cut frame material with an oxyacetylene cutting torch

E. Cut rivets and bolts with an oxyacetylene cutting torch

F. Heat metal to a desired temperature with an oxyacetylene torch

G. Join two pieces of frame material by manual metal arc welding

H. Join two pieces of sheet metal with an arc-spot welder

RELATED INSTRUCTION TOPICS

I. BODY ALIGNMENT AND REPAIR

A. Methods of removing body deadener

1. Using putty knife
2. Using wire brush
3. Using solvents
4. Using heat

B. Characteristics of metal

1. Elastic ability
2. Grain structure
3. Resistance to corrosion
4. Weldability
5. Plasticity

C. Factors affecting metal structure

1. Stress
2. Strain
3. Work hardening
4. Shear
5. Bonding and fusion
6. Heat

D. Technique of drilling and tapping a hole

1. Laying out
2. Center punching
3. Drilling
4. Using types of taps
5. Starting the tap

E. Abrasives

1. Cutting materials

    a. Flint quartz
    b. Emery (natural aluminum oxide)
    c. Garnet
    d. Crocus

        - e. Aluminum oxide
        - f. Silicon carbide
    - 2. Backings
        - a. Paper
        - b. Cloth
        - c. Fiber
        - d. Combinations
    - 3. Bonding agents
        - a. Dry-type
        - b. Wet- or dry-type
    - 4. Types
        - a. Open-grain
        - b. Closed-grain
        - c. Grits
- F. Types of fasteners
    - 1. Threaded
        - a. Sheet metal screws
        - b. Machine screws
        - c. Carriage head bolts
        - d. Studs
    - 2. Other
        - a. Spring
        - b. Snap-on clip
        - c. Rivets
- G. Fiber glass
    - 1. Qualities
        - a. Strength or relative strength
        - b. Resistance to impact
        - c. Localization of damage
    - 2. Materials
        - a. Resins

- b. Fillers
- c. Catalysts
- d. Fiber glass cloth
- e. Precautions to follow when using

H. Inspection and planning of repair procedures

1. Basic damage conditions

    - a. Displaced areas
    - b. Simple bends
    - c. Rolled buckles
    - d. Upsets
    - e. Sketches

2. Variable factors in collision

    - a. Impact angle
    - b. Relative speed of impact object
    - c. Size, rigidity, and weight of object
    - d. Construction of impact area

II. SPECIAL JOBS

A. Adhesives

1. Types
2. Bonding characteristics
3. Advantages and disadvantages of each type

B. Electrical controls

1. Types of manual switches

    - a. Headlight
    - b. Dimmer
    - c. Directional signal
    - d. Backup light
    - e. Windshield wiper

2. Reading specifications
3. Reading schematics

C. Cleaning upholstery

1. Types of upholstery materials

      - a. Fabrics
      - b. Genuine leather
      - c. Coated fabrics (vinyl or nylon)
      - d. Polyurethane foam
    - 2. Types of cleaners
      - a. Volatile cleaners
      - b. Synthetic detergents
      - c. Neutral soaps
      - d. Ammonia
    - 3. Specific stains
      - a. Battery acids
      - b. Blood
      - c. Candy
      - d. Chewing gum
      - e. Fruit, liquor, wine
      - f. Grease and oil
      - g. Ice cream
      - h. Nausea
      - i. Shoe polish and dressings
      - j. Tar
      - k. Urine
      - l. Lipstick

III. PAINTING

  - A. Base coats (bare metal to finish coats)
    - 1. Sealers
      - a. Enamel finish
      - b. Lacquer finish
      - c. Universal
      - d. Bleeder sealers
    - 2. Primers
      - a. Lacquer
      - b. Enamel
      - c. Universal

        3. Primer-surfacers, a base for
            a. Lacquer
            b. Synthetic finishes
    B. Color coats
        1. Synthetic enamel
        2. Acrylic enamel
        3. Nitrocellulose lacquer
        4. Acrylic lacquer
    C. Color-coat conditioners
        1. Thinner and reducers
            a. Use of thinner designed for specific color coat
            b. Correct amounts of thinners to use
            c. Thinners for use at extreme temperatures
        2. Retarders
    D. Surface cleaning and conditioning materials
        1. Wax, polish, and grease solvents
        2. Metal conditioners
        3. Etches
        4. Rust inhibitors
    E. Air-pressure requirements of painting
        1. For guns, approximately 9 cfm
        2. For synthetic enamels, 60 psi at the transformer
        3. For lacquers, 50 psi at the transformer
        4. For all applications, constant pressure

IV. FRAME ALIGNMENT

- A. Measuring diagonals (X checking)
    - 1. Making direct measurements
    - 2. Transfering measurements to the floor with plumb bob
- B. Using tram gages
- C. Using self-centering gages
- D. Using frame-checking and correcting machine

V. WELDING PROCESSES AND TECHNIQUES

- A. Fusion
  - 1. Oxyacetylene
    - a. Equipment
    - b. Types of joints
    - c. Procedure
    - d. Hazards
  - 2. Manual metal arc
    - a. Equipment
    - b. Types of joints
    - c. Procedure
    - d. Hazards
  - 3. Arc-spot
    - a. Equipment
    - b. Procedure
    - c. Hazards
- B. Bonding
  - 1. Brazing
    - a. Equipment
    - b. Brazing alloys
    - c. Fluxes
    - d. Procedure
    - e. Hazards
  - 2. Soldering
    - a. Equipment
    - b. Solders
    - c. Fluxes
    - d. Procedures
    - e. Hazards
- C. Cutting
  - 1. Equipment
  - 2. Procedure

        3. Hazards

VI. MATHEMATICS

- A. Whole numbers
    1. Addition
    2. Subtraction
    3. Multiplication
    4. Division
    5. Trade applications
- B. Fractions
    1. Addition
    2. Subtraction
    3. Multiplication
    4. Division
    5. Conversion to fractions
    6. Trade applications
- C. Decimals
    1. Addition
    2. Subtraction
    3. Multiplications
    4. Division
    5. Conversions to fractions
    6. Trade applications
- D. Measurements
    1. Linear
    2. Angular
    3. Surface
    4. Volume
    5. Temperature
    6. Weight
- E. Percentage
    1. Changing a percent to a decimal
    2. Changing a decimal to a percent
    3. Changing a fraction to a percent

- 4. Computing percentages
- 5. Applying principles of percentage to the trade

VII. APPLIED SCIENCE

- A. Center of gravity
- B. Forces
    - 1. Angular
    - 2. Parallel
- C. Motion
- D. Friction
- E. Simple machines
    - 1. Lever
    - 2. Pulley
    - 3. Wheel axle
    - 4. Inclined plane
    - 5. Wedge
    - 6. Screw
- F. Power
    - 1. Source
    - 2. Transmission
- G. Specific gravity
- H. Hydraulic principles
- I. Heat
    - 1. Sources
    - 2. Measurement
    - 3. Transmission
    - 4. Effects

AUTOMOBILE BODY REPAIR
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EQUIPMENT LIST

for the

VOCATIONAL AUTOMOBILE-BODY REPAIR

Quantity	Item
1	Air compressor; horizontal tank; two cylinder; 7-1/2 hp; 3-phase, 220-volt
2	Oil and water extractors, with regulators (one for open shop, one for paint room); 75 cfm capacity; two main line pressure outlets; two regulated pressure outlets
4	Air hose, 50 ft. lengths; 5/16" diameter; furnished with 1/4" St.P connections
1	Spray gun, with qt cup; 1/4" St.P fluid hose connection; lacquer nozzle set-up
1	Spray gun, with qt. cup; 1/4" St.P fluid hose connection; enamel nozzle
1	Spray gun, with qt cup; 1/4" St.P fluid hose connection; lacquer nozzle set-up (for primer)
1	Wrench, air drive; hex sockets 1/2", 9/16", 5/8", 11/16", 3/4",13/16"
1	Metal-working tool kit, air driven; air slugger, cutter, chisel, rivet buster, extension chisel, scraper, punch, panel crimper
1	Orbital sander, air file; with built-in air regulator; fingertip air control
3	Orbital sander, air driven; heavy-duty; 3-2/3"x 9" pad
2	Automotive disc sanders; heavy-duty; 7" and 9" pads; 4250 rpm; 115V
4	Backup pad assembly, for body grinder; 5/8" arbor; 7" diameter
4	Backup pad assembly, for body grinder; 5/8" arbor; 9" diameter
1	Electric drill; 1/4"; 115V
1	Electric drill; 3/8"; 115V; with reversible drive
1	Portable polisher; heavy-duty; 7" pad, 5/8" spindle
1	Apron taping machine; 15" capacity
1	Grinder, bench; 7" wheels, 36 and 60 grit stones; with light, shields, pot, and stand
1	Grinder, bench; 7" wheels, wire brush and grindstone; with light, shields, pot, and stand
1	Gun, air dusting; 1/4" NPT (F)
1	Air chuck: for air tires
1	Spot welding gun; 110V, 30 amp; 8 ft heavy-duty power cord, with 3-prong polarizing plug; 15 ft work lead with Quick-tite clamp
1	Welder, a-c transformer type; 180 amp output; 230 volt, 60-cycle input; with pigtail and accessories

4	Helmets, welders flip-front; rachet headgear; #1 shade
4	Safety goggles, plastic 1-piece
4	Combination outfits for oxyacetylene welding, cutting, brazing, heating, and soldering; with dolly
2	Jacks, floor roller; minimum 2-ton capacity
1	Jack, twin saddle; hydraulic; 1-1/2-ton capacity
8	Stands, adjustable; 5-ton capacity; adjust 15" to 25"
1	Body-and-fender jack; push-and-pull action; 4-ton capacity; with stand and accessories
1	Body-and-fender jack; push action only; 4-ton capacity; with stand and accessories
1	Body-and-fender jack; push action only; 10-ton capacity; with stand and accessories
1	Jack, portable frame; 20,000 lbs capacity; with hydraulic unit and accessories
1	Panel puller, slide-hammer type; with attachments
4	Work benches; metal top; 28-1/2 x 60" x 34"
2	Vises, machinist; 5" jaw width, maximum opening 8"; with swivel base
4	Creepers, hardwood; 18" x 36", with adjustable headrest
2	Holding units, for removable panels; jacking platform; 52" door bar, bar bolt assemblies; pull bar 90"; clamps with adapters; holding stands
1	Door bar unit, single; 52" door bar; center support; adjustable clamps, with adapters
1	Steam cleaner, portable oil fired; 100 gal per hour capacity; electric starter, 115V
1	Arbor press; 5-ton capacity; with stand and adjustable handle
1	Sandblast gun, portable; handles grit sizes 16 to 1000; air pressure 60-150 psi; with abrasive container, abrasive hose, and face mask
1	Pop-rivet tool, general-purpose; for up to 1/8" diameter steel rivets; with starting assortment of rivets
10	Dollies, heel
10	Dollies, general-purpose
2	Dollies, low-crown general-purpose bumping
2	Dollies, high-crown
2	Dollies, roughing; heavy-duty
2	Dollies, general-purpose rail type

1	Spoon, double-end lower back panel and quarter panel
1	Spoon, double-end door and side apron
1	Spoon, double-end heavy-duty driving
1	Tool, double-end heavy-duty driving and fender beading
1	Ezy-edger
1	Spoon, surfacing
1	Spoon, low-crown surfacing
1	Hammer, round head and extra long pick
1	Hammer, roughing, heavy-duty with all-purpose dolly
1	Hammer, bullet-type, short pick
4	Hammers,bumping; 4" overall
1	Hammer, square-face taper-shank and molding
4	Hammers, bumping; 6" overall
1	Hammer, offset square face and cross-peen
1	Hammer, serrated face
1	Hammer, short bullet-type fender
1	Hammer, trim; magnetic
1	Mallet, bumping and shrinking
1	Pick, short curved
1	Pick,deep-throat straight
1	Pick, long curved
1	Pick, long tee handle chisel bit
1	Punch, curved finishing
1	Punch, hooked finishing
1	Punch, piercing
6	Solder paddles, curved face
6	Solder paddles, flat face
1	Cutter, sheet metal
1	Angle cutter, handklip
1	Pliers, drip molding
3	Pliers, vise-grip; 10 inch; with wire cutter and easy release
4	Pliers, slip-joint; 6-1/2"
1	Pliers, side cutting; 7"
1	Pliers, long chain nose; 6-3/4"

4	File holders, flexible adjustable
12	Files, flat; 8 teeth per inch
12	Files, half-round, 8 teeth per inch
2	Tools, door handle pin removing
2	Tools, door handle clip removing

Screwdrivers, square shank, standard tip

	Blade length	Tip width
1	2-1/2"	1/8"
1	1-1/2"	1/4"
1	4"	1/4"
2	7-1/2"	1/4"
1	3"	1/4"
1	4"	5/16"
1	9"	2/16"
1	5"	3/8"
1	6"	3/8"

Screwdrivers, Phillips, plastic handle

	Tip No.	Blade length
1	0	2-1/2"
1	1	3"
4	2	4-1/4"
1	3	6"
1	4	8"
1	2	9/16"

Screwdrivers, clutch head

	Tip size	Blade length
1	5/32"	4"
1	3/16"	4"
1	1/4"	5"
1	5/16"	5"

2 sets	Combined 1/4" and 3/8" drive sockets; 1/4" drive: 3/16", 7/32", 1/4", 9/32", 5/16", 11/32", 3/8", 7/16", 1/2", and spinner handle; 3/8" drive: 9/16", 5/8", 11/16", 3/4", 13/16", 7/8", 15/16", 1"; reversible ratchet, 3" and 6" extensions, 3/8" to 1/4" adapter, and 13/16" spark plug socket
2 sets	1/2" drive sockets; 7/16", 1/2", 9/16", 5/8", 11/16", 3/4", 13/16", 7/8", 15/16", 1", 1-1/4"; ratchet; 5-1/2" and 11" extensions; 16" flex handle and 18" speeder
1 set	Allen wrenches 5/64" - 1/4"
2 sets	Wrenches, open-end; 11 pieces, 1/4" - 1" by 16ths
2 sets	Wrenches, box; 6 pieces, 3/8" - 1"
1 set	Wrenches, combination; box-end and open-end; 14 pieces 3/8" - 1-1/4"

3	Scratch awl, heavy-duty; 3-1/2
1	Putty knife; wood handle; 2-1/8" blade
1	Putty Knife; wood handle; 4" blade
1	Putty knife; wood handle; 1-1/2" blade
1	Putty knife; wood handle; 3-1/2" blade
6 each	Drill bits; high-speed steel, 1/4" shank 1/16", 1/8", 3/16", 1/4"
6 each	Drill bits; high-speed steel, 3/8" shank 5/16", 3/8", 7/16", 1/2"
1	Tap and die set; one each of the following NF plug tap and NF die: 1/4-20, 5/16-18, 3/8-16, 7/16-14, 1/2-13, 9/16-12, 5/8-11, 3/4-10; one each of the following NC plug tap and die: 1/4 x 28, 5/16 x 24, 3/8-24, 7/16-20, 1/2-20, 9/16-18, 5/8-18, 3/4-16; one each 1/8" and 1/4" pipe tap and die; all dies 1-1/2" OD; with appropriate die stock and tap reamer wrench

SUPPLIES

Quantity	Item
12 sleeves	Silicon carbide paper; waterproof; 3-2/3 x 9"; 40 grit; 100 per sleeve
12 sleeves	Silicon carbide paper; waterproof; 3-2/3 x 9"; 80 grit; 100 per sleeve
6 sleeves	Silicon carbide paper; 2-3/4" x 17-1/2"; 40 grit; 100 per sleeve
6 sleeves	Silicon carbide paper; 2-3/4" x 17-1/2"; 80 grit; 100 per sleeve
12 sleeves	Silicon carbide paper; 9" x 11"; 500 grit; 100 per sleeve
12 sleeves	Silicon carbide paper; 9" x 11"; 400 grit; 100 per sleeve
2 sleeves	Silicon carbide paper; 4-1/2" x 11"; 400 grit; 100 per sleeve
6 sleeves	Silicon carbide paper; 9" x 11"; 320 grit; 100 per sleeve
12 sleeves	Silicon carbide paper; 9" x 11"; 240 grit; 100 per sleeve
6 boxes	Body sanding discs; 5/8" center hole, 9" OD; 16 grit; 50 per box
6 boxes	Body sanding discs; 5/8" center hole, 9" OD; 24 grit; 50 per box
3 boxes	Body sanding discs; 5/8" center hole, 9" OD; 36 grit; 50 per box
100 lbs	Body solder; 20/80/; 1/2 lb bars
8 qts	Soldering flux (Rubyfluid); in 1 qt containers
2 doz	Acid swabs; stiff bristle; with tin handle
10-25 gals	Plastic filler; for repairing holes, dents, etc.
4 pkgs	Plastic body filler spreader; 12 per package
5 gals	Body deadener-undercoating; 1 gal cans
3 tubes	Super-weatherstrip adhesive (yellow); 5 oz. tubes
3 tubes	Weatherstrip adhesive (black); 5 oz tubes
6 tubes	Trim adhesive; 5 oz tubes
12 tubes	Feathering disc adhesive; 5 oz tubes
5 cans	Windshield sealer; 1 pt cans with dispenser
4 tubes	Drip-check sealer; for drip molding; 5 oz tubes
6 tubes	Body calk; with gun
3 boxes	Strip calk; 60 one-foot lengths per box
2 cases	Masking tape; 3/4" width; 48 rolls per case, 100 ft per roll
3 rolls	Masking paper; 12" width, 100 ft per roll
1 drum	Acrylic lacquer thinner; low grade for gun cleaning and priming (55 gals)

1 drum	Acrylic lacquer thinner; high grade for color coat (55 gals)
1 gal	Retarder, for acrylic lacquer
6 bottles	Fish eye; 2 oz bottles
20 gals	Enamel reducer, variable temperature
3 containers	Tack rags, 6 per container
10 doz	Masks, filter face
100 lbs	Steam cleaner compound
2 drums	Kerosene; for steam cleaner (55 gals each)

VT003 495

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A Basic Plan for the Organization and Management of Instruction in Vocational Diesel-Engine Mechanics.

Mississippi State Univ., State College. Curriculum Lab.
Mississippi State Dept. of Vocat. Educ., State College
Pub Date - Aug67
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*CURRICULUM GUIDES, *TRADE AND INDUSTRIAL EDUCATION, *DIESEL MECHANICS, *DIESEL ENGINES, HIGH SCHOOLS, POST SECONDARY EDUCATION, EQUIPMENT,

This curriculum guide was prepared to assist the trade instructor in planning and developing instructional materials for a course in diesel mechanics for training high school students for employment at advanced learner's level. The material was developed by trade instructors by a systematic analysis of the operations of the trade The major instructional areas are organized in blocks of operations and informational topics related to specific jobs to be performed by groups, subgroups, or individuals. The instructional blocks are (1) Block Assembly, (2) Head Assembly, (3) Electrical System, (4) Fuel System, (5) Cooling System, (6) Intake-Exhaust-Blower System, and (7) Miscellaneous. The course is designed for a 2-year program with 1,080 hours of training. Instructional procedures are recommended for the trade competent teacher. Students should have a background in mathematics and general science. Equipment and consumable supplies are listed, and a bibliography contains recommended textbooks and suggested references. The document is available for $1.00 from Curriculum Laboratory, Box NU, State College, Mississippi 39762. (HC)

BASIC PLAN

for the

Organization and Management of Instruction

in

VOCATIONAL

DIESEL-ENGINE MECHANICS

PRELIMINARY DRAFT -- FOR DISCUSSION ONLY

Prepared and Issued by the
CURRICULUM LABORATORY
TRADE AND TECHNICAL EDUCATION
STATE DEPARTMENT OF VOCATIONAL AND TECHNICAL EDUCATION
Jackson, Mississippi

Located in the
DEPARTMENT OF INDUSTRIAL EDUCATION
MISSISSIPPI STATE UNIVERSITY
State College, Mississippi

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Organization and Management of Instruction
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(Address) P.O. Drawer NU, State College, Mississippi 39762

DATE: September 11, 1967

RE: (Author, Title, Publisher, Date) Mississippi Curriculum Laboratory

A BASIC PLAN FOR VOCATIONAL DIESEL-ENGINE MECHANICS
State College, Miss: Curriculum Laboratory of the State Department of Vocational and Technical Education, Mississippi State University, 1967

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(3) Utilization of Material:
Appropriate School Setting Vocational (trade) training
Type of Program Preparatory
Occupational Focus P
Geographic Adaptability Normally found in the secondary schools, but believed to be
Uses of Material applicable at post secondary level; for use by instructor in
Users of Material planning daily teaching activities

(4) Requirements for Using Material:
Teacher Competency Trade competent, with teaching skills
Student Selection Criteria Those who want, need, and are able to profit from the training; recommend screening by testing, by examination of school records, and by
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State College, Mississippi

ACKNOWLEDGMENTS

Initial development of instructional materials for diesel-engine mechanics began on the campus of Mississippi State University on May 11 and 12, 1967. Mr. Eldon Davis of Hinds County Junior College and Mr. William Russell of Parchman Vocational School worked with Laboratory personnel in preparing the contents of this publication beginning with an analysis of operations and carrying through to a listing of equipment, tools, and supplies. Mr. Davis and Mr. Russell are to be commended for their efforts and contributions.

Following the work of the Committee, the staff of the Laboratory compiled, edited, duplicated, and distributed the material. This publication, which is the first step, will be the base for further development. A definite part of the developmental process is an evaluation and authentication by a representative industrial committee.

The staff of the Curriculum Laboratory also wishes to acknowledge the continued support of Mississippi schools and their administrators who make their personnel available.

HOW TO USE THIS PUBLICATION

As a tool for teaching, this publication is primarily designed for use in planning, preparing, presenting, and evaluating instruction. As a tool, it lists operations, jobs, and informational topics--with the job as the focal point. Each job should be assigned to students, either as a group, a subgroup, or individually. The following procedure is recommended as an effective teaching sequence.

Step I. -- Tell how the job is done.
Give a full explanation of the steps necessary to perform the job. Emphasize the proper sequence; stress techniques requiring special care; point out the hazards to persons and the equipment.

Step II. -- Show how the job is done.
Demonstrate the proper procedure for performing the job. Re-emphasize the sequence, techniques, and hazards. Make sure each student can see what is being done and understands the steps.

Step III. -- Have the student do the job.
Assign each student the task of applying what he has just learned. Supervise his work; correct any variation from proper procedure or any hazardous techniques. Re-explain when necessary.

Step IV. -- Check the student for proficiency.
Assign a similar job to the student to be performed independently. Observe his work and examine the completed product or service. He is proficient when he can perform the job without supervision in a prescribed length of time.

Students who have demonstrated proficiency in one job move to the next job. The teaching steps *tell, show, do, check* are used again. Students who are not proficient perform additional jobs of a similar nature and are retaught in weak areas.

Additionally, this publication can be used (1) by the director and the instructor in a local program in communicating with their craft committee, (2) by the local director in supervising instruction and program operation, and (3) by the state supervisory staff in communicating with local school administrators and in supervising the operation of local programs.

TABLE OF CONTENTS

DESCRIPTION OF DIESEL-ENGINE MECHANIC

The diesel engine mechanic repairs and maintains diesel engines used to power machines such as buses, ships, trucks, trains, electric generators, and construction machinery. The mechanic diagnoses trouble, disassembles engines, examines the parts for defects and excessive wear, reconditions or replaces parts, and reassembles engines.

He removes engines from their mountings and rebuilds individual components, such as the head assembly and the block assembly, and certain accessories, such as the starter, generator, and rootes-type superchargers, but not the exhaust-driven supercharger or the fuel pump.

He uses diagnostic equipment for the fuel system and the electrical system; he reconditions pistons, rods, cylinders, and valves, using shop equipment, such as the engine lathe, boring bar, drill press, and electric hand drill, as well as metalworking hand tools, such as taps, dies, reamers, and files; he makes precision measurements, using micrometers and dial indicators.

The mechanic reassembles engines and installs them in their mounting. He starts them and adjusts their controls for proper operation.

The experienced mechanic may diagnose and/or start dead or malfunctioning equipment in the field; or with additional training he may specialize in fuel-system rebuilding and work in a "clean" room.

Another definition of the diesel engine mechanic may be found in *The Dictionary of Occupational Titles*, under the title DIESEL MECHANIC (any ind.) 625.281.

COURSE DESCRIPTION

GENERAL OBJECTIVE

To assist the trainee in developing knowledges and skills which prepare him to enter the diesel-engine repair trade on the advanced learner's level.

ASSUMPTIONS

1. That those enrolling in training have had no previous experience in diesel-engine repair
2. That trainees have a vocational commitment to the diesel-engine repair trade
3. That trainees have a general mechanical aptitude

DESIRABLE PREREQUISITES

That trainees have a background in elementary mathematics and in general science

NOTE: Those desiring to enroll who lack the above prerequisites should be counseled concerning their deficiencies and then assigned to remedial courses when these are available. It is not recommended that a person lacking the above prerequisites be denied training.

NATURE OF THE TRAINING

1. The duration of the training is normally three hours per day, five days per week, thirty-six weeks per year for two years; or, six hours per day, five days per week, thirty-six weeks per year for one year--a total of 1080 clock hours of training.

2. Related instruction by lecture, demonstration, the use of audio-visuals, and others immediately precedes application by the trainee in shop practice; instruction and its application are correlated as closely as possible at all times; and the major allotment of time is given to the development of manipulative skills.

3. No instruction directly related to the trade is offered outside the shop.

CONTENT OF RELATED INSTRUCTION

Systematic and purposeful presentation of the following:

1. A thorough coverage of the components of the engine, head, and all engine systems, which includes nomenclature, function, and typical service required
2. A nontechnical presentation of fundamental electrical data, of characteristics of fuels and lubricants, and of principles of air and fluid flow
3. Broad coverage of fundamentals of internal combustion engines, the two-stroke cycle, the four-stroke cycle, as well as the timing and synchronization of all engine components
4. An introduction to the testing of fuel pumps and fuel nozzles, and the use of a dynomometer in testing or calibrating engines
5. General coverage of diagnostic and troubleshooting of the engine and its systems

LEVELS OF SKILL

1. Full use of all hand tools and small equipment
2. General use of electrical and fuel test equipment
3. Marketable skill in disassembly and cleanup of engines and system components
4. Marketable skill in service of certain engine components, such as grinding valves and seats, turning starter and generator commutators, as well as replacing brushes, and installing piston rings and rod bearings

INSTRUCTIONAL BLOCKS

The following blocks are the major areas of instruction. Each block has been assigned a number of hours for the purpose of indicating the relative amount of emphasis it is to receive in the total training period. Instructors are urged to plan training carefully, to select, sequence, and assign learning experience, thus making maximum use of available time. It should not be inferred that hour allotments be rigidly adhered to or that students be rotated on a clockwork or calendar basis. On the contrary, the emphasis is on individual proficiency. It is likely that students of lesser ability will require longer periods in certain areas. These students may gain only the minimum proficiencies while more able students will progress more rapidly and engage in many enriching experiences. Consequently, the planning, sequencing, and allotting are not designed to standardize programs, but to assist local teachers in planning more carefully and in conducting their instruction more carefully.

INSTRUCTIONAL BLOCKS

I.	Block Assembly	270
II.	Head Assembly	135
III.	Electrical System	150
IV.	Fuel System	270
V.	Cooling System	105
VI.	Intake-Exhaust-Blower System	105
VII.	Miscellaneous	45
	TOTAL	1080

OPERATIONS

I. MEASURE

A. With scale-type tools

1. Measure with a steel rule or tape
2. Measure angles with a semicircular protractor
3. Transfer measurements with dividers or calipers
4. Measure threads with a screw-pitch gage
5. Check twist-drill points with a drill-point gage
6. Measure holes and recesses with a (scaler) depth gage

B. With precision instruments

1. Measure with an outside micrometer
2. Measure with an inside micrometer
3. Measure with a dial indicator
4. Measure with a micrometer depth gage
5. Transfer measurements with telescoping gages
6. Measure with a feeler gage
7. Check clearances with plastigage

II. MARK OUT

1. Scribe a line with a scratch awl or scribe, and a straight edge
2. Mark a location with a prick punch and a hammer
3. Mark a center with a center punch and a hammer
4. Mark a center with an automatic center punch
5. Scribe arcs and circles with dividers or a hermaphrodite caliper
6. Scribe a parallel line with a steel square and a scratch awl or scribe
7. Sharpen a scratch awl, center punch, or prick punch
8. Mark with letter and number stamps

III. CUT OUT

A. Sheet metal

1. Cut along a straight line with straight-pattern snips or combination snips
2. Cut along a curved line with aviation snips
3. Cut pieces held in a vise, with a flat chisel
4. Cut pieces lying flat, with a chisel

    5. Punch holes with a solid punch or a hollow punch and a hammer
    6. Cut rivets with a chisel
    7. Cut circles with a hole cutter held in a hand drill
    8. Cut a square hole with a hole cutter

  B. Heavy stock

    1. Cut flat and round stock with a chisel
    2. Cut flat, round, and angular stock with a hacksaw
    3. Cross-file for rapid stock removal with a mill bastard file

  C. Other

    1. Drill holes with a hand drill and a twist drill
    2. Countersink holes with a hand drill and a countersink bit
    3. Ream holes with a hand reamer
    4. Cut internal threads in a drilled hole, with a tap and a T handle
    5. Cut external threads with a die and a diestock
    6. Cut a groove with a cape chisel or a diamond-point chisel
    7. Move a hole which is improperly started, with a diamond-point chisel

IV. FORM WITH HAND TOOLS

  A. Sheet metal

    1. Form sheet metal with a wood, rubber, composition, or rawhide mallet
    2. Brake a piece of sheet metal at 90°, using a piece of angle iron, C clamp, and mallet
    3. Form a radius in a piece held over a pipe with a clamp, using a mallet
    4. Form a 90° angular bend, using angle iron and a hydraulic press

  B. Heavy stock

    1. Make angular bends in a piece held in a vise, by striking with a hammer
    2. Make angular bends in a piece held over an anvil, by striking with a hammer
    3. Twist a piece held in a vise, using a monkey wrench
    4. Form an eye in a piece of flat stock over a short pipe held in a vise
    5. Form irregular curves, using a wooden jig
    6. Heat a piece for forming, using an acetylene torch

V. FASTEN WITH HAND TOOLS

A. Removable

1. Tighten or loosen screws with standard-tip screwdriver
2. Tighten or loosen screws with a Phillips screwdriver
3. Tighten or loosen screws with clutch-head screwdriver
4. Tighten or loosen nuts and bolts with open- and box-end wrenches
5. Tighten and loosen nuts and bolts with a socket set, Allen wrench, etc.
6. Tighten nuts and bolts with a torque wrench
7. Tighten and loosen nuts and bolts with an adjustable wrench (crescent), a pipe wrench, and plier (vise-grip) wrench
8. Tighten or loosen nuts and bolts with striker wrenches and a hammer
9. Hold a piece in place by applying a C clamp
10. Remove and install snap rings with snap-ring pliers
11. Remove and install springs with brake-spring pliers

B. Permanent

1. Drive, set, and flange rivets with a riveting hammer and a rivet set
2. Rivet with pop rivets
3. Solder terminals and electrical connections with a soldering gun
4. Apply soft solder with a propane torch
5. Apply soft solder with an oxyacetylene torch

VI. WELD

A. With oxyacetylene equipment

1. Install a cylinder valve and a regulator on a cylinder
2. Assemble a welding torch
3. Assemble a cutting torch
4. Attach a welding torch or a cutting torch to a regulator, using dual-type hose, and adjust the regulator
5. Light a welding torch and adjust it for a carburizing, a neutral, and an oxidizing flame
6. Light and adjust a cutting torch
7. Form a puddle, using an acetylene torch
8. Add filler rod to a puddle
9. Change the tip on a welding or a cutting torch
10. Change the lens in welding goggles
11. Shut off the tank, close the regulator, and bleed the line

B. With manual metal arc equipment

1. Plug the pigtail into an outlet (CAUTION!)
2. Attach a lug and a ground clamp or an electrode holder to a lead cable
3. Attach the welding lead and the ground lead to the welding machine
4. Attach the ground lead to the work or to the worktable
5. Put an electrode in the holder
6. Put on and adjust a welding helmet
7. Change a cover plate and/or lens in a helmet
8. Strike an arc and hold it
9. Adjust the current controls

VII. FINISH

1. Finish-file edges and corners
2. Draw-file a piece of flat or round stock
3. Wire-brush a surface
4. Clean and/or polish a surface with steel wool or abrasive cloth
5. Degrease a surface with a solvent
6. Apply enamel to a finished piece
7. Apply lacquer to a finished piece
8. Hand-buff a finished surface

VIII. PERFORM MISCELLANEOUS OPERATIONS

1. Bend tubing with a tubing bender
2. Flare tubing with a flaring tool kit
3. Remove studs with a stud puller
4. Extract broken screws, bolts, studs, etc., with a screw extractor
5. Scrape with a putty knife
6. Hone cylinders with a cylinder hone and an electric drill
7. Compress valve springs with a valve-lifter tool
8. Pull gears or wheels with a gear or wheel puller

SUGGESTED JOBS FOR DIESEL-ENGINE MECHANICS

I. BLOCK ASSEMBLY

A. Visually inspect the block assembly

B. Disassemble and clean the block assembly for a visual inspection

C. Check the pistons, cylinder sleeves, crankshaft, and camshaft for wear

D. Check the piston and pins, valve lifter push rods, cam gear, and crank gear by visual inspection and fee

E. Replace the wrist pin and/or rod bushing and hone to fit

F. Check the connecting rod for alignment

G. Check the piston and rod assembly for alignment

H. Remove and replace cylinder sleeves

I. Install the crankshaft and torque to specifications

J. Install the piston and rod assembly

K. Install the cam assembly: bushings, cam, gear

L. Inspect the oil pump for clearances and wear; install it in the block

M. Install the oil pan and gaskets

N. Diagnose block assembly malfunctions: worn or stuck rings and pistons, bearing failure, etc.

II. HEAD ASSEMBLY

A. Replace rocker-arm cover gaskets

B. Remove the head and clean it for inspection and repair

C. Remove carbon from the combustion chamber

D. Inspect a head to determine if it requires resurfacing

E. Grind the valve face and the valve stem and reface the rocker arm

F. Replace and/or grind the valve seat

G. Replace the valve guides

H. Install the rocker-arm assembly

I Clean and adjust the injectors

J. Install the head and torque the head bolts

K. Adjust the valves on an operating engine

L. Replace a head gasket

M. Diagnose head-assembly malfunctions: blown gasket, fouled injector, burned valve, improper adjustments, etc.

III. FUEL

1. Visually inspect tanks and lines for corrosion and leaks
2. Steam-clean and rinse tanks and lines; flush with diesel fuel
3. Replace fuel lines (tank to pump)
4. Service the fuel filters: clean and flush the permanent type; replace the element in the throw-away type

*5. Replace jerk-type pump

*6. Rebuild pump for common-rail system

7. Replace/service high-pressure fuel lines
8. Test injectors; rebuild when necessary
9. Check the fuel flow on each type of pump
10. Adjust the governor
11. Diagnose problems in a fuel system with a jerk-type pump
12. Diagnose problems in a common-rail fuel system

* Requires a clean room: When time and facility are available, rebuild jerk-type pump

IV. INTAKE-EXHAUST-BLOWER

1. Service an oil-bath air cleaner
2. Replace a throwaway-type element in the air cleaner
3. Install or replace intake pipes and manifold
4. Rebuild/replace a rootes-type blower
5. Replace an exhaust-driven turbocharger
6. Run/replace the external oil line to the turbocharger
7. Visually inspect and service the exhaust lines to the turbocharger; the lines from the turbocharger to the intake manifold
8. Inspect the exhaust manifold and pipe for leaks
9. Replace the gaskets, pipes, and mufflers
10. Diagnose intake-system malfunctions (normally aspirated)
11. Diagnose problems in the intake system (rootes-type blower)
12. Diagnose problems in the intake system (turbocharger)

V. COOLING SYSTEM

1. Inspect and test the radiator cap
2. Remove the radiator for major repairs; re-install it
3. Check the radiator for leaks: visual, pressure
4. Solder minor leaks in the radiator
5. Check and/or replace the coolant hoses

6. Check and/or replace the thermostat
7. Replace the inner seal in the water pump
8. Replace the water pump
9. Flush and fill the cooling system; put in a corrosion inhibitor
10. Check the drive belts for condition and tension
11. Inspect the pulleys for alignment, warp, etc.
12. Diagnose problems in the cooling system

VI. ELECTRICAL SYSTEM

1. Visually inspect the starter, generator (or alternator), battery, regulator, and wiring
2. Replace brushes on starters and generators; turn the commutator on a lathe
3. Replace bushings and/or bearings on starters and generators
4. Check the armature for shorts or opens
5. Check the field for opens and ground
6. Rebuild or replace the starter solenoid
7. Check and/or replace starter drive (bendix)
8. Make an electrical bench test (dynamically) of the generator or alternator
9. Check and/or replace generator-drive belt
10. Inspect and/or replace the points in the voltage regulator
11. Check the regulator setting and operation
12. Replace the wiring harness
13. Clean battery terminals and posts
14. Load-test the battery
15. Check the electrolyte in a battery
16. Diagnose problems in the electrical system

VII. MISCELLANEOUS

1. Steam-clean engines and parts
2. Clean parts with Oakite in a cleaning tank
3. Make minor repairs by welding with an oxyacetylene torch
4. Cut with an oxyacetylene torch
5. Make minor repairs by welding with a manual metal arc torch

RELATED INSTRUCTION

I. INTRODUCTION TO THE DIESEL ENGINE

A. General description of the engine

   1. Block assembly
   2. Head assembly
   3. Electrical system
   4. Fuel system
   5. Cooling system
   6. Intake-exhaust system

B. The four-stroke cycle

   1. Intake stroke
   2. Compression stroke
   3. Power stroke
   4. Exhaust stroke

C. Two-stroke cycle

   1. Compression stroke
   2. Power stroke
   3. Exhaust-intake action

D. Methods of induction

   1. Natural aspiration
   2. Forced induction

E. Engine configurations

   1. In line
   2. Vee
   3. Horizontal
   4. Opposed
   5. W
   6. Radial

II. THE BLOCK ASSEMBLY: ITS COMPONENTS, ITS FEATURES

A. Block assembly

   1. The block

2. The crankshaft assembly
3. The cam assembly
4. The oil pump
5. The oil pan
6. The accessory drive case

B Block construction

1. Metal composition
    a. Cast iron
    b. Steel
2. Method of fabrication
    a. Cast
    b. Flame-cut and welded
3. Cylinder design
    a. Integral walls
    b. Cylinder sleeves

C. Crankshaft

1. Composition
    a. Steel
    b. Nodular iron
2. Fabrication
    a. Cast
    b. Forged
    c. Bolted
    d. Machined
    e. Induction or flame hardened
3. Features
    a. Bearing surfaces
    b. Counter weights
    c. Oil passages
    d. Nose and heel

D. Connecting rods

1. Composition: steel
2. Method of fabrication
    a. Forged
    b. Machined
3. Types
    a. Standard
    b. Fork and blade
    c. Articulated

E. Pistons, rings, and pins

1. Composition
    a. Aluminum alloy
    b. Steel
2. Fabrication
    a. Forged
    b. Cast
3. Features
    a. Head
    b. Ring grooves and lands
    c. Rings
    d. Pin
    e. Pin locks
    f. Skirt

F. Camshaft

1. Composition: steel
2. Fabrication
    a. Cast
    b. Machined
3. Features
    a. Shaft
    b. Lobes

c. Accessory drive gear or teeth

d. Bearing surfaces and bearing or bushing

e. Timing gear mounting

G. Oil pump

1 Composition and fabrication

2. Features

a. Drive method

b. Housing

c. Gears

d Relief valve

e Oil pickup

H Dry sump lubricating systems

1 Pumps

2 External lines

3 Oil coolers

4 Oil filters

5. Reservoir

I Other block assembly features

1. Accessory mounting pads

2 Accessory drive methods

3. Access holes or plates

4. Oil passages

5 Coolant passages

6. Valve lifters and lifter bores

III. HEAD ASSEMBLY: ITS COMPONENTS, ITS FEATURES

A The head assembly

1 Head

2 Valves, springs, guides, retainers

3 Rocker arm assembly

4. Injectors

5. Passages

a Coolant

b. Intake, exhaust gases

        - c Lubricant

- B The head
    - 1 Composition and fabrication
    - 2 Features
        - a Block-head mating surface
        - b. Combustion chamber; precombustion chamber
        - c. Valve seats
        - d. Passages
    - 3. Service
        - a Grinding mating surfaces
        - b. Grinding valve seats
        - c Cleaning combustion chamber(s)
        - d. Cleaning coolant passages
        - e. Cleaning oil passages
        - f. Replacing valve guides
- C. Valves, springs, retainers, seals
    - 1 Types
        - a. Poppet-type in head
        - b. Valve ports in cylinder
    - 2. Features of poppet-type
        - a Head
        - b. Face or mating surface
        - c Tip
        - d. Retainer groove
    - 3. Composition and fabrication of poppet-type
        - a. Solid head and stem
        - b. Sodium-filled head and stem
    - 4 Feature of cylinder ports
        - a. Location
        - b Sealing action of the piston

- 5. Valve springs and dampeners
    - a. Composition
    - b. Number per valve
    - c. Open and closed tension
- 6. Others
    - a. Retainers
    - b. Stem seals
- 7. Service
    - a. Grinding angles for valves
    - b. Checking spring tension
    - c. Checking assembled height
    - d. Checking valve stems and guides for wear

D. Rocker arm assembly

- 1. Components
    - a. Rocker arm
    - b. Shaft
    - c. Stand
    - d. Push rod
- 2. Service
    - a. Adjusting clearances between valve and rocker arm
    - b. Checking rocker arm and shaft for wear
    - c. Grinding valve articulating surface on rocker arm
    - d. Replacing bent push rods

IV. THE ELECTRICAL SYSTEM

A. Fundamental electrical data

- 1. The electron theory and the structure of the atom
    - a. Electron
    - b. Proton
    - c. Neutron
- 2. Current flow in a conductor; the flow of electrons
- 3. Characteristics of conductors and insulators

    4. Principles of magnetism
        a. Types of magnets
        b. Polarity of magnets
        c. Attraction and repulsion of poles
        d. Simple magnetic induction
    5. Basic electrical terms
        a. Volt
        b. Ampere
        c. Ohm
        d. Watt
    6. The use of instruments in making simple measurements
        a. The voltmeter
        b. The ammeter
        c. The ohmmeter
        d. The wattmeter
    7. Electrical circuits
        a. Series
        b. Parallel
        c. Series-parallel
    8. Ohm's law
    9. Kirchhoff's law
    10. The electric storage cell: the conversion of chemical to electrical energy
        a. The primary cell
        b. The secondary cell

B. The starting circuit

    1. Components
        a. Battery
        b. Starting motor
        c. Starting solenoid
        d. Starting switch
        e. Ignition switch
        f. Wiring

2. Major parts of the battery
    - a. Cell
    - b. Case
    - c. Cell connectors
    - d. Terminal posts
    - e. Vent cap
    - f. Electrolyte
3. Principles and operation of the battery
    - a. Energy conversion
    - b. Volts available
    - c. Amperes available
    - d. Typical types
4. Tests for proper operation of a battery
    - a. Electrolyte gravity
    - b. Light load
    - c. Full load
5. Maintenance and service for the battery
    - a. Cleaning
    - b. Discharge and slow charge
    - c. Proper connections
6. Major parts of the starter
    - a. Case
    - b. Field coils
    - c. Armature
    - d. Brushes
    - e. Drive mechanism
7. Operating principle
8. Typical internal arrangements
    - a. Four-pole, two-field
    - b. Four-pole, four-field
    - c. Six-pole, six-field

9. Starter-motor service
    - a. Disassembling and cleaning
    - b. Replacing brushes
    - c. Checking armature with growler
    - d. Turning commutator
    - e. Making continuity check of field coils

10. Starter-motor switches
    - a. Manual-operated
    - b. Vacuum-operated
    - c. Solenoid-operated
    - d. Solenoid-and-relay-operated

11. Solenoid test techniques

12. Solenoid repair methods

13. Control switches and circuit
    - a. Ignition switch
    - b. Starter button
    - c. Wiring in circuit

14. Battery-solenoid-starter circuit analysis
    - a. Ignition switch
    - b. Starter button
    - c. Wiring in circuit

C. The charging system

1. Introduction
    - a. Description: a mechanically driven electromagnetic device used to generate electricity
    - b. Principles
        - (1) Generation of a magnetic field
        - (2) Cutting of lines of force by conductors

2. D-C generators
    - a. Principles of operation
        - (1) Rotating conductors
        - (2) Fixed magnetic field

b. Construction features

  - (1) Housing
  - (2) Field coil
  - (3) Pole shoes
  - (4) Armature
  - (5) End plates
  - (6) Brushes
  - (7) Pulley
  - (8) Fan

c. Circuits

  - (1) Externally grounded
  - (2) Internally grounded

d. Service techniques

  - (1) Replacing bearings and brushes
  - (2) Testing and/or replacing the armature
  - (3) Turning the commutator
  - (4) Replacing field coils
  - (5) Checking external wires and connections
  - (6) Adjusting the belt

3. D-C regulators

a. Principle: varying resistance in the field circuit

b. Methods

  - (1) Externally grounded field
  - (2) Internally grounded field
  - (3) Cutout relay

c. Circuits

  - (1) Cutout relay
  - (2) Current regulation
  - (3) Voltage regulation

d. Temperature compensation

e. D-C regulator checks

  - (1) Cutout relay
  - (2) D-C regulator

- (3) Current-and-voltage regulator
  - (a) Autolite
  - (b) Delco-Remy
  - (c) Ford

4. A-C generator: alternator
   - a. Principles of operation
     - (1) Rotating magnetic field
     - (2) Fixed conductors
   - b. Construction features
     - (1) Rotor
       - (a) Field winding
       - (b) Pole pieces
       - (c) Slip rings and brushes
       - (d) Shaft
     - (2) Stator
       - (a) Winding
       - (b) Laminations
     - (3) Housing
       - (a) Mounting lugs
       - (b) Heat sink
       - (c) Diodes
       - (d) Capacitor
       - (e) Through Bolts
   - c. Circuit within alternator
     - (1) Within rotor
     - (2) Within stator
       - (a) Delta-connected
       - (b) Wye-connected
   - d. Service techniques
     - (1) External checks
       - (a) Adjusting drive belt

- (b) Checking output
- (2) Internal check
  - (a) Turning slip rings and replacing brushes
  - (b) Checking the field rotor
  - (c) Checking the stator
  - (d) Checking diodes
  - (e) Checking bearings

5. A-C regulators
   - a. Principle: varying resistance in field circuit
   - b. Types
     - (1) Conventional
       - (a) Single-unit
       - (b) Two-unit
       - (c) Three-unit
     - (2) Transistorized
       - (a) Partially
       - (b) Fully

6. Testing techniques for the charging circuit
   - a. Polarity check
     - (1) Positive-ground systems
     - (2) Negative-ground systems
   - b. Mechanical contact check of terminals and connections
   - c. Electrical checks of the charging circuit, using meters
     - (1) Excessive resistance
     - (2) Grounds
     - (3) Open Circuit

V. THE FUEL SYSTEM

A. System requirements

1. A measured quantity
2. The proper time
3. The proper rate
4. Proper distribution

B. System components

  1. Tank
  2. Lines
  3. Filter(s)
  4. Pumps
  5. Injectors
  6. Fuel

C. The fuel tank and its features

  1. Location and mounting
  2. Drain, filler, outlet
  3. Baffles
  4. Sending unit
  5 Coating

D. The fuel lines

  1. Low pressure
  2. High pressure: pump to injector

E. Fuel filters: types

  1. Porous bronze
  2 Metal disc
  3. Ceramic
  4. Other

F. Air injection

  1. Operational principles
  2. Uses: limited

G. Common-rail system with cam-operated spray valve (injector)

  1. High-pressure pump
  2. Relief valve
  3. Header or common rail
  4. Individual, high-pressure lines
  5. Cam assembly: cam, pushrods, control wedge, rocker arm
  6. Cam-operated spray valve

H Common-rail system with self-actuated spray valve (injector)

  1. Controlled-pressure pump
  2. Accumulator or common rail
  3 Fuel lines
  4 Cam assembly: governor-operated eccentric, control lever, cam
  5 Fuel injector
  6, Spring loaded or pressure differential valve (injector)

I. Pump-injection systems (jerk-pumps)

  1. Port-controlled pumps
  2. Valve-controlled pumps
  3. Variable-stroke pumps

J. Distributor system: Combination pump and distributor

K. Unit injectors (single unit)

  1. Cam action on plunger
  2. Gear action on plunger
  3 Helical edges on plunger
  4. Pressure differential nozzle

L. Unit-injectors (pressure-time principle)

  1. Governor and bypass valve action
  2 Cam-operated nozzel action

M. Content of crude oil

  1. Hydrocarbons: asphaltum, paraffin
    a. Hydrogen
    b. Carbon
    c. Others
  2 Impurities
    a Sulfur
    b. Oxygen
    c Nitrogen
    d. Other

N Types of crude oil

  1 Eastern or Pennsylvania

  2. Mid-Continent
  3. Western or California

O. Refining process

  1. Distillation
  2. Conversion

P. Properties of diesel fuel

  1. Ignition quality and octane number
  2. Volatility
  3. Viscosity
  4. Flash point
  5. Pour point
  6. Specific gravity
  7. Heating value
  8. Impurities content

Q. Other fuels

  1. Natural gas
  2. Manufactured gas
  3. By-product gas

DIESEL-ENGINE MECHANICS
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EQUIPMENT LIST
for
DIESEL-ENGINE MECHANICS

Quantity	Item
1	Air compressor: horizontal tank; two-cylinder, single-stage; 5 hp, 220-volt, 60-cycle, 3-phase electric motor; to deliver a minimum of 10 cfm air at 100 psi; with automatic start-up and shut-off, and beltguard
100 ft (min.)	Galvanized pipe; air delivery line for shop; 3/8" i.d.; with necessary ells, nipples, and swages
2	Oil and water extractors, with air regulators; 3/8" St.P. inlet, 1/4" St.P. outlets; 2 main line press outlets, 2 regulated pressure outlets; with inlet pressure gage and regulated pressure gage
4	Air hose: 50 foot lengths; two (2) quality cotton braids, neopreme over and tube of 1/4" i.d., 5/8" o.d., and 1/4" NPT (F) on each end
6	Quick detachable connections: 1/4" NPT (F)
2	Air chucks: 3.3 cfm @ 80 psi; 1/4" NPT (F)
1	Paint gun, spray; general purpose to spray equipment enamel; enamel nozzel; 1/4 St.P. (F) air inlet; with quart cup, aluminum
1	Arbor press, hydraulic: heavy-duty; structural steel frame; 50 ton capacity; hand operated, hand wheel and screw for quick adjustment; automatic ram return, adjustable table
1	Grinder; heavy-duty; push buttom switch; sealed ball bearings; tool tray with two (2) lift-out water pots mounted on base; adjustable safety shields; 1 hp, 1800 rpm, 220-volt, 60-cycle, 3-phase electric motor; with two (2) six-inch grinding wheels, one (1) course, one (1) medium, enclosed in adjustable wheel guards
2	Chain hoists, differential; one of two (2) ton capacity with nine (9) foot lift, and one of three (3) ton capacity with a ten (10) foot lift; pre-lubricate, ball bearings at each rotating point; gears sealed in lubricant; welded link steel chain; with upper and lower forged steel hooks

1	Drill press, sensitive; 15"; column diameter min. 4"; floor mounted; 1 hp, 220-volt, 60-cycle, 3-phase electric motor; with reducing sleeve for spindle
1	Drill press chuck, universal; 1/4"-3/4" capacity
2	V block sets, for general use; case-hardened steel; 1-1/4" max. stock diameter; each set consists of two (2) V blocks and two (2) clamps
2	Engine stands; for diesel engines, complete with adapters for selected engines; on heavy-duty, ball bearing, rubber-wheeled casters or rubber tires
3	Vise, machinists; swivel base; 4" jaw width, 6" jaw opening, 3-5/8" throat depth, all minimum
1 set	Pipe jaws for the above vises
1 set	Soft metal jaws for the above vises
1	Steam cleaner; automatic mixing of steam, cleaning compound, and water in proper proportions; adjustable mixing valve; 35 gallon per hour capacity at 55 psi; complete with pressure gages for steam and fuel, relief valves
1	Qyacetylene welding rig; combination-type for welding, cutting, brazing, heating, and soldering; complete rig includes the following items:
1	Welding torch
1	Gooseneck extension
3	Welding tips: one each of sizes 62, 55, 42
1	Gas mixer
1	Cutting attachment, with 90° heat
1	Cutting tip, size 53
1	Acetylene regulator: two-gage-type with gages
1	Oxygen regulator: two-gage-type with gages
25 ft	Welding and cutting hose: dual-type with two hoses permanently bonded together,1/4" i.d., with appropriate female connections on both ends
1 pair	Welding goggles: #5 lens; monogoggle-type
1	Spark lighter, with replaceable elements
1	Torch wrench

1	Cylinder truck; on 10" rubber tires; with tool box
1	Welding machine, (manual metal) arc; a-c transformer type, 300 amp output; 230-volt, 60-cycle, 3-phase input; with pigtail and 2 cable lugs
50	Cable: 25 ft. lead, 25 ft. ground; #2/0 gage cable
1	Electrode holder, with replaceable tip insulators
1	Ground clamp
1	Injector test stand
	either
1	Engine lathe: 13" swing, 42" between centers; geared-head, quick-change gear box; long-nose taper spindle; 2-speed, reversing-type, 220-volt, 60-cycle, 3-phase electric motor; coolant pump included
	or
1	Armature lathe and undercutter; 7" swing, 12" between chucks, minimum size; hollow head and tail stock
1	Hot tank: for cleaning blocks, heads, etc; minimum size: 4' x 4', x 2' deep; including natural gas heating unit
1	Honing machine
8	Adjustable stands: 5-ton capacity; min. height 15", max. height 25"
4	Creepers, universal: hardwood frame with vinal covered head rest; all-metal, offset casters with ball bearing pivots, 18" x 36"
1	Drill motor, electric: industrial rating, heavy-duty; 1/4" chuck; double gear train; 2000 rpm, 115-volt, 60-cycle, single phase
1	Drill motor, electric: industrial rating, heavy-duty; 3/8" chuck; double gear train; 1000 rpm, 115-volt, 60-cycle, single phase
1	Drill motor, electric: industrial rating, heavy-duty; 1/2" chuck; double gear train; 450 rpm no load speed, 115-volt, 60-cycle, single phase
1	Portable grinder: industrial rating, heavy-duty; sealed ball bearings on output shaft; 115-volt, 60-cycle, single phase motor; with 4" medium grit stone on 5/8" arbor
1	Portable sander: industrial rating, heavy-duty; sealed ball bearings on output shaft; 115-volt, 60-cycle, single phase motor; with 7" back-up pad on 5/8" arbor

	either
1	Impact wrench, air-driven: 5/8" drive, reversible; 1/4 NPT (F) air inlet; 400 ft-lb torque, 1800 impacts per minute; 1300 rpm free speed @ 90 psi
	or
	Impact wrench, electric: 5/8" drive, reversible; 175 ft-lb torque in 10 seconds; free speed 2000 rpm; 115-volt, 25-60 cycle, 4.5 amp, single phase motor
	for either of the above wrenches
1 set (17 pieces)	Impact wrench sockets; 5/8" drive, 6-point, alloy steel, heat treated; one each from 1/2" to 1-1/2" by 1/16 increments, plus 19/32"
1	Transmission jack: hydraulic; floor-type, on all metal casters; cradle height at low position 6-1/2:, at high position 29"; transmission saddle to tilt backwards and forwards through an angle of 70° or more; 1000 lb. capacity
2	Service jacks: hydraulic; handle moves through an angle of 90°, locks in three positions, minimum lift of 19"; one jack of 4 ton capacity, one jack of 2 ton capacity
1	Jack; all-purpose or truck-type; with 4" screw extension; 3 ton capacity; with handle
1	Gear puller set; internal and external jaws; interchangeable 2-jaw yoke and 3-jaw yoke; both slide-hammer action and pressure screw action; for small, medium, and large jobs of 1-1/4" to 12" diameter and up to 9" reach
1	Lubricating gun; high pressure, air operated; 50 lb capacity with min. of 36 oz. per minute output; 6 ft. hose with swivel and gun; on a base with caster
1	Gear lubricant dispenser; manually-operated pump; 50 lb capacity, with meter graduated in pints; 5 ft. hose with handle and nozzel; on a base with swivel casters
1	Lubricating gun; hand-operated, lever action, with two nozzels

NOTE: All electrical test equipment should be suitable for working on 6, 12, and 24 volt systems, and should be of burnout proof construction when possible. It is acceptable to combine one or more pieces of electrical test equipment into master panels; it may be necessary to duplicate certain items.

Quantity	Item
1	Diode tester; for alternator and regulator diodes, including zener-types; minimum of two scales reading 0-100 ohms, and 0-100,000 ohms
1	Generator and regulator tester; combination voltmeter (0-30 volt range) and ammeter (0-60 amp range)
1	Alternator and regulator tester; combination voltmeter (0-30 volt range) and ammeter (0-60 amp range)
1	Armature growler; for locating opens, shorts, grounds, and high-resistance connections; heavy-duty, suitable for high-output generators; with test probes, meter, and light
1	Dwell meter; for 4, 6, 8, and 12 cylinder engines
1	Tachometer, electric; minimum of two scales: 0-1000, 0-5000
1	Combustion analyzer; to include tail pipe connection and electrical lead(s) to analyzer
1	Compression gage; 0-300 range; either screw-in or press-in type
1	Coil tester
1	Capacitor checker
1	Spark plug tester; 0-30 range
1	Vacuum and pressure gage, combination; 0-7 lbs pressure, 0-30 inch vacuum
1	Valve lifter (valve spring compressor); C clamp type; for 7/8" - 2-1/2" diameter springs
1	Valve adjusting tool; for 1/2 square drive socket
1	Valve seat grinder set; heavy-duty, 115-volt, 5 amp, 60-cycle motor with 12,000 rpm free speed, and 55° offset head; to include valve guide pilot, ball bearing wheel carriers, and an assortment of rough and fine grinding wheels, which must be of both 30° and 45° angles in 1-1/2 - 2-1/2" diameters

1	Valve refacing machine; hand adjustable collet for holding valves, which rotates from 0-90^{o}; 80 grit stone; coolant pump; butt grinder; diamond wheel dresser; to include rocker arm grinding attachment, collets for 9/32-9/16" and 1/2'-11/16", 80 grit wheel for stellite tipped valves, and work light
1	Valve lapping tool
1	Valve spring tester, torque-wrench type
1	Valve guide puller
1 set	Valve adjusting wrenches; thin construction, open-end, 3/8-3/4 range
1	Battery charger; for 6, 12, and 24 volt systems
1	Pressure tester for radiator and radiator cap
1	Radiator-leak test tank
1	Radiator hydrometer; glass barrel, rubber bulb and tip, for testing antifreeze
1	Radiator can; heavy-duty, galvanized; 3 gallon capacity
1	Battery hydrometer; glass barrel, rubber bulb and tip, for testing electrolite specific gravity
2 sets	Twist drills; high-speed steel; fractional sizing, 29 drills, from 1/16 to 1/2 by 1/64 increments, in metal index
1 set	Twist drills; high speed steel; letter sizing; 26 drills, from A-2, in metal index
1 set	Reamers, adjustable; eleven reamers in sizes A through K, to hanlde jobs 15/32 - 1-1/2, plus L (1-1/2 - 1-13/16), M (1-13/16 - 2-7/32), and N (2-7/32 - 3-3/4)
1 set	Bushing drivers; complete set including screw shaft (1/2 - 20 threads),washers (1/2 - 20 threads), nuts (1/2 - 20 threads), and bushing drivers 1/2 - 1-3/4 by 1/64 increments
1	Torque wrench; dial-type with "click" indicator; 1/2" square drive; 0-300 lbs
2 each	Piston ring compressors; 2-1/2" to 5", 3-1/2" to 7"
1	Double flaring tool kit; to include tubing cutter, yoke, bar, and 6 adapters, 3/16, 1/4, 5/16, 3/8, 7/16, 5/8
4	Extension lights; 25 ft of 16 gage wire, neoprene covered; swing-open guard; heavy-duty male plug

4	Extension cords; 25 ft of 14 gage wire; 3-wire; with heavy-duty, rubber male and female ends
1 pr	Battery jumper cables; 12 ft of #4 ga. copper wire, neoprene covered, with 4 heavy-duty, spring action ends
6	Work benches; all steel construction: 12 gage, one piece top, metal shelf at moderate height, metal legs, all riveted and welded; 72" long by 30" high
1	Grinding wheel dresser; diamond-tipped
1	Grinding wheel dresser; star-wheel type
1	Oil-can cutter spout
1	Carrying strap for battery
2	Flashlights, 2 dry cell
100 ft	Water hose; 5/8", heavy-duty with solid brass ends
1 set	Bolt extractors; multi-spline type; 1/4" hex head; one each of the following: 1/8, 5/32, 3/16, 7/32, 1/4, 9/32, 5/16, 11/32, 3/8, 13/32
1 each	Stud puller; 1/4 - 1/2 capacity; 1/2 - 3/4 capacity
4	Micrometers, outside: 0-1" range
2	Micrometers, outside: 1-2" range
1	Micrometer, outside: 2-3" range
1	Micrometer, outside: 3-4" range
1	Micrometer, outside: 4-5" range
1	Micrometer, outside: 5-6" range
1 set	Inside Micrometers: 2-8" range
1	Tap and die set; one each of the following NF plug tap and NF die: 1/4-20, 5/16-18, 3/8-16, 7/16-14, 1/2-13, 9/16-12, 5/8-11, 3/4-10; one each of the following NC plug tap and die: 1/4 x 28, 5/16 x 24, 3/8-24, 7/16-20, 1/2-20, 9/16-18, 5/8-18, 3/4-16; one each 1/8" and 1/4" pipe tap and die; all dies 1-1/2" OD; with appropriate die stock and tap reamer wrench

HAND TOOLS

Quantity	Item
3	Awls, scratch
2	Brushes, bristle; for parts washing
6	Brushes, wire
3	Calipers, inside, 8"
3	Calipers, outside, 8"
2	Calipers, hermaphrodite, 6"
1 set	Drifts, brass; 1/2" d. x 7", 3/4 x 7", 7/8 x 8, 1 x 8"
1 set	Starting or driving punches; 5/16 square x 3/32 point x 5-1/4" long; 3/8 x 1/8 x 5-3/4; 3/8 x 5/32 x 6; 7/16" x 3/16" x 6-1/4; 1/2 x 1/4 x 6-3/4; 9/16 x 5/16 x 7-1/4
2 sets	Center punches; 1/8 point x 5"; 3/16 x 6"
1 set	Chisels; square body: 3/8"; 7/16"; 1/2"; 5/8"; 11/16"
2 sets	Cape chisels; square body; 5/16 sq. x 1/4 edge x 5-5/8 length; 3/8 x 5/16" x 6
2	Compass, pencil
1 set	Diesel injection service tools
1	Dividers, wing; 2 each: 8", 10", 12"
1	Electric soldering iron; 115 v
2	Feeler gages; general use; 3-3/8 blade length in .001 increments, range .002 to .025, plus .0015
2	Feeler gages; wire type: .010, .012, .015, .018, .020, .022,.024, .025, .030
4	File clearer
4	Files, mill; bastard, 10"
4	Files, mill; smooth, 10"
4	Files, flat; double cut, bastard, 10"
4	Files, flat; double cut, smooth 10"

4	Files, hand; double cut, bastard, 8"
4	Files, hand; double,cut, smooth, 8"
4	Files, square; bastard, 10"
4	Files, square; smooth, 10"
4	Files, round; bastard, 10"
4	Files, round; smooth, 10:
4	Files, half round; bastard, 10"
4	Files, half round; smooth, 10"
4	Files, three corner; bastard, 10"
4	Files, three corner; smooth, 8"
6 doz	File handles; No. 2
6 doz	File handles; No. 3
1 set	Grease fitting tools
4	Hack saw frames; pistol grip 8", 10", 12" adjustments; square shank blade holder
2	Hammers, machinist's ball peen; 8 oz
2	Hammers, machinist's ball peen; 12 oz
2	Hammers, machinist's ball peen; 16 oz
2	Hammers, machinist's ball peen; 24 oz
2	Hammers, brass faces or solid brass head; 16 oz
1	Hammer, sledge; 12 lb
1	Mallet, rawhide; 2" d. x 3-1/2" l. head
6	Knives, putty; 1-1/2" wide blade
3	Oil cans; 1 pt capacity; lever action
2	Pliers, snap-ring; 5/16" tip x 8-7/8 long
1	Pliers, snap-ring; 5/16" tip x 14" long
2	Pliers, hose clamp; 8"
1	Pliers, brake spring; 13-1/4" long

2	Pliers, battery clamp; 7-3/4"
6	Pliers, combination, 8"
6	Pliers, straight nose
4	Pliers, side cutting, 7"
4	Pliers, needle nose of medium length, 6"
6	Pliers, locking jaw, 10"
1	Torch kit, LPG
2	Rule, pocket; flexible steel, black figures on white background; 6"
1	Steel tape; black figures on white background; 50"
6	Rules, steel
4	Screwdrivers; regular tip, square shank, stubby; 7/32" wide x 1" long blade, plastic handle
4	Screwdrivers; regular tip, square shank, 5/16" wide x 6" long blade, plastic handle
4	Screwdrivers; regular tip, square shank, 1/2" wide x 10" long blade, plastic handle
2	Screwdrivers, Phillips; #1 tip, 1-7/16" blade, stubby, plastic handle
2	Screwdrivers, Phillips; #2 tip, 1-5/16" blade, stubby, plastic handle
2	Screwdrivers, Phillips; #2 tip, 4" blade, plastic handle
2	Screwdrivers, Phillips; #3 tip, 6" blade, plastic handle
2	Screwdrivers, Phillips; #4 tip, 8" blade, plastic handle
2	Screwdrivers, offset; 1/4" tip, 4-5/8 length
2	Screwdrivers, offset; 3/8" tip, 6-1/8 length
2	Screwdrivers, clutch head; 1/8" tip x 3/16 dia. x 3" blade
2	Screwdrivers, clutch head; 1/4" tip x 9/32 dia. x 6" blade
1 set (16)	Sockets; 1/2" square drive, 6 point or single hex; one each, 3/8 - 1-5/16 range by 1/16" increments
1 set (19)	Sockets; 1/2" square drive, 12 point or double hex; one each, 3/8 - 1-1/2" range by 1/16" increments

1 set (11)	Sockets; 1/2" square drive, 12 point or double hex, long reach or deep; one each, 1/2 - 1-1/8 range by 1/16" increments
1 set (10)	Sockets; 1/2" drive; 2 square or 8 point; one each: 3/8, 7/16, 1/2, 9/16, 5/8, 11/16, 3/4, 13/16, 7/8, 1
3	Universal joints; 1/2" drive
3	Rachets; 1/2" drive, standard length
2	Speed handles; 1/2" drive, with rotating handle
2	Extension bars; 1/2" drive, 3" long
2	Extension bars; 1/2" drive, 6" long
2	Extension handles; 1/2" drive, 12" long
2	Flex handles; 1/2" drive, 16" long
2	Sliding T handles; 1/2" drive
2 set (12 pieces each)	Sockets; 3/8" square drive, 12 point or double hex; two each, 1/4" - 7/8" range by 1/16" increments
1 set	Sockets; 3/8" square drive, 12 point or double hex, long reach or deep; one each, 1/4" - 7/8" range by 1/16" increments
1 set	Sockets; 3/8 square drive; double square or 8 point; one each: 1/4, 5/16, 3/8, 7/16, 1/2, 9/16, 5/8
3	Universal joints, 3/8" drive
3	Rachets; 3/8" drive, standard length
3	Speed handles; 3/8" drive, with rotating handle
2	Extension bars; 3/8" drive, 3" long
2	Extension bars; 3/8" drive, 6" long
2	Extension bars; 3/8" drive, 12" long
2	Flex handles; 3/8" drive, 10-3/8" long
2	Sliding T handles; 3/8" drive
2 sets (21 pieces each)	Sockets, 1/4" drive; single hex or 6 point sockets: 3/16, 7/32, 1/4, 9/32, 5/16, 11/32, 3/8, 7/16, 1/2, 9/16; 3 square or 12 point sockets: 1/4, 5/16, 3/8; plastic grip handle on 1/4" drive shaft; 1/4" rachet; 1/4" universal joint; 1/4" drive x 2" extension bar; 1/4" drive x 6" extension bar; sliding T handle; flex handle, 6"; in a metal box

3 each	Wrenches, adjustable; locking jaw; 7" length, 10" length
3 each	Wrenches, adjustable; 6", 8", 10"
2 sets	Wrenches, box-end; double hex or 12 point, long handle; one each per set: 3/8 x 7/16, 1/2 x 9/16, 5/8 x 3/4, 11/16 x 13/16, 7/8 x 1, 15/16 x 1-1/16, 1-1/8 x 1-1/4, 1-3/16 x 1-5/16, 1-3/8 x 1-1/2, 1-7/16 x 1-5/8
2 sets	Wrenches, open-end; 15° angle offset; one each per set: 1/4 x 5/16, 3/8 x 7/16, 1/2 x 9/16, 5/8 x 3/4, 11/16 x 13/16, 7/8 x 1, 15/16 x 1-1/16, 1-1/8 x 1-1/4, 1-3/16 x 1-5/16, 1-3/8 x 1-1/2, 1-7/16 x 1-5/8
2 sets	Wrenches, combination open and box end; long handle; one each per set: 3/8, 7/16, 1/2, 9/16, 5/8, 11/16, 3/4, 13/16, 7/8, 15/16, 1, 1-1/16, 1-1/8, 1-3/16, 1/4, 1-5/16, 1-3/8, 1-7/16, 1-1/2, 1-5/8
2 sets	Wrenches, hex head; standard length, 90° angle on one end; one each per set: .028, .035, 3/64, 1/16, 5/64, 3/32, 7/64, 5/32, 3/16, 7/32, 1/4, 5/16, 3/8, 7/16, 1/2, 9/16, 5/8, 3/4
1 each	Wrenches, pipe; forged steel; 8", 12", 18", 24"
1	Soldering gun; 115-v, 60 cycle, 275 watt; pistol grip; to include two extra tips
2	Pry bars; forged alloy steel; rolling head, 7/16 dia. shaft, 12" long
2	Pinch bars; forged alloy steel; 1/2" sq. shaft, 5/8" edge, 16" long
1	Spring-tension gage; 0-24 oz; for generator brushes
1	Magnetic pickup tool
3	Carbon brushes, 1/4" stem, 1-5/8 dia.
1 set	Figure and letter stamps; steel, Gothic 1/4" high; 0-9 figures A-Z letters; packed in wood box; for marking metal
2	Snips, metal; combination pattern; inlaid cutting edge; 12-1/2 overall length
1 pr	Pliers, electrical; for stripping wire and crimping solderless terminals
1	Screw pitch gage; 24 pitches: 4, 4-1/2, 5, 5-1/2, 6, 7, 8, 9, 10, 11, 11-1/2, 12, 13, 14, 15, 16, 18, 20, 22, 24, 26, 27, 28, 30

SUPPLIES LIST

The following list indicates the types of supply items necessary for the operation of a program in diesel-engine mechanics. It is not an exhaustive list. Quantities and prices are not given since many factors have great influence, such as the number of trainees in the class, the content of the instruction, and local supply channels.

It is customary to replenish supplies on a yearly basis. Additionally, the instructor should keep a running inventory and submit purchase requests on small quantities needed during the school year early enough in advance to assure delivery before present supplies are exhausted. Also, many items listed as equipment and tools must be periodically replaced by the local school, such as hammer handles, hacksaw blades, twist drills, and extension cords.

Abrasive materials
- Commutator paper
- Crocus cloth
- Emery cloth
- Sanding discs: 7", open and closed coat
- Sandpaper (aluminum oxide: 400, 240, 100 grit)

Batteries
- Flashlight
- Truck: 6-v, 12-v, 24-v

Brazing and welding supplies
- Acetylene, in cylinders
- Brazing flux
- Brazing rod: 1/8, 3/16
- Oxygen, in cylinders
- Salammoniac
- Soapstone
- Soft solder: bar, wire
- Welding electrode: 5/32-AWS-E6010 or 6011
- Welding rod: mild steel, copper coated, 1/16, 3/32, 1/8

Brooms
- Shop
- Household

Brushes, paint: assorted, 3/4" - 3" width; 1 dozen

Cement
    Gasket: hard-dry, soft-dry
    Plastic
    Rubber
    Upholstery
    Weatherstrip

Chalk: white; colored

Cleaning materials
    Alcohol
    Baking soda
    Chamois
    Cleaning cloths (shop rags)
    Oil solvent compound
    Soaps: car wash, hand, steam cleaner, abrasive scouring powder
    Solvents, cleaning: engine, carburetor, odd parts (all should be nonflammable whenever possible)
    Sweeping compound

Covers: fender, seat

Electrical materials
    Bulbs: 6-v, 12-v, 24-v; various candlepower
    Fuses
    Tape: plastic; friction
    Terminals: assortment for the below listed wire sizes, both solder and solderless types; battery-type, lead coated
    Wire: 8, 10, 12, 14, 16, 18, 20, 20 gages, in solid colors and braids

Fastener assortment
    Bolts and nuts: NF, NC; steel, brass
    Cotter keys
    Screws, machine: round and flat heads
    Washers: flat, lock, star

Fire extenguishers
    For gasoline and oil fires
    For electrical fires

Gage stock: sheet brass in varying thicknesses

Gaskets
    Asbestos: sheet stock 1/16" thick
    Assorted items: head, pan, water pump, manifold, etc.
    Rebuild packs for engines: three packs per engine
    Sheet stock: tan fiber, 1/32" thick

Hacksaw blades: 18, 24, 32 teeth per inch

Hose
    Windshield wiper
    Vacuum
    Engine coolant

Iron wire, light gage

Light bulbs, shop: incandescent and/or flourescent

Lubricant
- Chassis grease
- Differential grease
- Door striker plate
- Heat-control valve
- Hypoid gear
- Lithium grease
- Lubriplate
- Oil: 10, 20, 30 weight; detergent and nondetergent
- Penetrating or rust-solvent oil
- Powered graphite, in a dispenser
- Power steering, automatic transmission oil
- Rubber lubricant
- Silicon, aerosol spray
- Transmission (standard) grease
- Upper cylinder lubricant
- Wheel bearing grease

Manuals, shop: minimum of one per engine used in training; must be current

Masking tape

Paint, engine: heat resistant; in the following colors: red, yellow, green, gray, blue, black; with thinner

Plastigage

Prussian blue

Tubing: copper; steel; 3/16", 1/4", 3/8", 1/2", 5/8"

Tubing fittings: steel, brass; such as:
- Ts
- Ls
- Unions
- Ferrules

Valve grind and lapping compound; fine, course

VT003 503

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Industrial Radiography Course, Instructors' Guide, Volume 2.

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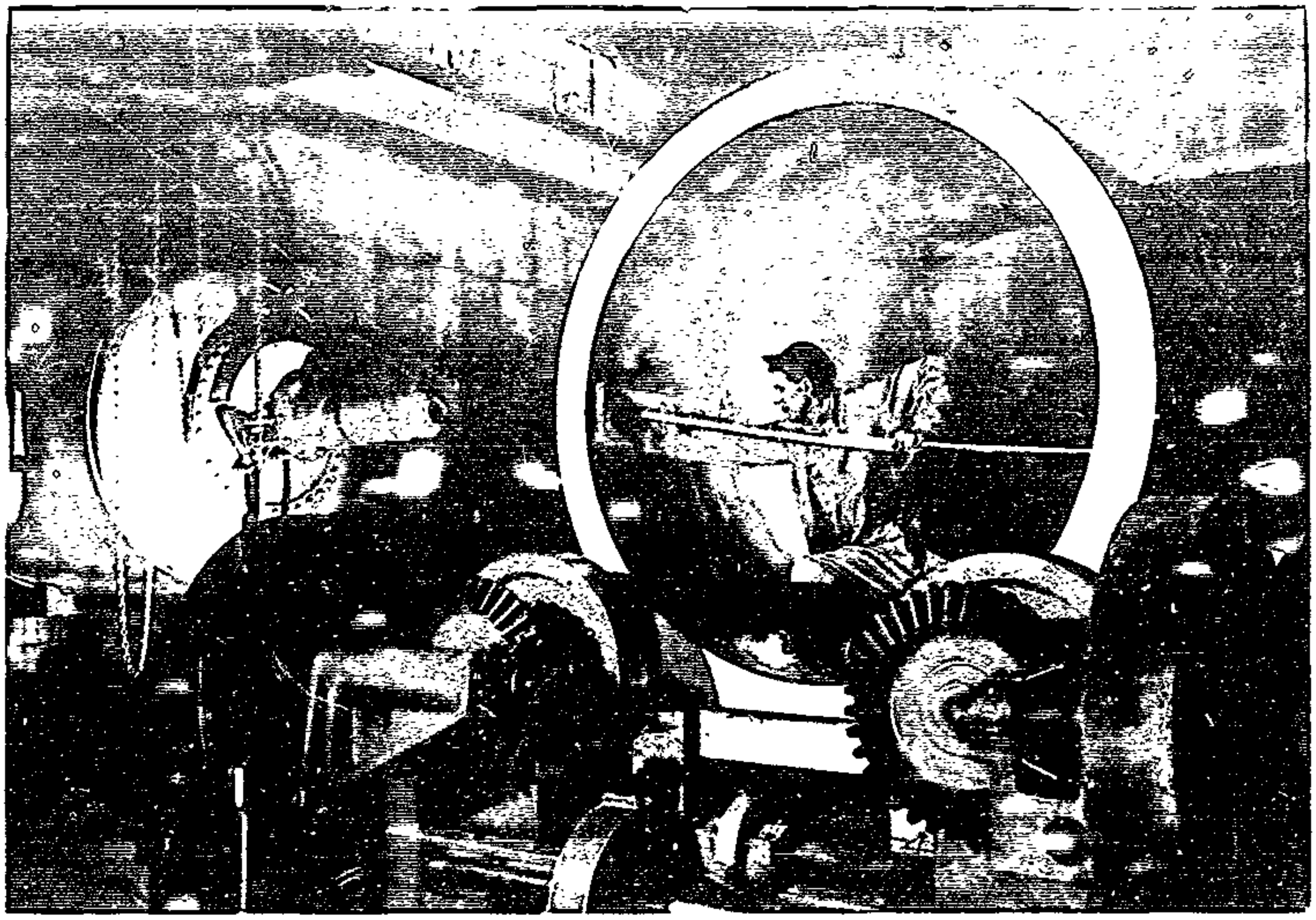
*RESOURCE MATERIALS, *TRADE AND INDUSTRIAL EDUCATION, *RADIATION, *RADIOGRAPHERS, TECHNICAL EDUCATION,

Information relative to the lesson plans in "Industrial Radiography Course, Instructor's Guide, Volume I" (VT 003 565) is presented on 52 information sheets including the subjects Shielding Equations and Logarithms, Metal Properties, Field Trip Instructions for Students, Welding Symbols and Sizes, Sample Report Forms, and Typical Shipping Container. The sheets were prepared by the Engineering Extension Service, Texas Agricultural and Mechanical University, College Station, Texas. They are for instructor use at the post-secondary level with students having courses in mathematics, chemistry, and physics or formal training as industrial or medical X-ray technicians. The sheets can be duplicated for class distribution, or they can be projected. They are illustrated with photographs, line drawings, and tables. A bibliography of books and films, and a glossary are included. (EM)

INSTRUCTORS' GUIDE Volume 2

INDUSTRIAL RADIOGRAPHY COURSE



U. S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
Office of Education

INSTRUCTORS' GUIDE Volume 2

INDUSTRIAL RADIOGRAPHY COURSE

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TABLE OF CONTENTS -- Volume 2

INFORMATION SHEETS

NOTE

The material contained in this volume consists of informational matter calculated to aid the instructor in his presentations.

In some instances, the instructor will find it advisable to duplicate some of the information sheets and use them as hand out material. In other situations it may be more advantageous to project the image on a screen using an overhead projector for this purpose.

Other applications may include the need for the disassembly of the text and its subsequent reassembly, all of which suggested the desireability of binding this material separately from the lesson plans and introductory statements.

Information Sheet
on
RADIOGRAPHER

Information
Sheet # 1

JOB DEFINITION

Controls radiography equipment to take radiographs of metal castings, weldments, metal samples pipes, machinery, and structural members to detect flaws, cracks, porosity, and presence of foreign objects. Aligns object on stand between source of x-rays and film or plate; or aligns source of gamma rays, such as cobalt or iridium isotope and film or plate on opposite sides of object, manually or using hand or electric truck, chain hoist, or crane. Masks peripheral areas with lead shields. Selects type of radiation source and type of film, and applies standard mathematical formulas to determine exposure distance and time, considering size, mobility, and strength of radiation sources in relation to density and mobility of object. Verifies radiation intensities, using radiation meters. Takes radiograph by adjusting controls of x-ray machine or by exposing source of radioactivity. Removes and develops film or plate. Monitors working area, using survey meters, to protect personnel area. May replace radioactive isotope source in containers by manipulating tongs from behind protective lead shield Marks defects appearing on film and assists in analyzing findings May specialize in x-ray work and be designated as X-RAY TECHNICIAN.

EDUCATION, TRAINING, AND EXPERIENCE

High school graduation, including courses in mathematics, chemistry, and physics, is considered sufficient to qualify for on-the-job training. Formal training as an industrial or medical x-ray technician constitutes qualifying experience. Training or experience in welding, metallurgy or photography is considered helpful.

SPECIAL CHARACTERISTICS

Aptitudes

Verbal ability to understand and discuss technical material related to construction, operation and application of equipment

Numerical ability to apply standard formulas when computing exposure time and distances to set up equipment

Spatial ability to determine optimum placement of objects and shielding preparatory to taking radiograph

Form perception to perceive pertinent details in exposed film

Temperaments:
Worker determines angle and distance of equipment to object and time and intensity of exposure on basis of verifiable criteria such as strength of radiation source and density of object. The attainment of precise standards of accuracy is involved.

Physical Demands and Working Conditions:
Work requires occasional lifting of materials weighing up to 20 pounds. In some establishments, worker occasionally may lift radiation containers weighing up to 75 pounds. Individual walks or stands most of the time

Climbing ladders sometimes is required to rig equipment or when photographing large objects such as aircraft

Stooping and crouching when working on materials at or below floor level

Reaching, handling and fingering required to work in a darkroom, set up equipment and adjust controls

The hazard of exposure to radiation is present although reduced by the presence of warning and safety devices. In some plants, may be exposed to noise levels of 80-90 decibels from welding machines and high frequency equipment

Work is performed indoors and outdoors.

* Job description from "Selected Occupations Concerned with Atomic Energy," June, 1961; BES No. E-197; Bureau of Employment Security, U.S. Dept. of Labor, Washington, D.C.

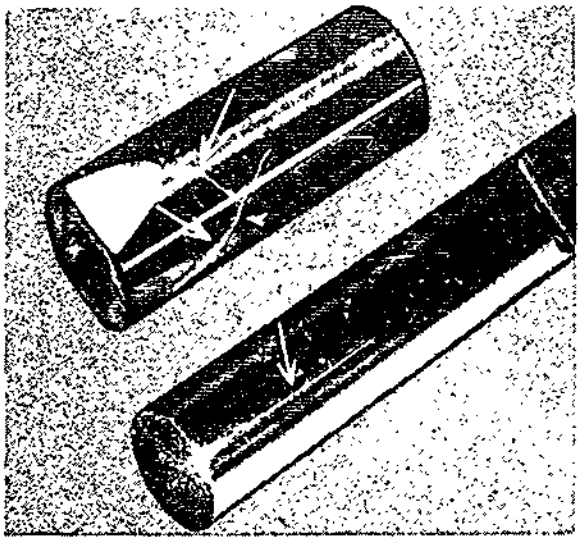
Information
Sheet # 2

Information Sheet
on
SAMPLES OF NONDESTRUCTIVE TESTING RESULTS

1.

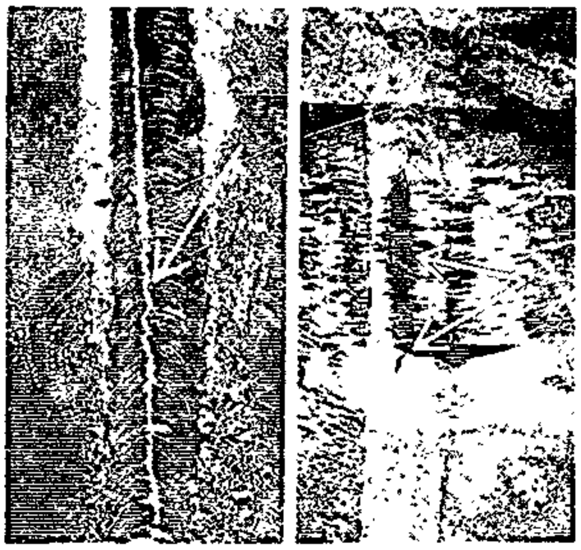
1. Cracks in critical jet engine blades as shown by Magnaglo paste method

2.



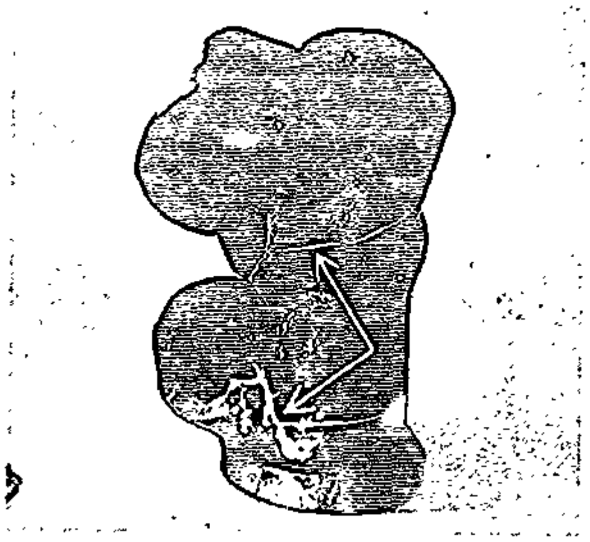
2. Heat treat cracks (a seam) as shown by the fluorescent magnetic particle method

3.



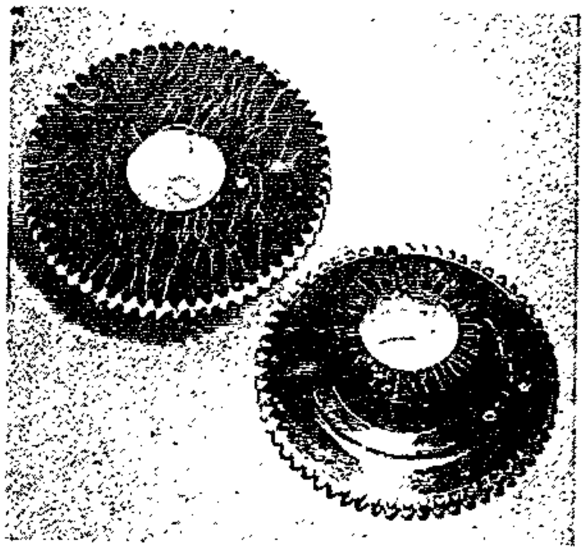
3. Welding defects as shown by the magnetic particle dry powder method

4.



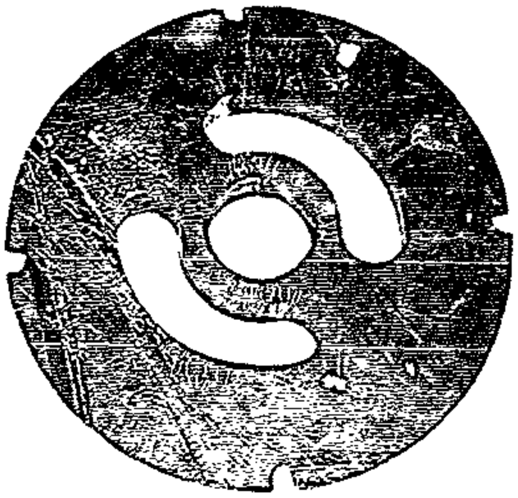
4. Quench cracks in steel castings as shown by the fluorescent magnetic particle method

5.



5. Grinding check on gears as shown by the fluroescent magnetic particle method

6.



6. Grinding cracks as shown by the fluorescent magnetic particle method

Information
Sheet # 3

Information Sheet
on
ATOMIC ENERGY COMMISSION
REGULATIONS

UNITED STATES ATOMIC ENERGY COMMISSION

RULES and REGULATIONS ○ TITLE 10 - ATOMIC ENERGY

PART 20

STANDARDS FOR PROTECTION AGAINST RADIATION

GENERAL PROVISIONS

§ 20.1 Purpose.

(a) The regulations in this part establish standards for protection against radiation hazards arising out of activities under licenses issued by the Atomic Energy Commission and are issued pursuant to the Atomic Energy Act of 1954 (68 Stat. 919).

(b) The use of radioactive material or other sources of radiation not licensed by the Commission is not subject to the regulations in this part. However, it is the purpose of the regulations in this part to control the possession, use, and transfer of licensed material by any licensee in such a manner that exposure to such material and to radiation from such material, when added to exposures to unlicensed radioactive material and to other unlicensed sources of radiation in the possession of the licensee, and to radiation therefrom, does not exceed the standards of radiation protection prescribed in the regulations in this part.

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§ 20.2 Scope.

The regulations in this part apply to all persons who receive, possess, use or transfer byproduct material, source material, or special nuclear material under a general or specific license issued by the Commission pursuant to the regulations in Part 30, 40, or 70 of this chapter.

§ 20.3 Definitions.

(a) As used in this part:

(1) "Act" means the Atomic Energy Act of 1954 (68 Stat. 919) including any amendments thereto;

(2) "Airborne radioactive material" means any radioactive material dispersed in the air in the form of dusts, fumes, mists, vapors, or gases;

(3) "Byproduct material" means any radioactive material (except special nuclear material) yielded in or made radioactive by exposure to the radiation incident to the process of producing or utilizing special nuclear material;

(4) "Calendar quarter" means any period determined according to either of the following subdivisions:

25 FR 13952

(i) The first period of any year may begin on any date in January; provided that the second, third and fourth periods accordingly begin on the same date in April, July, and October, respectively, and that the fourth period extend into January of the succeeding year, if necessary to complete a three-month quarter. During the first year of use of this method of determination by a licensee, the first period for that year shall also include any additional days in January preceding the starting date for the first period.

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(ii) The first period in a calendar year of 13 complete, consecutive calendar weeks; the second period in a calendar year of 13 complete, consecutive calendar weeks; the third period in a calendar year of 13 complete, consecutive calendar weeks; the fourth period in a calendar year of 13 complete, consecutive calendar weeks.

*Alternatively, the four periods may consist of the first 14 complete, consecutive calendar weeks; the next 12 complete, consecutive calendar weeks; the next 14 complete, consecutive calendar weeks; and the last 12 complete, consecutive calendar weeks. If at the end of a calendar year there are any days not falling within a complete calendar week of that year, such days shall be included for purposes of this part) within the last complete calendar week of that year. If at the beginning of any calendar year there are days not falling within a complete calendar week of that year, such days shall be included (for purposes of this part) within the last complete calendar week of the previous year.

No licensee shall change the method observed by him of determining calendar quarters for purposes of this part except at the beginning of a calendar year.

(5) "Commission" means the Atomic Energy Commission or its duly authorized representatives;

(6) "Government agency" means any executive department, commission, independent establishment, corporation, wholly or partly owned by the United States of America which is an instrumentality of the United States, or any board, bureau, division, service, office, officer, authority, administration, or other establishment in the executive branch of the Government;

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*Added 25 FR 13952

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(7) "Individual" means any human being;

(8) "Licensed material" means source material, special nuclear material, or byproduct material received, possessed, used, or transferred under a general or specific license issued by the Commission pursuant to the regulations in this chapter:

(9) "License" means a license issued under the regulations in Part 30, 40, or 70 of this chapter. "Licensee" means the holder of such license;

(10) "Occupational dose" includes exposure of an individual to radiation (i) in a restricted area; or (ii) in the course of employment in which the individual's duties involve exposure to radiation; provided, that "occupational dose" shall not be deemed to include any exposure of an individual to radiation for the purpose of medical diagnosis or medical therapy of such individual.

(11) "Person" means (i) any individual, corporation, partnership, firm, association, trust, estate, public or private institution, group, Government agency other than the Commission, any State, any foreign government or nation or any political subdivision of any such government or nations, or other entity; and (ii) any legal successor, representative, agent, or agency of the foregoing;

(12) "Radiation" means any or all of the following: alpha rays, beta rays, gamma rays, X-rays, neutrons, high-speed electrons, high-speed protons, and other atomic particles; but not sound or radio waves, or visible, infrared, or ultraviolet light;

(13) "Radioactive material" includes any such material whether or not subject to licensing control by the Commission;

25 FR 13952

(14) "Restricted area" means any area access to which is controlled by the licensee for purposes of protection of individuals from exposure to radiation and radioactive materials. "Restricted area" shall not include any areas used as residential quarters, although a separate room or rooms in a residential building may be set apart as a restricted area;

27 FR 5905

(15) "Source material" means (i) uranium or thorium, or any combination thereof, in any physical or chemical form; or (ii) ores which contain by weight one-twentieth of one percent (0.05%) or more of *a* uranium, *b* thorium or c. any combination thereof. Source material does not include special nuclear material

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(16) "Special nuclear material" means (i) plutonium, uranium 233, uranium enriched in the isotope 233 or in the isotope 235, and any other material which the Commission, pursuant to the provisions of section 51 of the act, determines to be special nuclear material, but does not include source material; or (ii) any material artificially enriched by any of the foregoing but does not include source material;

25 FR 13952

(17) "Unrestricted area" means any area access to which is not controlled by the licensee for purposes of protection of individuals from exposure to radiation and radioactive materials, and any area used for residential quarters.

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(b) Definitions of certain other words and phrases as used in this part are set forth in other sections, including:

(1) "Airborne radioactivity area" defined in § 20.203;

(2) "Radiation area" and "high radiation area" defined in § 20.202;

(3) "Personnel monitoring equipment" defined in § 20.202;

(4) "Survey" defined in § 20.201;

(5) Units of measurement of dose (rad, rem) defined in § 20.4;

(6) Units of measurement of radioactivity defined in § 20.5.

§ 20.4 Units of radiation dose.

(a) "Dose," as used in this part, is the quantity of radiation absorbed, per unit of mass, by the body or by any portion of the body. When the regulations in this part specify a dose during a period of time, the dose means the total quantity of radiation absorbed, per unit of mass, by the body or by any portion of the body during such period of time. Several different units of dose are in current use. Definitions of units as used in this part are set forth in paragraphs (b) and (c) of this section.

(b) The rad, as used in this part, is a measure of the dose of any ionizing radiation to body tissues in terms of the energy absorbed per unit mass of the tissue. One rad is the dose corresponding to the absorption of 100 ergs per gram of tissue. (One millirad (mrad) = 0.001 rad.)

(c) The rem, as used in this part, is a measure of the dose of any ionizing radiation to body tissue in terms of its estimated biological effect relative to a dose of one roentgen (r) of X-rays. (One millirem (mrem) = 0.001 rem.) The relation of the rem to other dose units depends upon the biological effect under consideration and upon the conditions of irradiation. For the purpose of the regulations in this part, any of the following is considered to be equivalent to a dose of one rem:

(1) A dose of 1 r due to X— or gamma radiation;

(2) A dose of 1 rad due to X—, gamma, or beta radiation;

(3) A dose of 0.1 rad due to neutrons or high energy protons;

(4) A dose of 0.05 rad due to particles heavier than protons and with sufficient energy to reach the lens of the eye;

If it is more convenient to measure the neutron flux, or equivalent, than to determine the neutron dose in rads, as provided in subparagraph (3) of this paragraph, one rem of neutron radiation may, for purposes of the regulations in this part, be assumed to be equivalent to 14 million neutrons per square centimeter incident upon the body; or, if there exists sufficient information to estimate with reasonable accuracy the approximate distribution in energy of the neutrons, the incident number of neutrons per square centimeter equivalent to one rem may be estimated from the following table:

NEUTRON FLUX DOSE EQUIVALENTS

Neutron energy (Mev)	Number of neutrons per square centimeter equivalent to a dose of 1 rem (neutrons/cm²)	Average flux to deliver 100 millirem in 40 hours (neutrons/cm² per sec)
Thermal	970×10^6	670
0.0001	720×10^6	500
0.005	820×10^6	570
0.02	400×10^6	280
0.1	120×10^6	80
0.5	43×10^6	30
1.0	26×10^6	18
2.5	29×10^6	20
5.0	26×10^6	18
7.5	24×10^6	17
10	24×10^6	17
10 to 30	14×10^6	10

(d) For determining exposures to X or gamma rays up to 3 Mev, the dose limits specified in §§ 20.101 to 20.104, inclusive, may be assumed to be equivalent to the "air dose". For the purpose of this part "air dose" means that the dose is measured by a properly calibrated appropriate instrument in air at or near the body surface in the region of highest dosage rate.

§ 20.5 Units of radioactivity.

(a) Radioactivity is commonly, and for purposes of the regulations in this part shall be, measured in terms of disintegrations per unit time or in curies. One curie (c) $=3.7\times10^{10}$ disintegrations per second (dps) $=2.2\times10^{12}$ disintegrations per minute (dpm). A commonly used submultiple of the curie is the microcurie (μc). One $\mu c=0.000001\ c=3.7\times10^4$ dps $=2.2\times10^6$ dpm.

(b) For purposes of the regulations in this part, it may be assumed that the daughter activity concentrations in the following table are equivalent to an air concentration of 10^{-7} microcuries of Radon 222 per milliliter of air in equilibrium with the daughters RaA, RaB, RaC, and RaC':

Maximum time between collection and measurement (hours)[1]	Alpha-emitting daughter activity collected per milliliter of air	
	Microcuries/cc	Total alpha disintegrations per minute per cc
0.5	7.2×10^{-8}	0.16
1	4.7×10^{-8}	0.10
2	1.3×10^{-8}	0.028
3	0.3×10^{-8}	0.0072

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[1] The duration of sample collection and the duration of measurement should be sufficiently short compared to the time between collection and measurement, as not to have a statistically significant effect upon the results

(c) *Natural uranium and natural thorium.* (1) For purposes of the regulations in this part, one curie of natural uranium (U-natural in Appendix B or C) means the sum of 3.7×10^{10} disintegrations per second from U-238 plus 3.7×10^{10} dis/sec from U-234 plus 9×10^{8} dis/sec from U-235. Also, a curie of natural thorium (thorium-natural in Appendix B or C) means the sum of 3.7×10^{10} dis/sec from Th^{232} plus 3.7×10^{10} dis/sec from Th^{228}.

(2) For the purpose of the regulations in this part, one curie of natural uranium (U-natural in Appendix B or C) is equivalent to 3,000 kilograms, or 6,615 pounds of natural uranium; and one curie of natural thorium (thorium-natural in Appendix B or C) is equivalent to 9,000 kilograms or 19,850 pounds of natural thorium.

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§ 20.6 Interpretations.

Except as specifically authorized by the Commission in writing, no interpretation of the meaning of the regulations in this part by any officer or employee of the Commission other than a written interpretation by the General Counsel will be recognized to be binding upon the Commission.

§ 20.7 Communications.

Except where otherwise specified in this part, all communications and reports concerning the regulations in this part, and applications filed under them, should be addressed to the Director of Regulation, U.S Atomic Energy Commission, Washington, D.C., 20545. Communications, reports and applications may be delivered in person at the Commission's offices at 1717 H Street NW., Washington, D.C.; at 4915 St. Elmo Avenue, Bethesda, Md.; or at Germantown, Md.;

31 FR 4668

§ 20.101 Exposure of individuals to radiation in restricted areas.

(a) Except as provided in paragraph (b) of this section, no licensee shall possess, use, or transfer licensed material in such a manner as to cause any individual in a restricted area to receive in any period of one calendar quarter from radioactive material and other sources of radiation in the licensee's possession a dose in excess of the limits specified in the following table:

		Rems per calendar quarter
1	Whole body; head and trunk; active blood-forming organs; lens of eyes; or gonads	1¼
2	Hands and forearms; feet and ankles	18¾
3	Skin of whole body	7½

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(b) A licensee may permit an individual in a restricted area to receive a dose to the whole body greater than that permitted under paragraph (a) of this section, provided:

(1) During any calendar quarter the dose to the whole body from radioactive material and other sources of radiation in the licensee's possession shall not exceed 3 rems; and

(2) The dose to the whole body, when added to the accumulated occupational dose to the whole body, shall not exceed 5 (N-18) rems where "N" equals the individual's age in years at his last birthday: and

(3) The licensee has determined the individual's accumulated occupational dose to the whole body on Form AEC-4, or on a clear and legible record containing all the information required in that form; and has otherwise complied with the requirements of § 20.102. As used in paragraph (b), "Dose to the whole body" shall be deemed to include any dose to the whole body, gonads, active blood-forming organs, head and trunk, or lens of eye.

§ 20.102 Determination of accumulated dose.

(a) This section contains requirements which must be satisfied by licensees who propose, pursuant to paragraph (b) of § 20.101, to permit individuals in a restricted area to receive exposure to radiation in excess of the limits specified in paragraph (a) of § 20.101.

(b) Before permitting any individual in a restricted area to receive exposure to radiation in excess of the limits specified in paragraph (a) of § 20.101, each licensee shall:

(1) Obtain a certificate on Form AEC-4, or on a clear and legible record containing all the information required in that form, signed by the individual showing each period of time after the individual attained the age of 18 in which the individual received an occupational dose of radiation; and

(2) Calculate on Form AEC-4 in accordance with the instructions appearing therein, or on a clear and legible record containing all the information required in that form, the previously accumulated occupational dose received by the individual and the additional dose allowed for that individual under § 20.101(b).

(c)(1) In the preparation of Form AEC-4, or a clear and legible record containing all the information required in that form, the licensee shall make a reasonable effort to obtain reports of the individual's previously accumulated occupational dose. For each period for which the licensee obtains such reports, the licensee shall use the dose shown in the report in preparing the form. In any case where a licensee is unable to obtain reports of the individual's occupational dose for a previous complete calendar quarter, it shall be assumed that the individual has received the occupational dose specified in whichever of the following columns apply:

Part of body	Column 1 Assumed exposure in rems for calendar quarters prior to Jan 1, 1961	Column 2 Assumed exposure in rems for calendar quarters beginning on or after Jan. 1, 1961
Whole body, gonads, active blood-forming organs, head and trunk, lens of eye	3¾	1¼

(2) The licensee shall retain and preserve records used in preparing Form AEC-4.

If calculation of the individual's accumulated occupational dose for all periods prior to January 1, 1961 yields a result higher than the applicable accumulated dose value for the individual as of that date, as specified in paragraph (b) of § 20.101, the excess may be disregarded.

§ 20.103 Exposure of individuals to concentrations of radioactive material in restricted areas.

(a) No licensee shall possess, use or transfer licensed material in such a manner as to cause any individual in a restricted area to be exposed to airborne radioactive material possessed by the licensee in an average concentration in excess of the limits specified in Appendix B, Table I, of this part. "Expose" as used in this section means that the individual is present in an airborne concentration. No allowance shall be made for the use of protective clothing or equipment, or particle size, except as authorized by the Commission pursuant to paragraph (c) of this section.

(b) The limits given in Appendix B, Table I, of this part are based upon exposure to the concentrations specified for forty hours in any period of seven consecutive days. In any such period where the number of hours of exposure is less than forty, the limits specified in the table may be increased proportionately. In any such period where the number of hours of exposure is greater than forty, the limits specified in the table shall be decreased proportionately.

(c)(1) Except as authorized by the Commission pursuant to this paragraph, no allowance shall be made for particle size or the use of protective clothing or equipment in determining whether an individual is exposed to an airborne concentration in excess of the limits specified in Appendix B, Table I.

(2) The Commission may authorize a licensee to expose an individual in a restricted area to airborne concentrations in excess of the limits specified in Appendix B, Table I, upon receipt of an application demonstrating that the concentration is composed in whole or in part of particles of such size that such particles are not respirable; and that the individual will not inhale the concentrations in excess of the limits established in Appendix B, Table I. Each application under this subparagraph shall include an analysis of particle sizes in the concentrations; and a description of the methods used in determining the particle sizes.

(3) The Commission may authorize a licensee to expose an individual in a restricted area to airborne concentrations in excess of the limits specified in Appendix B, Table I, upon receipt of an application demonstrating that the individual will wear appropriate protective equipment and that the individual will not inhale, ingest or absorb quanti-

ties of radioactive material in excess of those which might otherwise be permitted under this part for employees in restricted areas during a 40-hour week Each application under this subparagraph shall contain the following information;

(i) A description of the protective equipment to be employed, including the efficiency of the equipment for the material involved;

(ii) Procedures for the fitting, maintenance and cleaning of the protective equipment; and

(iii) Procedures governing the use of the protective equipment, including supervisory procedures and length of time the equipment will be used by the individuals in each work week. The proposed periods for use of the equipment by any individual should not be of such duration as would discourage observance by the individual of the proposed procedures; and

(iv) The average concentrations present in the areas occupied by employees.

§ 20.101 Exposure of minors.

(a) No licensee shall possess, use or transfer licensed material in such a manner as to cause any individual within a restricted area who is under 18 years of age, to receive in any period of one calendar quarter from radioactive material and other sources of radiation in the licensee's possession a dose in excess of 10 percent of the limits specified in the table in paragraph (a) of § 20 101.

25 FR 10914

(b) No licensee shall possess, use or transfer licensed material in such a manner as to cause any individual within a restricted area, who is under 18 years of age to be exposed to airborne radioactive material possessed by the licensee in an average concentration in excess of the limits specified in Appendix B, Table II of this part For purposes of this paragraph, concentrations may be averaged over periods not greater than a week.

(c) The provisions of paragraph (c) of § 20.103, shall apply to exposures subject to paragraph (b) of this section.

§ 20.105 Permissible levels of radiation in unrestricted areas.

(a) There may be included in any application for a license or for amendment of a license proposed limits upon levels of radiation in unrestricted areas resulting from the applicant's possession or use of radioactive material and other sources of radiation. Such applications should include information as to anticipated average radiation levels and anticipated occupancy times for each unrestricted area involved. The Commission will approve the proposed limits if the applicant demonstrates that the proposed limits are not likely to cause any individual to receive a dose to the whole body in any period of one calendar year in excess of 0 5 rem

(b) Except as authorized by the Commission pursuant to paragraph (a) of this section, no licensee shall possess, use or transfer licensed material in such a manner as to create in any unrestricted area from radioactive material and other sources of radiation in his possession:

(1) Radiation levels which, if an individual were continuously present in the area, could result in his receiving a dose in excess of two millirems in any one hour, or

(2) Radiation levels which, if an individual were continuously present in the area, could result in his receiving a dose in excess of 100 millirems in any seven consecutive days.

§ 20.106 Concentrations in effluents to unrestricted areas.

(a) A licensee shall not possess, use, or transfer licensed material so as to release to an unrestricted area radioactive material in concentrations which exceed the limits specified in Appendix "B", Table II of this part, except as authorized pursuant to § 20.302 or paragraph (b) of this section. For purposes of this section concentrations may be averaged over a period not greater than one year.

(b) An application for a license or amendment may include proposed limits higher than those specified in paragraph (a) of this section. The Commission will approve the proposed limits if the applicant demonstrates:

(1) That the applicant has made a reasonable effort to minimize the radioactivity contained in effluents to unrestricted areas; and

(2) That it is not likely that radioactive material discharged in the effluent would result in the exposure of an individual to concentrations of radioactive material in air or water exceeding the limits specified in Appendix "B", Table II of this part.

29 FR 14434

(c) An application for higher limits pursuant to paragraph (b) of this section shall include information demonstrating that the applicant has made a reasonable effort to minimize the radioactivity discharged in effluents to unrestricted areas, and shall include, as pertinent:

(1) Information as to flow rates, total volume of effluent, peak concentration of each radionuclide in the effluent, and concentration of each radionuclide in the effluent averaged over a period of one year at the point where the effluent leaves a stack, tube, pipe, or similar conduit.

(2) A description of the properties of the effluents, including:

(i) chemical composition;

(ii) physical characteristics, including suspended solids content in liquid effluents, and nature of gas or aerosol for air effluents;

(iii) the hydrogen ion concentrations (p^H) of liquid effluents; and

(iv) the size range of particulates in effluents released into air.

(3) A description of the anticipated human occupancy in the unrestricted area where the highest concentration of radioactive material from the effluent is expected, and, in the case of a river or stream, a description of water uses downstream from the point of release of the effluent.

(4) Information as to the highest concentration of each radionuclide in an unrestricted area, including anticipated concentrations averaged over a period of one year:

(i) In air at any point of human occupancy; or

(ii) In water at points of use downstream from the point of release of the effluent.

(5) The background concentration of radionuclides in the receiving river or stream prior to the release of liquid effluent.

(6) A description of the environmental monitoring equipment, including sensitivity of the system, and procedures and calculations to determine concentrations of radionuclides in the unrestricted area and possible reconcentrations of radionuclides.

(7) A description of the waste treatment facilities and procedures used to reduce the concentration of radionuclides in effluents prior to their release.

(d) For the purposes of this section the concentration limits in Appendix "B", Table II of this part shall apply at the boundary of the restricted area. The concentration of radioactive material discharged through a stack, pipe or similar conduit may be determined with respect to the point where the material leaves the conduit. If the conduit discharges within the restricted area, the concentration at the boundary may be determined by applying appropriate factors for dilution, dispersion, or decay between the point of discharge and the boundary.

(e) In addition to limiting concentrations in effluent streams, the Commission may limit quantities of radioactive materials released in air or water during a specified period of time if it appears that the daily intake of radioactive material from air, water, or food by a suitable sample of an exposed population group, averaged over a period not exceeding one year, would otherwise exceed the daily intake resulting from continuous exposure to air or water containing one-third the concentration of radioactive materials specified in Appendix "B", Table II of this part.

(f) The provisions of this section do not apply to disposal of radioactive material into sanitary sewerage systems, which is governed by § 20.303

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§ 20.107 Medical diagnosis and therapy.

Nothing in the regulations in this part shall be interpreted as limiting the intentional exposure of patients to radiation for the purpose of medical diagnosis or medical therapy.

§ 20.108 Orders requiring furnishing of bio-assay services.

Where necessary or desirable in order to aid in determining the extent of an individual's exposure to concentrations of radioactive material, the Commission may incorporate appropriate provisions in any license, directing the licensee to make available to the individual appropriate bio-assay services and to furnish a copy of the reports of such services to the Commission.

Precautionary Procedures

§ 20.201 Surveys.

(a) As used in the regulations in this part, "survey" means an evaluation of the radiation hazards incident to the production, use, release, disposal, or presence of radioactive materials or other sources of radiation under a specific set of conditions. When appropriate, such evaluation includes a physical survey of the location of materials and equipment, and measurements of levels of radiation or concentrations of radioactive material present.

(b) Each licensee shall make or cause to be made such surveys as may be necessary for him to comply with the regulations in this part.

§ 20.202 Personnel monitoring.

(a) Each licensee shall supply appropriate personnel monitoring equipment to, and shall require the use of such equipment by:

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(1) Each individual who enters a restricted area under such circumstances that he receives, or is likely to receive, a dose in any calendar quarter in excess of 25 percent of the applicable value specified in paragraph (a) of § 20.101.

(2) Each individual under 18 years of age who enters a restricted area under such circumstances that he receives, or is likely to receive, a dose in any calendar quarter in excess of 5 percent of the applicable value specified in paragraph (a) of § 20.101.

(3) Each individual who enters a high radiation area.

(b) As used in this part,

(1) "Personnel monitoring equipment" means devices designed to be worn or carried by an individual for the purpose of measuring the dose received (e. g., film badges, pocket chambers, pocket dosimeters, film rings, etc.);

(2) "Radiation area" means any area, accessible to personnel, in which there exists radiation, originating in whole or in part within licensed material, at such levels that a major portion of the body could receive in any one hour a dose in excess of 5 millirem, or in any 5 consecutive days a dose in excess of 100 millirems;

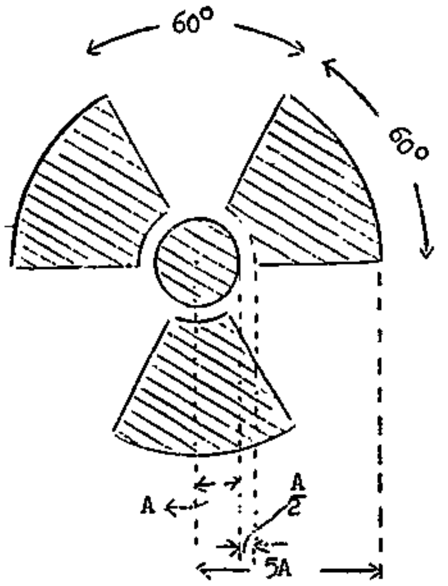
(3) "High radiation area" means any area, accessible to personnel, in which there exists radiation originating in whole or in part within licensed material at such levels that a major portion of the body could receive in any one hour a dose in excess of 100 millirem.

§ 20.203 Caution signs, labels, and signals.

(a) *General.* (1) Except as otherwise authorized by the Commission, symbols prescribed by this section shall use the conventional radiation caution colors (magenta or purple on yellow background). The symbol prescribed by this section is the conventional three-bladed design:

Radiation Symbol

1. Cross-hatched area is to be magenta or purple.
2. Background is to be yellow.



(2) In addition to the contents of signs and labels prescribed in this section, licensees may provide on or near such signs and labels any additional information which may be appropriate in aiding individuals to minimize exposure to radiation or to radioactive material.

(b) *Radiation areas.* Each radiation area shall be conspicuously posted with a sign or signs bearing the radiation caution symbol and the words:

CAUTION[1]
RADIATION AREA

(c) *High radiation areas.* (1) Each high radiation area shall be conspicuously posted with a sign or signs bearing the radiation caution symbol and the words:

CAUTION[1]
HIGH RADIATION AREA

(2) Each high radiation area shall be equipped with a control device which shall either cause the level of radiation to be reduced below that at which an individual might receive a dose of 100 millirem in one hour upon entry into the area or shall energize a conspicuous visible or audible alarm signal in such a manner that the individual entering and the licensee or a supervisor of the activity are made aware of the entry. In the case of a high radiation area established for a period of 30 days or less, such control device is not required.

(d) *Airborne radioactivity areas.* (1) As used in the regulations in this part, "airborne radioactivity area" means (i) any room, enclosure, or operating area in which airborne radioactive materials, composed wholly or partly of licensed material, exist in concentrations in excess of the amounts specified in Appendix B, Table I, Column 1 of this part; or (ii) any room, enclosure, or operating area in which airborne radioactive material composed wholly or partly of licensed material exists in concentrations which, averaged over the number of hours in any week during which individuals are in the area, exceed 25 percent of the amounts specified in Appendix B, Table I, Column 1 of this part.

(2) Each airborne radioactivity area shall be conspicuously posted with a sign or signs bearing the radiation caution symbol and the words:

CAUTION[1]
AIRBORNE RADIOACTIVITY AREA

(e) *Additional requirements.* (1) Each area or room in which licensed material is used or stored and which contains any radioactive material (other than natural uranium or thorium) in an amount exceeding 10 times the quantity of such material specified in Appendix C of this part shall be conspicuously posted with a sign or signs bearing the radiation caution symbol and the words:

CAUTION[1]
RADIOACTIVE MATERIAL(S)

(2) Each area or room in which natural uranium or thorium is used or stored in an amount exceeding one-hundred times the quantity specified in Appendix C of this part shall be conspicuously posted with a sign or signs bearing the radiation caution symbol and the words:

CAUTION
RADIOACTIVE MATERIAL(S)

(f) *Containers.* (1) Except as provided in subparagraph (3) of this paragraph, each container of licensed material shall bear a durable, clearly visible label identifying the radioactive contents.

(2) A label required pursuant to subparagraph (1) of this paragraph shall bear the radiation caution symbol and the words "CAUTION, RADIOACTIVE MATERIAL" or "DANGER, RADIOACTIVE MATERIAL". It shall also provide sufficient information[1] to permit individuals handling or using the containers, or working in the vicinity thereof, to take precautions to avoid or minimize exposures.

31 FR 10514

(3) Notwithstanding the provisions of subparagraph (1) of this paragraph, labeling is not required:

(i) For containers that do not contain licensed materials in quantities greater than the applicable quantities listed in Appendix C of this part.

(ii) For containers containing only natural uranium or thorium in quantities no greater than 10 times the applicable quantities listed in Appendix C of this part.

(iii) For containers that do not contain licensed materials in concentrations

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[1] Or "Danger"

[1] As appropriate, the information will include radiation levels, kinds of material, estimate of activity, date for which activity is estimated, mass enrichment, etc.

greater than the applicable concentrations listed in Column 2, Table I, Appendix B of this part.

(iv) For containers when they are attended by an individual who takes the precautions necessary to prevent the exposure of any individual to radiation or radioactive materials in excess of the limits established by the regulations in this part.

(v) For containers when they are in transport and packaged and labeled in accordance with regulations of the Interstate Commerce Commission, Federal Aviation Agency, or Coast Guard.

(vi) For containers which are accessible[2] only to individuals authorized to handle or use them, or to work in the vicinity thereof, provided that the contents are identified to such individuals by a readily available written record.

(vii) For manufacturing or process equipment, such as nuclear reactors, reactor components, piping, and tanks

§ 20.204 Exceptions from posting requirements.

Notwithstanding the provisions of § 20.203.

(a) A room or area is not required to be posted with a caution sign because of the presence of a sealed source provided the radiation level twelve inches from the surface of the source container or housing does not exceed five millirem per hour

(b) Rooms or other areas in hospitals are not required to be posted with caution signs because of the presence of patients containing byproduct material provided that there are personnel in attendance who shall take the precautions necessary to prevent the exposure of any individual to radiation or radioactive material in excess of the limits established in the regulations in this part.

(c) Caution signs are not required to be posted at areas or rooms containing radioactive materials for periods of less than eight hours provided that (1) the materials are constantly attended during such periods by an individual who shall take the precautions necessary to prevent the exposure of any individual to radiation or radioactive materials in excess of the limits established in the regulations in this part and: (2) such area or room is subject to the licensee's control.

(d) A room or other area is not required to be posted with a caution sign because of the presence of radioactive materials packaged and labeled in accordance with regulations of the Interstate Commerce Commission, Federal Aviation Agency, or Coast Guard.

§ 20.206 Instruction of personnel: posting of notices to employees.

(a) All individuals working in or frequenting any portion of a restricted area shall be informed of the occurrence of radioactive materials or of radiation in such portions of the restricted area; shall be instructed in the safety problems associated with exposure to such materials or radiation and in precautions or procedures to minimize exposure, shall be instructed in the applicable provisions of Commission regulations and licenses for the protection of personnel from exposures to radiation or radioactive materials, and shall be advised of reports of radiation exposure which employees may request pursuant to these regulations.

(b) Each licensee shall post a current copy of the regulations in this part, a copy of the license and a copy of operating procedures applicable to work under the license conspicuously in a sufficient number of places in every establishment where employees are employed in activities licensed by the Commission to permit them to observe such documents on the way to or from their place of employment or shall keep such documents available for employees' examination upon request

(c) Form AEC-3, "Notice to Employees", shall be conspicuously posted in a sufficient number of places in every establishment where employees are employed in activities licensed by the Commission to permit employees working in or frequenting any portion of a restricted area to observe a copy on the way to or from their place of employment.

NOTE Copies of Form AEC-3, "Notice to Employees," may be obtained by writing to the Director of the appropriate U S Atomic Energy Commission Regional Compliance Office listed in Appendix "D" or the Director, Division of Materials Licensing, U S Atomic Energy Commission, Washington, D C, 20545.

§ 20.207 Storage of licensed materials.

Licensed materials stored in an unrestricted area shall be secured against unauthorized removal from the place of storage.

WASTE DISPOSAL

§ 20.301 General requirement.

No licensee shall dispose of licensed material except

(a) By transfer to an authorized recipient as provided in the regulations in Part 30, 40, or 70 of this chapter, whichever may be applicable; or

(b) As authorized pursuant to § 20 302; or

(c) As provided in § 20 303 or § 20 304, applicable respectively to the disposal of licensed material by release into sanitary sewerage systems or burial in soil, or in § 20 106 (Concentrations in Effluents to Unrestricted Areas).

§ 20.302 Method for obtaining approval of proposed disposal procedures.

Any licensee or applicant for a license may apply to the Commission for approval of proposed procedures to dispose of licensed material in a manner not otherwise authorized in the regulations in this chapter. Each application should include a description of the licensed material and any other radioactive material involved, including the quantities and kinds of such material and the levels of radioactivity involved, and the proposed manner and conditions of disposal. The application should also include an analysis and evaluation of pertinent information as to the nature of the environment, including topographical, geological, meteorological, and hydrological characteristics, usage of ground and surface waters in the general area, the nature and location of other potentially affected facilities; and procedures to be observed to minimize the risk of unexpected or hazardous exposures

The Commission will not approve any application for a license to receive licensed material from other persons for disposal on land not owned by the Federal government or by a State government.

§ 20.303 Disposal by release into sanitary sewerage systems.

No licensee shall discharge licensed material into a sanitary sewerage system unless:

(a) It is readily soluble or dispersible in water; and

(b) The quantity of any licensed or other radioactive material released into the system by the licensee in any one day does not exceed the larger of subparagraphs (1) or (2) of this paragraph:

(1) The quantity which, if diluted by the average daily quantity of sewage released into the sewer by the licensee, will result in an average concentration equal to the limits specified in Appendix B, Table I, Column 2 of this part; or

(2) Ten times the quantity of such material specified in Appendix C of this part, and

(c) The quantity of any licensed or other radioactive material released in any one month, if diluted by the average monthly quantity of water released by the licensee, will not result in an average concentration exceeding the limits specified in Appendix B, Table I, Column 2 of this part; and

(d) The gross quantity of licensed and other radioactive material released into the sewerage system by the licensee does not exceed one curie per year

Excreta from individuals undergoing medical diagnosis or therapy with radioactive material shall be exempt from any limitations contained in this section.

§ 20.304 Disposal by burial in soil.

No licensee shall dispose of licensed material by burial in soil unless:

(a) The total quantity of licensed and other radioactive materials buried at any one location and time does not exceed, at the time of burial, 1,000 times the amount specified in Appendix C of this part; and

(b) Burial is at a minimum depth of four feet; and

(c) Successive burials are separated by distances of at least six feet and not more than 12 burials are made in any year

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[2] For example, containers in locations such as water-filled canals, storage vaults, or hot cells.

§ 20.305 Treatment or disposal by incineration.

No licensee shall treat or dispose of licensed material by incineration except as specifically approved by the Commission pursuant to §§ 20.106(b) and 20.302.

RECORDS, REPORTS, AND NOTIFICATION

§ 20.401 Records of surveys, radiation monitoring, and disposal.

(a) Each licensee shall maintain records showing the radiation exposures of all individuals for whom personnel monitoring is required under § 20.202 of the regulations in this part. Such records shall be kept on Form AEC-5, in accordance with the instructions contained in that form or on clear and legible records containing all the information required by Form AEC-5. The doses entered on the forms or records shall be for periods of time not exceeding one calendar quarter.

(b) Each licensee shall maintain records in the same units used in the appendices to this part, showing the results of surveys required by § 20.201 (b), and disposals made under §§ 20.302, 20.303, and 20.304.

25 FR 10914

(c) Records of individual radiation exposure which must be maintained pursuant to the provisions of paragraph (a) of this section shall be preserved until December 31, 1970, or until a date 5 years after termination of the individual's employment, whichever is later. Records which must be maintained pursuant to this part may be maintained in the form of microfilms.

NOTE: Prior to December 31, 1970, the Commission may amend this paragraph to assure the further preservation of records which it determines should not be destroyed.

30 FR 14551

§ 20.402 Reports of theft or loss of licensed material.

Each licensee shall report by telephone and telegraph to the Director of the appropriate Atomic Energy Commission Regional Compliance Office listed in Appendix D, immediately after its occurrence becomes known to the licensee, any loss or theft of licensed material in such quantities and under such circumstances that it appears to the licensee that a substantial hazard may result to persons in unrestricted areas.

§ 20.403 Notifications of incidents.

(a) *Immediate notification.* Each licensee shall immediately notify the Director of the appropriate Atomic Energy Commission Regional Compliance Office shown in Appendix D by telephone and telegraph of any incident involving byproduct, source or special nuclear material possessed by him and which may have caused or threatens to cause:

(1) Exposure of the whole body of any individual to 25 rems or more of radiation; exposure of the skin of the whole body of any individual of 150 rems or more of radiation; or exposure of the feet, ankles, hands or forearms of any individual to 375 rems or more of radiation; or

(2) The release of radioactive material in concentrations which, if averaged over a period of 24 hours, would exceed 5,000 times the limits specified for such materials in Appendix B, Table II; or

(3) A loss of one working week or more of the operation of any facilities affected; or

(4) Damage to property in excess of $100,000.

(b) *Twenty-four hour notification.* Each licensee shall within 24 hours notify the Director of the appropriate Atomic Energy Commission Regional Compliance Office listed in Appendix D by telephone and telegraph of any incident involving licensed material possessed by him and which may have caused or threatens to cause:

(1) Exposure of the whole body of any individual to 5 rems or more of radiation; exposure of the skin of the whole body of any individual to 30 rems or more of radiation, or exposure of the feet, ankles, hands, or forearms to 75 rems or more of radiation; or

(2) The release of radioactive material in concentrations which, if averaged over a period of 24 hours, would exceed 500 times the limits specified for such materials in Appendix B, Table II, or

(3) A loss of one day or more of the operation of any facilities affected; or

(4) Damage to property in excess of $1,000.

27 FR 5905

(c) Any report filed with the Commission pursuant to this section shall be prepared so that names of individuals who have received exposure to radiation will be stated in a separate part of the report.

28 FR 6822

§ 20.404 Report to former employees of exposure to radiation.

At the request of a former employee each licensee shall furnish to the former employee a report of the former employee's exposure to radiation as shown in records maintained by the licensee pursuant to § 20.401(a). Such report shall be furnished within 30 days from the time the request is made; shall cover each calendar quarter of the individual's employment involving exposure to radiation, or such lesser period as may be requested by the employee. The report shall also include the results of any calculations and analyses of radioactive material deposited in the body of the employee and made pursuant to the provisions of § 20.108. The report shall be in writing and contain the following statement:

> This report is furnished to you under the provisions of the Atomic Energy Commission regulations entitled "Standards for Protection Against Radiation" (10 CFR Part 20). You should preserve this report for future reference.

(b) The former employee's request should include appropriate identifying data, such as social security number and dates and locations of employment.

25 FR 10914

§ 20.405 Reports of overexposures and excessive levels and concentrations.

(a) In addition to any notification required by § 20.403, each licensee shall make a report in writing within 30 days to the * Director, Division of State and Licensee Relations, U.S. Atomic Energy Commission, Washington, D.C., 20545 , with a copy to the Director of the appropriate Atomic Energy Commission Regional Compliance Office listed in Appendix D, of (1) each exposure of an individual to radiation or concentrations of radioactive material in excess of any applicable limit in this part or in the licensee's license; (2) any incident for which notification is required by § 20.403; and (3) levels of radiation or concentrations of radioactive material (not involving excessive exposure of any individual) in an unrestricted area in excess of ten times any applicable limit set forth in this part or in the licensee's license. Each report required under this paragraph shall describe the extent of exposure of persons to radiation or to radioactive material; levels of radiation and concentrations of radioactive material involved; the cause of the exposure, levels or concentrations; and corrective steps taken or planned to assure against a recurrence.

27 FR 5905

(b) In any case where a licensee is required pursuant to the provisions of this section to report to the Commission any exposure of an individual to radiation or to concentrations of radioactive material, the licensee shall also notify such individual of the nature and extent of exposure. Such notice shall be in writing and shall contain the following statement:

> This report is furnished to you under the provisions of the Atomic Energy Commission regulations entitled "Standards for Protection Against Radiation" (10 CFR Part 20). You should preserve this report for future reference.

25 FR 10914

(c) Any report filed with the Commission pursuant to this section shall be prepared so that names of individuals who have received exposure to radiation will be stated in a separate part of the report.

28 FR 6822

§ 20.406 Notice to employees of exposure to radiation.

At the request of any employee each licensee shall advise such employee annually of the employee's exposure to radiation as shown in records maintained by the licensee pursuant to § 20.401(a).

25 FR 10914

EXCEPTIONS AND ADDITIONAL REQUIREMENTS

§ 20.501 Applications for exemptions.

The Commission may, upon application by any licensee or upon its own initiative, grant such exemptions from the requirements of the regulations in this part as it determines are authorized by law and will not result in undue hazard to life or property.

§ 20.502 Additional requirements.

The Commission may, by rule, regulation, or order, impose upon any licensee such requirements, in addition to those

25 FR 10914

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*Revised 31 FR 4668

established in the regulations in this part, as it deems appropriate or necessary to protect health or to minimize danger to life or property.

ENFORCEMENT

§ 20.601 Violations.

25 FR 10914

An injunction or other court order may be obtained prohibiting any violation of any provision of the act or any regulation or order issued thereunder. Any person who willfully violates any provision of the act or any regulation or order issued thereunder may be guilty of a crime, and upon conviction, may be punished by fine or imprisonment or both, as provided by law.

APPENDIX A [Reserved]

APPENDIX B

CONCENTRATIONS IN AIR AND WATER ABOVE NATURAL BACKGROUND

[See notes at end of appendix]

Element (atomic number)	Isotope [1]		Table I		Table II	
			Column 1 Air (μc/ml)	Column 2 Water (μc/ml)	Column 1 Air (μc/ml)	Column 2 Water (μc/ml)
Actinium (89)	Ac 227	S	2×10^{-12}	6×10^{-5}	8×10^{-14}	2×10^{-6}
		I	3×10^{-11}	9×10^{-3}	9×10^{-13}	3×10^{-4}
	Ac 228	S	8×10^{-8}	3×10^{-3}	3×10^{-9}	9×10^{-5}
		I	2×10^{-8}	3×10^{-3}	6×10^{-10}	9×10^{-5}
Americium (95)	Am 241	S	6×10^{-12}	1×10^{-4}	2×10^{-13}	4×10^{-6}
		I	1×10^{-10}	8×10^{-4}	4×10^{-12}	3×10^{-5}
	Am 242m	S	6×10^{-12}	1×10^{-4}	2×10^{-13}	4×10^{-6}
		I	3×10^{-10}	3×10^{-3}	9×10^{-12}	9×10^{-5}
*	Am 242	S	4×10^{-8}	4×10^{-3}	1×10^{-9}	1×10^{-4}
		I	5×10^{-8}	4×10^{-3}	2×10^{-9}	1×10^{-4}
	Am 243	S	6×10^{-12}	1×10^{-4}	2×10^{-13}	4×10^{-6}
		I	1×10^{-10}	8×10^{-4}	4×10^{-12}	3×10^{-5}
*	Am 244	S	4×10^{-6}	1×10^{-1}	1×10^{-7}	5×10^{-3}
		I	2×10^{-5}	1×10^{-1}	8×10^{-7}	5×10^{-3}
Antimony (51)	Sb 122	S	2×10^{-7}	8×10^{-4}	6×10^{-9}	3×10^{-5}
		I	1×10^{-7}	8×10^{-4}	5×10^{-9}	3×10^{-5}
	Sb 124	S	2×10^{-7}	7×10^{-4}	5×10^{-9}	2×10^{-5}
		I	2×10^{-8}	7×10^{-4}	7×10^{-10}	2×10^{-5}
	Sb 125	S	5×10^{-7}	3×10^{-3}	2×10^{-8}	1×10^{-4}
		I	3×10^{-8}	3×10^{-3}	9×10^{-10}	1×10^{-4}
Argon (18)	A 37	Sub [2]	6×10^{-3}	…………	1×10^{-4}	…………
	A 41	Sub	2×10^{-6}	…………	4×10^{-8}	…………
Arsenic (33)	As 73	S	2×10^{-6}	1×10^{-2}	7×10^{-8}	5×10^{-4}
		I	4×10^{-7}	1×10^{-2}	1×10^{-8}	5×10^{-4}
	As 74	S	3×10^{-7}	2×10^{-3}	1×10^{-8}	5×10^{-5}
		I	1×10^{-7}	2×10^{-3}	4×10^{-9}	5×10^{-5}
	As 76	S	1×10^{-7}	6×10^{-4}	4×10^{-9}	2×10^{-5}
		I	1×10^{-7}	6×10^{-4}	3×10^{-9}	2×10^{-5}
	As 77	S	5×10^{-7}	2×10^{-3}	2×10^{-8}	8×10^{-5}
		I	4×10^{-7}	2×10^{-3}	1×10^{-8}	8×10^{-5}
Astatine (85)	At 211	S	7×10^{-9}	5×10^{-5}	2×10^{-10}	2×10^{-6}
		I	3×10^{-8}	2×10^{-3}	1×10^{-9}	7×10^{-5}
Barium (56)	Ba 131	S	1×10^{-6}	5×10^{-3}	4×10^{-8}	2×10^{-4}
		I	4×10^{-7}	5×10^{-3}	1×10^{-8}	2×10^{-4}
	Ba 140	S	1×10^{-7}	8×10^{-4}	4×10^{-9}	3×10^{-5}
		I	4×10^{-8}	7×10^{-4}	1×10^{-9}	2×10^{-5}
Berkelium (97)	Bk 249	S	9×10^{-10}	2×10^{-2}	3×10^{-11}	6×10^{-4}
		I	1×10^{-7}	2×10^{-2}	4×10^{-9}	6×10^{-4}
*	Bk 250	S	1×10^{-7}	6×10^{-3}	5×10^{-9}	2×10^{-4}
		I	1×10^{-6}	6×10^{-3}	4×10^{-8}	2×10^{-4}
Beryllium (4)	Be 7	S	6×10^{-6}	5×10^{-2}	2×10^{-7}	2×10^{-3}
		I	1×10^{-6}	5×10^{-2}	4×10^{-8}	2×10^{-3}
Bismuth (83)	Bi 206	S	2×10^{-7}	1×10^{-3}	6×10^{-9}	4×10^{-5}
		I	1×10^{-7}	1×10^{-3}	5×10^{-9}	4×10^{-5}
	Bi 207	S	2×10^{-7}	2×10^{-3}	6×10^{-9}	6×10^{-5}
		I	1×10^{-8}	2×10^{-3}	5×10^{-10}	6×10^{-5}
	Bi 210	S	6×10^{-9}	1×10^{-3}	2×10^{-10}	4×10^{-5}
		I	6×10^{-9}	1×10^{-3}	2×10^{-10}	4×10^{-5}
	Bi 212	S	1×10^{-7}	1×10^{-2}	3×10^{-9}	4×10^{-4}
		I	2×10^{-7}	1×10^{-2}	7×10^{-9}	4×10^{-4}
Bromine (35)	Br 82	S	1×10^{-6}	8×10^{-3}	4×10^{-8}	3×10^{-4}
		I	2×10^{-7}	1×10^{-3}	6×10^{-9}	4×10^{-5}
Cadmium (48)	Cd 109	S	5×10^{-8}	5×10^{-3}	2×10^{-9}	2×10^{-4}
		I	7×10^{-8}	5×10^{-3}	3×10^{-9}	2×10^{-4}
	Cd 115m	S	4×10^{-8}	7×10^{-4}	1×10^{-9}	3×10^{-5}
		I	4×10^{-8}	7×10^{-4}	1×10^{-9}	3×10^{-5}
	Cd 115	S	2×10^{-7}	1×10^{-3}	8×10^{-9}	3×10^{-5}
		I	2×10^{-7}	1×10^{-3}	6×10^{-9}	4×10^{-5}
Calcium (20)	Ca 45	S	3×10^{-8}	3×10^{-4}	1×10^{-9}	9×10^{-6}
		I	1×10^{-7}	5×10^{-3}	4×10^{-9}	2×10^{-4}
	Ca 47	S	2×10^{-7}	1×10^{-3}	6×10^{-9}	5×10^{-5}
		I	2×10^{-7}	1×10^{-3}	6×10^{-9}	3×10^{-5}
Californium (98)	Cf 249	S	2×10^{-12}	1×10^{-4}	5×10^{-14}	4×10^{-6}
		I	1×10^{-10}	7×10^{-4}	3×10^{-12}	2×10^{-5}
	Cf 250	S	5×10^{-12}	4×10^{-4}	2×10^{-13}	1×10^{-5}
		I	1×10^{-10}	7×10^{-4}	3×10^{-12}	3×10^{-5}
*	Cf 251	S	2×10^{-12}	1×10^{-4}	6×10^{-14}	4×10^{-6}
		I	1×10^{-10}	8×10^{-4}	3×10^{-12}	3×10^{-5}
	Cf 252	S	2×10^{-11}	7×10^{-4}	7×10^{-13}	2×10^{-5}
		I	1×10^{-10}	7×10^{-4}	4×10^{-12}	2×10^{-5}

See footnotes at end of table. *Added 30 FR 15801

CONCENTRATIONS IN AIR AND WATER ABOVE NATURAL BACKGROUND—continued

[See notes at end of appendix]

Element (atomic number)	Isotope [1]		Table I		Table II	
			Column 1 Air (μc/ml)	Column 2 Water (μc/ml)	Column 1 Air (μc/ml)	Column 2 Water (μc/ml)
Californium (98)	Cf 253	S	8×10^{-10}	4×10^{-3}	3×10^{-11}	1×10^{-4}
		I	8×10^{-10}	4×10^{-3}	3×10^{-11}	1×10^{-4}
*	Cf 254	S	5×10^{-12}	4×10^{-6}	2×10^{-13}	1×10^{-7}
		I	5×10^{-12}	4×10^{-6}	2×10^{-13}	1×10^{-7}
Carbon (6)	C 14	S	4×10^{-6}	2×10^{-2}	1×10^{-7}	8×10^{-4}
	(CO_2)	Sub	5×10^{-5}	…………	1×10^{-6}	…………
Cerium (58)	Ce 141	S	4×10^{-7}	3×10^{-3}	2×10^{-8}	9×10^{-5}
		I	2×10^{-7}	3×10^{-3}	5×10^{-9}	9×10^{-5}
	Ce 143	S	3×10^{-7}	1×10^{-3}	9×10^{-9}	4×10^{-5}
		I	2×10^{-7}	1×10^{-3}	7×10^{-9}	4×10^{-5}
	Ce 144	S	1×10^{-8}	3×10^{-4}	3×10^{-10}	1×10^{-5}
		I	6×10^{-9}	3×10^{-4}	2×10^{-10}	1×10^{-5}
Cesium (55)	Cs 131	S	1×10^{-5}	7×10^{-2}	4×10^{-7}	2×10^{-3}
		I	3×10^{-6}	3×10^{-2}	1×10^{-7}	9×10^{-4}
	Cs 134m	S	4×10^{-5}	2×10^{-1}	1×10^{-6}	6×10^{-3}
		I	6×10^{-6}	3×10^{-2}	2×10^{-7}	1×10^{-3}
	Cs 134	S	4×10^{-8}	3×10^{-4}	1×10^{-9}	9×10^{-6}
		I	1×10^{-8}	1×10^{-3}	4×10^{-10}	4×10^{-5}
	Cs 135	S	5×10^{-7}	3×10^{-3}	2×10^{-8}	1×10^{-4}
		I	9×10^{-8}	7×10^{-3}	3×10^{-9}	2×10^{-4}
	Cs 136	S	4×10^{-7}	2×10^{-3}	1×10^{-8}	9×10^{-5}
		I	2×10^{-7}	2×10^{-3}	6×10^{-9}	6×10^{-5}
	Cs 137	S	6×10^{-8}	4×10^{-4}	2×10^{-9}	2×10^{-5}
		I	1×10^{-8}	1×10^{-3}	5×10^{-10}	4×10^{-5}
Chlorine (17)	Cl 36	S	4×10^{-7}	2×10^{-3}	1×10^{-8}	8×10^{-5}
		I	2×10^{-8}	2×10^{-3}	8×10^{-10}	6×10^{-5}
	Cl 38	S	3×10^{-6}	1×10^{-2}	9×10^{-8}	4×10^{-4}
		I	2×10^{-6}	1×10^{-2}	7×10^{-8}	4×10^{-4}
Chromium (24)	Cr 51	S	1×10^{-5}	5×10^{-2}	4×10^{-7}	2×10^{-3}
		I	2×10^{-6}	5×10^{-2}	8×10^{-8}	2×10^{-3}
Cobalt (27)	Co 57	S	3×10^{-6}	2×10^{-2}	1×10^{-7}	5×10^{-4}
		I	2×10^{-7}	1×10^{-2}	6×10^{-9}	4×10^{-4}
	Co 58m	S	2×10^{-5}	8×10^{-2}	6×10^{-7}	3×10^{-3}
		I	9×10^{-6}	6×10^{-2}	3×10^{-7}	2×10^{-3}
	Co 58	S	8×10^{-7}	4×10^{-3}	3×10^{-8}	1×10^{-4}
		I	5×10^{-8}	3×10^{-3}	2×10^{-9}	9×10^{-5}
	Co 60	S	3×10^{-7}	1×10^{-3}	1×10^{-8}	5×10^{-5}
		I	9×10^{-9}	1×10^{-3}	3×10^{-10}	3×10^{-5}
Copper (29)	Cu 64	S	2×10^{-6}	1×10^{-2}	7×10^{-8}	3×10^{-4}
		I	1×10^{-6}	6×10^{-3}	4×10^{-8}	2×10^{-4}
Curium (96)	Cm 242	S	1×10^{-10}	7×10^{-4}	4×10^{-12}	2×10^{-5}
		I	2×10^{-10}	7×10^{-4}	6×10^{-12}	3×10^{-5}
	Cm 243	S	6×10^{-12}	1×10^{-4}	2×10^{-13}	5×10^{-6}
		I	1×10^{-10}	7×10^{-4}	3×10^{-12}	2×10^{-5}
	Cm 244	S	9×10^{-12}	2×10^{-4}	3×10^{-13}	7×10^{-6}
		I	1×10^{-10}	8×10^{-4}	3×10^{-12}	3×10^{-5}
	Cm 245	S	5×10^{-12}	1×10^{-4}	2×10^{-13}	4×10^{-6}
		I	1×10^{-10}	8×10^{-4}	4×10^{-12}	3×10^{-5}
	Cm 246	S	5×10^{-12}	1×10^{-4}	2×10^{-13}	4×10^{-6}
		I	1×10^{-10}	8×10^{-4}	4×10^{-12}	3×10^{-5}
	Cm 247	S	5×10^{-12}	1×10^{-4}	2×10^{-13}	4×10^{-6}
		I	1×10^{-10}	6×10^{-4}	4×10^{-12}	2×10^{-5}
*	Cm 248	S	6×10^{-13}	1×10^{-5}	2×10^{-14}	4×10^{-7}
		I	1×10^{-11}	4×10^{-5}	4×10^{-13}	1×10^{-6}
	Cm 249	S	1×10^{-5}	6×10^{-2}	4×10^{-7}	2×10^{-3}
		I	1×10^{-5}	6×10^{-2}	4×10^{-7}	2×10^{-3}
Dysprosium (66)	Dy 165	S	3×10^{-6}	1×10^{-2}	9×10^{-8}	4×10^{-4}
		I	2×10^{-6}	1×10^{-2}	7×10^{-8}	4×10^{-4}
	Dy 166	S	2×10^{-7}	1×10^{-3}	8×10^{-9}	4×10^{-5}
		I	2×10^{-7}	1×10^{-3}	7×10^{-9}	4×10^{-5}
* Einsteinium (99)	Es 253	S	8×10^{-10}	7×10^{-4}	3×10^{-11}	2×10^{-5}
		I	6×10^{-10}	7×10^{-4}	2×10^{-11}	2×10^{-5}
	Es 254m	S	5×10^{-9}	5×10^{-4}	2×10^{-10}	2×10^{-5}
		I	6×10^{-9}	5×10^{-4}	2×10^{-10}	2×10^{-5}
	Es 254	S	2×10^{-11}	4×10^{-4}	6×10^{-13}	1×10^{-5}
		I	1×10^{-10}	4×10^{-4}	4×10^{-12}	1×10^{-5}
	Es 255	S	5×10^{-10}	8×10^{-4}	2×10^{-11}	3×10^{-5}
		I	4×10^{-10}	8×10^{-4}	1×10^{-11}	3×10^{-5}
Erbium (68)	Er 169	S	6×10^{-7}	3×10^{-3}	2×10^{-8}	9×10^{-5}
		I	4×10^{-7}	3×10^{-3}	1×10^{-8}	9×10^{-5}
	Er 171	S	7×10^{-7}	3×10^{-3}	2×10^{-8}	1×10^{-4}
		I	6×10^{-7}	3×10^{-3}	2×10^{-8}	1×10^{-4}

CONCENTRATIONS IN AIR AND WATER ABOVE NATURAL BACKGROUND—continued

[See notes at end of appendix]

Element (atomic number)	Isotope [1]		Table I		Table II	
			Column 1 Air (μc/ml)	Column 2 Water (μc/ml)	Column 1 Air (μc/ml)	Column 2 Water (μc/ml)
Europium (63)	Eu 152 (T/2=9.2 hrs)	S	4×10^{-7}	2×10^{-3}	1×10^{-8}	6×10^{-5}
		I	3×10^{-7}	2×10^{-3}	1×10^{-8}	6×10^{-5}
	Eu 152 (T/2=13 yrs)	S	1×10^{-8}	2×10^{-3}	4×10^{-10}	8×10^{-5}
		I	2×10^{-8}	2×10^{-3}	6×10^{-10}	8×10^{-5}
	Eu 154	S	4×10^{-9}	6×10^{-4}	1×10^{-10}	2×10^{-5}
		I	7×10^{-9}	6×10^{-4}	2×10^{-10}	2×10^{-5}
	Eu 155	S	9×10^{-8}	6×10^{-3}	3×10^{-9}	2×10^{-4}
		I	7×10^{-8}	6×10^{-3}	3×10^{-9}	2×10^{-4}
Fermium (100)	Fm 254	S	6×10^{-8}	4×10^{-3}	2×10^{-9}	1×10^{-4}
		I	7×10^{-8}	4×10^{-3}	2×10^{-9}	1×10^{-4}
	Fm 255	S	2×10^{-8}	1×10^{-3}	6×10^{-10}	3×10^{-5}
		I	1×10^{-8}	1×10^{-3}	4×10^{-10}	3×10^{-5}
	Fm 256	S	3×10^{-9}	3×10^{-5}	1×10^{-10}	9×10^{-7}
		I	2×10^{-9}	3×10^{-5}	6×10^{-11}	9×10^{-7}
Fluorine (9)	F 18	S	5×10^{-6}	2×10^{-2}	2×10^{-7}	8×10^{-4}
		I	3×10^{-6}	1×10^{-2}	9×10^{-8}	5×10^{-4}
Gadolinium (64)	Gd 153	S	2×10^{-7}	6×10^{-3}	8×10^{-9}	2×10^{-4}
		I	9×10^{-8}	6×10^{-3}	3×10^{-9}	2×10^{-4}
	Gd 159	S	5×10^{-7}	2×10^{-3}	2×10^{-8}	8×10^{-5}
		I	4×10^{-7}	2×10^{-3}	1×10^{-8}	8×10^{-5}
Gallium (31)	Ga 72	S	2×10^{-7}	1×10^{-3}	8×10^{-9}	4×10^{-5}
		I	2×10^{-7}	1×10^{-3}	6×10^{-9}	4×10^{-5}
Germanium (32)	Ge 71	S	1×10^{-5}	5×10^{-2}	4×10^{-7}	2×10^{-3}
		I	6×10^{-6}	5×10^{-2}	2×10^{-7}	2×10^{-3}
Gold (79)	Au 196	S	1×10^{-6}	5×10^{-3}	4×10^{-8}	2×10^{-4}
		I	6×10^{-7}	4×10^{-3}	2×10^{-8}	1×10^{-4}
	Au 198	S	3×10^{-7}	2×10^{-3}	1×10^{-8}	5×10^{-5}
		I	2×10^{-7}	1×10^{-3}	8×10^{-9}	5×10^{-5}
	Au 199	S	1×10^{-6}	5×10^{-3}	4×10^{-8}	2×10^{-4}
		I	9×10^{-7}	4×10^{-3}	3×10^{-8}	2×10^{-4}
Hafnium (72)	Hf 181	S	4×10^{-8}	2×10^{-3}	1×10^{-9}	7×10^{-5}
		I	7×10^{-9}	2×10^{-3}	3×10^{-10}	7×10^{-5}
Holmium (67)	Ho 166	S	2×10^{-7}	9×10^{-4}	7×10^{-9}	3×10^{-5}
		I	2×10^{-7}	9×10^{-4}	6×10^{-9}	3×10^{-5}
Hydrogen (1)	H3	S	5×10^{-6}	1×10^{-1}	2×10^{-7}	3×10^{-3}
	**	I	5×10^{-6}	1×10^{-1}	2×10^{-7}	3×10^{-3}
		Sub	2×10^{-3}	....	4×10^{-5}	....
Indium (49)	In 113m	S	8×10^{-6}	4×10^{-2}	3×10^{-7}	1×10^{-3}
		I	7×10^{-6}	4×10^{-2}	2×10^{-7}	1×10^{-3}
	In 114m	S	1×10^{-7}	5×10^{-4}	4×10^{-9}	2×10^{-5}
		I	2×10^{-8}	5×10^{-4}	7×10^{-10}	2×10^{-5}
	In 115m	S	2×10^{-6}	1×10^{-2}	8×10^{-8}	4×10^{-4}
		I	2×10^{-6}	1×10^{-2}	6×10^{-8}	4×10^{-4}
	In 115	S	2×10^{-7}	3×10^{-3}	9×10^{-9}	9×10^{-5}
		I	3×10^{-8}	3×10^{-3}	1×10^{-9}	9×10^{-5}
Iodine (53)	I 125 **	S	5×10^{-9}	4×10^{-5}	8×10^{-11}	2×10^{-7}
		I	2×10^{-7}	6×10^{-3}	6×10^{-9}	2×10^{-4}
	I 126	S	8×10^{-9}	5×10^{-5}	9×10^{-11}	3×10^{-7}
		I	3×10^{-7}	3×10^{-3}	1×10^{-8}	9×10^{-5}
	I 129	S	2×10^{-9}	1×10^{-5}	2×10^{-11}	6×10^{-8}
		I	7×10^{-8}	6×10^{-3}	2×10^{-9}	2×10^{-4}
	I 131	S	9×10^{-9}	6×10^{-5}	1×10^{-10}	3×10^{-7}
		I	3×10^{-7}	2×10^{-3}	1×10^{-8}	6×10^{-5}
	I 132	S	2×10^{-7}	2×10^{-3}	3×10^{-9}	8×10^{-6}
		I	9×10^{-7}	5×10^{-3}	3×10^{-8}	2×10^{-4}
	I 133	S	3×10^{-8}	2×10^{-4}	4×10^{-10}	1×10^{-6}
		I	2×10^{-7}	1×10^{-3}	7×10^{-9}	4×10^{-5}
	I 134	S	5×10^{-7}	4×10^{-3}	6×10^{-9}	2×10^{-5}
		I	3×10^{-6}	2×10^{-2}	1×10^{-7}	6×10^{-4}
	I 135	S	1×10^{-7}	7×10^{-4}	1×10^{-9}	4×10^{-6}
		I	4×10^{-7}	2×10^{-3}	1×10^{-8}	7×10^{-5}
Iridium (77)	Ir 190	S	1×10^{-6}	6×10^{-3}	4×10^{-8}	2×10^{-4}
		I	4×10^{-7}	5×10^{-3}	1×10^{-8}	2×10^{-4}
	Ir 192	S	1×10^{-7}	1×10^{-3}	4×10^{-9}	4×10^{-5}
		I	3×10^{-8}	1×10^{-3}	9×10^{-10}	4×10^{-5}
	Ir 194	S	2×10^{-7}	1×10^{-3}	8×10^{-9}	3×10^{-5}
		I	2×10^{-7}	9×10^{-4}	5×10^{-9}	3×10^{-5}
Iron (26)	Fe 55	S	9×10^{-7}	2×10^{-2}	3×10^{-8}	8×10^{-4}
		I	1×10^{-6}	7×10^{-2}	3×10^{-8}	2×10^{-3}
	Fe 59	S	1×10^{-7}	2×10^{-3}	5×10^{-9}	6×10^{-5}
		I	5×10^{-8}	2×10^{-3}	2×10^{-9}	5×10^{-5}
Krypton [3] (36)	Kr 85m	Sub	6×10^{-6}	....	1×10^{-7}	....
	Kr 85	Sub	1×10^{-5}	....	3×10^{-7}	....
	Kr 87	Sub	1×10^{-6}	....	2×10^{-8}	....

See footnotes at end of table.

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*Revised 29 FR 14434

**Added 30 FR 15801

CONCENTRATIONS IN AIR AND WATER ABOVE NATURAL BACKGROUND—continued

[See notes at end of appendix]

Element (atomic number)	Isotope [1]		Table I		Table II	
			Column 1 Air (μc/ml)	Column 2 Water (μc/ml)	Column 1 Air (μc/ml)	Column 2 Water (μc/ml)
Krypton (36)	Kr 88 **	Sub	1×10^{-6}	....	2×10^{-8}	....
Lanthanum (57)	La 140	S	2×10^{-7}	7×10^{-4}	5×10^{-9}	2×10^{-5}
		I	1×10^{-7}	7×10^{-4}	4×10^{-9}	2×10^{-5}
Lead (82)	Pb 203	S	3×10^{-6}	1×10^{-2}	9×10^{-8}	4×10^{-4}
		I	2×10^{-6}	1×10^{-2}	6×10^{-8}	4×10^{-4}
	Pb 210	S	1×10^{-10}	4×10^{-6}	4×10^{-12}	1×10^{-7}
		I	2×10^{-10}	5×10^{-3}	8×10^{-12}	2×10^{-4}
	Pb 212	S	2×10^{-8}	6×10^{-4}	6×10^{-10}	2×10^{-5}
		I	2×10^{-8}	5×10^{-4}	7×10^{-10}	2×10^{-5}
Lutetium (71)	Lu 177	S	6×10^{-7}	3×10^{-3}	2×10^{-8}	1×10^{-4}
		I	5×10^{-7}	3×10^{-3}	2×10^{-8}	1×10^{-4}
Manganese (25)	Mn 52	S	2×10^{-7}	1×10^{-3}	7×10^{-9}	3×10^{-5}
		I	1×10^{-7}	9×10^{-4}	5×10^{-9}	3×10^{-5}
	Mn 54	S	4×10^{-7}	4×10^{-3}	1×10^{-8}	1×10^{-4}
		I	4×10^{-8}	3×10^{-3}	1×10^{-9}	1×10^{-4}
	Mn 56	S	8×10^{-7}	4×10^{-3}	3×10^{-8}	1×10^{-4}
		I	5×10^{-7}	3×10^{-3}	2×10^{-8}	1×10^{-4}
Mercury (80)	Hg 197m	S	7×10^{-7}	6×10^{-3}	3×10^{-8}	2×10^{-4}
		I	8×10^{-7}	5×10^{-3}	3×10^{-8}	2×10^{-4}
	Hg 197	S	1×10^{-6}	9×10^{-3}	4×10^{-8}	3×10^{-4}
		I	3×10^{-6}	1×10^{-2}	9×10^{-8}	5×10^{-4}
	Hg 203	S	7×10^{-8}	5×10^{-4}	2×10^{-9}	2×10^{-5}
		I	1×10^{-7}	3×10^{-3}	4×10^{-9}	1×10^{-4}
Molybdenum (42)	Mo 99	S	7×10^{-7}	5×10^{-3}	3×10^{-8}	2×10^{-4}
		I	2×10^{-7}	1×10^{-3}	7×10^{-9}	4×10^{-5}
Neodymium (60)	Nd 144	S	8×10^{-11}	2×10^{-3}	3×10^{-12}	7×10^{-5}
		I	3×10^{-10}	2×10^{-3}	1×10^{-11}	8×10^{-5}
	Nd 147	S	4×10^{-7}	2×10^{-3}	1×10^{-8}	6×10^{-5}
		I	2×10^{-7}	2×10^{-3}	8×10^{-9}	6×10^{-5}
	Nd 149	S	2×10^{-6}	8×10^{-3}	6×10^{-8}	3×10^{-4}
		I	1×10^{-6}	8×10^{-3}	5×10^{-8}	3×10^{-4}
Neptunium (93)	Np 237	S	4×10^{-12}	9×10^{-5}	1×10^{-13}	3×10^{-6}
		I	1×10^{-10}	9×10^{-4}	4×10^{-12}	3×10^{-5}
	Np 239	S	8×10^{-7}	4×10^{-3}	3×10^{-8}	1×10^{-4}
		I	7×10^{-7}	4×10^{-3}	2×10^{-8}	1×10^{-4}
Nickel (28)	Ni 59	S	5×10^{-7}	6×10^{-3}	2×10^{-8}	2×10^{-4}
		I	8×10^{-7}	6×10^{-2}	3×10^{-8}	2×10^{-3}
	Ni 63	S	6×10^{-8}	8×10^{-4}	2×10^{-9}	3×10^{-5}
		I	3×10^{-7}	2×10^{-2}	1×10^{-8}	7×10^{-4}
	Ni 65	S	9×10^{-7}	4×10^{-3}	3×10^{-8}	1×10^{-4}
		I	5×10^{-7}	3×10^{-3}	2×10^{-8}	1×10^{-4}
Niobium (Columbium) (41)	Nb 93m	S	1×10^{-7}	1×10^{-2}	4×10^{-9}	4×10^{-4}
		I	2×10^{-7}	1×10^{-2}	5×10^{-9}	4×10^{-4}
	Nb 95	S	5×10^{-7}	3×10^{-3}	2×10^{-8}	1×10^{-4}
		I	1×10^{-7}	3×10^{-3}	3×10^{-9}	1×10^{-4}
	Nb 97	S	6×10^{-6}	3×10^{-2}	2×10^{-7}	9×10^{-4}
		I	5×10^{-6}	3×10^{-2}	2×10^{-7}	9×10^{-4}
Osmium (76)	Os 185	S	5×10^{-7}	2×10^{-3}	2×10^{-8}	7×10^{-5}
		I	5×10^{-8}	2×10^{-3}	2×10^{-9}	7×10^{-5}
	Os 191m	S	2×10^{-5}	7×10^{-2}	6×10^{-7}	3×10^{-3}
		I	9×10^{-6}	7×10^{-2}	3×10^{-7}	2×10^{-3}
	Os 191	S	1×10^{-6}	5×10^{-3}	4×10^{-8}	2×10^{-4}
		I	4×10^{-7}	5×10^{-3}	1×10^{-8}	2×10^{-4}
	Os 193	S	4×10^{-7}	2×10^{-3}	1×10^{-8}	6×10^{-5}
		I	3×10^{-7}	2×10^{-3}	9×10^{-9}	5×10^{-5}
Palladium (46)	Pd 103	S	1×10^{-6}	1×10^{-2}	5×10^{-8}	3×10^{-4}
		I	7×10^{-7}	8×10^{-3}	3×10^{-8}	3×10^{-4}
	Pd 109	S	6×10^{-7}	3×10^{-3}	2×10^{-8}	9×10^{-5}
		I	4×10^{-7}	2×10^{-3}	1×10^{-8}	7×10^{-5}
Phosphorus (15)	P 32	S	7×10^{-8}	5×10^{-4}	2×10^{-9}	2×10^{-5}
		I	8×10^{-8}	7×10^{-4}	3×10^{-9}	2×10^{-5}
Platinum (78)	Pt 191	S	8×10^{-7}	4×10^{-3}	3×10^{-8}	1×10^{-4}
		I	6×10^{-7}	3×10^{-3}	2×10^{-8}	1×10^{-4}
	Pt 193m	S	7×10^{-6}	3×10^{-2}	2×10^{-7}	1×10^{-3}
		I	5×10^{-6}	3×10^{-2}	2×10^{-7}	1×10^{-3}
	Pt 197m	S	6×10^{-6}	3×10^{-2}	2×10^{-7}	1×10^{-3}
		I	5×10^{-6}	3×10^{-2}	2×10^{-7}	9×10^{-4}
	Pt 197	S	8×10^{-7}	4×10^{-3}	3×10^{-8}	1×10^{-4}
		I	6×10^{-7}	3×10^{-3}	2×10^{-8}	1×10^{-4}
Plutonium (94)	Pu 238	S	2×10^{-12}	1×10^{-4}	7×10^{-14}	5×10^{-6}
		I	3×10^{-11}	8×10^{-4}	1×10^{-12}	3×10^{-5}
	Pu 239	S	2×10^{-12}	1×10^{-4}	6×10^{-14}	5×10^{-6}
		I	4×10^{-11}	8×10^{-4}	1×10^{-12}	3×10^{-5}

CONCENTRATIONS IN AIR AND WATER ABOVE NATURAL BACKGROUND—continued

[See notes at end of appendix]

Element (atomic number)	Isotope [1]		Table I Column 1 Air (μc/ml)	Table I Column 2 Water (μc/ml)	Table II Column 1 Air (μc/ml)	Table II Column 2 Water (μc/ml)
Plutonium (94)	Pu 240	S	2×10^{-12}	1×10^{-4}	6×10^{-14}	5×10^{-6}
		I	4×10^{-11}	8×10^{-4}	1×10^{-12}	3×10^{-5}
	Pu 241	S	9×10^{-11}	7×10^{-3}	3×10^{-12}	2×10^{-4}
		I	4×10^{-8}	4×10^{-2}	1×10^{-9}	1×10^{-3}
	Pu 242	S	2×10^{-12}	1×10^{-4}	6×10^{-14}	5×10^{-6}
		I	4×10^{-11}	9×10^{-4}	1×10^{-12}	3×10^{-5}
	Pu 243	S	2×10^{-6}	1×10^{-2}	6×10^{-8}	3×10^{-4}
		I	2×10^{-6}	1×10^{-2}	8×10^{-8}	3×10^{-4}
***	Pu 244	S	2×10^{-12}	1×10^{-4}	6×10^{-14}	4×10^{-6}
		I	3×10^{-11}	3×10^{-4}	1×10^{-12}	1×10^{-5}
Polonium (84)	Po 210	S	5×10^{-10}	2×10^{-5}	2×10^{-11}	7×10^{-7}
		I	2×10^{-10}	8×10^{-4}	7×10^{-12}	3×10^{-5}
Potassium (19)	K 42	S	2×10^{-6}	9×10^{-4}	7×10^{-8}	3×10^{-5}
		I	1×10^{-7}	6×10^{-4}	4×10^{-9}	2×10^{-5}
Praseodymium (59)	Pr 142	S	2×10^{-7}	9×10^{-4}	7×10^{-9}	3×10^{-5}
		I	2×10^{-7}	9×10^{-4}	5×10^{-9}	3×10^{-5}
	Pr 143	S	3×10^{-7}	1×10^{-3}	1×10^{-8}	5×10^{-5}
		I	2×10^{-7}	1×10^{-3}	6×10^{-9}	5×10^{-5}
Promethium (61)	Pm 147	S	6×10^{-8}	6×10^{-3}	2×10^{-9}	2×10^{-4}
		I	1×10^{-7}	6×10^{-3}	3×10^{-9}	2×10^{-4}
	Pm 149	S	3×10^{-7}	1×10^{-3}	1×10^{-8}	4×10^{-5}
		I	2×10^{-7}	1×10^{-3}	8×10^{-9}	4×10^{-5}
Protoactinium (91)	Pa 230	S	2×10^{-9}	7×10^{-3}	6×10^{-11}	2×10^{-4}
		I	8×10^{-10}	7×10^{-3}	3×10^{-11}	2×10^{-4}
	Pa 231	S	1×10^{-12}	3×10^{-5}	4×10^{-14}	9×10^{-7}
		I	1×10^{-10}	8×10^{-4}	4×10^{-12}	2×10^{-5}
	Pa 233	S	6×10^{-7}	4×10^{-3}	2×10^{-8}	1×10^{-4}
		I	2×10^{-7}	3×10^{-3}	6×10^{-9}	1×10^{-4}
*Radium (88)	Ra 223	S	2×10^{-9}	2×10^{-5}	6×10^{-11}	7×10^{-7}
		I	2×10^{-10}	1×10^{-4}	8×10^{-12}	4×10^{-6}
	Ra 224	S	5×10^{-9}	7×10^{-5}	2×10^{-10}	2×10^{-6}
		I	7×10^{-10}	2×10^{-4}	2×10^{-11}	5×10^{-6}
	Ra 226	S	3×10^{-11}	4×10^{-7}	3×10^{-12}	3×10^{-8}
		I	5×10^{-11}	9×10^{-4}	2×10^{-12}	3×10^{-5}
	Ra 228	S	7×10^{-11}	8×10^{-7}	2×10^{-12}	3×10^{-8}
		I	4×10^{-11}	7×10^{-4}	1×10^{-12}	3×10^{-5}
Radon (86)	Rn 220	S	3×10^{-7}	......	1×10^{-8}	......
		I	......	......	......	......
	Rn 222	S	1×10^{-7}	......	3×10^{-9}	......
Rhenium (75)	Re 183	S	3×10^{-6}	2×10^{-2}	9×10^{-8}	6×10^{-4}
		I	2×10^{-7}	8×10^{-3}	5×10^{-9}	3×10^{-4}
	Re 186	S	6×10^{-7}	3×10^{-3}	2×10^{-8}	9×10^{-5}
		I	2×10^{-7}	1×10^{-3}	8×10^{-9}	5×10^{-5}
	Re 187	S	9×10^{-6}	7×10^{-2}	3×10^{-7}	3×10^{-3}
		I	5×10^{-7}	4×10^{-2}	2×10^{-8}	2×10^{-3}
	Re 188	S	4×10^{-7}	2×10^{-3}	1×10^{-8}	6×10^{-5}
		I	2×10^{-7}	9×10^{-4}	6×10^{-9}	3×10^{-5}
Rhodium (45)	Rh 103m	S	8×10^{-5}	4×10^{-1}	3×10^{-6}	1×10^{-2}
		I	6×10^{-5}	3×10^{-1}	2×10^{-6}	1×10^{-2}
	Rh 105	S	8×10^{-7}	4×10^{-3}	3×10^{-8}	1×10^{-4}
		I	5×10^{-7}	3×10^{-3}	2×10^{-8}	1×10^{-4}
Rubidium (37)	Rb 86	S	3×10^{-7}	2×10^{-3}	1×10^{-8}	7×10^{-5}
		I	7×10^{-8}	7×10^{-4}	2×10^{-9}	2×10^{-5}
	Rb 87	S	5×10^{-7}	3×10^{-3}	2×10^{-8}	1×10^{-4}
		I	7×10^{-8}	5×10^{-3}	2×10^{-9}	2×10^{-4}
Ruthenium (44)	Ru 97	S	2×10^{-6}	1×10^{-2}	8×10^{-8}	4×10^{-4}
		I	2×10^{-6}	1×10^{-2}	6×10^{-8}	3×10^{-4}
	Ru 103	S	5×10^{-7}	2×10^{-3}	2×10^{-8}	8×10^{-5}
		I	8×10^{-8}	2×10^{-3}	3×10^{-9}	8×10^{-5}
	Ru 105	S	7×10^{-7}	3×10^{-3}	2×10^{-8}	1×10^{-4}
		I	5×10^{-7}	3×10^{-3}	2×10^{-8}	1×10^{-4}
	Ru 106	S	8×10^{-8}	4×10^{-4}	3×10^{-9}	1×10^{-5}
		I	6×10^{-9}	3×10^{-4}	2×10^{-10}	1×10^{-5}
Samarium (62)	Sm 147	S	7×10^{-11}	2×10^{-3}	2×10^{-12}	6×10^{-5}
		I	3×10^{-10}	2×10^{-3}	9×10^{-12}	7×10^{-5}
	Sm 151	S	6×10^{-8}	1×10^{-2}	2×10^{-9}	4×10^{-4}
		I	1×10^{-7}	1×10^{-2}	5×10^{-9}	4×10^{-4}
	Sm 153	S	5×10^{-7}	2×10^{-3}	2×10^{-8}	8×10^{-5}
		I	4×10^{-7}	2×10^{-3}	1×10^{-8}	8×10^{-5}

*Revised 29 FR 14434

**Revised 30 FR 15801

*** Added 30 FR 15801

CONCENTRATIONS IN AIR AND WATER ABOVE NATURAL BACKGROUND—continued

[See notes at end of appendix]

Element (atomic number)	Isotope [1]		Table I Column 1 Air (μc/ml)	Table I Column 2 Water (μc/ml)	Table II Column 1 Air (μc/ml)	Table II Column 2 Water (μc/ml)
Scandium (21)	Sc 46	S	2×10^{-7}	1×10^{-3}	8×10^{-9}	4×10^{-5}
		I	2×10^{-8}	1×10^{-3}	8×10^{-10}	4×10^{-5}
	Sc 47	S	6×10^{-7}	3×10^{-3}	2×10^{-8}	9×10^{-5}
		I	5×10^{-7}	3×10^{-3}	2×10^{-8}	9×10^{-5}
	Sc 48	S	2×10^{-7}	8×10^{-4}	6×10^{-9}	3×10^{-5}
		I	1×10^{-7}	8×10^{-4}	5×10^{-9}	3×10^{-5}
Selenium (34)	Se 75	S	1×10^{-6}	9×10^{-3}	4×10^{-8}	3×10^{-4}
		I	1×10^{-7}	8×10^{-3}	4×10^{-9}	3×10^{-4}
Silicon (14)	Si 31	S	6×10^{-6}	3×10^{-2}	2×10^{-7}	9×10^{-4}
		I	1×10^{-6}	6×10^{-3}	3×10^{-8}	2×10^{-4}
Silver (47)	Ag 105	S	6×10^{-7}	3×10^{-3}	2×10^{-8}	1×10^{-4}
		I	8×10^{-8}	3×10^{-3}	3×10^{-9}	1×10^{-4}
	Ag 110m	S	2×10^{-7}	9×10^{-4}	7×10^{-9}	3×10^{-5}
		I	1×10^{-8}	9×10^{-4}	3×10^{-10}	3×10^{-5}
	Ag 111	S	3×10^{-7}	1×10^{-3}	1×10^{-8}	4×10^{-5}
		I	2×10^{-7}	1×10^{-3}	8×10^{-9}	4×10^{-5}
Sodium (11)	Na 22	S	2×10^{-7}	1×10^{-3}	6×10^{-9}	4×10^{-5}
		I	9×10^{-9}	9×10^{-4}	3×10^{-10}	3×10^{-5}
	Na 24	S	1×10^{-6}	6×10^{-3}	4×10^{-8}	2×10^{-4}
		I	1×10^{-7}	8×10^{-4}	5×10^{-9}	3×10^{-5}
*Strontium (38)	Sr 85m	S	4×10^{-5}	2×10^{-1}	1×10^{-6}	7×10^{-3}
		I	3×10^{-5}	2×10^{-1}	1×10^{-6}	7×10^{-3}
	Sr 85	S	2×10^{-7}	3×10^{-3}	8×10^{-9}	1×10^{-4}
		I	1×10^{-7}	5×10^{-3}	4×10^{-9}	2×10^{-4}
	Sr 89	S	3×10^{-8}	3×10^{-4}	3×10^{-10}	3×10^{-6}
		I	4×10^{-8}	8×10^{-4}	1×10^{-9}	3×10^{-5}
	Sr 90	S	** 1×10^{-9}	1×10^{-5}	3×10^{-11}	3×10^{-7}
		I	5×10^{-9}	1×10^{-3}	2×10^{-10}	4×10^{-5}
	Sr 91	S	4×10^{-7}	2×10^{-3}	2×10^{-8}	7×10^{-5}
		I	3×10^{-7}	1×10^{-3}	9×10^{-9}	5×10^{-5}
	Sr 92	S	4×10^{-7}	2×10^{-3}	2×10^{-8}	7×10^{-5}
		I	3×10^{-7}	2×10^{-3}	1×10^{-8}	6×10^{-5}
Sulfur (16)	S 35	S	3×10^{-7}	2×10^{-3}	9×10^{-9}	6×10^{-5}
		I	3×10^{-7}	8×10^{-3}	9×10^{-9}	3×10^{-4}
Tantalum (73)	Ta 182	S	4×10^{-8}	1×10^{-3}	1×10^{-9}	4×10^{-5}
		I	2×10^{-8}	1×10^{-3}	7×10^{-10}	4×10^{-5}
Technetium (43)	Tc 96m	S	8×10^{-5}	4×10^{-1}	3×10^{-6}	1×10^{-2}
		I	3×10^{-5}	3×10^{-1}	1×10^{-6}	1×10^{-2}
	Tc 96	S	6×10^{-7}	3×10^{-3}	2×10^{-8}	1×10^{-4}
		I	2×10^{-7}	1×10^{-3}	8×10^{-9}	5×10^{-5}
	Tc 97m	S	2×10^{-6}	1×10^{-2}	8×10^{-8}	4×10^{-4}
		I	2×10^{-7}	5×10^{-3}	5×10^{-9}	2×10^{-4}
	Tc 97	S	1×10^{-5}	5×10^{-2}	4×10^{-7}	2×10^{-3}
		I	3×10^{-7}	2×10^{-2}	1×10^{-8}	8×10^{-4}
	Tc 99m	S	4×10^{-5}	2×10^{-1}	1×10^{-6}	6×10^{-3}
		I	1×10^{-5}	8×10^{-2}	5×10^{-7}	3×10^{-3}
	Tc 99	S	2×10^{-6}	1×10^{-2}	7×10^{-8}	3×10^{-4}
		I	6×10^{-8}	5×10^{-3}	2×10^{-9}	2×10^{-4}
Tellurium (52)	Te 125m	S	4×10^{-7}	5×10^{-3}	1×10^{-8}	2×10^{-4}
		I	1×10^{-7}	3×10^{-3}	4×10^{-9}	1×10^{-4}
	Te 127m	S	1×10^{-7}	2×10^{-3}	5×10^{-9}	6×10^{-5}
		I	4×10^{-8}	2×10^{-3}	1×10^{-9}	5×10^{-5}
	Te 127	S	2×10^{-6}	8×10^{-3}	6×10^{-8}	3×10^{-4}
		I	9×10^{-7}	5×10^{-3}	3×10^{-8}	2×10^{-4}
	Te 129m	S	8×10^{-8}	1×10^{-3}	3×10^{-9}	3×10^{-5}
		I	3×10^{-8}	6×10^{-4}	1×10^{-9}	2×10^{-5}
	Te 129	S	5×10^{-6}	2×10^{-2}	2×10^{-7}	8×10^{-4}
		I	4×10^{-6}	2×10^{-2}	1×10^{-7}	8×10^{-4}
	Te 131m	S	4×10^{-7}	2×10^{-3}	1×10^{-8}	6×10^{-5}
		I	2×10^{-7}	1×10^{-3}	6×10^{-9}	4×10^{-5}
	Te 132	S	2×10^{-7}	9×10^{-4}	7×10^{-9}	3×10^{-5}
		I	1×10^{-7}	6×10^{-4}	4×10^{-9}	2×10^{-5}
Terbium (65)	Tb 160	S	1×10^{-7}	1×10^{-3}	3×10^{-9}	4×10^{-5}
		I	3×10^{-8}	1×10^{-3}	1×10^{-9}	4×10^{-5}
Thallium (81)	Tl 200	S	3×10^{-6}	1×10^{-2}	9×10^{-8}	4×10^{-4}
		I	1×10^{-6}	7×10^{-3}	4×10^{-8}	2×10^{-4}
	Tl 201	S	2×10^{-6}	9×10^{-3}	7×10^{-8}	3×10^{-4}
		I	9×10^{-7}	5×10^{-3}	3×10^{-8}	2×10^{-4}
	Tl 202	S	8×10^{-7}	4×10^{-3}	3×10^{-8}	1×10^{-4}
		I	2×10^{-7}	2×10^{-3}	8×10^{-9}	7×10^{-5}
	Tl 204	S	6×10^{-7}	3×10^{-3}	2×10^{-8}	1×10^{-4}
		I	3×10^{-8}	2×10^{-3}	9×10^{-10}	6×10^{-5}

CONCENTRATIONS IN AIR AND WATER ABOVE NATURAL BACKGROUND—continued

[See notes at end of appendix]

Element (atomic number)	Isotope[1]		Table I Column 1 Air (μc/ml)	Table I Column 2 Water (μc/ml)	Table II Column 1 Air (μc/ml)	Table II Column 2 Water (μc/ml)
Thorium (90)	Th 228	S	9×10^{-12}	2×10^{-4}	3×10^{-13}	7×10^{-6}
		I	6×10^{-12}	4×10^{-4}	2×10^{-13}	10^{-5}
	Th 230	S	2×10^{-12}	5×10^{-5}	8×10^{-14}	2×10^{-6}
		I	10^{-11}	9×10^{-4}	3×10^{-13}	3×10^{-5}
	Th 232	S	3×10^{-11}	5×10^{-5}	10^{-12}	2×10^{-6}
		I	3×10^{-11}	10^{-3}	10^{-12}	4×10^{-5}
	Th natural	S	3×10^{-11}	3×10^{-5}	10^{-12}	10^{-6}
		I	3×10^{-11}	3×10^{-4}	10^{-12}	10^{-5}
	Th 234	S	6×10^{-8}	6×10^{-4}	2×10^{-9}	2×10^{-5}
		I	3×10^{-8}	5×10^{-4}	10^{-9}	2×10^{-5}
Thulium (69)	Tm 170	S	4×10^{-8}	1×10^{-3}	1×10^{-9}	5×10^{-5}
		I	3×10^{-8}	1×10^{-3}	1×10^{-9}	5×10^{-5}
	Tm 171	S	1×10^{-7}	1×10^{-2}	4×10^{-9}	5×10^{-4}
		I	2×10^{-7}	1×10^{-2}	8×10^{-9}	5×10^{-4}
Tin (50)	Sn 113	S	4×10^{-7}	2×10^{-3}	1×10^{-8}	9×10^{-5}
		I	5×10^{-8}	2×10^{-3}	2×10^{-9}	8×10^{-5}
	Sn 125	S	1×10^{-7}	5×10^{-4}	4×10^{-9}	2×10^{-5}
		I	8×10^{-8}	5×10^{-4}	3×10^{-9}	2×10^{-5}
Tungsten (Wolfram) (74)	W 181	S	2×10^{-6}	1×10^{-2}	8×10^{-8}	4×10^{-4}
		I	1×10^{-7}	1×10^{-2}	4×10^{-9}	3×10^{-4}
	W 185	S	8×10^{-7}	4×10^{-3}	4×10^{-8}	1×10^{-4}
		I	1×10^{-7}	3×10^{-3}	4×10^{-9}	1×10^{-4}
	W 187	S	4×10^{-7}	2×10^{-3}	2×10^{-8}	7×10^{-5}
		I	3×10^{-7}	2×10^{-3}	1×10^{-8}	6×10^{-5}
Uranium (92)	U 230	S	3×10^{-10}	1×10^{-4}	1×10^{-11}	5×10^{-6}
		I	1×10^{-10}	1×10^{-4}	4×10^{-12}	5×10^{-6}
	U 232	S	1×10^{-10}	8×10^{-4}	3×10^{-12}	3×10^{-5}
		I	3×10^{-11}	8×10^{-4}	9×10^{-13}	3×10^{-5}
	U 233	S	5×10^{-10}	9×10^{-4}	2×10^{-11}	3×10^{-5}
		I	1×10^{-10}	9×10^{-4}	4×10^{-12}	3×10^{-5}
	U 234	S	6×10^{-10}	9×10^{-4}	2×10^{-11}	3×10^{-5}
		I	1×10^{-10}	9×10^{-4}	4×10^{-12}	3×10^{-5}
	U 235	S	5×10^{-10}	8×10^{-4}	2×10^{-11}	3×10^{-5}
		I	1×10^{-10}	8×10^{-4}	4×10^{-12}	3×10^{-5}
	U 236	S	6×10^{-10}	1×10^{-3}	2×10^{-11}	3×10^{-5}
		I	1×10^{-10}	1×10^{-3}	4×10^{-12}	3×10^{-5}
	U 238	S	7×10^{-11}	1×10^{-3}	3×10^{-12}	4×10^{-5}
		I	1×10^{-10}	1×10^{-3}	5×10^{-12}	4×10^{-5}
*	U 240	S	2×10^{-7}	1×10^{-3}	8×10^{-9}	3×10^{-5}
		I	2×10^{-7}	1×10^{-3}	6×10^{-9}	3×10^{-5}
	U-natural	S	7×10^{-11}	5×10^{-4}	3×10^{-12}	2×10^{-5}
		I	6×10^{-11}	5×10^{-4}	2×10^{-12}	2×10^{-5}
Vanadium (23)	V 48	S	2×10^{-7}	9×10^{-4}	6×10^{-9}	3×10^{-5}
		I	6×10^{-8}	8×10^{-4}	2×10^{-9}	3×10^{-5}
Xenon (54)	Xe 131m	Sub	2×10^{-5}		4×10^{-7}	
	Xe 133	Sub	1×10^{-5}		3×10^{-7}	
*	Xe 133m	Sub	1×10^{-5}		3×10^{-7}	
	Xe 135	Sub	4×10^{-6}		1×10^{-7}	
Ytterbium (70)	Yb 175	S	7×10^{-7}	3×10^{-3}	2×10^{-8}	1×10^{-4}
		I	6×10^{-7}	3×10^{-3}	2×10^{-8}	1×10^{-4}
Yttrium (39)	Y 90	S	1×10^{-7}	6×10^{-4}	4×10^{-9}	2×10^{-5}
		I	1×10^{-7}	6×10^{-4}	3×10^{-9}	2×10^{-5}
	Y 91m	S	2×10^{-5}	1×10^{-1}	8×10^{-7}	3×10^{-3}
		I	2×10^{-5}	1×10^{-1}	6×10^{-7}	3×10^{-3}
	Y 91	S	4×10^{-8}	8×10^{-4}	1×10^{-9}	3×10^{-5}
		I	3×10^{-8}	8×10^{-4}	1×10^{-9}	3×10^{-5}
	Y 92	S	4×10^{-7}	2×10^{-3}	1×10^{-8}	6×10^{-5}
		I	3×10^{-7}	2×10^{-3}	1×10^{-8}	6×10^{-5}
	Y 93	S	2×10^{-7}	8×10^{-4}	6×10^{-9}	3×10^{-5}
		I	1×10^{-7}	8×10^{-4}	5×10^{-9}	3×10^{-5}
Zinc (30)	Zn 65	S	1×10^{-7}	3×10^{-3}	4×10^{-9}	1×10^{-4}
		I	6×10^{-8}	5×10^{-3}	2×10^{-9}	2×10^{-4}
	Zn 69m	S	4×10^{-7}	2×10^{-3}	1×10^{-8}	7×10^{-5}
		I	3×10^{-7}	2×10^{-3}	1×10^{-8}	6×10^{-5}
	Zn 69	S	7×10^{-6}	5×10^{-2}	2×10^{-7}	2×10^{-3}
		I	9×10^{-6}	5×10^{-2}	3×10^{-7}	2×10^{-3}

*Added 30 FR 15801

CONCENTRATIONS IN AIR AND WATER ABOVE NATURAL BACKGROUND

[See notes at end of appendix]

Element (atomic number)	Isotope[1]		Table I Column 1 Air (μc/ml)	Table I Column 2 Water (μc/ml)	Table II Column 1 Air (μc/ml)	Table II Column 2 Water (μc/ml)
Zirconium (40)	Zr 93	S	1×10^{-7}	2×10^{-2}	4×10^{-9}	8×10^{-4}
		I	3×10^{-7}	2×10^{-2}	1×10^{-8}	8×10^{-4}
	Zr 95	S	1×10^{-7}	2×10^{-3}	4×10^{-9}	6×10^{-5}
		I	3×10^{-8}	2×10^{-3}	1×10^{-9}	6×10^{-5}
	Zr 97	S	1×10^{-7}	5×10^{-4}	4×10^{-9}	2×10^{-5}
		I	9×10^{-8}	5×10^{-4}	3×10^{-9}	2×10^{-5}
* Any single radionuclide not listed above with decay mode other than alpha emission or spontaneous fission and with radioactive half-life less than 2 hours.		Sub	1×10^{-6}		3×10^{-8}	
* Any single radionuclide not listed above with decay mode other than alpha emission or spontaneous fission and with radioactive half-life greater than 2 hours.			3×10^{-9}	9×10^{-5}	1×10^{-10}	3×10^{-6}
* Any single radionuclide not listed above, which decays by alpha emission or spontaneous fission.			6×10^{-13}	4×10^{-7}	2×10^{-14}	3×10^{-8}

☆ [1] Soluble (S); Insoluble (I).

[2] "Sub" means that values given are for submersion in a semispherical infinite cloud of airborne material.

NOTE. In any case where there is a mixture in air or water of more than one radionuclide, the limiting values for purposes of this Appendix should be determined as follows:

1. If the identity and concentration of each radionuclide in the mixture are known, the limiting values should be derived as follows: Determine, for each radionuclide in the mixture, the ratio between the quantity present in the mixture and the limit otherwise established in Appendix B for the specific radionuclide when not in a mixture. The sum of such ratios for all the radionuclides in the mixture may not exceed "1" (i.e., "unity").

EXAMPLE: If radionuclides A, B, and C are present in concentrations C_A, C_B, and C_C, and if the applicable

MPC's, are MPC_A, and MPC_B, and MPC_C respectively, then the concentrations shall be limited so that the following relationship exists:

$$\frac{C_A}{MPC_A}+\frac{C_B}{MPC_B}+\frac{C_C}{MPC_C}\leq 1$$

☆ 2. If either the identity or the concentration of any radionuclide in the mixture is not known, the limiting values for purposes of Appendix B shall be:

a. For purposes of Table I, Col. 1—6×10^{-13}
b. For purposes of Table I, Col. 2—4×10^{-7}
c. For purposes of Table II, Col. 1—2×10^{-14}
d. For purposes of Table II, Col. 2—3×10^{-8}

26 FR 11046

3. If any of the conditions specified below are met, the corresponding values specified below may be used in lieu of those specified in paragraph 2 above.

a. If the identity of each radionuclide in the mixture is known but the concentration of one or more of the radionuclides in the mixture is not known, the concentration limit for the mixture is the limit specified in Appendix "B" for the radionuclide in the mixture having the lowest concentration limit; or

b. If the identity of each radionuclide in the mixture is not known, but it is known that certain radionuclides specified in Appendix "B" are not present in the mixture, the concentration limit for the mixture is the lowest concentration limit specified in Appendix "B" for any radionuclide which is not known to be absent from the mixture; or

30 FR 15801

c. Element (atomic number) and isotope	Table I		Table II	
	Column 1 Air (μc/ml)	Column 2 Water (μc/ml)	Column 1 Air (μc/ml)	Column 2 Water (μc/ml)
If it is known that Sr 90, I 125, I 126, I 129, I 131, (I 133, table II only), Pb 210, Po 210, At 211, Ra 223, Ra 224, Ra 226, Ac 227, Ra 228, Th 230, Pa 231, Th 232, Th-nat, Cm 248, Cf 254, and Fm 256 are not present	....	9×10^{-5}	....	3×10^{-6}
If it is known that Sr 90, I 125, I 126, I 129, (I 131, I 133, table II only), Pb 210, Po 210, Ra 223, Ra 226, Ra 228, Pa 231, Th-nat, Cm 248, Cf 254, and Fm 256 are not present	....	6×10^{-5}	....	2×10^{-6}
If it is known that Sr 90, I 129, (I 125, I 126, I 131, table II only), Pb 210, Ra 226, Ra 228, Cm 248, and Cf 254 are not present	....	2×10^{-4}	....	6×10^{-6}
If it is known that (I 129, table II only), Ra 226, and Ra 228 are not present	....	3×10^{-3}	....	1×10^{-4}
☆☆ If it is known that alpha-emitters and Sr 90, I 129, Pb 210, Ac 227, Ra 228, Pa 230, Pu 240, and Bk 240 are not present	3×10^{-9}	....	1×10^{-10}	....
If it is known that alpha-emitters and Pb 210, Ac 227, Ra 228, and Pu 241 are not present	3×10^{-10}	....	1×10^{-11}	....
If it is known that alpha-emitters and Ac 227 are not present	3×10^{-11}	....	1×10^{-12}	....
If it is known that Ac 227, Th 230, Pa 231, Pu 238, Pu 239, Pu 240, Pu 242, Pu 244, Cm 248, Cf 249 and Cf 251 are not present	3×10^{-12}	....	1×10^{-13}	....

25 FR 13952

4. If the mixture of radionuclides consists of uranium and its daughter products in ore dust prior to chemical processing of the uranium ore, the values specified below may be used in lieu of those determined in accordance with paragraph 1 above or those specified in paragraphs 2 and 3 above.

a. For purposes of Table I, Col. 1—1×10^{-10} μc/ml gross alpha activity; or 2.5×10^{-11} μc/ml natural uranium; or 75 micrograms per cubic meter of air natural uranium.

b. For purposes of Table II, Col. 1—3×10^{-12} μc/ml gross alpha activity; or 8×10^{-13} μc/ml natural uranium; or 3 micrograms per cubic meter of air natural uranium.

26 FR 11046

5. For purposes of this note, a radionuclide may be considered as not present in a mixture if (a) the ratio of the concentration of that radionuclide in the mixture (C_A) to the concentration limit for that radionuclide specified in Table II of Appendix "B" (MPC_A) does not exceed 1/10, (i.e. $\frac{C_A}{MPC_A}\leq\frac{1}{10}$) and (b) the sum of such ratios for all the radionuclides considered as not present in the mixture does not exceed ¼ i.e.

$$\frac{C_A}{MPC_A}+\frac{C_B}{MPC_B}+\ldots\ldots\leq\frac{1}{4}).$$

*Revised 30 FR 15801
**ERRATUM: This line should read:
"210, Ac 227, Ra 228, Pa 230, Pu 241, and Bk 249 are not"

Appendix B from 25 FR 10914 except as otherwise noted.

APPENDIX C

Material	Microcuries
Ag^{105}	1
Ag^{111}	10
As^{76}, As^{77}	10
Au^{198}	10
Au^{199}	10
$Ba^{140}+La^{140}$	1
Be^{7}	50
C^{14}	50
Ca^{45}	10
$Cd^{109}+Ag^{109}$	10
$Ce^{144}+Pr^{144}$	1
Cl^{36}	1
Co^{60}	1
Cr^{51}	50
$Cs^{137}+Ba^{137}$	1
Cu^{64}	50
Eu^{154}	1
F^{18}	50
Fe^{55}	50
Fe^{59}	1
Ga^{72}	10
Ge^{71}	50
H^{3}(HTO or $H^{3}_{2}O$)	250
I^{131}	10
In^{114}	1
Ir^{192}	10
K^{42}	10
La^{140}	10
Mn^{52}	1
Mn^{54}	50
Mo^{99}	10
Na^{22}	10
Na^{24}	10
Nb^{95}	10
Ni^{59}	1
Ni^{63}	1
P^{32}	10
$Pd^{103}+Rh^{103}$	50
Pd^{109}	10
Pm^{147}	10
Po^{210}	0.1
Pr^{143}	10
Pu^{239}	1
Ra^{226}	0.1
Rb^{86}	10
Re^{186}	10
Rh^{105}	10
$Ru^{106}+Rh^{106}$	1
S^{35}	50
Sb^{124}	1
Sc^{46}	1
Sm^{153}	10
Sn^{113}	10
Sr^{89}	1
$Sr^{90}+Y^{90}$	0.1
Ta^{182}	10
Tc^{96}	1
Tc^{99}	1
Te^{127}	10
Te^{129}	1
Th (natural)	50
Tl^{204}	50
Tritium. See H^{3}	250
U (natural)	50
U^{233}	1
U^{234}-U^{235}	50
V^{48}	1
W^{185}	10
Y^{90}	1
Y^{91}	1
Zn^{65}	10
Unidentified radioactive materials or any of the above in unknown mixtures	0.1

NOTE: For purposes of §§ 20.203 and 20.304, where there is involved a combination of isotopes in known amounts the limit for the combination should be derived as follows: Determine, for each isotope in the combination, the ratio between the quantity present in the combination and the limit otherwise established for the specific isotope when not in combination. The sum of such ratios for all the isotopes in the combination may not exceed "1" (i.e., "unity").

EXAMPLE: For purposes of § 20.304, if a particular batch contains 2,000 μc of Au^{198} and 25,000 μc of C^{14}, it may also include not more than 3,000 μc of I^{131}. This limit was determined as follows:

$$\frac{2{,}000\ \mu c\ Au^{198}}{10{,}000\ \mu c}+\frac{25{,}000\ \mu c\ C^{14}}{50{,}000\ \mu c}+\frac{3{,}000\ \mu c\ I^{131}}{10{,}000\ \mu c}=1$$

The denominator in each of the above ratios was obtained by multiplying the figure in the table by 1,000 as provided in § 20.304.

APPENDIX D

UNITED STATES ATOMIC ENERGY COMMISSION

COMPLIANCE OFFICES

Region
I
Connecticut, Delaware, District of Columbia, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, and Vermont.
II
Alabama, Arkansas, Florida, Georgia, Kentucky, Louisiana, Mississippi, North Carolina, Panama Canal Zone, Puerto Rico, South Carolina, Tennessee, Virginia, Virgin Islands, and West Virginia.
III
Illinois, Indiana, Iowa, Michigan, Minnesota, Missouri, Ohio, and Wisconsin.
IV
Colorado, Idaho, Kansas, Montana, Nebraska, New Mexico, North Dakota, Oklahoma, South Dakota, Texas, Utah, and Wyoming.
V
Alaska, Arizona, California, Hawaii, Nevada, Oregon, Washington and U.S. territories and possessions in the Pacific.

Address	Telephone	
	Daytime	Nights and holidays
Region I, Division of Compliance, USAEC, 376 Hudson St., New York, N.Y., 10014	212-989-1000	212-989-1000
Region II, Division of Compliance, USAEC, 50 7th St. NE., Atlanta, Ga., 30323	404-526-5791	404-526-5791
Region III, Division of Compliance, USAEC, Suite 410, Oakbrook Professional Bldg., Oak Brook, Ill., 60523	312-654-1690	312-739-7711
Region IV, Division of Compliance, USAEC, 10395 West Colfax Ave., Denver, Colo., 80215	303-297-4211	303-237-5095
Region V, Division of Compliance, USAEC, 2111 Bancroft Way, Berkeley, Calif., 94704	415-841-5620	415-841-5620

31 FR 4668

NOTE: The record keeping and reporting requirements contained in this part have been approved by the Bureau of the Budget in accordance with the Federal Reports Act of 1942.

Appendix C from 25 FR 10914.

Appendix D from 27 FR 10826.

UNITED STATES ATOMIC ENERGY COMMISSION

RULES and REGULATIONS ○ TITLE 10 - ATOMIC ENERGY

PART 34

LICENSES FOR RADIOGRAPHY AND RADIATION SAFETY REQUIREMENTS FOR RADIOGRAPHIC OPERATIONS

30 FR 8185

§ 34.1 Purpose and scope.

This part prescribes requirements for the issuance of licenses for the use of sealed sources containing byproduct material and radiation safety requirements for persons using such sealed sources in radiography. The provisions and requirements of this part are in addition to, and not in substitution for, other requirements of this chapter. In particular, the provisions of Part 30 of this chapter apply to applications and licenses subject to this part. Nothing in this part shall apply to uses of byproduct material for medical diagnosis or therapy.

§ 34.2 Definitions.

As used in this part:

(a) "Radiography" means the examination of the structure of materials by nondestructive methods, utilizing sealed sources of byproduct materials;

(b) "Radiographer" means any individual who performs or who, in attendance at the site where the sealed source or sources are being used, personally supervises radiographic operations and who is responsible to the licensee for assuring compliance with the requirements of the Commission's regulations and the conditions of the license;

(c) "Radiographer's assistant" means any individual who, under the personal supervision of a radiographer, uses radiographic exposure devices, sealed sources or related handling tools, or radiation survey instruments in radiography;

(d) "Radiographic exposure device" means any instrument containing a sealed source fastened or contained therein, in which the sealed source or shielding thereof may be moved, or otherwise changed, from a shielded to unshielded position for purposes of making a radiographic exposure;

(e) "Sealed source" means any byproduct material that is encased in a capsule designed to prevent leakage or escape of the byproduct material;

(f) "Storage container" means a device in which sealed sources are transported or stored.

§ 34.3 Applications for specific licenses.

Applications for specific licenses for use of sealed sources in radiography shall be filed on Form AEC 313R, "Application for Byproduct Material License—Use of Sealed Sources in Radiography."

Subpart A—Specific Licensing Requirements

§ 34.11 Issuance of specific licenses for use of sealed sources in radiography.

An application for a specific license for use of sealed sources in radiography will be approved if:

(a) The applicant satisfies the general requirements specified in § 30.33 of this chapter;

(b) The applicant will have an adequate program for training radiographers and radiographers' assistants and submits to the Commission a schedule or description of such program which specifies the:

(1) Initial training;

(2) Periodic training;

(3) On-the-job training;

(4) Means to be used by the licensee to determine the radiographer's knowledge and understanding of and ability to comply with Commission regulations and licensing requirements, and the operating and emergency procedures of the applicant; and

(5) Means to be used by the licensee to determine the radiographer's assistant's knowledge and understanding of and ability to comply with the operating and emergency procedures of the applicant;

(c) The applicant has established and submits to the Commission satisfactory written operating and emergency procedures as described in § 34.32;

(d) The applicant will have an adequate internal inspection system, or other management control, to assure that Commission license provisions, Commission regulations, and the applicant's operating and emergency procedures are followed by radiographers and radiographers' assistants;

(e) The applicant submits a description of its over-all organizational structure pertaining to the radiography program, including specified delegations of authority and responsibility for operation of the program; and

(f) The applicant who desires to conduct his own leak tests has established adequate procedures to be followed in leak testing sealed sources, for possible leakage and contamination and submits to the Commission a description of such procedures including:

(1) Instrumentation to be used,

(2) Method of performing test, e.g., points on equipment to be smeared and method of taking smear, and

(3) Pertinent experience of the person who will perform the test.

Subpart B—Radiation Safety Requirements

EQUIPMENT CONTROL

§ 34.21 Limits on levels of radiation for radiographic exposure devices and storage containers.

Radiographic exposure devices measuring less than four (4) inches from the sealed source storage position to any exterior surface of the device shall have no radiation level in excess of 50 milliroentgens per hour at six (6) inches from any exterior surface of the device. Radiographic exposure devices measuring a minimum of four (4) inches from the sealed source storage position to any exterior surface of the device, and all storage containers for sealed sources or for radiographic exposure devices, shall have no radiation level in excess of 200 milliroentgens per hour at any exterior surface, and ten (10) milliroentgens per hour at one meter from any exterior surface. The radiation levels specified are with the sealed source in the shielded (i.e., "off") position.

§ 34.22 Locking of radiographic exposure devices and storage containers.

30 FR 8185

Each radiographic exposure device shall be provided with a lock or outer locked container designed to prevent unauthorized or accidental removal or exposure of a sealed source and shall be kept locked at all times except when under the direct surveillance of a radiographer or radiographer's assistant, or as may be otherwise authorized pursuant to § 34.41. Each storage container likewise shall be provided with a lock and kept locked when containing sealed sources except when the container is under the direct surveillance of a radiographer or radiographer's assistant.

§ 34.23 Storage precautions.

Locked radiographic exposure devices and storage containers shall be physically secured to prevent tampering or removal by unauthorized personnel.

§ 34.24 Radiation survey instruments.

The licensee shall maintain sufficient calibrated and operable radiation survey instruments to make physical radiation surveys as required by this part and Part 20 of this chapter. Each radiation survey instrument shall be calibrated at intervals not to exceed three (3) months and after each instrument servicing and a record maintained of the latest date of calibration. Instrumentation required by this section shall have a range such that two milliroentgens per hour through one roentgen per hour can be measured.

§ 34.25 Leak testing, repair, tagging, opening, modification and replacement of sealed sources.

(a) The replacement of any sealed source fastened to or contained in a radiographic exposure device and leak testing, repair, tagging, opening or any other modification of any sealed source shall be performed only by persons specifically authorized by the Commission to do so.

(b) Each sealed source shall be tested for leakage at intervals not to exceed 6 months. In the absence of a certificate from a transferor that a test has been made within the 6 months prior to the transfer, the sealed source shall not be put into use until tested.

(c) The leak test shall be capable of detecting the presence of 0.005 microcurie of removable contamination on the sealed source. An acceptable leak test for sealed sources in the possession of a radiography licensee would be to test at the nearest accessible point to the sealed source storage position, or other appropriate measuring point, by a procedure to be approved pursuant to § 34.11 (f). Records of leak test results shall be kept in units of microcuries and maintained for inspection by the Commission.

(d) Any test conducted pursuant to paragraphs (b) and (c) of this section which reveals the presence of 0.005 microcurie or more of removable radioactive material shall be considered evidence that the sealed source is leaking. The licensee shall immediately withdraw the equipment involved from use and shall cause it to be decontaminated and repaired or to be disposed of, in accordance with Commission regulations. A report shall be filed, within 5 days of the test, with the Director, Division of Materials Licensing, U.S. Atomic Energy Commission, Washington, D.C., 20545, describing the equipment involved, the test results, and the corrective action taken. A copy of such report shall be sent to the Director of the appropriate Atomic Energy Commission Regional Compliance Office listed in Appendix D of Part 20 of this chapter "Standards for Protection Against Radiation."

(e) A sealed source which is not fastened to or contained in a radiographic exposure device shall have permanently attached to it a durable tag at least one (1) inch square bearing the prescribed radiation caution symbol in conventional colors, magenta or purple on a yellow background, and at least the instructions: "Danger—Radioactive Material—Do Not Handle—Notify Civil Authorities if Found."

§ 34.26 Quarterly inventory.

Each licensee shall conduct a quarterly physical inventory to account for all sealed sources received and possessed under his license. The records of the inventories shall be maintained for inspection by the Commission, and shall include the quantities and kinds of byproduct material, location of sealed sources, and the date of the inventory.

§ 34.27 Utilization logs.

Each licensee shall maintain current logs, which shall be kept available for inspection by the Commission at the address specified in the license, showing for each sealed source the following information:

(a) A description (or make and model number) of the radiographic exposure device or storage container in which the sealed source is located;

(b) The identity of the radiographer to whom assigned; and

(c) The plant or site where used and dates of use.

PERSONAL RADIATION SAFETY REQUIREMENTS FOR RADIOGRAPHERS AND RADIOGRAPHERS' ASSISTANTS

§ 34.31 Limitations.

(a) The licensee shall not permit any person to act as a radiographer until such person:

(1) Has been instructed in the subjects outlined in Appendix A of this part and shall have demonstrated understanding thereof;

(2) Has received copies of and instruction in the regulations contained in this part and the applicable sections of Part 20 of this chapter, AEC license(s), and the licensee's operating and emergency procedures, and shall have demonstrated understanding thereof; and

(3) Has demonstrated competence to use the radiographic exposure devices, sealed sources, related handling tools and survey instruments which will be employed in his assignment.

(b) The licensee shall not permit any person to act as a radiographer's assistant until such person:

(1) Has received copies of and instructions in the licensee's operating and emergency procedures, and shall have demonstrated understanding thereof; and

(2) Has demonstrated competence to use under the personal supervision of the radiographer the radiographic exposure devices, sealed sources, related handling tools and radiation survey instruments which will be employed in his assignment.

§ 34.32 Operating and emergency procedures.

The licensee's operating and emergency procedures shall include instructions in at least the following:

(a) The handling and use of licensed sealed sources and radiographic exposure devices to be employed such that no person is likely to be exposed to radiation doses in excess of the limits established in Part 20 of this chapter "Standards for Protection Against Radiation";

(b) Methods and occasions for conducting radiation surveys;

(c) Methods for controlling access to radiographic areas;

(d) Methods and occasions for locking and securing radiographic exposure devices, storage containers and sealed sources;

(e) Personnel monitoring and the use of personnel monitoring equipment;

(f) Transporting sealed sources to field locations, including packing of radiographic exposure devices and storage containers in the vehicles, posting of vehicles and control of the sealed sources during transportation;

(g) Minimizing exposure of persons in the event of an accident;

(h) The procedure for notifying proper persons in the event of an accident; and

(i) Maintenance of records.

§ 34.33 Personnel monitoring control.

(a) The licensee shall not permit any person to act as a radiographer or as a radiographer's assistant unless, at all times during radiographic operations, each such person shall wear a film badge and either a pocket dosimeter or pocket chamber. Pocket dosimeters and pocket chambers shall be capable of measuring doses from zero to at least 200 milliroentgens. A film badge shall be assigned to and worn by only one person.

(b) Pocket dosimeters and pocket chambers shall be read and doses recorded daily. A film badge shall be immediately processed if a pocket chamber or pocket dosimeter is discharged beyond its range. The film badge reports received from the film badge processor and records of pocket dosimeter and pocket chamber readings shall be maintained for inspection by the Commission.

30 FR 8185

PRECAUTIONARY PROCEDURES IN RADIOGRAPHIC OPERATIONS

§ 34.41 Security.

During each radiographic operation the radiographer or radiographer's assistant shall maintain a direct surveillance of the operation to protect against unauthorized entry into a high radiation area, as defined in Part 20 of this chapter, except (a) where the high radiation area is equipped with a control device or an alarm system as described in § 20.203(c)(2) of this chapter, or (b) where the high radiation area is locked to protect against unauthorized or accidental entry.

§ 34.42 Posting.

Notwithstanding any provisions in § 20.204(c) of this chapter, areas in which radiography is being performed shall be conspicuously posted as required by § 20.203 (b) and (c)(1) of this chapter.

§ 34.43 Radiation surveys and survey records.

(a) No radiographic operation shall be conducted unless calibrated and operable radiation survey instrumentation as described in § 34.24 is available and used at each site where radiographic exposures are made.

(b) A physical radiation survey shall be made after each radiographic exposure during a radiographic operation to determine that the sealed source has been returned to its shielded condition.

(c) A physical radiation survey shall be made to determine that each sealed source is in its shielded condition prior to securing the radiographic exposure device and storage container as specified in § 34.22.

(d) Records shall be kept of the surveys required by paragraph (c) of this section and maintained for inspection by the Commission.

EXEMPTIONS

§ 34.51 Applications for exemptions.

The Commission may, upon application by any licensee or upon its own initiative, grant such exemptions from the requirements of the regulations in this part as it determines are authorized by law and will not result in undue hazard to life or property.

APPENDIX A

I. Fundamentals of radiation safety.
A. Characteristics of gamma radiation.
B. Units of radiation dose (mrem) and quantity of radioactivity (curie).
C. Hazards of excessive exposure of radiation.
D. Levels of radiation from licensed material.
E. Methods of controlling radiation dose.
1. Working time.
2. Working distances.
3. Shielding.
II. Radiation detection instrumentation to be used.
A. Use of radiation survey instruments.
1. Operation.
2. Calibration.
3. Limitations.
B. Survey techniques.
C. Use of personnel monitoring equipment.
1. Film badges.
2. Pocket dosimeters.
3. Pocket chambers.
III. Radiographic equipment to be used.
A. Remote handling equipment.
B. Radiographic exposure devices.
C. Storage containers.
IV. The requirements of pertinent Federal Regulations.
V. The licensee's written operating and emergency procedures.

CROSS REFERENCE TABLE

New section	Old section
34 1	New
34 2	31 3 (a)-(f)
34 3	New
34 11	30.24(g)
34 21	31.101
34.22	31 102
34 23	31.103
34 24	31.104
34 25	31 105
34 26	31 106
34 27	31 107
34 31	31 201
34 32	31 202
34 33	31.203
34.41	31 301
34 42	31 302
34 43	31 303
34 51	31 401
Appendix A	Appendix A. Part 31

Information
Sheet # 4

Information Sheet
on

RADIOGRAPHY FORMULAS AND EQUATIONS

1. $EF \times D^2 = T$ (Exposure time)

2. $$\frac{T_1}{T_2} = \frac{D_1^2}{D_2^2}$$

3. $$\frac{MAS\ 1}{MAS\ 2} = \frac{D_1^2}{D_2^2}$$

4. $$\frac{I_1}{I_2} = \frac{D_2^2}{D_1^2}$$

5. $$\frac{TS}{D^2} = EF$$

Where:

FF or EF = Film factor or exposure factor
D = Distance (source to film)
I = Radiation intensity
T = Time (exposure time)
TS = Time x source strength

Some rules involving algebraic expressions:

Monomial - Algebraic expression with one term
Binomial - Algebraic expression with two terms
Polynomial - Algebraic expression with two or more terms
Algebraic expressions - Group of literal numbers and symbols that stand for a number
Term - Algebraic expression whose parts are not separated by plus or minus signs
Symbols - Plus, minus signs
Literal number - Letter that stands for a number
Absolute value of a signed number - The value of a signed number
Negative number - Shows minus sign before number
Signed number - Shows plus or minus before number

Information
Sheet # 5

Information Sheet
on
TABLES OF SQUARES AND SQUARE ROOTS OF NUMBERS FROM 1-800

Number	Square	Square root	Number	Square	Square root
1	1	1.0000	41	16 81	6.4031
2	4	1.4142	42	17 64	6.4807
3	9	1.7321	43	18 49	6.5574
4	16	2.0000	44	19 36	6.6332
5	25	2.2361	45	20 25	6.7082
6	36	2.4495	46	21 16	6.7823
7	49	2.6458	47	22 09	6.8557
8	64	2.8284	48	23 04	6.9282
9	81	3.0000	49	24 01	7.0000
10	1 00	3.1623	50	25 00	7.0711
11	1 21	3.3166	51	26 01	7.1414
12	1 44	3.4641	52	27 04	7.2111
13	1 69	3.6056	53	28 09	7.2801
14	1 96	3.7417	54	29 16	7.3485
15	2 25	3.8730	55	30 25	7.4162
16	2 56	4.0000	56	31 36	7.4833
17	2 89	4.1231	57	32 49	7.5498
18	3 24	4.2426	58	33 64	7.6158
19	3 61	4.3589	59	34 81	7.6811
20	4 00	4.4721	60	36 00	7.7460
21	4 41	4.5826	61	37 21	7.8102
22	4 84	4.6904	62	38 44	7.8740
23	5 29	4.7958	63	39 69	7.9373
24	5 76	4.8990	64	40 96	8.0000
25	6 25	5.0000	65	42 25	8.0623
26	6 76	5.0990	66	43 56	8.1240
27	7 29	5.1962	67	44 89	8.1854
28	7 84	5.2915	68	46 [illegible]	8.2462
29	8 41	5.3852	69	47 61	8.3066
30	9 00	5.4772	70	49 00	8.3666
31	9 61	5.5678	71	50 41	8.4261
32	10 24	5.6569	72	51 84	8.4853
33	10 89	5.7446	73	53 29	8.5440
34	11 56	5.8310	74	54 76	8.6023
35	12 25	5.9161	75	56 25	8.6603
36	12 96	6.0000	76	57 76	8.7178
37	13 69	6.0828	77	59 29	8.7750
38	14 44	6.1644	78	60 84	8.8318
39	15 21	6.2450	79	62 41	8.8882
40	16 00	6.3246	80	64 00	8.9443

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Number	Square	Square root	Number	Square	Square root
81	65 61	9.0000	121	1 46 41	11.0000
82	67 24	9.0554	122	1 48 84	11.0454
83	68 89	9.1104	123	1 51 29	11.0905
84	70 56	9.1652	124	1 53 76	11.1355
85	72 25	9.2195	125	1 56 25	11.1803
86	73 96	9.2736	126	1 58 76	11.2250
87	75 69	9.3274	127	1 61 29	11.2694
88	77 44	9.3808	128	1 63 84	11.3137
89	79 21	9.4340	129	1 66 41	11.3578
90	81 00	9.4868	130	1 69 00	11.4018
91	82 81	9.5394	131	1 71 61	11.4455
92	84 64	9.5917	132	1 74 24	11.4891
93	86 49	9.6437	133	1 76 89	11.5326
94	88 36	9.6954	134	1 79 56	11.5758
95	90 25	9.7468	135	1 82 25	11.6190
96	92 16	9.7980	136	1 84 96	11.6619
97	94 09	9.8489	137	1 87 69	11.7047
98	96 04	9.8995	138	1 90 44	11.7473
99	98 01	9.9499	139	1 93 21	11.7898
100	1 00 00	10.0000	140	1 96 00	11.8322
101	1 02 01	10.0499	141	1 98 81	11.8743
102	1 04 04	10.0995	142	2 01 64	11.9164
103	1 06 09	10.1489	143	2 04 49	11.9583
104	1 08 16	10.1980	144	2 07 36	12.0000
105	1 10 25	10.2470	145	2 10 25	12.0416
106	1 12 36	10.2956	146	2 13 16	12.0830
107	1 14 49	10.3441	147	2 16 09	12.1244
108	1 16 64	10.3923	148	2 19 04	12.1655
109	1 18 81	10.4403	149	2 22 01	12.2066
110	1 21 00	10.4881	150	2 25 00	12.2474
111	1 23 21	10.5357	151	2 28 01	12.2882
112	1 25 44	10.5830	152	2 31 04	12.3288
113	1 27 69	10.6301	153	2 34 09	12.3693
114	1 29 96	10.6771	154	2 37 16	12.4097
115	1 32 25	10.7238	155	2 40 25	12.4499
116	1 34 56	10.7703	156	2 43 36	12.4900
117	1 36 89	10.8167	157	2 46 49	12.5300
118	1 39 24	10.8628	158	2 49 64	12.5698
119	1 41 61	10.9087	159	2 52 81	12.6095
120	1 44 00	10.9545	160	2 56 00	12.6491

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Number	Square	Square root	Number	Square	Square root
161	2 59 21	12.6886	201	4 04 01	14.1774
162	2 62 44	12.7279	202	4 08 04	14.2127
163	2 65 69	12.7671	203	4 12 09	14.2478
164	2 68 96	12.8062	204	4 16 16	14.2829
165	2 72 25	12.8452	205	4 20 25	14.3178
166	2 75 56	12.8841	206	4 24 36	14.3527
167	2 78 89	12.9228	207	4 28 49	14.3875
168	2 82 24	12.9615	208	4 32 64	14.4222
169	2 85 61	13.0000	209	4 36 81	14.4568
170	2 89 00	13.0384	210	4 41 00	14.4914
171	2 92 41	13.0767	211	4 45 21	14.5258
172	2 95 84	13.1149	212	4 49 44	14.5602
173	2 99 29	13.1529	213	4 53 69	14.5945
174	3 02 76	13.1909	214	4 57 96	14.6287
175	3 06 25	13.2288	215	4 62 25	14.6629
176	3 09 76	13.2665	216	4 66 56	14.6969
177	3 13 29	13.3041	217	4 70 89	14.7309
178	3 16 84	13.3417	218	4 75 24	14.7648
179	3 20 41	13.3791	219	4 79 61	14.7986
180	3 24 00	13.4164	220	4 84 00	14.8324
181	3 27 61	13.4536	221	4 88 41	14.8661
182	3 31 24	13.4907	222	4 92 84	14.8997
183	3 34 89	13.5277	223	4 97 29	14.9332
184	3 38 56	13.5647	224	5 01 76	14.9666
185	3 42 25	13.6015	225	5 06 25	15.0000
186	3 45 96	13.6382	226	5 10 76	15.0333
187	3 49 69	13.6748	227	5 15 29	15.0665
188	3 53 44	13.7113	228	5 19 84	15.0997
189	3 57 21	13.7477	229	5 24 41	15.1327
190	3 61 00	13.7840	230	5 29 00	15.1658
191	3 64 81	13.8203	231	5 33 61	15.1987
192	3 68 64	13.8564	232	5 38 24	15.2315
193	3 72 49	13.8924	233	5 42 89	15.2643
194	3 76 36	13.9284	234	5 47 56	15.2971
195	3 80 25	13.9642	235	5 52 25	15.3297
196	3 84 16	14.0000	236	5 56 96	15.3623
197	3 88 09	14.0357	237	5 61 69	15.3948
198	3 92 04	14.0712	238	5 66 44	15.4272
199	3 96 01	14.1067	239	5 71 21	15.4596
200	4 00 00	14.1421	240	5 76 00	15.4919

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Number	Square	Square root	Number	Square	Square root
241	5 80 81	15.5242	281	7 89 61	16.7631
242	5 85 64	15.5563	282	7 95 24	16.7929
243	5 90 49	15.5885	283	8 00 89	16.8226
244	5 95 36	15.6205	284	8 06 56	16.8523
245	6 00 25	15.6525	285	8 12 25	16.8819
246	6 05 16	15.6844	286	8 17 96	16.9115
247	6 10 09	15.7162	287	8 23 69	16.9411
248	6 15 04	15.7480	288	8 29 44	16.9706
249	6 20 01	15.7797	289	8 3 [illegible]	17.0000
250	6 25 00	15.8114	290	8 41 00	17.0294
251	6 30 01	15.8430	291	8 46 81	17.0587
252	6 35 04	15.8745	292	8 52 64	17.0880
253	6 40 09	15.9060	293	8 58 49	17.1172
254	6 45 16	15.9374	294	8 64 36	17.1464
255	6 50 25	15.9687	295	8 70 25	17.1756
256	6 55 36	16.0000	296	8 76 16	17.2047
257	6 60 49	16.0312	297	8 82 09	17.2337
258	6 65 64	16.0624	298	8 88 04	17.2627
259	6 70 81	16.0935	299	8 94 01	17.2916
260	6 76 00	16.1245	300	9 00 00	17.3205
261	6 81 21	16.1555	301	9 06 01	17.3494
262	6 86 44	16.1864	302	9 12 04	17.3781
263	6 91 69	16.2173	303	9 18 09	17.4069
264	6 96 96	16.2481	304	9 24 16	17.4356
265	7 02 25	16.2788	305	9 30 25	17.4642
266	7 07 56	16.3095	306	9 36 36	17.4929
267	7 12 89	16.3401	307	9 42 49	17.5214
268	7 18 24	16.3707	308	9 48 64	17.5499
269	7 23 61	16.4012	309	9 54 81	17.5784
270	7 29 00	16.4317	310	9 61 00	17.6068
271	7 34 41	16.4621	311	9 67 21	17.6352
272	7 39 84	16.4924	312	9 73 44	17.6635
273	7 45 29	16.5227	313	9 79 69	17.6918
274	7 50 76	16.5529	314	9 85 96	17.7200
275	7 56 25	16.5831	315	9 92 25	17.7482
276	7 61 76	16.6132	316	9 98 56	17.7764
277	7 67 29	16.6433	317	10 04 89	17.8045
278	7 72 84	16.6733	318	10 11 24	17.8326
279	7 78 41	16.7033	319	10 17 61	17.8606
280	7 84 00	16.7332	320	10 24 00	17.8885

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Number	Square	Square root	Number	Square	Square root
321	10 30 41	17.9165	361	13 03 21	19.0000
322	10 36 84	17.9444	362	13 10 44	19.0263
323	10 43 29	17.9722	363	13 17 69	19.0526
324	10 49 76	18.0000	364	13 24 96	19.0788
325	10 56 25	18.0278	365	13 32 25	19.1050
326	10 62 76	18.0555	366	13 39 56	19.1311
327	10 69 29	18.0831	367	13 46 89	19.1572
328	10 75 84	18.1108	368	13 54 24	19.1833
329	10 82 41	18.1384	369	13 61 61	19.2094
330	10 89 00	18.1659	370	13 69 00	19.2354
331	10 95 61	18.1934	371	13 76 41	19.2614
332	11 02 24	18.2209	372	13 83 84	19.2873
333	11 08 89	18.2483	373	13 91 29	19.3132
334	11 15 56	18.2757	374	13 98 76	19.3391
335	11 22 25	18.3030	375	14 06 25	19.3649
336	11 28 96	18.3303	376	14 13 76	19.3907
337	11 35 69	18.3576	377	14 21 29	19.4165
338	11 42 44	18.3848	378	14 28 84	19.4422
339	11 49 21	18.4120	379	14 36 41	19.4679
340	11 56 00	18.4391	380	14 44 00	19.4936
341	11 62 81	18.4662	381	14 51 61	19.5192
342	11 69 64	18.4932	382	14 59 24	19.5448
343	11 76 49	18.5203	383	14 66 89	19.5704
344	11 83 36	18.5472	384	14 74 56	19.5959
345	11 90 25	18.5742	385	14 82 25	19.6214
346	11 97 16	18.6011	386	14 89 96	19.6469
347	12 04 09	18.6279	387	14 97 69	19.6723
348	12 11 04	18.6548	388	15 05 44	19.6977
349	12 18 01	18.6815	389	15 13 21	19.7231
350	12 25 00	18.7083	390	15 21 00	19.7484
351	12 32 01	18.7350	391	15 28 81	19.7737
352	12 39 04	18.7617	392	15 36 64	19.7990
353	12 46 09	18.7883	393	15 44 49	19.8242
354	12 53 16	18.8149	394	15 52 36	19.8494
355	12 60 25	18.8414	395	15 60 25	19.8746
356	12 67 36	18.8680	396	15 68 16	19.8997
357	12 74 49	18.8944	397	15 76 09	19.9249
358	12 81 64	18.9209	398	15 84 04	19.9499
359	12 88 81	18.9473	399	15 92 01	19.9750
360	12 96 00	18.9737	400	16 00 00	20.0000

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Number	Square	Square root	Number	Square	Square root
401	16 08 01	20.0250	441	19 44 81	21.0000
402	16 16 04	20.0499	442	19 53 64	21.0238
403	16 24 09	20.0749	443	19 62 49	21.0476
404	16 32 16	20.0998	444	19 71 36	21.0713
405	16 40 25	20.1246	445	19 80 25	21.0950
406	16 48 36	20.1494	446	19 89 16	21.1187
407	16 56 49	20.1742	447	19 98 09	21.1424
408	16 64 64	20.1990	448	20 07 04	21.1660
409	16 72 81	20.2237	449	20 16 01	21.1896
410	16 81 00	20.2485	450	20 25 00	21.2132
411	16 89 21	20.2731	451	20 34 01	21.2368
412	16 97 44	20.2978	452	20 43 04	21.2603
413	17 05 69	20.3224	453	20 52 09	21.2838
414	17 13 96	20.3470	454	20 61 16	21.3073
415	17 22 25	20.3715	455	20 70 25	21.3307
416	17 30 56	20.3961	456	20 79 36	21.3542
417	17 38 89	20.420	457	20 88 49	21.3776
418	17 47 24	20.4450	458	20 97 64	21.4009
419	17 55 61	20.4695	459	21 06 81	21.4243
420	17 64 00	20.4939	460	21 16 00	21.4476
421	17 72 41	20.5183	461	21 25 21	21.4709
422	17 80 84	20.5426	462	21 34 44	21.4942
423	17 89 29	20.5670	463	21 43 69	21.5174
424	17 97 76	20.5913	464	21 52 96	21.5407
425	18 06 25	20.6155	465	21 62 25	21.5639
426	18 14 76	20.6398	466	21 71 56	21.5870
427	18 23 29	20.6640	467	21 80 89	21.6102
428	18 31 84	20.6882	468	21 90 24	21.6333
429	18 40 41	20.7123	469	21 99 61	21.6564
430	18 49 00	20.7364	470	22 09 00	21.6795
431	18 57 61	20.7605	471	22 18 41	21.7025
432	18 66 24	20.7846	472	22 27 84	21.7256
433	18 74 89	20.8087	473	22 37 29	21.7486
434	18 83 56	20.8327	474	22 46 76	21.7715
435	18 92 25	20.8567	475	22 56 25	21.7945
436	19 00 96	20.8806	476	22 65 76	21.8174
437	19 09 69	20.9045	477	22 75 29	21.8403
438	19 18 44	20.9284	478	22 84 84	21.8632
439	19 27 21	20.9523	479	22 94 41	21.8861
440	19 36 00	20.9762	480	23 04 00	21.9089

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Number	Square	Square root	Number	Square	Square root
481	23 13 61	21.9317	521	27 14 41	22.8254
482	23 23 24	21.9545	522	27 24 84	22.8473
483	23 32 89	21.9773	523	27 35 29	22.8692
484	23 42 56	22.0000	524	27 45 76	22.8910
485	23 52 25	22.0227	525	27 56 25	22.9129
486	23 61 96	22.0454	526	27 66 76	22.9347
487	23 71 69	22.0681	527	27 77 29	22.9565
488	23 81 44	22.0907	528	27 87 84	22.9783
489	23 91 21	22.1133	529	27 98 41	23.0000
490	24 01 00	22.1359	530	28 09 00	23.0217
491	24 10 81	22.1585	531	28 19 61	23.0434
492	24 20 64	22.1811	532	28 30 24	23.0651
493	24 30 49	22.2036	533	28 40 89	23.0868
494	24 40 36	22.2261	534	28 51 56	23.1084
495	24 50 25	22.2486	535	28 62 25	23.1301
496	24 60 16	22.2711	536	28 72 96	23.1517
497	24 70 09	22.2935	537	28 83 69	23.1733
498	24 80 04	22.3159	538	28 94 44	23.1948
499	24 90 01	22.3383	539	29 05 21	23.2164
500	25 00 00	22.3607	540	29 16 00	23.2379
501	25 10 01	22.3830	541	29 26 81	23.2594
502	25 20 04	22.4054	542	29 37 64	23.2809
503	25 30 09	22.4277	543	29 48 49	23.3024
504	25 40 16	22.4499	544	29 59 36	23.3238
505	25 50 25	22.4722	545	29 70 25	23.3452
506	25 60 36	22.4944	546	29 81 16	23.3666
507	25 70 49	22.5167	547	29 92 09	23.3880
508	25 80 64	22.5389	548	30 03 04	23.4094
509	25 90 81	22.5610	549	30 14 01	23.4307
510	26 01 00	22.5832	550	30 25 00	23.4521
511	26 11 21	[illegible]	551	30 36 01	23.4734
512	26 21 44	22.6274	552	30 47 04	23.4947
513	26 31 69	22.6495	553	30 58 09	23.5160
514	26 41 96	22.6716	554	30 69 16	23.5372
515	26 52 25	22.6936	555	30 80 25	23.5584
516	26 62 56	22.7156	556	30 91 36	23.5797
517	26 72 89	22.7376	557	31 02 49	23.6008
518	26 83 24	22.7596	558	31 13 64	23.6220
519	26 93 61	22.7816	559	31 24 81	23.6432
520	27 04 00	22.8035	560	31 36 00	23.6643

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Number	Square	Square root	Number	Square	Square root
561	31 47 21	23.6854	601	36 12 01	24.5153
562	31 58 44	23.7065	602	36 24 04	24.5357
563	31 69 69	23.7276	603	36 36 09	24.5561
564	31 80 96	23.7487	604	36 48 16	24.5764
565	31 92 25	23.7697	605	36 60 25	24.5967
566	32 03 56	23.7908	606	36 72 36	24.6171
567	32 14 89	23.8118	607	36 84 49	24.6374
568	32 26 24	23.8328	608	36 96 64	24.6577
569	32 37 61	23.8537	609	37 08 81	24.6779
570	32 49 00	23.8747	610	37 21 00	24.6982
571	32 60 41	23.8956	611	37 33 21	24.7184
572	32 71 84	23.9165	612	37 45 44	24.7385
573	32 83 29	23.9374	613	37 57 69	24.7588
574	32 94 76	23.9583	614	37 69 96	24.7790
575	33 06 25	23.9792	615	37 82 25	24.7992
576	33 17 76	24.0000	616	37 94 56	24.8193
577	33 29 29	24.0208	617	38 06 89	24.8395
578	33 40 84	24.0416	618	38 19 24	24.8596
579	33 52 41	24.0624	619	38 31 61	24.8797
580	33 64 00	24.0832	620	38 44 00	24.8998
581	33 75 61	24.1039	621	38 56 41	24.9199
582	33 87 24	24.1247	622	38 68 84	24.9399
583	33 98 89	24.1454	623	38 81 29	24.9600
584	34 10 56	24.1661	624	38 93 76	24.9800
585	34 22 25	24.1868	625	39 06 25	25.0000
586	34 33 96	24.2074	626	39 18 76	25.0200
587	34 45 69	24.2281	627	39 31 29	25.0400
588	34 57 44	24.2487	628	39 43 84	25.0599
589	34 69 21	24.2693	629	39 56 41	25.0799
590	34 81 00	24.2899	630	39 69 00	25.0998
591	34 92 81	24.3105	631	39 81 61	25.1197
592	35 04 64	24.3311	632	39 94 24	25.1396
593	35 16 49	24.3516	633	40 06 89	25.1595
594	35 28 36	24.3721	634	40 19 56	25.1794
595	35 40 25	24.3926	635	40 32 25	25.1992
596	35 52 16	24.4131	636	40 44 96	25.2190
597	35 64 09	24.4336	637	40 57 69	25.2389
598	35 76 04	24.4540	638	40 70 44	25.2587
599	35 88 01	24.4745	639	40 83 21	25.2784
600	36 00 00	24.4949	640	40 96 00	25.2982

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Number	Square	Square root	Number	Square	Square root
641	41 08 81	25.3180	681	46 37 61	26.0960
642	41 21 64	25.3377	682	46 51 24	26.1151
643	41 34 49	25.3574	683	46 64 89	26.1343
644	41 47 36	25.3772	684	46 78 56	26.1534
645	41 60 25	25.3969	685	46 92 25	26.1725
646	41 73 16	25.4165	686	47 05 96	26.1916
647	41 86 09	25.4362	687	47 19 69	26.2107
648	41 99 04	25.4558	688	47 33 44	26.2298
649	42 12 01	25.4755	689	47 47 21	26.2488
650	42 25 00	25.4951	690	47 61 00	26.2679
651	42 38 01	25.5147	691	47 74 81	26.2869
652	42 51 04	25.5343	692	47 88 64	26.3059
653	42 64 09	25.5539	693	48 02 49	26.3249
654	42 77 16	25.5734	694	48 16 36	26.3439
655	42 90 25	25.5930	695	48 30 25	26.3629
656	43 03 36	25.6125	696	48 44 16	26.3818
657	43 16 49	25.6320	697	48 58 09	26.4008
658	43 29 64	25.6515	698	48 72 04	26.4197
659	43 42 81	25.6710	699	48 86 01	26.4386
660	43 56 00	25.6905	700	49 00 00	26.4575
661	43 69 21	25.7099	701	49 14 01	26.4764
662	43 82 44	25.7294	702	49 28 04	26.4953
663	43 95 69	25.7488	703	49 42 09	26.5141
664	44 08 96	25.7682	704	49 56 16	26.5330
665	44 22 25	25.7876	705	49 70 25	26.5518
666	44 35 56	25.8070	706	49 84 36	26.5707
667	44 48 89	25.8263	707	49 98 49	26.5895
668	44 62 24	25.8457	708	50 12 64	26.6083
669	44 75 61	25.8650	709	50 26 81	26.6271
670	44 89 00	25.8844	710	50 41 00	26.6458
671	45 02 41	25.9037	711	50 55 21	26.6646
672	45 15 84	25.9230	712	50 69 44	26.6833
673	45 29 29	25.9422	713	50 83 69	26.7021
674	45 42 76	25.9615	714	50 97 96	26.7208
675	45 56 25	25.9808	715	51 12 25	26.7395
676	45 69 76	26.0000	716	51 26 56	26.7582
677	45 83 29	26.0192	717	51 40 89	26.7769
678	45 96 84	26.0384	718	51 55 24	26.7955
679	46 10 41	26.0576	719	51 69 61	26.8142
680	46 24 00	26.0768	720	51 84 00	26.8328

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Number	Square	Square root	Number	Square	Square root
721	51 98 41	26.8514	761	57 91 21	27.5862
722	52 12 84	26.8701	762	58 06 44	27.6043
723	52 27 29	26.8887	763	58 21 69	27.6225
724	52 41 76	26.9072	764	58 36 96	27.6405
725	52 56 25	26.9258	765	58 52 25	27.6586
726	52 70 76	26.9444	766	58 67 56	27.6767
727	52 85 29	26.9629	767	58 82 89	27.6948
728	52 99 84	26.9815	768	58 98 24	27.7128
729	53 14 41	27.0000	769	59 13 61	27.7308
730	53 29 00	27.0185	770	59 29 00	27.7489
731	53 43 61	27.0370	771	59 44 41	27.7669
732	53 58 24	27.0555	772	59 59 84	27.7849
733	53 72 89	27.0740	773	59 75 29	27.8029
734	53 87 56	27.0924	774	59 90 76	27.8209
735	54 02 25	27.1109	775	60 06 25	27.8388
736	54 16 96	27.1293	776	60 21 76	27.8568
737	54 31 69	27.1477	777	60 37 29	27.8747
738	54 46 44	27.1662	778	60 52 84	27.8927
739	54 61 27	27.1846	779	60 68 41	27.9106
740	54 76 00	27.2029	780	60 84 00	27.9285
741	54 90 81	27.2213	781	60 99 61	27.9464
742	55 05 64	27.2397	782	61 15 24	27.9643
743	55 20 49	27.2580	783	61 30 89	27.9821
744	55 35 36	27.2764	784	61 46 56	28.0000
745	55 50 25	27.2947	785	61 62 25	28.0179
746	55 65 16	27.3130	786	61 77 96	28.0357
747	55 80 09	27.3313	787	61 93 69	28.0535
748	55 95 04	27.3496	788	62 09 44	28.0713
749	56 10 01	27.3679	789	62 25 21	28.0891
750	56 25 00	27.3861	790	62 41 00	28.1069
751	56 40 01	27.4044	791	62 56 81	28.1247
752	56 55 04	27.4226	792	62 72 64	28.1425
753	56 70 09	27.4408	793	62 88 49	28.1603
754	56 85 16	27.4591	794	63 04 36	28.1780
755	57 00 25	27.4773	795	63 20 25	28.1957
756	57 15 36	27.4955	796	63 36 16	28.2135
757	57 30 49	27.5136	797	63 52 09	28.2312
758	57 45 64	27.5318	798	63 68 04	28.2489
759	57 60 81	27.5500	799	63 84 01	28.2666
760	57 76 00	27.5681	800	64 00 00	28.2843

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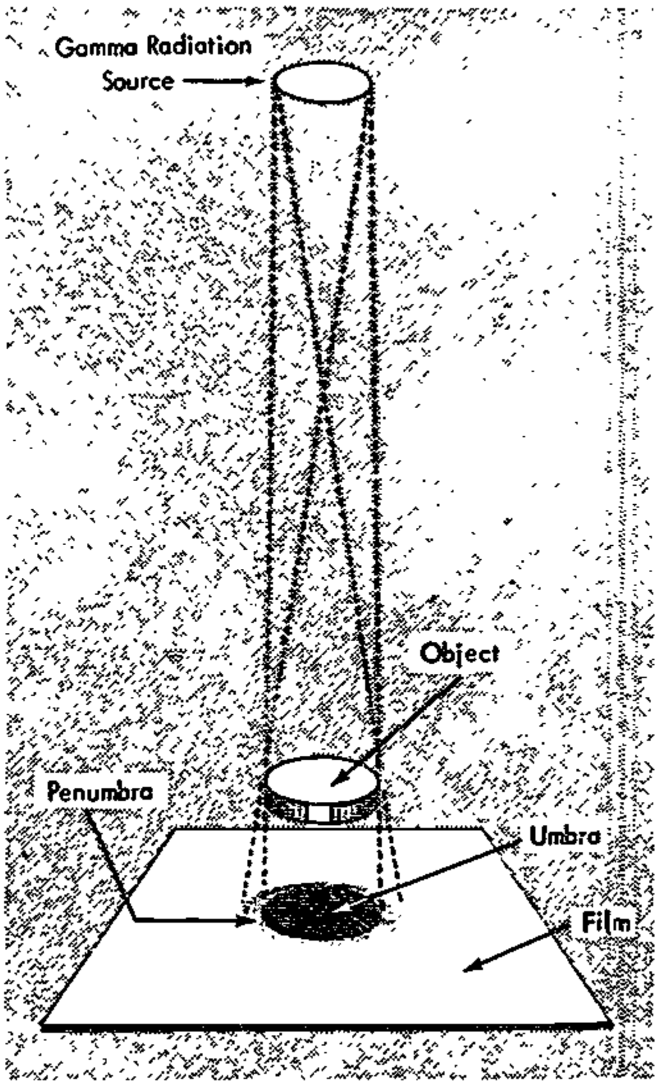
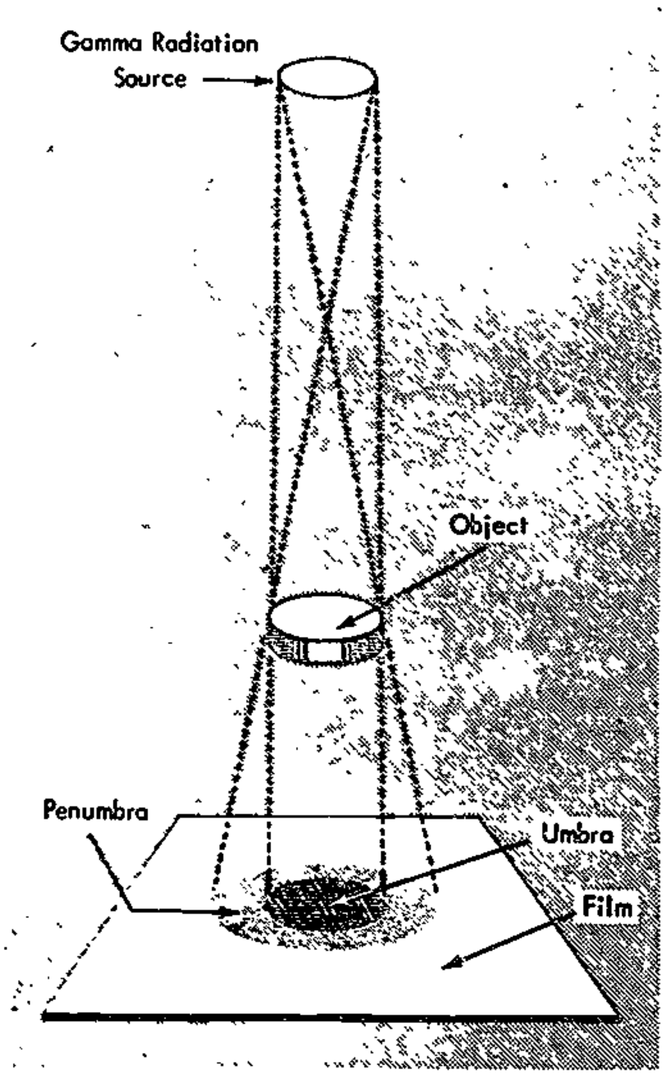
Information
Sheet # 6

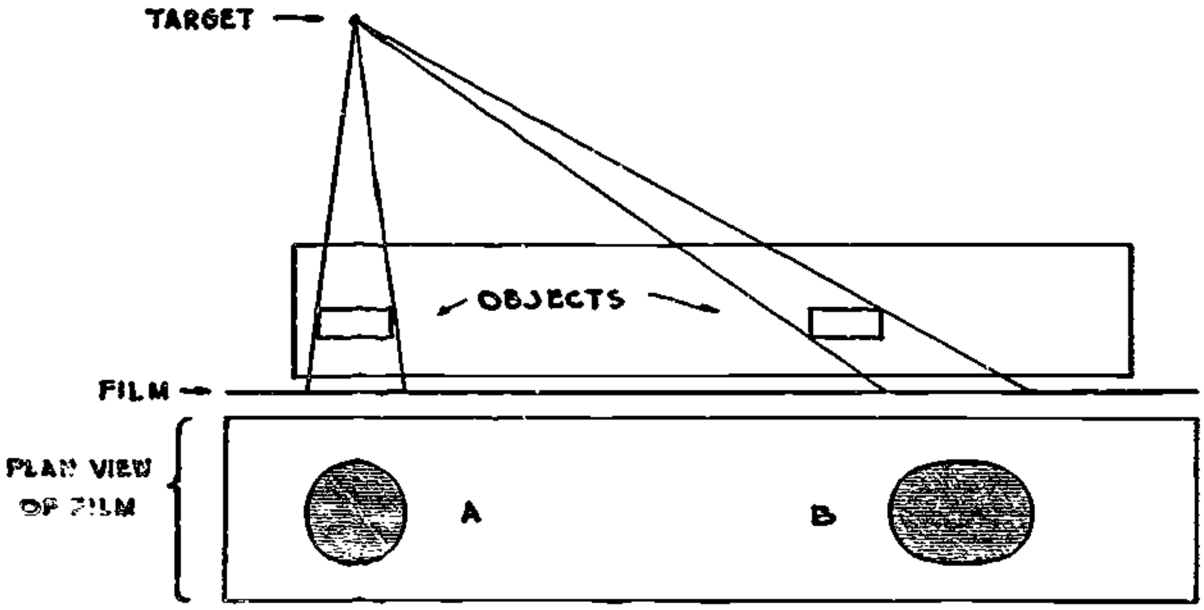
Information Sheet
on
EFFECT OF GEOMETRY ON SHADOW IMAGE



REDUCING THE OBJECT-TO-FILM DISTANCE



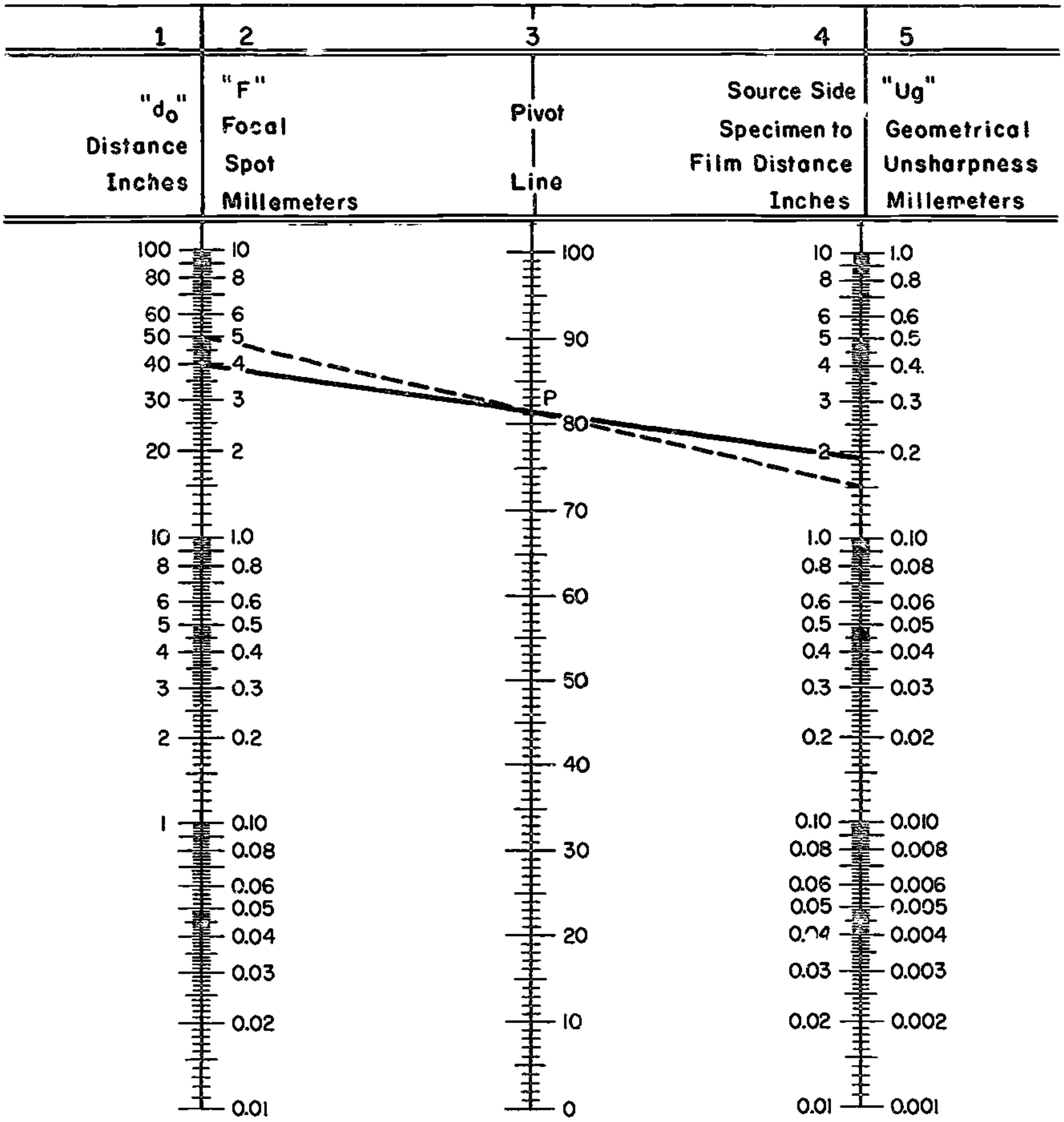
INCREASING THE SOURCE-TO-FILM DISTANCE



DISTORTION RESULTING FROM DIFFERENT FILM ANGLES

Information Sheet # 7

Information Sheet
on
NOMOGRAM FOR DETERMINING GEOMETRIC UNSHARPNESS



Courtesy of The Ronald Press Company (see Reference (4))

Nomogram for Determining Geometric Unsharpness.

Note: 2 to 4 to find 3(Pivot); then 1 through 3(Pivot) to find 5.

Information Sheet
on
SHIELDING EQUATIONS AND LOGARITHMS

Information
Sheet # 8

Logarithmic method of determining half value and tenth value layers

$$N = \text{LOG} \frac{I_1}{I_2}$$

Where:
N= Number of TVL's
I_1 = Intensity of the incident radiation at a point
I_2 = Intensity of the emergent radiation at the same point

$$M = 3.3 \ \text{LOG} \frac{I_1}{I_2}$$

Where:
M= Number of half value layers

THREE-PLACE COMMON LOGARITHMS

Number	.0	.1	.2	.3	.4	.5	.6	.7	.3	.9
1.0	0.000	041	079	114	146	176	204	230	255	279
2.0	0.301	322	342	362	380	398	415	431	447	462
3.0	0.477	491	505	519	532	544	556	568	580	591
4.0	0.602	613	623	634	644	653	663	672	681	690
5.0	0.699	708	716	724	732	740	748	756	763	771
6.0	0.778	785	792	799	806	813	820	826	833	839
7.0	0.845	851	857	863	869	875	881	887	892	898
8.0	0.903	909	914	919	924	929	935	940	945	949
9.0	0.954	959	964	969	973	978	982	987	991	996

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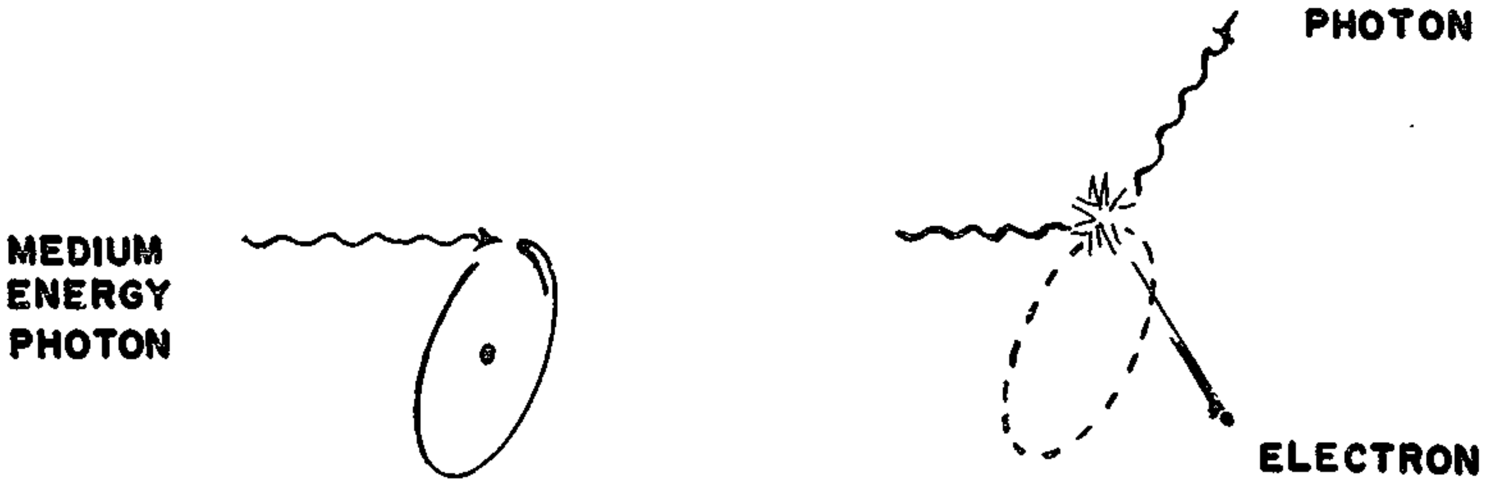
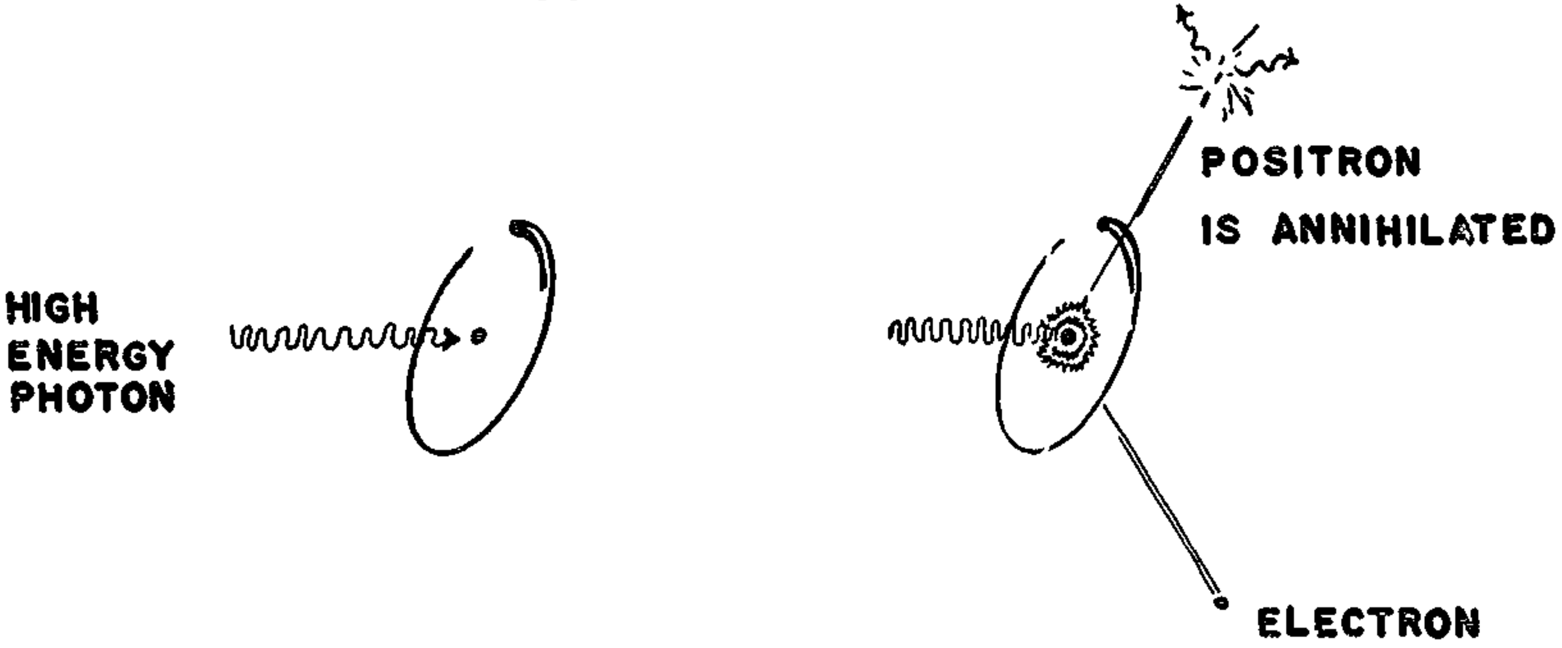
Information Sheet
on

GAMMA RADIATION EFFECT ON MATTER

PHOTOELECTRIC EFFECT



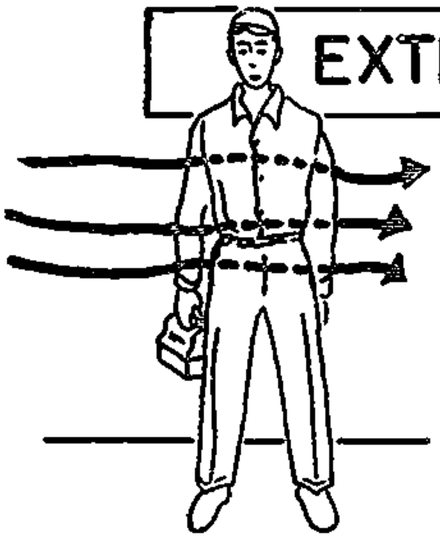
COMPTON EFFECT



PAIR PRODUCTION

Information Sheet
on
PHYSICAL RADIATION EFFECTS

EXTERNAL RADIATION HAZARD



Some radiation goes through the body like X-rays, gamma rays and neutrons. (Beta particles to limited extent.)

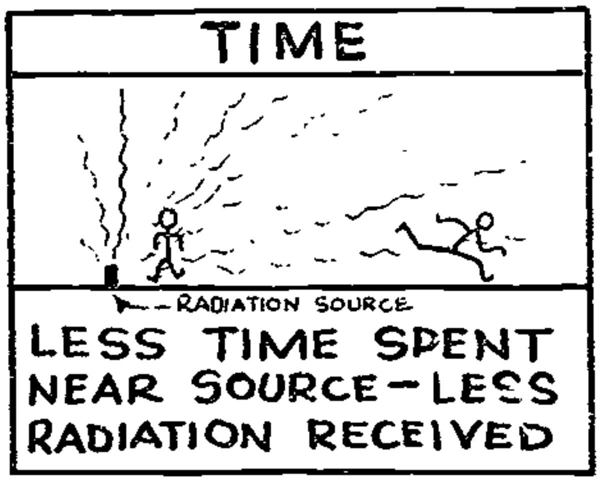
INTERNAL RADIATION HAZARD

We can receive radiation by swallowing or breathing radioactive materials. Includes alpha particles, beta particles and gamma ray emitter.

Information
Sheet # 11

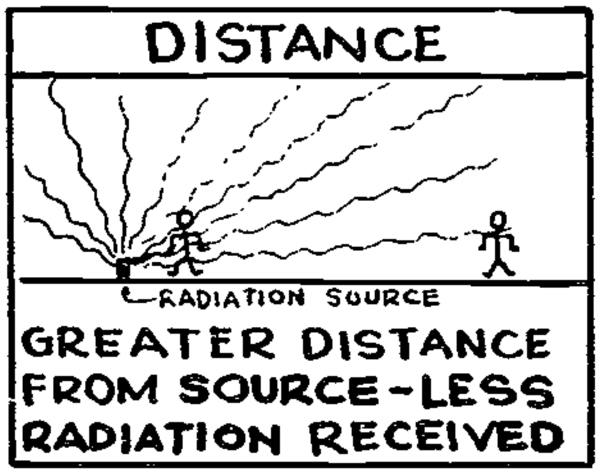
Information Sheet
on
RADIATION PROTECTION FACTORS

1.



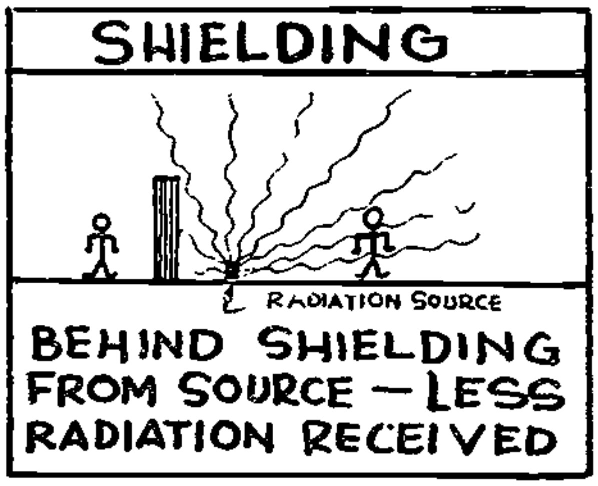
1. Radiation dose directly proportional to time

2.



2. Intensity of radiation is proportional to the inverse square law of the distance from the source

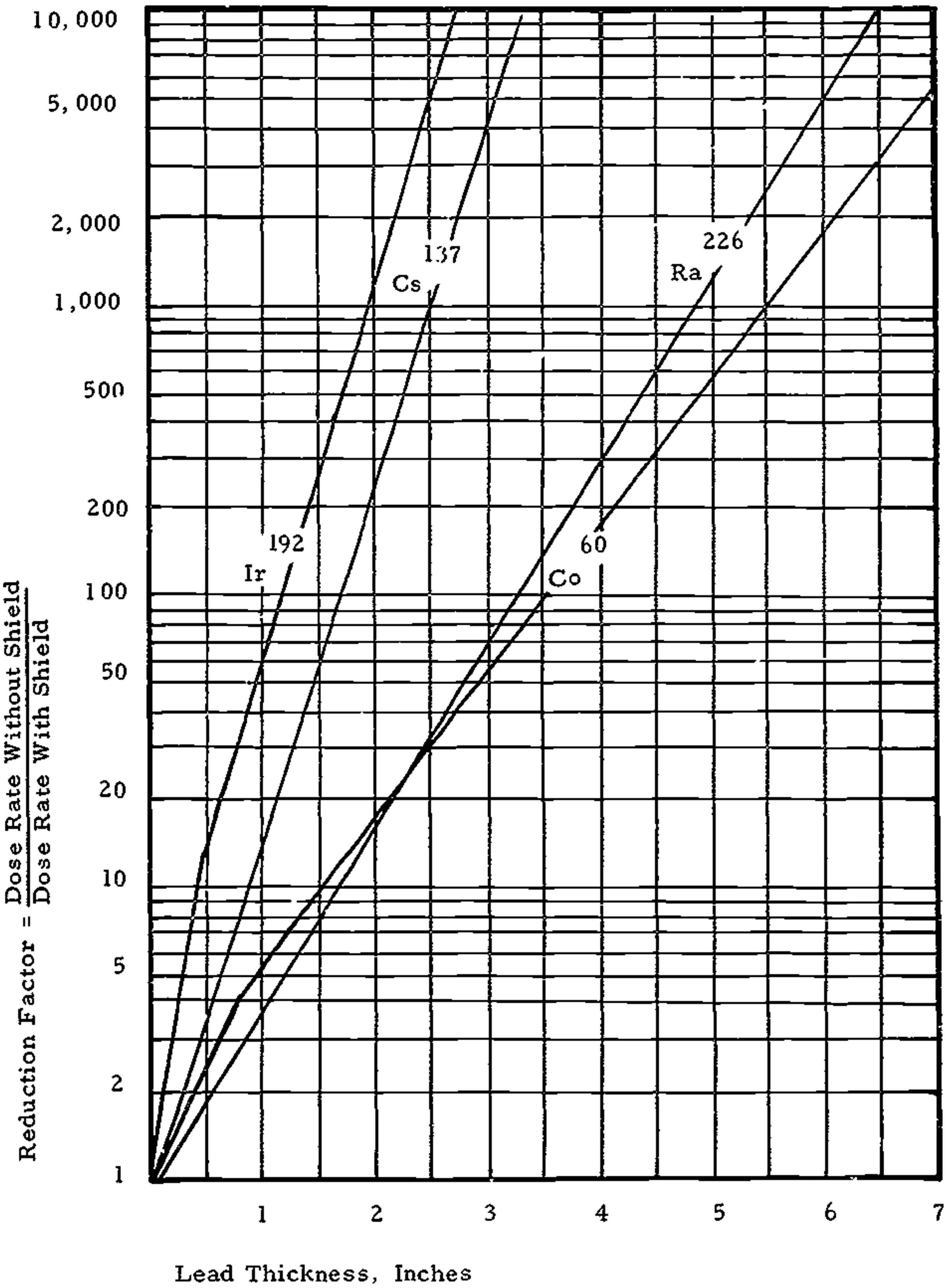
3.



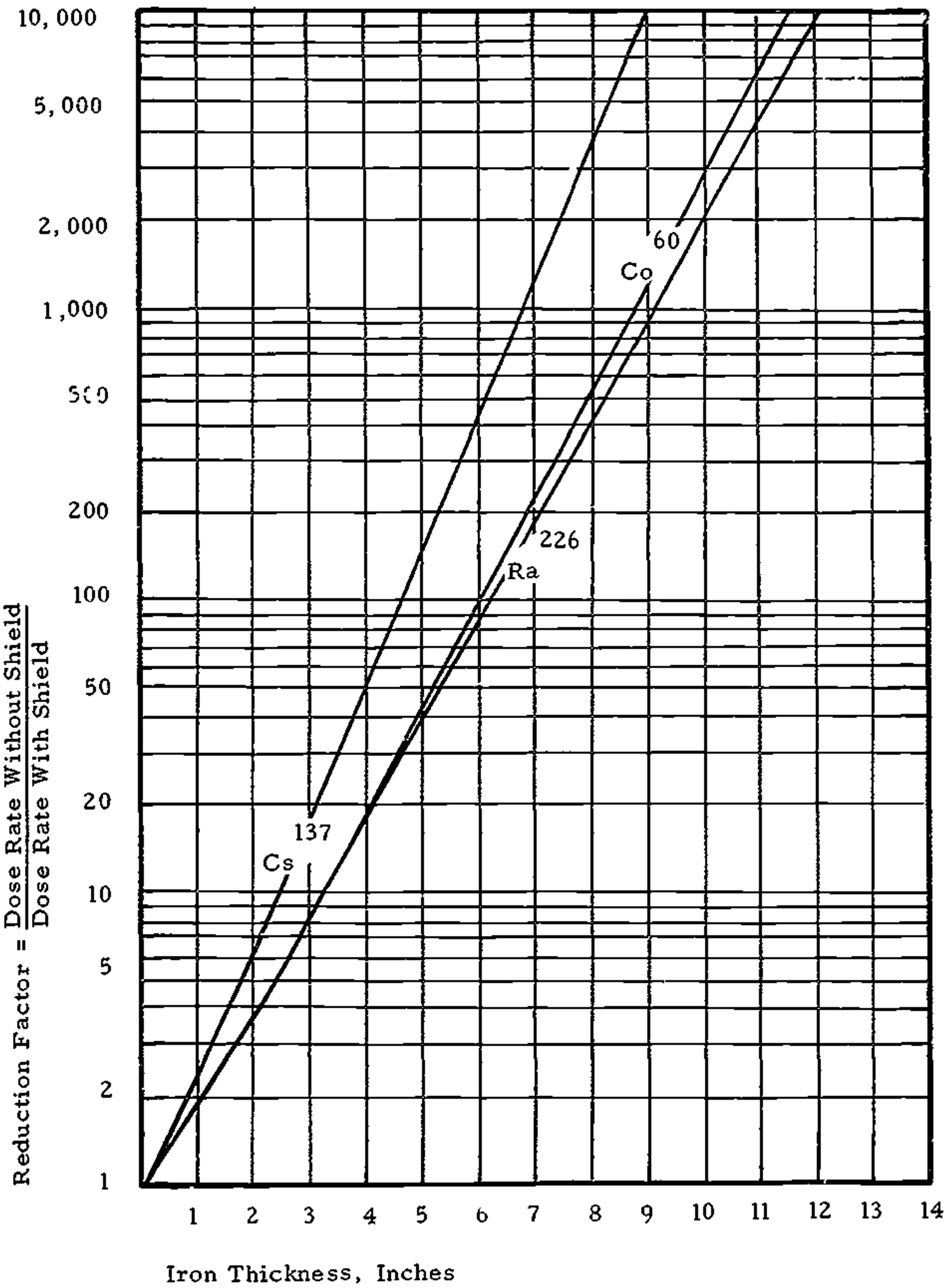
3. Density and thickness of the shielding material and the intensity and energy of the source are factors in radiation exposure

Information Sheet
on
SHIELDING CHARTS

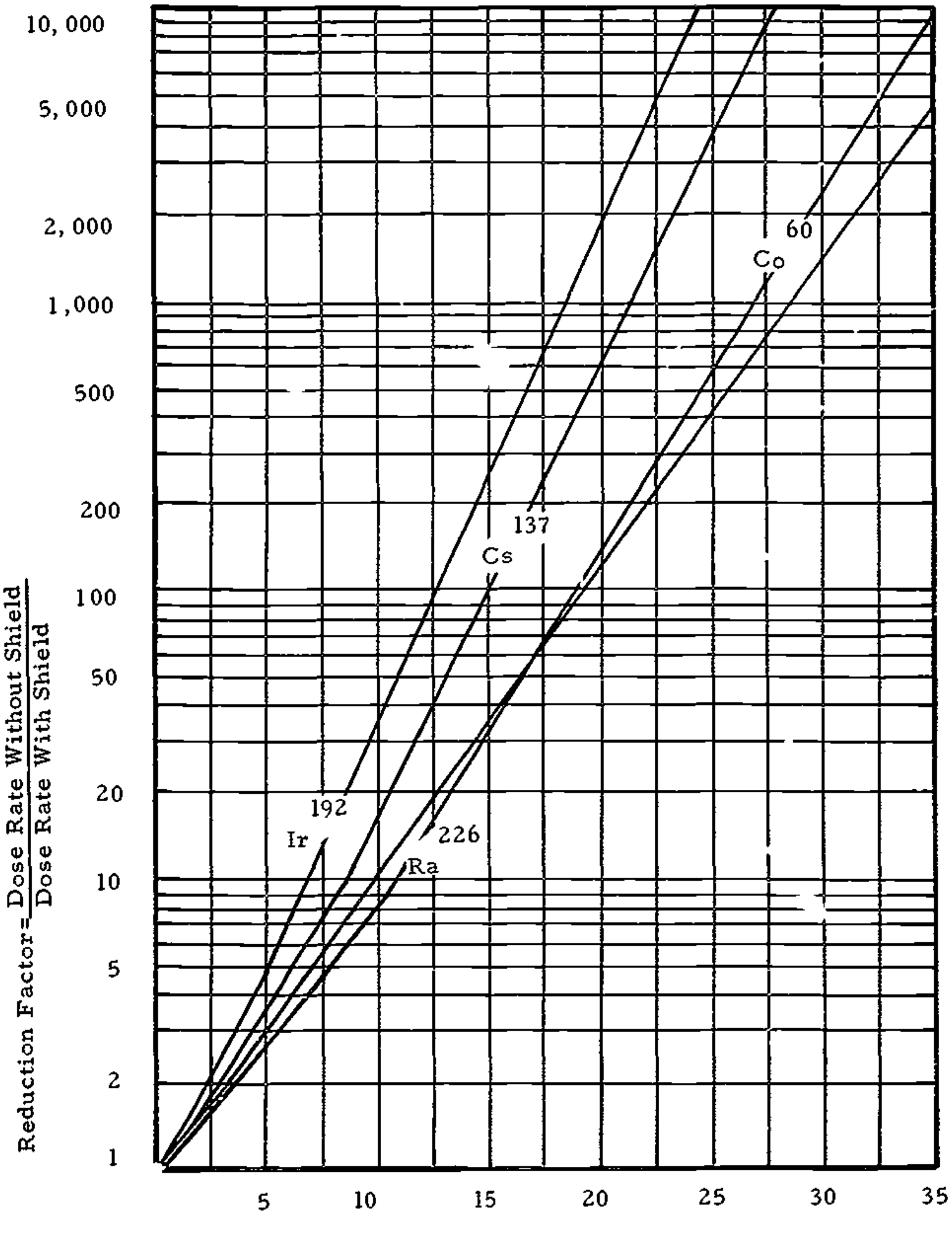
Information
Sheet # 12



BROADBEAM SHIELDING FOR ABSORPTION OF
^{192}Ir, ^{137}Cs, ^{60}Co, AND ^{226}Ra
GAMMA RAYS IN LEAD



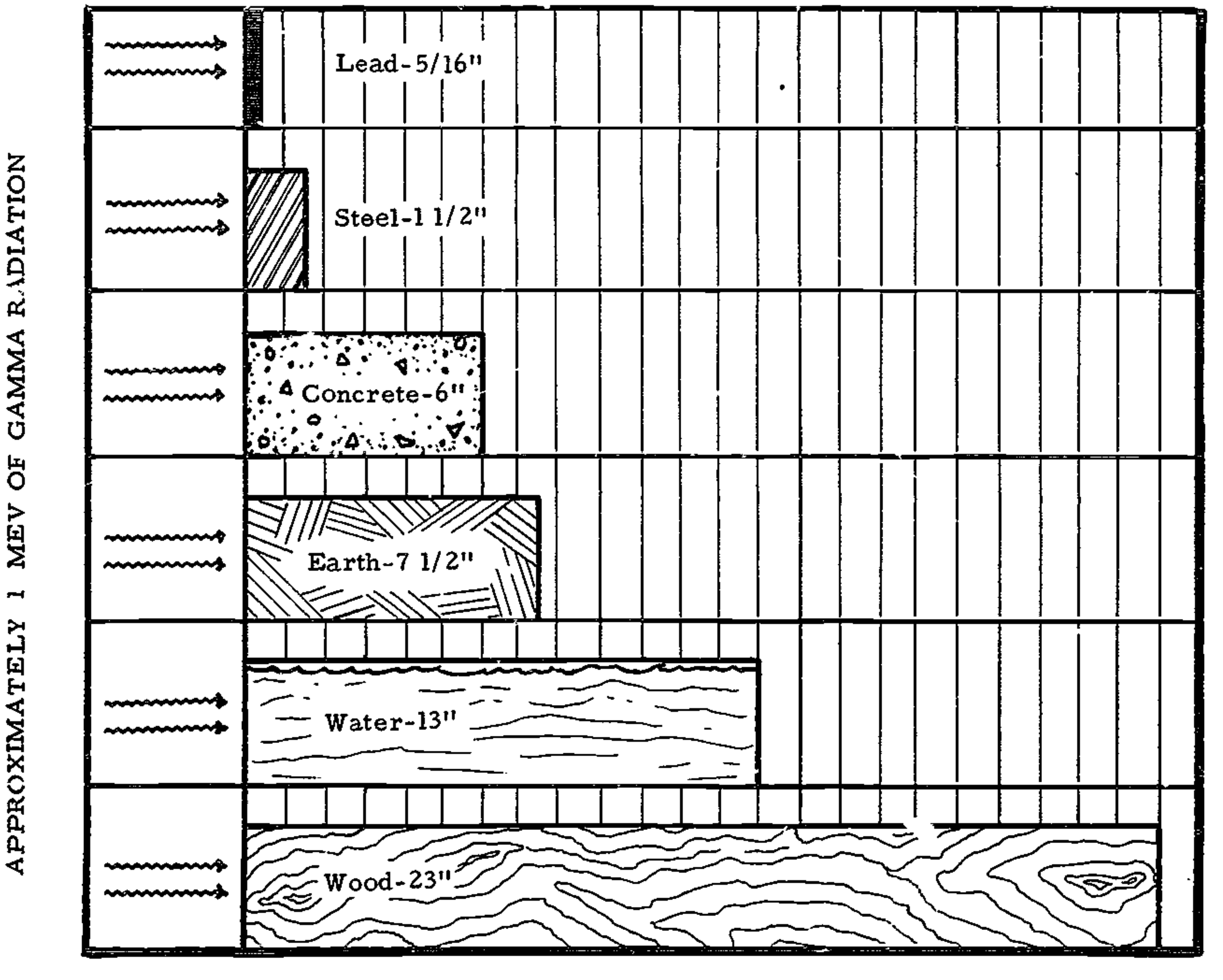
BROADBEAM SHIELDING FOR ABSORPTION OF ^{137}Cs, ^{60}Co, ^{226}Ra --GAMMA RAYS IN IRON



BROADBEAM SHIELDING FOR ABSORPTION OF ^{192}Ir, ^{137}Cs, ^{60}Co, AND ^{226}Ra GAMMA RAYS IN CONCRETE

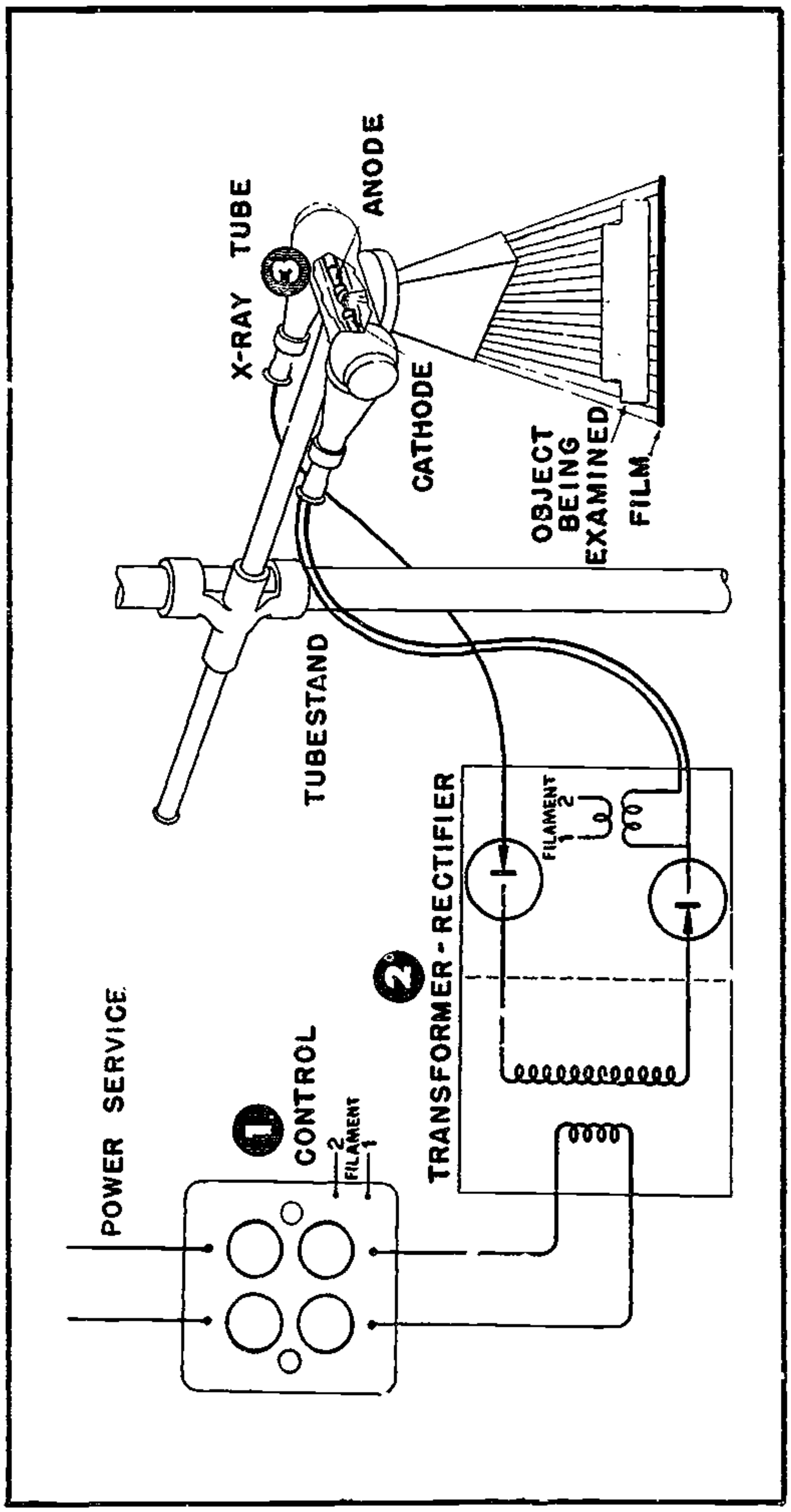
Information Sheet
on
RELATIVE EFFECIENCY OF SHIELDING MATERIALS

Relative thickness of materials required to absorb the same amount of gamma radiation having energy approximately 1 mev



RELATIVE EFFECIENCY OF SHIELDING MATERIALS

Information Sheet
on
X-RAY SCHEMATIC REPRESENTATION



Information Sheet
on
GAMMA RAY DECAY TABLES

SOURCE STRENGTH CALIBRATION

To find source strength at any number of months after known source strength at calibration, multiply by the following percentages.

Months	0	1	2	3	4	5	6	7	8	9
0	--	98.9	97.8	96.8	95.7	94.7	93.6	92.6	91.6	90.6
10	89.6	88.6	87.7	86.7	85.8	84.8	83.9	83.0	82.1	81.2
20	80.3	79.4	78.6	77.7	76.9	76.0	75.2	74.4	73.6	72.8
30	72.0	71.2	70.4	69.7	68.0	68.1	67.4	66.7	65.9	65.2
40	64.5	63.8	63.1	62.4	61.7	61.1	60.4	59.7	59.1	58.4
50	57.8	57.2	56.5	55.9	55.3	54.7	54.1	53.5	53.0	52.4
60	51.8	51.2	50.7	50.1	49.6	49.1	48.5	48.0	47.5	46.9
70	46.4	45.9	45.4	44.9	44.4	44.0	43.5	43.0	42.5	42.1
80	41.6	41.2	40.7	40.2	39.8	39.4	39.0	38.5	38.1	37.7
90	37.3	36.9	36.5	36.1	35.7	35.3	34.9	34.5	34.2	33.8
100	33.4	33.1	32.7	32.3	32.0	31.6	31.3	31.0	30.6	30.3
110	30.0	29.6	29.3	29.0	28.7	28.4	28.0	27.7	27.4	27.1
120	26.8	26.6	26.3	26.0	25.7	25.4	25.1	24.9	24.6	24.3
130	24.1	23.8	23.5	23.3	23.0	22.8	22.5	22.3	22.0	21.8
140	21.6	21.3	21.1	20.9	20.6					

COBALT^{60} , HALF- LIFE 5. 27 YEARS

The exposure time is multiplied by a coefficient to compensate for the age of Cobalt^{60} dated from its removal from the reactor. Consider the date of the source and increase the time accordingly.

Age in Months	Coefficient	Age in Months	Coefficient
6	1.07	66	1.51
12	1.13	72	1.54
18	1.18	78	1.57
24	1.23	84	1.60
30	1.28	90	1.62
36	1.32	96	1.65
42	1.37	102	1.68
48	1.41	108	1.69
54	1.45	114	1.71
60	1.48	120	1.73

^{192}IRIDIUM , HALF-LIFE 74.27 DAYS

To find source strength at any number of months after known source strength at calibration multiply, by the above percentages. For example:
1. Given: 100,000 millicuries. Required: activity after 20 months. Solution. 100,000 millicuries is 100 curies. .32% is .0032. Whence 100 x .0032 equals .32 curies, .32 curies x 100 equals 320 millicuries.
2. Given: 100 curies. Required: source strength after 29 months. Read directly from table. Answer: .02 curies.

Months	Percent	Months	Percent	Months	Percent
0	100.0	10	5.9	20	.32
1	74.5	11	4.2	21	.23
2	59.4	12	3.2	22	.17
3	41.5	13	2.3	23	.13
4	31.5	14	1.7	24	.09
5	23.3	15	1.3	25	.07
6	16.5	16	.88	26	.06
7	13.2	17	.75	27	.04
8	8.8	18	.59	28	.03
9	7.5	19	.42	29	.02

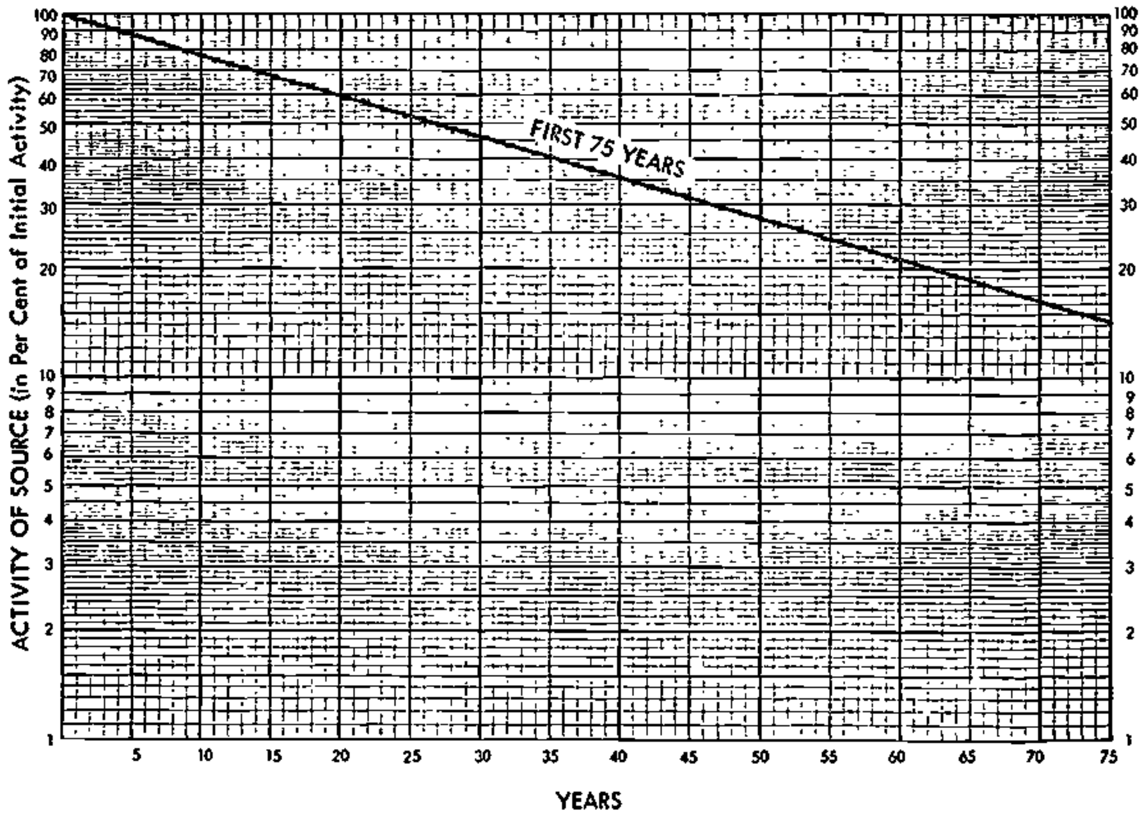
COMPARISON OF RADIATION FIELDS

Radiation field of one curie at different distances in milliroentgens per hour.

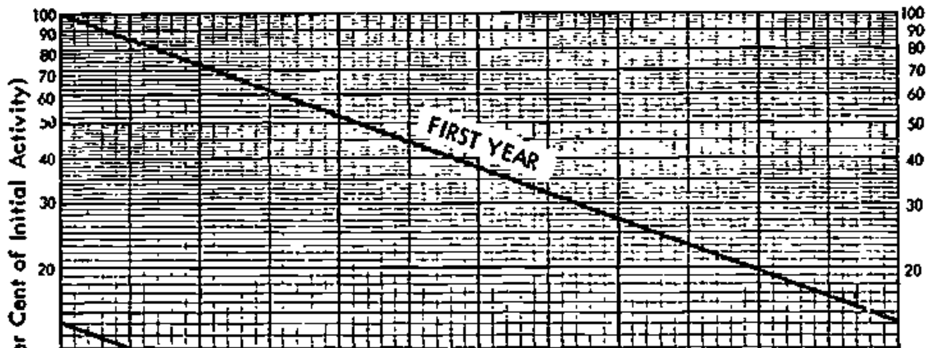
Source	1 ft.	2 ft.	4 ft.	8 ft.	16 ft.	32 ft.
^{192}Iridium	5900	1500	400	90	23	6
^{137}Cesium	4200	1100	260	70	16	4
^{60}Cobalt	14500	3600	900	230	60	14

Information Sheet
on
DECAY CHARTS

(COSIUM^{137} AND THULIUM^{170})



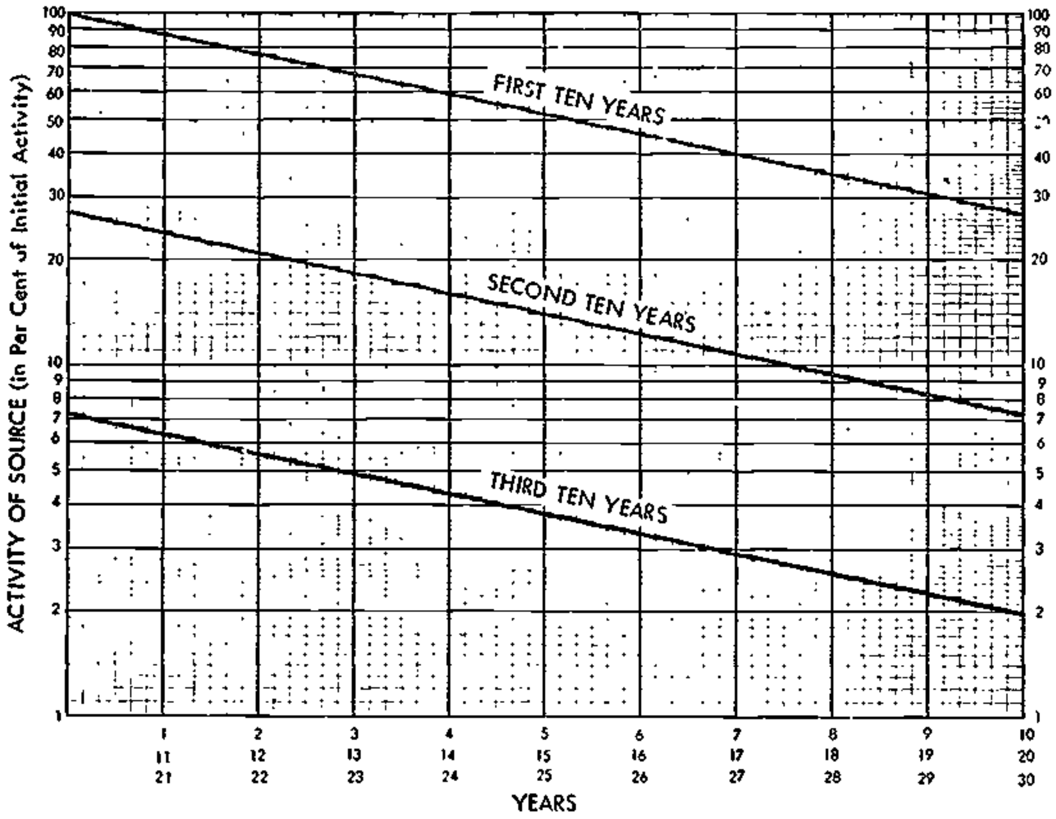
CESIUM^{137} DECAY



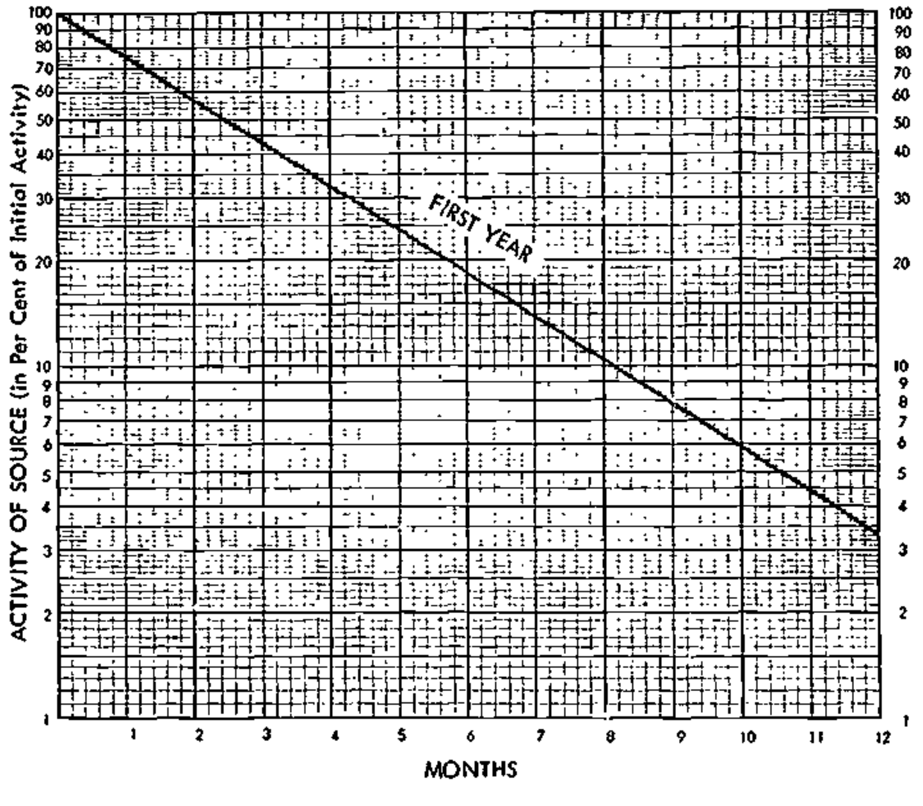
THULIUM^{170} DECAY

Information
Sheet # 17

Information Sheet
on
DECAY CHARTS AND HALF-LIFE
(IRIDIUM^{192} AND COBALT^{60})

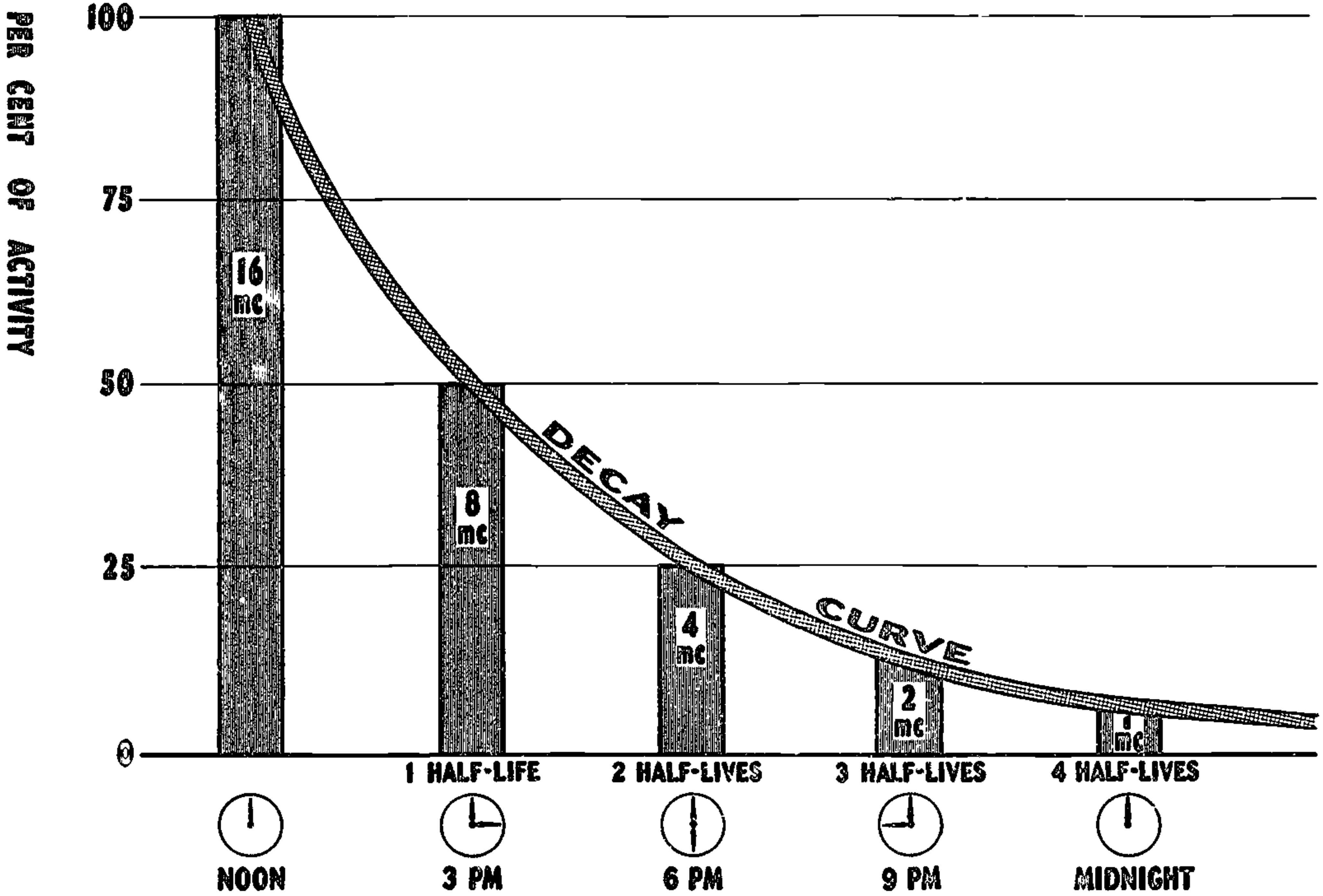


^{60}
COBALT DECAY



^{192}
IRIDIUM DECAY

THE MEANING OF HALF-LIFE



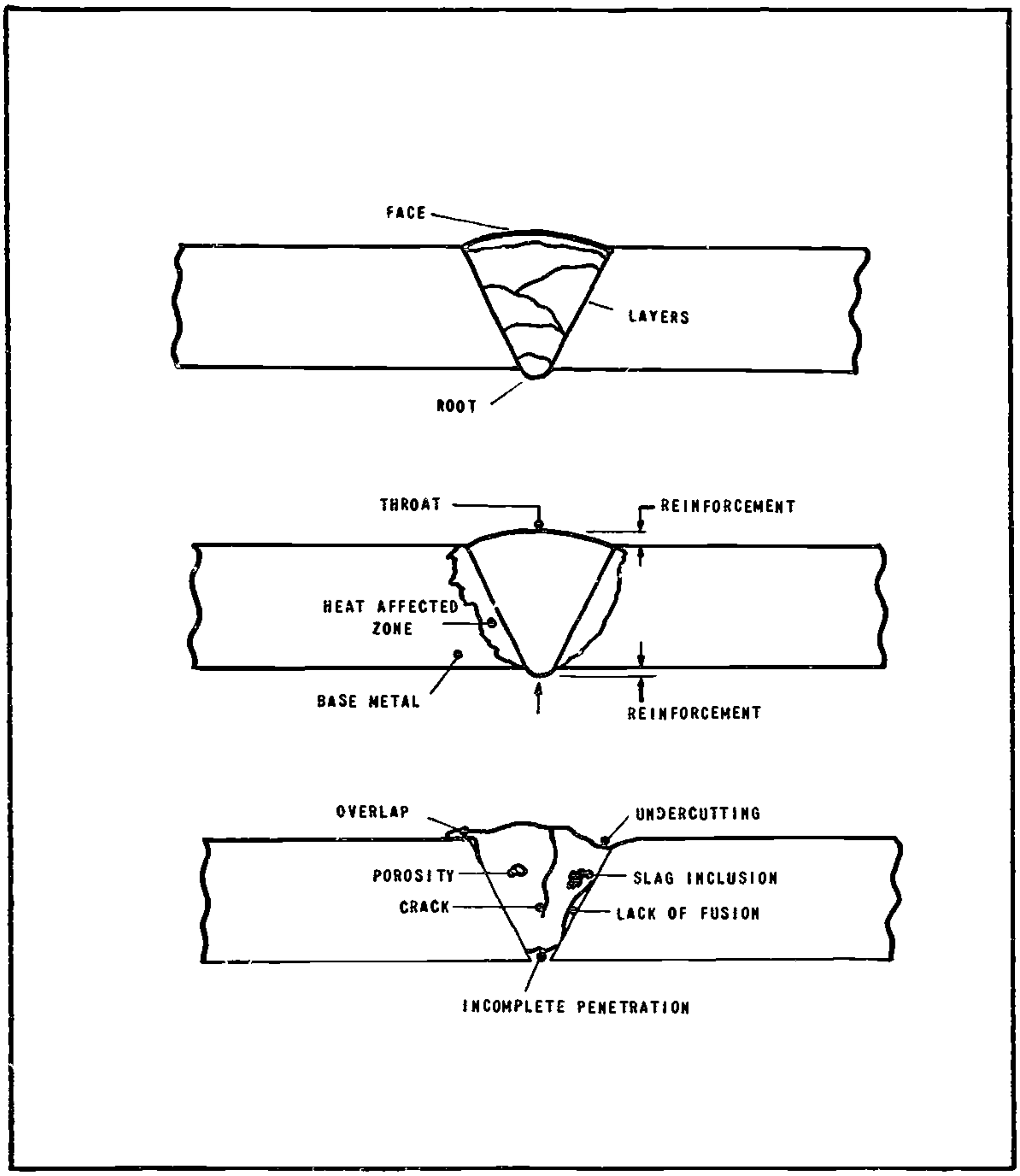
MIL-STD-23A
25 August 1952
SUPERSEDING
MIL-STD-23
27 November 1950

MILITARY STANDARD

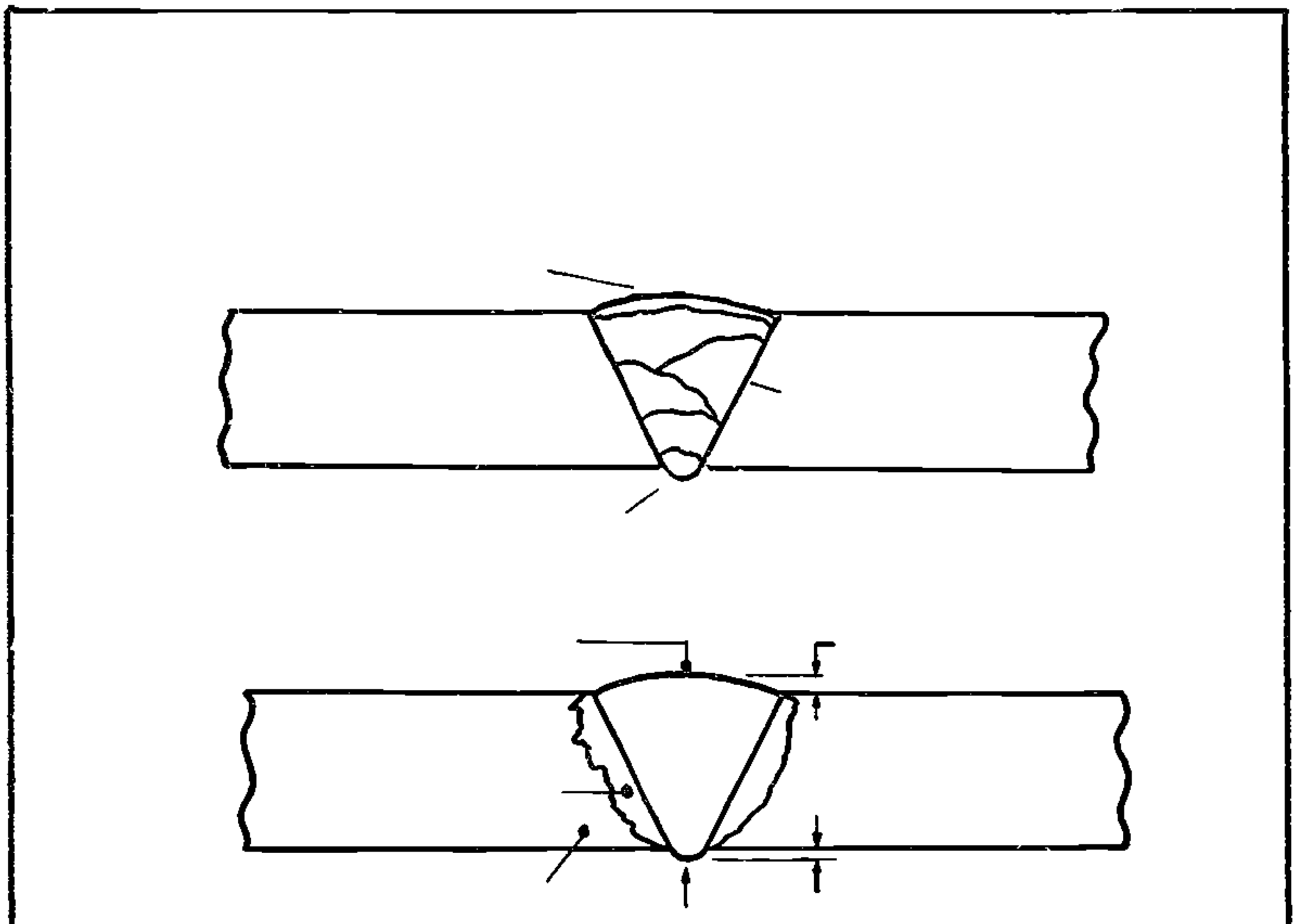
NONDESTRUCTIVE TESTING SYMBOLS

DEPARTMENT OF DEFENSE
UNITED STATES OF AMERICA

Information Sheet
on
WELD TERMINOLOGY



Information Sheet
on
WELD TERMINOLOGY
(TEST)



Information
Sheet # 21

Information Sheet
on
FIELD TRIP INSTRUCTION SHEET

Students will sign the register provided, take a pair of safety glasses (unless your own glasses have safety lens), be assigned to a company guide, follow the guide's instructions and the company rules throughout the tour.

Safety consideration such as the following should be remembered:

1. Do not pickup any metal chips; they may be hot.
2. Do not touch parts in process or just removed(they are hot).
3. Do not look at arc welding.
4. Follow close to the guide at all times and do not go off the tour path; some areas are dangerous.
5. Be aware of moving vehicles, overhead cranes, conveyors, and material handling equipment.
6. Do not talk to operators or distract them from their jobs.
7. Listen to what your guide has to say and if you see a process that you do not understand, ask questions and take notes.
8. Wear your safety glasses at all times while in the plant.
9. Take note book and pencil.
10. Do not talk while guide is talking to group.

Information Sheet
on
STEEL PIPE AND THICKNESS TABLE

Information
Sheet # 22

A53 AND A106 PIPE

Pipe Size	O.D. In.	Sch 20	Sch 30	Sch 40	Sch 60	Sch 80	Sch 100	Sch 120	Sch 140	Sch 160	XX Strong
.50	.84			.109		.147					.294
.75	1.05			.113		.154					.308
1.00	1.31			.133		.179					.358
1.25	1.66			.140		.191					.382
1.50	1.90			.145		.200					.400
2.00	2.37			.154		.218					.436
2.50	2.87			.203		.276					.552
3.00	3.50			.216		.300					.600
3.50	4.00			.226		.318					.636
4.00	.50			.237		.337		.438			.674
5.00	5.56			.258		.375		.500			.750
6.00	6.[illegible]			.280		.432		.562			.864
8.00	8.62		.277	.322	.406	.500	.593	.718			.875
10.00	10.75		.307	.365	.500	.593	.718	.843			
12.00	12.75		.330	.406	.560	.687	.843	1.000			
14.00		.312	.375	.438	.593	.750	.937	1.090	1.250	1.40	
16.00		.312	.375	.500	.656	.843	1.030	1.210	1.438	1.59	
18.00		.312	.438	.563	.750	.937	1.156	1.370	1.562	1.78	
20.00		.375	.500	.593	.812	1.030	1.281	1.500	1.750		
24.00		.375	.562	.687	.968	1.210	1.531	1.810			

Information
Sheet # 23

Information Sheet
on
MILITARY STANDARD NONDESTRUCTIVE TESTING SYMBOLS-MIL - STD - 23A 25 August, 1952

Obtained from:
Munitions Board
Standards Agency
Department of Defense
Washington 25, D. C.

MIL-STD-23A
25 August 1952

SUPERSEDING
MIL-STD-23
27 November 1950

MILITARY STANDARD

NONDESTRUCTIVE TESTING SYMBOLS

DEPARTMENT OF DEFENSE
UNITED STATES OF AMERICA

MUNITIONS BOARD STANDARDS AGENCY
DEPARTMENT OF DEFENSE
Washington, D. C.

25 August 1952

Nondestructive Testing Symbols
MIL-STD-23A

1. This standard has been approved by the Departments of the Army, the Navy, and the Air Force, and establishes the symbols for use on drawings to specify nondestructive tests for determining the soundness of materials.

2. The Munitions Board Standards Agency on 25 August 1952 approved the revision of this standard for printing.

3. In accordance with established procedure the Munitions Board Standards Agency has designated the Ordnance Corps, Bureau of Ships, and the Department of the Air Force, respectively, as Army-Navy-Air Force custodians of this standard.

4. This revised standard is mandatory for use effective 25 August 1952. Where repeated deviation from the approved Military Standard is granted by a department, a report shall be made to the Munitions Board Standards Agency by that department with the reasons for deviation.

5. Recommended corrections, additions, or deletions should be addressed to the Director, Munitions Board Standards Agency, Washington 25, D. C.

CONTENTS

FIGURES

TABLE

MIL-STD 23A
25 August 1952

SUPERSEDING
MIL-STD-23
27 November 1950

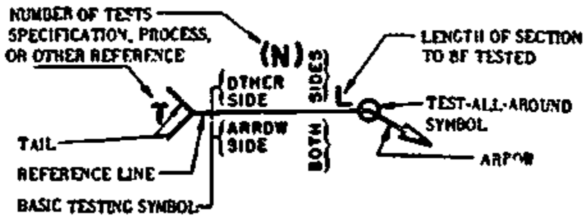
1. BASIC SYMBOLS

1.1 BASIC TESTING SYMBOLS. Basic Nondestructive Testing symbols shall be as shown in table I.

TYPE OF TEST	SYMBOL
RADIOGRAPHIC	RT
MAGNETIC-PARTICLE	MT
PENETRANTS	PT
ULTRASONIC	UT

1.2 ELEMENTS OF THE TESTING SYMBOL. The assembled testing symbol consists of the following elements. Such of these elements as are necessary shall be used and shall have standard locations with respect to each other as shown on figure 1.

- Reference Line
- Arrow
- Basic Testing symbol
- Test-all-around symbol
- (N) Number of Tests
- Tail
- Extent of test
- Specification, process, or other reference

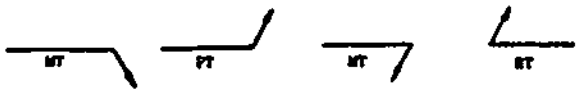


2. GENERAL PROVISIONS

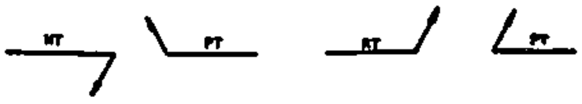
2.1 SIGNIFICANCE OF ARROW. The arrow shall connect the reference line to the part to be tested. The side of the part to be tested, to which the arrow points shall be considered the arrow side of the part. The side opposite the arrow side of the part shall be considered the other side.

2.2 LOCATION OF TESTING SYMBOL.

2.2.1 Tests to be made on the arrow side of the part shall be indicated by the test symbol on the side of the reference line toward the reader as follows:

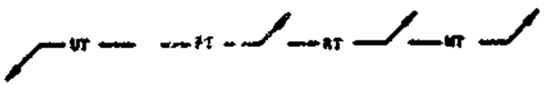


2.2.2 Tests to be made on the other side of the part shall be indicated by the test symbol on the side of the reference line away from the reader as follows:

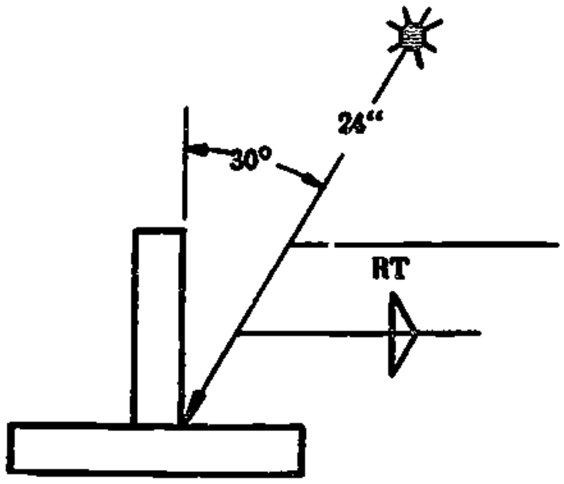


2.2.3 Tests to be made on both sides of the part shall be indicated by test symbols on both sides of the reference line, as follows:

2.2.4 When nondestructive testing symbols have no arrow or other-side significance, the testing symbols shall be centered on the reference line as follows:

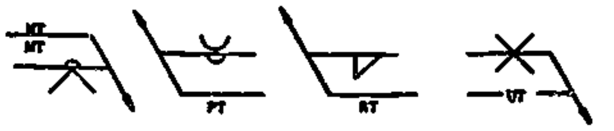


2.3 DIRECTION OF RADIATION. When specified, the location of the source of radiation and the direction of radiation shall be shown in conjunction with radiographic testing symbol. The location of the source of radiation shall be indicated by a symbol located on the drawing at the desired source of radiation, connected, and oriented as necessary by dimensions, as shown on figure 2.

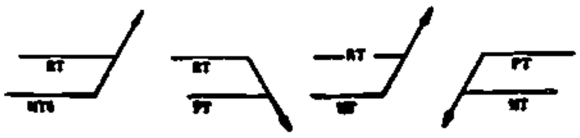


2.4 COMBINATION OF NONDESTRUCTIVE TESTING SYMBOLS AND WELDING SYMBOLS

2.4.1 Nondestructive testing symbols and welding symbols may be combined as follows:



2.4.2 Nondestructive testing symbols may be combined as follows:



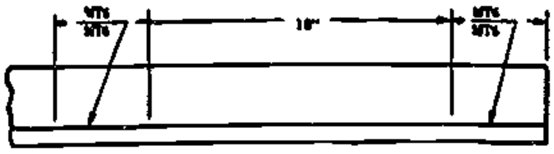
2.5 USE OF REFERENCES. Specifications, process, classification, or other references need not be used on testing symbols when the testing procedure is prescribed elsewhere. When a specification, process, classification, or other reference is used with a testing symbol, the reference shall be placed in the tail, as follows:

3. METHODS OF SPECIFYING EXTENT OF NONDESTRUCTIVE TESTS

3.1 SPECIFYING LENGTH OF SECTION TO BE TESTED

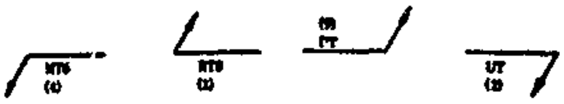
3.1.1 To specify tests of welds or parts where only length of section need be considered, the length in inches shall be shown to the right of the basic test symbol, as follows:

3.1.2 To show the exact location of a section to be tested as well as its length, dimension lines shall be used as follows:



3.1.3 When the full length of a part is to be tested, no length dimension need be shown on the testing symbol.

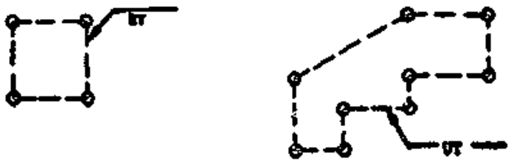
3.2 SPECIFYING NUMBER OF TESTS. To specify a number of tests to be taken at random, the number of desired tests shall be shown in parenthesis, as follows:



3.3 SPECIFYING TESTS MADE ALL AROUND A PART. To specify tests to be made all around a part, the test-all-around symbol shall be used, as follows:

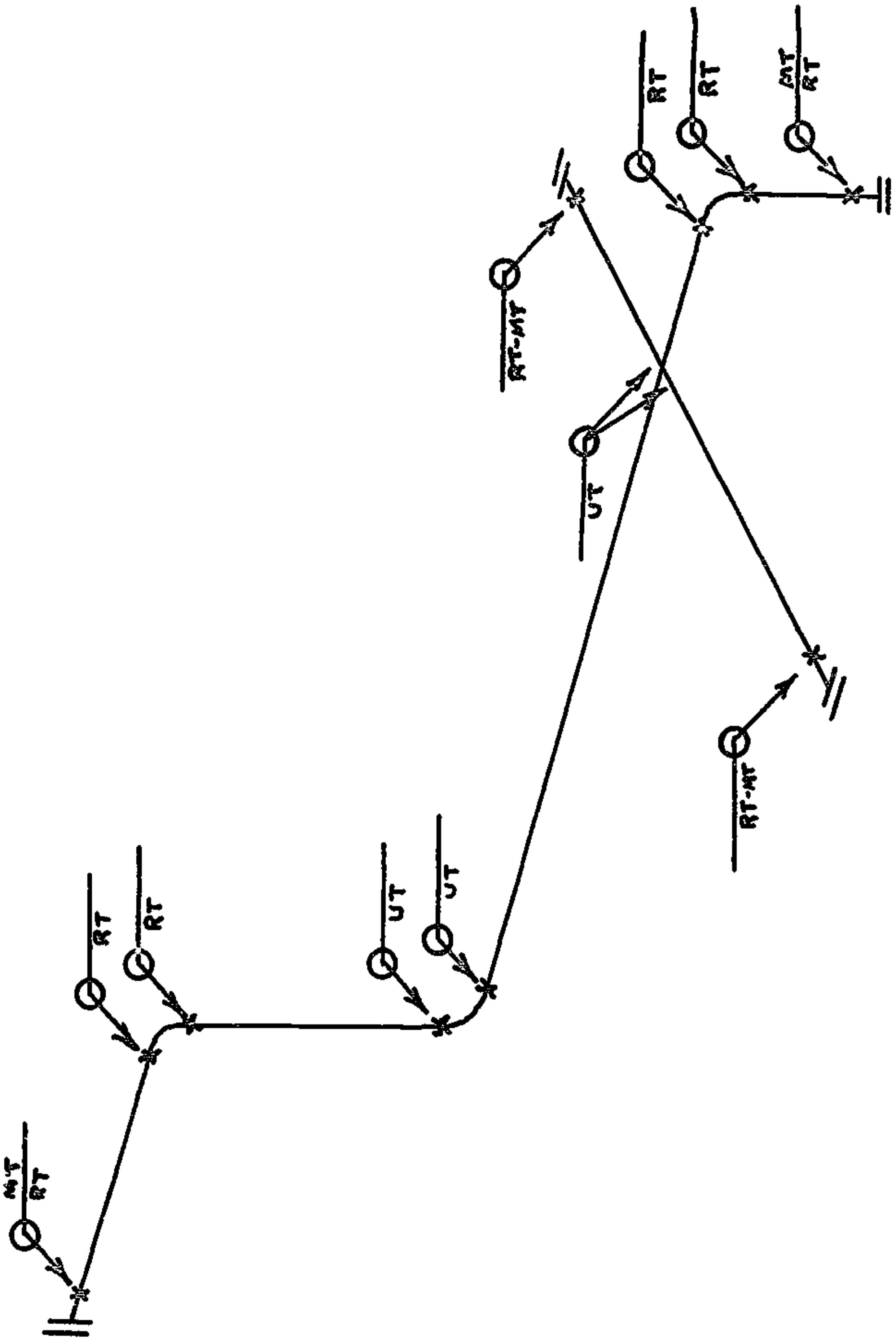
3.4 SPECIFYING TESTS OF AREAS. When required, nondestructive tests of areas shall be indicated by one of the following methods:

3.4.1 For nondestructive testing of an area represented as a plane on the drawing, the area to be tested shall be enclosed by straight broken lines having a circle at each change of direction. The testing symbol specifying the kind of nondestructive test shall be used in connection with these lines, as shown below. When necessary, these inclosures shall be located by dimensions.



Information Sheet
on
NONDESTRUCTIVE TESTING SYMBOL TEST SHEET

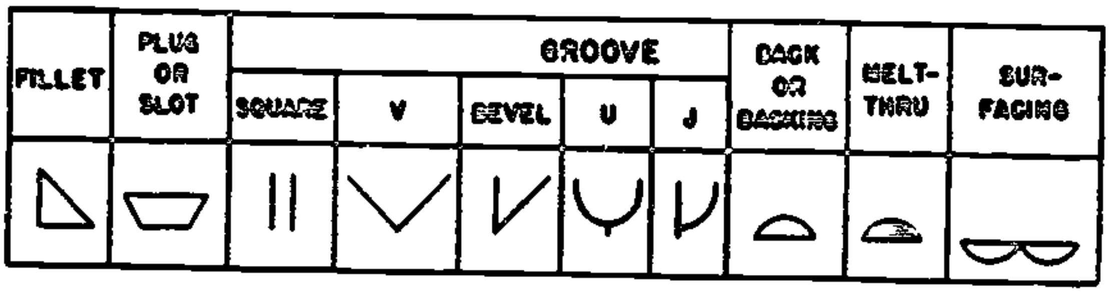
Information
Sheet # 24



Information Sheet
on
WELDING SYMBOLS AND SIZES

The first step in making a good weld is to know what the designer wants. The welding symbols used on prints are a simple, exact method of indicating welds and weld sizes, and you must be able to specify and read them correctly. Here is a brief summary of some of the more commonly used welding symbols:

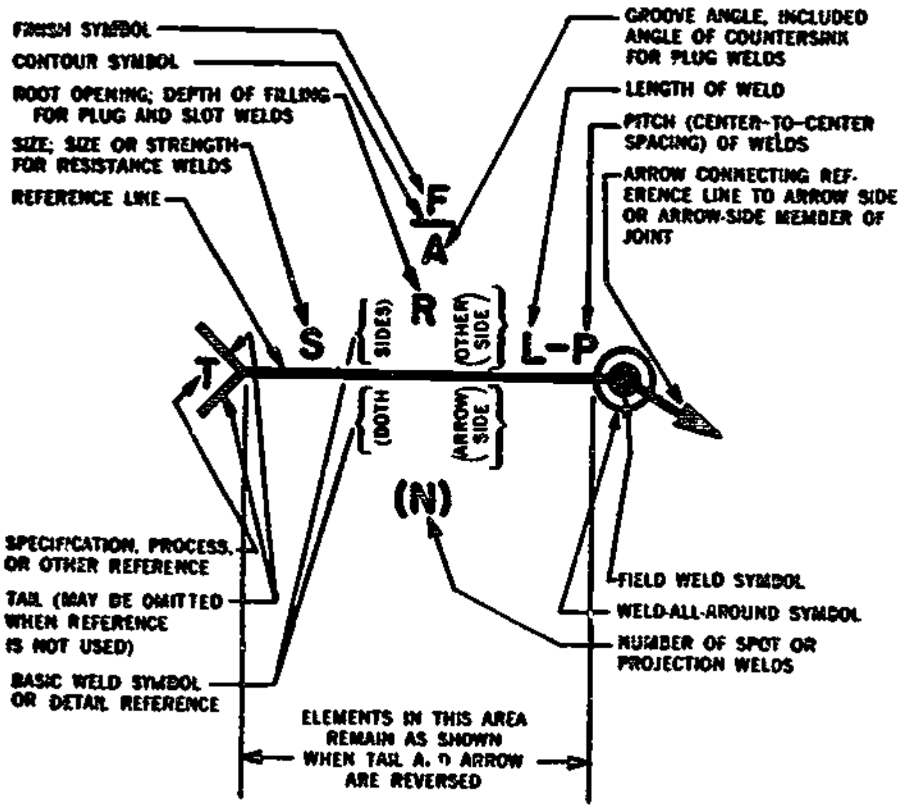
Basic Arc and Gas Weld Symbols



Supplementary Symbols

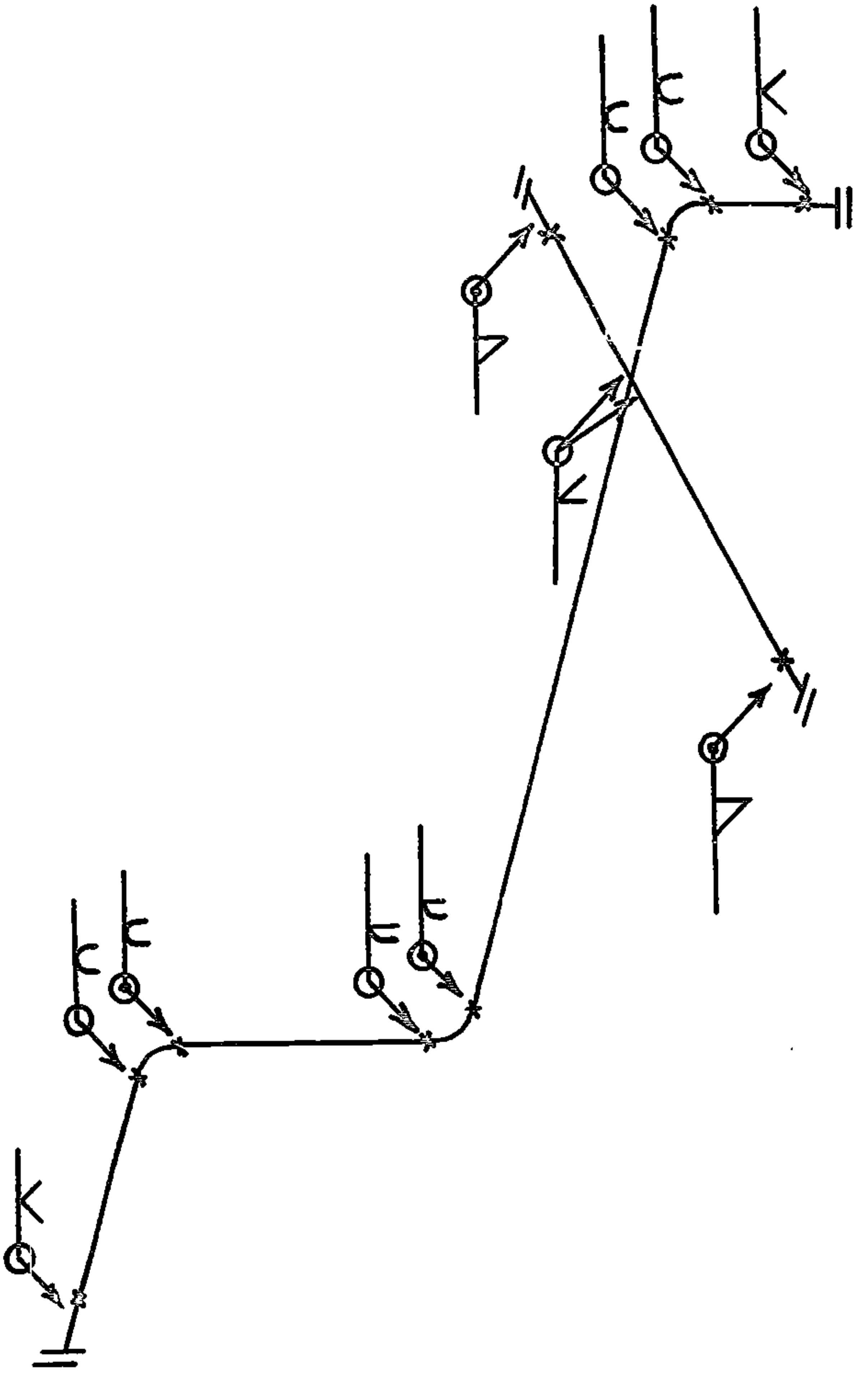
WELD ALL AROUND	FIELD WELD	CONTOUR	
		FLUSH	CONVEX
○	●	—	⌒

Location of Elements of a Welding Symbol

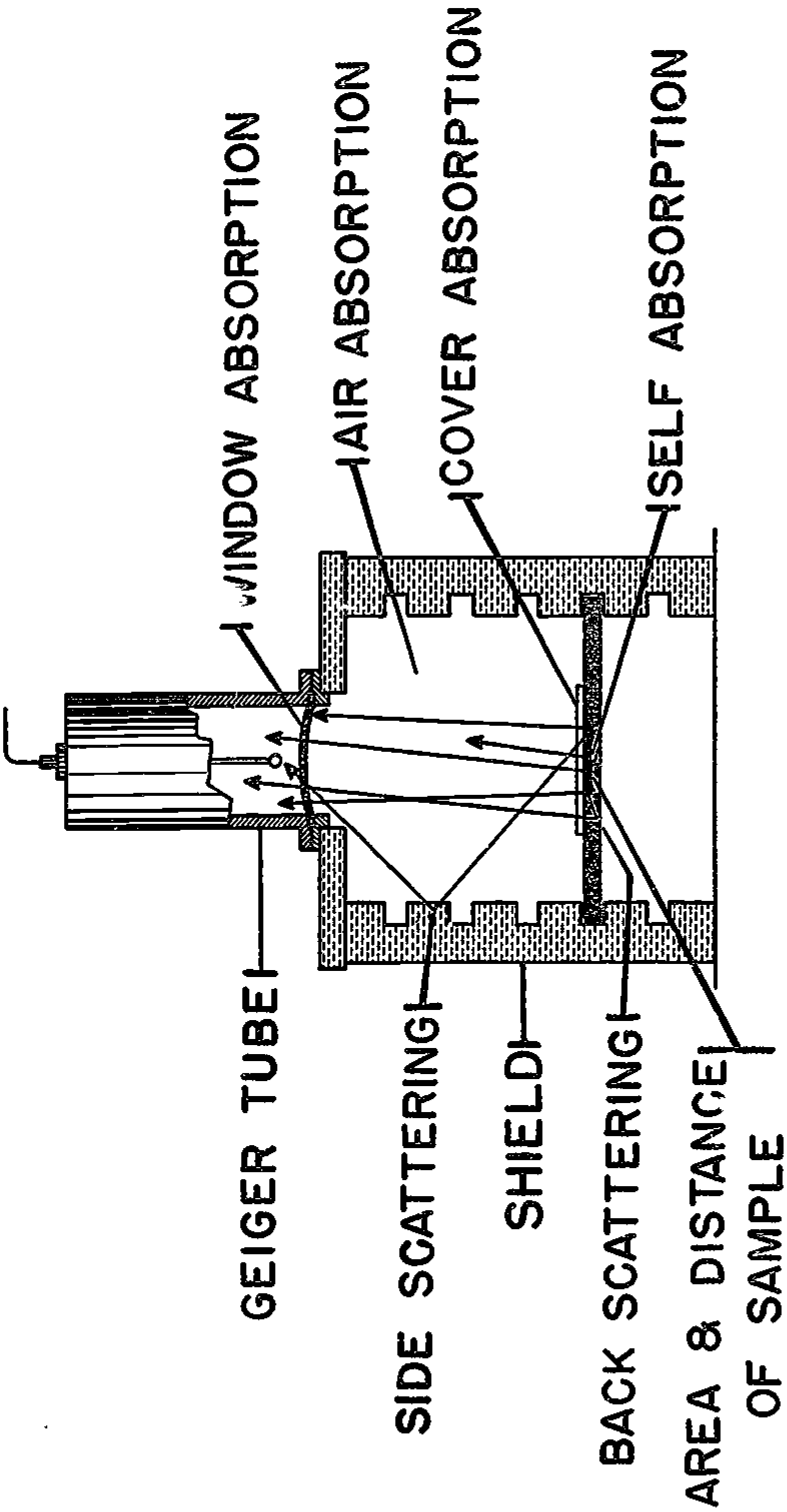


Information Sheet
on
WELDING SYMBOLS TEST SHEET

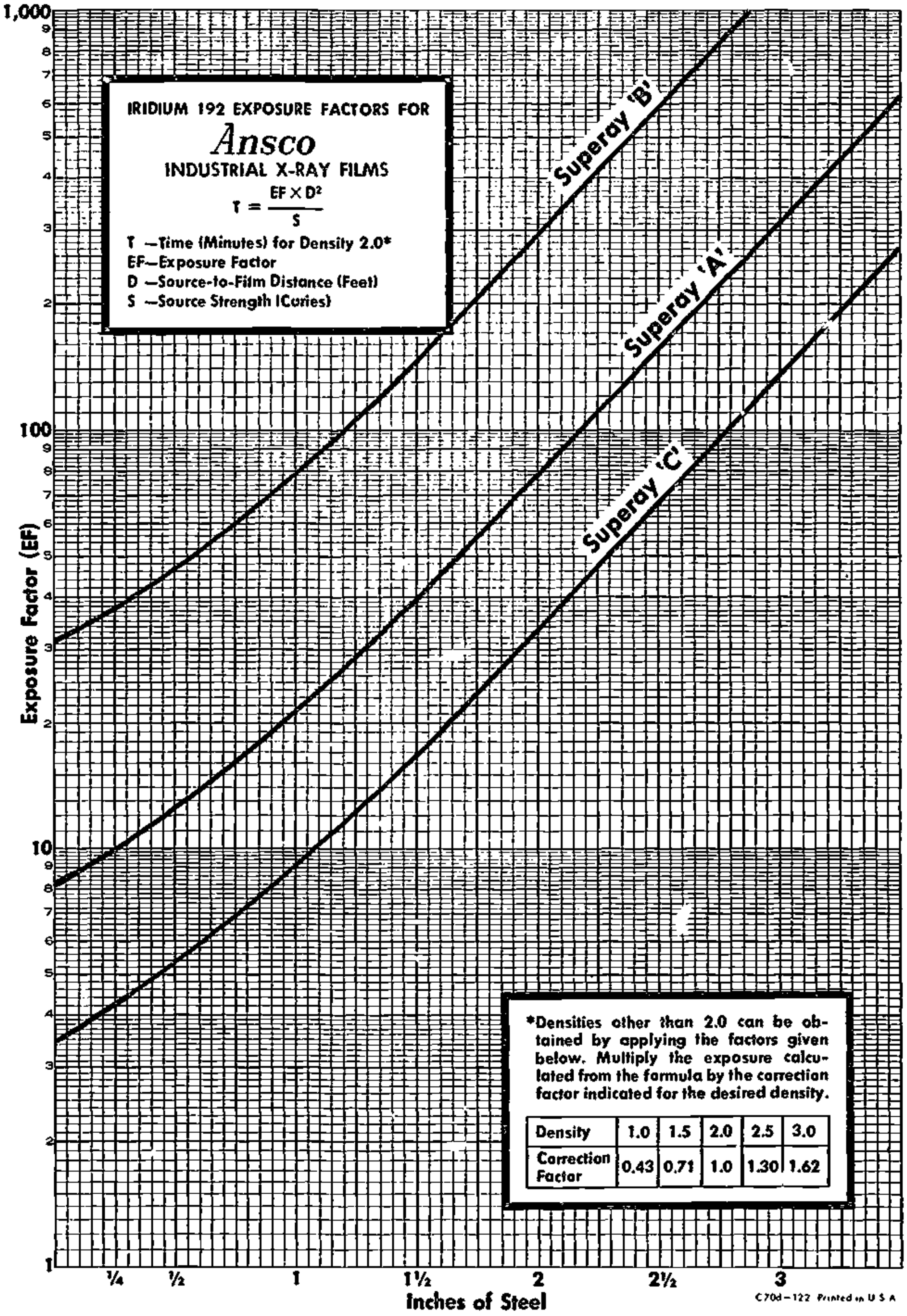
Information
Sheet # 26



Information Sheet
on
CONSIDERATIONS IN RADIOACTIVITY MEASUREMENTS



Information Sheet on ANSCO EXPOSURE FACTORS FOR IRIDIUM^{192}



IRIDIUM 192 EXPOSURE FACTORS FOR

Ansco

INDUSTRIAL X-RAY FILMS

$$T = \frac{EF \times D^2}{S}$$

T —Time (Minutes) for Density 2.0*
EF—Exposure Factor
D —Source-to-Film Distance (Feet)
S —Source Strength (Curies)

*Densities other than 2.0 can be obtained by applying the factors given below. Multiply the exposure calculated from the formula by the correction factor indicated for the desired density.

Density	1.0	1.5	2.0	2.5	3.0
Correction Factor	0.43	0.71	1.0	1.30	1.62

Information Sheet
on
TYPICAL EXPOSURE FACTOR FOR PIPE AND PLATE
(KODAK TYPE AA FILM)

Inches of Steel	Kodak "AA" Factor	Pipe Size	Pipe Square of Distance	Flat Plate
1/8	41	3"	11"	9"
1/4	48	4"	19"	16"
3/8	58	5"	30"	25"
1/2	70	6"	44"	36"
5/8	81	8"	75"	64"
3/4	97	10"	116"	100"
7/8	115	12"	163"	144"
1-	138	14"	196"	196"
1-1/8	160	16"	256"	256"
1-1/4	196	18"	324"	324"
1-3/8	230	20"	400"	400"
1-1/2	270	22"	484"	484"
1-5/8	320	24"	576"	576"
1-3/4	380	26"	676"	676"
1-7/8	450	28"	784"	784"
2-	530	30"	900"	900"
2-1/8	630	32"	1024"	1024"
2-1/4	740	34"	1156"	1156"
2-3/8	900	36"	1296"	1296"
2-1/2	1050			
2-5/8	1250			
2-3/4	1405			
2-7/8	1750			
3-	2050			

Note: These factors can be used under the following conditions:

(a) Developing time 5 minutes @ 68° F.
(b) H & D Density of base metal-1. 5
(c) Ir. 192 Gamma Radiation
(d) Radiation source must be within 1/2" of near pipe wall for exposure of far side of pipe wall.
(e) Always figure a total of 2 wall thicknesses for this type exposure because radiation is passing through both walls although exposure is made of one wall only. (This applies to pipe)
(f) Density may vary slightly depending on brand and condition of chemicals.

Note: Although nominal pipe diameter varies with the actual pipe size, this variation ceases with 14" pipe. Example: 10" pipe is actually 10. 75 inches in outside diameter; 14" pipe is 14 inches in outside diameter.

Information Sheet
on
MATERIAL DENSITY FACTORS

Multiply the thickness of material by the multiplier to find the equivalent thickness of steel.

Material	Multiplier
Copper	1.14
Nickel	1.13
Monel	1.12
Bronze	1.12
Inconel	1.08
Free-cutting Brass	1.08
Stainless Steel	1.02
Titanium	0.58
Aluminum	0.34
Magnesium	0.22

Information Sheet
on

COLLIMATION EFFECT ON EXPOSURE TIME

Information
Sheet # 31

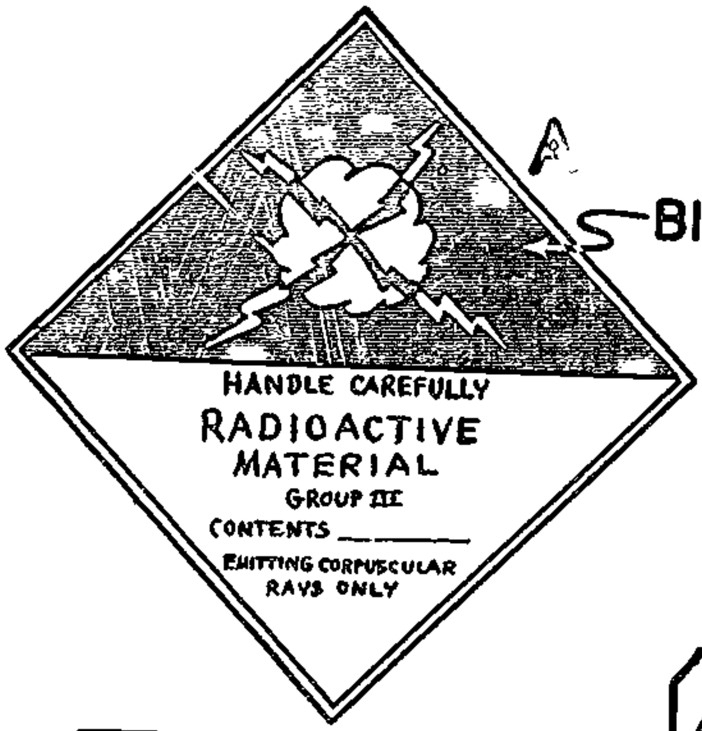
1. Collimation requires an increase in exposure time.
   a. Experiment done with AA film, no lead screens
   b. 851 curie Cobalt^{60} source, 2.0 density 5'4" F. F. D.

Steel Thickness	Collimator Size	Exposure Time
10"	None	3.9 hours
10"	18" x 18"	8.0 "
10"	11 1/2" x 11 1/2"	10.0 "
10"	4" x 4"	19.0 "
7"	None	19.5 minutes
7"	18" x 18"	31.0 "
7"	11 1/2" x 11 1/2"	40.0 "
7"	4" x 4"	60.0 "
5"	None	4.25 "
5"	18" x 18"	4.7 "
5"	11 1/2" x 11 1/2"	5.8 "
5"	4" x 4"	8.5 "

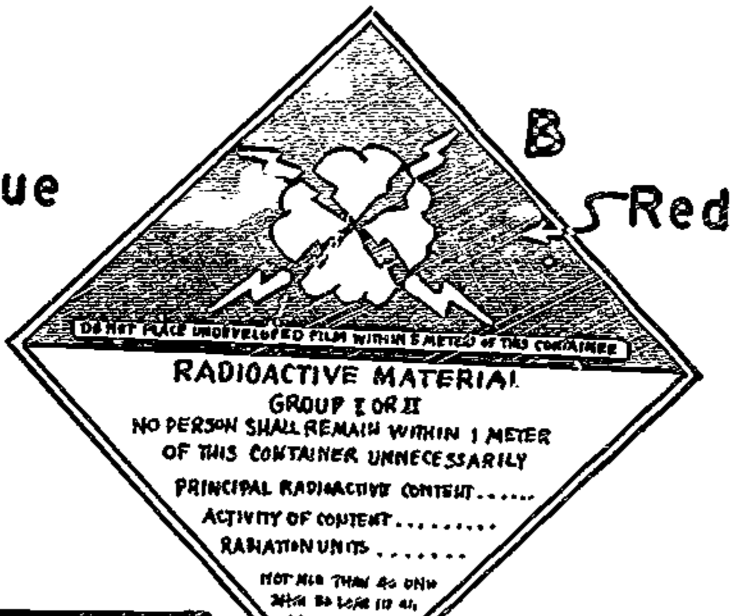
Develop 7 minutes @ 70° F.

2. The collimation effect increases with increased thickness.
   a. Increases sensitivity
   b. Increases latitude

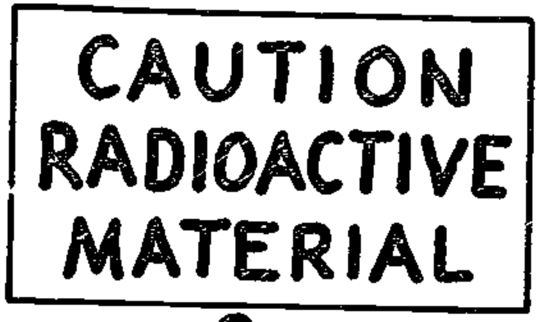
Information Sheet
on
RADIATION WARNING SIGNS AND SHIPPING TAGS



A



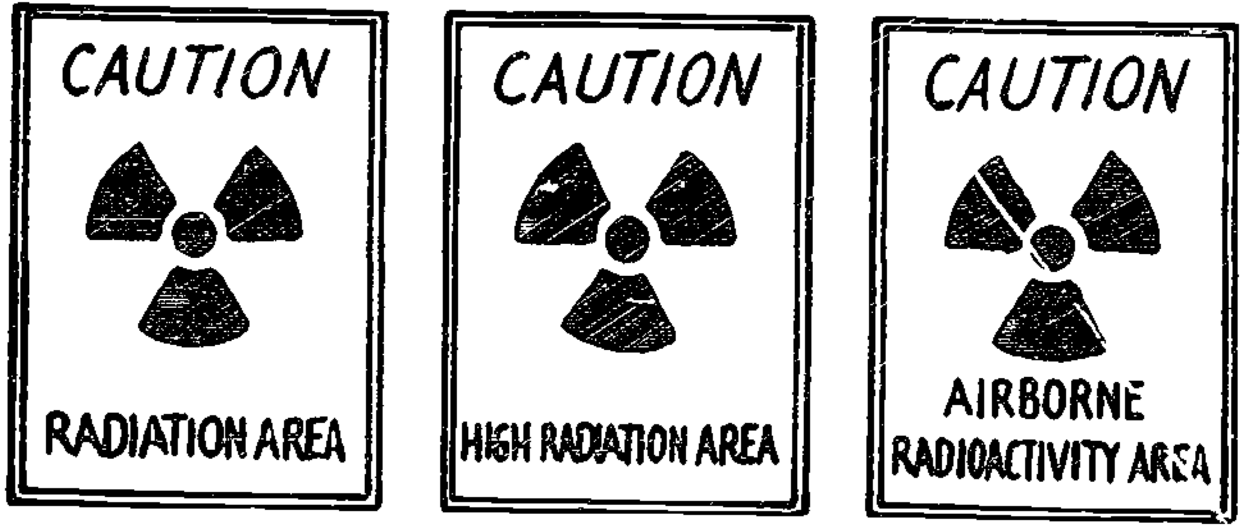
B



C

D

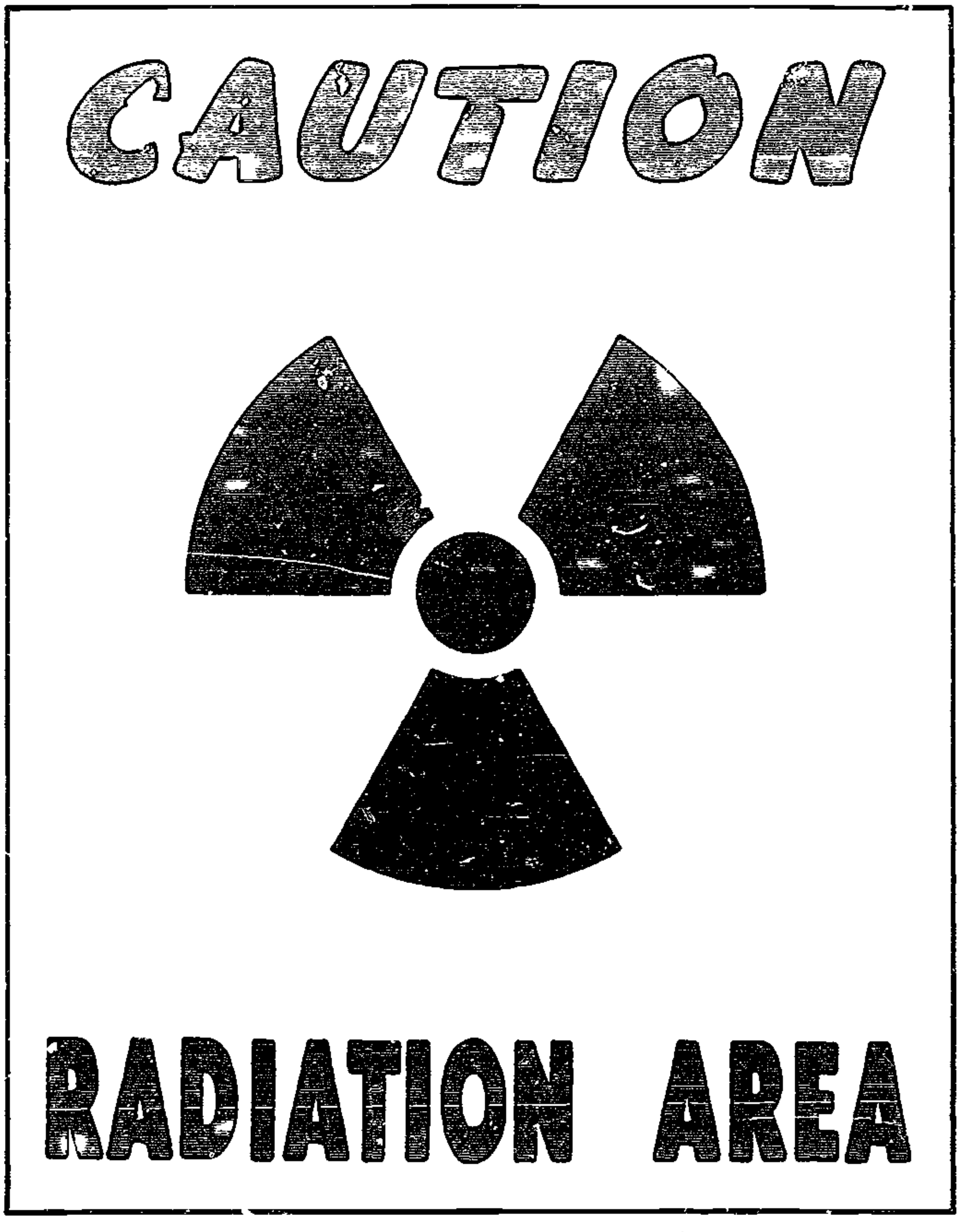
E



A. Interstate Commerce Commission Blue label shipping placard.
B. Interstate Commerce Commission Red label shipping placard.
C. Placard for motor vehicle carrying radioactive materials.
D. Tag for radioisotopes.
E. Various warning signs displayed by radioisotope users.

Information
Sheet # 33

Information Sheet
on
RADIATION CAUTION SIGN



The radiation warning symbol is a purple colored propeller-shaped figure upon a yellow background. The wording on different radiation warning signs may vary but the symbol is standard.

Information Sheet
on
NOTICE TO EMPLOYEES SIGN

TRC Form 21-1
(3-63)

Texas State Department of Health
1100 West 49th Street
Austin 56, Texas

NOTICE TO EMPLOYEES

TEXAS REGULATIONS FOR CONTROL OF RADIATION

The Texas State Department of Health has established standards for your protection against radiation hazards, pursuant to the Texas Radiation Control Act, Art. 4590f, Revised Civil Statutes, State of Texas.

YOUR EMPLOYER'S RESPONSIBILITY

Your employer is required to--

1. Apply these regulations to work involving sources of radiation.
2. Post or otherwise make available to you a copy of the Texas State Department of Health regulations, licenses, and operating procedures which apply to work you are engaged in, and explain their provisions to you.

YOUR RESPONSIBILITY AS A WORKER

You should familiarize yourself with those provisions of the regulations and the operating procedures which apply to the work you are engaged in. You should observe their provisions for your own protection and protection of your co-workers.

WHAT IS COVERED BY THESE REGULATIONS

1. Limits on exposure to radiation and radioactive material in restricted and unrestricted areas;
2. Measures to be taken after accidental exposure;
3. Personnel monitoring, surveys and equipment;
4. Caution signs, labels, and safety interlock equipment;
5. Exposure records and reports; and
6. Related matters.

REPORTS ON YOUR RADIATION EXPOSURE HISTORY

1. The regulations require that your employer give you a written report if you receive an exposure in excess of any applicable limit as set forth in the regulations or in the license. The basic limits for exposure to employees are set forth in Section 21.101, 21.103, and 21.104 of the regulations. These sections specify limits on exposure to radiation and exposure to concentrations of radioactive material in air and water.
2. If you work where personnel monitoring is required,
   - (a) Your employer must give you a written report, upon termination of your employment, of your radiation exposures, and
   - (b) Your employer must advise you annually of your exposure to radiation.

INSPECTIONS

All licensed or registered activities are subject to inspection by representatives of the Texas State Department of Health.

INQUIRIES

Inquiries dealing with the matters outlined above can be sent to the Texas State Department of Health, Division of Occupational Health and Radiation Control, 1100 West 49th Street, Austin 56, Texas.

POSTING REQUIREMENT

Copies of this notice must be posted in a sufficient number of places in every establishment where employees are employed in activities licensed or registered pursuant to Part 41 of Texas Regulations for Control of Radiation, by the Texas State Department of Health, to permit employees working in or frequenting any portion of a restricted area to observe a copy on the way to or from their place of employment.

Information
Sheet # 34

Information Sheet
on
SAMPLE REPORT FORM

CURRENT OCCUPATIONAL EXTERNAL RADIATION EXPOSURE

Identification

1. Name (Print--Last, First. and Middle Doe, John J.	2. Social Security No. 404-61-9080
3. Date of Birth (Month, Day. Year 3 16 1922	4. Name of Licensee or Registrant Ajax Testing Labs.

Occupational Exposure

5. Dose Recorded for (Specify: Whole Body skin of whole body; or hands and forearms, feet and ankles.) whole body	6. Whole Body Dose Status (rem) 14	7. Method of Monitoring (e.g., ✓ Film Badge--FB; ✓ Pocket Chamber--PC; Calculations--Calc.) X or GAMMA ✓ BETA ✓ NEUTRONS ______

8. Period of Exposure (From-To)	Dose for the Period (rem)				13. Running Total for Calendar Quarter (rem)
	9. X or Gamma	10. Beta	11. Neutron	12. Total	
6-1-63 to 8-1-63	✓	✓		3	3
8-1-63 To 9-1-63	✓	✓		4	7

Lifetime Accumulated Dose

14. Previous Total (rem)	15. Total Quarterly Dose date rem	16. Total Accumulated Dose (rem)	17. Perm. Acc. Dose 5(n-18) (rem)	18. Unused Part of Permissible Accumulated Dose (rem)
14	7	21	120	99

Information Sheet
on
SAMPLE REPORT FORMS

YEARLY EXPOSURE SUMMARY

Year	Film Badge 1 MR	Dosi-meter 1 MR	Film Badge 2	Dosi-meter 2	Film Badge 3	Dosi-meter 3	Film Badge 4	Dosi-meter 4
January	160	180						
February	120	130						
March	170	150						
1st Quarter	450	460						
April	600	550						
May	100	90						
June	110	100						
2d Quarter	810	740						
July	410	300						
August	660	700						
September	360	400						
3d Quarter	1430	1400						
October	200	200						
November	160	150						
December	150	140						
4th Quarter	510	490						
Yearly Total	3,200 MR or 3.2 REM	3090 MR or 3.09 REM						

DAILY DOSIMETER READING

Name John Doe

Date 4-2-64
Work Week Beginning

Serial Number	Date		Dosimeter Reading in Milliroentgens		Daily Exposure
			Start	Finish	
166	Monday	4-2	0	30	30
✓	Tuesday	4-3	30	70	40
✓	Wednesday	4-4	0	25	25
✓	Thursday	4-5	25	60	35
✓	Friday	4-6	60	100	40
✓	Saturday	4-7	0	100	100
✓	Sunday	4-8	—	—	—
				Total Weekly Exposure	270 MR

John Doe
Signature

Information Sheet
on
SAMPLE REPORT FORMS

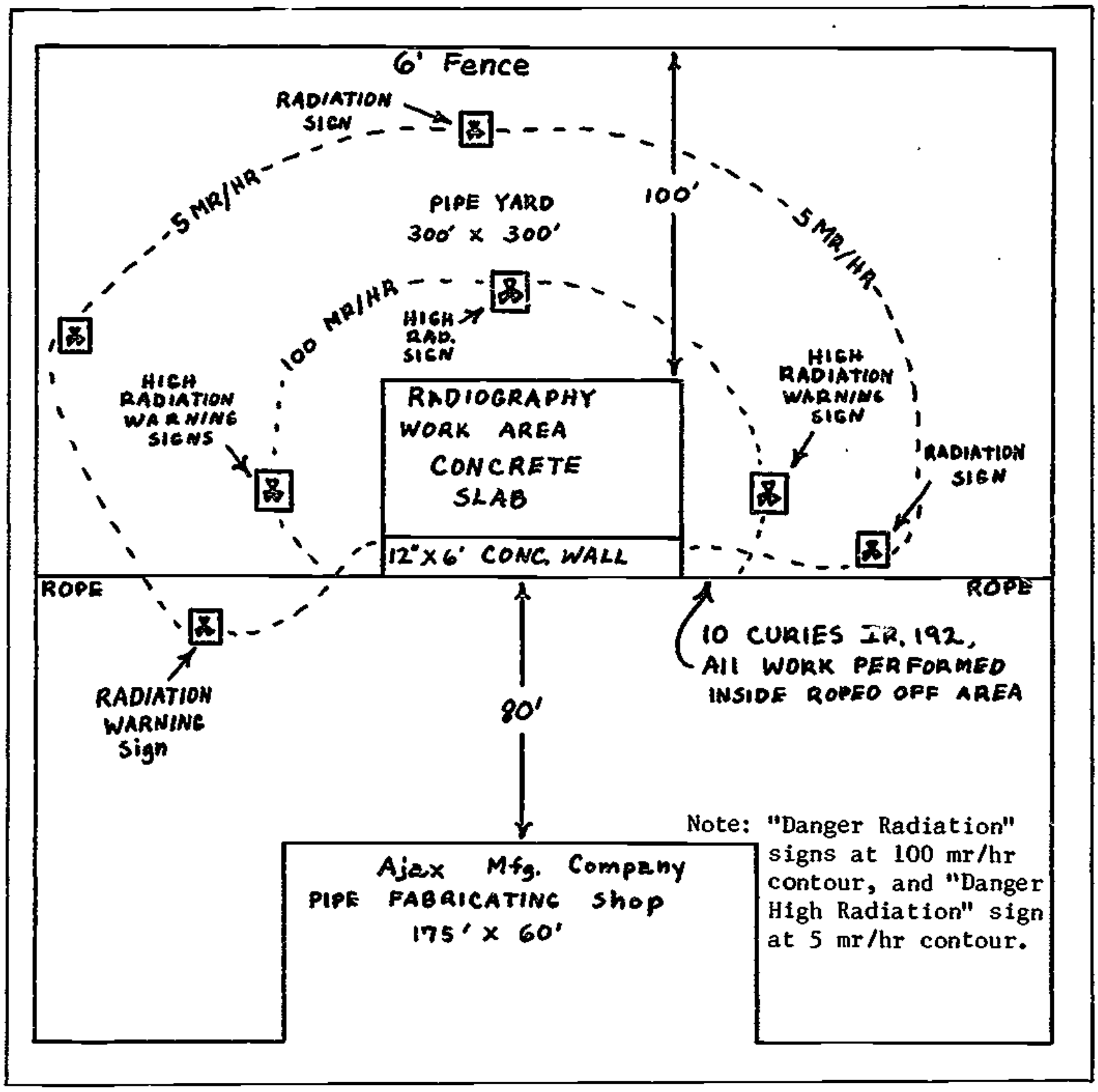
AREA SURVEY RECORD

Radioactive Material IR. 192 Source No. 75

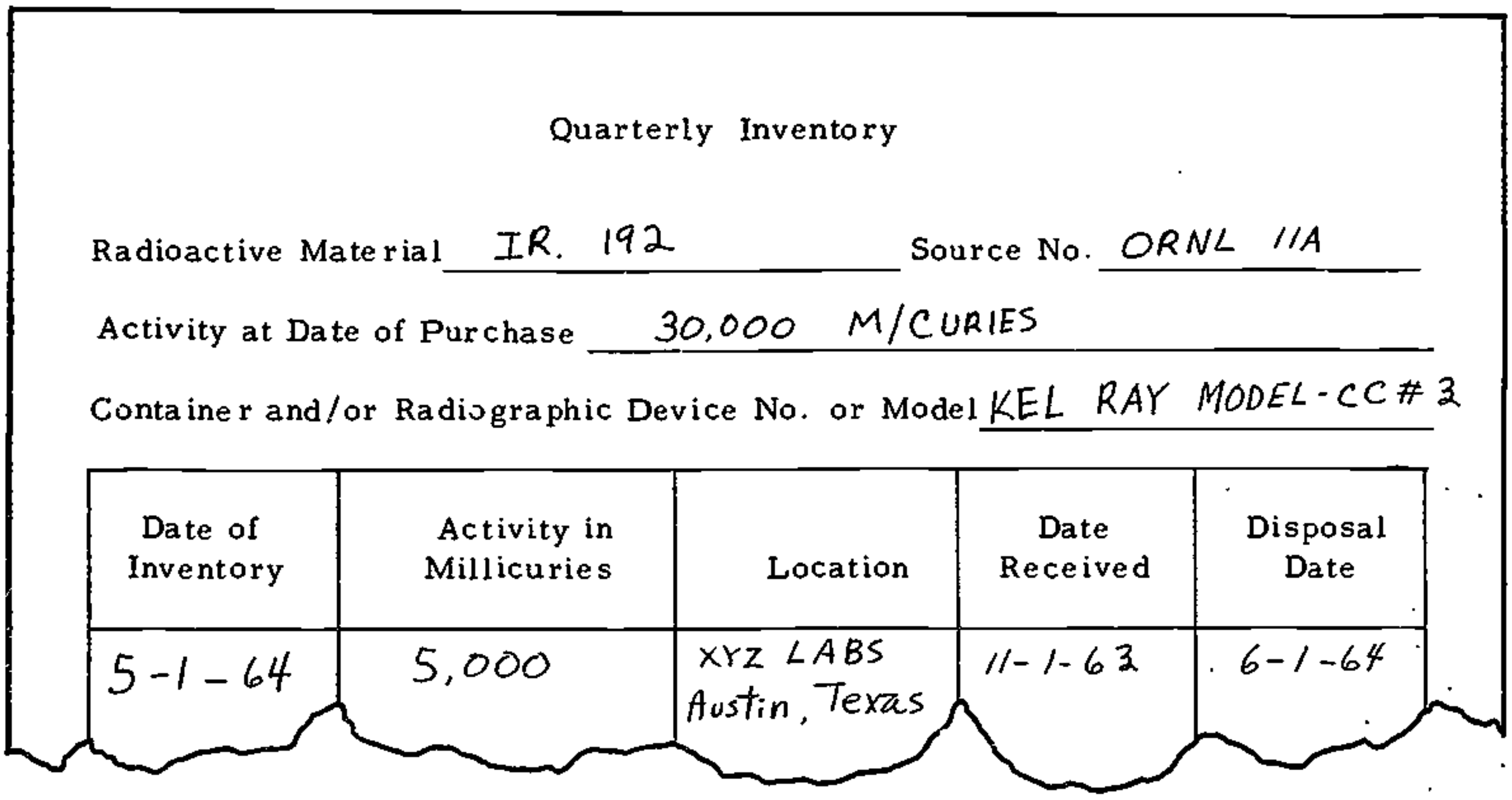
Container and/or Radiographic Device No. or Model KELRAY CC #10

Date of Survey 3-1-64 Survey Instrument No. # 14

Location AJAX Mfg. Co. PIPE FABRICATING YARD HOUSTON, TEXAS



Note: "Danger Radiation" signs at 100 mr/hr contour, and "Danger High Radiation" sign at 5 mr/hr contour.



Quarterly Inventory

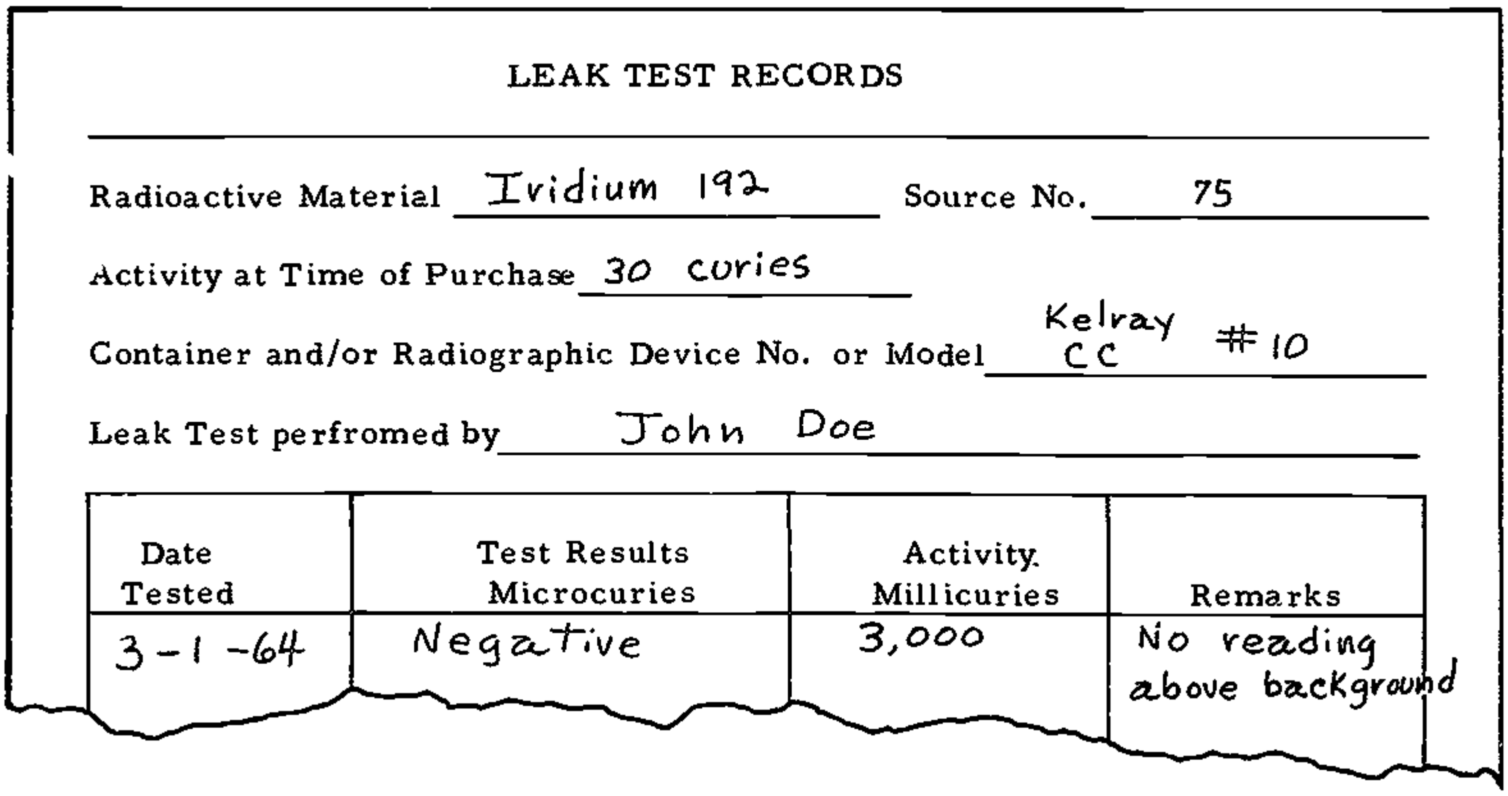
Radioactive Material IR. 192 Source No. ORNL 11A

Activity at Date of Purchase 30,000 M/CURIES

Container and/or Radiographic Device No. or Model KEL RAY MODEL-CC#2

Date of Inventory	Activity in Millicuries	Location	Date Received	Disposal Date
5-1-64	5,000	XYZ LABS Austin, Texas	11-1-63	6-1-64

Information Sheet
on
SAMPLE REPORT FORMS



LEAK TEST RECORDS

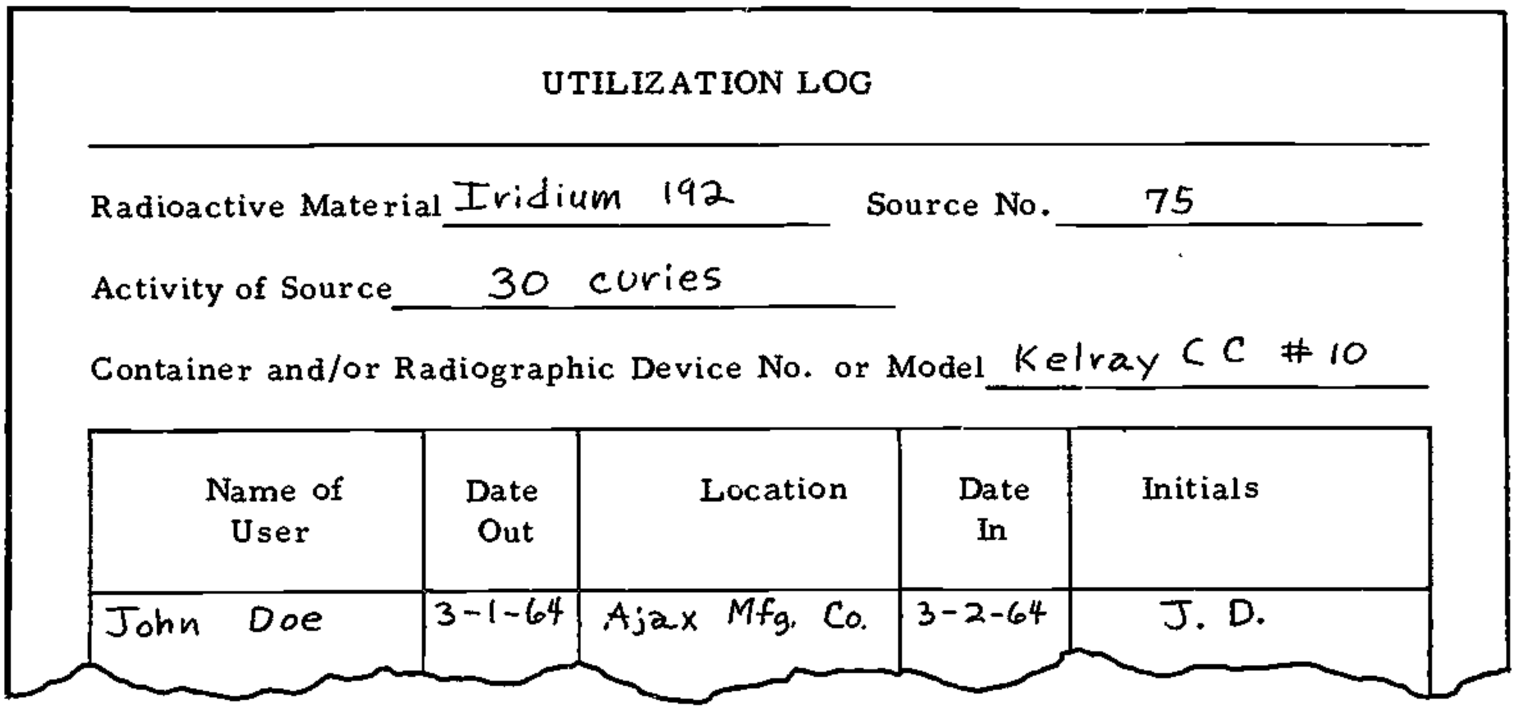
Radioactive Material Iridium 192 Source No. 75

Activity at Time of Purchase 30 curies

Container and/or Radiographic Device No. or Model Kelray CC #10

Leak Test perfromed by John Doe

Date Tested	Test Results Microcuries	Activity Millicuries	Remarks
3-1-64	Negative	3,000	No reading above background



UTILIZATION LOG

Radioactive Material Iridium 192 Source No. 75

Activity of Source 30 curies

Container and/or Radiographic Device No. or Model Kelray CC #10

Name of User	Date Out	Location	Date In	Initials
John Doe	3-1-64	Ajax Mfg. Co.	3-2-64	J. D.

STORAGE SECURITY AND UTILIZATION LOG
FOR IN-PLANT RADIOGRAPHY

Location AJAX Testing LABS. Austin, Texas

Container and/or Radiographic Device No. or Model Kelray CC #10

Name of User	Source Material	Source Out		Source In		Radiation Level	Source Secure Initials
		Date	Time	Date	Time		
John Doe	IR. 192	2-2-64	9:00AM	2-2-64	4:00PM	17.2 Curies	John Doe

Information Sheet # 39

Information Sheet
on
SAMPLE REPORT FORMS

SURVEY OF SOURCE STORAGE

Radioactive Material IR. 192 Source No. 75

Activity at Time of Purchase 30 curies

Container and/or Radiographic Device No. or Model Kelray C.C. #10

Leak Test performed by John Doe

Date Tested	Test Results Microcuries	Activity Millicuries	Remarks
3-1-64	Negative (below .05 uc)	6,000	No meter indication Above background

INSTRUMENT CALIBRATION RECORD

Instrument Type IONIZATION Type Survey Meter

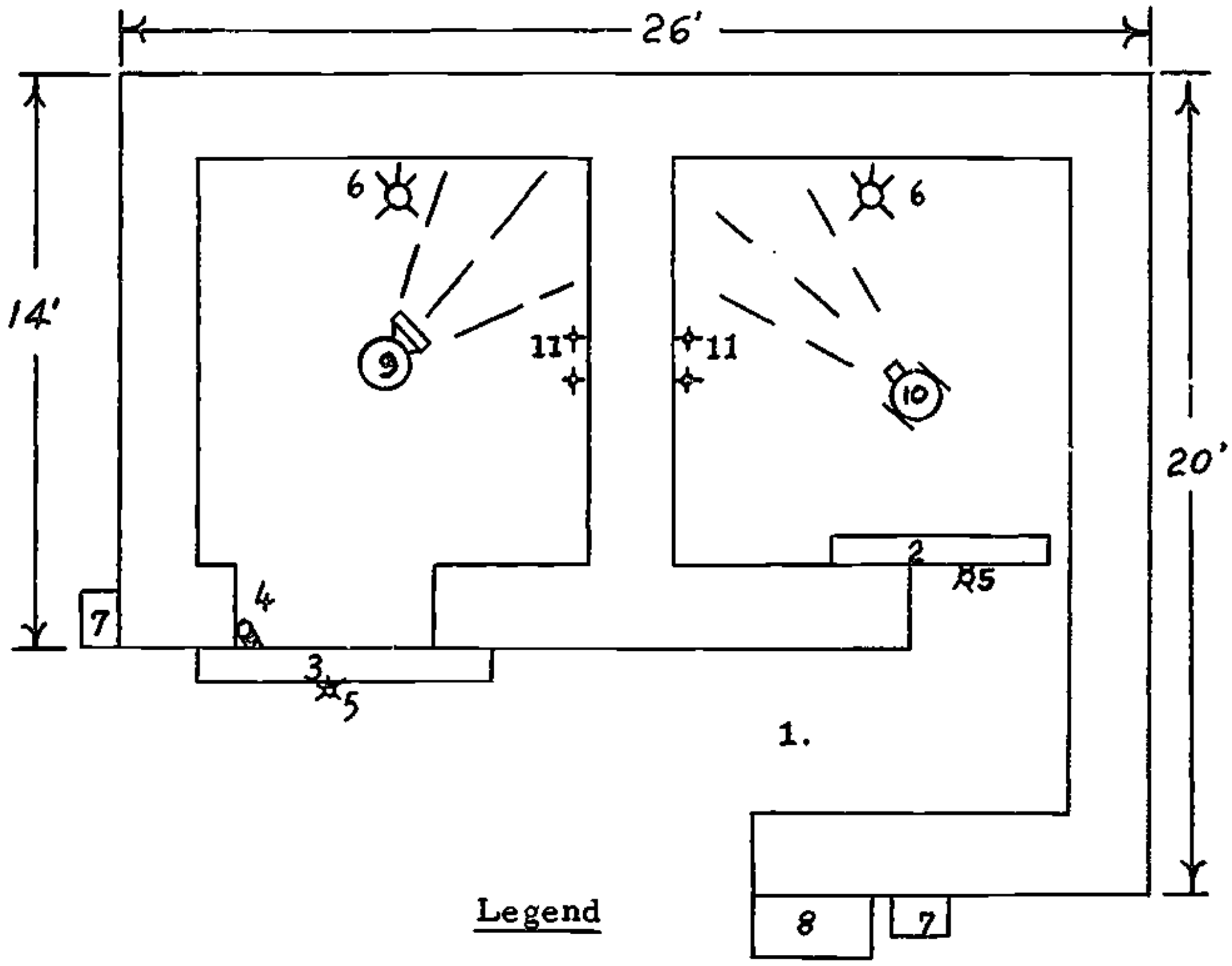
Instrument Model SR50

Serial Number 1765

Range 0-50 R/HR Year 1964

Date Calibrated	Calibrated By	Remarks
3-1-64	John Doe	CalibRATED @ 1,2+4 ft. on MR/HR Range and @ 1' on MR/HR Range using - MG RADIUM

Information Sheet
on
SUGGESTED LAYOUT OF EXPOSURE FACILITIES

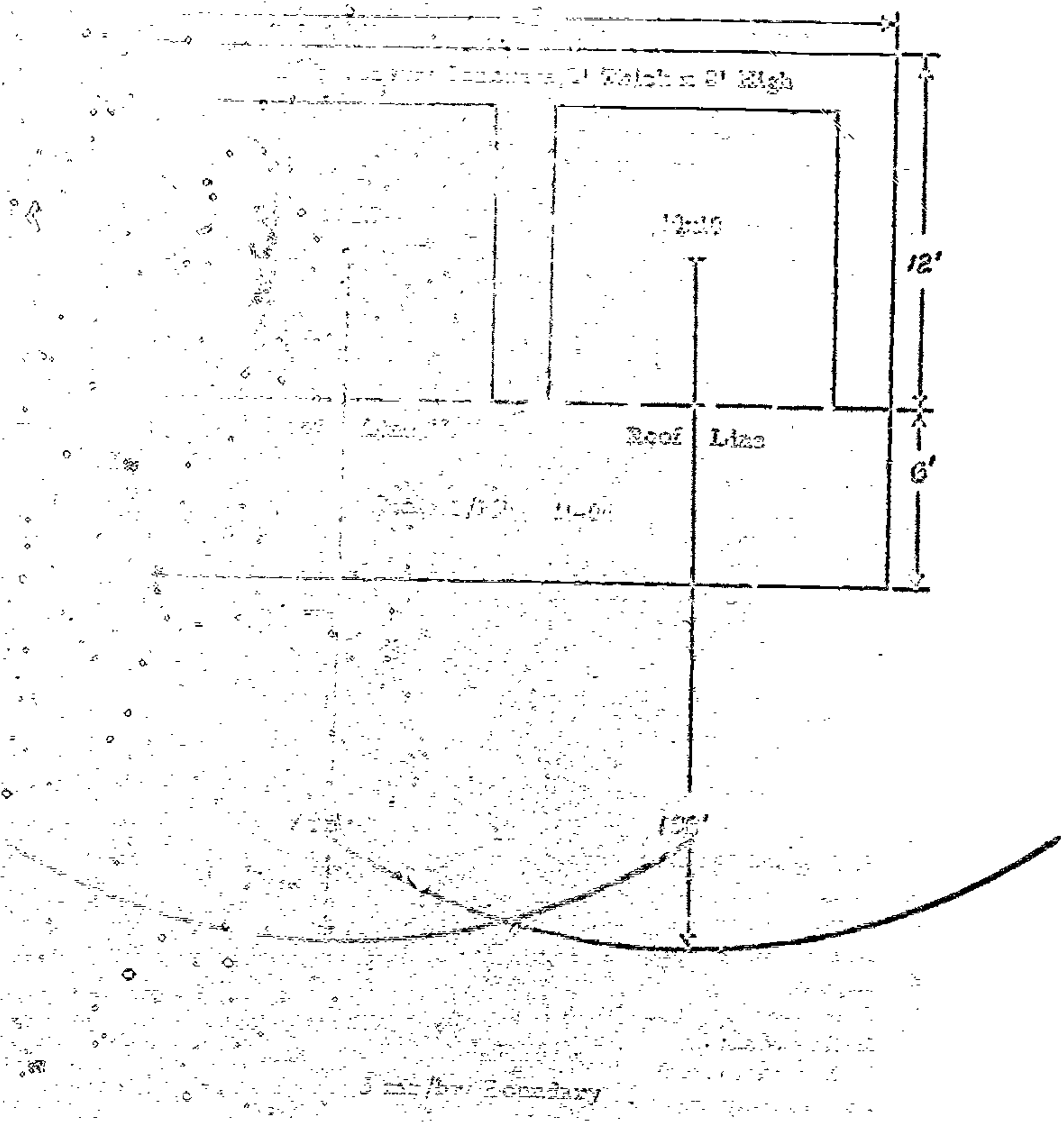


Legend

1. Labyrinth for bringing in heavy objects with a fork lift.
2. Sliding lead sandwich door.
3. Sliding lead sandwich door.
4. Safety switch shuts off power to X-Ray generator when door is opened.
5. Red warning lights on doors while exposure is being made.
6. Lights.
7. Radiation Monitor, 110 volt AC power supply.
8. X-Ray controls.
9. X-Ray generator.
10. Gamma Ray exposure device.
11. Cooling water taps for X-Ray head.

Note: Lead sheets on floor and walls are desirable, expecially in X-Ray exposure room, to reduce scatter. If this facility is built inside a building containing upper floors it may be necessary to provide a permanent roof to shield the floors above this facility. If built as a separate building, an attenuation survey should include the roof. Warning signs and a fence around the roof are desirable.

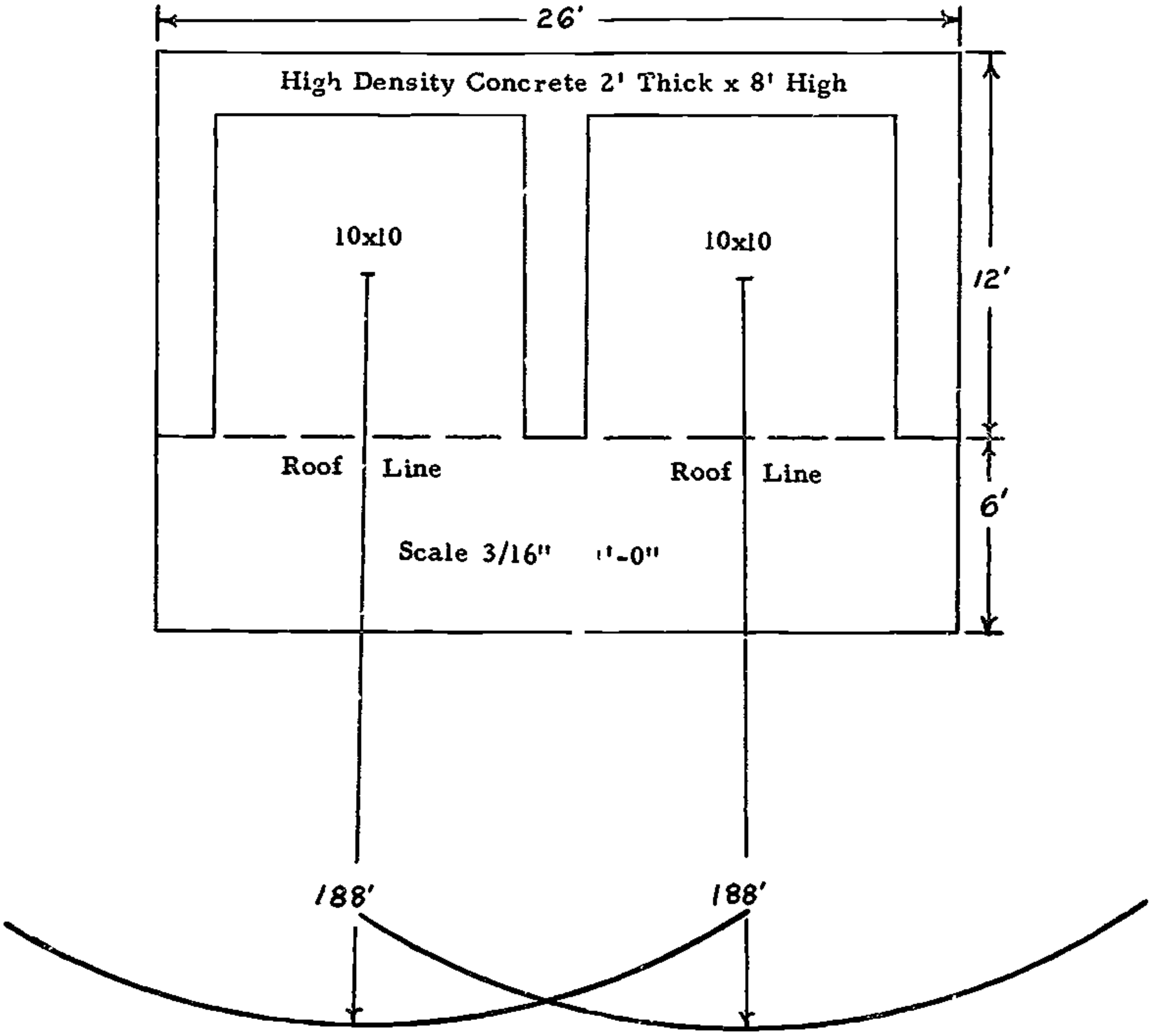
INDOOR FACILITIES



[illegible] equals 10,000 [illegible] in. 192.

[illegible] in center of cell, reading at outside surface of [illegible]

[illegible] FACILITIES



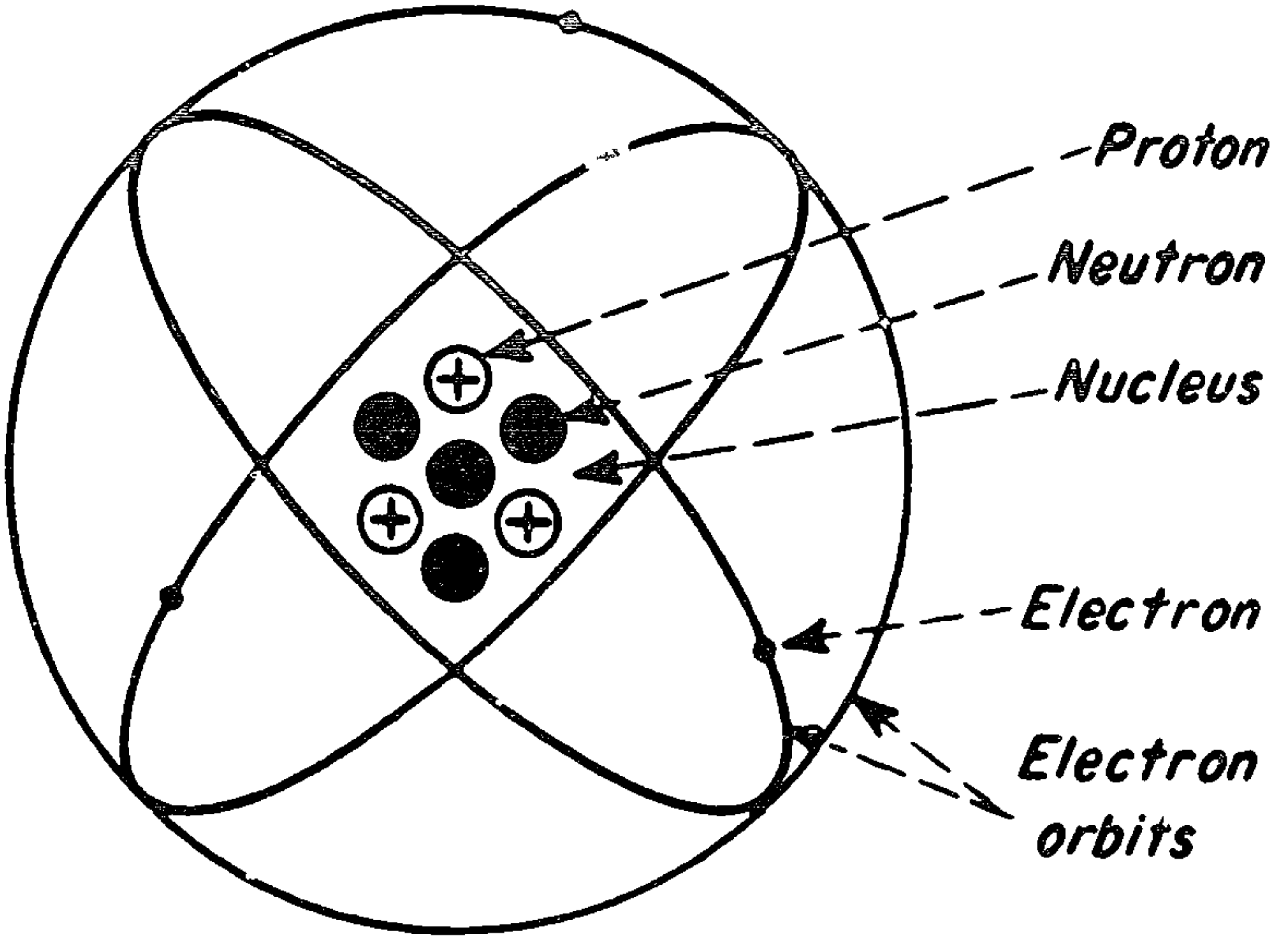
5 mr/hr Boundary

Attenuation factor for 24" concrete equals 10,000 for ir. 192.

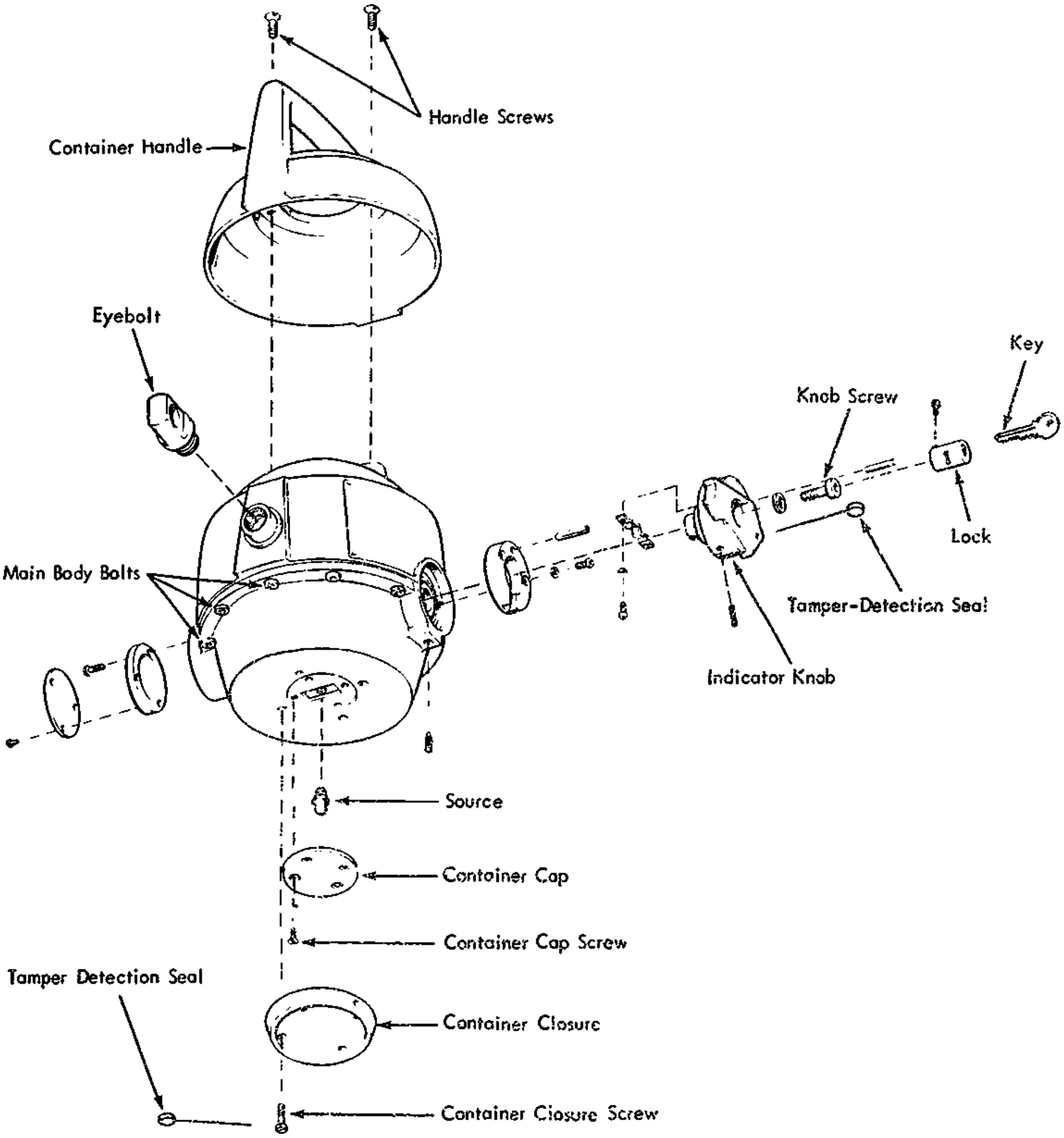
With 30 curies ir. 192 positioned in center of cell, reading at outside surface of walls would be less than 1/2 mr/hr.

OUTDOOR FACILITIES

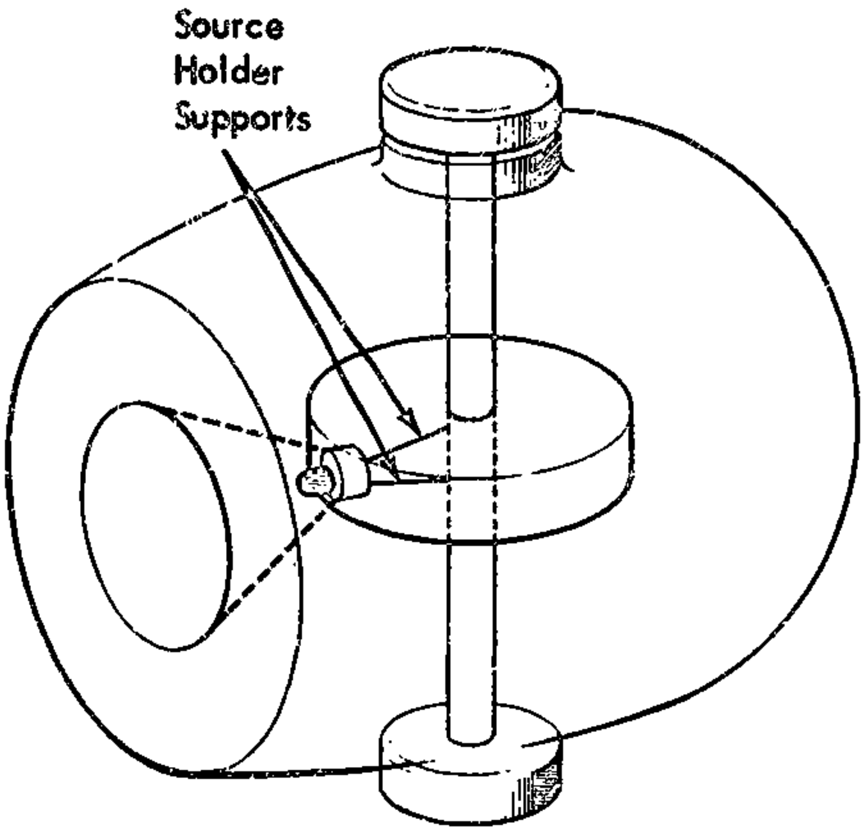
Information Sheet
on
STRUCTURE OF THE ATOM



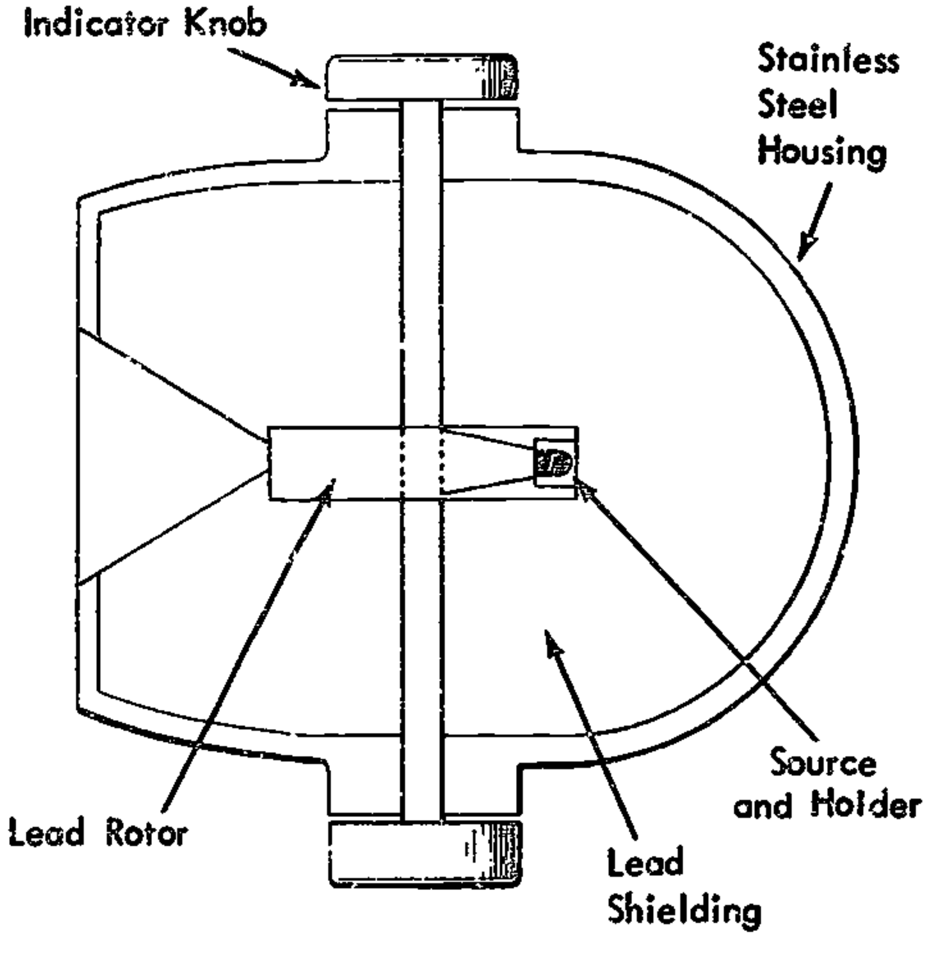
Information Sheet
on
MODEL CC PROJECTOR



EXPLODED VIEW OF THE MODEL CC PROJECTOR

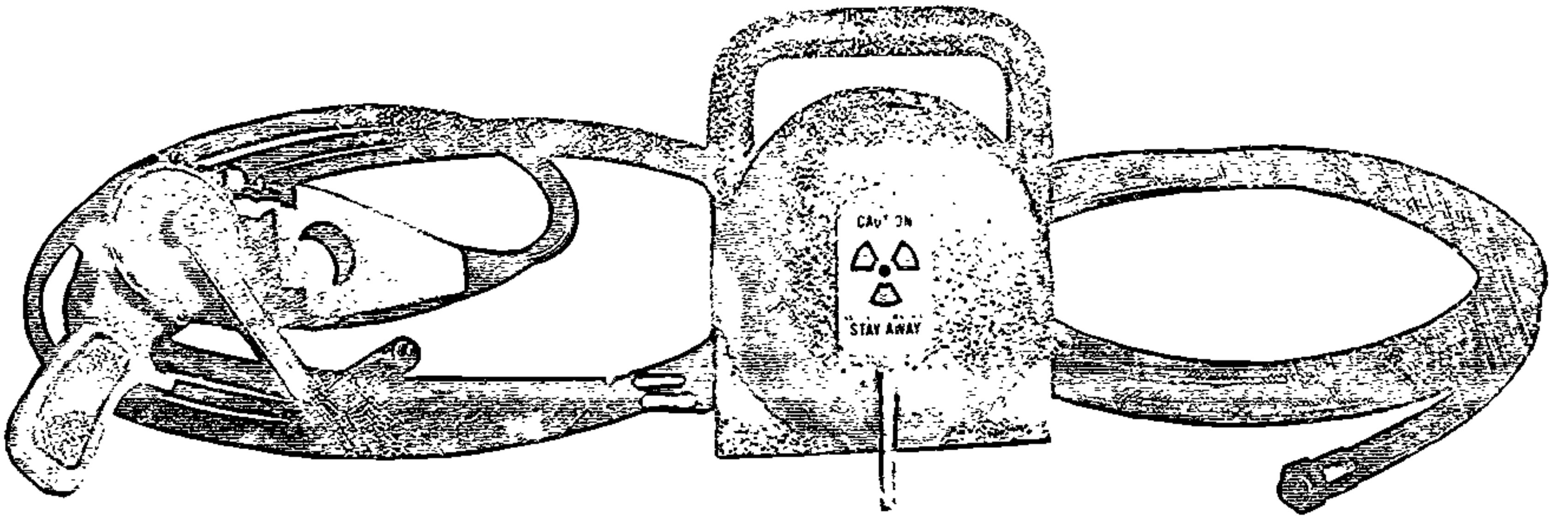


SOURCE IN "ON" POSITION

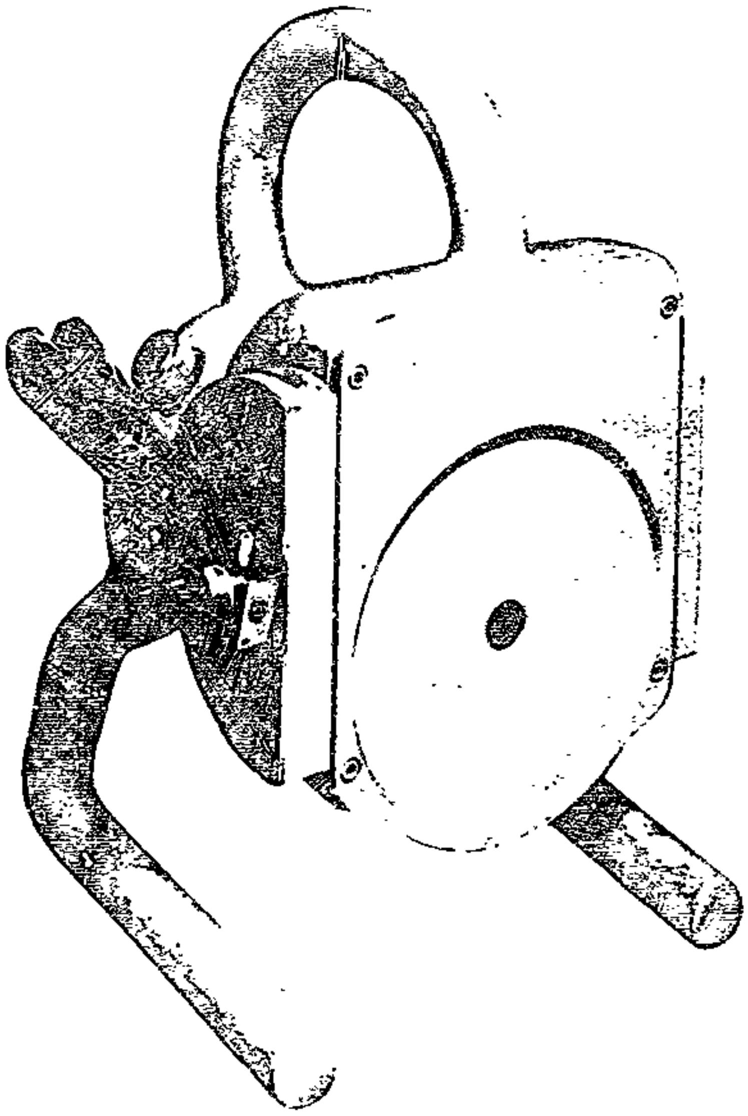


SOURCE IN "OFF" POSITION

Information Sheet on TYPICAL EXPOSURE DEVICES



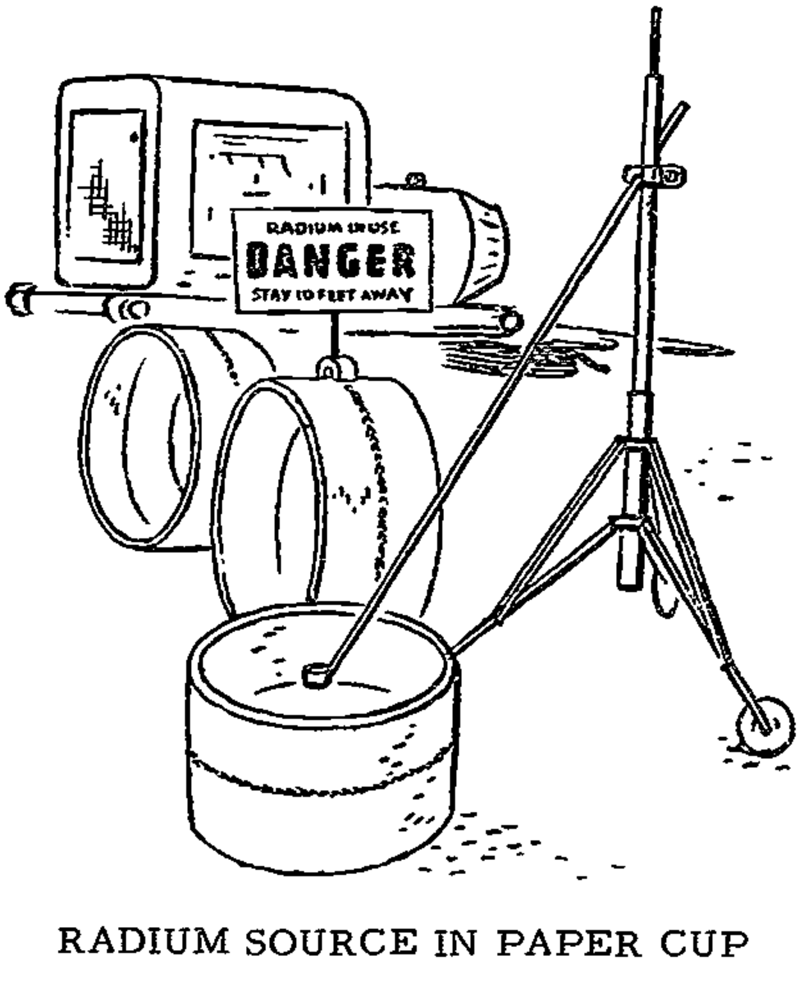
Philips Electronic Instruments



Electronic Instrument Division, The Budd Company

Information Sheet
on
EARLY METHODS OF RADIOGRAPHY

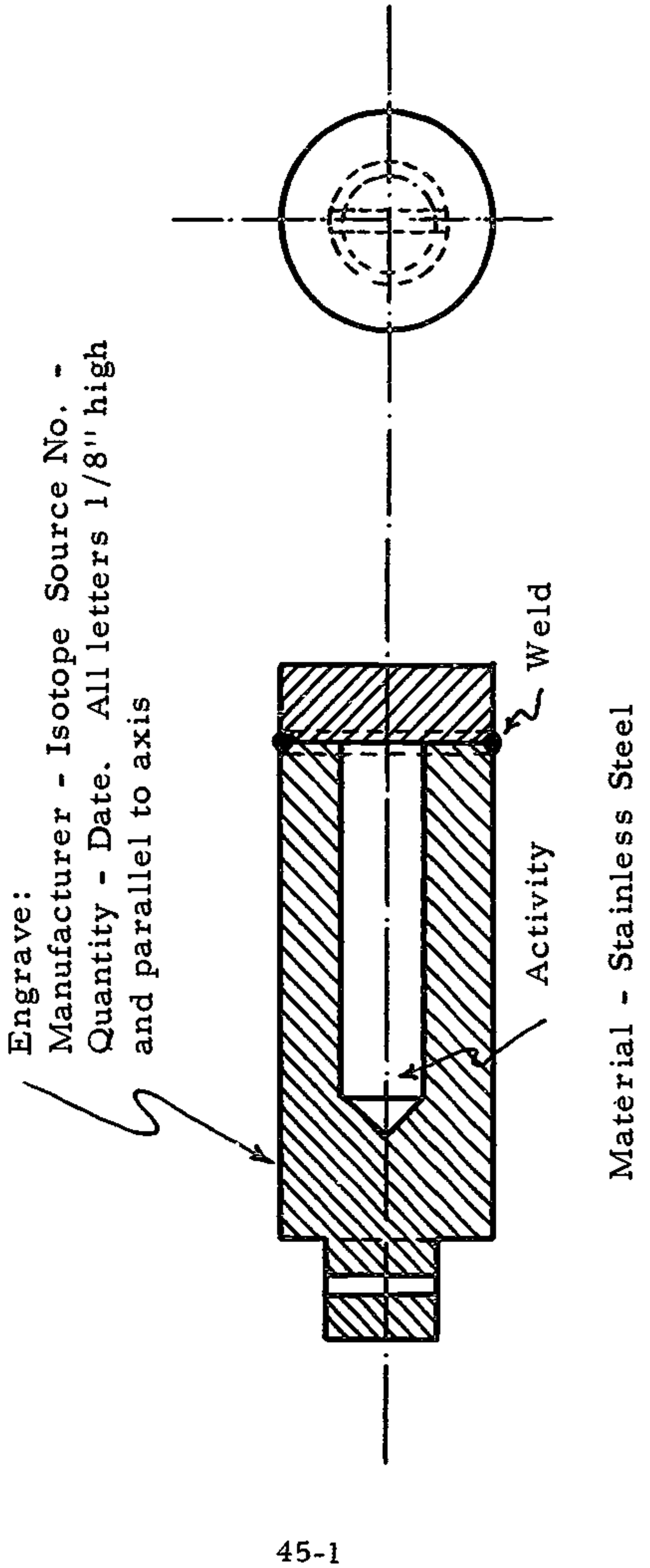
RADIUM "FISH POLE" METHOD



RADIUM SOURCE IN PAPER CUP

Information Sheet
on
TYPICAL GAMMA SOURCE CAPSULE

Information Sheet # 45



Information
Sheet # 46

Information Sheet
on
RELATIVE FILM DENSITIES

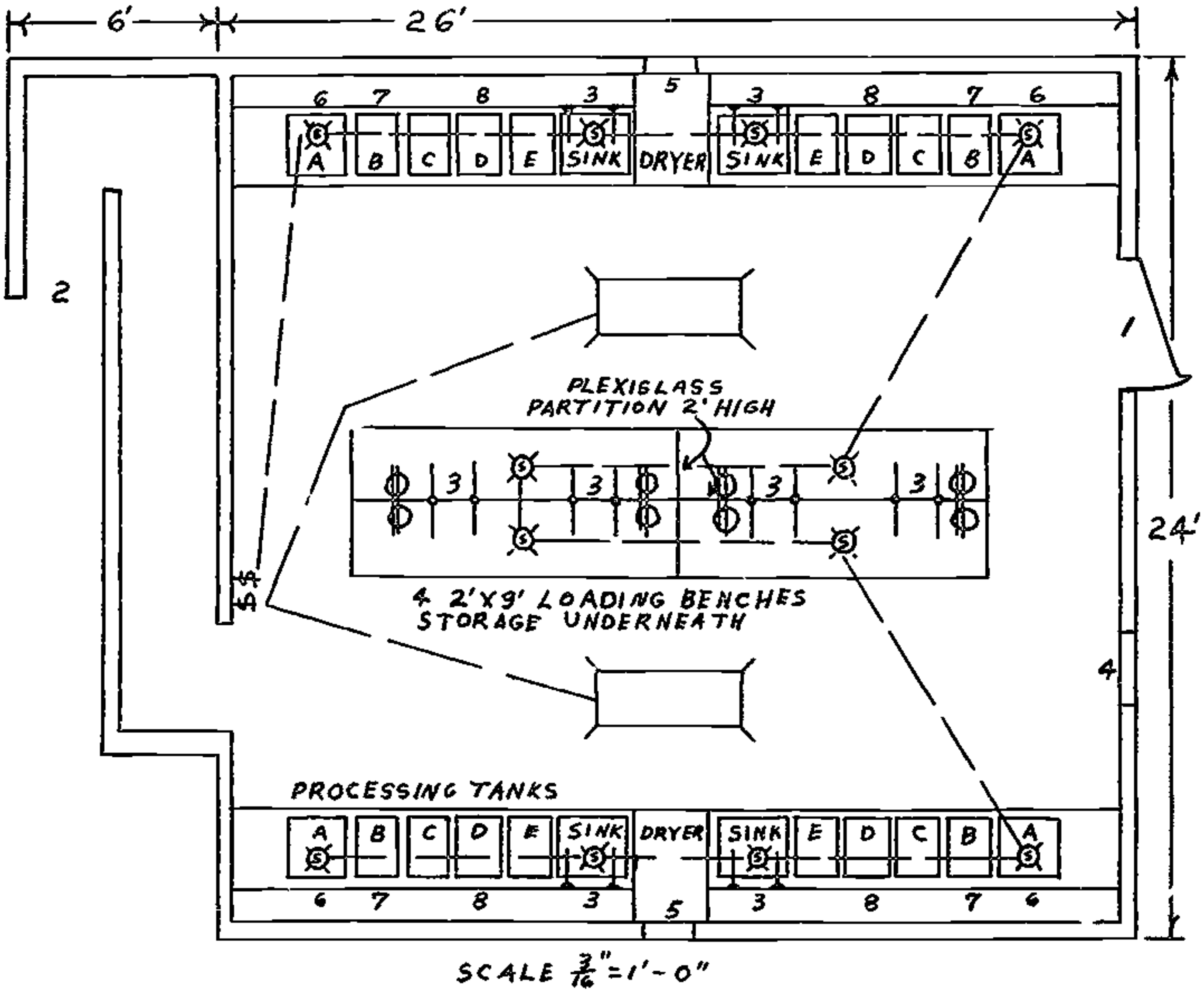
140 KV 4 MA

Aluminum	.005" Lead Density	.010" Lead Density
1 inch	1.06	.72
7/8 inch	1.27	.80
3/4 inch	1.45	.93
5/8 inch	1.74	1.10
1/2 inch	2.00	1.25
3/8 inch	2.18	1.40

Comparison of vlatine

Film densities obtained at 140 kv 4 ma
using .005" lead screens compared
with use of .010" lead screens

Information Sheet
on
SUGGESTED DARKROOM LAYOUT PLAN



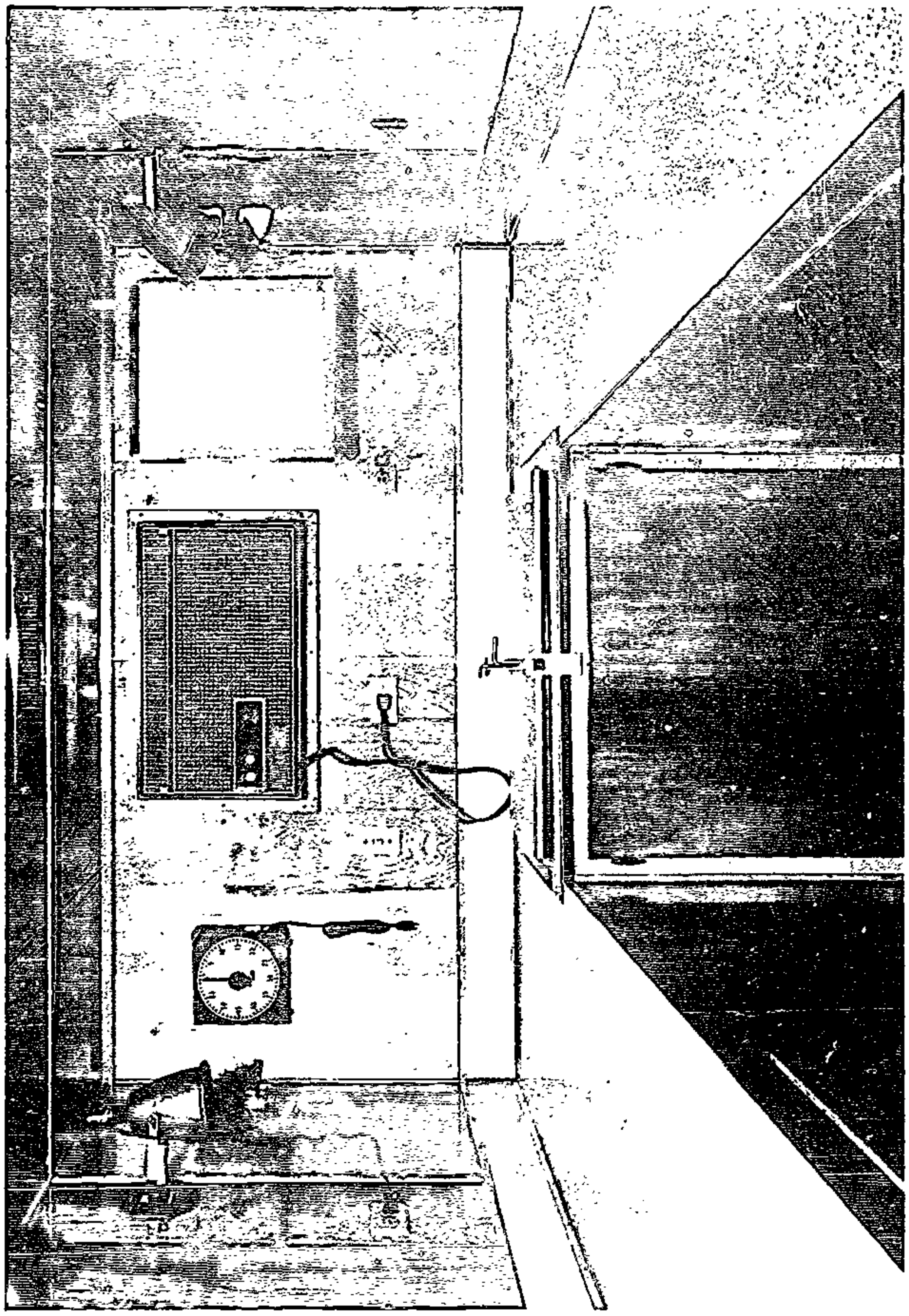
Legend

1. Door, 3'x6' 8", locked from inside, for moving equipment into room.
2. Labrynth
3. Film hanger
4. Air Duct
5. Film dryer exhausts
6. Timers
7. Chart boards
8. Illuminators
9. Indirect safelight lamps
10. A, B, C, D, E. Processing tanks

Direct safelight lamps

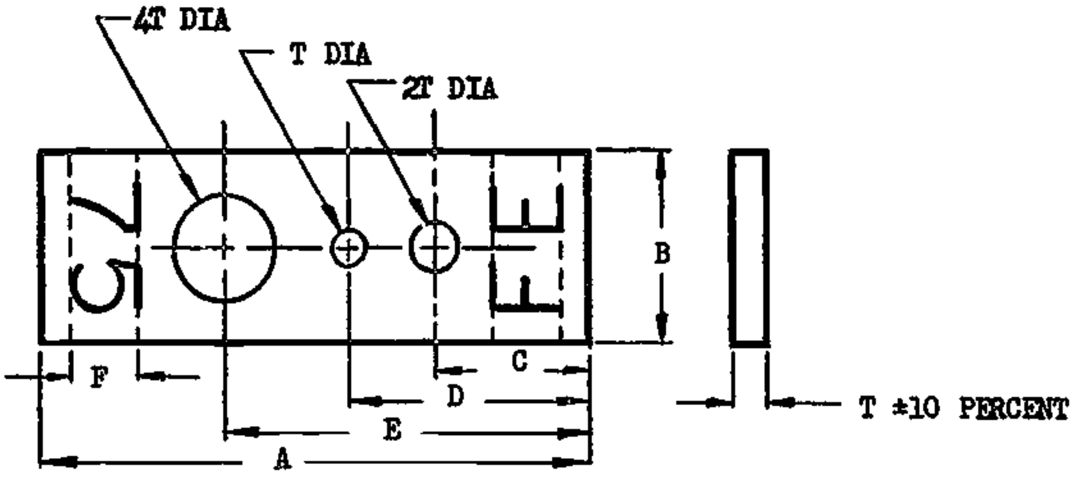
Note: Temperature control in darkroom is desirable for chemicals and film storage. (68 - 72 °F.) Film storage, waste bins, equipment storage under work benches.

Information Sheet
on
INTERIOR OF PORTABLE DARKROOM



Information Sheet
on
TYPICAL MILITARY PENETRAMETERS

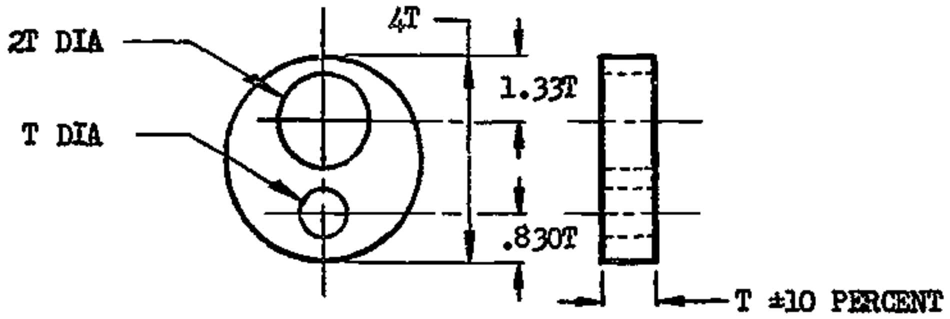
MIL-STD-453
29 OCTOBER 1962



T	INCREMENTS	A	B	C	D	E	F
.005-.020 INCL.	.0025	2.000	.500	.520	.800	1.150	.250
.025-.050 INCL.	.005	2.000	.500	.520	.800	1.150	.250
.060-.160 INCL.	.010	2.850	1.000	.800	1.250	1.900	.375

MIN PENETRAMETER THICKNESS	.005 ±10 PERCENT
MIN DIAMETER FOR 1T HOLE	.010 ±10 PERCENT
MIN DIAMETER FOR 2T HOLE	.020 ±10 PERCENT
MIN DIAMETER FOR 4T HOLE	.040 ±10 PERCENT

DESIGN FOR PENETRAMETER THICKNESSES UP TO AND INCLUDING 0.160



DESIGN FOR PENETRAMETER THICKNESSES OF 0.180 AND OVER MADE IN .020 INCREMENTS

SYMBOL	MATERIALS (SEE 4.2.2.2.3)
SS	STAINLESS STEEL
AL	ALUMINUM
FE	STEEL
MG	MAGNESIUM
CU	COPPER
TI	TITANIUM

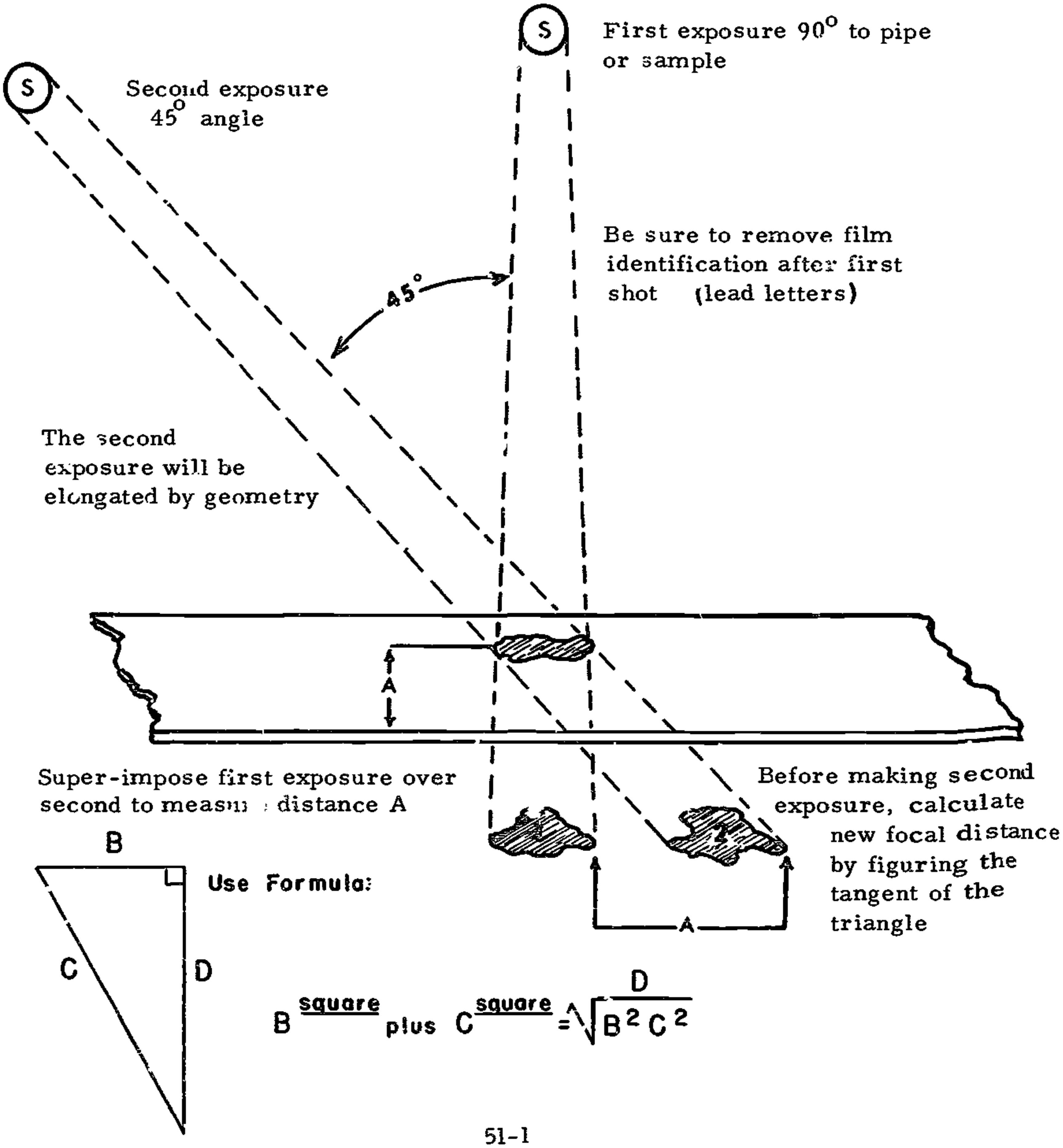
ALL DIMENSIONS IN INCHES.
HOLES SHALL BE TRUE AND NORMAL TO THE SURFACE OF THE PENETRAMETER. DO NOT CHAMFER.
TOLERANCES ON PENETRAMETER THICKNESSES AND HOLE DIAMETERS SHALL BE ±10 PERCENT OR 1/2 OF THE THICKNESS INCREMENT BETWEEN PENETRAMETER SIZES, WHICHEVER IS SMALLER.

Information Sheet
on
ASME PENETRAMETERS (GAMMA)

STEEL THICKNESS (INCHES)	PENETRAMETER NUMBER
Up to 1/4" incl.	5
1/4 to 3/8	7
3/8 to 1/2	10
1/2 to 5/8	12
5/8 to 3/4	15
3/4 to 7/8	17
7/8 to 1. 0	20
1. 0 to 1 1/4	25
1 1/4 to 1 1/2	30
1 1/2 to 2. 0	35
2. 0 to 2. 5	40
2. 5 to 3. 0	45
3. 0 to 3. 5	50

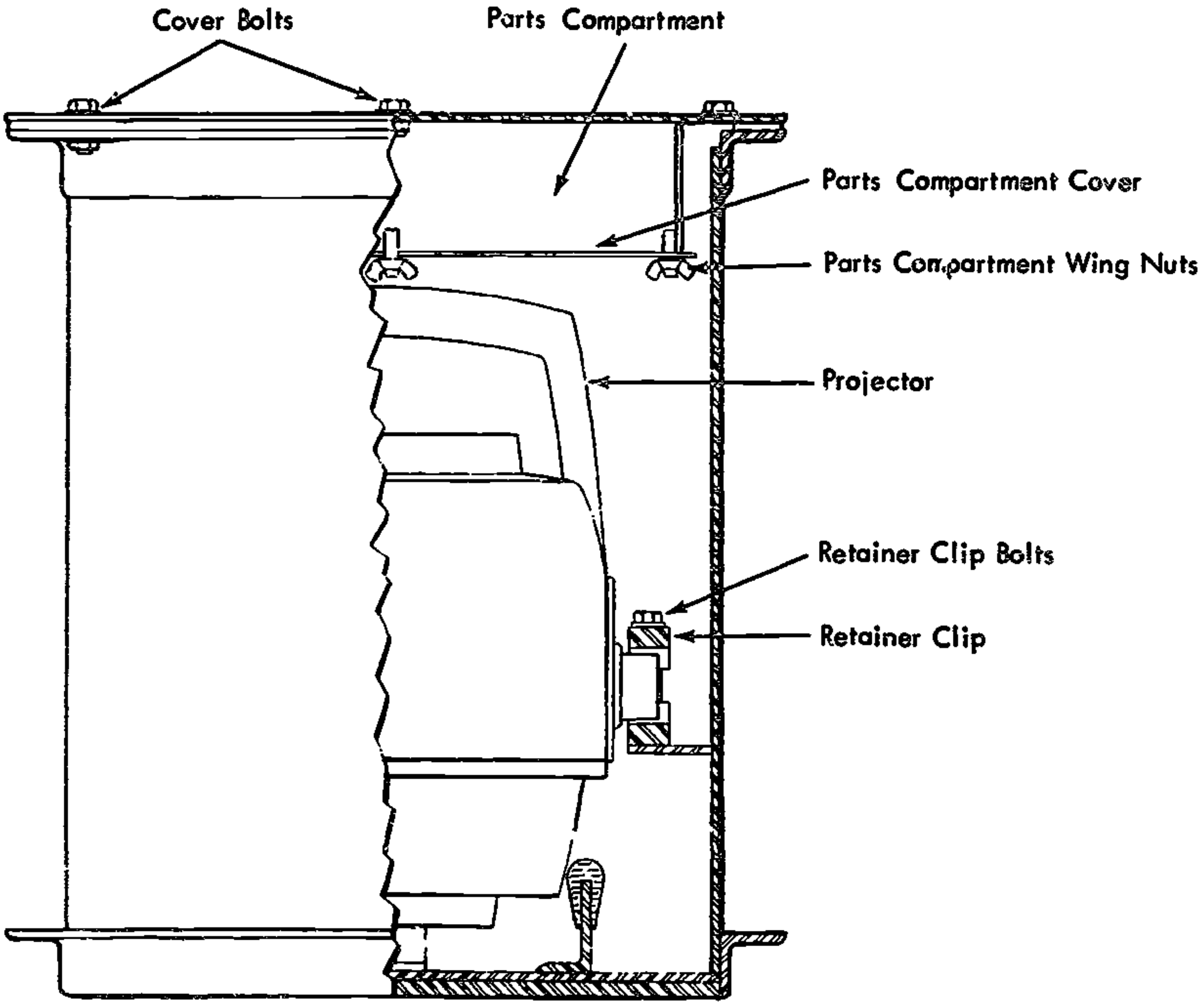
Information Sheet
on
TECHNIQUE FOR FAULT LOCATION

Should one radiograph show a flaw, it's approximate location in the parent metal can be determined thus:



$$B^{\underline{\text{square}}} \text{ plus } C^{\underline{\text{square}}} = \overset{D}{\sqrt{B^2 C^2}}$$

Information Sheet
on
TYPICAL SHIPPING CONTAINER



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SEMI-FINISHED STEEL, 8 minutes, 16 mm, sound, U.S. Steel Corp.

HOT ROLLING STEEL SHEETS, 8 minutes, 16 mm, sound, U.S. Steel Corp.

SHOP DRAWINGS, 22 minutes, 16 mm, sound, Pennsylvania State University, University Park, Pa.

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GLOSSARY

"A": Symbol for mass number, that is, the number of the protons in the nucleus; hence the number of positive charges on the nucleus. The mass number is approximately equal to the atomic weight. For example: "A" is 1 for hydrogen, 2 for deuterium and 235 for uranium.

ABSORPTION: Act or process of being absorbed - being taken in

ACTUATING: Putting into action

A. E. C.: U. S. Atomic Energy Commission

ALPHA RAY: Stream of fast-moving helium nuclei (alpha particles). A strongly ionizing and weakly penetrating radiation.

ANGSTROM UNIT: A minute unit of length equal to one ten-thousandth of a micron or one one-hundred millionth of a centimeter, used in expressing the length of light waves.

ANODE: Positive electrode; electrode to which negative ions are attracted

A. S. M. E.: American Society of Mechnical Engineers

A. S. T. M.: American Society for Testing Materials

ATOM: The basic building block of nature and the smallest particle that can enter into a chemical reaction. The atom can be subdivided and consists of an inner core or nucleus make up by neutrons and protons, surrounded by electrons which rotate around this nucleus like planets around the sun

ATOMIC NUMBER: The number of protons (positively charged particles) found in the nucleus of an atom. All elements have different atomic numbers. The atomic number of hydrogen is 1, that of oxygen 8, iron 26, lead 82, uranium 92. The atomic number is also called charge number and is usually denoted by Z.

ATOMIC WEIGHT: The atomic weight is approximately the sum of the number of protons and neutrons found in the nucleus of an atom. This sum is also called mass number. The atomic weight of oxygen, for example, is approximately 16, with most oxygen atoms containing 8 neutrons plus 8 protons. Aluminum is 27 - it contains 14 neutrons and 13 protons.

ATTENUATION: The process by which a beam of radiation is reduced in intensity when passing through some material.

AUTORADIOGRAPHY: Self-portraits of radioactive sources made by placing the radioactive material next to photographic film. The radiations fog the film leaving an image of the source. It was such self-portraits that led to the discovery of radioactivity.

AVERAGE LIFE: (MEAN LIFE): The average of the individual lives of all the atoms of a particular radioactive substance. It is 1.443 times the radioactive half-life.

A.W.S.: American Welding Society

BACKGROUND RADIATION: This is due to cosmic rays from outer space, small amounts of radioactive substances present in our bodies and in many of the materials surrounding us

BACKSCATTER The deflection of radiation by scattering processes through angles greater than 90 degrees with respect to the original direction of motion

BETA PARTICLE Charged particle emitted from the nucleus of an atom and having a mass and charge equal in magnitude to those of the electron.

BINDING ENERGY: The energy which holds the neutrons and protons of an atomic nucleus together.

BREMSSTRAHLUNG: Secondary photon radiation produced by deceleration of charged particles passing through matter

CALIBRATION: Determination of variation from standard, or accuracy of a measuring instrument to ascertain necessary factors

CASSETTE A holder for film

CATHODE: Negative electrode, electrode to which positive ions are attracted

CESIUM -137: An isotope of the element cesium having a mass number of 137. One of the important fission products and a constituent of fallout. It has a half-life of 33 years.

CHAMBER, IONIZATION: Ion chambers are filled with gas (often air) and are provided with two oppositely charged electrodes. They differ from Geiger counters in simply collecting the electric charge on the ions that radiation produces in the gas.
The collected ions produce a minute electrical current, which may be detected directly by a sensitive electrometer or may be amplified to give a meter reading. This current is a measure of the radiation.

COBALT - 60: A radioactive isotope of the element cobalt. Cobalt-60 is important as one of the least expensive sources of gamma radiation and is used widely in radiography.

COLLIMATOR: A device for confining the elements of a beam within an assigned solid angle (A device for directing the useful radiation into a more or less parallel beam.)

COMPATIBLE: Capable of coexisting in harmony

COMPTON EFFECT: The glancing collision of a gamma ray with an electron. The gamma ray gives up part of its energy to the electron. The name is taken from the discoverer, Dr. Arthur Compton .

CONTAMINATION: Disposition of radioactive material, generally in a finely divided or liquid form in any place where it is not desired and will produce a hazard to personnel.

CORPUSCULAR RADIATION: A general term given those types of radiation which consist of particles such as alpha and beta radiation.

COSMIC RADIATION: Extremely high energy radiation consisting of both particles and rays which originate out in space and constantly bombard the earth. Cosmic radiation has great penetrating ability in all materials.

COUNTER, PROPORTIONAL: Gas filled radiation detection tube in which the pulse produced is proportional to the number of ions formed in the gas by the primary ionizing particle.

CURIE That quantity of radioactive nuclide disintegrating at the rate of 37 billion atoms per second (abbreviated: c.)

DECAY CURVE: A curve showing the relative amount of radioactive substance remaining after any time interval.

DECAY, RADIOACTIVE. When a radioactive atom disintegrates it is said to decay. What remains is a different element. An atom of polonium decays to form lead, ejecting an alpha particle in the process.

DECONTAMINATION: The removal, by physical or chemical means, of unwanted radioactive material from a surface.

DENSITOMETER: Instrument utilizing a photocell to determine the degree of darkening of developed photographic film.

DENSITY (Photographic) Denotes the degree of darkening of photographic film. (Physics) Ratio of the mass of a homogeneous portion of matter to its volume.

DICHROIC: Having the property of presenting colors in two different directions, by transmitted light.

DISINTEGRATE: When a radioactive atom gives off its excess energy in the form of radiation it is said to disintegrate.

DOSE, PERMISSIBLE: The amount of radiation which may be received by an individual within a specified period with expectation of no significantly harmful result to himself.

DOSE RATE. The radiation dose delivered to the body in a certain period of time. Rate of any radiation energy absorption per gram of any material.

DOSE RATE METER Any instrument which measures radiation dose rate.

DOSIMETER: Instrument used to detect and measure an accumulated dosage of radiation. In common usage it is a pencil-sized ionization chamber with a built-in self-reading electrometer, used for personnel monitoring.

DROSS: The scum or waste matter from molten ore or metal.

ELECTROMETER: Electrostatic instrument for measuring change of electric potential of charged electrodes resulting from ionization produced by radiation.

ELECTRON: Negatively charged particle which is a constitutent of every neutral atom.

ELECTRON, SECONDARY: An electron ejected from an atom, molecule, or surface as a result of a collision with a charged particle or photon.

ELECTROSCOPE: Instrument for detecting the presence of electric charges by the deflection of charged bodies.

ELEMENT: A basic substance consisting of a "family" of naturally occuring isotopes. For example, hydrogen, lead and oxygen are elements. All atoms of an element contain a definite number of protons and thus have the same atomic number.

ENCAPSULATED: Enclosed in a capsule (a small container)

ENERGY: Capacity for doing work.

ENVIRONMENTAL: Related to the external conditions and influences affecting the life and development of an organism.

EROSION: The act of being eaten or worn away.

EXTERNAL RADIATION: Exposure to radiation from radioactive sources located outside of the body.

FILM BADGE: A pack of photographic film used for approximate measurement of radiation exposure for personnel monitoring purposes. The badge may contain a filter which shields part of the film from certain types of radiation.

FILM CONTRAST: The slope or steepness of the characteristic curve of the film. It depends upon the type film, the processing it receives, and the density.

FISSION, NUCLEAR: A nuclear transformation characterized by the splitting of a nucleus into at least two other nuclei and the release of a relatively large amount of energy. The division or splitting of an atomic nucleus releasing very great amounts of heat and radioactivity.

FLAW: A crack; a gap; a defect; a fault

FLUOROSCOPY: The process of examining an object by direct observation of the fluorescence of a screen caused by radiation transmitted through the object.

FOCAL SPOT (X-rays): The part of a target of the X-ray tube which is struck by the main electron stream.

GAMMA RADIATION: Short wavelength electromagnetic radiation of nuclear origin with a range of wavelengths from about 10-8 to 10-11 cm, emitted from the nucleus.

GEIGER COUNTER: Highly sensitive gas-filled radiation-measuring device which operates at voltages sufficiently high to produce avalanche ionization.

HALF-LIFE RADIOACTIVE: Time required for a radioactive substance to lose 50% of its activity by decay. Each radionuclide has a unique half-life.

HALF-THICKNESS (HALF VALUE LAYER): The thickness of any particular material necessary to reduce the intensity of an X-ray or gamma ray beam to one-half its original value.

HEALTH PHYSICS: A name given to that branch of radiation science concerned with the protection of personnel from radiation.

INCLUSIONS: Internal discontinuities commonly encountered in radiographic work such as trapped gas or blowholes and porosity; slag; or other foreign bodies.

INTENSITY: Rate of radiation energy passing through unit surface area.

ION: Atomic particle, atom, or chemical radical bearing an electrical charge, either negative or positive.

IONIZATION: The process or the result of any process by which a neutral atom or molecule acquires either a positive or a negative charge.

IONIZATION CHAMBER: A gas filled region in an electrical field between electrodes across which a potential difference is applied.

ISODOSE CHART: Chart showing the distribution of radiation in a medium by means of lines or surfaces drawn through points receiving equal doses.

ISOTOPE: One of several nuclides having the same number of protons in their nuclei, and hence having the same atomic number, but differing in the number of neutrons, and therefore in the mass number. Almost identical chemical properties exist between isotopes of a particular element.

MEV: A unit of nuclear energy equal to 1 million electron volts.

MICROCURIE: A measure of radioactive material. One-millionth of a curie.

MILLICURIE: A measure of radioactive material. One-thousandth of a curie.

MILLIROENTGEN: (mr) A submultiple of the roentgen equal to one one-thousandth (1/1,000) of a roentgen.

MODERATOR: Material used in a nuclear reactor to moderate (slow down) neutrons from the high energies at which they are released.

MONITOR: A radiation detector used to determine whether an area is safe for workers.

MONITORING: Periodic or continuous determination of the amount of ionizing radiation or radioactive contamination present in an occupied region as a safety measure for purposes of health protection.

NONDESTRUCTIVE TESTING: Includes all possible methods of detection or measurement of the properties or performance capabilities of materials, parts, assemblies, or structures, which do not impair their serviceability.

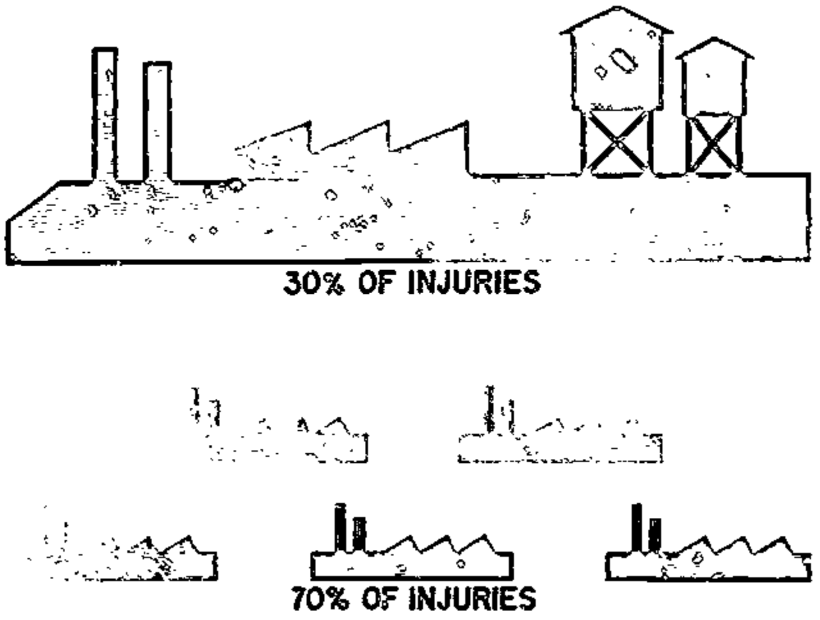
NEUTRON: Elementary nuclear particle with a mass approximately the same as that of a hydrogen atom and electrically neutral. Neutrons are divided into sub-classifications: thermal-.025 ev, epithermal-0.1 ev to 100 ev; slow-less than 100 ev; intermediate, 10^2 to 10^5 ev; fast, greater than .1 mev.

NUCLEUS: That part of an atom in which the total positive electric charge and most of the mass are concentrated.

PAIR PRODUCTION: An absorption process for X- and gamma radiation in which the incident photon is annihilated in the vicinity of the nucleus of the absorbing atom with subsequent production of an electron and positron pair.

PENETRAMETER: A standard test piece superimposed on the specimen to be radiographed to determine radiographic sensitivity by the visibility of the test piece on the finished radiograph.

NATIONAL PROBLEM



ENGINEERING
EDUCATION
ENFORCEMENT

CHART 6—SERIES A

SMALL PLANTS ARE A NATIONAL PROBLEM

Studies made over the years have established that out of 2 million disabling work injuries (per year), about 30 percent, or 600,000, were in plants which had organized safety programs; while 70 percent, or 1,400,000, occurred in plants which had no organized safety program.

It was found that these plants which had no organized safety programs were mainly small plants whose managements felt that they "could not afford" an accident-prevention program, or were "too small" for one.

THREE "E's"

In fact, no plant is "too small" for a safety program and every plant can "afford" such a program. The basic fundamentals of accident-prevention programs are the three "E's": Engineering, Education, and Enforcement.

ENGINEERING ENFORCEMENT

1. *Engineering* is to furnish information as to what is wrong and what should be done about it. (Technical know-how).
2. *Education* is the teaching of safety to all concerned. Convincing management, (a) to correct conditions found in the engi-

PHOTOELECTRIC EFFECT: Occurs when an electron is knocked out of an atom by a light ray or gamma ray. This effect is used in an "electric eye" Light falls on a sensitive surface, knocking out electrons which can then be detected.

PHOTON: A quantity of electromagnetic energy whose value in ergs is the product of its frequency in cycles per sec. and Planck's constant. (a natural constant of proportionality relating the frequency of a quantum of energy to the total energy of the quantum.)

PLATEAU: As applied to radiation detector chambers, the level portion of the counting rate-voltage curve where changes in operating voltage introduce minimum changes in the counting rate.

PLATEAU SLOPE; RELATIVE: The relative increase in the number of counts as a function of voltage expressed in percentage per 100 volts increase above the Geiger threshold

POSITRON: Particle equal in mass to the electron and having an equal but opposite charge.

PROTON: Elementary nuclear particle with a positive electric charge equal numerically to the charge of the electron and a mass of 1.007594 units.

QUANTUM THEORY: Concept that energy is radiated intermittently in units of definite magnitude called quanta, and absorbed in a like manner.

RAD: The unit of absorbed dose, which is 100 ergs/gram. The rad is a measure of the energy imparted to matter by ionizing radiation per unit mass of irradiated material at the place of interest.

RADIATION: The emission and propagation of energy through space or through a material medium in the form of waves.

RADIATION, BACKGROUND. Radiation arising from radioactive material other than the one directly under consideration. Background radiation due to cosmic rays and natural radiation is always present.

RADIOACTIVITY: Process whereby certain nuclides undergo spontaneous disintegration in which energy is liberated, generally resulting in the formation of new nuclides. The process is accompanied by the emission of one or more types of radiation, such as alpha particles, and gamma photons.

RADIOCHEMISTRY: That phase of chemistry concerned with the properties and behavior of radioactive materials.

RADIOGRAPHY: The making of radiographs or shadow images on photographic emulsion by the passage of X-rays or gamma rays through a specimen or object onto a film which, after development, provides a permanent visible record of the internal condition of the specimen or object. The shadow image is the result of the differential attenuation of the radiation in its passage through the object being radiographed.

RADIOISOTOPES: Another name for radioactive materials.

RADIUM: One of the earliest known naturally radioactive elements. It is far more radioactive than uranium and is found in the same ores.

RBE DOSE: Biological dose.

REACTOR: A nuclear reactor is an "atomic furnace". In a reactor, nuclei of the fuel are burned (i.e., undergo controlled fission) under the influence of neutrons, in a chain reaction. This energy is removed as heat which may be used to make steam for driving steam engines and to produce electricity. The moderator for the first reactor was piled-up blockes of graphite. Thus, a nuclear reactor was formerly referred to as a pile. Reactors are usually classified now as research, test, process heat and power, depending on their principal function. No workable design for a controlled fusion reactor has yet been devised.

REM: A measure of the dose to body tissue of any ionizing radiation in terms of its estimated biological effect relative to a dose of 1r. of X-rays.

RESOLVING TIME, COUNTER: The minimum time interval between two distinct events which will permit both to be counted. It may refer to an electronic circuit, to a mechanical indicating device, or to a counter tube.

ROENTGEN: The quantity of X or gamma radiation such that the associated corpuscular emission per .001293 grams of air produces, in air, ions carrying 1 electrostatic unit of quantity of electricity of either sign.

ROENTGEN EQUIVALENT MAN (REM): That quantity of any type ionizing radiation which when absorbed by man produces an effect equivalent to the absorbtion by man of one roentgen of X or gamma radiation (400 kv)

SCALER: An electronic device which registers current pulses received over a given time interval.

SHIELD: A body of material used to prevent or reduce the passage of particles of radiation.

SOURCE: Any substance which emits radiation. Usually refers to a piece of radioactive material conveniently packaged for scientific or industrial use.

URANIUM: The heaviest naturally occurring radioactive element, atomic number 92. Pure uranium is an alpha radiation emitter and an internal radiation hazard. Two of the radioisotopes of uranium are fissionable and can be used as fuel in reactors. Uranium-235 is the one most commonly used.

WELDMENT: A unit formed by welding together an assembly of pieces.

X-RAYS: Penetrating electromagnetic radiations having wavelengths shorter than those of visible light. They are usually produced by bombarding a metallic target with fast electrons in a high vacuum.

"Z": Symbol for atomic number. An element's atomic number is the same as the number of protons found in one of its nuclei. All isotopes of a given element have the same "Z" number. Z=92 for uranium isotopes.

Additional useful terminology may be found in the following listed publications:

Health Physics Handbook, Ft. Worth, Tex. General Dynamics Corp. 1963

101 Atomic Terms and What They Mean, Linden, N. J., Esso Research and Engineering Company, (Booklets free on request)

Radiological Health Handbook, Washington: Office of Technical Services, Department of Health, Education, and Welfare, 1957

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Rigging Cargo Gear. (Safety in Industry, Mechanical and Physical Hazards Series).

Netterstrom, Ralph W.
Bureau of Labor Standards, Washington, D.C.
Pub Date - 66
DOCUMENT NOT AVAILABLE FROM EDRS   27p.

*SAFETY, *STEVEDORES, INDUSTRY, *RIGGING, *TEXTBOOKS, *INDUSTRIAL EDUCATION,

This bulletin is for use as an instructional handbook for stevedores in preventing ship's cargo gear failures and resulting personal injury and property damage. One of a series on safety in industry, it was prepared in the Maritime Branch. Safe practices in rigging and using cargo handling gear are suggested for the swinging boom, burtoned loads, stress on guys, jackknifing, and preventers. The document size is 6 by 9 inches. The document is available as GPO L16.3--240 for 15 cents from Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402. (PS)

PUBLICATIONS IN THE SAFETY IN INDUSTRY SERIES

MECHANICAL AND PHYSICAL HAZARDS SERIES

Bulletin 216: Control of Electrical Shock Hazards. (Rev. 1962.) 15 pp. 15 cents.
Bulletin 219: Mechanical Handling of Materials. 1960. 29 pp 15 cents.
Bulletin 231: Personal Protective Equipment. 1961. 26 pp. 15 cents.
Bulletin 232: Fire Protection for the Safety Man. 1961. 25 pp. 15 cents.
Bulletin 239: Mechanics for the Safety Man. 1962. 21 pp. 15 cents.
Bulletin 240: Rigging Cargo Gear. (Rev. 1966.) 23 pp. 15 cents.
Bulletin 246: Maintenance and Safety. 1962. 15 pp. 15 cents.
Bulletin 256: Static Electricity. 1963. 20 pp. 15 cents.
Bulletin 110: Teach Them To Lift (Rev. 1965.) 15 cents.

ENVIRONMENTAL AND CHEMICAL HAZARDS SERIES

Bulletin 207: Controlling Noise Hazards. 1959. 8 pp. 10 cents.
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Bulletin 259: The Use and Handling of Compressed Gases. 1963. 30 pp. 15 cents.
Bulletin 265: The Inorganic Acids. 1964. 27 pp. 15 cents.

ORGANIZATION AND ADMINISTRATION SERIES

Bulletin 211: Control of the Physical Environment. 1960. 13 pp. 15 cents.
Bulletin 223: The Consultative Approach to Safety. 1960. 9 pp. 15 cents.
Bulletin 247: Fundamentals of Accident Prevention. 1962. 14 pp. 15 cents.
Bulletin 255: Using Injury Statistics. 1963. 18 pp. 15 cents.

This bulletin, one of the series on Safety in Industry, was prepared in the Maritime Branch by Ralph W. Nelstrom

For sale by the Superintendent of Documents, U.S. Government Printing Office
Washington, D.C., 20402 - Price 15 cents

CONTENTS

Safety in Industry

MECHANICAL AND PHYSICAL HAZARDS

RIGGING CARGO GEAR

THIS bulletin, "Rigging Cargo Gear," differs from others in the Safety in Industry series in that it is written for and about a specific industry—stevedoring. Since this is the case, the terminology of the industry, which may or may not be familiar to some of the people acquainted with other bulletins in the series, has been used. Also, a much more informal and personalized style of presentation has been adopted.

"Rigging Cargo Gear" was first published in mimeograph form in 1953. Over the years it has been revised and extended to reflect the Bureau of Labor Standards' efforts to prevent injuries in the use of ship's gear, first on a promotional and educational basis, and later under the administrative authority contained in Public Law 85–742 amending the Longshoremen's and Harbor Workers' Compensation Act. Although the bulletin is based on equipment peculiar to the maritime industry, it is believed that the suggestions offered can, in some cases, be applied to shore based hoisting apparatus as well.

★ ★ ★

Failure of conventional ship's cargo gear, while not common, occurs more frequently than necessary. Claims for gear replacement, cargo damage, loss of time and occasional injuries to personnel are the costs which the stevedore must often pay for the failure of gear which he does not own and over which he does not have complete control.

The fundamental cause of gear failure in burtoning cargo is the lack of safety devices to prevent overloading the gear and the lack of information available to the stevedore or the ship operator as to when gear is being overloaded.

Experienced seamen and stevedores know that if the falls are tightlined with little or no load on the hook, all but the weakest winches will part a guy or tear down a boom. They also know that if a load close to the alleged "5 ton SWL" of a set of gear is burtoned, the gear seems to be under excessive stress and may fail. The reason for these failures is seldom understood.

It is the purpose of this bulletin to give an understanding of the stresses to which the gear is subjected, to present a few simple rules for rigging the gear to keep these stresses at a minimum, and to point out in a general way the practices and conditions which are likely to result in failures. The illustrations used are based on the dimensions of a single specific set of gear. For other gear and other setups of the same gear, the stresses will differ from those indicated, but, except in very unusual cases, not to a significant degree. In any case the principles involved apply to all gear used for burtoning. If the stevedore combines this information with his own experienced judgment of the condition of the particular gear which he happens to be working, he can prevent many gear failures and so obtain a safer and more efficient operation.

The attempt has been made to present the explanatory material in as simple terms as possible, taking the development step by step. If a single model boom is erected, using approximately the proportions given in the examples, the statements regarding tension on lines can be demonstrated with a small spring scale and some fishline and sinkers.

The conclusions and practical applications of each step are summarized in the back of the bulletin.

THE SWINGING BOOM

Failures of swinging booms from overloading are rare because their safe working loads can be stated clearly and the safety factor is relatively high. The stresses on a swinging boom will be considered, however, because a knowledge of them will aid in understanding the additional stresses that are set up by burtoning cargo.

Figure 1A shows the compression on the boom and the tension on the topping lift produced by a 1-ton load hanging from the head of the boom. (The compression on the boom produced by the tension of the fall between the head block and the heel block has been disregarded. With a single part fall, it is equal to the weight of the load.) The boom is 55 feet long and is supported by a mast that is 43 feet between the heel of the boom and the topping lift block. The boom is shown in three different positions, from horizontal to about as high an angle as is likely to be worked. (See Plate 1.)

At 75° elevation of the boom, the tension on the topping lift is only 0.4 ton while, when the boom is horizontal, the tension on the topping lift is 1.6 tons. This increase is easy to understand if one realizes that, if the boom were standing upright, all the weight would be on the heel, and a man upon the mast could keep it from falling with his hand.

PLATE I.—Stresses on swinging boom at various boom angles.

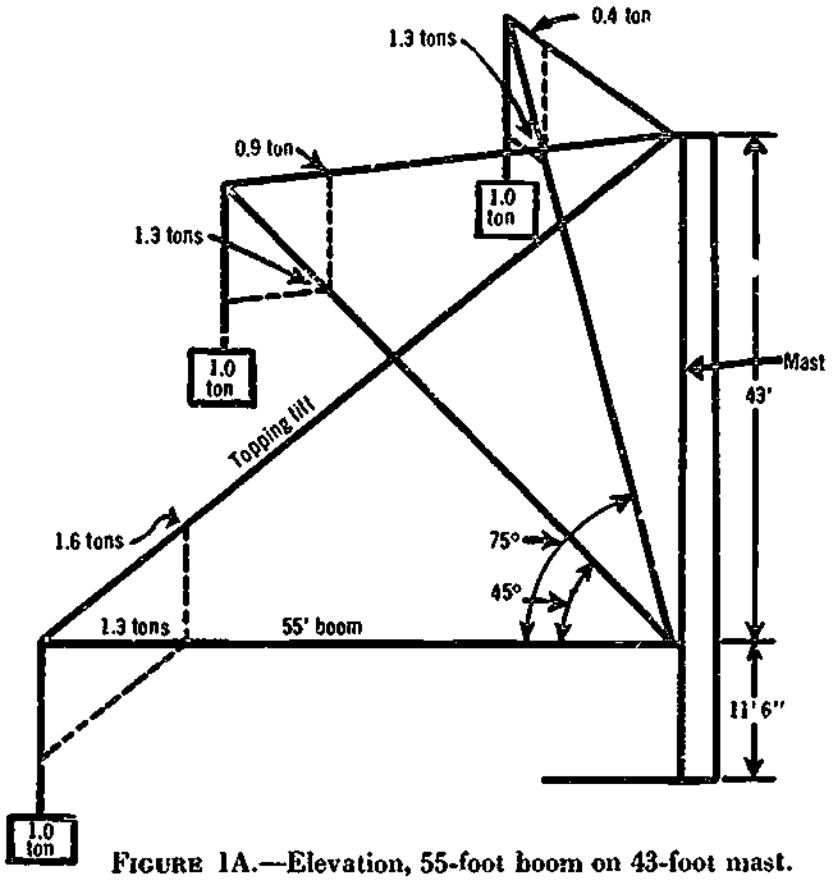

FIGURE 1A.—Elevation, 55-foot boom on 43-foot mast.

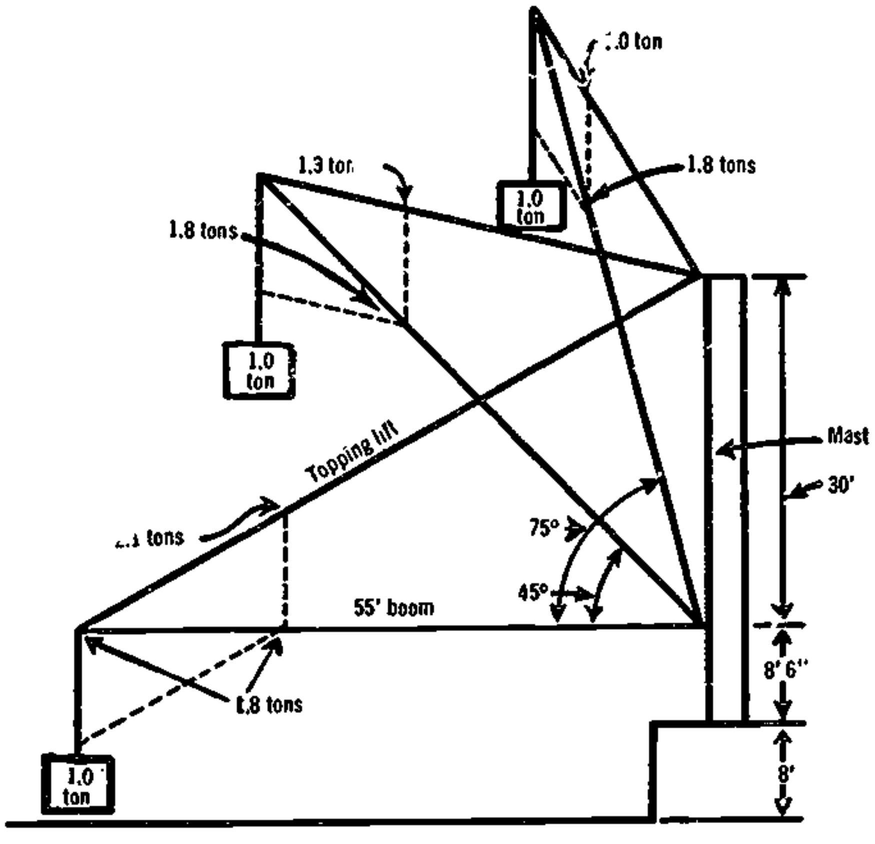

FIGURE 1B.—Elevation, 55-foot boom on 30-foot mast.

When the boom is horizontal, however, it is supporting none of the load, which is held entirely by the topping lift. The boom now serves only to force the load and the topping lift away from the mast.

The weight of the boom itself acts in a similar manner. In a vertical position this weight is all on the heel but when the boom is horizontal, half the weight is on the heel and the other half is supported by the topping lift.

Failure to realize that the tension on the topping lift increases as the boom is lowered has caused many booms to be dropped. The longshoreman takes enough turns on a cleat or gypsy to hold the boom when it is high, but when the tension gradually increases to the point at which he realizes that he needs another turn, he can't hold the line with one hand while he takes it. Then he must let go and the boom drops. On the other hand a boom is rarely dropped while raising it as the man must have sufficient turns to pick it up.

Figure 1B shows the stresses produced by a 1-ton load on the same length boom but on a shorter mast—30 feet from heel to topping lift block. The same three angles of the boom have been taken. At each angle the tension on the topping lift is greater than it was for the longer mast, going from 1 ton at 75° to 2.1 tons when the boom is horizontal.

This difference in tension on the topping lift for the two heights of mast is caused by the difference in the angle between the topping lift and the boom in the two cases. The smaller this angle, for the same angle of the boom, the greater the tension on the topping lift will have to be. (This can easily be demonstrated by raising the cover on a manhole. Your arm is the topping lift. If you pull always at right angles to the cover, it comes easily. But try raising it with your arm just a few inches above the hinge.) As might be expected, an increase in the tension on the topping lift produces an increase in the compression on the boom. In Figure 1A the compression is 1.3 tons, while in Figure 1B it has gone up to 1.8 tons.

This relationship between height of mast and length of boom is of no importance on a jumbo because it is taken into account in designing the gear. On light gear, however, it may be overlooked and the same strength, 55-foot boom, for example, may be used on a short mast as on a tall one. Since the difference in compression on the boom applies just as well to burtoning as it does to handling a load on a swinging boom, it is suggested that when he has a choice, the stevedore handle heavier loads, such as lift trucks, on the set of gear with the taller mast or king post.

Stress at High Angles

If the mast were the same height as the length of the boom, the tension on the topping lift would continue to decrease as the boom was topped higher than the 75° shown in the illustrations and would become zero when the boom was vertical.

Since in almost every set of gear the mast is shorter than the boom, a point is reached in topping the boom beyond which no further reduction in tension on the topping lift occurs. For example, with the proportions shown in Figure 1A, the tension on the topping lift will decrease to about one-quarter the weight of the load at more than 85° but with the proportions shown in Figure 1B the tension on the topping lift will remain approximately equal to the weight of the load at angles above 75° while the compression on the boom will increase slightly.

There is also a slight increase in topping lift tension and boom compression at high angles caused by the fact that these two lines do not meet the boom at a point, as shown in the drawings, but are offset from the axis of the boom by the head fittings. The result is the same as lengthening the boom. These increases are small and of no importance in practical operations.

Boom Failures

Since it is general knowledge that there is more danger of boom failure when the boom is low than when it is topped well up, the figures indicating that the compression on the boom remains the same at all angles may seem in error. The fact is that a boom fails, not through collapsing like an accordion but by bending like a soda straw. As long as the straw remains perfectly straight it can support a considerable weight, but once it starts to bend very little weight will cause it to fold up completely. What happens to the soda straw happens also to the boom.

When the boom is topped well up, its own weight is pretty much in line with its axis. Just as a man with his arms extended above his head can brace himself against the wall with his finger tips and keep his body straight, the boom easily remains straight. If, however, the average man tries to support himself with his toes on one chair and his extended arms reaching another, he will sag in the middle. The boom laid flat and supported by the gooseneck at one end and the topping lift at the other tends, like the man, to sag in the middle.

The boom has a greater tendency to fail at a low angle, not because there is greater compression on it but because it is less able to withstand the same compression when it is slightly bent by its own weight.

These principles apply equally well to both burtoning and to the use of the swinging boom. Three practical applications of the above facts can be made.

1. Particular care should be taken to avoid overloading or putting shock loads on the gear when the boom is at a low angle.

2. Care should be taken to avoid letting a loaded boom come up against a stay, shroud, or other fixed object, as the resultant bending may cause the boom to fail.

3. While it would be difficult, if not impossible, to judge from appearance just how much a boom was weakened by one or two inches of permament set, there is no doubt that its strength is reduced. It is suggested that the stevedore inspect all booms before starting work and report any bent booms to the mate.

Gooseneck Failures

Failures of the jumbo gear are usually confined to breaking the gooseneck or pacific iron. The most obvious cause is heaving on the guys with power when the gooseneck is frozen through lack of lubrication. It is suggested that stevedores try to have the ship's crew break out the jumbo and see that it is swinging freely before the longshoremen touch it. If the stevedore must break out the boom it should be lowered to an angle of about 45°, keeping the guy on the high side taut if there is a list on the vessel. Then have a few men swing on a guy to be sure that the gooseneck is free. If it will not turn by hand, additional effort should be made at the gooseneck rather than by heaving on the guy with winch power. Power applied to the end of a 50-foot wrench handle (the boom) is certainly going to move something but it may not break loose the rusted pin.

Another cause of bending or breaking the pacific iron is attempting to slew the boom with the guys when the boom is topped high. A moment's thought will show that if the boom is straight up and down, it must rotate to turn the gooseneck. Pulling on a guy would only bend the pacific iron—not rotate the boom. To be sure, neither the jumbo nor any other boom is worked in a vertical position, but at high angles the head of the boom goes through a very small arc as the gooseneck turns. In such a position more of the pull on the guy tends to bend the pacific iron than tends to turn the gooseneck.

For this reason it is suggested that the boom be topped no higher than necessary for the load to clear the deck before it is swung into its athwartships position. It can then be topped as high as necessary. In discharging cargo from the near end of the hatch, the boom should be lowered before it is swung.

Guy Failures

The guys on jumbo booms have carried away because the two drivers of the guy winches did not act together. One heaved while the other held or both heaved together. This can be avoided by being sure that both men can see the signalman. As a further precaution, winch drivers should be instructed to stop heaving and hold if at any time the stress on the guy appears to be excessive. It is difficult to imagine a situation in which to stop heaving would introduce a hazard. To stop in case of doubt might disclose a misunderstanding of signals in time to avoid carrying away a guy.

Auxiliary Stays

Some vessels, notably the Liberty ships, require setting up auxiliary stays on the mast when the jumbo is used. Failure to observe this precaution, which is clearly stated on the rigging plans, has resulted in carrying away some masts.

Conclusion

By observing the safe working loads for which the booms are rated and the precautions noted above, the possibility of failure of gear when using a swinging boom is very slight if proper inspection and maintenance schedules are followed.

BURTONED LOADS

The stresses on the gear when the boom is used swinging are relatively simple. Overstressing any part of the gear far beyond the designed limits can be avoided merely by keeping the loads within the rated capacity. In burtoning, however, no simple load limitation can be fixed. The stresses produced by a given weight of load vary widely with differences in the trimming of the booms, the position of the guys and the height to which the load is raised.

We shall start the discussion of these factors with the last point and consider the effect of the height of the load on the tension in the falls.

Tension on the Falls

The tension on the falls increases as the angle between them increases. Suppose we tie one end of a line to a pad eye on the bulkhead, hang a block with a 20-pound weight in the bight, attach the other end of the line to a scale, and then hold the scale. If we hold the scale close to the padeye, as in Figure 2A, it will read one-half the weight of the load, or 10 pounds. We support one-half the weight and the pad eye supports the other half. As we move back from the bulkhead, the reading on the scale will gradually increase. When the angle between the two parts of the line is 90° (Figure 2B), the scale will read 14 pounds. When the angle in the bight is 120°, the scale will read 20 pounds (Figure 2C), or the weight of the load. (See Plate II.)

From this point on a small change in the angle between the lines will produce an increasingly large change in the scale reading as shown in succeeding figures. At 140° (Figure 2D), the stress is

PLATE II.—Tension on the falls depends upon angle between the falls.

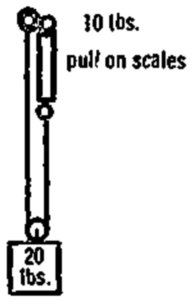

Figure 2A.—Fall angle 0°.

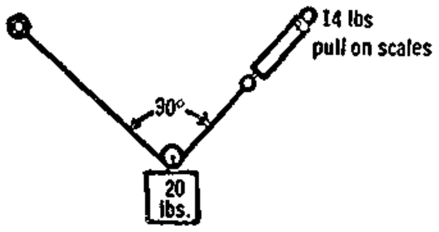

Figure 2B.—Fall angle 90°.

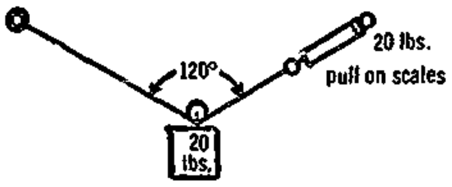

Figure 2C.—Fall angle 120°.

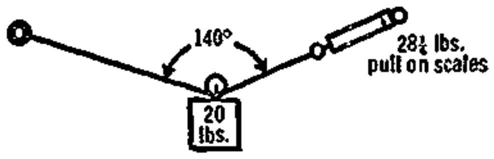

Figure 2D.—Fall angle 140°.

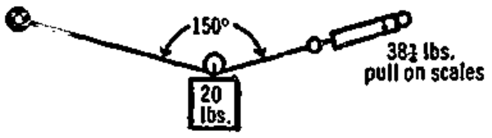

Figure 2E.—Fall angle 150°.

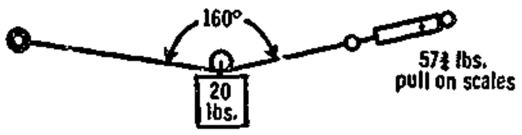

Figure 2F.—Fall angle 160°.

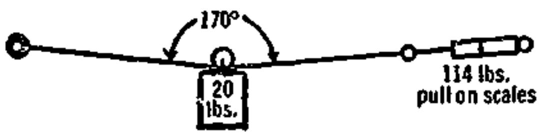

Figure 2G.—Fall angle 170°.

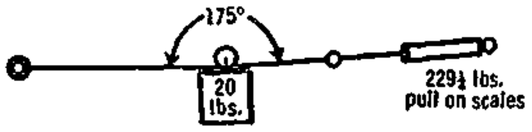

Figure 2H.—Fall angle 175°.

almost one and one-half times the weight of the load, and at 150° (Figure 2E) is almost double. At 160° (Figure 2F), the stress in the line is nearly 3 times the weight of the load, and to get the angle to 170° (Figure 2G) will require a pull of 5¾ times the weight of the load. If we wish to flatten the angle out to 175° (Figure 2H), we will have to pull 229¼ pounds or 11½ times the weight of the load to do so.

Keeping in mind that the actual downward pull of the load is only 10 pounds on each end of the line, what happens to all this extra pull? If you look closely at the figures you will see (and if you try the experiment you will feel) that it is largely a horizontal pull. Exactly the same thing takes place when a load is supported between the heads of the two booms. This horizontal pull tends to move the heads of the booms together. The outboard or working guys hold the booms against this pull.

Table I lists the tension on the fall and the horizontal pull tending to move the heads of the booms together for a load of a 2,000-pound ton at various angles between the falls. When loads are tightlined as high as the winch can lift them, the tension on the falls is limited only by the strength of one winch. With a heavy load the final fall angle will be small. With a light load it will be large. The interesting thing is that the light load at the large fall angle will produce a greater horizontal force than will the heavier load which stalls the winch at a smaller fall angle. It is this horizontal pull that the guys have to counteract.

TABLE I

Fall angle	Angle of each fall with horizon	Ratio of tension on fall to weight of load	Tension on each fall with load of 2,000 pounds	Horizontal pull tending to bring boom heads together
			(Pounds)	*(Pounds)*
0°	90°	.50	1,000	0
60°	60°	.57	1,155	577
90°	45°	.71	1,414	1,000
120°	30°	1.00	2,000	1,732
140°	20°	1.46	2,924	2,748
150°	15°	1.93	3,864	3,732
160°	10°	2.88	5,759	5,671
170°	5°	5.74	11,474	11.430
175°	2.5°	11.46	22,926	22,904

The above values for the tension on the fall are most frequently seen in tables and diagrams of sling angles. The only difference is that the sling angle diagram is upside down when applied to fall angles.

These facts have the following practical applications in burtoning:

1. Use slings which are no longer than necessary.
2. Keep the hook as close to the junction of the falls as possible.[1] If chain is used for additional weight, hang it in a bight beside the hook rather than between the hook and the junction of the falls.
3. Keep the loads as close to the rail as is practicable.
4. Severe tightlining of even very light loads is dangerous because a difference of only a foot or two in the height of the load may increase the stress tremendously.

STRESS ON GUYS

Experience shows that the burton (yard) gear very seldom presents any difficulty. When failures occur they are confined almost entirely to the up-and-down (midships) gear. For this reason the following discussion of stresses in relation to trimming the boom and guy refers exclusively to this side of the rig with only brief mention of the burton gear.

Figure 3A shows a plan view of a typical set of gear (No. 4 aft on a C–3) trimmed to work the near end of the hatch with the up-and-down boom in a fore and aft line through its heel and the guy in line with the fall. A number of elevation views are shown with calculations to indicate the tension on the guy produced by a one-ton load at several different fall angles. In these and the following illustrations the actual compression on the boom is not shown. Instead, the figure on the boom indicates the weight of load which, when lifted on a swinging boom, would produce approximately the same compression in the boom as is produced by the one-ton load in the situation shown. (The tension of the fall along the boom from head block to heel block has been disregarded. See Plate III.)

It will be noted (Figure 3B) that even with a fall angle of only 90°, where the junction of the falls is about 20 feet above the deck, the tension on the guy is 1.6 tons and the boom has to support the equivalent of 2.1 tons. The stresses go up (Figures 3C and 3D) as the one-ton load on the hook is raised until, (Figure 3E) the angle between the falls reaches 150°, when the tension on the guy is 6.2 tons and the equivalent load on the boom is 6.4 tons.

This explains why a boom which has been tested with a swinging load of 7 tons will sometimes fail under a load of only 3 or 4 tons which is being supported by 2 booms. Unless otherwise stated, "5 ton SWL" stenciled on the heel of a boom refers to a load on a swinging boom, not to a burtoned load.

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[1] See. 1504.52(f) of the Safety and Health Regulations for Longshoring limits this distance to 2 feet.

PLATE III.—Tension on guy and equivalent load on swinging boom for various fall angles. Boom fore and aft. Guy in line with fall.

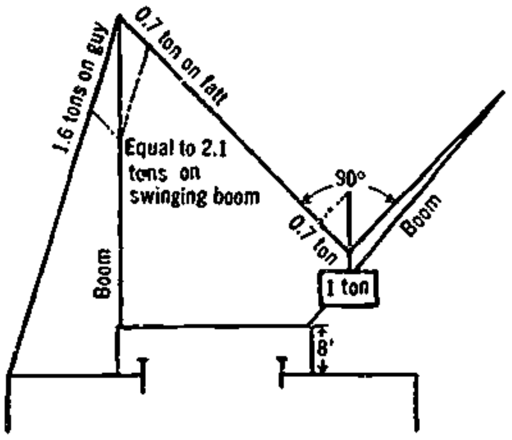


Figure 3B.—Stresses at fall angle of 90°.

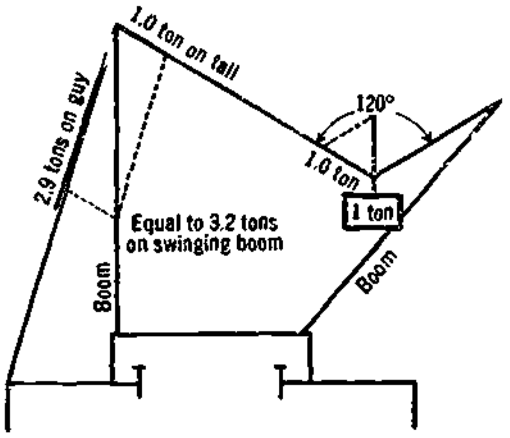


Figure 3C.—Stresses at fall angle of 120°.

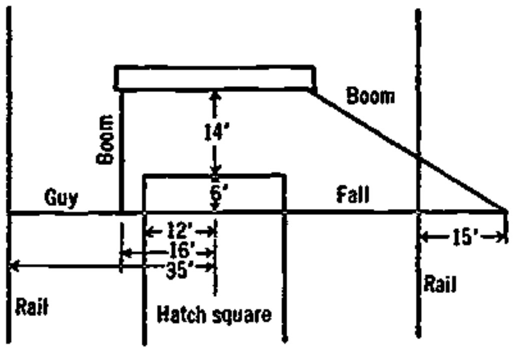
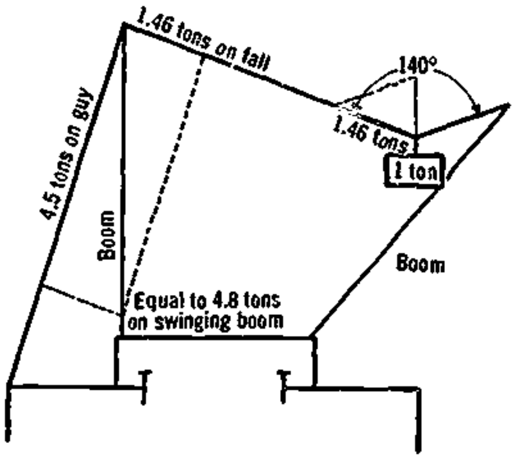


Figure 3A.—Plan, stresses on gear, 55-foot boom fore and aft. Guy in line with fall.



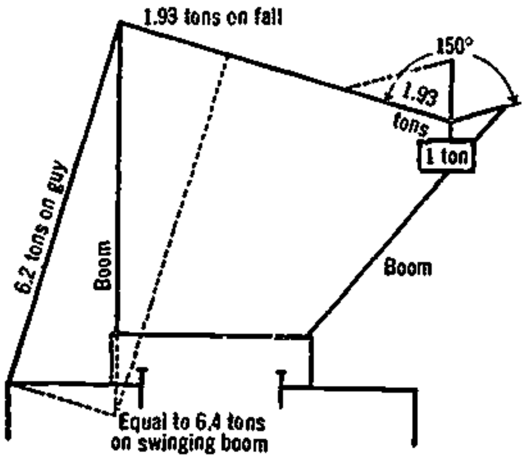


Figure 3D.—Stresses at fall angle of 140°. Figure 3E.—Stresses at fall angle of 150°

Boom Angled Inboard From Heel

Merely by swinging the boom inboard to the center line of the vessel (and slacking off on the topping lift so that the head of the boom is still the same distance from the end of the hatch, Figure 4A), we find that the stresses are considerably reduced. At a fall angle of 90° (Figure 4B), the tension on the guy has dropped from 1.6 tons to 1.0 ton and the equivalent load on the boom from 2.1 to 1.3 tons. At a fall angle of 120° (Figure 4C), the guy tension drops from 2.9 tons to 1.7 tons and the equivalent load on the boom from 3.2 to 1.9 tons. (Since the values for other fall angles are reduced in proportion, they are not shown. See Plate IV.)

Since the fall angles and therefore the horizontal pull are the same, one may wonder why the tension on the guy is lower in Figure 4C than in Figure 3C. A comparison of the two figures will show that the guy in Figure 3C is much more nearly vertical than it is in Figure 4C. Since the guy serves only to keep the head of the boom from moving horizontally, it could do this most easily if it too were horizontal. (You pull straight out on a door handle, not down toward the floor.) On the other hand, it should be clear that pulling straight down on the guy would do nothing to keep the boom head from swinging around. Therefore, the further the guy is from the vertical, the less tension on it, and the more nearly it approaches the vertical, the greater the tension on it.

One other benefit of swinging the boom inboard should be pointed out. In Figure 3B the fall angle of 90° was reached with the junction of the falls 20 feet above the deck, while in Figure 4B this angle was not reached until the junction of the falls was 26 feet above the deck. In other words if, with the setup shown in Figure 4B, we kept the load only 20 feet above the deck, we should have had a smaller fall angle and hence even less tension on the guy.

Now let us leave the boom where it is but move the guy around to see whether any further reduction in tension can be obtained. Looking at the plan shown in Figure 5B, we see that the head of the boom is not going to move directly athwartships in line with the fall but is going to swing in an arc around the mast or king post along the path of the curved arrow. The guy can most easily prevent this swing if it is at right angles to the boom. (Remember that you keep your arm at right angles to the door when opening a heavy one.) With the guy in line with the fall, Figure 5B, the horizontal pull acting on the guy must be the same as that produced by the fall. For a fall angle of 120°, this is equal to .86 times the weight of the load as shown in Figure 5A Using this value in Figure 5C, we find that the horizontal pull on the guy when it is at right angles to the boom has been reduced to .70 times the weight of the load. In Figures 5D and 5E are shown the guys in the two respective positions as they

PLATE IV.—Tension on guy and equivalent load on swinging boom at various fall angles. Boom over center line. Guy in line with fall.

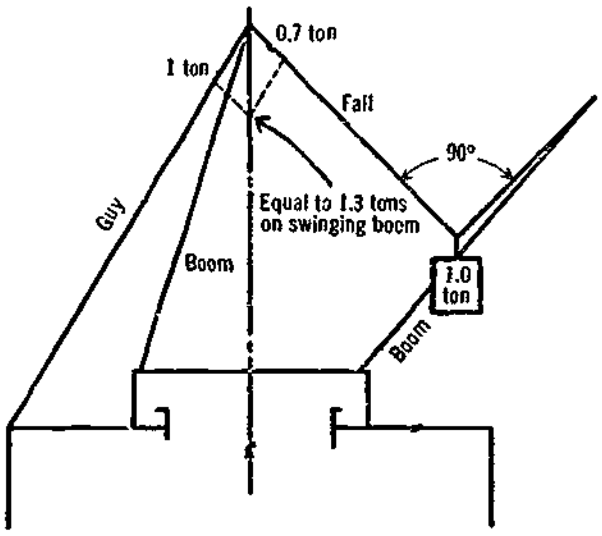


FIGURE 4B.—Elevation, stresses at fall angle of 90°

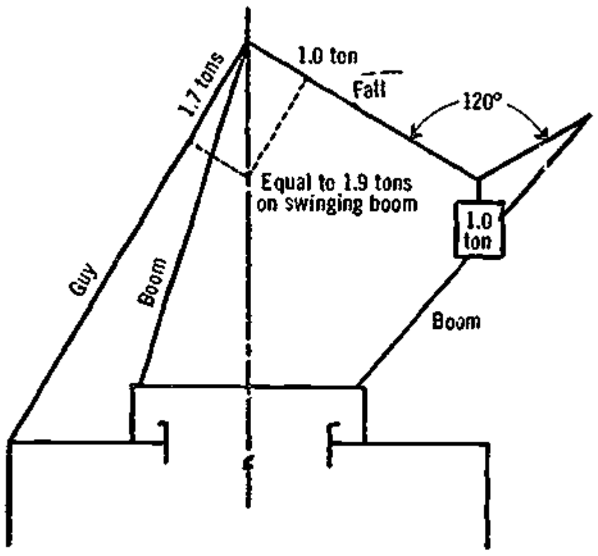


FIGURE 4C.—Elevation, stresses at fall angle of 120°.

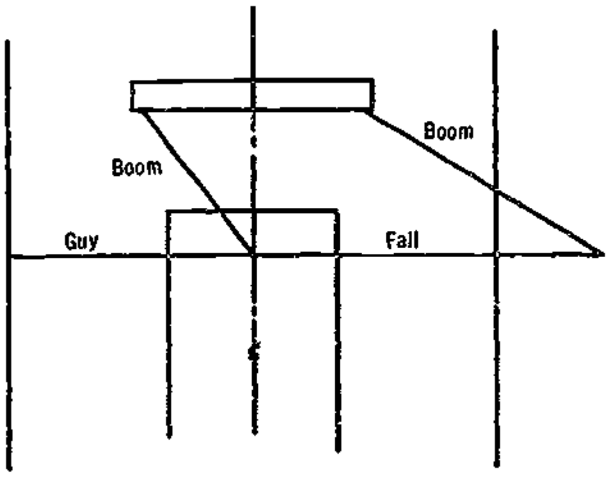


FIGURE 4A.—Plan, stresses on gear. 55-foot boom angled inboard from heel. Guy in line with fall.

would appear at their true length. The .86-ton horizontal pull produces an actual tension of 1.7 tons in the guy in line with the fall (the same value which was reached by a different method in Figure 4C) and the .70-ton horizontal pull produces an actual tension of only 1.1 tons on the guy at right angles. In the latter position, the tension on the guy is reduced not only by a decrease in the horizontal pull but also by the fact that the guy is flatter and hence can hold the boom more easily. The equivalent load on the boom is 1.5 tons as compared with 1.9 tons when the guy is in line with the fall. (See Plate V.)

Theoretically we could move the guy even beyond a right angle to the boom and have some further slight reduction because the guy would become still flatter. From a practical standpoint however, the movement of the guy in this direction is either limited by the shrouds at the next set of gear or, when the boom is not angled so far inboard, might be carried too far.

The practical application of these facts is as follows:

1. The closer the heads of the two booms are together, and the higher they are, the less will be the tension on the falls and therefore on the guys for any given height of the junction of the falls.

2. When the boom angles inboard from its heel, the tension on the guy will be least when the guy is approximately at right angles to the boom in plan view, or as seen when looking up from on deck.

Boom Fore and Aft From Heel

Referring back to Figure 3C, we saw that with the boom fore and aft, and the guy in line with the fall, a one-ton load at a fall angle of 120° produced a tension of 2.9 tons on the guy. If we move the guy back abreast the heel, as in Figure 6A, we will find (Figure 6B) that the tension on the guy has increased to 3.0 tons but the equivalent load on the boom has decreased from 3.2 tons to 2.9 tons. If, however, we lead the guy out ahead of the boom, as in Figure 6C, the same distance that it was behind the head in Figure 6A, the tension on the guy is not changed (Figure 6D). It remains at 3.0 tons but the equivalent load on the boom will increase from 2.9 tons to 3.6 tons. (See Plate VI.)

This increase in load on the boom when the guy is out ahead of the boom is caused by an increased tension on the topping lift, which went up from 0.5 to 2.8 tons. The guy pulls against the topping lift. When, however, the guy is abreast the heel, it pulls more nearly in the same direction as the topping lift and actually takes some of the load from it. (An extreme example of this occurs when the guy is so far behind the heel that it causes the boom to jackknife. There is then no load on the topping lift at all.)

The application of these facts is as follows:

With the boom fore and aft, the least compression will be placed on the boom if the guy is back near the heel. The least tension on the

PLATE V.—Showing change in tension on guy and equivalent load on swinging boom with change in position of guy. Boom over center line. Fall angle of 120°.

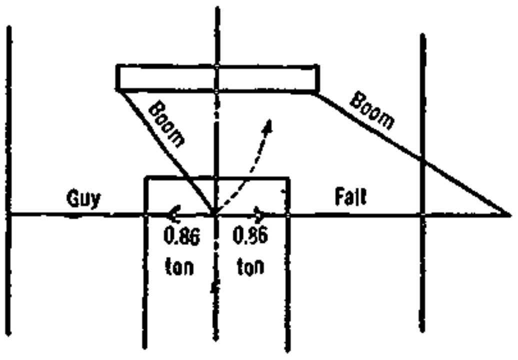


FIGURE 5B.—Plan, horizontal pull on fall and guy. Guy in line with fall.

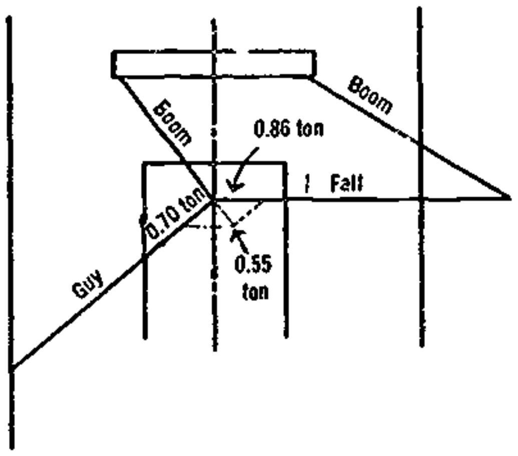


FIGURE 5C.—Plan, horizontal pull on fall and guy. Guy at right angle to boom.

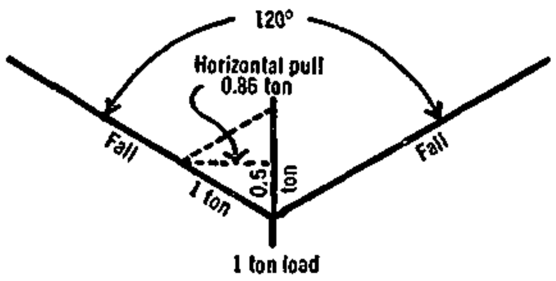


FIGURE 5A.—Elevation, junction of falls showing tension on falls and horizontal pull on falls at angle of 120°.

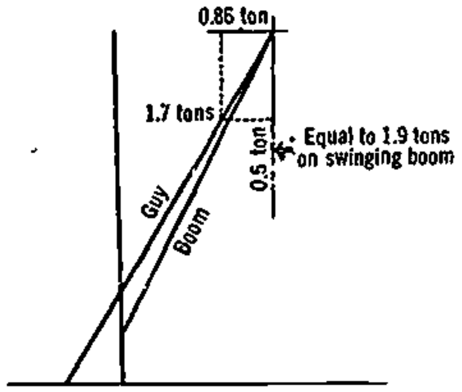


FIGURE 5D.—Guy and boom from 5B in true length showing tension on guy and equivalent load on swinging boom.

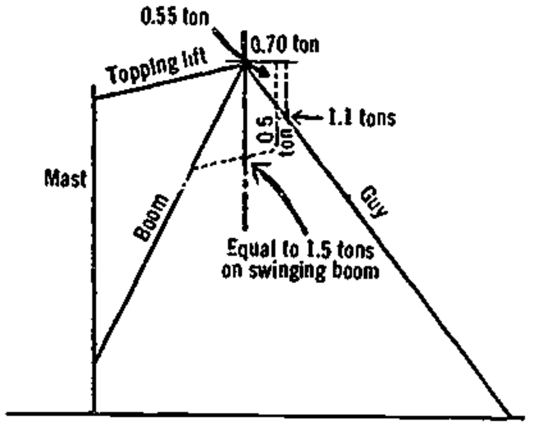


FIGURE 5E.—Guy and boom from 5C in true length showing tension on guy and equivalent load on swinging boom.

PLATE VI.—Showing changes in tension on guy and equivalent load on swinging boom with changes in position of guy. Boom fore and aft. Fall angle 120°.

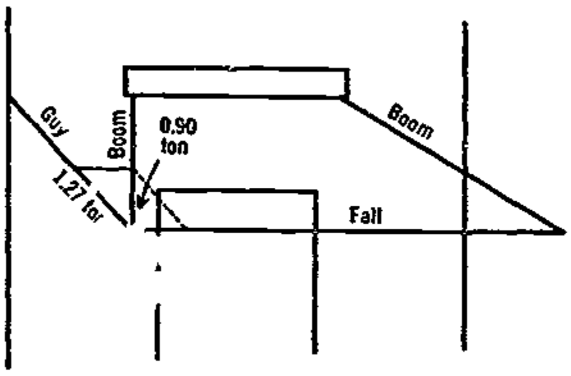


FIGURE 6A.—Plan, horizontal pull on guy and horizontal thrust on boom. Guy abreast heel. Fall angle 120°.

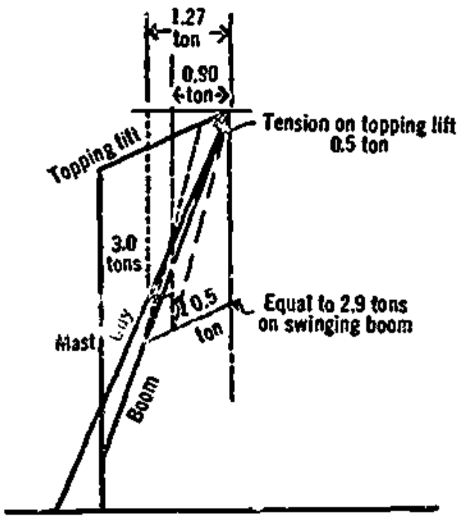


FIGURE 6B.—Guy and boom from 6A in true length showing tension on guy and topping lift and equivalent load on swinging boom.

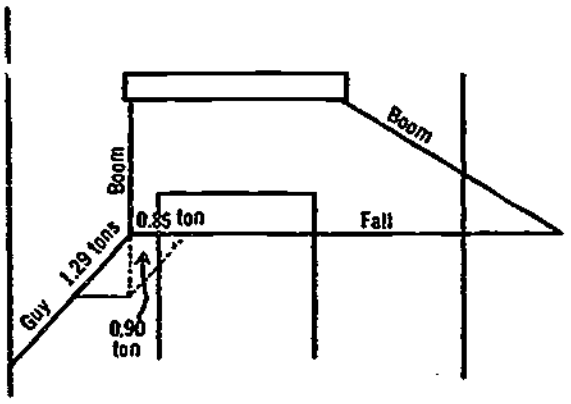


FIGURE 6C.—Plan, horizontal pull on guy and horizontal thrust on boom. Guy ahead of fall. Fall angle 120°.

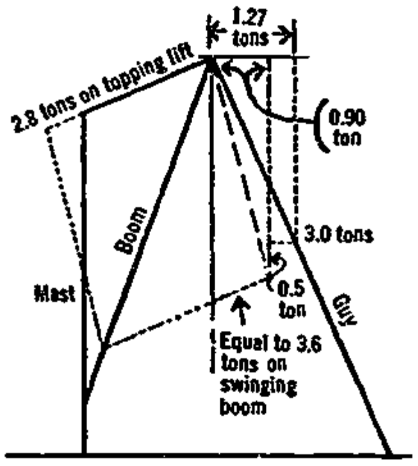


FIGURE 6D.—Guy and boom from 6C in true length showing tension on guy and topping lift and equivalent load on swinging boom.

guy will result if it is at right angles to the boom. With light booms on short masts, place the guy near the heel. With heavy booms and light guys, place the guy at right angles to the boom.

Boom Angled Outboard From Heel

In working an offshore deckload, or in spotting a boom over the offshore coaming, the boom on most gear will angle outboard. In such a case, it is very important that the guy be led back abreast the heel to avoid excessive stress. Figure 7 illustrates such a situation and shows three possible guy locations. At A, it is in line with the fall; at B, it is abreast the heel; and at C, it is about as far back of the heel as it can be placed without allowing the boom to jackknife. (See Plate VII.)

The corresponding stresses on the guy and the equivalent load on the boom are shown in Figures 7A, B, and C and are listed in the following table for a one-ton load at a fall angle of 120°.

Guy position	*Guy tension* (tons)	*Equivalent load on boom* (tons)
A	4.4	4.8
B	2.9	2.9
C	2.6	2.5

From the above it should be evident that when the boom angles outboard from its heel, the guy should be placed abreast the heel or as much farther back as it is possible to go without permitting the boom to jackknife.

Burton Boom

The infrequent failure of the burton gear can now easily be explained in the light of the previous discussion. The boom always angles outboard from its heel. In fact, it is often so far outboard that the angle between the fall and the boom in plan view is less than that between the boom and the guy, which is normally placed well behind the heel of the boom. Because the burton boom is usually lower than the up-and-down boom, the stress on the guy is further decreased by the fact that the guy of the burton boom is more nearly horizontal than is the offshore guy. Taken together these factors all combine to keep the stresses on the burton boom at a minimum.

JACKKNIFING

It was pointed out above that when the up-and-down boom angles outboard from its heel, the guy (and the preventer) will have the least tension on it when it is as far back of the heel as possible but not so far back as to allow the boom to jackknife. The question is, how far is "as possible"?

PLATE VII.—Showing changes in tension on guy and equivalent load on swinging boom with changes in position of guy. Boom angled outboard. Fall angle 120°.

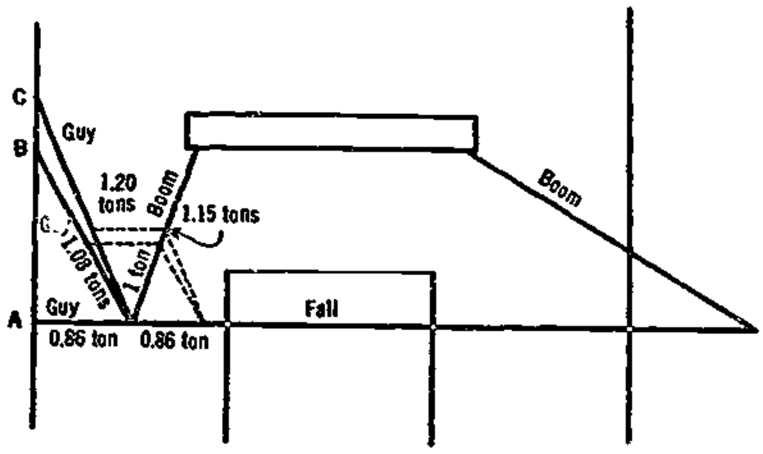


FIGURE 7.—Plan, three different positions of guy showing horizontal pull on guy and horizontal thrust on boom. Fall angle 120°.

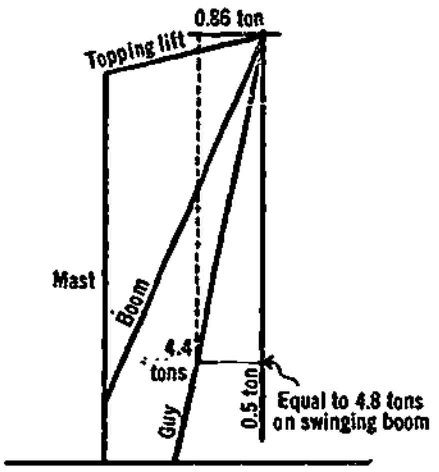


FIGURE 7A.—Tension on guy and equivalent load on swinging boom with guy at A in plan.

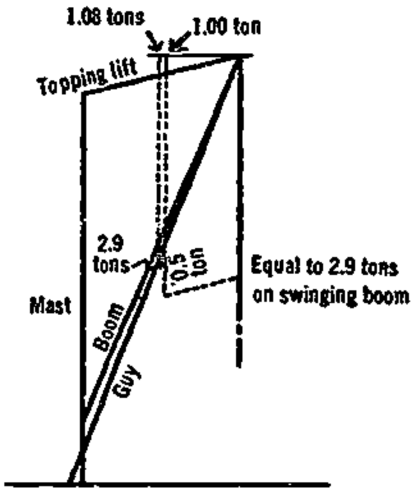


FIGURE 7B.—Tension on guy and equivalent load on swinging boom with guy at B in plan.

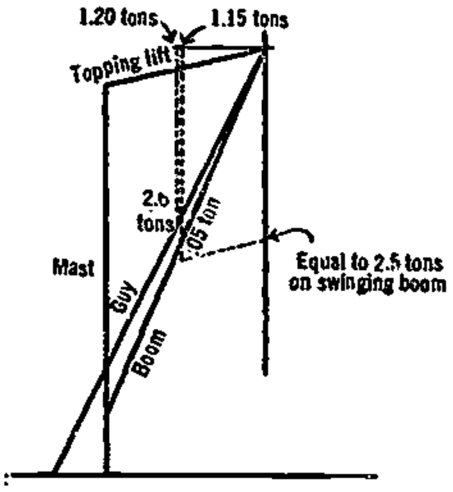


FIGURE 7C.—Tension on guy and equivalent load on swinging boom with guy at C in plan.

There is no way, other than calculation or experiment, to tell whether a particular setup will cause the boom to jackknife with a particular fall angle. For example, with the guy at C in Figure 7, a load at a fall angle of 120° is perfectly safe, but over 150° the boom would probably jackknife.

For safety, it is desirable to place the guy in a position which will hold the boom down, no matter how much it is tightlined, without securing it so far out toward the head of the boom as to place an unnecessarily high stress on the gear. This condition is met when either the guy or the preventer is secured to a pad eye located so that when one sights from the pad eye to the head of the burton boom the latter appears just beneath the up-and-down boom.

Again, using the examples in Figure 7, sighting from the pad eye on deck at C, the head of the burton boom would appear above the heel of the up-and-down boom, indicating that the latter can jackknife. On the other hand, sighting from the pad eye on deck at B, the head of the burton boom would appear a couple of feet below the up-and-down boom. Unless the burton boom itself jackknifed high enough to appear above the up-and-down boom, the latter could not jackknife even by tightlining the empty hook.

Jackknifing the Burton Boom

Once the up-and-down boom starts to jackknife, it is practically impossible to drop the load fast enough to stop it. Since the burton boom is the lower of the two, it does not act in the same manner but is raised by the fall. As soon as the winch driver stops heaving, the boom stops rising. For this reason, it is not so important that the burton boom be held down by the guy.

The same method of sighting is used for the burton boom as for the up-and-down boom. Sighting from the pad eye to which the outboard guy of the burton boom is secured, the head of the up-and-down boom will probably appear either above the burton boom or below it.

If the head of the up-and-down boom appears below the burton boom, the latter cannot rise at all.

If the head of the up-and-down boom appears above the burton boom, the latter can rise until it reaches the line of sight. It cannot be raised above this line even by tightlining an empty hook. This is the usual condition in actual practice. It causes no harm as long as the amount of rise is not enough to cause the up-and-down boom to jackknife.

If the head of the up-and-down boom should appear behind the king post which supports the burton boom, the latter can be raised all the way and will, by changing the line of sight, probably cause the up-and-down boom to jackknife also. This situation is often found at the

No. 4 forward gear on Victories and on any set of gear where the heels of the booms are close to the rail.

In such cases, particularly at No. 2 aft and No. 3 forward on many C-4's, it is suggested that the guy be left well back of the heel. To put the guy where it would prevent topping the boom, would mean that it would be so nearly parallel to the boom as to place it under terrific tension. Then to hold the boom down, place the preventer under the boom and leave it a foot or two slack.

This exception to the rule that preventers must be kept tight is to avoid the chance of the guy becoming slack (as in drying out after having been set up while wet) and throwing all the load on the preventer which, in this position, would probably carry away with a very light load.

Ebel Gear

On many new vessels there is an unusual rig known as the Ebel gear, in which each boom is supported by two topping lifts. The outboard topping lift reeves through a block and continues down to the deck to serve as a guy. The result of tightlining a load on this gear is to cause the burton boom, or in some cases the up-and-down boom, to top up. No danger is involved as the booms will not fly back. They will stop rising as soon as the winch driver stops heaving in.

With this gear, it is important that no attempt be made to hold the booms down with preventers, as to do so would subject the gear to excessive stress such as occurs when the usual type of gear is tightlined. As designed, the Ebel gear can burton the full 5 or 10 tons for which it is rated and, as long as the booms are free to top up, the gear will not be overloaded no matter how high the load is raised. This is the only burtoning gear of which we know that has this safety characteristic.

PREVENTERS

Preventers are poor substitutes for guys that are not strong enough. First, they cannot equally share the load with the guy. The preventer is usually a single heavy wire while the guy has a manila purchase. If the preventer and the guy have an equal tension under a light load, the guy stretches much more than the preventer under heavier loads so that the latter has to take most of the increase.

Second, rarely are fastenings available to secure the guy and the preventer close together on the deck or rail. We have seen that changing the position of the guy, changes the tension on it. If the guy is in one place and the preventer in another, the tension on the two will not be equal under all degrees of tension because the stress on one will increase more rapidly than on the other.

Third, the preventer is not usually included in the design and therefore gets little attention. Often it is a worn out fall, to start with, suitable provisions for properly securing it may be lacking, and it may be permitted to get in very poor shape.

While there have been few cases in which either the guy or preventer parted and the other held, it is undoubtedly true that the proper use of preventers has saved many a weak guy. It is therefore false economy for the stevedore to neglect to set them up properly. The following suggestions are offered:

1. Secure the preventer as close to the guy as available fastenings permit.
2. When the two cannot be nearly parallel, it is preferable that the guy be in the position of greater stress. That is, more nearly in line with the fall under most conditions.
3. Under light load (which is better produced by lifting a pontoon or beam on the hook than by hooking into a pad eye and using the winch power directly), the guy should be adjsuted until there is a little more tension on it than on the preventer. Under a heavy load the guy will stretch and let the preventer have its share.
4. Neither the preventer nor the guy should have real slack in it as it is almost a certainty that if one fails, the other will part when it fetches up with a jerk after the slack is taken out, and there will be two pieces of gear flying around instead of only one. The preventer is useful only in keeping the guy from parting, not in holding the boom after the guy parts. (A few vessels have heavy preventers which are intended to carry the guy load, and very light guys which are intended only for trimming the booms. So little additional strength is provided by these guys that they may better be left slack.)
5. Since the manila guy purchase shrinks when wet and stretches when dry, it must be checked from time to time during the job.

SUMMARY OF SUGGESTED SAFE PRACTICES IN RIGGING AND USING CARGO HANDLING GEAR

1. Since the load on a topping lift increases as a boom is lowered, longshoremen should be instructed to take sufficient turns while the boom is high to insure having control of it when it reaches a low position (p. 4).
2. Where there is a choice between a long and a short mast, with corresponding high and low topping lift blocks, in relation to the length of the boom, it will usually be safer to burton heavier loads, such as lift trucks, with the gear on the longer mast (p. 4).
3. Particular care should be taken to avoid overloading or putting shock loads on the gear when the boom is at a low angle (p. 5).

4. Care should be taken to avoid letting a loaded boom rest against a stay, shroud, or other fixed object as the resultant bending may cause the boom to fail (p. 6).

5. Booms should be inspected before starting work, and any that are visibly bent should be recognized as having been weakened (p. 5).

6. Before applying power to a guy, be sure that the gooseneck is free to turn by heaving on the guy by hand (p 6).

7. In using the jumbo, avoid slewing the boom at high angles by slewing the boom first and then topping to the desired position in loading and by lowering it before swinging in discharging (p. 6).

8. Guy winch drivers, or men handling the guys on a jumbo boom, should both have the signalman in clear sight at all times and should be instructed to stop heaving if at any time the stress on the hauling part appears to be excessive (p. 6).

9. A check should be made with the mate before making a heavy lift with the jumbo to find out whether auxiliary stays need to be set up (p. 7).

10. To keep tension on the falls as low as possible in burtoning and so avoid excessive tension in the guys, the following suggestions are offered (pp. 7, 10):

a. Use slings as short as practical.

b. Keep the hook as close to the junction of the falls as possible. Chain for additional weight should be hung in a bight beside the hook rather than used to connect the hook with the junction of the falls.

c. Keep the loads as close to the rail, deck, and coaming as possible.

d. Avoid severe tightlining of even very light loads as a difference of only a foot or two in the height of the load may increase the stress tremendously.

11. The closer the heads of the booms to each other and the higher they are, the less will be the tension on the fall and hence on the guys for a given height of the junction of the falls (p. 14).

12. Rules for placing guys for minimum stress:

a. When the up-and-down boom angles inboard from its heel, place the guy at right angles to the boom as seen when looking up from on deck (p. 14).

b. When the boom is fore and aft, the stress on the guy will be least when it is at right angles to the boom. With a spindly boom and a heavy guy, the guy should be abreast the heel of the boom. The tension on it will be increased slightly but the compression on the boom will be reduced (p. 17).

c. When the boom angles outboard from its heel, place the guy abreast the heel or as much behind it as possible without permitting the boom to jacknife (p. 17).

13. Jackknifing:

a. The up-and-down boom cannot jackknife if either the guy or the preventer is abreast the heel of the boom and no higher than the heel (p. 19).

b. The means of controlling jackknifing of the burton boom are explained on (p. 19).

14. Preventers should be secured as close to the guy as available pad eyes permit (p. 21).

15. Under light load, the guy should be adjusted so that it has a little more tension on it than does the preventer. It is safer to apply this load by lifting a weight than by shackling the fall to the deck and heaving with the winch (p. 21).

☆ ☆ ☆

Compliance with the suggestions contained in this bulletin should be helpful in preventing gear failures. Its use as an instructional handbook for stevedores is recommended as a means of preventing personal injury and property damage.

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Introduction to Industrial Safety. (Safety in Industry, Instructor Outline).

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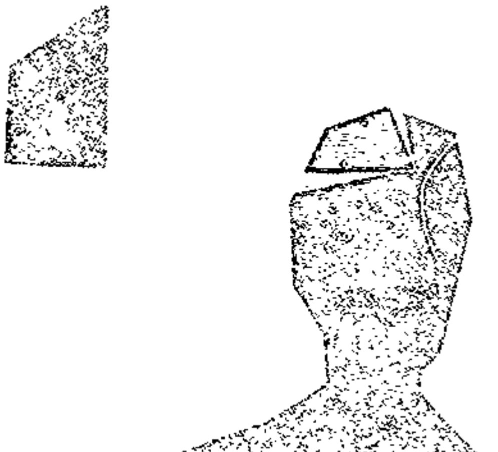
*CURRICULUM GUIDES, *SAFETY, *INJURIES, *INDUSTRY, *INDUSTRIAL EDUCATION,

The outline is for instructor use as a guide to standard presentation of safety instruction in industry. Additional information, materials, and illustrations should be included for a complete presentation. It was developed by staff of the Office of Occupational Safety and the International Division, Bureau of Labor Standards, U.S. Department of Labor. Illustrations and basic content are included for (1) Early Injury Causes, (2) Unsafe Act--Unsafe Condition, (3) New Injury Sources, (4) Growth of Machine Age, (5) Industrial Injuries in the United States, (6) National Problem, (7) Functions of Federal and State Government, (8) The Inspector's Job, and (9) Consultative Approach. The document is available as GPO L16.3--267 for 20 cents from Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402. (PS)

SAFETY IN INDUSTRY
INSTRUCTOR OUTLINE

ED020442

introduction to industrial safety



U DEPARTMENT OF LABOR
W illard Wirtz, Secretary
B AU OF LABOR STANDARDS
N on M Bortz, Director

Bulletin 267

This instructor outline is one of a series developed by staff of the Office of Occupational Safety and the International Division, Bureau of Labor Standards, U.S. Department of Labor.

The outline is intended only as a guide to standard presentation of the subject in sequence and basic content. Additional information, material, and illustrations should be included for a complete presentation suitable to the conditions, locality, industry, or occupational group.

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SAFETY TRAINING TECHNIQUES

It is of utmost importance that the instructor become acquainted with some of the basic training techniques in order to better prepare himself to conduct the course successfully.

Planning

1. The instructor should have such visual aids as are pertinent to the subject matter of the course. These should be set up in proper sequence. An indication or note on the instructor's outline could be very helpful as a guide that a particular visual aid should be used.

2. The course outline as well as the handout material and the visual aids should be checked at regular intervals. This should be done by the instructor in order to revise, improve, and modernize the course presentation. The material should also be checked to make sure that it conforms with policies of labor and management in the country where it will be presented.

3. The instructor's outline should be adapted by him to his particular method of presentation, keeping in mind that this is a discussion conference type of session.

4. The instructor would do well to get an advance list of the students that will participate and their positions and backgrounds. A study of such information could be very helpful to the instructor when he faces his class.

Preparation of Classroom

Many conferences and courses have failed simply because no preparation was made for the classroom facilities.

1. The classroom should be located in an area where there is the least amount of noise or distraction.

2. Good ventilation, lighting, and sufficient room are important aspects to consider.

3. The seating arrangement and seats should be comfortable as well as informal. A round-table seating arrangement is the most effective for discussion-conference sessions.

4. The room should be equipped with a good blackboard, sufficient chalk, and a clean eraser. A stand should be available for mounting the charts and visual aids to be used during the conference. A 35-mm. slide projector should be available.

Teaching

1. An official of the organization should open the first session with a statement regarding the general objectives of the course. He then should introduce the instructor to give him the proper posture in relation to the group he will teach.

2. At the first session, the instructor should open with an explanation of the course objectives and its method of presentation. At this time, he should draw upon his experiences to relate an illustrative incident that will bring him in closer relationship with the group and, at the same time, enable him to introduce the theme of the first session.

3. The course should be presented by employing the discussion-conference method.

4. The instructor should have the class follow a predetermined schedule and maintain order at all times. Only one participant should be permitted to give his viewpoint at a time. The instructor should keep the class discussion within the subject matter as contained in the instructor's outline.

5. If possible, an official should be asked to speak at the termination of the course.

Tips for Instructors

Learning is actually the acquisition of new ideas, abilities, and skills acquired through the senses of hearing, seeing, and feeling by touch.

1. New ideas are conveyed through the presentation of knowledge, and thought is stimulated through the student's sense of hearing.

Abilities and skills are presented through the media of telling, demonstrating, and having students demonstrate under the supervision of the instructor. Students acquire abilities and skills via the senses of hearing, seeing, and feeling by touch.

2. An important aspect of teaching is to remember that the student absorbs more when he participates in a discussion. The instructor therefore strives to get 100-percent class participation.

3. The instructor should become aware of outstanding characteristics of his students. This could be very helpful when leading discussions. For example:

   A. Some may be more mature.

   B. Some may have a knowledge of safety.

   C. Some may have actual experience to draw on in the discussion.

   D. Some may have a faster learning speed than others.

   - E. Some may be "stallers" who can slow down the discussion.
   - F. Others may be aggressive and want to monopolize the discussion.
   - G. There may be a "know-it-all" in the group who must be properly controlled.
   - H. Some may be constant latecomers who ask questions about previous discussions and delay the class.

4. The teaching process consists of:
   - A. Telling—this means giving background information to introduce a subject.
   - B. Showing—a demonstration of some equipment pertaining to the subject to be discussed is very impressive.
   - C. Illustrating—using charts, blackboard, slide. or films are very helpful to highlight specific points in the discussion.
   - D. Discussion conference—the participation of the students in formulating their thinking about the subject under discussion is fundamental to getting the most out of the session.
   - E. Conclusions—the instructor's summation of the session should knit together the points discussed during the session, and should include other important details that may have been overlooked by the group.
   - F. Questions—during the session. the instructor should use questions to stimulate discussion, and also to help bring the discussion back to the subject matter if it has strayed.

Guest Instructors

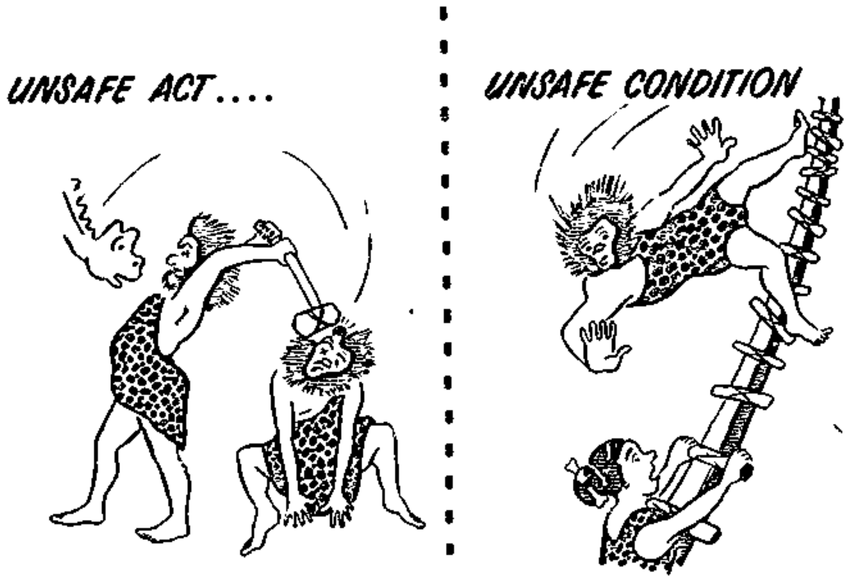
It is necessary that the instructor be granted full responsibility for conduct of the class: at times, however. he may wish to call in an expert in a particular field as a guest instructor (or lecturer). In such event, it is essential that the instructor maintain control of the course.

The instructor must tie in the work of the guest instructor with the balance of the course: he must outline the phase of the subject to be covered by the guest and satisfy himself that the guest limits himself to the field as outlined: he should summarize the guest's contribution, pointing out its relative importance in the field of accident prevention. While the use of a few guest instructors (properly utilized) can add to the effectiveness of the course, a series of "lecturers" whose topics are not correlated will inevitably result in confusion.

It is recommended that "guest experts" be used only for *supplementary* training. and not to replace even part of this course which ould be taught by *one instructor*.

INTRODUCTION TO INDUSTRIAL SAFETY

EARLY INJURY CAUSES



ACCIDENTS ARE NOT NEW

CHART 1—SERIES A

ACCIDENTS NOT NEW	Accidents have always been with us and have been caused by unsafe conditions and unsafe acts.
PREHISTORIC	Primitive man moved to caves, formed clan or tribe organizations, made tools and weapons and learned the use of fire. These afforded him more protection but introduced new hazards.
NO STANDARDS	It would be difficult to judge him from this time distance, as there were no standards in his day to compare him, his facilities, his actions, his conditions, his customs, and his accomplishments. Risk-taking, unknown to us, to procure food and other necessities was part of his daily life.

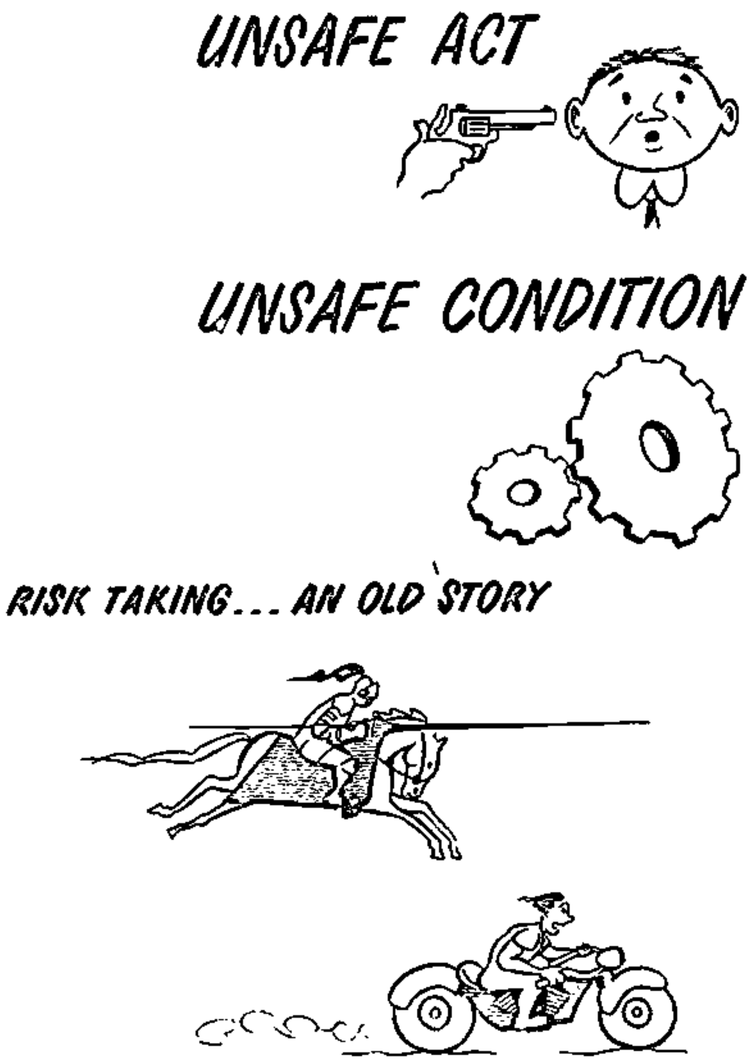


CHART 2—SERIES A

RISK-TAKING OLD STORY	With prehistoric and Stone Age man, risk-taking was usually "calculated risk for their personal and tribal welfare." In the Middle Ages, this had changed to risk-taking for thrills or glory, as the knight who took part in jousts or in tournaments for the personal satisfaction of winning, and for the excitement of action and danger involved. Today, we have the same motivation, in those who take part in racing of automobiles, motorcycles, and aircraft ("drag" races also). Boxing and wrestling are a part of this same urge.
RISKS AT WORK	Until recently and to some extent today, we find that there were workers who were proud of their ability to fell trees, ride logs, lift heavy objects, and to walk beams high in the air. They believed that safety was "sissy." By today's concept of safe performance, "risk-taking" at work is most unnecessary, but was characteristic of the daily lives of our forefathers in their work and in their recreation.

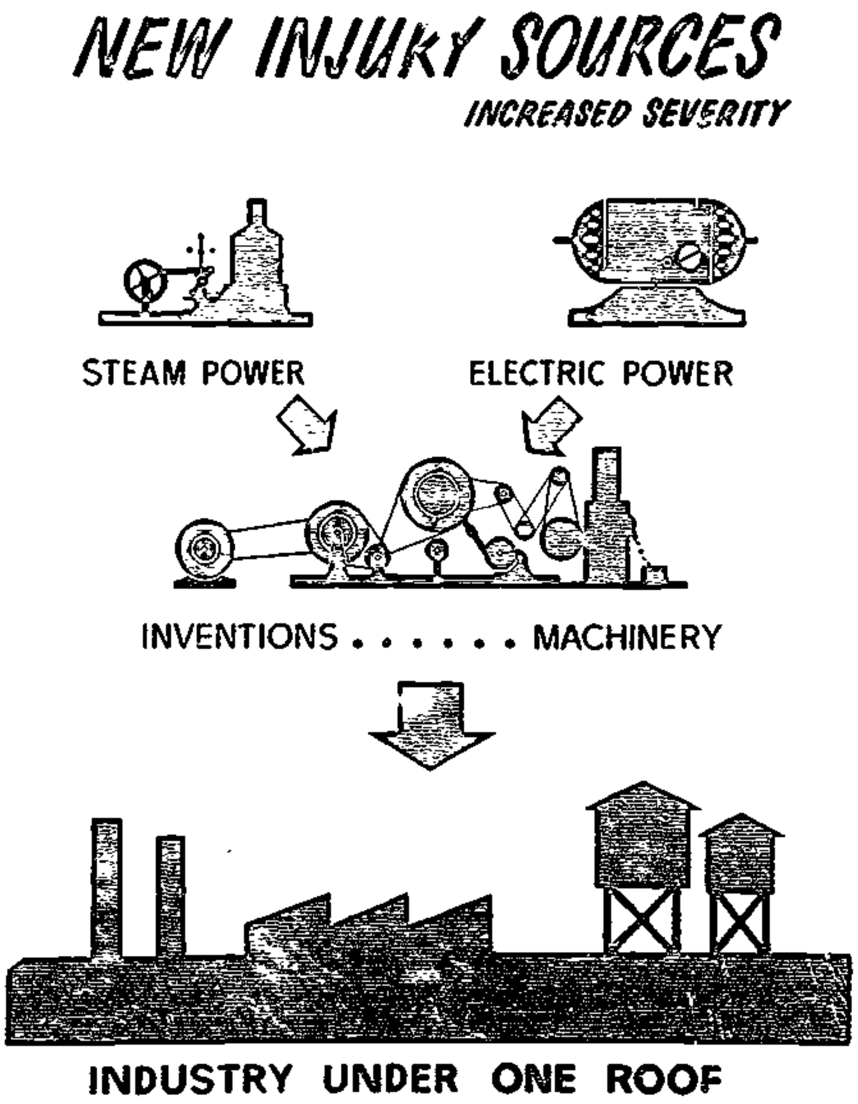


CHART 3—SERIES A

START OF INDUSTRY	
HOME WORKSHOPS AND CRAFTSMEN	The individual craftsman (shoemaker, hatter, blacksmith, carpenter, bricklayer, etc.) generally worked alone or with a helper or apprentice. If he was killed or severely disabled in a work accident, it would not attract much attention, as it would be an isolated incident and generally known only to his neighbors, customers, family, and immediate associates.
TYPES OF ACCIDENTS TO CRAFTSMEN	The power used was generally manpower or horsepower, except in gristmills (waterpower) and pumping (windpower). Serious accidents generally were caused by falls, falling objects, burns, drownings, and injuries inflicted by domestic animals.
EARLY INDUSTRIAL DISEASES	Certain industrial diseases were accepted as part of the job; for example, mercury poisoning of hatters, lead poisoning of painters, etc. Also silicosis in mining and in grinding operations.

NEW INJURY SOURCES	
STEAM AND ELECTRIC POWER	With the coming of the factory, waterpower was extended into manufacturing, closely followed by steam, and later, by electricity. Machinery was invented and improved to keep pace with expanding industrialization. This brought new hazards. The new machines were designed with no consideration for either the safety or the convenience of the operators. The workers were untrained and unskilled in the use of the new machines, and in the generation and use of the new power. Accidents multiplied and injuries became more severe as a result of these new and increased hazards.
INDUSTRY UNDER ONE ROOF	Due to the use of more efficient power and improved machinery, large factories came into existence when the new industries were placed under one roof. The resulting overcrowded conditions brought about an increase in the number of injuries which were thus sharply brought to the attention of the community.
INDUSTRIAL DEVELOPMENT 1837 TO PRESENT TIME	It may be considered that the first upward surge of industrialization started in the United States in 1837, and slowed up as a result of the Civil War (1861-1865). The next upsurge began about 1880 and continued until about 1890 when development became even more widespread.
STEEL INDUSTRY	To a great extent, this was due to the development of the steel industry. In 1886, the United States passed Great Britain in steel production, and has continued to lead the world in steel production since that year.
EFFECTS OF "PANICS" OR "DEPRESSIONS"	The increase in industrialization continued rapidly until the present time (halted or slowed only by "panics," "depressions," or "recessions," which have been followed by spurts of industrial activity and process improvements).

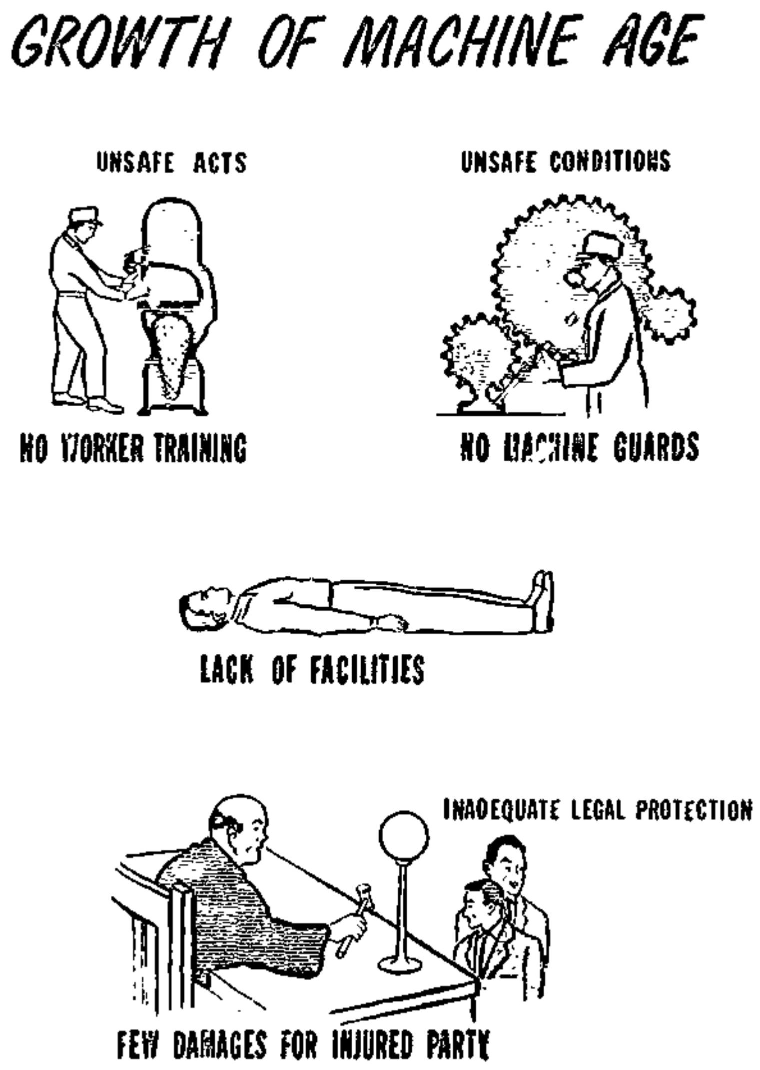


CHART 4—SERIES A

NO WORKER TRAINING NO MACHINE GUARDS	The growth of the machine age brought new sources of accidents. It also brought increasingly severe injuries. There were no machine and transmission guards. There was no worker training. The workday was very long and the worker was given only a short time to eat his lunch. In some continuous or shift operations, the work period was as long as 11 or 12 hours for the day shift, and 11 to 13 hours for the night shift, with lunch to be eaten on the job as the time and nature of the work permitted.
LACK OF FACILITIES	When workers were injured, there were no adequate facilities for emergency care and few, if any, persons on the premises were trained in first aid. In most cases, a medical doctor was not immediately available nor on call for their care. Most companies that had such facilities classed them as "welfare or charity activities."

PRIOR TO WORKMEN'S COMPENSATION

DISADVANTAGES TO EMPLOYER

COSTS OF DISASTERS

To management, disasters (such as those of Cherry, Ill.; Monongah, W. Va.; and "Darr," Jacob's Creek, Pa. where 858 men were killed, leaving about 2,000 dependents. Direct payments in addition to emergency relief amounted to more than $500,000), could result in ruin because of large judgments obtained against the companies. There was no definite basis for budget allowances to cover costs of accidents.

FEW DAMAGES FOR INJURED WORKER

Seldom did the injured worker get any compensation. During this period, *rights* of the injured worker were debated. He had to bear the burden of proof and then he could not collect if his employer could establish any of the following:

1. It was the fault of a fellow worker.
2. He had assumed the risks of his job.
3. It was his own fault.

Even when the injured worker won the verdict of the court, it was generally only after years of litigation with a large part of the money going to pay his attorney. Many times the worker was forced to seek other employment at once, at any wage, in order to support himself and his family. Almost invariably he did not sue.

STUDIES 1908–1910

In 1909, a study was made in Allegheny County, Pa. of the fatal industrial accidents (1-year = 526) in that county. "Over 50 percent of the widows and children were left by the employer to bear (alone) the entire income loss. It was calculated that 30 percent of those who did make settlements received more than $500.00." The same report states that there were 30,000 fatal industrial injuries in the United States the same year (1909).

In 1908, the Wisconsin Commission reported that there were 35,000 fatal injuries in industry in 1907.

In the same year, a study was made of all cases which were decided in the courts of New York. All of these involved widows and children (averaging 3 + children per family). The awards averaged $1,600 each; and of this amount, an average of $913 went to the lawyer.

PUBLIC REACTION TO SITUATION

Also, public sympathy in many sections was turning strongly in favor of the worker due to the publicity of disasters and publication of reports of investigative surveys.

In some cases, juries awarded large sums to injured workers or to their families.

An example of this is two almost identical cases in New York and in Kansas. In New York, the widow was denied compensation, while in Kansas, the widow was awarded a very substantial sum.

STRONGER EMPLOYER LIABILITY LAWS	Because of the pressure of public opinion, several States passed advanced "Liability Laws" which eliminated the defenses of "fellow servant," "strangers," "assumption of risk," and "own fault" (except deliberate actions). The burden of proof was transferred to the employer, and the employer was held accountable for the actions of foremen and supervisors. Example: Ohio—1910
FIRST LEGAL WORKMEN'S COMPENSATION LAW	The first workmen's compensation law in the United States was passed in 1908 and covered a small group of civilian, Federal workers. Several States passed workmen's compensation laws in 1911. The last of the States passed such a law in 1948. As the laws in each State are a matter for determination by that State, the laws vary among the individual States, although progress is being made to standardize the minimum benefits.
BENEFITS UNDER WORKMEN'S COMPENSATION TO MANAGEMENT	To management—the employer can calculate the costs of adequate insurance to protect his workers. The compensation law affords him relief from suits for damages for industrial injuries.
TO EMPLOYEE	To employee—He is assured of proper medical service, free from cost of law suits. Receives compensation as a matter of course. Receives immediate weekly payments—part of wages (tax free). Receives specified amounts for specific injuries (permanent-partial disabilities).
START OF ORGANIZED SAFETY MOVEMENT	Several large companies in the United States had "Safety" Departments as early as the 1890's. The first organized "Safety Congress" was held in Milwaukee, Wis., September 30 through October 5, 1912, under the auspices of the Association of Iron and Steel Engineers (Chairman was Lew Palmer, Jones and Laughlin Steel). It was voted to hold the next Safety Congress in September 1913, with Mr. Fred C. Schwedtman of the National Association of Manufacturers serving as Chairman. Wisconsin reported that it had 1 permanent and 2 traveling safety exhibits in use in Wisconsin.
FIRST ORGANIZED SAFETY CONGRESS	
"SAFETY MEN"	In April 1913, the National Association of Manufacturers reported that "276 member companies (of NAM) now have a special man in charge of Safety Shop Organization." They further reported that "three years ago the conclusion was reached that the time had

	passed when attention to these problems in the abstract was to any extent effective, and that results could be secured only by practical campaign methods . . . efforts of the Committee formed at that time (1909) and entrusted with this work, has carried on during these three years (1910–1912)." The National Association mailed out questionnaires to 20,000 U. S. manufacturers (in 1910) and "Ninety-nine per cent of the members answering expressed themselves emphatically in favor of an extended progressive campaign for accident prevention and compensation for injured workers." In 1913, NAM sent a special Accident-Prevention train to tour the United States, carrying exhibits, speakers, and moving pictures.
U. S. DEPARTMENT OF LABOR ESTABLISHED	The U. S. Department of Labor was created (in 1913) "to foster, promote, and develop the welfare of the wage earners of the United States, to improve their working conditions and to advance their opportunities for profitable employment."
NATIONAL SAFETY COUNCIL	The second "National Safety Congress" of the "National Council for Industrial Safety" was held in New York City, September 22 through 25, 1913. Mr. R. W. Campbell was elected President and Mr. William E. Cameron was elected Secretary, with offices in Chicago, Ill. The name was changed to National Safety Council in 1914.
UNITED STATES LAGGED BEHIND SOME EUROPEAN COUNTRIES IN SAFETY LEGISLATION	It is important to note at this point that the United States was several years behind some European countries (such as Germany) in passing legislation which required guarding of machinery, safety in mines, etc. In the United States, the enactment and enforcement of such laws were matters for the individual States with no overall *Federal* laws or regulations as in most other countries.
VOLUNTARY COOPERATIVE EFFORT	The result has been that safety started as separate efforts by individual companies and, to a great extent, reached its turning point in the formation of many voluntary programs and joint activities coincident with the founding of the National Council for Industrial Safety.
POSITIVE RESULTS PLUS STEADY IMPROVEMENT	Although late in starting, the United States has progressed rapidly in actual reduction in frequency and severity rates compared to those in most other countries. We have stressed individual cooperation of all interested persons in taking an active part in accident prevention, instead of only enforcing the law of guarding machines and neglecting the activities which we emphasized.

INDUSTRIAL INJURIES IN THE UNITED STATES

	1943	*1963*
Deaths	18,400	14,200
Permanent totals	1,700	1,400
Permanent partials	108,000	83,400
Temporary totals	2,285,000	1,921,000
Total	2,413,100	2,020,000

The average employment has increased 13,463,000 between 1943 and 1963.

Estimated annual losses from industrial injuries:

Wage loss to labor	$1,300,000,000
Total loss to management	3,700,000,000
Total	$5,000,000,000

CHART 5—SERIES A

COMPARISON INDUSTRIAL INJURIES, 1943-1963	Since World War II, industrial injuries in the United States have been decreasing both as to number and severity. Between 1943 and 1963 there was a reduction from 2,413,100 to 2,020,000 disabling injuries (a decrease of 390,000), while there was an increase of 13,463,000 workers in the same 20-year period. Thus, there was a decrease of 16 percent in the number of disabling injuries and an increase of 25+ percent in the average employment. This amounted to a net decrease of 33⅓ percent in the injury-frequency toll between 1943 and 1963.
ESTIMATED ANNUAL LOSSES	The estimated annual loss from industrial injuries in one year amounts to approximately $5 billion. Of this sum, about 30 percent represents loss by the workers and 70 percent, the costs to the companies.
FROM INDUSTRIAL INJURIES	Part of this overall loss is assumed by the State, since the disabled worker is a State problem. These include: A. Assistance to the family of the injured worker. B. Rehabilitation and second-injury fund, plus medical care beyond compensation. C. Costs of inspections, investigation, and hearings before the Compensation Board. D. Costs of regular accident-prevention service and inspection by the department of labor of the individual State. E. Taxes used to pay costs of public assistance, investigation, and control.

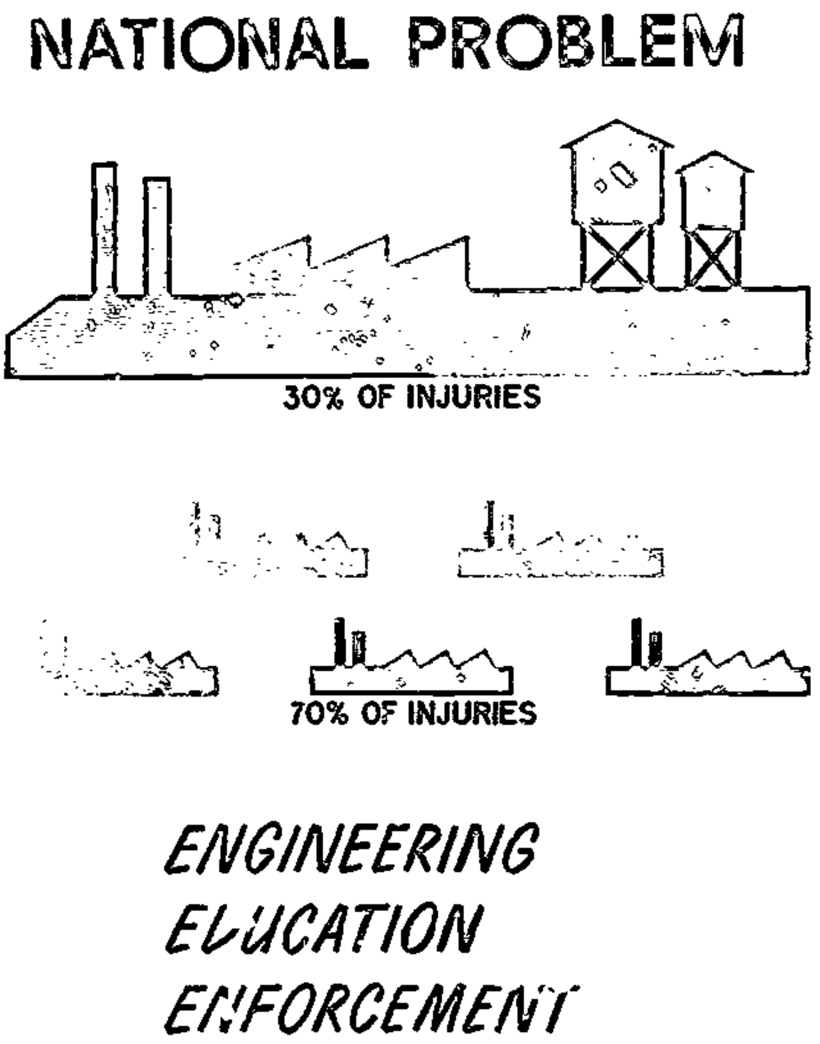


CHART 6—SERIES A

SMALL PLANTS ARE A NATIONAL PROBLEM

Studies made over the years have established that out of 2 million disabling work injuries (per year), about 30 percent, or 600,000, were in plants which had organized safety programs; while 70 percent, or 1,400,000, occurred in plants which had no organized safety program.

It was found that these plants which had no organized safety programs were mainly small plants whose managements felt that they "could not afford" an accident-prevention program, or were "too small" for one.

THREE "E's"

In fact, no plant is "too small" for a safety program and every plant can "afford" such a program. The basic fundamentals of accident-prevention programs are the three "E's": Engineering, Education, and Enforcement.

ENGINEERING
ENFORCEMENT

1. *Engineering* is to furnish information as to what is wrong and what should be done about it. (Technical know-how).
2. *Education* is the teaching of safety to all concerned. Convincing management, (a) to correct conditions found in the engi-

	neering survey; and (b) to inaugurate and support a safety program. Training workers and getting their support in the program. Selling foremen and technical people to give willing cooperation. 3. *Enforcement*—within the plant *enforcement* means to the worker the enforcement of rules of the company. Enforcement to the State means the inspection of the plant and the issuance of orders for the correction of violations of the law. This is the weakest of the three "E's." Several States, realizing this, have started the consultative approach which will be discussed later.
GOVERNMENTAL PARTICIPATION IN SAFETY	
GOVERNMENTAL	Broad in scope—dictionary states that "*governmental* refers to exercise of administrative powers; the mode or system of governing; the function; office, right or power of governing." Can, therefore, apply to Federal, State, municipal, county, or political subdivisions. For our purposes, we will discuss the Federal, State, and local government activities.
PARTICIPATION	To participate is "to have a share in common with others;" partaking; joint efforts; cooperation.
SAFETY	A keeping of oneself or others safe, from danger of accident or disease, or pertaining to the safeguarding of the public, or of a group of employees, or the like, from accident.
SUMMATION OF TITLE	Governmental agencies, through cooperative efforts with each other and with the public, play an important part in reducing accidents, injuries, and property damage.
SCOPE OF SUBJECT	Activities of government service-type safety functions devoted to safeguarding from injury the Nation's work force rather than to confining activities to their own personnel.

Explain that since governmental functions vary, there can be no standard pattern for each level, so we will deal with each one separately.

FUNCTION OF FEDERAL AND STATE GOVERNMENTS	To assist and advise the State and local governments.
FUNCTION OF THE FEDERAL GOVERNMENT	
SAFETY TECHNICIANS AND TECHNICAL ASSISTANCE	Provide competent safety technicians and technical assistance to the various State and local governments.
RESEARCH	Provide leadership in the field of research; collect and make available information on a national scale.
PRODUCTION AND WORKING CONDITIONS	Maintain agencies to assist and work with national organizations representing both management and labor to bring about improved production and working conditions.
STANDARDS	Provide trained personnel and facilities to develop the standards for safety and health of the Nation's work force, and assist the States to improve their safety administration.
EDUCATION SERVICES	Provide for safety and health education services which will be available to the various State agencies and to industry and labor.
ADVICE AND ASSISTANCE TO STATES	Assist and advise the States so that the experiences and methods developed by the various States are readily available to each other, to industry, to labor, and to the public.
PROMOTION	Provide leadership to promote the designing production of safer machines, equipment, and procedures. Cooperate with international safety and health organizations, and with all other agencies engaged in the promotion of accident prevention on a national, State, or local level.
LEGAL RESPONSIBILITIES	Carry out its legal responsibilities under the laws designating responsibility for safety in longshoring and ship repair and ship construction operations, coal mining, interstate commerce, and certain manufacturing under Federal contracts.
FUNCTION OF STATE GOVERNMENTS	Places of employment to be made safe and environments healthful to work in. To carry this out, agencies are set up with authority to develop standards and codes and to administer them.

SAFETY ACTIVITIES

State safety activities take many forms, and vary in type and effectiveness to a very great degree.

These safety activities relate to various areas of accident prevention for the public welfare—mining, highway safety, general occupational (industrial) safety, and safety for personnel employed by the State itself.

Many States have created safety advisory boards, or public safety commissions, State safety councils, Governor's safety committees, and similar bodies.

> We will concern ourselves primarily with *occupational* safety in this discussion.

ALL STATES HAVE ASSIGNED THIS RESPONSIBILITY IN SOME MANNER

Every State has created some department, bureau, or other subdivision, or has assigned to some such existing unit, the responsibility—in whole or in part—for the safety of that State's working force.

The responsibility—and all too often the authority which should accompany such responsibility—has been tragically weak in some cases.

Organization titles vary, but usually it is Department of Labor, Department of Labor and Industry, or Industrial Commission.

The first organization of this type was the Massachusetts Department of Factory Inspection created in 1867.

CONCEPTS ARE CHANGING

Originally, such agencies were set up only to enforce laws to correct hazards or abuses which could cause accidents.

Strong trend now is to temper enforcement—or replace it—with education: such as the "Consultative Approach" or (the "Sales Approach").

THE STATE INSPECTOR'S JOB

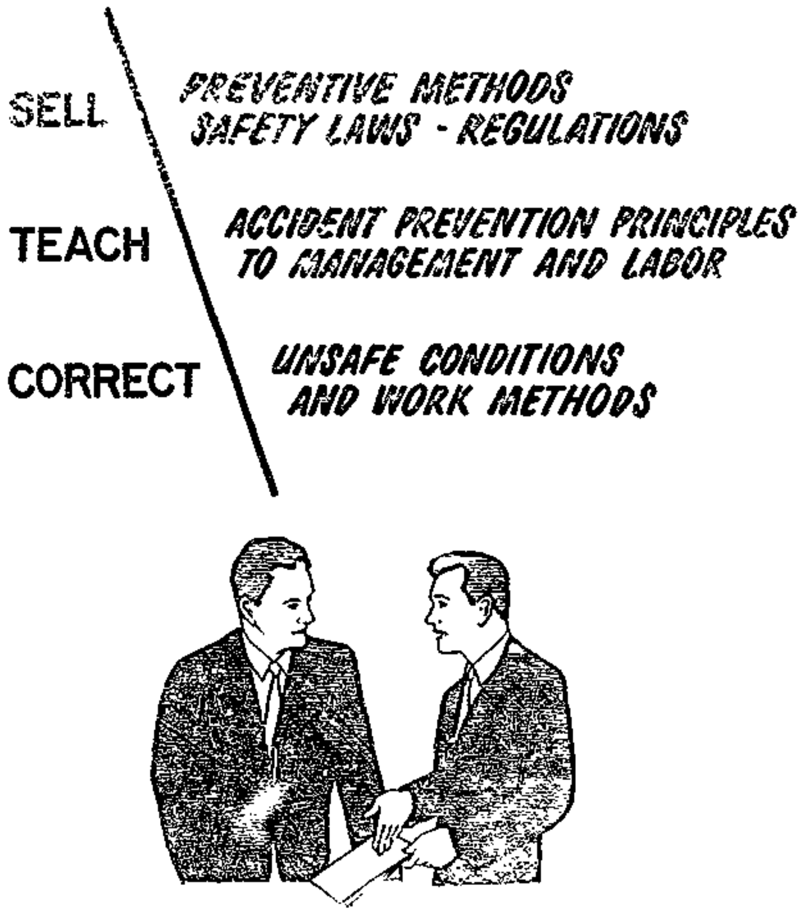


CHART 7—SERIES A

"CONSULTATIVE APPROACH"	A substantive theory is that even though the safety representative is backed by authority, if he knows his subject and can present it effectively, he will rarely have to use that authority. If management is "*sold*" on the idea that accidents are serious, preventable losses, it will "do something" to prevent them.
CONSULTATIVE ASSISTANCE	Particularly important to smaller firms. Requires a competent staff of safety technicians to provide services. Must include Industrial hygiene, fire prevention, and protection against disaster-producing hazards.
EDUCATION	Programs for safety and health, training for supervisors, members of safety committees, and employees of the industrial firms of the State.
TECHNICAL MATERIAL PRODUCTION	Such material would include posters, statistical information, technical bulletins. These are for use by safety committees, and for the development of regulations. They should not duplicate or supplant those being done by insurance companies, trade associations, or other groups.
LOCAL GOVERNMENTS	Safety programs are usually limited in scope. Should be confined to problems peculiar to city, town, or county, or to the problem

	created by congestion of population. Should relate to regulation of buildings, boilers, elevators, electrical installations, plumbing, and the like.
INTER-NATIONAL SAFETY ACTIVITIES	U. S. Federal Government agencies participate in the exchange of ideas in the field of occupational safety with developed and developing countries. This includes technical advice and assistance to developing countries under the foreign aid technical assistance program.
ILO	International Labor Office in Geneva, Switzerland, has an Industrial Safety Section. Has committee of 29 safety experts from 19 countries which assists by providing information. Has prepared international safety regulations for docks, construction operations, coal mines, and factories. Has prepared technical handbooks on hazardous operations and materials, such as power presses, acetylene, etc. Has also adopted numerous conventions and recommendations.

Distribute occupational safety aid—Development of the Safety Movement.

OCCUPATIONAL SAFETY AID

THE DEVELOPMENT OF THE SAFETY MOVEMENT

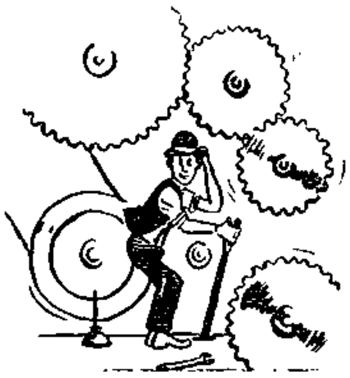
- The Industrial Revolution
- Early Legislation
- Safety Leadership

We hear the word "safety" so much nowadays that we may easily overlook its significance. Accidents are not new, but the organized safety movement *is* relatively new; and the achievements of that movement were hard won.

IN FACT, THE STORY OF "ORGANIZED SAFETY" IS ONE OF PAINSTAKING PROGRESS.

U.S. INDUSTRIAL EXPANSION UNDERSCORES A PROBLEM

The appalling number of workers killed or injured at their jobs began to dawn on the public conscience about the middle of the 19th century. Workers began to leave their small shops in ever increasing numbers to work in the larger plants. New machinery brought new hazards and new injuries. By 1867, legislation was enacted in Massachusetts to improve working conditions in the mills.



WHO IS RESPONSIBLE FOR SAFETY?

In spite of a growing concern for safety, there was a lack of unity among industry, labor, and the government. At first, employers assumed only a limited degree of liability for injuries; in defense against damage suits, they claimed negligence on the part of the worker or his fellow worker, or assumption of risk by the injured worker. But the rising tide of injuries led to stricter legislation to protect the worker, the now-familiar workmen's compensation laws.

U.S. DEPARTMENT OF LABOR
Bureau of Labor Standards

AMERICA TAKES ACTION

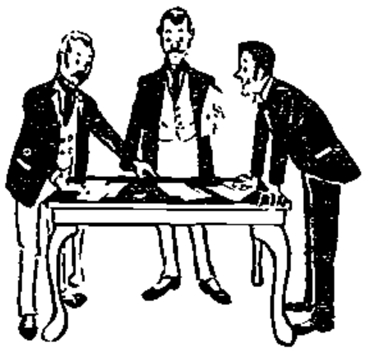
In 1867, Massachusetts passed a law providing for the services of factory inspectors; and 2 years later, it created the first bureau of labor statistics to study the accident problem. In 1877, the Massachusetts legislature voted to compel employers to safeguard hazardous machinery. This leadership in industrial safety was due to the humanitarian and social arguments voiced by the clergy and the press. In 1885, Alabama passed an Employer's Liability Law; and Massachusetts did likewise in 1887. Although these laws were a long step in advance, the financial burden on the employer was not sufficient to spur him to take steps to safeguard workers ftom injury.

WORKMEN'S COMPENSATION BECOMES UNIVERSAL

The oldest workmen's compensation system in the United States is the one that covers civil employees of the Federal Government. The Federal Employees' Compensation Act (FECA) is a plan for a single employer with over 2.5 million workers and operations as diversified as American business itself. It is financed by annual congressional appropriations.

The original limited act was passed in 1908 at the demand of President Theodore Roosevelt. It was replaced by the present basic law in 1916 (5. U.S.C. sec. 751 et seq.). In 1949, the act was amended to revise the entire benefit structure (P.L. 357, 81st Cong.). It is now considered "one of the most advanced workmen's compensation laws in the world."

Between 1911 and 1915, 30 States enacted compensation laws. By 1948, all States had workmen's compensation laws. One of the effects of such legislation was to impress on employers the high costs of accidents. Little by little, the economic protection afforded workers by such laws led to an enlightened interest in SAFETY on the part of the employers.



ACCIDENT-PREVENTION AS A POSITIVE GOAL

Laws had been put on the books to compel employers to practice certain safety measures. For example, at the turn of the century, guards were required on hazardous machinery in most European countries; and safety codes were set up for coal mining and steam-boiler operations. But now, with the economic pressure of workmen's compensation laws, employers set out on their own to promote safety.

Some firms were farsighted and realized that safety would pay its own way. In 1892, for example, a plant safety program was established by the Illinois Steel Company—the first of its kind. In 1912, a group of engineers representing insurance companies, industry, and government met in Milwaukee to exchange data on accident prevention. The organization formed at this meeting was to become the National Safety Council, which today carries on major safety campaigns for the general public as well as assisting in safety promotion for industry. The Council is supplemented by local safety councils, of which there are more than 500 throughout the country.

SAFETY IS A PART OF UNION BUSINESS

A safety conscious union has long been a most lethal weapon against worker injuries. Labor unions have campaigned vigorously for safe working conditions on the job. Local unions have established specialized safety education programs for their respective types of industry. Some unions have produced safety films, and others have drafted, with the cooperation of management, "Safety Regulations" under which proper observance is a condition of employment.

INDUSTRY PROVIDES SPECIALIZED PROGRAMS

The American Society of Safety Engineers

Incorporated in 1915, this group operated as a section of the National Safety Council from 1924 to 1947 when it withdrew to again become an independent organization. It is dedicated to accident-prevention techniques, and to the development of safety engineering as a profession.

Underwriters' Laboratories, Incorporated

A nonprofit organization which maintains facilities for the examination and testing of devices, systems, and materials to determine if they meet established standards of safety.

The American Standards Association

The ASA provides the machinery for voluntary establishment of recognized standards of safety engineering, frequently more rigorous than State safety codes in the same field.

The American Society of Mechanical Engineers

Since 1911, this organization has provided leadership in the development of safety codes including those for boilers and elevators.

American Mutual Insurance Alliance

A group of over 100 United States mutual fire and casualty companies whose accident-prevention activities are carried on through three independently operated affiliated associations:

- Federation of Mutual Fire Insurance Companies
- National Association of Automotive Mutual Insurance Companies
- National Association of Mutual Casualty Companies

The Association of Casualty and Surety Companies

In cooperation with the American Standards Association, this body provides technical books, pamphlets, and research services for the prevention of accidents in industry, schools, and in the home. New York University's Center for Safety Education is largely supported by annual grants from the Association.

HOW THE GOVERNMENT HELPS

State Government

Every State has created some department or bureau that is charged with at least partial responsibility for the safety of the wage earners employed in that State. The first organization of this type to be created was the Massachusetts Department of Factory Inspection in the year 1867.

Federal Government

Bureau of Mines, U. S. Department of the Interior, Washington, D. C., was organized in 1910. One of its major functions is to study the causes of accidents and ill health among miners, and to promote preventive measures against mine explosions.

Bureau of Labor Statistics, U. S. Department of Labor, Washington, D. C., organized in collects, tabulates, and disseminates statistical information about industrial accidents a health. It issues annual reports on industrial injuries, giving estimated national totals and breakdowns by industry.

National Bureau of Standards, U. S. Department of Commerce, Washington, D. C., was organized in 1910 to create safety standards for various materials and equipment, and to formulate testing methods for determining their safety.

Division of Safety in the U. S. Department of Labor's Bureau of Labor Standards, provides technical, educational, and promotional services to everyone concerned with industrial safety. The Division of Safety also administers the safety and health regulations that have been determined by the Secretary of Labor to be reasonably necessary to protect the life, health, and safety of employees engaged in longshoring, ship repairing, and related employments covered by section 41 of the Longshoremen's and Harbor Workers' Compensation Act.

Federal Safety Council was established in 1950 in the U. S. Department of Labor to serve in an advisory capacity to the Secretary of Labor in matters relating to the safety of Federal employees.

Other Organizations rendering safety services:

Literally hundreds of other organizations provide specialized safety services in more or less limited fields: The following are a few:

The National Bureau of Casualty Underwriters
The Industrial Hygiene Foundation of America
The National Council of Compensation Insurance
The American Industrial Hygiene Association
The National Society for the Prevention of Blindness
The Factory Insurance Association
The International Association of Industrial Accident Boards and Commissions
The National Fire Protection Association
The Associated General Contractors of America
The American Public Health Association

THE HISTORY OF ACCIDENT PREVENTION ACTIVITIES IS THAT OF COOPERATION BETWEEN GOVERNMENT, INDUSTRY, AND WORKERS.

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Accident Cost Control. (Safety in Industry, Instructor Outline).

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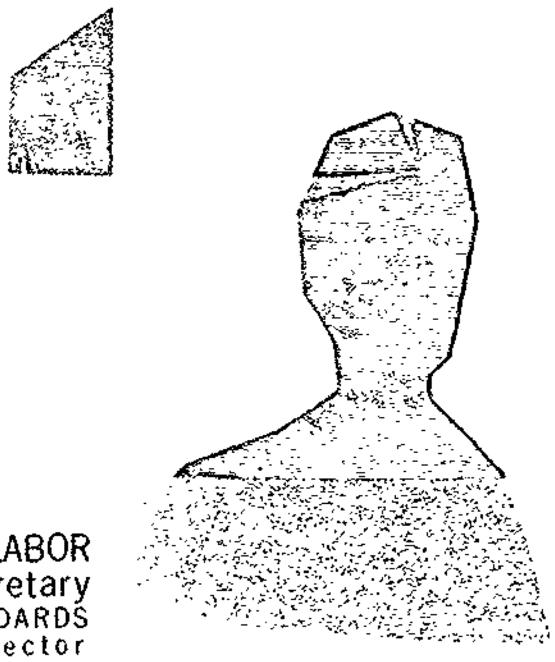
*CURRICULUM GUIDES, *SAFETY, *INDUSTRY, *ACCIDENTS, *COSTS, INDUSTRIAL EDUCATION,

This outline is for instructor use as a guide to standard presentation of an accident cost control system which will show how much accidents cost and will therefore be an important factor in determining the safety program in a plant. Additional information, materials, and illustrations should be included for a complete presentation. It was developed by staff of the Office of Occupational Safety and the International Division, Bureau of Labor Standards, U.S. Department of Labor. Illustrations and basic content are included for (1) Direct-Indirect Costs, (2) Insurance and Uninsured Costs, (3) Element of Production, Accident Cost Concept, (4) Medical and Compensation Costs, (5) Manpower Costs, (6) Machinery, Material, and Equipment Costs, (7) Total Costs of Accidents, (8) Elements of Production--Accident Cost Form, and (9) Workers Lose. This document is available as GPO L16.3--268 for 20 cents from Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402. (PS)

SAFETY IN INDUSTRY
INSTRUCTOR OUTLINE

accident cost control



U [illegible] DEPARTMENT OF LABOR
W[illegible]llard Wirtz, Secretary
B[illegible]U OF LABOR STANDARDS
Nelson M. Bortz, Director

Bulletin 268

This instructor outline is one of a series developed by staff of the Office of Occupational Safety and the International Division, Bureau of Labor Standards, U.S. Department of Labor.

The outline is intended only as a guide to standard presentation of the subject in sequence and basic content. Additional information, material, and illustrations should be included for a complete presentation suitable to the conditions, locality, industry, or occupational group.

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SAFETY TRAINING TECHNIQUES

It is of utmost importance that the instructor become acquainted with some of the basic training techniques in order to better prepare himself to conduct the course successfully.

Planning

1. The instructor should have such visual aids as are pertinent to the subject matter of the course. These should be set up in proper sequence. An indication or note on the instructor's outline could be very helpful as a guide that a particular visual aid should be used.
2. The course outline as well as the handout material and the visual aids should be checked at regular intervals. This should be done by the instructor in order to revise, improve, and modernize the course presentation. The material should also be checked to make sure that it conforms with policies of labor and management in the country where it will be presented.
3. The instructor's outline should be adapted by him to his particular method of presentation, keeping in mind that this is a discussion conference type of session.
4. The instructor would do well to get an advance list of the students that will participate and their positions and backgrounds. A study of such information could be very helpful to the instructor when he faces his class.

Preparation of Classroom

Many conferences and courses have failed simply because no preparation was made for the classroom facilities.

1. The classroom should be located in an area where there is the least amount of noise or distraction.
2. Good ventilation, lighting, and sufficient room are important aspects to consider.
3. The seating arrangement and seats should be comfortable as well as informal. A round-table seating arrangement is the most effective for discussion-conference sessions.
4. The room should be equipped with a good blackboard, sufficient chalk, and a clean eraser. A stand should be available for mounting the charts and visual aids to be used during the conference. A 35-mm. slide projector should be available.

Teaching

1. An official of the organization should open the first session with a statement regarding the general objectives of the course. He then should introduce the instructor to give him the proper posture in relation to the group he will teach.

2. At the first session, the instructor should open with an explanation of the course objectives and its method of presentation. At this time, he should draw upon his experiences to relate an illustrative incident that will bring him in closer relationship with the group and, at the same time, enable him to introduce the theme of the first session.

3. The course should be presented by employing the discussion-conference method.

4. The instructor should have the class follow a predetermined schedule and maintain order at all times. Only one participant should be permitted to give his viewpoint at a time. The instructor should keep the class discussion within the subject matter as contained in the instructor's outline.

5. If possible, an official should be asked to speak at the termination of the course.

Tips for Instructors

Learning is actually the acquisition of new ideas, abilities, and skills acquired through the senses of hearing, seeing, and feeling by touch.

1. New ideas are conveyed through the presentation of knowledge, and thought is stimulated through the student's sense of hearing.

Abilities and skills are presented through the media of telling, demonstrating, and having students demonstrate under the supervision of the instructor. Students acquire abilities and skills via the senses of hearing, seeing, and feeling by touch.

2. An important aspect of teaching is to remember that the student absorbs more when he participates in a discussion. The instructor therefore strives to get 100-percent class participation.

3. The instructor should become aware of outstanding characteristics of his students. This could be very helpful when leading discussions. For example:

   A. Some may be more mature.

   B. Some may have a knowledge of safety.

   C. Some may have actual experience to draw on in the discussion.

   D. Some may have a faster learning speed than others.

E. Some may be "stallers" who can slow down the discussion.

F. Others may be aggressive and want to monopolize the discussion.

G. There may be a "know-it-all" in the group who must be properly controlled.

H. Some may be constant latecomers who ask questions about previous discussions and delay the class.

4. The teaching process consists of:

A. Telling—this means giving background information to introduce a subject.

B. Showing—a demonstration of some equipment pertaining to the subject to be discussed is very impressive.

C. Illustrating—using charts, blackboard, slide, or films are very helpful to highlight specific points in the discussion.

D. Discussion conference—the participation of the students in formulating their thinking about the subject under discussion is fundamental to getting the most out of the session.

E. Conclusions—the instructor's summation of the session should knit together the points discussed during the session, and should include other important details that may have been overlooked by the group.

F. Questions—during the session, the instructor should use questions to stimulate discussion, and also to help bring the discussion back to the subject matter if it has strayed.

Guest Instructors

It is necessary that the instructor be granted full responsibility for conduct of the class; at times, however, he may wish to call in an expert in a particular field as a guest instructor (or lecturer). In such event, it is essential that the instructor maintain control of the course.

The instructor must tie in the work of the guest instructor with the balance of the course; he must outline the phase of the subject to be covered by the guest and satisfy himself that the guest limits himself to the field as outlined; he should summarize the guest's contribution, pointing out its relative importance in the field of accident prevention. While the use of a few guest instructors (properly utilized) can add to the effectiveness of the course, a series of "lecturers" whose topics are not correlated will inevitably result in confusion.

It is recommended that "guest experts" be used only for *supplementary* training, and not to replace even part of this course which should be taught by *one instructor*.

ACCIDENT COST CONTROL

Accident Cost Control

Develop purpose with class; list items on the blackboard and discuss.

PURPOSE	
SHOWS NEED FOR PROGRAM	An accident cost control system will show how much accidents cost and will therefore be an important factor in determining the safety program in a plant.
ENLISTS SUPPORT OF MANAGEMENT	Management's interest in accident prevention should be stimulated by putting it on a profit-and-loss basis and integrating it with other production costs.
ENLISTS SUPPORT OF OTHERS	Supervision should take an interest in accident cost control, since it is an important factor in production costs. Workers and their organizations should be interested, since it affects their personal safety as well as their job security.
DETERMINING ACCIDENT COSTS	We know of three systems or concepts that are used for determining accident costs. The concept or system used will depend largely upon the degree of accuracy demanded, the scope of the program, and the availability of the data necessary to implement the system.
DIRECT-INDIRECT COSTS CONCEPT	This is the concept where the indirect costs (hidden or intangible costs) are in a ratio of 4:1 to direct costs (medical and compensation costs). Highly inaccurate and not generally acceptable to management. Management will accept the medical and compensation costs but will not in all instances accept the hidden or intangible costs.
INSURANCE AND UNINSURED COSTS CONCEPT	This is the concept where the insurance cost includes medical, compensation, and overhead insurance costs (insurance premium). The uninsured costs include A times number of lost-time cases + B times number of doctors' cases + C times number of first-aid cases + D times number of no-injury accidents (A, B, C, and D are estimated constants for the average cost of each category of cases, preferably based upon studies of a large number of such cases). This is a more complicated procedure than the direct-indirect 4:1 ratio cost method, but it is somewhat more accurate if the averages are based upon adequate studies.

ELEMENTS OF PRODUCTION, ACCIDENT COST CONCEPT

This concept is concerned with accident costs of injury to manpower, damage to machinery, equipment and material, as well as loss of production time.

This concept does *not* include such costs as: Cost of time lost by employees who stop work because of sympathy or curiosity and not because of injury, or cost of time that supervisors and company executives spend in assisting injured employee or investigating the accident, etc.

Only actual costs that are of sufficient importance, of easy recognition and accuracy to be acceptable to management are included. Averages, estimates, and ratios are excluded. This does not include all costs but is accurate and simple in what it does include and provides ready comparability of statistics.

Ask the class to participate with you in developing the elements of production concept; list on the board and discuss.

ELEMENTS OF PRODUCTION	
MANPOWER	Includes all employees from the worker to the engineer, as well as clerical and other salaried employees. Injuries to any of these people may result in medical and compensation costs and will result in lost production time.
MACHINERY AND TOOLS	Includes production machinery, machine tools, auxiliary machinery, as well as any other tools that are used in the plant. Accidents may result in damage of machinery and tools which will require repair or replacement as well as interference with production.
MATERIAL	Includes raw material, goods in process, and finished products. Accidents may result in damage to material requiring repair or replacement, as well as interference with production.
EQUIPMENT	Includes yards, buildings, electrical power, ventilation, lighting equipment, ladders, containers for material in process, tables and chair, and other physical equipment other than machinery and tools that are essential to plant operations. Damages from accidents result in increased costs as well as interference with production.

TIME	Includes production time loss resulting from damaged machinery and tools, material, equipment, as well as loss of production time by the injured employee.
ELEMENTS OF PRODUCTION, ACCIDENT COST CONCEPT	Every accident damages at least one or more of the elements of production. A decrease in the number of accidents should eventually affect the cost of production.

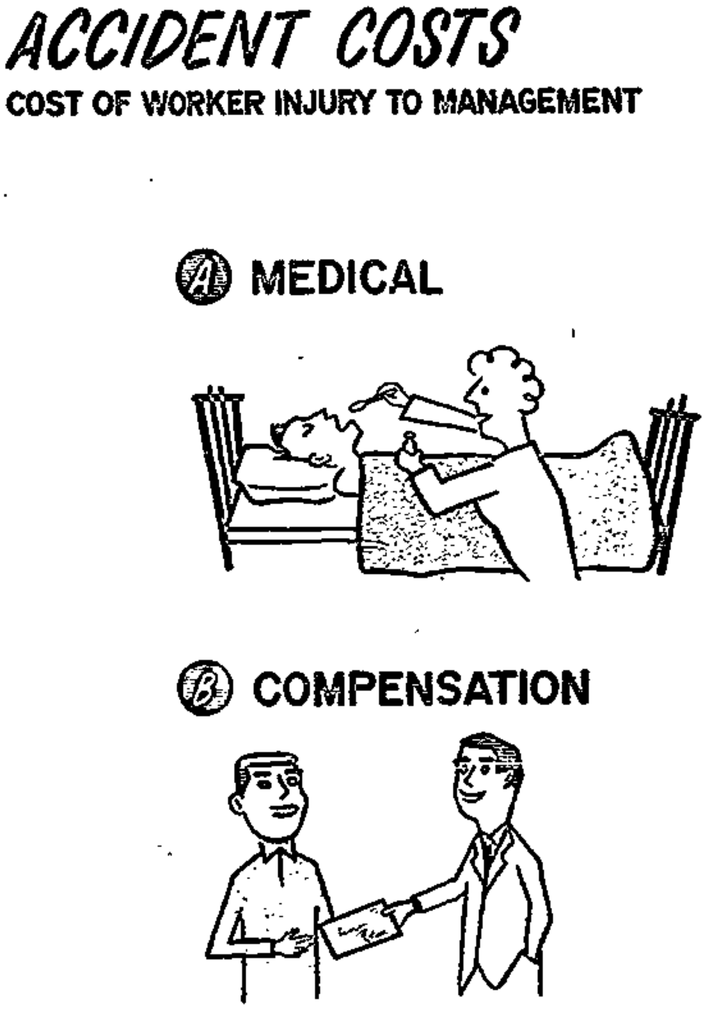

CHART 3—SERIES A

ACCIDENT COSTS	Extent of damage to machinery, material, and equipment determined by supervisor; cost of damage, lost production time, and manpower costs determined by accounting department.
MANUFACTURING BURDEN COST PER PRODUCTION UNIT	The accounting department computes the manufacturing burden cost per production unit which includes: supervisory costs, indirect labor costs, pensions and pension plans, insurance, taxes, social security, fuel, power, light, water, depreciation, research, etc.

	This cost is ordinarily added to the labor and material costs of each production unit to determine basic production costs per unit.
MANPOWER COSTS	Medical and compensation plus loss of production time by injured employee. Medical costs for the injured employee include all medical costs covered by compensation insurance, as well as those medical costs not covered. Compensation costs include workmen's compensation payments to the injured employee. Loss of production time costs of manpower includes the injured employee's salary that is paid for periods such as time lost on day of injury, time lost on subsequent days for medical treatment, or other reasons. It also includes the difference between workmen's compensation and the injured worker's regular salary if it is paid by the employer. It also includes the time the injured worker is on light work or reduced output.

ACCIDENT COSTS

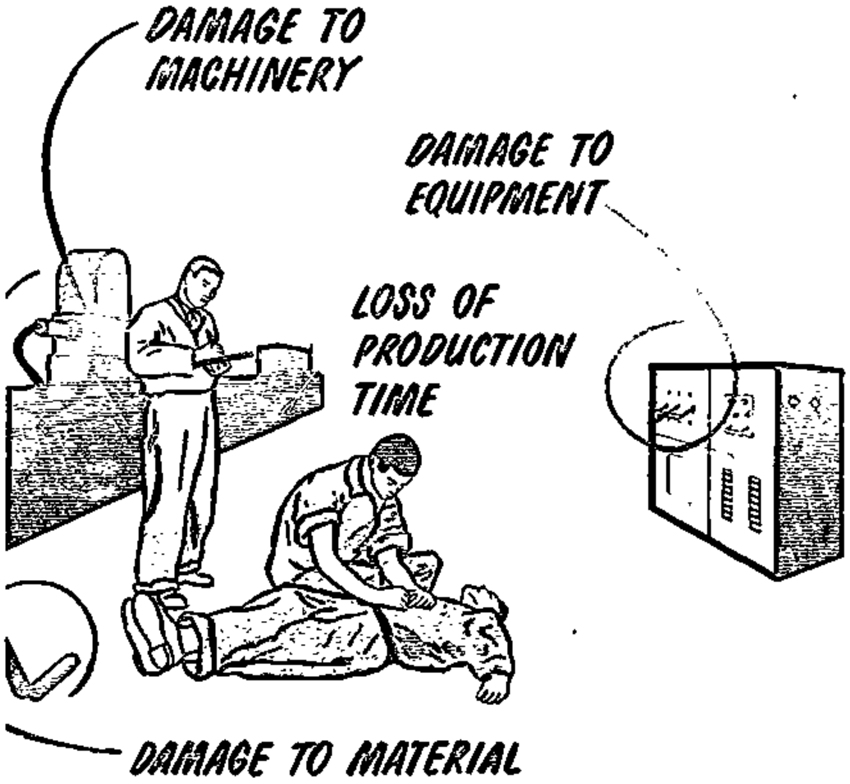

CHART 9—SERIES A

MACHINERY COSTS	Includes cost of repair to damaged machinery resulting from an accident, as well as loss or production time. This latter item is determined by establishing the amount of time that the machine was not in operation because of the accidental damage and the number of production units that would have been produced during this period of time. The number of production units are then multiplied by the manufacturing burden (overhead) costs per unit. (Determined by accounting department.) This will give you the loss of production time cost. Days machine is out of operation because of accident × production units per day × manufacturing burden cost per unit = Lost production time cost
EXAMPLE	Machine down 3 days × 80 units per day × manufacturing burden cost per unit .10 3 × 80 × .10 = $24 Cost of lost machine production.

	Repair of machine................$120 Cost of lost production........... 24 Total cost of damaged machine from accident................$144
MATERIAL COSTS	Includes cost of repair or replacement of material damaged by accident and loss of production time cost if the damaged material was the direct cause of such lost time. The cost of such time may be determined by establishing the days lost and the number of units produced per day by the operation involving this material and using the manufacturing burden unit cost. Days lost from damaged material × production units per day × manufacturing burden cost per unit = Lost production time cost from damaged material
EQUIPMENT COSTS	Includes the cost of repair of equipment that was damaged by an accident and loss of production time if the damaged equipment was the direct cause of such lost time. Days lost from damaged equipment × production units per day × manufacturing burden cost per unit = Lost production time cost from damaged equipment.
TOTAL COST OF ACCIDENTS	Manpower costs = Medical + compensation + lost production time + Machine and tool costs = Machine damage + lost production time + Material costs = Material damage + lost production time + Equipment costs = Equipment damage + lost production time Total cost of accidents Lost production time. Whenever more than one of the elements of production—machinery and tools, material, or equipment—are damaged because of the same accident and result in lost production time, then only one computation is used for lost production time: the one resulting in the greater loss. In other words, we use one lost production time figure for each accident.
HOW TO START	Use a form for investigating accidents and injuries that includes information for determining costs. This will be used first by the supervisor. It will therefore eliminate the need for any other supervisor's accident investigation form.

Distribute and discuss in detail the Elements of Production—Accident Cost Form.

ELEMENTS OF PRODUCTION—ACCIDENT COST FORM

Name of employee directly involved__________ Dept.__________ Job title__________

Injury if any__________

When injured__________ Lost time__________ First aid__________ No injury__________

What was employee doing before accident?__________

What happened?__________

Unsafe condition:__________

Unsafe act:__________

Correction:__________

MANPOWER

Returned to job__________ Compensation payments__________

Days of compensation__________ All medical expenses__________

Total compensation and medical costs__________

Injured worker's wage__________ Hour

Time lost on day of injury__________ Hours__________ Minutes__________

Time lost on subsequent days ________Hours________ Minutes ________
(Treatment or other reasons)

Time on light work or
reduced output________Days Percent output decreased ________

Wages paid other than compensation during disability ________

Medical costs other than those covered by compensation insurance ________

TOTAL MANPOWER COSTS ________

MACHINERY

Damage to machinery (Describe)

____

____

Cost of repair or replacement________

Lost production time________Cost________

MATERIAL

Damage to material (Describe)

____

____

Cost of repair or replacement________

Lost production time________Cost________

EQUIPMENT

Damage to equipment (Describe)

____

____

Cost of repair or replacement________

Lost production time________Cost________

TOTAL COST OF ACCIDENT ________

PROCEDURE	Two key groups that are closely concerned with this procedure are the supervisors and the accounting office. Their cooperation should be solicited through top management before this procedure is put into effect.
SUPERVISOR'S RESPONSIBILITY	The supervisor should be made responsible for determining the accident cause, the extent of damage to machinery and tools, material, and equipment, as well as the amount of time these elements of production are not normally producing because of damage resulting from an accident.
ACCOUNTING OFFICE RESPONSIBILITY	The accounting office should be made responsible for determining the cost of damage to one or more of the elements of production as well as the cost of production units lost because of such damage.
SAFETY DEPARTMENT RESPONSIBILITY	The safety department should be charged with the responsibility of making final cumulative tabulations of accident costs. These should be discussed with management and at central and departmental safety committee meetings.
CHARGE TO EACH DEPARTMENT	The accident costs should be added to the production costs in each department.
START WITH DISABLING INJURIES	To simplify the start of such a program, it may be advisable to begin with the investigation of accidents resulting in disabling injuries. Later, when the procedure is in operation and is working successfully, it can be expanded to include the investigation of minor-injury and no-injury accidents as well.
EFFECT OF PROGRAM	A good accident cost control program creates a stronger incentive for management and supervisors to actively participate in a safety program. It also helps to place accident prevention in the proper perspective as an integral part of production and plant administration.

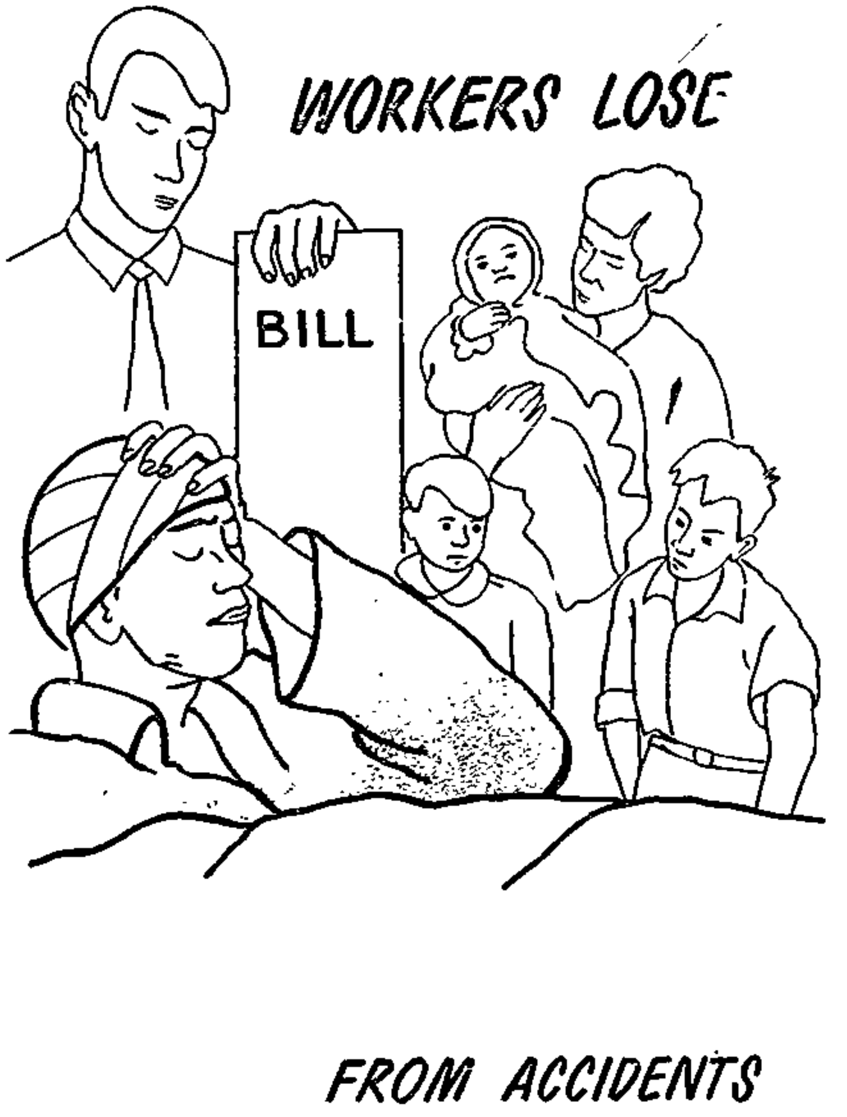

CHART 10—SERIES A

COST TO EMPLOYEE	This procedure for measuring accident costs is concerned mostly with management's costs. The employee, in addition to the physical suffering from the injuries, also loses money when accidents resulting in injuries occur. Employee's actual monetary losses are high in relation to the ability to afford the extra financial burden. Generally, an employee loses the difference between workmen's compensation payments and his regular salary. If his injury results in any permanent impairment, he may have a continuing wage -loss for the rest of his life. If the employee is injured off the job, he must pay his medical costs, and he will incur wage losses if he is unable to work because of the injury.
REDUCTION OF ALL ACCIDENT COSTS	The surest way to reduce all accident costs to employers and employees is to reduce accidents through an efficient accident control program.

Distribute paper "Accident
Cost Control."

Accident Cost Control

The need for an improvement of accident cost control systems has been recognized for many years in the United States. Many managements have a sincere humanitarian interest in their employees and their families. They, therefore, allocate some money toward the prevention of accidents without expecting a fair return for their investment. We might point out that "experience rating," which permits insurance companies to reduce workmen's compensation premiums for companies having safety programs and showing a reduction in the number of accidents, has been an important factor in the allocation of funds by industrial management for accident prevention programs. Despite this favorable position of the safety department, it cannot afford to neglect the effect of its activities on production and company profits. Competition has, in many cases, forced management to reduce overhead costs to a point where only such staff departments that show a profitable operation can be supported. It is, therefore, of primary importance that such management is aware of actual production cost reductions resulting from a safety program. In other words, a good safety program must prevent lost production and increased costs resulting from accidents.

Direct and Indirect Costs

In 1928, the American Engineering Council published a research report which resulted in the development of the direct and indirect cost concept. The compensation payments, plus the medical expense taken together, were referred to as direct costs. The indirect costs included:

1. Cost of lost time of injured employee.
2. Cost of time lost by other employees who stop work:
    a. Out of curiosity.
    b. Out of sympathy.
    c. To assist injured employee.
    d. For other reasons.
3. Cost of time lost by foremen, supervisors, or other executives as follows:
    a. Assisting injured employee.
    b. Investigating the cause of the accident.
    c. Arranging for the injured employee's production to be continued by some other employee.
    d. Selecting, training, or breaking in a new employee to replace the injured employee.
    e. Preparing State accident reports, or attending hearings before State officials.
4. Cost of time spent on the case by first-aid attendant and hospital department staff when not paid for by the insurance carrier.
5. Cost due to damage to the machine, tools, or other property or to the spoilage of material.
6. Incidental cost due to interference with production, failure to fill orders on time, loss of bonuses, payment of forfeits, and other similar causes.
7. Cost to employer under employee welfare benefit systems.

8. Cost to employer in continuing the wages of the injured employee in full after his return—even though the services of the employee (who is not yet fully recovered) may, for a time, be worth only about half of their normal value.

9. Cost due to the loss of profit on the injured employee's productivity, and on idle machines.

10. Cost that occurs in consequence of the excitement or weakened morale due to the accident.

11. Overhead cost per injured employee—the expense of light, heat, rent, and other such items, which continues while the injured employee is a nonproducer.

It was during this same period that the 4 to 1 ratio was developed. The ratio was an attempt to indicate that the indirect costs of an accident were at least 4 times as great as the direct cost of a disabling injury. The validity of this ratio has often been questioned. Subsequent studies have yielded ratios as low as 1 to 1 and as high as 20 to 1.

Recently, the terminology was changed from "direct cost and indirect cost" to "insured cost and uninsured cost," because it is felt that the latter is a more definite description of the costs and it also brings management to regard the uninsured costs with more interest. The change in terminology did not affect the content of what constituted "direct costs and indirect costs."

Generally, the feeling by industrial management has been to accept the "direct" or "insured" costs of accidents as the actual cost without regard for the "indirect" or "uninsured" costs. The reason for this reaction was due to the fact that "indirect" or "uninsured" costs were intangible in nature and could not be determined without an extensive amount of research detail. For example, it is difficult to determine the amount of time that supervisors and company executives spend in assisting an injured employee, investigating the accident, arranging for the employee's production to be continued by some other employee, selecting, training, or breaking in a new employee and preparing accident reports. These activities are conducted during the course of carrying out their job and are integrated to a degree where it is difficult to separate them. This is just one of many items that are included in the "indirect" or "uninsured" accident costs that fall into this category. It was with this problem in mind that a new, simple accident control concept was developed.

Elements of Production Concept

The concept described below has been under consideration in many countries including the United States of America and is being applied in some areas of the world. It is felt that this concept can be more successful when put into effect in plants that have an adequate safety and accounting department.

In this concept, we do not concern ourselves with such terminology as "direct costs," "indirect costs," "insured costs" or "uninsured costs," instead we use five basic factors of production which we call the elements of production. They include:

1. *Manpower*

By manpower, we mean the plant employees including workers, clerks, engineers, and other salaried employees. Injuries to these people result in lost production time and compensation and medical costs.

2. *Machinery*

This includes production machinery, machine tools, auxiliary machinery, and handtools. Accidents result in machine damage requiring repair or replacement which, in turn, results in interruptions to production. This means higher costs and lower quantity and quality production.

3. *Material*

This includes raw material, goods in process, and finished products. Accidents result in damage to material which then requires repair or replacement. This results in production interference and increased costs.

4. *Equipment*

This includes the buildings, yards, electrical power, ventilation and lighting equipment, ladders, containers for material in process, tables and chairs, and other physical equipment other than machinery that is essential to plant operations. Damages from accidents including fire and explosion result in increased costs and interference with production.

5. *Time*

Time includes production time lost because of injuries to employees, damaged machinery, equipment, and material.

Every accident damages at least one or more of the elements of production. A decrease in the number of accidents should eventually affect the unit cost of production.

When using the "Elements of Production" concept, we are concerned with accident costs as they affect production without any consideration of such terminology as "direct," "indirect," "hidden," "insured," or "uninsured." This concept has been found to be more acceptable to management. It should be recognized that this concept does not include all the items that were listed under "indirect" costs. It does, however, include such costs that are easily recognizable and more acceptable to management.

In order to derive the greatest benefit possible from a good accident cost control program, every accident, whether it results in an injury or not, should be investigated and reported. The determination as to the practicability of investigating all accidents should be made by management after a discussion of this procedure and its possible benefits.

The same form may be used for reporting all accident costs, costs of accidents resulting in disabling and minor injuries or costs of accidents resulting only in disabling injuries.

It might be desirable in some instances to start with the costs of accidents resulting in disabling injuries and as this system is used and greater experience is gained, it could be broadened to eventually include all accident costs.

Accident Cost Program Procedures

There are two key groups that can make this procedure successful or result in failure—they are the supervisor and the accounting office. It is, therefore, extremely important that top management impresses on them the importance of this procedure and its value to the plant.

The supervisor is in the best position to discover and make an immediate investigation of the accident, both for cause and for damage. He should also be instructed to notify the safety department as soon after the accident as possible about its extent and severity.

The accounting office will have to set up a separate record system for determining the cost of repairs and replacement of damaged machinery, material, and equipment and the cost of lost production time. This will enable them to complete the form that was originally started by the supervisor. The form should then be submitted to the safety department for final and cumulative tabulation. The safety department can compile the reports for scheduled periods and issue compiled copies to management and each departmental supervisor. Accident costs should be discussed as a regular agenda item during departmental safety committee and central safety committee meetings.

The cost of accidents should be charged back to each department and included as an item in the unit cost production within that department.

Such an accident cost control procedure will create a greater incentive for all levels of management and supervision to participate in an accident control program for direct benefits to management and labor. should assist in putting an accident prevention program in the proper perspective where the production and administration of a plant are concerned.

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Appraising Safety Performance. (Safety in Industry, Instructor Outline).

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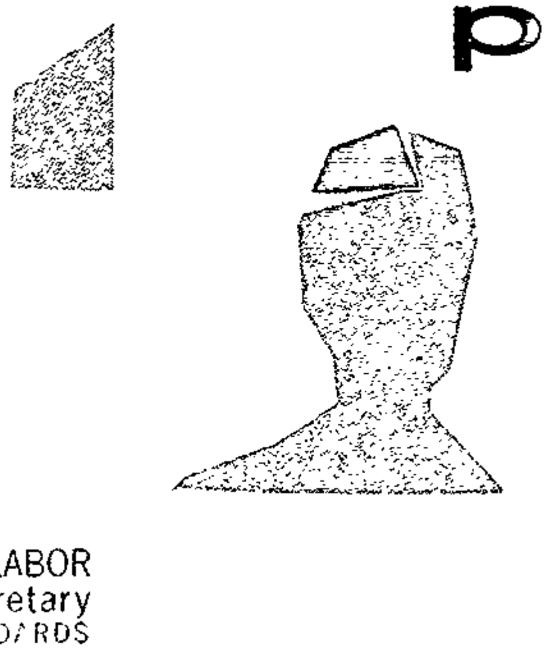
*SAFETY, *INDUSTRY, *CURRICULUM GUIDES, *INDUSTRIAL EDUCATION, ACCIDENTS, INJURIES, *PROGRAM EVALUATION,

The course is concerned with appraising the effectiveness of the safety program and the quality of the safety performance in industry. This instructor outline is intended only as a guide to standard presentation of the subject in sequence and basic content. Additional information, material, and illustrations should be included. Content includes use of records, use of injury rates, frequency rate definition, frequency rate computation, severity rate definition, and use of time charges, severity rate computation, and other methods of appraisal. The outline was developed by staff of the Office of Occupational Safety and the International Division, Bureau of Labor Standards, U.S. Department of Labor. This document is available as GPO L16.3--269 for 20 cents from Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402. (PS)

SAFETY IN INDUSTRY
INSTRUCTOR OUTLINE

appraising safety performance



. DEPARTMENT OF LABOR
Willard Wirtz, Secretary
EAU OF LABOR STANDARDS
son M. Bortz, Director

Bulletin 269

This instructor outline is one of a series developed by staff of the Office of Occupational Safety and the International Division, Bureau of Labor Standards, U.S. Department of Labor.

The outline is intended only as a guide to standard presentation of the subject in sequence and basic content. Additional information, material, and illustrations should be included for a complete presentation suitable to the conditions, locality, industry, or occupational group.

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SAFETY TRAINING TECHNIQUES

It is of utmost importance that the instructor become acquainted with some of the basic training techniques in order to better prepare himself to conduct the course successfully.

Planning

1. The instructor should have such visual aids as are pertinent to the subject matter of the course. These should be set up in proper sequence. An indication or note on the instructor's outline could be very helpful as a guide that a particular visual aid should be used.
2. The course outline as well as the handout material and the visual aids should be checked at regular intervals. This should be done by the instructor in order to revise, improve, and modernize the course presentation. The material should also be checked to make sure that it conforms with policies of labor and management in the country where it will be presented.
3. The instructor's outline should be adapted by him to his particular method of presentation, keeping in mind that this is a discussion conference type of session.
4. The instructor would do well to get an advance list of the students that will participate and their positions and backgrounds. A study of such information could be very helpful to the instructor when he faces his class.

Preparation of Classroom

Many conferences and courses have failed simply because no preparation was made for the classroom facilities.

1. The classroom should be located in an area where there is the least amount of noise or distraction.
2. Good ventilation, lignting, and sufficient room are important aspects to consider.
3. The seating arrangement and seats should be comfortable as well as informal. A round-table seating arrangement is the most effective for discussion-conference sessions.
4. The room should be equipped with a good blackboard, sufficient chalk, and a clean eraser. A stand should be available for mounting the charts and visual aids to be used during the conference. A 35-mm. slide projector should be available.

Teaching

1. An official of the organization should open the first session with a statement regarding the general objectives of the course. He then should introduce the instructor to give him the proper posture in relation to the group he will teach.

2. At the first session, the instructor should open with an explanation of the course objectives and its method of presentation. At this time, he should draw upon his experiences to relate an illustrative incident that will bring him in closer relationship with the group and, at the same time, enable him to introduce the theme of the first session.

3. The course should be presented by employing the discussion-conference method.

4. The instructor should have the class follow a predetermined schedule and maintain order at all times. Only one participant should be permitted to give his viewpoint at a time. The instructor should keep the class discussion within the subject matter as contained in the instructor's outline.

5. If possible, an official should be asked to speak at the termination of the course.

Tips for Instructors

Learning is actually the acquisition of new ideas, abilities, and skills acquired through the senses of hearing, seeing, and feeling by touch.

1. New ideas are conveyed through the presentation of knowledge, and thought is stimulated through the student's sense of hearing.

Abilities and skills are presented through the media of telling, demonstrating, and having students demonstrate under the supervision of the instructor. Students acquire abilities and skills via the senses of hearing, seeing, and feeling by touch.

2. An important aspect of teaching is to remember that the student absorbs more when he participates in a discussion. The instructor therefore strives to get 100-percent class participation.

3. The instructor should become aware of outstanding characteristics of his students. This could be very helpful when leading discussions. For example:

   A. Some may be more mature.

   B. Some may have a knowledge of safety.

   C. Some may have actual experience to draw on in the discussion.

   D. Some may have a faster learning speed than others.

E. Some may b scussion.

F. Others may e the discussion.

G. There may b must be properly contr

H. Some may be c ns about previous discus

4. The teaching proce

A. Telling—this n ation to introduce a sub

B. Showing—a den taining to the subject t

C. Illustrating—usi ms are very helpful to h ssion.

D. Discussion confe dents in formulating th r dis- cussion is funda f the session.

E. Conclusions—the ssion should knit togeth ses- sion, and should in may have been overlook

F. Questions—during use questions to stimul ing the discussion back ed.

Guest I

It is necessary that the instr for conduct of the class; at times, expert in a particular field as a such event, it is essential that the course.

The instructor must tie in the the balance of the course; he must be covered by the guest and satisfy self to the field as outlined; he shoul tion, pointing out its relative import vention. While the use of a few gue can add to the effectiveness of the co topics are not correlated will inevita

It is recommended that "guest e *mentary* training, and not to replace should be taught by *one instructor*.

APPRAISING SAFETY PERFORMANCE

Apr

ety progra

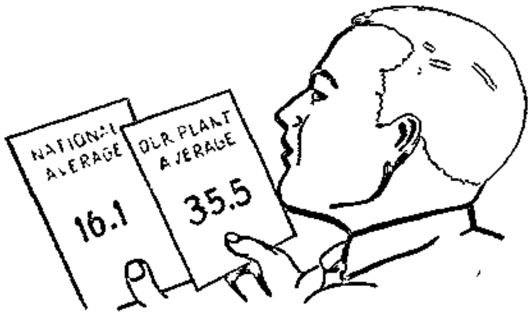
ce with the standard method, the safe
the safety director with information on the
contribute most to high rates of injuries.

Use board to develop with class how records m
be used.

RECORDS MAY BE USED TO—

1. Cr amor pervisors by furnishing them with
injur ormation about their departments.
ne prin accident sources.
vide s sors and safety committees with information.
Pro mparisons with experience of similar organizations.

SHOWS SERVICE NEEDS



MEASURES PERFORMANCE

CHART 11—SERIES A

USE OF INJURY RATES

1. To measure safety performance and indicate servic
2. To compare present with past performance and similar plants, operations, etc.

nt shou
ade e
est in

STANDARD METHOD SHOULD BE USED

Comparisons from plant to plant are possible only when uses the same measure.

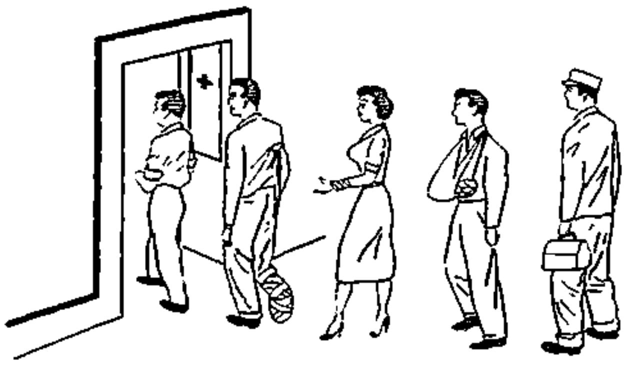
The American Standards Association
Standard

FREQUENCY RATE DEFINED

AS THE NUMBER OF DISABLING INJURIES PER MILLION EMPLOYEE-HOURS WORKED

FORMULA

$$F = \frac{\text{NUMBER OF DISABLING INJURIES} \times 1{,}000{,}000}{\text{NUMBER OF EMPLOYEE-HOURS WORKED}}$$



DISABLING INJURIES

CHART 12—SERIES A

FREQUENCY RATE	
USED TO DETERMINE:	1. Whether the comparative number of work injuries in an operating unit is fewer or greater than in other operating units in the same industry or in other operations having similar hazards. 2. Whether a given operating unit is having fewer or more injuries this year or this month than it had last year or last month. 3. Whether an industry has a better or worse accident experience than similar industries, or than the average for all similar industries.
FORMULA FOR COMPUTATION	Expressed as the number of disabling injuries multiplied by 1 million and divided by the total number of man-hours worked. This formula provides what is known as "the frequency rate of disabling injuries" or the number of disabling injuries per 1 million man-hours of exposure.

Use blackboard to develop this formula.

EXAMPLES:	FREQUENCY RATE = $\frac{\text{Number of disabling injuries} \times 1{,}000{,}000}{\text{Number of employee-hours worked}}$ Plant A had 10 injuries and worked 200,000 man-hours during 1 year. Using the above formula, we would have a frequency rate of 50 disabling injuries per million man-hours worked. FREQUENCY = $\frac{10 \times 1{,}000{,}000}{200{,}000} = 50.0$
DISABLING INJURY DEFINED	A disabling injury is one which results in death or permanent body impairment or which renders the injured person unable to perform a regularly established job that is open and available to him during the entire time interval corresponding to the hours of his regular shift on any one or more days subsequent to the day of the injury.

Make particular stress

EXPOSURE	Man-hours is the total hours worked by all employees—men and/or women.
THE FIGURE 1,000,000	The use of 1 million as a unit of exposure is for convenience and is accepted as standard. It is also a means of stability. Equals 500 persons working 1 year.
TIME ELEMENT	Definition of his next regular shift.

Distribute "Frequency Rate Work Sheet."
Discuss with class. Work out problems.

U. S. DEPARTMENT OF LABOR
Bureau of Labor Standards
Washington, D. C. 20210

FREQUENCY-RATE COMPUTATION

1. Plant "A" worked 103,000 man-hours during the month of January, 95,000 during February, and 131,000 during March. The number of disabling injuries totaled seven for January, four for February, and five for March. Using the standard formula, compute the cumulative frequency rate for the 3 months.

Answer____________________

2. Plant "B" had 500 employees during the month of July. They worked a total of 108,000 hours for the month. During this month, there were 15 first-aid cases and 5 disabling injuries. Using the standard formula, compute the frequency rate for the month of July.

Answer____________________

3. Plant "C" has 500 employees working an average of 8 hours per day. There are 20 working days in the month. (a) Find the estimated hours worked. If there were five disabling injuries during the month. (b) Compute the frequency rate.

Answer (a)--- ------------------- (b)----------------------

4. Plant "D" had 625 employees who worked 40 hours a week for 50 weeks during the year. They had 17 disabling injuries. Compute the man-hours and the frequency rate.

Man-hours---------------------- Frequency----------------------

5. Plant "E" had 500 employees throughout the year. The frequency rate for the first 6 months was 15.0 and for the last half of the year was 15.0. What was the frequency rate for the year?

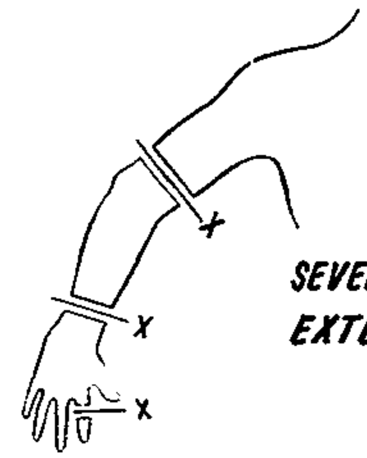
Answer--------------------

SEVERITY RATE DEFINED

AS THE ACTUAL TIME LOST (DAYS)
PER MILLION EMPLOYEE·HOURS WORKED

FORMULA

$$S = \frac{\text{TOTAL DAYS LOST} \times 1{,}000{,}000}{\text{NUMBER OF EMPLOYEE HOURS WORKED}}$$



SEVERITY RATE =
EXTENT OF INJURY

CHART 13—SERIES A

SEVERITY RATE	
USED TO DETERMINE	The severity rate should be used with discretion since only under certain conditions can it be used as a satisfactory gauge of the seriousness of injuries, provided the base is of a sufficient number, preferably 1,000 injuries or more. The smaller the exposure on which the rate is based, the greater the need for supplemental evidence obtained by analysis of the accident record, operating conditions, and the types of hazards involved.
DEFINITION	Number of days lost and/or charged per 1 million man-hours worked.

Place formula on board and work some problems; explain and clarify each step.

FORMULA	Severity Rate $= \frac{\text{Total days lost and/or charged} \times 1{,}000{,}000}{\text{Man-hours of exposure}}$
DAYS LOST	Sum of all days lost by disabling injuries except those in which there is some permanent disability.
DAYS CHARGED	Days charged for death, permanent total, or partial disability are taken from the "Table of Standard Time Charges." When there is any permanent disability, the actual days lost are not used.

WHEN TO USE TIME CHARGES

X *DEATH*

X *PERMANENT TOTAL DISABILITY*

X *PERMANENT PARTIAL DISABILITY*

TEMPORARY TOTAL DISABILITY

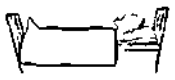


CHART 14—SERIES A

USE OF TIME CHARGES	
REASON	When there is a continuing disability such as a stiff leg, a lost finger, or a lost eye, the actual loss of time while the injury is healing is not an adequate measure of its seriousness. Therefore, an ASA standard schedule of time-loss charges has been agreed upon for all permanent injuries in the United States.
DEATH	Deaths resulting from work injuries shall be assigned a time charge of 6,000 days each.
PERMANENT-TOTAL DISABILITY	Permanent-total disability is assigned a time charge of 6,000 days because the insured's useful, industrial life is ended.
PERMANENT-PARTIAL DISABILITY	Functioning of some part of worker's body has been lost or impaired permanently.
TEMPORARY-TOTAL DISABILITY	Worker is totally disabled for work during a temporary period of time. Time charges are not used in this case; instead, the actual days lost are used.

Have class compute severity rates involving different combinations.

U. S. DEPARTMENT OF LABOR
Bureau of Labor Standards
Washington, D. C. 20210

STUDENT WORK SHEET

INJURY-SEVERITY RATE COMPUTATION

1. Plant "A" worked 108,000 man-hours. During this time, they had 11 disabling injuries, totaling 90 days' lost time. Compute the injury-severity rate.

   Answer______________ ______

2. The injury-severity rate for a plant having 10 injuries and causing 200 days lost in 200,000 hours worked would be—

   Answer______________________

3. A plant worked a total of 900,000 man-hours during a 6-month period. During this period, it had the following injuries:

   15 first-aid cases_____________________ __________no days lost
   3 permanent-partial cases_______________________3,150 days' time charged
   22 temporary-total disabilities____________________150 days lost

   Find the injury-severity rate for the 6-month period.

   Answer______________________

4. During 1 year, a plant operating 40 hours a week had 765 men. The plant had the following injuries:

   16 first-aid cases
   7 temporary totals__________64 days lost
   1 loss of thumb and two fingers, same hand
   1 loss of hearing, one ear__________lost 11 days
   1 loss of leg, below the knee.

   Compute the injury-severity rate.

   Answer______________________

OTHER METHODS OF APPRAISAL	
HOUSEKEEPING	Poor housekeeping is a major factor in accident causation: good housekeeping is a major factor in the efficient production of goods of high quality. The relationship is so close that it can safely be said that a management's standard of housekeeping is an excellent guage of its competency.
MACHINE GUARDING	The attention paid to the safeguarding of machinery furnishes a valuable clue to management's knowledge and backing of accident prevention.
MAINTENANCE	The condition of all equipment, safeguards, etc., which is essential to worker safety is a valuable guide to the probability of injury.
SAFETY EQUIPMENT	In every establishment or undertaking, there are activities or conditions for which specific equipment is essential to worker safety.
PROVISIONS FOR WORKER COMFORT	The provisions made for the comfort of the workers in a plant are strongly indicative of management's concern.
SAFETY TRAINING PROGRAM	Training in safe work practices is an essential to good safety performance.
SUMMARIZATION	"Frequency" means the number of disabling injuries. "Severity" means the seriousness of these injuries. There are other means of appraising a safety program in addition to frequency and severity.

Distribute occupational safety aid "How To Compute Injury Rates."

OCCUPATIONAL SAFETY AID

HOW TO COMPUTE INJURY RATES

(Frequency and Severity Rates)

Injury frequency and severity rates are important because they enable a company or operating unit to determine how effectively its employee injury problem is being met, and what progress is being made.

To accomplish this, a standard method of computing these rates is utilized, which adjusts for differences in size of operating units and other variables. This method is included in Standard Z16.1-1954 of the American Standards Association, entitled "American Standard Method of Recording and Measuring Work Injury Experience." It is widely accepted and used by industry.

Bulletins showing the monthly and annual frequency and severity rates of individual industries are issued periodically by the U.S. Department of Labor's Bureau of Labor Statistics.

INJURY-FREQUENCY RATES

INJURY-FREQUENCY RATES give a measure of how often a work-connected disabling injury happens. The ASA defines frequency rate as "The number of disabling injuries per million employee hours of exposure." The rates are used to determine:

(1) whether the number of work injuries in any particular operating unit is lesser or greater than in other operating units in the same industry;

(2) whether a given operating unit is having more or less injuries when compared to a previous period of time and similar operations;

(3) whether an industry has a better or worse injury experience than other industries, or than the average for all industries.

For example, let us assume an operating unit had an injury frequency rate of 9.8 disabling injuries per million man-hours worked, for this year. If the frequency was 10.5 last year, and 11.8 the year before, the 9.8 rate this year would indicate the injury experience is improving.

If the average frequency for this industry this year was 10.1, the injury experience of the unit with 9.8 frequency is slightly better than the average for other operating units having similar hazards. However, this industry frequency is an average made up of some units having frequencies much higher than 10.1, and of some other units having frequencies extending considerably below 10.1. In fact some industries have a number of plants which operate at or close to a zero frequency.

U.S. DEPARTMENT OF LABOR
Bureau of Labor Standards

This means that although the unit with the 9.8 frequency is slightly better than the average for the industry, there are still many other units in the industry having similar hazards, that have better frequency rates. Consequently, the injury experience is still not as good as it should be, and the use of better or additional safety measures for further reduction of accidental injury occurrence should be considered.

THE NUMBER OF DISABLING INJURIES and the MAN-HOURS OF EXPOSURE are needed for computing the injury frequency rate.

DEFINITIONS:

The DISABLING injury is a work injury that results in:

A. Death.
B. Permanent Total Disability.
C. Permanent Partial Disability.
D. Temporary Total Disability.

DEATH is any fatality resulting from a work injury, regardless of the time intervening between the injuty and death.

A PERMANENT TOTAL DISABILITY is any injuty, other than death, which permanently and totally incapacitates an employee from following any gainful occupation, or which results in the loss of, or the complete loss of the use of, any of the following in one accident:

A. Both eyes.
B. One eye and one hand, or arm, or leg, or foot.
C. Any two of the following: hand, arm, foot, or leg.

A PERMANENT PARTIAL DISABILITY is any injury other than death or permanent total disability which results in the complete loss of use of any member or part of a member of the body, or any permanent impairment of functions of the body or part thereof, regardless of any preexisting disability of the injured member or impaired body function.

A TEMPORARY TOTAL DISABILITY is any injury which does not result in death or permanent impairment, but which renders the injured person unable to perform a regularly established job which is open and available to him during the entire time interval corresponding to the hours of his regular shift on any one or more days (including Sundays, days off, or plant shutdowns) subsequent to the date of injury.

A MEDICAL TREATMENT (OR FIRST AID) injury is one which does not result in death, permanent impairment, or temporary total disability, but which requires medical treatment (including first aid).

MAN-HOURS OF EXPOSURE is the total number of employee-hours worked by all employees of the operation involved for the given period of time.

INJURY-FREQUENCY RATE COMPUTATION

First step: GATHER THE INFORMATION

1. Obtain the number of employee-hours of exposure.
2. Obtain the number of Disabling Injuries that occurred during the period of time covered by the employee hours.

It is important that both of these figures be taken from actual records of the plant or industry. Estimates of either can make the final rate only slightly better than a guess. Hours of exposure should be taken from payroll or time records. If an estimate of exposure MUST be made the best yearly estimate is obtained by multiplying the number of employees by 2,000 in the case of a 40-hour week. Suitable adjustment can be made for a shorter or longer workweek. Attempts to adjust for overtime or part-time employment should be avoided unless actual records are available. Absenteeism would likely balance these exposures.

The number of disabling injuries should be obtained from injury reports or similar records.

Second step: CALCULATE THE INJURY-FREQUENCY RATE

Use the above information and the following formula to calculate the injury-frequency rate:

$$\text{Injury-Frequency Rate} = \frac{\text{Number of Disabling Injuries} \times 1{,}000{,}000}{\text{Total Number of Man-Hours of Exposure}}$$

EXAMPLE: In one year there were 8 Disabling Injuries and 1,500,000 man-hours worked

$$\text{Injury-Frequency Rate} = \frac{8\ (\text{Disabling Injuries}) \times 1{,}000{,}000}{1{,}500{,}000\ (\text{Man-Hours of Exposure})}$$

$$\text{or: } \frac{8{,}000{,}000}{1{,}500{,}000} = 5.33$$

Injury-Frequency Rate is 5.33

INJURY-SEVERITY RATE COMPUTATION

The INJURY SEVERITY RATE is a measure of how serious the disabling injuries were. It is defined by ASA as "The average number of days per million hours of employee-exposure." In the case of death or permanent disablement the number of days should be taken from the standard scale of time charges and the actual absence should be disregarded.

First step: GATHER THE INFORMATION

1. Obtain the Man-Hours of Exposure by the same method used for computing Injury-Frequency Rates.

2. Obtain total days lost due to injuries, for the corresponding period of Man-Hours Exposure. This figure may be obtained from the employee injury record.

(Note that death and certain kinds of permanently disabling injuries are arbitrarily assigned a specific time charge in number of days regardless of the time the employee actually was absent from the job. See "Scale of Time Charges," (below) and American Standard Z16.1-1954.)

Second step: CALCULATE THE INJURY-SEVERITY RATE

The formula for computing Injury-Severity Rate is as follows:

$$\text{Injury-Severity Rate} = \frac{\text{Total Days Lost, plus time charges} \times 1{,}000{,}000}{\text{Total Number of Man-Hours of Exposure}}$$

Scale of Time Charges (in days)
(From ASA Standard Z16.1-1954)

Death	6,000
Permanent total disability	6,000

Amputation involving all or part of bone	Thumb	Fingers				Great toe	Each of other toes
		Index	Middle	Ring	Little		
Distal Phalange	300	100	75	60	50	150	35
Middle Phalange		200	150	120	100		75
Proximal Phalange	600	400	300	240	200	300	150
Metacarpal/Metatarsal	900	600	500	450	400	600	350

Hand at the wrist	3,000
Foot at the ankle	2,400
Any part of arm above elbow including shoulder joint	4,500
Any point above the wrist and at or below the elbow	3,600
Any point above the knee	4,500
Any point above the ankle and at or below the knee	3,000

-- **Impairment of function** --

One eye (loss of sight) regardless of sight in other eye	1,800
Both eyes (loss of sight) in one accident	6,000
One ear (complete industrial loss of hearing) irrespective of hearing in the other ear	600
Both ears (complete industrial loss of hearing) one accident	3,000
Unrepaired hernia	50

For complete details regarding loss of use without amputation see scheduled charges in A.S.A. report Z16.1-1954 available from the American Standards Association, Inc., 10 East 40th Street, New York 17, N. Y.

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Basic Principles of Machinery Safeguarding. (Safety in Industry,
Instructor Outline).

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*SAFETY EQUIPMENT, *INDUSTRY, *CURRICULUM GUIDES, *INDUSTRIAL EDUCATION, *SAFETY,

It is management's responsibility to provide adequate machine safeguarding to protect the employee. Such safeguarding should also protect the machine from damage as well as prevent loss of production. Basic principles of machine safeguarding are illustrated by means of charts. This instructor's outline provides a guide to standard presentation of the course in sequence and basic content. Additional information, materials, and illustrations should be included. Content includes why and where guards are needed, guard requirements, reasons for making and buying guards, design of guards, basic guard types, hazard control, and mechanical and operational hazards. This outline was developed by staff of the Office of Occupational Safety and the International Division, Bureau of Labor Standards, U.S. Department of Labor. This document is available as GPO L16.3--276 for 40 cents from Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402. (PS)

b.

This instructor outline is one of a series developed by staff of the Office of Occupational Safety and the International Division, Bureau of Labor Standards, U.S. Department of Labor.

The outline is intended only as a guide to standard presentation of the subject in sequence and basic content. Additional information, material, and illustrations should be included for a complete presentation suitable to the conditions, locality, industry, or occupational group.

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SAFETY TRAINING TECHNIQUES

It is of utmost importance that the instructor become acquainted with some of the basic training techniques in order to better prepare himself to conduct the course successfully.

Planning

1. The instructor should have such visual aids as are pertinent to the subject matter of the course. These should be set up in proper sequence. An indication or note on the instructor's outline could be very helpful as a guide that a particular visual aid should be used.

2. The course outline as well as the handout material and the visual aids should be checked at regular intervals. This should be done by the instructor in order to revise, improve, and modernize the course presentation. The material should also be checked to make sure that it conforms with policies of labor and management in the country where it will be presented.

3. The instructor's outline should be adapted by him to his particular method of presentation, keeping in mind that this is a discussion conference type of session.

4. The instructor would do well to get an advance list of the students that will participate and their positions and backgrounds. A study of such information could be very helpful to the instructor when he faces his class.

Preparation of Classroom

Many conferences and courses have failed simply because no preparation was made for the classroom facilities.

1. The classroom should be located in an area where there is the least amount of noise or distraction.

2. Good ventilation, lighting, and sufficient room are important aspects to consider.

3. The seating arrangement and seats should be comfortable as well as informal. A round-table seating arrangement is the most effective for discussion-conference sessions.

4. The room should be equipped with a good blackboard, sufficient chalk, and a clean eraser. A stand should be available for mounting the charts and visual aids to be used during the conference. A 35-mm. slide projector should be available.

Teaching

1. An official of the organization should open the first session with a statement regarding the general objectives of the course. He should then introduce the instructor to give him the proper posture in relation to the group he will teach.

2. At the first session, the instructor should open with an explanation of the course objectives and its method of presentation. At this time, he should draw upon his experience to relate an illustrative incident that will bring him in closer relationship with the group and, at the same time, enable him to introduce the theme of the first session.

3. The course should be presented by employing the discussion-conference method.

4. The instructor should have the class follow a predetermined schedule and maintain order at all times. Only one participant should be permitted to give his viewpoint at a time. The instructor should keep the class discussion within the subject matter as contained in the instructor's outline.

5. If possible, an official should be asked to speak at the termination of the course.

Tips for Instructors

Learning is actually the acquisition of new ideas, abilities, and skills acquired through the senses of hearing, seeing, and feeling by touch.

1. New ideas are conveyed through the presentation of knowledge, and thought is stimulated through the student's sense of hearing.

Abilities and skills are presented through the media of telling, demonstrating, and having students demonstrate under the supervision of the instructor. Students acquire abilities and skills via the senses of hearing, seeing, and feeling by touch.

2. An important aspect of teaching is to remember that the student absorbs more when he participates in a discussion. The instructor, therefore, strives to get 100-percent class participation.

3. The instructor should become aware of outstanding characteristics of his students. This could be very helpful when leading discussions. For example:

A. Some may be more mature.
B. Some may have a knowledge of safety.
C. Some may have actual experience to draw on in the discussion.
D. Some may have a faster learning speed than others.
E. Some may be "stallers" who can slow down the discussion.
F. Others may be aggressive and want to monopolize the discussion.
G. There may be a "know-it-all" in the group who must be properly controlled.
H. Some may be constant latecomers who ask questions about previous discussions and delay the class.

4. The teaching process consists of:
   - A. Telling—this means giving background information to introduce a subject.
   - B. Showing—a demonstration of some equipment pertaining to the subject to be discussed is very impressive.
   - C. Illustrating—using charts, blackboard, slides, or films is very helpful to highlight specific points in the discussion.
   - D. Discussion Conference—the participation of the students in formulating their thinking about the subject under discussion is fundamental to getting the most out of the session.
   - E. Conclusions—the instructor's summation of the session should knit together the points discussed during the session, and should include other important details that may have been overlooked by the group.
   - F. Questions—during the session, the instructor should use questions to stimulate discussion, and also to help bring the discussion back to the subject matter if it has strayed.

Guest Instructors

It is necessary that the instructor be granted full responsibility for conduct of the class; at times, however, he may wish to call in an expert in a particular field as a guest instructor (or lecturer). In such event, it is essential that the instructor maintain control of the course.

The instructor must tie in the work of the guest instructor with the balance of the course; he must outline the phase of the subject to be covered by the guest and satisfy himself that the guest limits himself to the field as outlined; he should summarize the guest's contribution, pointing out its relative importance in the field of accident prevention. While the use of a few guest instructors (properly utilized) can add to the effectiveness of the course, a series of "lecturers" whose topics are not correlated will inevitably result in confusion.

It is recommended that "guest experts" be used only for *supplementary* training, and not to replace even part of this course which should be taught by *one instructor.*

BASIC PRINCIPLES OF MACHINERY SAFEGUARDING

Basic Principles of Machine Safeguarding

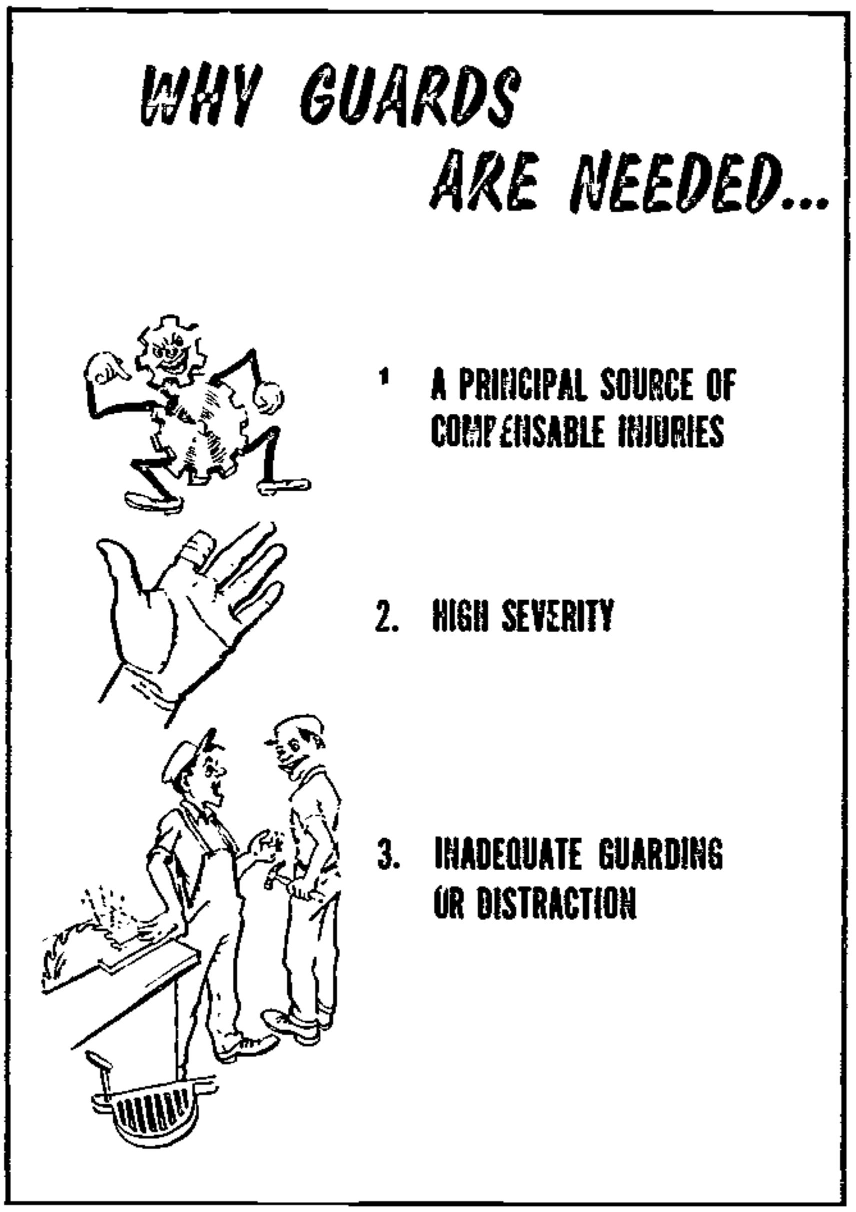


CHART 1—SERIES E

WHY GUARDS ARE NEEDED	
HIGH SOURCE OF INJURY	The National Safety Council estimates that 10 to 15 percent of all occupational injuries involve machinery and other power-operated equipment (excluding vehicles).
HIGH SEVERITY	The National Safety Council estimates that 19.2 percent of the compensable work injuries with permanent-partial disability involved machinery; 3.1 percent of the work-injury fatalities involved machinery.
INADEQUATE GUARDING OR DISTRACTION	It is management's responsibility to provide adequate machine safeguarding to protect the employee—even when he is distracted. Such safeguarding should also protect the machine from damage as well as prevent loss of production.

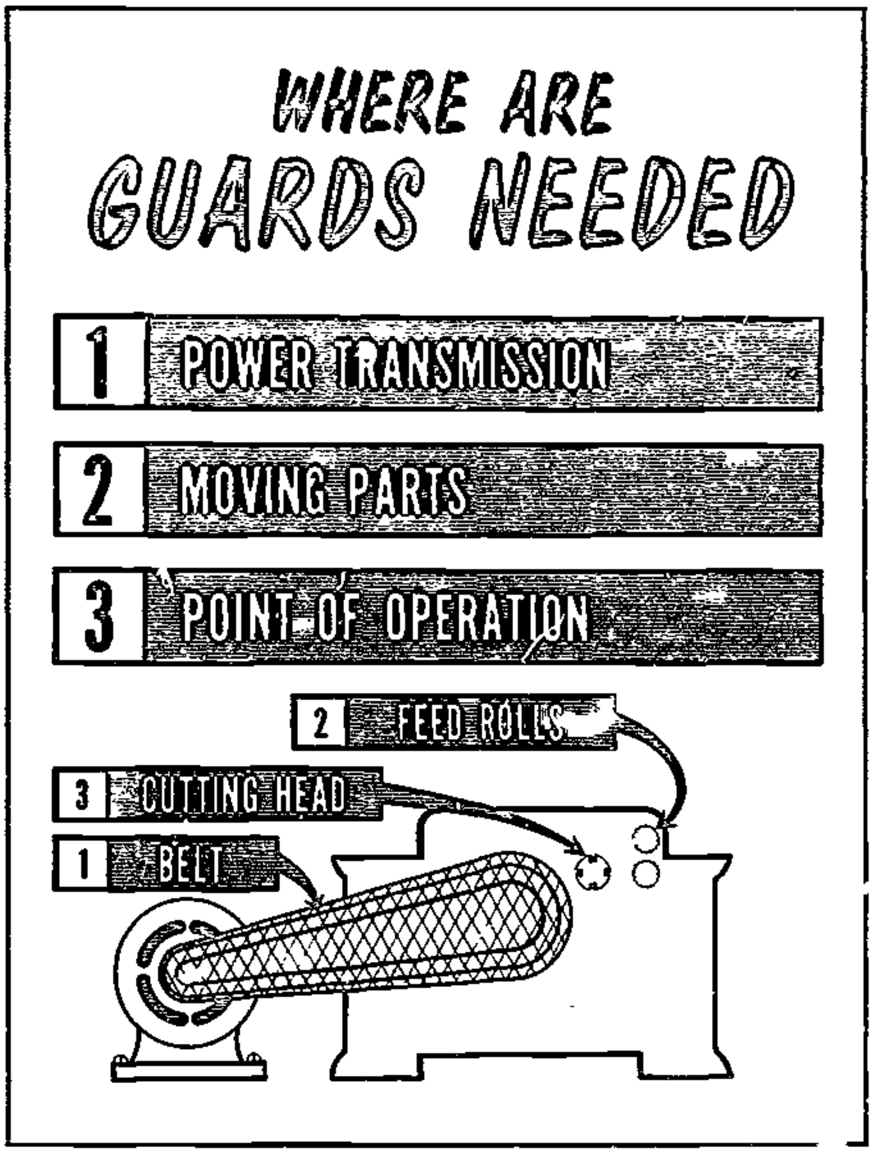


CHART 2—SERIES E

WHERE GUARDS ARE NEEDED	
POWER TRANSMISSION	This is the initial transfer of power from the motor to the machine. Mechanical power transmission apparatus includes shafting, flywheels, pulleys, belts, connecting rods, couplings, spindles, cranks, gears, etc.
MOVING PARTS	This constitutes the secondary transfer of power from the initial power transmission apparatus to the point of operation. Moving parts include reciprocating and rotating parts, cams, clutches, etc. They also include feed rolls and auxiliary parts that do not transfer power but are moving parts of the machine.
POINT OF OPERATION	This is that part of the machine where the material meets the machine. Here, the material is changed from one form to another; e.g., cutting, turning, shaping, stamping, etc.

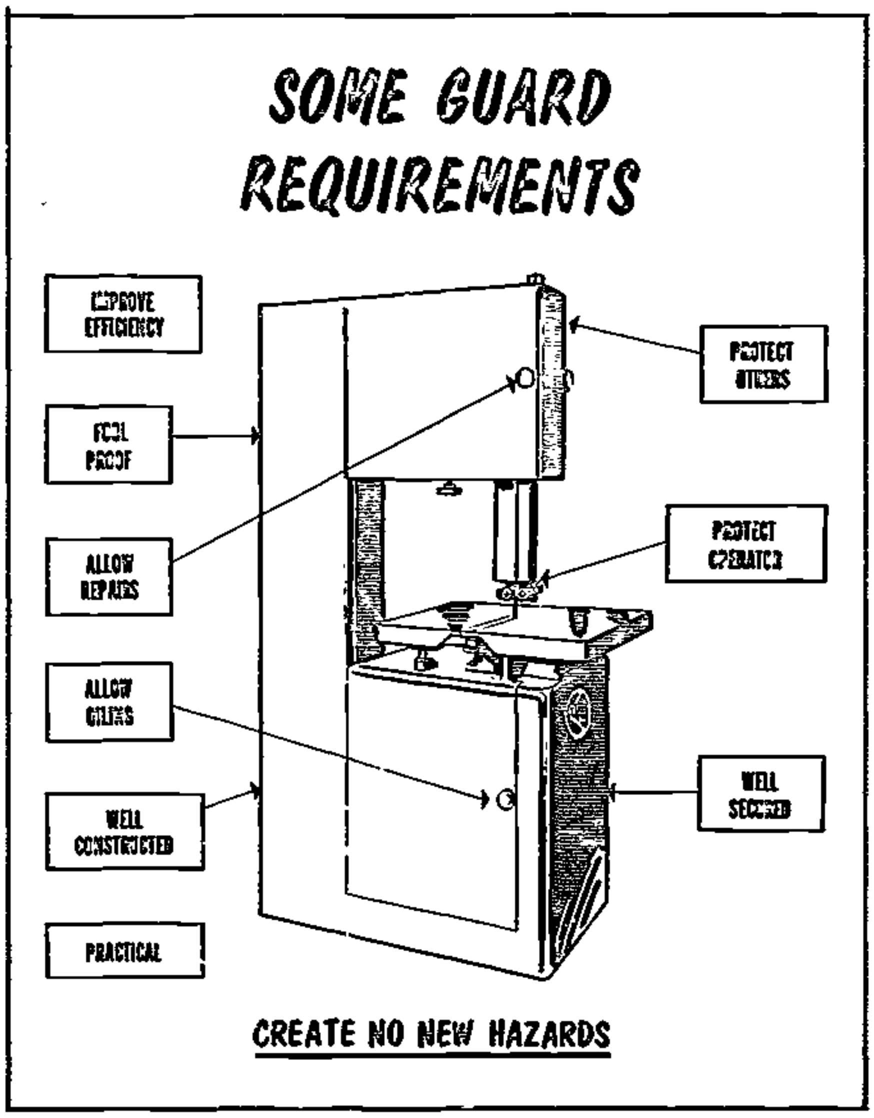


CHART 3—SERIES E

SOME GUARD REQUIREMENTS	Good engineering principles should be applied to the design and construction of each machine in order to eliminate hazards and to permit safe and efficient operation. When this is not possible or in cases where the machine is to be installed, then suitable safeguards should be provided.
PROTECT OPERATOR	The most important function of machine guarding is to protect the operator. This protection must be positive and as nearly as possible should control or eliminate the hazard.
PROTECT OTHERS	Personnel not working directly on a machine but working close to or passing by it should be protected against their coming in contact with machine hazards.
IMPROVE EFFICIENCY	Guards should be so designed and installed as not to interfere with production nor reduce or affect in any way the operator's efficiency. Good guarding gives the operator a sense of security from injury, enabling him to work with less tension and with greater ease of operation.
FOOLPROOF	Guards should be so constructed that their purpose and use are evident, even to the most uninformed worker, and their design and construction should be such that they resist tampering or easy removal.

ALLOW REPAIRS	Provision should be made for adjusting and making repairs on machine parts which are enclosed by guards without exposing personnel to the moving parts.
ALLOW OILING	Provision should be made for lubricating machines without removing the guards. Whenever possible, oil reservoirs should be located outside the guard, with the oil line leading to the point of lubrication.
PRACTICAL	All guards should have a practical application and should not interfere with the operation of the machine.
WELL CONSTRUCTED	Guards should be made of material substantial enough to withstand all conditions and made of quality at least equal to the materials in any other part of the machine.
WELL SECURED	Guards should be not only constructed but well secured so that any blow to, or vibration of, the machine will not cause the guards to work loose or break and fall into or off the area being guarded.
CREATE NO NEW HAZARDS	In the construction of guards, we must make sure that the guards themselves do not create a hazard. Shear points, sharp edges, exposed bolts, or jagged or unfinished surfaces can cause cuts and lacerations. All edges should be rolled and bolted in such a way as to reduce sharp edges and corners to a minimum.

REASONS FOR

MAKING GUARDS

FIT OLDER TYPE MACHINERY
FIT NON STANDARD MACHINES
USE OF OWN IDEAS

BUYING GUARDS

COMPLEX MACHINERY
INTERLOCKS
BETTER DESIGN
PART OF MACHINE

CHART 4—SERIES E

MAKING GUARDS	
TO FIT OLDER MACHINERY	Many industries, particularly smaller ones, may be using an older type machine which, though still serviceable, is not adequately guarded and for which guards cannot be purchased because of the machine's age. Oftentimes, they cannot be replaced by newer, modern type, guard-equipped machines, because the purchase of machinery generally is considered a capital expense which is closely budgeted. It then becomes necessary for guards to be designed and built locally.
TO FIT NON-STANDARD MACHINES	Machines in use by many industries are standard-type machines that have been converted or equipped to perform a special function. At time of purchase, the machine may or may not have been equipped with guards. However, its special use precludes the use of a standard type guard; therefore, guards must be designed and built locally to provide adequate protection for the operator.
USE OF OWN IDEAS	Foremen, maintenance personnel, and workers alike should be encouraged to use or submit their own ideas as to the design and construction of locally made guards. It should be pointed out, however, that these

designs and the construction should conform to the standards of the American Standards Association or to the State inspection department having jurisdiction.

BUYING GUARDS

COMPLEX MACHINERY

When machinery is purchased, guards should be included with the machine. It should be clearly specified in the purchase contract that the guards will meet the standards of the American Standards Association or the State or country inspection specifications.

INTERLOCKS

When guards are purchased with the machine from the manufacturer, interlocks are or can be designed and built into the machine to cover all hazardous parts. Thus, anytime the guard is open, removed, or malfunctions, the machine will stop automatically and cannot be restarted until the guard is returned to its proper position. An interlocking guard must satisfy three requirements:

1. It must guard the dangerous part before the machine can be operated.
2. It must stay closed until the dangerous part is at rest.
3. It must prevent operation of the machine if the interlocking device fails.

BETTER DESIGN

Guards for a particular machine, obtainable through the manufacturer, are the result of research and design by specialists. Therefore, it is almost impossible for the user to design a guard or possess a design that will meet specifications for a specific machine.

PART OF MACHINE

Guards designed and built by the manufacturer are generally designed and constructed so that they are not only an improvement on the appearance of the machine but are also functional. For example: sometimes the guards may be a part of the exhaust system, serve as a part of the oil or grease system, or provide hand or foot rests for the operator.

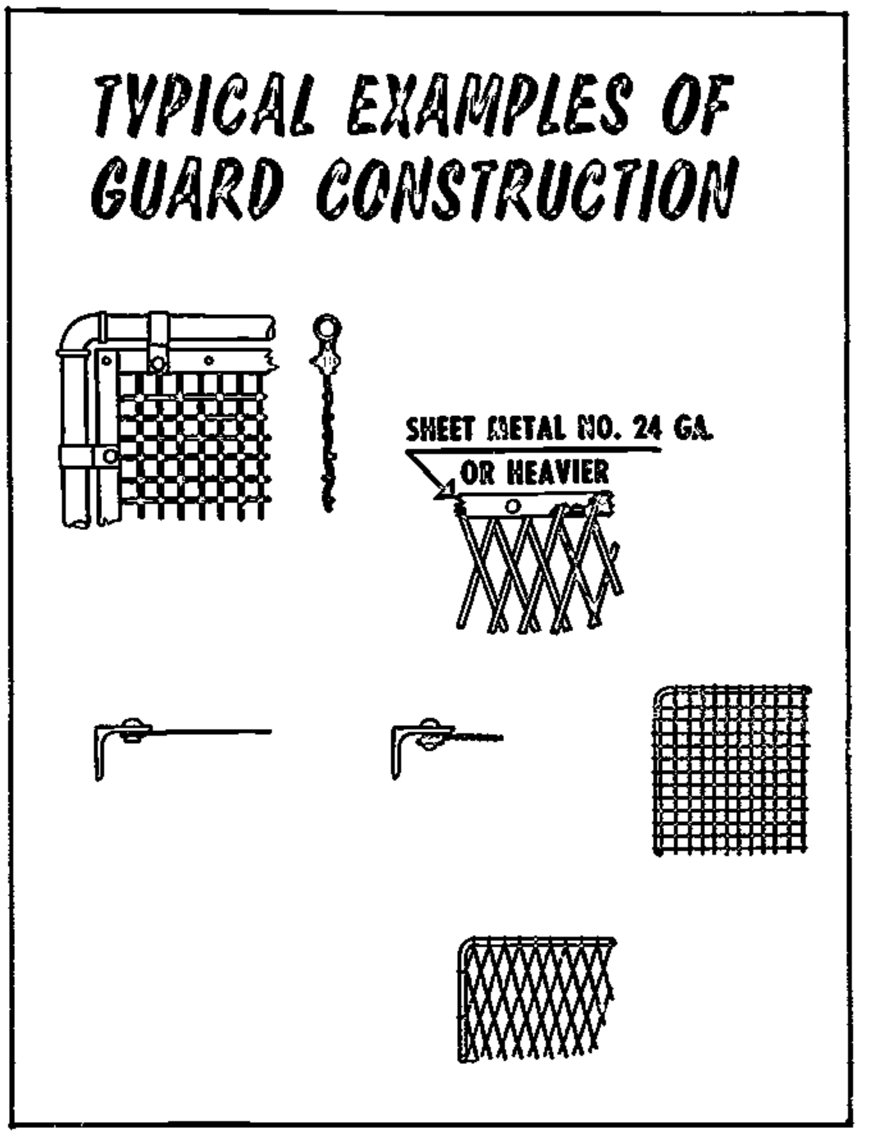


CHART 5—SERIES E

MATERIAL FOR GUARDS

Standard materials for construction of guards include expanded metal, perforated or solid sheet metal, or wire mesh on a frame of angle iron or iron pipe securely fastened to the floor or to the frame of the machine.

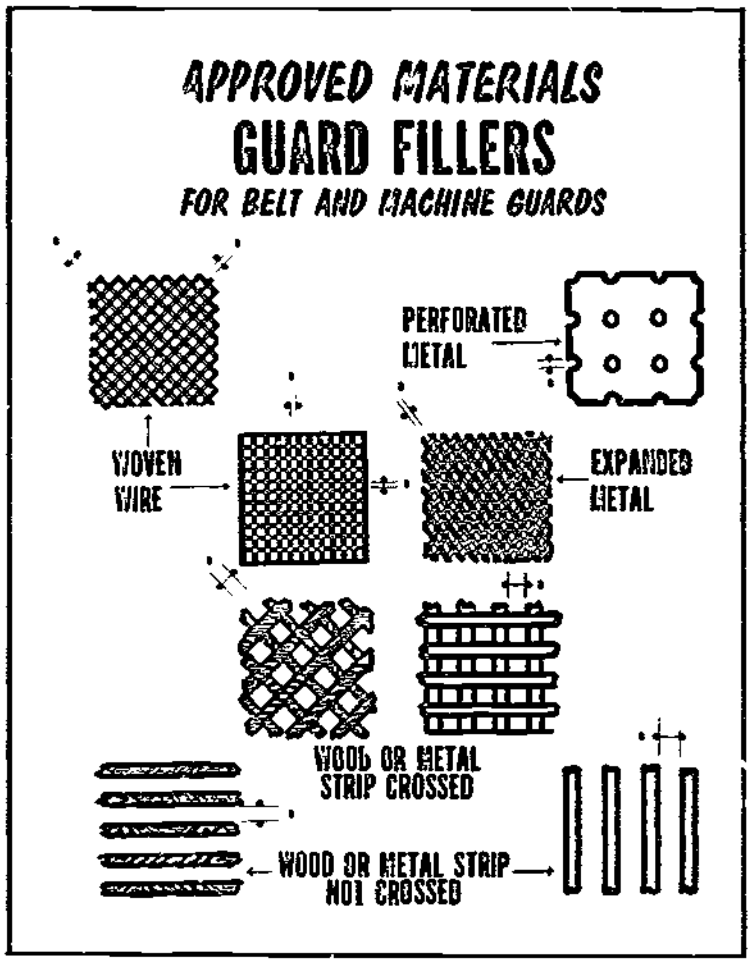


CHART 6—SERIES E

Table of Standard Materials and Dimensions

Material	Clearance from moving part at all points (in inches)	Largest mesh or opening allowable "B" (in inches)	Minimum gage (U.S. standard) or thickness	Minimum height of guard from floor or platform level (in feet)
Woven wire..........	Under 2 inches.....	⅜ inch	No. 16..........	7 feet
	2 inches–4 inches...	½ inch	No. 16..........	7 feet
	Under 4 inches.....	½ inch	No. 16..........	7 feet
	4 inches–15 inches..	2 inches.........	No. 12..........	7 feet
Expanded metal......	Under 4 inches....	½ inch	No. 18..........	7 feet
	4 inches–15 inches..	2 inches.........	No. 13..........	7 feet
Perforated metal......	Under 4 inches.....	½ inch	No. 20..........	7 feet
	4 inches–15 inches..	2 inches.........	No. 14..........	7 feet
Sheet metal..........	Under 4 inches.....	....	No. 22..........	7 feet
	4 inches–15 inches..	....	No. 22..........	7 feet
Wood or metal strip crossed.........	Under 4 inches.....	⅜ inch	Wood ¾ inch or Metal No. 16...	7 feet
	4 inches–15 inches..	2 inches.........		
Wood or metal strip not crossed..........	Under 4 inches.....	½ inch width		
	4 inches–15 inches..	1 inch width.....		
Standard rail.........	Minimum 15 inches. Maximum 20 inches	....	....	3 feet–6 inches

American Standard for Mechanical Power-Transmission Apparatus ASA B15.1—1953 Reaffirmed 1958.

DESIGN OF GUARDS	Where it is necessary to change belts, make adjustments, or apply oil or grease, guards should have hinged sections or should be removable. Guards should be designed so as not to interfere with the usual machine operations, but give maximum protection to the operator.

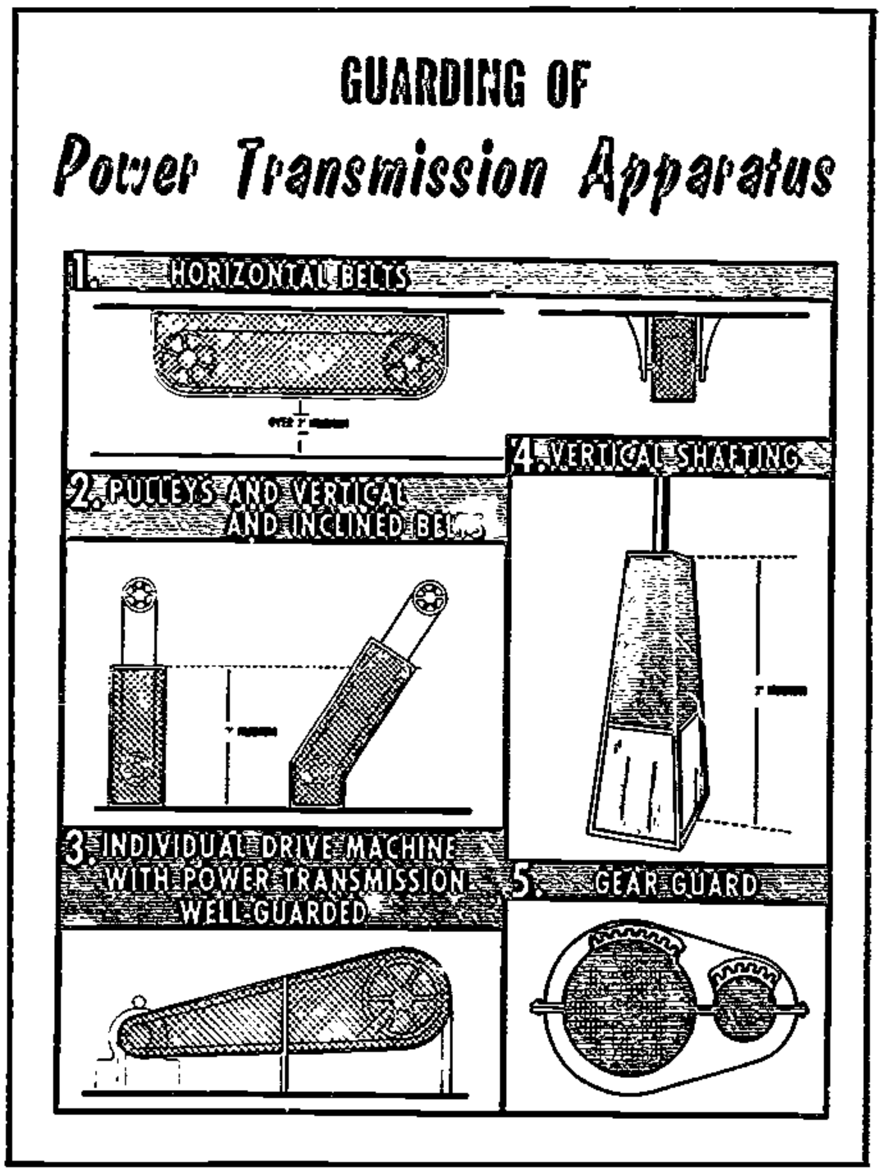
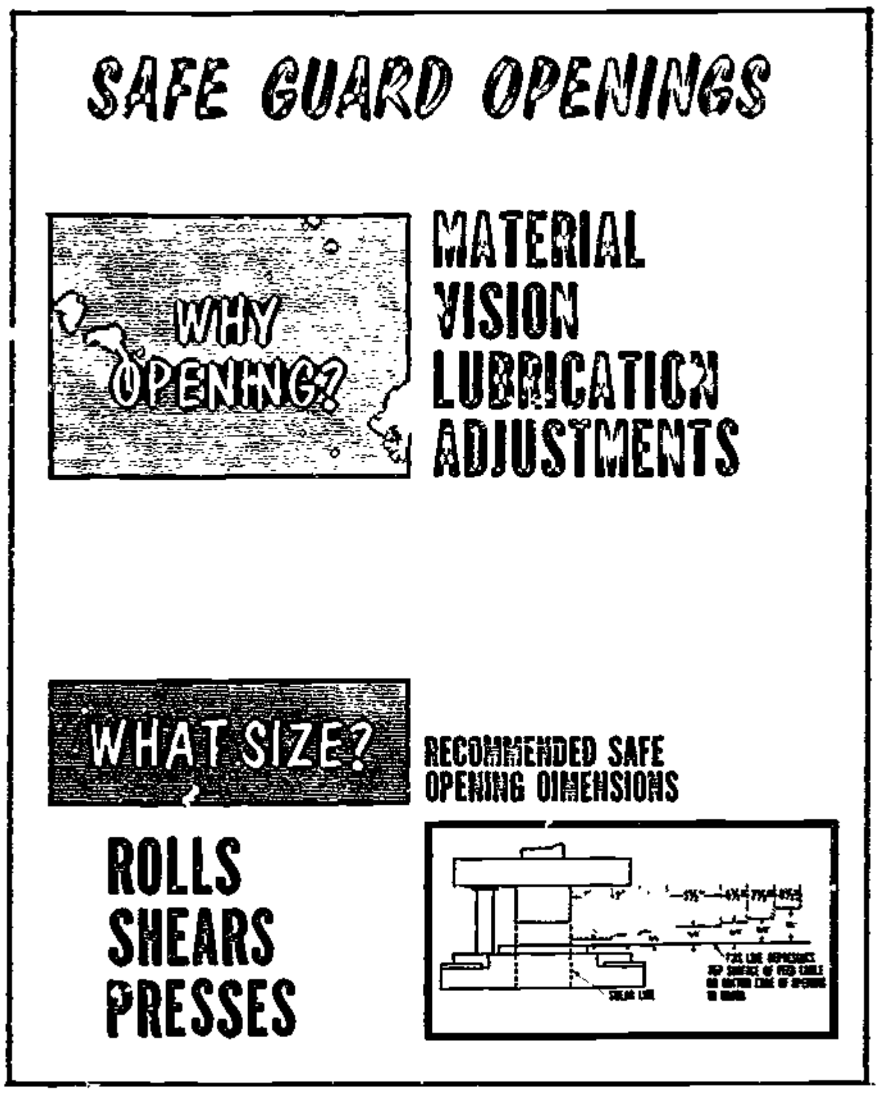


CHART 7—SERIES E

POWER TRANSMISSION INCLUDES	Prime movers including connecting rods, flywheels, as well as other moving parts of equipment used in the mechanical transmission of power, such as shafting, pulleys, belts, sprocket chains, clutches, and couplings.
FLYWHEEL GUARDS	When located so that any part is 7 feet or less above floor or platform shall be guarded.
COMPLETE ENCLOSURE	With sheet, perforated or expanded metal, or woven wire.
GUARDRAILS	Placed not less than 15 inches nor more than 20 inches from the rim. When flywheel extends into a pit or is within 12 inches from the floor, a standard toe board shall also be provided.
DISK GUARD	Flywheels with smooth rims 5 feet or less in diameter where the preceding methods cannot be applied, the following may be used: disk attached to flywheel to cover spokes on exposed side and to present a smooth surface and edge. To facilitate turning the wheel, a 4-inch wide space may be left between the outside edge of disk and rim.

GUARDS FOR CRANKS AND CONNECTING RODS	Full enclosure or guardrail.
HORIZONTAL SHAFTING	All exposed parts of horizontal shafting 7 feet or less from the floor or working platform except runways used exclusively for oiling or running adjustments shall be protected by a stationary casing which encloses shafting completely, or by a trough which encloses sides and top or sides and bottom of shafting, as location requires.
EXTENDING	Wherever shafting extends over a walkway or driveway, it should be protected as stated above unless it is located 15 feet or more above the walkway or driveway.
UNDER BENCH	Shafting under bench machines shall be enclosed by a stationary casing or by a trough at sides and top or sides and bottom, as location requires. The sides of the trough shall come within at least 6 inches of the underside of table, or if shafting is located near floor, within 6 inches of floor. In every case, the sides of trough shall extend at least 2 inches beyond the shafting or protuberance.
VERTICAL AND INCLINED SHAFTING	Vertical and inclined shafting 7 feet or less from floor of working platform, except maintenance runways, shall be enclosed with a stationary casing.
PROJECTING SHAFT ENDS	Projecting shaft ends shall present a smooth edge and end and shall not project more than one-half the diameter of the shaft unless guarded by nonrotating caps or safety sleeves. Unused keyways shall be filled up or covered.
PULLEY GUARDS	Any part of a pulley which is 7 feet or less from the floor or working platform shall be guarded in accordance with ASA standards. Pulleys serving as balance wheels (e.g., on punch presses) on which the point of contact between belt and pulley is more than 6 feet 6 inches from the floor or platform may be guarded with a disk covering the spokes.
PRECAUTIONS	1. Broken pulleys, pulleys with cracks, or pieces out of rim shall not be used. 2. Pulleys permanently out of service should not be allowed to remain on shafting which is in use. 3. Composition or laminated wood pulleys shall not be installed where they are subjected to influences detrimental to their structural composition. 4. Pulleys exposed to corrosive atmospheres should be made of corrosion-resistant material.

	5. Deep grooved sheaves should be used to quarter-turn drives for V-belts.
HORIZONTAL BELTS	Where both runs of horizontal belts are 7 feet or less from the floor level, the guard shall extend to at least 15 inches above the belt (see ASA standard), except that where both runs of a horizontal belt are 42 inches or less from the floor, the belt shall be fully enclosed.
OVERHEAD HORIZONTAL BELTS	Overhead horizontal belts with lower part 7 feet or less from the floor or platform shall be guarded on sides and bottom. Overhead horizontal belts more than 7 feet above floor or platform shall be guarded for their entire length under the following conditions: 1. If located over passageways or workplaces and traveling 1,800 feet or more per minute. 2. If center-to-center distance between pulleys is 10 feet or more. 3. If belt is 8 inches or more in width.
VERTICAL BELTS	Vertical belts running over a lower pulley more than 7 feet above floor or platform shall be guarded at the bottom in the same manner as horizontal overhead belts.
INCLINED BELTS	All guards for inclined belts shall be arranged in such manner that a minimum clearance of 7 feet is maintained between the belt and floor at any point outside the guard.
V-BELTS	Completely enclose all V-belts.
GEAR GUARDS	1. A complete enclosure. 2. A standard guard at least 7 feet high extending 6 inches above the mesh point of the gears. 3. A band guard covering the face of the gear and having flanges extended inward beyond the root of the teeth on the exposed side or sides. Where any portion of the train of gears guarded by a band guard is less than 6 feet from the floor, a disk guard or a complete enclosure to a height of 6 feet shall be required.
SPROCKETS AND CHAINS	All sprocket wheels and chains shall be enclosed unless more than 7 feet above the floor or platform. Where the drive extends over other machines or working areas, protection against falling shall be provided.



SAFE GUARD OPENINGS

WHY OPENING?

MATERIAL
VISION
LUBRICATION
ADJUSTMENTS

WHAT SIZE?

RECOMMENDED SAFE OPENING DIMENSIONS

ROLLS
SHEARS
PRESSES

CHART 8—SERIES E

WHY GUARD OPENINGS	For material: entrance, removal, scrap removal. For vision: cutting line, inspection, selection. For lubrication: greasing, oiling, cleaning. For adjustments: repairs, alterations, changes.
MAXIMUM SAFE OPENINGS	The average woman's fingers (glove size 6½) will go through ⅜-inch openings; therefore, for openings in any guard, use ¼-inch as the largest allowable opening within 1½ inch of the hazard.

TABLE OF DISTANCES

DISTANCE OF OPENING FROM SHEAR POINT (in inches)	MAXIMUM WIDTH OF OPENING (in inches)
0 to 1½	¼
1½ to 2½	⅜
2½ to 3½	½
3½ to 5½	⅝
5½ to 6½	¾
6½ to 7½	⅞
7½ to 8½	1¼

REASON FOR OPENINGS	The various openings are placed so they do not permit the operator's fingers to reach the shear point even though the guard contact is on the back of the fingers, hand, or forearm.
EXAMPLE	Suppose it is necessary to provide a ¾-inch opening between the bottom of the guard and the top of the feed table or between openings in a guard for the feeding of material. In this case, the diagram shows that a ¾-inch opening is permissible to within 5½ inches from the shear point.
CAUTION	When installing guards with openings over ¼ inch, tests should be carefully made by operators, particularly women, to make certain the guard is effective before the machine is operated. Test with hand flat on feed table; extend hand without support.

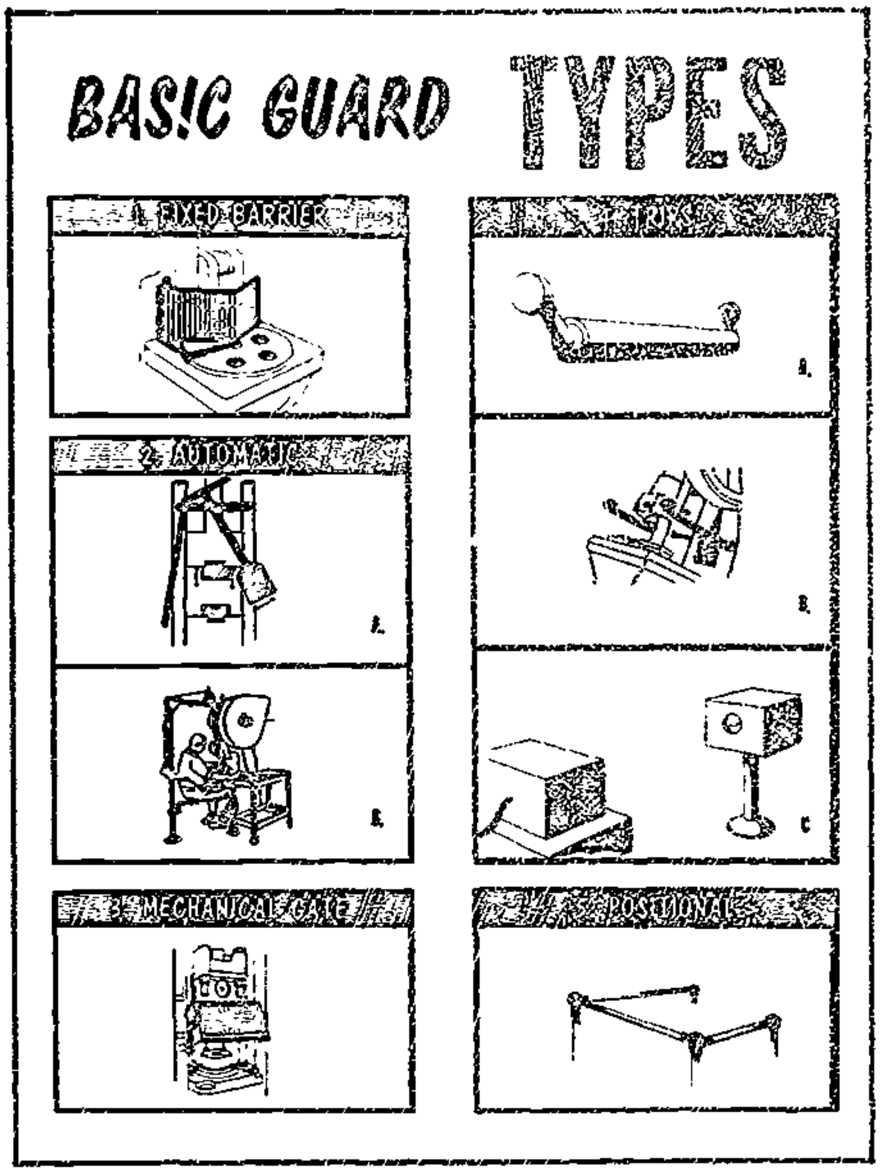


CHART 9—SERIES E

POINT OF OPERATION	
FIXED BARRIER GUARD	The fixed barrier guard may be best described as a stationary enclosure so arranged that it will protect the machine operator from accidental contact with the power transmission, moving parts, or point-of-operation hazard. It shall be secured to the machine by fasteners which cannot readily be removed by the operator. They are often used in connection with special feeding devices. Interlocking devices may be installed to control or prevent operation of the machine when a removable section is opened.
AUTOMATIC FEED	This is a feeding device which does not require the services of the operator except at intervals to restock the feeding device or magazine.
SEMIAUTOMATIC OR MECHANICAL FEED	An appliance, such as dial, slide, push, rotating, or other similar feed arrangement, actuated by or attached to the machine by which stock is fed under the slide, ram, or plunger without necessitating the operator's hands entering the danger zone.

RAM ACTUATED AUTOMATIC GUARDS	"Automatic guards" are generally two protective devices which remove the operator's hands, arms, or body from the danger zone as the slide or ram descends. These guards are operated by the machine itself by means of connections to the slide or ram. *"Sweep," "knock-away," or "push-away" device* is a moving barrier connected to the slide or ram of the machine. (It should be padded to avoid injury to the operator.) *"Pull-away" or "handcuff" device* is a "handcuff" arrangement connected to the hands or arms of the operator and to the slide or ram of the machine.
MECHANICAL GATE GUARD	In using this guard, the gate moves in front of the operation, and the press cannot be tripped until the guard is in position. This guard is not entirely reliable because it is actuated by the clutch, and the ram can repeat when the clutch is defective. The forward edge of the gate should be padded to avoid injury to the operator. This guard can also be converted to a fixed barrier guard.
TRIP GUARDS	a. *Trip guards for a calender roll* are horizontal trip rods located so that contact with the body or head of the operator will instantly actuate the stopping mechanism and quickly stop the roll within the travel limits set by the ASA. b. *Hand trips* are usually of a type requiring the application of pressure on two levers or buttons simultaneously. The two-hand trip can be rendered ineffective unless it is equipped with an equalizer or guarding arranged so that one lever cannot be tied down or blocked (which would permit one-hand operation). c. *Electric eye* type of guard is usually very expensive to install and to maintain. As part of this installation, a positive braking system is required which will effectively stop the machine, and will prevent it from being started if anything is in the danger zone protected by the beam of the electric eye.
POSITIONAL GUARD	A positional guard acts as a barrier or fence to prevent accidental contact of a person with moving machinery, chips, cuttings, etc. This is best illustrated by a standard guardrail.

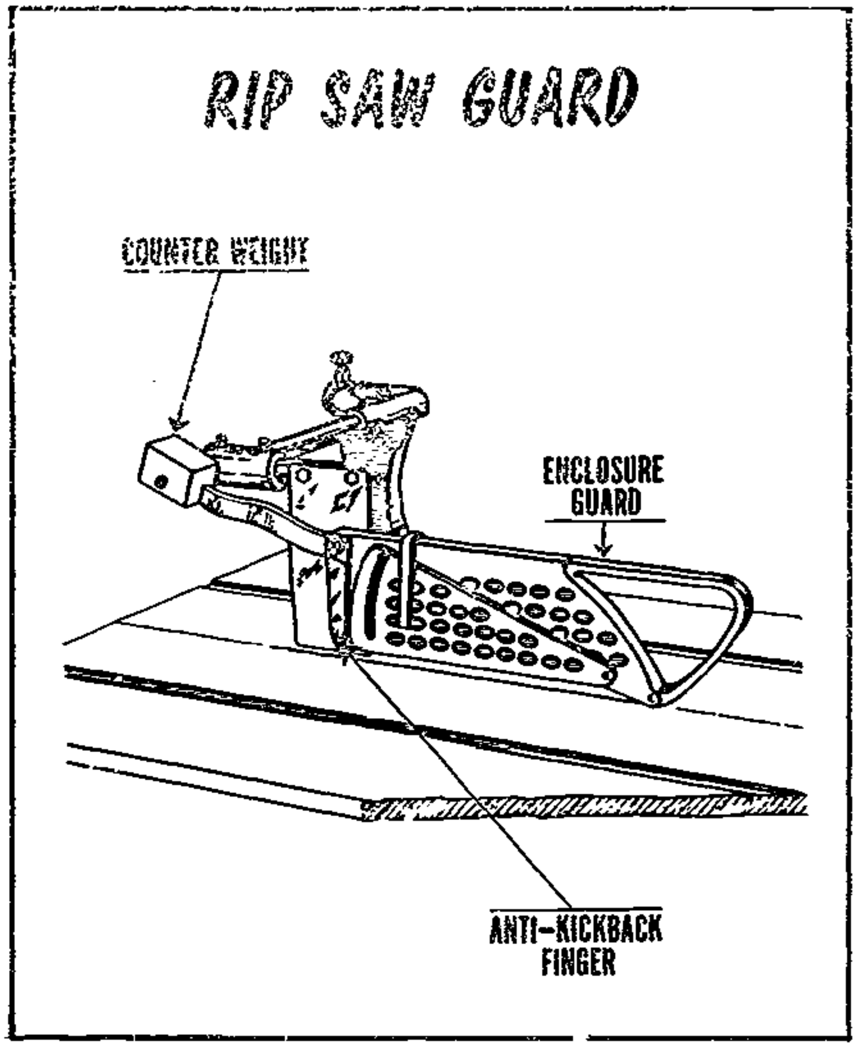


CHART 10—SERIES E

HAND-FED RIP SAWS	A basic type of power table saw which uses a circular blade, the teeth of which are usually larger, and is constructed to "rip" or cut along the grain of the wood.
MECHANICAL AND OPERATIONAL HAZARDS	General hazards are inherent in the following: power transmission, point of operation, kickbacks, or flying particles.
POWER TRANSMISSION	The saw may be driven by an individual motor or from a line shaft, comprising belts, gears, and pulleys.
POINT OF OPERATION	Accidental contact with the saw blade by the operator or others is possible.
KICKBACKS	Kickbacks or throwing material toward the operator through action of the blade can be caused by unsafe operating methods, improperly maintained equipment, or by lack of proper physical safeguards.
FLYING PARTICLES	Sawdust, splinters, and chips are thrown off as a result of the cutting action of the blade and can come in contact with the operator or others.

HAZARD CONTROL	
POINT-OF-OPERATION GUARD	Each circular, hand-fed ripsaw should be guarded by a device which would completely enclose the portion of the saw above the table, with the exception of an opening large enough to permit suitable visibility at the point of operation. This opening should not exceed one-half inch in width. The guard and mounting shall be so arranged that the guard will automatically adjust itself at all times to the thickness of, and remain in contact with, the material being cut. The guard should be of adequate strength to resist blows and strains incidental to normal operation, adjusting, and handling, and shall be so designed as to protect the operator from flying splinters and broken saw teeth. The guard should be mounted so as to insure that its operation will be positive, reliable, and in true alinement with the saw. The mounting shall be strong enough to resist any reasonable side thrust or other forces tending to throw it out of line.
SPREADER	Each hand-fed, circular ripsaw should be furnished with a spreader or splitter to prevent material from being thrown back. The spreader should be made of saw steel or tool steel which has been hardened, tempered, and ground to gage so that it is thinner than the saw kerf but thicker than the saw blade. The spreader should be of sufficient width —not less than 2 inches—to provide adequate stiffness or rigidity to resist a reasonable side thrust or blow tending to bend or throw it out of position. The spreader should be so attached as to remain in true alinement with the saw, even when either the saw or the table is tilted, and shall be placed so that no more than ½-inch space is between the spreader and the back of the saw when the largest saw is mounted in the machine.
ANTIKICKBACK ANTI-KICKBACK FINGERS	Each hand-fed, circular ripsaw should be provided with one or more antikickback fingers, or dogs of steel, or its equivalent in strength and so located as to oppose the thrust or tendency of the saw to pick up the material or to kick it back toward the operator. It should be designed to provide adequate holding power for all thicknesses of materials being cut.
EYE PROTECTION	Operators shall be provided with proper protective equipment, such as goggles and/or face shield, and it should be mandatory to use them each time the saw is operated.
POWER TRANSMISSION GUARDS	If saw parts are driven by belts that are exposed, belts and pulleys should be completely enclosed by sheet-metal or heavy mesh guards, even though the saw may be partially fenced off or partially removed from other machines.

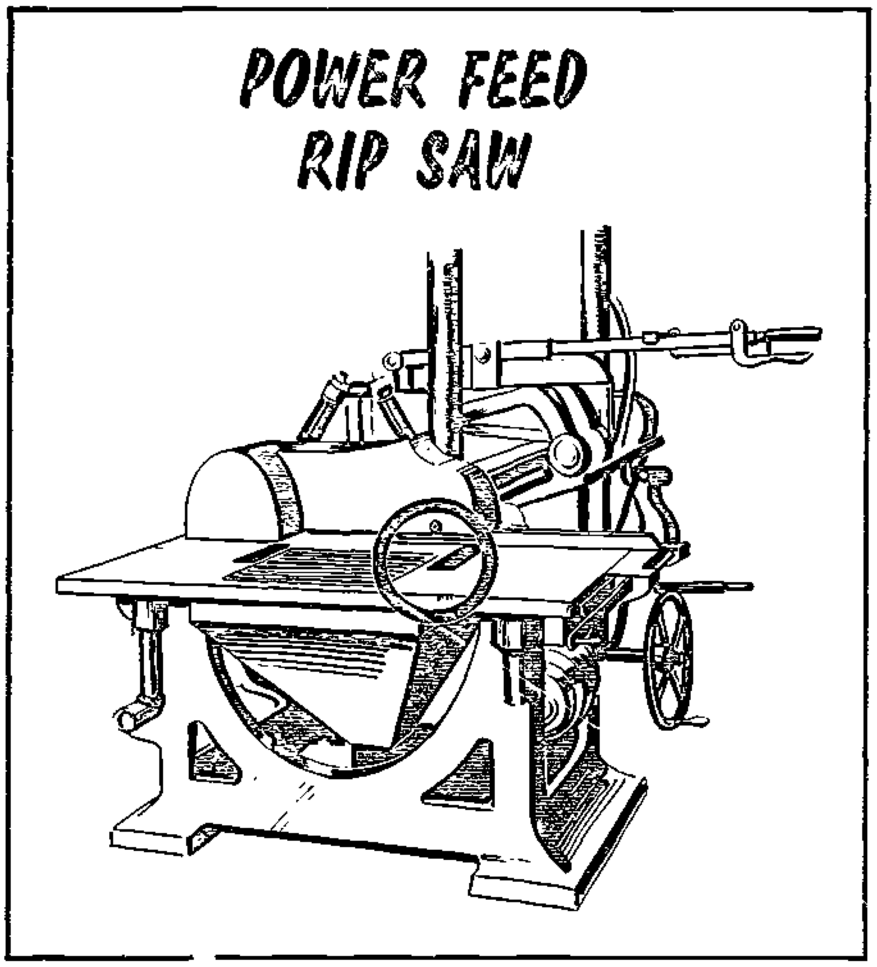


CHART 11—SERIES E

POWER FEED RIP SAW	This type of saw is used to "rip" or cut with the grain heavy, thick, long, lengths of lumber. This saw is equipped with rollers or a conveyor system that holds the lumber and force feeds it into the saw blade.
MECHANICAL AND OPERATIONAL HAZARDS	General hazards may be inherent in the following: power transmission, point of operation, kickbacks, and flying particles.
POWER TRANSMISSION	Saw may be driven by an individual motor or from a line shaft, comprising belts, gears, and pulleys.
POINT OF OPERATION	Accidental contact with the saw blade, or being pinched between the stock and the inrunning rolls by the operator or others, is possible.
KICKBACKS	Kickbacks or throwing material toward the operator through action of the blade can be caused by unsafe operating methods, by equipment being improperly maintained, or by lack of proper physical safeguards.
FLYING PARTICLES	Sawdust, splinters, and chips are thrown off as a result of the cutting action of the blade and can come in contact with the operator or others nearby.

CLEARANCES	Long stock is often ripped on power feed ripsaws, but it obstructs passageways and interferes with operation of other machines located too near.
HAZARD CONTROL	
POINT-OF-OPERATION GUARD	A power feed ripsaw should be guarded by a device which would completely enclose the top and sides of the saw and rolls. Such a guard shall be constructed so that the hands are prevented from coming in contact with the saw or from being pinched between the stock and in-running rolls, regardless of the thickness of the stock. At the front, the guard should extend to within ⅜ inch of the lowest part of the rolls. The guard should be so mounted as to insure that its operation will be positive, reliable, and in true alinement with the saw. The mounting shall be strong enough to resist any reasonable side thrust or other force tending to throw it out of line.
ANTI-KICKBACK FINGERS	Even though the feed rolls are automatic and help prevent kickbacks, kickbacks can still occur unless rolls are kept clean and corrugations, sharp. Each power-fed ripsaw shall be provided with one or more nonkickback fingers, or dogs of steel, or its equivalent in strength, and so located as to oppose the thrust or tendency of the saw to pick up the material or to kick it back toward the operator.
EYE PROTECTION	Proper protective equipment, such as goggles and/or face shield, shall be worn by the operator and helpers while the saw is being operated.
EMERGENCY STOPS	Emergency stop buttons should be provided, one each for the operator and the off-bearer.
CLEARANCE	A clearance at each working end of the saw table should exceed by at least 3 feet the length of the longest material handled.

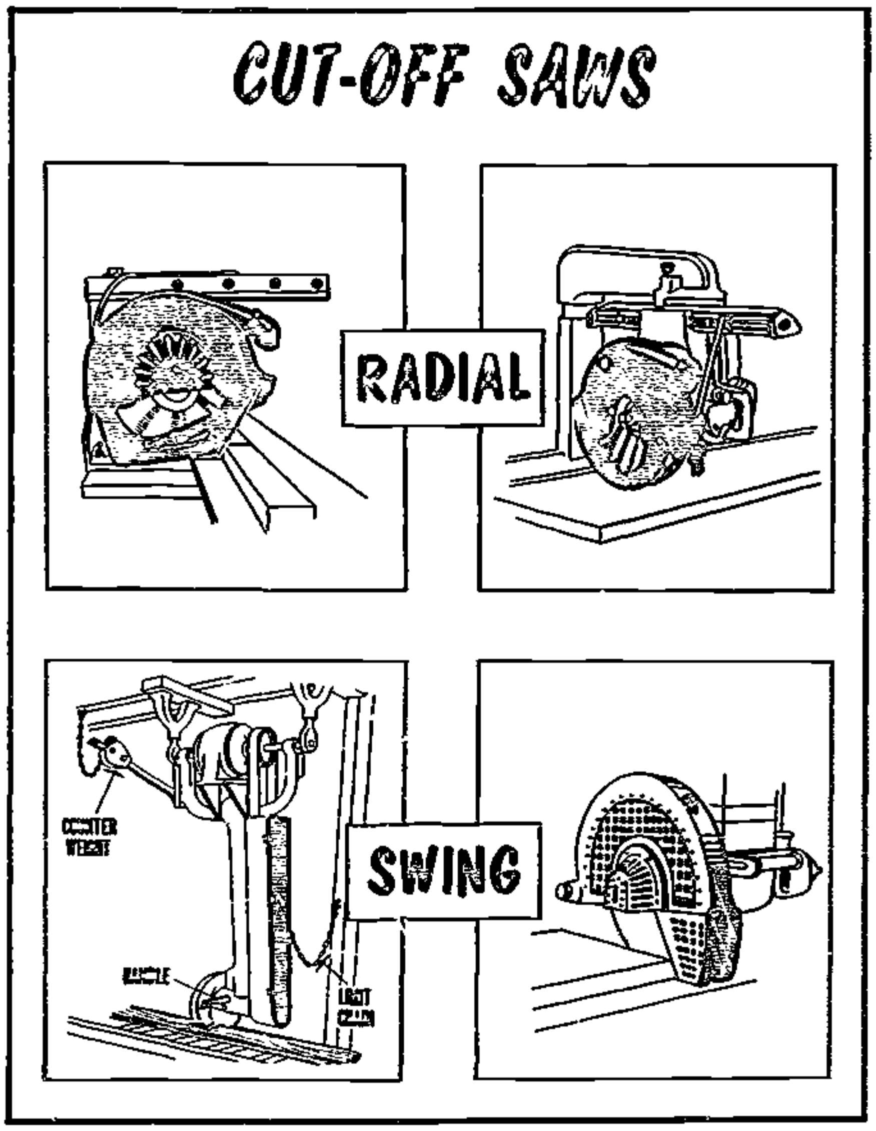


CHART 12—SERIES E

CUT-OFF SAWS	**Cut-off saws are used to cut across the grain of lumber. There are two types: radial, which is pulled forward horizontally along a fixed track toward the operator; swing, which is suspended from the roof or overhead and is pulled forward, like a pendulum, by the operator.**
MECHANICAL AND OPERATION HAZARDS	**Hazards in general may be inherent in power transmission and at point of operation.**
POWER TRANSMISSION	**This type of saw is driven generally by an individual motor with the saw attached directly to the motor shaft, or may be driven by an individual motor by belt and pulleys.**
POINT OF OPERATION	**Accidental contact with the saw blade by the operator while pulling saw forward; reaching for sawed stock before saw returns to normal "rest" position; or saw is not properly adjusted, permitting it to swing beyond saw table into body of operator.**

HAZARD CONTROL	
POINT-OF-OPERATION GUARD	Each swing or sliding cut-off saw should be provided with a hood that will completely enclose the upper half of the saw, the arbor end, and the point of operation at all positions of the saw. The hood should be constructed in such a manner and of such material that it will protect the operator from flying splinters and broken saw teeth and will afford him a clear view of the cutting edge of the saw at all times. The hood should be hinged at the back and provided with an extension at the front, so that when the saw is returned to the back of the table, the hood will rise on top of the fence. When the saw is moved forward, the hood shall drop on top of, and remain in contact with, the material being cut. At the end of the cut, the lip of the hood will be in contact with the table surface.
COUNTER-WEIGHT	Each swing cut-off saw should be provided with an effective device to return the saw automatically to the back of the table when it is released at any point of its travel. Such device should not depend upon any rope, cord, or spring for its proper functioning. If there is counter-weight, the bolts supporting the bar and counterweight should be prevented from dropping by either a bolt passing through both the bar and counterweight, or by a bolt being put through the extreme end of the bar, with a safety chain attached to it.
LIMIT CHAINS	Each swing cut-off saw should be provided with limit chains or some other equally effective device to prevent the saw from swinging beyond a front or back position where the gullets of the lowest tooth will rise above the table top.
LATCH	A latch should be provided to catch and retain the saw at the rear of table and to prevent it from rebounding.
SAW TABLE	Each swing and sliding cut-off saw table should be made wide enough at the point of operation to maintain table surface below the exposed edge of the saw blade to the full extent of the travel of the saw. It should be equipped with a backrail and dead rolls of sufficient length to provide support for the longest stock. Saw should not extend in front of back-rail when in released position.
SAFE OPERATION	While operating the saw, it is important that operator stand to the side of the saw on which the handle is located. Operator should used the hand nearest the handle. This keeps the operator's body out of line with saw and makes it unnecessary to expose the hands near the saw.
GOGGLES	Proper personal protective equipment, such as goggles or face shield, should be worn by the operator.

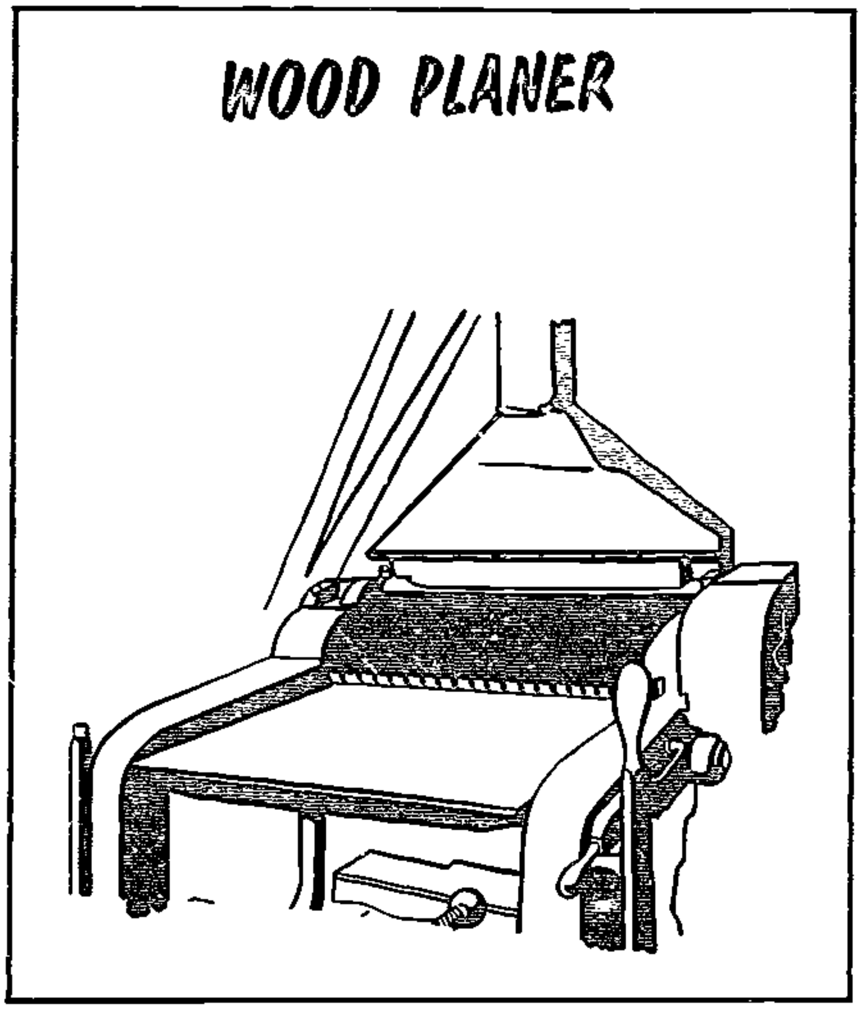


CHART 13—SERIES E

WOOD PLANER	Wood planers are production machines intended for volume work and designed to dress and size rough sawed lumber on one or more sides. These surfacing machines are less hazardous than jointers and shapers because they are power fed and the operator's hands need not come close to the cutting head.
MECHANICAL AND OPERATIONAL HAZARDS	Hazards in general may be inherent in power transmission, point of operation, kickbacks, flying particles, vibration, or clearances.
POWER TRANSMISSION	Often driven from line shaft, comprising belts, pulleys, and gears located on back side of planer.
POINT OF OPERATION	Accidental contact with blades while sharpening or adjusting. Pinching of fingers and hands between material and inrunning rolls by operator unless guarded adequately.
KICKBACKS	Kickbacks or throwing material toward the operator through action of the blade can be caused by unsafe operating methods, by equipment being improperly maintained or adjusted, or by lack of physical safeguards.

FLYING PARTICLES	Chips, splinters, etc., are thrown off as a result of the cutting action of the blade, since blade travels at high speed and can come in contact with operator or others nearby.
VIBRATION	A planer is powerful and fast running and tends to vibrate excessively. Vibration may also be caused by dull or improperly sharpened blades.
CLEARANCES	Since material passing through planer is generally long and moves fast, workers can be caught between stock emerging from the planer and stationary objects or structural members of the building.

HAZARD CONTROL

POWER TRANSMISSION GUARDS	Planer parts driven by belts and pulleys, even though they may be on the back side of the planer, should be completely enclosed by sheet metal or heavy mesh guards. Guards should always be used regardless of planer's location.
POINT-OF-OPERATION GUARDS	Cutter heads (blades) should be completely enclosed in solid metal guards which should be kept closed when planer is running. Where exhaust system is used, the guards should form part or all of the exhaust hood and should be constructed of sheet metal not less than 1/16 inch in thickness or cast iron not less than 3/16 inch in thickness. Sheet-metal guards should be reinforced with angle iron or other bracing to insure rigidity.
FEED ROLL GUARDS	Feed rolls should be guarded by a hood or a semicylindrical guard which will allow the material to pass but will prevent the hands of the operator from coming in contact with the inrunning rolls at any point. The guard should be fastened to the frame carrying the rolls so as to remain in adjustment for any thickness of stock.
ANTI-KICKBACK FINGERS	Kickbacks cannot be prevented entirely by mechanical means; therefore, operator should always stand out of line of board travel. Operators should never feed boards of different thicknesses at the same time because the thinner board will not be held by the feed rolls and can be kicked back from the cutter heads. Feed roll corrugations should be kept clean and free from dust, pitch, etc. They should be kept sharp by filing as needed so that they grip the material as tightly as possible. A row of antikickback dogs or fingers should be placed in front of the feed roll and should extend the width of the feed roll to give further protection.
EYE PROTECTION	The operator should wear a face shield or goggles as protection against slivers and chips thrown back by the cutter heads.

VIBRATION INSULATION	Vibration should be reduced by anchoring the planer on a solid foundation and, if necessary, by insulating it from the foundation with vibration-absorbing material.
LAYOUT	Planers should be located away from other machines to prevent workers from being caught between material emerging from the planer and stationary objects or structural members of the building. The space at the outrunning end should be fenced or marked off to keep workers out of the area where they might be struck by long, fast-moving boards. Insofar as possible, aisleways should be located where it will not be necessary for personnel to pass in front or rear of planer. Because planers create a great deal of noise, they should be isolated.

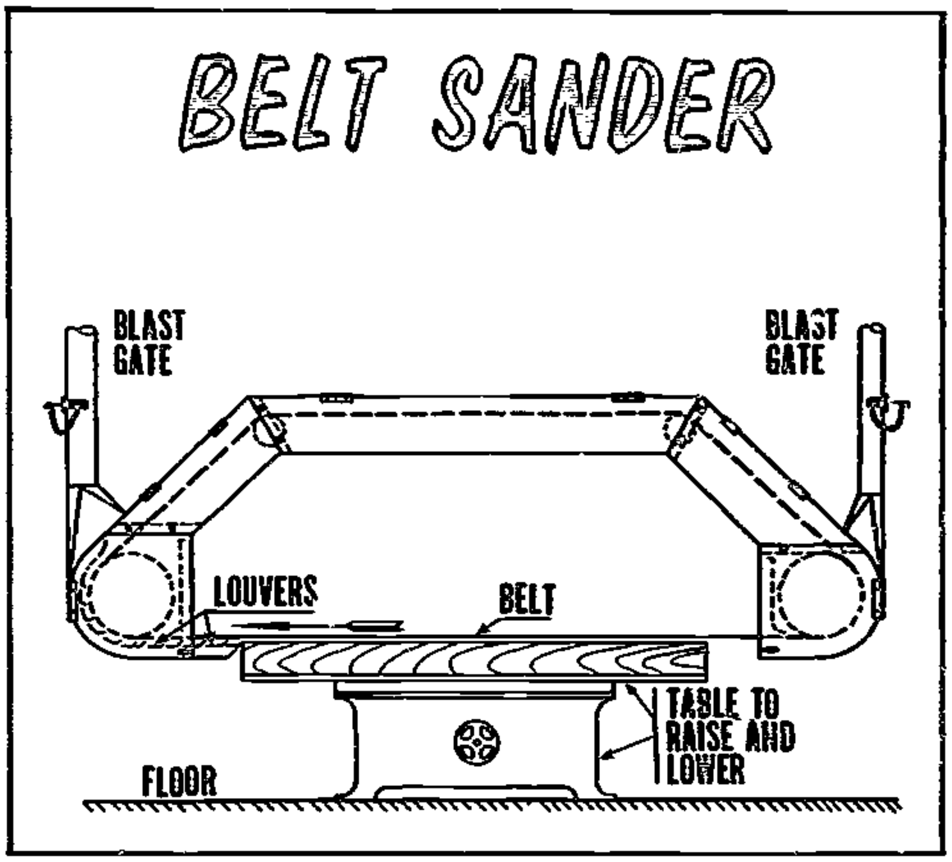


CHART 14—SERIES E

BELT SANDER	A belt sander is a type of sanding machine which uses a continuous strip of abrasive material and travels at moderate speed over two opposed power driven rollers. It is used to smooth large flat areas.
MECHANICAL AND OPERATIONAL HAZARDS	
POWER TRANSMISSION	A belt sander may be driven by an individual motor or from a line shaft, comprising belts and pulleys.
POINT OF OPERATION	Accidental contact by operator with moving abrasive belt. Operator's hands or fingers being caught between work rest and belt on manually fed machine, or between feed rolls and material on self-fed machine.
DUST AND FLYING PARTICLES	Considerable dust and bits of wood are thrown off in the sanding process.
LOOSE BELTS	Loose or improperly tensioned belts cause undue wear and fraying, and can tear or break, causing material on jam or belt to fly toward operator.

CONTROL OF HAZARDS	
POWER TRANSMISSION GUARDS	All power transmission parts of sanders driven by belts and pulleys even though they are on the back side of the machine should be completely enclosed by sheet metal or mesh guards.
WORK REST AND BELT GUARDS	All manually fed sanders should be equipped with a work rest and properly adjusted to provide minimum clearance between belt and rest and to secure support for the work being sanded. Pieces too small to allow the hands to be kept a safe distance from the work should be held in a jig or similar holding device. Feed rolls of self-fed machines should be protected with a guard to prevent the operator's hands from coming in contact with the inrunning rolls at any point. The guard shall be of substantial metal construction, firmly secured to the frame carrying the rolls so as to remain in adjustment for any thickness of material. The bottom of the guard should come down to within three-eighths inch of a plane formed by the bottom of the contact face of the feed roll where it touches the material. Each feed sanding machine should also have both pulleys or drums enclosed in such manner as to guard the points where the abrasive belt runs onto the pulley-drum. The unused run of the abrasive belt should be guarded where exposed to contact by the operator.
EXHAUST SYSTEMS	All belt sanders should be provided with an exhaust system. The exhaust hood should cover all the sanding surface except the operating area. Exhaust intakes should be designed and placed so that the natural throw of the abrasive belt is directly into the exhaust hood. Intakes should be placed as near as possible to the point of contact of the wood with the abrasive belt. Personnel operating sanders should wear goggles and dust-type respirators during sanding operations and while cleaning up afterwards.
BELT MAINTENANCE	Abrasive belts used on sanders should be the same width as the pulley-drum, and drums should be adjusted to keep the abrasive belt taut enough to turn at the same speed as the pulley-drum, yet not slip on the drum when material is brought into contact with the moving abrasive belt. Abrasive belts should be inspected before use, and those found to be cracked, frayed, or excessively worn in spots should be replaced, even though the remainder of the belt appears to be in good condition.

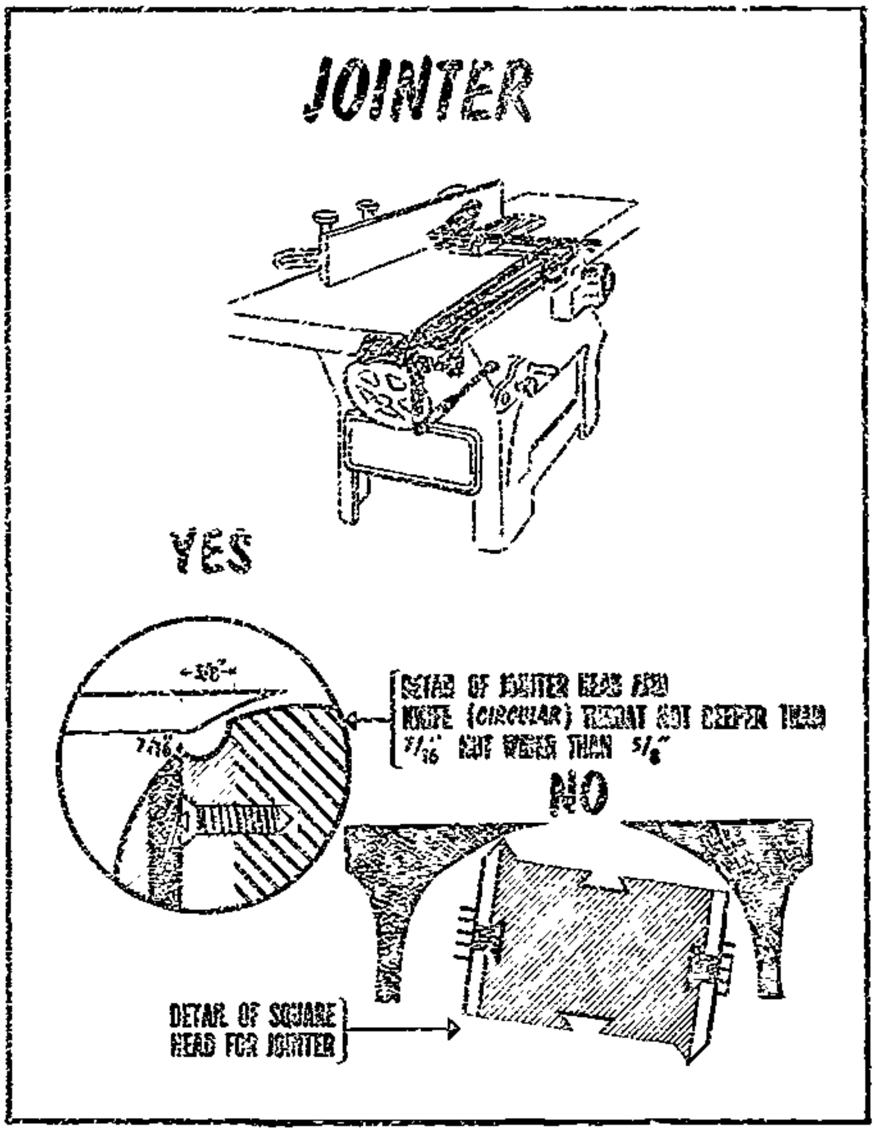


CHART 15—SERIES E

JOINTER	This is a type of wood surfacing machine considered to be second only to circular saws from the standpoint of danger among woodworking machines. Since jointers are used primarily in the jointing of small pieces of material, the many accident experiences are due chiefly to the prevalent practice of not using jigs or similar holding devices when working with small size material.
MECHANICAL AND OPERATIONAL HAZARDS	
POWER TRANSMISSION	Power transmission.—Jointers may be driven by an individual motor or from a lineshaft, comprising belts and pulleys.
POINT OF OPERATION	Point of operation.—Accidental contact by the operator with blades while attempting to hold material with hands instead of holding device. Operator attempting to oil or adjust knives or guide while machine is operating. Using hands instead of brush to clean chips away from knives. Operator making automatic guard inoperative.

KICKBACKS	Kickbacks.—Kickbacks or throwing material toward operator through action of the blade can be caused by unsafe operating methods, by equipment being improperly maintained, or by improper adjusting of cutting head.
FLYING PARTICLES	Flying particles.—Chips, splinters, etc., are thrown off as a result of the high-speed cutting action of the blades. This creates a housekeeping problem as well as danger to the operator.
CONTROL OF HAZARDS	
POWER TRANSMISSION GUARDS	Jointers driven by belts and pulleys: even though these belts and pulleys are at the rear of the machine, should be completely enclosed by sheet metal or mesh guards.
POINT-OF-OPERATION GUARDS	Each hand-fed jointer that has a horizontal head should be equipped with a cylindrical head, the throat of which should not exceed 7/16 inch in depth nor 5/8 inch in width. No cylinder should be used if the throat exceeds 3/8 inch in depth or 1/2 inch in width. Each hand-fed jointer that has a horizontal cutting head should be equipped with an automatic guard which will cover all of the head on the working side of the fence or gage. The guard should automatically adjust horizontally for edge jointing and vertically for surface work and should remain in contact with the material at all times. Each hand-fed jointer that has a horizontal cutting head should be equipped with a guard which will cover the section of the head back of the fence or gage. Each wood jointer that has a vertical head should be equipped with either an exhaust hood or a guard arranged so as to enclose completely the revolving head, except for a slot wide and convenient enough to insert the material to be jointed.
SAFE MAINTENANCE	At no time should adjustments to knives or fence-guide be attempted unless the machine has come to a complete stop and power has been turned off. Knives on jointers should be checked often to insure proper setting or adjustment. Knives should be kept sharp at all times. To insure efficient operation, the operator should make sure that no heavy cuts are taken. Floors and the area around jointers should be kept free of stumbling and slipping hazards. Since considerable dust and chips are formed during operation, operator should be provided with proper and adequate personal-protective equipment. Provision should be made for brushes, etc., to keep machine and surrounding floor area clean.

SAFE OPERATION

A push block should be used on short stock (generally any stock less than 18 inches in length) to prevent stock tipping and causing operator's fingers to come in contact with the knives.

Neither gloves nor loose or torn clothing should be worn by the operator or others working around jointers.

Always use a brush to remove chips and dust from around knives or cutting head area.

Guards should be inspected frequently, and operators should not make guard inoperative for any purpose.

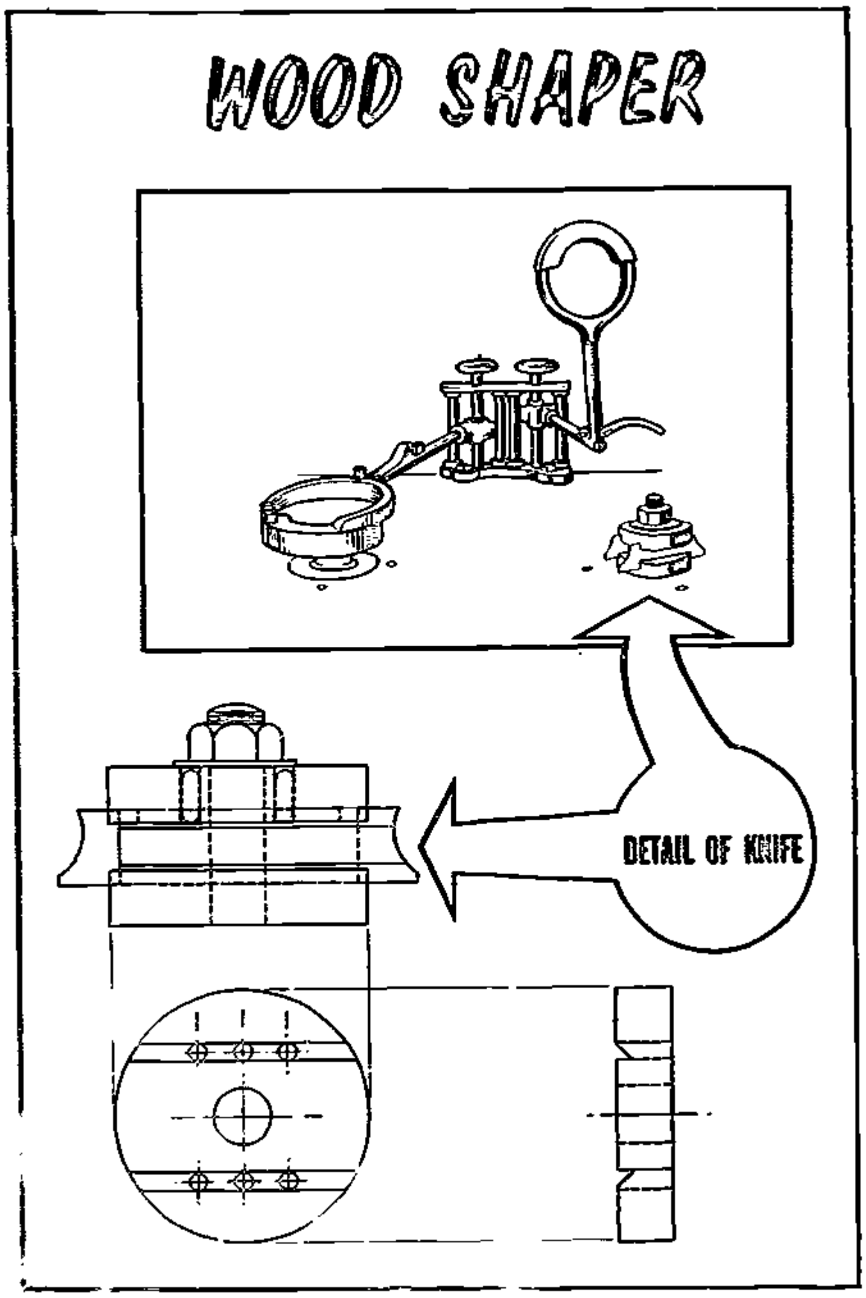


CHART 16—SERIES E

WOOD SHAPER	This type of woodworking machine has a variety of uses, but its best known or most common use is shaping the edges of material by placing the material in contact with knives rotating on one or more spindles at high speed. The shaper is one of the most difficult of all woodworking machines to guard effectively.
MECHANICAL AND OPERATIONAL HAZARDS	
POWER TRANSMISSION	Power transmission.—Of necessity, shapers must turn at high speeds and while most are driven by individual motors, some are driven from lineshafts, comprising belts and pulleys.

POINT OF OPERATION	Point of operation.—Accidental contact by operator with blades while attempting to hold material with hands instead of with jigs or holding devices. Knives breaking or working loose and being hurled at the operator. Using hands instead of a brush to clean chips and dust from knives. Failure of operator to use guard, or the guard is inadequate or is improperly designed.
KICKBACKS	Kickbacks.—Kickbacks or throwing material toward the operator through action of the fast-turning blades can be caused by unsafe operating methods, by equipment being improperly maintained, or by improperly adjusted cutting head.
FLYING PARTICLES	Flying particles.—Chips, splinters, etc., are thrown off as a result of the high speed cutting action of the blades, constituting a housekeeping problem as well as danger to the operator.
CONTROL OF HAZARDS	
POWER TRANSMISSION GUARDS	All belts, pulleys, and drives should be completely enclosed by metal or mesh guards.
POINT-OF-OPERATION GUARDS	The cutting heads of each wood shaper which is not automatically fed should be enclosed with a cage or adjustable guard so designed as to keep operator's hands away from the cutting edge. The diameter of the circular shaper guards should be greater than the greatest diameter of the cutter. At no time should a warning device, made of leather or any other material, be attached to the spindle.
KNIFE CONSTRUCTION	Knives on shapers should be made from the best material available. Knives should be sharpened and kept in adjustment by qualified personnel. Knives should be balanced and should fit properly. Material should always be fed into knives gradually, and at no time should cuts be heavy.
EXHAUST SYSTEM	Exhausts with adjustable hoods are considered a necessity. They help keep chips and dust from accumulating near cutter heads, reducing the need for manual cleaning of heads and surrounding floor area. Operator should be provided with proper and adequate personal-protective equipment.
SAFE OPERATION	Cylindrical heads should be used wherever the nature of the work will permit. Templates, jigs, and fixtures which will remove the operator's hands from the point of operation should be used wherever possible. All double-spindle shapers should be provided with a starting and stopping device for each spindle. Solid cutters which fit over the spindle are preferred to knives which can be broken or thrown. Always use a brush instead of the hands to clean from around knives and cutting head areas.

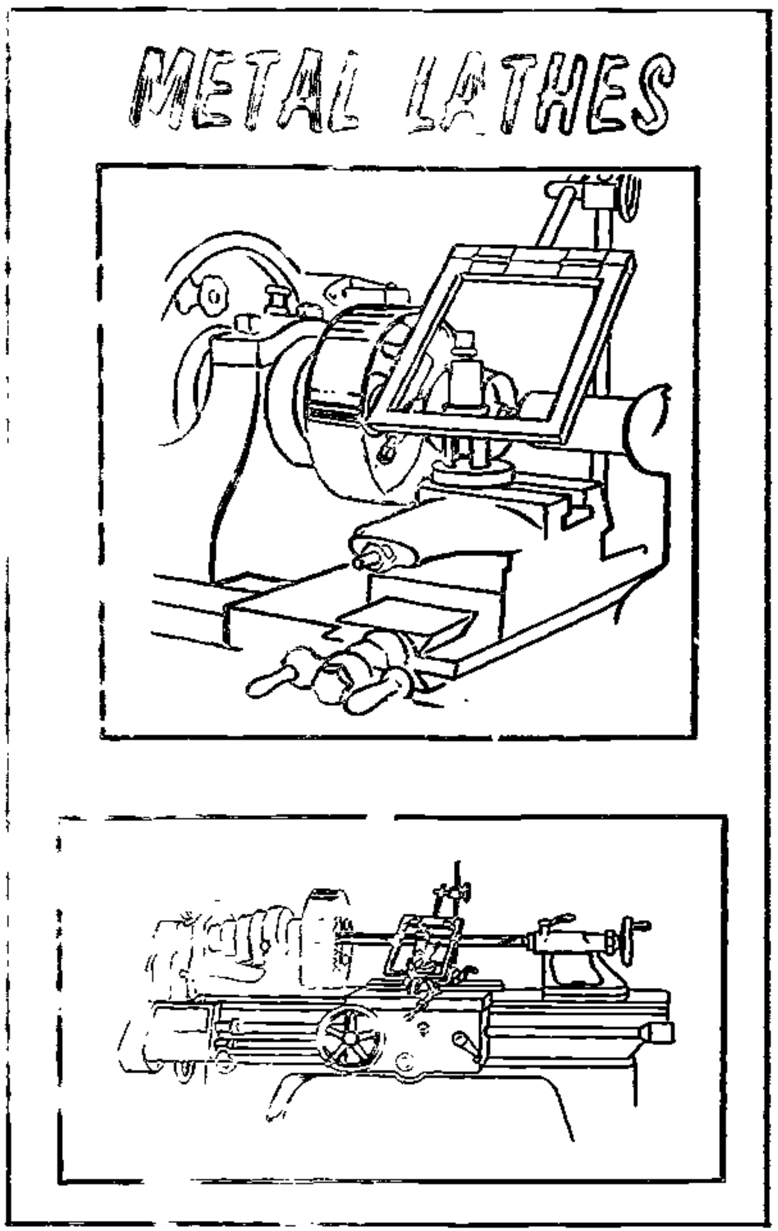


CHART 17—SERIES E

METAL LATHES	There are two main types of lathes: A. *The engine lathe* (includes the ordinary bench lathe). This is the regular revolving or turning lathe found in the majority of machine shops. B. *The turret lathe.* Here a number of tools are fixed in a monitor or turret, pivoted so as to revolve and present any of the various tools to the work. In many automatic lathes and screw-machines, the motions of the work and the turret are directed by a *cam wheel*, and the finished pieces of work are dropped out continuously at one end, while a bar from which the pieces are formed is fed at the other end.
MECHANICAL AND OPERATIONAL HAZARDS	
POWER TRANSMISSION	Lathes may be driven by individual motors or from a line shaft, comprising belt and pulleys, also exposed gears in the headstock.

MOVING PARTS	1. Contact with projections on faceplates and chucks. 2. Contact with lathe dogs (especially projecting set screws). 3. Filing with the right hand, especially near dog or chuck, or using the hand instead of a stick to hold emery cloth against the work.
POINT OF OPERATION	4. Calipering or gaging the job while the machine is in operation. 5. Accidental contact with the tool. 6. Attempting to clean chips while machine is in operation. 7. Contacting projections on work or stock.
FLYING PARTICLES	On some types of metals, a continuous spiral is produced which frequently causes injuries to the hands, arms, or face; also, small particles are thrown off, creating a hazard to the eyes of operators and others.
CONTROL OF HAZARDS	
POWER TRANSMISSION GUARDS	All belts, pulleys, shafting, gears, etc., should be guarded in accordance with ASA standards.
MOVING PARTS GUARDS	A guard should be provided for the faceplate and chuck to protect the operator from accidental contact with them. If possible, faceplates and chucks should be without projections. Safety type lathe dogs should be substituted for ordinary ones. All filing should be done with the left hand, and the file should be kept away from the chuck and lathe dog.
POINT-OF-OPERATION GUARDS	A wire mesh or plastic guard should be provided which will protect the operator from accidental contact with the tool and from flying chips.
CONTROL OF OPERATIONAL HAZARDS	Care should be taken to remove chuck keys from the chuck sockets before the lathe is started. The floor and aisle area should be kept clear, and all tools, extra work, stock, etc., should be placed in a suitable rack. A lifting device should be provided for changing chucks, face plates, etc. Center holes of taper work should be clean and true, and lathe centers, true and sharp. The work should be well countersunk at the tailstock end to eliminate any danger or to keep work from being torn loose. Chips should be removed as follows: Continuous spiral chips should be removed with a hooked rod, never with the hand; small chips should be removed with a brush. Remove chips only after the lathe has completely stopped.
SAFE CLOTHING	Lathe operators should not wear gloves, neckties, loose clothing, long sleeves, nor wrist watches, chains, rings, etc., while operating the lathe. Gloves may be worn if there is a hazard from handling work with burrs

	or sharp edges, but should be taken off before starting the lathe. Always wear goggles or face shields for protection against flying chips and oil spatters. Operators should wash thoroughly and wear clothes free of oil. Operators should wear a hat or cap while working.

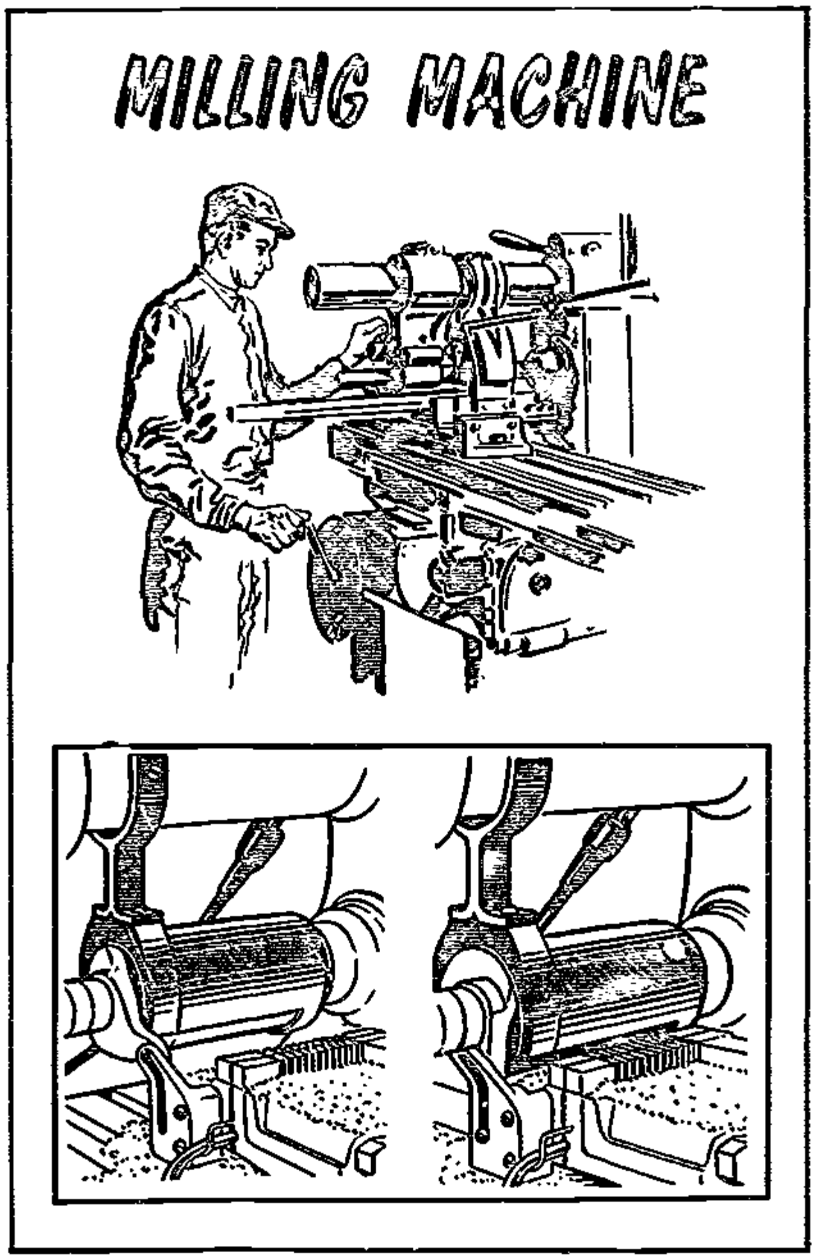


CHART 18—SERIES E

MILLING MACHINE	There are several types of milling machines. The following are the four most common ones: *Horizontal*—having the spindle horizontal to the table. *Vertical*—having the spindle vertical to the table. *Plain*—with tables that cannot swivel. *Universal*—with tables that can swivel up to 90 degrees of horizontal position.
MECHANICAL AND OPERATIONAL HAZARDS	
POWER TRANSMISSION	Milling machines may be driven by individual motors or from a line-shaft, comprising belt and pulleys.

POINT OF OPERATION	Accidental contact with the cutter or cutters by the operator or others. There is danger of the cutters breaking under strain, and pieces may fly, creating a hazard to the operator and others.
CONTROL OF HAZARDS	
POWER TRANSMISSION GUARDS	All belts, pulleys, shafting, and gears should be guarded in accordance with the ASA standards.
POINT-OF-OPERATION GUARDS	There should be a fixed hood over the cutter or cutters clamped firmly to the overhead arm and adjustable to the work being done. This should effectively protect the operator against accidental contact with the cutters and against flying chips and fragments.
CONTROL OF OPERATIONAL HAZARDS	Coolant should be directed on that part of the tool which is turning away from the work. Work should always be clamped firmly to the table before the milling machine is started. Operators should remove chips with a brush at regular intervals while the milling machine is stopped. Snug clothing should be worn when operating milling machines. The wearing of loose clothing, neckties, long sleeves, wrist watches, rings, etc., should be prohibited. Milling machine operators should wash thoroughly to prevent danger of dermatitis and infections from lubricants. All guards should be in place while the machine is running. Operators should wear face shields or safety goggles to protect their eyes from chips and other objects, such as pieces of the cutter. The machine should be stopped before measuring the work.

PLANERS

(METAL)

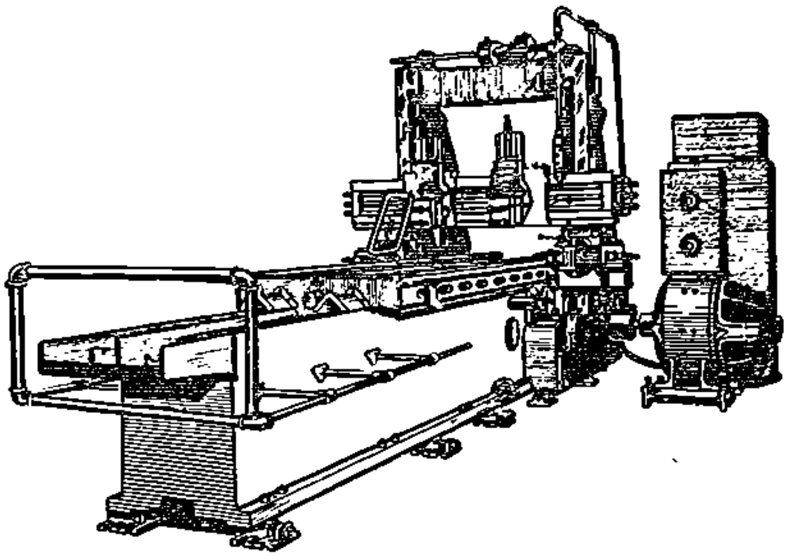


CHART 19—SERIES E

METAL PLANER AND SHAPER	The three types of metal working planers are: Single head. Double head. Open side. The metal planer, like many other machine shop power tools, is not dangerous to operate if certain safeguards are installed and if the operator is experienced and careful to closely follow safety rules and safe operating procedures.
MECHANICAL AND OPERATIONAL HAZARDS	
POWER TRANSMISSION	Planers may be driven by individual motors or from a lineshaft, comprising belt and pulleys. Counterweight and exposed power gears. Contact with reversing dogs.
POINT OF OPERATION	Contact with the tool. Breaking of tool or gouging of work caused by cutting tools shifting and cutting into work.

OPERATIONAL HAZARDS	Work breaking loose because it was not wedged and clamped securely. Failing to turn on current when a magnetic chuck is used (before starting the planer). Cutting hands on sharp edges of work. Having insufficient clearance for the work. Flying chips or particles thrown off, creating a hazard to the eyes of the operator and others.
CONTROL OF HAZARDS	
POWER TRANSMISSION GUARDS	All belts, pulleys, shafting, gears, etc., should be guarded in accordance with ASA standards. Counterweights should be guarded from the floor, extending upward throughout the travel of the counterweight. The reversing dogs on planers (and shapers) should be covered.
POINT-OF-OPERATION GUARD	A hinged guard made of wire mesh or plastic should be provided which will protect the operator from accidental contact with the tool and from flying chips. The tool should be set so that if it shifts, it will raise away from the cut and will not dig into the work. All work should be clamped properly and securely before planer is started. When magnetic chucks are used, the work should be set in its proper position and the current turned on before the planer is started. A chip guard of heavy close-mesh wire screen or of heavy clear plastic material should be placed over the tool to prevent chips from flying and striking the operator or other workers.
MOVING PARTS GUARDS	All openings in the beds of planers should be covered with a permanent covering of solid heavy sheet metal to prevent a person from being caught between the bed and the planer table and to prevent the space from being used for the storage of tools and other articles. When the planer table is placed or materials thereon travel to within 18 inches of a post, wall, or other obstruction, the space between the end of the planer and such wall or object should be protected by a standard railing on each side of such space. Safety dogs should be placed at each end of the planer table to prevent it from running off the gear rack.
CONTROL OF OPERATIONAL HAZARDS	1. Before starting a planer or shaper, check the condition of the machine and its setup; be sure all guards are in place. 2. If any adjustments or repairs are necessary, stop the machine to make them. 3. Use a brush to remove chips.

	4. Keep floor area clear. 5. Do not leave tools under the "bed." 6. Wear goggles. 7. Wear snugly fitting clothes, short sleeves, and no necktie. 8. The planer should never be left running unattended.

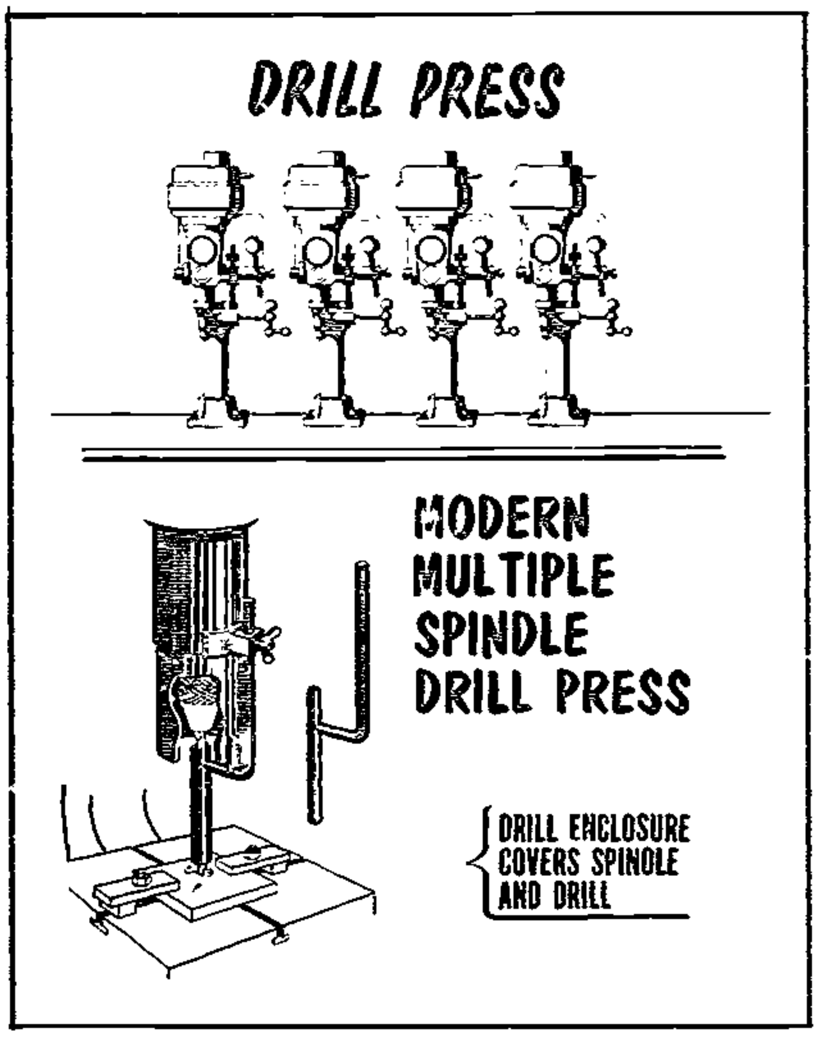


CHART 20—SERIES E

DRILL PRESSES	There are three main types of drill presses: Upright (vertical spindle). Multiple spindle. Radial.
MECHANICAL AND OPERATIONAL HAZARDS	
POWER TRANSMISSION	Drill presses may be driven by individual motors or from a lineshaft, comprising belts and pulleys. There is also the hazard of gears, spindles, and counterweights.
POINT OF OPERATION	1. Contact with the drill. 2. Work slipping or turning because it was not properly clamped. 3. Catching clothes or hair in drill, chuck, or spindle. 4. Attempting to clean chips while drill is turning. 5. Breaking the drill (flying pieces).

CONTROL OF HAZARDS	
POWER TRANSMISSION GUARDS	All belts, pulleys, shafting, gears, etc., should be guarded in accordance with ASA standards.
COUNTER-WEIGHTS	Counterweights should be enclosed with guards, preferably iron pipe or sheet metal and angle iron, from the floor to the top of the weight when in extreme upward position.
EMERGENCY STOP	An emergency stopping device should be provided within easy reach of the operator. (If motor-driven, stop-and-start buttons are acceptable.)
POINT-OF-OPERATION GUARDS	Where practical, a telescope guard should be installed over the drill and spindle to protect against accidental contact. All work should be firmly and securely clamped to the table before starting the drill press.
CONTROL OF OPERATIONAL HAZARDS	Operators of the drill press should wear snugly fitted clothes, short sleeves, and no necktie. Hair should be confined in a proper hair net, snood, or cap (if a woman), or a cap (if a man). A brush or stick should be used to remove chips from a drill. File or scrape all burrs from drill hole. This should be done while drill is stopped. Do not operate the drill at excessive speed or feed; the drill may break or shatter. Chuck wrenches should not be left in chucks or on the table. All tools and loose material should be removed from the table before starting the machine. Operators should shut off power and be certain the machine has stopped before leaving. Goggles should be worn when operating drill presses.

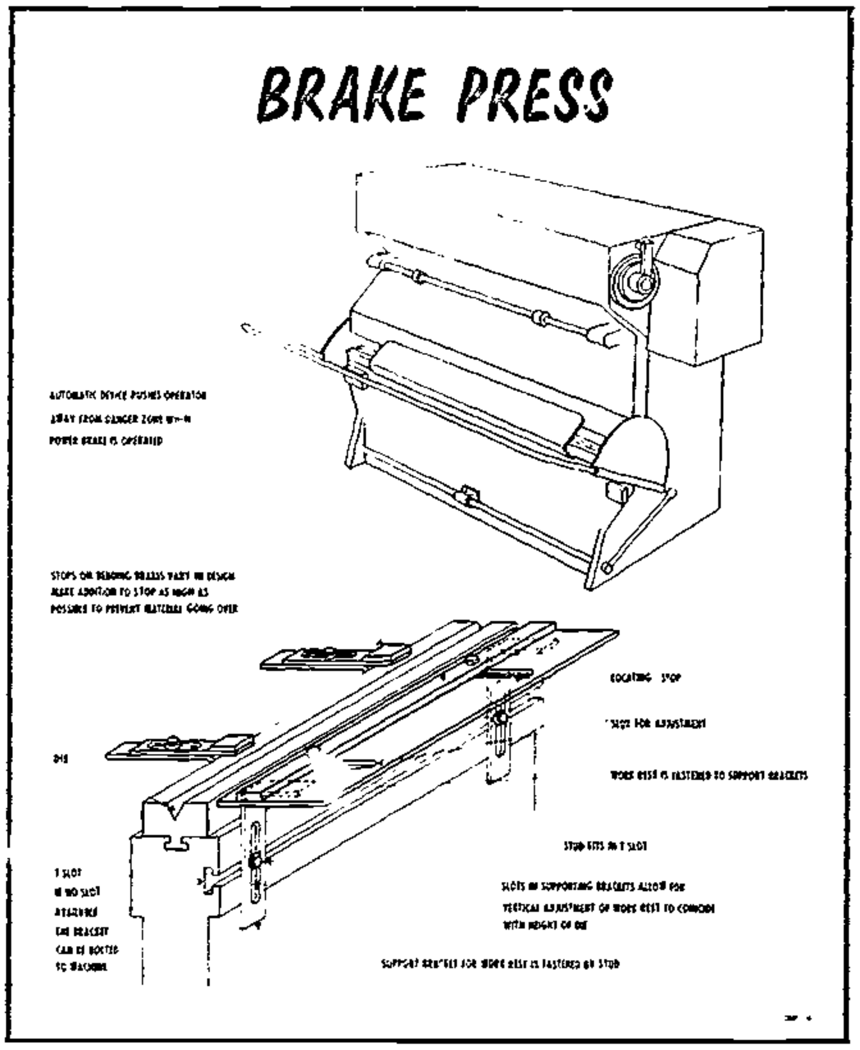


CHART 21 — SERIES E

BRAKE PRESS	The brake press is also called the "press brake," "bending brake," "power brake," "bending press," etc. This press is a development of the "hand brake" or "folder." Its primary function is forming (cold) channels, angles, etc., in metal plates, strips, and in sheet metal. It is used less frequently for punching, corrugating, notching, trimming, embossing, and for other operations usually performed on other types of presses.
MECHANICAL AND OPERATIONAL HAZARDS	
POWER TRANSMISSION	Contact with power pulleys, gears, chains, cranks, couplings and other moving parts exposed to contact.
POINT OF OPERATION	Fingers or hands may be crushed between the punch and the die or between the work and the ram. Cuts from contact with work being processed.

CONTROL OF HAZARDS	
POWER TRANSMISSION GUARDS	All belts, pulleys, gears, chains, cranks, couplings and other moving parts should be guarded with complete enclosures of either sheet metal or standard guards to a height of at least 7 feet from the floor or working platform.
POINT-OF-OPERATION GUARDS	When narrow stock is being worked, the hands of the operator are very near the path followed by the ram. To reduce this hazard, equip the machine with mechanical safeguards and maintain them in good working order. The press should be provided with starting devices which will keep the hands of the operator out of the danger zone. These may include two-hand switches, or levers and treadle bars, foot pedals, and foot switches.
FOOT CONTROLS	Press brakes should be provided with foot controls for use on those jobs where the size of the stock being processed requires an operator to hold it in position. Before the ram is driven home, the two-hand buttons or levers are used to bring the die into position, allowing minimum clearance. The stock is then centered and formed by the further action of the ram which is actuated by the operator depressing the foot controls. Foot controls should be covered by stirrup guards. If a treadle bar is used, all portions of the bar should be covered except an area large enough for the operator's foot. These precautions are necessary to prevent accidental tripping.
CONTROL OF OPERATIONAL HAZARDS	Before the press action is started, it should be positively determined that there is adequate clearance for changing the shape of the stock being worked and that work stops or back gages are at the proper height. All parts of the control mechanism should be inspected at regular intervals, and the machine should be test-operated at the beginning of each shift; check especially the functioning of the disk-friction clutch. All replacement parts should be purchased from the manufacturer and his recommendations for the operation and maintenance of this machine should be followed. The operator should know the capacity of the machine and the three factors which determine the brake pressure required to form the material to be worked to a 90 degree bend (length of work, thickness of work, and the sharpness of the bend).

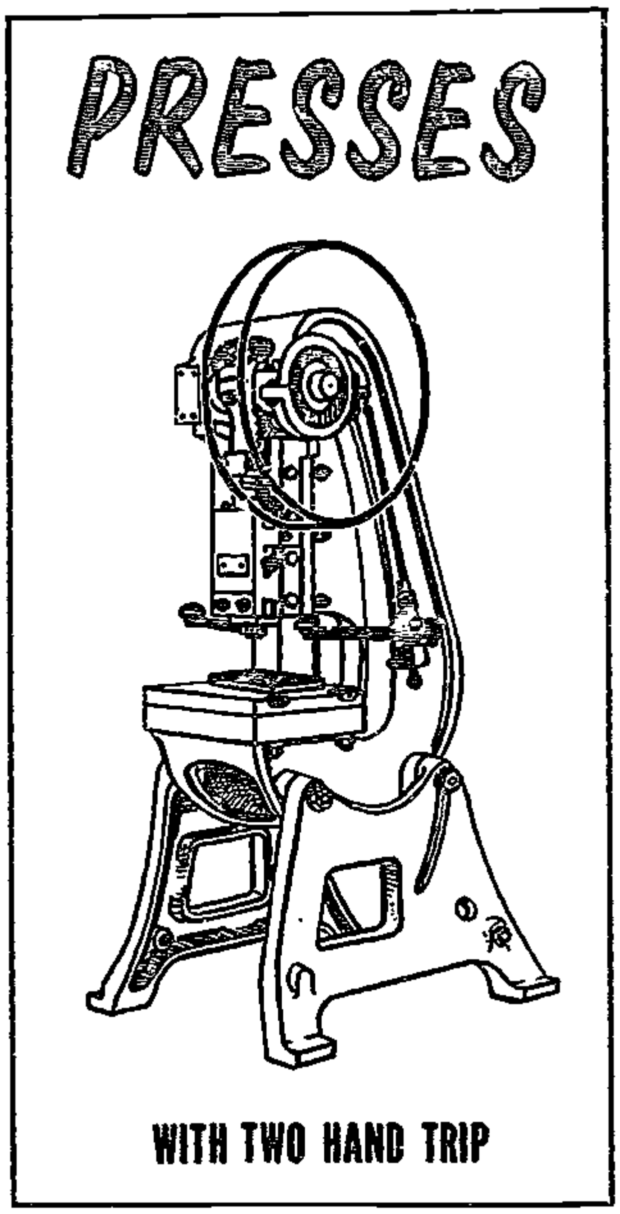


CHART 22—SERIES E

PRESSES	As a source of accidents, presses present possibly the most serious problem of any stationary machine in industry, particularly those accidents which result in permanent-partial injuries. The safeguarding of presses has been complicated by the wide variety of operations and operating conditions, owing to the variations in size, speed, and type of press; size, thickness, and kind of pieces to be worked; design and construction of dies; required accuracy of the finished work; skill of operators; and length of the run. (For more complete, specific information, please refer to ASA Standard Safety Code for Power Presses, B11.1—1960.) The most common types of presses are: Foot (kick or hand press). Power presses.

MECHANICAL AND OPERATIONAL HAZARDS	
POWER TRANSMISSION	Power presses may be driven by individual motors or from a lineshaft, comprising belts and pulleys, clutch and brakes, counterweights and cables, flywheels, gears crankshaft and attachments, foot treadle, tripping mechanism.
POINT OF OPERATION	Dies and ram hazards. Reaching into danger zone for any purpose. Repeating of press.
CONTROL OF HAZARDS	
POWER TRANSMISSION GUARDS	All belts, pulleys, gears, flywheels, etc., should be guarded in accordance with ASA standards. Any counterweights and cables should be enclosed with a guard extending to at least 7 feet from the floor. The crankshaft and its attachments should be inspected at regular intervals; if exposed to contact, it should be guarded to a height of at least 7 feet from the floor.
POINT-OF-OPERATION GUARDS	A careful study should be made of the specific operating hazard on a particular job on a specific press. The safest guard should be installed to eliminate the hazard, and it should be maintained on a regular schedule. Guards should be so designed and constructed that they completely protect the operator at the point of operation.
CONTROL OF OPERATIONAL HAZARDS	Positive means should be taken to make sure the press does not repeat. Before starting work, operate the press without feeding it until you are completely satisfied as to its safe condition. Check all safety devices before starting work. There should be complete protection at the danger zone. Adequate lighting is very important to safety (ASA standards). All repairs and adjustments should be made by competent, authorized persons. Automatic feeding devices should be provided wherever possible.

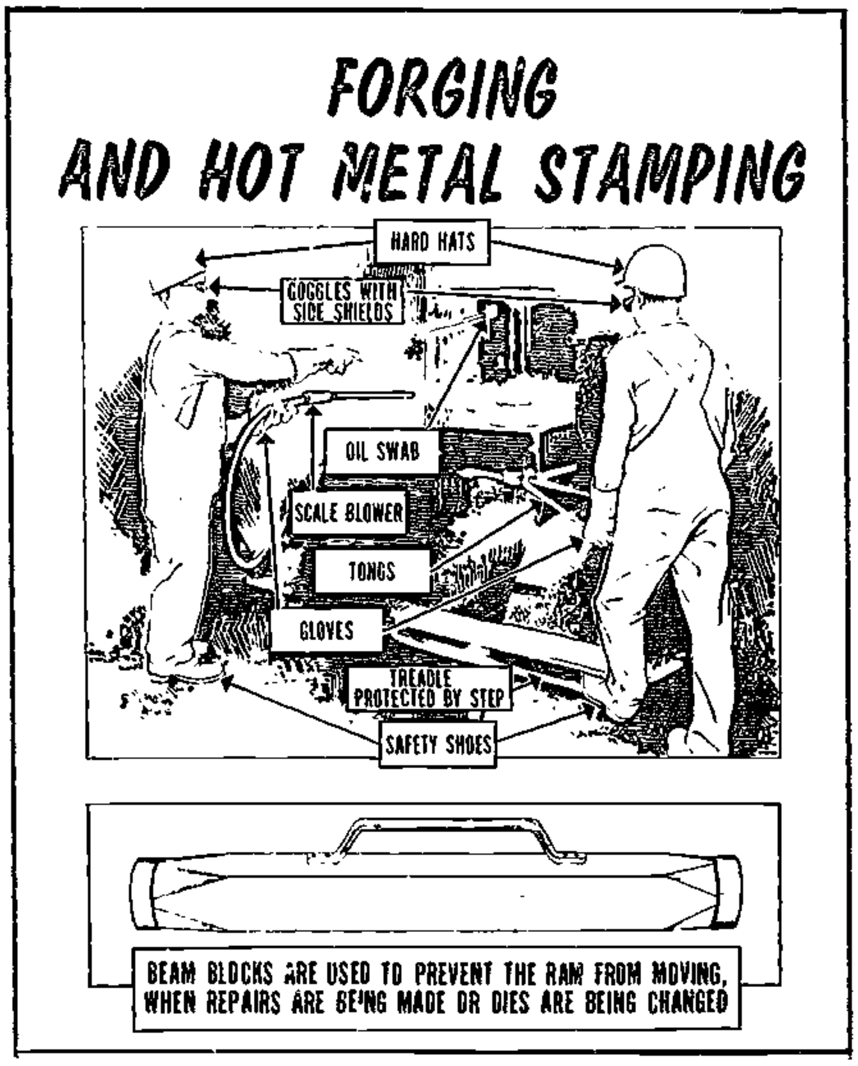


CHART 23—SERIES E

POWER HAMMERS	Power hammers may be classified in either of two different ways: Forging hammer or drop hammer. The classification is based upon the type of work that is to be done, and upon the manner in which the anvil is assembled in relation to the operating mechanism and machine supports; or they may be called steam hammers, pneumatic hammers, or mechanical hammers, the distinction being based upon the manner in which the ram is actuated.
MECHANICAL AND OPERATIONAL HAZARDS	
POWER TRANSMISSION	Unguarded flywheels, belts, pulleys, rolls, ropes, drums, etc.
POINT OF OPERATION	Danger of flying drift key fragments and hot scale. Danger of head injuries from ram or falling objects. Danger of fingers or hands being crushed in tong reins. Danger of crushing fingers, hands, or arms between ram and die.

CONTROL OF HAZARDS

POWER TRANSMISSION

All belts, pulleys, shafting and gears should be guarded in accordance with ASA standards.

CONTROL OF OPERATIONAL HAZARDS

The hammer should not be operated while dies are cold. The dies should be closed temporarily on a bar of hot metal until they are heated.

Goggles or face shields should be worn around all hammer operations.

Scale should be removed with a scale blower which has a long handle.

Safety shoes should be worn.

A guard bar or guardrail should be installed over the treadle so it cannot be accidentally tripped.

Keep treadle clear of tools and scrap to avoid accidental tripping.

Hard hats or skull-guards should be worn by operators and helpers while working on these machines.

Tongs should be used and maintained in good condition.

Adequate hand protection should be worn while working on rough, sharp, or hot work.

Oil swabs and scale blowers should have adequate handles to avoid injury to the hands of operators.

Care must be taken that persons are in the clear when ram is raised. A ram beam block should be used to support ram if it must be left raised (unattended, repairs, etc.).

Care must be exercised in the use of tongs (kickbacks can be fatal).

Keep hands in the clear when using tongs.

Keep hands, arms, fingers, and head from under the ram.

Strength and Dimensions for Ram (Beam) Blocks

Size of timber[1] (in inches)	Square inches in cross section	Minimum allowable crushing strength parallel to grain. (p.s.i.[2])	Maximum static load within short column range[3]	Safety factor	Maximum recommended weight of forging hammer for timber used	Maximum allowable length of timber (in inches)
4 x 4........	16	5,000	80,000	10	8,000	44
6 x 6........	36	5,000	180,000	10	18,000	66
8 x 8........	64	5,000	320,000	10	32,000	88
10 x 10.......	100	5,000	500,000	10	50,000	100
12 x 12.......	144	5,000	720,000	10	72,000	132

[1] Actual dimension.

[2] Adapted from U.S. Department of Agriculture Technical Bulletin 479. Hardwoods recommended are those whose ultimate crushing strengths in compression parallel to grain are 5,000 p.s.i. or greater.

[3] Slenderness ratio formula for short columns is $\frac{L}{d} = 11$, where L = length of timber in inches, d = least dimension in inches; this ratio should not exceed 11.

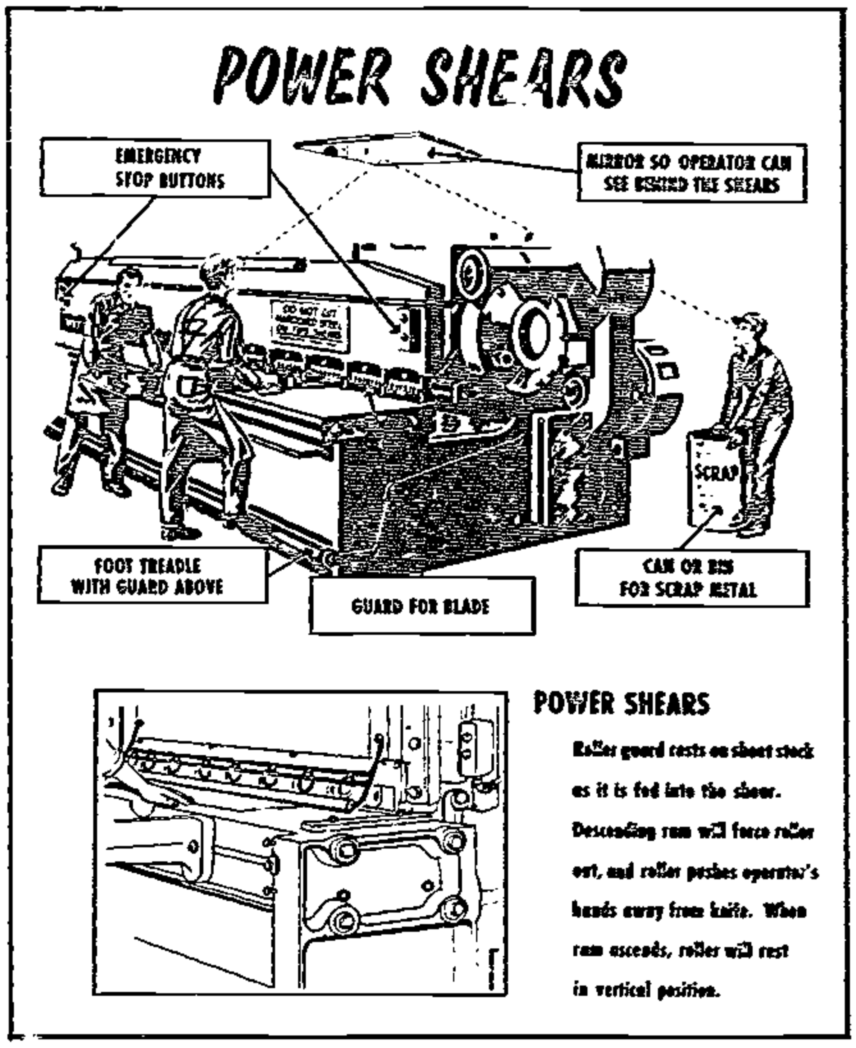


CHART 24—SERIES E

POWER SHEARS	Metal squaring shears are operated by any 1 of 3 means: hand, foot, or power. It should always be borne in mind that once the upper blade or knife has been set in motion, it cannot be stopped until the cutting stroke has been completed. Generally, a stock of material is placed on the cutting table and is fed into the shears by hand.
MECHANICAL AND OPERATIONAL HAZARDS	
POWER TRANSMISSION	Power shears may be driven by individual motors or from a lineshaft, comprising belts and pulleys.
POINT-OF-OPERATION HAZARDS	The exposed blade or knife on the feed side and at the rear of the machine. Possible accidental tripping of power shear.

CONTROL OF HAZARDS	
POWER TRANSMISSION GUARDS	All belts, pulleys, gears, and motor couplings should be enclosed in standard guards of angle iron with a filler of wire mesh, or expanded, perforated sheet metal (should conform to the requirements of ASA standards). Belt-driven shears should be equipped with positive acting and locking belt shifters. Start and stop buttons on motor-driven shears should be located within easy reach of the operator, preferably where they cannot be accidentally struck.
POINT-OF-OPERATION GUARDS	The movable knife on both foot- and power-operated shears should be protected by a fixed barrier guard the entire length of the table, extending downward to within three-eighths inch of the table, so as to admit the work but not the fingers. Any slots, perforations, or other openings in the guard should not exceed one-fourth inch between the knife or blade and the guard at all points. On foot- and power-operated shears, this guard should be located in front of the holddown, which can be guarded separately, or as a part of the knife guard. The back of the knife should be so guarded that a person cannot get his fingers under the knife. Before putting the shears in operation, the operator should always be sure that everyone is in the clear.
FOOT TREADLE GUARD	The foot treadle should be equipped with a guard, running the full length of the treadle, so arranged that the treadle cannot be accidentally tripped.
CONTROL OF OPERATIONAL HAZARDS	Boxes, bins, or other containers should be provided and used to keep scrap off the floor. Placed on every shear should be a warning sign reading, "Do not cut hardened steel," also a plate showing the cutting capacity. Only experienced operators should be allowed to operate shears. Operators should not wear torn or loose fitting clothes. They should wear safety shoes.

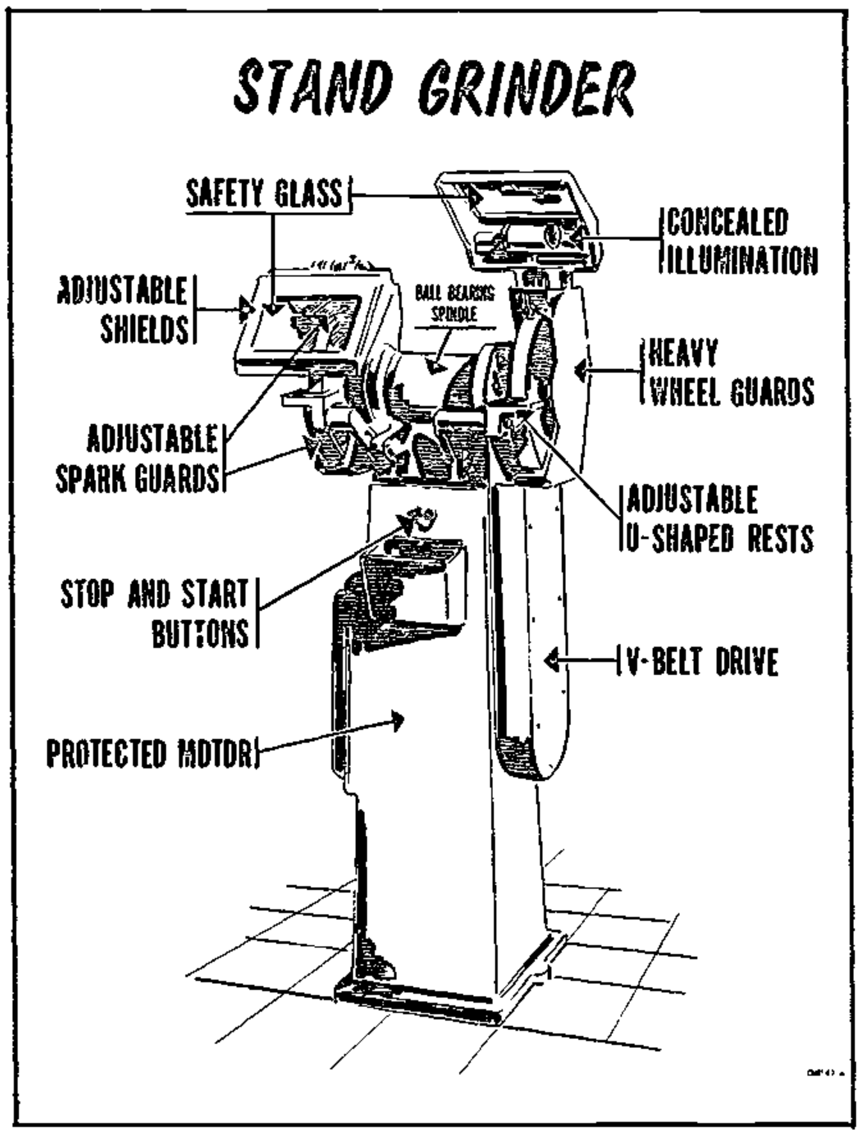
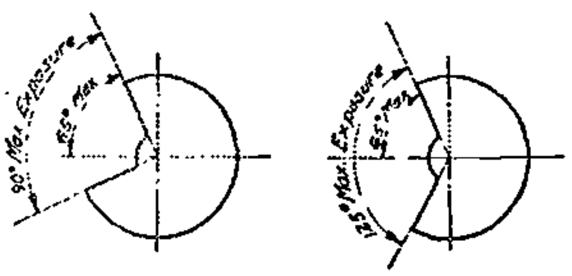


CHART 25—SERIES E

TYPES OF GRINDING MACHINES AND ABRASIVE WHEELS	For the purpose of this discussion, we will consider only the "stand grinder," although there are many types. These include bench, floor, swing frame, portable, precision, surface, cutoff grinder, etc. The types of wheels include plain (or straight) wheel, straight cup wheel, tapered wheel, cylindrical wheel, taper cup wheel, cutting-off wheel, dish wheel, etc.
MECHANICAL AND OPERATIONAL HAZARDS	
POWER TRANSMISSION	Stand grinders may be driven by individual motors or from a lineshaft, comprising belts and pulleys.
POINT OF OPERATION	Work getting caught between tool rest (or guard) and wheel. Hand coming into contact with the wheel. Clothing caught by wheel or by spindle ends. Tool rest (improper shape or size, wrong position, loose, worn).

WHEEL EXPLOSION	Flying fragments due to disintegration or "explosion" of abrasive wheel. This may result from: Improper mounting of the wheel. Cracks or flaws in the wheel. Incorrect wheel for the work. Wheel being run too fast. Flanges (lack of flanges, unequal size, etc.). Improper use of wheel (excessive shock, etc.). Vibration caused by the wheel's being out of balance, worn bearings, etc. Vibration caused by the use of abrasive wheel on buffing wheel stand, etc. Side pressure on wheels not designed for that work. Work being caught between tool rest or guard and the wheel.
FLYING PARTICLES	Particles from material being ground as well as wheel particles.
CONTROL OF HAZARDS	
POWER TRANSMISSION GUARDS	Power transmission hazards of shafting, belts, pulley, etc., should be guarded in accordance with ASA standards.
POINT-OF-OPERATION GUARDS	Abrasive wheels should be guarded in accordance with ASA standards; for example: The angular exposure of the grinding wheel periphery and sides for safety guards used on these machines should not exceed 90 degrees or one-fourth of the periphery. This exposure shall begin at a point not more than 65 degrees above the horizontal plane of the wheel spindle. Wherever the nature of the work requires contact with the wheel below the horizontal plane of the spindle, the exposure shall not exceed 125 degrees. Tool rests should be kept adjusted close to the wheel, and secured rigidly in place, so they do not move while in use. Flanges should be of equal size.

Draw these sketches on the board and explain



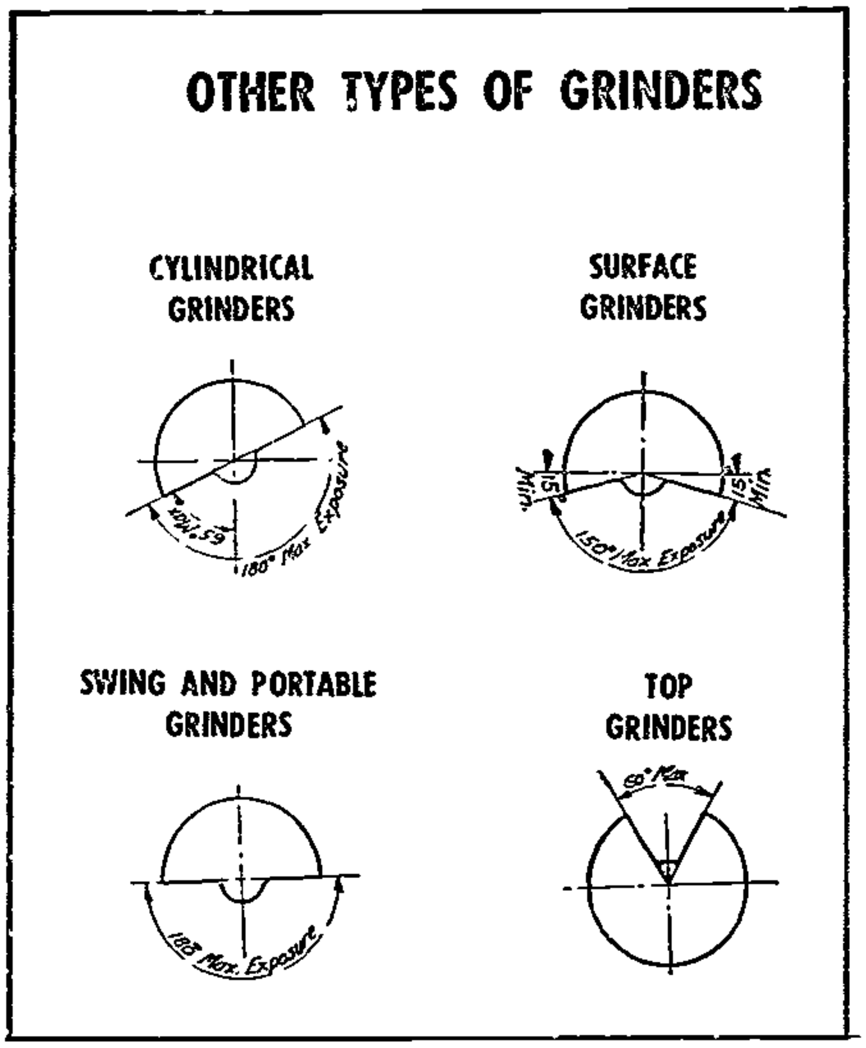


CHART 26—SERIES E

CYLINDRICAL GRINDERS	The maximum angular exposure of the grinding wheel periphery and sides for safety guards used on cylindrical grinding machines shall not exceed 180 degrees. The exposure shall begin at a point not more than 65 degrees above the horizontal plane of the wheel spindle.

Why do we insist on 65 degrees with horizontal even though allowing a wider opening for exceptional cases? (Sparks, metal in eyes, if higher.) This type of grinding requires even greater opening (180 degrees) but still has the angle start at 65 degrees with the horizontal.

SURFACE GRINDERS	The maximum angular exposure of the grinding wheel periphery and sides for safety guards used on cutting off machines and on surface grinding machines which employ the wheel periphery shall not exceed 150 degrees. This exposure shall begin at a point not less than 15 degrees below the horizontal plane of the wheel spindle.

SWING AND PORTABLE GRINDERS	The maximum angular exposure of the grinding wheel periphery and sides for safety guards used on these machines must be not more than 180 degrees. Exposed underside usually protected some by work it does (inside grinding).
TOP GRINDING	There are cases of grinding where only the top of the wheel is used. Where the work is applied to the wheel above the horizontal center line, the exposure of the grinding wheel periphery must be as small as possible, and shall not exceed 60 degrees.
STORAGE	Suitable racks, bins or drawers shall be provided to store the various types of wheels used. Stored wheels shall not be subject to extremes of temperature and humidity. Wheels can be damaged by high humidity and/or freezing temperatures.

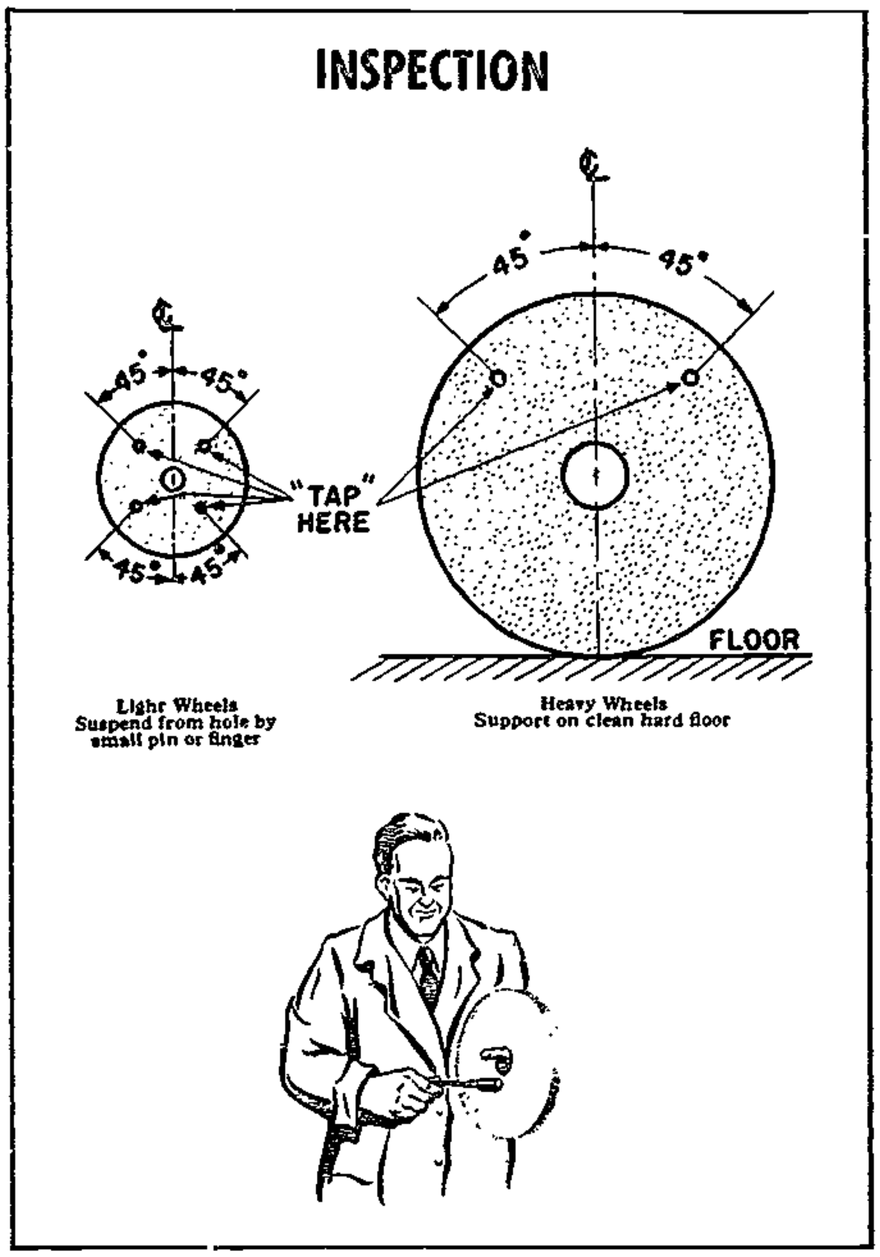


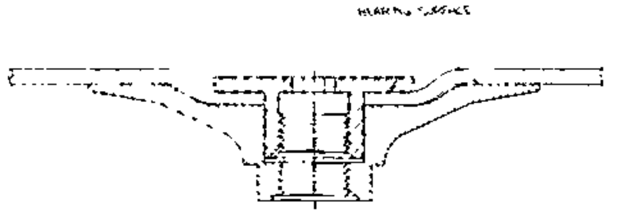
CHART 27—SERIES E

INSPECTION

Immediately after unpacking, all wheels should be carefully inspected to make sure that they have not been damaged by handling, shipping, or other causes. As an added precaution, wheels should be tapped gently with a light nonmetallic implement, such as the handle of a screwdriver for light wheels or a wooded mallet for heavier wheels. If they sound cracked (dead), they should not be used. Tap wheels about 45 degrees each side of the vertical center line and about 1 or 2 inches from the periphery, as indicated by the spots in chart 27. Then rotate the wheels 45 degrees and repeat the test. A sound and undamaged wheel will give a clear metallic tone. If cracked, there will be a "dead" sound and not a clear ring. This is known as the "ring" test. Wheels must be dry and free from sawdust when giving the ring test; otherwise, the sound will be deadened. It should also be noted that organic bonded wheels do not emit the same clear metallic ring as do vitrified and silicate wheels.

MAINTAINING EQUIPMENT	When operating grinding wheels on equipment specially designed for high speed, it shall be the responsibility of the user to maintain this equipment in safe operating condition at all times. Rules for the safe operation of this equipment submitted by the builder shall be observed.
ALTERED MACHINERY	If an existing machine is altered by the user to operate at special speeds, the user shall assume all of the responsibility of a machine builder.
INFORM ALL OPERATING PERSONNEL	The user shall fully inform all operating personnel that only wheels identified for operation at special speeds shall be used and that at no time shall the maximum speed marked on the wheel be exceeded. Protection to operating personnel, as well as adjacent areas, shall be maintained at all times.
POWER	Grinding machines should be supplied with sufficient power to maintain the rated spindle speed under all conditions of normal operation.
EXHAUST PROVISIONS	Stationary machines used for dry grinding should have provision made for connection to an exhaust system. For detailed recommendations, reference is made to American Standard for Ventilation Control of Grinding, Polishing, and Buffing Operations (Z43).
DIAMETER OF SPINDLE	Table 1 of ASA B7.1 shows the minimum diameters of spindles for wheels of various sizes. It applies to machines where wheels are not mounted between bearings. The use of heavier spindles than those listed in this table is often desirable.

GRINDING WHEEL MOUNTING



One type of adaptor for a Type 27 wheel.

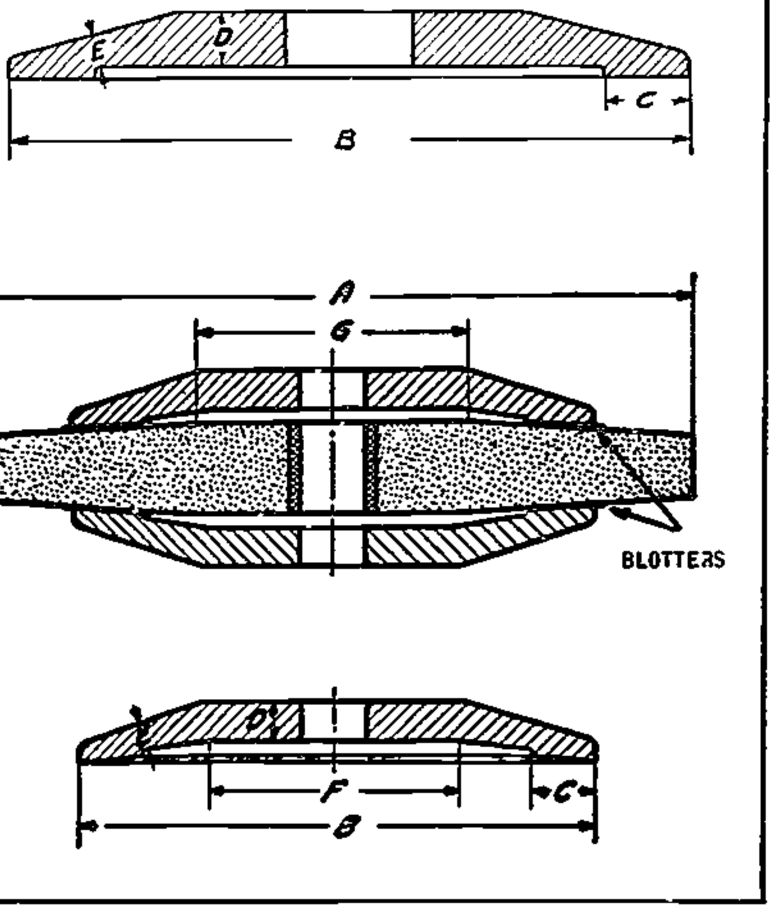


CHART 28—SERIES E

FLANGES

Grinding machines shall be equipped with flanges in accordance with the requirements shown below.

All abrasive wheels shall be mounted between flanges which should not be less than one-third the diameter of the wheel. Exceptions to this rule are listed below:

(1) Mounted wheels.

(2) Portable wheels with threaded inserts or projecting studs.

(3) Abrasive disks (inserted nuts, inserted washer, and stud type).

(4) Plate mounted wheels.

	(5) Cylinder, cup, or segmental wheels that are mounted in chucks. (6) Types 27 and 28 wheels which are mounted by means of a special adapter.

GRINDING WHEEL MOUNTING

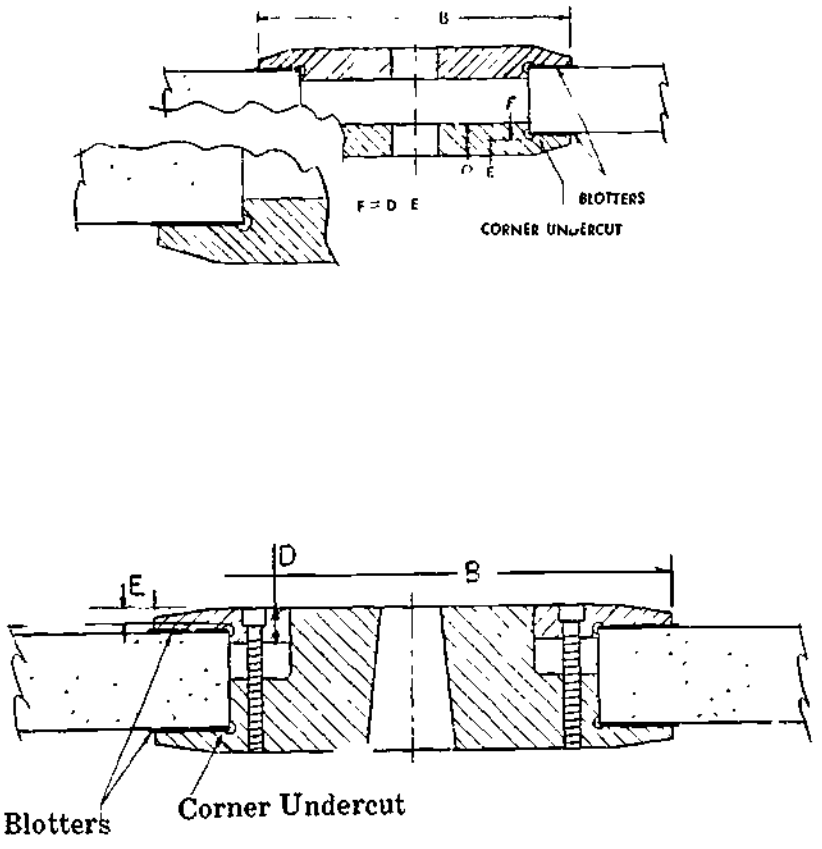


CHART 29—SERIES E

INSPECTION	There are four types of flanges: straight relieved flanges; straight unrelieved flanges; safety flanges and adapter flanges. Straight relieved flanges and tapered flanges shall be recessed at least 1/16 inch on the side next to the wheel for a distance as specified in the dimensions for these flanges. Straight flanges of the adapter or sleeve type should be undercut so that there will be no bearing on the sides of the wheel within ⅛ inch of the arbor hole.
WORK RESTS	On fixed base, offhand grinding machines, work rests shall be used to support the work. They shall be of rigid construction and designed to be adjustable to compensate for wheel wear.
LIMITING WHEEL DIAMETER	Grinding machines should be provided with a means of limiting the diameter of wheel which can be mounted. The safety guard is generally satisfactory for this purpose on single speed machines. On variable speed machines, the speed shifting device should be interlocked with an adjustable guard or other diameter limiting device to prevent the mounting of a wheel which might run at higher than the recommended surface speed.

WHEEL MANUFACTURER'S RESPONSIBILITY

It shall be the wheel manufacturer's responsibility to test wheels required for special speeds and so identify them.

MANUFACTURER'S TEST

It shall be the wheel manufacturer's responsibility to speed test wheels to determine their suitability for safe application.

Wheel Manufacturers Testing Speeds

Class of wheel	Operating speed (Surface feet per minute)	Minimum test factor[1]
Cutting-off wheels	All speeds	1.20
All bonds and wheel types (Except cutting-off wheels)	Up to 5,000	1.25
All bonds and wheel types (Except cutting-off wheels)	Faster than 5,000	1.50

[1] Actual operating speed shall be multiplied by this test factor to establish minimum speed at which wheels shall be tested by the wheel manufacturer.

IDENTIFICATION

It shall be the wheel manufacturer's responsibility to identify wheels which may be run at special speeds.

USER RESPONSIBILITY

The user shall be responsible for the proper handling, storage, and inspection of grinding wheels after receipt.

> The sections on Handling, Storage, and Inspection should be carefully reviewed by the class to assure a good understanding of all requirements.

HANDLING

All grinding wheels are breakable; therefore, care should be exercised in handling and storage to prevent damage. The following rules, which are based on experience, shall always be observed:

(1) Handle wheels carefully to prevent dropping or bumping.
(2) Do not roll wheels (hoop fashion).
(3) Use truck or suitable conveyors which will provide proper support for transportation of all wheels which cannot be carried by hand.

SPECIAL SPEEDS

The maximum safe operating speed marked on a wheel is not necessarily the most efficient grinding speed. Better results may be obtained at lower speeds.

Material used in construction of guard		Maximum thickness of grinding wheel	Grinding Wheel Diameters													
			3 to 5 inches		7 to 12 inches		13 to 16 inches		17 to 20 inches		21 to 24 inches		25 to 30 inches		31 to 48 inches	
			A	B	A	B	A	B	A	B	A	B	A	B	A	B
		(Inches)	(Inches)		(Inches)		(Inches)		(Inches)		(Inches)		(Inches)		(Inches)	
Materials satisfactory for speeds up to 7,000 feet per minute	Cast iron	2	1/4	1/4	3/8	5/16	1/2	3/8	5/8	1/2	7/8	5/8	1	3/4	1 1/4	1
		4	5/16	5/16	3/8	5/16	1/2	3/8	3/4	5/8	1	5/8	1 1/8	3/4	1 3/8	1
		6	3/8	5/16	1/2	7/16	5/8	1/2	1	5/8	1 1/8	3/4	1 1/4	7/8	1 1/2	1 1/8
	Malleable iron	2	1/4	1/4	3/8	5/16	1/2	3/8	5/8	1/2	3/4	5/8	7/8	3/4	1	7/8
		4	5/16	5/16	3/8	5/16	1/2	3/8	5/8	1/2	3/4	5/8	7/8	3/4	1 1/8	7/8
		6	3/8	5/16	3/8	5/16	5/8	1/2	3/4	5/8	7/8	5/8	1	3/4	1 1/4	7/8
Materials satisfactory for speeds up to 10,000 feet per minute[1]	Steel castings	2	1/4	1/4	1/4	1/4	3/8	3/8	1/2	7/16	5/8	1/2	3/4	5/8	7/8	3/4
		4	1/4	1/4	1/4	1/4	3/8	3/8	1/2	7/16	5/8	1/2	3/4	5/8	1	3/4
		6	3/8	1/4	3/8	1/4	1/2	3/8	5/8	1/2	3/4	5/8	7/8	3/4	1 1/8	3/4
	Structural steel	2	1/8	1/16	3/16	1/8	3/16	3/16	1/4	1/4	5/16	1/4	3/8	5/16	1/2	3/8
		4	1/8	1/16	3/16	1/8	3/16	3/16	1/4	1/4	5/16	1/4	3/8	5/16	1/2	3/8
		6	3/16	1/16	1/4	1/8	1/4	3/16	3/8	1/4	3/8	1/4	7/16	5/16	5/8	3/8

[1] Includes cutting-off wheels, 16 inches in diameter and smaller, at speeds not exceeding 16,000 SFPM.

REQUIREMENTS FOR SPECIAL SPEEDS	Wheels used on special applications at higher speeds shall be subject to the following four conditions: (A), (B), (C), and (D).
CONDITION (A)	The machine builder shall make certain at time of manufacture that the machine is of suitable design and adequately guarded for the operation in question. The machine user shall maintain the machine in satisfactory condition.
CONDITION (B)	The wheel manufacturer shall make certain that the wheels are of adequate strength, have been tested at suitable overspeed, and bear the wheel manufacturer's approval of the higher speed.

In those cases where the shape, size, construction, or use conditions of the wheel make a speed test impractical or unnecessary, the wheel manufacturer should establish the maximum operating speed by other equally effective tests or past experience. Examples of wheels which need not be speed tested are: Wheels less than 6 inches in diameter; diamond wheels; metal and organic bonds; ball grinding wheels; segment, and segment disks; regulating wheels (for centerless type grinders); mounted wheels.

CONDITION (C)	The machine user shall make certain that the machine is used with an approved safety guard.
CONDITION (D)	It shall be the machine builder's responsibility to consult with a wheel manufacturer to determine that a wheel for the special speed application can be manufactured and tested in accordance with the requirements established in the table on page 59.
MACHINE BUILDER'S RESPONSIBILITY	It shall be the responsibility of the machine builder to approve machines manufactured by him for operation at higher speeds. The following areas are of importance in this regard.
GENERAL MACHINE CONDITIONS	If an existing machine is to be adapted for use at a special speed, the general machine conditions shall be observed and all component parts of the grinding machine shall be checked and, if necessary, modified or adjusted prior to operating at the special speed.

Specific requirements are detailed as follows so that each requirement will be discussed and understood by the class.

MACHINE DESIGN	It shall be the machine manufacturer's responsibility to design, and the user's responsibility to maintain, his machines for safe operating condition.

Distribute occupational safety aid "Safeguarding Machinery" to the class.

OCCUPATIONAL SAFETY AID

SAFEGUARDING MACHINERY

AREAS REQUIRING MACHINE GUARDING

Machine guarding is divided into three logical classifications:

1. Power transmission

The moving parts (shafting; pulleys; belt, rope, and chain drives; gears, sprockets; friction drives; keys, set screws, and other projections; collars and couplings) that transmit power from the source to the working parts of the machine.

2. Moving parts

The accessories to transmission (control or feeding devices; prime movers, cranks, connecting rods, tailrods, governors; moving heads or tables) other than direct power transmission or point of operation.

3. Point of operation

That part of the machine which does the work on the material or object being processed.

REASONS FOR MACHINE GUARDING

1. There is no way to keep an operator's mind on his work all the time.
2. A dangerous mechanical condition will eventually catch this person off guard during one of these moments.
3. The more effectively you control the hazard, the less the chance of injury.
4. There is no place in proximity to machinery in motion to which men do not go at some time.
5. Reasonably safe machinery is a <u>must</u> to any successful plant safety program.

U. S. DEPARTMENT OF LABOR
Bureau of Labor Standards

IMPORTANCE OF GUARDING

The statement that men not machinery cause most accidents and injuries is highly misleading if not false.

The importance of machinery as a source of injuries is shown by getting the facts. The facts show machinery to be a major source of injuries in manufacturing industries.

1. In practically every case of injury both mechanical hazard and faulty behavior are present.
2. The large number of injuries and the high proportion of deaths and permanent disabilities arising from mechanical equipment is adequate evidence of the importance of machinery safeguarding.
3. Human practices and habits are difficult to control; mechanical safeguards are permanent.

FUNCTIONS OF THE IDEAL GUARD

A mechanical safeguard should meet all these requirements:

1. Full protection to the operator or passer-by.
2. Maximum protection for the repairman and oiler.
3. Be interlocked where possible so that the machine is inoperable unless the guard is in place.
4. Provide for safe oiling, repair, and adjustments.
5. Be strong and secure enough to resist wear and tear.
6. Be secure enough to retain broken machine parts in case of failure.
7. Must not introduce any hazards of its own.
8. Must not interfere with efficient production.

Properly designed guards give steadier, more reliable production and usually bring higher production as well.

CONSTRUCTION DETAILS:

Fundamentals to keep in mind when designing a mechanical safeguard:

1. Size of opening in a guard must be limited in accordance with the distance of guard from hazard point inside.
2. While specific size of opening in guards should be obtained from the standards table, the following "rule of thumb" may be used:
   - (a) Where a finger may reach through a guard to a moving part, openings must be limited to 3/8".
   - (b) Where moving parts are beyond the reach of fingers, care must be taken to keep hands out, limiting openings to 2".
3. Guards about points of operation should have satisfactory visibility of the point of operation so the operator will use them.
4. Openings left for oiling, repairing, or adjusting should have hinged gates or covers to prevent their being laid aside or left off. These gates should, where practical, be constructed to interlock the machine so machine will not operate with gate open.

ADVANTAGES OF HOMEMADE GUARDS

1. Often only practicable course with old, obsolete machinery.
2. Satisfactory and cheapest for transmission machinery if plant has own machine shop.
3. Are sometimes cheaper also for point of operation if the plant has the machinery and skill to make them.
4. Can be designed to fit a nonstandard situation.
5. Can be installed on individual dies and feeding mechanisms.
6. Safeguarding work by plant personnel can help to promote safety mindedness.

DISADVANTAGES OF HOMEMADE GUARDS

1. Can't be fitted into the design of the machine.
2. Often weak and not durable; not properly constructed.
3. Made by inexperienced personnel; value dependent on designer.
4. Difficult to make so as to interlock with controls.

ADVANTAGES OF MANUFACTURED GUARDS

1. Usually less expensive than homemade guards of similar effectiveness.
2. Guard is designed for standard machine models.
3. No danger of weakening the machine structure.
4. Strong, durable, and less likely to be removed.
5. Can often be made to interlock with controlling mechanism.

OTHER OPERATING HAZARDS

Important as machine guarding is, there are still numerous other elements to be considered in connection with machine operation. Among these are:

1. Unsafe arrangement of work area.
2. Faulty illumination.
3. Faulty ventilation.
4. Excessive heat or temperature change.
5. Monotony, noise and vibration.
6. Unsafe work clothing.

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Demolition. Safety in Industry, Instructor Outline, Construction Safety Series.

Otto, Francis L.
Bureau of Labor Standards, Washington, D.C.

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*SAFETY, *INDUSTRY, *DEMOLITION, CURRICULUM GUIDES, *TEACHING GUIDES, *INDUSTRIAL EDUCATION,

The sequence and basic content of a course on safety techniques in demolition are given in this instructor's outline. Additional information, materials, and illustrations should be included for a complete presentation suitable to the conditions, locality, industry, or occupational group. Black and white picture charts illustrate 47 safe and unsafe demolition practices. Each is discussed briefly. Some chart titles are (1) Unsafe Wrecking Methods, (2) Brick Cleaning, (3) Window Removal, (4) Warning Signs, (5) Flagman, (6) No Sidewalk Protection, (7) Unsafe Ladder Use, (8) Long Chute, (9) Standing Wall Section, (10) Demolition by Clamshell, (11) Steel Framing, (12) Burning Operation, and (13) Safe Working Methods. The outline was developed in the Office of Occupational Safety. This document is available as GPO L16.3--277 for 45 cents from Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402. (PS)

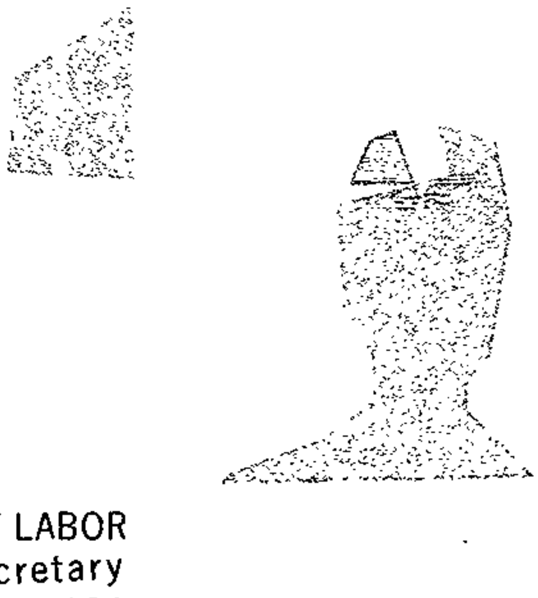
U. S. DEPARTMENT OF LABOR SAFETY TRAINING PROGRAMS

SAFETY IN INDUSTRY

INSTRUCTOR OUTLINE

CONSTRUCTION SAFETY SERIES

demolition



U[illegible] DEPARTMENT OF LABOR
W[illegible]illard Wirtz, Secretary
B[illegible]U OF LABOR STANDARDS
N[illegible]n M. Bortz, Director

Bulletin 277

The outline is intended only as a guide to standard presentation of the subject in sequence and basic content. Additional information, material, and illustrations should be included for a complete presentation suitable to the conditions, locality, industry, or occupational group.

This instructor outline was developed in the Office of Occupational Safety by Francis L. Otto.

For sale by the Superintendent of Documents, U.S. Government Printing Office
Washington, D.C., 20402 - Price 45 cents

SAFETY TRAINING TECHNIQUES

It is of utmost importance that the instructor become acquainted with some of the basic training techniques in order to better prepare himself to conduct the course successfully.

Planning

1. The instructor should have such visual aids as are pertinent to the subject matter of the course. These should be set up in proper sequence. An indication or note on the instructor's outline could be very helpful as a guide that a particular visual aid should be used.

2. The course outline as well as the handout material and the visual aids should be checked at regular intervals. This should be done by the instructor in order to revise, improve, and modernize the course presentation. The material should also be checked to make sure that it conforms with policies of labor and management in the country where it will be presented.

3. The instructor's outline should be adapted by him to his particular method of presentation, keeping in mind that this is a discussion conference type of session.

4. The instructor would do well to get an advance list of the students that will participate and their positions and backgrounds. A study of such information could be very helpful to the instructor when he faces his class.

Preparation of Classroom

Many conferences and courses have failed simply because no preparation was made for the classroom facilities.

1. The classroom should be located in an area where there is the least amount of noise or distraction.

2. Good ventilation, lighting, and sufficient room are important aspects to consider.

3. The seating arrangement and seats should be comfortable as well as informal. A round-table seating arrangement is the most effective for discussion-conference sessions.

4. The room should be equipped with a good blackboard, sufficient chalk, and clean eraser. A stand should be available for mounting the charts and visual aids to be used during the conference. A 35-mm. slide projector should be available.

Teaching

1. An official of the organization should open the first session with a statement regarding the general objectives of the course. He then should introduce the instructor to give him the proper posture in relation to the group he will teach.

2. At the first session, the instructor should open with an explanation of the course objectives and its method of presentation. At this time, he should draw upon his experiences to relate an illustrative incident that will bring him in closer relationship with the group and, at the same time, enable him to introduce the theme of the first session.

3. The course should be presented by employing the discussion-conference method.

4. The instructor should have the class follow a predetermined schedule and maintain order at all times. Only one participant should be permitted to give his viewpoint at a time. The instructor should keep the class discussion within the subject matter as contained in the instructor's outline.

5. If possible, an official should be asked to speak at the termination of the course.

Tips for Instructors

Learning is actually the acquisition of new ideas, abilities, and skills acquired through the senses of hearing, seeing, and feeling by touch.

1. New ideas are conveyed through the presentation of knowledge, and thought is stimulated through the student's sense of hearing.

Abilities and skills are presented through the media of telling, demonstrating, and having students demonstrate under the supervision of the instructor. Students acquire abilities and skills via the senses of hearing, seeing, and feeling by touch.

2. An important aspect of teaching is to remember that the student absorbs more when he participates in a discussion. The instructor therefore strives to get 100-percent class participation.

3. The instructor should become aware of outstanding characteristics of his students. This could be very helpful when leading discussions. For example:

A. Some may be more mature.
B. Some may have a knowledge of safety.
C. Some may have actual experience to draw on in the discussion.
D. Some may have a faster learning speed than others.
E. Some may be "stallers' who can slow down the discussion.
F. Others may be aggressive and want to monopolize the discussion.
G. There may be a "know-it-all" in the group who must be properly controlled.

   H. Some may be constant latecomers who ask questions about previous discussions and delay the class.

4. The teaching process consists of:
   - A. Telling—this means giving background information to introduce a subject.
   - B. Showing—a demonstration of some equipment pertaining to the subject to be discussed is very impressive.
   - C. Illustrating—using charts, blackboard, slide, or films are very helpful to highlight specific points in the discussion.
   - D. Discussion conference—the participation of the students in formulating their thinking about the subject under discussion is fundamental to getting the most out of the session.
   - E. Conclusions—the instructor's summation of the session should knit together the points discussed during the session, and should include other important details that may have been overlooked by the group.
   - F. Questions—during the session, the instructor should use questions to stimulate discussion, and also to help bring the discussion back to the subject matter if it has strayed.

Guest Instructors

It is necessary that the instructor be granted full responsibility for conduct of the class; at times, however, he may wish to call in an expert in a particular field as a guest instructor (or lecturer). In such event, it is essential that the instructor maintain control of the course.

The instructor must tie in the work of the guest instructor with the balance of the course; he must outline the phase of the subject to be covered by the guest and satisfy himself that the guest limits himself to the field as outlined; he should summarize the guest's contribution, pointing out its relative importance in the field of accident prevention. While the use of a few guest instructors (properly utilized) can add to the effectiveness of the course, a series of "lecturers" whose topics are not correlated will inevitably result in confusion.

It is recommended that "guest experts" be used only for *supplementary* training, and not to replace even part of this course which should be taught by *one instructor*.

DEMOLITION

DEMOLITION—Continued

Instructor Outline

DEMOLITION

INTRODUCTION	Fifty years ago, buildings were razed by salvage and scrap dealers to build up their stocks of used building materials. It was a high injury-rate occupation. Today, it is a highly specialized and competitive field, and a large and active industry in its own right. In spite of the changes in methods and equipment, and the advances which have been made, demolition still continues to be a high accident-and-injury producing industry.
INJURY RATES	Injury rates for demolition and operations continue to be unduly high, both per se and by comparison with other types of work. INSTRUCTOR NOTE: Fill in current figures in the following paragraph. Also explain what injury rates are. The most recent statistics show demolition to have a frequency rate of ——, which is the highest of the "special trades," and a severity rate of ——.
Reasons for High Injury Rates	Some contractors that do this work are not fully qualified. Each individual job is unusual in some ways. Demolition is a highly specialized field. Detailed planning and care are necessary, but are not always provided.

CONTRACT ASPECTS	The demolition contractor should establish, by legal agreement with the property owner and any others involved, what care, obligations, responsibilities, and other requirements he is to be liable for. A reasonable completion date should be included, since time-pressure often motivates chance-taking to meet deadlines. When a reasonable completion date cannot be specifically set for any reason (due to property acquisition problems, etc.), a fixed period after the START of demolition should be agreed upon.
ADVANCED JOB ANALYSIS AND PLANNING	Advanced job analysis and planning are necessary because unsafe acts and methods and other conditions resulting from the lack of advanced planning greatly increase the probability of accidents. Thoroughly planning the job, including safety, is a regular procedure of the leading organizations in this industry. INSTRUCTOR NOTE: Principles expressed in the instructor's outline on "Planning for Safety on the Jobsite" can be applied here. These principles should be explained to the degree that appears desirable for each group instructed.
SAFETY STANDARDS	On the one hand, not all jobs can be performed in the same way and standard methods which apply to all situations have not been developed. It is true that different jobs sometimes require different practices, which in turn produce varying rates of progress and types of hazards and problems. However, standards which can be APPLIED to all jobs and which will produce greater efficiency and a safer operation have been developed. INSTRUCTOR NOTE: As of 1966, ASA demolition standards are "in preparation." Recommend their use when published.

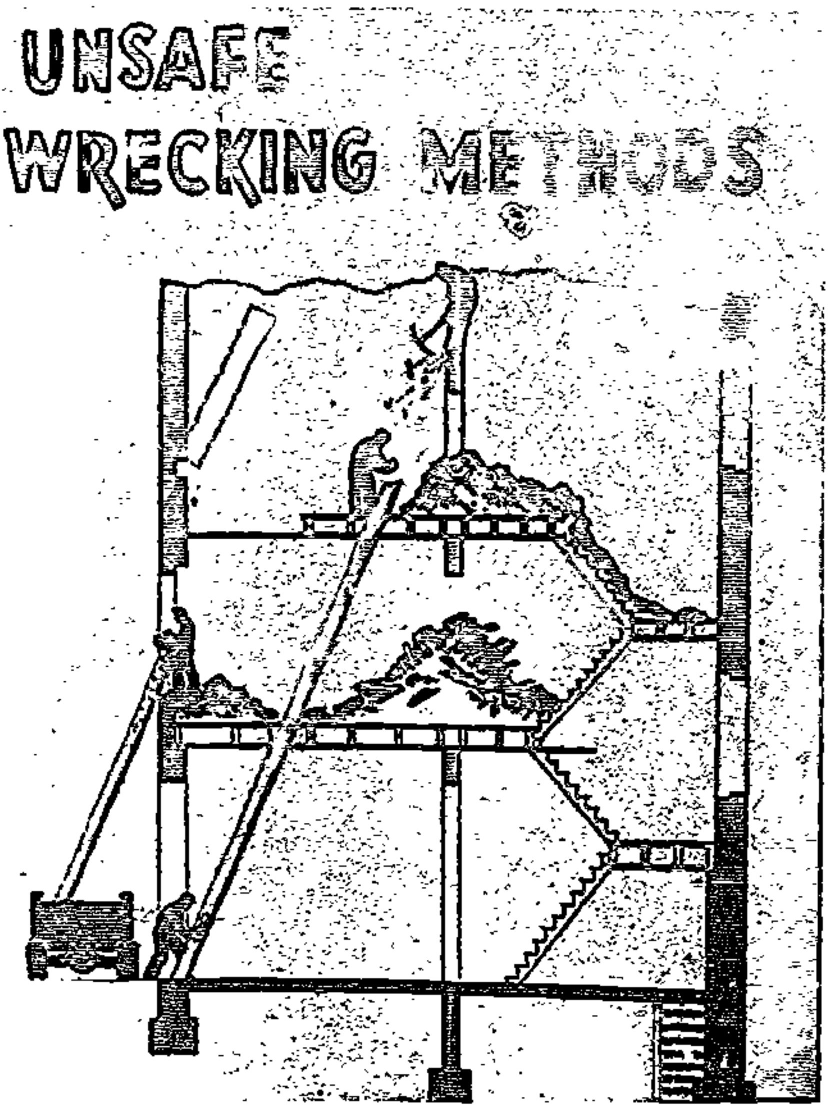


Chart 1. Unsafe Wrecking Methods.

Chart Discussion: UNSAFE WRECKING METHODS. At this point, comment briefly on the major areas which your subject will cover, as depicted by the slide: wall removal, floor holes, chutes, catch platforms, and other aspects of razing a structure.

SALVAGE AS AN EXAMPLE	Salvage can either increase or decrease hazards: decrease them due to the extra care used (the housekeeping necessary, for instance), and increase them due to the extra operations necessary (brick cleaning is an example).

Chart 2. Brick cleaning.

Chart Discussion: BRICK CLEANING. Point out the cost, the hazards, the supervision, and other problems represented by the operation depicted in this chart. Of course, the "other side" of the story can also be discussed as · ..

ELIMINATING OPERATIONS	Possible salvage profits must be compared with those of savings in time, efficiency, money, and reduced hazards which can be gained by eliminating some salvage operations, and making decisions as to the best course to follow.
WORK TIMING IS IMPORTANT	When demolition is to provide a location for a new structure, order of operations, orderliness on the site, and timing are very important. It is necessary to avoid delays to gain cost sav ., and to prevent an abnormal time-span between completion of the razing and the start of the next operation on the site.

CODES, RULES, ORDINANCES, AND OTHER REGULATIONS	**Applicability of Federal, State, or local codes, ordinances, or other regulations must be determined in advance, and plans made for compliance.**
ANTICIPATE COLLAPSE POSSIBILITIES	**An advance survey of the building should be made to determine the type and condition of the framing and walls (and other factors) to anticipate the possibility of collapse of any portion of the structure, or of adjacent structures.** **Any necessary shoring, bracing, underpinning, or other protection should be planned in advance.**

Chart 3. Bracing an adjacent building.

Chart Discussion: BRACING AN ADJACENT BUILDING. This chart shows bracing which was NOT erected in advance. This building started to settle into the excavation, causing it to crack and shift. Result was complete evacuation, condemnation, and its occupancy and use prohibited —a huge financial loss for the party responsible. Considerable loss of life could have resulted had the building COLLAPSED before the occupants were removed.

FLOOR LOAD PROBLEMS

When any unusual loads are to be imposed upon the floors of the structure to be demolished (storage, mobile equipment, etc.), steps should be taken to insure against, or compensate for, these overloads.

SPECIAL KNOWLEDGE NECESSARY	Although construction experience and knowledge are important in performing demolition, these operations also require a special know-how that many construction contractors do not possess.
REMEMBER THE OBJECTIVE	The site must be cleared as quickly as possible—at the least cost—but COMMENSURATE WITH the safety of the workers and the public.
PLAN FOR THE NEED	Operations, therefore, should always be preceded by thorough analysis of the job to plan the best applicable methods for accomplishing the work safely and quickly.
PREPARATORY OPERATIONS	Advanced planning and appraisal should bring out what these methods should be in each individual case.
APPRAISE ANY PRIOR DAMAGE	If the building has been damaged by fire, flood, explosion, or other cause, shoring or bracing should be installed, wherever necessary.
REMOVE HEALTH HAZARDS	If the building was used previously for storage or operations involving hazardous chemicals, explosives, certain flammable materials, or other dangerous substances, or if such items were used in any tanks, pipes, or other equipment on the property, all necessary steps should be taken to remove any remaining hazards. If the removal is not possible, or if the effect of attempted removal is questionable, personal protective measures should be applied.
REMOVE GLASS	Windows, glazed doors, and other glass and shatterable articles should be removed before actual demolition begins.

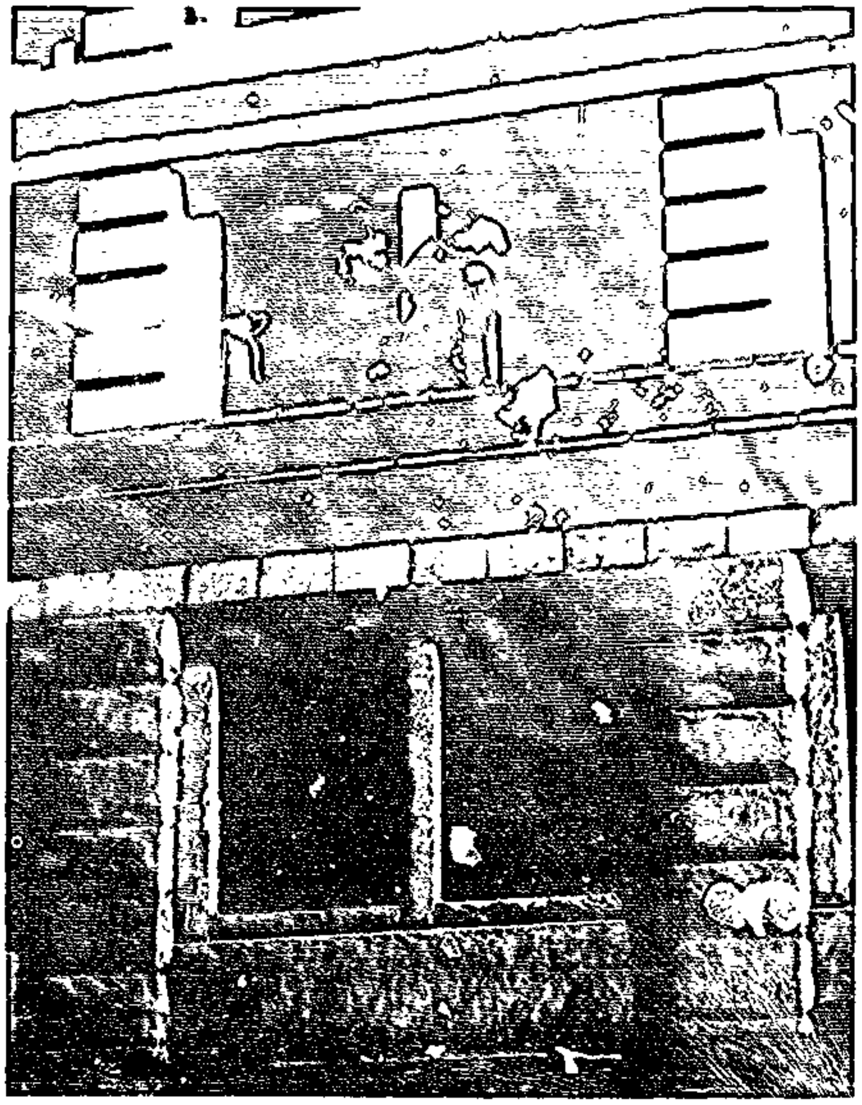


Chart 4. Window removal.

Chart Discussion: WINDOW REMOVAL. The point here is very simple: the windows were removed before regular razing began. A point to be made here, however, is in pointing out that the sidewalk shed should have been constructed before any other exterior work. (Also comment on incompleteness of shed.)

CLOSE UNNEEDED OPENINGS	Floor openings, shafts, or other apertures which are not to be used by workers or for the movement of materials should be covered, barricaded, or otherwise guarded. Exterior wall openings on all floors except grade should be protected by barricades at least 44 inches high or they should be closed off completely.

UTILITIES	Utilities, such as gas, water, steam, and similar service lines, should be cut off and capped outside the building line. Electric power should be disconnected outside the building line. Approval and cooperation of the utility company involved are usually needed, and sometimes its services. Sewer openings should be plugged to prevent storm water, debris, or other materials from entering the collection system. If any power, water, or other utilities are to be needed during demolition, these lines should be properly located and protected according to the recommendations of the utility company, and in compliance with any applicable codes.
CHECK STRUCTURAL MEMBER STRENGTH	All floor members should be checked to determine whether they are safe before workmen are sent in. Inspections should be continued during operations to detect weaknesses which may develop as a result of the work. Shoring or bracing should be installed as needed.
STARTING THE WORK	Except for cutting holes in the floor for chutes or material drops, for the preparation of storage space, or similar necessary preparatory work, the demolition of floors and exterior walls should begin at the top of the structure and proceed downward. Each story should be wrecked and removed before work is started on the story below. Suspended ceilings, floors, and similar structural segments should be removed from their supporting slabs before basic demolition operations begin.
PUBLIC AND GROUND-LEVEL PROTECTION	Protection of the public and that of his employees is probably more complex for the demolition contractor than for construction industry operators.
PROHIBITIVE LOSSES ARE POSSIBLE	Public liability, unlike worker-injury compensation which is limited, can result in awards which could be of near-disaster proportions for the contractor. It therefore behooves the demolition contractor to be very wary regarding the public's safety.
TRESPASSING AND VANDALISM	Trespassing and vandalism present definite public hazard problems. Work should start as promptly as possible after the demolition contractor assumes responsibility because— Vacant buildings present a legal liability for protecting the public, including trespassers and vandals. Catastrophe liability could also arise, as in the event of fire or explosion.

	If a building must be left vacant, it should be boarded up, barricaded, or otherwise protected to prevent entry by, or harm to, the public. This may even be required by ordinance or other code.
PUBLIC THOROUGHFARES	Arrangments should be made, if possible, to close off streets, sidewalks, or other public use facilities which may expose the public to a hazard. This is desirable to the contractor for the added protection it gives him. In some cases, street surfaces and sidewalks should be removed, altered, or relocated. In any event, any appreciable use of such facilities usually presents a need for corrective action before demolition begins, during the work, and sometimes after it is completed.

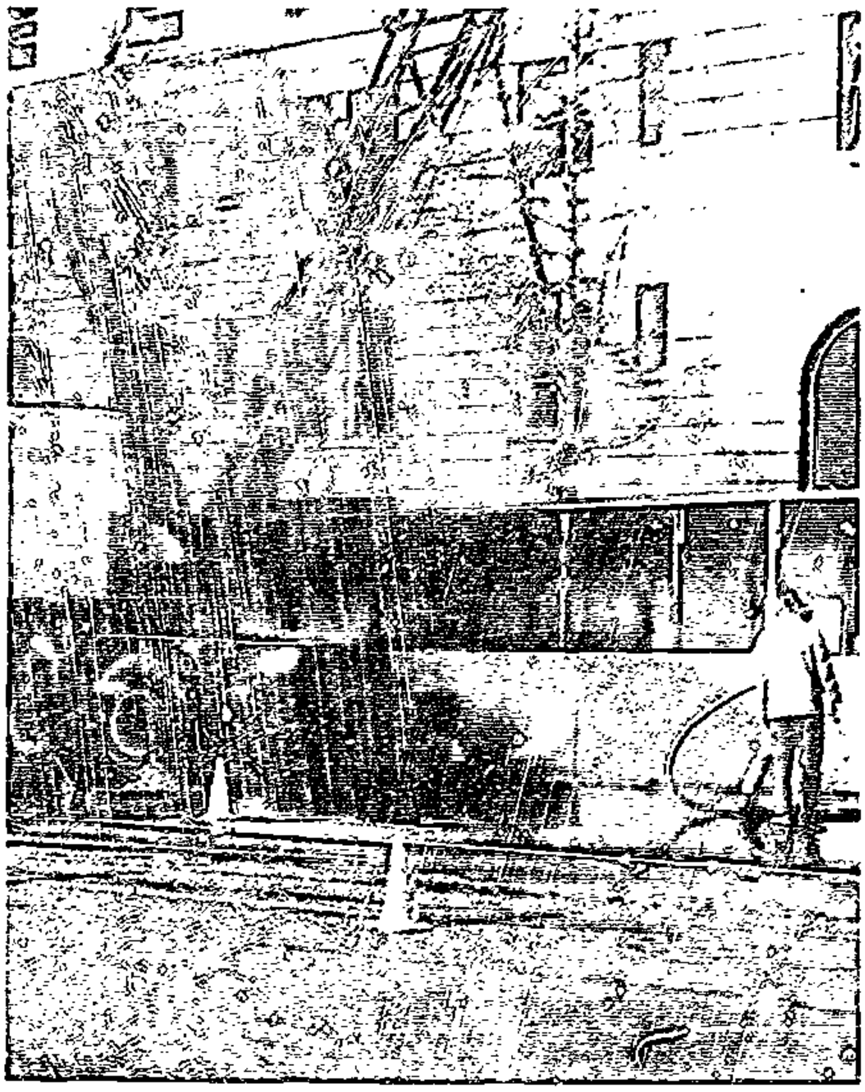


Chart 5. Street washing.

Chart Discussion: STREET WASHING. This illustrates washing down a street outside a job. Note flagman and markers for auto traffic.

MAINTAIN GOOD HOUSEKEEPING	**All public-use facilities should be kept clean, clear, unobstructed, and amply lighted at all times.**

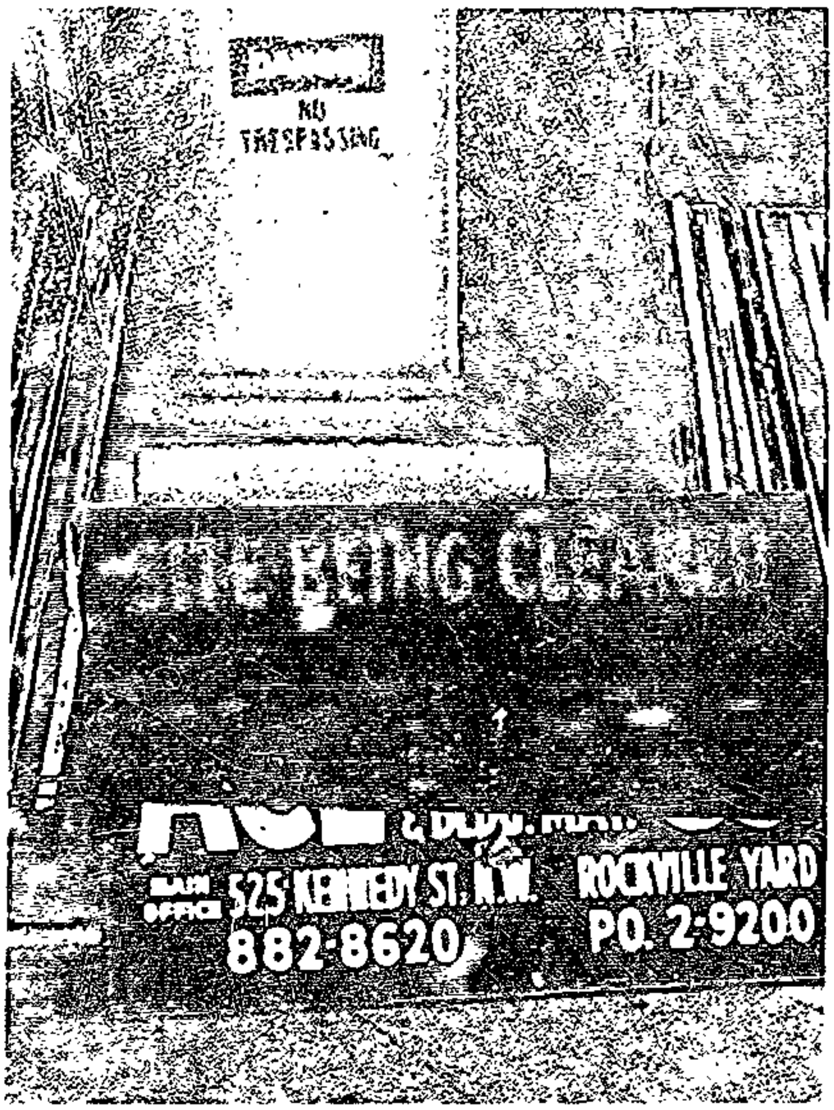


Chart 6. Warning signs.

Chart Discussion: WARNING SIGNS. These are not "shining examples" of the best warning signs, but they do depict the idea. It should also be stressed that the function of such signs is usually to supplement, not to substitute for, other protective devices.

WARNING DEVICES ARE NEEDED

Clear, understandable, durable, and easily seen "Danger" signs, designed effectively of ample size and when necessary properly illuminated, should be conspicuously located all around the area affected.

Dependable, bright red lights or flares should be strategically located and secured on all barricades, and elsewhere as needed, during the hours of darkness.

Lamps, torches, and similar flame-type lights should be located with care and secured firmly to prevent their becoming a fire or public hazard.

Chart 7. Debris on sidewalk and in street.

Chart Discussion: DEBRIS ON SIDEWALK AND IN STREET. Here is an example of flagrant disregard of public-protection principles. The sidewalk is completely covered, and the debris is well out into the streets. The old piece of two-by-four running out to the old nightstand is the only evidence of any protection for the public here.

CLOSE INGRESS POINTS	All outside openings of the structure and the surrounding work area should be effectively closed or barricaded, except when in actual use by personnel or by equipment. Doors or gates on such openings should not be permitted to open out into the line of travel of either pedestrians or vehicles.

PROVIDE GUARD	In many cases, a watchman should be provided when work is not in progress to maintain protective devices and to protect the public. The location of the job, or the extent or type of work, etc., may make it advisable to have a watchman on duty at all times.
TRAFFIC HAZARDS	Arrangements should be made for movement of vehicles and the security of the loads as protection of both the public and the workers involved. All truckloads, whether of dirt, debris, or other material, should be "trimmed" before leaving the jobsite. Any material which falls from a truck should be cleaned up immediately. A flagman should be provided to stop traffic and to direct vehicles in and out of the jobsite. When cranes or other equipment are in the street or jut out into it, a flagman, barricades, or other protective measures should be provided.

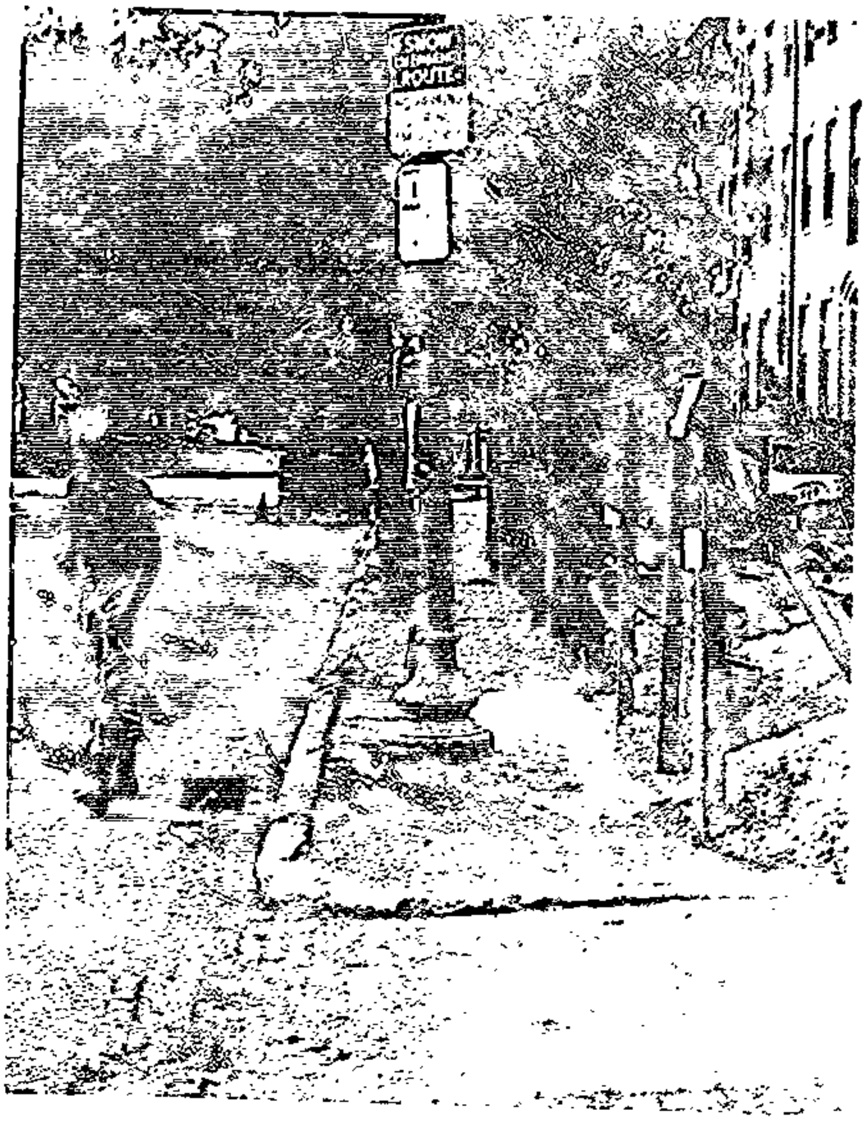


Chart 8. Cleaning up.

Chart Discussion: CLEANING UP. Any dirt, debris, or material which falls from a truck onto a public-use thoroughfare should be cleaned up immediately, as illustrated in this chart.

Chart 9. Flagman.

Chart Discussion: FLAGMAN. Depicted here is a flagman stopping traffic and directing the safe entry into the street of a truck coming out of the jobsite.

TRUCKS ENTERING OR LEAVING THE JOBSITE	Entry and exit of trucks and equipment from the worksite should be in such a manner as to guarantee the safety of passing pedestrians and vehicles.

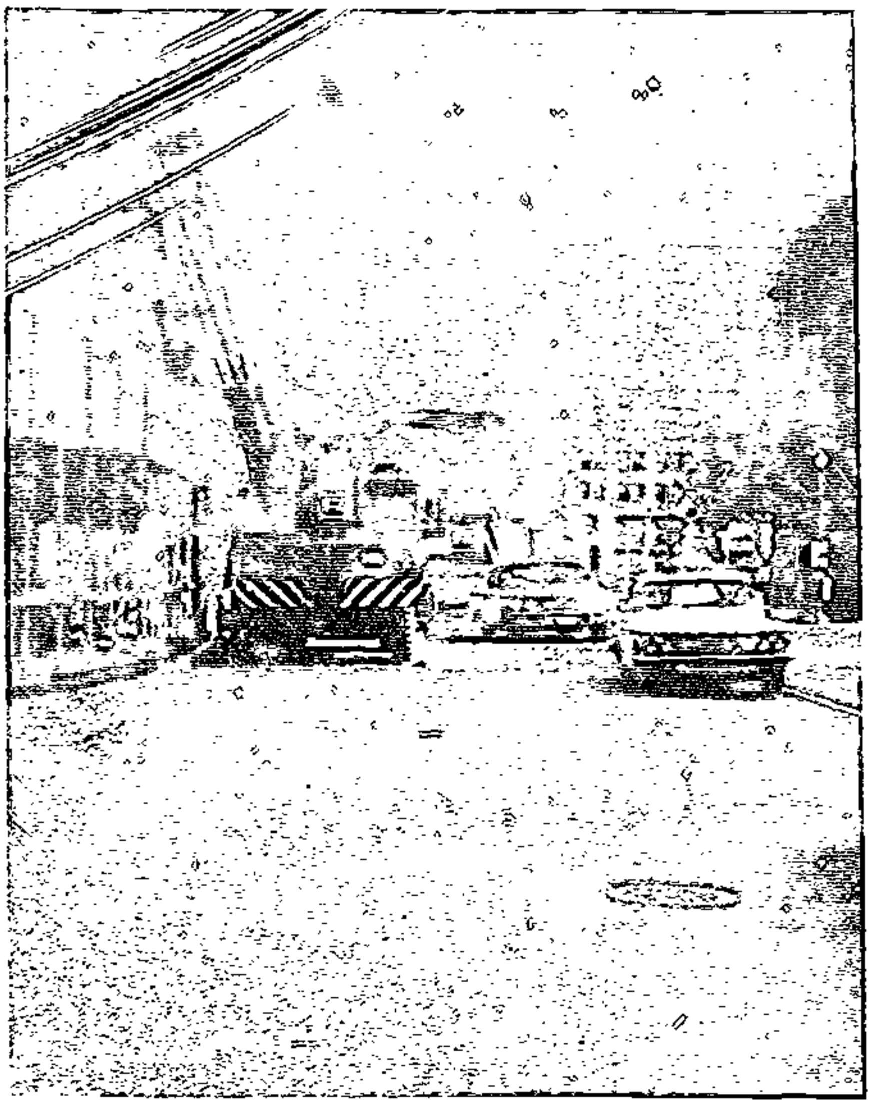


Chart 10. No street protection.

Chart Discussion: NO STREET PROTECTION. Graphically shown in this chart and the next one are the do's and don'ts of street protection. The "NO" picture shows a crane swinging out into the line of moving auto traffic; it has to swing out around its extended bed. There is no barricade, no flagman, no protection whatsoever.

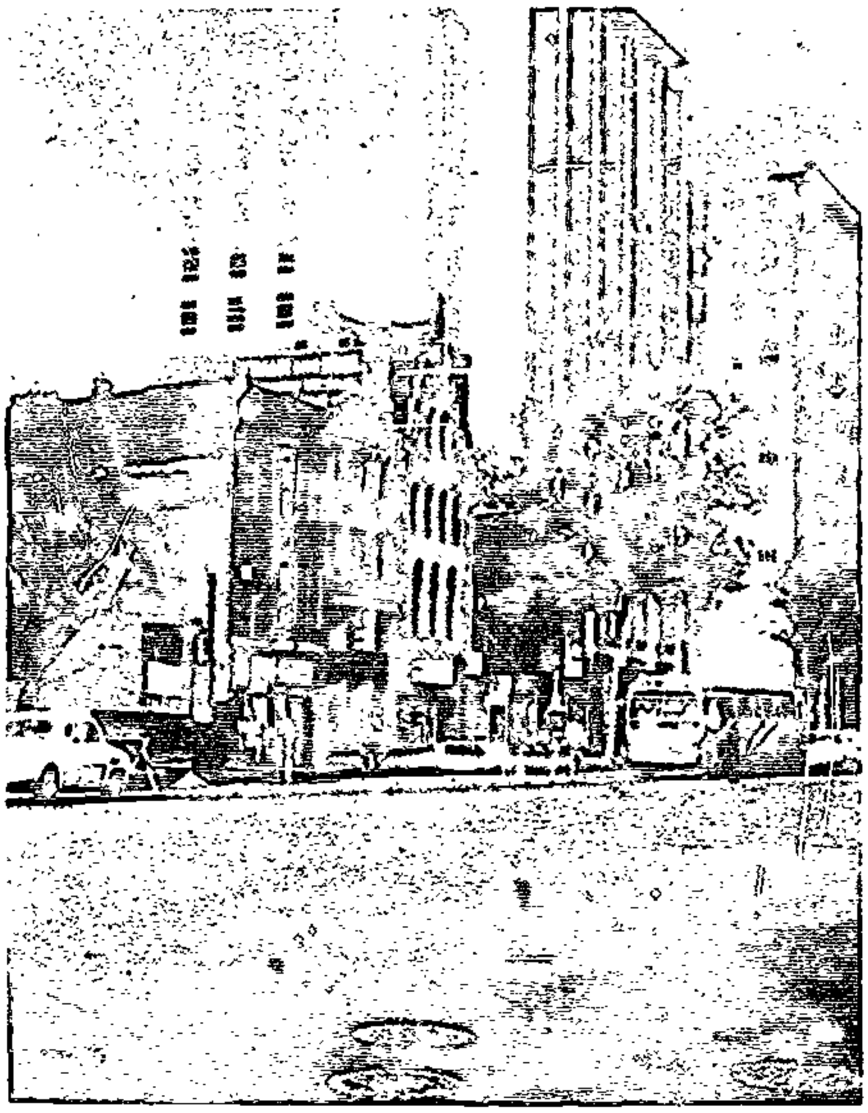


Chart 11. Good street protection.

Chart Discussion: GOOD STREET PROTECTION. In the "GOOD" picture, arrangements have been made not only for a flagman, but for a police officer as well. Note the officer just to the right of the front of the bus, where he has stopped it and the traffic behind it.

EQUIPMENT OUTSIDE THE JOBSITE

When cranes, compressors, or other equipment must be located EVEN "TEMPORARILY" on a street or walkway adjacent to the jobsite, barricades, flagmen, warning signs, or some other protection should be provided.

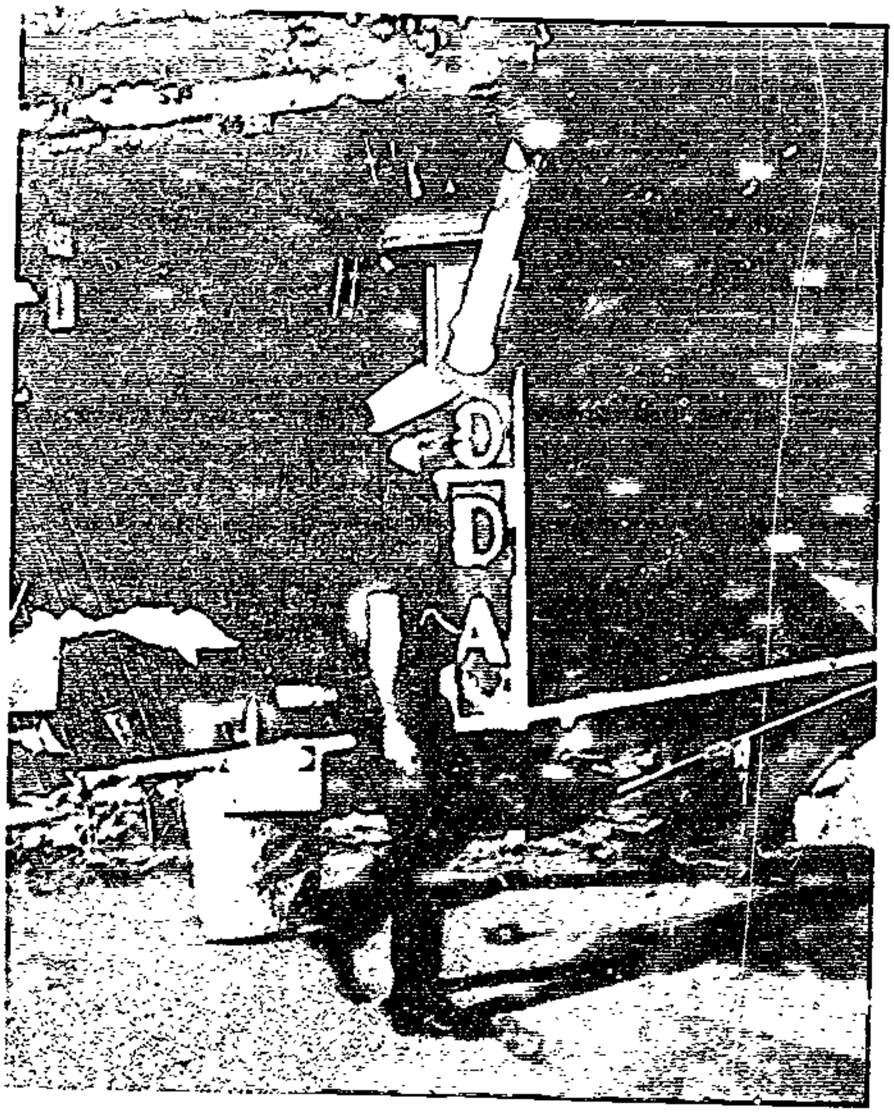


Chart 12. No sidewalk protection.

Chart Discussion: NO SIDEWALK PROTECTION. In the "No Sidewalk Protection" chart, we see well-advanced demolition work on a corner in a large city; no real protection has been provided for pedestrians.

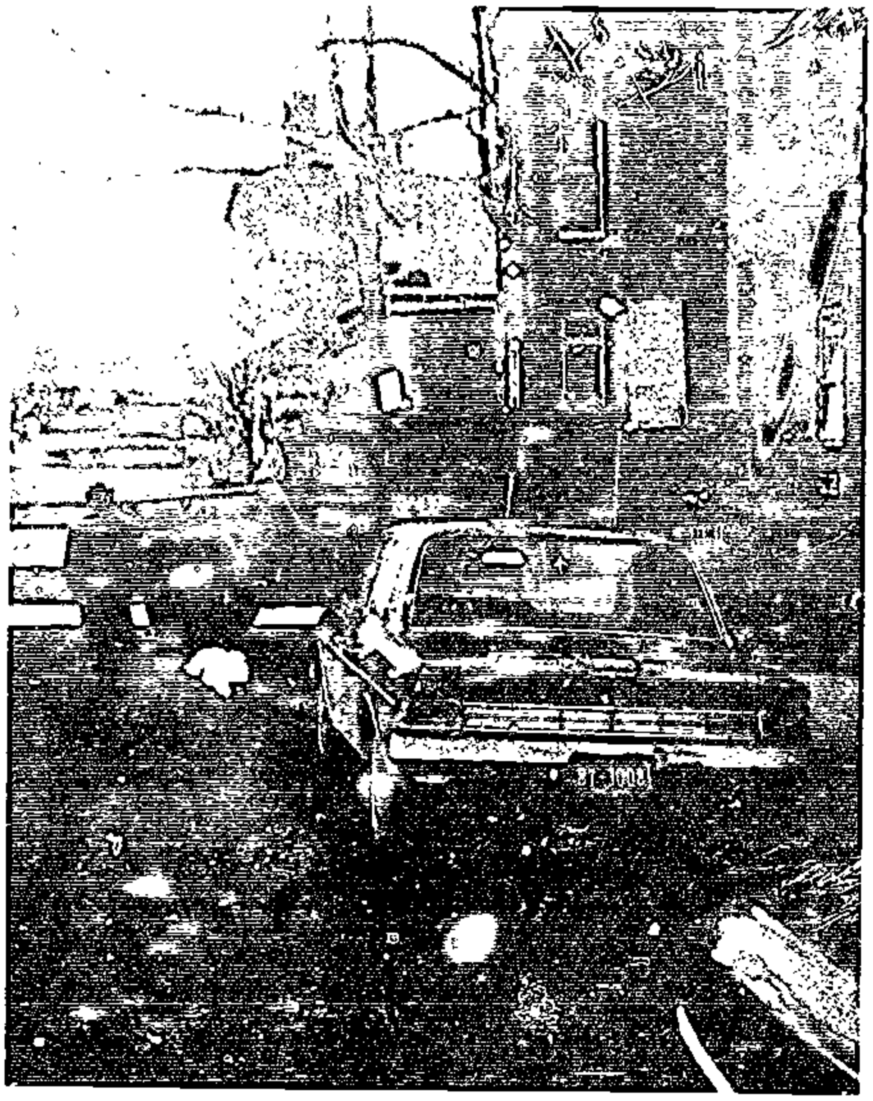


Chart 13. Sidewalk completely blocked.

Chart Discussion: SIDEWALK COMPLETELY BLOCKED. In the "Sidewalk Blocked" chart, a truck, backed up and parked for loading, is shown completely blocking the sidewalk, forcing pedestrians to walk out into the street. The truck-block may be unavoidable, but a flagman or some other protection should be provided, especially if the truck juts out into the *second* traffic lane.

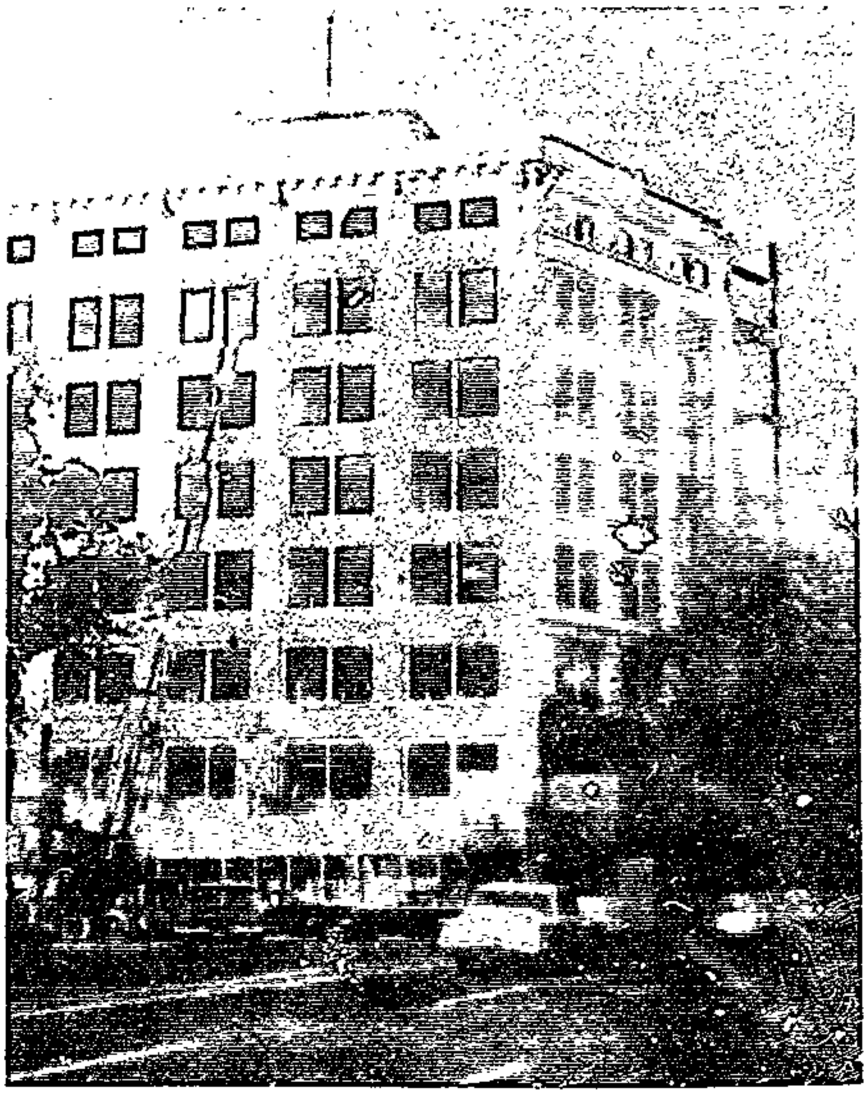


Chart 14. Sidewalk shed.

Chart Discussion: SIDEWALK SHED. Illustrated here is a good sidewalk shed, but it still does not embody all the features which should be included, as will be brought out in our discussion.

SIDEWALK SHEDS	When a sidewalk cannot be closed or relocated, a sidewalk shed should be erected if the structure to be razed is more than two stories or 25 feet high, and the horizontal distance from the inside edge of the sidewalk is 15 feet or less from the building.
Shed Strength and Length	A sidewalk shed should be substantial and conform structurally to the standards applicable for such sheds, and it should also cover the entire length of the sidewalk or other similar public-use pedestrian thoroughfare.
Shed Width	The sidewalk shed should be wide enough to permit reasonably normal pedestrian use without causing congestion.

Shed Lights	Provision should be made for ample illumination by either natural or artificial means, or both.
Shed Roofs	Shed roofs should be capable of sustaining a load of 150 pounds per square foot. If they are to be used for storage of materials, the load capability should be 300 pounds per square foot. Roofs should be a minimum of 8 feet from the ground. Shed roofs should be constructed of sound planking and a minimum of 2 inches thick, laid closely and evenly, and should be made watertight if the need is indicated.
Roof Extensions	Extensions should be attached to the outside edge and both ends of the roof. These extensions should project 42 inches from the roof edge and ends. The extensions may be vertical, but, preferably, they should be inclined outward to an angle no greater than 45°. They should be constructed of substantial boards which abut each other and are secured to braced supports. Alternate construction may be toe boards and galvanized wire netting of 1½-inch steel, wire mesh of not less than #16 U. S. gauge.
Openings	Any openings through a sidewalk shed should be used for work purposes only. These openings should be kept closed with strong, solid gates when not in use.
Supports	All supporting members for a sidewalk shed should be connected and braced to prevent their displacement.
Inside Shed Fence	A solid fence should be erected on the inside face of a sidewalk shed, except when the shed abuts the structure being demolished. If openings are necessary, they should be equipped with solid gates and kept closed when not in use.

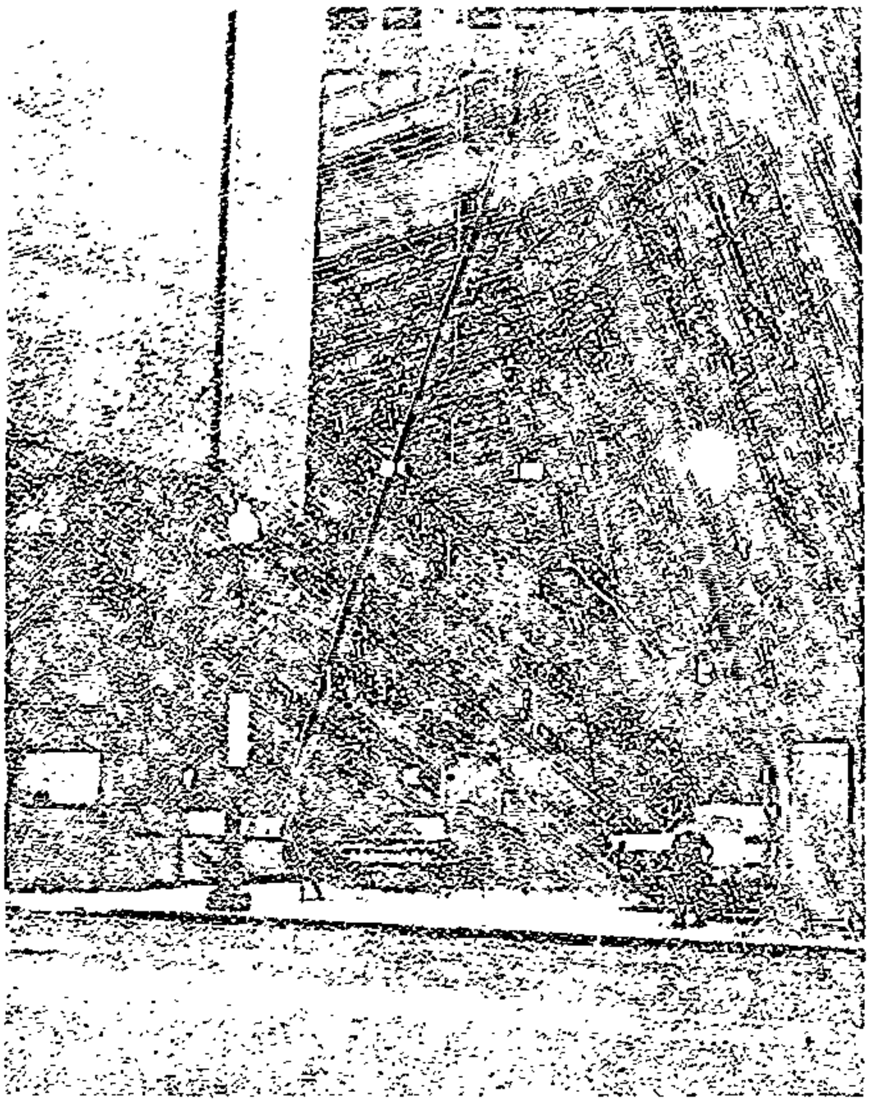


Chart 15. Sidewalk shed openings.

Chart Discussion: SIDEWALK SHED OPENINGS. Here is a glaring example of what we call an "exaggerated opening." On this job, an opening, for discussion purposes, is actually a length of sidewalk at the end of the job area where the contractor just didn't bother to erect a sidewalk shed. He left the entire stretch open and put a barricade at the end. At the time of the picture, the building had been completely razed and was being used for parking. This, of course, does not alter the fact that a shed *should have been* erected there.

FENCES AND RAILS

When the structure is more than 15 feet, but less than 25 feet, from the sidewalk, a fence may be erected along the inside edge of the sidewalk in lieu of a sidewalk shed.

	In those cases where closing the sidewalk has been permitted, the fence can be erected along the curb or the inside edge of the roadway if it is not to be used by pedestrians. This type of fence should be at least 6 feet high, be solidly constructed of sound wood or equally stable material for the entire length. All necessary openings should be equipped with solid gates, which are kept closed when not in use. If the traffic lane adjacent to a closed sidewalk is to be used by pedestrians, a sidewalk shed should be erected over the traffic lane.
Railings	When the structure to be demolished is more than 25 feet from the inside sidewalk line, a railing may be erected along the inside sidewalk line in lieu of either a shed or solid fence. The railing should run for the entire length of the site, and may be equipped with movable sections for work performance needs.
WORKERS' ENTRANCE PROTECTION	When the workers' means of access to the structure are not fully protected by a sidewalk shed, the entrances should be protected by a canopy extending at least 8 feet from the face of the building. Each side of the canopy should extend 1 foot beyond the side of the entrance for a total minimum of 2 feet wider than the total entrance width. Canopies should meet the same structural requirements that apply to a sidewalk shed roof.
ADJACENT STRUCTURE PROTECTION	When an adjacent structure is lower than the one to be demolished, its roof should be amply protected by the erection of debris catchers, barriers, or other effective covering. Structural support of adjoining buildings may also be necessary, through the use of shoring, underpinning panels, bracing, or other means.
CATCH PLATFORMS	The exterior walls of a structure 70 feet or higher should be equipped with catch platforms whenever the workers or the public are exposed to possible injury.
Exception	Outside scaffolding erected from the ground level upward may, if properly planked, serve in lieu of a catch platform.
Location	Catch platforms should be positioned not more than three stories below the level of the exterior walls being wrecked.
Not Necessary in Some Cases	Catch platforms are not necessary when the demolition has progressed to within three stories above grade, except in circumstances where good safety practice indicates otherwise.

Size and Material	Catch platform should extend at least 5 feet from the building, and they should be made of sound planks securely attached onto outriggers. The inner edge of the platform should touch the building wall. Its component planks should abut each other.
Load	The platform should be able to withstand a live load of not less than 125 pounds per square foot.
Incline	The platform should be inclined upward from the building so the outer edge is no less than 6 inches higher than the inner edge.
Supports	The outriggers should be at least 2- by 10-inch planks, not more than 10 feet apart, set on edge, and secured to prevent displacement. Outriggers should be securely supported where they meet the building wall and should be securely attached to the building.
Platform	The catch platform surface should be made of 2-inch planks. The planks should overlap each other over the outrigger supports and should be secured.
Outer Edge Enclosures	A strong enclosure should be mounted on the outer edge of a catch platform at approximately 45° with the horizontal. Outer edge enclosures should be at least 4 feet wide. Outer edge enclosures should be made of substantial boards, sheet iron, or galvanized ½-inch wire mesh of not less than #18 U.S. gauge. These enclosures should be mounted on at least 2- by 6-inch supports or equal which are securely attached and are not more than 10 feet apart. The supports should be mounted with the greater dimension at right angles to the enclosure. The joint between the catch platform and its outer edge enclosure should be tight.
Platform Use	Catch platforms are intended as a protective facility. Materials should not be stored or dumped on them. They should be cleaned daily—more often if necessary.
STAIRS, PASSAGEWAYS, AND LADDERS	The very nature of demolition operations requires that stairs, passageways, and ladders receive more than ordinary attention and care.

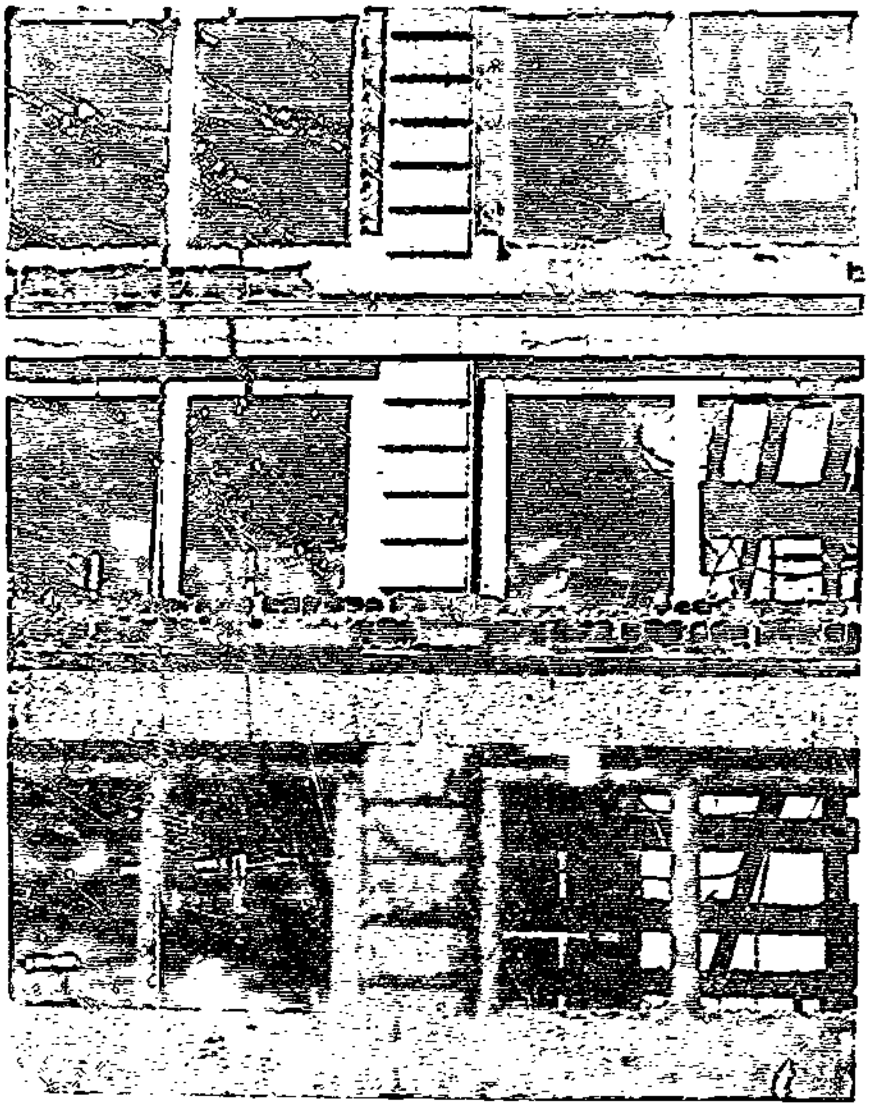


Chart 16. Interior ladder.

Chart Discussion: INTERIOR LADDER. By looking closely at the interior of the building in the center of the picture, you can see a specially installed ladder of the type often used during multistory demolition. This replaces the stairs which, by this time, have been removed.

STANDARDS

There are several applicable standards which should be followed when using stairs, passageways, ladders, and similar equipment during demolition operations.

INSTRUCTOR NOTE: Recommend the acquisition and use of ASA standards.

INGRESS AND EGRESS	Only those passageways and other such facilities which are *intended* for the workers should be used for this purpose. Other means of ingress and egress to the building should be closed off.
LADDER SIDE RAILS	Ladder side rails should extend at least 3 feet above the floor, platform, or other level to which they provide access.

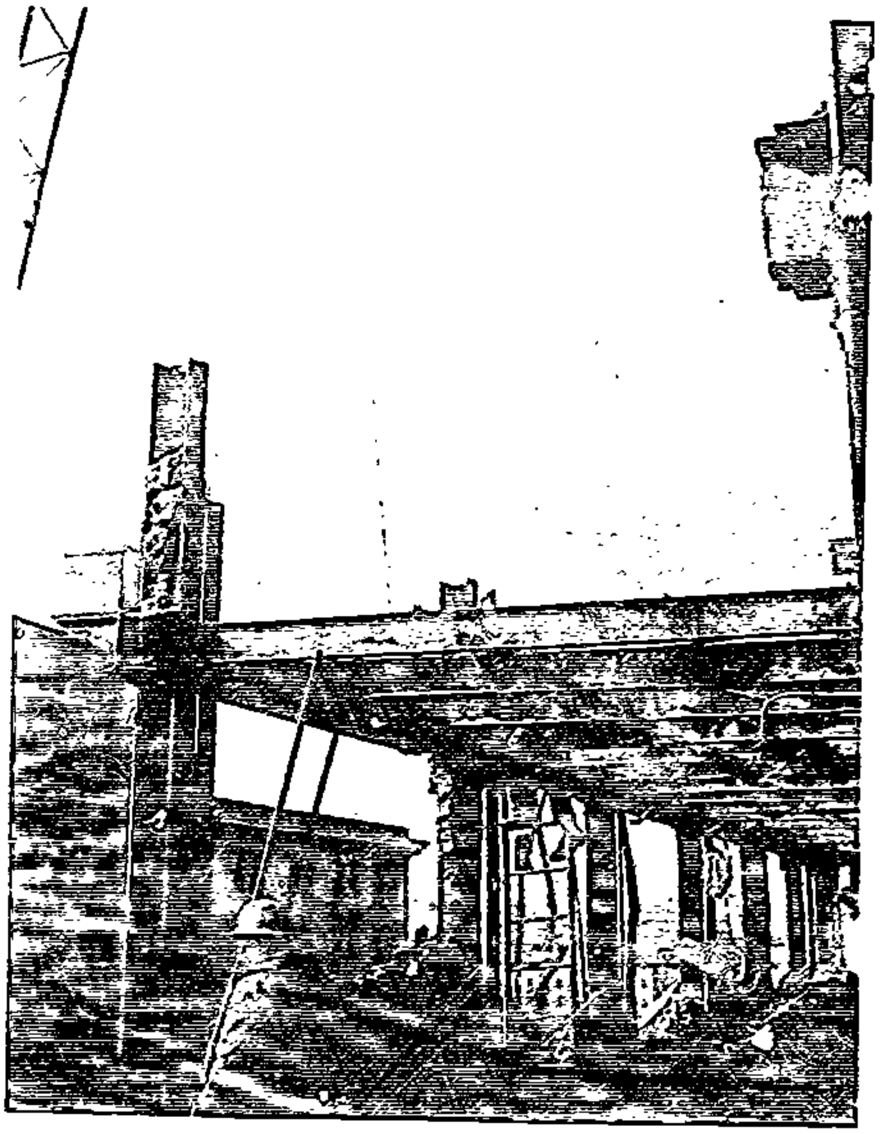


Chart 17. Unsafe ladder use.

Chart Discussion: UNSAFE LADDER USE. Here, a ladder is being used as an unsafe and inefficient substitute for a more proper means, such as a portable platform, to reach and cut beams, which are being removed.

SECURE THE LADDER	**When the use of a ladder is necessary, it should be secured to prevent slipping at the bottom and from moving at the top.**
SET OUT BOTTOM	**The bottom of the ladder should be set out one-fourth the length from the bottom to the point of contact.**
STAIRS	**On multistory structures, a stairwell which is being used should be effectively covered not less than two stories below the floor where work is in progress. Access to a work floor should be provided via a separate passageway.**

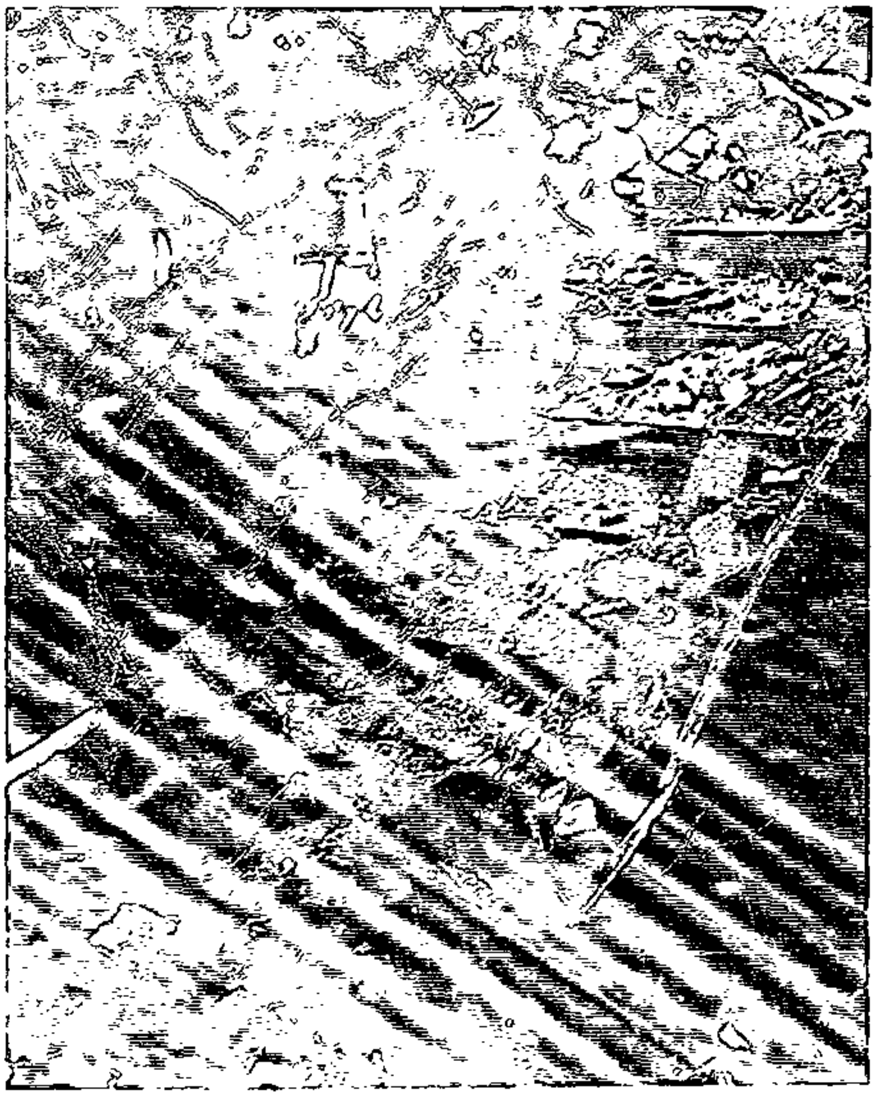


Chart [illegible] **Unsafe stairs**

Chart Discussion. UNSAFE STAIRS. The stairwell shown in this chart was being used regularly by the workers on this project. Note not only the unsafe clutter on the steps and landing levels, but also the lack of handrails.

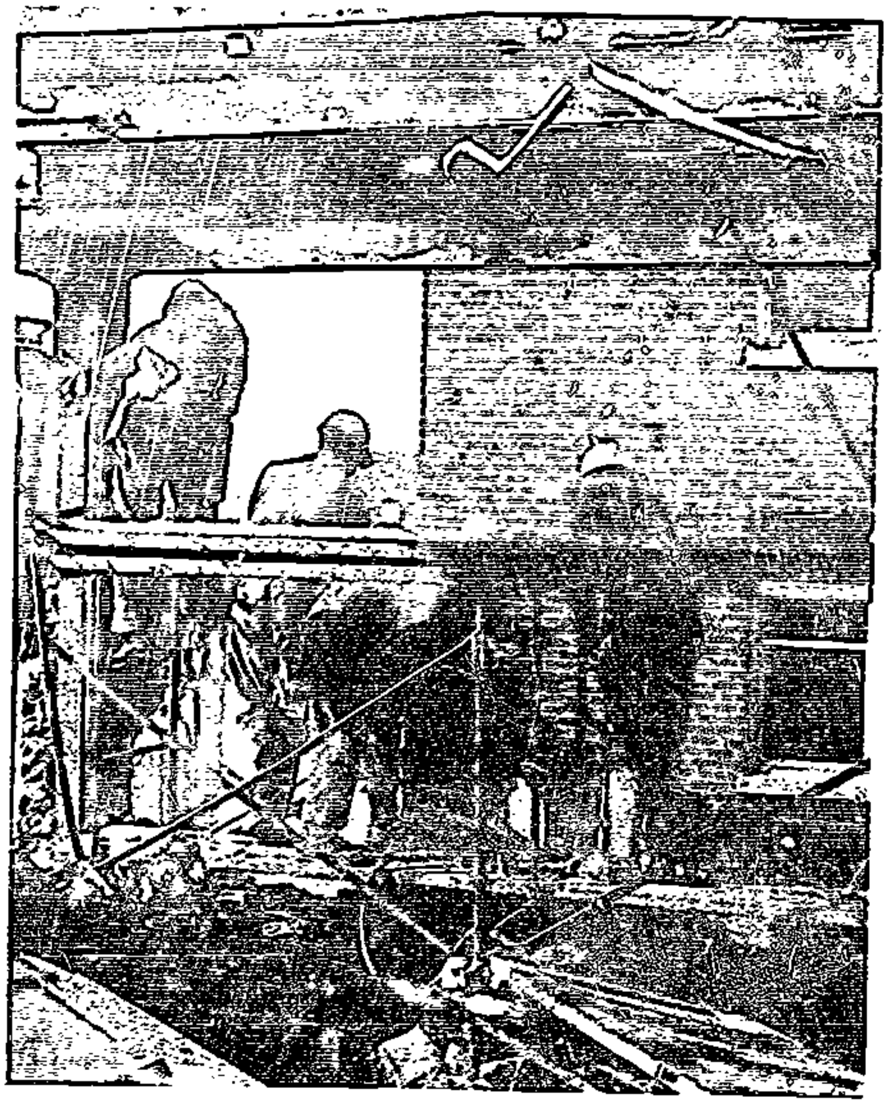


Chart 19. Scaffold

Chart Discussion: SCAFFOLD. Here is an example of a good type interior scaffold. Although it provides a good working level and has a railing on the INSIDE, unfortunately, there is no railing on the OUTSIDE where the men are moving the wall, and where a railing is considerably more important.

SCAFFOLDS	When work cannot be done safely from the ground or from solid construction, safe and substantial scaffolding should be provided, except for necessary ladder work.
Plan	Scaffolds should be planned and built to sustain any overload to which they might be subjected, e.g., materials falling on them. The requirements of ASA Standard A10.8 should be applied where applicable to demolition scaffolding.

Care	Due to the rough treatment scaffolds may get from falling materials, etc. in wrecking work, they should receive special care and maintenance.
Tie Lines	In demolition work, special care must be taken in tieing off scaffold lines. Where steel beams are involved, the saw-tooth edges sometimes found on old steel can damage lines. The lines should be protected from the sharp edges by wooden pads of at least 2-inch lumber. Also, before tieing off a line to a steel beam, make sure that that beam is not going to be removed.
MATERIAL CHUTES	Under most circumstances, dropping material by chute is the safe way. In some situations though, when job safety conditions warrant, material may be simply "gravity dropped." In this situation, however, the area to be used to receive the materials should be effectively barricaded, and all persons completely excluded from it.
Closed Chute	A chute should be closed on all four sides when it is at an angle of 45° or more from horizontal, except for floor-level closure-equipped openings for deposit of materials.
Openings in Chute	Openings should be not more than 4 feet long and, except on the top floor, should be kept closed when not being used for material deposit.
Open Top	When a chute has an angle of less than 45°, the upper side may be left open. However, when such a chute discharges into another chute which has an angle of more than 45°, the steeper chute should be completely enclosed.
Gates	The discharge end of a chute should be equipped with a strong gate. A dependable employee should be assigned to control the operation of the gate, as well as the movement of trucks being loaded and the protection of persons who may be in the area.
Openings Around Chute	The area around the discharge end of the chute should be so protected that when the chute is not being used, the area would not be accessible. Any wall openings where workers dump materials into a chute, or any opening on either side of the chute, should be guarded by a sturdy rail at least 44-inches high. The space between a chute and the edges of any floor openings through which it passes should also be protected, by being planked over.
Wheelbarrows	When dumping from a wheelbarrow, a bumper block at least 2 by 6 inches should be used.

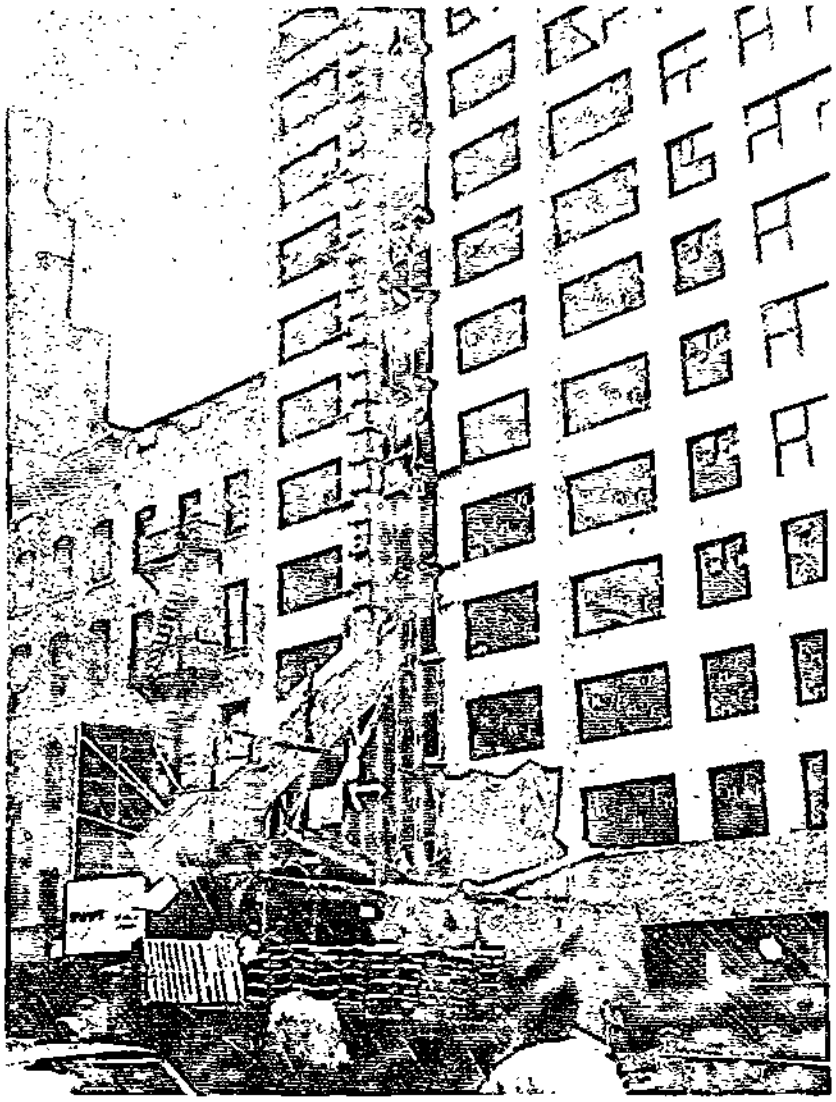


Chart 20. Long chute.

Chart Discussion: LONG CHUTE. Here is a good chute. However, we show it to point out that, for demolition purposes, it would present a hazard were an unduly heavy object inserted into such a long, drop chute. A heavy object would probably go right through the bottom of the drop, rather than out the discharge angle. As previously discussed, a manually controlled discharge gate is also a safety necessity on chutes.

Chute Length	Long chutes should be avoided, but when they are necessary, their direction should be changed at least every two floors. At direction-change points, sharp turns may require installation of a "baffle" or corner angle to prevent clogging the chute at that point.
Debris, Type and Size	Materials which might clog a chute should not be inserted into it. Also, objects weighing approximately 50 pounds or more should not be chuted; lowering is safer.

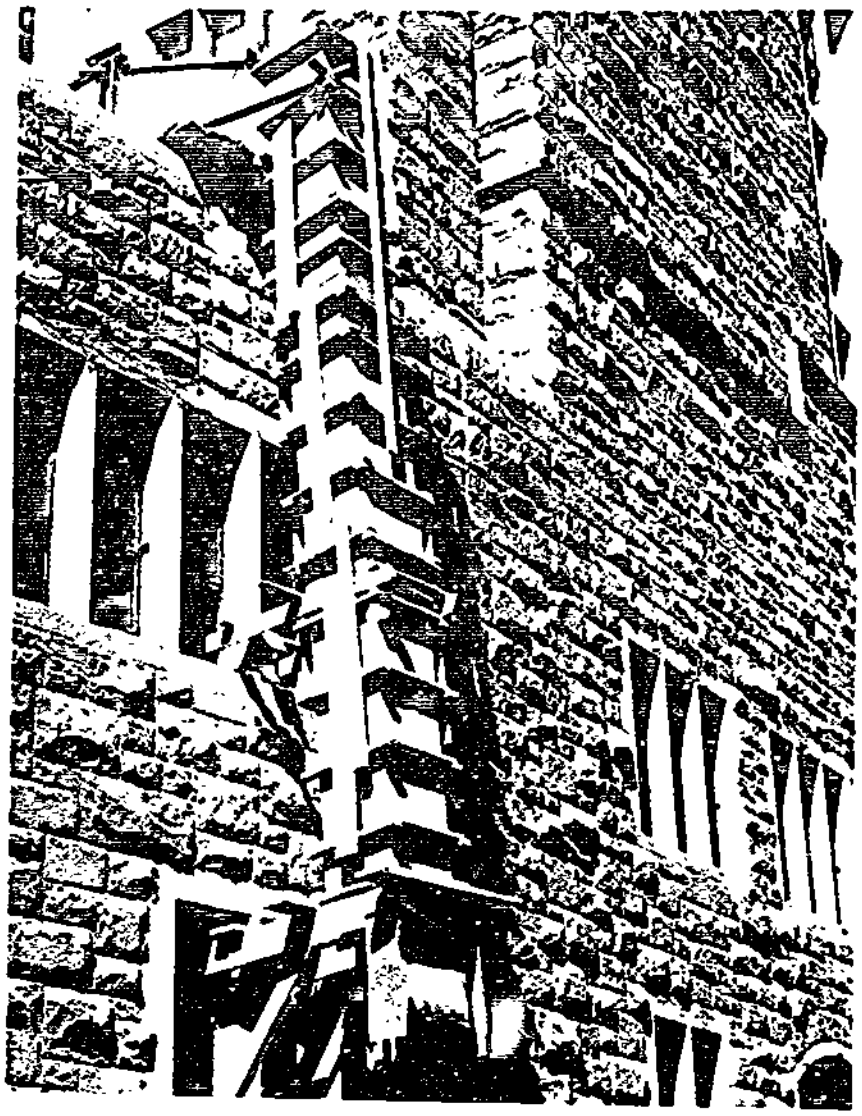


Chart 21. Wood chute.

Chart Discussion: WOOD CHUTE. This wood chute shows good construction, but there is a complete lack of protection at the discharge end.

Chart 22. Oil drum chute.

Chart Discussion: OIL DRUM CHUTE. The oil drum chute has no gate.

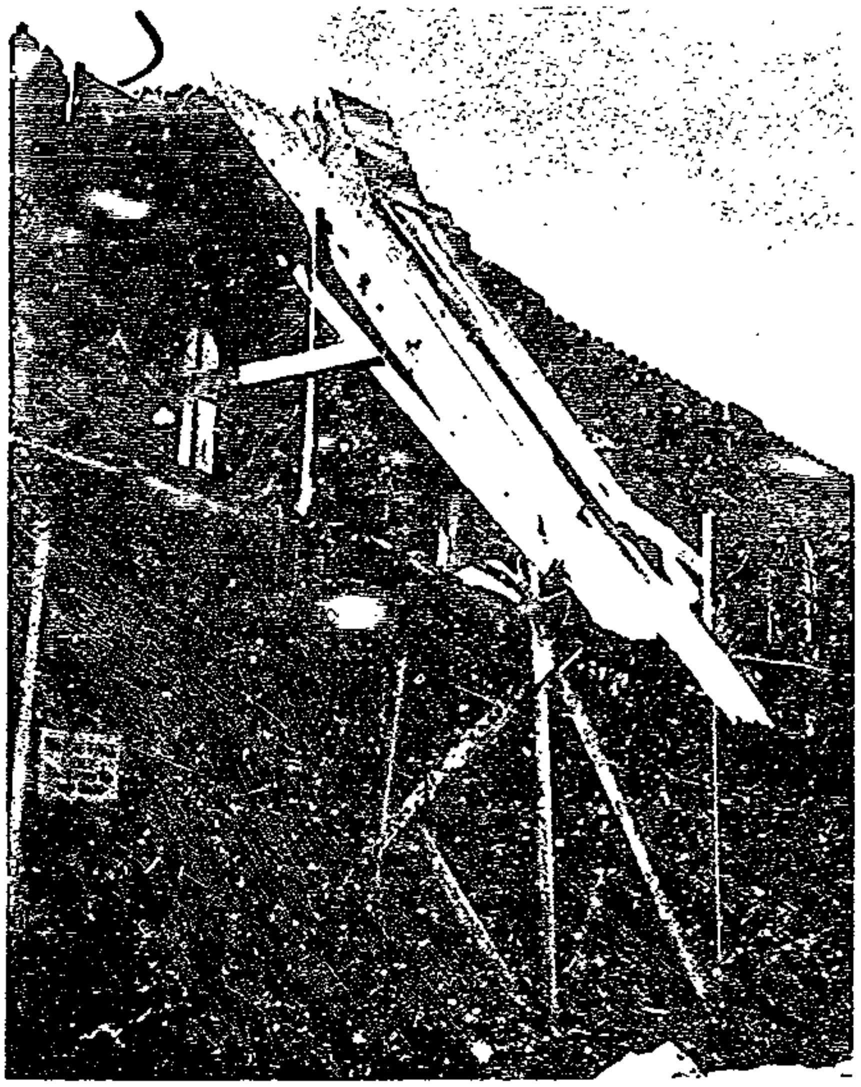


Chart 23. A sad chute.

Chart Discussion: A SAD CHUTE. Shown is an all-inclusive horrible example of just about everything a chute should NOT be.

WALLS, MASONRY SECTIONS, AND CHIMNEYS	Advance planning is usually important in wall removal. Which wall to remove first should be determined and then the sequence of removing the others.

Chart 24. Corner block removal No. 1.

Chart Discussion: CORNER BLOCK REMOVAL. The purpose for showing this chart and the following one is to illustrate unsafe practices in manual wall removal. In No. 1, the men are barring down corner blocks, causing them to work precariously and without benefit of lifeline protection. Note the special catch-shed built in front of the adjacent building.

Chart 25. Corner block removal No. 2.

Chart Discussion: CORNER BLOCK REMOVAL. Here, we see an almost unbelievable example of foolhardiness. The man shown is jackhammering the corner blocks away from the steel framing WITH ONE HAND, while holding on with the other. In doing so, he is hanging out over the corner of the building WITHOUT a lifeline, or any protection whatever. At the 8-story height from which he was working, only the fingers of one hand were keeping him from sure death.

DON'T OVERLOAD FLOORS	Walls or other masonry sections should never be dropped on a floor in a mass large or heavy enough to exceed the load capacity of the floor.

STANDING WALL SECTIONS	If the height of a wall section is 22 times greater than its thickness, it should not be permitted to stand alone unless it is braced laterally. An exception would be that the wall was originally designed and constructed to stand to a greater height alone and that it is still capable of doing so. At the close of any work period, *no* wall should be left in an unstable condition.
WEATHER HAZARDS	When ice, snow, wind, etc., present a hazard, workmen should not be permitted to do wall-top work.

Chart 26. Standing wall section.

Chart Discussion: STANDING WALL SECTION. Here, we see a section of wall left standing after work has stopped in the afternoon. The picture was taken from a frequently used sidewalk—even in the evening—in a large city. Note that there is no protection between it and the sidewalk, which is not more than 25 or 30 feet away. Fortunately, the wall did not fall. BUT IT MIGHT HAVE. MANY DO. THAT'S THE POINT.

Chart 27. Removing floor arches.

Chart Discussion: REMOVING FLOOR ARCHES. The purpose of this chart is to illustrate the balling method of floor removal. The crane, from the position shown, has balled out the wall sections and is in the process of dropping the ball on the floor arches, which will expose the steel framing for its removal.

REMOVAL OF STRUCTURAL MEMBERS

Structural or other members which support a floor should not be removed or cut until the stories above have been removed.

This would not preclude the cutting of floor beams for the purpose of creating floor holes for the disposal of material.

Nor would this preclude cutting for the purpose of installing equipment, or for storage purposes.

Any exceptions should, of course, give due consideration to maintaining the necessary structural safety of the building.

OPENINGS NEARBY	When a wall is being wrecked, any floor opening within 10 feet of the wall should be covered over, or effective measures should be taken to prevent personnel from entering the area immediately below the opening.
STEEL FRAMING	The steel framing of a structure may be left in place during the removal of the masonry. However, when the steel framing is left in place, all loose material should be removed from the beams, girders, etc., as the demolition progresses.

Chart 28. Steel framing.

Chart Discussion: STEEL FRAMING. Here, we see the steel framework which remains after the walls, floors, etc., have been removed, and while the steel removal is taking place. Note the men working the beams without any protection against falling.

WALKWAYS	Walkways at least 30 inches wide should be provided so that the workmen may safely reach or leave a wall or scaffold.
FOUNDATION WALLS	Those walls which function to retain or support earth or adjoining buildings should not be removed until the earth has been removed or supported, or until any adjoining structures affected have been braced or underpinned. When a foundation wall is a "party" wall, or will be used to retain debris, it should first be checked to determine that it has ample structural strength.

Chart 29. Wall demolition by balling.

Chart Discussion: WALL DEMOLITION BY BALLING. This chart shows the operation of knocking walls out with a demolition ball. Note that this building has steel framing. Note also the signalman.

Chart 30. Demolition by clamshell.

Chart Discussion: DEMOLITION BY CLAMSHELL. Note that the height, location, and type of framing of this building lends itself to the use of clamshells.

SPRAYING	When demolition balls or clamshells are used for demolition, the debris should be thoroughly wetted down by spraying with a hose to keep dust and dirt in the air to a minimum.

Chart 31. Watering down debris.

Chart Discussion: WATERING DOWN DEBRIS. Unless the operation shown here is performed, the air becomes heavily contaminated with dust and dirt, creating problems affecting efficiency, personnel, and public-relations.

CHIMNEYS AND STACKS	Toppling chimneys is very often a specialty-type operation, particularly if the stack is constructed of metal sections or is of a specialized construction or design.
Drop Inside	When chimneys or stacks of masonry construction cannot be toppled or dropped, debris should be dropped on the inside, unless job safety conditions are such that it is feasible to drop material on the outside.
Scaffolds	For chimney work, standard scaffolds should be provided when possible (see section on "Scaffolds"). When unusual job conditions require a specially designed and constructed scaffold, one should be erected which meets accepted safety standards.

Belts	Safety belts and lifelines or safety nets should be required.
Access	Safe access to the top should be provided for the workmen when a chimney is to be demolished manually.
Chutes	When a chute is used on chimney demolition, the discharge end should have an overhead canopy of closely and evenly laid planking at least 2 inches thick.
STEEL DEMOLITION	During the removal of steel framing, the stability of the remaining steel must be maintained.
Workers Should Be Briefed	Workers should be briefed on the planned sequence and procedure, with particular emphasis being placed on bracing and struts.
Coordinate	Coordination of the various phases of steel demolition is important so that no phase creates a hazard for any other.
Lower Steel	Steel should always be lowered, rather than dropped, unless a safely barricaded or otherwise protected receiving area is provided.
Planking Over	When a crane or derrick is not to be used for wrecking steel, the full tier of beams not more than two stories below the work point should be planked over. This would not apply to floors which still have their arches, or to openings in floors used for materials or equipment.
Sectioning	The removal of steel framing should be column length by column length, and tier by tier. To dismantle columns in two-story lengths is considered safe.
No Stress	No external stress should be permitted to affect a structural steel member which is to be cut off or dismembered.

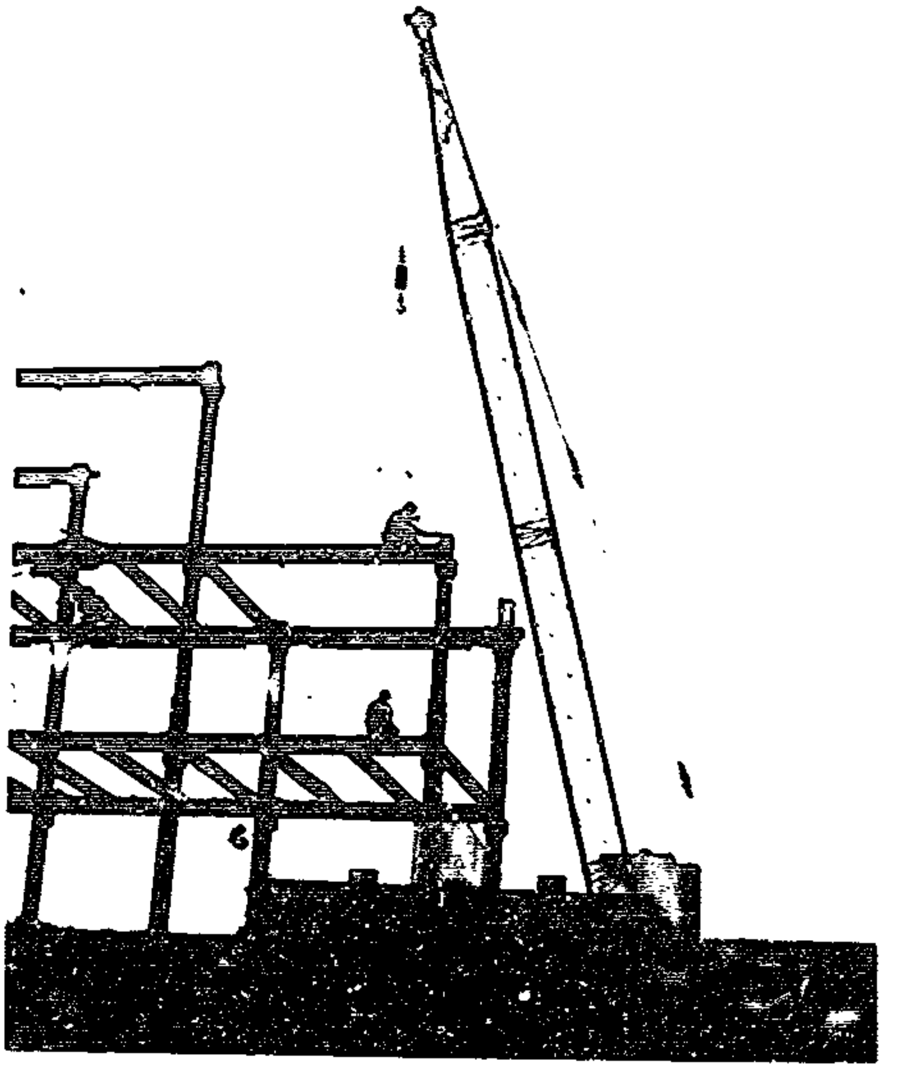


Chart 32. Steel framing removal.

Chart Discussion: STEEL FRAMING REMOVAL. Depicted here is the process of taking down the steel structure in sections, with the use of a crane. The walls, floors, etc., are gone, and columns are being removed. Note the men working the beams with no protection against falling.

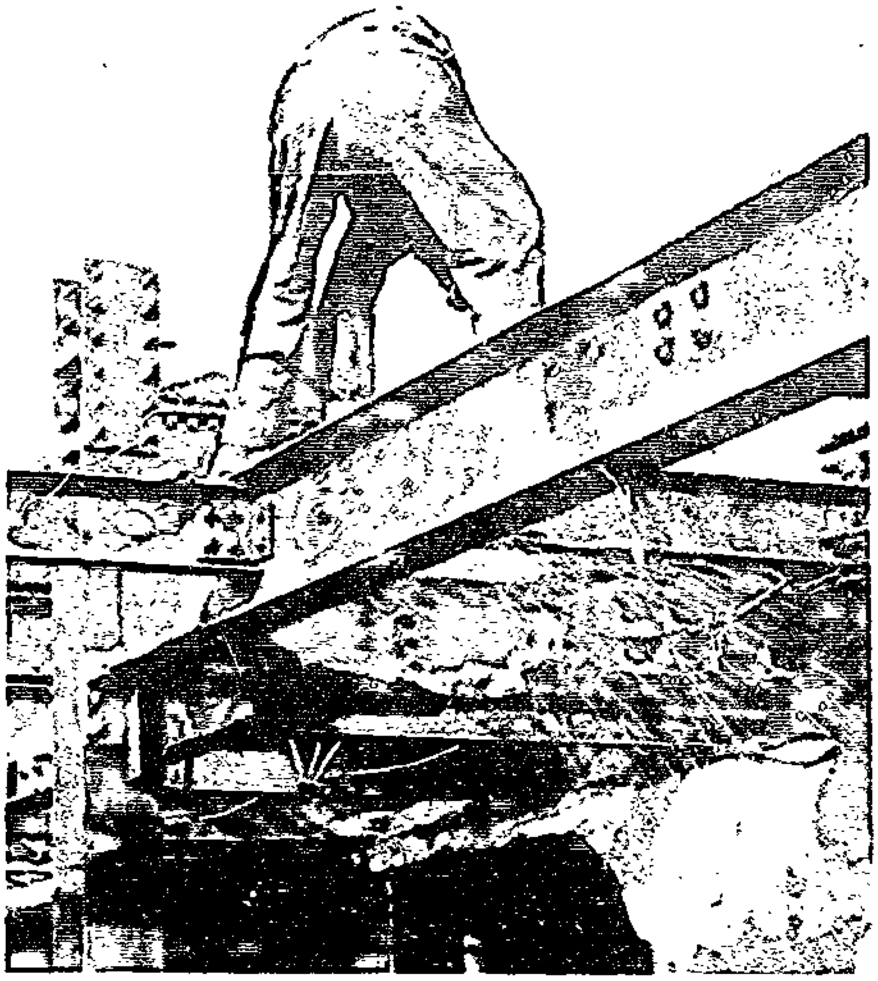


Chart 33. Sectioning.

Chart Discussion: SECTIONING. Here is a close-up of a man burning sections of steel framing for removal. Note the precarious working position. In this case, the floor arch below was still in place, so a platform or at least a ladder could have been used.

DERRICK ERECTION	Before the erection of a derrick, tower, crane, or other hoisting device on any floor support, it should be determined if any shoring is necessary. Necessary shoring should be designed and built to comply with accepted engineering standards, with a minimum safety factor of 4. If the floor arches have been removed at the point where a derrick or similar hoisting device is to be used, the entire tier of beams upon which the derrick is erected should be substantially planked over. Openings required in this planking for materials and equipment are acceptable.

CRANE SIGNALS	A standard signal system should be used in crane, hoist, derrick, and similar operations. Signal requirements of American Standard Code B30.2 are recommended for this purpose. All workers affected should be trained and required to use these signals, and to observe them.

Chart 34. Signaling.

Chart Discussion: SIGNALING. Although this is a balling operation, it illustrates the need for proper signaling. In this case, note the dangerous location of the signalman. He has no protection against falling should he slip or be struck.

HOOKING	The weight of a beam should be known before hooking up, and it should also be ascertained that the equipment to be used has sufficient capacity to handle the beam safely. Before hooking on, any loose material which is on the beam should be removed. In any case, hooking on should not be done until the workers have received authority to do so from the foreman in charge. At least a two leg sling should be used for hooking on.
TAG LINES	When lowering or hoisting a load, tag lines or guide ropes should be used. When dismantling steel sections, a tag line should be secured to each end of the member to prevent it from swinging. This is particularly important if the hooking on is by one line to the center of the beam, which could result in the attachment not being made at the center of gravity of the member. As previously discussed, hooking on should be made by two lines, one to either end of the beam. If only one line is used, certainly every effort must be made to attach at the exact center. The proper attachment of tag lines at each end of a member should not encourage dependence upon them as a substitute for proper hooking on.
TRANSPORTING CYLINDERS	When using cranes or similar hoisting devices for transporting cylinders, a cradle, boat, or suitable protected platform should be used. Protective caps should be in place. Cylinders should never be hoisted by hooking to regulators, torches, or other utilization equipment, nor by connecting slings directly to the cylinders.
DEMOLITION BALLS AND CLAMSHELL BUCKETS	Streets, walkways, or any other public-use thoroughfares which are adjacent or near enough to this work to present hazards should be closed, relocated, or the hazard otherwise resolved.
Protective Steps	The entire zone of operation for this work should be barricaded to protect both the workers and the public.
Prohibited Areas	Workers should not be allowed in any building area which can be adversely affected by these operations, nor should they be permitted in the barricaded area when balling is in progress. The number of workers in these areas should be limited to those necessary for the balling operations. A safety zone arc of 25 feet out from the line of bucket travel should be maintained for clamshell bucket work.

Posting	Appropriately worded, easily seen, well maintained warning signs should be located at all means of entry to any area where balling operations are being performed.
Ball Weights and Lines	The weight of a demolition ball should not be greater than 50 percent of the safe capacity of the crane at the maximum radius at which the ball will be used. The weight of a demolition ball should not be greater than 25 percent of the breaking strength of the line which holds it.
Ball Connection	Attachment of the ball to the load line should be by swivel-type connection to eliminate twisting of the load line. The ball should also be attached so securely that the weight cannot become disconnected by load line slack or other cause. The weight connection and the load line should be checked regularly, preferably twice daily.
Have Short Line	The load line and the crane boom on which it is hung should be as short as practicable.
CRANE WORK	Cranes used in this work should be equipped with boom stops.
Vibration Tests	Vibration or seismic tests should be made when there is any evidence of the need to do so to establish safe limits for the weight of the ball or the length of its drop, in order to prevent damage to nearby structures or utilities.
Cab Windows	For balling and clam operations, crane cab windows should be equipped with heavy-gauge metal screening.
Outriggers	Properly leveled outriggers should be used on truck-mounted cranes when the length of the boom or line or the weight of the ball or other factors relative to the size and weight of the crane require it.
Swing Limit	The boom of the crane should swing no more than 30°.
Checking Boom Swing	The crane operator should not check the ball's pendulum swing, or add impetus to the swing, by reversing the travel of the boom before the weight is at the peak of its arc.

Cut the Steel	When pulling over walls with a clamshell, a demolition ball, or a cable, any structural steel which might be affected should first be cut free.
Cornices	The roof, cornices, and similar ornamental parts of a structure should be removed before any wall pulling is done by clams or bails.
Riding the Ball	Riding the ball is a very dangerous practice, and should be prohibited.

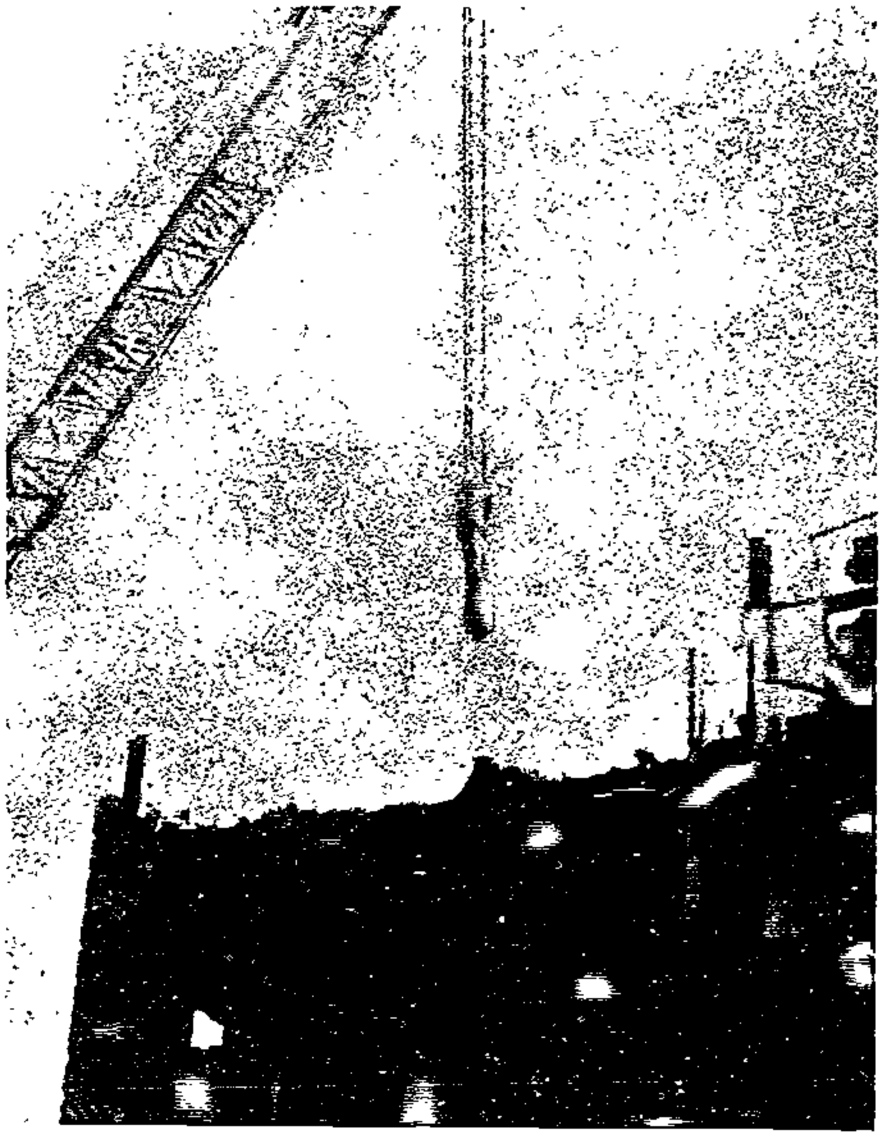


Chart 35. Riding the ball.

Chart Discussion: RIDING THE BALL. This picture is truly worth a thousand words. If this fellow, shown riding to the top of the building, wants to be killed, he's headed in the right direction. Fortunately, he made it to the top of the building this time.

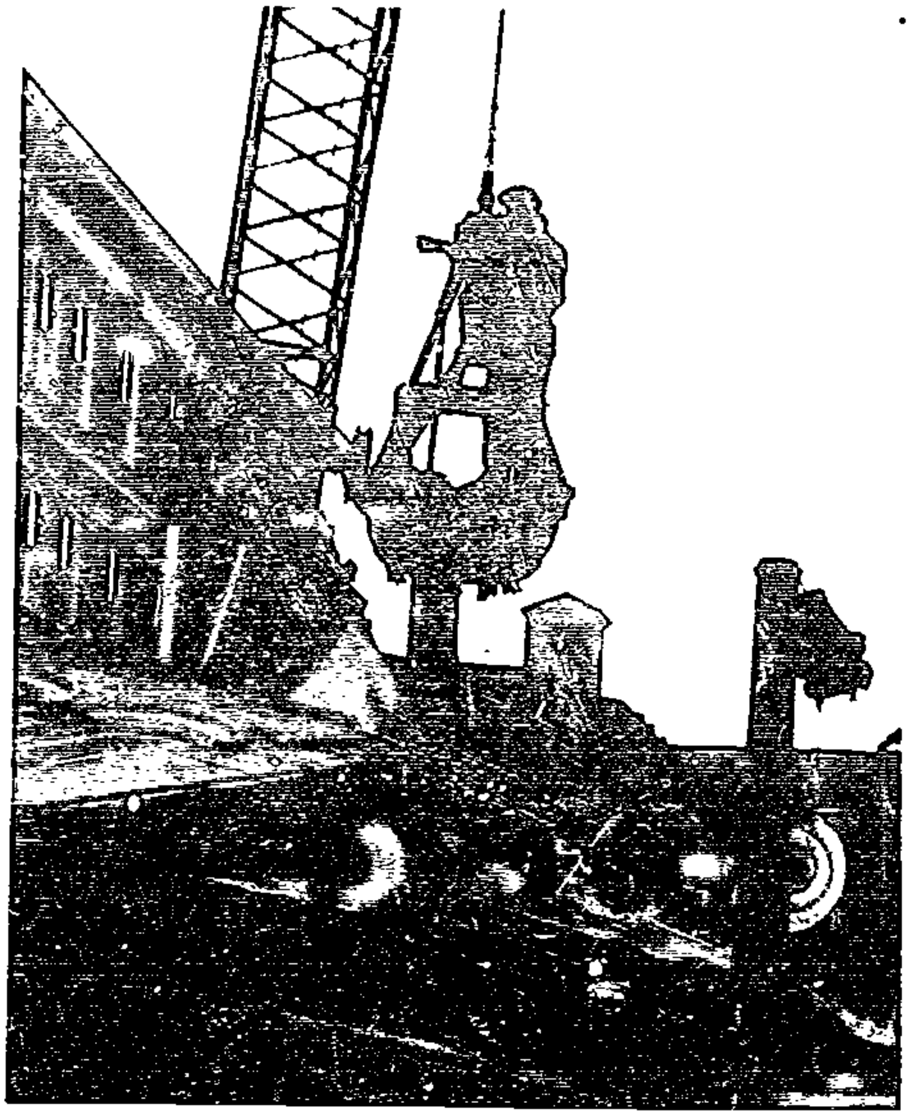


Chart 36. Riding the bucket.

Chart Discussion: RIDING THE BUCKET. This man must be a buddy to the fellow in the last slide. If he slips, at least he has a little better chance to survive, but not much.

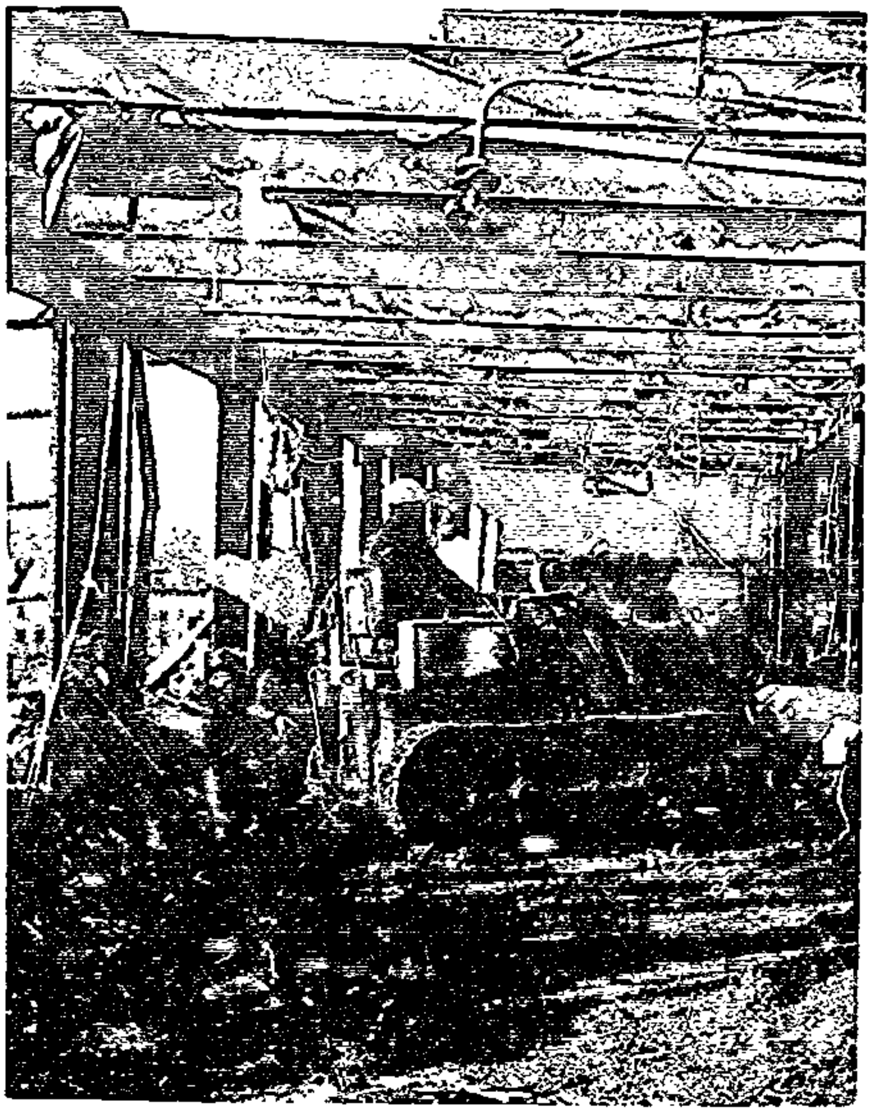


Chart 37. Removing floor debris with mechanical equipment.

Chart Discussion: REMOVING FLOOR DEBRIS WITH MECHANICAL EQUIPMENT. An illustration of debris being removed from the floor arch above with mechanical equipment. Note sparks from the burner's torch.

Chart 38. Dumping floor debris through wall hole.

Chart Discussion: DUMPING FLOOR DEBRIS THROUGH WALL HOLE. Size of hole eliminates need for bump block; operation OK as shown.

FLOOR REMOVAL	Debris and material storage should not exceed established floor loads.
Wood Beam Construction	When a structure has wooden floors, it is an accepted practice to remove the flooring boards from no more than one floor above grade level for the purpose of providing storage space, provided that dropping material therein does not affect the structure's stability. When free-standing exterior walls or interior walls are braced by wooden floor beams, the floor beams should not be removed until equal support is provided in their place.

Fire-Resistant Construction	In buildings of this construction, floor arches no higher than 25 feet above grade level may be removed, providing that removal does not adversely affect the structure's stability. Any intermediate steel floor beams that do not provide structural stability may also be removed. When, for storage purposes, floor arches are removed from more than one level, the removal should start at the highest floor and proceed downward, and should always be done according to the recommendations applying to the removal of floor arches. Also acceptable is an alternate method to remove floor arches for storage by starting at the lowest level and proceeding upward if the top surface of the debris stored is no more than one story below an arch which is to be removed.
STORAGE	
Workers Below	Material should not be dumped into a storage area while men are removing floor arches or beams, or performing any other work in the storage space.
Barricade	Storage areas should be blocked off, except for necessary openings for the removal of materials. Any necessary openings should be secured whenever materials are not actually being removed.
No Lateral Pressure	The storing of debris or material should not subject any wall to lateral pressure or lateral impact from falling material.
Fire Problem	The ever-present hazard of fire on a demolition job is particularly acute in storage areas. Appropriate precautionary measures should be taken.

Chart 39. Dumping into storage.

Chart Discussion: DUMPING INTO STORAGE. Here, debris is being dumped by a front-end loader through a wall opening. The principles we have discussed on this subject are being observed here. The area being used for the dumping is clear of men, safely isolated and barricaded, and is being wet down. All's clear.

WELDING AND RELATED OPERATIONS	**Torches, valves, regulators, blow pipes, and all other related equipment should be of the proper type.**
Secure Cylinders	**Cylinders should be kept in an upright position and lashed together when in use.**

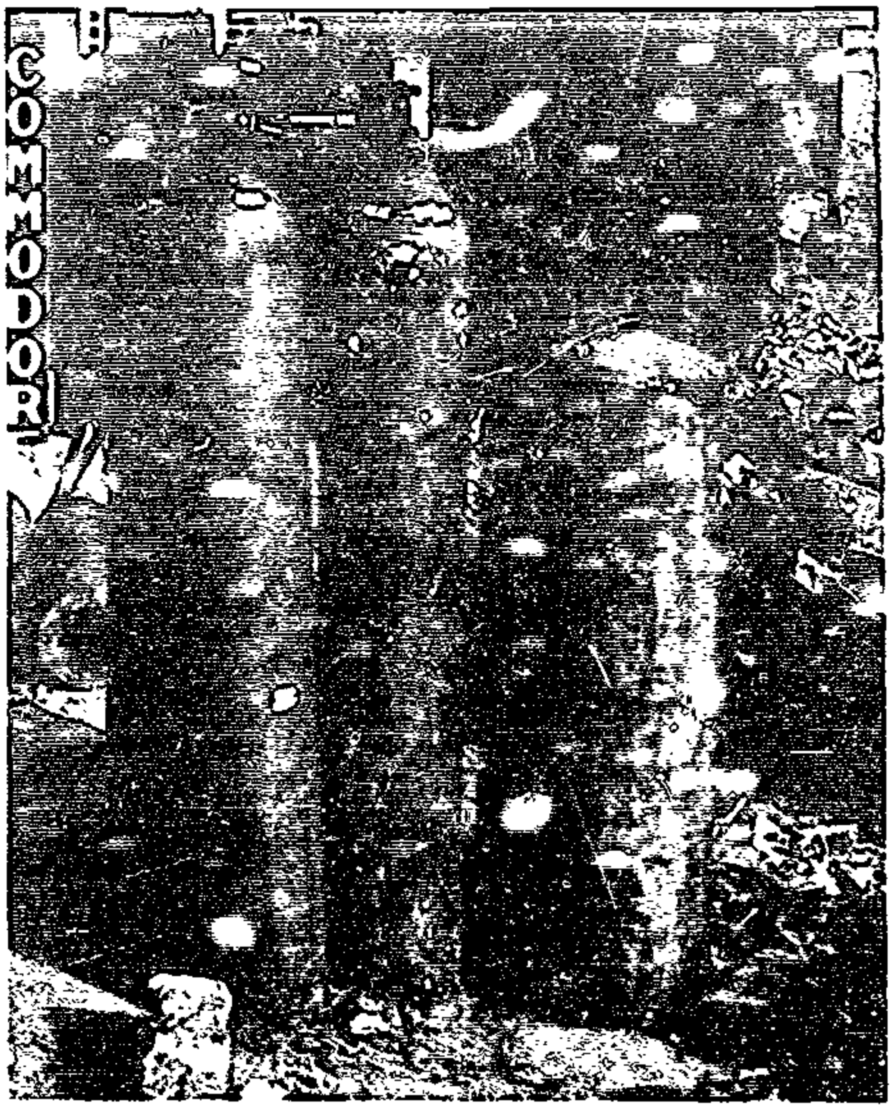


Chart 40. Cylinders.

Chart Discussion: CLYINDERS. Here's an attempt at safe practices: the cylinders are wired together, even though very close to the edge on a high building. The hose presents a tripping hazard. A better location and the use of a cylinder buggy would be more efficient and safer. Cylinders should *always* be fastened to something to keep them upright.

Moving Cylinders	Transportation of cylinders was outlined in the discussion under Steel Demolition (see p. 48).
Personal Protective Equipment	Welders and burners and other employees working in the area should be provided with necessary protective equipment, and be required to use it. See Personal Protective Equipment, p. 59.

Chart 41. Burning operation.

Chart Discussion: BURNING OPERATION. Reasonably well equipped, this burner has goggles, hard hat, and gauntlet gloves. We also hope he is wearing safety shoes in case that beam section he is burning swivels around on him when he cuts it loose. Neither his jacket nor his pants look to be fire resistant.

FIRE PROBLEMS	Fire extinguishing equipment should be located at or near any welding or oxygen cutting operations on a demolition job. (See section on Fire Protection.)
Purging	Tanks, gas lines, or other objects or containers which have contained flammable liquid or gas should have no welding or cutting done on them until they have been freed of flammable residues. The purging should be checked and approved by the foreman in charge of the job.

	If any residue remains after a container has been purged, the container should be filled with water or an inert gas before any welding or cutting is attempted on it.
Ventilation	Ample ventilation should be provided when burning operations are being done in an enclosed area.
TOOL CARE AND USE	For the care and use of tools, a formal program works best. Set up a procedure for systematic inspection, maintenance, repair, and replacement, and for maintaining records.
Tripping and Damage	Keep tools stored when not in use. This will eliminate unnecessary tripping hazards as well as damage to the tools.
Electric Tools	Electric tools should be grounded in the approved manner, and their cords inspected regularly for breaks, kinks, abrasions, etc. Any damages or defects should be repaired promptly.
Pneumatic Tools	Pneumatic tools and their air hoses and lines should be examined regularly, and any defects discovered should be taken care of promptly. Before removing the hose from these tools, or making any adjustments to them, be sure the air pressure has been cut off.
BLASTING	Blasting should be done only by an experienced and competent person who has been assigned to this responsibility. (License is required in some jurisdictions.)
Warning	Ample warning (several minutes) should always be given with flag or similar device by an assigned competent employee stationed at every means of approach to the blast area and a safe distance from the blast location. Personnel should always be sent a safe distance from the blast location, and should not be permitted to return until advised to do so by the blaster or by an employee assigned to do so for him.
FIRE PROBLEMS	A qualified fire plan should be established before demolition begins. This plan should include fire protection and control, an evacuation plan, and duty assignments to key personnel.
Heating Devices	Salamanders and other heating devices should be placed on a base of earth, sand, metal plate, or similar nonflammable material. Effective venting to the outside, through safe means, should be provided.
Fire Extinguishers	Fire extinguishers should be provided in a sufficient quantity, of proper type, and well dispersed in locations throughout the job. Signs should be posted to show fire extinguisher locations.

Hydrants	Ready access to hydrants, standpipes, or similar facilities should be maintained, if available, by prohibiting storage of material within 5 feet of them.
PERSONAL PROTECTIVE EQUIPMENT	The many hazards prevalent in this type work require the use of a fairly wide variety of safety clothing and equipment.
Safety Belts and Life Nets	Much of wall work in demolition operations necessitates using safety belts or life nets. These are especially important when working on chimneys.
Respiratory Protection	Because many phases of demolition work are particularly dusty, respiratory protection should be provided. When cutting or welding is done on steel covered with leadbase or other paints, platings, or coatings, the operators and other workers within 15 feet should be provided with appropriate respiratory equipment. (See ASA Codes Z49.1 and Z2.1 for details.)
Hands	Gloves and hand leathers should be provided to employees required to handle sharp or very rough materials.
Feet	The use of foot protection—safety shoes, instep protectors, etc.—should be required.
Body	Ragged, torn, loose, and otherwise hazardous clothing should not be permitted.

INSTRUCTOR NOTE: Refer to ASA L18 series for more information on protective clothing.

GENERAL SAFETY TIPS	Several other categories, while not requiring separate coverage, are important and worthy of attention.
Glass	Don't leave broken glass around the operation.
Stairs	Keep selected stairs and rails in place as long as possible.
Loads	Don't overload hoists or other mechanical equipment.
Flying Objects	Place screens where necessary to protect workers from flying objects.
Spray	Water should be sprayed to control dusts when tearing down plaster and other interior materials, and as needed.

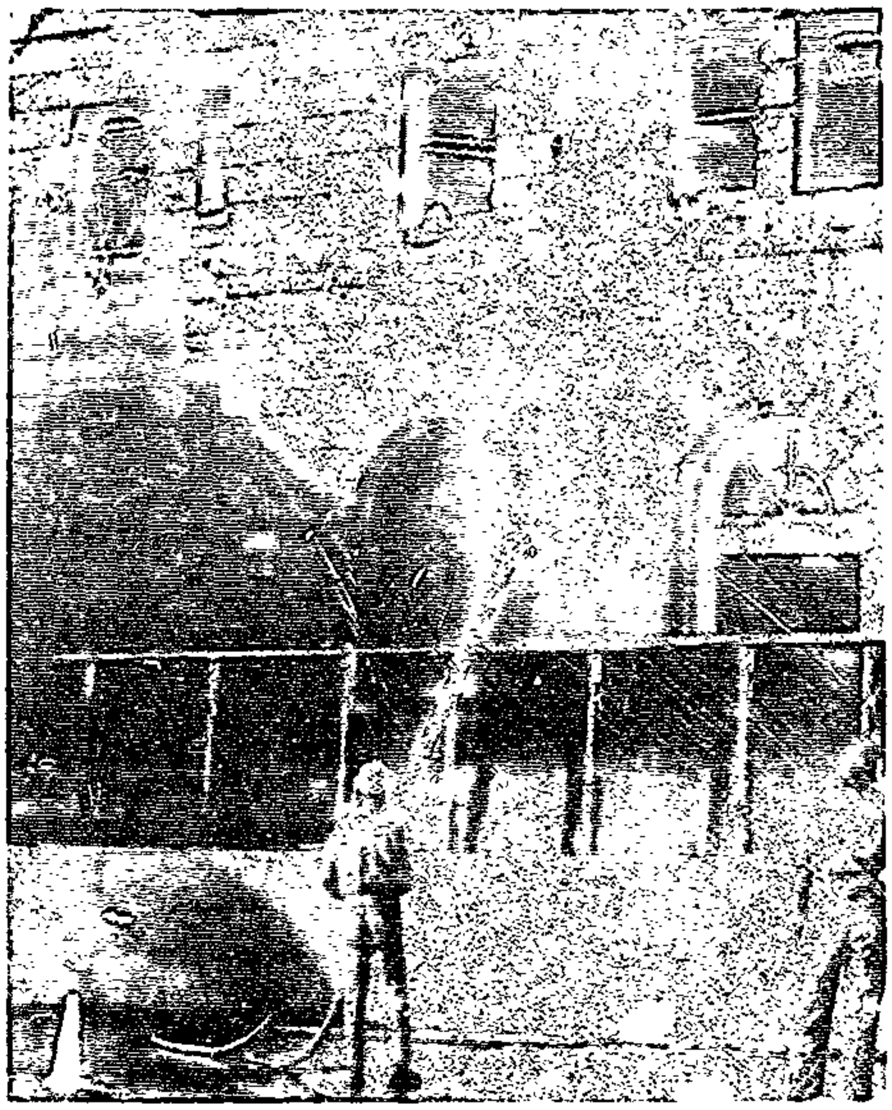


Chart 42. Spraying inside building.

Chart Discussion: SPRAYING INSIDE BUILDING. Here, they are hosing water through a window to spray down inside the building, to accomplish the result just discussed.

Nails	**Remove nails from lumber, bend them over, or drive them in.**
Piling	**Store materials in a safe way and in a safe place. Pile and stack safely.**
Hooks	**Don't use open hooks on cranes and hoists. Use a shackle or safety hook.**
Sheds	**Construction sheds, toolboxes, and similar supplemental structures should be placed well away from the danger of falling walls or other hazards.**
Occupancy	**In some cases, but not often, part of a structure or area being wrecked may be occupied. Special precautions must be taken in such situations.**

Lighting	Ample illumination should be provided for nightwork, or as required. (Reference: ASA A11.1.)
Slippery Conditions	All sidewalks, roadways, and other surfaces used by the public and workers should be kept clear of snow, ice, grease, mud, and other material or condition which would make it slippery.
Supervision	When there is more than one foreman on a demolition job, one should be designated as senior foreman in overall charge of the operations.

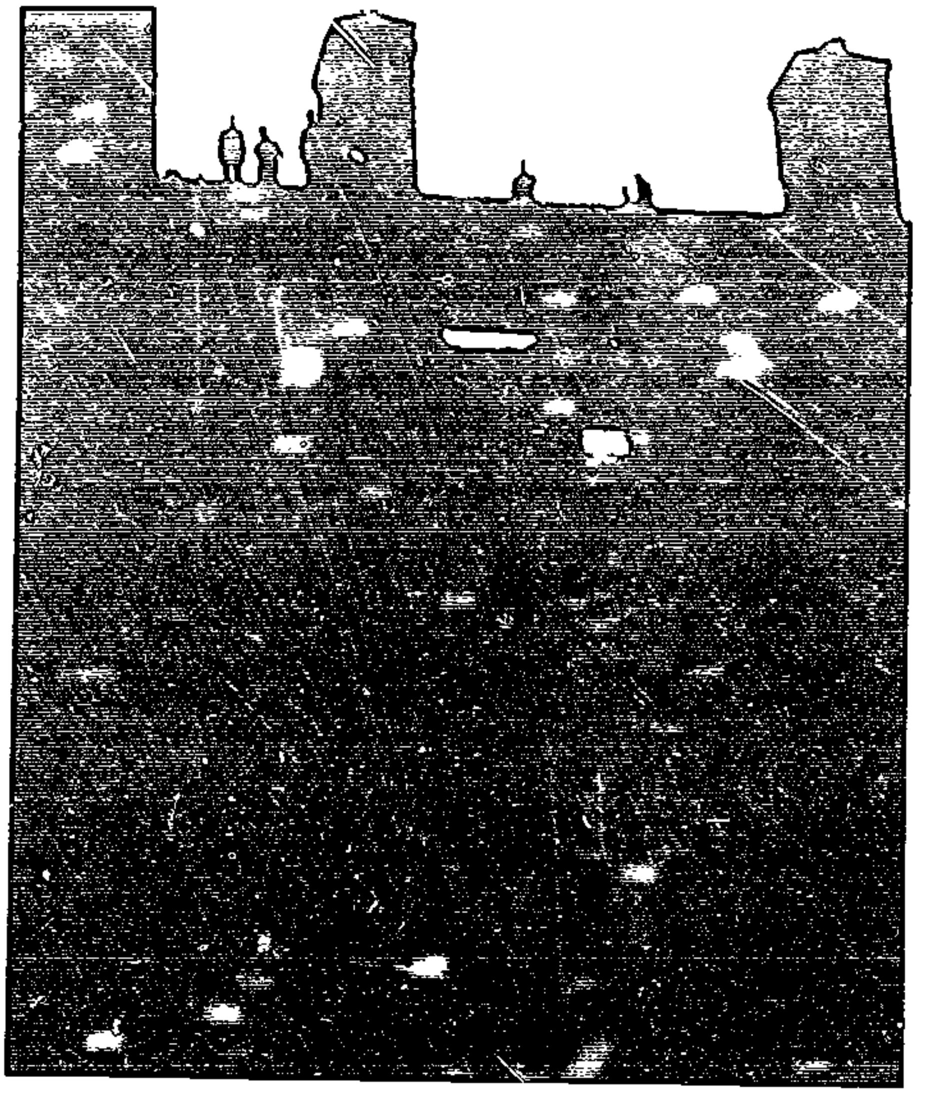


Chart 43. "Too many cooks?"

Chart Discussion: TOO MANY COOKS? This picture was taken as preparations were being made to pull down a stack near these men. Observe how each man is trying to say how it should be done. This can often cause confusion, and, in turn, often cause an accident. The point is: One man should be in charge; he should make the decisions, and only his directions should be followed. Other workers should be required to stay out of the area.

HOUSEKEEPING	Safety is efficiency. The neater the piling and the cleaner the operation, the faster and more efficiently the work progresses.

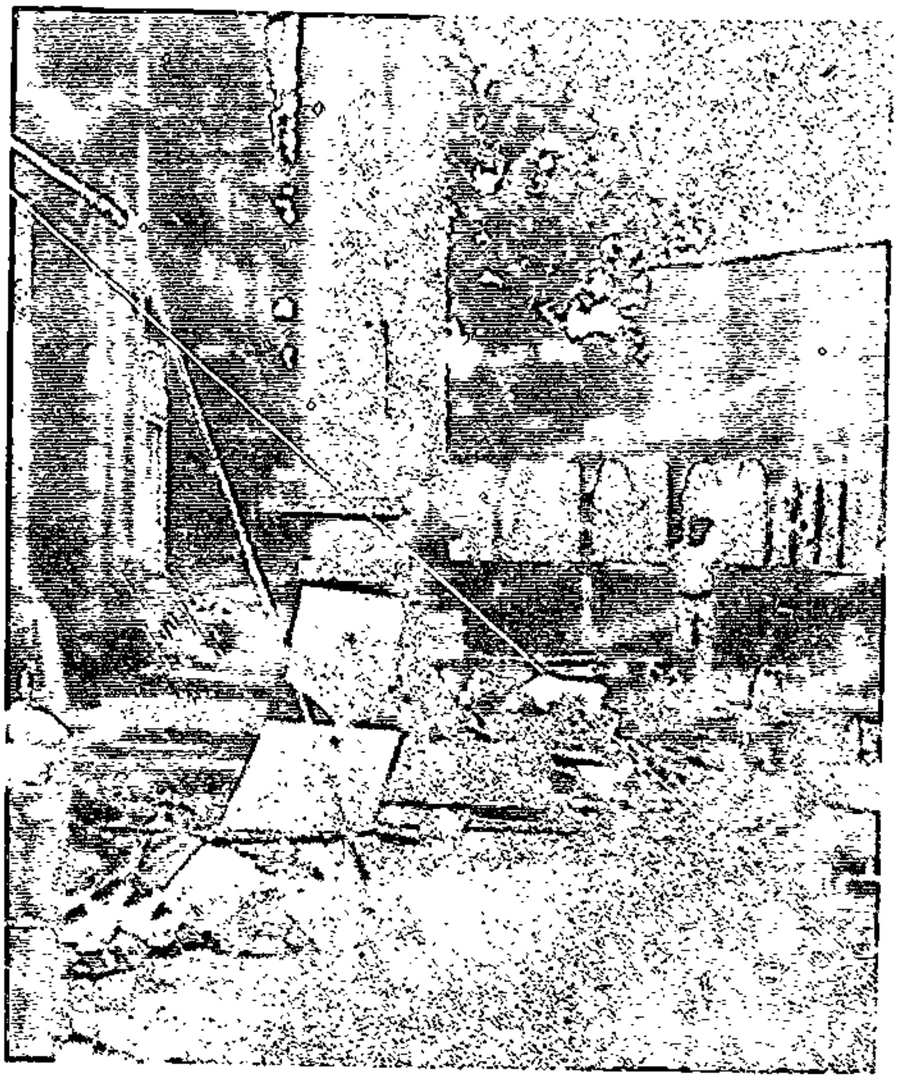


Chart 44. Housekeeping.

Chart Discussion: **HOUSEKEEPING.** Here is an example of poor housekeeping which sets up an obstacle course for the performance of the work, also conditions which could produce accidents.

Chart 45. Water and lunch facilities.

Chart Discussion: WATER AND LUNCH FACILITIES. This is hardly an example of how to promote worker morale. Such a drinking water facility can only give the impression of having been grudgingly provided. The lack of a better place has caused one worker to place his lunch on top of the water can. We wonder where the other fellows put their lunches.

PERSONAL FACILITIES	**Workers should be provided with good drinking and washing facilities, as well as toilet and other necessary personal facilities.**

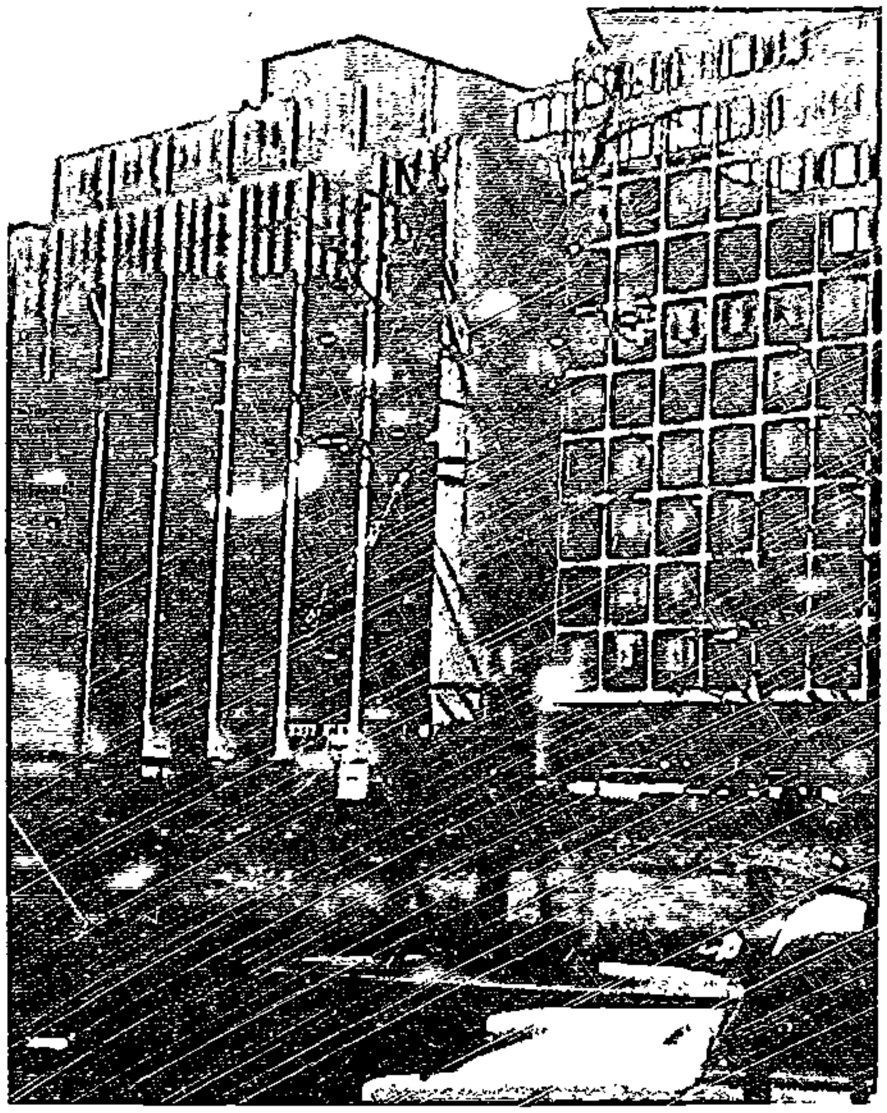


Chart 46. The final result.

Chart Discussion: THE FINAL RESULT. Here, we see a tract from which the building has been razed. The land is level, clear, free of holes, dry, clean, fenced, and posted. This situation and condition will not present any undue hazards to the public, which might produce a liability claim.

THE FINAL RESULT	When the job has been completed, the land should be clear, clean, dry, level (usually), fenced (when necessary) and left in a completely safe condition.
SUMMARY	At this point, we will make a comparison between the working conditions and practices which were highlighted from a negative standpoint at the beginning of this discussion and these conditions and practices from an affirmative standpoint as they were brought out during the discussion.

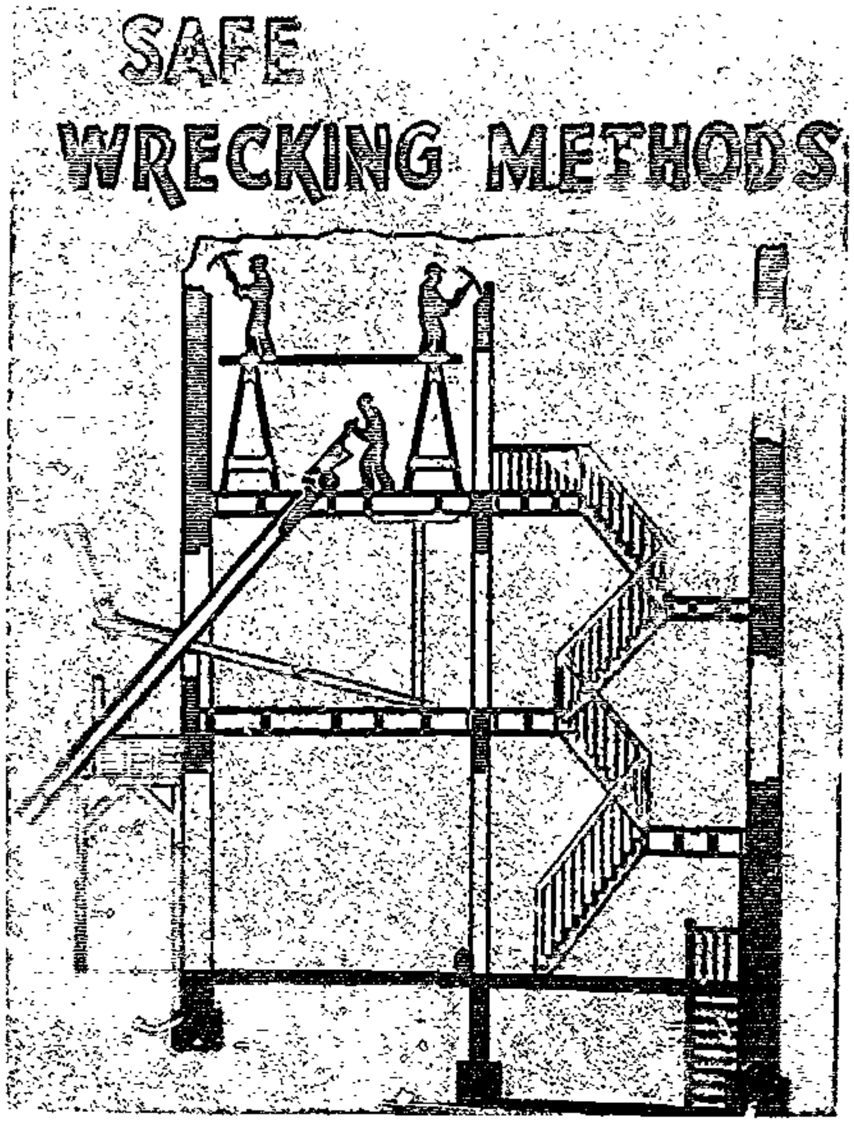


Chart 47. Safe working methods.

Chart Discussion: SAFE WORKING METHODS. INSTRUCTOR: At this time, make the comparison with the unsafe work methods as illustrated by the chart of that title. Show and discuss, in summary, how it "should be done"—the wall removal, scaffolding, chute, sidewalk shed, stairs, and all other points illustrated.

REFERENCES

> INSTRUCTOR NOTE: This information is for your use as circumstances require, or as you see fit. The ASA codes listed below are applicable to demolition operations.

A11.1 — Lighting (For illumination)
A10.14 — Demolition Code (This is being developed, 1966. Encourage its acquisition when published.)
A14.1 — Portable wood ladders
A14.2 — Portable metal ladders
A14.3 — Fixed ladders
A85.1 — Protective lighting
B19 — Compressed air machinery and equipment
B30.2 — Cranes, derricks and hoists
B57.1 — Compressed gas cylinders
C1 — Electrical supply stations
L18 Series — Protective clothing
Z2.1 — Head, eye and respiratory protection
Z4.1 — Sanitation
Z16.1 — Injury experience records and measurement
Z35.1 — Accident prevention signs
Z41 Series — Protective footwear
Z48.1 — Marking compressed gas cylinders
Z49.1 — Welding and cutting

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Safety Inspection Procedures. (Safety in Industry, Instructor Outline).

Otto, Francis L.
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*SAFETY INSPECTION, *SAFETY, *INDUSTRY, *CURRCULUM GUIDES, *INDUSTRIAL EDUCATION,

The basic purposes of safety inspection are to detect potential accident causes so that they may be corrected and to prevent an accident from occurring. Safety inspection procedures are illustrated by charts in this instructor's outline which provides a guide to standard presentation of the course in sequence and basic content. Additional information, materials, and illustrations should be included. Content includes (1) purpose of inspection, (2) inspection methods, (3) who inspects, (4) what guides, charts, and other aids the inspector should have, (5) what the inspector should look for, (6) reporting and recording procedures, (7) examples of what to check in a safety inspection, and (8) a plant inspection check sheet. The outline was developed by staff of the Office of Occupational Safety and the International Division, Bureau of Labor Standards. This document is available as GPO L16.3--286 for 35 cents from Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402. (PS)

SAFETY IN INDUSTRY
INSTRUCTOR OUTLINE

U. S. DEPARTMENT OF LABOR SAFETY TRAINING PROGRAMS

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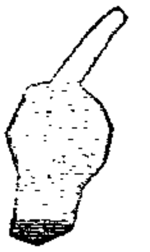

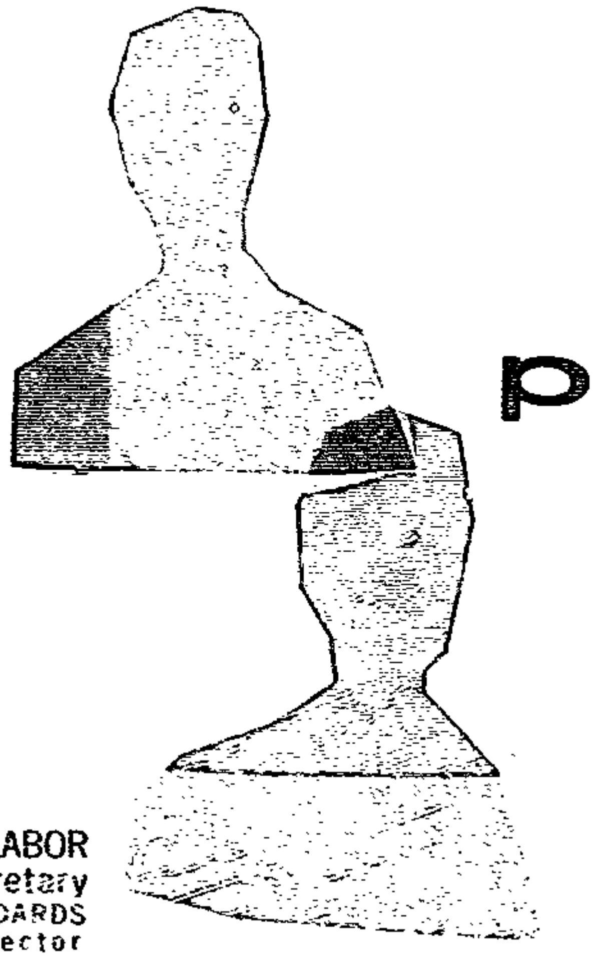

safety inspection procedures

U EPARTMENT OF LABOR
W lard Wirtz, Secretary
B OF LABOR STANDARDS
N n M. Bertz, Director

This instructor outline is one of a series developed by staff of the Office of Occupational Safety and the International Division, Bureau of Labor Standards.

The outline is intended only as a guide to standard presentation of the subject in sequence and basic content. Additional information, material, and illustrations should be included for a complete presentation suitable to the conditions, locality, industry, or occupational group.

This outline was revised in the Office of Occupational Safety by Francis L. Otto.

NOTE: American Standards Association name was changed to United States of America Standards Institute (USASI) August 1966. All American Standards now known as USA Standards (USAS).

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SAFETY IN INDUSTRY

INSTRUCTOR OUTLINE

safety inspection procedures

U. S. DEPARTMENT OF LABOR
W. Willard Wirtz, Secretary
BUREAU OF LABOR STANDARDS
Nelson M. Bortz, Director

Bulletin 286

SAFETY TRAINING TECHNIQUES

It is of utmost importance that the instructor become acquainted with some of the basic training techniques in order to better prepare himself to conduct the course successfully.

Planning

1. The instructor should have such visual aids as are pertinent to the subject matter of the course. These should be set up in proper sequence. An indication or note on the instructor's outline could be very helpful as a guide that a particular visual aid should be used.
2. The course outline as well as the handout material and the visual aids should be checked at regular intervals. This should be done by the instructor in order to revise, improve, and modernize the course presentation. The material should also be checked to make sure that it conforms with policies of labor and management in the country where it will be presented.
3. The instructor's outline should be adapted by him to his particular method of presentation, keeping in mind that this is a discussion conference type of session.
4. The instructor would do well to get an advance list of the students that will participate and their positions and backgrounds. A study of such information could be very helpful to the instructor when he faces his class.

Preparation of Classroom

Many conferences and courses have failed simply because no preparation was made for the classroom facilities.

1. The classroom should be located in an area where there is the least amount of noise or distraction.
2. Good ventilation, lighting, and sufficient room are important aspects to consider.
3. The seating arrangement and seats should be comfortable as well as informal. A round-table seating arrangement is the most effective for discussion-conference sessions.
4. The room should be equipped with a good blackboard, sufficient chalk, and a clean eraser. A stand should be available for mounting the charts and visual aids to be used during the conference. A 35-mm. slide projector should be available.

Teaching

1. An official of the organization should open the first session with a statement regarding the general objectives of the course. He then should introduce the instructor to give him the proper posture in relation to the group he will teach.

2. At the first session, the instructor should open with an explanation of the course objectives and its method of presentation. At this time, he should draw upon his experiences to relate an illustrative incident that will bring him in closer relationship with the group and, at the same time, enable him to introduce the theme of the first session.

3. The course should be presented by employing the discussion-conference method.

4. The instructor should have the class follow a predetermined schedule and maintain order at all times. Only one participant should be permitted to give his viewpoint at a time. The instructor should keep the class discussion within the subject matter as contained in the instructor's outline.

5. If possible, an official should be asked to speak at the termination of the course.

Tips for Instructors

Learning is actually the acquisition of new ideas, abilities, and skills acquired through the senses of hearing, seeing, and feeling by touch.

1. New ideas are conveyed through the presentation of knowledge, and thought is stimulated through the student's sense of hearing.

Abilities and skills are presented through the media of telling, demonstrating, and having students demonstrate under the supervision of the instructor. Students acquire abilities and skills via the senses of hearing, seeing, and feeling by touch.

2. An important aspect of teaching is to remember that the student absorbs more when he participates in a discussion. The instructor therefore strives to get 100-percent class participation.

3. The instructor should become aware of outstanding characteristics of his students. This could be very helpful when leading discussions. For example:

   A. Some may be more mature.

   B. Some may have a knowledge of safety.

   C. Some may have actual experience to draw on in the discussion.

   D. Some may have a faster learning speed than others.

E. Some may be "stallers" who can slow down the discussion.
F. Others may be aggressive and want to monopolize the discussion.
G. There may be a "know-it-all" in the group who must be properly controlled.
H. Some may be constant latecomers who ask questions about previous discussions and delay the class.

4. The teaching process consists of:
   A. Telling—this means giving background information to introduce a subject.
   B. Showing—a demonstration of some equipment pertaining to the subject to be discussed is very impressive.
   C. Illustrating—using charts, blackboard, slide, or films are very helpful to highlight specific points in the discussion.
   D. Discussion conference—the participation of the students in formulating their thinking about the subject under discussion is fundamental to getting the most out of the session.
   E. Conclusions—the instructor's summation of the session should knit together the points discussed during the session, and should include other important details that may have been overlooked by the group.
   F. Questions—during the session, the instructor should use questions to stimulate discussion, and also to help bring the discussion back to the subject matter if it has strayed.

Guest Instructors

It is necessary that the instructor be granted full responsibility for conduct of the class; at times, however, he may wish to call in an expert in a particular field as a guest instructor (or lecturer). In such event, it is essential that the instructor maintain control of the course.

The instructor must tie in the work of the guest instructor with the balance of the course; he must outline the phase of the subject to be covered by the guest and satisfy himself that the guest limits himself to the field as outlined; he should summarize the guest's contribution, pointing out its relative importance in the field of accident prevention. While the use of a few guest instructors (properly utilized) can add to the effectiveness of the course a series of "lecturers" whose topics are not correlated will inevitably result in confusion.

It is recommended that "guest experts" be used only for *supplementary* training, and not to replace even part of this course which should be taught by *one instructor*.

SAFETY INSPECTION PROCEDURES

Safety Inspection Procedures

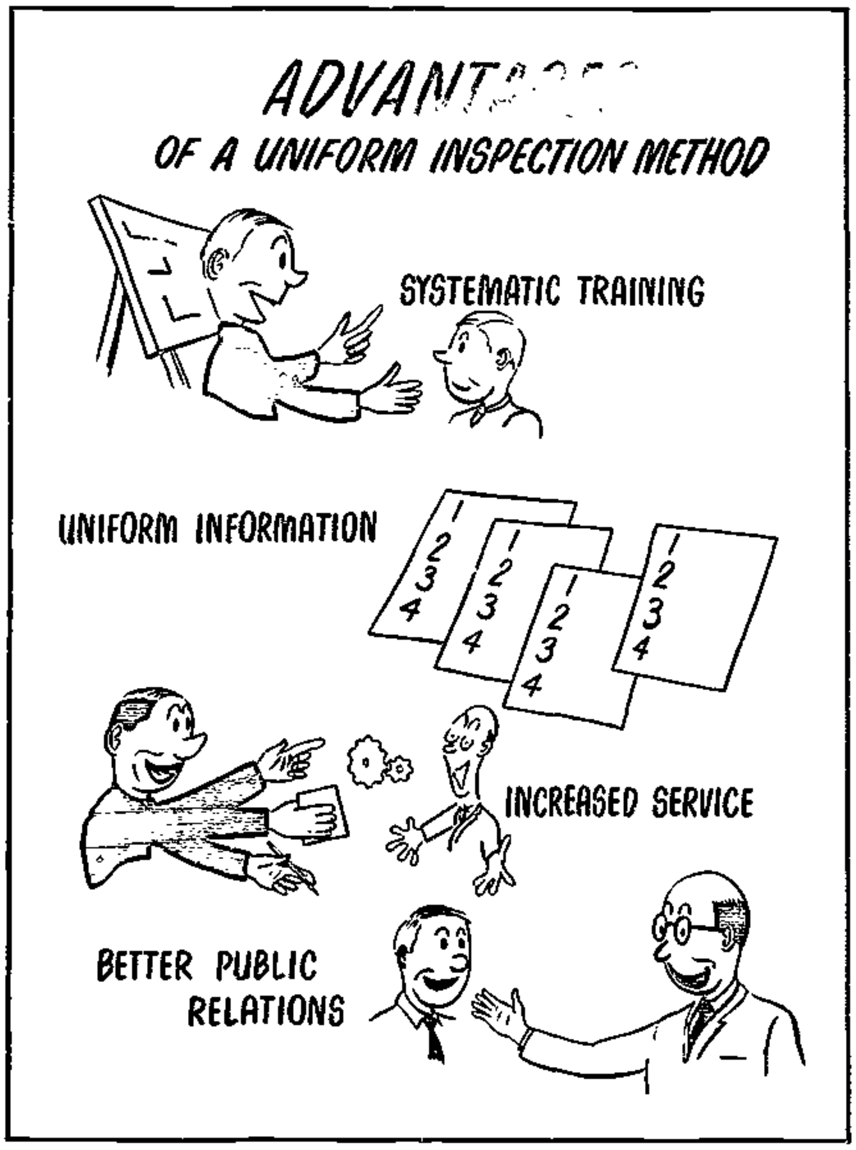


CHART 11—SERIES B

SAFETY INSPECTIONS

INSPECTIONS ARE A NECESSARY ACTIVITY IN A SAFETY PROGRAM

Every industrial plant and each occupational function or operation harbors some existing or potential hazards which arise through normal working or production procedures and through changes due to deletion or introduction of machines, materials, processes or methods, or structural changes due to construction. This points up the need for an effective method of hazard appraisal through inspections.

PURPOSE OF INSPECTION	
TO DETECT ACCIDENT CAUSES	The basic purpose of inspection is to *detect* potential accident causes so they may be corrected and to *prevent* an accident from occurring. Through inspection it is possible to determine those deficiencies which need to be corrected or improved to bring the plant or operation up to at least minimum accepted standards both from a safety and operational standpoint.
SYSTEMATIC PROTECTION	Methodical and well-performed safety inspections, done periodically, are an unequalled medium for determining accident-prevention needs. A definite, planned system is as necessary for safety inspection as for any other procedure.
UNIFORM INFORMATION	The use of standard or specially developed forms and procedures results in uniform information for use in checking against previous inspections or inspections of other area plants, jobs, or companies. With uniform information, repeatedly finding the same unsafe condition will be recognized and further necessary action can be taken.
CORRECTIVE ACTION	The practical value of inspection comes through corrective action being accomplished as soon as possible. The extent of hazard indicated for each item reported must be weighed to determine if immediate action is required or if some delay is necessary to obtain materials, etc. It is possible that temporary corrective action may be substituted until final action can be taken.
INCREASED EFFICIENCY	Good safety inspections often produce safer as well as more efficient methods. Methodically, uniformly planned and conducted safety inspections may be examples of efficient operations.
INSPECTIONS EXPRESS A TRUE INTEREST IN SAFETY	Coupled with effective action as a result of recommendations, safety inspection is one of the best methods by which management can demonstrate its sincerity regarding accident prevention.
OTHER SPECIFIC RESULTS ARE ACHIEVABLE	Other benefits which are shared by both management and the workers as a result of safety inspections include increased efficiency and better public and employee relations.

BETTER PUBLIC AND EMPLOYEE RELATIONS	Safety and efficiency always bring their own reward in better personnel and public relations. Employees usually prefer working in a safe plant, and the reputation of a company is usually judged by reports of accidents and injuries. Astute management which encourages or requires safety inspections realizes that good will and morale values can be obtained in no other way.
SAFETY TRAINING FOR EMPLOYEES	Safety inspections can be valuable in pointing out areas, operations, or methods which require emphasis in supervisor or employee training.

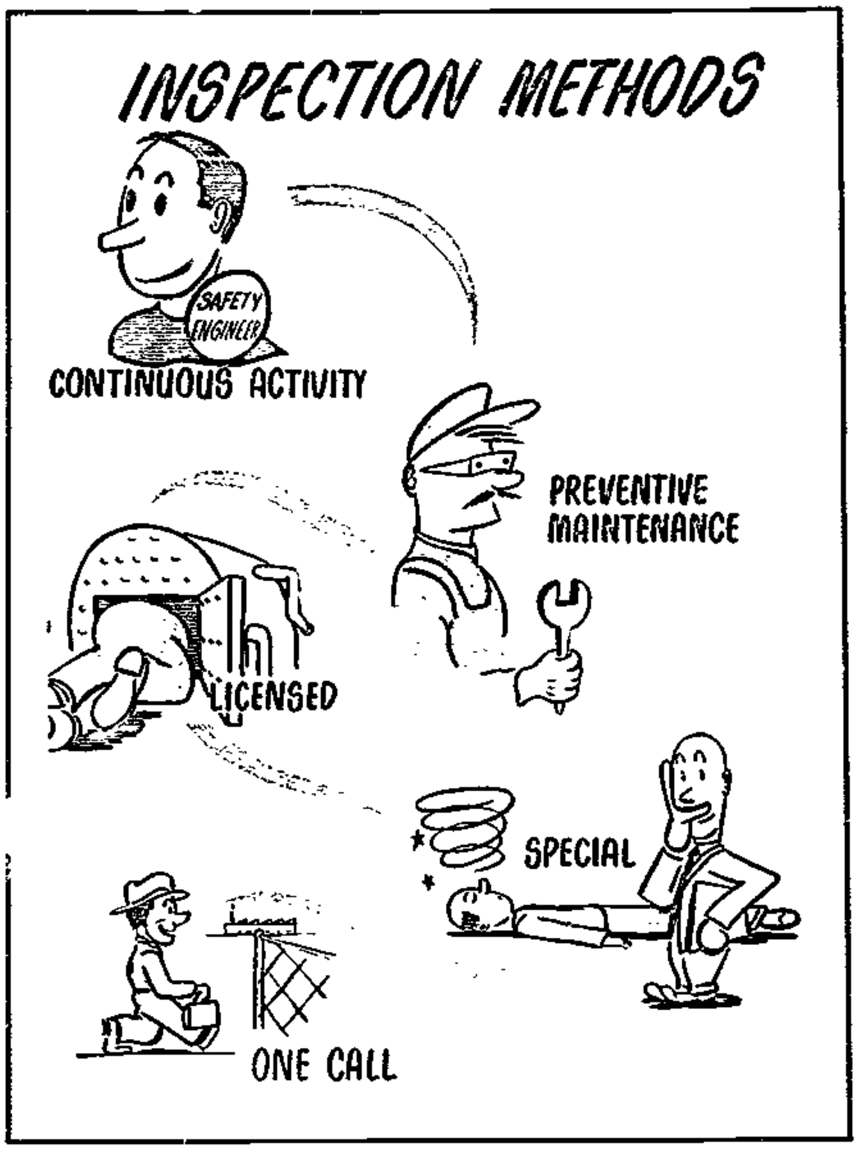


CHART 12—SERIES B

INSPECTION METHODS	
CLASSES OF SURVEYS	There are two fundamental classes of surveys: (1) those made or requested by the organization surveyed or some segment thereof as a function of an internal safety effort; and (2) those made by an "outside" agency or organization. These two classes are composed of five basic types. They are as follows:
CONTINUOUS ACTIVITY SURVEYS	These are regular periodic surveys made by safety engineers, safety directors, or their staffs. It includes safety committee surveys also, when such committees include weekly or monthly inspections in their activities. The advantages of this method include: a regular, planned program of inspection designed to cover all areas and subjects; familiarity by the staff and safety committee inspectors with the operations and procedures; early detection of changes in operations or equipment; followup of recommendations.

PREVENTIVE MAINTENANCE SURVEYS	These cover scheduled or continuing surveys by designated plant personnel, such as electricians, mechanics, and maintenance men. They include both safety surveys and those performed for mechanical functioning, lubrications, etc. Progressive plants schedule surveys at regular intervals, keyed to maintenance records of machinery and other equipment. Thus, potential machine, power, or other failures are sought out before they happen, thereby preventing damage, breakdowns, and injury-producing accidents.
LICENSED SURVEYS	These represent surveys made by specially trained certified or licensed inspectors, usually not part of the organization being inspected. Boiler, elevator, and electrical surveys are illustrations of this type. These surveys, and the tests which are usually a part of them, are very exacting and are made at specified times and intervals.
SPECIAL SURVEYS	These surveys are made for special purposes, usually at the request of management, employee groups, or unions. In some cases, they are made by a political subdivision, such as a State or municipality, and are sometimes required by law. Such surveys may be made to investigate a serious fire, explosion, or a serious accident. Many lost-time accidents (in some States, any accident involving machinery or any type permanent disability) and all deaths by accident may be subject to a special survey.
ONE-CALL SURVEYS	These surveys are made according to a predetermined schedule by "outside" inspectors; for example, State agency surveys. This type is generally performed on an annual or semiannual basis, since the usually small safety staffs and large coverage make it impossible for State, insurance, and similar engineers to do so more often. This method is termed "one-call" because there is seldom a personal followup on recommendations or orders issued, this being done by mail, if at all.

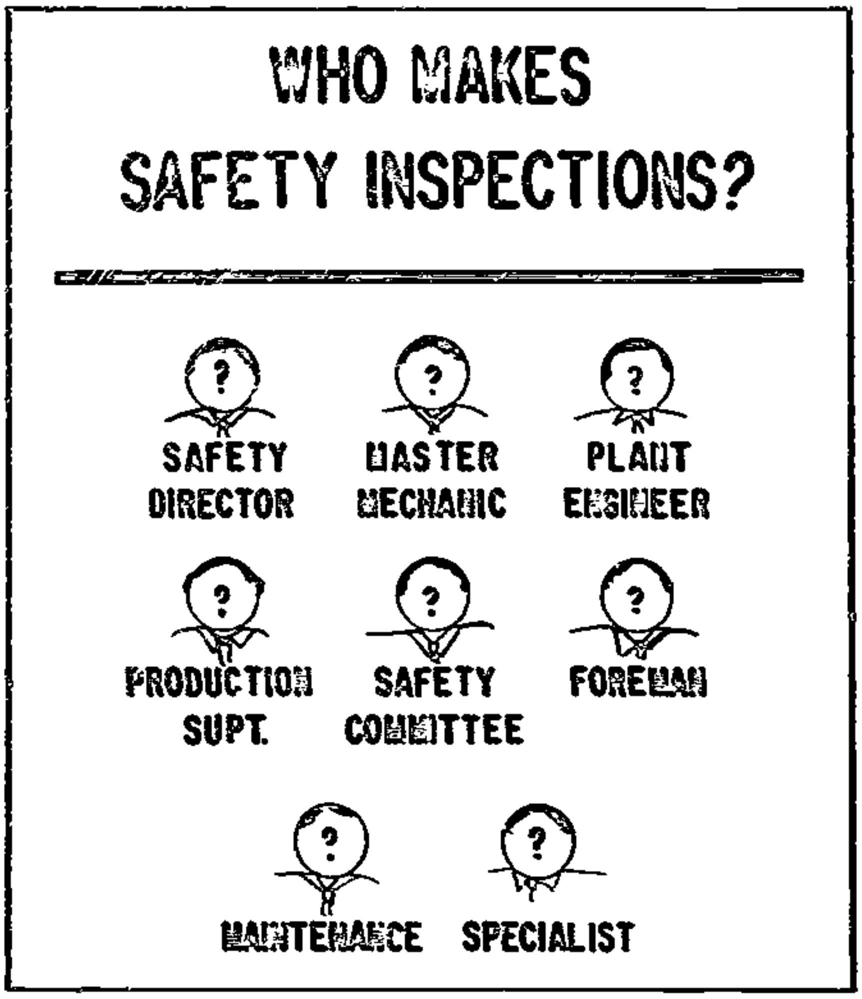
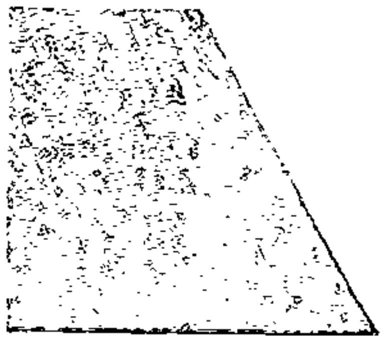


CHART 13—SERIES B

INTERNAL PLANT INSPECTIONS	
WHO SHOULD MAKE SAFETY INSPECTIONS?	**There are several possibilities: the safety engineer, the supervisor, the safety committee, a specialist in the operation affected, or somone from the boss' office.**

WHO INSPECTS

SUPERVISOR



Constantly **Daily**

Hourly

CHART 14—SERIES B

WHO INSPECTS—SUPERVISOR

Part of the answer to "Who inspects?" is based upon the fact that, in most cases, there should be more than one type of safety inspection.

Depending upon the size of plant, type, or circumstances involved in each case, safety inspections by several persons might be necessary.

The supervisor should be making a constant safety inspection as he makes his rounds—always alert to changing conditions or work methods. In some types of work (especially special or unusual work for his men), he may need to make *hourly* checks and inspections to be certain that all safety precautions are being taken. In some cases, the supervisor is instructed to make a *daily* inspection at the beginning of the shift to be sure there are no existing unsafe condtiions.

WHO INSPECTS

SAFETY COMMITTEE

Monthly Bi-monthly

CHART 15—SERIES B

WHO INSPECTS—SAFETY COMMITTEE	Inspections by the members of a safety committee may reveal hazards which might be overlooked by persons less familiar with the work. Also, inspections serve as a training medium by providing an opportunity for thinking and concentratng on safety as a group. By actually seeing conditions and work methods, members of the committee can conduct more intelligent and knowledgeable discussions in their meetings. Depending upon the size and complications of the operation, installation, or plant, varying schedules may be established. Some committees make inspections each month; others inspect every other month, holding meetings only once a month.
MORE THAN ONE PERSON	In almost all cases (a very small plant might be an exception), more than one person should make the safety inspections. Although the safety director should have charge of regular, functional-type safety inspections, inspections may be done under the direction of either the master mechanic, plant engineer, production superintendent, or other similar functionary. The important point is that such inspections should be under the direction of a responsible executive who can and will give the supervision necessary to assure effectiveness to prevent these inspections from becoming meaningless, perfunctory, routine gestures and functions.

THEY ALL SHARE THE DUTY

As the needs of an organization dictate, circumstances, times, and situations may arise when the safety director or one of his staff should make safety inspections.

So, too, recurring occasions may arise when safety inspections should be made by other persons or groups: management representatives, supervisors, committees or their members, "specialists," or maintenance personnel.

This is not meant to favor one of these in lieu of any of the others. For example, the "safety man's" regular inspections could be supplemented by regular inspections of the safety committee.

No individual or group should have exclusive responsibility for safety inspections.

CAN THE "NEW BROOM SWEEP CLEANER"?

In some organizations, when inspections are made by the safety committee, which is composed of workers or supervisors, the individuals involved inspect each other's areas of operation.

It has been found that in many situations, the "stranger" notes unsafe conditions or acts which the persons familiar with the operation have been missing, and therefore are likely to miss again when inspecting for safety.

WHAT SHOULD THE "INSPECTOR" KNOW OR LEARN?

Whatever position the person making the safety inspection has — a worker, supervisor, insurance engineer, State inspector—he should possess a good working knowledge of the machines, processes, functions, needs, problems, etc., of the plant, area, or operation which he plans to inspect, as well as a sound knowledge of basic accident causes.

SOMETIMES, SPECIAL KNOWLEDGE IS REQUIRED

In some special circumstances, he should be an expert; for example, in a special industrial hygiene inspection and in comparable situations, a high degree of technical and specialized training, background, or ability is required. In *this* topic under discussion, however, we are not covering such situations.

HOW CAN THE "NON-PROFESSIONAL" PREPARE HIMSELF?

Where the need exists, before attempting a safety inspection, an individual should acquire and digest all pertinent information available on the type operations which he proposes to survey.

He should review and acquaint himself with the details of these functions, generally and specifically and in relation to each other.

Other supplementary information also is often applicable, depending on the circumstances, such as data on accidents which have occurred, review of previous safety inspection reports, specific regulations which may be required, and standards which may be applicable.

WHAT "MAKES" A SAFETY INSPECTOR?

1. Expertise?
2. Ability?
3. Experience?
4. Capacity for ideas?
5. Self-analysis?

CHART 16—SERIES B

WHAT KNOWLEDGE IS NECESSARY TO QUALIFY AS A "SAFETY INSPECTOR"?	"Knowledge" should encompass at least a reasonable acquaintanceship with the various aspects of the operations which an individual is to inspect and an understanding of the hazards or other problems affecting safety which they represent.
EXPERTISE	An old adage refers to "not seeing the forest for the trees." In some cases, this has been applied to safety inspection in the sense that sometimes being too completely familiar with an operation or area can cloud a person's ability to discern even obvious hazards.

	There are certain techniques in making a safety inspection which are learned by *doing*. The more times a person makes inspections, the more expert he becomes in concentrating on looking for and recognizing unsafe conditions. The more knowledge the inspector has of the specific types of hazards that may exist in the operation he is inspecting, the closer he comes to being an expert in this activity.
ABILITY	Some people have a greater ability to see, perceive, and recognize potential accident causes—because of their basic safety interest, perceptiveness, and curiosity. Such natural ability can be improved through experience.
EXPERIENCE	Some persons assigned the responsibility for making safety inspections have never done so before and therefore have no experience. Lack of experience may be somewhat compensated for by studying and learning the basic accident causes and by reviewing previous inspection reports. If committee members are rotated, it is important that their rotation be staggered so that some persons with experience are always retained.
CAPACITY FOR IDEAS	It has been said that "accident prevention is mostly common sense." The knowledge that the inspector should have—particularly the nonprofessional—would therefore not necessarily include the ability to *solve* accident prevention problems, especially from a technical standpoint, but it is very advantageous if he "gets ideas" easily. What he needs most of all is the ability to *recognize hazards* or conditions and acts which represent potential hazards.
SELF-ANALYSIS	Good intentions and a desire to help, even when combined with common sense referred to previously, are not usually enough to qualify a person to inspect for safety. Therefore, to be truly effective, the conscientious inspector should critically analyze his own qualifications to inspect for safety.

WHO INSPECTS

SAFETY ENGINEER

Daily Weekly
Monthly Special

CHART 17—SERIES B

WHO INSPECTS—SAFETY ENGINEER	Where an organization has a safety engineer, safety director, or whatever his title might be, part of his responsibility is conducting safety inspections. He determines the frequency of his inspections depending upon the other factors involved. If there are great variations in conditions, such as a construction project, he may devote a part of each day to safety inspection. Distance between jobs or plants or other considerations may require that his inspections be made weekly or monthly. New construction, installations, or changes in processes or materials being used may require that he make special, unscheduled inspections to make certain that safety requirements are met in making the changes and in preparation for putting the new equipment or process into operation.

WHO INSPECTS

STATE SAFETY
REPRESENTATIVE

Annually

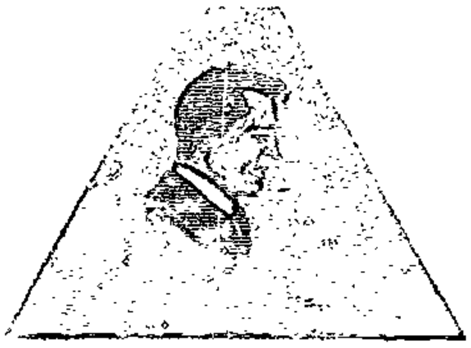
CHART 18—SERIES B

WHO INSPECTS—STATE SAFETY REPRESENTATIVE	Most States have a safety inspection staff in the Department of Labor, the Industrial Commission, or some other agency responsible for labor law administration. The extent of authority depends upon the specific State law and the type of promotion or enforcement prescribed. The small number of State safety representatives, compared with the number of establishments, generally allows only one inspection per year—often without any additional followup.

WHO INSPECTS

Federal Government

(WHPC – USDL)
(LSB– USDL)



By Contact

By Job

By Loadinq

CHART 19—SERIES B

WHO INSPECTS—FEDERAL GOVERNMENT

The Federal Government's responsibility for industrial safety inspections rests primarily on two Bureaus of the Department of Labor. The safety activity of the Wage and Hour and Public Contracts Divisions generally is confined to manufacturing firms with Government contracts of $10,000 and over. Safety standards established by WHPC are used as a basis for such inspections. In some States, these inspections are conducted by the State safety representatives.

The Longshoremen's and Harbor Workers' Compensation Act gives authority to the Bureau of Labor Standards to inspect longshoring, ship repairs, and shipbreaking activities.

WHO INSPECTS

INSURANCE COMPANY
SAFETY ENGINEER

According to Policy
Agreement

CHART 20—SERIES B

WHO INSPECTS— INSURANCE COMPANY SAFETY ENGINEER	**Workmen's compensation insurance companies often assign safety engineers to inspect the premises to detect unsafe conditions and submit recommendations. While there seems to be no standard, the amount of the premium usually is used to determine the extent of this service. Probably the greatest influence for making corrections is obtained by threatening to cancel the policy.**

WHAT AIDS ARE NEEDED?

1. Plans
2. Guides
3. Forms
4. Incidental Equipment
5. Technical Materials
6. Incentives

CHART 21—SERIES B

WHAT GUIDES, CHARTS, AND OTHER AIDS SHOULD INSPECTOR HAVE?	This is an important part of the preparation for a safety inspection. Good preparation is essential for good inspection.
LAYOUT AND MACHINERY	In many cases, a layout of the area to be inspected is helpful or even essential. A chart or listing of machinery, equipment, etc., helps considerably. All items in this general category should be considered or as the need may indicate.
FORMS	There are several types of forms available which can be applied to most safety inspections. A form adapted to meet local conditions and patterned to fit the particular aspects involved in the inspection to be made is even better.

	The form used may be filled out during inspection or completed afterwards from notes made. But, whatever the techniques, the use of forms is an integral part of good safety inspection. (Discussed later on.)
INSPECTION GUIDES	Such aids as checklists and similar inspection guides should be used to help guarantee a thorough inspection, thus minimizing the possibility of something being overlooked or forgotten.
INCIDENTAL EQUIPMENT	The inspector should take along incidental necessities, such as a hard hat, goggles, flashlight, tape measure, pencil, and any other basic accessories needed to make an efficient inspection.
ROUTING THE INSPECTION	Although there is no standard sequence for the most productive safety inspection, it is best to follow a process or operation from the beginning —*from* the raw material, step by step through to the finished product. This would be true in most production operations, chemical and manufacturing plants, etc. But in custom operations or in an area making a product by different methods, the layout may lend itself to unit-by-unit or a nonrouted method, rather than the step-by-step method of safety inspection. Usually, inspection in sequence is easier, saves time, and is more efficient; also, needs are recognized more readily. Then, too, there is less chance of missing something even though the safety inspector may feel that he is familiar with the operation.
SOME DO'S AND DONT'S	Make necessary notes, but don't be "obvious"; the fewer, the better. Avoid "showiness" in recording information. Don't disturb workers. As you make your inspection, do so without disrupting operations. Avoid conversation with workers, except with supervisor's approval. Do not "lecture"; do not argue. Inspect all areas. Check thoroughly, open doors, don't be "steered away" from any area whether isolated or not. (Exception: where security clearance is required but inspector has not been cleared.) Seek out the reasons why any adverse condition exists. Discuss the inspection with supervisors if they wish to, but don't get into an argument with them.

RECOMMENDATIONS

The safety inspector should organize his notes and decide upon necessary recommendations, listing each recommendation's definite location in the area inspected.

Recommendations should have a good basis in logic, be well worded, and take into account as much as possible the viewpoints of the people they affect.

He should be prepared to substantiate his opinions with standards, codes, or accepted practice and should not "load" the recommendation list with any of questionable importance.

WHAT SHOULD YOU LOOK FOR?

1. General Conditions
2. Specific Hazards
3. Work Practices

CHART 22—SERIES B

WHAT SHOULD THE SAFETY INSPECTOR LOOK FOR?	There are three basic categories in a safety inspection: general conditions, specific operations, and work practices.
GENERAL CONDITIONS	General conditions would include lighting, housekeeping, ventilation, and similar matters.
SPECIFIC HAZARDS	Specific hazards category would include tools, machines, equipment, materials, etc.
WORK PRACTICES	The work practices category is an appraisal of methods and the manner in which methods are implemented.

Pass out "Student Work Sheet," entitled "Thirty-five Items To Consider for a Safety Inspection," then discuss each of the items, pointing out that the list is illustrative and intended as a guide. Encourage class discussion.

HOW TO GET RESULTS

1. Reporting
2. Recording
3. Application

CHART 23—SERIES B

WHAT REPORTING AND RECORDING PROCEDURES SHOULD BE USED?	Reports and records should be as simple as possible. Cumbersome elaboration of any good, basic system will not necessarily make it work better nor will it produce a more effective result.

FORMS

Forms are a valuable adjunct to safety inspection if they are comprehensive and well prepared. The checklist and similar type forms have a tendency, of course, to limit the breadth of the inspection. On the other hand, completely narrative-type reporting usually is verbose, cumbersome, incoherent, and difficult to understand.

Inspection and reporting forms are therefore usually more effective when they combine the better features of both the checklist and narrative type which produce a quick and easy method of reporting, but also allows narrative description when necessary.

RECORDING AND HANDLING PROCEDURES

Recording and the procedural aspects of safety inspections, the recommendations made as a consequence, and the further activity resulting also are areas where brevity and efficiency combined with proper and established procedures and thoroughness will produce meaningful results.

APPLYING THESE PRINCIPLES

In this discussion, the foregoing comments on reporting and procedures are, of necessity, quite general. No exact rules or ideas can apply in all instances.

The main point here is that in each case, based upon the circumstances involved, a standard procedure *should* be set up to cover the type of reporting to be used and the method by which recommendations will be handled, recorded, filed, classified, and followed up, and all other material and functional details which are produced by safety inspections.

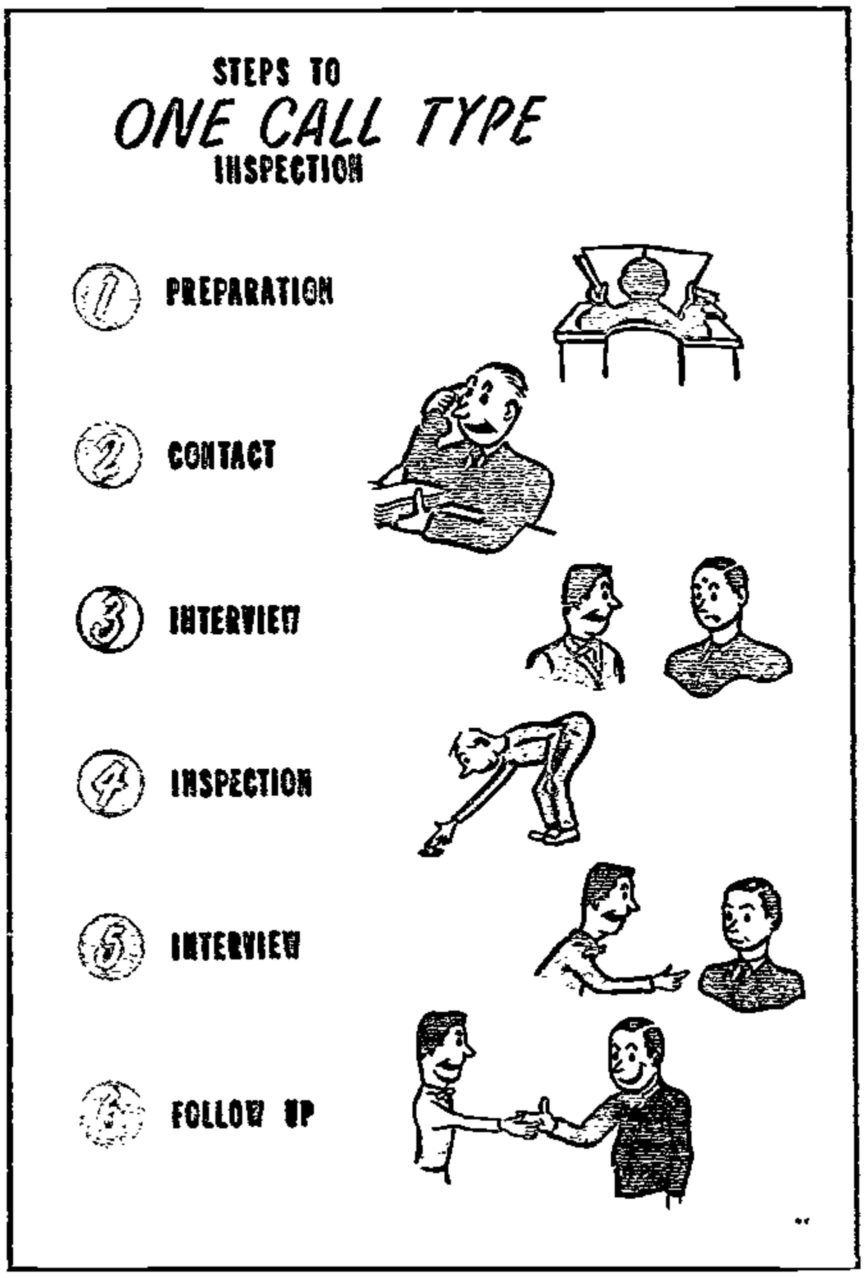


CHART 24—SERIES B

INSPECTION PROCEDURES	A worthwhile, productive, and valuable inspection must be a complete and well-planned operation. The following discussion on this subject relates primarily to the situation as it affects the representatve of a State agency, casualty company, etc., but much of the material, particularly that on the actual survey and the preparation for it, is important to the inplant survey operation as well.
PREPARATION HAS MANY SEGMENTS	Advance planning is an absolute essential for a worthwhile safety survey. The following steps must be given careful consideration and be thoroughly planned, when applicable:
REVIEW THE CIRCUMSTANCES IN GENERAL	Digest all pertinent information available on the industry and the type of operations involved, both generally and specifically, and in relation to each other. Acquire, develop, and study injury-frequency and severity rates and information on past accidents for both the industry concerned and the plant to be surveyed.

ANALYZE THE HAZARDS	Study published material on typical hazards of the industry and the plant or operation to be surveyed. If available, procure and study other surveys previously made by insurance, State, consultative, or other agencies or individuals.
APPRAISE YOURSELF	Is this an unusual situation, so far as your capabilities and experience is concerned? Are you fully qualified to handle this matter alone or should you arrange for assistance or collaboration?
DELIBERATE UPON LEGAL ASPECTS	Give consideration to what laws, codes, regulations, standards, and other required or established data may be applied. National, State, or local laws or codes and standards, such as ASA, NFPA, etc., may have appreciable bearing upon the decisions you will have to make in your survey.
THE TIMING ELEMENT	For obvious reasons, surveys should not be attempted when a plant is not operating in reasonably normal fashion, such as during slack operation, changeovers, or when, for any reason, a distorted or misleading picture might result. Exceptions to this would be a need for a survey under unusual circumstances. In some cases, planning the time of the survey would include consideration of personal expediency for either the person making the survey or for those in the plant. But, if a "surprise" type of survey is in order, the best time should be determined in advance. Under some conditions, timing can be important, and in all cases, it should be given due thought.
PERSONAL INFORMATION	Some personal information about persons with whom one must deal is helpful, particularly if some "selling" of safety becomes necessary. In any case, pertinent information on backgrounds, attitudes, and past actions and responses in such circumstances will be helpful.
INCIDENTAL PROCEDURES	Should a letter be directed to the plant, asking for an appointment, or should a notice of intent to survey be sent? Who will the surveyor contact in the organization or plant to be surveyed? Is coordination with any other persons or circumstances necessary? Are there any other special or unusual aspects which should be planned for in advance?
DEVELOP A PLAN	To the extent possible and based upon one's information of the plant, a plan or route for the survey should be developed, having definite objectives; a determination should be made of the areas, buildings, and operations which are to be covered and the order in which they should be studied. This would also apply to the order in which particular functions, such as repair, housekeeping, or maintenance will be surveyed, or whether they will be considered as parts of the operations they affect. Also to be decided are sequences of given operations.

	The objective of advance planning is usually a logical step-by-step sequence from the first step to the last, whether it is an entire plant or one particular operation to be surveyed. Advanced consideration should be given to special machinery, functions, or other aspects included. In general, the scope and specifics of the survey should be defined in advance as much as possible.
"SALES" IDEAS AND MATERIALS ARE NEEDED	Whether or not any safety improvements will actually be made on the basis of the inspection depends on how well the inspector is able to sell his ideas. He should therefore assemble materials that will support his recommendations.
TECHNICAL OR OTHER SAFETY MATERIALS	Inspectors should acquire booklets, posters, drawings, and plans of the areas, and other materials to present to plant or operations management for either use or distribution, or to use to complete explanation of recommendations.
FORMS ARE USUALLY NEEDED	There are several types of forms which might be used in an inspection or as a result of it—those for compiling data or for reporting purposes; usually State, insurance, and other similar groups have these. When such forms are not available, the surveyor should anticipate his needs and procure them in advance.
CONTACT	The State inspector's first contact may be preceded by a letter or notice. In any event, he should see top management first, present identification, clarify visit's purpose, maintain proper decorum, and make his original contact only with "the boss"—president, manager, etc.—but not with the line supervisor or staff.
PREINSPECTION INTERVIEW	The purpose of the preinspection interview is to provide an opportunity for the State, Government, or insurance inspector to discuss with top management the objectives and procedures for the inspection and to make arrangements for persons to accompany the inspector, etc. This is an excellent opportunity to establish good relationships, promote a safety program, and to reach a mutual understanding of purposes, procedures, and expected results. It is important that the interview be with the top official of the plant or installation.
THE INSPECTION "ROUTE" OR ORDER OF INSPECTION	It is not possible to outline any order of survey steps which will fit all situations. Whether the safety program records, when applicable (and a study of these as well as the plant can be very important), or the operations themselves should be surveyed first depends upon a number of factors. If the person making the inspection is not familiar with the departments and processes in a given plant, or if he wishes to determine plant safety needs before inspecting records, it may be more expedient to survey the operations first. If he is sufficiently familiar with the

	establishment and its procedures to be certain that the records are authentic, he can take this into consideration in making this conclusion. However, if there is a possibility that evidence of violations, needs, or other pertinent information might be concealed, it might be better to review the records first. Some agencies require their men to vary inspection procedures so that management will not know what the procedure will be.
WHAT TO LOOK FOR	To accomplish the objectives of checking general conditions, specific hazards, and work practices, the scope of your inspection would include:
RECEIVING, SHIPPING, STORAGE	Equipment, job planning, layout, methods. Piling and stacking—safe heights, floor loads, projecting materials, methods.
MATERIALS HANDLING	Inplant transportation—hand trucks, power trucks, push trucks, gantrys, overhead materials handling—monorails, hoists, bridge cranes.
BUILDING CONDITIONS, PLANT LAYOUT, HOUSEKEEPING	Floors, walls, exits, stairs, walkways, ramps, ceilings, building and operations locations, flow of materials equipment location aisles, special fixtures, storage. Waste disposal, tool cleanliness, leakage and spillage, general and immediate work areas, methods.
ELECTRICAL EQUIPMENT LIGHTING	Electrical—switches, breakers, fuses, junctions, motors, grounding, explosion-proof equipment. Lighting—modern, permanent, bright enough, well diffused, no glare, approved installation, independently controlled, not in the way, supplementary lighting.
VENTILATION	Temperature and ventilation—warm enough, cool enough, humidity, good artificial or natural ventilation. Dusts, fumes, gases—individual and general exhaust systems capacities, types, storage or disposition of contaminants.
COLOR CONDITIONING	Color—painted walls, floors, ceilings, machines, objects, equipment, piping, color coding.
MACHINERY	Point of operation, flywheels, gears, shafts, pulleys, keyways, belting, couplings, sprockets, chains, frame, methods of attachment, general condition, operating controls, electrical grounding, lighting, incidental tools and equipment, brakes, exhausting, oiling and adjusting, speeds, operating authority.
EMPLOYEES	Experienced; trained; clean, oil and adjust machinery safely; wear safe clothes and shoes; use protective equipment; use guards; use feeding devices; check machine before starting; store tools and equipment safely; lift safety. Check age, class, type, sex of employees.

MOTION AND FATIGUE	Repetitive motion and fatigue—muscular strain, pads and cushions, chairs and stools.
MANUAL LIFTING	Proper grip, safe footing, back straight, knees bent, gets help, carries slowly, steady motion. Objects not too heavy, slippery, poorly shaped, bulky.
PERSONAL EQUIPMENT	Protective clothing and equipment—shoes, gloves, eye protection, respirators, caps, coats, spats, aprons. Close fit or easy-to-remove clothes, maintenance. Psychological aspects.
FALLS—CAUSES	Floors, steps, ramps, slopes, platforms, different levels.
FLYING OBJECTS	Consider size and range from dust to kickbacks. Materials, flying machine parts, wheels, etc.
MAINTENANCE	Regular, effective, trained and specialized personnel, good materials and parts, safe methods.
FIRE PREVENTION	Fire prevention and control—extinguishers, exits, assigned personnel, safe conditions, proper storage, dangerous operations separated, fire doors and walls, flammable materials, explosion-proof fixtures.
WELDING	Cylinders, hoses, valves, torches, regulators, isolation, protection, actinic rays.
TOOLS	Handtools and power tools—purchase, inspection, storage, repair, maintenance, transport, safe use, proper type, proper size, special tools, grounding.
PRESURE VESSELS	Experienced operators, regular inspection, maintenance and repair, safety device equipped, safely located or protected.
FACILITIES	Employee facilities—roomy, clean, well lighted, screened, ventilated, painted.
LIFTING DEVICES	Conveyors, elevators, and other lifting devices—enclosed shafts, machinery protected, no unauthorized use, regular inspection, good maintenance.
DANGEROUS SUBSTANCES	Chemicals, explosives, and other dangerous substances—storage, handling, transportation, protective clothing and equipment, supervision, training, amounts, warning signs.
NOISE	Isolation, ear protection, baffles.
SAFETY PROGRAM	Present safety activities—safety engineer, safety committees, meetings, training, accident reporting, investigations, accident records, job safety analyses, cost charging system, responsibilities, job hazard analyses.

SUMMARY

The foregoing list is not a complete one; it is intended only as a guide to which the student will add as circumstances dictate to make up a thorough survey.

PERSONAL CONDUCT

The inspector's conduct should be exemplary at all times, particularly if he has legal authority. He should never assume that management is unwilling to obey the law or is indifferent to the safety of its employees. Employers are rarely consciously inhuman. The overwhelming majority of accidents are due to the lack of safety-mindedness either of management or workers and in no way justifies an attitude of condemnation on the part of the inspector. He is there to determine conditions and secure improvement where it is needed; it is his job to arouse management's interest in safety. He is there as a service to the workers, the employer, and the public.

Only if an employer consistently refuses to cooperate should force be used; however, a competent and experienced inspector rarely needs to use force.

POST-SURVEY INTERVIEW

This, too, is an important part of the work. Agreement must be reached on the results of, and the needs for, action disclosed by the inspection.

PREPARATION FOR THE INTERVIEW

Organize notes and decide upon necessary orders or recommendations, giving each of them a definite location in the plant for easy reference. Work the presentation carefully, taking into account the viewpoints of management and labor, the justification for any higher-than-normal expenditures, and sales points which may be used. Orders and recommendations should be written in order of importance, and the inspector should be prepared to substantiate all recommendations or orders.

SOME HINTS TO CONVINCE

This is the point at which the ability to give clear, concise, and reasonable explanations and descriptions—and to convince (sell) management of the importance and necessity for making the corrections or additions—will determine to an appreciable degree just how much good will come of this effort. A few rules of good salesmanship apply here: (1) be neat in dress and appearance; (2) have ability to sell one's self—have winning personality; (3) observe good human relations practices; (4) know your product; (5) observe the principles of the agency or organization you may represent; and (6) generate acceptance and enthusiasm.

THE ACTUAL DISCUSSION

Open with a compliment; think of something appropriate that you can remark upon. Tailor your recommendations to fit the particular needs of this plant or installation to the greatest degree possible, making sure you present them in a reasonable and well-organized fashion. Try to "tie in" any recommendations, orders, or plans you suggest with any safety activities presently existing in the plant. Be constructive, remembering that your approach should be clear, certain, and definite. Don't over-elaborate—be as brief as is commensurate with comprehensive coverage of your subject. Press for definite conclusions and get agreement. Arrange schedule for any revisit or other followup.

ISSUANCE OF ORDERS

Since the issuance of orders, as in the case of State agency inspectors, often presents a different situation than what occurs as a result of a normal "survey," particularly a voluntary one, a few words on this category are in order. The procedure for giving safety orders to the employer for compliance with the law will vary with the policy of each individual State labor department. Some departments require that all such orders be given by the head of the department by letter, based on information provided by the written report of the inspector. In this case, the inspector usually explains the regulations to the employer, pointing out any variance between the practice in the plant and the requirements of the law and writes and returns to his superior officer a complete and accurate report of his findings.

ORDERS BY INSPECTOR TO EMPLOYER

Where the policy of the department permits the inspector to give the orders to an employer, it is generally agreed that they should be given in writing to the plant executive, after verbal discussion and explanation. Securing the employer's signature is required by some States on the theory that the department thereby establishes a record of the fact that the conditions cited were known to the employer on a specific date and that he understood that he was responsible for making certain changes to comply with the law. Written orders should be at least in duplicate—a copy for the employer, one for the department, and perhaps a third copy for the inspector.

INSPECTOR TO DISCUSS ORDERS WITH EMPLOYER

In either of the foregoing cases, the inspector should discuss with the employer practical means of making the changes legally required, since the ultimate value of the inspector's work lies in the extent to which he is able to promote the employer's desire and interest to comply with the orders.

FOLLOWUP

Rarely does a safety inspection produce a complete result in and of itself; more often, it establishes what should be done. In most cases, therefore, further action, assistance, subsequent surveys, rechecking, or attention of some sort is necessary.

Followup is most practical on internal inspections where the persons making the original inspection are readily available to see if corrections have been made or if the changes or additions are satisfactory. This is a most important part of the inspection procedure which, in many cases, is not practical or possible where State, insurance company, or other inspection staffs are overworked or have too few inspectors.

While followup may be made by telephone or letter, the most productive and satisfactory method is the personal visit, at which time the inspector may give his approval and have the opportunity for further discussion and safety promotion.

SAFETY INSPECTION IN A NUTSHELL

1. What is to be inspected?
2. How often?
3. Who will inspect?
4. Who will supervise?
5. Reports and records?
6. Corrective action?

CHART 25—SERIES B

SUMMARY	Many details are involved in a good safety inspection procedure, but the points requiring full consideration and development in an effective system which will produce meaningful results are quite simple; namely— What is to be inspected? How often is each thing, process, or area to be inspected? Who is to do the inspecting, and what procedures are to be used? Who will supervise inspection activities and how? What reports and records will be needed, and how will they be handled? What provisions must be made for taking corrective action? Sincere and diligent safety inspection efforts made as a result and part of a good inspection system and which are based upon the foregoing principles can only produce a valuable and fulfilling result.

Hand out occupational safety aids, "Inspecting for Safety," "Plant Inspection Check Sheet," and "A Ladder and Stairway Inspection Sheet."

OCCUPATIONAL SAFETY AID

INSPECTING FOR SAFETY

Safety inspections are a necessary segment of a complete safety program. They are essential to maintaining acceptable standards of safety for physical facilities and working practices. Conditions are constantly changing. Materials are moved, stockpiles are depleted, waste materials accumulate, and many other changes occur daily or even by the hour. If machinery is involved, changes occur as a result of use, wear, or abuse. In offices and similar places of employment, there are changes in layout, additions of equipment, and wear and tear of such items as floors, rugs, and equipment.

Safety inspections are a means of surveying and appraising the problems of unsafe conditions and work practices which result from these changes. Safety inspections provide for:

DETECTION

--seeking out the unsafe work methods and conditions.

ANALYSIS

--determining why the unsafe methods or conditions exist.

CORRECTION

--elimination of the unsafe methods or conditions.

UNITED STATES DEPARTMENT OF LABOR
BUREAU OF LABOR STANDARDS
Washington, D. C. 20210

TYPES OF INSPECTIONS

CONTINUOUS ACTIVITY - These are the "day-to-day" inspections made by safety directors, safety engineers, or their staffs. Inspection activities of safety committees are included.

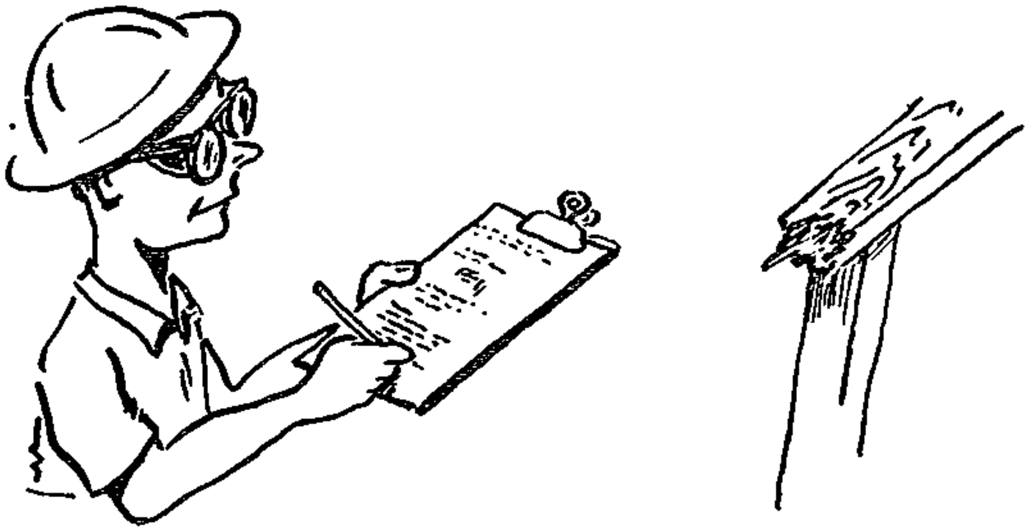
PREVENTIVE MAINTENANCE - Scheduled or continuing inspections by designated plant personnel such as electricians, mechanics, maintenance men and similar personnel. This includes inspections for safety as well as for mechanical functioning, damage, lubrication, and wear and tear.

LICENSED - Inspections made by certified and/or licensed inspectors, usually not employees of the organization being inspected. Boiler, elevator, and electrical inspectors conduct this type of inspection.

SPECIAL INSPECTIONS - Inspections made for special purposes; usually upon request of management, governmental officials, employee groups, or unions.

ONE-CALL - These are inspections made according to a predetermined schedule by "outside" inspectors, usually annually or semi-annually. An example would be State agency inspections.

STEPS IN A SAFETY INSPECTION



PREPARATION - **PLAN** - Prepare for your inspection beforehand by planning the procedures to be followed.
REVIEW - Check available records on past history of area to be inspected.
STUDY - Obtain and review information on hazards of operations to be inspected.
OUTLINE - Prepare list of specific items to check.
PROCURE - Acquire booklets, posters, or other materials to be distributed.

EQUIPMENT - **NOTEBOOK**, pencil, hard hat, flashlight, goggles, tape measure.

PLAN ROUTE - **HAVE DEFINITE OBJECTIVE** - Determine areas, buildings, operations, or other objectives such as housekeeping, machine guarding.
FOLLOW SEQUENCE - Observe operations by starting from first process, and following through in sequence.

INSPECTION PATTERN - **GENERAL CONDITIONS** - Lighting, work areas, buildings, chemicals, and materials.
SPECIFIC HAZARDS - Tools, machines, equipment.
WORK PRACTICES - The human element; how work is done.

SOME INSPECTION TIPS

MAKE NOTES But don't be obvious. Avoid "showiness" in recording information.

DON'T DISTURB As you make your tour, do so without disrupting operations.

AVOID CONVERSATION Don't stop and speak to the workers, except with the supervisor's permission.

INSPECT ALL AREAS Don't miss anything; even those areas "where no one ever goes." Don't be steered away from anything.

BE CONSTRUCTIVE Your approach should be clear and certain. Remember, you are performing an affirmative function.

SEEK REASONS Look for "why" adverse conditions exist; but think in terms of corrective action only.

ADVISE SUPERVISORS Give the benefit of your thinking to the supervisors you contact. Answer their questions, discuss items with them if they wish. (But, don't get into arguments, or time-consuming and disrupting discussion—a good inspector doesn't get involved in arguments.)

PREPARE RECOMMENDATIONS Be prepared to discuss recommendations with supervisor and top management. Have good reference notes. Make sure your ideas are reasonable and well organized. Use "selling" approach to convince of the needs you have observed.

EXAMPLES OF WHAT TO CHECK IN A SAFETY INSPECTION - This list does not cover *all* conditions. It is intended as a guide.

RECEIVING, SHIPPING, STORAGE - Equipment, job planning, layout, heights, floor loads, projection of materials, material-handling methods

BUILDING CONDITIONS - Floors, walls, ceilings, exits, stairs, walkways, ramps, platforms, driveways, aisles

HOUSEKEEPING - Waste disposal, tools, objects, materials, leakage and spillage, methods, schedules, work areas, remote areas, windows, ledges

ELECTRICITY - Equipment, switches, breakers, fuses, switchboards, junctions, special fixtures, circuits, insulation, extensions, tools, motors, grounding, code compliance

LIGHTING - Type, intensity, controls, condition, diffusion, location, glare and shadow control, standards applied

HEATING AND VENTILATION - Type, effectiveness, temperature, humidity, controls, natural and artificial ventilation and exhausting

MACHINES - Points of operation, flywheels, gears, shafts, pulleys, key ways, belts, couplings, sprockets, chains, frames, controls, lighting, tools and equipment, brakes, exhausting, feeding, oiling, adjusting, maintenance, grounding, how attached, work space, location

PERSONNEL - Training, experience, methods of checking machines before use, methods of cleaning, oiling, or adjusting machinery, type clothing, personal protective equipment, use of guards, tool storage, work practices

HAND AND POWER TOOLS - Purchasing standards, inspection, storage, repair, types, maintenance, grounding, use and handling

CHEMICALS - Storage, handling, transportation, amounts used, warning signs, supervision, training, protective clothing and equipment

FIRE PREVENTION - Extinguishers, alarms, sprinklers, smoking rules, exits, personnel assigned, separation of flammable materials and dangerous operations, explosion-proof fixtures, waste disposal

MAINTENANCE - Regularity, effectiveness, training of personnel, materials and equipment used, method of locking out machinery, general methods

PERSONAL PROTECTION - Type, size, maintenance, repair, storage, assignment of responsibility, purchasing methods, standards observed, rules of use, method of assignment

BUREAU OF LABOR STANDARDS

STUDENT WORK SHEET

U.S. DEPARTMENT OF LABOR SAFETY TRAINING PROGRAMS

SWS LS-128 OOS 11.64

PLANT INSPECTION CHECK SHEET

Metal Working Machines	Woodworking Machines
1. Engine and turret lathes	1. Swing cut-off saws
2. Milling machines	2. Table saws
3. Planers	3. Planers
4. Drill presses	4. Jointers
5. Grinding wheels	5. Band saws

I. Items of inspection to check on each machine:

		YES	NO
Point of Operation	a. Is there a point-of-operation guard provided for this machine?		
	b. Does it keep operator's fingers and hands out of the hazard zone?		
	c. Is there any evidence to show that protective devices are being removed?		
	d. Could you design or suggest a more practical, workable guard?		
	e. Could changes be made on the machine which would remove the point-of-operation hazard and increase the work efficiency?		
Power Transmission	f. Are there any exposed gears, sprockets, pulleys, or flywheels?		
	g. Are there any belt or chain drives exposed?		
	h. Are the starting and stopping devices within easy reach?		
	i. If there is more than one operator, are separate controls provided?		
	j. Are there any exposed set screws, key ways, collars, etc.?		

2. Other specific conditions relating to machines

		YES	NO
Guards	a. Do the guards provided meet the minimum State or ASA standards?		
	b. Would you suggest a change in the existing guard structure?		
	c. Can oiling be done without removing the guards?		
	d. Is there a system for shutting down machinery when guards are removed?		
General	e. Is there a chip hopper or exhaust system to take up scrap?		
	f. Is the flooring about the machine clear, free of holes, dry, etc.?		
	g. Is space provided for new or completed work?		

NOTES

3. Items to check in connection with machine operations

		YES	NO
Personal Hazards	a. Is there a possible strain due to faulty "handling" operations?		
	b. Does the operator have to reach over, through, or under dangerous equipment or objects?		
	c. Is there any danger of the operator starting the machine by accidentally pushing, pulling, dropping materials, or stepping on the operating mechanism?		
	d. Does the work of this machine endanger the operator on front, back, or at either side of this area?		
	e. Is seat provided for operator and does it have proper adjustment?		
	f. Where audible signals are used, can they be heard at this machine?		
	g. Is there any danger of this operator being pushed, shoved, or struck by passing trucks, material, or workers?		
Protective Equipment	h. Is this operator dressed for the job, i.e., short sleeves, tight clothing, absence of ties or finger rings, etc.?		
	i. Is this operator provided with protective clothing where needed, i.e., goggles, gloves, safety shoes, etc.?		

NOTE: From the answers, formulate, in narrative style, your recommendations (continue notes on page 4).

NOTES

STUDENT WORK SHEET

U. S. DEPARTMENT OF LABOR SAFETY TRAINING PROGRAMS

SWS LS-113 OOS 11.64

A LADDER AND STAIRWAY INSPECTION SHEET

Work sheet is to assist in locating and analyzing specific defects and condition of ladders, stairways and scaffolds. Also serves as an aid in making specific recommendations.

Plant:	Department:		
COLUMNS ARE LISTED FOR BRIEF NOTES ON CONDITIONS FOUND DURING INSPECTION			
I. TYPES OF LADDERS BEING USED:	YES	NO	REMARKS What they are used for
Fixed			
Portable Straight			
Extension			
Sectional			
Trestle or "A" Frame			
Step			
Trolley			
Slide-rolling			
Other			

2. DEFECTS IN LADDER	Type Ladder	Location or ladder number	REMARKS condition and recommendation
a. Non-uniform rung spaces?			
b. Too wide or too narrow?			
c. Inadequate clearances?			
d. Handholds lacking?			
e. Cages needed?			
f. Defective condition noted?			
g. Inadequate locking devices?			
h. Safety feet not used?			

3. MAINTENANCE	YES	NO	REMARKS condition and recommendation
a. Are ladders painted?			
b. Inspected regularly?			
c. Marked for identification?			
d. Stored properly?			

NOTES:

4. DEFECTS IN STAIRWAYS to and from area being inspected	YES	NO	REMARKS condition and recommendation
a. Non-uniform riser heights?			
b. Non-uniform tread widths?			
c. Worn or slippery steps?			
d. Nosing missing?			
e. Treads too narrow?			
f. Risers too high?			
g. Stairway too steep?			
h. Insufficient railing?			
i. Railing design correct?			
j. Stairway too long?			
k. Stairway too narrow?			
l. Other			

Note: Stairway lighting is treated later under the subject "Illumination."

Summarize your notes above for each subject or condition noted and write the recommendation in the space provided below as you would present it to management.

1. LADDER DEFECTS NOTED:

2. MAINTENANCE SUGGESTIONS:

3. RECOMMENDATIONS FOR STAIRWAY:

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Personal Protective Equipment. (Safety in Industry, Instructor Outline).

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*SAFETY, *SAFETY EQUIPMENT, *INDUSTRY, *CURRICULUM GUIDES,
*INDUSTRIAL EDUCATION,

This instructor outline consists of illustrations of protective equipment and informative material on construction requirements, use of equipment, other factors to consider for eye, head, and foot protection, and protective clothing materials. Instructions for planning the course and preparing the classroom and tips for teaching are provided. The outline was developed by staff of the Office of Occupational Safety and the International Division, Bureau of Labor Standards, U.S. Department of Labor. This document is available as GPO L16.3--299 for 35 cents from Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402. (PS)

SAFETY IN INDUSTRY
INSTRUCTOR OUTLINE

personal protective equipment

DEPARTMENT OF LABOR
W. Willard Wirtz, Secretary
BUREAU OF LABOR STANDARDS
Nelson M Bortz, Director

Bulletin 299

This instructor outline is one of a series developed by staff of the Office of Occupational Safety and the International Division, Bureau of Labor Standards, U.S. Department of Labor.

The outline is intended only as a guide to standard presentation of the subject in sequence and basic content. Additional information, material, and illustrations should be included for a complete presentation suitable to the conditions, locality, industry, or occupational group.

Note: American Standards Association name was changed to United States of America Standards Institute (USASI) August 1966. All American Standards now known as USA Standards (USAS).

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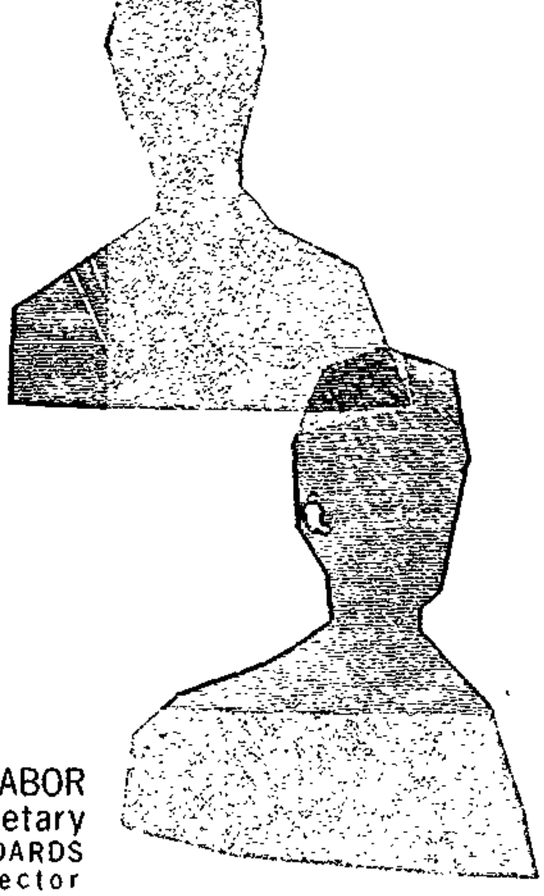
SAFETY IN INDUSTRY

INSTRUCTOR OUTLINE

U. S. DEPARTMENT OF LABOR SAFETY TRAINING PROGRAMS

personal protective equipment



U. S. DEPARTMENT OF LABOR
W. Willard Wirtz, Secretary
BUREAU OF LABOR STANDARDS
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SAFETY TRAINING TECHNIQUES

It is of utmost importance that the instructor become acquainted with some of the basic training techniques in order to better prepare himself to conduct the course successfully.

Planning

1. The instructor should have such visual aids as are pertinent to the subject matter of the course. These should be set up in proper sequence. An indication or note on the instructor's outline could be very helpful as a guide that a particular visual aid should be used.

2. The course outline as well as the handout material and the visual aids should be checked at regular intervals. This should be done by the instructor in order to revise, improve, and modernize the course presentation. The material should also be checked to make sure that it conforms with policies of labor and management in the country where it will be presented.

3. The instructor's outline should be adapted by him to his particular method of presentation, keeping in mind that this is a discussion conference type of session.

4. The instructor would do well to get an advance list of the students that will participate and their positions and backgrounds. A study of such information could be very helpful to the instructor when he faces his class.

Preparation of Classroom

Many conferences and courses have failed simply because no preparation was made for the classroom facilities.

1. The classroom should be located in an area where there is the least amount of noise or distraction.

2. Good ventilation, lighting, and sufficient room are important aspects to consider.

3. The seating arrangement and seats should be comfortable as well as informal. A round-table seating arrangement is the most effective for discussion-conference sessions.

4. The room should be equipped with a good blackboard, sufficient chalk, and a clean eraser. A stand should be available for mounting the charts and visual aids to be used during the conference. A 35-mm. slide projector should be available.

Teaching

1. An official of the organization should open the first session with a statement regarding the general objectives of the course. He then should introduce the instructor to give him the proper posture in relation to the group he will teach.

2. At the first session, the instructor should open with an explanation of the course objectives and its method of presentation. At this time, he should draw upon his experiences to relate an illustrative incident that will bring him in closer relationship with the group and, at the same time, enable him to introduce the theme of the first session.

3. The course should be presented by employing the discussion-conference method.

4. The instructor should have the class follow a predetermined schedule and maintain order at all times. Only one participant should be permitted to give his viewpoint at a time. The instructor should keep the class discussion within the subject matter as contained in the instructor's outline.

5. If possible, an official should be asked to speak at the termination of the course.

Tips for Instructors

Learning is actually the acquisition of new ideas, abilities, and skills acquired through the senses of hearing, seeing, and feeling by touch.

1. New ideas are conveyed through the presentation of knowledge, and thought is stimulated through the student's sense of hearing.

Abilities and skills are presented through the media of telling, demonstrating and having students demonstrate under the supervision of the instructor. Students aquire abilities and skills via the senses of hearing, seeing, and feeling by touch.

2. An important aspect of teaching is to remember that the student absorbs more when he participates in a discussion. The instructor therefore strives to get 100-percent class participation.

3. The instructor should become aware of outstanding characteristics of his students. This could be very helpful when leading discussions. For example:

A. Some may be more mature.
B. Some may have a knowledge of safety.
C. Some may have actual experience to draw on in the discussion.
D. Some may have a faster learning speed than others.

- E. Some may be "stallers" who can slow down the discussion.
- F. Others may be aggressive and want to monopolize the discussion.
- G. There may be a "know-it-all" in the group who must be properly controlled.
- H. Some may be constant latecomers who ask questions about previous discussions and delay the class.

4. The teaching process consists of:
   - A. Telling—this means giving background information to introduce a subject.
   - B. Showing—a demonstration of some equipment pertaining to the subject to be discussed is very impressive.
   - C. Illustrating—using charts, blackboard, slide, or films are very helfpul to highlight specific points in the discussion.
   - D. Discussion conference—the participation of the students in formulating their thinking about the subject under discussion is fundamental to getting the most out of the session.
   - E. Conclusions—the instructor's summation of the session should knit together the points discussed during the session, and should include other important details that may have been overlooked by the group.
   - F. Questions—during the session, the instructor should use questions to stimulate discussion, and also to help bring the discussion back to the subject matter if it has strayed.

Guest Instructors

It is necessary that the instructor be granted full responsibility for conduct of the class; at times, however, he may wish to call in an expert in a particular field as a guest instructor (or lecturer). In such event, it is essential that the instructor maintain control of the course.

The instructor must tie in the work of the guest instructor with the balance of the course; he must outline the phase of the subject to be covered by the guest and satisfy himself that the guest limits himself to the field as outlined; he should summarize the guest's contribution, pointing out its relative importance in the field of accident prevention. While the use of a few guest instructors (properly utilized) can add to the effectiveness of the course, a series of "lecturers" whose topics are not correlated will inevitably result in confusion.

It is recommended that "guest experts" be used only for *supplementary* training, and not to replace even part of this course which should be taught by *one instructor.*

PERSONAL PROTECTIVE EQUIPMENT

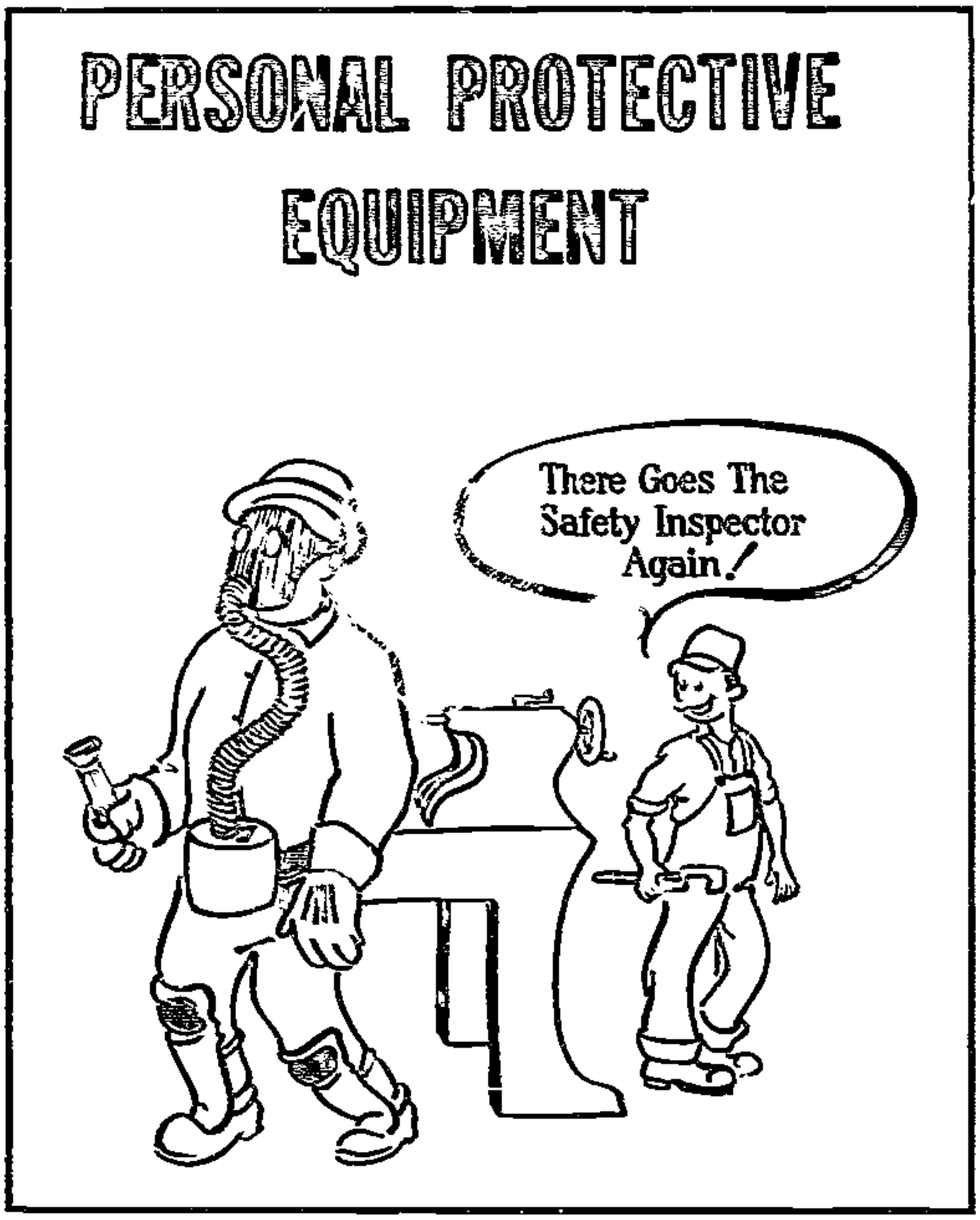


CHART 17—G

Check to see that visual aids and other course materials are in order and ready to use.

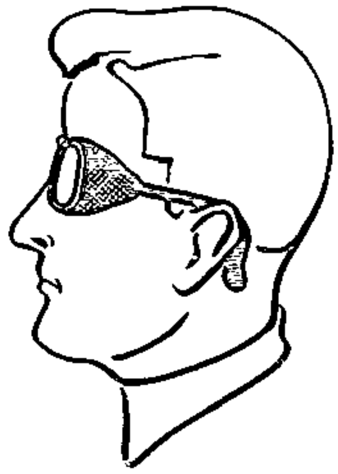
USE OF PERSONAL PROTECTIVE EQUIPMENT

Personal protective equipment should always be considered as the "last thin line of defense." Both the employer and the worker should realize that failure of the device or failure to use it exposes one immediately to the hazard in question.

FACTORS TO BE CONSIDERED	
NEED	There are three factors to be considered in regard to personal protective equipment. First, it is necessary to establish that a need exists.
SELECTION	Second is that of selection; to be considered is the degree of protection needed and provided and the facility of application. Will partial protection be sufficient, or is the exposure so extreme or long lasting as to require complete protection?
MAKE SURE WORKERS USE EQUIPMENT PROPERLY	Third is the problem of making sure that the workers wear personal protective equipment once it has been chosen. The following points should be considered as a means of solving this problem: 1. The extent to which the men who must wear the equipment understand its necessity. 2. The ease and comfort with which it can be worn and with minimum interference to normal work procedures. 3. The available economic, social, and disciplinary sanctions which can be used to influence the attitudes of the men.
AVAILABILITY	Much research, study, experimentation, and testing have been devoted to the development of effective personal protective equipment and devices. As a result, a great variety of excellent equipment to protect any part of the body is available commercially.

PERSONAL PROTECTIVE EQUIPMENT CLASSIFICATION	
FACE AND EYE PROTECTION	1. Spectacles and goggles. 2. Face shields. 3. Hoods. 4. Welding helmets.
HEAD PROTECTION	1. Protective hats. 2. Head protection. 3. Ear protection.
HAND, FOOT, AND LEG PROTECTION	1. Gloves and hand leathers. 2. Safety shoes. 3. Foot guards.

EYE PROTECTION



U.S.A. STATISTICS

1.	AVERAGE ANNUAL NUMBER OF EYE INJURIES	75,000
2.	PERSONS LOSING ONE OR BOTH EYES AT WORK	5,000
3.	AVERAGE ANNUAL COST OF EYE INJURIES	$80,000,000

CHART 18—G

EYE PROTECTION	The protection of eyes from damage or destruction by physical or chemical agents or by radiation has long been an important part of industrial accident prevention. Many thousands of disabling eye injuries occur annually, which indicate that eye protection is not used widely enough. The importance of protecting the eyes against flying objects resulted in the development of a method of hardening and mounting glass lenses which gives them substantial resistance to blows.
GOGGLE IMPACT TESTING	The severity of the specified test for these goggles is indicated by the fact that lenses for impact goggles in their mountings must withstand the blow from a steel ball seven-eighths of an inch in diameter dropped from a height of 50 inches. Protective goggles manufactured in accordance with currently accepted standards will protect the eye against a blow so severe that without goggles, the same blow would not only destroy the eye but would fracture the bone as well.

U.S.A. EYE INJURY STATISTICS	Every year about 5,000 persons lose one or both eyes in industrial accidents, and another 70,000 to 75,000 lose time from work because of injuries to their eyes while at work.
MONETARY LOSSES	The amount of money spent to acquire and fit eye protective devices is small when measured against the savings afforded by the protection given. For example, the purchase and fitting of a pair of impact resistant spectacles would cost from $2 to $10. Compensation costs for a lost eye may range from $1,600 to $10,000. While it is difficult to obtain reliable information concerning the actual cost due to industrial injuries to the eyes, it is safe to estimate it at a minimum of $80 million annually in the United States.
NO RECOGNIZED APPROVAL SERVICE	No nationally recognized testing or approval service, such as rendered by the Bureau of Mines for respiratory protective equipment, is available for eye and face protective equipment. Some, but not all, States require approval of such equipment through a State approval agency. The purchaser of equipment should, in all cases, be sure that the eye protectors meet the requirements of the American Standards Association Code.
AMERICAN STANDARD SAFETY CODE Z2.1–1959	The code classifies occupational eye hazards into eight categories and establishes minimum performance standards for the devices needed to protect against the hazards in each category.

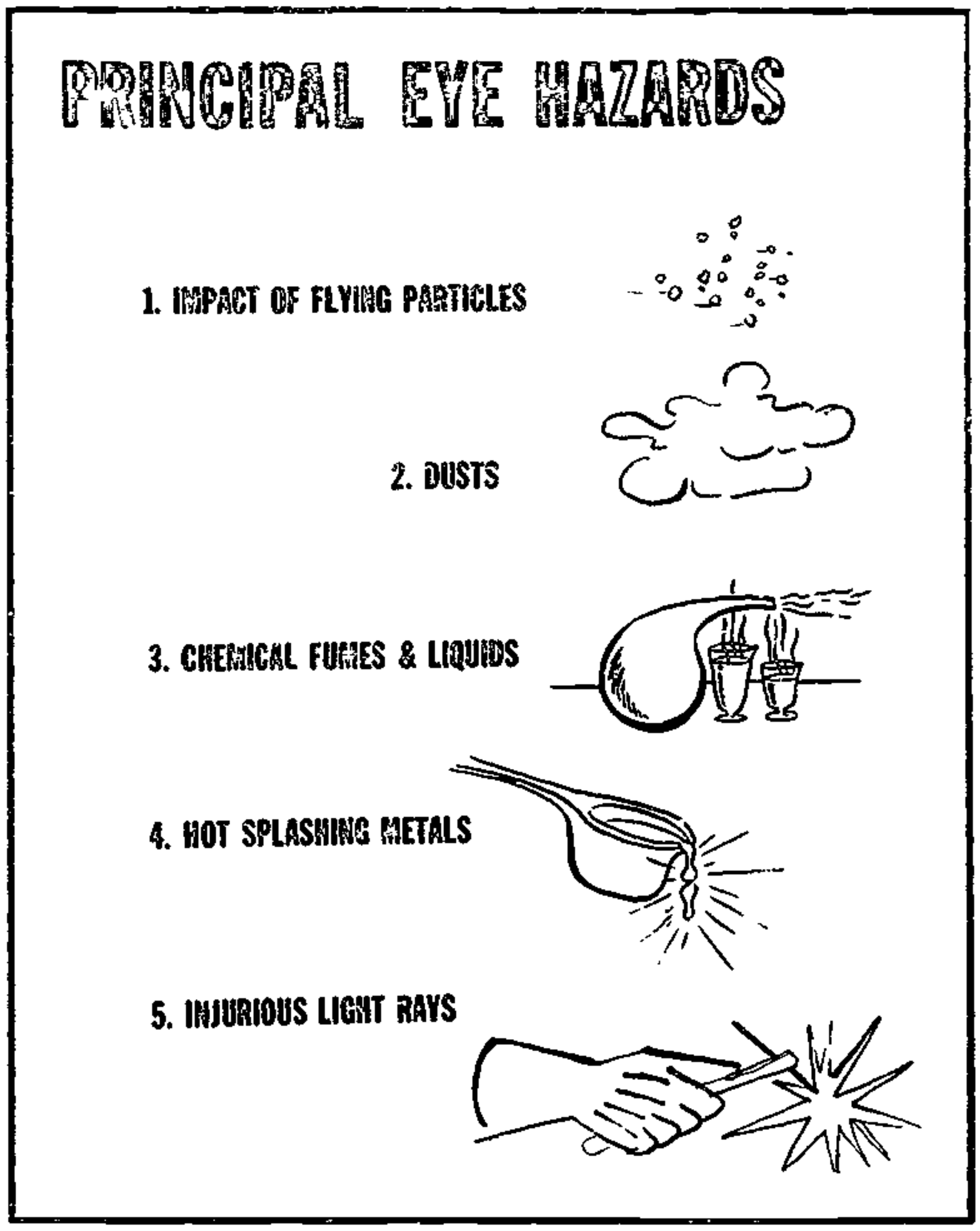


CHART 19—G

PRINCIPAL EYE HAZARDS	
FACTORS TO CONSIDER	The protection of eyes from damage or destruction by physical or chemical agents or by radiant energies should be an integral part of an industrial safety program. Eye protective devices must be considered as optical instruments; therefore, they should be carefully selected, fitted, and used. The devices should be selected for maximum effectiveness against the particular hazards anticipated.
IMPACT OF FLYING PARTICLES	Flying particles become a hazard on such jobs as chipping or finishing of iron and steel forgings and on jobs requiring the use of such tools as chisels, jackhammers, rock drills, sledges, hammers, and other impact tools, or on handling materials which may fly, as in cutting steel strapping.
PROTECTION NEEDED	Eye protection for this type of hazard should have impact-resistant lenses and side shields—lenses, lens containers, frames, and side shields should

	be of maximum comfort to the wearer. The frames should be light weight and not subject to rust or corrosion under sterilization. On those jobs where the particles may be fairly large, heavy-duty cup goggles with impact resistant lenses should be used.
DUSTS, WIND, AND METAL SPARKS	Dusts, wind, and metal sparks are hazards on such jobs as operating road building equipment, construction work, operating tractors and power shovels, electric spot and butt welding where there is no exposure to ultraviolet rays, scaling and grinding of metals, stone dressing, wood working, etc.
PROTECTION NEEDED	Eye protection for this type of hazard may be cover-all goggles of moderate strength that enclose the eye completely and have indirect port ventilation, face shields, or safety spectacles with impact-resistant lenses with or without side shields. Plastic lens eye protectors are particularly appropriate for butt and spot welding because of their resistance to damage by sparks.
CHEMICAL FUMES AND LIQUIDS	Chemical fumes and liquids are hazards on such jobs as handling volatile and corrosive chemicals, dipping in plating and pickling tanks, etc.
PROTECTION NEEDED	Eye protection for this type of hazard should be gasproof goggles with impact resistant lenses or rubber mask goggles with indirect, screened ventilation ports and wide vision impact resistant lenses. In severe conditions where chemicals are concentrated or where splash hazards are continuous, the goggles should be worn under face shields or acid hoods for greater protection.
HOT SPLASHING METALS	Hot splashing metals are a hazard on such jobs as casting, tinning, babbitting, pouring of lead joints, galvanizing, etc.
PROTECTION NEEDED	Eye protection for this type of hazard should be cup goggles with impact-resistant lenses capable of withstanding moderate blows, and with lens containers made to hold cracked lens in position (all materials should be nonflammable); metal screen face shields, or heavy plastic face shields with impact-resistant spectacles beneath.
INJURIOUS LIGHT RAYS	Light rays can be injurious on such jobs as torch brazing, welding, and cutting; irradiation with actinic rays; arc welding; hydrogen welding; lamp testing (exposure to excessive brightness); tending an electric Bessemer and other types of furnaces; crucible steel-making, etc.
PROTECTION NEEDED	Eye protection for this type of hazard should be carefully chosen to cope with the particular hazard or combination of hazards. For flame welding, brazing, or cutting, cup goggles with impact-resistant filter lenses and clear cover glass to save the welding lenses from pitting (with indirect screened ventilating ports to prevent fogging of lenses)

and to exclude injurious flashes, hot metal, and sparks are appropriate. For electric arc welding and other jobs (e.g., arc furnaces) involving heavy exposure to ultraviolet rays, it is important that the filter lenses protect from ultraviolet rays, as well as glare. Wearing an appropriate face shield over these goggles will protect the face as well as the eyes.

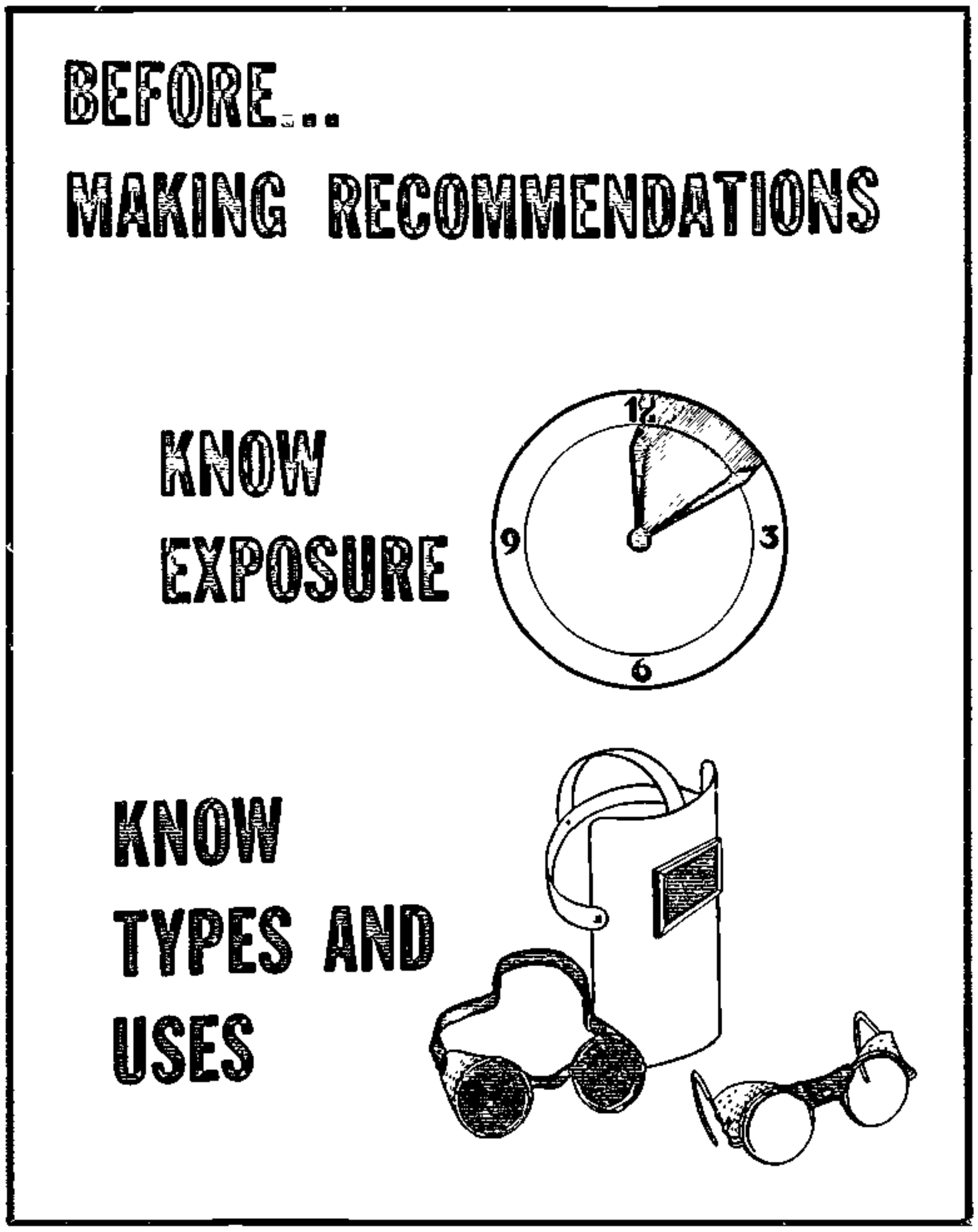


CHART 20—G

KNOW EXPOSURE	Before an inspector or safety director recommends an eye protection program, he should make a detailed study of the exposures to conditions hazardous to the eyes. He should list the eye protection requirements for each job.
KNOW TYPES AND USES	The inspector should know the various types of protective equipment and their proper uses and limitations and should know how to obtain maximum protection and comfort through the use of each for the exact purpose intended.
SPECIAL TESTS	All eye protectors should pass all American Standards Association standard test requirements.

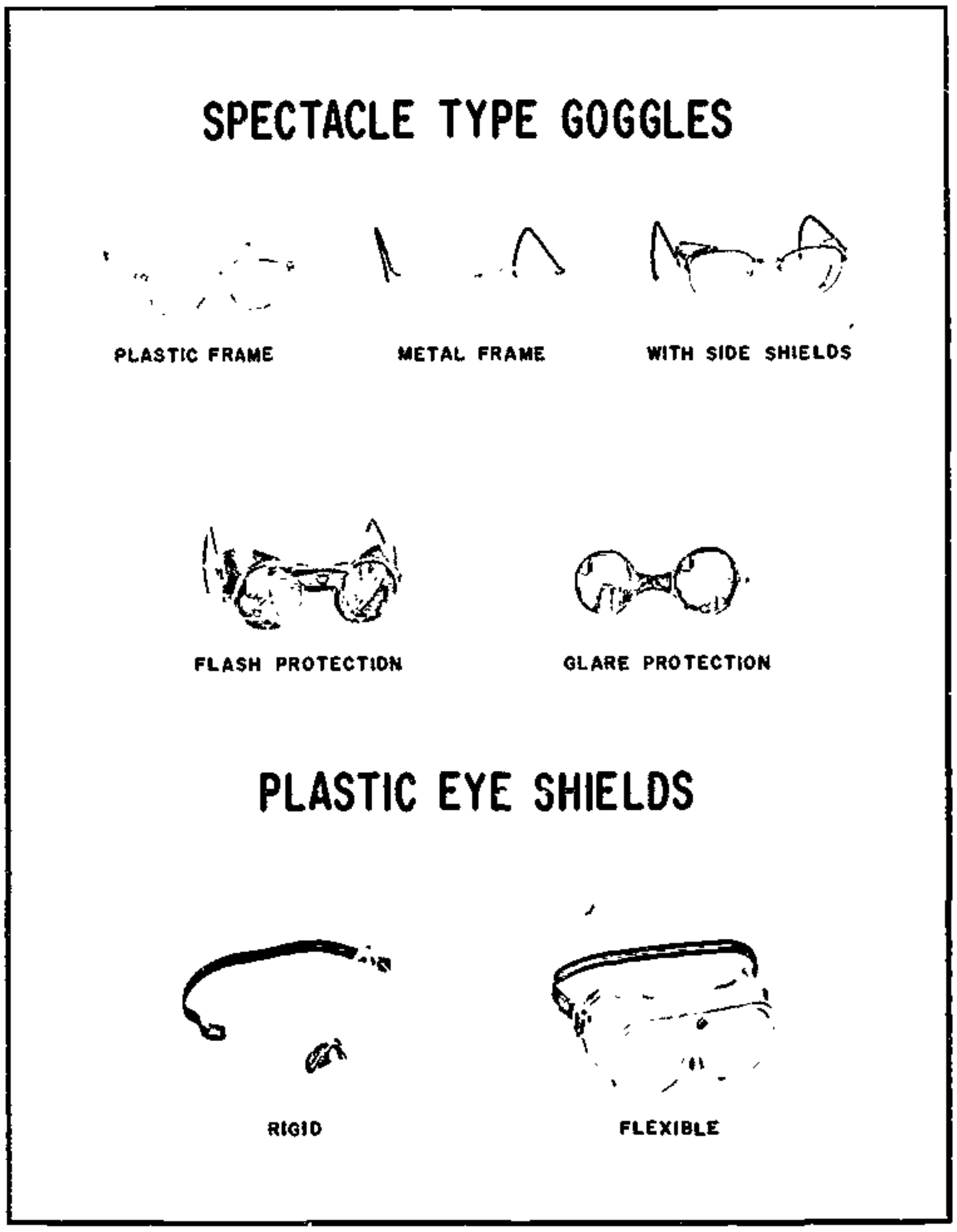


CHART 21—G

SPECTACLES	Safety spectacles are patterned after conventional-type spectacles but are of a more substantial construction.
SPECTACLES—METAL OR PLASTIC FRAMES	Spectacles consist of two lenses and two lens frames (of suitable size and shape for the purpose intended), connected by a nose bridge and supported on the face by temples or other suitable means. The lenses may be either glass or plastic and the bridge may be rigid with nose pads or flexible. They are provided with or without side shields, depending upon their intended use. The side shields (when provided) and the frames should be made of metal or of slow burning plastic material. In addition to these specific requirements, the materials used should be capable of withstanding tests for disinfection, corrosion resistance, water absorption, lens container construction, and flammability, as well as other tests required by the American Standards Association standards.
PROTECTION	Spectacles should provide protection to the eye from flying objects and, where required, from glare and injurious radiation. Spectacles without

	side shields provide frontal protection only. Where side as well as frontal eye protection is required, the spectacles should be provided with side shields.
CONSTRUCTION	Plastic lenses used in plastic eyeshields should be not less than 0.050 inch in thickness. Materials used should be capable of meeting the applicable requirements and withstanding the test as outlined in the standard.
PLASTIC EYESHIELD	Plastic eyeshield should consist of a frame of metal, fiber, or plastic material, plastic lens or lenses, and temples or other suitable means of support to retain the frame before the eyes. The lens or lenses need not be an integral part of the frame. The eyeshields should have side shields, if required for their intended use.
FLEXIBLE FITTING	Flexible fitting eyeshields consist of a frame (composed of a flexible, chemical resistant, nontoxic, nonirritating, and slow-burning material, forming a lens holder), lenses, and a positive means of support on the face, such as an adjustable headband of suitable material to hold the frame comfortably and snugly in place in front of the eyes. The lens or lenses should be held firmly and tightly in place in the lens holder.
CONSTRUCTION	The American Standards Association Z2 standard provides that plastic lenses used in flexible fitting goggles should be not less than 0.05 inch (1.25 mm.) in thickness. Materials used must be capable of withstanding the disinfection, corrosion resistance, water absorption, and flammability tests required by this standard.
FLASH GOGGLES	Flash goggles are spectacle-type goggles with leather side shields. The bridge is covered with leather for protection against radiant heat and flying hot particles. The lenses are impact resistant and are available in clear, medium, dark, and extra dark shades for protection against exposure to ultraviolet and infrared rays and glare. They are suggested for wear under welding helmets and for furnace work, brazing, babbitting, and other work involving heat and glare.
SMELTER'S GOGGLES	These are spectacle-type goggles with cobalt blue lenses for use by steel smelters and others whose work requires periodic inspection of metal heats. These goggles protect against glare and frontal impact from sparks and fine scale. The cobalt glass reduces the sodium yellow glare from fluxes and transmits red well, making temperature estimates from melt color relatively easy.

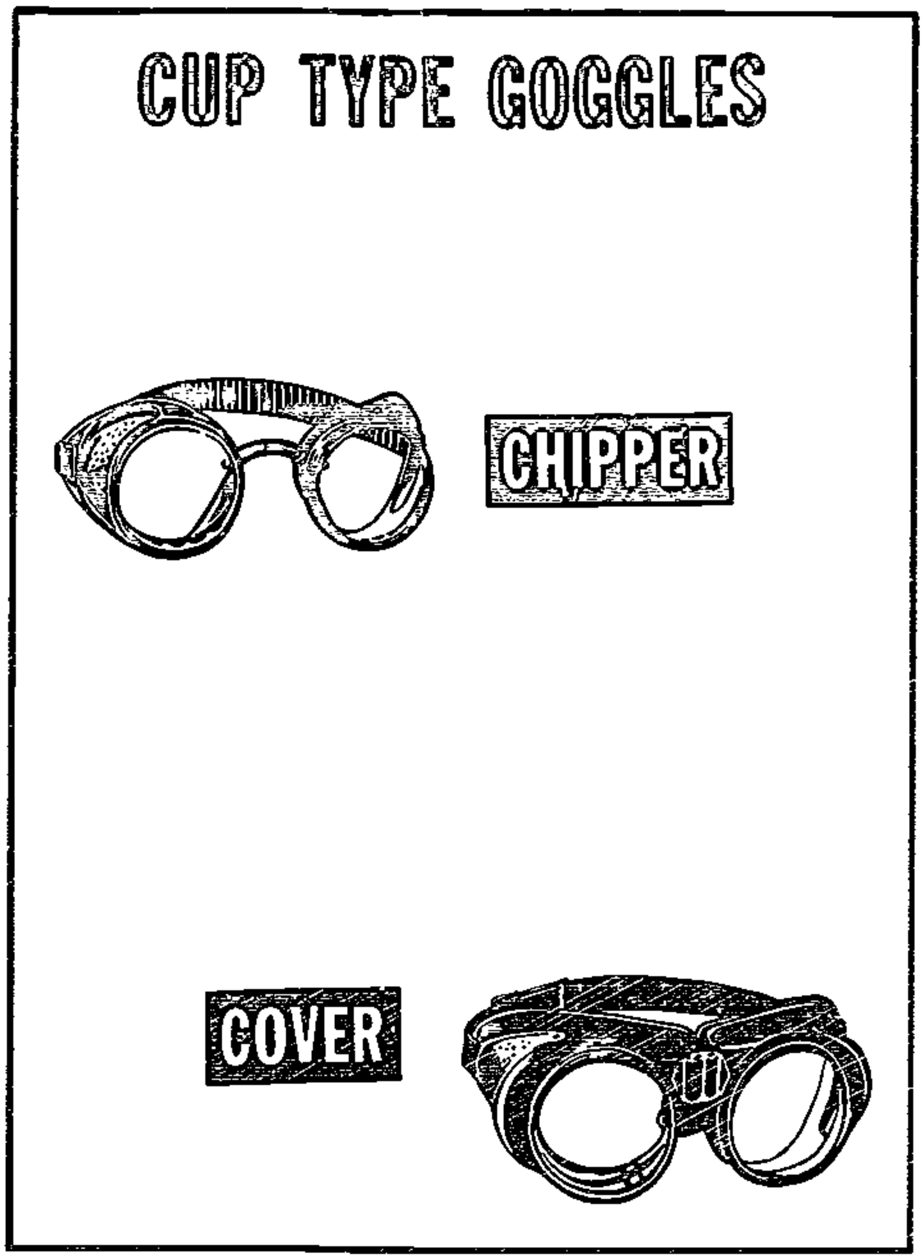


CHART 22—G

CUP-TYPE GOGGLES	Cup-type goggles should be used when greater protection is required than can be provided by spectacles with side shields. Each eyecup is provided with a lens retainer bearing evenly on the lens with sufficient pressure to retain fragments in the event of breakage. They are designed to permit ready removal or replacement of lenses. Lens retainers for welder's and cutter's models are made to accommodate a filter lens, fiber gasket, and cover lens. Eyecups are made from plastic or other composition that can withstand the heat deformation test and the disinfection, water absorption, and flammability tests of the American Standards Association. Eyecups should be right and left in pairs and should permit an effective angle of vision of not less than 105 degrees. They should fit closely and comfortably to the face and cover the entire eye socket. All models should be vented to permit air circulation. Eyecups are supported before the eyes by an elastic headband or by a headgear.

STANDARD CUP-TYPE GOGGLES	Standard cup-type goggles are designed to be worn by individuals who do not wear corrective spectacles.
COVER CUP-TYPE GOGGLES	Cover cup-type goggles are designed to fit over corrective spectacles.
CHIPPER'S MODELS	Chipper's goggles provide protection from front or sides against flying objects. Ventilation is provided through perforations in the cups which are shielded against strong light.
DUST AND SPLASH MODELS	Dust and splash goggles provide protection against flying objects from the front or sides. Ventilation openings are baffled to protect against the entry of liquid splashes or fine dusts.
WELDER'S AND CUTTER'S MODELS	Welder's and cutter's goggles provide protection against glare and injurious radiation. The basic design may be modified to provide more protection against special hazards, but the modified equipment should meet the same requirements as the basic design.

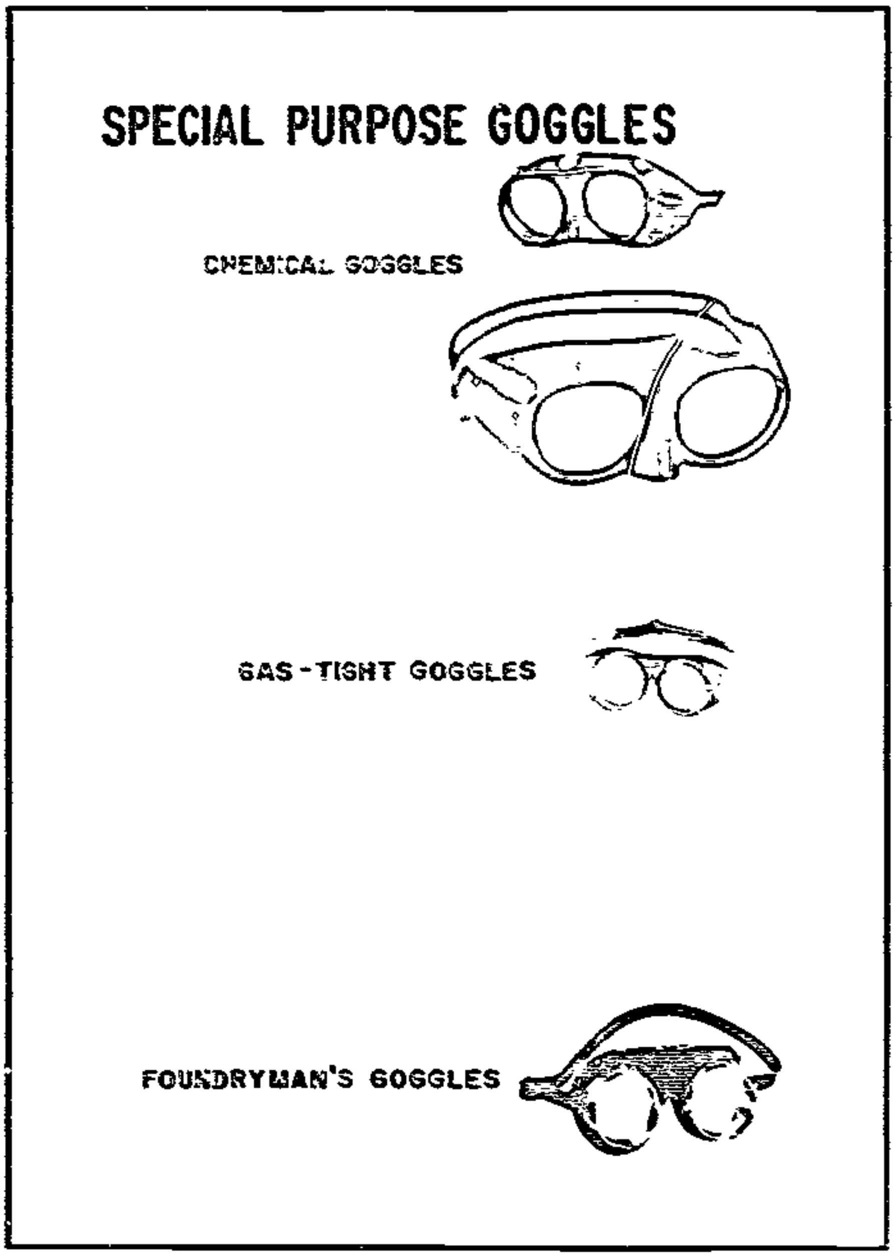


CHART 23—G

CHEMICAL GOGGLES	Chemical goggles form a tight seal against the face and prevent the entry of liquid splashes and dusts. They are ventilated with baffles to be splash-proof. They are ordinarily furnished with impact resistant lenses which may be clear, or in various shades if there is also exposure to glare, ultraviolet and infrared radiation.
VENTILATION	Where chemical goggles are ventilated, openings should be small enough to minimize the possibility of entry of dust or mists. If the goggles are intended to be used in connection with the handling of liquids, the ventilation openings should be splash-proof.
GAS-TIGHT GOGGLES	Gas-tight goggles have rubber frames with lens retaining cups so constructed that a small quantity of water may be placed inside each cup and, by bending (nodding) and gently shaking the head, the water will be thrown across the lens surface, thus eliminating any fog. They are available in the same type lenses as are all the others.

FOUNDRYMAN'S GOGGLES	Foundryman's goggles are masks of soft plastic with snug fitting edges bound in corduroy and soft sponge rubber. The ventilation openings of the eyecups are covered with fine, wire screen to prevent entry of dust and molten metal splashes. These goggles are used for protection against impact hazards normally encountered in foundries. They can be obtained in clear or in several shades of tinted, impact resistant lenses.

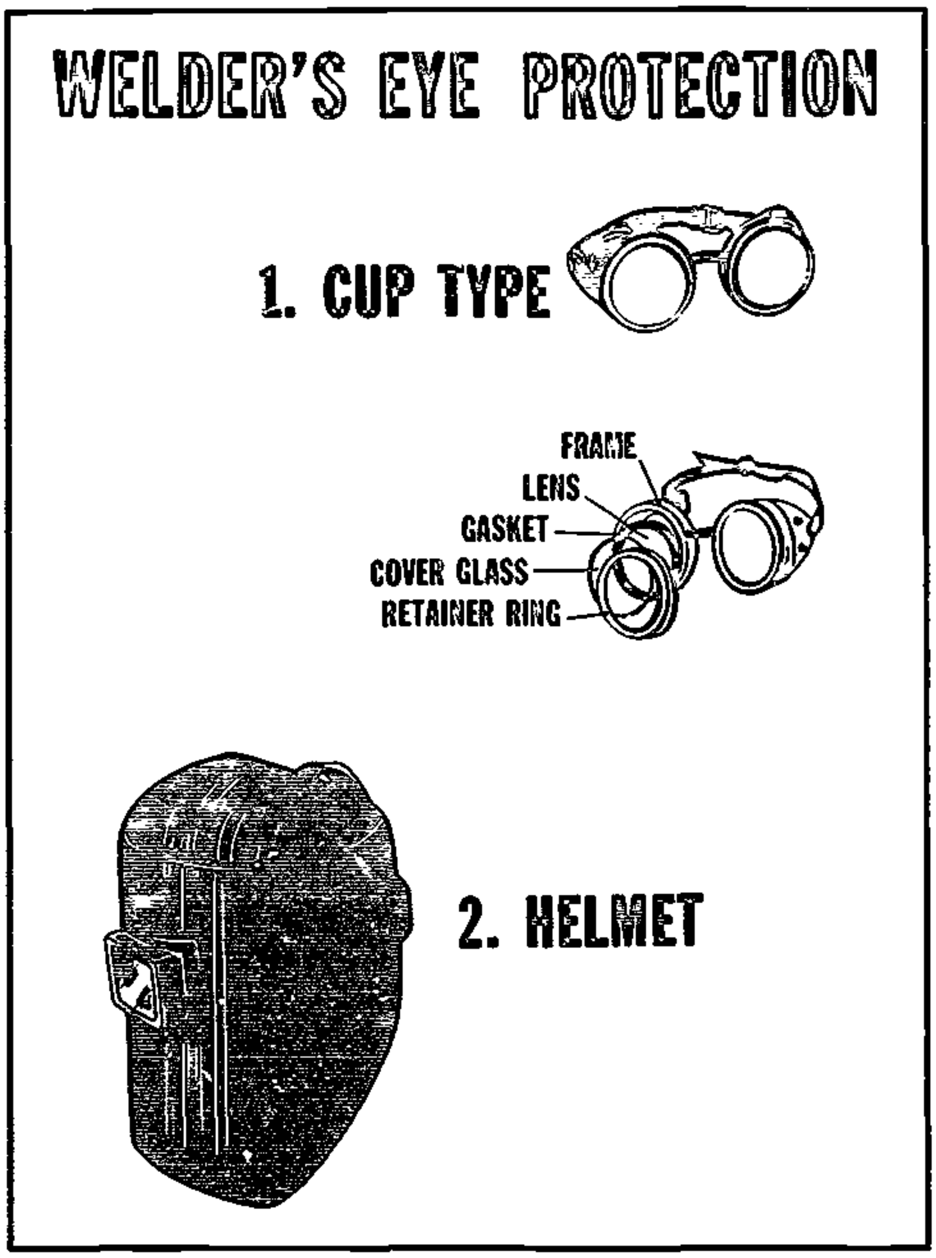


CHART 24—G

WELDER'S GOGGLES	Welder's and cutter's goggles should not only protect against flying sparks and scale, but should also reduce transmitted light to a safe level; they should also absorb dangerous ultraviolet and infrared rays. Welder's goggles are cup type with side shields; they are properly ventilated to reduce fogging and are designed to keep out stray light rays, sparks, and metal splashes. They are supported by an elastic headband or by a headgear for ease in flipping them up when the flame is not being used. They are usually supplied with welding lenses Nos. 4, 5, or 6. They also have clear cover lenses to protect the colored welding lenses from pitting by sparks. Cup goggles should be used for welding which involves only moderate exposure to radiant energy, such as in ordinary gas cutting or welding. Welding helmets should be worn for heavy gas cutting or arc welding.
WELDER'S HELMETS	A welder's helmet is constructed in size and shape to protect the face, top of the head, and the neck to a vertical line back of the ears. This design

	provides protection for the eyes, face, ears, and neck against intense radiant energy.
CONSTRUCTION	The helmet body has an opening or openings in the front for a filter plate and a cover plate. It is supported by a headgear to prevent contact with any part of the head. The welder is able to lift up the front to examine a weld. The body of the helmet should be made from vulcanized fiber, reinforced plastic, or other suitable material which is heat and flame resistant, opaque to visible, ultraviolet and infrared radiations, and should be capable of withstanding disinfection. All metal parts should be suitably insulated on the inside surface. The weight of the helmet, exclusive of the filter and cover glasses, should be no more than 24 ounces (680) grams.
VIEWING WINDOW OR OPENING	The window through which the welding or cutting operation is observed by the wearer should be at least 3⅞ inches wide and 1⅝ inches high. The lens frame must permit the removal and replacement of filter lens and cover plate without the use of tools or without damage to the plates or frame. The mounting should be so designed that the filter plate will be at least 2 inches (50.8 mm.) from the eyes of the wearer.
FILTER PLATES	Filter plates should be no less than 0.08 inch (2 mm.) and no more than 0.15 inch (3.8 mm.) thick. They should be free of striae, waves, or other defects which would impair their optical quality. Filter plates should conform with the radiant-energy transmission requirements of the American Standards Association Z2. The surfaces should be flat and substantially parallel.
COVER PLATES	Cover plates made of plain glass, glass coated on one or on both sides with plastic, or of a slow burning, solid plastic sheet should be used to protect the filter plates from damage. They should be the same size and shape as the filter plates, and should transmit not less than 75 percent of the incident luminous radiation; they should be substantially free from optical imperfections.
CHIPPING SLAG	If it is necessary to chip slag, a "standby" pair of goggles should be worn under the helmet.
HAND SHIELDS	Hand shields are used in some welding operations or for observing the welding process. The handle, used instead of a headgear, is made of material which is a nonconductor of electricity and is noncombustible or slow burning. Hand shields are constructed of materials similar to the ones used for helmets, also the lens mounting arrangements and filter and cover plates.

NONRIGID HELMETS	Helmets to be used in confined spaces may be made of nonrigid materials or they may be collapsible for convenience in carrying. The shape of a nonrigid helmet may be the same as the rigid helmet, except that a more complete covering of the top of the head is necessary to maintain the face, side, and windows in proper position.
FACE SHIELDS	Face shields provide protection to the face (i.e., the front part of the head, including forehead, eyes, cheeks, nose, mouth, and chin) from flying particles and sprays of hazardous liquids; they also provide antiglare protection.
CONSTRUCTION	Plastics used in the manufacture of face shields should combine mechanical strength and lightness of weight to a high degree, should be nonirritating to the skin, as well as capable of withstanding frequent disinfection. The materials used should be slow burning. Clear or colored plastic materials used should be of an optical grade to provide performance equivalent to the optical, physical, and radiant energy requirements specified for other eye protectors. When face shields are to be used in atmospheres or working areas that require special conditions of nonconductivity or nonsparking, then all materials used should meet these requirements. The face shields should be permanently and plainly labeled, either as nonconductive face shield or nonsparking face shield.

SOME GOGGLE COMPLAINTS

GOGGLES:

1. **ARE TOO TIGHT**
2. **IRRITATE SKIN**
3. **CAUSE HEADACHES**
4. **CAUSE EYES TO HURT**
5. **ARE TOO DIRTY AND PITTED**
6. **FOG UP**
7. **CAUSE SWEAT WHICH BOTHERS WORKER**
8. **LOOK STRANGE**

CHART 25—G

MOST FREQUENT COMPLAINTS	
GOGGLES DON'T FIT CORRECTLY	1. A properly trained person who has the responsibility for fitting goggles to the wearer should be stationed at the point of goggle distribution. 2. Each foreman should understand how to fit goggles and check on (and assist) all workmen in the proper fit and use of them.
GOGGLES IRRITATE THE SKIN	1. Goggles may not be suitable for the work being done. 2. Check on the cleaning schedule and sterilizing materials.
GOGGLES CAUSE HEADACHES	1. Goggles may be improperly fitted. 2. The worker may need corrective lenses.
EYES HURT AFTER WEARING GOGGLES	1. The worker may need corrective lenses. 2. Worker may need goggles with correct filter lenses (if used near actinic rays).

GOGGLES ARE TOO DIRTY TO WEAR AND ARE PITTED	1. Worker may be wearing his goggles hanging around his neck where they collect dirt and dust. 2. The worker may be handling goggles with dirty hands and does not understand the need for clean goggles. 3. The worker may be doing very dirty work. (Cleaning stations should be available for occasional cleaning of goggles and for replacement of pitted or scratched lenses.)
GOGGLES FOG UP	1. Worker may be able to use goggles with better ventilation. 2. Goggles should be inspected for possible change in design. 3. If fogging cannot be corrected, antifog compounds should be used inside lenses.
SWEAT BOTHERS THE WORKER	1. Goggles should be cleaned and dried frequently to avoid accumulation of moisture. 2. Use sweatband (absorbent) on forehead.
GOGGLES LOOK STRANGE	1. Be sure goggles are the required type. 2. Rules should be enforced regardless of complaints that goggles look strange. They could save your eyes.

EYE PROTECTION PLAN

A. MAKE A SURVEY

1. RECORDS

B. SET UP A PLAN

1. VISION ETC.
2. DISTRIBUTION ETC.
3. EXHIBITS

C. SELL THE PLAN

D. ENFORCEMENT

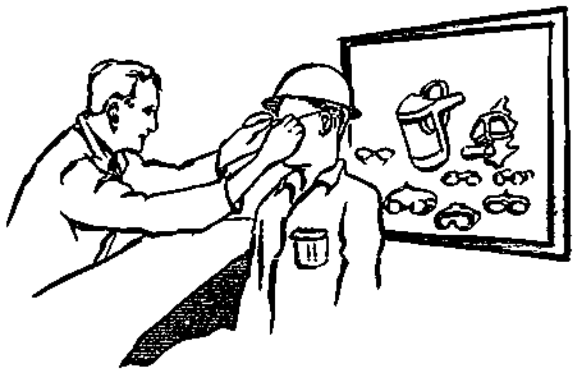


CHART 26—G

MAKE A SURVEY	Check records of past eye injuries and prepare a system for checking the results of a new program as it develops.
CHECK STATISTICS	Check over statistics and locate hazard spots as shown by experience.
STUDY ALL JOBS	Study all jobs for kind of eye protection needed—flying objects, particles of dusts, fumes, splashing chemicals or molten metals, intense heat and light.
STUDY DEMANDS ON EYESIGHT OF WORKERS	1. Distance from eyes of worker to point of operation. 2. Size of central working area. Depth perception factor. 3. Type of visual attention required—fixed or changing, casual or concentrated, detailed or gross. 4. Motion of work—slow or rapid, rotating, vertical, horizontal or reciprocating, fixed or intermittent.

	5. Foot candles of illumination at work point, foot candles of illumination surrounding areas, and direction of light reflected or direct glare. 6. Types of working surfaces—glossy or nonglossy, smooth or slightly or grossly uneven. Angle of working surface. Position of work in relation to normal level of eyes (if worker must look upward, down, or ahead). 7. Colors to be perceived and discriminated.
SET UP A PLAN	1. Make tentative recommendations on the types of eye protection needed. 2. Vision testing is a necessary part of the program. (Prescription ground lenses where needed.) 3. Plan a central distribution system with a designated person in charge of goggle distribution, fitting, repair, sterilization, and maintenance. 4. Set up necessary rules which can be enforced.
SELL THE PLAN	First, sell yourself, be sure of your facts and be sincere. Next, sell management. 1. Use economic gains as a selling point (saving one eye will pay for the entire program). 2. Convince supervisors—get their cooperation—have them help in the survey of their own departments—have them approve all rules—get them to wear goggles themselves and get others to wear goggles where needed.
SELL THE WORKER	
GET COOPERATION	Get cooperation of workers (use safety committee, if possible) and enlighten them on the need for and purpose of the plan.
STATISTICS	Prepare plant statistics and distribute to the workers.
WORKERS' APPROVAL	Have workers approve eye protection rules.
PUBLICIZE	Use bulletin boards, plant publications, and films on eye safety for promoting the program to all workers.
EXPLAIN WHY PROTECTION IS NEEDED	Be sure everyone understands why the eye safety program is needed.
NEAR INJURIES	Use bulletin boards to dramatize "near injuries" in which eye protection prevented personal injuries to workers; exhibit broken goggles, metal-splashed face shields, and other examples of no-injury accidents in which personal protective equipment shielded the worker's vision.

ENFORCEMENT	
APPROVAL OF RULES	Rules should be developed and approved by a safety committee composed of workers and management.
GOOD RULES	No rule should be approved as mandatory unless it can be enforced with the penalty provided. If a rule cannot be enforced, it should be canceled.
MANAGEMENT APPROVAL	The rules, as approved by the committee, should be sent to management for tentative approval.
POST RULES	After management approval, the rules should be posted on the bulletin boards and copies sent to all committee members. A notice signed by top management should be posted at the same time, approving the rules tentatively.
HOLD MEETING ON RULES	About 30 days after posting the rules, the safety rules committee should meet to discuss all objections and suggestions. When agreement is reached as to what the rules should be, copies of the new rules should be sent to all foremen. The committee should then meet with the foremen to obtain their suggestions; then the rules are ready for final approval by the safety rules committee.
FINAL APPROVAL	The rules should be sent to management for final approval. After approval, the rules should be printed with a foreword signed by top management.
DISTRIBUTE RULE BOOKS	The printed rules should be given to each foreman and each worker. Each person receiving a rule book should sign a dated receipt for it.
ENFORCE RULES	The foreman should enforce the rules. If a rule cannot be enforced as written, it should be modified or repealed. Final rules should be rigidly enforced.

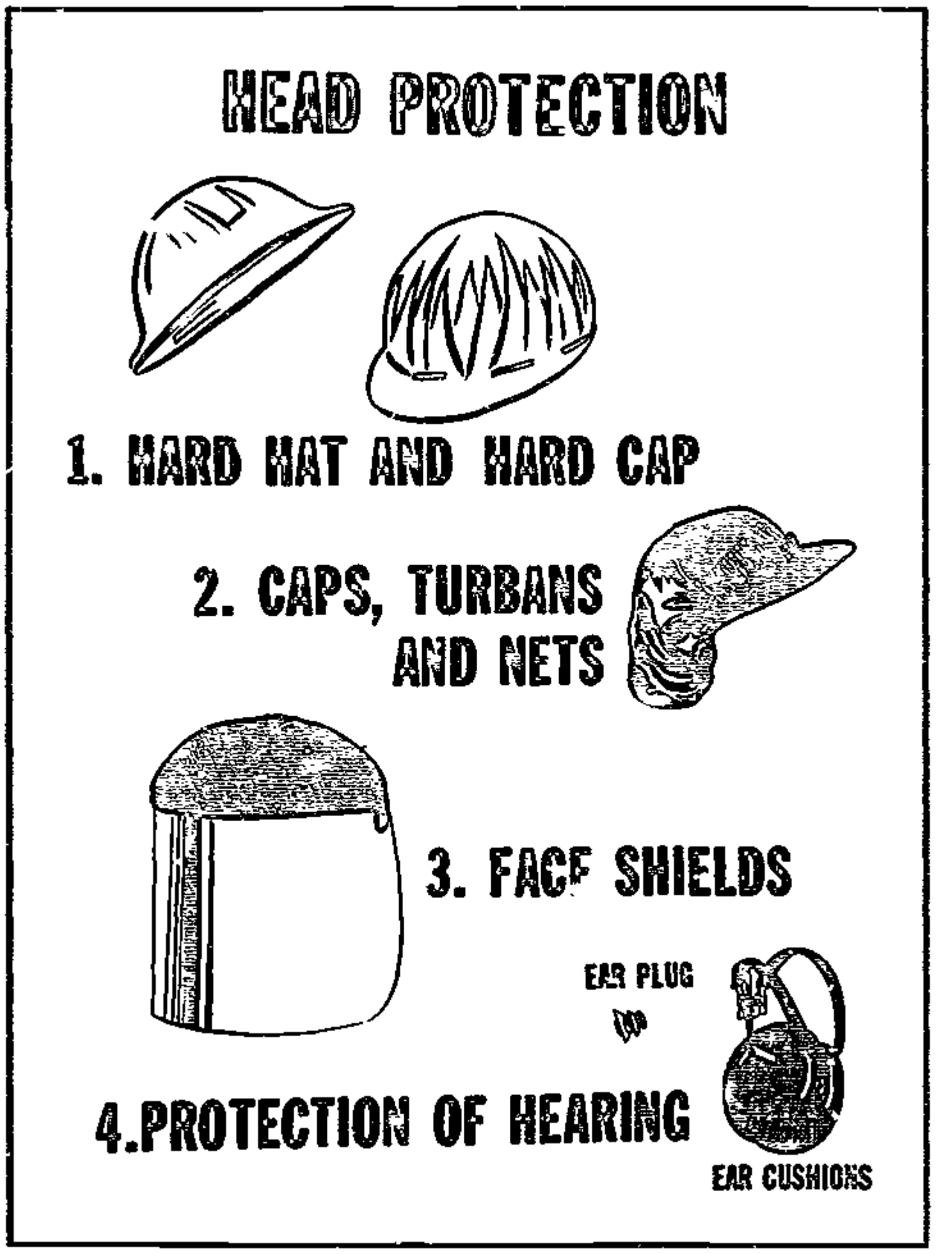


CHART 27—G

PROTECTIVE HATS	
TYPES AND CLASSES	Protective hats are classified into two types and four classes: Type No. 1 . . . . .Hat, full brim Type No. 2 . . . . .Cap, brimless, with peak
CLASS A	General service: protection against impact and flying particles; limited dielectric strength (not exceeding 600 volts).
CLASS B	Utility service: protection against impact and flying particles; high dielectric strength.
CLASS C	Special service: limited protection against impact; no dielectric strength (particular reference is made to metallic protective hats and caps).
CLASS D	Fireman service: protection against impact; limited dielectric strength (not exceeding 600 volts)—Type No. 1 only.

CONSTRUCTION REQUIREMENTS	
SHELL	The shell should be of one piece, seamless construction and designed to resist impact from falling materials.
SWEATBAND AND CROWN STRAPS	The shell is supported away from the head by a cradle formed by the sweatband and crown straps. The crown straps help absorb the force of impact. They are designed to maintain a clearance of not less than 1¼ inches between the shell and the skull of the wearer. Crown strap assemblies for use in Class B protectors contain no electrical conducting material.
INSULATION RESISTANCE	Although designed to protect against voltages of not over 600, Class A protectors are required to withstand 2,200 volts of alternating current for 1 minute with leakage current not in excess of 3 milliamperes. Class B protectors are required to withstand 15,000 volts of alternating current for 1 minute, with leakage current not in excess of 8 milliamperes. Class B protectors when tested to breakdown must withstand up to 20,000 volts.
IMPACT RESISTANCE	All three classes are tested by dropping an 8-pound steel ball on the crown from a height of 5 feet. Mounted on a standard head form, the protector must not transmit an average force of more than 850 pounds. The crown clearance for this test is 1½ inches for Classes A, B, and C.
PENETRATION RESISTANCE	Protectors shall be neither dented nor pierced for more than ⅜ inch when a 1-pound hardened steel plumb bob is dropped squarely onto the center of the crown from a height of 10 feet.
CAPS, TURBANS, AND NETS	Protecting the hair against scalping accidents could be classified as head protection. Women working around machinery always pose a problem because their hair may come in contact with moving shafts, belts, pulleys, drills, inrunning gears, etc. The problem of static electricity which may lift unconfined hair into the danger zone may also be present.
NO ACCEPTED STANDARDS	No standards have been accepted for women's caps, but the caps should be made of a durable fabric to withstand regular laundering and disinfecting. They should be of simple design for easy pressing or ironing by machine, and they should be available in various head sizes or be adjustable to fit all wearers.
SOME SPECIFICATIONS	The visor on a woman's cap should be long and rigid enough to provide warning before the head itself comes into contact with a moving object. The cap should be cool and lightweight. If dust protection is not required, the cap should be made of open weave material for better ventilation.
EAR PROTECTION	The problem of excessive noise in industry is receiving increased attention. When noise cannot be reduced to an acceptable value, ear protectors should be worn.

TWO TYPES OF EAR PROTECTORS	Ear protectors in general use fall into two groups: the plug or insert type and the cup or muff type.
PLUG OR INSERT TYPE	The plug type is inserted into the ear canal and varies considerably both in design and material. Materials used are rubber, soft or hard plastic, wax, and cotton. Rubber and plastic types are popular because they are easy to keep clean, inexpensive, and give good performance. It is important that earplugs contain no parts which could be driven into the ear canal by a blow to the side of the head, causing damage to the drum or middle ear.
SIZES	Since ear canals vary in size, these inserts come in several sizes. Some individuals might even require a different size for each ear. It is important that the ear plugs fit properly and remain correctly seated.
MATERIALS	
HARD	Inserts made of hard materials must be custom molded to the shape of the ear canal so they will fit precisely. They must have a substantial flange to fix the depth to which they can be inserted.
SOFT PLASTIC	Soft plastic plugs give more comfort than do hard types. To be effective, all earplugs must be pressed into the ear canal hard enough to form an airtight seal, which means that they are bound to produce some sensation of pressure in the ear.
WAX	Wax protectors vary in form from plugs of pure wax to impregnated cotton paper. If carefully molded to the ear canal, they can provide good protection.
COTTON	Dry cotton inserted in the ear is a poor choice as a noise suppressor.
MUFF TYPE	Cup or muff type protectors cover the external ear to provide an acoustic barrier.
AMOUNT OF PROTECTION	Commercially available earplugs, if properly fitted and used, will generally reduce noise reaching the ear by 20 to 35 decibels in the important sound frequencies. Muffs worn over earplugs give additional protection.

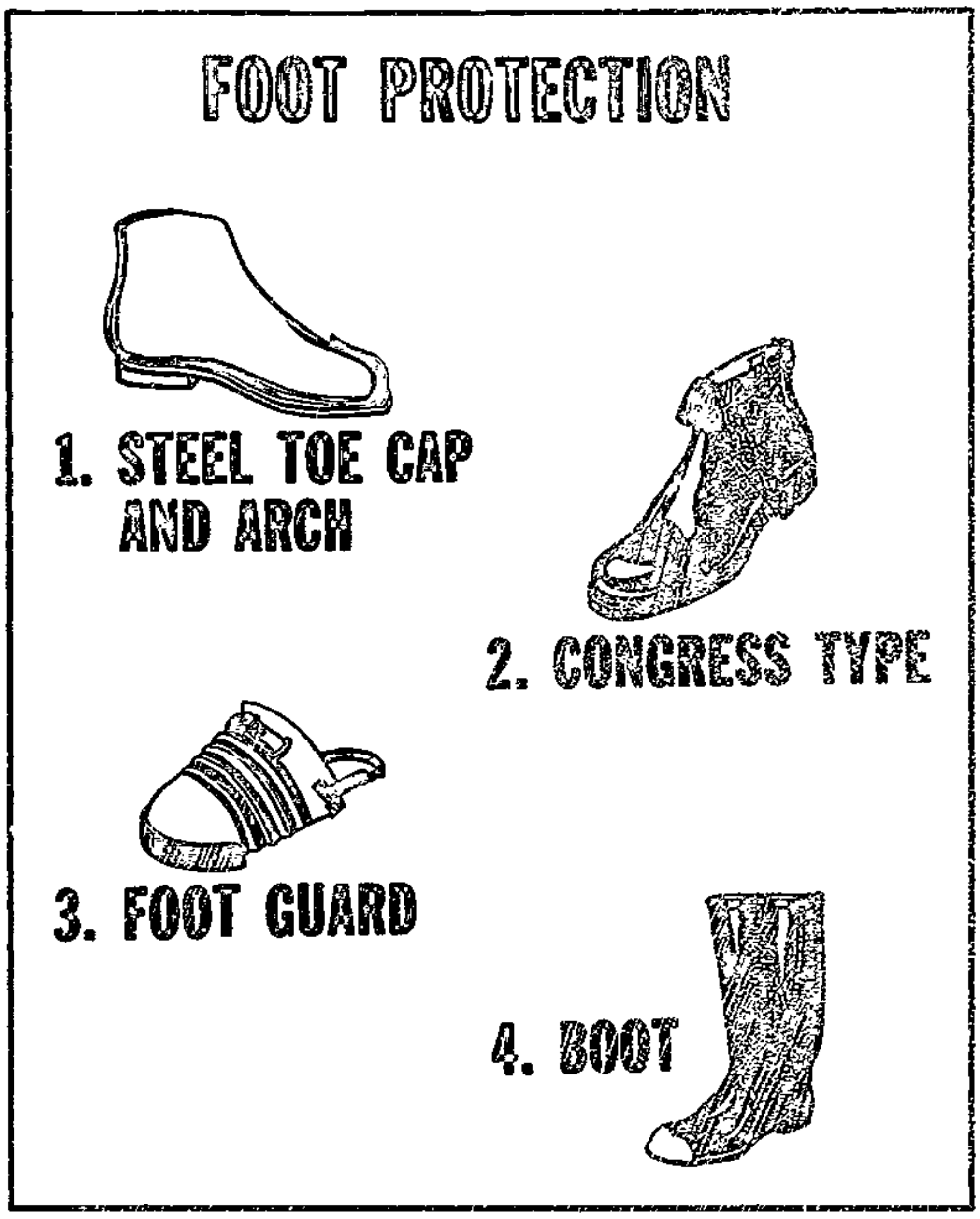


CHART 28—G

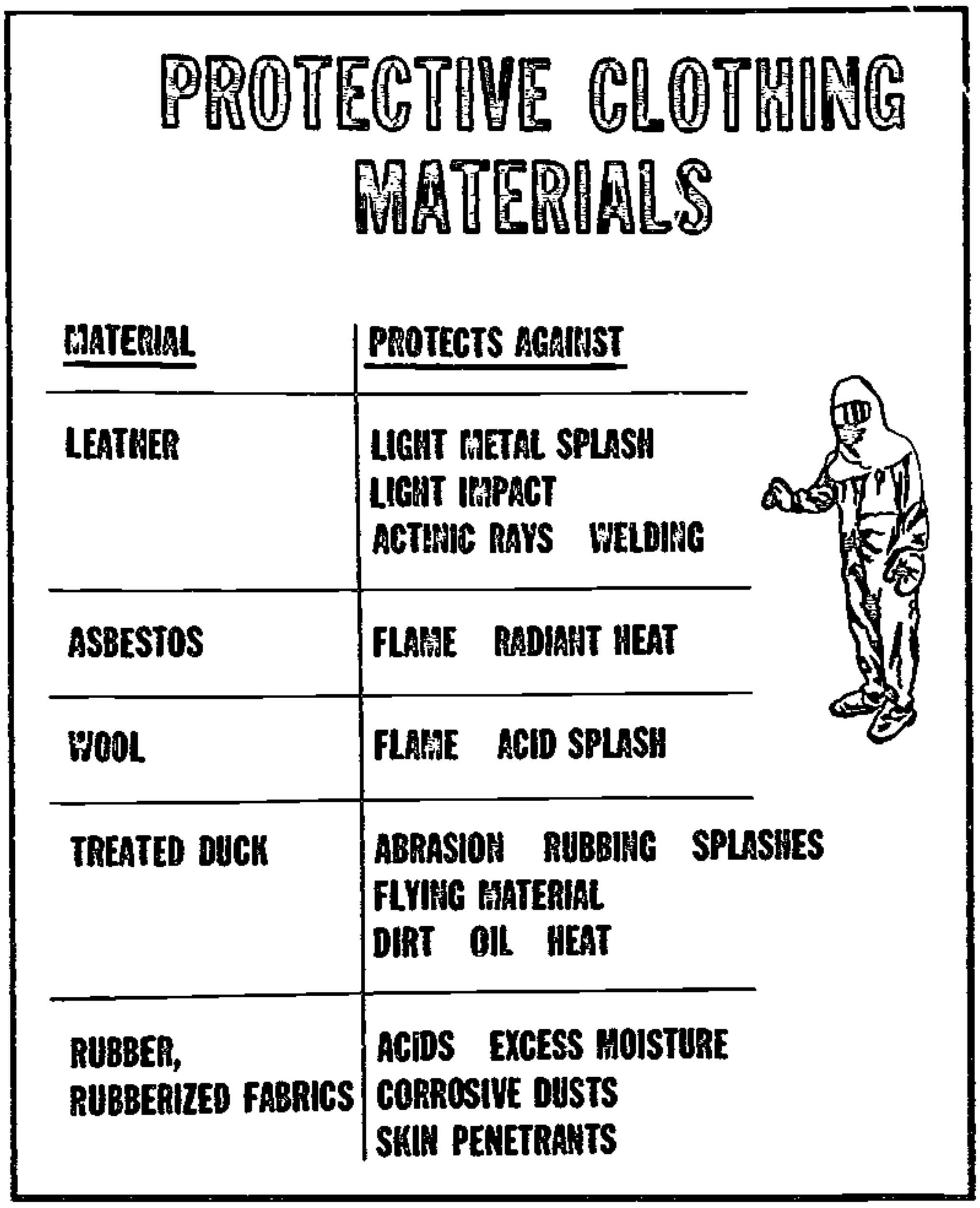
FOOT PROTECTION	Personal protective footwear is the accepted method of protection against injuries from heavy falling objects, against crushing from rolling objects, or against lacerations from edged tools. Protective footwear is also used against the hazards of molten metal and electricity.
SAFETY SHOES	For general wear, safety shoes should be well constructed with an impact-resisting metal toecap. These shoes must be comfortable, well fitted, and no heavier than regular style shoes. The protective toecap should support a static load of 2,500 pounds or 50 pounds dropped 18 inches.
STYLES AND MATERIALS FOR SAFETY-TOE SHOES	Safety-toe shoes are made in a large variety of styles and materials. Safety toes are incorporated into leather boots, rubber boots, oxfords, and many other types. Soles may be of leather, rubber, cord, or wood to protect against slipperiness, oil, heat, or other physical hazards. Safety-toe shoes are also made with insulation against heat or cold or with special features to protect against specific hazards, such as metal insoles to protect against puncture wounds. Plastic instep guards may be incorporated into safety-toe shoes where protection to the instep is desirable.

CONGRESS-TYPE SHOES	Congress-type safety shoes are usually required for places where molten metal may get into shoes. Laced shoes could be dangerous, so the congress type is recommended, because they can be removed quickly. These shoes generally have wooden soles or are attached to wooden soled sandals.
FOOT GUARDS	In addition to the basic type of safety shoes, a number of other types of foot guards are used. These foot guards should be capable of withstanding up to 200 pounds dropped 1 foot.
METAL FOOT GUARDS	Metal foot guards are coverings of aluminum alloy or galvanized steel which are temporarily attached to the shoes. They protect not only the toes but also the instep.
FOOT AND SHIN GUARDS	Where there is also a hazard to the shin, a combination foot and shin guard is available. The shin guard, made of the same material as the foot guard, is hinged to it and held in place by straps around the leg.
WOODEN SOLED SANDALS	Strap on sandals, consisting of wooden soles and held in place by straps over the shoes, are used as protection against hot walking surfaces, as in paving with hot asphalt.
BOOTS	Boots are generally made of rubber with safety toecaps. They are also available in neoprene, plastic, and leather. Wooden soles are available as well as nonslipping styles. The protective toecap should support a static load of 2,500 pounds or 50 pounds dropped 18 inches. Overshoes and pacs are also available for special requirements.

CHART 29—G

BODY AND LEG PROTECTION	Body and leg protective devices are used for a variety of purposes; however, in wearing these protective devices, care should be taken that these protective devices themselves do not create additional hazards.
APRONS	Aprons may be of either the bib type, covering the chest, waist, and knees or ankles, or of the waist type which lacks the chest covering bib. Aprons are available to protect against heat, hot metal splashes, impact and cut hazards, splashing liquids, or radiation hazards.
CAPE SLEEVES	Cape sleeves cover back, shoulders, and arms, and extend over the upper chest; they may have a detachable bib to protect the lower chest.
JACKETS	Jackets are used to protect the upper part of the body. They cover the shoulders and extend to the hips. Jackets made for flame and heat hazards are suitable for welding, particularly overhead welding, and for furnace or firefighting work. Other jackets intended for general laboratory or industrial use offer protection against chemical splashes, solvents, acids, alkalis, oils, and greases.

COATS	Coats and jackets are of similar material, coats being knee or ankle length which give leg as well as body protection.
COVERALLS AND OVERALLS	Coveralls and overalls cover the body, except head, hands, and feet. They also are made of materials designed to protect against heat and flame, or chemical burns.
NIGHT HAZARD CLOTHING	Luminescent clothing is designed to reflect light and is used by nighttime workers where there is a hazard from moving vehicles.
FIREFIGHTING SUITS	Flame resistant suits are designed to completely protect firemen while extinguishing fires and during rescue work around fires.
RADIATION EXPOSURE SUITS	Coverall suits, made of plastic or paper, protect clothing against contamination from particulate matter.
LIQUID HAZARD SUITS	Suits, consisting of lightweight jacket, overall pants, and hood, are used by maintenance men and repairmen when they are working around hazardous liquids.
OTHER PROTECTORS	Other personal protective devices (leggings, shinguards, kneeguards, pants, waders, or spats) are available for use against specific hazards.
ARM AND HAND PROTECTION	There are a large number of hand and arm protective devices, many of them designed for specific purposes.
GLOVES AND MITTENS	Gloves and mittens are intended to provide protection to the fingers, hands, and sometimes to the wrists and forearms. They should not be worn where there is the hazard of being caught in moving machinery. Materials available are leather, cloth, rubber, plastics, impregnated cloth, asbestos cloth, and metal mesh.
HAND PADS	Hand pads are used to protect the palm of the hand against cuts and abrasions or against burns caused by direct contact with hot objects or against sparks, flame, or heat. Generally, hand pads are heavier and less flexible than gloves or mittens and are used for heavy duty protection against direct contact.
FINGER COTS	Finger cots provide protection to finger tips only. They are designed to protect against moisture, acids, alkalis, oil, grease, and solvents, or against cuts. Cots are also used when only the fingers come in contact with hot materials.
SLEEVES	Where protection to the arms are necessary, sleeves are worn in conjunction with gloves. They are made in three lengths: cuff length for wrist and forearm, elbow length, and shoulder length. Rubber sleeves are worn by electricians and linemen for protection against live conductors.



PROTECTIVE CLOTHING MATERIALS

MATERIAL	PROTECTS AGAINST
LEATHER	LIGHT METAL SPLASH LIGHT IMPACT ACTINIC RAYS WELDING
ASBESTOS	FLAME RADIANT HEAT
WOOL	FLAME ACID SPLASH
TREATED DUCK	ABRASION RUBBING SPLASHES FLYING MATERIAL DIRT OIL HEAT
RUBBER, RUBBERIZED FABRICS	ACIDS EXCESS MOISTURE CORROSIVE DUSTS SKIN PENETRANTS

CHART 30—G

LEATHER MATERIALS	
PROTECTION	Good quality leather protective clothing will provide adequate protection against light metal splashes, light impacts, and harmful actinic rays.
CLOTHING	Leather is usually used to make coats, overalls, sleeves, aprons, leggings, capes, gloves, and hand leathers.
SPECIFICATIONS	Clothing should be made of a good quality leather and so fastened as to avoid any exposures during body movements. Clothing should cover completely, yet be designed for instant removal when necessary. All stitching should be protected from sparks and hot metal splashes.
ASBESTOS MATERIALS	
PROTECTION	Asbestos clothing should protect against excess dry heat and flame.

CLOTHING	Asbestos is usually used to make coats, overalls, sleeves, aprons, leggings, capes, gloves, and hand pads.
SPECIFICATIONS	All fastenings should be covered with flaps. When clothing is subjected to continual use, a leather backing is recommended for reinforcement.
DUCK MATERIALS	
PROTECTION	Duck material makes good light-duty protective clothing against small cuts and bruises on jobs where heavy, sharp, or rough materials must be handled.
CLOTHING	Duck is used primarily for gloves, aprons, and light clothing. In recent years, aluminized duck has been developed for protection against work exposure to radiant heat.
WOOLEN MATERIALS	
HEAT AND FLAME RESISTANT	Generally, woolen clothing is suitable for work in cold areas, around furnaces, and some chemical plants (especially acids).
RUBBER AND RUBBERIZED FABRICS (ALSO NEOPRENE AND PLASTIC)	Hats, hoods, gloves, coveralls, coats, pants, jackets, and aprons are available for use as protection in chemical plants and wherever there is exposure to acids. Clothing made of neoprene or plastics should be used for protection against solvents.

Distribute occupational safety aids "Face and Eye Protection," "A Plant Checksheet for Face, Head and Eye Protection," "Safe Practices—Gas Welding and Cutting Equipment," "Safe Practices—Arc Welding."

OCCUPATIONAL SAFETY AID

FACE AND EYE PROTECTION

More than 100,000 disabling eye injuries are reported each year. This high annual toll can be minimized and severity reduced by the use of proper engineering revision or point of operation guarding.

Even though most of the injuries are preventable by the above procedures, the severity of most of them could have been controlled by the use of personal protective equipment.

When a hazardous situation exists, examine the process of manufacture or the handling method to determine what changes could be made to eliminate the hazard. Sometimes, a simple design change on a machine will eliminate a cause of accidents by controlling the hazard at the source.

It is only after these measures have been considered and found to be impractical that the use of personal protective equipment should be considered.

There are definite limitations in the use of every piece of protective equipment. Detailed studies should be made before making recommendations. These studies should include:

KEEP RECORDS of injuries to the face or eyes to determine where and how such injuries are occurring.

MAKE A SURVEY of the establishment to determine the types and locations of eye hazards.

EDUCATE SUPERVISORS - Supervisors should be advised of the sources of eye injuries and the protective measures necessary.

EDUCATE THE WORKERS - Show them the need for eye protection. Work up statistics and distribute them. Answer workers' questions. Get a film on eye safety and show it to all workers. Post bulletins on eye protection and get the Safety Committee to work actively on the promotion set up.

VISION TESTING - This is a vital part of all eye protection programs. All employees who are to wear goggles should be tested to determine the need for corrective lenses. Eye tests on substantial groups indicate that 15 to 20 percent of adults should wear corrective lenses.

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FITTING - DISTRIBUTION - It is good practice to arrange with the oculist who does the eye testing to fit the goggles. Workers will not have full confidence if fitted by a stockroom attendant or foreman. Goggles that are confortable to wear and do not interfere with eye comfort or vision will be worn IF the wearer knows the hazards.

It is essential to provide for control and distribution to insure careful and thorough maintenance of all eye protection. This can be arranged by the examining oculist who will be able to give proper instructions to the persons selected to handle this work.

REPAIR OR REPLACEMENT - Protective eyewear should be handled through a central storeroom, to insure that it is checked for bent frames, worn temple coverings, or missing parts. Also, eyewear should be cleaned and sterilized regularly.

EXHIBITS - Many plants maintain a location where protective equipment, that has prevented injury, is displayed. This is a good practice as it helps in selling the program.

DISCIPLINE - Rules should be written out so there can be no misunderstanding. Have rule book signed. To back the rules, require rigid enforcement.

A program can be successful when properly administered according to the following recommendations:

1. MAKE ONE PERSON RESPONSIBLE FOR THE EYE PROTECTION PROGRAM.
2. PURCHASE PROPER TYPE OF EQUIPMENT.
3. PROVIDE ADEQUATE FITTING, AND VISION TESTING.
4. INSURE THAT GOGGLES ARE PROPERLY CARED FOR AND REPAIRED.
5. SELL THE PROGRAM THROUGH EXHIBITS AND BULLETIN BOARDS.
6. ENFORCE RULES BY RIGID DISCIPLINE.

The following chart is designed to assist in determining the type of equipment according to work being done, and is adapted from ASA Standard Z2.1-1959 "Head, Eye, and Respiratory Protection."

Face and Eye Protection*

FOR PROTECTION FROM-	In jobs such as-	Select this face or eye protection
Large flying objects rivets, nails, metal or rockchips, fragments from mushroomed tools.	Chipping, finishing of iron and steel castings, and forgings, lathe work.	Safety spectacles with impact resistant lenses, lens containers, frames, and side shields of maximum strength and comfort for wearer. Frames that are light in weight, and not subject to corrosion under sterilization. Heavy duty cup goggles with impact resistant lenses.
Dust and small flying particles.	Scaling and grinding of metals stone dressing, woodwork, etc.	Composition cup coverall goggles of moderate strength, that enclose eye completely and have indirect port ventilation. Cover type of plastic one piece lens; safety spectacles with impact resistant lenses, and side shields.
Dust, wind and metal sparks.	Operating road building equipment, construction work; operating tractors and power shovels; electric spot and butt welding, where there is no exposure to radiant energy.	Safety spectacles with impact resistant lenses. Full face plastic shield of moderate strength cover type of plastic one piece lens.
Splashing metal.	Casting, tinning, babbitting pouring lead joints. These operations are serious industrial eye hazards.	Cup goggles with impact resistant lenses capable of withstanding moderate blow of molten metal and with lens containers made to hold cracked lens in position--all materials nonflammable. Cover type of plastic one piece lens wire screen face shield with wide flare safety spectacles with side shields and impact resistant lenses.

* Adapted from ASA Standard Z2.1-1959.

Face and Eye Protection*--Continued

For protection from-	In jobs such as-	Select this face or eye protection
Gases, vapor and liquids entering the eyes.	Handling of volatile and corrosive chemicals, dipping in galvanizing and pickling tanks, etc.	Tight gas-proof goggles with impact resistant lenses. Wide flare plastic face shield. Cup goggles with impact resistant lenses. Rubber mask goggles with indirect screened ventilation ports, and wide-vision impact resistant lenses.
Reflected light and glare welding flash.	Working near or adjacent to furnaces, welding operations, etc.	Safety spectacles with filter shade lenses with or without side shields (with side shields and with use of helmet in gas shielded arc welding). Cup goggles with filter lenses, retaining and opaque side shields.
Injurious radiant energy when a moderate reduction of intensity of the visible radiant energy is desired.	Oxyacetylene, oxyhydrogen, or resistance welding and cutting, testing of lamps involving exposure to excessive brightness, tending electric, Bessemer and other types of furnaces, crucible steelmaking.	Cup goggles with impact resistant filter lenses and clear cover glass to save the welding lenses from pitting--with indirect, screened, ventilating ports to prevent fogging of lenses and to exclude injurious flashes, hot metal and sparks.
Injurious radiant energy when a large reduction of the visible radiant energy is desired.	Electric arc welding and cutting, irradiation with ultraviolet light, hydrogen welding.	Scarfing shield with impact resistant filter lenses and clear cover glass. One piece shell welding helmet with flip front. Welding section that can be raised for quick inspection of weld, and with a stationary section fitted with clear impact resistant glass for observation of weld. Fabricated shell welding helmet with stationary filter glass section.

* Adapted from ASA Standard Z2.1-1959.

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A PLANT CHECKSHEET FOR FACE, HEAD, AND EYE PROTECTION

1. Are goggles, helmets, and face shields available for each employee exposed to the danger of:
   - (a) Splashing of molten metal or injurious chemicals? .... ________
   - (b) Flying dust or particles of emery, metal, rock wool or other hard substances? .... ________
   - (c) Falling or thrown tools or other large objects? .... ________
2. Are goggles fitted to the individual workman? .... ________
3. Are emery wheels equipped with glass shields, metal hoods, or other adequate protection? .. ________
4. Is some one person charged with responsibility for cleaning and replacing pitted or broken emery wheel shields? .... ________
5. (a) Is each worker needing a head [illegible], helmet, or goggles provided with such for his exclusive use? (The use of the same goggles by more than one person involves the danger of communication of disease.) .... ________
   - (b) Is there provision for approved sterilization of eye protection devices turned in by one employee before they are issued to another? .... ________
6. Is there adequate provision of proper goggles, masks, and helmets to protect workers from injurious heat and light rays in occupations involving:
   - (a) Acetylene welding? .... ________
   - (b) Electric welding? .... ________
   - (c) Irradiation by ultraviolet light? .... ________

PROTECTION AGAINST THE HAZARDS OF UNDUE EYE FATIGUE

7. Are prescription lenses provided for all employees with defective vision? (Yes or No) .... ________

ASSIGNMENT OF WORK

8. Is the vision of each employee taken into account in an assignment of work? .... ________
   - (a) Is it done through job analysis and test of vision? .... ________
   - (b) Is it left to the judgment of personnel manager, foremen, or other supervisors? .... ________
9. Is there a periodic check of the relation of worker's vision to the character and quality of his job which will lead to the recommendation of change to a less hazardous occupation if necessary? (If so, state how often) .... ________

SAFETY RULES

10. Is there a mandatory rule concerning the wearing of face shields, head protection, and goggles in prescribed occupations and is this rule enforced? .... ________

RECORDS

11. Are accurate records kept of:
    - (a) Number, nature, and cause of eye injuries? .... ________
    - (b) Frequency and severity rate of such injuries? .... ________
    - (c) Compensation and other costs due to such injuries? .... ________

OCCUPATIONAL SAFETY CHART No. 4

SAFE PRACTICES — ARC WELDING

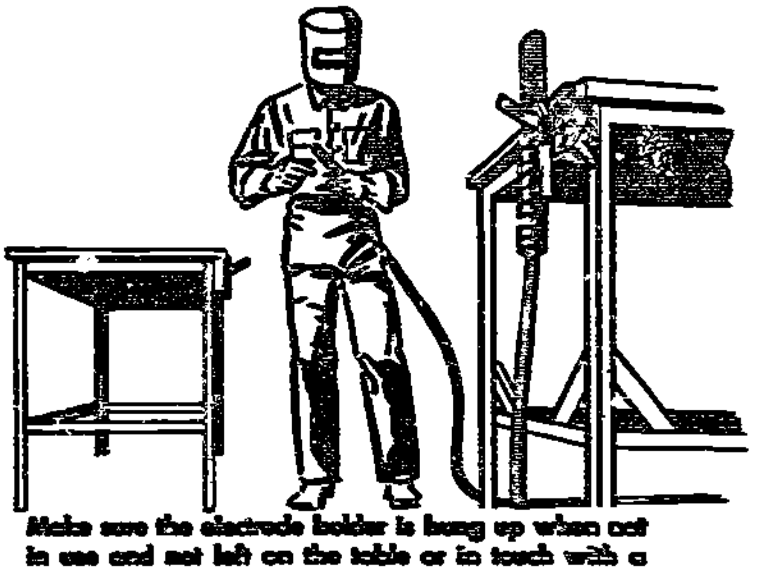
Wear Protective Clothes and Helmet — avoid injury

Wear protective equipment, such as leather sleeves, jacket, apron and welder's leather gloves to protect the skin from intense heat and sparks. Protect the eyes and face by means of a suitable helmet or shield equipped with a filter glass plate. Wear safety shoes, tightly laced.

See That All Connections Are Tight — avoid injury

See that cable connections to electrode holder and ground are tight and insulated. Make sure electrode holder is in good condition and grips electrode firmly. Always use well insulated holders.

Hang Up Electrode Holders Not In Use — avoid injury

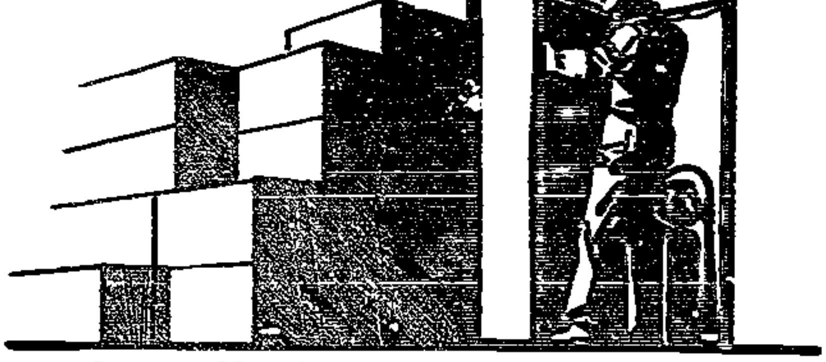


Make sure the electrode holder is hung up when not in use and not left on the table or in touch with a grounded object.

Wear Goggles When Chipping Weld — avoid injury

Always wear safety goggles under helmet for protection when chipping or grinding a weld. Clear or light tinted goggles will also help to prevent eye flashes when other welders are working nearby.

Don't Weld Near Combustible Materials — avoid injury



Erect suitable safeguards around any flammable materials near work and keep a fire extinguisher handy. Where sparks may come through floor or partition, have helper or fire watcher stationed where he can control the situation.

Protect Nearby Employes From Arc — avoid injury

Erect large screen around welding work to protect nearby employes from arc rays. If unable to shield the arc completely, warn every one nearby not to look at the arc. Wherever possible, stand so you are between the arc and other workmen.

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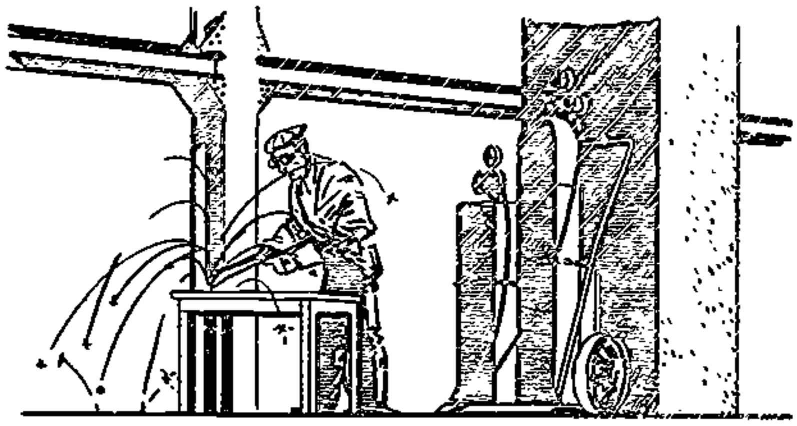
OCCUPATIONAL SAFETY CHART No. 5

SAFE PRACTICES — GAS WELDING & CUTTING EQUIPMENT

Handle Gas Cylinders Safely—Avoid Injury

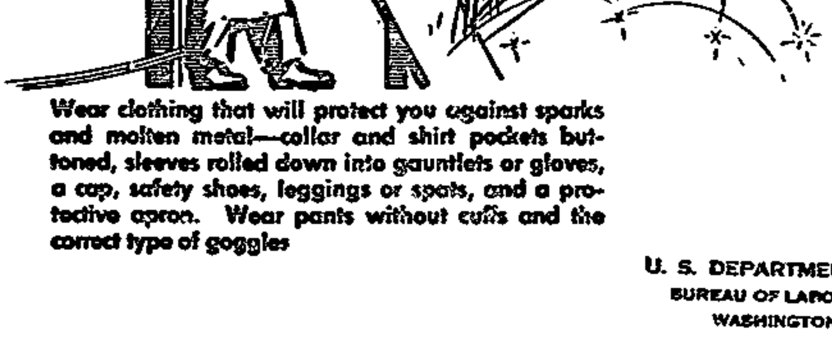


See that gas cylinders are firmly fastened and out of the way of shop trucks and other hazards. Keep cylinders away from electrical equipment and hot locations, including the direct rays of the sun. Close cylinder valves when stopping work for 15 minutes or longer. Disconnect torch and place in tool box.

Take Proper Precautions Against Fire—Avoid Injury

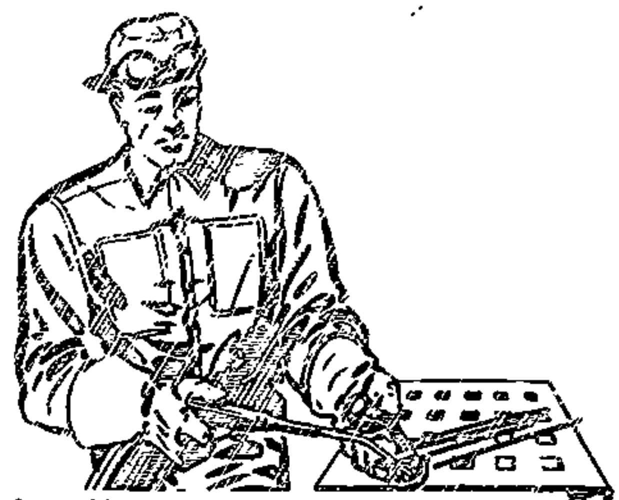
See that all combustible materials are well out of the way, or protected from sparks. If necessary use a spark shield. Keep a fire extinguisher handy.

Wear Proper Protective Clothing—Avoid Injury



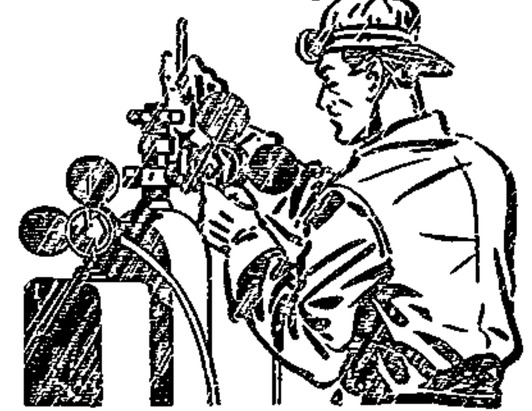
Wear clothing that will protect you against sparks and molten metal—collar and shirt pockets buttoned, sleeves rolled down into gauntlets or gloves, a cap, safety shoes, leggings or spats, and a protective apron. Wear pants without cuffs and the correct type of goggles

Use Torches Properly—Avoid Injury



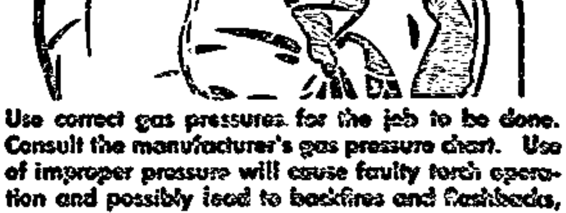
See that welding or cutting torches are in good condition. Light torch according to the manufacturer's instructions. Use friction lighter, not matches, so as to avoid hand burns.

Make Sure Connections Are Tight—Avoid Injury



Before using gas welding or cutting equipment, make sure that all cylinder, regulator and hose connections are tight. Tighten connections with wrench before gas pressure is applied and stand to one side of regulator before opening cylinder valves. Check hose and connections periodically for leaks by using soapy water.

Use Correct Gas Pressure—Avoid Injury



Use correct gas pressures for the job to be done. Consult the manufacturer's gas pressure chart. Use of improper pressure will cause faulty torch operation and possibly lead to backfires and flashbacks, which may damage inside of hose.

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WASHINGTON 25, D. C.

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Guidelines for Home Experiences.

Alaska State Dept. of Educ., Juneau. Div. of Vocat. Educ.
Pub Date - 64
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*PROGRAM PLANNING, *GUIDELINES, *HOME ECONOMICS EDUCATION, HOME VISITS, *HOME PROGRAMS, *STUDENT EXPERIENCE, HIGH SCHOOLS,

This guide is for teacher use in planning a home experience program for high school students. It was developed by the state home economics supervisor and a professor of home economics from teacher reports and materials from other states. Home experiences are usually of three types--individual, family, or community. Well directed home experiences offer opportunities for developing greater pupil responsibility, self-confidence, skill, and initiative. Content covers meaning and purpose of the home experience program, introducing the program, home visits, student conferences, ideas for home experiences, evaluation, checklist for rating a program, and references. Forms of letters to be sent to parents and students, evaluations, plans, records, and reports are included. (FP)

GUIDELINES

FOR

HOME EXPERIENCES

M E M O R A N D U M

TO: The ERIC Clearinghouse on Vocational and Technical Education
The Ohio State University
980 Kinnear Road
Columbus, Ohio 43212

FROM: (Person) Mrs. Elladean H. Bittner (Agency) Department of Education
Division of Home Ec. & Health
(Address) Alaska Office Building, Pouch F, Juneau, Alaska 99801

DATE: February 19, 1968

RE: (Author, Title, Publisher, Date) Mrs. Phyllis A. Davis, Supervisor, Home Economics, Department of Education, Division of Vocational Education, Pouch F, Alaska Office Building, Juneau, Alaska 99801. Miss Ann Walsh, Assistant Professor, Department of Home Economics, University of Alaska, College, Alaska 99735. "Guidelines for Home Experiences".

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(2) Means Used to Develop Material: Reports by teachers of home ec. Materials from other States.
Development Group Mrs. Phyllis A. Davis, See above & Miss Ann Walsh, See above.
Level of Group State.
Method of Design, Testing, and Trial

(3) Utilization of Material:
Appropriate School Setting Area vocational high school.
Type of Program High School class.
Occupational Focus Home Economics program in Alaska.
Geographic Adaptability --
Uses of Material --
Users of Material Teacher, student.

(4) Requirements for Using Material:
Teacher Competency Certificated Vocational Teacher
Student Selection Criteria --

Time Allotment --

Supplemental Media --
Necessary x
Desirable
(Check Which)

Describe All media available to enrich program.

Source (agency) Whatever applies to unit from all available media.
(address)

FOREWORD

Every individual has a place of abode which is home to him. Regardless of the size or type of home, there are certain competencies which enable the individual to make family living in that home satisfying for himself and for others. Home economics education aims to provide the kind of learning situations which will develop within the student skills and relationships competencies basic to successful family life. The home experience aspect of vocational home economics education is an integral part of that program.

Home experiences are learning experiences related to home and family problems which are planned and carried out in the home of the student under supervision of the teacher with the cooperation of the family. These learning experiences have definite goals for personal development of the student and for contributing some phase of family living.

A need for home experiences as a part of the home economics program is evident since it makes relating classroom learning to home situations more effective. Directed home experiences aid in keeping home economics education practical and usable. Through close contact with homes and families, the teacher can gain the insight and understanding necessary for planning and carrying out worthwhile learning activities with students. Well-directed home experiences offer opportunities for developing greater pupil responsibility, self-confidence, skill, and initiative. Therefore, the home experience program makes a unique contribution to the present family life situation of the student and paves the way for assuming home responsibilities in the future.

Dr. [illegible] E. Hartman
Acting Commissioner
Department of Education

INTRODUCTION

The home experience program is a vital part of vocational home economics. Those who teach home economics are aware of the value of this teaching technique and have expressed a desire for information that would aid them in using this education device more effectively.

At the 1966 Curriculum Development Summer Workshop, it was concluded that a home experience guide was a necessary supplement for Guidelines to Home Economics. It was felt that such a manual should be developed immediately, and many suggestions were given. Those suggestions plus many others gleaned from annual reports submitted by the teachers of home economics in the state of Alaska have been incorporated in this bulletin. Additional ideas were gathered from materials received from other states and modified to make them applicable to the home economics program in Alaska.

It is intended that this manual be a sharing of ideas. Therefore, the user is welcome to reproduce any portion giving credit to the source.

Mrs. Phyllis A. Davis
Supervisor, Home Economics
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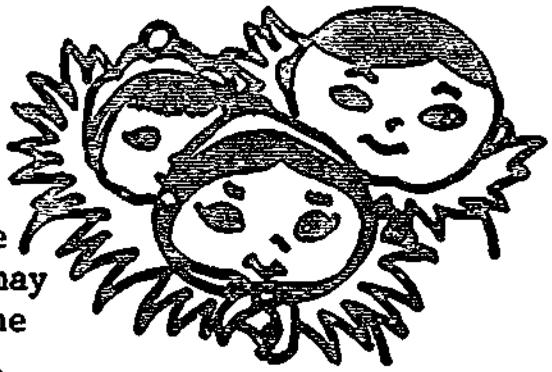
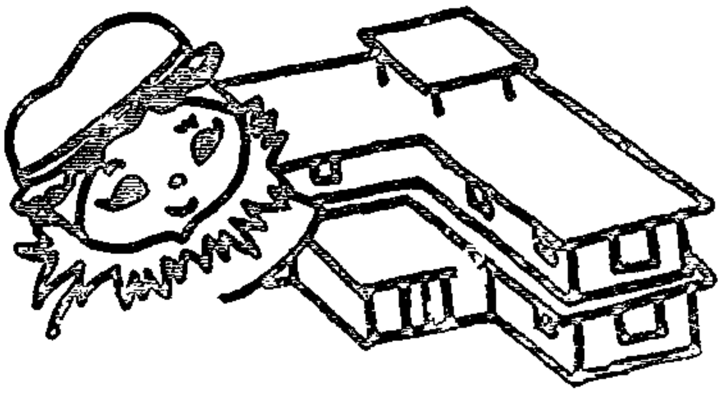
THE MEANING OF HOME EXPERIENCES

Home experiences usually are of three types: the individual home experience, the family home experience, and the community home experience.

The individual home experience emphasizes improvement of the student and may not greatly affect other family members. Such activities might develop from problems of personality development, personal grooming, improving eating habits, money management, career planning.

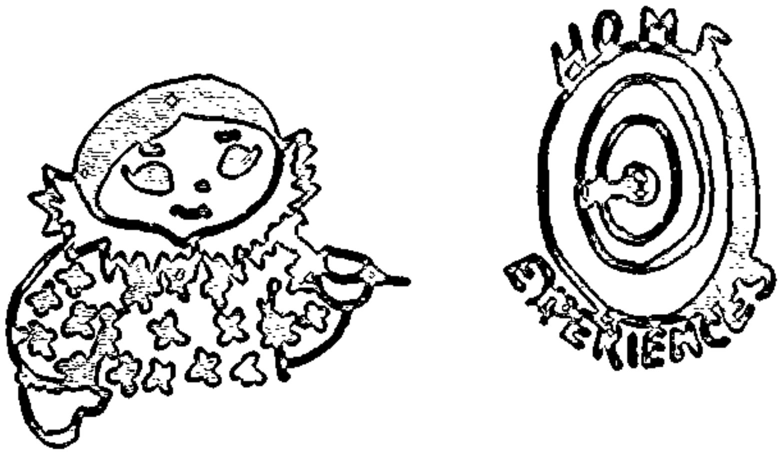


A family home experience directly affects the family of the student. These afford opportunities to attempt to solve home problems through cooperative effort of the whole family. The student takes the initiative and assumes the major responsibility. Projects of this nature may revolve around problems involving considering the desires and rights of others, caring for others, common goals of the family. Activity examples are marketing for the family, cooperating to preserve food for the family, redecorating the kitchen, planning a family celebration, caring for small siblings.



Community home experiences directly affect the welfare of the family and extends beyond the home. This type of experience may be a joint activity of several students. Some examples of community projects are assisting with a summer play group of small children, cooperating in a local safety program, exploring employment opportunities for women in the community. An experience of this type may serve to make students conscious of local concerns and aware that the home can contribute to the solution of community problems.

It would be ideal for pupils to experience all three types of home experiences during their enrollment in home economics courses. Opportunities for desirable experiences may be planned as (1) part of the overall home economics program, (2) parallel with the unit being studied, (3) to be carried out when practical or convenient regardless of the unit being studied at the time, or (4) a part of the FHA program.



THE PURPOSES OF HOME EXPERIENCES

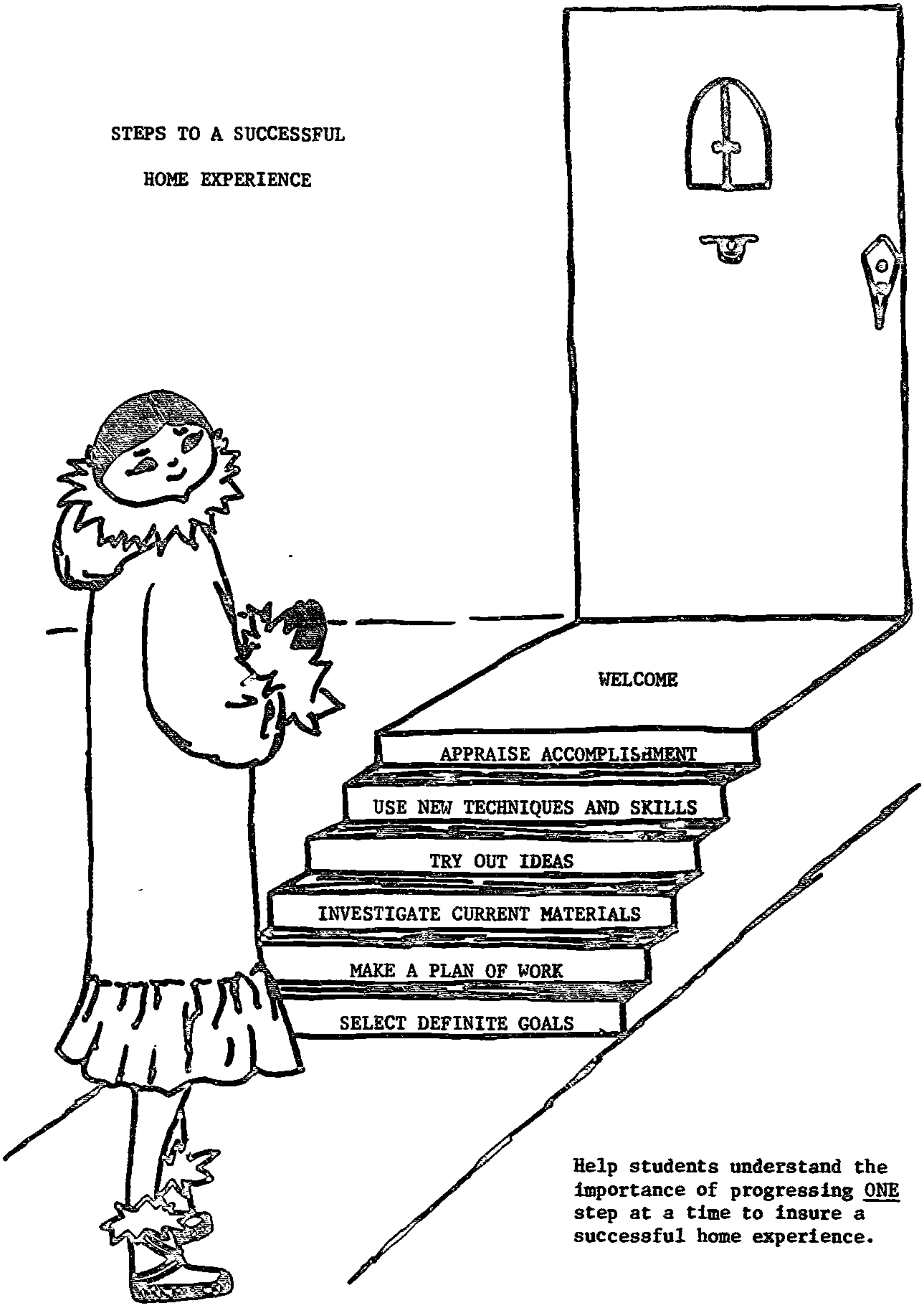
Home experiences are considered to be an integral part of a good home experience program. As such, the role they play is many-fold. Home experiences serve to:

* Relate classroom learnings to the everyday life of the student.
* Extend the scope of class work by encouraging activities that relate to concepts developed through in-class experiences.
* Provide for individual differences--differences in level of achievements, differences in rate of learning, differences in capacity for learning, differences in goals.
* Offer an opportunity for self-expression.
* Promote mutual understanding, interest, and cooperation among students, parents, and the school and thereby increase communication.
* Interpret home economics and the careers that may result from utilization of its knowledge and skills.
* Promote good public relations.

Home experiences offer students who are enrolled in home economics classes opportunities to:

* Develop problem-solving skills
* Work on projects which have definite meaning for the individual.
* Progress according to individual speed and ability.
* Become more aware of personal strengths and weaknesses.
* Practice self-evaluation.

STEPS TO A SUCCESSFUL HOME EXPERIENCE



Help students understand the importance of progressing ONE step at a time to insure a successful home experience.

INTRODUCING THE HOME EXPERIENCE PROGRAM

The teacher meets the same problems in making the home experience program effective that are encountered in making class instruction effective. She must stimulate and maintain keen, active pupil interest and guide the selection, organization, completion, and evaluation of the results. Recognition of these problems by the teacher and successful solution of them is essential.

The most successful methods of introducing the home experience program are those which permit interaction between students and teacher. They also provide a specific framework to guide the student by giving her activity suggestions and defining time limits.

Some methods which have proven effective tools for introducing the home experience program are:

* Write letters to the parents explaining the home experience program.

* Introduce the program through home visits.

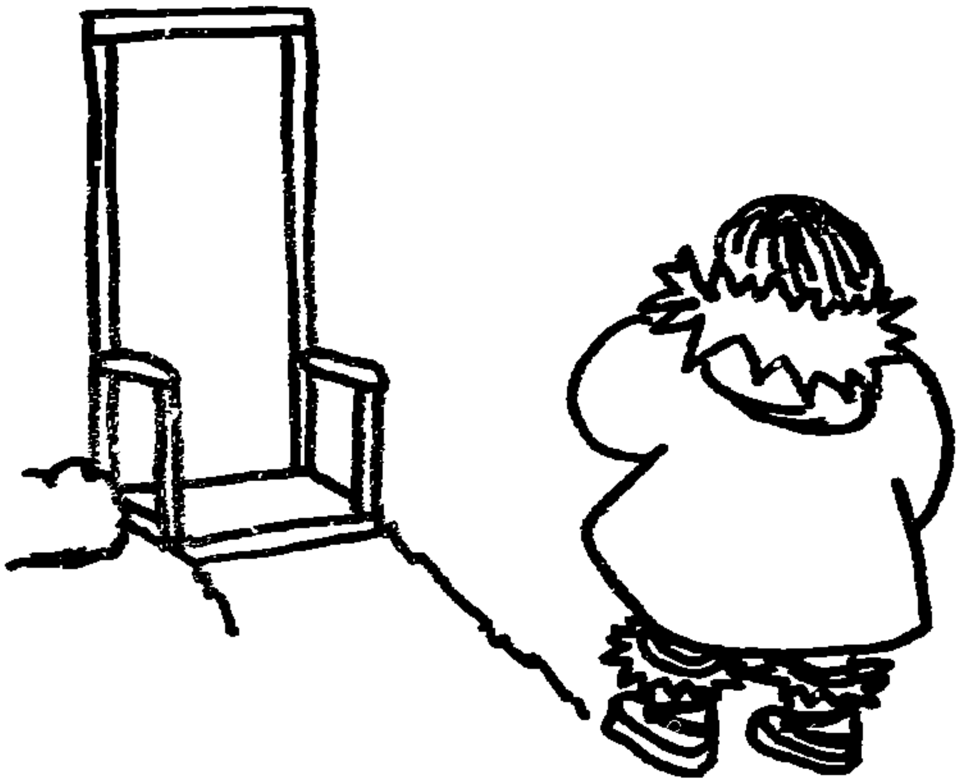
* Conduct a "Parent Night" to explain the home experience program.

- Have students from other classes discuss various types of projects.
- Conduct a class tour to see some completed experiences.
- Arrange an exhibit of the reports and the products of completed experiences.
- Give students a teacher-prepared list of experiences from which to choose.
- Display pictures of completed projects.
- Maintain a display of experiences in the school exhibit case.
- Have students present skits of home projects.
- Read outstanding projects from the previous year.
- Keep a department scrapbook or reference file of outstanding experiences to which students can refer.
- Divide a class into groups to prepare lists of home experience suggestions.
- Instruct students that they must do so many experience activities within a given period of time.
- Instruct students that they must do so many experience activities within a given time and within a given subject area.
- Assign an activity for each class member to carry out at home.
- Cooperatively plan home experiences in class.
- Have conferences with individual students.
- Present the home experience program through Future Homemakers of America as part of the chapter program of work.
- Incorporate the home experience program in the FHA degree program.

Careful planning is an absolute essential. No method of presentation will be successful if the teacher does not organize her part of the program first. The value of a home experience activity depends not only upon the opportunity for experience and practice, but also upon the guidance given the student in order that the practice is made meaningful.

Another absolute essential is a positive attitude by the teacher. A negative, unsympathetic attitude on the part of the teacher will doom the effectiveness of the program regardless of how complete the planning. There needs to be evidence of sincere interest in the joys, sorrows, and difficulties of the families of the students. Every individual is entitled to just treatment with justice based on understanding. Enthusiasm is infectious. So is imagination and creativity.

HOME VISITS



One of the most effective ways the home economics teacher may gain a real understanding of the students, the families, the homes, and the community is through the home visit. It provides the basic understandings she needs to plan and carry out an effective home experience program.

Preliminary planning of home visits is important and will help the teacher to receive invitations to students' homes. Several different approaches may be used, such as:

1. A letter to parents to explain the home economics program, including mention of home experiences and home visiting.
2. An invitation to parents to visit the home economics department during National Education Week.
3. A schedule of times the teacher has available for visiting may be posted on the bulletin board and students may "sign up" for a time best for them.
4. FHA offers excellent opportunities. If some students invite a committee to come to their homes, this provides a natural way to make a home visit that may provide valuable background as you work with the student on home experiences.
5. Taking a student home provides a natural situation to invite the teacher to come in and meet the family.
6. Teacher participation in community activities afford an opportunity to meet families of some students and may result in an invitation from the parents to visit the home.
7. An invitation to mothers to "coffee" in the teacher's home often results in a return invitation to visit the home.

In some communities, the home economics teacher is employed beyond the regular school year. This may mean she is employed two weeks before school begins in the fall and/or two weeks after school closes in the spring.

Extended employment affords an excellent opportunity for the home economics teacher to make home visits that may have been impractical or impossible during the school term. It also provides opportunity to plan and direct home experiences that extend into the summer.

Some Keys to Successful Home Visits*

1. Be friendly, natural, at ease, and express a sincere interest in the student.

2. Do not stay too long, especially on the first visit.

3. Explain the home economics program and tell how home experiences are included.

4. Give parents an opportunity to ask questions.

5. Enlist parents' assistance in providing real experiences for students in a home setting.

6. Show an interest in hobbies of family members.

7. If you are ill-at-ease, remember the family may be too. Try to put them at ease with your manner.

8. Remember, when you do home visits, you are an ambassador of the school; as such, you have a real opportunity to strengthen good relationships between the school and the home.

9. Be careful in keeping a confidential, professional attitude toward what you may learn on home visits.

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* Home Economics Education, Oregon State College. *Individualizing Teaching Through Home Experiences.* Corvallis, Oregon. 1952.

STUDENT CONFERENCES

Conferences with students, individually and/or collectively, are a "must" for a strong home experience program.

Vocational home economics programs have a conference time set aside for working specifically with students. This time may not always be satisfactory, but the teacher with foresight will arrange a schedule with her students which will be of advantage to both herself and them.

The conference period is important. It will give the teacher an opportunity to discuss with the student home experiences she may be interested in and will help her make a choice. Following the first conference, the student should have several ideas about experiences she is interested in. She should then discuss the possibilities with her mother and together they should make a choice.

When a second conference is held, the student should present a plan for the home experience selected. The teacher should take this opportunity to discuss the plans pointing out possible problems, suggesting sources of help, a time plan, and type of record(s) to keep.

The number of conferences held with an individual will vary according to need.

Group conferences may be held, and students may report on progress and success of their experiences. The teacher should note progress and schedule further individual conferences if a need arises.

It is helpful to keep a record of conferences held and home visits made. The following record form is suggested:

RECORD OF CONFERENCES AND HOME VISITS
(use 4 x 6 file cards)

Name

Address

Phone

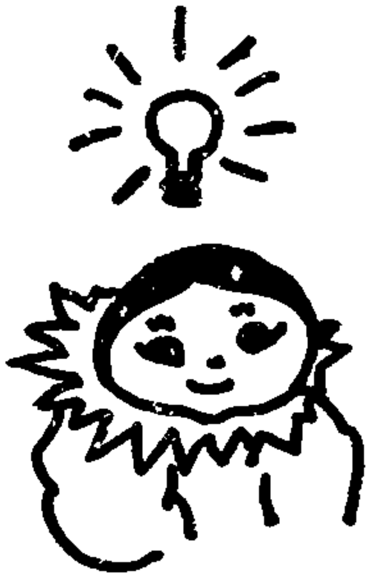
Conferences	Home Visits

CUMULATIVE RECORD OF HOME EXPERIENCES
(use 4 x 6 file cards)

Year	Home Experience	Evaluation
Freshman		
Sophomore		
Junior		
Senior		

IDEAS FOR HOME EXPERIENCES

Care and Guidance of Children



1. Learn to bathe, dress, and change a baby.
2. Take complete care of an infant's clothing, blankets, and equipment.
3. Learn to sterilize the baby's feeding bottles and to prepare formula.
4. Plan a story hour for a younger brother or sister or a neighbor's child.
5. Take care of a young child over a period of time; plan different types of entertainment and study development.
6. Serve as a "baby-sitter" for a period of time with a definite plan for the child's best care.
7. Supervise a small child's meals for two weeks helping him develop his eating habits.
8. Teach your three-year-old brother or sister to dress himself.
9. Prepare a baby-sitter's packet of "tricks" which will be helpful when you baby sit.
10. Prepare a variety of toys, books, games, and creative materials suitable for children three and four years old.
11. Observe children you know at different developmental levels for such things as bathing, feeding, dressing, and caring for themselves.
12. Make some inexpensive toys suitable and safe for children.
13. Investigate household objects which are safe and with which young children enjoy playing.
14. Plan and give a children's party for three to five year olds. Include appropriate records, toys, stories, books, and food.
15. Review current magazine articles which deal with habit formation of young children.

16. Make a chart using pictures to illustrate the steps in the physical development of a child during the first eighteen months of life.

17. Take complete care of a younger brother, sister, or relative for several days or a weekend.

18. Over a period of time, observe children in groups for various behavior patterns. Evaluate observations.

19. Practice reading or telling stories, singing songs, directing games for children. Evaluate results.

20. Compile a suitable list of games, records, stories for young children.

21. Make a check sheet, "What the Baby-Sitter Should Know."

22. Observe the parallel play of several children; note the frequency and form that social interaction takes.

23. Plan completely and carry out a party for a young chil· and his guests.

24. Make an observation over a period of time of a young baby. Record observations of such things as sleep, clothing, habits, mental and physical development, emotional responses, family adjustment to the new baby.

Consumer Buying

1. Visit a local grocery store over a period of several weeks. Observe arrangement of store, frequency of sales, prices of some standard items in comparison to other stores, services offered, peak hours of business, types of customers frequenting store. Analyze observations.

2. Do some comparative shopping for a small appliance, such as a toaster, hair dryer, hand mixer. Evaluate results and determine which model you would purchase.

3. Visit the baby department in a local store or consult a mail-order catalog and compile a list of clothing and equipment recommended for a new baby. Figure the cost.

4. Investigate several models of sewing machines reading available literature on each; then decide which you would purchase. Validate your reasons for selection.

5. Do a comparative study of a ready-made garment that is similar to a garment you have made. Record findings.

6. Select an item; study newspapers, magazines, and mail-order catalogs to see how much information is given about it. Record results.

7. Make a comparative study of several foods--raw, frozen, pre-cooked, and ready prepared. Record findings.

8. Work out a buying plan for clothing, including articles to buy; order of buying--what to buy first; time of buying--season, sale; qualities you expect in article; amount of money available; types of things you want to buy; what you have that can be used; make-over jobs that can be done; ready-made garments to be purchased; material to be purchased to make garments; how additions will fit into present wardrobe--color, style.

9. Investigate sources of ready-made garments--mail-order, department stores, specialty shops, custom made. Compare findings.

10. Visit local grocery stores and observe the variety of foods available and their relative costs.

11. Evaluate sales policies of various markets and decide on the economies of "sale buying."

12. Investigate various types of household equipment as to cost, availability, ease of care, efficiency, performance, etc.

13. Conduct a research project to determine meaning of different Seals of Approval, Brands, Trade Marks, Labels.

14. Study various consumer buying guides and evaluate information.

15. Do a comparative study on one of the following and decide which model you would purchase. Validate reasons and indicate from what source you would purchase. (Use a minimum of three sources in comparison.)

    Snow traveler
    Boat
    Outboard motor
    Camping trailer
    Airplane

Money Management

1. Make a plan for spending the money you earn.

2. Make a record of a week's personal spending; study and analyze good and poor management.

3. Keep an account of money earned during the summer. Make a plan for buying school clothes for the year.

4. Plan how to use summer earnings to best advantage. Prepare a plan indicating short- and long-term goals.

5. Discuss with your parents the financial planning for a college education or training for the career of your choice. Make plans for attaining this goal.

6. Keep a record of the money you spend for one month. Analyze the expenditures and use the information to plan a personal budget.

7. Keep a daily account of all the money spent by the family for one week; then discuss with the family how part of it may have been spent, saved, or used more wisely.

8. Make a budget plan which will help you to save money for college.

9. Plan on an allotted budget the whole family's "Easter outfit" and assist the members in their purchases.

10. Determine the family clothing budget for the year; then plan how each family member may purchase one new outfit.

11. Study a variety of methods of saving, such as government bonds, savings accounts, etc. Select one for personal use and work out a plan to add money to account at regular intervals. Report progress.

12. Develop a check list for good money management. Rate yourself and plan how to improve your habits.

13. Investigate the cost of one year at the college of your choice. Set up a budget for yourself based on findings.

14. Study ways of buying (cash, credit, revolving plan, etc.) and relate to overall cost of a specific item.

15. Keep track of family food purchases for one month. Analyze and plan how to cut down expenditures. Repeat, using new plan.

16. Set up a budget for your family based on actual income. Include items such as food, clothing, rent, utilities, recreation, education, insurance, savings, etc.

17. Work out a "Christmas Club Plan" for yourself. Test over a period of time and report results.

18. Investigate the various types of money-lending agencies and compare their interest rates.

19. Work out problems such as buying a TV, car, radio, etc., and figure cost of credit, amount of down payment, monthly payment, total finance charges, amount you will be paying and compare difference with cash value.

20. Investigate the kinds of insurances available and select the type of coverage needed by your family and the cost of same. Determine how your family will pay for this.

21. Select items of food, clothing, and household and make a study of sale prices versus regular prices. Use mail-order catalogs, local stores, and discount houses and determine savings, if any.

Grooming and Personal Development

1. Develop a list of needed improvements in individual appearance. Check on progress.

2. Keep a record of time required for grooming. Evaluate record and determine improvements to be made.

3. Determine your own figure type, designs, texture, and color best suited to self.

4. Make an inventory of and evaluate the accessories you have on hand. List those needed and plan how they may be obtained.

5. Evaluate personal wardrobe and wardrobes of family members in order to determine personal and family clothing needs.

6. Make plans for a self-improvement project; carry out project making periodic progress reports.

7. List problems of hands, nails, face, and feet and devise a plan for correcting. Report progress.

8. Decide which qualities you need to work on to be better accepted socially. Plan and carry out project recording results.

9. Keep a time and activity schedule for several days. Analyze and make changes as needed.

10. List personality traits you would like to acquire and develop a plan for improvement.

11. [illegible] a personal dating code. Try out and evaluate.

12. Keep a [illegible]ly schedule for a week and plan for better use of leisure time.

13. Devise a plan for forming a good habit to substitute for a [illegible] one. Carry out plan over a definite period of time and evaluate [illegible]sults.

14. Make a good grooming chart. Choose one item which has to do with good health habits and plan how you can improve this habit.

15. Plan and execute a project for improving personal appearance, such as taking care of hair and skin, learning to stop biting nails, or improving posture by exercise and diet.

16. Keep a daily record of time for one week. Study record and develop a plan for the following week. Evaluate the two weeks and develop schedules for another week on the basis of evaluation.

17. Devise a score sheet to evaluate your eating and health habits. Analyze results and plan for improvement.

18. Select a career in which you are interested. Study all available materials concerning the career and the necessary attributes for success in this career. Determine which attributes you now lack and plan how to develop them.

19. Interview several employers and determine their opinions of the importance of grooming and personality in employees. Summarize opinions.

20. If you are shy and ill-at-ease, make a determined effort to overcome this by attending a variety of social events. Report progress.

21. Make a schedule to take care of the clothes you will wear for the next week. See that clothes are ready and in good repair. At end of week summarize results. Repeat for another week improving on first week's schedule.

22. Make a grooming schedule for one week. At end of week analyze results. Repeat for another week making some necessary changes and evaluate progress.

23. Interview several women in various walks of life and determine their opinions of the kind and importance of grooming and personality development in relation to their station in life. Tabulate results.

24. Develop a self-rating chart to use in making a vocational choice.

Family and Social Relations

1. Plan the food and fun for some family occasions. Record results.

2. Make a work sheet for the family, including jobs for the small child. Study results and make necessary changes to improve efficiency.

3. Plan and carry out a project for improving table manners and/or table service. Report on results.

4. Plan with the family ways that each member may share responsibility for care of the home.

5. Discuss with your family their special hobbies and interests and plan how your home can better provide for these interests.

6. Work out a plan for improving and strengthening relationships with one or more members of the family; then carry out plan and report progress.

7. Devise means of improving relationships between self and family. Plan and carry out an evening of fun for family and friends.

8. Make a work plan to help improve cooperative attitude toward those with whom one shares responsibility for a room.

9. Make a scrapbook collection of games, stunts, and puzzles that might be used for entertainment of family members or friends.

10. Determine some of your family's special traditions. Discuss these traditions with family members to determine their origin, how they contribute to the family unit, and the value of continuing these ·ditions.

11. Devise a score sheet to evaluate your eating and health habits.

12. Help guide younger members of the family in learning courtesy and consideration for others.

13. Devise a fair way of sharing family possessions with other family members.

14. Reserve some time each week for family work and recreation. Plan and carry out independently certain home responsibilities.

15. Assist in planning special family activities for holidays, anniversaries, and birthdays.

16. Relieve your mother of household chores so that she will have some leisure time.

17. Investigate community activities in which family may participate; then devise plan for family participation.

18. Enlist the help of older family members in learning such skills as needlework, carpentry, wood carving, gardening, photography.

19. Evaluate the family's use of leisure time. Set up a plan for making the best use of the time in order to include a variety of activities.

20. Plan an outing for the family, such as a camping, hunting, or fishing trip. Make all arrangements for transportation, food, and equipment. Figure cost and evaluate results.

Family Health and Safety

1. Plan, equip, and label items for a medicine chest at home.

2. Make a survey of your home for possible safety hazards and plan how they might be corrected.

3. Find out what immunizations each member of the family has and check with the local health service or the family physician to see whether each one is protected against disease-carrying bacteria by the proper immunization. If not, make arrangements to have it done.

4. Prepare a chart of first-aid rules for common emergencies and post in a convenient location in your home.

5. Study the problem of waste disposal in your home and provide for its sanitary handling; waste food, waste tin and glass, waste paper, waste water.

6. Care for some member of the family who is ill, including good nursing care.

7. Make some improvised equipment and use in the care of an ill family member.

8. Take a first-aid course and make a simple first-aid kit for your family.

9. Plan ways of entertaining the sick child, adult, or aged.

10. Investigate the types of fever thermometers used in the home. Learn how and when to take temperatures, cleanse and store thermometers, and to record temperatures.

11. Prepare attractive food for a sick person in the home. Record results.

12. Get acquainted with the various types of medical care available in the community.

13. Study city health rules regarding garbage disposal.

14. Devise a chart for mother's care after the birth of a baby.

15. Check for danger spots in the homes of children with whom you sit. Suggest ways to correct or eliminate them.

16. Take an inventory of and appraise the medicine cabinet at home and make necessary changes.

17. Make a plan for your family in case of national or local emergency.

18. Help develop a good health habit chart for younger members of your family to keep. Check results at periodic intervals.

19. Assume responsibility for caring for family members who become ill. Prepare attractive trays to tempt their appetites; plan such surprises as flowers, cards, books.

20. Check your home and neighborhood to see if health and safety standards are satisfactory.

21. Prepare and use a check list on home safety. Check your home.

22. Teach younger brothers and sisters good health habits. Report progress.

Housing and Home Improvement

1. Work out a schedule for daily, weekly, monthly, and seasonal care of your home.
2. Study the storage facilities in your home and make plans to improve.
3. Make some improvised storage containers for specific use in your home.
4. Study traffic patterns in your home and experiment with ways to improve the flow of traffic.
5. Refinish a piece of furniture.
6. Upholster a piece of furniture.
7. Make some improvised furniture with boxes and/or barrels.
8. Take the responsibility of cleaning your home for two weeks. Make a schedule for daily and weekly care.
9. Take complete care of your room.
10. Plan kitchen storage. Plan specific places for all utensils.
11. Assume responsibility in your home by sharing in making beds, dusting, and cleaning.
12. Make simple, attractive accessories for your room, such as a waste basket, pin-up board, or a clothes hamper.
13. Arrange belongings conveniently and attractively, such as drawers, furniture, desk, closet, top of dresser.
14. Create a study center in your home.
15. Use and arrange flowers and materials of beauty in the home.
16. Decorate your home for Christmas or another special occasion.
17. Study the proper kind of pressing equipment and make some needed improvements to provide efficiency and safety.
18. Plan and make efficient arrangement of equipment in one or more work areas at home. Evaluate results.
19. Develop a score card for use in evaluating performance of duties in home care.

20. Make a cleaning kit for home use equipping it with all the necessary items.

21. Plan and improve the closet arrangement and storage for a room. Improvise a closet for a bedroom.

22. Plan a storage space for toys and books for a young child. Teach him to put his toys away.

23. Plan a window treatment for a room; select and make the articles.

24. With your family, plan the general outside repairs needed to improve the appearance of home and yard. Take responsibility for some repairs and evaluate results.

Laundering

1. Do the family wash for a period of time. Compare time spent and methods used.

2. Be responsible for the family wash; try different detergents and compare results.

3. Prepare a stain-removal chart and hang in a convenient place in the laundry area.

4. Assemble a stain-removal kit and place in a convenient place in the laundry area.

5. Assume responsibility for laundering your clothes for a period of time. Keep a record of time spent and methods used.

6. Make a comparative study of two or more laundry products.

7. Plan with mother to do family washing for the week. Check over laundry supplies and equipment and make improvements for mother's convenience and use.

8. Draw a plan of the laundry area at home and make suggestions as to how it could be arranged to save time and energy. Talk this over with the family and plan any changes which would seem desirable.

9. Do the family wash for one week. Check through clothes to find stains and remove according to directions. Do any necessary mending.

10. Do the family ironing. Practice ironing men's shirts according to the new time-saving method until proficient. Record progress.

11. Using a coin-operated dry cleaning machine, do the family dry cleaning; follow directions for use of machine and care for clothes when cleaned. Record results. Repeat several times to improve efficiency. Determine amount saved by doing dry cleaning in this manner as compared to sending to professional cleaners.

12. Collect all hang tags with laundering instructions from ready-made garments family has. Identify each and file in convenient place in laundry area for ready reference.

13. Set up a time and motion study in doing personal laundry. Evaluate.

14. Do a comparative study of washing some articles by hand and/or machine.

15. Set up a schedule for doing the family laundry. Test schedule and make necessary changes.

16. Compare results of doing family wash with cold water and cold-water detergent versus hot water and detergent.

17. Make a study of the laundry and spot-removal products on the market and available in your locality.

Family Foods and Nutrition

1. Plan the family's breakfast for one week seeing that each member has a balanced meal.

2. Plan and prepare the family's Sunday dinner for a given period of time.

3. Care for and plan for the use of all leftovers from meals for one week.

4. Plan menus for your family for one week.

5. Plan and prepare three meals a day for your family on some weekend.

6. Plan, prepare, and pack lunches for one week for yourself and other family members.

7. Take the responsibility for a luncheon for your mother's club entertainment.

8. Supervise the family meals for one week to see that every member has his quota of milk.

9. Plan and prepare a meal for a special occasion, birthday, holiday.

10. Prepare some special dishes to supplement mother's cooking, such as salad, dessert, vegetable, meat.

11. Keep a record of foods eaten for several days and summarize in terms of basic food groups. If improvement is needed, make a plan for it.

12. Check the nutritive value of all foods served at home for a given period of time. Analyze results.

13. Help your mother prepare the weekly grocery list, shopping, and assisting in storing purchases made.

14. Using a special diet problem, plan several days' menus for the family in such a way that the special diet can be provided without much trouble.

15. Become familiar with newer foods by using current magazines, newspapers, television, radio, etc., and compile the information.

16. Plan for a new meat, vegetable, and fruit to be included in the family's meals. Prepare and evaluate results.

17. Plan meals for one week and buy groceries based on the family food budget.

18. Collect recipes and ideas for creative means of preparing and serving foods for special occasions. Try some and record results.

19. Plan ways to make regular meals "special occasions" for the family.

20. Make a plan for improving dietary habits of self and/or a family member. Test and evaluate results.

21. Purchase family meat for at least one week. Take full responsibility for cooking the meat for the main meal each day.

22. Plan, prepare, and serve family meals with home preserved foods.

23. Assist mother in preserving foods at home. Compare cost of these foods preserved at home with foods commercially preserved.

24. Compare home canned and commercially canned food from a nutritional standpoint. Compare the Vitamin C content in foods canned by open-kettle and hot-water bath methods.

25. Plan and prepare desserts for family dinners for two weeks.

26. Make a scrapbook of ideas for special occasion dinners—menus, decorations, recipes, etc.

27. Plan, prepare, and serve a dinner for a special occasion.

28. Plan family menus for two weeks, including one menu for a special occasion.

29. Plan a foreign meal for the family and evaluate results.

30. Plan nutritious after-school snacks for younger members of your family.

31. Investigate the local foods available for preservation and preserve some using different methods of preservation. Compare results.

32. Plan and prepare several dinners using native products available locally for main dishes. Calculate nutritive value.

33. Gather wild berries and preserve by several different methods.

34. Prepare several main dishes that will freeze and store for later use.

35. Plan and prepare several main dishes using wild game, such as moose, reindeer, caribou, mountain goat.

36. If fish is plentiful in your area, experiment with it preparing it in several different ways. Record results.

37. Try a variety of yeast breads. Determine types family prefers and freeze some for later use.

38. Preserve wild game and fish by canning and/or freezing.

Community Experiences

1. Assist with a community drive to collect items of clothing and household articles to be used for families whose homes have been destroyed.
2. Volunteer your services to a charitable organization for a period of time. Report activities.
3. Assist with community playground activities.
4. Visit patients in your local hospital, especially the older people.
5. Volunteer your time to baby sit while mothers go to vote.
6. At Christmas or Thanksgiving, help collect food, clothing, toys and make them usable for some family.
7. Assist in a Sunday School, Church, or PTA nursery.
8. Volunteer to assist at a community health clinic for children.
9. Make a survey of local organizations which deal with children and identify the purpose they serve.
10. Volunteer to help serve at some large public banquets.
11. Assist in entertaining at special occasions, such as church socials, FHA, banquets, etc.
12. Assume responsibility for a Civil Defense job in the community.
13. Volunteer to work as a nursing aid or for other jobs at a hospital or health center.
14. Set up a gift-wrapping service or a messenger service during the holiday season.
15. Organize a recreation hour for children in your neighborhood.
16. Select a child who is a "shut in" and visit him at regular intervals.
17. Visit elderly people in your community offering to do little favors for them.
18. Increase your knowledge about health service agencies within the community.
19. Conduct a survey of your community to determine the job opportunities available to students not entering college. Prepare a report for the school newspaper.

20. Assist with community drives, such as Red Cross, Heart, March of Dimes, United Good Neighbor.

21. Cooperate with community organizations in preserving historical buildings and landmarks as part of our American heritage.

22. Work with community leaders to carry out a "Keep Our City Clean, Safe, and Beautiful" campaign.

23. Organize a neighborhood children's group to help children develop hobbies.

24. If a Head Start program is operating in your community, volunteer to assist. Report experiences.

25. Help organize a community information center to assist visitors in your community during the tourist season.

26. Volunteer to be a tourist guide during tourist season. Record experiences.

27. Study community traditions and help preserve those unique to community.

Clothing Care, Repair, Renovation, and Construction

1. Sort all clothes in your closet; repair those needing it and discard those beyond repair.
2. Press, clean, spot, and repair clothing at regular intervals.
3. Make a garment for a younger brother or sister.
4. Take care of the clothing of a younger brother or sister (launder, iron, repair).
5. Do all the family mending for a period of time.
6. Make a formal dress for yourself or your sister for some special occasion. Compare cost with ready-made garment.
7. Clean and store your summer or winter clothes.
8. Make a parka for yourself or a member of your family.
9. Make a pair of mukluks for yourself or a member of your family.
10. Learn the techniques of skin sewing by making a pair of mittens.
11. Alter a garment for yourself.
12. Make a small sewing kit and equip with the necessary items for making general repairs on clothing.
13. Arrange a sewing center in your home organizing equipment and storage in the most convenient way possible.
14. Remodel several garments for self or family members.
15. Store out-of-season clothing for the family.
16. Plan how to keep clothes in good condition and check on their care and storage. Report progress.
17. Repair clothes you no longer wear and give them to a community agency for distribution.
18. Study the advantages and disadvantages of buying fabric from fabric clubs, mail-order houses, out-of-town department stores.
19. Investigate the price charged by a store, tailor, dressmaker, dry cleaners, and/or laundry for alterations on ready-to-wear garments.

20. Study new man-made fabrics on the market; learn how to care for these fabrics. Select one fabric and make a garment following carefully manufacturer's instructions for fabric. Report results.

21. Study and practice the care of woolen garments, such as sweaters, skirts, coats.

22. Plan your clothing wardrobe for one year considering additions, discards, renovations.

23. Plan and construct a summer wardrobe for yourself.

24. Plan the clothes you will wear to school for a week and see that all garments are clean, pressed, mended, and ready to wear.

25. Study present wardrobe and decide what accessories you could make which will enhance wardrobe.

EVALUATION OF HOME EXPERIENCES

Evaluation of home experiences may be accomplished in a variety of ways, such as rating scales and score cards which have been developed by the students themselves.

Other methods might include written evaluations by parents and students, diary records, anecdotal records, and oral and written reports.

The devices used in the evaluation of home experiences should be developed in terms of the extent to which they furnish real evidence of growth. In some instances, this may mean that it is desirable to use several devices for evaluating each project. For example, soon after the project is under way one method of evaluation may be used. As the project progresses toward completion, another device is used. The final evaluation may be a device developed by the teacher, the pupil, and the parent. In this way, all concerned can see the growth of the pupil over a period of time.

The following are some suggested criteria for evaluating the home experience program:

1. The home experience should be evaluated in terms of pupil growth as it is related to the goals set up in the original plan for the home experience.

2. The teacher, pupil, and parents should all be involved in evaluating the home experience.

3. Techniques used in evaluation may vary with the individual and with the home experience being evaluated.

4. In record keeping, the evaluation is best recorded in the form of comments rather than grades.

5. Evaluation is not the final objective, but rather it should lead to new experiences.

Regardless of the method of evaluation selected, to be effective it must take into consideration the four parts of the home experience: the selection of the experience; the plan; the execution of the plan; and the student's judgment of the results.

CHECK LIST FOR THE HOME EXPERIENCE PROGRAM

Now that we've discussed what a good home experience program is like, let's take a look at the home experience program you have right now. Rate it on the following check list.

	Yes	No
1. Students and their families are aware of the purpose of home experience program.		
2. Home visits are conducted to enable the teacher to better understand the student, the home, and the community.		
3. Home visits are utilized to help interpret the home experience program to parents.		
4. The values of home experiences are emphasized to the students and their parents.		
5. Needs and interest, rather than grades, are used to motivate home experience selection.		
6. Results of outstanding home experiences are displayed.		
7. Home experiences are used as a means of helping students broaden interests and develop skills.		
8. Parents are helped to feel their responsibility in the home experience program.		
9. School and home experiences are used to supplement each other and build toward the goals of the total homemaking program.		
10. Home experiences are planned cooperatively by the student, teacher, and parent.		
11. Each home experience is planned to fill a need in the family, the school, or the community.		
12. Students are guided to select tasks done at home as a basis for selecting home experiences.		
13. Each home experience is adapted to the needs, abilities, and interests of the student.		
14. Students are helped to identify specific goals toward which to work.		
15. Students are guided to plan specific activities for attaining their goals.		

	Yes	No
16. Conferences are scheduled regularly with students.		
17. Specific topics of discussion for conferences are identified to the student in advance.		
18. Students gain satisfactions through accomplishment of goals.		
19. Accomplishments are evaluated in terms of student goals.		
20. Evaluation is continuous throughout the experience.		
21. Experiences are evaluated in terms of student growth.		
22. Evaluation of home experiences is done cooperatively with the student, the family, and the teacher participating.		
23. Each home experience provides the teacher with more insight and understanding about the student and his family.		

If your present home experience program rates a "yes" for 20 or more items, you have a well-planned and well-presented program that is producing the desired results. Give yourself an E for Excellent. If you score "yes" to 16-19 items, give yourself a G. The program is Good but can be improved. A "yes" score of 12-15 gives you an F for Fair. You have been overlooking a step or two that would make home experiences more valuable to your students. If you can answer "yes" to 11 items or less, record an O for Ouch! Your home experience program is getting less-than-desirable results. Some changes are in order.

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SUPPLEMENT

The following pages contain samples of devices used in the home experience program. All devices not otherwise identified are developed from those used by home economics teachers in Alaska.

LETTERS TO BE SENT TO PARENTS

Dear _______________:

Your daughter (son) is enrolled in the Home Economics _____ class this year. The class meets for a single period daily so that she (he) may include more elective subjects in her (his) (sophomore, junior, senior) school year.

The goal of the home economics program is to help students become the kind of home members who can successfully assume the complex responsibilities of homemakers. Our program is no longer merely cooking and sewing. The student is offered a much broader view of homemaking. In addition to Foods and Clothing, we include activities in Child Care, Money Management, Home Nursing, House Planning and Decoration, Clothing Selection and Care, and Home Management.

We feel that close relations with the home of the students is necessary if good homemaking is to be taught in our school. We also feel that the activities introduced in school will have greater meaning if they are put into practice by the girl in her own home.

Therefore, your daughter (son) will be asked to select some activity to be carried on at home which will be related to the particular unit being studied in her (his) homemaking class. We will help her (him) select and plan something in which she (he) is interested and for which she (he) recognizes a need.

We hope that you will go over these plans with her (him) and give her (him) your suggestions. At the completion of this activity, we will appreciate your comments.

I would like very much to be able to call on you sometime or have you call on me in my home or visit school so that I may further explain the program as well as enlist your aid in carrying out these home experiences.

Your help in really "putting the home into homemaking" will be of great value to us. We thank you for your cooperation with the home economics department.

Sincerely,

Home Economics Teacher

Dear ______________:

As part of our home economics program, we include assignments known as home experiences.

A home experience is a task undertaken by home economics students at home which gives them an opportunity to learn something that will be important to them as a family member now and as a homemaker in the future. These projects are not "busy work" and are not simply for the purpose of acquiring skills. They serve a three-fold purpose.

1. They help the student learn to recognize and attempt to solve their individual problems.
2. They provide a means of putting our home economics program to work for the student.
3. They enrich our home economics program by helping us to become aware of the student's needs.

It is important that you and your daughter (son) agree on what experience is needed and together work out the means of accomplishing it effectivly. You are in a position to contribute considerably to the choice and accomplishment of those experiences that will some day help her (him) to be the kind of homemaker we both want her (him) to be.

Your cooperation and overseeing of home experiences is important if this purpose is to be attained. Your written approval is needed with the initial choice of the home experience. Your thoughtful appraisal and comment at its completion is also important if we are both to assess what your daughter (son) learned from her (his) undertaking.

I am looking forward to meeting you at our "Open House."

Very truly yours,

Home Economics Teacher

Adapted from "Home Experiences in Homemaking Education in New Jersey," Department of Education, Vocational Division, Trenton, New Jersey, 1962.

LETTER TO BE SENT TO SUPERINTENDENTS, PRINCIPALS, AND FACULTY

Dear _______________:

The goal of the homemaking program in the school is to help pupils develop into the kind of home members who will be able to assume successfully the complex responsibilities of homemakers.

For many years, homemaking or home economics was thought of as a program of cooking and sewing. With our changing world, this can no longer be so. Homemaking has become a career in itself; and the homemaker must be a well-informed buyer, nurse, manager, child care expert, home decorator, and counselor. We are trying to prepare the students, as best we can, to meet these tasks. In addition to instruction in Foods and Clothing, we are able to offer to the student instruction in Child Care, Health and Home Nursing, House Planning and Decoration, Home Management, and Family Relationships.

In connection with our program at school, it is recommended that each student participate in home experiences. These experiences are carried on by the student at home and require planning and supervision. Sometime during the year I hope to visit with each mother to explain the program and enlist her aid in carrying out these home experiences.

With the cooperation of school officials, faculty, and parents, it is felt that the homemaking department can help develop a more worthy citizen for the school, community, and home.

Sincerely yours,

Home Economics Teacher

Adapted from "Homemaking Education Progress Report, Curriculum Study Program - Vermont," State Board for Vocational Education.

PARENTS' CHECK LIST ON NEEDED HOME EXPERIENCES

My daughter needs experience in the following activities:

___ Preparing breakfast

___ Preparing other meals

___ Setting the table properly

___ Cleaning up after meals

___ Preparing school lunches

___ Preparing family meals

___ Preparing dishes from leftovers

___ Making breads

___ Baking cakes and pies

___ Canning

___ Freezing

___ Planning menus

___ Buying groceries

___ Arranging cupboards and drawers

___ Cleaning or caring for her own room

___ Cleaning other rooms

___ Painting or rearranging room

___ Doing family ironing

___ Doing family washing

___ Mending, repairing, darning

___ Personal grooming

___ Caring for her clothing

___ Sewing for herself

___ Sewing for family

___ Making over clothes

___ Correcting posture

___ Developing good manners

___ Sharing family responsibilities

___ Caring for younger children

___ Cooperation with other family members

___ Choosing and buying general merchandise

___ Budgeting spending money

___ Choosing and buying own things

___ Refinishing furniture

___ Reupholstering furniture

___ Cleaning upholstered furniture

___ Develop hobbies for spare time

Add additional suggestions:

Taken from Vocational Homemaking News Bulletin, Vol. IV, No. 2, April '56, Helena, Montana.

CHECK LIST FOR STUDENTS	Things I Do At Home	Things I Would Like To Do	Things I Would Like To Be Able To Do
1. To care for my clothes.			
2. To get in the habit of caring for my room before school in the morning.			
3. To get up when I am called.			
4. To get in the habit of doing the dishes as soon as the meal is over.			
5. To prepare breakfast for my family.			
6. To prepare the evening meal.			
7. To prepare desserts.			
8. To help with cleaning the house on Saturday.			
9. To do sewing for myself at home.			
10. To get along better with other members of the family.			
11. To serve and wait on the table.			
12. To plan my wardrobe.			
13. To redecorate my room.			
14. To refinish some furniture.			
15. To keep my closet and dresser drawers neat.			
16. To care for my shoes.			
17. To care for little children.			
18. To budget my money.			

Taken from "Home Experiences in Homemaking Education in New Jersey," Department of Education, Vocational Division, Trenton, New Jersey, 1962.

HOME EXPERIENCE PLAN FORM

Name of student ______________________________ Date ____________

Project ____

Date on which project was begun ______________________

Date on which project was completed ____________________

Mother's consent on subject of project ___________________

Before starting the project:

Consider several possibilities. Think each one over and see if it meets the following requirements of a good project.

1. It is an out growth of my school work or related to it.
2. It gives me a chance to use at home something I have learned or started to learn at school.
3. I have a definite goal which I am trying to accomplish.
4. I really want to do it.
5. It is difficult enough so that I will have to work to accomplish it.
6. It will require planning and management.
7. It will have the cooperation and interest of my family.
8. It needs to be done.

My reasons for choosing this project are:

My purposes and aims for this project:

My plans for doing this project are:

What I need to know and where I can find it are:

If it involves buying something, how will I finance it?

Who will help you?

Where might you get additional information.

Do you intend to refer to any books, magazines, etc.?

Report of my project:

Record (step by step):

Results:

The most successful part of my home project was:

My difficulties in accomplishing my goals were:

The changes I made in my project and the changes I would make if I were doing it again are:

The ways in which I gained ability by doing this project:

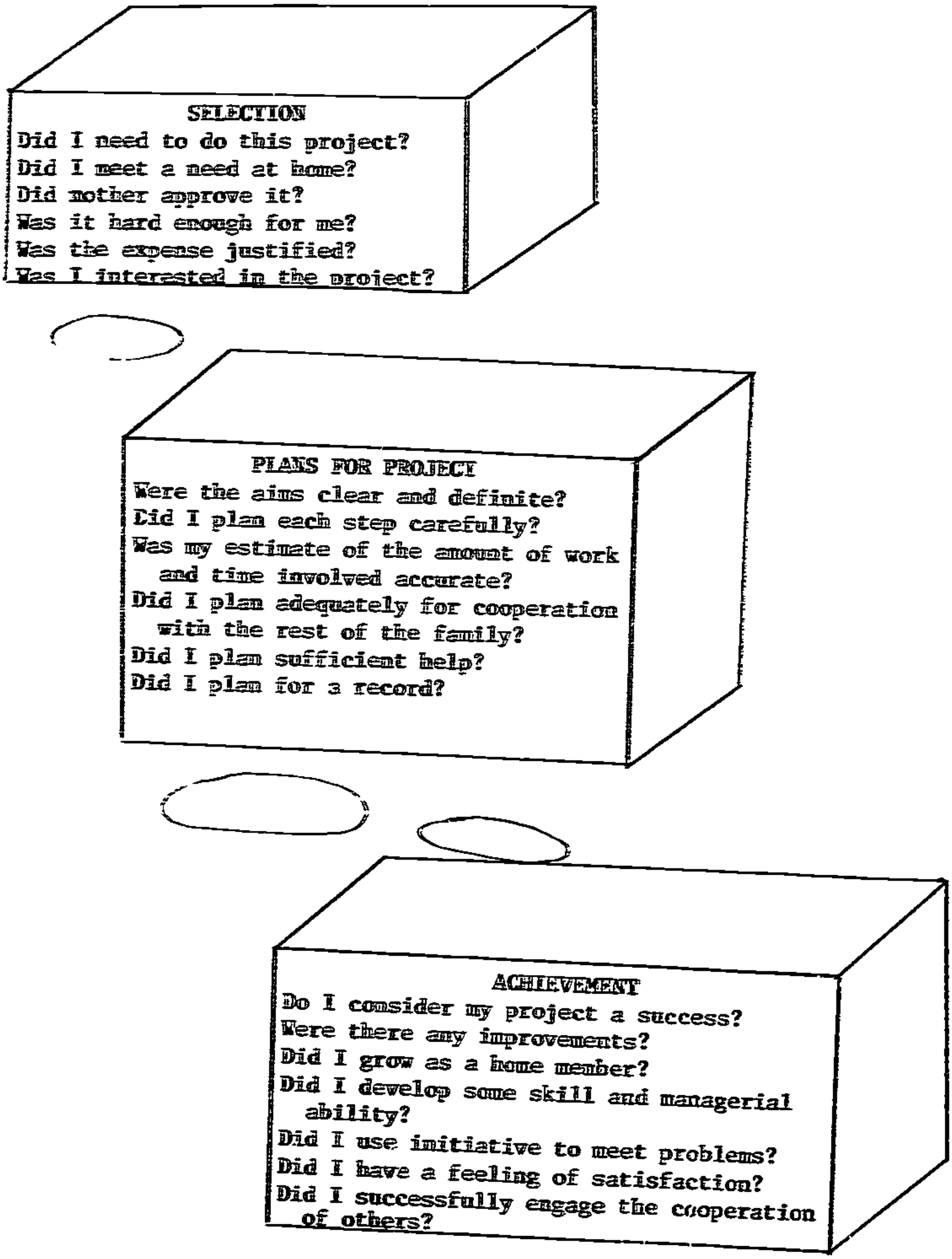
Where did I get the idea for my project:

Does my family feel the project is worthwhile:

What additional information is there about your project that might be of interest:

Comments and signature of my parents or person with whom I worked:

STUMBLING BLOCKS OR STEPPING STONES OF MY PROJECT



SELECTION

Did I need to do this project?
Did I meet a need at home?
Did mother approve it?
Was it hard enough for me?
Was the expense justified?
Was I interested in the project?

PLANS FOR PROJECT

Were the aims clear and definite?
Did I plan each step carefully?
Was my estimate of the amount of work and time involved accurate?
Did I plan adequately for cooperation with the rest of the family?
Did I plan sufficient help?
Did I plan for a record?

ACHIEVEMENT

Do I consider my project a success?
Were there any improvements?
Did I grow as a home member?
Did I develop some skill and managerial ability?
Did I use initiative to meet problems?
Did I have a feeling of satisfaction?
Did I successfully engage the cooperation of others?

A PARENT HAS THE LAST WORD

Name____________________________

	Much	Some	Little
1. Was she interested in the project? Comments:			
2. Did she use her time well? Comments:			
3. Was she able to follow her plans? Comments:			
4. Was she able to meet difficulties? Comments:			
5. Did she obtain good results? Comments:			
6. Did she benefit from the project? Comments:			
7. Did the family benefit from the project? Comments:			

In what ways did YOU think the project was worthwhile?

____
Parent's Signature

Name________________
Class________________
Date________________

HOME EXPERIENCES

What are They?

Home experiences are designed to give you an opportunity to do things on your own in order to help you grow and develop and acquire skills which will aid you as an individual person, as a family member, or as a member of your school and community. Your projects are to be carried on outside of school but with the aid of your teacher, parents or some other family member, or friend if necessary.

Your home experience should help you reach some goal which you have set for yourself. Two projects are required each year, and at least one of the projects should be for someone in the family other than yourself. Use the following pages as a guide. When you have completed your project, you may bring it to school for checking, take pictures of your project as you work along on it, or you may ask your teacher to visit your home to see it.

The Important Thing is to Follow the Four Main Steps:

1. Decide upon a goal which has meaning for you and your family. (Mom and Dad may be a real help here.)
2. Set your goal and plan for reaching it.
3. Follow your plan recording your successes and failures.
4. Evaluate or judge the success of your project.

How are They Graded?

Each home project requires a minimum of twenty hours of work. Record the hours immediately after you work on your project so you will not forget how many hours you put in and what you did. (See page c.)

1. A good job which is well reported rates a ____ grade and will ______ your ________ grade.
2. An average or "so-so" kind of report and project gets a ____ and ____________ your ________ grade.
3. A poor sloppy project showing lack of interest and effort will receive a ____ grade and will _______ your ________ grade.
4. Failure to do a home project means _______ for the _________.

PLANNING YOUR PROJECT

MY GOALS:	**MY REASON FOR CHOOSING EACH GOAL:**

MY PLAN FOR WORKING TOWARD GOALS

WHAT I NEED TO LEARN:	**HOW I WILL LEARN:**

HOW I WILL REPORT PROGRESS TOWARD GOALS

(b)

Checking Your Plan

Keep a careful record here of your progress toward your goals or goal. Be sure to record date and time each time you work on the project:

Goal: ____

Date	Time	What I Did

Give yourself credit for your success. Think how you may be able to improve upon the things that did not turn out so well.

What I Learned	Ways I Was Successful	Need To Improve

Summary of information gained from my references:

Parents' Evaluation

We would like to get your parents' honest opinion on this project. Did they think it was of benefit to you and your family or was it just a waste of time?

COMMENTS ABOUT QUALITY OF STUDENT'S WORK:____________________________

____

____

____

COMMENTS ABOUT VALUE TO THE FAMILY OF HOME EXPERIENCE PROGRAM:__________

____

____

____

COMMENTS OR SUGGESTIONS FOR IMPROVEMENT OF HOME EXPERIENCE PROGRAM:_____

____

____

____

Signed____________________________

Date______________________________

Teacher Evaluation

Date project is due:______________________

Early (Excellent)________
On time (Good)________
Late (Poor)________

REPORT INCLUDES OR SHOWS:

	Yes	?	No
1. Clearly stated goal			
2. Outside help			
3. Outside reference			
4. Dates started and finished			
5. Time spent on project			
6. Project involved enough effort . . .			
7. Adequate records were kept			
8. Goals were accomplished			
9. Project was neat			
10. Report was neat			
11. There is need for further growth . .			

YOUR GRADE:

☐ +
☐ ✓
☐ −
☐ 0

MY HOME EXPERIENCE PLAN AND REPORT

Page a is to be filled out before the experience is started.

NAME______________________________ GRADE (9)___ (10)___ (11)___ (12)___

HOME ECONOMICS AREA CHOSEN____

SPECIFIC AREA CHOSEN____

NAME OF EXPERIENCE____

PREVIOUS EXPERIENCE RELATED TO THIS PROJECT______________________________

____

____

I CHOSE THIS EXPERIENCE BECAUSE____

1.____

2.____

3.____

GOALS I WILL TRY TO MEET IN THIS EXPERIENCE______________________________

____

____

____

____

REFERENCES I WILL USE____

____

SIGNATURE OF PARENT OR GUARDIAN (BEFORE WORK IS STARTED) IF PROJECT IS APPROVED____

SIGNATURE OF HOMEMAKING TEACHER____

This must be signed before the project is started.

(a)

Record of My Home Project

Keep a careful record here of your progress toward your goals. Be sure to record the following information each time you work on the project.

Date	Time	What I Did	My Difficulties	Achievement Level			Cost
				Fair	Good	Excellent	
Date							

(b)

Evaluation of Home Experience

The new skills I have gained in this experience are____________________

____

____

Did I improve my skills in workmanship?____________ How?____________

____

____

Problems that occurred during my project and I solved__________________

____

____

Was my experience a real help to me and others? No___ Yes___ Partly___

I gained speed in work? No___ Yes___ Partly___

Did I make gains in learning? No___ Yes___ Partly___

Did I manage my time well? No___ Yes___ Partly___

Was my goal achieved? No___ Yes___ Partly___

Was my home experience useful? No___ Yes___ Partly___

Do I need any further work in this area of homemaking? No___ Yes___ Partly___

Parent's signature and comments__________________________________

____

____

Teacher's signature and comments_________________________________

____

____

(c)

VT003 565

VT 003 565 ED 015 271
Industrial Radiography Course, Instructor's Guide, Volume I.

Texas Agricultural and Mechanical Univ, College Station
Pub Date - 67
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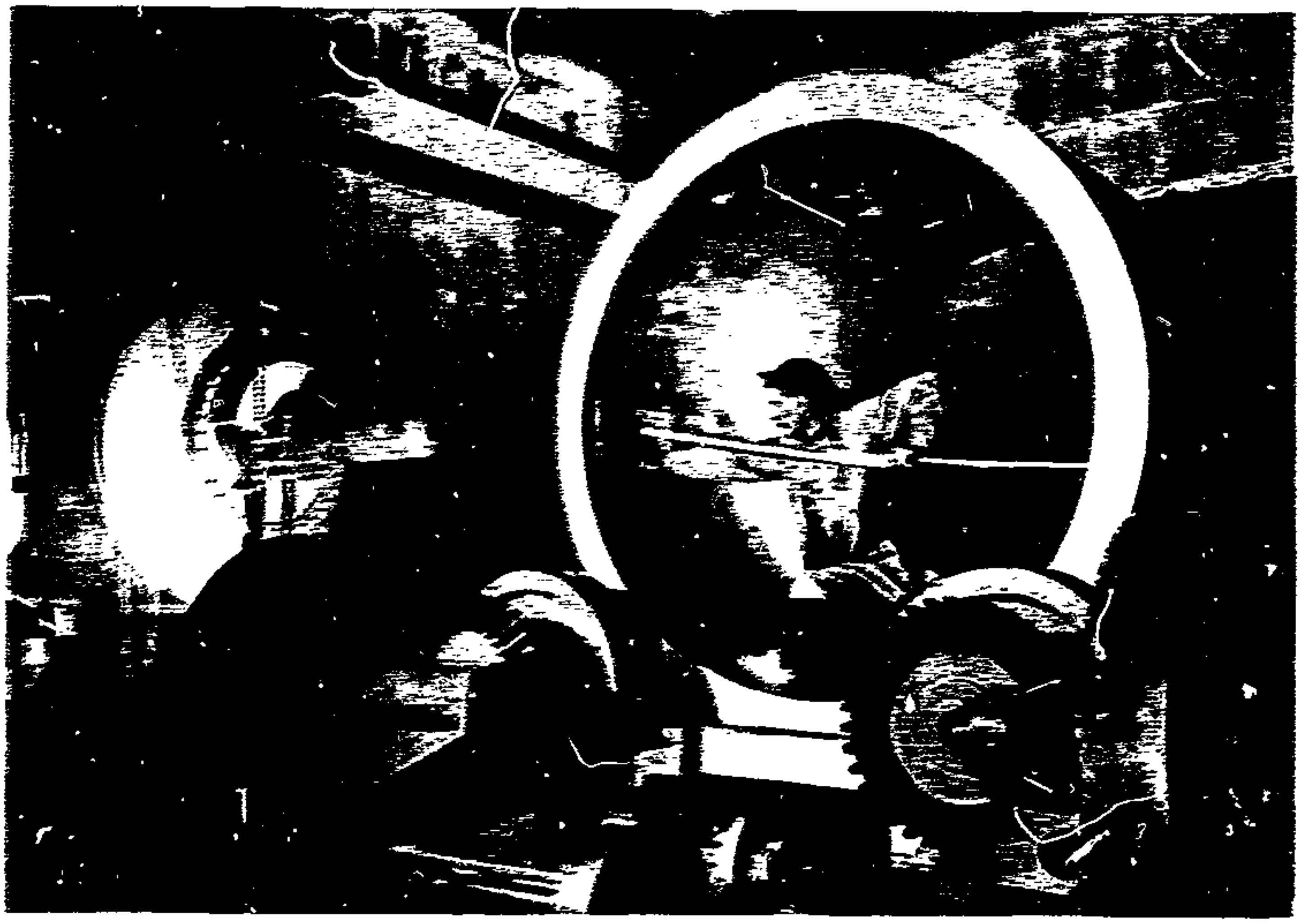
*CURRICULUM GUIDES, *TEACHING GUIDES, *TRADE AND INDUSTRIAL EDUCATION, *RADIOGRAPHERS, *RADIATION, TECHNICAL EDUCATION,

The purpose of the guide is to give maximum assistance to instructors in planning the training of licensed industrial radiographers. It was developed by the Engineering Extension Service, Texas Agricultural and Mechanical University, College Station, Texas. The 21 units include (1) industrial applications, (2) nondestructive testing methods, (3) professional ethics, (4) radiation detection instruments, (5) related mathematics, (6) effects of radiation, (7) iron and steel, (8) applications of welding, (9) contamination tests, (10) film exposure factors, (11) standards and licenses, (12) required records and reports, (13) equipment, (14) film, (15) measurement of radiographic sensitivity, and (16) transportation of radioactive materials. The 114 lesson plans each give subject, purpose, teaching aids, references, preparation of the learner, instructional topics, application, test, and summary. Students should be 18 years old and high school graduates who, whenever possible, possess proficiency in mathematics, physics, and chemistry. They must not be accident prone, emotionally unstable, or have a tendency to panic. Total lesson time required is 242 hours. A companion volume (VT 003 503) contains 52 information sheets related to the lesson plans, a glossary, and a bibliography of books and films. (EM)

INSTRUCTORS' GUIDE Volume 1

INDUSTRIAL RADIOGRAPHY COURSE



U. S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
Office of Education

INSTRUCTORS' GUIDE Volume 1

INDUSTRIAL RADIOGRAPHY COURSE

U. S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
Office of Education

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1967

INTRODUCTION

Anyone planning to teach the course outlined in this guide should briefly review his objectives recognizing the fact that the field of radiography has not been reduced to an exact science capable of providing repeatable, predictable and non-variable responses to tests and scientific exploration.

He must recognize as well the greater importance of interpreting the findings of a test as compared to the more accurate pictorial representation of the conditions being examined.

The basic objectives of the course previously referred to are simply these:

To train adept individuals in the appropriate techniques of inspecting parts, materials and processes using for this purpose radioactive material or radiation producing equipment including all technical and practical applications related thereto, that is, film exposure, film processing, interpretation and evaluation.

To develop individual competency in the art or science of radiography to a degree that the individual can meet all of the requirements for a license that may be issued by an appropriate state licensing authority or the U. S. Atomic Energy Commission.

In order to give maximum assistance to the instructor in meeting the objectives of the course and in the accomplishment of his teaching assignment this instructors guide outlines in detail all information, helps, guides and suggestions that he may need in acquitting his responsibility.

The lesson plans contained herein provide the instructor with essential information relating to each topic together with other helpful aids and ready references for his use.

These lessons are not intended as inflexible guides or stereotyped formats but should be used as suggested and when coupled with the skilled techniques and professional ability of the teacher can be most helpful in allowing for each individuals own personal treatment of the subject matter being careful, however, that a thorough course coverage is effected.

Topic arrangement has been planned and should be adhered to whenever possible providing for the orderly development of procedural knowledge and technical aptitude.

The instructor must take sufficient time to review each lesson plan prior to its use giving himself the opportunity of procuring the suggested teaching aids, films or whatever else is suggested therein.

Several films are listed as essential conveyors of information, however, the instructor should be aware of the need for scheduling these well in advance of the anticipated date of showing to insure adequate time for delivery.

It might be stated merely as a refresher note that good instructors have no difficulty in placing the proper emphasis on the use of films, visual aids and other teaching devices, never using them in place of sound teaching techniques but rather to emphasize and stress various elements of the program or as a device for effective summarization of course material.

In addition to the aforementioned related technical information lesson plans, manipulative lesson plans, and experiment exercises are also included in this guide. These are used in conjunction with laboratory exercises and planned practice sessions. Their use and application is quite similar to those previously discussed and will be found to be quite helpful in the operation of the training program.

Appropriate tests and examinations are also included for the instructor's use and should be applied in their respective sequences or at such times when it is a reasonable certainty that all subject matter covered by the test has been adequately presented.

The appendix of this instructors guide also contains a glossary of terms, bibliography, film list, selected reference material, specifications, drawings and suggested instructional aids.

ENROLLEE QUALIFICATIONS

The basic or fundamental qualifications of a radiographic trainee are a minimum age of 18 with a capability of rendering mature and sound judgements, making intelligent decisions and correct interpretations. The individual must also possess good health and be physically able to perform routine manually dextross operations.

The prospective student should have a high school education or its equivalent. Whenever possible it is desirable that the trainee possess or develop proficiency in algebra, trigonometry, mechanical drawing, elementary physics and chemistry.

The individual should possess a reasonably neat appearance, have normally good or properly corrected vision making him capable of detecting minute structural plans in poorly lighted areas.

There must be no record of accident proneness, emotional instability or tendency to panic.

He must be ready adaptable to any work situation, be reasonably facile, completely honest and dependable.

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Lesson 1
Time 2 hours

SUBJECT: Radiography as an Industrial Tool

AIM (or purpose): To develop a familiarization with the various uses of penetrating radiation as it may be used by industry

TEACHING AIDS: Radiography facilities
Radiographic film of defects in welds and castings
Film of corrosion damage in piping
Sample defective parts

REFERENCES: Nondestructive Testing Handbook, Volume I, 1963, Society of Nondestructive Testing, Evanston, Ill.
Information Sheet #1 (Included in Appendix of this manual)

I. PREPARATION (of the learner)

A. As an introduction, explain the purpose of this course and briefly describe the procedures and activities in which the class will be involved during the course
Define radiography (write it on chalkboard)
State briefly the function of a radiographer
Make comparison of medical and industrial radiography
Indicate some uses of radiography besides defect detection
Point out that some defects are not detectable by radiography

B. Introduce the aim or purpose of this lesson.

II. PRESENTATION (of the information)

Instructional Topics	Things to Remember to Do or Say
A. Radiography for flaw detection	1. Explain and discuss preventive maintenance programs to detect fatigue cracks, corrosion, and other service defects. 2. Explain & discuss the code requirements for inspection of new fabrication. 3. Explain the use of radiography for inspection of high performance equipment such as aircraft, where failure cannot be tolerated. 4. Explain & discuss flaw detection for the improvement of manufacturing processes. 5. Questions
B. Radiography as a gauging device	1. List the automated devices used by steel mills to control the thickness of sheet steel. Processes whereby sheet steel is gauged through detecting variation in radiation intensity as it passes through the sheet while it moves past the radiation beam. 2. Explain the control of cigarette density by radiation gauging. 3. Explain & discuss the measurement of corrosion damage employing the use of radiographs and instrumented radiation gauges. 4. Sketch a typical fluid level gauging application using a "Penetron" type device. 5. Questions
C. Other uses of radiography	1. Describe the: a. Identification of false art works b. Location of hidden objects c. Inspection of components for proper placement in electronic manufacturing 2. Questions

III. APPLICATION (drill, illustrations, analogies, oral questions or assignments)

A. Take students on a guided tour of the school facilities and point out the various pieces of equipment used in industrial radiography.

B. Show sample of radiographs, defective welds, castings and corrosive metal loss in steel pipe.

C. Promote discussions during tour regarding the use of penetrating radiation.

IV. TEST (final check on students' comprehension of material presented)

NOTE TO INSTRUCTOR: The following essay type test questions will be given for most of the lesson plans in this course. It is suggested that the instructor use the essay questions as a guide for designing objective type test items (true-false, multiple choice, completion, matching, etc.) to be used as a printed "Pass-out" test. The testing method should be varied to maintain a high interest level.

Conduct a question and answer period on the uses of penetrating radiation for industrial purposes.

A. How can penetrating radiation measure thickness of materials?

B. How can penetrating radiation measure the relative density of a material?

C. How can penetrating radiation be used as a remote liquid level indicator and/or level controller?

D. How can penetrating radiation be used to detect the presence of internal erosion or corrosion in a pipe or vessel?

E. How can penetrating radiation detect internal flaws in opaque objects?

V. SUMMARY

A. Radiograph is a shadow image of an opaque object.

B. Radiographs cannot detect all hidden discontinuities in an opaque object.

C. Penetrating radiation has many other industrial uses.

The Next Lesson is: Industrial Applications of Radioisotopes

INSTRUCTOR'S LESSON PLAN
Related Technical Information

Unit 1
Lesson 2
Time 2 hours

SUBJECT: Industrial Applications of Radioisotopes

AIM (or purpose): To develop an understanding of the many industrial uses of radioisotopes

TEACHING AIDS: Film: Industrial Applications of Radioisotopes, (1960), 57 mins., 16 mm, sound, U.S. Atomic Energy Commission

EQUIPMENT: Film projector and screen

I. PREPARATION (of the learner)

Introduce the film - name, length, color, etc. stress lesson aim,

A. The following points should be observed by the student when viewing the film:
   1. The three fundamental divisions of industrial usage
   2. The various types of gauging devices and how they differ; i.e., the through - transmission, the backscatter, the beta and the gamma ray gauges
   3. Methods of flow measurement using radioisotopes
   4. Uses of flow gauges and fluid level indicators
   5. The various types of radiographic exposure devices shown in the film

B. The above points will give a better understanding of the many applications of industrial radioisotopes.

C. After the film is shown a test will be given regarding the previously discussed items.

II. PRESENTATION (of the information)

Instructional Topics	Things to Remember to Do or Say
"Industrial Applications of Radioisotopes"	Show the film

III. APPLICATION (drill, illustrations, analogies, oral questions or assignments)

Discuss the film - with the students and emphasize the following points:

A. The three fundamental classifications of industrial radioisotope applications:

   1. Gauging
   2. Radiography
   3. Tracing

   As each of these areas of work are discussed the subject should be amplified and elaborated upon.

B. The principles and applications of:

   1. Back scatter gauges
   2. Beta gauges
   3. Gamma gauges
   4. Through-transmission gauges
   5. Fluid densitometers
   6. Fluid level gauges

C. The different types of gamma exposure devices seen in the film and the various applications of each.

D. Tracer applications

E. If certain points need additional clarification reshow the film or portions of it.

IV. TEST (final check on students' comprehension of material presented)

Note: Oral Quiz

A. What are the three basic categories or classifications of industrial isotope applications?

B. Explain the difference between a back scatter and a through transmission thickness gauge.

C. What is the field of application of a beta gauge? Of a gamma gauge?

D. Why is it necessary to have different types of gamma ray exposure devices in radiographic applications? Why are different isotopes used?

E. How can a volume of fluid flow be measured using radioisotopes?

V. SUMMARY

A. Industrial applications of radioisotopes are being applied by manufacturers of rubber, steel, plastics, paper, nylon, foods, cement, ships, oil and automobiles.

B. Tracer materials must be handled carefully and controlled because they are not usually recovered.

C. Beta emitters are used for penetrating thin materials having a low relative density.

D. Gamma emitters are used in radiography and in measuring thick, high density materials.

The Next Lesson is: Ultrasonic Nondestructive Testing

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INSTRUCTOR'S LESSON PLAN
Related Technical Information

Unit 2
Lesson 1
Time 1 hour

SUBJECT: Untrasonic Nondestructive Testing

AIM (or purpose): To develop understanding of nondestructive testing methods outside the field of industrial radiography

TEACHING AIDS:
- Ultrasonic test equipment
- Ultrasonic test blocks
- Sample defective parts
- Transducers

REFERENCES: Nondestructive Testing Handbook, Volume II, 1963, Society for Nondestructive Testing, Evanston, Ill.

I. PREPARATION (of the learner)

Explain how this method of testing can be useful to the radiographer:

A. As a supplement to radiography

B. Where radiography can not be effected

C. When a less expensive method of testing is needed

D. As a thickness test where only one side of the material is exposed

II. PRESENTATION (of the information)

Instructional Topics	Things to Remember to Do or Say
A. Pulse echo testing 1. Transmission 2. Reception 3. Reflection	1. Draw a chalkboard sketch to illustrate the introduction of sound into a material, its reflection, and reception by the instrument. 2. Explain the pulsing of the sound to allow time for receiving the reflected signal. 3. Questions
B. Ultrasonic transducers	1. Explain the piezoelectric phenomenon. Term means "Pressure Electric" Pressure applied to Quartz crystal causes a potential difference between its opposite sides; ultrasonic transducer contains such a crystal. 2. Describe the construction of transducers including the wear-plate, dampening materials, and electrical connections. 3. Display typical transducers. 4. Questions
C. Wave propagation 1. Longitudinal 2. Shear 3. Surface 4. Lamb	1. Illustrate and define on chalkboard the various wave forms. 2. Illustrate applications for each mode or wave form. 3. Questions
D. Acoustic impedance	1. Explain sonic reflections in terms of accoustical mismatch. 2. Explain why some materials reflect part and transmit part of the incident beam. 3. Explain the decay of the sound intensity as the beam travels farther away from the transmitter. 4. Questions

II. PRESENTATION (continued)

Instructional Topics	Things to Remember to Do or Say
E. Applications for sonic testing 1. Flaw detections 2. Thickness measurement	1. Illustrate flaw detection on chalkboard. 2. Illustrate on chalkboard the measurement of pipe wall thickness. 3. Questions
F. Limitations of ultrasonics 1. Favorably oriented defects 2. Surface condition	1. Compare favorable flaw orientation to radiography. 2. Define the minimum preparation required of parts to be tested. Weld spatter on surface should be removed to ensure proper contact with probe. Small balloon filled with water can be placed between probe and specimen surface to ensure proper contact over irregular surfaces. Oil or grease sometimes used to improve probe-specimen contact. 3. Questions

III. APPLICATION (drill, illustrations, analogies, oral questions or assignment)

Have students illustrate or explain the following:

A. The three methods of pulse echo testing.

B. The detection of a defect by chalkboard sketches using the longitudinal wave, the shear wave, and surface wave techniques.

C. The piezoelectric effect.

D. How discontinuities in a casting can be located by the acoustic impedance method.

E. The sonic method of flow detection; thickness measurement.

F. Advantages and disadvantages of the ultrasonic method of testing.

NOTE: A field trip to a commercial testing lab should be undertaken later to give the students a better understanding of ultrasonic non-destructive testing techniques.

IV. TEST (final check on students' comprehension of material presented)

NOTE: Written Test

A. Define the piezoelectric effect.
B. Draw a sketch of longitudinal wave, shear wave and surface wave propagation modes.
C. What is meant by pulse echo testing?
D. What is acoustical impedance?
E. What are the two major uses of ultrasonic testing?

Check papers and discuss

V. SUMMARY

A. Ultrasonic testing advantage over radiography is that operator can work from only one side of specimen being examined.
B. Disadvantage is intimate contact with specimen requires smooth working surfaces or angle inspections.
C. Area covered in a given time is usually greater than that covered by radiographic methods.
D. Lack of a permanent record, as in radiography, is a disadvantage
E. Wave propagation method of testing is a visual method of inspection employing the use of an oscilloscope.
F. Acoustic impedance method of testing employs the use of sound waves.

The Next Lesson is: Magnetic Particle Testing

INSTRUCTOR'S LESSON PLAN
Related Technical Information

Unit 2
Lesson 2
Time 2 hours

SUBJECT: Magnetic Particle Testing

AIM (or purpose): To develop an understanding of a testing technique other than radiography

TEACHING AIDS: Chalkboard, chalk, and eraser
Horseshoe magnet and cracked specimen

MATERIALS: Oil for wet powder method
Magnetic powders

REFERENCES: Information Sheet #2
Nondestructive Testing Handbook, Volume II, Society for Nondestructive Testing, 1963, Evanston, Illinois
Nondestructive Testing-Magnetic Particle Testing PI-4-3, 1964, General Dynamics-Convair, San Diego, California

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I. PREPARATION (of the learner)
   A. Explain the advantages of the magnetic particle method
      1. Very sensitive to surface defects
      2. Useful for detection of fine fatigue cracks
      3. Requires very little training for most tasks

   B. Show how the method can be used to aid the radiographer
      1. Help to identify film defect indications
      2. Can be used where radiography may not be effective
      3. May be less expensive test for the same quality of inspection

II. PRESENTATION (of the information)

Instructional Topics	Things to Remember to Do or Say
A. Magnetic fields 1. Longitudinal fields 2. Circular fields 3. Induced fields	1. Pass out sheet #2, (PP. 7-8 Inst. Guide). 2. Draw chalkboard sketch of the various type fields and how they are produced. 3. Explain how the direction of the energizing current determines the type of magnetic field. 4. Explain how the anticipated defect orientation determine the type of field to be used. 5. The type of current determines the depth of the defect which can be detected. 6. Question the group to emphasize the major points on this topic.
B. Flux leakage 1. At a discontinuity 2. Related to field direction 3. From subsurface defects 4. Methods of detecting	1. Explain the polarity of the flux leakage at a discontinuity. 2. Illustrate why the defect must be of proper shape and orientation to cause leakage. 3. Illustrate by sketching, on chalkboard, the broadening of the flux leakage from subsurface defects. 4. Explain the attraction of magnetic powder to a flux leakage field: a. Particle polarity b. Magnetic attraction 5. Briefly review key points.
C. Magnetic particles 1. Color contrast dry powder 2. Color contrast wet powder 3. Fluorescent wet powders	1. Explain the difference between the three primary types of powders, and the advantages of each type: a. Dry powder has more mobility b. Dry best for subsurface defects c. Wet powders best for fine defects d. Fluorescent powders easier to see when used with ultraviolet light e. Color contrast powders require less expensive equipment

Instructional Topics	Things to Remember to Do or Say
	2. Ask questions
D. Magnetic particle method	1. Demonstrate the magnetic particle method. 2. Select a piece of ferrous material known to contain a discontinuity. 3. Place specimen on table and sprinkle iron powder on surface known to contain discontinuity. 4. Straddle discontinuity with open end of horseshoe magnet 5. Have students observe how iron powder particles rearrange themselves to the shape of the discontinuity.

III. APPLICATION (drill, illustrations, analogies, oral questions or assignments)

A. Draw typical part shapes on chalkboard or have students to make the drawing on the chalkboard showing typical defects and ask the following questions:
   1. What type of magnetizing field is used to magnetize the part for each type defect?
   2. What type defects cannot be detected by this method?
   3. What type magnetic particle would be best for each defect?

B. Have students sketch the magnetizing of parts to produce:
   1. A longitudinal field
   2. A circular field
   3. An induced field

C. Let students make some applications of magnetic particle flaw detection and observe the pattern of rearrangement of the iron powder particles.

IV. TEST (final check on students' comprehension of material presented)

NOTE: Written Test

A. What is a magnetic particle?

B. What causes flux leakage?

C. Why does the direction of the field influence the test results?

D. Draw a sketch of a longitudinal field, a circular field and an induced field indicating the method used to achieve each field.

With the class participating check and discuss the test.

V. SUMMARY

A. Magnetic particle method is a relatively simple, easy to learn, operation.

B. This method locates small cracks that cannot be picked up by radiography.

C. Specimen must be capable of being magnetized.

D. Magnetic particle inspection confined to surface or near-surface discontinuties.

E. This is a relatively inexpensive method of inspection.

The Next Lesson is: Liquid Penetrant Testing

INSTRUCTOR'S LESSON PLAN
Related Technical Information

Unit 2
Lesson 3
Time 1 hour

SUBJECT: Liquid Penetrant Testing

AIM (or purpose): To acquaint the student with testing methods other than radiography

TEACHING AIDS: Chalkboard, chalk, and eraser
Sample defective parts and test blocks

MATERIALS: Liquid penetrant spray can kit

REFERENCES: Information Sheet #2
Nondestructive Testing Handbook, Volume I, Society for Nondestructive Testing, 1963, Evanston, Illinois
Nondestructive Testing - Liquid Penetrant Inspection - PI-4-2, 1964, General Dynamics-Convair, San Diego, California

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I. PREPARATION (of the learner)

Write aim of lesson on chalkboard

A. Explain the advantages of the liquid penetrant method briefly:
   1. Describe liquid penetrant
   2. For inspection of nonmagnetic materials
   3. Detection of surface defects
   4. Relatively inexpensive equipment and materials create economic advantage

B. Tell how the method can be used to aid the radiographer:
   1. Helps to identify film defect indications
   2. Can be used where radiography may not be effective
   3. May be a less expensive test for the same quality of inspection

II. PRESENTATION (of the information)

Instructional Topics	Things to Remember to Do or Say
A. Types of penetrants 1. Oil phase 2. Water soluble 3. Color contrast 4. Fluorescent	1. For each type of penetrant describe and explain why used: a. Removal control b. Number of operations involved c. Equipment required d. Ease of viewing 2. Questions
B. Preparation of the part 1. Remove paint, dirt, etc. 2. Degrease	1. Explain and give reasons why: a. Penetrant cannot enter defects b. Penetrant will not displace oil 2. Improper cleaning can cause erroneous answers -- give reasons. 3. Questions
C. Application of penetrant 1. Brushing, spraying, and dipping 2. Time of soak	1. Explain the various methods and application: a. Drag off b. Field inspection vs. laboratory c. Production line testing 2. Manufacturers recommendations should be followed on time of soak since soak time determines entrapment of penetrant. 3. Questions
D. Removal of penetrant 1. Plain water wash 2. Emulsified water wash 3. Solvent removal	1. Water wash for soluble types. 2. Oil phase penetrants require emulsification prior to wash -- explain. 3. Small volume of parts may be solvent cleaned --explain why. 4. Over washing should be avoided. 5. Questions
E. Development 1. Wet developers 2. Dry developers	1. Wet developers best for water phase penetrants on production line testing. 2. Wet developers best suited to use with oil phase penetrants

3. Parts must be dry to use dry developers.
4. Good ventilation required for dry developers.
5. Explain use of developers for withdrawing entrapped penetrant.
6. Questions

F. Inspection
   1. Inspection area
   2. Lighting

1. Refer to information sheet #2 -- explaining why.
2. Inspection should be performed immediately after development.
3. Well lighted area is needed for color contrast penetrant inspections.
4. A darkened area is needed for fluorescent penetrant inspections.
5. Ultra-violet light is needed for viewing fluorescent penetrants.
6. Questions

III. APPLICATION (drill, illustrations, analogies, oral questions or assignments)

A. Promote the discussion of the limitations of the penetrant method:
   1. Will the method detect subsurface defects?
   2. What effect does oil have on the entrapment of a penetrant?
   3. Would the technique be useful for detecting leaks in vessels, etc?

B. Request a listing of the steps of the process in their proper order.

C. Discuss the advantages of the fluorescent method over the color contrast method.

IV. TEST (final check on students' comprehension of material presented)

NOTE: Written Test

A. List the steps of the penetrant process in the proper order.

B. List three examples of poor practice which will cause false results.

C. Why do the listed practices cause false results?

D. Why is the penetrant method more effective on shallow surface defects than radiography?

Check papers and discuss.

V. SUMMARY

A. Liquid penetrants can be used to inspect non-magnetic materials.

B. Specimen must first be thoroughly cleaned and de-greased.

C. Liquid penetrant method is limited to detecting surface defects.

The Next Lesson is: Inspection of a Defective Part using the Liquid Penetrant Method

INSTRUCTOR'S LESSON PLAN
Manipulative Skills

Unit	2
Lesson	4
Time	2 hours

JOB (or operation): Inspect a defective part using the liquid penetrant method

AIM (or purpose): To develop skill in the technique of liquid penetrant inspection

MATERIALS: Paper Towels
Liquid Penetrant Kit

TEACHING AIDS: Chalkboard, chalk and eraser
Sample defective parts and test blocks
Manufacturers instruction sheets

REFERENCES: Nondestructive Testing Handbook, Volume I, Society for Nondestructive Testing, 1963, Evanston, Illinois
Nondestructive Testing - Liquid Penetrant Inspection PI-4-2, 1964, General Dynamics-Convair, San Diego, California

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I. PREPARATION (of the learner)
   A. Write AIM of lesson on chalkboard.

   B. Explain the importance of being able to perform a liquid penetrant inspection:
      1. A good technician has a basic knowledge of testing methods
      2. The test can be useful in the interpretation of radiographs
      3. The method may be more useful than radiography for certain applications

II. PRESENTATION (of the skills)

Operations or Steps	Key Points (things to remember to do or say)
	Proceed slowly & carefully explaining each step -- questioning as demonstration develops Give reasons whenever necessary.
A. Demonstrate	
1. Preparation of part	1. Remove all paint, dirt, etc, by brushing, chemicals or other suitable methods. 2. Degrease part with spray can cleaner.
2. Place part on inspection table	1. Turn area to be inspected upward 2. Place on paper or cloth to protect table.
3. Apply penetrant	1. Direct spray nozzle toward inspection area. 2. Hold about 12" from part to get best coverage. 3 Press valve to release penetrant 4. Spray to cover entire inspection area. 5. Do not waste penetrant by spraying until dripping 6 Allow to soak for time recommended by supplier.
4. Remove penetrant	1. Wipe off surface penetrant with cloth. 2. Wet cloth or towel with cleaner/remover from spray can. 3. Wipe off remaining excess penetrant with dampened cloth. 4. Continue to clean until only a trace of penetrant is visible. 5. Caution: overcleaning by direct spraying may remove all penetrant from very shallow or wide defects
5. Apply developer	1. Direct developer nozzle toward the inspection area.

	2. Hold nozzle 12" to 18" from the part to achieve best action of developer. 3. Spray lightly by pressing spray can valve. 4. Inspection area should just be damp while applying developer. 5. Caution: over wetting of the inspection surface will cause running of the indications and hinder interpretation of results.
6. Inspection	1 Allow adequate time for developer to stand. Check for recommended time. 2. Observe any indication of stains which indicate a defect. NOTE: BEFORE GOING FURTHER MAKE SURE OF UNDERSTANDING BY ASKING QUESTIONS

III. APPLICATION (practice by learner under close supervision)

A. Supervise groups of students in the performance of a liquid penetrant inspection.

B. Discuss the factors which can cause poor results after student has made liquid penetrant inspection.

C. Instruct students to tell what they did and why.

IV. TEST (performance of skill to acceptable standards)

A. Assign students to perform a complete penetrant inspection. Give each student close supervision during test.

B. Discuss and comment on results observed.

V. SUMMARY

A. Preparation of test specimen must be thorough to insure best results.
B. Use of the penetrant materials in the proper sequence is mandatory.
C. Each step must be timed according to manufacturers instructions.

The Next Lesson is: Visiting a Commercial Nondestructive Testing Laboratory.

INSTRUCTOR'S LESSON PLAN
Manipulative Skills

NOTE TO INSTRUCTOR: All field trips must be carefully planned well in advance to make sure students will be able to observe the items given in Step I of this lesson.

Unit 2
Lesson 5
Time 6 hours
(includes travel)

JOB (or operation): Visiting Commercial Nondestructive Testing Laboratory

AIM (or purpose): Develop a better understanding of the various inspection techniques employed by industry for control of material quality

MATERIALS: Film badges
Dosimeters
Safety glasses
Hard hats

TEACHING AIDS: Chalkboard
Chalk
Eraser

I. PREPARATION (of the learner)
   A. Write aim on chalkboard.

   B. Ask students to observe the following:
      1. The different types of inspection equipment and processes
      2. The internal quality control measures to insure reliable inspection results
      3. The methods used to identify the customers materials
      4. Preparation of materials prior to inspection
      5. Preparation of technique cards and work logs
      6. Marking of parts for disposition
      7. Preparation of reports and certifications
      8. Radiation safety devices
      9. A test will be given to check the results of this field trip

II. PRESENTATION (of the skills)

Operations or Steps	Key Points (things to remember to do or say)
A. Stress safety procedures which are to be followed in the laboratory	1. Select a commercial nondestructive testing laboratory which offers a a complete complement of testing processes.
B. Issue equipment, goggles, hard hats, etc., before entering laboratory or as instructed by company officials	2 Cover all aspects of safety. 3. Point out the need for gentlemanly behaviour and the fact that we are visitors.

III. APPLICATION (practice by learner under close supervision)

A. After returning from the trip, ask the students to discuss and explain:

1. The different processes and techniques observed in use by the laboratory
2. Established internal controls to insure a quality inspection
3. Methods of maintaining records of techniques employed in various tests
4. Safety devices used in maintaining radiation survelliance

B. Discuss any unusual situations observed during the tour of the laboratory.

IV. TEST (performance of skill to acceptable standards)

NOTE: WRITTEN TEST

A. Name the different types of nondestructive testing methods you observed in this laboratory.

B. Describe their safety equipment and procedures.

C. Describe some of the records that must be kept and also furnished the client.

D. What is meant by "Internal Controls" to insure a quality inspection?

Discuss results of test

V. SUMMARY

A. Safety precautions.

B. Various types of tests and inspections.

C. Need for records.

D. Conduct on tours and plant visitations.

The Next Lesson is: Professional Ethics for the Industrial Radiographer

INSTRUCTOR'S LESSON PLAN
Related Technical Information

Unit 3
Lesson 1
Time 2 hours

SUBJECT: Professional Ethics for the Industrial Radiographer

AIM (or purpose): To develop an appreciation of the responsibilities of a Radiographer and situations which may arise in the span of his career

NOTE TO TEACHER:
Secure sufficient number of copies of AEC or State regulations in advance of this class to hand out at this time

TEACHING AIDS: Chalkboard, chalk, and eraser
Copy of AEC or State regulations

REFERENCES: Welding Inspection Manual D-1, D-46, Page 42, FOREWORD "Description of an Inspector" American Welding Society 33 WEST 39th St., New York, N. Y.

AEC or State regulations (Information Sheet #3)

I. PREPARATION (of the learner)

A. Write aim of lesson on chalkboard.

B. Ask the following questions:
   1. How can a radiographer augment his salary?
   2. What are the normal results of unethical business practices and conduct?
   3. Express how you feel about such practices

II. PRESENTATION (of the information)

Instructional Topics	Things to Remember to Do or Say
A. The inspector	1. Explain that the radiographer may not always be the inspector. 2. Explain also that the inspector is generally not the evaluator. 3. Define the job of the inspector as: The interpretation of the results of an inspection of parts or an assembly and the report of this inspection to the controlling authority. 4. Questions
B. The responsibility of the inspector-radiographer	1. Explain to the prospective inspector-radiographer his role in: a. Ensuring product reliability b. Prevention of accidents and loss of life c. Securing a profit for the employer d. Maintenance of radiographer equipment e. Reporting deficiencies in equipment and personnel under his supervision 2. Questions
C. Short cuts which lead to professional degradation	1. Point to the tendency to produce inferior quality as the working conditions worsen. 2. Explain the hazard and consequences of the following unethical practices: a. Incorrect penetrameters b. Wrong placement of penetrameters c. Incorrect film types d. Incorrect film-focal distance e. Substitution of satisfactory film for film from areas of inferior quality 3. Explain the moral and legal problems caused by irradiation of persons not under a health control program.

  - a. You and your company could be sued
  - b. Your AEC License could be revoked
  - c. Criminal charges could be filed against you and your company
  - d. You have a moral responsibility to protect those who are in your work area
- 4. Questions

D. The industrial spy

1. Point out the tendency of some companies to employ means of gaining information from competitors.
2. Illustrate a number of job assignments where a radiographer has access to confidential information:
   - a. Defense plant work
   - b. Research work on space programs
   - c. Work on parts for which a patent has been applied
3. Warn the student of the hazard if discussing his work with people outside of his job responsibilities.
4. Questions

III. APPLICATION (drill, illustrations, analogies, oral questions or assignments)

A. Ask the students for an opinion of their responsibilities to an employer observing unusual attitudes as this will indicate individuals who may need closer supervision and guidance.

B. Invite students to explain or discuss the legal consequences for accepting gratuities for the falsification of test records.

C. Suggest students explain and discuss the role of the inspector in:
   - a. Making a profit for the company
   - b. Maintenance of equipment
   - c. Ensuring safety of company and customer personnel

D. Assign students to discuss the job of an inspector.

IV. TEST (final check on students' comprehension of material presented)

NOTE: WRITTEN TEST

A. What are the possible consequences of accepting favors or money for falsifying records?

B. What is the job of the inspector?

C. Name three hazards of using unethical radiographic short cuts.

D. What possible monetary loss or consequence could arise from the unnecessary exposure of others to radiation?

E. What is the best way to avoid revealing industrial secrets?

Check and discuss

V. SUMMARY

A. Unethical reporting methods and practice can destroy the value of product inspections.

B. Improper inspection practice can create and propogate hazardous working conditions.

C. Poor inspection practices can be considered a form of sabotage.

D. How federal laws control the possession, use and handling of radioisotopes in industry.

The Next Lesson is: Radiation detection instruments

INSTRUCTOR'S LESSON PLAN
Related Technical Information

Unit 4
Lesson 1
Time 2 hours

SUBJECT: Radiation Detection Instruments

AIM (or purpose): To develop an understanding of the use of instruments for detection and measuring ionizing radiation

TEACHING AIDS: Film strip: Civil Defense Radiological Instruments, 35 mm Office of Civil Defense, Department of Defense, (Complete with lecture narrative from Radiological monitoring for Instructors course; RMI, or Exhibit-A of Appendix)
35mm film slide projector and screen
Dosimeters, dosimeter charge, and survey meters

REFERENCES: Maintenance manuals for instruments
Radiation Safety in Industrial Radiography with Radioisotopes, P.M. Frazier, C.R. Buchanan, B.W. Morgan, Bulletin AECU 2967, U.S. Atomic Energy Commission, Washington, D.C.

I. PREPARATION (of the learner)

A. State the subject of this lesson and briefly explain why radiographers must be familiar with radiation detection instruments.

B. Introduce the film and explain briefly the important items it covers including the following:

1. Different types of instruments for detecting ionizing radiation
2. Purpose of each type of detecting instrument
3. Similarities in the ability of each to detect ionizing radiation
4. The limitations of each type of detecting instrument
5. The basic difference between a dosimeter and a survey meter
6. The comparison of total dose vs dose rate
7. The definitions of the following: Roentgen, rad, and rem and how they apply to radiation safety
8. Abbreviations of certain often used terms

C. Advise group a test will be given.

II. PRESENTATION (of the information)

Instructional Topics	Things to Remember to Do or Say
A. Show the film strip in three parts	NOTE: Present the narrative in three (3) parts as furnished with the film strip. NOTE: Ask for questions or ask questions during the showing of each of the three parts.
Part I:	Part I: Dosimeters and dosimeter charges
Part II:	Part II: Geiger Muller-type survey meters
Part III:	Part III: Ionization chamber-type survey meters

III. APPLICATION (drill, illustrations, analogies, oral questions or assignments)

A. Review the following points of information presented in the film:
   1. Similarity of the various types of radiation detection instruments
   2. Difference between a geiger counter and an ionization chamber
   3. Meaning of dose rate
   4. Meaning of roentgen, rad, and rem
   5. Desirable characteristics of detection instruments
   6. Undesirable characteristics of different types of detecting instruments
   7. Care and maintenance of detecting instruments

B. Call on individuals in the class to give the abbrevations for roentgens, roentgens per hour, milliroentgens per hour.

C. Point out the basic difference between a dosimeter and a survey meter as was illustrated in the film strip.

IV. TEST (final check on students' comprehension of material presented)

A. Give a written test -- (The following questions are suggested)
  1. List four desirable characteristics of survey meters.
  2. What is the phenomenon on which the detection of radiation is based in the construction of gamma ray detection and measuring instruments ?
  3. What are the two most popular types of enclosed gas volume rate-measuring instruments ?
  4. Define dose and dose rate.
  5. Explain the operation of an ionization chamber. Use a sketch if necessary.
  6. Draw a sketch of the ionization chamber and electrometer suspension of the pocket dosimeter. Label the parts.

B. After the class has completed the test, state the correct answers to each question with the students assisting.

The Next Lesson is: The Film Badge

INSTRUCTOR'S LESSON PLAN
Related Technical Information

Unit	4
Lesson	2
Time	1 hour

SUBJECT: The Film Badge

AIM (or purpose): To thoroughly acquaint the student with the function and construction of an industrial film badge

TEACHING AIDS: Film badge holder and film badge
Cut-away of film badge and holder

I. PREPARATION (of the learner)

A. Write aim on chalkboard.

B. Explain the importance of the film badge.
  1. Give an account of an actual incident such as the following: A filme badge processing service company wired a customer that one of its film badges indicated an exposure to 5,000 millirem of gamma ro x radiation. An investigation revealed the employee had lost his film badge temporarily while making radiographic exposures and the film badge was later found a few inches from the exposure device. This indicated the film badge, but not the wearer, was exposed to 5,000 m/rem.
  2. Indicate that it used to control the radiographers radiation exposure and will determine if the radiographer has exceeded his safe operating dosage.
  3. Point out that control and monitoring of dosage is essential to the continued health and safety of the radiographer.

II, PRESENTATION (of the information)

Instructional Topics	Things to Remember to Do or Say
A. Purpose of film badge	1. Display cut away badge and film envelopes so that all may see construction. 2. Explain how the badge is used to measure accumulative dosage.

II. PRESENTATION (continued)

Instructional Topics	Things to Remember to Do or Say
	3. Point out reason why film badge is used in addition to the dosimeter. 4. Indicate that the badges are for permanent record.
B. Types of radiation detected	1. List the two basic types of radiation detected: beta and gamma. 2. Explain how these are recorded on one film by use of filters, filter density and thickness filters out beta particles.
C. Construction of film badges and film badge holders	1. Sketch the construction of the badge and holder, and display actual items. 2. Stress that the purpose of the cadmium and copper strips in the holder-filters out beta particles in filtered area leaving only an indication of gamma radiation. 3. Define the function of the film badge holder case; In addition to filtering it provents damage to films, also provides convenient carrying case.
D. Wearing of film badges	1. Give reasons why badges should be worn: a. Badges should be worn on the body b. Badges should be worn at all times while performing radiographic operations c. By only one person
E. Care of film badges	1. Point out why: a. Badges must not be placed near heat. b. Film badges must be stored away from radiation.

c. Badges must be in holder when worn.
d. Badges must be kept dry.

F. Control badge

1. Explain purpose of control badge:
   a. During shipment to and from customer and while radiographer is not using badge, all badges are stored with control badge.
   b. If control badge indicates 50 m/rem when checked, subtract same amount from individual users dose.

III. APPLICATION (drill, illustrations, analogies, oral questions or assignments)

A. Have all students sketch a cross section of the typical film badge holder with filters.

B. Ask students to explain the purpose of the filters.

C. Ask students to list three actions which could damage the film badge.

D. Have students explain all the rules for wearing film badges.

IV. TEST (final check on students' comprehension of material presented)

NOTE: Written Test

A. What are three mandatory rules regarding the wearing of film badges?

B. Why does a film badge holder have metal strips attached inside?

C. Why is the film badge worn in addition to the dosimeter?

D. What are the three types of radiation recorded by the film badge?

E. Does the film badge record total dose or dose rate? Explain in detail?

Check and discuss when all tests are completed.

V. SUMMARY

A. Film badges advantage is that a permanent record of total accumulated exposure is obtained.

B. Badge can indirectly differentiate between beta and gamma radiation.

C. Film badge and dosimeter readings compliment each other.

The Next Lesson is: Use of Pocket Dosimeters

INSTRUCTOR'S LESSON PLAN
Manipulative Skills

Unit 4
Lesson 3
Time 2 hours

JOB (or operation): Use of Pocket Dosimeters

AIM (or purpose): To develop skill in the use, and maintenance of pocket dosimeters and chargers

TEACHING AIDS: Pocket dosimeters
Dosimeter charger
Small source of ionizing gamma radiation such as 5 mc Co60 sources used in civil defense classes

REFERENCES: Manufacturers operation and maintenance manuals for dosimeter and charger

I. PREPARATION (of the learner)

A. Show the class a pocket dosimeter and explain its importance to a radiographer.

B. Point out advantages of the dosimeter over the film badge.

C. Emphasize the importance of proper maintenance of pocket dosimeter and charger.

II. PRESENTATION (of the skills)

Operations or Steps	Key Points (things to remember to do or say)
A. Reading the dosimeter	Position students so they can see and hear. 1. (DEMONSTRATE) and point out the various parts of a dosimeter and charger. 2. Point out that the eyepiece should be held about 1/2" from the eye.

	3. Call attention to the strong light or use light on charger.
	4. <u>CAUTION</u> not to press the dosimeter to charger position when using charger as this would cause the reading to be altered.
	5. Emphasize that the zero mark should be to the left of the field of vision.
	6. Note that the dosimeter need not be set to exactly zero at the beginning of the exposure period.
	7. Explain that the dosage is determined by subtracting the first reading from the last reading in the exposure period.
B. Charging of dosimeters	Demonstrate and explain each step
1. Place charger on table	1. Place at convenient height for ease of reading of dosimeter. Remove dust cover from charging receptacle.
2. Connect dosimeter to charger	2. Remove dust cover from dosimeter. Insert contact into charging receptacle.
3. Adjust the dosimeter	3. Place eye about 1/2" from the eyepiece of the dosimeter.
	4. Depress the dosimeter to the bottom of the receptacle.
	5. Rotate the adjust knob on the charger until the dosimeter reads near zero.
	6. Release pressure on dosimeter until charger disengages.
	7. Read dosimeter using internal light to ascertain if charging is correct.
	8. Emphasize importance of reading scale in horizontal positions.

II. PRESENTATION (continued)

Operations or Steps	Key Points (things to remember to do or say)
C. Dosimeter charger adjustments	Demonstrate and explain. 1. If dosimeter will not zero: a. Replace battery in charger b. Polish battery contacts with crocus cloth 2. If replacement battery is not available, try removing the light bulb inside charger. 3. Explain why 4. If bulb is burned out, replace with the spare bulb located inside the case.

III. APPLICATION (practice by learner under close supervision)

A. Have students demonstrate ability to read and charge dosimeter.

B. Let students reset dosimeters to read exactly 100 mr. Ask students to turn dosimeter 180 degrees so that the reticle or scale is up-side-down, and have them read dosimeter in the inverted position.

Repeat readings obtained at 90 degrees and at 180 degrees from horizontal. Compare readings with horizontal reading.

IV. TEST (performance of skill to acceptable standards)

A. Ask one or more students to charge dosimeters to near zero and let other class members check for correct procedure.

B. Have students place their dosimeters on the rim of a 2 foot radius circle. Place a 5 MC cobalt 60 source in the exact center of the circle and let each student calculate the period of time to produce a dosage of from 100 to 150 mr. at the circle. Remove all dosimeters at the same time.

C. Have students read, record, and recharge his dosimeter.

D. Compare and discuss the results of each students efforts.

The Next Lesson is: How to Use a Survey

INSTRUCTOR'S LESSON PLAN
Manipulative Skills

Unit 4
Lesson 4
Time 2 hours

JOB (or operation): How to use a Survey Meter

AIM (or purpose): To develop adeptness in the operation of beta-gamma survey meters

TOOLS AND EQUIPMENT: Several beta-gamma survey meters
Radioactive gamma source

REFERENCES: Manufacturers operation and maintenance manuals

I. PREPARATION (of the learner)

A. Explain the importance of the proper use of survey meters. Pointing out that it is the most valuable piece of safety equipment in the radiographers possession. It indicates the presence of a radiation field and immediately indicates its intensity.

B. Indicate that in almost every case radiographic accidents could have been avoided if the survey meters had been used properly.

C. Relate story or personal experience along this line such as: A radiographer was making several exposures using a gamma exposure device as illustrated on the chalkboard. This device enabled the radiographer to crank the source capsule into a flexible tube. At the end of each exposure he was supposed to crank the capsule back into the device and then check the surface of the device with his survey meter to make certain the capsule was safely back in the storage device.

After making several routine exposures he stopped checking the device with his survey meter after each exposure.

At the completion of his assignment he noticed that the survey meter indicated the source was not in the storage device. A quick check with his survey meter located the capsule at the far end of the flexible source tube.

For quite some time he had been cranking the source out when he should have been cranking it in. As a result he had been exposing himself to a large amount of ionizing radiation and was not making any radiographs. A quick check with the survey meter before and after each exposure would have prevented this accident.

II. PRESENTATION (of the skills)

Operations or Steps	Key Points (things to remember to do or say)
NOTE: Encourage students to ask questions during Demonstration. Position students so they can see and hear.	
A. Pick up survey meter	1. Grasp meter by handle. 2. Point chamber end away from body, explaining why.
B. Turn instrument switch to on position	1. Turn selector switch to zero position. 2. Allow the instrument to warm up at least two minutes, pointing out why.
C. Zero calibrate	1. Turn zero knob until needle reads zero on meter. 2. Observe needle for drift or erratic action. 3. Repeat zero step after waiting a short period if needle tends to drift.
D. Range selection	1. Check the zero reading on each scale as the switch is moved to each position. <u>NOTE:</u> The zero should not shift when the meter is not in a radiation field. 2. Turn selector switch to the position for the required measurement of radiation.
E. AEC range requirements	Explain that meter must be capable of indicating ionizing radiation intensity from 2 mr/hr to 1 r/hr.

III. APPLICATION (practice by learner under close supervision)

A. Request that each student perform the normal operation of zeroing and checkout of the survey meter.

B. Draw meter readings and range switch position on chalkboard and have students state dose rates indicated.

C. Question group in the areas of what, how and why.

IV. TEST (performance of skill to acceptable standards)

NOTE: Written Test

A. What is the purpose of the adjustable rheostat knob?

B. The survey meter ____________ and measures ______ ________.

C. A survey does not measure ___________ dose.

D. Survey meter ranges can be ________ to indicate __________ per hour as well as ____________ per hour.

E. An AEC approved survey meter for use in radiography must have a range of __________ mr/hr or lower to __________ r/hr or higher.

V. SUMMARY

A. Survey meters or rate meters give a quick indication of the presence of a radiation field.

B. Rate meters also indicate the dose rate of a radiation field.

C. Rate meters cannot indicate the total accumulated dose unless the radiation field is constant.

The Next Lesson is: Practical Procedures for Measurement

INSTRUCTOR'S LESSON PLAN
Related Technical Information

Unit 4
Lesson 5
Time 2 hours

SUBJECT: "Practical Procedures for Measurement"

AIM (or purpose): To develop an understanding of the supporting theory of radiation detection instruments used in industrial radiography

TEACHING AIDS: Film: PRACTICAL PROCEDURES FOR MEASUREMENT, 48 mins., 16 mm, sound, U.S. Atomic Energy Commission

EQUIPMENT: Film projector and screen

I. PREPARATION (of the learner)

A. In order to achieve the maximum benefit from radiation detecting and measuring devices a radiographer must be familiar with the operating characteristics of the equipment. A thorough knowledge of the equipment in which the radiographer has entrusted his life can only be termed as good common sense.

B. LOOK FOR THE FOLLOWING POINTS IN THE FILM:
The avalanche effect in a geiger tube.
Fluorescent effect in a scintillator.
Steady flow of current generated in an ionization chamber.
The operating ranges of the three types of instruments and their individual characteristics.

II. PRESENTATION (of the information)

Instructional Topics	Things to Remember to Do or Say
A. "Practical Procedures for Measurement." First part, Principles of Radiation Detection	1. Show film, rerun if necessary stopping film to clarify points as needed.

III. APPLICATION (drill, illustrations, analogies, oral questions or assignments)

A. Request students to show by chalkboard sketches or with pencil and paper the range of voltage operation of each of the three type detectors.

B. Have them review and discuss the characteristics of the three types of detectors.

C. Discuss the formation of secondary ion pairs and the phenomenon called an "ion avalanche".

IV. TEST (final check on students' comprehension of material presented)

NOTE: Written Test

A. List in increasing order of operating voltage the three types of detection instruments shown in the film.

B. Outline the operating characteristics of each type instrument.

C. What happens in a detection chamber when a gamma ray passes through?

D. What are secondary ions?

E. What is an ion avalanche?

Check papers and discuss

V. SUMMARY

A. The need for radiation detection and measurements, the principles and the use of various types of instrumentation.

B. Emphasis on the Geiger-Muller tube

C. Absolute and comparative activity measurements.

The Next Lesson is: Radiation

V. SUMMARY

A. Safety Precautions

B. Various types of tests and inspections

C. Need for records

D. Conduct on tours and plant visitations

The Next Lesson is: Professional Ethics for the Industrial Radiographer

INSTRUCTOR'S LESSON PLAN
Related Technical Information

Unit 4
Lesson 6
Time 1 hour

SUBJECT: Radiation

AIM (or purpose): To develop familiarization with the methods of monitoring and the control of penetrating radiation

TEACHING AIDS: Film: Living with Radiation, 28 mins., 16mm, sound, U.S. Atomic Energy Commission

EQUIPMENT: Film, projector and screen

I. PREPARATION (of the learner)

- A. Introduce subject and aim of lesson - write it on chalkboard.
- B. Look for the following points while viewing the film:
  1. Continuous employment of survey meters by the atomic workers while conducting work with radioactive materials.
  2. Types of monitoring devices used at the facility in addition to survey meters.
  3. Methods used in disposal of unwanted radioactive materials.
  4. Heavy shielded chambers used to make precision measurements of weak source strengths.
- C. The points given above will assist the learner to better understand the various methods of monitoring and controlling penetrating radiation.
- D. Advise group a test will be given.

II. PRESENTATION (of the information)

Instructional Topics	Things to Remember to Do or Say
"Living with Radiation"	Show film, rerun if necessary stopping film to clarify situations as necessary.

III. APPLICATION (drill, illustrations, analogies, oral questions or assignments) Discuss the film - Emphasizing these points:

A. Use of safety devices and monitoring equipment used by the atomic workers.

B. Monitoring devices used by atomic workers but seldom employed in industrial radiography.

C. The safety record of the facility shown in the film relating this to the safety devices used by the facility.

D. Waste disposal procedures shown for the disposal of radiographic sources.

E. The purpose of the heavy shielding used in the construction of the counting devices. Relate this to instruments used in wipe testing.

F. Rerun film again if necessary for understanding of certain situations or of certain items that still may not be clear.

IV. TEST (final check on students' comprehension of material presented)

NOTE: Oral Quiz

A. Name at least four different detection devices used by the atomic workers in the film.

B. Why is it necessary to have controlled disposal methods for radioactive materials?

C. What is the purpose of the heavy shielding used with the counters shown in the film?

D. Why do the atomic workers always use the survey meter when working with radioactive materials?

V. SUMMARY

A. Separation-distance factor

B. Storage and/or disposal of radioactive wastes

C. Protection of populations, water, crops, and livestock by air and enviromental monitoring.

D. Protection of workers through use of film badges, radiation counters, shielding, remove-control devices, decontamination procedures and biochemical studies.

E. The various types of detection instruments

The Next Lesson is: Algebriac Expressions

INSTRUCTOR'S LESSON PLAN
Related Technical Information

Unit 5
Lesson 1
Time 1.5 hours

SUBJECT: Algebraic Expressions

AIM (or purpose): To develop skill in the use of algebraic equations

REFERENCES: Brief College Algebra, W.L. Hart, 1947, D.C. Heath and Co., Boston, Mass.
Industrial X-ray Handbook, Allan Lytel, 1962, H.W. Sams, Indianapolis, Ind.
Information Sheet #4

I. PREPARATION (of the learner)

A. Using chalkboard list the subject of lesson explaining why it is essential to have a working knowledge of algebraic expressions.

B. List several algebraic formulas on the board gauging their complexity to the contemplated proficiency level of the group in attendance.

C. Upon determining the lowest level of understanding present, proceed with the presentation, keeping before the group good and sufficient reason for wanting to know.

II. PRESENTATION (of the information)

Instructional Topics	Things to Remember to Do or Say
A. The fundamental operations a. Addition b. Subtraction c. Multiplication d. Division	Define and illustrate on the chalkboard: 1. Addition: Combining two or more numbers so as to obtain a number called a sum. 2. Subtraction: The act of taking one number or quantity from another. 3. Multiplication: The process of adding a given number or quantity a certain number of times by a briefer computation.

	4. Division: The process of determining how many multiples of one number are contained in another.
B. Numbers a. Explicit b. Literal	Define the explicit and literal numbers: 1. Explicit number-absolute value of a signed number. 2. Literal number-letter that stands for a number.
C. Law of	List the rules on the chalkboard and explain: 1. When multiplying or dividing, the answer will have a plus sign if both numbers have the same sign and a negative sign if the operators are of opposite sign. 2. When adding like signs, the sum has the sign of the operators. When adding unlike signs, the sum has the sign of the operator with the greatest absolute value. 3. To subtract, change the sign of the operator and add.
D. Principles of fractions	State and illustrate on the chalkboard: 1. The value of the fraction is not changed if both the numerator and denominator are multiplied or divided by the same number, not zero 2. The product of two fractions is the product of the numerators divided by the same number, not zero. 3. To divide a fraction by another invert the divisor and multiply. 4. To multiply a fraction by a number, multiply the numerator by the number.

5. To divide a fraction by a number, multiply the denominator by the number.

E. The equation

1. List the following definitions:
   a. An equation is a statement that two members of an expression are equal.
   b. A solution is a set of values that satisfy the equation. Illustrate.
2. Illustrate the rules of equivalent equations:
   a. Add and subtract the same value from both sides.
   b. Multiply both sides by the same value.
   c. Cancel equal terms on both sides.
   d. Transpose terms from one side to the other by changing signs.

F. Equations

$$\frac{EP \times D^2}{S} = T$$

Explain step by step use of equation using the following information work problem: Explain each step what is being done and why:

1. A client requests a gamma radiograph be made of a steel casting 4"x6"x 1/2" thick. Relative film density should be 1.5, film should be Kodak type AA, film-focal distance should be 12" and an Iridium 192 gamma source should be used. You have a 10 curie (10,000 millicurie) source. What should your exposure time be?
   Ans: Exposure factor - 70 (from chart) film-focal distance squared = 12x12=144" Gamma source strength= 10,000MC (10 curies) = $\frac{70 \times 144}{10,000}$ = 1.08 minutes exposure time.

Instructor using a chalkboard, should have students tell what to do, how to do it, and why it is being done in solving the following problems (2) and (3):

2. Solve for exposure time if EF = 100 D = 10" and S = 5 curies.

$$\frac{EF x D^2}{5} = T$$

3. Work step by step on chalkboard. If radiation intensity at one foot is 500 MR/HR:; what is the intensity at five feet?

$$\frac{I_1}{I_2} = \frac{D_2^2}{D_1^2}$$

$$\frac{500}{X} = \frac{25}{I}$$

$$\frac{500}{25} = \frac{X}{I}$$

$$\underline{X = 20}$$

Ans: 20 mr/hr at 5 feet

G. Work step by step on chalkboard: If it took 100 milliamp seconds (MAS) to produce an x-ray radiograph @ 1 foot film-focal distance how many film-focal distance MAS would be required if the film-focal distance was lengthened to 2 feet?

$$\frac{MAS\ 1}{MAS\ 2} = \frac{D_1^2}{D_2^2}$$

$$\frac{100}{X} = \frac{1}{4}$$

$$\frac{100}{x} = \frac{X}{4}$$

$$X = 400$$

Ans: 400 MAS @ 2 feet

H. Work step by step on chalkboard: What is the exposure factor if a radiograpn was made in 10 minutes with 5,000 millicuries of Iridium 192 at a focal distance of 8 feet?

$$\frac{TS}{D^2} = EF$$

$$\frac{10 \times 5000}{64} = \frac{50,000}{64} = 781$$

Ans: EF = 781

III. APPLICATION (drill, illustrations, analogies, oral questions or assignments)

A. Require students to solve for a given value in terms of all others using the equations for: The Time-Distance rule, the Ma-Time rule, the Ma-Distance rules, and the inverse square law. Supervise very closely until all students have mastered the technique of handling algebraic expressions.

B. Have them list the laws governing signs in the operations of addition, subtraction, multiplication, and division.

C. Ask for a listing of the rules governing operations to produce equivalent equations.

D. Have class solve the following problems and explain.

1. Intensity at 2 feet is 600 mr/hr. What is it @ six feet? @ 1.5 ft?
2. T = 2 minutes, S = 500 mc, D = 4 feet, what is EF?
3. T_1 = 2 minutes, D_1 = 4 minutes, D_2 = 1 foot what will T_2 be?
4. EF = 100, D = 2 feet S = 2000 mc. What is T in minutes?

Work all problems on the chalkboard allowing class to discover and correct any errors as they may develop.

IV. TEST (final check on students' comprehension of material presented)

NOTE: Written Test

A. Olve for D^2: $\frac{I}{I_o} = \frac{D^2}{D^2}$

B. Solve for Ma_1: $\frac{D_2^2}{D_1^2} = \frac{Ma_1 \; S_1}{Ma_2 \; S_2}$

C. If Ma_1 = 5 ma
S_1 = 60 sec.
Ma_2 = 10 ma
What is the time of S_2 if $Ma_1 \; S_1 = Ma_2 \; S_2$

D. Solve for the new time if:
T_1 = 10 sec.
D_1 = 24 inches
D_2 = 48 inches

and

$$\frac{T_2}{T_1} = \frac{D_2^2}{D_1^2}$$

Check and discuss

V. SUMMARY

A. An understanding of the use of algebraic expressions, formulas, and equations is essential in radiography.

B. Mathematical law of signs must be understood.

C. Formulas and equations tend to speed up and simplify most radiographic mathematical problems.

The Next Lesson is: The Inverse Square Law

INSTRUCTOR'S LESSON PLAN
Related Technical Information

Unit 5
Lesson 2
Time 1.5 hours

SUBJECT: The Inverse Square Law

AIM (or purpose): To develop an understanding of the meaning, manipulation, and use of the mathematical relationship as used in radiography calculations

REFERENCES: Radiography in Modern Industry, Eastman Kodak Co., 1958, Rochester, N.Y.
Nondestructive Testing Handbook, Society for Nondestructive Testing, 1963, Evanston, Illinois
Information Sheet #4 (see appendix)

I. PREPARATION (of the learner)

A. Find out by oral questions what knowledge the class has about the inverse square law.

B. Point out that all exposure calculations in radiography are based on the inverse square law and that the radiographer will never fully understand his trade until he has mastered its use in making necessary calculations.

C. Indicate that the inverse square law is used to calculate the distance required to be safe from harmful radiation.

II. PRESENTATION (of the information)

Instructional Topics	Things to Remember to Do or Say
A. The inverse square law-define and explain	1. The inverse square law is: a. The basic mathematicsl relationship between intensity and distance b. The most frequently used relationship in industrial radiography

	c. The basis of all exposure calculations
B. The mathematical formula	1. Write the inverse square law in mathematical terms on the chalkboard. 2. Explain the symbols in the inverse square law equation. 3. Transpose the equation to all forms-distance, time, intensity.
C. Visual schematic illustration	Draw on chalkboard a geometric sketch of the inverse square law relationship and discuss with the class.
D. Application of inverse square law	Work the following problems on chalkboard step by step. Explain each step encouraging students to ask questions: a. Exposure time is 3 minutes at 1 foot. What is exposure time at 3 feet? b. Intensity at 1 foot is 500 mr/hr. What is intensity at 2 feet? c. Intensity at 5 feet is 200 mr/hr. At what distance is intensity 2 mr/hr?

III. APPLICATION (drill, illustrations, analogies, oral questions or assignments)

A. Ask the students to recite a word statement of the inverse square law.

B. Ask the students to define the inverse square law by an example.

C. Place the inverse square law on the chalkboard in one form and ask the students to transpose to all the other possible forms.

D. Give the students a set of conditions for each of the following cases: Calculate from the given data:
   1. A value of I_o
   2. A value of D_o
   3. A value of D
   4. A value of I

IV. TEST (final check on students' comprehension of material presented)

A. Write the inverse square law in any form.
B. Transpose to all other forms. Show each step.
C. Give three examples for use of the inverse square law.
D. Given the following information, solve each problem:
Cobalt 60 yields 14,500 mr/hr/curie at 1 foot
Iridium 192 yields 5,900 mr/hr/curie at 1 foot

1. What is the distance where the intensity of radiation from 5 curies of Cobalt 60 is 20 mr/hr?
2. At 20 feet from a source of Iridium 192 the radiation intensity is 250 mr/hr. How many curies of Iridium is present?

Check the answers with the class and discuss -- correcting all errors.

The Next Lesson is: The Square Root

INSTRUCTOR'S LESSON PLAN
Related Technical Information

Unit 5
Lesson 3
Time 2 hours

SUBJECT: The Square Root

AIM (or purpose): To develop skill and understanding in solving problems involving square root as applied to radiography work

REFERENCES: Information Sheet #5

I. PREPARATION (of the learner)

A. Explain briefly why it is important for a radiographer to be able to figure square root.

B. Give practical situations where this type calculation is needed. For example: To solve problems involving safe working distances and distance shielding problems.

II. PRESENTATION (of the information)

Instructional Topics	Things to Remember to Do or Say
A. The square root	Using simple examples explain the meaning of square root.
B. The long division-estimate method of determination	1. Illustrate on the chalkboard the calculation of the square root of the number 2 using the following procedure: a. Write the number as a non-terminating decimal; i.e., 2.000000. b. Group the digits to the right and left of the decimal point in pairs; i.e., 02. 00 00 00. c. Construct the square root sign over the number and place the decimal point just above the decimal point in the number.

d. Estimate the square of the first pair of numbers. Use the whole number which is nearest but just less than the first pair.
e. Write this number above the first pair and the square of the number below the pair.
f. Subtract the squared number from the first pair and draw down the next pair as in long division; i. e., 1+00 = 100.
g. Double the value of the number above the first pair (1) and add a zero to the value; i. e., 2 (1) - 2, 2+0 = 20.
h. Divide this number (20) into the number obtained in step "f". Add the quotient to the number in step "g" and multiply by the quotient. If the product is greater than the value of step "f" reduce the quotient number by one and repeat until the product is just less than step "f"; (20+4) times 4=96.
i. Write this number above the second pair.
j. Double the value of the number above the radical sign and add a zero 2(14) = 28+0 = 280. Repeat steps "h" and "i".
k. Continue the process to obtain the accuracy desired. Ask questions, and have students solve problems.

2. Work several problems on the chalkboard with the class assisting.

C. The estimate- average technique

Illustrate on the chalkboard the calculation of the square root of the number 10.
a. Estimate the value of the root of 10. (Use the figure 3).
b. Divide 10 by 3 for an approximate answer of 3. 3.

c. Add 3 and 3.3; divide the result by 2.
d. Divide 10 by 3.15 from step "c". Ans. 3.17.
e. Add 3.15 and 3.17; divide the result by 2.
f. Continue the process as above until the desired accuracy is obtained.

Have students solve problems using this technique.

D. Use of square root tables

Hand out and explain the use of tables.

III. APPLICATION (drill, illustrations, analogies, oral questions or assignments)

Have students solve the following problems using the <u>long division estimate method</u> first, then solve the same problems using the <u>estimate average technique.</u>

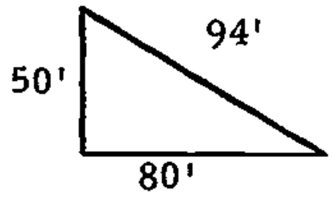
A. Assume you were making a radiograph in a pipe yard and you needed to know what distance from the exposure device your radiation intensity would be 5 mr/hr so that you could place your warning signs at that distance. Your gamma source emits 5,900 mr/hr per curie @ 1 foot. You have a 10 curie source.

B. A 30 curie source of Ir. 192 was being used at ground level. A water tank located 80 feet from the source was being painted. The painters were working on the near side of the tank (80') at a height of 50'. What was their exposure dose rate assuming they remained at the near side of the tank?

Calculations and answers: (for instructors' use)

1. $D = \sqrt{80^2 + 50^2} = 94'$ (Distance to 50' level to tank)
2. $I_1 = 5.9 \times 30 = 177,000$ Mr/hr @ 1

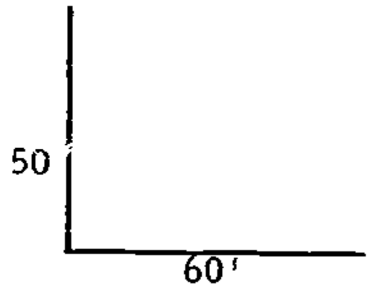
$$I_2 - \frac{177000}{94^2} = \frac{177000}{8836} = 20 \text{ mr/hr}$$



IV. TEST (final check on students' comprehension of material presented)

A. Give a brief written test to determine if all class members understand procedure of square root calculations.

1. A cobalt 60 source produces a radiation intensity of 217, 500 mr/hr @ 1 foot. At what distance would the intensity be 1 mr/hr?
2. At a distance 1 the survey meter reads 215 r/hr. At what distance does the meter read 5 r/hr?
3. Meter reads 450 mr/hr @ point 1. A worker on a scaffold 60 feet from point 1 and 50 feet high is exposed to how much radiation intensity.



B. Check answers to the test with the assistance of the class and review problems solving procedures as needed is indicated.

The Next Lesson is: Geometric Principles of Exposure

INSTRUCTOR'S LESSON PLAN
Related Technical Information

Unit 5
Lesson 4
Time 1.5 hours

SUBJECT: Geometric Principles of Exposure

AIM (or purpose): To teach the fundamentals of exposure as related to the geometric arrangement of the exposure setup and develop a thorough knowledge of the subject.

TEACHING AIDS: Spot film viewer
A round cardboard disc taped to the end of a stick or pointer

REFERENCES: Information Sheets No. 6 and No. 7
Nondestructive Testing Handbook, Volume I, 1963, Society for Nondestructive Testing, Evanston, Illinois

I. PREPARATION (of the learner)

Explain briefly that certain very simple and basic laws govern the art of making good radiographs.

X-rays and gamma rays obey the same physical laws as light and formation of shadows or radiation may be better understood by knowledge of these laws. The relationships of source, object and film will have a considerable bearing on the definition in the reproduced image. The skill displayed by the radiographer in image reproduction will depend a great deal on his knowledge of geometric principles and how these factors govern exposure patterns.

II. PRESENTATION (of the information)

Instructional Topics	Things to Remember to Do or Say
A. Geometric enlargement	1. Explain by chalkboard sketch the enlargement of the image when the film is moved away from the object.

Instructional Topics	Things to Remember to Do or Say
	2. Illustrate the geometric principle by using the spot viewer and the cardboard disc. 3. Use the method of similar triangles to show how the magnification can be predetermined.
B. Distortion	1. Use the spot viewer and cardboard disc to illustrate distortion caused by inclination of the object to the film. 2. Explain the difficulties caused by distorted images: a. A blurred image is hard to identify. b. It is difficult to estimate the actual size of a distorted image.
C. Geometrical unsharpness	1. Show by a chalkboard sketch the formation of penumbra. 2. Use the spot viewer to illustrate penumbra 3. Using the chalkboard sketch, define geometrical unsharpenss. 4. On chalkboard using the method of similar triangles, derive the formula for geometrical unsharpness; i. e., $U_g = \frac{Ft}{d}$ 5. Handout Information Sheet No. 7 (Contains explanation of formula) 6. Display and explain the use of a nomogram for determining geometrical unsharpness. (Nomogram on information sheet #7)

III. APPLICATION (drill, illustrations, analogies, oral questions or assignments)

Have individual students:

A. Draw a sketch of the situation which causes penumbra explaining why and using the spot viewer and disc to illustrate.

B. Explain enlargement of the image in radiography. Use the viewer and disc to illustrate. Show calculation to predetermine the magnification.

C. Outline the consequences of image distortion.

D. Define geometrical unsharpness. Derive the formula and illustrate the use of a nomogram.

Solve the Following Practice Problems:

E. An exposure device's focal spot is positioned 36" from the specimen to be radiographed. The specimen is 12" x 12" x 1" thick. The x-ray film is positioned 12" beyond the specimen, what would be the projection of the image?

F. A flat plate 12" x 12" x 2" thick is radiographed at a film-focal distance of 15". What is the width of the penumbra shadow?

G. Use nomogram to determine the geometric unsharpness in millimeters of a radiograph of a flat plate that is 12" x 12" x 2" thick if the radiograph was made with a Cobalt 60 source 5 millimeters in diameter and a film-focal distance of 20".

IV. TEST (final check on students' comprehension of material presented)

NOTE: Written Test

A. If the object is placed at 24 inches from the source and the film at 36 inches, what would be the magnification of the image?

B. If a flat plate 1" thick is radiographed using a 20" film-focal distance and a 3 mm diameter source, what is the size of the penumbra?

C. What would be the focal distance to produce a radiograph with no more than 0.2 geometrical unsharpness, if the source is 5 mm diameter and the object is four inches thick?

Check and discuss.

V. SUMMARY

A. Certain geometric principles are applied in radiography.

B. Image distortion is generally caused by improper geometric considerations.

C. Image unsharpness is a major problem when making radiographs.

The Next Lesson is: Logarithms

INSTRUCTOR'S LESSON PLAN
Related Technical Information

Unit 5
Lesson 5
Time 2 hours

SUBJECT: Logarithms

AIM (or purpose): To outline the advantages of the use of logarithms as applied to radiography and to develop ability in their use

REFERENCES: Brief College Algebra, W.L. Hart, 1947, D.C. Heath and Co., Boston, Mass.
Radiography in Modern Industry, 1958, Eastman Kodak Co., Rochester, N.Y. (Page 39)
Information Sheet #8. Logarithm tables. Shielding equations

I. PREPARATION (of the learner)

A. Through adroit questioning determine the level of understanding of logarithms by various members of the class.

B. Explain the importance of using logarithms in radiography pointing out that:
   1. Logarithms are used to determine exposure times required to produce satisfactory radiographs.
   2. Exposure time varies with film speed. There are many different types of industrial radiography film, each having a different speed.
   3. Decay of radioactive materials are logarithmic function which every radiographer should be able to calculate.
   4. Shielding or attenuation properties of the elements are determined by the use of logarithms.

II. PRESENTATION (of the information)

Instructional Topics	Things to Remember to Do or Say
A. The logarithm	1. Define a logarithm of a number "N" to the base "a" as the exponent of the power to which "a" must be raised to obtain "N". 2. Place the mathematical form on the chalkboard.

	3. Define a natural and common logarithm
B. Properties of logarithms: a. Multiplication b. Division c. Powers	State the rules and illustrate each type of computation on chalkboard.
C. The characteristic and mantissa	Illustrate on chalkboard the integer and decimal parts of a logarithmic expression.
D. Properties of the characteristic and mantissa	List the following theorems--illustrate on chalkboard: 1. The characteristic depends only on the number of digits to the left of the decimal point in the number. 2. When the number is greater than one, the characteristic is an integer which is one less than the digits in the number left of the decimal place. 3. When the number is less than one, the characteristic is negative and equal to the number of spaces left of the decimal to the first significant figure. 4. Explain each of the above by chalkboard example. 5. Show the students a log table Information sheet #8 for determination of the mantissa.
E. Computation with logarithms	Show on the chalkboard simple computations to determine a product, quotient, extraction of roots and determination of a power.
F. The antilogarithm	Define the antilogarithm and illustrate the determination from table and computation. The number corresponding to a given logarithm is called the antilogarithm.
G. Slide rule	Display slide rule and refer students to illustration of scale for determining mantissa logarithms - Page 39 in the Eastman Kodak Textbook.

III. APPLICATION (drill, illustrations, analogies, oral questions or assignments)

A. List a group of numbers on the chalkboard and ask the students for the characteristic and mantissa of each number. Show each on the chalkboard after students have given the answers.

B. Ask individual students to explain the rules for multiplication, division,. and computation of powers by logarithms.

C. State simple problems on chalkboard for student exercise. Solve problems on chalkboard after students have completed calculations. (Furnish mantissa values from log tables).

D. Using equations on information sheet #8, work the following problem: Radiation intensity is 500 mr/hr. How many half-value layers are required to reduce the intensity to 100 mr/hr?

E. How many tenth value layers are required to reduce radiation intensity from 500 mr/hr to 2 mr/hr?

IV. TEST (final check on students' comprehension of material presented)

NOTE: Written Test

A. What is the characteristic and mantissa of the following logarithmic expressions?
   a. 1.4271
   b. 3.9721
   c. 8.4731-10
   d. 17.6541-20

B. What is the logarithm of the product of the logarithms: 3.5001 and 5.4379?

C. What is the logarithm of log 5.4970 divided by the log 4.3660

D. What is the logarithm of $(27.315)^4$ if the mantissa of 273 is .4362.

E. What is the value of 27.315^4 if the antilogarithm of the mantissa .7448 is 5556?

Check and Discuss

V. SUMMARY

A. The whole number of a logarithm is called the characteristic.

B. The fraction of the number is called the mantissa.

C. The characteristic number contains one less digit than the number it represents in log form.

D. The mantissa of a logarithm can be obtained from a log table such as the one used in this lesson.

E. The mantissa can also be found by using a slide rule.

F. Problems of shielding can be solved quickly and accurately by the use of logarithms.

G. Exposure time charts and the characteristic curve of x-ray film are drawn on semi-log paper forms.

The Next Lesson is: Ionizing Radiation

INSTRUCTOR'S LESSON PLAN
Related Technical Information

Unit 6
Lesson 1
Time 1.5 hours

SUBJECT: Ionizing Radiation

AIM (or purpose): To familiarize the student with the basic concepts of radiation physics

TEACHING AIDS: Film: Invisible Bullets, Challenge Series, 45 mins., 16 mm., sound, U. S. Atomic Energy Commission

EQUIPMENT: Film projector and screen

I. PREPARATION (of the learner)

A. Caution group to look for the following points while viewing the film and advise that a test will be given regarding some of these situations later in the session.
   1. Ionization traces in the cloud chamber
   2. The relative energy of the different types of radiation
   3. The type of shielding necessary to stop different types of radiation
   4. The explanation of various terms used in evaluation of biological effects of radiation
   5. The effects of overdosage on the human body
   6. The geiger counter and the different windows used to detect different types of radiation

B. Explain and stress the importance of these situations to the radiographer.

II. PRESENTATION (of the information)

Instructional Topics	Things to Remember to Do or Say
"Invisible Bullets"	Introduce Film
	1. Title
	2. Length

III. APPLICATION (drill, illustrations, analogies, oral questions or assignments,

Discuss the film. Emphasize strong points in the discussion. Use questions listed below to spark discussion.

A. The spark chamber and the cloud chamber.
   1. Methods of visually observing ionization from radiation
   2. The ionization path of the different forms of radiation
   3. The effect of radiation on the conductivity of gases

B. The geiger counter and the different window materials needed for the different forms of radiation.

C. The relative penetrating power of different types of radiation.
   1. Lead shielding for gamma
   2. Glass for beta
   3. Paper for alpha

D. The units of measurement for biological radiation effects.
   1. The RAD
   2. The RBE

E. The effects of overdosage on the human body.
   1. Blood damage
   2. Bone marrow damage
   3. Nausea
   4. Lethal dose

F. Why are alpha and beta particles not usually considered hazardous in radiography?

G. When could they create a hazard?

H. Explain whether or not the human body can repair radiation damage.

I. Name three considerations in determining a lethal dose of ionizing radiation to a human being.

J. In what manner may the blood be damaged by ionizing radiation?

K. What is meant by the relative biological effect?

L. How does a geiger counter measure radiation dose rate?

IV. TEST (final check on students' comprehension of material presented)

NOTE: Written Test

A. What is the effect of radiation on an air path through which it passes?

B. Explain how this can be seen.

C. Which of the three types of radiation (alpha, beta, and gamma) has the greatest penetrating power? The least?

D. Which of these could be shielded by a piece of paper?

E. What is the rad and the rbe? What are they used to measure?

F. Do all forms of radiation have the same biological effects?

G. What is the dosage level considered lethal?

Check and discuss

V. SUMMARY

A. The meaning of radiation, its natural source, the various forms it takes, and how it is used.

B. The difference between alpha and beta particles and between gamma rays and x-rays.

C. The extent of damage to living tissue by ionizing radiation depends on: type and intensity of the radiation; amount and parts of body exposed; duration of exposure.

D. Ionizing radiation can be observed in a cloud chamber instrument.

E. Time, distance, and shielding can reduce the hazards of ionizing radiation.

The Next Lesson is: Isotopes - Excursions in Science

INSTRUCTOR'S LESSON PLAN
Related Technical Information

Unit 6
Lesson 2
Time 1 hour

SUBJECT: Isotopes - Excursions in Science

AIM (or purpose): To acquaint class members with the basic concepts of the nuclear sciences

TEACHING AIDS: Film: Isotopes - Excursions in Science, 20 mins., 16mm, sound, U.S. Atomic Energy Commission

EQUIPMENT: Film projector and screen

I. PREPARATION (of the learner)

A. Introduce the film by title giving a brief rundown on content pointing out that in order to be able to employ and use radioisotopes in industry one must satisfy the Atomic Energy Commission and/or the State that one fully understands the basic concepts of nuclear science.

B. Suggest that group watch for the following items when viewing the film:

1. The three rays (or particles) ejected by radioactive decay.
2. The definition of half-life.
3. The methods used to create artificial isotopes.
4. The safety precautions used by companies and individuals working with radioactive materials.
5. The encapsulation of radioactive materials.

II. PRESENTATION (of the information)

Instructional Topics	Things to Remember to Do or Say
"Isotopes - Excursions in Science"	Show the film

III. APPLICATION (drill, illustrations, analogies, oral questions or assignments)

Discuss the film, emphasizing these points in the discussion and questioning as needed:

A. The rays and particles produced by radioactive decay
   1. Alpha
   2. Beta
   3. Gamma

B. Re-define and discuss decay half-life.

C. Production of artificial isotopes used for industrial radiography.

D. Safety equipment used by the workers in the film.

E. Encapsulation, particularly where related to radiography.

F. What is meant when one states that half-life is exponential?

G. Give an example: (If a radioactive isotope is said to have passed through three half-lives what percentage of its original activity remains?

H. Explain why all isotopes of elements are not radioactive.

I. Which of the three emitters has the greatest penetrating power, Alpha, Beta, or Gamma?

J. Which emitter is most suitable for radiography?

K. Why?

L. What are the three basic methods of shielding against nuclear radiation?

M. Why is an isotope that is used in radiography encapsulated?

N. How is the isotope encapsulated?

IV. TEST (final check on students' comprehension of material presented)

NOTE: Oral Quiz

A. What are the three types of particles or rays emitted by radioactive decay?

B. Define a half-life of a radioisotope.

C. How are radioisotopes produced?

D. Why are isotopes used in radiography encapsulated?

V. SUMMARY

A. The three types of radiation produced by radioactive decay.

B. Encapsulation usually eliminates alpha and beta radiation.

C. Half-life of a particular isotope of an element determines its useful life in an industrial application.

D. Safe handling procedures and rules must be understood and observed in order to use and handle radioactive materials.

The Next Lesson is: Atomic Structure of Matter

INSTRUCTOR'S LESSON PLAN
Related Technical Information

Unit 6
Lesson 3
Time 2 hours

SUBJECT: Atomic Structure of Matter

AIM (or purpose): To outline the basic nuclear science concepts and assist the student in developing a proper vocabulary regarding the subject

REFERENCES: Radiological Monitoring for Instructors, Instructor's Guide, Lesson 2, Department of Defense, Office of Civil Defense, Training Division, Battle Creek, Mich.
Information Sheet #41

I. PREPARATION (of the learner)

A. Introduce topic developing interest by asking a few simple questions regarding the structure of matter, supplying quick and informative explanations.

B. Stress the fact that the atomic theory as related to radiography is not difficult to understand if you develop the theory a step at a time. Explain that the purpose of this lesson is to help to visualize the atomic structure of matter and how it can be altered to make gamma radiography possible.

II. PRESENTATION (of the information)

Instructional Topics	Things to Remember to Do or Say
A. Matter	1. Anything which occupies space and has mass or weight. 2. That which can be classified according to physical and chemical properties. 3. Many different kinds of matter exist. 4. Classification of matter is an important part of nuclear science.

II. PRESENTATION (continued)

Instructional Topics	Things to Remember to Do or Say
B. Classification of Matter 1. Mixture	1. Physical combination of two or more substances characterized by no definite ratio. Each substance maintaining its individual identity: Example: Cup of coffee.
2. Compound	2. Chemical combination of two or more substances characterized by definite ratio of the combining substances. Water contains two parts hydrogen to one part oxygen no matter where it is found.
3. Element	3. Substance which cannot be separated into substances different from itself by ordinary chemical means. Gold is one of the over 100 different substances which contain <u>only</u> atoms of the same chemical property. Silver is another.
4. Molecule	4. Smallest part of a compound that can exist and still retain the chemical properties of the compound. A molecule contains two or more atoms.
5. Atom	5. Smallest conceivable part of an element. Smallest portion of an element that can enter into chemical combination.
C. Concept of the atom	Information Sheet #41 1. The term "atom" means undividable. It is from the Greek letter "a" meaning "not" and the word "tomos" meaning "cut". 2. The Greek concept proved to be erroneous, and it has been demonstrated, that an atom is dividable. 3. In about 1900 scientists discovered the atom was not a uniform sphere. 4. It was also determined that it contained a strong positive charge in its center with a negative charge about it.

II. PRESENTATION (continued)

Instructional Topics	Things to Remember to Do or Say
	5. The center dimension is small compared to the atom as a whole, about 1 to 10,000 ratio and the negative charges orbit around a nucleus. 6. If the nucleus of an atom was the size of a marble the entire atom would weight about 36 million tons and the closest negative charge would orbit about 200 feet away.
D. Atomic structure	1. An atom consists of protons, electrons, and neutrons. 2. Proton: is a subatomic particle found in the nucleus of an atom. It is positively charged. 3. Electron: a very light particle, negatively charged. Orbits the nucleus. A proton is 1840 times heaver than an electron. 4. Neutron: carries no electrical charge. Weighs the same as a proton and is found in the nucleus. 5. Properties of each element are the period functions of the number of protons in its nucleus.
E. Isotopes of elements	1. Different forms of the same element. 2. Like brothers, they have the same last name but different first names. 3. Each element is assigned an atomic number which is equal to the number of protons in the nucleus of its atom (Sometimes called "Z" number). 4. Each different form, or isotope, of an element has a mass number (The "A" number) The "A" number equals the total number of neutrons and protons in the nucleus of its atoms. 5. Write on the chalkboard the correct symbols for describing cobalt 60.

6. Draw the structure of an atom other than the one shown on information sheet and explain each step. Ask for student participation.
7. Some isotopes are not radioactive. (Stable)
8. Only unstable isotopes can be used in radiography. Explain.

F. Ioniziation

1. A process which results in the formation of electrically charged particles (ions) from neutral atoms or molecules.
2. Ionization is the process and positive and negative ions are products of the process.
3. All three types of radiation, alpha, beta, and gamma. Cause ionization as they interact with various matter.
4. On the chalkboard, demonstrate how radiation strikes orbital electrons and moves them out of orbit.
5. They actually disturb the organized balance of the atomic structure disrupting the normal electrical balance of the atom.
6. Ionization is also the process by which nuclear radiation loses its energy.
7. Ionization permits detection of nuclear radiation, produces the biological effects from nuclear radiation and provides a means of shielding against nuclear radiation.

III. APPLICATION (drill, illustrations, analogies, oral question or assignments)

A. Suggest that students draw an atomic structure without refering to information sheet.

B. Have them state the number of positive and neutral charges in the structure.

C. Ask them to define the "z" number, "a" number.

IV. TEST (final check on students' comprehension of material presented)

NOTE: Oral Quiz

A. Describe a compound, give an example.

B. A mixture, give an example

C. An isotope, give an example

D. Describe the structure of an atom, illustrate on chalkboard.

E. Define ionization.

F. Describe its (ionizations) safety value in radiography.

V. SUMMARY

A. An atom is the smallest part of the elements hydrogen and oxygen. If two atoms of hydrogen and atom of oxygen combine chemically they form one molecule of the compound water.

B. Concepts of the atom

C. Atomic structure

D. Isotopes

E. Ionization

The Next Lesson is: Nuclear Radioactivity

INSTRUCTOR'S LESSON PLAN
Related Technical Information

Unit 6
Lesson 4
Time 2 hours

SUBJECT: Nuclear Radioactivity

AIM (or purpose): To assist the student in developing a basic understanding of the source of the energy emitted from radioactive materials

REFERENCES: Information Sheet #41
Nondestructive Testing Handbook, Volume I, Society for Nondestructive Testing, 1963, Evanston, Illinois

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I. PREPARATION (of the learner)

Explain the importance of understanding the radioactive decay process because:

A. The information will aid the radiographer in selection of the proper isotope material for each radiographic assignment.

B. The information is useful in the design of effective shielding.

II. PRESENTATION (of the information)

Instructional Topics	Things to Remember to Do or Say
A. The structure of an atom	Draw chalkboard sketch of a typical atomic structure. Also use information sheet #41 for this discussion.
B. The atomic nucleus 1. The proton 2. The neutron 3. Atomic number 4. Atomic weight	1. Define: a. Proton - positive parts of atom b. Neutron - neutral parts c. Atomic weight - mass or weight of atom, total number of protons and neutrons in an atom d. Atomic number - total number of protons in an atom 2. Show by sketches why the isotope has the same atomic number but a different atomic weight.

C. Radiation emitters 1. Natural emitters 2. Neutron activated emitters	1. List on chalkboard some natural emitters such as radium - uranium 2. Explain energy equilibrium and radioactive decay. Stable isotopes are in equilibrium - not radioactive. 3. Explain how elements can become radioactive by neutron bombardment - Unstable isotopes are not in equilibrium and decay back to stability. Neutrons upset stability by changing the atomic weight. 4. Illustrate the reaction of a neutron with the element Cobalt 59 to illustrate the formation of Cobalt 60.
D. Products of nuclear radiation 1. Alpha particles 2. Beta particles 3. Gamma rays	1. Define the alpha particle - lightly penetrating highly ionizing stream of fast-moving helium nuclei 2. Explain why the alpha particle is stopped by a small amount of light shielding material. 3. Define a beta particle. 4. List the properties of beta particles - negative charged particle emitted from nucleus of atom. Mass and charge equal to electron. Low penetrating power. 5. Explain the origin of the gamma ray. Short wave length; electromagnetic radiation of nuclear origin, emitted from the nucleus, pure energy. 6. List the properties of gamma rays: a. Electromagnetic energy b. Discrete energy levels c. Penetrating power relatively high 7. Discuss and contrast the electronic and magnetic properties of the three types of radiation.

III. APPLICATION (drill, illustrations, analogies, oral questions or assignments)

A. Have students sketch a model of a typical atomic structure and label each component.

B. Ask students in turn to indicate and define the following:
   1. The proton
   2. The neutron
   3. The Electron
   4. Atomic weight
   5. Atomic number

C. Questions why an element becomes radioactive if an extra neutron is injected into the nucleus.

D. Ask the students what materials are necessary to shield:
   1. Alpha particles
   2. Beta particles
   3. Gamma rays
   4. X-rays

IV. TEST (final check on students' comprehension of material presented)

A. Give brief test:
   1. List the three nuclear disintegration products.
   2. Indicate their penetrating power in increasing order.
   3. Explain the physical difference in the three types of radiation.
   4. Why are alpha and beta particles deflected by a magnetic field when gamma rays are not.
   5. What is the difference between the gamma rays emitted from different radioactive sources?

B. Check answers and discuss with the class.

V. SUMMARY

A. Gamma rays emitted from radioisotopes of elements have discrete energy levels, therefore, the isotope and the element can be identified.

B. Gamma energy is non-magnetic.

C. Beta particles can be deflected in a magnetic field.

D. Gamma rays are pure energy therefore they have no mass.

E. Beta particles have mass or weight.

F. Alpha particles are the least penetrating but are highly ionizing.

The Next Lesson is: X-radiation

INSTRUCTOR'S LESSON PLAN
Related Technical Information

Unit 6
Lesson 5
Time 2 hours

SUBJECT: X-radiation

AIM (or purpose): To explain the theory of x-ray generation and to develop a thorough understanding of the subject

TEACHING AIDS: Chart of the Electromagnetic Spectrum - Page 3- Radiography in Modern Industry

REFERENCES: Nondestructive Testing Handbook, Volume I, Society for Nondestructive Testing, 1963, Evanston, Illinois

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I. PREPARATION (of the learner)

Explain briefly why an industrial radiographer must have an understanding of the principles of x-ray generation. Point out that a knowledge of these principles is necessary to understand the calculations of exposure.

II. PRESENTATION (of the information)

Instructional Topics	Things to Remember to Do or Say
A. The nature of radiation 1. Rays and/or particles 2. Energy	1. Define electromagnetic wave energy. 2. Explain gamma and x-radiation in terms of rays of energy. 3. Display and explain chart of the electromagnetic spectrum.
B. X-ray generation 1. Decelleration of charged particles 2. Source of particles 3. Target materials 4. Voltage potential 5. Radiation from point of impact	1. Sketch on chalkboard an atomic structure model and a point representing a source of charged particles. 2. Explain: a. The source of charged particles b. Function of the target c. Reason for the high voltage

6. Energy converted to heat	3. Illustrate on the sketch the reaction at the point of impact, showing electron being displaced from orbit. 4. Indicate the efficiency of this system.
C. The continuous spectrum 1. Short wave length limit 2. Effect of kilovoltage	1. Sketch a typical intensity vs. wave length graph on the chalkboard. 2. Define and point out the short wave length limit. 3. Define and explain the effect of decelleration alone on the wave length of radiation. 4. Sketch in additional curves to show the effect of changing kilovoltage.
D. The characteristic spectrum 1. Critical voltage 2. Definite wave lengths	1. Add a characteristic line to the chalkboard sketch. 2. Explain the origin of this line. 3. Use chalkboard to define the critical voltage. 4. Explain the relation between the characteristic wave length and the orbits of the atomic structure.

III. APPLICATION (drill, illustrations, analogies, oral questions or assignments)

A. Using a sketch of an atomic structure on the chalkboard or on a passout sheet have students identify the parts of the structure and indicate the source of charged particles.

B. Have students indicate the following:
1. The reaction which produces the continuous spectrum.
2. The reaction which produces the characteristic spectrum.
3. The effect of increasing the kilovoltage by drawing a graph of intensity vs. wave length.

IV. TEST (final check on students' comprehension of material presented)

A. Suggested questions for written test:
1. Explain radiation in terms of rays of energy.
2. What is the function of the target?
3. What is produced at the target besides radiation?
4. Why does decelleration produce white radiation?
5. What is the effect of kilovoltage on the short wave length limit?

B. Review answers with the class allowing brief time for students to make needed corrections.

The Next Lesson is: The Effects of Radiation on Physical Matter

INSTRUCTOR'S LESSON PLAN
Related Technical Information

Unit 6
Lesson 6
Time 2 hours

SUBJECT: The Effects of Radiation on Physical Matter

AIM (or purpose): To outline and thoroughly explain the reactions which occur within a material when it is subjected to radiation

REFERENCES: Nondestructive Testing Handbook, Volume 1, Society for Nondestructive Testing, 1963, Evanston, Illinois
Information Sheet #9, Scattering Effect

I. PREPARATION (of the learner)

A. Impress upon the students the need for developing a thorough understanding of the subject and how this knowledge can affect the personal safety of the individual.

B. Help him to understand the damage that could be done to his body.

C. Attempt to develop a sense of responsibility in each student that untoward actions on his part may affect not only his but the safety of others as well.

II. PRESENTATION (of the information)

Instructional Topics	Things to Remember to Do or Say
A. Scattering	Pass out Information Sheet #9
1. Coherent energy scattering	1. Draw sketch of typical atomic structure on chalkboard.
2. The Compton effect	2. Explain on the sketch:
3. Pair production	a. The reaction in coherent scattering
4. Photoelectric effect	b. The dual Compton reaction
	c. The formation of the particles in pair production
	d. The formation of the particle in the photoelectric effect
	e. The fluorescence of certain materials

	3. Compare and contrast the four common types of scattering.
B. Ionization 1. Photon 2. Electron	1. Draw sketch on chalkboard of atomic structure as an ion. 2. Define an ion. 3. Explain how an ion can be created by a photon of energy 4. Indicate how the ejected electron can create other ions. 5. Point out useful utilization of the ionizing effect. a. Sterilization of food b. Radiation detection instruments 6. Explain metallic bonding and show why metals are not permanently affected by irradiation.
C. Permanent effects	Point out that: 1. Irradiation does not leave the material in a state of radioactivity. 2. Most ionization is permanent.

III. APPLICATION (drill, illustrations, analogies, oral questions or assignments)

A. Give individual students one of the following problems to be illustrated on chalkboard:

1. Coherent energy scattering
2. The compton effect
3. Pair production
4. Photoelectric effect
5. Creation of an ion by a photon of energy
6. Creation of an ion pair by a photon and the ejected electron

B. Have each student explain his subject to the rest of the class asking the group to offer comments or questions as the subject is developed.

IV. TEST (final check on students' comprehension of material presented)

NOTE: Written Test

A. Why does radiation cause ionization?

B. What is the difference between coherent and incoherent (Compton) scattering?

C. Does irradiation leave any residual radioactivity? (Explain)

D. Describe a use of ionizing radiation.

E. Contrast pair production with the Compton effect.

Check papers and discuss.

V. SUMMARY

A. Radioisotopes normally used in industrial radiography do not affect the materials being radiographed.

B. Radioisotopes normally affect only living matter.

C. Ionization can damage or destroy living tissue.

D. Ionizing radiation can be created in several ways.

The Next Lesson is: Biological Effects of Nuclear Radiation

INSTRUCTOR'S LESSON PLAN
Related Technical Information

Unit 6
Lesson 7
Time 1.5 hours

SUBJECT: Biological Effects of Nuclear Radiation

AIM (or purpose): To develop an awareness of the effects of nuclear radiation on the radiographers' personal health

REFERENCES: Title 10, Federal Register, Part 20, U.S. Atomic Energy Commission, Washington, D.C. Radiological Health Handbook - U.S. Dept. of Health, Education and Welfare - Public Health Service, Washington, D.C. Distributed by U.S. Dept. of Commerce - Office of Technical Services.
Information Sheet #10

I. PREPARATION (of the learner)

A. Point out that this lesson will help to insure the future health of the radiographer.

B. That it can also help to prevent serious injury to the radiographer.

C. Stress that it will help the radiographer to understand why his employer has certain safety rules which the radiographer must observe if he is to keep his job.

D. Explain that it will provide a thorough understanding of the biological effects of ionizing radiation and precautionary measures that must be taken, if a person is to be licensed to use, possess, and handle radioactive materials.

II. PRESENTATION (of the information)

Instructional Topics	Things to Remember to Do or Say
A. Types of exposure	Pass out Information Sheet #10
1. External radiation	1. Explain the difference between: a. External exposure
2. Inhalation and ingestion	b. Inhalation and ingestion
3. Energy level of radiation	2. Emphasize the increased hazard of inhalation particularly of blood soluble elements.

II. PRESENTATION (continued)

Instructional Topics	Things To Remember to Do or Say
	3. Explain the effect of exposure from increasingly higher energy radiation.
B. Immediate effects 1. Radiosensitivity 2. Erythema 3. Blood blisters 4. Drying of mucous	1. Explain the immediate effects of the ionization of sensitive tissue. 2. Point out the immediate skin disorders which indicate over-exposure. 3. Explain other side effects such as: nausea, lifeless feeling, and general ill feeling.
C. Delayed effects 1. Genetic effects 2. Scar tissue 3. Cancer	1. Explain the function of chromosomes. 2. List some changes in offspring caused by alteration of chromosomes a. Possible deformation b. Features unlike either parent 3. List the effects on cancer formation: a. Heavy over-exposure could cause cancer. b. Exposure can cause accerlerated growth of existing cancer. c. Radiation can sometimes destroy cancer. 4. Tissue which has been damaged remains as scar tissue without useful function.
D. Permissible dosages 1. Roentgen 2. Rem 3. Biological limitations 4. Legal limitations a. whole body b. partial exposure	1. Define a roentgen and a rem on chalk-board 2. Explain the relation of a roentgen to the rem. 3. Outline the following biological effects: a. 50 to 100 rem—temporary blood changes b. 100 rem and greater - erythema, blood blisters, inflamation of mucous membranes, possible fatality c. 450 rem and greater - 50% chance of survival, loss of hair, changes in nails 4. Indicate the whole body dosage allowed by law, a. 1250 millirem every 13 weeks b. 5 rem per year c. Life time dosage determined by the formula 5 (N-18) Explain fully

5. Outline the partial exposure allowed by law for persons in restricted areas:
    a. Hands and forearms, feet and ankles - 18 3/4 rems every 13 weeks
    b. Skin of whole body - 7 1/2 rems in 13 weeks
6. Outline the whole body dosage allowed by law for person outside restricted areas:
    a. Maximum of 1/2 rem in one year
    b. No more than 100 millirem in seven days

III. APPLICATION (drill, illustrations, analogies, oral questions or assignments)

A. Invite the students to discuss and list the biological effects of exposure to ionizing radiation.

B. Discuss the effects listed.

C. Have members of the class give the legal permissible dosages for whole body exposure in restricted and unrestricted areas.

D. Ask for exact definitions of a roentgen and a rem.

E. Discuss the limits and effects of massive doses of radiation—chances of survival and visible effects.

IV. TEST (final check on students' comprehension of material presented)

NOTE: Written Test

A. List the permissible legal dosages for whole body exposure.

B. If a group of adults was exposed to a short term, whole body dose of 450 rems of radiation what percentage would probably survive?

C. List five effects of excessive exposure of the human body to nuclear radiation.

... Why does the higher energy radiation have a greater biological effect?

E. From what dosage level of exposure would the average person completely recover from all ill effects?

Check papers and discuss

V. SUMMARY

A. The total permissible accumulated radiation dose is determined by a formula: 5 (N-18).

B. The permissible dose varies with individual parts of the body.

C. Detailed, current dose records of personal radiation exposure must be kept.

D. Ionizing radiation can destroy cancer cells but can also cause growth of existing cancer cells.

E. Internal radiation exposure to alpha, beta, or gamma radiation can be caused by inhalation or ingestion of contaminated air, food, or water.

The Next Lesson is: Methods of Reducing Radiation Dosage

INSTRUCTOR'S LESSON PLAN
Related Technical Information

Unit 6
Lesson 8
Time 2 hours

SUBJECT: Methods of Reducing Radiation Dosage

AIM (or purpose): To develop a working knowledge of the methods used to reduce unwanted radiation intensities

TEACHING AIDS: Small source of radioactivity
Samples of shielding materials
Dosimeters

REFERENCES: Nondestructive Testing Handbook, Volume I, Society for Nondestructive Testing, 1963, Evanston, Illinois
Information Sheet #11

I. PREPARATION (of the learner)

A. Review the important points on effects of radiation convered in the two previous lessons.

B. Introduce the three essential ways of reducing or controlling radiation dosage when working with radioactive materials.

C. Explain why it is essential for a radiographer to understand methods of reducing radiation dosage.

II. PRESENTATION (of the information)

Instructional Topics	Things to Remember to Do or Say
A. Time of exposure	Pass out Information Sheet #11 1. Explain the concept of dose rate and total dosage. 2. Demonstrate: a. Place two dosimeters at a fixed distance from a source of radiation. b. Remove one dosimeter after a short period.

c. Remove the second after twice the time of the first.
d. Have students read and report the results of both dosimeters.
e. Discuss the results & why.

B. Distance from Source

1. Review the inverse square law.
2. Demonstrate:
   a. Place one dosimeter a fixed distance from the source and a second at twice the distance.
   b. Expose both for the same period of time.
   c. Have students read and report the results of both dosimeters.
   d. Discuss the results & why.

C. Shielding of Source

1. Explain absorption and attenuation of radiation by shielding.
2. Demonstrate:
   a. Place two dosimeters at a fixed distance from a source of radiation.
   b. Place shielding material between source and one dosimeter.
   c. Remove both dosimeters at the same time.
   d. Have students read and report the results of both dosimeters.
   e. Discuss the results & why.
   f. Explain the "Half-Value and Tenth-Value Layers"
      1. Amount of <u>any</u> shielding materials required to reduce radiation intensity to one-half.
      2. Amount required to reduce to one-tenth.

III. APPLICATION (drill, illstrations, analogies, oral questions or assignments)

A. Repeat the three preceding demonstrations.

B. For the "Time of Exposure" demonstration have students estimate the dosage of the second dosimeter before reading.

C. For the "Distance from Exposure" demonstration have students calculate the dosage on the second dosimeter before reading.

D. For the "Shielding of Source" demonstration use several dosimeters and layers of shielding material to obtain data for the plotting of a curve of dosage vs. thickness.
Ask the students to estimate the thickness of the material to reduce the dosage to half of that without shielding.

IV. TEST (final check on students' comprehension of material presented)

A. Ask class to write answers to the following questions:
   1. Name the three factors in the control of dosage.
   2. If a radiographer receives a dose of 7 mr/hr from a source by standing 100 feet away for 5 minutes, how much will he receive in 12 minutes?
   3. If a radiographer receives a dose of 7 mr/hr from a source by standing 100 feet away for 5 minutes, how much would he receive in 5 minutes at 75 feet away?
   4. How thick is a Half-Value Layer? A tenth-value layer?

B. Check and discuss answers given. Make sure all class members understand correct answers.

V. SUMMARY

Emphasize the following major points:

A. Time, distance and shielding are the three most important radiation protection factors.

B. Radiation intensity is inversely proportional to the square of the distance of source of radiation.

C. All materials having density and mass have some radiation shielding value.

D. Time spent in radiation field is proportional to the total exposure dose.

The Next Lesson is: The Calculation of Shielding Thickness

INSTRUCTOR'S LESSON PLAN
Related Technical Information

Unit 6
Lesson 9
Time 2 hours

SUBJECT: The Calculation of Shielding Thickness

AIM (or purpose): To develop understanding and ability in making calculations required for determining the thickness of radiation shielding

REFERENCES: Radiation Safety in Industrial Radiography with Radioisotopes, P.M. Frazier, C.R. Buchanan, and G.W. Morgan, 1954, U.S. Dept of Commerce, Washington, D.C.
Information Sheets #8, #9, #12

I. PREPARATION (of the learner)

A. Introduce the topic and briefly review the need for shielding radioactive sources and radiographers from ionizing radiation.

B. Outline some of the subjects to be studied explaining why it is important to know the thickness of a half or tenth value layer, the location of shielding material, its properties and amounts needed for varying source intensities.

II. PRESENTATION (of the information)

Instructional Topics	Things to Remember to Do or Say
A. Absorption of gamma radiation 1. Compton effect 2. Photoelectric effect 3. Pair production	Refer to information sheet #9 and review mechanisms of attenuation of a photon beam as it passes through a material.
B. Geometry of Absorption 1. Narrow beam 2. Broad beam	1. Define the two terminoligies and contrast their meanings: a. Broad beam shielding includes the effects of scattered radiation resulting from deflection of the primary radiation as well as absorption of the primary radiation.

II. PRESENTATION (continued)

Instructional Topics	Things to Remember to Do or Say
	b. Narrow beam shielding does not include the effects of scatter from the shield. 2. Explain the importance of determining the method of calculation. 3. Questions
C. Calculations of narrow beam shielding $I = I_0e - ut$	1. Define the terms of the equations on the chalkboard: Reduction factor = eut e = 2.718 (A constant) u = the linear absorption coefficient t = thickness of shield (in centimeters) $I = I_0e - ut$ I_0 = the original radiation exposure rate I = the attenuated radiation exposure rate e = 2.178 (a constant) u = the linear absorption coefficient t = the thickness of shield in centimeters 2. Show calculations of a typical problem in shielding. 3. Questions
D. Emperical data for broad beam absorption	1. Define: a. Reduction factor - $\frac{\text{Dose rate without shield}}{\text{Dose rate with shield}}$ b. Half-value and tenth-value layer - amount of shielding material required to reduce radiation intensity to one half its original value Tenth value layer - amount of shield material required to reduce radiation intensity to one-tenth its original value 2. Explain the origin of the NBS curves for broad beam absorption. 3. Demonstrate the determination of shielding thickness by use of half-value layers. Explain and discuss

	4. Tabulate on the chalkboard the values of half value and tenth value layer of iron, lead, and concrete for Cobalt, Iridium, and Cesium radiation. 5. Distribute copies of the NBS reduction factor curves for broad beam shielding and information sheets 12A, 12 B, 12C. 6. Explain and discuss.
E. Relative efficiency of shielding materials	Hand out information sheet #13 - Explain and discuss
F. Equation for determining the number of half-value layers required to reduce primary radiation to an acceptable level and equation for tenth-value layers (Logarithmic method)	Refer to Information Sheet #8: 1. Write both equations on chalkboard. 2. Have students copy them. 3. Work two problems on chalkboard using each equation. 4. Prove validity of answers.

III. APPLICATION (drill, illustrations, analogies, oral questions or assignments)

A. Ask students to define broad and narrow beam absorption and to explain the limitations of the calculations from narrow beam absorption.

B. Request others to define the Compton effect, photoelectric effect, and pair production.

C. Have another define the reduction factor, half-value layer, and tenth-value layer.

D. Suggest members of the group use or explain the NBS curves for broad beam absorption.

E. Have each individual determine the number of half-value layers to reduce an Iridium 192 radiation intensity of 1000 mr/hr to 10 mr/hr. Ask for verbal replies and demonstrate the solution.

F. Ask the students to determine the thickness of lead, iron, and concrete which corresponds to the half-value layers in the above problem.

G. Invite all class members to work two shielding problems requiring the use of the logarithmic method for solving the problems as explained in step II. Discuss answers. Review the equations if necessary.

IV. TEST (final check on students' comprehension of material presented)

NOTE: Written Test

A. Define:
   1. Half-value layer
   2. Tenth-value layer
   3. Reduction factor

B. How many half-value layers are needed to reduce a radiation intensity of 250 mr/hr to 2 mr/hr?

C. How much lead shielding is required to reduce the level of Cobalt 60 from 250 to 2 mr/hr?

D. What thickness of lead is required if the information is taken from the NBS absorption curves?

E. What is the difference between narrow beam and broad beam absorption?

Check and discuss.

V. SUMMARY

A. Shielding can be achieved with any relatively non-porous material or anything that has mass or weight.

B. The required amount of shielding can be calculated by several methods.

C. Shielding from contamination is not as simple as shielding from a point source of radiation.

D. A mixture of several different types of material is sometimes used as shielding; i.e., concrete, steel, sand, water, wood, etc.

The Next Lesson is: Elements of Electrical Circuits

INSTRUCTOR'S LESSON PLAN
Related Technical Information

Unit 6
Lesson 10
Time 1.5 hours

SUBJECT: Elements of Electrical Circuits

AIM (or purpose): To outline and acquaint the student with the fundamentals of electronic circuitry

TEACHING AIDS: Film: Elements of Electrical Circuits, 11 mins., 16 mm, sound, Pennsylvania State University, University Park, Pa.

EQUIPMENT: Film projector and screen

I. PREPARATION (of the learner)

A. Point out that an understanding of the fundamentals of electronic circuitry is necessary if the student is going to use and maintain x-ray generating, portable power generating, and nuclear radiation detecting equipment properly and in a non-hazardous manner.

B. Invite special attention to the definitions of the following terms by the student:

1. Conductivity
2. The amp
3. The volt
4. Resistance and the ohm
5. Ohm's Law

C. Caution the group that a test will be given at the conclusion of the film showing.

II. PRESENTATION (of the information)

Instructional Topics	Things to Remember to Do or Say
"Elements of Electrical Circuits"	Review film before showing to students. Make notes of key points and inform students of these key points before showing them the film.

II. PRESENTATION (continued)

Instructional Topics	Things to Remember to Do or Say
	Have film and projector set up before students arrive.

III. APPLICATION (drill, illustrations, analogies, oral questions or assignments)

Discuss the film, emphasizing these points in the discussion.

A. The definition of the terms:
   1. Conductivity
   2. Insulators and conductors
   3. The volt, amp, and ohm

B. Ohm's Law and its application

C. The effects of heat on resistance

D. The effects of size and length of the conductor on resistance

IV. TEST (final check on students' comprehension of material presented)

NOTE: Oral Quiz

A. If a six volt battery was connected across a 3 ohm resistor, how many amps would flow?

B. Define:
   1. Resistance
   2. Amperage
   3. Voltage

C. What happens to the electrons in a conductor when a voltage is applied? How is this related to the atomic bonding in metals?

V. SUMMARY

A. In order to understand the behavior of electric power one must first learn to understand the basic laws pertaining to this subject.

B. The terms used in applying these laws must be interpreted properly.

C. Students must learn to use these circuits in a non-hazardous manner.

The Next Lesson is: Gamma Ray Apparatus

INSTRUCTOR'S LESSON PLAN
Related Technical Information

Unit 7
Lesson 1
Time 1.5 hours

SUBJECT: Gamma Ray Apparatus

AIM (or purpose): To provide knowledge and understanding of the characteristics of gamma ray exposure apparatus

TEACHING AIDS: Sample radiographs
Film viewer

REFERENCES: Nondestructive Testing Handbook, Volume I, Society for Nondestructive Testing, 1963, Evanston, Illinois
Radiography in Modern Industry, Eastman Kodak Company, 1958, Rochester, N. Y.

I. PREPARATION (of the learner)

A. Introduce subject and explain the usefulness of the information to be given in this lesson; point out that it will aid the radiographer in obtaining better radiographs making his job easier and safer.

B. Stress the fact that a thorough understanding of the equipment and its capabilities will result in improved techniques and economic advantages.

II. PRESENTATION (of the information)

Instructional Topics	Things to Remember to Do or Say
A. Penetrating power of gamma rays	1. List on the chalkboard and explain, the useful range of penetration for Cobalt, Iridium, Cesium and Radium. 2. Explain the term KEV and MEV. 3. List the KEV range or MEV range of the three synthetic isotopes - cobalt, iridium, and cesium. 4. Explain main energy spectrum of CO 60, i.e., 1.1 MEV and 1.3 MEV.

B. Quality of Radiation	1. Define radiation quality. 2. Explain: a. Why the radiation quality of gamma radiation is fixed b. The effect of the fixed radiation quality on the latitude of thickness c. The difficulties of sensitivity control with isotope radiation 3. Show sample radiographes 4. Questions
C. Safety	1. Point out the hazards of the continuously active source: a. Cannot be turned off while being transported b. During periods of storage c. Between exposures d. In the event of capsule rupture 2. Explain the problems of shielding: a. Other workers b. Confined areas c. Scaffolds d. Congested areas e. Uncontrolled areas 3. Questions
D. Disadvantages of gamma radiation	Discuss: 1. The cost of source replacement 2. The expense of safety programs 3. The limitations for inspection of thin or light materials 4. Questions
E. Advantages peculiar to gamma radiation	Explain: 1. Equipment mobility 2. Self containment 3. Unrestricted beam geometry 4. Questions

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III. APPLICATION (drill, illustrations, analogies, oral questions or assignments)

Discuss the following questions:

A. What is the useful thickness range (in steel) of radiation from Iridium 192 ? Cobalt 60 ? Cesium 137 ?

B. What is the KEV range of Iridium 192? Cesium 137?

C. What is the MEV of the two Cobalt 60 gammas?

D. What is the duty cycle of isotope radiation?

E. What is the greatest operational disadvantage of isotope radiation?

F. Why are the shielding requirements greater for Cobalt than Cesium?

G. Why is gamma radiation ineffective for inspection of light materials such as aluminum and magnesium?

IV. TEST (final check on students' comprehension of material presented)

NOTE: Written Test

A. Define KEV and MEV.

B. List the useful range of thickness for radiography with:
1. Cobalt 60
2. Iridium 192
3. Cesium 137

C. What effect on contrast would result from changing the radiographic technique of a 1/4" steel plate from the use of Iridium to Cobalt?

D. What is the greatest advantage of gamma radiation for radiographic use?

Check and discuss

V. SUMMARY

A. Gamma rays have relatively more penetrating power than portable x-ray generators.

B. Gamma radiation cannot be shut off.

C. Gamma ray uses are more flexible than those of x-ray generators.

D. Gamma rays are unsuitable for radiographing thin, light metals and plastics.

E. Gamma ray intensity decays with time.

The Next Lesson is: X-ray Apparatus

INSTRUCTOR'S LESSON PLAN
Related Technical Information

Unit 7
Lesson 2
Time 1.5 hours

SUBJECT: X-ray Appartus

AIM (or purpose): To familiarize the student with the characteristics of x-ray generators and x-ray apparatus

TEACHING AIDS: Sample radiographs
Film viewer
X-ray generator and apparatus

REFERENCES: Nondestructive Testing Handbook, Volume I, Society for Nondestructive Testing, 1963, Evanston, Illinois
Radiography in Modern Industry, Eastman Kodak Co., 1958, Rochester, N.Y.
Information Sheet #14

I. PREPARATION (of the learner)

A. Arrange the class in good viewing position around the x-ray apparatus and point out the essential parts and characteristics of the equipment.

B. Give a brief review of the capabilities and uses of x-ray with special emphasis on industrial application.

C. Point out that each student will be given individual instruction on how to use x-ray apparatus.

II. PRESENTATION (of the information)

Instructional Topics	Things to Remember to Do or Say
A. Penetrating power of x-ray apparatus	1. List on the chalkboard the range of penetrating power for portable generators, fixed generators, and accelerations. Portable x-ray generators range: about 1/8" to 1 1/2" steel equivalent. Fixed type:

1/4" to 2 1/2"; accellerators up to 12" or more.

2. Explain how penetration power can be varied by changing kilovoltage.
3. Point out that as x-ray wave length decreases, the penetrating power increases.

B. Quality of radiation

1. Define radiation quality. X-ray quality can be compared to the KV or wave length of the x-rays being generated.
2. Explain:
   a. How radiation quality can be varied on an x-ray generator by changing KV setting
   b. The effect of radiation quality on thickness latitude
   c. The ability to adjust sensitivity by changing the radiation quality
3. Show sample radiographs of the above.
4. Hand out Information Sheet No. 14.

C. Safety

1. Point out the advantages of electrically generated radiation from a safety standpoint. Radiation can be turned off when not in use.
2. Explain why x-rays are easier to shield than higher energy gamma radiation. The higher the energy the more shielding necessary.

D. Disadvantages of x-ray apparatus

1. Define duty cycle and constant potential. Explain the length of time than an x-ray generator can be operated without overheating tube is called duty cycle.
2. Explain why cooling is required in the operation of x-ray generators. Cooling required to protect target and tube.
3. Point out the disadvantages of:
   a. Large size of x-ray tube heads
   b. Electrical power requirements
   c. Restricted beam geometry of tank units
   d. Restircted duty cycle because of

excessive heat generated by electrons striking target in x-ray tube.

III. APPLICATION (drill, illustrations, analogies, oral questions or assignments)

Ask the class to assist in answering the following questions:

A. What is the thickness range in steel of x-rays from a 200 KVP x-ray generator?

B. How can penetrating power be adjusted on x-ray generators?

C. What effect does radiation quality have on the latitude of thickness which can be covered by a single exposure?

D. How does radiation quality effect sensitivity?

E. Why are x-rays from portable generators easier to shield than gamma rays?

F. What is meant by an x-ray generators duty cycle?

G. How can the duty cycle be increased?

H. List four disadvantages of x-ray generators?

IV. TEST (final check on students' comprehension of material presented)

A. Suggested questions for oral or written test:
   1. Define radiation quality.
   2. What happens to the wave length of the radiation when the KV is increased?
   3. Define thickness latitude capability.
   4. List three safety features of x-ray generators.
   5. What is meant by a constant potential x-ray generator?

B. Discuss correct answer for each question included in the test and clarify any additional questions class members may have about x-ray apparatus.

The Next Lesson is: Decay of Radioactive Materials

INSTRUCTOR'S LESSON PLAN
Related Technical Information

Unit 7
Lesson 3
Time 1.5 hours

SUBJECT: Decay of Radioactive Materials

AIM (or purpose): To develop an understanding of radioactive decay mechanisms

REFERENCES: Nondestructive Testing Handbook, Volume I, Society for Nondestructive Testing, 1963, Evanston, Illinois
Information Sheets #15, and #16

I. PREPARATION (of the learner)

A. Write aim of lesson on chalkboard explaining that the lesson is calculated to help the radiographer in selecting the proper source of radiation for a particular assignment and should help him understand the safety requirements for each type of source.

B. Briefly review previously discussed material by holding a short discussion, on alpha and beta particles, gamma photons and where these energy forms originate.

II. PRESENTATION (of the information)

Instructional Topics	Things to Remember to Do or Say
A. Disintegration mechanisms	1. List the four modes of disintegration alpha particle emission, beta and positron particle emission and "K" capture. 2. Define electron or "K" capture, i.e., electron capture from the "K" shell by the nucleus of the atom. 3. Define: a. Alpha particle - stream of fast moving helium nuclei, highly ionizing, weakly penetrating

   b. Beta particle - negatively charged particle emitted from nucleus.
   c. Gamma photon - short wave length, electromagnetic radiation of nuclear origin
4. Questions

B. Disentegration scheme

1. Draw chalkboard sketch of Cobalt 60 decay scheme explaining:
   a. The intermediate gamma emission
   b. The two beta disintegrations
   c. The final two gamma emissions
   d. The formation of stable Nickel 60
2. Questions

C. Decay half- life

Refer to information sheets #15 and 16

1. Define half-life and decay rates on chalkboard.
2. List the half-life values for:
   a. Cobalt 60 = 5.3 years
   b. Iridium 192 = 75 days
   c. Cesium 137 = 27 years
3. Sketch a half-life decay curve on the chalkboard, explaining its use.
4. Questions

D. Decay tables

1. Explain the advantages of decay tables:
   a. Helps in figuring exposure time accurately and quickly
   b. Reduces calculation errors
   c. Helps to project future needs of replacement source capsules
2. Work sample problems using decay tables.

III. APPLICATION (drill, illustrations, analogies, oral questions or assignments)

A. Have the group list the four modes of disintegration.

B. Ask students to define each mode and discuss.

C. Request students draw the Cobalt 60 decay scheme and explain.

D. Ask the following questions and discuss each:
   1. What is meant by half-life?
   2. What is the half-life of Iridium 192? Cobalt 60?
   3. What is the value of the decay chart?

E. Have students work the following problem using a Cesium decay chart:
   1. 5 Curie Cesium 137 source was purchased in 1959. When will its remaining activity be 30% of its original activity? What is its activity now?
   2. Using Cobalt tables (Information Sheet #15) what is the remaining activity of a 2 curie Cobalt 60 source that was encapsulated in September 1960?

IV. TEST (final check on students' comprehension of material presented)
NOTE: Written Test

A. Why are the two beta disintegrations of Cobalt 60 not used in industrial radiography?

B. Does nuclear disintegration always produce a stable element- Explain.

C. How long is a half-life?

D. What is the half-life of Cobalt 60? Iridium 192?

E. Define K capture?

F. What is the result of K capture?

G. How many half-lives has a cobalt 60 source had if it is 21.2 years old?

H. What percentage of its original activity does it still retain?

Check and discuss.

V. SUMMARY

A. Time required for a radioactive isotope of an element to lose one-half of its original energy or intensity is called half-life.

B. Long half-life is desirable in selecting a radioactive isotope for use in radiography.

C. Only a few radioisotopes are economically useful in industrial radiography.

D. Most radioactive isotopes are either too weak having a long wave length or have an undesirable half-life, or a combination of both.

The Next Lesson is: Construct an Isotope Decay Chart

INSTRUCTOR'S LESSON PLAN
Manipulative Skills

Unit	7
Lesson	4
Time	2 hours

JOB (or operation): Construct an isotope decay chart

AIM (or purpose): To develop skill in the preparation of decay charts and to develop an awareness of the importance of decay charts

MATERIALS: Pencils, straightedge, and eraser
Cartesian coordinate paper
Semi-log paper, 2 cycle, 70 divisions

REFERENCES: Information Sheet #17

I. PREPARATION (of the learner)

Introduce the subject and stress that this lesson is recommended to enable one to find the source strength of a capsule so that accurate exposure time can be calculated. It should also help to project the basis for source capsule replacement.

II. PRESENTATION (of the skills)

Operations or Steps	Key Points (things to remember to do or say)
A. Place semi-log paper on table	1. Pass out information sheet # 17. 2. Place log scale vertically facing upward.
B. Title the paper	Write the following in the upper right hand corner: 1. The source model and serial number 2. The type of radioactive material 3. The date of chart preparation
C. Label coordinates on paper	1. Label the log scale as "Activity in Curies". 2. Label the arithmetic scale in months or years according to type of source.

	3. Start with the month or year the isotope was measured. 4. Use abbreviations to avoid cluttering paper. 5. The scale across the bottom should cover the period of usefulness of the source.
D. Mark the present activity	1. Determine source activity from manufacturers data or measurements previously made on the source. 2. Place mark on the chart for this activity. 3. Mark is placed at point representing the date of measurement.
E. Mark the activity at one-half the life-decay period from the present	1. The source activity will be one half the present value in one half-life period. 2. Mark the time on the scale across the bottom of the paper. 3. Mark the source activity for that date.
F. Draw the decay curves	1. Connect the lines between the present and the first half-life activities. 2. Extend the curve for the entire period of the graph.
G. Semi-log paper	1. Give advantages of using semi-log paper for this chart. 2. Compare a chart made on semi-log paper to a chart made on cartesian coordinate paper. 3. Questions

DEMONSTRATE AGAIN BUT HAVE THE STUDENTS INDICATE THE PROPER SEQUENCE AND PROCEDURE.

III. APPLICATION (practice by learner under close supervision)

A. Supervise the students in the preparation of a decay chart for 75 curies of Iridium 192 using the steps outlined in Step II.

B. Have group prepare a chart for twenty years decay of 30 curies of Cobalt 60.

C. Suggest students prepare Iridium 192 decay chart substituting cartesian coordinate graph paper for semi-log graph paper.

D. Compare the two charts and invite students to explain the advantages of using semi-log graph paper.

IV. TEST (performance of skill to acceptable standards)

NOTE: Written Test

A. Prepare a decay chart on 50 curies of Iridium 192.

B. Develop a decay chart on 20 curies of Cobalt 60.

C. Determine the strength of the Iridium source 60 days from now. 6 months later.

D. Show the Cobalt source will have one-fourth the activity of the present time.

E. What is meant by a half-life of decay? Check and discuss.

V. SUMMARY

A. Decay charts save time when making calculations for radiographic exposures.

B. Semi-log paper condenses the size of charts necessary to plot decay and straighten the curve.

C. Separate decay charts are necessary for each type of radioisotope because of differences in decay rates.

D. Decay charts are not used in x-ray exposure calculations.

The Next Lesson is. Chemistry of Iron and Steel

INSTRUCTOR'S LESSON PLAN
Related Technical Information

Unit 8
Lesson 1
Time 1 hour

SUBJECT: Chemistry of Iron and Steel

AIM (or purpose): To acquaint the class members with the basic metallurgical processes in iron and steel refining

TEACHING AIDS: Film: Chemistry of Iron and Steel, 14 mins., 16 mm, sound, U.S. Steel Corperation
16 mm projector
Pieces of metal with defects

REFERENCES: Metals Handbook, 1948 Edition, American Society for Metals, Cleveland, Ohio

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I. PREPARATION (of the learner)

This film will illustrate how certain types of defects originate in steel plate, forgings and castings. The radiographer's job will include locating and identifying these defects. Gas bubbles as well as solid materials trapped in the solidified metal are considered defects.

Point out the following to be noted during the showing of the film:

A. The product of the blast furnace is iron.

B. The product of the open hearth and electric furnaces is steel.

C. Iron must be separated from other elements before it is of commercial value.

D. Very high temperatures must be used to accomplish separation of iron from other chemicals.

E. Other chemicals are added to the iron and steel to cause reactions that produce slag and gases.

F. Notice the melting temperature of iron as given in the film.

G. Announce to the class that an oral test will be given after the film is viewed.

II. PRESENTATION (of the information)

Instructional Topics	Things to Remember to Do or Say
A. "The Chemistry of Iron and Steel"	Show the film NOTE: The film should be viewed by the instructor in advance to showing it to the class. Detailed notes should be made by the instructor on important information presented by the film for use in class discussion after the film showing.
B. Causes of defects in metals	Review the basic causes of defects in metals and relate to the information presented in the film. Explain how these defects makes radiography necessary.

III. APPLICATION (drill, illustrations, analogies, oral questions or assignments)

A. Discuss the film. Note the following points and invite comments from the students:

1. The purpose of the blast furnace
2. The purpose of the open hearth and electric furnaces.
3. The materials which are charged to each type furnace.
4. The temperatures required for the making of iron and steel.

B. Show class examples of metal with defects and discuss what caused the defects.

IV. TEST (final check on students' comprehension of material presented)

Give verbal quiz. The following questions are suggested:

A. What is the product of the blast furnace?

B. What is the product of the open hearth furnace?

C. What is the material charged to the blast furnace?

D. What is the temperature of the iron in the bottom of the blast furnace?

E. What are the bubbles that rise to the top of the metal in the open hearth furnace?

F. What are some typical defects in metal and what are their causes?

The Next Lesson is: Semi-finished Steel

INSTRUCTOR'S LESSON PLAN
Related Technical Information

Unit 8
Lesson 2
Time 1 hour

SUBJECT: Semi-finished Steel

AIM (or purpose): To teach the basic metallurgical practices employed in steel making

TEACHING AIDS: Film: Semi-Finished Steel, 8 mins., 16 mm, sound, United States Steel Corporation

EQUIPMENT: Film projector and screen

REFERENCES: Metals Handbook, 1948 Edition, American Society for Metals, Cleveland, Ohio
Nondestructive Testing-Introduction PI-4-1, 1964, General Dynamics-Convair, San Diego, California

I. PREPARATION (of the learner)

A. Introduce the film, pointing out some of the features to watch for:
   1. The castings of the ingot
   2. Various types of ingot molds
   3. Addition of aluminum during pouring
   4. The squeezing of the metal as it passes through the rolling mill

B. Stress that this information will help the radiographer to better understand how some defects are removed while some remain in the ingots.

II. PRESENTATION (of the information)

Instructional Topics	Things to Remember to Do or Say
"Semi-finished Steel"	Show the Film

III. APPLICATION (drill, illustrations, analogies, oral questions or assignments)

A. Have students discuss the practice of pouring the ingot:
   1. The use of the various types of ingot molds
   2. Hot topping molds
   3. Cropping of molds after solidification
   4. The source of future defects from improper cropping

B. Discuss the practice of deoxidation in the mold:
   1. The addition of aluminum and/or silicon to control gases in the steel
   2. The source of future defects from improper deoxidation

C. Discuss the reason for reducing the steel in several passes instead of one and the problem of internal rupture from excessive single pass reduction.

D. Discuss the problem of laminations and the effect of gas bubbles which do not weld during rolling.

E. Invite questions from students for further discussion.

F. Reshow film if all points or questions have not been cleared up.

IV. TEST (final check on students' comprehension of material presented)

NOTE: Written Test

A. What is the purpose of the hot top on an ingot mold?

B. Give reasons for the addition of aluminum during pouring.

C. What happens to the gas bubbles in the ingot when it passes through the rolling mill?

D. Why is the top of an ingot mold cut off and discarded?

E. What type of defect can be caused by poor stirring of the materials added for deoxidation, i.e., aluminum and silicon?

Discuss test results - give help where needed

V. SUMMARY

A. Casting of semi-finished steel requires many methods of removing undesirable components and discontinuities from the ingot.

B. It is important that the correct amounts of each material be added to the steel before the ingot is poured so that the ingot will meet required specifications.

The Next Lesson is: Rolling of Sheet and Plate Steel

INSTRUCTOR'S LESSON PLAN
Related Technical Information

Unit	8
Lesson	3
Time	1 hour

SUBJECT: Rolling of Sheet and Plate Steel

AIM (or purpose): To develop an understanding of the basic metallurgical practices in the making and finishing of steel

TEACHING AIDS: Film: Hot Rolling Steel Sheets, 8 mins., 16 mm, sound, U.S. Steel Corporation

EQUIPMENT: Film projector and screen

REFERENCES: Metals Handbook, 1948 Edition, American Society for Metals, Cleveland, Ohio
Nondestructive Testing-Introduction - PI-4-1, 1964, General Dynamics-Convair, San Diego, California
Information Sheet #18

I. PREPARATION (of the learner)

A. Introduce film and point out the following highlights to be noted during the viewing of the film:
   1. The ragged ends of the plates and sheets as they are being rolled
   2. The removal of defects in the slab before final rolling
   3. The use of x-ray radiation to control the thickness of the sheet
   4. The control of the final temperature at the end of the rolling
   5. How some defects are removed at the mill and how some cannot be removed because their presence and location is not known
   6. The importance of temperature control if proper strength, welding and impact properties are to be obtained from the finished product

B. Stress the importance of acquiring this related information and how it will benefit the student in the pursuit of knowledge in the field of radiography.

II. PRESENTATION (of the information)

Instructional Topics	Things to Remember to Do or Say
"Hot rolling steel sheets"	Show the Film

III. APPLICATION (drill, illustrations, analogies, oral questions or assignments)

A. Have students discuss the control of end and edge defects:
   1. The cropping of the skelp to eliminate edge laminations
   2. The shearing of sheet strip before coiling

B. Discuss the removal of defects before final rolling.
   1. Defects may not be removed on thicker materials
   2. Areas of removal are leveled by subsequent rolling in thin sheet
   3. All defects may not be detected by the mill

C. Discuss the techniques of gauging thickness by radiation

D. Discuss the effect of poor finishing temperature on the steel:
   1. Wrong strength properties
   2. Poor welding properties
   3. Poor impact properties

E. Invite questions throughout discussion and reshow all or parts of film if necessary.

F. Pass out information sheet # 18 and discuss.

IV. TEST (final check on students' comprehension of material presented)

NOTE: Oral Quiz

A. Why is it necessary to crop the edges and ends of rolled sheet and plate?

B. What is the result of improper control of the final rolling temperature?

C. Are all plates and sheets rolled from materials from which the defects have been removed?

D. Can improper final rolling temperature cause defects to occur in later fabrication?

Upon completion of test, discuss answers given, give help where needed

V. SUMMARY

A. Sheet and plate steel ends are cropped to remove laminations.

B. Grinders remove surface defects before final rolling.

C. Radiation emitting gauges are used to control the desired plate thickness as plate is being rolled.

D. Steel must be soaked before rolling to insure uniform temperature throughout the plate before rolling.

E. Temperature control during rolling insures proper strength, welding and impact properties

The Next Lesson is: The Structure of Metals

INSTRUCTOR'S LESSON PLAN
Related Technical Information

Unit 8
Lesson 4
Time 1.5 hours

SUBJECT: The Structure of Metals

AIM (or purpose): To outline the basic structure of metals and develop a thorough understanding of the subject

TEACHING AIDS: Prepared sketches on passout sheets showing the three basic metallic structures

REFERENCES: Elements of Material Science, L. H. Van Vlack, 1961, Addison-Wesley Publishing Company, Reading, Mass.
Physical Metallurgy for Engineers, D. S. Clark, and W.R. Varney, 1962, D. Van Nostrand Company, Princeton, N. J.

I. PREPARATION (of the learner)

Explain why the knowledge of basic structure of metals is necessary information for the radiographer.

Point out that this information will be most helpful in interpreting x-ray films and in giving explanation of defects shown in the film.

Review again some of the defects of metals that are evidenced by x-ray film.

II. PRESENTATION (of the information)

Instructional Topics	Things to Remember to Do or Say
A. The metallic bond	1. Sketch a single plane view of a metallic structure. 2. Explain: a. The loosely held orbital electrons b. The electron cloud c. The forces holding the structure together 3. Relate the loosely held electron forces to the high electrical and thermal conductivity of metals.

II. PRESENTATION (continued)

Instructional Topics	Things to Remember to Do or Say
B. The crystalline structure or space lattice	1. Sketch the three basic metallic structures on the chalkboard. 2. Draw sketches and show the major slip planes in each structure. 3. Define yield point and ultimate strength in terms of bonding energies.
C. The metallic phases	1. Define the phase as a physically homogenous and distinct portion of a material system. 2. List some possible types of phases in metals such as: pure component, intermetallic compounds, solid solutions, etc. 3. Define the intermetallic compound and solid solution on chalkboard. 4. Use the example of ice tea and sugar to illustrate possible phases; liquid, solid (ice) and steam vapor. 5. Define and contrast the substitutional and interstitial solid solutions. Explain that substitutional solid solutions have limited effects on strengthening of metals. Point out that substitutional alloying is generally used to improve properties other than strength; such as corrosion resistance, better impact properties, ductility. Interstitial alloying is generally employed to increase tensile and yield strength. 6. Use the example of carbon in iron and copper in nickel to illustrate the two types of solid solutions. 7. Ask questions for understanding.

III. APPLICATION (drill, illustrations, analogies, oral questions or assignments)

A. Have students explain the ice tea and sugar system in terms of the type of solution and the phases present from frozen to boiling.

B. Have students sketch the three basic metallic crystalline structures.

C. Ask the students to define an intermetallic compound, a substitutional solid solution, and an interstitial solid solution. Have the students draw sketches to illustrate the structures of each of the above phases.

D. Ask students to define "steel".

E. Review with the class the reason for the high electrical and thermal conductivity of metals.

F. Discuss with the class the yield point and untimate strength of a metal in terms of atom movements in the structure.

IV. TEST (final check on students' comprehension of material presented)

A. Suggested questions for a brief written test:
  1. List and sketch the three basic metal lattice structures.
  2. Define a phase.
  3. What are three types of phases found in metallic structures?
  4. What happens to the atomic structure when a piece of metal is yielded? Pulled into two pieces?
  5. What is steel?

B. Discuss correct answers with the class.

V. SUMMARY

Before advancing to the next lesson review the following points of this lesson.

A. The bonding between atoms determines the properties of the materials.

B. The properties of metals are determined by their crystalline structure. All metals have one of three basic types of crystalline structure: body centered lattice, face centered cubic, and hexagonal close pack.

C. The properties of a specific alloy system can be altered by suitable changes in the phases present in the system. These changes are generally accompanied by heat treatment.

The Next Lesson is: The Phase Diagram (Metallurgy)

INSTRUCTOR'S LESSON PLAN
Related Technical Information

Unit 8
Lesson 5
Time 2 hours

SUBJECT: The Phase Diagram (Metallurgy)

AIM(or purpose): To acquaint the student with the basic metallurgical principles

TEACHING AIDS: Copies of Iron-Carbon Diagram

REFERENCES: Elements of Material Science, L. H. Van Vlack, 1961, Addison-Wesley Publishing Company, Reading, Mass.
Physical Metallurgy for Engineers, D. S. Clark and W. R. Varney, 1962, D. Van Nostrand Co., Princeton, N. J.

I. PREPARATION (of the learner)

A. Introduce topic giving a thorough explanation of why this subject is important to the development of a radiographer.

B. Also show how this lesson will help one to understand the properties of metals and how they can be altered or tailored to fit a particular need.

C. Create discussion by explaining what properties are desirable in an automobile spring, a cutting tool, a pocket knife, coil spring, and baling wire.

D. Point out the difference between cast iron and steel and how raw material is altered to make cast iron or steel.

II. PRESENTATION (of the information)

Instructional Topics	Things to Remember to Do or Say
A. The phase diagram	1. Define the phase diagram as a graphical representation of temperature and composition of phases. Draw a typical diagram on the chalkboard.
	2. Explain the equilibrium conditions under which the diagram is constructed. a. All diagrams based on very slow temperature changes b. Diagrams reveal phases present at a given temperature c. They serve as reference to possible phases present in an alloy system.
	3. Draw a phase diagram of copper-nickel.
	4. Label and define coordinates.
	5. Define terminal phases as the pure component or liquid solubility phase.
	6. Define liquid phase as molten metal.
	7. Define the liquid plus solid phase field as the phase where solid metal floats in liquid.
	8. Define solid phase field as the phase below the melting point of all alloys.
	9. Draw phase diagrams of the Ag-Cu system.
	10. Define Eutectic as the reaction of a liquid that forms two or more different solid phases during cooling.
	11. Ask questions
B. The Iron-Carbon diagram	1. Sketch the iron-carbon diagram on chalkboard.
	2. Define Ferrite as iron with a maximum of 0.07% carbon content.
	3. Define Austenite as a body centered cubic lattice structure in iron at temperatures above 1,333 Deg. F. or at room temperature in steel achieved by alloying with suitable elements. More ductile than alpha ferretic steel.
	4. Define the Eutectoid reaction as the reaction of a solid that forms two or more new solid phases during cooling.

As with Eutectic, the word Eutectoid can also refer to an alloy composition or structure associated with the reaction.

5. Carbide or Cementite is also called iron carbide; a normal constituent of annealed steels and cast iron. Strengthens steel but decreases ductility.
6. Explain the upper and lower critical temperatures between ferrite and austenite fields.
7. Define limits of steel as between 0.07% and 1.7% carbon content.
8. Define limits of cast iron as between 1.7% and 6.6% carbon content.
9. Explain the lower melting point of the Eutectic composition and explain its importance in casting practice. The eutectic temperature can be achieved with less expensive equipment because of the lower temperatures required. Eutectic composition contains 4.3% carbon.
10. Indicate the temperature ranges of melting for cast steel. (about 2,800 Degrees F.)
11. Ask questions

C. The phase transformation

1. Explain the transformation from one phase to another on heating or cooling through the transformation temperature:
   a. As temperature changes metal may go through a change because the structure at that temperature may be unstable.
   b. This phenomenon used to advantage to change properties of an alloy system.
   c. Example: Steel heated to transform structure to austenite; if quenched in oil the phase produced results in much higher strength.
   d. Alpha iron: The form of iron that is stable below 1,670 Deg. F., the temperature at which a change in phase occurs.

   - e. Gamma iron: The form of iron that is stable between 1, 670 Deg. F. and 2, 550 Deg. F.
2. Indicate the crystalline structure change in the transformation of austenite to ferrite by explaining that austenite is the high temperature body cubic centered structure (sketch) and ferrite is the FCC structure (draw sketch).
3. Elaborate on the temperature range of transformation of steel compositions above and below as well as the eutectoid composition.
   - a. Full transformation to austenite below eutectoid composition accomplished at 1, 650 Deg. F.
   - b. Above the eutectoid temperature the maximum required is 2, 065 Deg. F. at a carbon content of 1. 7%.
   - c. To achieve full hardness from heat treatment the temperature must produce a full austenitic structure.
4. Explain the martensite reaction on the chalkboard as the change from the austenitic structure (face centered cubic) at elevated temperature to the ferrite structure (body centered cubic) at low temperatures.
5. Define the properties of martensite:
   - a. strong
   - b. hard
   - c. tough

   Ask and invite questions

III. APPLICATION (drill, illustrations, analogies, oral questions or assignments)

A. Have a student sketch a simple phase diagram of a system of components which are completely soluble in one another,

B. Ask group to explain various parts of the diagram.

C. Have another student sketch the iron-carbon diagram.

D. Request group members to label each phase field by its metallurgical name.

E. Have a discussion on the limits of the steel and iron ranges of composition.

F. Ask for comments on the difference in melting points of steel and cast iron.

G. Have each member explain the advantages and methods of using the diagram.

H. Ask and invite questions throughout the drill.

IV. TEST (final check on students' comprehension of material presented)

NOTE: Written Test

A. Describe the composition of the following:
   1. Ferrite or alpha iron
   2. Austenite or gamma iron
   3. Cementite or carbide

B. Outline the composition limits of irons and steel.

C. Define a terminal phase.

D. What does the upper and lower critical temperature represent on the phase diagram?

E. What is a eutectic composition?

F. Sketch the iron-carbon diagram.

Check and discuss.

V. SUMMARY

A. The phase diagram is useful for determining changes in structure when the temperature or composition of the alloy is altered.

B. The iron-carbon system is the most important engineering alloy system.

C. The alteration of composition and temperature can produce a multitude of desirable properties.

D. The phase transformation is a result of changing the temperature of the system. The martensite transformation is the most widely used and most economical strengthening material used in engineering alloys.

The Next Lesson is: The Manufacture of Castings

INSTRUCTOR'S LESSON PLAN
Related Technical Information

Unit 8
Lesson 6
Time 2 hours

SUBJECT: The Manufacture of Castings

AIM (or purpose): To familiarize the student with the methods used to produce castings and the defects which can result from improper casting procedures

TEACHING AIDS: Sample castings with and without defects
Small casting with riser, runner, and sprue attached

REFERENCES: Cast Metals Handbook, American Foundrymen's Society, 1944, Chicago, Illinois
Physical Metallurgy for Engineers, D. S. Clark and W. R. Varney, 1962, D. Van Nostrand Co., Princeton, N. J.

I. PREPARATION (of the learner)

A. Introduce the subject and explain the importance of the information contained in this lesson pointing out that a knowledge of the origin of casting defects aids in their interpretation as they may be shown on radiographs.

B. Explain further that a good inspector should be able to discuss the nature of a casting defect and the alleged origin of it in the language of the foundryman.

II. PRESENTATION (of the information)

Instructional Topics	Things to Remember to Do or Say
A. The mold	1. Sketch a typical foundry mold and label the drag, the cope, cores, risers, and downsprue. 2. Define the function of the various parts of the mold. 3. Show the casting with all gates and risers still in place.

	4. Ask pertinent questions and invite discussion.
B. The pattern	1. Explain the function of the pattern and how it creates the shape of the casting in the mold. 2. Explain why the pattern is always larger than the final part: a. To allow for thermal expansion b. Allowing for surface defect removal without altering size of casting. c. Ask questions
C. The molding materials	1. Define the composition of the sand used for molding. 2. Explain the difference between a green and dry sand mold pointing out that green sand used wet is more economical than dry sand. Steam generated from wet sand causes little trouble on large castings. Scabs may be formed but can be avoided by skin-drying mold with gas flame. 3. Describe the process of ramming as the packing of sand around the pattern in making a sand mold. It is necessary to overcome the formation of voids, however, care must be exercised in the process to prevent the shifting of the pattern in the mold. 4. Ask questions
D. Pouring of the hot metal	1. Define metal fluidity explaining that it pertains to molten metal and its ability to flow as into a mold. 2. Explain why metals are poured 200 to 700 degrees above their melting temperatures: a. To prevent cold laps b. To allow thicker section of casting to form properly before metal solidification 3. Ask questions.

E. Solidification	1. Explain the solidification in thin and thick sections of a mold stressing that metal must flow from thin to thick section of mold or vice versa and must not solidify prematurely. 2. Define "hot spots". 3. Ask questions
F. Casting defects	1. Define and illustrate the origin of: a. Porosity b. Dross c. Shrinkage cavity d. Misruns e. Cold shuts f. Cracks 2. Show the sample castings and defects discussing and explaining as each is shown.

III. APPLICATION (drill, illustrations, analogies, oral questions or assignments)

A. Have a member of the group draw a cross section of a casting mold on the chalkboard.

B. Have another student draw in a simple pattern with all necessary openings.

C. Have still another label all the parts of the mold.

D. Ask participants to explain why the pattern cavity is larger than the final part.

E. Ask each individual student to explain the origin of the following defects: (Using a sketch for clarity if necessary)
   1. Porosity
   2. Dross
   3. Shrinkage cavity
   4. Misruns
   5. Cold shuts
   6. Cracks

IV. TEST (final check on students' comprehension of material presented)
NOTE: Written Test

A. Why is the pattern always larger than the final part ?

B. Do larger castings require higher pouring temperatures? Why?

C. What type of defect could occur if the pouring temperature was not high enough?

D. What type of defects can develop from the contraction or shrinkage of the metal on cooling?

E. What is meant by ramming a mold?

F. What type defect would occur from improper ramming?

Check and Discuss

V. SUMMARY

A. Proper design of mold can eliminate the formation of casting defects.

B. Pattern size allows for shrinkage that occurs when casting cools and solidifies.

C. Some molding materials are porous to allow escape of hot vapors and gases through the walls of the mold.

D. Castings with a wide thickness latitude can contain shrinkage cracks due to uneven cooling.

E. There are several types of casting defects, the more numerous being porosity and shrinkage.

The Next Lesson is: The Heat Treatment of Steel

INSTRUCTOR'S LESSON PLAN
Related Technical Information

Unit 8
Lesson 7
Time 2 hours

SUBJECT: The Heat Treatment of Steel

AIM (or purpose): To outline the operations which are employed in strengthening of steel

TEACHING AIDS: Sketch of iron-carbon diagram on pass out sheet (one for each class member)
Sample of normal, quenched and tempered steel strips
Samples of heat treat cracks in metal

REFERENCES: Elements of Material Science, L. H. Van Vlack, 1961, Addison-Wesley Publishing Company, Reading, Mass.
Physical Metallurgy for Engineers, D. S. Clark and W. R. Varney, 1962, D. Van Nostrand Company, Princeton, N. J.

I. PREPARATION (of the learner)

Use the following questions with explanation to introduce this lesson:

A. What happens when a piece of metal is heated to red hot and immersed in water?

B. What process has been used on your pocket knife blade to give it proper temper?

C. Why is this process sometimes used on welds?

D. Why do some metals crack when subjected to this type treatment?

E. After heating and cooling, what would happen if the piece was reheated to a lower temperature?

F. Explain that this information will assist the radiographer in understanding the cause of equipment failure due to a lack of heat treatment or because of improper heat treatment.

II. PRESENTATION (of [illegible] information)

Instructional Topics	Things to Remember to Do or Say
A. The iron-carbon diagram	1. Sketch the iron-carbon diagram on the chalkboard. 2. Call to the students attention that this is an equilibrium diagram. 3. Review the phase change of cooling from the austenite phase to the ferrite region. 4. Explain the formation of pearlite in slow cooling when cooled slowly from critical temperature, it is a direct transformation product from Austenite. Pearlite is the eutectoid of iron and iron carbide and it resembles mother-of-pearl when viewed under a microscope. It consists of alternate layers of lamellae of iron and cementite and contains 0.33% carbon. 5. Explain the expansion of steel in the transformation change due to the difference in volume of the two phases.
B. The martensite reaction	1. Define the martensitic structure as a body centered tetragonal. Martensite is the hardest of the transformation products of austenite. When carbon content exceeds 0.5% tetragonality of the crystal structure is observed. Martensite is not an equilibrium phase. 2. Explain the distortion of the ferritic structure by the wedging action of the supersaturated carbon. 3. Describe how martensite is formed by rapid cooling to prevent the transformation to pearlite. Martensite in quenched steel has needle-like patterns. This structure in steel is obtained by direct transformation from austenite, by rapid cooling to prevent upper transformation products.

II. PRESENTATION (of the information)

Instructional Topics	Things to Remember to Do or Say
A. The iron-carbon diagram	1. Sketch the iron-carbon diagram on the chalkboard. 2. Call to the students attention that this is an equilibrium diagram. 3. Review the phase change of cooling from the austenite phase to the ferrite region. 4. Explain the formation of pearlite in slow cooling. When cooled slowly from critical temperature it is a direct transformation produce from AUSTENITE. Pearlite is the eutectoid of iron and iron carbide and it resembles mother-of-pearl when viewed under a microscope. It consists of alternate layers of lamellae of iron and cementite and contains 0.33% carbon. 5. Explain the expansion of steel in the transformation change due to the difference in volume of the two phases.
B. The martensite reaction	1. Define the martensitic structure as a body centered tetragonal. Martensite is the hardest of the transformation products of austenite. When carbon content exceeds 0.5% tetragonality of the crystal structure is observed. Martensite is not an equilibrium phase. 2. Explain the distortion of the ferritic structure by the wedging action of the supersaturated carbon. 3. Describe how martensite is formed by rapid cooling to prevent the transformation to pearlite. Martensite in quenched steel has needle-like patterns. This structure in steel is obtained by direct transformation from austenite, by rapid cooling to prevent upper transformation products.

4. Define the martensite start and finish temperatures.
5. Describe the properties of martensite before tempering. It has the maximum hardness and strength of any decomposition product from austenite in steels.

C. The tempering process

1. Define the term "tempering" (sometimes called "drawing") as a treatment below the lower critical temperature below the lower critical temperature followed by any desired rate of cooling. Example: One percent carbon steel after quenching in water from 1, 450 degrees F. is extremely hard and brittle. Tempering at between 200 and 400 degrees F. results in slight loss of hardness and a great increase in toughness.
2. Explain the effect of tempering on the structure of martensite, pointing out that quench cracking may be prevented and the steel is less susceptible to distortion.
3. List some desirable properties of tempered martensite.

D. Cracking caused by heat treatment

Show samples containing heat treating cracks.

1. Discuss the stresses caused by the martensite reaction.
2. Explain the quench crack and its formation -- show sample.
3. Draw a chalkboard sketch of the stress that develops in the transformation to martensite.

Demonstrate·

1. Display three strips of steel about 1/4" x 1/4" x 12" long. One should be heated and quenched, one tempered and one without heat treatment.
2. Explain the properties of each steel strip and how they differ.

III. APPLICATION (drill, illustrations, analogies, oral questions or assignments)

A. Have students explain by a chalkboard sketch the formation of pearlite by the slow cooling of steel from the austenite to the ferrite region.

B. Have students explain by a chalkboard sketch the formation of martensite by rapid cooling from the austenite region.

C. Ask students to elaborate on the transformation of martensite in terms of the volume change and stresses created. Have them contrast the martensite and pearlite transformation.

D. Ask the students to list the desirable properties of tempered martensite.

IV. TEST (final check on students' comprehension of material presented)

A. Explain the martensite reaction using a sketch of the iron-carbon diagram.

B. What is the purpose of tempering the martensitic structure?

C. Explain how stresses are created by the martensitic reaction. Account for the stresses from both transformation and cooling.

D. Sketch the crystalline structure of steel in the austenite range and after transformation to martensite.

E. List three desirable properties of tempered martensite.

Discussion of questions by the group after the test

V. SUMMARY

A. Heat treatment of steel can both prevent and cause equipment failure.

B. Heat treatment can remove stresses that were formed in a weldment during the welding process.

C. Metal properties can be changed to fit their applications by heat treatment.

D. Some of these properties are: ductility, elasticity, malleability, toughness, and brittleness.

The Next Lesson is: Visit to a Foundry

INSTRUCTOR'S LESSON PLAN
Field Trip

Unit 8
Lesson 8
Time 6 hours

SUBJECT: Visit to a Foundry

PURPOSE: To permit the students to observe the pouring, control and inspection of cast metals

MATERIALS: Film badges, dosimeters, safety hats, and safety glasses

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I. PREPARATION (of the learner)

A. Outline purpose of visit and stress need to observe all safety precautions.

B. The students should also be coached to carefully observe and make notes of the following:

1. Preparation of the sand for molds
2. Preparation of the molds (ramming)
3. Placement of the chaplets and chills
4. The flow paths of the molten metal
5. Pouring of the molten metal
6. The removal of the casting from the sand (shakeout)
7. Inspection of the finished casting

II. PRESENTATION (of the information)

A. Issue safety instructions to be followed while in the plant stressing the need for gentlemanly behaviour.

B. Make the tour only under the guidance of a designated foundry employee and the instructor.

III. APPLICATION

A. After completing the trip, ask the students to discuss:

1. Why the sand is given so much care and testing.
2. Why the molds are larger than the final part.
3. The purpose of chaplets and chills in mold preparation.
4. Why the metal is allowed to flow back to the surface of the mold during pouring.
5. How defects can result from removing the casting from the sand while the metal is still red hot.

6. The inspection techniques used by the foundry.

B. Invite questions and discuss unusual procedures noted.

IV. TEST

NOTE: Written Test

Write a brief report on the observations made during the field trip covering all aspects of foundry operation from preparation of molding materials to the inspection of the finished product.

V. SUMMARY

A. A casting is the result of many closely controlled processes and steps.

B. Misalignment of molds can cause casting defects.

C. Extra metal is necessary when pouring a mold to allow for shrinkage during the cooling process.

D. Final inspection of castings may include hardness tests and a variety of other types of nondestructive explorations.

E. A ladle analysis is generally made before castings are poured.

The Next Lesson is. The Metallurgy of Welding

INSTRUCTOR'S LESSON PLAN
Related Technical Information

Unit 9
Lesson 1
Time 2 hours

SUBJECT: The Metallurgy of Welding

AIM (or purpose): To provide information and develop an understanding of the reactions which occur during the welding process and their effect on the weld structure

TEACHING AIDS: Iron carbon diagram chart (pass out sheet for each class member)
Sample electrodes with coatings
Sectioned and etched welds

REFERENCES: Welding Metallurgy, G.H. Linnert, 1965, American Welding Society, New York, N.Y.
Physical Metallurgy for Engineers, D. S. Clark and W.R. Varney, 1962, D. Van Nostrand, Princeton, N.J.

I. PREPARATION (of the learner)

A. Introduce the lesson subject by asking selected basic questions to start short discussions. The following questions should be used to help lead the class into a discussion of the lesson:
   1. Have any of you ever done any welding?
   2. What is welding?
   3. How many different types of welding processes do you know of?

B. Point out that a general knowledge of welding processes is necessary to understand the cause of welding defects and a radiographer must have this understanding in order to intelligently perform his work.

II. PRESENTATION (of the information)

Instructional Topics	Things to Remember to Do or Say
A. The structure of the weld 1. The weld deposit 2. The fusion zone 3. The heat affected zone 4. The parent metal	1. Review the metallurgy of cast steel. 2. Draw a sketch of a typical weld and label the different zones. 3. Show samples of actual welds and explain pertinent features.

B. The molten metal shield 1. Inert gases 2. Electrode coatings a. Slagging coatings b. Volatile coatings 3. Suberged arc flux	1. Show sample electrodes and discuss: a. The degasification of the molted metal b. Protection of the molten metal from the atmosphere c. Reduction of impurities in the weld puddle d. Addition of alloys to the weld from slags and flux
C. Cooling of the weld puddle (solidification)	1. Draw a sketch of a typical weld and an iron-carbon diagram on the chalkboard. 2. Associate the structure of the weld with phases of the iron-carbon diagram. 3. Describe the effects of cooling on warpage and residual stresses in welds of steel.

III. APPLICATION (drill, illustrations, analogies, oral questions or assignments)

A. Ask students to sketch a typical weld profile on the chalkboard and label each metallurgical zone.

B. Have students plot the changes in volume and explain the stresses developed in the solidification and cooling of welds.

C. Discuss with student participation the control of the final structure of welds in steel by proper heat control, i.e., preheat, postheat and interpass temperature.

D. Have the students explain the purpose of electrode coatings, gas shielding and fluxes.

IV. TEST (final check on students' comprehension of material presented)

A. Suggested questions for written test:

1. Outline the purpose of the coating on welding electrodes.
2. Describe the source and action of the stresses developed in the cooling of the weld deposit in a weld of carbon steel.
3. Sketch a typical weld and label each distinct metallurgical zone.
4. What is the purpose of preheat and postheat in the welding process?
5. How do the slag and flux shields differ from that produced by gases?
6. What are the advantages of the slagging shields?

B. Check the test with the class, making sure each person has the correct answers.

V. SUMMARY

The structual soundness of a weldment depends upon: proper selection of weld electrode, controlled metal temperature, proper joint preparation, removal of foreign materials from weld, prevention of oxidation of the weld, and joint, control of effects of expansion, contraction and warpage and environmental factors.

The Next Lesson is: The Welding and Joining Processes

INSTRUCTOR'S LESSON PLAN
Related Technical Information

Unit 9
Lesson 2
Time 2 hours

SUBJECT: The Welding and Joining Processes

AIM (or purpose): To develop an acquaintance with the various approved methods and processes of joining metals

TEACHING AIDS: Posters and charts
Samples of various types of welds
Samples of soldering

REFERENCES: Welding Metallurgy, G. H. Linnert, 1965, American Welding Society, New York, N. Y.

I. PREPARATION (of the learner)

A. Introduce the topic and briefly describe the radiographer's interest in the proposed subject.

B. To arouse attention and create interest discuss and outline the difference between welding and soldering, also point out the advantages of welding a structure instead of bolting it together, and whether the welding assembly is considered as sound structurally as one that has been made by the forging process.

C. In addition, explain that the lesson should help the radiographer in the interpretation of radiographs. Radiographic interpretation of weldments depends to a significant degree upon the radiographers understanding of the welding or joining process. For this reason, the radiographer should be able to assure the welder that he (the radiographer) knows enough about the welding process to be able to render sound judgements.

II. PRESENTATION (of the information)

Instructional Topics	Things to Remember to Do or Say
A. Fusion welding 1. Shielded metal arc (coated electrode) 2. Inert gas metal arc 3. Submerged arc 4. Tungsten inert gas arc 5. Gas welding 6. Thermit welding	1. Explain and illustrate the process of fusion and how it is employed to join metals. 2. Give a brief description of each of the various fusion processes: a. Coating on the electrode protects weld puddle from oxidation . b. Inert gas, usually argon, displaces air around weld puddle. c. Air is submerged beneath granular coating for protection from air. d. Tungsten inert gas arc - heat generated by arcing between it and the material being welded. Tungsten does not melt during process. e. Acetylene and Oxygen furnish heat in gas welding. f. In Thermit welding aluminum and iron powder are mixed and burned to give off heat up to 5,000° F. for welding. 3. Discuss the method of heat generation for each method. 4. Outline the purpose of shielding the molten weld metal from air contact thereby preventing oxidation. 5. Show sample welds of each method. 6. Explain the advantages and disadvantages of each method.
B. Electric resistance welding: 1. Spot and seam welding 2. Flash welding 3. Induction welding	1. Explain and discuss the method of heat generation in electrical resistance welding. 2. Explain the contact of mating parts during and after the heating cycles. 3. Explain the advantages and disadvantages of the processes: a. High initial cost of equipment is a disadvantage. b. Results easily reproduced an advantage.

   c. Speed of production also is an advantage.

C. Solid phase welding
   1. Ultrasonic welding
   2. Diffusion bonding
   3. Forge welding
   4. Pressure welding

1. Explain the process of diffusion, i. e., the movement of atoms across weld interface.
2. Describe the methods of creating a diffusion bond.
3. Explain the advantages and disadvantages of the listed group of welding processes:
   a. Limited to thin materials
   b. Very accurate control needed for good welds
   c. Entrapped oxides remain in weld
   d. No filler metal needed
   e. No heat needed for ultrasonic method
   f. Heavy forge equipment unnecessary for ultrasonic diffusion, and pressure welds

D. Liquid to solid joining or soldering

1. Explain and illustrate the wetting of a solid metal with a molten metal:
   a. This process is sometimes called "tinning". Specimens to be joined are first dipped in or coated with molten solder.
   b. Soldering is widely used in developing electrical circuitry.
   c Galvanized materials such as root gutters are also joined by soldering.
   d Household appliances usually have some soldered joints.
2. Give some additional examples where soldering is applicable.
3. Explain the advantages and disadvantages of the method
4. Show samples of soldering and explain.

III. APPLICATION (drill, illustrations, analogies. oral questions or assignments)

   A. Suggest that students describe the fusion joining process.

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B. Have group explain the origin of the heat in the various arc welding processes.

C. Request a thorough discussion and explanation of heat generation in the electrical resistance welding methods.

D. Ask class for examples of applications using the various methods discussed. Have members justify their choice.

E. Have class identify the type of welding used to join each of the samples exhibited in the classroom.

IV. TEST (final check on students' comprehension of material presented)

NOTE: Written Test

A. What are the four major classifications of metal joining techniques?

B. What is the purpose of the gas or slag shield of the molten weld puddle?

C. What is the nature of the bond between the parent metal and solder in the solder-type joint?

D. Compare the advantages and disadvantages of:
   a. The shielded metal arc weld
   b. The inert gas metal arc weld

E. Why are the electrical resistance methods used primarily for production line work? Check and discuss.

V. SUMMARY

A. Fusion methods of welding are the types that account for a major part of industrial radiography work. They include shielded metal arc, inert gas metal arc, submerged arc, tungsten inert gas arc, acetyline gas, and Thermit welding processes.

B. Another widely used method is the electric resistance welding method which includes spot and seam welding, flash welding and induction welding.

C. Solid phase welding usually precludes the use of bonding metal and includes ultrasonic welding, diffusion bonding, forge welding, and pressure welding.

D. Liquid to solid joining is more commonly called soldering.

The Next Lesson is: The Weld Profile

INSTRUCTOR'S LESSON PLAN
Related Technical Information

Unit 9
Lesson 3
Time 1 hour

SUBJECT: The Weld Profile

AIM (or purpose): To develop knowledge and understanding of the component parts of a weld and welding terminology in general

TEACHING AIDS: Sample weld sections
Sample steel plates prepared for welding

REFERENCES: Welding Metallurgy. G. H. Linnert, 1965, American Welding Society, New York, N. Y.
Information Sheet #19
Test

I. PREPARATION (of the learner)

A. Explain the importance of the lesson and how it will help the radiographer to properly interpret radiographs of weldments, the radiographer must know the structure of a weld, its components and correct welding terminology if he is to have the confidence of his associates.

B. The welder will naturally have greater respect for the radiographer when discussing detected weld defects if the radiographer can converse in the language of the welder and make a professional diagnosis of the defects.

II. PRESENTATION (of the information)

Instructional Topics	Things to Remember to Do or Say
A. The fillet weld	Use an overhead projector if transparencies have been prepared. If not, make chalkboard sketch as follows:
1. Width	
2. Throat	
3. Toe	
4. Root	1. Draw a sketch of a typical fillet weld on the chalkboard.
5. Face	

	2. Label parts. 3. Explain the method of measuring the various dimensions. 4. Draw sketches of dimensionally correct and incorrect fillet welds. 5. Ask questions.
B. The butt weld 1. Groove 2. Groove angle 3. Root 4. Face 5. Root face 6. Root opening 7. Backing strips	1. Draw a sketch of a typical butt weld. 2. Describe and sketch the single and double groove butt welds 3. Label the parts of the welds. 4. Explain the methods of determining the various dimensions of butt welds. 5. Explain the purpose of the groove angle, the root opening, and the root face. 6. Sketch a backing strip in place on a single groove butt weld. 7. Explain the purpose of the backing strip. 8. Review welds and terminology throughout the discussion. 9 Ask questions.
C. Weld passes or layers 1. Stringer or root	Refer to information sheet # 19 and to the first illustration on the chalkboard The root pass is probably the most important and most troublesome pass. 1. Complete penetration of this pass is necessary. 2. A root pass can contain: incomplete penetration, burn through, icicles, incomplete fusion, slag and cracks. Illustrate these on chalkboard during discussion.
2. Hot pass	A hot pass follows the root pass. 1. Some defects found in the root pass can be eliminated with a hot pass. 2. Lack of fusion, slag and cracks are sometimes found in a hot pass.

3. Filler passes	Filler passes follow the hot pass.
4. Crown or reinforcement pass	The crown is the top or final pass and some crown defects include, undercut, and lack of form in that some are concave or convex.

III. APPLICATION (drill, illustrations, analogies, oral questions or assignments)

A. Pass the sample plates and welds among the students for examination.

B. Ask a student to:
   1. Sketch a fillet weld on the chalkboard
   2. Label the various parts of the fillet weld
   3. Sketch a single groove butt weld on the chalkboard
   4. Label the parts of the butt weld

C. Ask for the definition and purpose of the following parts of the but weld:
   1. The groove opening
   2. The root face
   3. The backing strip
   4. The root opening

D. Request discussion and definition of root, hot fillet, and crown passes or layers.

E. Discuss possible flaws sometimes found in these passes and invite questions.

IV. TEST (final check on students' comprehension of material presented)

NOTE: Written Test

A. Sketch a fillet weld and name the parts.

B. Sketch a single groove buttweld and name the parts.

C. Explain the purpose of:
   1. The root opening
   2. The root face
   3. Backing strips

D. Give test on Information Sheet #20

Check and discuss

V. SUMMARY

A. An understanding of the weld profile is essential when radiographs of weldments are being interpreted and discussed.

B. Fillet weldment description includes: toe, root, face, throat and width.

C. Butt weldments are described by: root, root opening, face, face opening, groove, groove angle, backing strips.

D. Weld passes include: root, hot pass, filler passes and crown.

The Next Lesson is: Weld Defects

INSTRUCTOR'S LESSON PLAN
Related Technical Information

Unit 9
Lesson 4
Time 2 hours

SUBJECT: Weld Defects

AIM (or purpose): To assist the student in acquiring the ability to recognize the defects found in weldments and to be aware of the capabilities of radiography to detect these defects

TEACHING AIDS: Samples of defective welds
Film of defective welds
High intensity film viewer

REFERENCES: Nondestructive Testing Handbook, 1963, Society for Nondestructive Testing, Evanston, Illinois
Information Sheet #19

I. PREPARATION (of the learner)

A. Introduce this lesson by discussing the following questions giving the correct answers.
  1. Can radiographic techniques be used to find all defects in welds? Why?
  2. What type of defects can be detected?
  3. Why is it important for the radiographer to know the limitations of the technique?

B. Explain that the information presented in this lesson will help to interpret radiographs correctly. Point out that the interpretation should indicate the type of defect shown in the radiograph as some defects are more serious than others. For example, a crack in a weld would be more important than a gas bubble.

II. PRESENTATION (of the information)

Instructional Topics	Things to Remember to Do or Say
A. Profile defects	1 Use overhead projector or draw a chalkboard sketch of fillet and

1. Undercutting 2. Excessive reinforcement 3. Lack of penetration 4. Concavity	butt welds showing each type of defect. 2. Refer to information sheet #19. 3. Illustrate the origin of each type defect. 4. Compare the severity of each defect. 5. Illustrate the appearance of the defect image on radiographic film. 6. Show sample film.
B. Structural defects 1. Porosity 2. Slag inclusions 3. Incomplete fusion 4. Cold lapping 5. Cracking a. Longitudinal b. Transverse c. Crater d. Underbead	1. Draw a chalkboard sketch of each type defect. 2. Illustrate the origin of each type defect. 3. Compare the severity of the defects. 4. Illustrate the appearance of the defect indication on radiographic film. 5. Show sample film-explain and discuss. 6. Explain the limitation of radiography in detecting certain types of defects.

III. APPLICATION (drill, illustrations, analogies, oral questions or assignments)

A. Have students sketch welds with the four types of cracks found in welds.

B. Ask students to explain the origin of the cracks.

C. Ask the students to define the limits of radiography for detection of weld defects.

D. Have the students identify defects on the sample film.

E. List the following defects in terms of their severity:
   1. Slag inclusions
   2. Porosity
   3. Concavity
   4. Cracking

IV. TEST (final check on students' comprehension of material presented)

A. List three types of profile defects.

B. List three types of structural defects.

C. What is the cause of slag inclusions in a weld?

D. Show the four types of cracks found in welds by sketches.

E. State what conditions must exist for a weld defect to be found by radiography.

Check and discuss

V. SUMMARY

A. Welding defects can be either structural or profile defects.

B. Profile defects are usually visible except if they are inside a small diameter pipe.

C. Structural defects can be either visible or invisible, such as cracks in the weld or the base metal or extending into both.

The Next Lesson is: Field Trip to Observe Welding Procedures and Operations

INSTRUCTOR'S LESSON PLAN
Related Technical Information
Field Trip

Unit	9
Lesson	5
Time	6 hours

SUBJECT: Welding Procedures and Operations

AIM (or purpose): To observe joint preparation, welding, and inspection of welded assemblies

MATERIALS: Film badges, dosimeters, safety glasses, hard hats

REFERENCES: Information Sheet #21

I. PREPARATION (of the learner)

A. Introduce subject of trip and its purpose requesting students to carefully observe the following procedures:
   1. Inspection of materials prior to fabrication
   2. The techniques of joint preparation
   3. The various types of welding processes
   4. Methods of marking for inspection identification
   5. Documentation of inspection and quality control

B. Read instructions to be followed while on field trip from Information Sheet #21, and invite any questions regarding the subject trip.

II. PRESENTATION (of the information)

Instructional Topics	Things to Remember to Do or Say
A. Tour a fabrication shop which maintains its own inspection department.	Stress the need for gentlemanly behaviour.
B. Students are to make notes as necessary.	

III. APPLICATION (drill, illustrations, analogies, oral questions or assignments)

A. After returning from the trip, ask the students to describe:
  1. Methods employed to inspect materials before beginning fabrication
  2. The various types of welding joints used by the fabricator
  3. All welding techniques and equipment employed by the manufacturer
  4. The observation of weldments at the final inspections
  5. The preparation of documents relative fabrication and inspection

B. Discuss any unusual observations made while touring the shop and invite questions.

IV. TEST (final check on students' comprehension of material presented)

NOTE: Written Test

A. Name and briefly describe the various welding processes you observed on the field trip.

B. How does the inspector know which welder or welders worked on a particular weldment?

C. Why do two or more welders work simultaneously on the first pass of a thick walled, large diameter pipe joint?

D. Describe briefly the joint preparation of a weldment.

E. Name some methods of quality control observed on this field trip.

Check and discuss

V. SUMMARY

A. Joint preparation

B. Types of passes

C. Inspection procedures and aids

D. Documentation and quality control

The Next Lesson is: Multiple Exposure Pipe Radiography

EXPERIMENT SHEET
Multiple Exposure Pipe Radiography

Unit 9
Lesson 6
Time 4 hours

SUBJECT:

Inspection of a circumferential pipe weld using the multiple exposure technique

NOTE: Instructor performs all operations

INTRODUCTORY INFORMATION:

Inspection of circumferential pipe welds may be accomplished using several techniques of exposure. The double wall multiple exposure technique is used when access is not available to the inside surface, or the diameter to thickness ratio is too small to achieve satisfactory sensitivity. The length of weld which can be inspected on each exposure is limited by the change in metal thickness and change in film-focal distance around the pipe. With proper procedures, satisfactory radiographs can be obtained from one side.

MATERIALS AND EQUIPMENT:

Gamma ray source and exposure facilities
Film cassettes and film
Gamma ray survey meter
Pipe samples
Penetrameters, lead numbers, and shims
Chart of diagnostic film lengths
Dark room facilities

PROCEDURE:

A. Single load film cassettes with selected film and lead screens.

B. Transport film, gamma ray exposure device, and accessories to exposure site.

C. Determine the diagnostic length of each exposure.

D. Divide the pipe circumference into segments equal to the diagnostic length.

E. Attach the exposure tube to the pipe opposite to the first segment to be exposed.

F. Position the tube to the edge of the weld and directly opposite to the center of the segment to be exposed.

G. Determine the extent of the weld reinforcement and select shims of this added thickness.

H. Select a penetrameter which will indicate 2-2T sensitivity on the pipe wall if its equivalent 2T penetrameter could be placed on the inside.

I. Attach penetrameters on shims to the pipe at the center and the extreme end of the segment selected for exposure.

J. Attach lead numbers to the pipe segment to identify the exposure and to facilitate location of defects.

K. Mark the location of the lead numbers on the surface of the pipe.

L. Attach the film cassette to the outside of the pipe.

M. Position the film neatly over the segment to be inspected.

N. Secure the film tightly to the pipe with tape or elastic bands to insure intimate contact of film and screens.

O. Attach a large letter "B" to the back side of the film cassettes where it will not interfere with the image of the weld line.

P. Calculate the exposure time required to produce a density not less than 1.5 on the greatest thickness or more than 3.3 on the least thickness.

Q. Attach the source tube to the camera and extend the control cables to a convenient location for operation.

R. Energize the survey meter, wait for warm up, and zero meter.

S. Extend source and expose for the required time.

T. Retract source into camera and survey camera to insure the safe return of the source. Lock source in camera.

U. Remove film, move source tube to next segment of the pipe, and repeat steps F through T until all segments have been exposed.

V. Develop all film for 5 minutes at 68°F. fix, wash, and dry.

W. View film for defects; prepare report of exposure and weld quality.

CONCLUSIONS:

A. Penetrameters are required at two locations on the pipe because the ____________ path is not of the same thickness and the __________ distance is different at these two locations.

B. The image of the letter "B" may appear on the radiograph due to ___________. This can be eliminated by ____________.

C. The sensitivity at the edge of the film is ________________ than the center of the film due to the effect of ______________________ radiation.

D. The density of the film at the edge of the film is ______________ than in the center because of the difference in ___________ _________________ distance.

The Next Lesson is: The Effect of Focal Distance

EXPERIMENT SHEET
The Effect of Focal Distance

Unit 9
Lesson 7
Time 4 hours

SUBJECT:

The effect of changing the film-focal distance on the distortion of the image and the sensitivity of the film

NOTE: Instructor performs all operations

INTRODUCTORY INFORMATION:

The degree of sharpness of an image depends on the size of the source and the distance between the source and the film. When the source is not a point, the case in all radiographic equipment, the image is distorted because each point in the source forms its own image. The overlapping of these images form a halo around the central image which is called penumbra. The penumbra distorts defects and the small holes of the penetrameter resulting in loss of definition. These effects can be reduced by increasing the film-focal distance and making use of the basic laws of mathematics.

MATERIALS AND EQUIPMENT:

Gamma ray (or x-ray) source and exposure facilities
8" x 10" film cassettes and film
Gamma ray survey meter
6" x 8" steel plate, 1/2" to 3/4" thick
Penetrameters and lead numbers
Dark room facilities

REFERENCES:

formation Sheet #7 Nomogram of Geometrical Unsharpness

PROCEDURE:

A. Single load film cassettes with selected film and lead screens.

B. Select penetrameters for 1/4" to 1 1/4" thickness in 1/8" steps.

C. Place the film on a lead sheet or exposure table.

D. Place the steel plate on the film and position in the center of the film.

E. Position the penetrameters on the plate in two neat rows in the center of the plate. Separate slightly and arrange in sequential order.

F. Attach lead number for identification. Avoid placing identification where it will obstruct the image of the penetrameters or plate edge.

G. Align source tube end directly over the center of the plate at a film - focal distance 5 times the thickness of the plate.

H. Calculate the exposure time required to produce a density of 1.8 to 2.2.

I. Attach the source tube to the camera and extend the control cables.

J. Energize the survey meter, wait for warmup, and zero meter.

K. Extend source and expose as required.

L. Retract source, survey, and lock source in camera.

M. Repeat steps C through L using 7, 10, 15 and 20 times the thickness of the plate for a film — focal distance.

N. Develop all film for 5 minutes at 68 F. Fix, wash and dry.

O. Examine film on viewer.

P. Record the minimum penetrameter sensitivity for each focal distance.

Q. Measure the geometric unsharpness of the plate dimensions and record for each focal distance.

R. Determine the expected geometrical unsharpness from the nomograms.

CONCLUSION:

A. The minimum sensitivity attained at a D/T of 7 is ______________.

B. A 2-2T sensitivity was observed at a D/T of __________ and above.

C. List the values obtained for geometrical unsharpness:

D/T	Actual Measurement	From Nomogram
5	____________________	________________
7	____________________	________________
10	____________________	________________
15	____________________	________________
20	____________________	________________

D. The measured value of geometrical unsharpness ________________ with that taken from the nomogram.

E. To improve radiographic sensitivity the film – focal distance is ____________________.

The Next Lesson is: Double Pipe Radiography.

EXPERIMENT SHEET
Double Wall Pipe Radiography

Unit 9
Lesson 8
Time 3 hours

SUBJECT:

Inspection of welds in small diameter pipe using the double wall method of exposure to produce an image of both walls.

NOTE: Instructor perform all operations.

INTRODUCTORY INFORMATION:

When the outside diameter of a pipe is less than about four inches, inspection of welds can be accomplished by exposing both walls of the pipe to produce an elliptical image of the weld. Two exposures are required to achieve 100% coverage using this technique.

MATERIALS AND EQUIPMENT:

Gamma ray source and exposure facilities
Film cassettes and film
Gamma ray survey meters
Penetrameters, lead numbers, and shims
Welded pipe samples 4" or less
Dark room facilities

REFERENCES:

<u>Information Sheet #22</u>

PROCEDURE:

A. Single load film cassettes with selected film and lead screens

B. Transport equipment to exposure site.

C. Determine the outside diameter of the pipe.

D. Position source tube to expose the weld.

E. Locate source tube to the side of the weld about 30 degrees from the centerline of the weld.

F. The film to focal distance should be at least seven times the outside diameter of the pipe.

G. Determine the extent of weld reinforcement and select a shim of this added thickness.

H. Select a penetrameter which will indicate 2-2T sensitivity on the total thickness of both walls.

I. Attach the penetrameter, on a shim, to the pipe on the source side.

J. Place penetrameter directly in line with the source tube end on the opposite side of the weld from the 30 degree offset with the long axis parallel to the pipe.

K. Attach a film cassette to the pipe.

L. Attach the film to the pipe opposite to the source tube. The film should not be wrapped to the pipe but should remain flat and tangent to the pipe, perpendicular to the centerline of the exposure.

M. Position film allowing for the throw of the shadow of the weld. About two inches overlap of the weld on the source offset side is sufficient.

N. Attach lead numbers to the film for identification of the exposure.

O. Mark the point of tangency of the film to facilitate location of defects.

P. Calculate the exposure time required to produce a density not less than 1.5 nor more than 3.3.

Q. Attach the source tube to the camera and extend control cables.

R. Energize the survey meter, wait for warmup, and zero meter.

S. Extend source and expose the required time.

T. Retract the source into the camera, survey, and lock camera.

U. Repeat the entire operation to achieve a second exposure at 90 degrees to the first exposure.

V. Develop film for 5 minutes at 68 F. Fix, wash and dry.

W. View film for defects, prepare reports.

CONCLUSIONS:

A. The equivalent single wall penetrameter sensitivity of this radiographic tehcnique is ______________.

B. Two exposures are required for 100% coverage because ______ ____.

C. The source is offset from the weld to prevent the image of the top _________________ from obscuring the image of the bottom ________________.

D. The pipe diameter is used as a basis for determining the _________ __________ distance in order to obtain a ________ image.

The Next Lesson is: Panoramic Pipe Radiography

EXPERIMENT SHEET
Panoramic Pipe Radiography

Unit 9
Lesson 9
Time 4 hours

SUBJECT:

Inspection of a circumferential pipe weld using the panoramic exposure technique

NOTE:

Instructor performs all operations

INTRODUCTORY INFORMATION:

Inspection of circumferential pipe welds may be performed using several techniques of exposure. The panoramic technique produces rapid reliable results when access is available to the internal surface of the pipe and the diameter to thickness ratio is sufficient to permit the necessary film — focal distance. The advantages of the panoramic technique are, exposure through a single wall, uniform film-focal distance, and one exposure for an entire weld circumference.

MATERIALS AND EQUIPMENT:

Gamma ray source and exposure facilities
Film cassettes and film
Gamma ray survey meter
Penetrameters, lead numbers, and shims
Pipe samples
Dark room facilities

PROCEDURE:

A. Single load film cassettes with selected film and lead screens .

B. Transport film, gamma ray exposure device, and accessories to exposure site.

C. Position exposure tube end at the exact inside center of the pipe in line with the weld.

D. Select a penetrameter which will indicate 2-2T sensitivity on the pipe wall if its equivalent 2T penetrameter were placed on the outside.

E. Determine the extent of the weld reinforcement buildup.

F. Select a shim equivalent to the amount of weld reinforcement.

G. Place a penetrameter, on a shim, on the outside surface of the pipe adjacent to the weld with the long axis parallel to the pipe axis.

H. Attach lead numbers to the outside circumference of the pipe on the opposite side of the weld from the penetrameter.

I. Place numbers in increasing sequential order every six inches of circumference of the pipe.

J. Mark the location of the numbers in crayon on the exterior of the pipe.

K. Prepare and attach an identification code made from lead numbers and letters.

L. Attach the film cassettes to the exterior of the pipe.

M. Position the film neatly over the weld with approximately 1 1/2" overlap of film.

N. Secure film tightly to the pipe to insure intimate contact of film and screen and a minimum distance between the pipe and cassette.

O. Calculate the exposure time required to produce a density not less than 1.5 on the greatest thickness and no more than 3.3 on the least thickness.

P. Connect exposure tube to the gamma ray camera.

Q. Extend control cables of gamma camera to a convenient location for operation.

R. Energize the survey meter, wait for warm up, and zero meter.

S. Unlock the gamma camera and extend source to exposure position. Expose film for the required time.

T. Return source to camera, survey to insure safe return, and lock source in camera.

U. Remove film from pipe, develop for 5 minutes at 68 F. fix, wash, and dry.

V. View film for defects. Prepare report of exposure and weld quality.

CONCLUSIONS:

A. Only one penetrameter is required to insure sensitivity because the ______________ is the same for all film.

B. The penetrameter will indicate 2% sensitivity of the __________ thickness through a total metal path equal to the _____________ thickness.

C. The penetrameter size used for this exposure did not correspond to the measured plate thickness because the penetrameter was placed on a shim equal in thickness to the weld ____________.

D. Sequential numbering of the pipe surface is performed to enable the inspector to determine the exact ___________ of defects.

The Next Lesson is: Radiography Film Interpretation (Welds)

INSTRUCTOR'S LESSON PLAN
Related Technical Information

Unit 9
Lesson 10
Time 2 hours

Note to Instructor: This is a practice lesson and time should be provided each week for practice on this material

SUBJECT: Radiography Film Interpretation (Welds)

AIM (or purpose): To acquaint the student with the fundamentals of weld film interpretation

TEACHING AIDS: Film viewer
Reference Radiographs of Steel Welds, ASTM E-99, American Society for Testing and Materials, Philadelphia, Pa.

MATERIALS: Sample welds
Sample film

REFERENCES: Nondestructive Testing Handbook, Volume I, Society for Nondestructive Testing, 1963, Evanston, Illinois

I. PREPARATION (of the learner)

Explain that knowledge of the theory of image formation cannot be substituted for experience in welding control. The radiographer must be able to explain each indication found on the film, and be able to differentiate the nonrelevant indications from those of consequence. This lesson is calculated to help the student to more fully understand the theoretical explanation of various defects and to assist him in gaining valuable experience in film interpretation.

II. PRESENTATION (of the information)

Instructional Topics	Things to Remember to Do or Say
A. Weld defects 1. Slag inclusions	1. Sketch a cross section of a butt weld containing slag inclusions.
2. Lack of penetration	2. Sketch a density profile corresponding

3. Porosity 4. Cracks 5. Lack of fusion 6. Surface discontinuities a. Root and crown concavity b. Excess penetration c. Excessive and irregular crown d. Misalignment (hi-lo) e. Undercut f. Backing rings	to the weld cross sections. 3. Explain the source of the density variations. 4. Display sample weld sections. 5. Show the sample film and explain. 6. Repeat the procedure for each of the other defects.
B. Viewing Screens	1. A high intensity film viewing screen is desirable for film interpretation. 2. A rheostat-type light intensifier is also a desirable feature. 3. Viewing screen should be free of artifacts. 4. Varying light intensity is an aid in studying shapes of defects.

III. APPLICATION (drill, illustrations, analogies, oral questions or assignments)

A. Ask the group to sketch each of the weld defects discussed in the presentation and show the density profile for each type of defect. Allow one or more students to present each type.

B. Display the sample film on a viewer one at a time to the group. Have individual students identify each defect and its origin. Repeat until each student can identify every defect.

C. Display the film one at a time to the class for identification. Ask the group to identify each film on a sheet of paper to be handed to the instructor. Examine the papers. Review the cause of the defect, the density profile, and the film of each defect which the student fails to identify.

IV. TEST (final check on students' comprehension of material presented)

Test the group on weld defect interpretation by displaying sample films to the group. Ask the students to identify each of the defects by placing their answers on a piece of paper to be turned in for scoring.

V. SUMMARY

A. To become skillful in weld defect interpretation the student should be able to identify weld defects by name.

B. The location of a defect in the weld is often a clue to its identification.

C. Weld defects are also called discontinuities.

D. Some defects are more serious than others so they should be correctly identified by their proper name.

The Next Lesson is: Radiograph Film Interpretation (Castings)

INSTRUCTOR'S LESSON PLAN
Related Technical Information

Unit 9
Lesson 11
Time 2 hours

Note to the Instructor: This is a practice lesson, time should be provided each week for practice on this material.

SUBJECT: Radiography Film Interpretation (Castings)

AIM (or purpose): To teach the student the fundamentals of casting inspection, the appearance of casting defects on film, and the interpretation of serviceability of castings

TEACHING AIDS: Film viewer
Industrial Radiographic Standards for Steel Castings, ASTM E-71, American Society for Testing Materials, Philadelphia, Pa.

MATERIALS: Sample castings
Sample film

REFERENCES: Defects and Failures in Pressure Vessels and Piping, Helmut Thielsch, 1965, Reihold Publishing Corp, New York, N. Y.

I. PREPARATION (of the learner)

Stress that this lesson should help an individual to recognize casting defects as the images appear on an x-ray film and should help the student to distinguish one type of defect from another. It should also develop an understanding of the cause of many casting defects recognizing that castings often exhibit certain defects which are peculiar to the process. Film interpretation of castings can be explained theoretically; however, there is no substitute for practical experience. In this effort the student will have an opportunity to constantly compare the film and theory in practice interpretations.

II. PRESENTATION (of the information)

Instructional Topics	Things to Remember to Do or Say
A. Casting defects 1. Gas and blow holes 2. Sand spots 3. Inclusions 4. Internal shrinkage 5. Hot tears and cracking 6. Unfused chaplets 7. Internal chills	1. Make a chalkboard sketch of a casting containing gas pockets. 2. Sketch the density profile corresponding to the casting. 3. Explain and discuss the source of the density variations. 4. Display film showing the defect. 5. Display sample casting with the defect. 6. Repeat the procedure for each of the other type defects.
B. Viewing Screens	1. A high intensity film viewing screen is desirable for film interpretation. 2. A rheostat-type light intensifier is also a desirable feature. 3. Viewing screen should be free of artifacts. 4. Varying lights intensity is an aid in studying shapes of defects.

III. APPLICATION (drill, illustrations, analogies, oral questions or assignments)

A. Ask individuals from the group to explain the origin of each of the casting defects, sketch a cross section showing the defect, and sketch a density profile for the defective casting.

B. Display the sample film to the group one at a time on a film viewer. Have individual students identify each defect and outline its cause. Repeat until the students can identify each type of defect.

C. Show the film again one at a time on a film viewer. Ask the students to identify and record the type of defect on a piece of paper to be turned in. Review the papers. Analyze the cause, the density profile, and discuss the film of each defect type the students fail to identify properly.

IV. TEST (final check on students' comprehension of material presented)

Test the group on casting defect interpretation by displaying sample radiographs on a viewer. Ask the students to identify each defect by placing their answers on a piece of paper. Have students exchange test papers. Review each radiograph on the screen and interpret. Check results.

V. SUMMARY

A. Casting defect interpretation requires practice.

B. Sample reference radiographs are used for practice.

C. Variable light intensity viewing screens are also a valuable training aid.

The Next Lesson is: How to Interpret Lines on Drawings or Blue Prints.

INSTRUCTOR'S LESSON PLAN
Related Technical Information

Unit 10
Lesson 1
Time 1.5 hours

SUBJECT: How to Interpret Lines on Drawing or Blue Prints

AIM (or purpose): To outline and explain the basic lines in drawings or blueprints

TEACHING AID: Chart showing lines with brief explanation identifying each type of line; chart with drawings fully dimensioned. Drawings or blueprints as used in radiography

MATERIALS: 8 1/2" x 11" paper, pencils, and straightedge

I. PREPARATION (of the learner)

Point out that to do an effective job of reading one must be able to interpret type, symbols, lines and the like, even in the simple task of reading a road map. We interpret symbols, lines and a variety of characters.

In drawing and blueprint reading, it is also necessary to recognize and understand the various lines used to construct, measure, and show the design of a machine part or structure. This interpretation of lines and figures is known as blueprint reading and if the task is to be handled effectively, considerable emphasis should be placed on the accuracy of the operations.

II. PRESENTATION (of the information)

Instructional Topics	Things to Remember to Do or Say
A. Object line	Pass out sample blueprints or drawings as used in radiographic work. Illustrate on chalkboard and point out on actual blueprints or drawings and explain. 1. Is a heavy solid line 2. Represents the real object on a drawing or blueprint

	3. May be shown from several views or angles 4. Ask questions
B. Extension line	1. Is a light solid line 2. Extends from object to indicate points of measurement 3. Seldom touches object (1/16" from object point of measure) 4. Ask questions
C. Dimension line	1. Is a light broken line 2. Is broken for indicated dimensions between points of measurement 3. Has arrow on either end 4. Arrows touch extension lines, usually 1/4" distance from end away from object 5. Ask questions
D. Hidden line	1. Is a heavy dashed line 2. Represents hidden shapes of the object that are obstructed by the exposed view 3. Ask questions

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III. APPLICATION (drill, illustrations, analogies, oral questions or assignments)

Have students do the following on chalkboard or paper. Give close supervision:

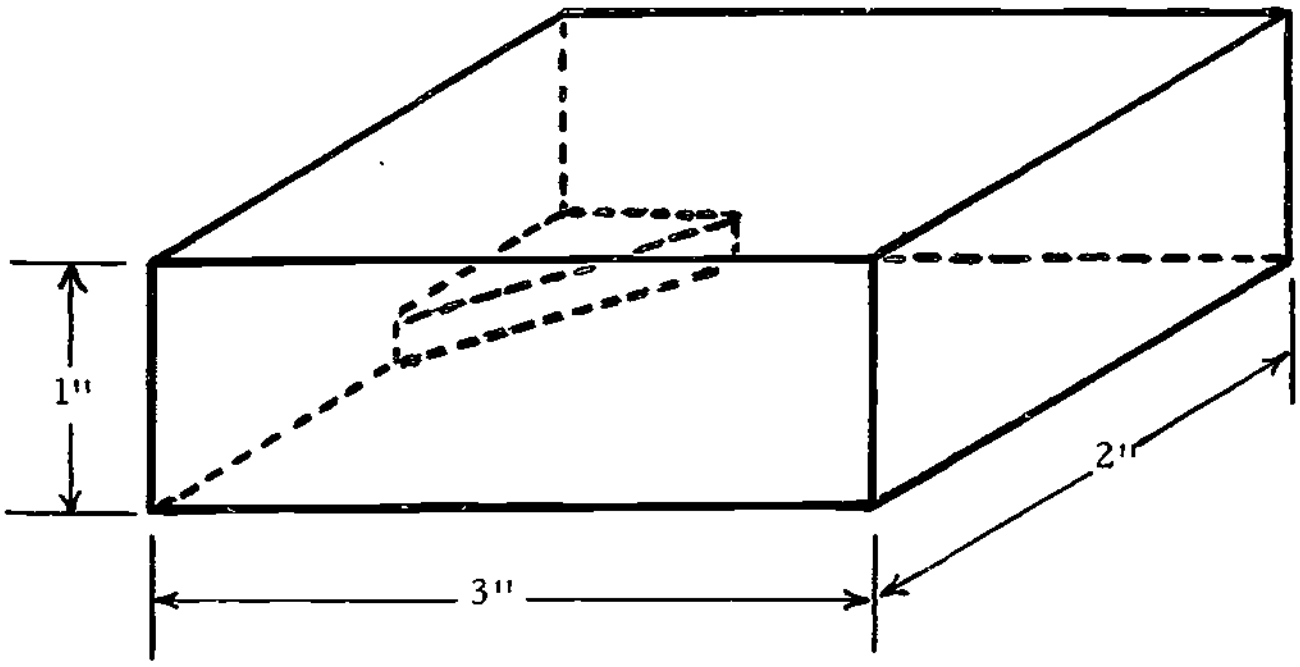
A. Draw or sketch an object 3" long, 2" wide, and 1" thick

B. Add extension lines

C. Install dimension lines, showing dimensions

D. Show a step cut across the back corner of the object, using a hidden line

E. Ask students to locate on drawings or bleuprints the following lines:
   1. Object lines
   2. Extension lines
   3. Dimension lines
   4. Hidden lines



IV. TEST (final check on students' comprehension of material presented)

NOTE: Written Test

A. What is the line that represents the real object on the drawing?

B. What is a hidden line? Why is it used?

C. What is the difference between a dimension line and an extension line?

Check and discuss.

V. SUMMARY

A. Object line - heavy solid line. Represents the real object on a drawing.

B. Extension line - thin, broken line with dimensions indicated in break. Indicates points of measurements.

D. Hidden line - heavy dash line. Indicates hidden shapes.

The Next Lesson is: Shop Drawings and Blueprints

INSTRUCTOR'S LESSON PLAN
Related Technical Information

Unit 10
Lesson 2
Time 2 hours

SUBJECT: Shop Drawings and Blueprints

AIM (or purpose): To develop an understanding of the process of blue print production and to assist the student in the interpretation of blue prints

TEACHING AIDS: Film: Shop Drawings, 22 mins., 16 mm, sound, Pennsylvania State University, University Park, Pa.

EQUIPMENT: Film projector and screen

I. PREPARATION (of the learner)

A. Introduce film, giving title and pointing out the following points should be observed or noted while viewing the film:

1. The types of lines used to denote various parts and areas of the image.
2. The number and placement of views necessary to clearly define the part.
3. Methods used to reduce the size of the drawing and the placement of dimensions.
4. The methods of indicating internal sections.

B. Stress that this lesson should help the individual to locate component parts on a drawing that are to be radiographed and should help the radiographer to make sketches indicating where radiographs are to be made or were made on a piece of equipment such as a refinery pressure vessel.

II. PRESENTATION (of the information)

Instructional Topics	Things to Remember to Do or Say
"Shop Drawings"	Show the film

III. APPLICATION (drill, illustrations, analogies, oral questions or assignments)

A. Discuss the film, emphasizing the following points in the discussion:
   1. Types of lines used in drawings and what they denote.
      a. Solid lines
      b. Dashed lines
      c. Center lines for axis of rotation
      d. Diagonal lines indicating sectioning
   2. The number of views necessary to define a part.
      a. The plain view
      b. The side view
      c. The front view
      d. Internal details
   3. Methods of scaling
      a. Shortening of uniform sections
      b. Section rotations

B. Have members of the group prepare sketches on chalkboard or paper using the various lines, views and details shown in the film.

C. Reshow the film in the event that any lack of understanding develops.

IV. TEST (final check on students' comprehension of material presented)

NOTE: Written Test

A. What type of lines are used for:
   1. Outlining the part?
   2. To show a center of rotation?
   3. To indicate a section?

B. How many views should be shown of a part?

C. Should all details be shown in every view? Why?

D. What is meant by scale?

V. SUMMARY

A. Radiographer sometimes works from a shop drawing.

B. It is important that you be able to identify the location of radiographed parts from a drawing.

C. Sketches sometimes contain several different views of an object.

D. Sketches are not always drawn to scale.

E. Sketches and symbols should indicate what part of weld is to be radiographed.

The Next Lesson is: Graphic Inspection Symbols

INSTRUCTOR'S LESSON PLAN
Related Technical Information

Unit 10
Lesson 3
Time 2 hours

SUBJECT: Graphic Inspection Symbols

AIM (or purpose): To teach the student the standard symbols used on drawings to indicate the place and type of inspection to be employed

TEACHING AIDS: Information Sheet #24 (test)

REFERENCES: Information Sheet #23
Nondestructive Testing Symbols, Military Standard 23A, August 1952, U. S. Department of Defense, Washington, D. C.

I. PREPARATION (of the learner)

This lesson is a continuation of the language of drawing symbols. The symbols discussed in this lesson are particularly useful to the inspectors. With a satisfactory blueprint or shop print the inspector can use these symbols to outline his inspection task without the necessity of further instructions.

II. PRESENTATION (of the information)

Instructional Topics	Things to Remember to Do or Say
A. The basic symbols	Pass out Information Sheet #23 1. List the basic methods and their symbols on the chalkboard; i.e., RT, MT, PT, and UT. 2. Explain the meaning of the symbols and answer questions.
B. Elements of the testing symbol: 1. Reference line and arrow	1. Draw the reference line on the chalkboard and add the arrow. 2. Explain the purpose of the arrow and the meaning of arrow and opposite side.

	3. Point out that the arrow can point in any direction from either end of the reference line. 4. Invite questions.
2. Test-all-around symbols	1. Add the symbol to the sketch. 2. Explain its meaning.
3. Extent of test	1. Sketch arrow to indicate a test from both sides - Explain. 2. Add information to sketch to indicate the length of the part to be inspected. 3. Add information to show the number to tests required for random testing.
4. Direction of radiation	1. Sketch a symbol indicating the location and distance of the radiation source from the area to be tested. 2. Explain, and discuss.
5. Combination of symbols	1. Sketch a combination welding and testing symbol. 2. Illustrate and explain the method of combining test symbols.
6. Specification	1. Add the tail to the reference line - Explain. 2. Show placement of specification information in the tail of the arrow. Explain and discuss. Invite questions.

III. APPLICATION (drill, illustrations, analogies, oral questions or assignments)

A. Ask several members of the class to draw on the chalkboard symbols to indicate types of tests indicated below:
   1. The symbol for a magnetic particle test of a pipe weld in accordance with ASTM specifications.
   2. A symbol for radiographic inspection of a weld on a plate. The film-focal distance should be indicated at 24" at an inclination of 15 degrees from the perpendicular.
   3. A symbol for a combination ultrasonic test of a plate from the top side and a magnetic particle test from the back side.
   4. A symbol combining the welding of a fillet weld in the field with a magnetic particle inspection in accordance with ASTM specifications.

5. A symbol for the panoramic X-ray of a large diameter pipe weld in accordance with Mil-Std-271.

B. Solicit the assistance of the entire class in checking the symbols drawn for accuracy and defining the meaning of each.

IV. TEST (final check on students' comprehension of material presented)

A. Ask the group to draw the following symbols on a paper to be turned in for checking:

1. A symbol for radiographic inspection of a butt weld with a film-focal distance of 12" and an inclination of the source from the perpendicular of 30 degrees.
2. A symbol for a radiographic inspection of a pipe weld in accordance with ASME specifications.
3. A symbol for magnetic particle and ultrasonic inspection of a weld.
4. A symbol for magnetic particle inspection of 20" of a power shaft which is six feet long.

B. Pass out the symbol test sheet #24 and ask the group to answer the following questions, to be turned in for checking:

1. How many different types of tests are indicated on the test sheet?
2. How many tests are required on the inside of the pipe?
3. What type of tests are made on the inside of the pipe?
4. How many welds are to be radiographed in whole or part.
5. What is the extent of testing required on the welds of this assembly?
6. Where in the system are the welds located that require two types of tests?

The Next Lesson is: Graphic Welding Symbols

INSTRUCTOR'S LESSON PLAN
Related Technical Information

Unit 10
Lesson 4
Time 2 hours

SUBJECT: Graphic Welding Symbols

AIM (or purpose): To acquaint the student with an accurate and quick method of determining the welding procedures used in fabrication and to improve an individual's ability to read blueprints

TEACHING AIDS: Information Sheet #26 (test)

REFERENCES: Standard Welding Symbols, AWS 2.0, American Welding Society, New York, N. Y.
Information Sheet #25

I. PREPARATION (of the learner)

Explain that a detailed drawing of each weld in an assembly might be pleasing to the eye; however, few draftsmen can achieve the artistic detail of a professional artist. To convey the necessary information to the craftsmen who must perform the work, engineers and draftsmen have created a language of symbols which adequately tell the workman what is to be done. A knowledge of the welding symbols will aid the radiographer in establishing proper work procedures and help a great deal in the interpretation of processed radiographic film.

II. PRESENTATION (of the information)

Instructional Topics	Things to Remember to Do or Say
A. Welding symbols	1. Distribute information sheet #25 depicting standard arc welding symbols.
	2. Explain the need for symbols as follows: a. Language understood by all b. Easy to learn and draw c. A lot of information in a small space
	3. Invite discussion

	4. Explain the use of these symbols in blueprint preparation.
B. The elements of the welding symbol	
1. The reference line and arrow	1. Draw a reference line on the chalkboard and add an arrow. 2. Explain the purpose of the arrow and the meaning of arrow side and opposite side; indicates the side to weld. 3. The arrow can point in any direction from either end of the line. 4. Ask questions.
2. Field weld and weld-around symbol	1. Add the field weld symbol to the sketch. 2. Add the weld-all-around symbol. 3. Explain their meaning. 4. Point out the meaning of the symbol without these elements.
3. Basic weld symbol	1. Add a basic weld or groove symbol to the chalkboard sketch. 2. Explain the meaning of the symbol placement. 3. Show alternate placements.
4. Contour symbols	1. Add symbol to chalkboard sketch. 2. Explain the symbols meaning. 3. Show placement and meaning.
C. Supplementary information	1. Using the information sheet #25 show the various other symbols for the finish, length of weld, groove angle, specification compliance, and root opening. 2. Give other illustrations on chalkboard as needed. 3. Illustrate the placement of information to indicate the length and size of welds. 4. Ask and invite questions.

III. APPLICATION (drill, illustrations, analogies, oral questions or assignments)

Suggest one or more students portray on the chalkboard symbols to indicate the following types of welds and accessory information. Have group discuss each:

A. An intermittent chain fillet weld to be completed in the field with a pitch of 5 inches on 2 inch increments.

B. A double "V" groove field weld on a large pressure vessel shell.

C. An example of a shop weld on flat plate with a "U" groove which requires a single pass back weld.

D. The pressure containing field type weld used on piping with a single "V" groove.

E. A field fillet weld of a large slip-on flange welded inside and out. (Provide a sketch or a print of the slip-on flange)

IV. TEST (final check on students' comprehension of material presented)

Pass out test sheet #26 showing different types of welds. Ask the students to:

A. Identify each type of weld profile shown on the drawing.

B. Indicate the number of shop welds and the number of field welds.

C. Enumerate the number of fillet welds.

D. Indicate the number of groove welds.

E. On a separate sheet of paper, have the students draw the symbol for
  1. A "V" groove field weld for pressure piping.
  2. The field fillet weld on a "T" joint with a fillet leg length of 1/2".

V. SUMMARY

A. Welding symbols condense welding information.

B. Shop welds can be identified and separated from field welds.

C. Knowledge of welding symbols is helpful in writing inspection specifications.

D. Knowledge of welding symbols is helpful in cost estimating of radiographic inspection services.

E. Welding symbols include identification of types of joint preparations required, as well as the length, type and contour of weld.

The Next Lesson is: Testing for Contamination

INSTRUCTOR'S LESSON PLAN
Related Technical Information

Unit 11
Lesson 1
Time 2 hours

SUBJECT: Testing for Contamination

AIM (or purpose): To outline the correct methods and procedures used to test for leakage of radioactive source capsules.

TEACHING AIDS: Empty source capsules
Dummy wipe test kits

REFERENCES: Information Sheet #27

I. PREPARATION (of the learner)

A. Explain to students that early methods of encapsulation proved inadequate and as a result many contamination incidents occurred.

B. Point out the possible hazards of handling source equipment that is leaking and explain why this is vital information for the radiographer.

C. Discuss the need for frequent leak testing of sources and generally indicate the grave hazards that develop if careless or contemptuous attitudes are formed regarding contamination.

II. PRESENTATION (of the information)

Instructional Topics	Things to Remember to Do or Say
A. The wipe test	1. Explain the purpose of the wipe test and why it is so called. 2. Point out that it is to detect and measure radiation contamination. 3. Show the students typical wipe test kit and explain the services available to the radiographer. Showing how an area being checked is wiped with a damp swab or towel.

4. Outline the requirements for authorization to perform wipe tests and the equipment necessary to achieve successful testing.
5. Explain the methods employed to wipe remote controlled equipment and hand cameras.
6. Define the Curie, explaining that it emits 37 billion disintegrations or counts per second.
7. Illustrate on the chalkboard the conversion of counts per second (disintergrations/sec) to curies.
8. Pass out Information Sheet #27.

B. Counting instruments

State the legal capabilities required of the instruments used for counting-ability to measure 0.005 microcuries of ionizing radiation.

C. Leaking sources and contamination

1. Outline the procedures for disposing of leaking sources and explain that a leaking source should be reported immediately by wire or telephone.
2. State the requirements for reporting a leaking source to the regulatory agencies.
   a. Place source and container in plastic bag to prevent spread of contamination.
   b. Place bag in locked permanent storage room.
   c. Notify AEC or State authorities.
   d. Monitor area for possible contamination.
   e. Check self with monitoring device and remove contamination as quickly as possible by using shower.

NOTE: PLUG SHOWER DRAIN AND HAVE WATER CHECKED FOR CONTAMINATION.

III. APPLICATION (drill, illustrations, analogies, oral questions or assignments)

A. Ask students to explain the purpose of the wipe test and the procedure for obtaining the sample.

B. Have the students calculate the leakage in curies of material from a given number of counts on a counting instrument.

C. Ask students to define the legal requirements for testing and handling of sources which show leakage.

D. Show the students samples of capsules used in industrial radiography and ask for discussion on how leakage occurs.

IV. TEST (final check on students' comprehension of material presented)

NOTE: Written Test

A. What is the maximum limit of contamination allowed on a wipe test of a radiographic source?

B. How often are wipe tests required by regulations?

C. What is the procedure when a source is found to be leaking?

D. How many microcuries of leakage has been detected by a wipe test if the counter indicates 50 disintegrations/sec?

E. Where is the wipe made on the testing of remote controlled equipment? On testing hand cameras? On testing loose capsules?

V. SUMMARY

A. Inadequate methods of encapsulation led to wipe testing regulations.

B. Improved techniques still inadequate in the event of an accident while transporting radioactive materials.

C. A.E.C. or State regulatory body arranges for disposal of contaminated materials.

The Next Lesson is: Make a Wipe Test

	3. Swab the port with a circular motion in order to cover the inside surface for a distance of about one-half inch. 4. Return the swab to the vial and replace the lid tightly. 5. Return the plug to the extension tube port and lock the source in place. 6. Tape the lid on the vial to prevent accidental opening. Vial made of plastic. 7. Check the vial with a survey meter to detect possible gross leakage. 8. <u>Caution:</u> Use a separate wipe test kit for each source or surface to be tested.
3. Preparation of tag for mailing, or shipping	1. Write the date, source number, source type and capsule model number on the tag. 2. Tape the tag or label to the vial. 3. Package the vial for shipment using sufficient insulation to prevent breakage.

III. APPLICATION (practice by learner under close supervision)

A. Divide the students into pairs and have each pair perform the entire wipe test, using all precautionary measures and plan demonstration so that it can be carried out according to regulations. Give close supervision.

B. After each individual team completes wipe test have other students offer constructive criticism.

C. If a Geiger counter is available have students test vial containing swab with this instrument after first having checked the background count in the room.

D. Arrange to hide a beta calibrating source under a paper towel near the vial containing the wipe test swab. Have student check the swab with Geiger counter and observe his reactions when counter picks up a reading from the hidden beta button. Be sure tube window is open to allow beta radiation to be detected.

E. If an Ion chamber is the only type of detection instrument available have one member of a team change the zero setting on instrument with the rheostat adjusting knob. This will give a false indication on the rate meter. Ask the other member of the team what he proposes to do since there is an apparent indication of contamination above the allowable level.

F. If training-type gamma sources are available (such as the cobalt 60, five millicurie sources used in Civil Defense classes) the instructor can bring one source into the work area, unobserved by the team performing the wipe test. This will give a high background count and will simulate a contamination problem.

Note: Use all available precautionary measures and plan student demonstration so that it can be carried out according to regulations. Give close supervision.

IV. TEST (performance of skill to acceptable standards)

A. Have each individual student perform a wipe test using the Gamma exposure device and wipe test kits.

B. Have each individual student fill out labels as required.

C. Give students simulated test results and have them record on proper report form.

D. Discuss results.

V. SUMMARY

A. AEC regulations require that wipe tests be performed every six months, or whenever contamination problem is suspected.

B. Contamination cannot be detected without the use of detection instruments.

C. Survey meters cannot be used to determine if contamination is being held at a permissable level. Low level counting instruments must be used.

D. AEC regulations outline reporting and emergency procedures in event contamination is found.

The Next Lesson is: Factors Governing Exposure

INSTRUCTOR'S LESSON PLAN
Related Technical Information

Unit 12
Lesson 1
Time 1.5 hours

SUBJECT: Factors Governing Exposure

AIM (or purpose): To teach the essential factors which govern the time calculation

TEACHING AIDS: Equivalence Factors P. 18 Eastman Kodak Textbook (table)

REFERENCES: Radiography in Modern Industry, 1958, Eastman Kodak Co., Rochester, N. Y.

I. PREPARATION (of the learner)

Explain the importance of this lesson by discussing and emphasizing the following points:

A. The calculation of exposure is the task in which the radiographer has the most difficulty. Explain why.

B. A basic understanding of the methods of exposure calculation is necessary for the student to become a successful radiographer. Give reasons why this is true.

Note to Instructor: This lesson is an overview of all the factors governing exposure. Individual factors will be covered by other lesson plans. The student should not be expected to retain all the information presented at this time.

II. PRESENTATION (of the information)

Instructional Topics	Things to Remember to Do or Say
A. Factors governing exposure	1. Explain the effect of each factor which alters the exposure setup:
1. Radiation source and strength	a. Source penetrating ability determines its density and thickness applications.
2. Film type	
3. Source to film distance	

4. Type of material being inspected 5. Intensification screens 6. Desired film density 7. Darkroom processing	Source strength is an exposure time factor. b. Film type is an exposure time factor. c. Source to film distance affects image sharpness and is an exposure time factor. d. Type of material being inspected governs type of source used for exposure or KV setting on x-ray exposure. e. Lead intensification screens affect exposure time. f. Radiographic quality. g. Desired film density is governed by adjusting exposure time. h. Darkroom processing time can adjust for improper exposure time.
B. The exposure factor, a proportionality constant	1. Express the relationship between the exposure factor and other parameters of the gamma exposure; i. e. $T=\frac{EFxD^2}{S}$ EF represents film speed, specimen density and thickness and wave length of radiation source being used. D represents source to film distance squared. S represents source strength in millicuries. T represents exposure time in minutes. 2. Explain how the equation can be used to determine the time of an exposure.
C. Exposure charts	1. Explain the origin of exposure factor charts. 2. Outline the methods used for preparation of exposure charts for x-ray generators. 3. Explain why an exposure factor is not a constant for x-ray exposure because KV can be adjusted.

D. Exposure factor corrections	1. Explain the radiographic equivalence factor. Refer to P. 18 Eastman Textbook. Specimen relative densities must be considered when using exposure factor charts. Equivalence factor tables uses aluminum as reference up to 100 KV and steel from 150 KV up. 2. Explain the film factors.
E. Conversion factors for exposure. a. Time-distance corrections b. Time-density corrections c. MaS-distance corrections	1. State the relationship between time and distance; i. e., $\frac{T_1}{T_2} = \frac{D_1^2}{D_2^2}$ 2. Show sample calculations of the above formula. 3. Display the characteristic curve and explain what is shown by the curve. 4. State the relationship between MaS and distance; i. e., $\frac{MaS_1}{MaS_2} = \frac{D_1^2}{D_2^2}$ 5. Show sample calculations of the above formula.

III. APPLICATION (drill, illustrations, analogies, oral questions or assignments)

Use the following for discussion:

A. As the students name them list on the chalkboard the factors which govern the radiographic exposure.

B. Have students define the gamma ray exposure factor.

C. Ask students to explain the exposure chart for gamma ray exposure factors and x-ray exposure.

D. Review with the class participating in the discussion the use of correction factors of radiographic equivalence and film factors.

E. Ask students to state the purpose of a characteristic curve.

F. Using a gamma exposure factor chart, have students calculate the time for a typical radiographic exposure.

IV. TEST (final check on students' comprehension of material presented)

A. Suggested questions for a short written test:

1. List five factors which will alter the radiographic exposure.
2. What is a gamma exposure factor?
3. What is meant by radiographic equivalence?
4. What is the purpose of the characteristic curve?
5. What is meant by film factors?

B. With the class assisting check the answers to the test making sure that all answers are corrected.

V. SUMMARY

A. Many factors govern the selection of proper exposure time. (Check off list in A of Step II)

B. Exposure factor is a proportionality constant and differs with each type film and gamma source.

C. Exposure charts simplify exposure computations.

D. Exposure factors are a combination of film speed, KV or MEV rating of radioactive source, and specimen density and thickness.

E. Conversion factors are for time-distance, time-density, and MaS-distance adjustments.

The Next Lesson is: Calculation of a Gamma Exposure

INSTRUCTOR'S LESSON PLAN
Related Technical Information

Unit 12
Lesson 2
Time 2 hours

SUBJECT: Calculations of a Gamma Exposure

AIM (or purpose): To adequately outline the use of mathematical expressions used for exposure calculations

MATERIALS: Film suppliers exposure factor charts for each student, Ansco C70d-31 Table of material or radiographic equivalence factors

REFERENCES: Radiography in Modern Industry, 1958, Eastman Kodak Co., Rochester, N. Y.
Information Sheets #28, #29, and #30

I. PREPARATION (of the learner)

A. It should be pointed out to the student body that radiography is not an exact science, therefore, it will always be important to make use of all information that will help to improve the final product, the radiographer, and hold the element of variability to a minimum. This lesson is calculated to assist the radiographer in correctly calculating the time it will take to make a radiographic exposure of the desired relative density. Inability to calculate exposure time correctly may require that the specimen be re-radiographed one or more times.

B. An explanation should also be given regarding the methods of determining the exposure necessary to produce an acceptable radiograph and how these methods can be applied to various situations.

II. PRESENTATION (of the information)

Instructional Topics	Things to Remember to Do or Say
A. The exposure factor	1. Define on the chalkboard the exposure factor as a proportionality factor between thickness and time

for a set of standard exposure conditions.

$$EF = \frac{TS}{D^2}$$

where: T=time
S= ource strength
D= ource to film istance

2. Distribute copies of suppliers exposure charts to the students, information sheets #28 and 29.
3. Explain the methods used for constructing an exposure factor chart.
4. Outline the restrictions on an exposure factor chart:
   a. For a single type of film
   b. For definite source type and size
   c. For one type of material
   d. For one set of darkroom conditions

B. Calculation of exposure from exposure factor charts

1. Establish a set of conditions for an exposure. List these conditions on the chalkboard: 1/2" steel plate, 12" focal distance 1.5 relative film density, Ansco "A" film, 5 curies Iridium 192.
2. Show the students how to read the chart to obtain the value of the exposure factor.
3. Show typical calculations to obtain the time of exposure using the exposure factor from the chart.
4. Show how to figure the exposure time. The unit cancellation method should be used to avoid the use of the wrong units of measure.

C. Radiographic equivalence factors

1. Issue information sheet #30 and define the radiographic equivalence factor.

2. Show the procedure for obtaining the equivalent thickness of steel from the thickness of another material.
3. Explain and illustrate by working problem on chalkboard using information listed on exposure chart.

D. Problems

1. Example problems
2. Work problems
3. Ask questions
4. Determine that there is full understanding.

E. Exposure factor tables

1. Tables for frequently used pipe and plate sizes are time savers.
2. A separate exposure factor column is necessary for each type film.
3. Outside pipe diameters do not vary with pipe wall thickness.
4. Use of tables cut down figuring time.
5. Work sample problems on chalkboard using information sheet.
6. Ask questions.

III. APPLICATION (drill, illustrations, analogies, oral questions or assignments)

A. Request students to illustrate to the class on the chalkboard, the calculation of exposure time using a different set of conditions for each student.

B. Have various individuals determine the time for an exposure using a set of conditions listed on the chalkboard. Student should restate these conditions on their individual papers.

C. Suggest that students calculate exposure times for the following problems using an exposure table:
a. 1" steel plate 12" in diameter. Use 5 curies, Iridium 192
b. 8" pipe, 3/8" wall thickness. Use 5c. IR. 192

D. Have group calculate exposure time for the following problems using an Ansco exposure chart:

a. 1" steel, focal distance 10", relative density 2.0, using Ansco "A" film and a 1 curie source of Iridium 192.
b. 2" steel, focal distance 14" relative density 1.5 using Ansco "C" film and 10 curies of Iridium 192.

IV. TEST (final check on students' comprehension of material presented)

NOTE: Written Test

A. What is the time for exposure of a 1" thick steel plate at a film-focal distance of 24" for a density of 2.0 using Ansco A film and a 20 curie source of Iridium 192?

B. What is the time for exposure of a 4" thick aluminum plate at a film-focal distance of 36" for a density of 2.0 using Ansco B film and a 15 curie source of Iridium 192?

C. If a piece of Ansco A film was exposed through 1" of steel for 2 minutes from a distance of 24" to produce a density of 2.0, what is the strength of the Iridium 192 source needed to make the exposure?

Check and discuss.

V. SUMMARY

A. Exposure factor represents the kind of gamma material and type of film being used.

B. Charts and tables enable you to figure exposure times quickly and accurately.

C. Exposure time considerations include:
   1. Specimen material
   2. Film-focal distance
   3. Relative density of film
   4. Film type
   5. Type of gamma source
   6. Source strength

The Next Lesson is: Conversion Formulas and Graphs used in X-ray Exposure Calculations

INSTRUCTOR'S LESSON PLAN
Related Technical Information

Unit 12
Lesson 3
Time 2 hours

SUBJECT: Conversion Formulas and Graphs used in X-ray Exposure Calculations

AIM (or purpose): To clarify and provide practice in the use of the mathematical expressions employed in exposure calculations

REFERENCES: Radiography in Modern Industry, 1958, Eastman Kodak Co., Rochester, N. Y., Pages 42 and 43.

I. PREPARATION (of the learner)

A. Outline the topic and explain the purpose of this lesson. Pointing out that although it is possible to make radiographs without making use of the characteristic curves for each type film, an understanding of the curves will eliminate a lot of guesswork in selecting the most appropriate film for a given assignment. These curves are especially helpful in selecting the right film when radiographing castings having a wide latitude of thickness. Operators who guess at the proper type of film to use are sometimes referred to as "picture takers" implying that their capabilities are limited to opening and closing a shutter. Therefore, take advantage of these characteristic curves and eliminate the possibility of being so categorized.

B. Stress the fact that a student must know the correct method of determining the x-ray exposure times necessary to produce satisfactory or acceptable results if he is to succeed as a radiographer.

II. PRESENTATION (of the information)

Instructional Topics	Things to Remember to Do or Say
A. Conversion formulas	1. Explain that a conversion formula is used to adjust exposure time for focal-film distance, film speed, and Ma settings.

2. Stress the need for conversion formulas when using X-ray exposure charts.
3. Outline the necessity for having an accurate exposure chart before application of the formulas pointing out that if the exposure chart is inaccurate, results after applying conversion formulas will also be inaccurate.

B. Time-distance relation

$$\frac{T_1}{T_2} = \frac{D_1^2}{D_2^2}$$

1. Show the relationship between the inverse square law and this relationship. The exposure time (T) required for a given exposure is directly proportional to the square of the focal-film distance (D).

$$\frac{I_1}{I_2} = \frac{D_2^2}{D_1^2}$$

2. Demonstrate on the chalkboard by showing a sample calculation for a change in the focal distance.

C. The Ma - time relation

1. Define the reciprocity law MT=C (Constant) showing that an increase in ma results in a proportinate decrease in exposure time.
2. Outline the limitations of the law. Refer to Table V page 38 of the Eastman Textbook.
3. Show sample chalkboard calculation for a change in the time of exposure and the change in milliamperage required.

D. The density- time relation

1. Have students turn to page 43 of the Eastman Textbook.
2. Review the information presented by the curves.
3. Review the definition of logarithms and antilogarithms.

4. Explain the determination of exposure increase required to double the density of Type AA film if the original density is 1.5.
5. Show sample calculations to alter the density from any value to another.

E. Problems

1. If a satisfactory radiographic exposure was made in 4 minutes at 1 foot what would be the exposure time at 9 inches (.75).
2. An exposure made in 5 minutes at 4 ma would take how long to make at 6 ma?
3. A 1.5 Density was obtained in 2 minutes with Kodak AA Film. What would be the time for a 2.0 density.
4. Solve problems with students participating.

III. APPLICATION (drill, illustrations, analogies, oral questions or assignments)

A. Ask for an explanation of the purpose of the time-distance relationship, and solve a sample problem on the chalkboard.

B. Request that someone define the reciprocity law, explain the limits of accuracy, and solve a sample problem on the chalkboard.

C. Have another member of the group explain to the class the method of determining the exposure change from one density value to another using the same exposure working the problem on the chalkboard as it develops.

D. Suggest that all participants work a sample problem using:
   1. The time-distance relationship
   2. The reciprocity law
   3. A characteristic curve to calculate a change in exposure time.

E. Additional problems to be used for drill.

1. If a radiograph was made in 4 minutes @ a 3 foot focal distance, how long would it take to make the same radiograph @ 2 feet?

2. If an X-ray picture was made in 2 minutes with 150 kv and 4 ma how long would it take to make same exposure @ 1.5 ma?

3. A radiograph was made with AA film, 1.5 density, in 2 minutes, how long would it take to make same radiograph if 2.5 density was required?

IV. TEST (final check on students' comprehension of material presented)

NOTE: Written Test

A. If satisfactory exposure is obtained in 2 minutes at a distance of 24", what is the time required at 36"?

B. If an acceptable exposure is obtained in 3 minutes at 5 ma, how long will the exposure be if the current is raised to 15 ma?

C. If a radiograph was made from an exposure chart to obtain a density of 1.0 using Kodak AA film, how much should the exposure time be increased to obtain a density of 2.5?

Check and discuss

V. SUMMARY

A. Conversion formulas and graphs help to make calculations of variations in film-focal distance, film density, ma settings and film speed.

B. Time and distance variations require use of the inverse square law.

C. Law of reciprocity is used in adjusting for ma settings.

D. Film density changes are calculated by a logarithmic method.

E. Practice problems are considered helpful in reviewing these calculations.

The Next Lesson is: How to Use X-ray Exposure Charts

INSTRUCTOR'S LESSON PLAN
Related Technical Information

Unit 12
Lesson 4
Time 2 hours

SUBJECT: How to Use X-ray Exposure Charts

AIM (or purpose): To promote the use of x-ray exposure charts

REFERENCES: Radiography in Modern Industry, 1958, Eastman Kodak Co., Rochester, N. Y. (Charts on pgs. 40 through 46)

I. PREPARATION (of the learner)

A. Develop interest by pointing out that x-rays and gamma rays are sometimes considered alike in every aspect except that their origins differ. Discuss the possibility that exposure time can be figured by one common method for x-rays and gamma rays explaining to the class what the basic difference is, and its effect on time calculations.

B. Point out that this lesson will explain the various methods that can be used to figure x-ray exposure times. X-ray quality can be altered by adjusting a knob on the x-ray console controlling the kv (kilovoltage). This means that with the x-rays you can select the radiation quality that should give the best results for a particular application. This also means that exposure time will differ with each setting. An x-ray exposure chart is a graph showing the relation between material thickness, kilovoltage, and exposure. Although exposure charts are available from manufacturers of x-ray equipment, corrections must be made for different brand generators. It is, therefore, considered desirable to prepare an exposure chart for ones own x-ray generator.

II. PRESENTATION (of the information)

Instructional Topics	Things to Remember to Do or Say
A. The x-ray exposure chart	1. Refer students to pages 40 to 46, in the reference textbook explaining the purpose of the exposure chart.

	a. Exposure chart usually offers a choice of about four KV selections. b. Exposure time is usually shown in milliampere seconds. c. One or two film-focal distances are usually listed. d. One relative film density is used. e. Conversion factors are available for changes in speed and film density.
B. Figuring exposure from the x-ray exposure chart	1. Establish a set of conditions for an exposure listing these conditions on the chalkboard. 2. Determine the kilovoltage for the exposure from the graphs of recommended voltage. 3. Illustrate the selection of the correct exposure from the chart. 4. If the exposure is given in milli-ampminutes, show how to obtain the time in minutes. If one ma is being used, read time directly; if two ma are used divide by 2, etc.
C. Film factors for change of film types	1. Define film speed and film factor. Film speed is relative; coarse grain film is faster than fine grain film. If one film has a relative speed of 1 and another film has a relative speed of 2, then the exposure factor for film with relative speed of 2 is twice as long as that for film with a relative speed of 1. NOTE: An industrial x-ray film is seldom described as being coarse grained, it is usually described "less fine", "very fast". 2. Explain how this factor can be used to obtain an equivalent exposure with a different type of film. Use film speed comparison between the two type films and increase or decrease time accordingly.

D. Film speed tables	1. Turn to page 55 of Eastman Textbook. Refer to the column on relative speed. Discuss differencies in film speed between Kodak AA and Kodak M film. (Ratio is 30:200 at 200 KV). Discuss how ratio changes with KV change.

III. APPLICATION (drill, illustrations, analogies, oral questions or assignments)

A. Suggest that students calculate the exposure for several sets of conditions. Ask the students to explain their method of figuring to the other students.

B. Have others in the group establish the time for exposure using a set of conditions listed on the chalkboard. Students should also list these conditions as a part of the solution to the problem.

C. Invite participating members to determine the new exposure time caused by changing the film from that specified on the exposure chart to another type.

IV. TEST (final check on students' comprehension of material presented)

NOTE: Written Test

A. In radiographing a part made of 3/4" thick steel, what is the exposure time to obtain a radiograph of 1.5 density on Kodak AA film using a film-focal distance of 40" using 200 kv and 2 ma?

B. What is the exposure time of the same set up if the film is Kodak M?

C. If the part is steel 1 1/4" thick, what is the exposure time to obtain a radiograph of 1.5 density on Kodak M film using a film-focal distance of 40" and 3 ma?

V. SUMMARY

A. X-ray exposure charts are used to figure x-ray exposure times.

B. Resultant time can be given in milliampere minutes, or milliampere seconds.

C. Each line on the chart represents a different kilovoltage setting.

D. Times are shown for a 1 milliamperage setting. Settings higher than 1 will reduce exposure time proportionally.

The Next Lesson is: X-ray Exposure Charts

EXPERIMENT SHEET
X-ray Exposure Charts

Unit 12
Lesson 5
Time 4 hours

SUBJECT:
Construction of an exposure chart for an industrial x-ray generator

NOTE:
Instructor performs all operations

INTRODUCTORY INFORMATION:
Problems of exposure calculation have been presented in the class room using an x-ray exposure chart. These charts are published and are generally furnished by the manufacturer; however, it is generally considered good practice to prepare a chart on each generator because of their variations in output. It is the purpose of this experiment to develop an x-ray exposure chart for a particular generator.

MATERIALS AND EQUIPMENT:
X-ray generator and exposure facilities
Film cassettes loaded with Kodak AA film and .005" lead screens front and back
Steel step wedges, 1/4" to 1 1/2" in 1/4" steps
Densitometer
Lead sheet for masking wedges
Darkroom facilities
Semi-log graph paper, two cycle, 70 divisions
Clean rags

REFERENCES:
Radiography in Modern Industry, 1958, Eastman Kodak Co., Rochester, N. Y., page 40

PROCEDURES:

A. Clean and examine cassettes before loading film. Use lead screens which have no visible defects.

B. Single load eight cassettes with Kodak AA film.

C. Set up x-ray machine for an exposure using a 36" film-focal distance and maximum milliamperage.

D. Place a film directly under the focal spot of the machine at 36" distance. Center the step wedge directly under the focal spot and mask all sides with lead sheeting. Mark the film for identification.

E. Make an exposure at 140 KV for 1 minute.

F. Repeat steps D and E using 160, 180 and 200 KV.

G. Repeat the procedure of D, E, and F using KV settings of 140, 160, 180, and 200 and a six minute exposure time.

H. Develop all eight film simultaneously at 68°F. for 5 minutes. Fix and dry.

I. Prepare a chart of KV settings versus thickness for a density of 1.5.

J. Using a transmission densitometer, determine the thickness which produces a density of 1.5 for the film 1 through 4.

K. The exact thickness will have to be determined by interpolation between the two steps where the density is 1.5.

L. Record the thickness opposite the KV on the prepared chart.

M. Note the ma-min for this set of values; for example, 5 ma for 1 minute equals 5 ma-min.

N. Repeat the procedure for the film set 5 through 8.

O. Record the thickness versus the KV which produced a density of 1.5.

P. Note the ma-time for this set of values; i.e., 5 ma for 6 minutes = 30 ma-min.

Q. Prepare a sheet of log paper by marking the thickness across the bottom and the ma-min along the side. The first cycle of the log paper will cover 1 ma-min to 10 ma-min.

R. Plot the points for thickness at a line representing the lower ma-min setting of exposures 1 through 4.

S. Plot the points for the ma-min setting for exposures 5 through 8.

T. Connect the point for each KV setting by straight lines. Extend these lines to the edge of the graph.

U. Label each KV line with the appropriate value.

CAUTION: Make sure only one thickness lead screens are used for this experiment.

CONCLUSIONS:

A. The prepared chart is valid for a density of ____________.

B. Type ___________ must be used when using this chart.

C. If an exposure was made of a 3/4" thick piece of steel using a 36" film-focal distance, 5 ma, and 160 KV, the time of exposure would be __________.

D. The purpose of the lead sheet masks is _________________.

The Next Lesson is: Scattered Radiation

INSTRUCTOR'S LESSON PLAN
Related Technical Information

Unit 12
Lesson 6
Time 2 hours

SUBJECT: Scattered Radiation

AIM (or purpose): To describe and develop proven methods and techniques of reducing scattered radiation thereby improving radiographic quality

TEACHING AIDS: Film samples, sample masks, film cassettes, screens and gamma ray collimators

REFERENCES: Nondestructive Testing Handbook, Volume I, 1963, Society for Nondestructive Testing, Evanston, Illinois
Information Sheet #31

I. PREPARATION (of the learner)

A. Introduce the subject explaining that this lesson will deal with minimizing the adverse effects of scattered radiation through the use of scatter controls.

B. Explain that when performing gamma radiography of welds, castings, and parts, the irradiated area and the hazard to personnel in the area can be materially reduced by using simple scatter control devices.

C. Stress the need for acquiring this knowledge and how important it is in protecting the life of the radiographer.

II. PRESENTATION (of the information)

Instructional Topics	Things to Remember to Do or Say
A. The effects of scattered radiation on radiographic quality	1. Explain the role of scattered radiation in: a. Reducing contrast b. Increasing film fog c. Reducing sensitivity d. Producing undercut 2. Show film samples

II. PRESENTATION (of the information -- continued)

Instructional Topics	Things to Remember to Do or Say
B. Sources of scattered radiation 1. The specimen 2. Cassettes 3. The floor or exposure surface 4. Filters	Illustrate by chalkboard sketches the creation of scattered radiation from each of the sources listed.
C. Methods of scatter control 1. Masks 2. Filters 3. Diaphragms 4. Collimators 5. Intensification screens	1. Describe the function of the mask and display several examples: Masks are usually thin lead sheets placed around the outside edges of a specimen to absorb scatter. 2. Define masking methods using clays, shot, and liquid lead solutions. 3. Explain the functions of the filter in radiography and how it reduces scatter filtering out soft, scatter producing rays before they reach the specimen and film. 4. Display typical diaphragms and collimators used to contain beam spread. 5. Illustrate by chalkboard sketches the function of each of these scatter control devices.
D. Exposure variations from the use of scatter control devices	1. Explain why the use of masks, filters, and collimators can result in increased exposure time. Show how the total relative film density is the product of primary radiation and scatter. 2. Emphasize the reduction in personnel hazard gained from the use of these devices, and how scatter control devices reduce these hazards by reducing environmental scatter. 3. Pass out information sheet #31 showing examples of exposure time with collimation variations.

III. APPLICATION (drill, illustrations, analogies, oral questions or assignments)

A. Invite students to describe to the class the origin of scattered radiation and its effect on the quality of the radiograph.

B. Ask members of the group to outline several sources of scattered radiation and the methods of controlling the scatter.

C. Suggest that students draw a chalkboard sketch of a radiographic setup using good scatter control techniques on a part of complicated shape.

D. Have the group define the increased safety derived from the use of scatter control devices.

IV. TEST (final check on students' comprehension of material presented)

NOTE: Written Test

A. What are the advantages that ensue from the reduction of scattered radiation?

B. Why does the reduction in scatter generally result in increased exposure time?

C. List three scatter control devices and tell how they reduce scatter.

D. Describe at least three methods of masking to reduce scatter.

E. What function does the collimator serve besides the reduction of scatter?

Check and discuss.

V. SUMMARY

A. Radiation scatter has a very detrimental effect on image quality.

B. Many factors contribute to creation of this adverse effect.

C. Several methods are used to minimize this adverse effect.

D. Elimination of scatter effect increases exposure time but also increases image quality.

E. Personnel safety is increased by controlling environmental scatter.

The Next Lesson is: The Control of Scattered Radiation

EXPERIMENT SHEET
The Control of Scattered Radiation

Unit 12
Lesson 7
Time 3 hours

SUBJECT:

Methods of reducing scattered radiation and improving radiographic quality

NOTE:

Instructor performs all operations

INTRODUCTORY INFORMATION:

Production of high quality radiographs requires the use of many techniques. The use of good exposure techniques, proper selection of film, and good dark room procedures will not always guarantee a satisfactory radiograph. Reduction of scattered radiation is also an essential necessity for the detection of very fine defects. This experiment will show the difference in quality obtained from good scatter control techniques.

MATERIALS AND EQUIPMENT:

X-ray generator and exposure facilities
Film cassettes, 0.005 and 0.010 lead screens, and film
2" thick aluminum casting
Lead sheet, barium clay, and lead acetate solutions
Penetrameters
Film viewer
Lead numbers
Dark room facilities with equipment, timer, materials, etc.

PROCEDURE:

A. Single load a film cassette with film and remove the intensifying screens.

B. Set up the x-ray generator for an exposure of the aluminum casting using 160 KV and the exposure chart constructed in a previous experiment. Use radiographic equivalence factors to determine the thickness of steel to be used in the exposure determination.

C. Place a 1" thick piece of wood on a steel plate and position the film on the wood block directly under the focal spot of the x-ray generator. Center the casting on the film. Mark the film for identification. Place a 2-2T penetrameter on the casting in the area of interest.

D. Expose the film to obtain a density of 2.0 in the area of interest.

E. Single load another cassette with the same film using a .005 front and a 0.010 back screen.

F. Place the film on a thick sheet of lead under the focal spot of the generator.

G. Position the part on the film using a good masking technique. A water tight aluminum pan is required if liquid masking is used. CAUTION: Liquid lead solutions are poisonous and must be handled with care.

H. Mark the film for identification and place a 2-2T penetrameter on the casting.

I. Place a diaphragm on the tube port of the x-ray generator.

J. Expose the film using the same exposure as in the first film.

K. Develop both films simultaneously at 68°F. for 5 minutes. Fix and dry.

L. Place film on a viewer and compare the results.

CONCLUSIONS:

A. The increased sensitivity of film number two is due to ____________.

B. The effect of the screens in the cassettes is to ____________________.

C. The two film ____________ or ___________ of the same density in the area of interest.

D. The purpose of the lead back up sheet in exposure number two was to ______________________.

The Next Lesson is: Exposure Changes for Changing Densities

EXPERIMENT SHEET
Exposure Changes for Changing Density

Unit 12
Lesson 8
Time 3 hours

SUBJECT:

Changing the density of radiographs from one value to a second desired value

NOTE:

Instructor performs all operations

INTRODUCTORY INFORMATION:

The exposure charts for x-ray radiography are constructed for a fixed density. It is often necessary to change the density of a radiograph to comply with specifications, increase contrast, or to improve the readability of the film. The radiographer should be able to adjust the density of the film by adjustment of the exposure time given by the exposure chart.

MATERIALS AND EQUIPMENT:

X-ray generator and exposure facilities
Film cassettes and Kodak AA film
Sample part for inspection
Densitometer
Characteristic curves for type AA film
Darkroom facilities including equipment, materials, lead numbers, etc.
Logarithm tables

PROCEDURE:

A. Single load film cassettes with type AA film.

B. Set up the x-ray generator for an exposure of the sample part using the exposure chart constructed in a previous experiment.

C. Place a film directly under the focal spot of the machine and center the sample part on the film. Mark the film for identification.

D Make an exposure in accordance with the exposure chart.

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E. Using the characteristic curve calculate the increase in exposure time necessary to increase the density of the film to 2.5 in the area of interest.

F. Change the time setting on the x-ray machine.

G. Place a second film under the machine and center the part on the film exactly as in the first exposure. Mark the film for identification.

H. Expose the second film in accordance with the new time setting.

I. Develop both films simultaneously at 68°F. for five minutes. Fix and dry.

J. Using the densitometer determine the density of each film at the point of interest on the image.

K. Measure the density at the lowest and highest densities on each film .

L. Record the values on the lab work sheet.

CONCLUSIONS:

A. The effect on contrast from the increase in density is ___________.

B. The density _____________ increase the same for all thicknesses of the part.

C. The increase in time necessary to achieve a density of 3.5 in the area of interest is _______________.

D. The same amount of time ______________ or __________ ___________ be required to raise the density at the lowest density spot to 3.5 as was required for the original area of interest because _________________.

The Next Lesson is: Changing Focal Distance

EXPERIMENT SHEET
Changing Focal Distance

Unit 12
Lesson 9
Time 3 hours

SUBJECT:

Obtaining equivalent exposures when changing the focal distance

NOTE: Instructor performs all operations

INTRODUCTORY INFORMATION.

The exposure charts for x-ray radiography are constructed using a fixed film-focal distance. It is often necessary to alter this distance because of the geometry of the part, obstructions in the radiation beam path, or a desire to increase sensitivity and resolution. The radiographer should be able to make the simple calculations required to achieve an exposure equivalent to that obtained at the standard focal distance.

MATERIALS AND EQUIPMENT:

X-ray generator and exposure facilities
Film cassettes and film
Sample part for inspection
Densitometer
Dark room facilities, supplies and materials
Lead numbers
Six foot tape

PROCEDURE:

A. Single load film cassettes with film selected for the experiment.

B. Setup x-ray generator for an exposure of the part selected using the exposure chart constructed in a previous experiment.

C. Place the film directly under the focal spot of the machine and center the sample part on the film. Mark the film for identification.

D. Make the exposure in accordance with the exposure chart.

E. Move the tube head of the machine from 36" to 24" focal distance.

F. Place a second film under the machine and center the part on the film exactly as on the first exposure. Mark the film for identification.

G. Calculate the change in time required by moving the tube head to the new position.

H. Expose the new set up in accordance with the calculated time.

I. Develop both film simultaneously at 68°F. for 5 minutes. Fix and dry.

J. Using the densitometer, determine the density of each film at the same point on the image of the part.

K. Record the values on the lab work sheet.

CONCLUSIONS:

A. If the procedures are correctly followed, the density of the film will be ____________________.

B. When the film-focal distance is shortened, the intensity of the radiation beam is ____________________.

C. When film-focal distance is shortened, the sharpness of the film is ____________________.

D. If the procedure did not produce the desired results, the difficulty could be caused by incorrectly ______________ the distance or an error in _________________.

The Next Lesson Is: Standards for Protection Against Radiation

INSTRUCTOR'S LESSON PLAN
Related Technical Information

Unit 13
Lesson 1
Time 2 hours

SUBJECT: Standards for Protection Against Radiation

AIM (or purpose): To outline the regulations imposed by the controlling agencies who issue licenses for use and possession of radiation producing devices

REFERENCES: Information Sheet #3, #32, #33 and #34
Copy of Title 10, Federal Register, Part 20, "Standards for Protection Against Radiation"

I. PREPARATION (of the learner)

A. Introduce the topic and develop student interest by touching briefly on the radiation banking concept and the minimum age of a radiographer. Explain what the maximum accumulated dosage is that a person may receive before he can no longer work as a radiographer, and how long a radiographer must be idle from work before he may return to his duties after receiving the maximum allowable dosage.

B. Point out how this lesson will help the individual to better understand the safety rules and regulations that govern the handling, use, transfer, disposal, and possession of radioactive materials.

II. PRESENTATION (of the information)

Instructional Topics	Things to Remember to Do or Say
A. Definitions under Part 20	1. Refer to Information Sheet #3 and read the pertinent part of each definition to the class.
1. 20.3-Byproduct material Calendar quarter Licensed material Occupational dose Radiation Radioactive material Restricted area Unrestricted area	2. After reading each definition translate the legal terminology into terms readily understood by the students.

II. PRESENTATION (continued)

Instructional Topics	Things to Remember to Do or Say
20.202 - Personnel monitoring equipment Radiation area High radiation area	
B. Permissible dose and radiation levels 1. 20.101 - Exposure of individuals	1. Read and explain all pertinent regulations to the students. 2. Explain the exceptions to the general rule. 3. Perform sample chalkboard calculations to determine maximum dosages for individuals.
2. 20.102 - Determination of accumulated dose	1. Read the regulations pertaining to records and calculation of dosages. 2. Display Form AEC-4 to the students. 3. Explain the preparation of the form
3. 20.104 - Exposure of minors	Read and explain the regulation to the students.
4. 20.105 - Permissible levels of radiation in unrestricted areas	Read and explain all pertinent matters to the students.
C. Precautionery procedures 1. 20.201 - Surveys 20.202 - Personnel monitoring	1. Refer to Information Sheets # 32 and 33 2. Read and explain the regulations to the students.
2. 20.203 - Caution signs and labels	1. Refer to Information Sheet #34. 2. Display the sample signs and explain where each is required by regulations
3. 20.206 - Posting of notices	Display AEC-3 forms and explain the requirements for posting them.
D. Waste disposal 1. 20.301 - General requirements	1. Read the section pertaining thereto and explain to the students. 2. Explain why the exceptions are not generally applicable to radiographic sources.

E. Notifications
   1. 20.403 - Incidents
   2. 20.404 - Former employees
   3. 20.405 - Report of over-exposure

Read each section and explain to the students.

III. APPLICATION (drill, illustrations, analogies, oral questions or assignments)

Have individual students explain to the class the regulations for:

A. Rules for exposure of individuals
B. Determination of accumulated dosage
C. Exposure of minors
D. Permissible levels of radiations in unrestricted areas
E. Requirements for use of monitoring devices, signs, and notices.
F. Disposing of radioactive materials
G Notifying the control agency of incidents and accidents

IV. TEST (final check on students' comprehension of material presented)

NOTE: Written Test

A. What is the normal whole body dosage allowed per calender quarter for individuals working in a restricted area?

B. If a radiographer were 25 years old, what would be the maximum accumulated dose he could have from occupational exposure?

C. What are the limits of radiation intensity marked by the "Radiation Area" and the "High Radiation Area"?

D. When are surveys required by regulations?

E. How are unwanted radiographic sources usually disposed of?

F. Where is the "Notice to Employees" sign required to be posted?

G. What are the exposure levels which require immediate and 24 hour notification that an accident has occurred?

H. What is the basis of the requirements for reporting over-exposure which do not exceed the levels specified for incidents or accidents?

I Who is responsible for furnishing information on an employee's previous exposure history? How is this information obtained? Who requests the information?

Check and discuss

V. SUMMARY

A. A thorough understanding of the AEC standards for protection from radiation are necessary in order to qualify for an AEC Radiography License.

B. Permissible dose and radiation levels must be observed and current records of dose levels must be maintained.

C. All precautionary procedures must be enforced.

D. Waste disposal procedures seldom apply to radiography licensees.

E. Notification time limits and procedures must be understood and maintained.

The Next Lesson is: Licensing of Byproduct Materials

INSTRUCTOR'S LESSON PLAN
Related Technical Information

Unit 13
Lesson 2
Time 1.5 hours

SUBJECT: Licensing of Byproduct Materials

AIM (or purpose): To develop an appreciation and understanding of the requirements and provisions for obtaining a license to use byproduct materials

REFERENCES: Information Sheet #3

I. PREPARATION (of the learner)

A. Develop an interest in the subject by discussing the purpose of the license.

B. Explain that federal laws control the possession, handling and use of synthetic radioactive materials and that the U. S. Atomic Energy Commission regulates the possession, use and handling of these materials. So-called "Agreement States" control these operations in their respective areas and some of these have reciprocal agreements among themselves. In the spring of 1966 there were about twelve agreement states in the United States.

C. Discuss the fact that while some radioactive materials can be obtained in very small amounts, usually ten microcuries or less, without a license, this small amount would have little or no value in radiography.

II. PRESENTATION (of the information)

Instructional Topics	Things to Remember to Do or Say
A. Definition in Part 30 1. Agreement states 2. Byproduct materials 3. Radiographer 4 Radiographers assistant 5. Sealed sources	1. Refer to Information Sheet #3 and read the definition of each term from the regulations. 2. Define each term in language understandable to the student. 3. Ask for questions and discuss all aspects 4. Give examples

B. Exemptions 1. AEC contracts 2 Carriers 3. Weak concentrations 4. Luminous dials	1. Read the pertinent part of each applicable section and explain to the students. 2. Ask for questions and discuss 3. Give examples
C. Licenses 1. Types - General and Specific 2. Applications 3. Requirements for issuance 4. Terms: a. Transferral b. Limits of use c. Implied and written 5. Expiration, termination and renewal	1. Read the applicable sections on each of the listed topics. 2. Explain the regulations to the students. 3. Ask for questions 4. Give examples
D. Enforcement 1. Modification and revocation 2. Recall 3. Violations	1. Read the pertinent part of each section and explain all subject matter to the student. 2. Ask questions 3. Cite practical examples

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III. APPLICATION (drill, illustrations, analogies, oral questions or assignments)

Have individual students explain to the class the regulations for:

A. Persons who are exempt from licensing for use and handling of radioactive materials.

B. The types of licenses available and to whom they apply.

C. The terms of issuance, usage, and the transferral of licenses.

D. The legal measures available to the government for enforcement of the provision of a license.

IV. TEST (final check on students' comprehension of material presented)

NOTE: Written Test

A. What are the two types of licenses issued for use of byproduct materials? What is the difference?

B. Who is exempt from license requirements?

C. What is the difference between a radiographer and a radiographer's assistant as defined by the regulations?

D. What is an agreement state? What authority does an agreement state have over licensing?

E. What type of penalities can be imposed on persons who violate the terms of a license?

Check results and discuss.

V. SUMMARY

A. The Atomic Energy Commission regulates the safe handling, use and possession of synthetic radioactive isotopes.

B. The licensee must have a thorough understanding of these regulations.

C. These regulations include use, handling and possession of gamma sources used in radiography.

D. Regulations also cover: enforcement of rules, types of licenses, requirements for issuance of licenses, definitions, agreement states and exemptions.

The Next Lesson is: Licenses for Radiography

INSTRUCTOR'S LESSON PLAN
Related Technical Information

Unit 13
Lesson 3
Time 2 hours

NOTE TO INSTRUCTOR: Repetition or application of this lesson should be given as often as possible

SUBJECT: Licenses for Radiography

AIM (or purpose): To explain and clarify the governmental requirements for licensed radiographic operations

REFERENCES: Information Sheet #3

I. PREPARATION (of the learner)

A. Point out that this lesson will help the individual to know the licensing requirements for possession, use, and the handling of radioactive materials. The AEC must control the use of this material in order to protect the operator and the public from the hazards of radiation. The lesson includes definitions, licensing requirements for radiographers, safety requirements and precautionary procedures.

B. Stress the importance of acquiring the information contained in this lesson because:
   1. The regulations contain the minimum training requirements for an individual acting as a radiographer in a licensed operation.
   2. The regulations contain the minimum safety program required by a licensee for the protection of his employees.

II. PRESENTATION (of the information)

Instructional Topics	Things to Remember to Do or Say
A. Definitions under Part 34 1. Radiography 2. Radiographic exposure device 3. Storage container	Read the definitions to the student and explain them having a short discussion as to the how, why, when, where and what.

B. Licensing requirements for radiography 1. Training program 2. Written procedure manual 3. Internal inspection program 4. Organizational structure for operational control	1. Read the entire section on requirements and explain and discuss. 2. Display an operational procedure manual. 3. Read Appendix A outlining the minimum training program.
C. Safety requirements 1. Radiation levels from exposure devices 2. Locks on exposure devices. 3. Storage areas 4. Survey meters 5. Wipe testing 6. Inventories 7. Emergency procedures 8. Personnel monitoring devices	1. Read and explain the applicable sections of the regulations and discuss them. 2. Read the applicable sections of the procedure manual dealing with these topics and discuss them thoroughly. 3. Explain the purpose of the procedure manual, explaining all aspects of the manual.
D. Precautionary procedures 1. Survellience of radiation areas 2. Posting of signs 3. Survey of radiation areas	Read, explain and discuss the applicable sections of the regulations, inviting all questions as they develop.

III. APPLICATION (drill, illustrations, analogies, oral questions or assignments)

Have various students explain:

A. The minimum requirements necessary to obtain a license for radiographic operations

B. The maximum radiation intensity allowed to be emitted by a locked exposure device.

C. Requirements for locking of storage and exposure devices

D. The basic requirements for survey meters

E. The need for wipe testing

F. The necessity of logging of source usage

G. The procedure for conducting inventories

H. The number and type of personnel monitoring devices required by law

I. The requirements for posting of notices

J. The essential need for conducting radiation intensity surveys during radiographic operations

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IV. TEST (final check on students' comprehension of material presented)

NOTE: Written Test

A. How often must survey meters be calibrated?

B. How frequently should wipe tests be performed?

C. When must an inventory be made of exposure devices and sources?

D. What are the requirements for tagging of sources and marking of storage areas?

E. When are exposure devices allowed to be unlocked?

F. What personnel monitoring devices must be worn by all radiographers?

G. What is the purpose of the operating procedure manual?

H. When must physical radiation surveys be performed?

I. What is the operating range of a survey meter which conforms to governmental regulations?

Check and discuss.

V. SUMMARY

A. Certain definitions must be studied and remembered if regulations are to be understood.

B. Licensing requirements include formal training, written procedures for company operation, and organizational control structures.

C. Many specific safety regulations must be observed.

D. Precautionary procedures must be spelled out.

The Next Lesson is: Emergency Procedures for Radiographic Operations

INSTRUCTOR'S LESSON PLAN
Related Technical Information

Unit 13
Lesson 4
Time 2 hours

SUBJECT: Emergency Procedures for Radiographic Operations

AIM (or purpose): To stress the need for adhering to safe practices when emergencies occur in radiographic operations

REFERENCES: Copy of typical operating and administrative procedures

I. PREPARATION (of the learner)

A. Introduce the subject and develop interest by pointing out that a radiographer must be capable of coping with emergencies which may arise while operating or transporting exposure devices. He may also be required to handle other emergencies caused by fires in the area where the exposure device is stored, or is being used, and in cases of suspected theft of radioactive materials.

B. The lesson will cover a variety of subjects and will help the individual to understand the importance of a licensee's emergency and operating procedures. Point out that these written procedures must be approved by the AEC.

II. PRESENTATION (of the information)

Instructional Topics	Things to Remember to Do or Say
A. Accidents involving radioactive exposure devices	1. Explain that accidents can occur regardless of the amount of care exercised. 2. Cite examples of accidents: i.e., fire in the exposure area, objects falling on the equipment, and auto accidents while transporting materials
B. Problems involving malfunction or breakage of exposure devices	1. Outline the procedures for posting signs, barricading, and alerting proper officials. 2. Warn against attempts to repair

	or recover devices when the radiographer is without experience in these functional areas. 3 Inform the students of agencies and individuals who should be contacted for assistance. 4. Caution against leaving the area unattended.
C. Problems involving stolen equipment	Instruct the students in the correct procedures for notifying the local regulatory officials of the theft.
D. Problems involving fire	1. Explain the importance of returning the source to the locked position in case of fire or a fire alarm. 2. Instruct in the removal of equipment from the hazard area. 3. Explain the notification procedures necessary if sources are exposed in the fire area. 4. Outline the assistance which must be rendered to fire fighters when sources are in the fire area.
E. Problems involving vehicle accidents	1. Instruct the student in the importance of removing injured personnel as a first action. 2. Explain why the area should be immediately surveyed and made secure. 3. Explain the importance of informing law enforcement officers of any hazards. 4. Impress on the student the necessity of keeping curiousity seekers from the area and notifying the proper officials of the accident.

III. APPLICATION (drill, illustrations, analogies, oral questions or assignments)

Ask the students to explain:

A. The procedures to follow in case of a malfunction or damage to an exposure device.

B. The proper action to take when equipment is stolen, explaining why.

C. What to do in case of fire and the reasons for the action.

D. How to handle a vehicle accident in which radioactive materials are involved.

IV. TEST (final check on students' comprehension of material presented)

NOTE: Written Test

A. What persons and officials are to be notified if equipment is stolen?

B If a fire breaks out in the area in which a radiographer is working, what is the first action to be taken?

C. What is the first concern of a radiographer involved in a vehicle accident where people are injured and equipment is damaged?

D. Who can a radiographer always turn to for assistance if he cannot contact his designated safety officer?

E. Under the circumstances should a radiographer leave a source which has been damaged?

Check and discuss.

V. SUMMARY

A. Accidents involving radioactive materials continue to happen despite the strict exacting regulations that cover it uses and handling.

B. Many accidents occur because of negligence, apathy and contempt on the part of the user of radioactive materials.

C. Stolen equipment must be reported to the AEC or the State immediately so that the danger created by the incident can be minimized by warning the public of the potential hazard that exists.

D. Emergency operating procedures must cover the measures to be taken in case of fire involving radioactive materials.

E. Emergencies involving transportation of radioactive materials must also be covered in the Emergency Operating Procedures.

The Next Lesson is: Record Keeping for Radiographic Operations

INSTRUCTOR'S LESSON PLAN
Related Technical Information

Unit 14
Lesson 1
Time 2 hours

SUBJECT: Record Keeping for Radiographic Operations

AIM (or purpose): To outline the type records and reports required for radiographic operations

REFERENCES: Information Sheets #3, #35, #36, #37, #38, and #39

I. PREPARATION (of the learner)

A. Center a short discussion around record keeping that students know, i.e., (income tax, bank book, employment, etc.) stressing the need for record keeping.

B. Point out that failure to keep adequate records is a legal violation of the license to possess radioactive materials and that failure to maintain record files can result in a citation for non-compliance with the regulations and result in possible revocation of a license.

C. Explain the importance of this lesson and stress that it will help the individual to set up and keep current the records that are required of the licensee and that the AEC requires that certain records pertaining to radiation safety be kept

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II. PRESENTATION (of the information)

Instructional Topics	Things to Remember to Do or Say
A. Why records are maintained	1. Explain the legal requirements for record keeping in that a federal law requires it and that AEC inspectors check these records for discrepencies. 2. Explain the advantages of adequate records to counteract and discourage employees claims of malpractice. 3. Impress on the student that the prime objective of record keeping is to insure his own safety.

B. Daily record requirements 1. Daily dosimeter records 2. Utilization logs 3. Job survey records 4. Set-up sketches	1. Distribute sample report forms. 2. Explain the proper methods for completing each form. 3. Explain why each is required and the extent of detail required. 4. Fill out each sample form while discussing procedures. 5. Invite questions.
C. Periodic records 1. Film badge summary and records 2. Dosimeter summary 3. Quarterly inventory 4. Wipe/leak tests 5. Survey meter calibration 6. Unscheduled surveys 7. Container and exposure device surveys	1. Distribute sample report forms. 2. Explain the source of information and the proper methods of completing the forms. 3. Illustrate techniques for summation of exposure records. 4. Explain the nature and purpose of an unscheduled survey.
D. Historical records 1. AEC-4 2. AEC-5 3. Transfer and disposal records	1. Distribute sample forms. 2. Show chalkboard calculations to determine allowable dosage. 3. Explain the need for maintaining transfer and disposal records; AEC keeps a careful awareness of each and every source of nuclear radiation under their control.

III. APPLICATION (drill, illustrations, analogies, oral questions or assignments)

A. Have individual students explain:
   1. The daily records required.
   2. The records required on a periodic basis and the time interval of each.
   3. The historical records of employees and equipment.

B. Invite students to fill in practice forms supplying all necessary information.

C. Create a variety of pseudo situations to fully cover the lesson in all its aspects, giving each student the opportunity for practice and questions.

IV. TEST (final check on students' comprehension of material presented)

NOTE: Written Test

A. What records require preparation on a daily basis?

B. What is the time interval for survey meter calibration? Wipe Test? Source inventory?

C. What record is necessary before a prospective radiographer may work for a new employer?

D. How often are dosimeter readings entered in the records?

E. What is the value of the sketch prepared of the exposure area?

Check and discuss.

V. SUMMARY

A. A well kept, current set of records is necessary if you are to keep your AEC radiography license.

B. Some records require daily entrys.

C. Proper entry on each form is essential.

D. Records are inspected periodically by AEC representatives.

E. Legitimate records are most helpful in planning safety improvements.

The Next Lesson is: Permanent Exposure Facilities

INSTRUCTOR'S LESSON PLAN
Related Technical Information

Unit 15
Lesson 1
Time 3 hours

SUBJECT: Permanent Exposure Facilities

AIM (or purpose): To cover in detail the features and construction characteristics of radiation exposure facilities

REFERENCES: Radiography in Modern Industry, 1958, Eastman Kodak Co., Rochester, N. Y.
Radiation Safety in Industrial Radiography with Radioisotopes, AECU 2967, 1954, U. S. Atomic Energy Commission
Information Sheet #40

I. PREPARATION (of the learner)

Explain that the construction of exposure rooms is a very expensive endeavor and that many rooms have been constructed which later proved inadequate or inconvenient because of poor planning. A familiarization with desirable features is mandatory if mistakes are to be avoided. Emphasize that every radiographer should be able to make some constructive contribution to the design of a facility for exposure.

II. PRESENTATION (of the information)

Instructional Topics	Things to Remember to Do or Say
A. Construction materials	1 Outline the use of lead and concrete for x-ray and gamma ray radiation shielding. Wide lead sheet for floor cover and wall cover is desirable but quite fragile and expensive. 2. State the maximum energy levels for practical use of each type shielding. 3. Compare construction costs for the various types of construction. 4. Draw chalkboard sketches of methods of lead construction

	such as lapping and nail head covering. Refer to page 114 of the Eastman textbook.
B. Construction features	1. Draw a chalkboard sketch of a typical exposure room layout or refer to Information Sheet #40. 2. Explain the desirability of keeping metallic members of construction to a minimum thereby minimizing scatter. 3. Describe how vacant areas or idle work space can be used for shielding; Employing the distance factor. 4. Define the limits of allowable intensity at the outside boundary of the exposure room 2mr/hr. 5. Describe the construction of pits and vaults for the storage of isotopes. 6. Describe the use of circuit breakers and entry way interlocks; Line voltage to X-ray tube should be interrupted when the door is opened while the unit is in operation.
C. Openings	1. List the requirements for openings in the exposure room walls or floors: i.e., control cables, piping, ventilation, access doors, etc; Should be angled. Refer to page 114, of the Eastman textbook. 2. Describe the construction methods of shielding around openings. See Information Sheet #40. 3. Draw a chalkboard sketch of a shielding maze at a major entry way. (Labyrinth)
D. Monitoring devices	1. Describe the console type instruments for continuous radiation monitoring. Automatic monitor alarms are activated when 2 mr/hr

is exceeded.

2. Explain why the survey meter must be used in addition to the automatic devices. Survey meters are portable and do not rely on line voltage for power. A survey meter is carried into the exposure room.
3. Describe warning light systems. Red light when radiation field exists. Green light when radiation field does not exist.

E. Auxiliary equipment

1. Explain the need for utilities, water lights, power, and air conditioning.
2. Explain the need for hoists, cranes, and exposure tables. To speed up production less lifting and positioning of specimen and equipment.
3. Explain the desirability of keeping metallic materials out of the exposure room to eliminate scatter.
4. Elaborate on the use of collimators for gamma radiography to reduce scatter.

III. APPLICATION (drill, illustrations, analogies, oral questions or assignments)

A. Have several students draw a sketch of an exposure room for use with 20 curies of Cobalt 60 and 50 curies of Iridium 192. Show calculations for determining the thickness of the walls. Justify the use of construction materials.

B. Have other students;
   1. Add safety devices to the design.
   2. Describe auxiliary equipment needed,
   3. Indicate control devices needed for the design.

C. Invite questions and promote discussion.

IV. TEST (final check on students' comprehension of material presented)

NOTE: Written Test

A. What type of material would be most economical for exposure room construction if a 300 KV X-ray generator were the only source of radiation? If Cobalt 60 is to be employed?

B. What techniques are used to shield openings in exposure room walls?

C. What type of safety devices are employed in construction of exposure facilities to insure against accidental entry?

D. Why is metal construction material (other than lead) undesirable in the exposure room?
Check and discuss.

V. SUMMARY

A. Permanent exposure facilities are very desirable in radiographic operations.

B. Selection of proper materials for exposure room will improve the quality of radiographs by minimizing the effects of scatter radiation.

C. Automatic interlock systems on all entrances to exposure room are very desirable.

D. Radiation monitoring devices are necessary for this type of installation.

The Next Lesson is: X-ray Tubes

INSTRUCTOR'S LESSON PLAN
Related Technical Information

Unit 16
Lesson 1
Time 2 hours

SUBJECT: X-ray Tubes

AIM (or purpose): To illustrate and describe the characteristics of commercial x-ray tubes

TEACHING AIDS: Defective x-ray tube to be used for demonstration

REFERENCES: Nondestructive Testing Handbook, Volume I, Section 14, 1963, Society for Nondestructive Testing, Evanston, Illinois

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I. PREPARATION (of the learner)

A. Write aim of lesson on the chalkboard and point out that this lesson explains the characteristics of various types of x-ray tubes and the uses of each type. Although some radiographers may not have an opportunity to advise on new equipment purchases, they will find this information useful for a variety of other purposes.

B. Identify the many different types of commercial x-ray generations and describe their individual identifying features. Use this opportunity to develop interest by relating some of the advantages and disadvantages of each type.

II. PRESENTATION (of the information)

Instructional Topics	Things to Remember to Do or Say
A. Tube components 1. The anode 2. The cathode	1. Draw a chalkboard sketch of a typical hot cathode vacuum x-ray tube.
3. The target 4. The envelope 5. The filament	2. Explain the function and construction of each component, describing the materials used.
6. The window	3. Label the parts of the tube as previously listed in tube component.
	4. Display sample tube.

B. X-ray tube targets 1. Target materials 2. Inclined targets 3. 360 degree emission 4. Rotating anodes 5. Reduced focal spot tubes	1. Define the optimum characteristics of target materials: a. High melting point b. High atomic number c. High termal conductivity d. Low vapor pressure 2. Draw chalkboard sketches of the various geometric shapes of targets. 3 Explain the advantages of each type of target design: a. 360° emission target for circumferential shots. b. Rotating target for longer target life 4 Explain the advantages of the smaller focal spot in that it reduces geometric unsharpness 5 Define and explain "heel effect".
C. Efficienty and heat dissipation	1 Define the efficiency of the x-ray tube for low and medium voltages explaining that as the voltage is lowered the penetrating ability of the x-ray is also lowered. 2. Explain the reason for the lack of efficiency (x-rays result in less than 1% of energy created in tube) 3. Explain techniques for dissipation of heat from the anode: a Tungsten target surrounded by copper heat dissipator b. Oil and water circulated around the anode c Metal heat dissipating fins 4. Define the duty cycle outlining the percentage of the total working day that an x-ray generator can be operated without overheating.
D. Special construction features 1. Focusing cuts 2. Hooded anodes	1. Draw chalkboard sketches of each of the special features. 2. Explain the advantages of each feature: a Focusing cups collimate the high speed electrons toward tungsten

	target b. Hooded anode improves geometry of the electrodes
E. Beryllium windows	Discuss the advantage of a beryllium window in an x-ray tube, explaining that it provides maximum radiographic contrast for thin or low density materials.

III. APPLICATION (drill, illustrations, analogies, oral questions or assignments)

A. Have each student sketch on paper a typical inclined target hot cathode vacuum x-ray tube.

B. Ask individual students to:
1. Sketch the x-ray tube on the chalkboard
2. Explain the function of each part
3. Discuss the target in detail and sketch other target designs
4. Sketch and explain the purpose of special features which are used to increase the performance of the tube
5. Approximate the efficiency of x-ray tubes and tell how heat is dissipated from the anode.

IV. TEST (final check on students' comprehension of material presented)

NOTE: Written Test

A. Draw a sketch of a hot filament, inclined target, high vacuum x-ray tube.

B. Label all of the parts of the tube.

C. Define the function of the filament, the anode, the target, and the envelope.

D. Why is the efficiency of x-ray tubes very low?

E. Outline the advantage of a small focal spot size.

F. What is the purpose of an anode hood and the beryllium window?

Check and discuss.

V. SUMMARY

A. X-ray generators consist of two main components, the control console and the tube head.

B. The tube head contains the x-ray generating tube.

C. X-ray tube focal spot size is important. It should be as small as possible.

D. The duty cycle of the tube is very important and depends upon the tube's ability to dissipate excessive heat generated while in use.

The Next Lesson is: X-ray Generator

INSTRUCTOR'S LESSON PLAN
Related Technical Information

Unit 16
Lesson 2
Time 2 hours

SUBJECT: X-ray Generator

AIM (or purpose): To develop an understanding of the basic circuitry of industrial x-ray generators

TEACHING AIDS: An x-ray generator with top of control panel removed to expose the internal wiring

MATERIALS: Colored pencils

REFERENCES: Nondestructive Testing Handbook, Volume I, Section 14, 1963, Society for Nondestructive Testing, Evanston, Illinois

I. PREPARATION (of the learner)

Introduce the subject and tell the group that the basic circuitry of x-ray generators will be discussed in detail. Although generators vary slightly in design and placement of meters, fuses, and circuit breakers, all generators are basically the same. As shown in schematic drawings, all circuitry also seems to be of the same general nature. It should be pointed out that knowledge of the basic circuitry is most useful when the radiographer by necessity must repair his own equipment.

II. PRESENTATION (of the information)

Instructional Topics	Things to Remember to Do or Say
A. The basic circuit 1. Fuses 2. Switch 3. Line voltage compensator 4. Voltmeter 5. Timer 6. Milliammeter	1. Pass out Information Sheet #14. Sketch a typical self-rectified x-ray generator circuit on the chalkboard.

7. Filament transformer 8. X-ray tube	2. Explain the function of each of the components as previously listed under A, the basic circuit. 3. Trace the current flow as it passes through the circuit.
B. Current characteristics 1. Self-rectifying 2. Valve tube half wave rectification 3. Full wave valve rectification	1. Draw chalkboard sketches of the voltage wave form applied to the tube of a self-rectifying tube. 2. Show the effect of self-rectification. 3. Draw a simple bridge circuit and explain how valve rectification is achieved. 4. With chalkboard illustration explain the advantages of the full wave valve rectification.
C. Tank unit designs 1. Grounded cathodes 2. Grounded anodes 3. Center ground systems	1. Define a tank unit and explain how it differs from externally fed high-voltage units. 2. Draw sketches of each of the various tank-type circuits. 3. Explain the advantage of each on the chalkboard.
D. Separated unit machines	1. Sketch the layout of this type machine by block diagrams. 2. Explain the use of rod anodes by illustrating their ability to make exposures in areas too small for conventional equipment. 3. Explain why these units are generally limited to fixed installations (360° radiation pattern creates a hazardous condition outside of the exposure room). 4. Explain the unlimited duty cycle and the ability to use the x-ray generator continuously without the danger of overheating the tube.

III. APPLICATION (drill, illustrations, analogies, oral questions or assignments)

A. Have several students make a chalkboard sketch of a self-rectified x-ray generator.

B. Suggest that others:
   1. Label all components
   2. Explain the function of each component
   3. Draw a sketch of the applied and the rectified wave form of this generator
   4. Explain the advantage of full wave rectification

C. Ask other students to describe the various tank unit circuitry designs and explain their advantages to the group.

IV. TEST (final check on students' comprehension of material presented)

NOTE: Written Test

A. Draw a sketch of a self-rectifying x-ray generator circuit.

B. Label all essential parts.

C. Draw arrows to indicate current flow in the circuit.

D. Explain the advantages of the grounded anode and the grounded cathode tank units.

E. What are the advantages of separated unit construction? What are the disadvantages?

V. SUMMARY

A. Self-rectified x-ray circuit is usually employed in a tank-type, or self-contained, portable x-ray unit.

B. Self-rectified x-ray circuits have a relatively low milliamperage output.

C. Rod-anode type units are used where access to exposure area must be made through a relatively small opening.

D. Rod-anode units are capable of making a circumferential exposure.

E. Constant potential circuits are used to increase penetration, reduce exposure time, and produce longer tube life. These units are almost always stationary or fixed.

F. Rectified high-voltage circuits allow a more compact design plus higher tube output.

The Next Lesson is: Set-up, Connecting, Preheating of X-ray Generator and Tube

INSTRUCTOR'S LESSON PLAN
Manipulative Skills

Unit 16
Lesson 3
Time 1 hour

JOB (or operation): Set-up, Connecting, and Preheating of X-ray Generator and Tube

AIM (or purpose): To develop skill in conditioning x-ray tubes before applying high voltages

TOOLS AND EQUIPMENT:
- X-ray exposure facilities
- X-ray generator
- X-ray tubes - (new and used)

REFERENCES: Equipment manufacturers instruction manual
Nondestructive Testing Handbook, Volume I, 1963, Society for Nondestructive Testing, Evanston, Illinois

I. PREPARATION (of the learner)

Point out that this lesson will provide instruction in the correct procedure for operating the x-ray generator, stressing that improper procedures could result in damage to the x-ray tube, which is relatively expensive and not an easy item to install.

Explain that the tube must be warmed up slowly at the beginning of the working day otherwise the radiation output will fluctuate and life of the tube may be materially shortened.

II. PRESENTATION (of the skills)

Operations or Steps	Key Points (things to remember to do or say)
A. Setup x-ray generator	Place generator as if to make exposure. 1. Rotate kv and ma controls to the minimum settings (Manufacturers recommendations).

B. Preset controls	2. Set line voltage control to the proper value 220v or 110 v.
C. Connect cables	1. Connect tube head to control panel. 2. Connect to power line. 3. <u>Caution:</u> Always connect ground lead to proper ground.
D. Turn on power switch	1. Check indicator lights to insure that generator is energized (Lights should be on).
E. Set timer	2. Check kv and ma readings for minimum values (Check manufacturers machine rating) Place timer on maximum value (Check range of generator)
F. Turn on high voltage	1. Press the kv button to energize the high voltage. 2. <u>Caution:</u> Generator is now producing dangerous radiation. Do not stand or walk in front of tube head. Increase kv slowly to one-half of the maximum rated value. Increase ma to one-half the rated maximum value.
G. Increase kilovoltage	1. To warmup generator wait one minute after making initial adjustment. 2. Increase voltage 10 kv every minute until maximum value is obtained. 3. <u>Caution</u>: X-ray generators which have been stored for long periods of time should be "<u>seasoned</u>" according to manufacturers recommendations. To season, warm up slower and longer.
H. Increase milliamperage	
I. Increase kv by steps	4. The warmup is performed slowly to prevent tube damage and to give constant radiation output rather than a fluctuating output. 5. Examine sample tubes and explain and discuss parts that are easily damaged.

III. APPLICATION (practice by learner under close supervision)

A. Supervise the students in performing the demonstrated x-ray tube set up and preheat procedure.

B. Have all students discuss and explain why the warmup procedure is essential.

C. Suggest that points of caution be repeated by all to impress the seriousness of the subject.

IV. TEST (performance of skill to acceptable standards)

NOTE: Demonstration

A. Have each student set up the x-ray generator from the beginning. Test for use of proper safety precautions and proper sequence of operations.

B. Rotate the assignment of warming up the x-ray generator each day.

C. Post the warmup sequence on the lid of the x-ray control console.

V SUMMARY

A. The x-ray tube is the most expensive and one of the most fragile parts of an x-ray generator.

B. Tubes cannot be replaced quickly and efficiently in the field.

C. An x-ray generator's behavior can vary between individual tubes.

D. A properly timed warmup period is essential.

E. Heat dissipation from x-ray tubes is a major problem on field units.

The Next Lesson is: Auxiliary Equipment for Handling X-ray Generators

INSTRUCTOR'S LESSON PLAN
Related Technical Information

Unit 16
Lesson 4
Time 1 hour

SUBJECT: Auxiliary Equipment for Handling X-ray Generators

AIM (or purpose): To acquaint students with the various devices employed to position and transport x-ray equipment

TEACHING AIDS: Photos of x-ray equipment and auxiliary handling equipment

REFERENCES: Manufacturers literature
Industrial X-ray Handbook, Allan Lytel, 1962, Howard W. Sams Co. Inc., Indianapolis, Indiana

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I. PREPARATION (of the learner)

Develop student interest by relating the fact that when a commercial photographer shoots certain pictures he is required to use necessary or auxiliary equipment to make an effective shot.

The job of a radiographer would be most difficult, in fact, almost impossible, if he were required to use an x-ray generator without the benefit of supporting equipment. Various types of handling devices have been devised to lighten the physical labor of radiography and to increase the production rate of routine jobs. Several of the more common devices will be discussed in this lesson. For example, the matter of moving an x-ray generator through a long section of welded pipe or the positioning of an x-ray tube for overhead exposures.

II. PRESENTATION (of the information)

Instructional Topics	Things to Remember to Do or Say
A. Tube stands for portable tank units	1. Display photographs of the several types of tube stands or display the actual equipment. 2. Explain and discuss the limits and uses of tube stands.

	3. Display photos of portable cranes and mechanical positioners used with tube-tank units. Discuss importance of these aids and give examples.
B. Positioners for fixed installations	1. Display photos of overhead rails and boom cranes used to position x-ray equipment. Explain their use, giving examples. 2. Show a photo of a production exposure box explaining its importance and purpose. 3. Discuss photos of precision positioning devices used to control beam orientation outlining their use and the assistance they render. 4. Show photos of semi-fixed fork lift and motorized equipment, explaining their advantages.
C. Special purpose devices 1. Pipe line crawlers 2. Vertical tank wall crawlers 3. Pipe girth weld positioners	1. Display photos of these special devices. 2. Explain the operation of these devices. 3. Discuss how the devices are used to speed production or to accomplish difficult jobs.

III. APPLICATION (drill, illustrations, analogies, oral questions or assignments)

Have all students outline the procedures for:

A. Positioning a portable x-ray machine to make a radiograph of a 6" pipe 10 feet from the ground in a refinery.

B. Setting up the equipment to make a radiograph of a 36" pipe line girth seam using both internal and external techniques.

C. Making an exposure of a section of a large oil storage tank if the weld is vertical and 15 feet from the ground.

D. Radiographing a rudder tab in place on the airplane.

IV. TEST (final check on students' comprehension of material presented)

NOTE: Oral Quiz

A. How can the expense of fabricating auxiliary equipment be justified?

B. If the radiographer were given a long production run of small parts to be inspected, what type of set up would probably be most economical?

C. What is the advantage of a pipeline crawler over external exposure devices?

V. SUMMARY

A. Tube stands and jigs are available from x-ray equipment manufacturers.

B. Special types of auxiliary equipment such as "crawlers" have been patented and are used extensively in pipeline construction.

C. Vertical wall crawlers and centering devices are used on tanks and pressure vessels.

The Next Lesson is: The X-ray Generator

INSTRUCTOR'S LESSON PLAN
Related Technical Information

Unit 16
Lesson 5
Time 2 hours

SUBJECT: The X-ray Generator

AIM (or purpose): To emphasize the need for exercising the proper care in the use and handling of x-ray generators

TEACHING AIDS: A defective or damaged x-ray tube

REFERENCES: Nondestructive Testing Handbook, Volume I, Section 14, 1963, Society for Nondestructive Testing, Evanston, Illinois

I. PREPARATION (of the learner)

A. Introduce the subject and invite consideration of the matters to be discussed on the basis that the information is both essential and quite interesting.

B. To insure satisfactory performance of x-ray generators, it is necessary to have knowledge of the many factors which can cause a malfunction. Following certain basic and accepted procedures in the care and maintenance of the equipment will insure the radiographer that the x-ray will perform satisfactorily. X-ray generators that remain in a fixed position or location usually require less care and maintenance than the portable field units and frequently have a longer duty cycle in warmer climates because the units can be kept cool by controlling tube head temperature with circulating air, oil or water and by controlling exposure room temperature.

II. PRESENTATION (of the information)

Instructional Topics	Things to Remember to Do or Say
A. X-ray tube ratings	1. Explain the meaning of kvp, ma, kvp-ma product, and duty cycle ratings.

  a. Kvp refers to kilovolt potential of an x-ray generator
  b. Ma refers to its milliamperage range
  c. X-ray exposure time is the product of kvp and ma
  d. Duty cycle ratings refer to length of time an x-ray generator can be used without overheating and the length of time it must remain off before being used again. This, of course, varies with the heat-dissipating features of the generator.
2. Explain the function of the thermal cut-off switch and how the thermal cut-off temperature effects the duty cycle.
  a. The thermal cut-off switch shuts off power to the tube head when the temperature in the head reaches a predetermined limit.
  b. Power remains off until tube head temperature returns to normal, but will not automatically turn itself on as this could create a safety hazard.
3. Explain the relation of the thermal control parameters to tube life and how overheating the tube head can shorten tube life.

B. Expected tube life
  1. Design life
  2. Guaranteed life

1. Inform the students that x-ray tubes are expected to produce several thousand hours of satisfactory service if properly handled.
2. Explain the inability of the suppliers to determine abuse and how this determines the guaranteed life.

C. Causes of failure

Explain, discuss and illustrate as necessary.

1. Mechanical failures caused by mechanical shock.
2. Ring fracture of glass caused by

	internal stress due to poor annealing of glass.
	3. Puncturing of glass caused by faulty mounting and/or bubbles in glass.
	4. Filament burn-out due to excessive heating in which case filament evaporates and burns out. Excessive filament voltage can be caused by defective connections.
	5. Inverse filament burn out caused by backfiring in tubes fed with alternating current because of over-loaded focal spot.
	6. Melted focal spot caused by load, exceeding instantaneous ratings, the effect of poor control being exercised by the user. It can also be caused by timer failure in the ma circuit.
	7. Melted anode caused by exceeding heat-storage capacity.
	8. Gassy tube, the result of tube over-load or a poorly gassed tube.
D. Aids to longer tube life 1. Preheating 2. Careful handling	1. Explain why x-ray tubes should be preheated before applying high voltage. 2. Outline the procedure for storage, transportation, and handling of x-ray tubes to minimize shock.

III. APPLICATION (drill, illustrations, analogies, oral questions or assignments)

A. Have individual students define:
  1. KVP
  2. KVP - MA product
  3. Duty cycle
  4. Thermal cut-off temperature

B. Suggest that students outline the various reasons for x-ray failures.

C. Have other students explain to the class the methods normally used to avoid or delay tube failure.

D. Invite all students to discuss the procedures for preheating an x-ray tube before using it for an exposure, being sure to always give the reasons why.

IV. TEST (final check on students' comprehension of material presented)

NOTE: Written Test

A. What are three possible consequences of thermal overloading of an x-ray tube?

B. How do x-ray tubes become gassy in service?

C. Why should an x-ray tube be preheated before applying high kv?

D. What is the proper method of preheating an x-ray tube?

E. What is meant by a thermal cutoff temperature?

F. What are the consequences of adjusting the cutoff temperature to gain a higher duty cycle than designed?

G. Approximately how long should a well-cared-for x-ray tube perform satisfactorily?

V. SUMMARY

A. X-ray tube ratings include maximum milliamperage and kilovoltage settings that may be controlled by automatic overload switches.

B. Thermal overload diaphragms and switches are also used.

C. Tube life usually depends upon the manner in which it was used and not upon the total time of use.

D. Careful preheating of the x-ray tube, observance of the suggested duty cycle and careful handling of the unit to prevent shock will prolong the life of the tube and other parts of the equipment.

The Next Lesson is: Measuring X-ray Tube Heel Effects

EXPERIMENT SHEET
Measuring X-ray Tube Heel Effect

Unit	16
Lesson	6
Time	3 hours

SUBJECT:

Measuring the variation in x-ray tube intensity due to the Heel Effect

NOTE:

Instructor performs all operations

INTRODUCTORY INFORMATION:

The beam characteristics of x-ray tubes depend partially upon the angle of inclination of the target with respect to the axis of the cathode. The beam intensity diminishes toward the anode side of the tube and increases toward the cathode side. Knowledge of the characteristics of the machine can be used to advantage as well as prevent the production of inadequate film information.

MATERIALS AND EQUIPMENT:

X-ray generator and exposure facilities
Film cassettes and film
Densitometer
Characteristic curves of the film
Dark room facilities including all materials, lead numbers, etc.

PROCEDURE:

A. Single load two 14" x 17" film cassettes with film which displays a near linear response to exposure from a density of 1.0 to 3.5. (Kodak M or Ansco B)

B. Setup x-ray machine for an exposure.

C. Place the two film cassettes tightly end to end to form a plane 14" x 34".

D. Position the tube head over the film with the focal point exactly 26 3/4" from the film.

E. Using a tube port pointer, align the focal spot directly over the abutting edges of the two film at the center of their 14" edges.

F. Mark the film with suitable identification in order to be able to identify film position with the respective ends of the tube head.

G. Using approximately 150 kv, expose the film for a density of 3.0 (If exposure factors are not known, make several trial exposures on small pieces of film in 5 x 7 cassettes before performing steps 3 through 6).

H. Develop both film simultaneously at 68°F for 5 minutes. Fix and dry.

I. With a crayon or pencil, draw a line 1/4" offset from the center line of the film. Draw the line the full length of the 17" dimension.

J. Commencing at the edge which was directly under the tube port, determine the density every 1/2" until the opposite side has been reached.

K. Prepare a table of distance in degrees for recording the density values.

L. Label the center as "zero" degrees with negative distance toward the anode side and positive distance toward the cathode. (Each 1/2" equal one degree).

M. Opposite the distance on the chart, place the value determined by densitometry.

N. Using the characteristic curves, determine the log of relative exposure for each value of density.

O. Using the log of relative exposure of the center point, divide each of the other values by this value and express as a percentage.

P. Enter this percentage value on the chart opposite the proper distance.

Q. Prepare a plot of emission angle vs. intensity using percentage values from the chart. (See Nondestructive Testing Handbook, pgs. 14/30.) Enter a value for every four degrees.

CONCLUSIONS:

A. For near uniform exposure results, the object should not be more than ____________ inches in diameter if this film-focal distance is employed.

B. For near uniform exposure, the ratio of diameter to focal distance should be ___________ for this machine.

C. The heel effect be used to advantage when __________ __________ distance must be kept to a minimum.

D. If density readings are made across the film plane, changes in density are also noted. The source of this difference is _________________.

E. The density decreases for all angles above the center line of the focal spots is explained by the _________ __________ law.

F. The ____________ electrode of the tube is nearest to the electrical connection.

The Next Lesson is: Design Characteristics of Gamma Cameras.

INSTRUCTOR'S LESSON PLAN
Related Technical Information

Unit 16
Lesson 7
Time 1.5 hours

SUBJECT: Design Characteristics of Gamma Cameras

AIM (or purpose): To illustrate and stress the various design features of gamma ray exposure devices

TEACHING AIDS: All available gamma camera equipment
Dummy source pigtail

REFERENCES: Nondestructive Testing Handbook, Volume I, Section 26, 1963, Society for Nondestructive Testing, Evanston, Illinois
Title 10, Federal Register, Part 34, Licenses for Radiography and Radiation Safety Requirements for Radiographic Operations
Information Sheets #42 and #43

I. PREPARATION (of the learner)

Write aim of lesson on chalkboard, introducing the topic and explaining that all gamma ray exposure devices are essentially of the same basic design; however, each manufacturer has incorporated individual features which differentiate his equipment from that of his competitors. The individual features of the different cameras may result in increased safety, reduced weight, or ease of operations; or they may act to produce the opposite results and for this reason the radiographer should be familiar with the essential design features of available gamma exposure equipment.

II. PRESENTATION (of the information)

Instructional Topics	Things to Remember to Do or Say
A. Shielding materials	1. Define shielding equivalent.
1. Lead	2. Draw a chalkboard sketch of density vs. HVL (Half value layers) and indicate points for the various shielding materials.
2. Tungsten	
3. Depleted uranium	3. Distribute information sheets #42, and #43.

	4. Illustrate by chalkboard sketch of a camera cross section showing the use of various construction materials.
B. Locking devices 1. Separate containers 2. Locking plugs 3. Pinned shutters 4. Pigtail locks	1. Display available equipment with different locking devices. 2. List and explain other types of locks by use of chalkboard sketches. 3. Display source pigtail and explain how locking mechanisms are designed to prevent removal during cable disconnects.
C. Radiation leakage 1. At camera surface 2. At surface of an outer container	1. Read the applicable section of AEC Title 10, Part 34 concerning limits of radiation levels for exposure defices. 2. Explain the technique used by manufacturers of enclosing the shield in a larger container to meet the requirements of the regulations.
D. Extension and control cables	1. Display webbed metal and plastic source extension tubes. 2. Illustrate by demonstration the ease of damage to some types of tubes. 3. List and explain the intended purpose of odometers and safety lights: a. Safety lights, red and green, indicate whether source is outside or inside the body of the exposure device. b. Odometers indicate distance source capsule has moved away from the stored position inside the body of the exposure device. 4. Explain the dangers of complete reliance on these safety devices. 5. Outline the maintenance procedures for cranks and cables.

	a. Prevent kinking of cables and housing b. Periodically check cable odometer zero setting c. Remove cable from housing and clean both d. Try to prevent stepping on cable housing.
E. Safety procedures	Remind students that the AEC requires the use of an operating survey meter to determine position or location of source capsule. There are no alternatives to this requirement.

III. APPLICATION (drill, illustrations, analogies, oral questions or assignments)

Use the following procedures to create discussion of the topic:

A. Have each student detail and construct a chalkboard sketch of the type of materials he would use and the safety features he would employ in the construction of an "ideal" camera. Have students justify each item as it is developed.

B. Invite other students to constructively criticize the construction designs and demonstrate how they would improve them.

IV. TEST (final check on students' comprehension of material presented)

NOTE: Written Test

A. List the common shielding materials in the increasing order of their shielding ability per unit mass.

B. What is the prime disadvantage of reliance on devices which are designed to indicate the location of the source in remote handling equipment?

C. What is the best device for determining if the source is extended or shielded?

D. Describe the procedure for maintaining remote controlled devices. What is the most important item to consider in the inspection?

E. What are the possible consequences of worn locking devices on detachable control cable exposure units?

Check and discuss

V. SUMMARY

A. Exposure device shielding materials are usually lead, tungsten, or depleted uranium. Depleted uranium is the most efficient but is expensive.

B. All exposure devices have locking mechanisms. This is an AEC requirement.

C. All exposure device designs must be approved by the AEC. This is to assure that devices do not create a radiation hazard.

D. Webbed metal flexible tubes, plastic hoses and aluminum tubes are used to contain the drive cable and source capsule while exposures are being made. These can all be damaged easily thus creating a radiation hazard.

E. Safety lights, flags, arrows, and odometers are helpful safety tools but are not foolproof. A properly operating survey meter must be used whenever the source is moved from its locked storage position.

The Next Lesson is: Gamma Ray Exposure Devices

INSTRUCTOR'S LESSON PLAN
Related Technical Information

Unit 16
Lesson 8
Time 2 hours

SUBJECT: Gamma Ray Exposure Devices

AIM (or purpose): To further the understanding of the various types of gamma ray exposure devices available to the radiographer

TEACHING AIDS: Photographs of various devices
All available gamma ray exposure equipment

REFERENCES: Manufacturers literature
Industrial X-ray Handbook, Allan Lytel, 1962, Howard W. Sams Co. Inc., Indianapolis, Indiana
Information Sheets #42 and #43

I. PREPARATION (of the learner)

Write aim of lesson on chalkboard and develop student interest by pointing out that certain design features have been adopted to better suit the gamma ray exposure device to a specific job. A particular type of device may be many times more efficient in the performance of a unique or specific task. The radiographer should be aware of the advantages and disadvantages, the limitations and attributes of each type of device. There is no universally best type exposure device. Knowledge of the types that are available can be a valuable asset to the radiographer when selecting a particular type equipment for a specific type of job.

II. PRESENTATION (of the information)

Instructional Topics	Things to Remember to Do or Say
A. Remote controlled portable units 1. Crank extension 2. Crank shutter 3. Pneumatic 4. Snorkels	1. Issue information sheets #42, and #43 and display available types of gamma ray equipment. 2. Demonstrate the operation of the equipment.

	3. Explain the principles of operations and construction using the chalkboard: a. A source capsule attached to a cable and cranked in and out of the storage capsule b. A shutter that is remotely opened and shut in a crank shutter-type of device c. A source capsule that is moved through a flexible tube pneumatically d. A source that is raised and lowered inside an aluminum tube with a nylon string is the snorkel type 4. Display photos of other types of devices. 5. Outline the scope of operations performed with these devices on chalkboard. 6. Indicate the maximum activity of the materials which are generally loaded into these devices i.e., 30 to 100 curies of iridium 192.
B. Fixed and semi-portable units 1. Lab units 2. Wheeled mountings	1. Display photos of large fixed installations and semi-portable wheel mounted units. 2. Explain the method of manipulating the source and the safety devices of large fixed exposure devices. 3. Outline the scope of operations performed with these devices and how they are used for radiographing thick, dense materials, usually with cobalt 60 which requires heavier shielding than iridium 192.
C. Hand cameras 1. Hinged shutter 2. Rotating shutter	1. Display available hand cameras. 2. Show photos of other hand camera units. 3. Outline the scope of operations with these devices and how they

are used mostly for panoramic shots and pipeline radiography.

4. Indicate the activity of the materials generally loaded into these devices i.e., about 30 curies of iridium 192.

D. Personnel exposure from portable exposure devices

1. Describe the radiation conditions which exist when a source is extended from a remote control camera pointing out that there is little or no shielding surrounding the capsule while exposure is being made.
2. Describe the radiation conditions that exist while using a hand camera and that a large percentage of the source capsule is shielded while the exposure is being made.

III. APPLICATION (drill, illustrations, analogies, oral questions or assignments)

A. Display available devices and illustration of devices and invite students to ask questions.

B. Ask for descriptions of the various types of portable remote control equipment that is available.

C. Suggest that students outline the scope of work performed with these devices.

D. Have them describe the construction and uses for various hand cameras.

IV. TEST (final check on students' comprehension of material presented)

NOTE: Written Test

A. What is the probable maximum amount of cobalt 60 which can be safely loaded and handled in remote controlled portable exposure devices?

B. What is the maximum amount of iridium 192 generally supplied in remote controlled portable devices?

C. Describe an exposure condition where a hand camera would be of more value than a portable remote extension unit.

D. Why is a portable remote extension unit best suited for work on construction sites?

E. Compare the radiation hazards of hand cameras and remote controlled extension units if both contained the same source.

V. SUMMARY

A. Remote controlled portable exposure devices can increase production because the relatively heavy body of the exposure device does not have to be repositioned with each exposure.

B. Remote controlled devices usually require more surveillance during exposures because of the large radiation field they create.

C. Fixed and semi-portable units usually use cobalt 60 as the source of radiation. Cobalt 60 requires much more shielding than does iridium 192.

D. Hand exposure devices are popular in shop work where space is at a premium and where workers are operating in the area will not be endangered. Hand exposure devices are also used extensively in pipeline construction due to their portability.

The Next Lesson is: Preparation of a Remote Controlled Gamma Ray Camera for an Exposure

INSTRUCTOR S LESSON PLAN
Manipulative Skills

Unit 16
Lesson 9
Time 4 hours

JOB (or operation): Preparation of a Remote Controlled Gamma Ray Camera for an Exposure

AIM (or purpose): To develop skill in the setup and assembly of the components of a gamma ray exposure device

TOOLS AND EQUIPMENT: Remote controlled gamma ray exposure device
Gamma radiation survey meter

TEACHING AID Exposure facility or restricted area

REFERENCES: Manufacturers instruction manuals

I. PREPARATION (of the learner)

A. Write aim of lesson on chalkboard - explain the importance of developing skill in the set up and assembly of the components of a gamma ray exposure device.

B. Explain that the proper procedures and safety precautions are essential in the assembly of an exposure device when preparing for radiographic operations. Improper procedures may result in the detachment of the source from the cable and cause serious exposure to the radiographer. Care must also be exercised to avoid damage to cables and extension tubes which can result in the improper lodging of the source in the extended position.

II. PRESENTATION (of the skills)

Operations or Steps	Key Points (things to remember to do or say)
A. Demonstrate 1. Placement of camera	1. Select an area free from obstructions and entanglements for the placement of the camera. 2. Place camera on a solid level surface.
2. Extend control cables	1. Extend cables with the crank away from the anticipated area of exposure. 2. Extend cables without kinks or loops
3. Energize survey meter	1. Turn on survey meter, wait for warm-up and zero meter. 2. Keep survey meter in clear view throughout the remainder of the operations.
4. Connect control cables to camera (Some cameras may have permanently attached cables)	1. Extend extension cable from sheath approximately six inches. 2. Caution: Do not drop or lay extended cable in the dirt. 3. Remove cover from source pig-tail port. 4. Connect cable to pig-tail. 5. Caution: Check to insure that the connection is properly made and free acting. 6. Bring cable sheath forward by cranking extension handle. 7. Connect sheath to camera.
5. Connect extension tube to camera	1. Select only the amount of tube length required to perform the job. 2. Firmly attach tube to camera (Tubes may have snap, quick twist, or screw-type connectors). 3. Attach end cap, source switch, or collimator to free end of tube.

	4. Extend tube to object to be radiographed. 5. Remove all kinds and loops from the tube using tape to support it if necessary.
6. Unlock the camera	1. Retract the source as far as possible by reverse cranking on the handle. 2. <u>Caution:</u> Do not force crank. Use only enough pressure to insure source is in the fully retracted position. 3. Place key in lock and unlock the source.
7. Extension and retraction of the source	1. Turn crank to extend until source is firmly against the end of the tube. 2. Make desired exposure. 3. Turn crank to retract source until source is firmly against stop in the camera. 4. Observe the survey meter to insure source is in the safe position. Approach camera with caution using survey meter to insure source in actually in the safe position.

III. APPLICATION (practice by learner under close supervision)

A. Divide the class into two groups and have one group instruct the other in the proper techniques while the second group performs the instructed operations.

B. Reverse the groups and repeat.

C. Supervise the students very closely to insure development of sound practices and safety procedures.

D. Stress very strongly the proper and constant use of the survey meter.

E. Invite questions and promote sound discussion whenever possible.

IV. TEST (performance of skill to acceptable standards)

Test each student determining that he can perform the proper technique of camera setup for gamma radiography. Have him state his intended actions before performing the next step. The student should explain the reasons for each of his actions as he progresses.

V. SUMMARY

A. No exposure is to be made without having a properly operating survey meter at the job site.

B. Survey meter must always be used for each individual exposure to make certain that the radioactive source is in a safe or controlled position.

C. Planning each exposure set-up beforehand will save a lot of steps and a lot of unnecessary lifting.

D. Personnel monitoring equipment and radiation warning signs must be used at all times while making exposures or handling radioactive materials and equipment.

The Next Lesson is: Radiography with Unattached Gamma Ray Sources

INSTRUCTOR'S LESSON PLAN
Related Technical Information

Unit 16
Lesson 10
Time 1.5 hours

SUBJECT: Radiography with Unattached Gamma Ray Sources

AIM (or purpose): To develop a working knowledge of the techniques for handling gamma source capsules

TEACHING AIDS: Magnetic source handlers, radioactive capsule and shield

MATERIALS: Paper cups
Tape

REFERENCES: Information Sheet #44

I. PREPARATION (of the learner)

A. Develop student interest by discussing the fact that the Atomic Energy Commission allows the use of a maximum of 1 curie of cobalt 60 and 3 curies of iridium 192 without an exposure device providing that a 1" x 1" metal tag is permanently attached to the capsule with stainless steel wire. The tag is colored magenta and yellow, has the standard radiation warning sign on one side and contains the following notice on the opposite side: "Warning - radioactive material - do not handle - if found notify civil authorities".

B. The use of these sources is becoming obsolete in radiography particularily with the advent of the crankout type exposure devices. Many incidents have occurred in the past when these type of sources were left unattended in shop and field operations. A well trained radiographer should be familiar with all types of operations involving radioactive material and especially the safety precautions related thereto.

II. PRESENTATION (of the information)

Instructional Topics	Things to Remember to Do or Say
A. The unattached gamma ray source	1. Briefly outline this practice referring to Information Sheet #44: a. A paper cup is taped to an object and the specimen to be radiographed is placed a pre-determined distance from cup. b. Source storage shield is unlocked and capsule is removed and placed in paper cup with a magnetic source-handling rod about eight feet long. c. Source is replaced in storage shield and shield locked after exposure has been made. 2. Tag attached by a length of wire to the capsule is usually kept hanging outside the storage shield to facilitate handling of capsule with magnetic handler. If necessary, a nylon cord attached to the tag can be attached to a pole to remove the capsule.
B. Handling precautions	1. Exposure to radiation by the radiographer can be calculated before the actual exposure is made. 2. Care must be taken to prevent damage to the source capsule as this could create a serious contamination problem. Explain at length. 3. Source storage shield cavity and plug have offsets in their diameters to prevent radiation from passing between cavity and plug. (Illustrate this on chalkboard) 4. A bright colored tag attached to capsule is an aid in locating a lost capsule.

5. Remember, if you can read the printing on the tag then you are probably too close to the capsule.

C. Advantages and disadvantages

1. An unattached source can be used to advantage when working in a relatively inaccessible area such as between two rows of boiler tubes.
2. This type source creates a hazard if dropped from a structure or into a stream where it would be difficult to retrieve.
3. Source of this type also creates an environmental hazard in the possibility of overexposure.
4. These sources usually represent a considerable saving in that costly exposure devices are not required and the storage shields used with unattached sources are relatively inexpensive.

III. APPLICATION (drill, illustrations, analogies, oral questions or assignments)

A. Ask students to cite situations where free sources could be used to advantage giving a full and thorough explanation of each condition.

B. Have students explain the approved methods for handling free sources.

C. Suggest that students:
   1. Outline the safety hazards associated with handling free sources.
   2. State the advantage of using free sources.
   3. Discuss the disadvantages of using free sources.

D. Simulate using a free source and have each student perform the operation. Discuss their techniques and make corrections if necessary inviting all questions as they arise.

IV. TEST (final check on students' comprehension of material presented)
NOTE: Written Test

A. List three advantages of radiography with free sources.

B. Give three disadvantages.

C. What is the chief cause of the decline in the use of free sources?

Check and discuss.

V. SUMMARY

A. Gamma ray sources used without an exposure device have had a long history of incidents involving overexposures to radiographers and workers near the area of operations.

B. This practice originally started with the use of radium as an industrial inspection tool. Regulations were non-existant during that time.

C. All safety precautions must be rigidly adhered to for this type of operation as well as for the more conventional methods.

D. With the advent of crankout and pneumatic type exposure devices, there is little justification for the use of the subject method.

The Next Lesson is: Changing Sources

INSTRUCTOR S LESSON PLAN
Manipulative Skills

Unit 16
Lesson II
Time 2 hours

JOB(or operation): Changing Sources

AIM (or purpose): To develop skill in the exchange of a depleted source with a new high activity unit

TOOLS AND EQUIPMENT: Remote control gamma ray exposure device
Source changer for the exposure device
Gamma radiation survey meter

TEACHING AIDS Exposure facility or restricted area

REFERENCES: Manufacturers instruction manuals
Information Sheet #45

I. PREPARATION (of the learner)

When a source's activity has decayed to an unsatisfactory level, it is replaced in the camera by a more active source. This is done by returning the equipment to the supplier or by its exchange as performed by the radiographer New sources are shipped in containers called source changers Changing of sources is a simple operation if properly performed; however, a series of accidents have resulted from inexperience or negligence in source changing. The radiographer must master the techniques to avoid these accidents and this lesson is calculated to help the individual to attain this desired skill.

II. PRESENTATION (of the skills)

Operations or Steps	Key Points (things to remember to do or say)
A. Placement of camera and source changer	1. Demonstrate by selecting an area free from obstructions and entanglements for placement of equipment.

	2. Place camera and source changer on a firm level surface.
B. Energize survey meter	1. Turn on survey meter, wait for warm-up, and zero meter. 2. Note: The changing of sources is best accomplished by two people and the use of two meters is recommended. 3. Each man should keep a meter in clear view throughout the operation.
C. Set up camera	1. Follow standard procedures for connecting the cables. 2. Use one length of tube (Special tubes may be supplied with the changer) to connect camera to source changer. 3. Connect tube to empty cell of changer. 4. Check cables and tubes for freedom from kinks, loops, or tension.
D. Disconnect old source	1. Issue Information Sheet #45 and extend old source into empty cell of changer. 2. Place survey meter in view throughout the disconnect operation. 3. Disconnect source from cable very carefully. 4. Danger: Source changers generally do not have locking devices to hold the source while disconnecting. Exercise extreme care not to pull source from the shielded position while making connections. 5. Remove the extension tube and lock old source in place.
E. Connect new source	1. Connect the tube to the cell containing the new source. 2. Place survey meter in view throughout the connect operation.

3. Using the same caution as before, connect the new source to the cable.
4. Retract the source into the camera.
5. Lock the camera.
6 Survey the camera to insure the source is in the safe position.
7. Disassemble the camera and return it to storage.
8. Prepare source changer for storage or shipment.

III. APPLICATION (practice by learner under close supervision)

A. Have each student perform the instructed operations under the close supervision of the instructor

B. Offer corrective suggestions, invite questions and repeat until all have performed the operation satisfactorily.

IV. TEST (performance of skill to acceptable standards)

A. Divide the students into groups of two. Each group must display the proper technique of camera setup, positioning of the source changer, and use of safety procedures while performing a change of sources. Have the students state their intended actions before performing the next step of their operations. Have students explain the reasons for their action.

B. Discuss and evaluate performance as tests progress.

V. SUMMARY

A. Same safety precautions necessary for source changing as when making an exposure.

B. Operation should not be performed by only one person as a second person is necessary to act as a monitor.

C. Source changers generally are not a safety locking device that can be used while sources are being exchanged.

D. Source changing operation should always be performed by using a written step procedure for each operation so that the proper sequence will be maintained.

The Next Lesson is: Focal Spot Size

EXPERIMENT SHEET
Focal Spot Size

Unit 16
Lesson 12
Time 4 hours

SUBJECT: Determining the Focal Spot Size of an X-ray Generator

NOTE:

Instructor performs all operations

INTRODUCTORY INFORMATION:

The size of the focal spot of an x-ray generator or the size of an isotope source has a great influence on the quality of the radiographs produced by the equipment. Occasionally the internal components of a tube will shift or become damaged altering the focal size and resulting in poor radiographic quality. Isotope sources are occasionally shipped in the wrong size for the job or specification intended The radiographer should be able to determine when any of these unusual conditions exist.

MATERIALS AND EQUIPMENT:

X-ray generator or gamma source and exposure facilities
Film cassettes and film
Sheet of lead, 8" x 10" by .005" thick
Sheet of plywood 8" x 10" with 1" diam. hold in center
Dark room facilities
Hand drill and 1/64" drill bit
1-6 ft. measuring tape with 1/32" graduations
1-rule with millimeter scale

PROCEDURE.

A. Single load 5" x 7" film cassette with selected film and lead screens.

B. Set up x-ray generator or gamma source for exposure.

C. Set the film-focal distance at 24".

D. Drill a 1/64" hole through the lead sheet at exactly the center.

E. Place the lead sheet on a sheet of plywood or similiar materials in which a hole about an inch in diameter has been cut Position the pin hole in the lead sheet in the center of the large hole.

F. Position the board and lead sheet directly under the source of radiation exactly half way between the film and the source. (approximately 12" distance from source)

G. Expose the film to a density between 1 and 1.5.

H. Develop the film at 68°F for 5 minutes. Fix and dry

I. Measure the image of the focal spot which appears on the developed film

J. Add 1/32" to the dimensions obtained by measurement.

CONCLUSIONS:

A. The focal spot size of this machine is ________________.

B. The value of twice the pin hole size is added to the dimensions of the focal spot because of the __________ ____________ distance.

C. The value obtained from measurement ____________ (does/does not) compare favorably with the manufacturers data.

NOTE TO INSTRUCTOR

If this experiment is performed with gamma rays, have one student process the radiographic film and continue with the same experiment using an x-ray generator

The Next Lesson: Visit to a Pipeline or Process Construction Job

INSTRUCTOR'S LESSON PLAN
Related Technical Information

Unit 16
Lesson 13
Time 6 hours
(1 day)

SUBJECT: Visit to a Pipeline or Process Construction Job

AIM (or purpose): To permit the student to observe the construction and inspection of pipe, and to experience the hazards and rigors of pipe construction

MATERIALS: Film badges
Dosimeters
Safety glasses
Hard hats

I. PREPARATION (of the learner)

A. Before leaving for the field trip,the student should be instructed as to the reasons for the trip, its objectives, and the need for carefully observing the following operations:

1. The hazards of the construction, particularly the overhead handling of pipe, overhead welding, movement of heavy equipment, and the work at elevated positions
2. The welding of pipe in all positions.
3. The care (or mishandling) of welding electrodes
4. The types of welding equipment employed
5. Methods of pipe alignment
6. Preheating and stress relieving practices
7. Weld bead preparation and cleaning practices
8. The types of inspections employed after completion of welding

B. Issue safety instructions to be followed while at the job site, particularly caution against watching the welders at work. Issue safety glasses, hard hats, and any other items that will be needed. Remind all students to behave as guests of the company and remain in the group under the guidance of the supervisor.

II. PRESENTATION (of the information)

Instructional Topics	Things to Remember to Do or Say
Observations in the visited facility	Be sure that students are made aware that a test will be given on what was observed.

III. APPLICATION (drill, illustrations, analogies, oral questions or assignments)

After returning from the trip, ask the students to discuss:

A. Their opinion of pipe construction work

B. The possible source of defects in welded pipe

C. The method of handling welding electrodes and how this can affect the weld quality

D. How the pipe ends were aligned and how this could affect the x-ray film image

E. How the weld cleaning practices affect quality and possible improved methods of weld cleaning

F. The methods used for inspection

G. The special handling tools used by the inspectors

IV. TEST (final check on students' comprehension of material presented)

A. Instruct each student to prepare a detailed written report on the observations made during the plant tour. Suggest that he cover in detail all observations that will in any way affect the radiographers function either in the field of manufacture, fabrication, inspection, handling or testing.

B. Have them list any suggestions they may have for future field trips and how these trips may be made more fruitful or benificial to them.

C. Check each report and discuss the results with the group.

The Next Lesson is: Film Manufacturing Process

INSTRUCTOR'S LESSON PLAN
Related Technical Information

Unit 17
Lesson 1
Time 1 hour

SUBJECT: Film Manufacturing Process

AIM (or purpose): To emphasize the methods and controls used in the making of radiographic film

TEACHING AIDS: Film: The Inside Story, 32 mins., 16 mm, sound,
Eastman Kodak Company, Rochester, N.Y.
Film projector and screen

I. PREPARATION (of the learner)

A. Introduce the film giving its name, length and type. Ask the students to carefully observe the following:
   1. The layers of different materials which comprise the structure of radiographic film
   2. The functions of each layer of the radiographic film
   3. The chemicals used to produce a sensitized emulsion
   4. The care used to insure uniformity of the finished product
   5. The care used in handling of radiographic film.
   6. The fact that most x-ray film consists of seven layers of materials

B. Advise the students that a test will be given after the film is shown and suggest that it be closely observed with this in mind.

II. PRESENTATION (of the learner)

Instructional Topics	Things to Remember to Do or Say
A. The Inside Story	Show the film.

III. APPLICATION (drill, illustrations, analogies, oral questions or assignments)

A. Review the film emphasizing these points in the discussion:
   1. The structural make up of radiographic film
      a. The film base
      b. The emulsion
      c. The surface gelation layer

EXPERIMENT SHEET
Exposure Changes for Changing Density

Unit 12
Lesson 8
Time 3 hours

SUBJECT:

Changing the density of radiographs from one value to a second desired value

NOTE:

Instructor performs all operations

INTRODUCTORY INFORMATION:

The exposure charts for x-ray radiography are constructed for a fixed density. It is often necessary to change the density of a radiograph to comply with specifications, increase contrast, or to improve the readability of the film. The radiographer should be able to adjust the density of the film by adjustment of the exposure time given by the exposure chart.

MATERIALS AND EQUIPMENT:

X-ray generator and exposure facilities
Film cassettes and Kodak AA film
Sample part for inspection
Densitometer
Characteristic curves for type AA film
Darkroom facilities including equipment, materials, lead numbers, etc.
Logarithm tables

PROCEDURE:

A. Single load film cassettes with type AA film.

B. Set up the x-ray generator for an exposure of the sample part using the exposure chart constructed in a previous experiment.

C. Place a film directly under the focal spot of the machine and center the sample part on the film. Mark the film for identification.

D Make an exposure in accordance with the exposure chart.

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2. The treatment of silver nitrate and potassium bromide to produce the sensitive silver bromide crystals
3. The extreme care exercised in making of film to insure freedom from defects in the finished product
4. The quality control checks used to insure uniformity of the finished product

B. In addition to reviewing the actual film content, some reference can be made regarding the need for continued careful handling of the product after it is received for use by the radiographer and the need for his being aware of expiration dates and film storage conditions.

IV. TEST (final check on students' comprehension of material presented)

NOTE: Written Test

A. What is the purpose of the plastic layer between the two emulsion layers of radiographic film?

B. What is the composition of the gelation layer in radiographic film?

C. What part does the emulsion perform in the exposure of a radiographic film?

D. Why is the radiographic film subjected to the various inspection by the manufacturer during the manufacture of the film?

E. What would be the consequences to the radiographic operator if the film did not react uniformly on exposure?

V. SUMMARY

A. Parts of this instructional movie were made under simulated conditions because the film cannot be exposed to white light.

B. It is possible for the resultant film speed to vary slightly from one batch of raw material used in the manufacture of the film to another.

C. When opening a new box of film, cut off a strip of the top or bottom sheet, or both, and develop without exposing it to check for film fog.

D. Always observe the manufacturing date on the box before accepting film.

The Next Lesson is: Characteristics of Radiographic Film

INSTRUCTOR'S LESSON PLAN
Related Technical Information

Unit 17
Lesson 2
Time 2 hours

SUBJECT: Characteristics of Radiographic Film

AIM (or purpose): To develop background information regarding the properties of industrial film and how these properties affect radiographic quality

TEACHING AIDS: Samples of coarse and fine grain film
Identical radiographs using different films

REFERENCES: Radiography in Modern Industry, 1958, Eastman Kodak Co., Rochester, N.Y.
Kodak Photographic Films and Plates for Scientific and Technical Use, Publication P-9, Eastman Kodak Co., Rochester, N.Y. (1960)
Characteristic curves of various films - Eastman Kodak Co

I. PREPARATION (of the learner)

A. State the subject and relate its aim or purpose outlining briefly why film characteristics are so vitally important to the radiographer.

B. Explain that the lesson will prove to be an interesting and informative one, imparting some fundamental and basic information that will be of considerable help to all.

II. PRESENTATION (of the information)

Instructional Topics	Things to Remember to Do or Say
A. The characteristic curve	1. Refer to curves shown in text. 2. Explain by chalkboard sketches: a. The method of constructing a characteristic curve b. The coordinates of the curve c. The relationship between density and exposure

	3. Outline the differences in characteristic curves of different film, i.e., the differences in chemistry and processing. 4. Display typical characteristic curves.
B. Granularity	1. Define granularity on chalkboard as minute silver particles having a tendency to group together in relatively large masses. This is referred to as clumping. Coarse grain film exhibit this graininess more than fine grain film. The x-ray image is composed of countless minute silver grains. 2. Explain: a. The relationship of granularity to film speed b. The effect of increased radiation energy on graininess c. The granularity from fluorescent screens d. The relationship of development time to graininess 3. Compare a fine grain film with a coarse grain film on chalkboard.
C. Resolving power	1. Define and explain resolving power. 2. Explain the dependence of resolving power on the character of the emulsion.
D. Turbidity	1. Explain film turbidity and its relation to exposure. 2. Define as muddled or stirred up.
E. Inherent film contrast	1. Differentiate between inherent film contrast and subject contrast. 2. Film contrast is: a. The range of inherent grain sizes b. Its relation to density 3. Subject contrast is the ratio of radiation intensities passing through two selected portions of a specimen.

	4. Show the method of determining the contrast exaggeration from the slope of the characteristic curve.
F. Sharpness (Acutance)	1. Define film sharpness as detail of image not blurred. Refer to Figure 20, Page 27 Eastman Textbook. 2. Explain: a. The dependence of sharpness on the emulsion b. Why weak developer reduces sharpness 3. Explain why sharpness is more important than resolving power in radiography. 4. Sharpness also depends upon intimate film and screen contact.
G. Factors affecting sensitivity	Have students turn to Page 48, Eastman Textbook and explain the factors listed in Table VI.

III. APPLICATION (drill, illustrations, analogies, oral questions or assignments)

Have all students:

A. Explain the construction of a characteristic curve,

B. Point out the information which can be derived from the curve. Have the student concentrate on speed and density gradient.

C. Explain film contrast and how to determine the density range which produces the maximum contrast.

D. Define granularity and how it is produced. Explain the techniques for minimizing "graininess".

E. Give a definition of sharpness.

IV. TEST (final check on students' comprehension of material presented)

NOTE: Written Test

A. From the characteristic curves which have been discussed, determine the film with the maximum speed. (Curves are in textbook)

B. Above what approximate value of density will contrast exaggeration occur in Kodak AA film?

C. What range of density will give the best contrast using Kodak M film with lead screens?

D. What is graininess? What factors can be controlled to minimize graininess?

E. Define image sharpness. How does the character of the emulsion effect sharpness?

F. Have students work a problem involving the use of logarithm tables in figuring a change in film exposure time for a particular film by increasing the required relative density from 1.5 to 2.0.

Check and discuss.

V. SUMMARY

A. The characteristic curve is most important in selecting film to be used for any particular assignment.

B. Film grain size increases with film speed. Relatively small grain size is desirable.

C. Film resolving power depends upon the character of the film emulsion.

D. Film contrast is inherent. Subject contrast depends upon the shape or thickness variation of the specimen and on its density variation.

E. Spent developer causes a reduction in image sharpness.

F. When using intensifying screens, good contact with film is necessary for maximum sharpness.

The Next Lesson is: Radiographic Screens

INSTRUCTOR'S LESSON PLAN
Related Technical Information

Unit 17
Lesson 3
Time 2 hours

SUBJECT: Radiographic Screens

AIM (or purpose): To define the purpose, and mechanisms of intensification and the advantages and disadvantages of radiographic intensification screens

TEACHING AIDS: Lead and fluorescent screens

REFERENCES: Radiography in Modern Industry, 1958, Eastman Kodak Co., Rochester, N. Y.
Information Sheet #46

I. PREPARATION (of the learner)

A. After introducing the subject, make the following statement to create interest and discussion: The use of lead screens with radiographic film will decrease the required exposure time and reduce the adverse effects of scattered radiation on the film and lead screens can also improve image quality. Calcium tungstate screens reduce exposure time and the amount of the x-ray radiation beam absorbed by the film is less than 1% of the total. This means that more than 99% of the available energy is performing no useful purpose. Therefore, any means of increasing the amount of energy utilized for creating the image will increase the efficiency of the operation. Radiographic screens are used for this purpose.

B. Explain that it is not expected that these statements will either be understood or accepted as such but are being made to demonstrate the depth and scope of this particular lesson and what exactly is being proposed for coverage.

II. PRESENTATION (of the information)

Instructional Topics	Things to Remember to Do or Say
A. The purpose of screens 1. Intensification 2. Reduction of scattering 3. Preferential intensification	1. Outline on the chalkboard the possible reductions in exposure time which result from the use of lead or fluorescent screens. 2. Explain the reduction in scattering when lead screens are employed and the problems of scattering when fluorescent screens are used. Lead screens filter out or absorb soft primary radiation and secondary scattered radiation while fluorescent screens cause film blurring and fogging, particularily if intimate contact is not made and maintained with the film. 3. Define on chalkboard the conditions which may result in longer exposure times when lead screens are used. 4. Explain the preferential intensification of lead to the primary beam and filtering of scattered radiation.
B. Mechanisms of intensification	1. Issue Information Sheet #46 and explain the action of lead screens in producing electron emission and secondary radiation pointing out that a lead screens' reaction to radiation is in the form of electron emission while secondary radiation is absorbed by the lead. 2. Explain the light emission of fluorescent screens in that certain chemicals fluoresse and as they absorb x-rays or gamma rays they immediately emit light. The light intensity depending upon radiation intensity.
C. Disadvantages of screens 1. Film contact 2. False indications	1. Explain the effects of non-uniform contact between film and screens resulting in blurring and fogging.

3. Static electricity marks
4. Afterglow
5. Graininess
6. Cleanliness requirements

2. Show how to determine if screens contact is uniform. Tape cassette tightly but do not damage film.
3. Explain how false indications are generated by scratches on the screens. See illustration page 24, figure 19, Eastman Textbook.
4. Discuss the generation of static electricity and the marks it produces. Static marks are star shaped and usually occur in dry climates when cassette is thrown on work bench and if operator is wearing rubber soled shoes.
5. Outline the effect of afterglow from fluorescent screens. Afterglow in fluorescent screens blurs film.
6. Explain why fluorescent screens cause graininess and why graininess from fluorescent screens is independent of film grain size.
7. Demonstrate the necessity of keeping screens free from dirt, lint, and trash. (images of dirt will appear on radiograph and will tend to scratch the film. It will also contaminate developing chemicals.)

III. APPLICATION (drill, illustrations, analogies, oral questions or assignments)

Have students:

A. Explain the effects of using lead screens on the speed of exposure when employing 160 kv or more.

B. Explain the effects of lead screens on the definition of the radiograph.

C. List and explain the undesirable effects of intensifying screen usage.

D. Explain the phenomenon which results in intensification when using lead screens.

E. Explain why lead screens are not used at lower kv settings.

F. Explain why calcium tungstate screens are not used with gamma rays.

G. Place a calcium tungstate screen near a source of gamma radiation and have students observe the greenish glow emitted by the screen. Darken the room before exposing the screen. Observe all required safety precautions when conducting this demonstration. Ask students to explain the demonstration.

IV. TEST (final check on students' comprehension of material presented)

NOTE: Written Test

A. What happens when radiation passes through a thin sheet of lead placed in contact with a film in its exposure holder?

B. What is the most objectionable characteristic of fluorescent screen intensification?

C. What is afterglow and why is it objectionable?

D. Scratches, dirt, and lint between the film and the screen cause undesirable effects. Elaborate.

E. What is the effect of poor film to screen contact? How can the degree of contact be determined?

Check and discuss.

V. SUMMARY

A. Lead intensifying screens are usually used at radiation intensities above 125 kv.

B. Calcium tungstate screens are for x-ray use only.

C. Lead screens speed exposure time by electron emission.

The Next Lesson is: Loading of Film Cassettes

INSTRUCTOR'S LESSON PLAN
Manipulative Skills

Unit 17
Lesson 4
Time 1 hour

JOB (or operation): Loading of Film Cassettes

AIM (or purpose): To assist the student in the development of skills and the proper techniques of handling film, screens and cassettes

MATERIALS: Film
Trichloroethylene
Cheese cloth
Very fine steel wool

TEACHING AIDS: Film cassettes
Intensifying screens

REFERENCES: Radiography in Modern Industry, 1958, Eastman Kodak Co., Rochester, N. Y.

I. PREPARATION (of the learner)

Write aim of lesson on chalkboard and stress the need for this effort in that proper handling, loading, and care of film cassettes and screens is essential to production of high quality radiographic film. Use of proper handling procedures and high quality work are characteristics of competent radiographers and an individual will prosper and succeed in direct proportion to how well he can perform the total task. Making a first class exposure is not enough if the film is damaged or destroyed through improper handling.

II. PRESENTATION (of the skills)

Operations or Steps	Key Points (things to remember to do or say)
A. Demonstrate in lighted room preparation of loading area	1. Clean work bench space of all objects in the area particularily where film is to be loaded

	2. Wipe top of work bench with damp cloth to remove all dirt and lint.
	3. Dry bench top with dry cloth
	4. Rub top of bench with palm of hand to insure freedom from grit and dirt.
B. Collect materials	1. Select cassettes, screens, and film to be used in loading.
	2. Place each component in convenient position for assembly.
	3. Stand film box upright against backboard behind work area.
C. Examine cassettes and screens	1. Open cassettes and inspect for lint or dirt. If necessary clean them with a damp cloth and dry thoroughly.
	2. Examine screens for lint, dirt, excessive oxidation, scratches, or creases.
	3. If necessary clean oxide from lead screens with cloth wetted in trichloroethylene. Dry thoroughly. Heavy concentrations of dirt and oxidation may be removed by light rubbing with very fine steel wool.
	4. Caution: Use only recommended solvents and never use an abrasive on fluorescent screens.
	5. Discard screens with creases.
	6. Examine screens to insure that intimate contact can be made over the full surface.
D. Assemble components	1. Place screens in cassettes with cassettes flat and open on the bench.
	2. If a thicker screen is to be used on one side, be sure that the screen is on the back side of the cassettes.

E. Load film

1. Remove film from the box one at a time.
2. Remove interleave from film.
3. Hold film by the edge and lay on screen opposite the flap of the cassettes.
4. Caution: Avoid crimping, sliding, fingerprinting or scratching the film.
5. Lay other screen on film without sliding.
6. Close cover, tape or lock.

III. APPLICATION (practice by learner under close supervision)

A. Have all students practice film loading while room is lighted, using old developed film.

B. Have all students practice film loading in dark room with only safe light illumination still using old developed film.

C. Give close supervision throughout, inviting all questions and repeating any procedure that is the least doubtful.

IV. TEST (performance of skill to acceptable standards)

NOTE: Performance Test

A. Collect cassettes, screens and undeveloped film on the work bench. Have each student load one cassette in total darkness from the disassembled layout.

B. Check results and discuss repeating operation where unsatisfactory results were obtained.

V. SUMMARY

A. Good Housekeeping in film loading room is absolutely necessary to prevent film artifacts.

B. Preliminary steps can be taken before white lights are extinguished.

C. Cassettes should be marked top and bottom so that proper thickness screen is on the proper side.

D. Screens are sometimes used on one side only.

The Next Lesson is: The Photographic Process

INSTRUCTOR'S LESSON PLAN
Related Technical Information

Unit 17
Lesson 5
Time 1.5 hours

SUBJECT: The Photographic Process

AIM (or purpose): To acquaint the students with the chemical reactions which occur in the process of producing a radiograph

REFERENCES: College Chemistry, Sinko and Plain, 1966, McGraw-Hill Book Co., New York, N. Y.
Negative Making - with Kodak, Blank and White Sheet Films, Kodak Publication No. F-5-1962, Eastman Kodak Co., Rochester, N. Y.

I. PREPARATION (of the learner)

A. Develop student interest in the proposed subject by pointing out that the sole purpose of the lesson is to assist the radiographer in doing quality work.

B. While a knowledge of the chemical processes of film exposure and development is not absolutely essential to the production of darkened film, this knowledge is essential if the radiographer desires to maintain the highest possible level of quality workmanship.

II. PRESENTATION (of the information)

Instructional Topics	Things to Remember to Do or Say
A. The emulsion 1. Gelatin 2. Chemical composition 3. Sensitive collodial suspension 4. Grain size	1. Explain the purpose of the gelatin: a. Acts as a vehicle which silver bromide crystals are distributed b. Crystal distribution must be uniform for dependable radiographs c. It has properties which increase silver bromide ($AgBr$) sensitivity to radiant energy

2. Outline on the chalkboard the process of mixing chemicals to form the sensitive collodial suspension:
   a. Start with a flexible cellulose derivitive base coated with an adhesive sub-coat which binds emulsion firmly to base
   b. Film coated on both sides to increase speed
   c. Film consists of seven layers; cellulose base, adhesive on both sides, emulsion on both sides, protective coating on both sides
3. Write the chemical equation for the reaction on the chalkboard, i.e.,
   $AgNo_3 + KBr = AgBr + KNO_3$
4. Explain the light-sensitive characteristics of silver bromide.
5. Explain the relationship between grain size and holding time of the suspension.

B. Exposure and the latent image

1. Explain the tendency of AgBr to decompose to free metallic silver when exposed to radiation.
2. Relate the amount of decomposition to the amount of exposure.
3. Ask questions.

C. Developing

1. Explain the reduction of AgBr by the developer to form black metallic silver.
2. Relate the film density to the extent of decomposition on exposure and the amount of AgBr converted on developing.
3. Define the time dependence of the developing process.

	4. Caution against over development and the reduction of all silver to the metallic form.
D. Fixing	1. Explain the presence of unaffected AgBr left in the film after developing and its sensitivity to radiation and light. 2. Outline the reaction between the fixer (sodium thiosulfate) and the unexposed AgBr to form water soluble silver thiosulfate ions. 3. Explain and discuss the time dependence of the fixing reaction. 4. Define the action of hardeners.
E. Washing and drying	1. Explain the necessity of washing to remove the soluble silver ions from the film. 2. Stipulate the time and temperature requirements of washing for adequate removal of the silver ions. 3. Explain and discuss the drying process necessary to put the film in condition for handling and storage: a. Remove excess moisture from film b. Vent drying cabinet c. Do not overheat film d. Clean, warm, dry air necessary

III. APPLICATION (drill, illustrations, analogies, oral questions or assignments)

A. Have individual students explain and illustrate when possible:
   1. The composition of the emulsion
   2. The exposure process and the chemical reactions that occur
   3. The chemical process of development
   4. The chemical process of fixation

B. Question to promote discussion:
   1. What is the result of prolonged over-development?
   2. What happens to the unaffected silver bromide crystals if film is exposed to light before fixation?
   3. How are solvable ions removed from film? Why?
   4. Why is film washed before drying?
   5. What effect does humidity have on film drying? How can it be reduced?

IV. TEST (final check on students' comprehension of material presented)

NOTE: Written Test

A. Define the sensitive chemical compound in film emulsions.
B. What occurs when radiation strikes the emulsion?
C. Describe what takes place in the developing of film.
D. What happens to the film if it is left in the developer for an amount of time longer than necessary to develop the latent image?
E. Define the element that forms the black image on the film?
F. What occurs when the film is fixed?
G. Why is it necessary to wash the film after fixing?
   Check and discuss.

V. SUMMARY

A. Radiographic film normally consists of seven layers of materials; three layers on each side of the base material.

B. Silver bromide crystals are light sensitive and are sensitive to radiation.

C. The latent image of a specimen is formed by the decomposition of silver bromide to free metallic silver.

D. Fixation and hardening are necessary for the removal of undeveloped silver salts and the hardening of the gelatin so it will withstand drying with warm air.

E. Washing diffuses and washes off the fixer.

The Next Lesson is: Film Artifacts

INSTRUCTOR'S LESSON PLAN
Related Technical Information

Unit 17
Lesson 6
Time 2 hours

SUBJECT: Film Artifacts

AIM (or purpose): To develop an understanding of the various unsatisfactory conditions which occur in radiography, the causes of these conditions, and how they are eliminated

TEACHING AIDS: An assortment of damaged film

REFERENCES: Radiography in Modern Industry, 1958, Eastman Kodak Company, Rochester, N. Y

I. PREPARATION (of the learner)

A. After introducing the subject of the lesson, point out that nothing reflects more on the abilities of a radiographer than the production of poor quality film, even though the poor quality may be the result of a variety of causes and many circumstances other than poor workmanship. Conditions quite often arise which change the quality level of the film and the radiographer must learn to recognize these conditions in order to be able to correct the cause and bring the level of quality back to normal.

B. This lesson will deal with the abnormal qualities that can affect the quality of film adversely and its importance is relatively self evident.

II. PRESENTATION (of the information)

Instructional Topics	Things to Remember to Do or Say
A. Incorrect density 1. Over or under-exposure 2. Over or under-development 3. Depleted developer	1. Explain the conditions which can result from incorrect exposure. 2. Describe the latitude in density which can result from developing procedures. Explain how changes

	in development can be beneficial as well as harmful. 3. Display sample film.
B. Incorrect contrast 1. Radiation quality 2. Over or under-development	1. Outline the effects of improper penetration characteristics on film contrast. 2. Describe the effects of development procedures on contrast. 3. Display sample film.
C. Poor sensitivity 1. Geometric factors 2. Film factors	1. Outline the methods of adjusting exposure dimensions to improve definition. 2. Review the effects of a large focal spot on film sensitivity. 3. Review the problems in the use of radiographic screens 4. Examine the choice of film for the job being performed. 5. Display sample film.
D. Fog 1. Light leaks 2. Radiation leaks 3. Improper safe lights 4. Heat, humidity, and vapors 5. Improper darkroom procedures	1. Describe the effect on film when exposed to light or radiation leaks. 2. State the desired characteristics of a safe light and detail the consequences of improper handling of film under safe light condition. 3. Explain the effects of atmospheric conditions on film fogging. 4. Describe the dark room procedures which result in fogging. 5. Display sample film.
E. Streaks and stains 1. Film hangers 2. Poor chemical agitation 3. Elimination of stop bath 4. Elimination of wetting agents 5. Spent chemicals	1. Explain why dirty film hangers cause streaks. 2. Describe the effects of improper agitation of developer, stop bath, and fixer on stains and streaking. 3. Explain why the elimination of stop bath and wetting agents cause streaking. 4. Describe the staining of film from the use of depleted chemicals.

	5. Display sample film.
F. Mechanical film defects 1. Damage to emulsion a. Loosening b. Scratching 2. Crimp marks 3. Static marks 4. Air bells 5. Dirt in cassettes	1. Describe the conditions which cause each of the listed defects. 2. Explain how these conditions are eliminated. 3. Display sample film.

III. APPLICATION (drill, illustrations, analogies, oral questions or assignments)

A. Have all students separate the sample film into groups representing:
   1. Improper techniques
   2. Improper darkroom practices
   3. Mechanical handling defects

B. Suggest that they identify the source of the defects in each category.

C. Have them explain how each defect can be eliminated.

IV. TEST (final check on students' comprehension of material presented)

NOTE: Written Test

A. What is the cause of light and dark streaks on film which has been developed using hangers?

B. What causes streaks at the top corners of film which has been processed while suspended on film hangers?

C. How can a radiographer determine if a crimp mark was made before or after exposure?

D. How is a static mark identified? Eliminated?

E. What happens to film that is washed for prolonged periods in warm water? Why?

F. Describe the effect of fogging on sensitivity? Why?

G. How can a radiographer determine when the darkroom chemicals need replenishing or replacing?

H. What causes air bells? How can they be eliminated?

Check and discuss.

V. SUMMARY

A. Correct optimum film density is seldom achieved.

B. Film contrast can be improved with correct developing procedures.

C. Good film sensitivity depends upon proper geometry of exposure set-up, proper film screens and the proper film.

D. Film fog is caused by age of film, heat, light leak, over-developing, improper safe lights, humidity, vapors, etc.

E. Other film or artifacts are streaks, stains.

F. Mechanical defects include damaged emulsion, static marks, dirt in cassettes, etc.

The Next Lesson is: Care and Handling of Radiographic Film

INSTRUCTOR'S LESSON PLAN
Related Technical Information

Unit 17
Lesson 7
Time 1.5 hours

SUBJECT: Care and Handling of Radiographic Film

AIM (or purpose): To teach the correct techniques for care and handling of radiographic film

TEACHING AIDS: Film boxes
Film with interleaves
Film storage envelope

REFERENCES: Radiography in Modern Industry, 1958, Eastman Kodak Co., Rochester, N.Y.

I. PREPARATION (of the learner)

Since radiographic film is highly sensitive and easily damaged. It is necessary to consider the subject of care and handling film. Radiographic film is sensitive to light, heat, moisture, some gases, radiation and physical strain. The best radiographic techniques can be rendered worthless if the film is damaged before, during, or after processing. To avoid this waste in time, energy, and money, a knowledge of film handling practices is most essential and in some instances mandatory.

II. PRESENTATION (of the information)

Instructional Topics	Things to Remember to Do or Say
A. Opening of film boxes	1. Demonstrate the operation. 2. Explain the function of the inner pack or seal (keeps out moisture) 3. Caution against rapid withdrawal of film from the box and explain static marks. 4. Recommend removal of the film in the interleave to avoid scratching.
B. Loading and handling cassettes	1. Recommend the loading of film in the interleave when screens are not employed.

2. Explain why the film cannot be loaded in the interleave when using screens; Interleaf image appears on radiograph.
3. Caution against abrasion of film in loading
4. Describe the strain damage to film caused by excessive bending or pressure on the cassette or exposure holder.

C. Storage of film

1. Explain the ideal storage facility, such as the film storage cabinet in the darkroom.
2. Explain the desire for:
   a. Controlled temperature and humidity
   b. Controlled environment
   c. Light tightness
   d. Radiation shielding to prevent fogging
3. Recommend a film supply equal only to requirements.
4. Explain the desirability of maintaining a stock rotation plan.

D. Dark room handling

1. Use oldest film first.
2. Explain and display film damage from:
   a. Improper attachment of film to hangers
   b. Overloading tanks
3. Explain why the temperature of the drying process must be controlled.
4. Excessive humidity and heat affects film quality and film drying time.
5. Explain the necessity of corner removal on processed film, because it removes corner clip holes and sharp edges that scratch other film.
6. Recommend the utilization of interleaving for storage of processed film as it prevents film abrasion.
7. Display the recommended edge seal envelope for processed film storage.

III. APPLICATION (drill, illustrations, analogies, oral questions or assignments)

Have all students:

A. Explain the procedures, precautions and whys for opening and handling of boxed film.

B. Outline the techniques for loading film cassettes, employing paper interleaving, and the avoidance of strain damage.

C. Describe the ideal film storage area and explain the reasoning behind the design.

D. List three operations in the darkroom where film may be damaged.

E. Describe the procedure for the storage of exposed film.

IV. TEST (final check on students' comprehension of material presented)

NOTE: Written Test

A. What is the purpose of the paper interleave found in new film packages? How can it be used to advantage after the box is opened for use?

B. What type of film defect can result from very rapid withdrawal of film from the package?

C. List four operations of film handling where emulsion strain is likely to occur.

D. Why is it best to keep only a limited amount of film in storage?

E. What is the purpose of corner cutting after the drying of film?

Check and discuss.

V. SUMMARY

A. Care must be taken when removing unexposed film from container to prevent static marks on film and to keep sharp corners of film from damaging other film.

B. Interleaving paper prevents abrasion and can be left on film if screens are not being used in cassettes.

C. Film storage includes proper inventory to prevent ageing of film; protection from x-ray and gamma radiation and protection from excessive heat.

D. Interleaves should be used in storing processed film.

The Next Lesson is: Multiple Film Exposure

EXPERIMENT SHEET
Multiple Film Exposure

Unit 17
Lesson 8
Time 4 hours

SUBJECT:

The radiographic inspection of parts or materials with high subject contrast due to shape of the part

NOTE:

Instructor performs all operations

INTRODUCTORY INFORMATION:

When a part must be inspected which has two or more areas of varying thickness, selection of the proper film involves a critical analysis to determine the density at the thickest and thinnest areas of the part. If the density of the film in these areas cannot be maintained within the limits desired for a single film, multiple exposures are required to achieve the desired results. To avoid the time consumption of multiple exposure, techniques may be used to achieve the desired results in a single exposure. Developing skill in the use of these techniques is the purpose of this experiment.

MATERIALS AND EQUIPMENT:

Gamma ray or x-ray source and exposure facilities
Film cassettes and film
Survey meter
Densitometer
Penetrameters, lead numbers, and shims
Characteristic curves of film
Sample parts
Darkroom facilities

PROCEDURE:

A. Measure the thickness of the part at the maximum and minimum areas. Determine the ratio of the thicknesses.

B. Examine film types to determine if a suitable film is available for a single film inspection.

C. Use characteristic curves to determine the difference in the relative exposure to maintain the density limits between 1.5 and 3.0.

D. If a single sheet film cannot be used, select a slow speed film for the thin section of the part. The film should be selected to be given an exposure for a density of 2.0.

E. Examine the characteristics of other film to determine which possesses a speed, at a density of 2.0, relative to the first equivalent to the ratio of the thicknesses from the maximum and minimum areas.

F. Load suitable film cassettes with one film of each type and appropriate screens. Use only two screens placing one screen on each side of the film sandwich.

G. Transport the equipment to the exposure site.

H. Select desired exposure conditions and erect equipment.

I. Setup film for exposure using 2-2T penetrameters for each thickness to be examined. Place penetrameters on shims of equal thickness if placement cannot be made directly on the part.

J. Mark the film with appropriate numbers for identification.

K. Calculate the exposure time to produce a density of 2.0 on the slower film and the thinnest section. Check the density which will result from exposure of the faster film in the thicker section. The density should be between 1 5 and 3.3.

L. Energize the survey meter, wait for warmup, and zero meter.

M. Perform exposure, survey equipment, and secure in safety condition.

N. Develop film for 5 minutes at 68°F., fix, wash and dry.

O. View each film individually in the areas of the part where the density and sensitivity meet the required limits.

P. Measure the density of each film in the areas of interest.

CONCLUSIONS:

A. The maximum thickness ratio which could be tolerated under these limitations if Kodak AA and M film were used is __________.

B. This technique _________, ___________, or ___________. be used with only one type film even though the density could not be maintained within limits on a single sheet of film. Explain.

C. The density of each film_________ or ______the value expected from the exposure calculations.

The Next Lesson is: Darkrooms

INSTRUCTOR'S LESSON PLAN
Related Technical Information

Unit 18
Lesson 1
Time 2 hours

SUBJECT: Darkrooms

AIM (or purpose): To acquaint the student with construction features of portable and stationary darkrooms

REFERENCES: Nondestructive Testing Handbook, Volume I, 1963, Society for Nondestructive Testing, Evanston, Illinois
Information Sheet #47 and #48

I. PREPARATION (of the learner)

A. Explain that it is sometimes necessary to improvise a temporary field darkroom, and a knowledge of the basic requirement of such a facility would be most helpful. It would be beneficial to know what problems occur when operating from portable darkrooms that generally do not occur in stationary facilities.

B. This lesson will also provide a thorough study and consideration of all construction features whether they are used in portable or fixed installations.

II. PRESENTATION (of the information)

Instructional Topics	Things to Remember to Do or Say
A. Stationary darkrooms 1. Layout	1. Issue information sheets #47 and 48. 2. Describe the area requirements by the planned volume of work to be performed. 3. Explain the desirability of separate loading and processing rooms for large work loads. 4. Discuss and explain the necessity for keeping the wet functions separate from the dry as it prevents damaging of the film.

2. Construction	1. Explain the desirability of using chemical resistant paints on smooth finished walls since photographic chemicals attack ordinary house paint. 2. Elaborate on the necessity for tile, stainless steel or plastic coverings around the processing tank area -- to combat corrosive chemicals. 3. Describe suitable floor coverings again stressing chemical resistant materials. 4. Draw chalkboard sketches of maze type entrance and light lock. 5. Explain the necessity for stainless steel or plastic plumbing-to combat corrosive effect caused by chemicals. Give examples. 6. Explain the function of water line check valves which are installed in automatic cooling lines preventing reverse flow contamination.
3. Processing tanks	1. List the desirable tank construction materials--some types of stainless steel, plastics, hard rubber or fiberglass. 2. Define the ideal water temperature control system. Controls at 68° - 72°. 3. Outline the desirable capacity ratio for developer, stop bath, fixer, and wash tanks. No less than 5 gallons each and 10 gallon for wash.
4. Dryers	1. Explain the necessity for adequate capacity so film won't touch and stick. 2. Describe the desirable features; i.e., timer, heat and fan controls, drip pans, etc.

5. Illumination

1. Outline the requirements for illumination.
2. List the restrictions on brightness:
   a. Filtered light fixtures positioned so film will be handled at least 4' away
   b. 15 watt bulbs and Wratten filters except for extremely light sensitive film use 7 1/2 watts
3. Describe the method of checking to determine if the room is over-illuminated:
   a. Cut piece of film in two
   b. Develop one piece
   c. Check density
   d. Place other piece on table top for an hour
   e. Develop second film
   f. Check density
   g. Compare the two films

B. Portable Darkrooms

1. Describe a typical portable darkroom in terms of size and method of construction, see information sheet #46 (both sides).
2. Explain the necessity for additional care when working in the restricted space of a portable darkroom:
   a. Danger of damaging developed, unexposed film
   b. Film must be protected if gamma exposure device is stored in darkroom
3. Discuss and explain the problems of entrances, cleanliness, sealing of tanks, maintenance of chemical temperature, drying of film, tank capacity, environmental temperature control, water supply, power supply, etc.

III. APPLICATION (drill, illustrations, analogies, oral questions or assignments)

Have students:

A. Describe the layout and facilities for the processing of several hundred hangers of film per day.

B. Outline the requirements and restrictions of darkroom illumination.

C. Discuss the available construction materials for processing tanks.

D. Describe the materials for protection of floors and walls of darkrooms.

E. Compare portable field darkrooms with stationary installations and discuss the additional problems of working from portable darkrooms.

IV. TEST (final check on students' comprehension of material presented)

NOTE: Written Test

A. Draw sketches of two types of entrance ways for stationary darkrooms.

B. Why are processing tanks usually made from stainless steel?

C. Why are check valves on processing tanks and water lines desirable and required by many city regulations?

D. List three problems of field darkroom construction which are not found in stationary facilities. Explain how these are overcome in field installations.

E. What is the safe distance from exposed film for a 15 watt bulb when used in an acceptable safelight holder with a filter?

Check and discuss.

V. SUMMARY

A. Portable field darkrooms are usually not as desirable as fixed installation. This is due mainly to an inadequate wash water supply and the problem of maintaining temperature control of the chemicals.

B. Darkrooms should be planned to provide a "dry" side for film loading and unloading and a "wet" side for film processing.

C. Film processing chemicals are corrosive and precautions must be taken to counteract this problem when designing darkroom facilities.

D. Portable facilities have much greater inherent problems in combating the effects of corrosion by film-developing chemicals.

The Next Lesson is: Darkroom Housekeeping

INSTRUCTOR'S LESSON PLAN
Related Technical Information

Unit 18
Lesson 2
Time 1.5 hours

SUBJECT: Darkroom Housekeeping

AIM (or purpose): To develop an appreciation for maintaining clean safe facilities and the care of clothing and skin

TEACHING AIDS: Plastic gloves and apron
Film hangers which have been cleaned and some which require cleaning

MATERIALS: Commercial process tank cleaners

REFERENCES: Radiography in Modern Industy, 1958, Eastman Kodak Company, Rochester, N. Y.

I. PREPARATION (of the learner)

A. Explain that most radiographer beginners subject their work uniforms to chemical stains unknowingly because their vision is obscured while processing films in the darkroom.

B. Outline further that it is possible to remove chemical stains from clothing and that this will be covered in the lesson, as well as the removal of chemical stains from the hands.

C. Stress the need for maintaining clean and safe facilities in which to work as these are the marks of true professionalism.

II. PRESENTATION (of the information)

Instructional Topics	Things to Remember to Do or Say
A. Processing tanks	1. List the sources of contamination: a. Chemical stain and gelatin b. Fungus and algae c. Precipitation from chemicals 2. Explain the necessity for cleanliness and sterility because of fungus growth

that can occur in chemical tanks.

3. Describe and display commercial cleaners for the removal of contamination.
4. List the chemical formulas on the chalkboard for use in removal of various contaminating agents.
5. Outline precautions to be employed in handling chemicals:
   a. Do not let chemicals remain in contact with the skin.
   b Avoid splashing liquid or chemicals in the eyes.

B. Processing hangers

1. Describe and explain the similarity of hanger contamination to tank contamination since hangers come in contact with tank walls and with chemicals in the tanks.
2. List chemical formulas of solutions for removal of contamination on the chalkboard.
3. Detail the use of nitric acid solutions for very difficult clip stains explaining the process of soaking hanger clips in nitric acid water solution a few minutes. Then rinse with tap water. NOTE: Always add acid to water (water in the tank first)
4. Display dirty and properly cleaned hangers.

C. Stains on clothing

1. Explain that the best method of control of clothing stains is the careful handling of materials to avoid spillage.
2. Display rubber or plastic apron used to keep chemicals from clothing. Demonstrate use.
3. Describe the chemicals and methods used to remove stains from clothing. Moisten with spot remover and rinse with water. Chemical spot and stain removers all supplied by film manufacturers.
4. List the chemical formulas for stain removers on the chalkboard.
5. Caution against the use of solutions on colored fabrics and synthetic fibers since some spot removers will bleach

out color of garment.

D. Care of hands

1. Caution against over exposure of hands to processing chemicals because they can cause skin discoloration and rash.
2. Recommend the use of gloves and disposable towels.
3. List on the chalkboard the formula for potassium permanganate solutions used to remove skin stains.
4. Describe the method of skin stain removal.
5. Demonstrate the preferred method.

III. APPLICATION (drill, illustrations, analogies, oral questions or assignments)

A. Explain the necessity for periodic cleaning of processing tanks and promote discussion.

B. Explain the consequences of dirty hanger clips and how to remove contamination asking questions as explanation progresses.

C. Describe the method of removing stains from hands and clothing demonstrate and have students participate in the examples used.

IV. TEST (final check on students' comprehension of materials presented)

NOTE: Written Test

A. What is the source of contamination found in chemical processing tanks?

B. What effect does contamination have on film processing quality? Describe.

C. How can stains be removed from clothing? Give examples.

D. What measures can be employed to prevent skin irritation from chemicals?

Check and discuss.

V. SUMMARY

A. Dirty film hangers are a major cause of film artifacts.

B. Quality work cannot be maintained without a constant program of darkroom housekeeping.

C. Fresh chemicals offer no advantage if chemical tanks are not kept clean.

D. Stains on worker's hands and clothing reflect poorly on the ability of the worker.

The Next Lesson is: Insertion of Film on Processing Hangers

INSTRUCTOR'S LESSON PLAN
Manipulative Skills

Unit 18
Lesson 3
Time 1.5 hours

JOB (or operation): Insertion of Film on Processing Hangers

AIM (or purpose): To develop skill in the insertion of film into processing hangers

TOOLS AND EQUIPMENT: Darkroom facilities

MATERIALS: Clean rags

TEACHING AIDS: Sheets of 14" x 17" film (defective or outdated)
14" x 17" processing hangers
14" x 17" film cassettes or exposure holders
Brush

I. PREPARATION (of the learner)

A. Introduce the subject and elaborate on how the best radiograph can be damaged by improper insertion into processing hangers. Explain that faulty insertion can result in film becoming detached in the chemicals or dryer with subsequent damage to one or more of the other film.

B. Outline that processing camera cut film sheets is very similar to processing x-ray film and if anyone has such experience it will stand him in good stead when studying the material about to be presented.

II. PRESENTATION (of the skills)

Operations or Steps	Key Points (things to remember to do or say)
A. Assemble equipment	1. Gather hangers to be loaded. 2. Collect exposure holders or cassettes containing exposed film. (Use outdated or damaged film.)

B. Inspect hangers	1. Examine hangers for contamination. 2. Inspect clips for bits of film left from previous processing. 3. Clean hangers if necessary before proceeding using brushes, solvents and rags.
C. Position equipment	1. Turn hangers upside down and lean them against back board of work bench. 2. Clear area to stack hangers after loading them (hang from hanger storage racks if convenient). 3. Stack cassettes near the hangers allowing room for opening and stacking of unloaded cassettes.
D. Remove film from cassette (Simulate darkroom procedure while demonstrating in white light)	1. Unlatch exposure holder. 2. Remove film from holder by grasping the upper left hand corner of the 17" length between the thumb and forefinger of the left hand.
E. Pick up processing hanger (hangers are stacked upside down. Directions apply to handling in the position in which they are stacked)	1. Pick up the hanger with the right hand. 2. Grasp the clip in the upper left corner between the thumb and forefinger. 3. Steady the hanger with the other three fingers of the right hand,
F. Clip film to hanger	1. Open clip in the right hand by squeezing. 2. Insert the corner of the film held in the left hand into the clip. 3. <u>Caution</u>: Do not pin it too close to the edge or force it too deeply into clip. The pin should pierce the film about 3/8" from each edge of the film. 4. Reverse hands and pin the other top corner. 5. <u>Caution</u>: Pin both top corners in such manner that the film hangs straight in the hanger. 6. Holding the hanger upside down in the right hand, grasp the bottom left edge of the film by the thumb and forefinger

	of the left hand with the bar of the hanger in the web of the thumb and the back of the hand toward the body.
	7. Turn the hanger over.
	8. Clip the corner held in the left hand.
	9. Grasp the upper right corner with the thumb and forefinger of the right hand.
	10. Clip the corner with the left hand.
	11. Stack or hang the loaded hangers to avoid damage until film is loaded into processing tanks.
G. Repeat steps D, E, and F with white lights extinguished and after adjusting to darkened room	Repeat the procedure outlined above.

III. APPLICATION (practice by learner under close supervision)

A. Have each student simultaneously perform the task of inserting a film into a processing hanger several times under supervision of the teacher. Do this in a lighted room.

B. Inspect work and discuss.

C. Repeat process several times in darkened room under closest possible supervision.

IV. TEST (performance of skill to acceptable standards)

NOTE: Performance Test

Have each student insert a film in a hanger in total darkness. Repeat until all students can load film without damage and without the aid of safe lights.

Check and discuss.

V. SUMMARY

A. All preliminary steps must be planned in advance so that student will be oriented as to equipment and material location before room is darkened.

B. Hands must be washed and dried before handling film to prevent artifacts.

C. Hangers must be inspected for cleanliness before lights are extinguished.

D. Film must hang squarely in hanger to prevent bulging and subsequently touching adjoining film while in the chemical processing tanks.

The Next Lesson is: Use of Film Processing Reels

INSTRUCTOR'S LESSON PLAN
Manipulative Skills

Unit 18
Lesson 4
Time 1.5 hours

JOB (or operation): Use of Film Processing Reels

AIM (or purpose): To familiarize the student with the correct use of film processing reels

TOOLS AND EQUIPMENT: Dark room facilities
Film cassettes
Reels
Plastic or stainless steel "tee" sticks

MATERIALS: Clean rags
Scrub brush

TEACHING AIDS: 70 mm film (used or outdated)

I. PREPARATION (of the learner)

A. Outline that many radiographic applications require the use of film over 17" long requiring for its processing a different type of film handler. A reel is usually substituted for the hanger in situations of this sort. Show students typical reels. There are several types on the market. Also show the students the "Tee" shaped stainless steel wire through which reels are threaded prior to immersion into chemicals.

B. Explain that the process is quite similar to that used in processing regular 35 mm film and if any of those present have experience in the processing of this size film,this exposure will be most helpful in acquiring the new skills.

II. PRESENTATION (of the skills)

Operations or Steps	Key Points (things to remember to do or say)
A. Preparation of 70 mm film	Illustrate and explain on the chalkboard that one end of the film should be trimmed with a paper cutter or scissors removing corners. This will facilitate starting the film into the grooved guides of the reels.
B. Inserting film in reel	1. The film is wound into the grooves in the reel or in the space between the wire that the reel is made of. (Show both types) The grooves act as spacers that allow the chemical solution to contact the film between each circumferential warp of the film. 2. Grooves are spaced so that properly inserted film surfaces will not come in contact with each other.
C. Demonstrate using previously developed film, in light	1. Hold the reel in one hand. 2. Place the end of the film in the clip located on the axle of the reel. Some reels have a sharp end of a nail that is forced through the end of the film. 3. Holding the side edges of the film with the other hand, between the thumb and index finger, apply slight, but steady pressure to the film to reduce its width until it is equal to the width between the reel grooves. 4. While maintaining this slight pressure on the film, start rotating the reel with the other hand,thereby feeding the film into the reel grooves. 5. After the film has been placed on the reel check to see if any film surfaces are touching. If they are, unwind the film to the point of film contact and rewind.
D. Placing reels in chemicals	1. String each completed reel of film on a "Tee" stick by threading the stick through the hollow axle of the reel.

	2. To develop film immerse the reels and stick in the chemicals. 3. Remove the film from the reels by grasping the very edge of the film with one hand and reel with the other hand and unwind it.
E. Removing developed film from reel	1. Developed film can be dried by hanging the film on an improvised clothes line made of nylon string and using plastic clothes pins. 2. If the film is dried outdoors avoid strong sunlight and dusty areas. 3. A large percentage of field radiographs are dried in this manner especially on pipeline construction jobs.
F. Reel housekeeping	Reels must be scrubbed the same as film hangers to remove contaminants

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III. APPLICATION (practice by learner under close supervision)

A. Pass out reels to each student

B. Review film inserting sequence and technique by threading an 18" x 70 mm film on reel.

C. Pass out strips of film to each student.

D Ask them to prepare film for threading as demonstrated in Step II.

E. Have each student thread film on reel.

F. Time this operation.

G. Examine each threaded reel for kinked film and for film surface contact.

H. Practice as many times as necessary.

I. Repeat E above, using exposed, undeveloped film with white lights out in dark room.

J. Process films.

K. Examine and discuss results.

IV. TEST (performance of skill to acceptable standards)

NOTE: Performance Test

A. Have students place films in film cassettes in dark room with white lights out.

B. Have students remove films from cassettes and thread film on reels.

C. Turn on lights, examine and discuss results.

D. Turn out white lights and distribute some previously exposed film that has not been developed. (Film should be in cassettes).

E. Have students remove film from cassettes, place on reels and develop.

After film have been processed, inspect each person's film on viewing screen and point out results of improper reel techniques. (Kinks, finger prints, etc.)

Remind students that film artifacts can sometimes be mistaken for specimen defects.

V. SUMMARY

A. Film preparation for aid in inserting film in reel groove.

B. Grooves separate layers of film.

C. Creases and kinks in film will cause film surface contact during processing and show up as artifacts on finished radiograph.

D. Film reels must be kept clean, especially groove surfaces.

The Next Lesson is: Film Processing Chemicals

INSTRUCTOR'S LESSON PLAN
Related Technical Information

Unit 18
Lesson 5
Time 2 hours

SUBJECT: Film Processing Chemicals

AIM (or purpose): To provide knowledge and information regarding the use of various chemicals in the processing of industrial radiographic film

MATERIALS: Bottles and packages of processing chemicals

REFERENCES: Radiography in Modern Industry, 1958, Eastman Kodak Company, Rochester, N. Y.

I. PREPARATION (of the learner)

Much of the students time to date has been devoted to developing a clear understanding of the principles of exposure or the taking of a good radiograph. The care exercised in the exposure must be followed by painstaking perfection in the darkroom if the fundamentals learned to date are to be fully utilized. Everyone produces better work when he understands the reasons for his actions. The principles of chemical processing will be reviewed and expanded in this lesson to help improve the procedures and processes employed in the darkroom.

II. PRESENTATION (of the information)

Instructional Topics	Things to Remember to Do or Say
A. Developer	1. This subject was discussed previously in the lesson plan entitled "The Photographic Process" and therefore it should be reviewed briefly. 2. Show the types of prepared chemicals available for radiographic use. 3. Explain the mixing of chemicals, especially the precautions that should be taken in mixing dry chemicals. 4 Describe the ideal storage environment for radiographic chemicals:

	a. Dry, cool room. b Chemicals must not be exposed to bright sunshine.
B. Stop bath	1. Define the purpose of the stop bath and explain that it stops the alkaline developing process with an acid neutralizer. 2. Relate the acidity of the stop bath to the alkalinity of the developer. 3. Describe commercial stop baths and the use of acetic acid 4. Caution: Use care in mixing strong acids demonstrating the proper method.
C. Fixer	1. Review the purpose of the fixer outlining that it removes all the undeveloped silver. 2 Explain the use of ammonium or sodium thiosulfate for fixing. 3. Describe the added benefits from use of commercially prepared chemicals containing agents to control the rate of reaction. 4. Outline the purpose of the hardener explaining that it conditions the gelatin so film can withstand drying with warm air.
D. Wetting agents	1. Describe the purpose of wetting agents: a. Wetting agents remove film water marks. b. Accelerates drying time. 2. Explain that household liquid detergents are sometimes used for this purpose.
E. Replenishers	1. Define the purpose of replenishing. 2. Tabulate the results in increased chemical usage from replenishing. 3. Explain the effect of replenishment on fixing and how it reduces fixing time. See Table XIII, P. 75, Eastman Textbook.

F. Supplemental

1. Describe the process of film intensification:
   a. Under developed film can be darkened by immersing it in hardener solution for 5 minutes.
   b Film can be washed for 5 minutes then immersed in an intensifier solution for up to 10 minutes.
2. Caution students on the safe handling of strong chemicals used in these processes.

III. APPLICATION (drill, illustrations, analogies, oral questions or assignments)

A. Suggest that students describe the entire and complete chemical processing of film.

B. Have individual students describe and elaborate on each step in the process.

C. Have students describe the controls employed for the reaction.

D. Ask for a description of the use of chemicals other than prepackaged that can be used in the processing of film.

E. Have one student develop a small radiograph in a set of chemicals previously prepared in jars. Reverse the sequence of the developer and the fixer, inviting a prediction of the results (Film will be clear).

IV. TEST (final check on students' comprehension of material presented)

NOTE: Written Test

A. What is the purpose of the stop bath?

B. What type of film artifacts result from elimination of the stop bath or from continued use of weak baths?

C. What happens to the fixer if the stop bath is depleted or is too weak to perform its intended task?

D. What is the purpose of replenishing?

E. What is the purpose of the post-wash wetting agents?

Check and discuss.

V. SUMMARY

A. Developer should be mixed thoroughly, kept in a temperature controlled environment and not exposed to sunlight.

B. The stop bath neutralizes the alkaline action of the developer.

C. The fixer removes all undeveloped silver. Also hardens or conditions gelatin for drying in warm air.

D. Wetting agents remove water marks and accelerate drying time.

The Next Lesson is: Darkroom Film Processing

INSTRUCTOR'S LESSON PLAN
Manipulative Skills

Unit 18
Lesson 6
Time 2 hours

JOB (or operation): Darkroom Film Processing

AIM (or purpose): To assist students in acquiring the necessary skill and the proper techniques in darkroom procedure and the chemical processing of film

TOOLS AND EQUIPMENT:
- Film hangers
- Processing tanks
- Development time indicator chart
- Darkroom facility
- Timer
- Thermometer

MATERIALS: Processing chemicals

TEACHING AIDS: Exposed or outdated film

REFERENCES: Radiography in Modern Industry, 1958, Eastman Kodak Company, Rochester, N. Y.
Nondestructive Testing Handbook, Volume I, 1963, Society for Nondestructive Testing, Evanston, Illinois

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I. PREPARATION (of the learner)

Explain that the exposure of a film is only one part of the process of producing a radiograph. The proper chemical processing of the film is equally as important as the exposure. Processing techniques do not change appreciably once the fundamentals have been mastered and repetition and practice does the rest, until ultimately the procedures become automatic reactions. It is therefore easy to see the importance of establishing good work habits from the beginning.

II. PRESENTATION (of the skills)

Operations or Steps	Key Points (things to remember to do or say)
A. Prepare processing tanks	1. Have all chemicals and materials ready to use in dark room. Establish proper temperature and prepare to demonstrate. 2. Remove lids from the tanks and store out of way. 3. Energize temperature control device. 4. Use plastic or rubber paddles to stir chemicals. 5. Replenish chemical to proper height in tanks.
B. Load hangers	Since hanger loading is covered by another lesson, review briefly.
C. Set timer	1. Check the temperature of the chemicals. 2. Use a process time indicator or chart to determine the optimum process time. 3. Set timer for the indicated time.
D. Developing	1. Pick up hangers containing film by the cross bar. 2. Caution: If more than one film is handled at a time, separate hangers with fingers. Do not attempt to handle more than three hangers at a time. 3 Lower film into tank slowly, keeping hangers vertical and separated. 4. Energize timer. 5. Agitate each film to remove air bubbles from the surface by raising hanger about 1/2" and tapping sharply on the top of the tank. 6. Agitate each film every 30 seconds by moving from side to side and up and down in tank. Better results can be obtained by lifting film clear of tank and draining from the corner. 7. Remove film from the tank and place in clear water when proper time has been reached.

	8. Accomplish Step 7 quickly as developing reaction is continuing.
E. Stopping development	Immerse film in stop bath for 30 to 60 seconds maintaining good agitation.
F. Fixation	1. Immerse film in fixing solution. 2. Agitate frequently using the same procedure as for development. 3. Allow the film to remain in the solution for twice the length of time required to clear for a pre-established time interval.
G. Washing	1. Remove the film from the fixer solution and place in the wash tank. 2. Preferably place it in the end of the tank nearest the drain. 3. Caution: Entire hanger must be immersed to remove all chemicals from the hanger as well. 4. Continue moving the film toward inlet side as more film is added to the wash tank. 5. Leave the film in the tank the length of time necessary to remove all of the fixer solution.
H. Removing water marks	1. Remove the film from the wash water and immerse it in a wetting agent. 2. Drain all excess water from the film and tap the hanger lightly on the tank to loosen all water under the clips.
I. Drying	1. Energize the film dryer. 2. Place the film in the dryer and allow it to remain until the film is thoroughly dry.

III. APPLICATION (practice by learner under close supervision)

A. Divide the students into groups of two. Have each pair run through the entire procedure using dry tanks (no chemicals).

B. Observe each group and make notations and corrections.

C. Discuss observations, give help as needed.

D. Continue practice. This time follow the same procedure but actually process undeveloped film Give close supervision.

IV. TEST (performance of skill to acceptable standards)

NOTE: Performance Test

A. Have each student develop an exposed film under safelight conditions using the procedures outlined in the lesson.

B. Continue testing until all students have developed acceptable film and have demonstrated proper darkroom procedures.

V. SUMMARY

A. Correct film processing technique is as important as correct exposure techniques in obtaining quality radiographs.

B. Shortening of recommended processing times can only result in a reduction of quality in the radiograph.

C. Every film processing step is important if optimum results are to be obtained.

The Next Lesson is: Control of Chemical Processing

INSTRUCTOR'S LESSON PLAN
Related Technical Information

Unit 18
Lesson 7
Time 2 hours

SUBJECT: Control of Chemical Processing

AIM (or purpose): To furnish the student with information on methods of testing and controlling dark room chemical processing

REFERENCES: Radiography in Modern Industry, 1958, Eastman Kodak Company, Rochester, N. Y.

I. PREPARATION (of the learner)

Write aim of lesson on chalkboard and point out that many laboratories employ a system of chemical replacement on a time or film-processed basis regardless of the activity of the chemicals. Other laboratories use chemicals until the quality of the processed film is noticeably affected. Competent radiographers use more economical and scientific approaches to the replacement of chemicals and this lesson will provide the information on how this important procedure is accomplished.

II. PRESENTATION (of the information)

Instructional Topics	Things to Remember to Do or Say
A. Developer control	1. Explain the desirability of controlling the chemical activity of the developer. 2. Describe the procedure and list the steps on the chalkboard for developer control: a. Exposure of test film b. Preparation of test strip c. Storage of test film d Development of test strip e. Determination of density f. Adjustment of procedure g. Preservation of standard strip

B. Stop bath control	1. Explain the method of control based on the area of film processed, noting that stop bath changes color as it weakens. 2. List on the chalkboard the area of the various types of film which can be processed with one gallon of stop bath.
C. Fixer control	1. Explain the use of emulsion clearing time to control baths which are not replenished explaining that total fixing time should be twice the clearing time. 2. Describe the limitation on replenishment cycles for discarding a fixer bath (Refer to Table XIII,P. 75, Eastman Textbook) 3. List on the chalkboard the areas of various films which can be processed with one gallon of fixer bath. See Table XIII,P. 18,Eastman Textbook.
D. Adequacy of washing	1. Describe commercial hypo test solutions for determining the amount of fixer remaining in the film emulsion after washing. 2. Inform the student of the existence of the American Standard ASA PH4.8 for precision determination of fixer remaining in the emulsion.

III. APPLICATION (drill, illustrations, analogies, oral questions or assignments)

A. Start discussion and have students explain the method of developer control.

B. Have them compare the amount of film processed to useful life of a stop bath.

C. Ask students to describe the methods for determining exhaustion of fixer solutions.

D. Have the group tell why all fixer should be removed from film and how to determine the adequacy of the wash cycle.

IV. TEST (final check on students' comprehension of material presented)

NOTE: Written Test

A. Why is a check system desirable for control of chemical solution activity in film processing?

B. What method is used to correct the activity of a developer if the film test strip has too high a density?

C. What is the common practice used to control fixer activity?

D. What undesirable effects restrict the repeated replenishment of fixer solutions?

Check and discuss.

V. SUMMARY

A. While recommended developing and fixing times vary, they are all based on fresh, full strength chemicals used at or near 68° F.

B. Some developer stop baths indicate a need for replacement by a change in color.

C. Developer is seldom contaminated because it is used first but liquid level must be maintained in addition to replacing spent developer with a replenishing agent.

D. Adequate cycle with a constant replacement of wash water is very desirable.

The Next Lesson is: Preparing for Field Radiography

INSTRUCTOR'S LESSON PLAN

Manipulative Skills

Unit 18
Lesson 8
Time 6 hours

JOB (or operation): Preparing for Field Radiography

AIM (or purpose): To develop skill in the procedures and precautions required to move radiographic equipment and portable darkrooms to a field location

TOOLS AND EQUIPMENT: Portable darkroom
Motor vehicle
Gamma ray camera and controls
Survey meter. Dosimeter charger,
Film badges

MATERIALS: All film and accessories necessary to perform the radiographic functions

REFERENCES: Title 10, Federal Register, Parts 20 and 34, Rules and Regulations, U. S. Atomic Energy Commission, Washington, D. C.
Information Sheet #3

I. PREPARATION (of the learner)

Much of the success achieved in any field operation depends in large measure on careful planning before leaving for the jobsite. A professional radiographer should form the habit of checking all equipment before leaving and be able to select the darkroom location which is most convenient to the work on the site. With practice and study these good work habits can be acquired and retained. Write aim on chalkboard.

II. PRESENTATION (of the skills)

Operations or Steps	Key Points (things to remember to do or say)
A. Prepare vehicle for travel	1. Place "Caution Radioactive Materials" signs on vehicle carrying the gamma source. 2. Stow all loose materials in the darkroom in the proper bins. 3. Fill water containers with fresh water. 4. Replenish process chemicals as needed. 5. Check expendable supplies and replenish where necessary. 6. Check accessory equipment: a. Film holders b. Lead numbers c. Film hangers d. Tape e. Measuring rules f. Survey meters g. Spare chemicals 7 Fasten all covers and doors securely. 8. Load gamma source and secure in place. 9. Load film. <u>Caution:</u> Store film at greatest distance possible from source.
B. Travel to location	1. Select route with smoothest road surface. 2. Avoid quick stops or weaving in and out of traffic. 3. Do not leave vehicle unlocked if unattended.
C. Place vehicle on location	1. Select a level location for spotting of the portable darkroom. <u>Caution:</u> Do not obstruct normal traffic. 2. Place jacks under vehicle for stability if jacks are available.

D. Preparation of job site	1. Examine the work area for presence of other workmen or for instruments which might be damaged by radiation. For example: Many processing plants use control instruments that respond to a fixed amount of radiation. If another radiation field is created near this instrument, it will start to give false signals that can upset the operation of the processing unit. 2. Erect rope barricades and radiation signs. Note: Do not obstruct normal operations with barricades unless a radiation hazard does actually exist. Do not omit the barricades from areas where radiation hazards exist just because it may hinder other operations. 3. Examine area again for presence of workmen. 4. Unload the equipment to be used.

III. APPLICATION (practice by learner under close supervision)

A. Divide the class into small groups. Have each group prepare the vehicle for movement, move to a job site, and setup for performance. Have the group return the vehicle to the laboratory and place the equipment in its original condition. Supervise the preparation and movements.

B. Repeat the operations having the students tell what they are doing and why they are doing it; correct any faulty concepts or operations.

IV. TEST (performance of skill to acceptable standards

NOTE: Performance Test

A. Grade each student on the preparation of equipment and vehicle, conduct of driving, and selection of location on each trip made with the portable darkroom.

B. After each trip, discuss the conduct of the trip with the students. Indicate areas of needed improvement.

V. SUMMARY

A. It is important to use a check list when preparing for a field assignment.

B. Gamma exposure devices must be locked at all times when not in use and especially when being transported to and from field assignments.

C. Vehicle transporting gamma exposure device must have radiation warning signs prominently displayed.

D. It is desirable to pick the smoothest route to and from field location because:
   - a. Chemicals can spill out of tank
   - b. Survey meters can be damaged
   - c. Exposure device can be damaged

E. Constant surveillance is necessary when using gamma and x-ray equipment outside a controlled area.

The Next Lesson is: Photographic Density

INSTRUCTOR'S LESSON PLAN
Related Technical Information

Unit 19
Lesson 1
Time 2 hours

SUBJECT: Photographic Density

AIM (or purpose): To develop an understanding of the meaning and the mathematical concepts of photographic density

TEACHING AIDS:
Light source (spot film viewer)
Film densitometer
Film density strips
Logarithm tables

REFERENCES: Radiography in Modern Industry, Eastman Kodak Company, 1958, Rochester, N. Y.

I. PREPARATION (of the learner)

The variation in film densities caused by differences in radiation intensity cause a contrast which outlines the image of the part and any possible defects. Film density is a logarithmic function which relates to the radiation absorption characteristics of the specimen. To better understand the character of the defect which alters the radiation intensity and the resultant film image, it is necessary to understand the nature of density variations. This lesson will help one gain a better understanding of these principles.

II. PRESENTATION (of the information)

Instructional Topics	Things to Remember to Do or Say
A. Photographic density	Write the definition on the chalkboard: "Density is the logarithm of a ratio of the amount of light striking a film compared to the amount which passes through to the other side".
B. The mathematical expression $D = \log \frac{I_o}{I_t}$	1. Write the expression on the chalkboard.

2. Also write the definition of each member of the expression on the chalkboard showing that density equals the log of light incident on the film divided by light intensity transmitted through the film.
3. Use an example to explain the use of the equation.
4. Display film strips to show differences in density. Do this with the use of a spot viewer.

C. Measuring density

1. Display the film densitometer.
2. Outline its function explaining that it measures relative film density.
3. Explain briefly the principle of the instruments operation:
   a. Measures the ratio between the amount of light reaching front side of film compared to amount of light emerging at the back side of film.
   b. That a photo cell is the basis of this method of measurement.
4. Show the instrument in operation using a film strip.
5. Demonstrate how to use the film strip to estimate the density without the necessity of performing an actual measurement:
   a. Hold film strip next to radiograph.
   b. Try to match up radiograph's density with a particular step of the calibrated film strip.
   c. Check results and discuss.

III. APPLICATION (drill, illustrations, analogies, oral questions or assignments)

To promote discussion and provide the basis for questioning, ask the group to answer the following statements giving one or more students an opportunity to handle each topic.

A. Define film density. Explain your definition.

B. How is density measured? How do densitometers measure density?

C. What is the mathematical equation of density?

Suggest that students solve the following problems on the chalkboard:

A. If the light entering a film has an intensity of 100 and the light coming through to the opposite side has an intensity of 10, what is the film density?

B. If the light passing through a film is reduced by a factor of 4, what is the film density?

C. If the percentage of light passing through a film is only 5% of that entering the film, what is the density?

IV. TEST (final check on students' comprehension of material presented)

NOTE: Written Test

Indicate the correct answer.

A. Film density is the logarithm of the reduction factor of the ____________ passing through the film.
   1. Radiation strength
   2. Radiation intensity
   3. Light emission
   4. Light intensity

B. Density is measured by determining the logarithm of the ___________.
   1. Ratio of the light entering to light leaving
   2. Ratio of the light leaving to the light entering
   3. Light intensity of the light leaving the film
   4. Intensity of the light entering the film

C. Density can be approximated by _______________.
   1. Measuring the thickness of the part being inspected
   2. Measuring the intensity of the light leaving the film
   3. Comparing the film with a density strip
   4. Approximating the intensity of the radiation reaching the film

Work the following problems:

D. The light entering a film has an intensity of 500 and the light coming through to the other side has an intensity of 50. What is the film density?

E. If the light passing through a film is reduced by a factor of 25, what is the film density?

F. If the density of a film is 2.0 and a light enters the film with an intensity of 100, what is the intensity of the light at the exit side?

V. SUMMARY

A. Radiographic relative film density is the log of the ratio of light incident on a film compared to the light emerging through the film.

B. Film densities cannot be estimated accurately on a visual basis, therefore, a densitometer should be used.

C. The radiographic film density range is important for quality work.

The Next Lesson is: Calibration of a Transmission Densitometer

INSTRUCTOR'S LESSON PLAN
Manipulative Skills

Unit 19
Lesson 2
Time 2hours

JOB (or operation): Calibration of a Transmission Densitometer

AIM (or purpose): To develop skill in calibrating and using a film densitometer

TOOLS AND EQUIPMENT: Photovolt transmission densitometer
Various types of measuring meters

TEACHING AIDS: Film density strips
Sample radiographs
Various types of measuring meters

REFERENCES: Manufacturers operating instruction manual

I. PREPARATION (of the learner)

Introduce this lesson by having students visually estimate three different relative densities on a radiograph of a steel step wedge. Record individual estimates on the chalkboard and follow up by checking the relative densities on the photovolt type densitometer. The results should be something less than accurate and this will demonstrate the importance of using a densitometer in measuring relative film density. Compare a densitometer to other type meters students should be familiar with. A densitometer is an instrument for measuring relative film density. Densitometers are of two types, visual and photoelectric. Great accuracy is generally not required in film density measurements, however, some specifications require a definite range of density for all film delivered to specification. It is necessary for the radiographer to know how to obtain the density of a film if the work is performed according to these specifications.

II. PRESENTATION (of the skills)

II. PRESENTATION (continued)

Operations or Steps	Key Points (things to remember to do or say)
A. Set up	1. Place densitometer on a table of convenient height. 2 Turn off main switch and power switch on the density unit. 3. Connect control panel to density unit. 4. Connect instrument to proper power source.
B. Zero and warmup	1. Check mechanical zero on indicating meter. Adjust if necessary. 2. Turn range switch to the lowest sensitivity setting. 3. Turn selector switch to warmup position. 4. Turn lamp control knobs on density unit full counter clockwise and energize power switch on the density unit. 5. Allow ten minutes for warmup.
C. Calibrate photometer	1. Set the pointer to the index on the high density side of the meter by electrical zero control adjustment. 2. Turn sensitivity switch to maximum and check above operation. Readjust if necessary. 3. Return sensitivity to minimum position. 4. Depress arm of density unit firmly to the aperture without a negative in position. 5. Open shutter by depressing plunger on end of arm. 6. Turn fine lamp control to midway position. 7. Make an approximate meter zero with the coarse lamp control. 8. Make final zero adjustment with fine control. 9. Release shutter and check index on high end of scale. Recalibrate if necessary

D. Measuring density

1. Place negative on density unit table with the area to be measured over the aperture.
2. Depress the arm and open the shutter.
3. Read the density direct from the meter.
4. For density above 1.3 move sensitivity switch to proper position and add a density value equal to the number on the selector switch opposite the index mark.

III. APPLICATION (practice by learner under close supervision)

Divide the students into small groups. Under close supervision have each student in each group repeat the following demonstration:

A. Set up.

B. Zero and warm up.

C. Calibrate photometer.

D. Measure density of film.

IV. TEST (performance of skill to acceptable standards)

NOTE: Performance Test

A. Request that each student calibrate the instrument.

B. Have them read and record the density of each increment of a test strip made of a step wedge.

E. Compare their results with yours.

Check and discuss.

V. SUMMARY

A. A densitometer is a valuable aid in improving the quality of radiographs.

B. The densitometer eliminates guesswork when checking results of exposure time calculations.

C. A densitometer is often used to estimate percentage of metal loss occurring in piping subject to corrosive attack.

The Next Lesson is: Measuring Radiographic Sensitivity

INSTRUCTOR'S LESSON PLAN
Related Technical Information

Unit 20
Lesson 1
Time 2 hours

SUBJECT: Measuring Radiographic Sensitivity

AIM (or purpose): To outline the purpose and methods of using image quality indicators

TEACHING AIDS: Assorted penetrameters
Film viewer
Sample film showing penetrameters

REFERENCES: Standard for Welding of Reactor Coolant and Associated Systems and Components for Nuclear Power Plants, Nav-Ships, 250-1500-1, Nov. 1960, U.S. Navy Bureau of Ships
Radiography in Modern Industry, Eastman Kodak Co., 1958, Rochester. N. Y.
Information Sheets #49 and #50

I. PREPARATION (of the learner)

Write aim on chalkboard explaining that much of the success of the radiographic operation depends on the ability of the radiographer to achieve the required sensitivity in his work. To insure that he has met the desired requirements, the radiographer must have some type of image quality indicator. The purpose of this lesson is to develop a better understanding of the various types of indicators, describe their use, and impart a thorough knowledge of the limitations of their use.

II. PRESENTATION (of the information)

Instructional Topics	Things to Remember to Do or Say
A. Penetrameter sensitivity	1. Write the following definition on the chalkboard: "An indication of the ability of the radiographic procedure is to indicate a certain difference in specimen thickness."

	2. Elaborate on the above definition: a. Penetrameter sensitivity does not guarantee the ability to detect a defect. b. The sharp edges of a penetrameter are more easily seen than natural defects. c. Only indicates ability to detect a thickness change, 3. Describe the generally accepted sensitivity levels of American specification (2% of the specimen thickness)
B. Penetrameter construction	1. Draw a chalkboard sketch of the various types of penetrameters including the European types. 2. Distribute a specification sheet on a typical American penetrameter. Information sheets #49 and #50 3. Explain the function of the holes and slots outlining that hole diameters are usually one, two and four times the penetrameter thickness. One or more holes should be perceptible in the radiographic image. 4. Display all available penetrameter types for student examination. 5. Explain why penetrameters should be made of similar material to that being inspected as they usually represent a 2% increase in subject thickness on the radiograph.
C. Radiographic quality level	1. Explain radiographic quality level in terms of shim thickness and hole size. 2. Standard quality level is generally designated as 2-2T. 3. To indicate 2-2T quality the 2T hole is a 2% shim must be clearly visible.

D. Placement of penetrameters	1. Explain that penetrameters are placed on the source side of the specimen because image quality indication should represent the farthest specimen-film distance. 2. Explain that shim blocks are required to achieve proper thickness since shim blocks make up difference in weld thickness and plate thickness. (Penetrameter is placed on the plate.) 3. Describe and illustrate with a chalkboard sketch the technique for determining the proper penetrameter when the penetrameter can not be placed on the source side.
E. Film quality	1. Caution students against acceptance of film quality on penetrameter image alone. 2. Outline other means of determining film quality such as: a. Freedom from light leaks b. Elimination of processing defects such as streaks, air bells, and water marks c. Cleanliness of film and freedom from dirt and scratches d. Absence of pressure marks and crimps e. Indication of poor screen contact

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III. APPLICATION (drill, illustrations, analogies, oral questions or assignments)

A. Refer to specification sheet for construction of penetrameters and ask individual students to explain the various dimensions and how they are obtained.

B. To stimulate discussion ask the group the following questions, give one or more students an opportunity to answer. In the event that no answer or an incorrect one is offered, hasten to supply the correct information and give all supporting data freely. Be careful not to request answers on subject not fully covered in previous presentations:

1. What is meant by penetrameter sensitivity?
2. What is the generally accepted penetrameter sensitivity?
3. What is meant by radiographic quality level?
4. What is the generally accepted value of radiographic quality level?
5. Why is the penetrameter placed on the source side of the specimen?
6. What does a penetrameter measure?
7. What are other factors which indicate film quality?

C. Have the students view the sample film and identify the penetrameter sensivity and the radiographic quality level of each film.

IV. TEST (final check on students' comprehension of material presented)

NOTE: Written Test

Each statement below contains a missing word or words, therefore, the missing information should be supplied.

A. Penetrameter sensitivity is an indication of the ability of a radiographic procedure to indicate a difference in specimen ____________.

B. The generally accepted radiographic quality level is ________, which means the procedure has the ability to resolve a _________ hole in a ___________ thick shim.

C. Shim blocks are used under penetrameter in weld inspection to increase the _________ of the metal to the same as the weld reinforcement.

D. Penetrameters are placed on the source side of the specimen because their image is ______________ greatest by this placement.

E. Penetrameters should be constructed of materials having similar radiation ___________ properties as the specimen to be inspected.

V. SUMMARY

A. A penetrameter is an image quality indicator.

B. An image quality indicator is used to detect a thickness change.

C. There are several shapes and sizes of penetrameters.

D. Penetrameters are placed between the source of penetrating radiation and the specimen being radiographed when feasible.

E. There are other means of determining film quality besides the penetrameter image.

The Next Lesson is: Radiographic Subject Contrast

INSTRUCTOR'S LESSON PLAN
Related Technical Information

Unit 20
Lesson 2
Time 2 hours

SUBJECT: Radiographic Subject Contrast

AIM (or purpose): To furnish the student with a basic understanding of the factors controlling radiographic sensitivity

TEACHING AIDS: Film viewer
X-ray exposure charts
Sample radiographic film

REFERENCES: Radiography in Modern Industry, Eastman Kodak Co., 1958, Rochester, N. Y.

I. PREPARATION (of the learner)

Since the primary purpose of most radiographic inspections is to detect defects and discontinuities in materials, a knowledge of the factors affecting the sensitivity of the procedure is quite important. The thickness of the various portions of the specimen influences the radiation reaching the film, therefore, the ratio of the intensities from different thicknesses is called the subject contrast. To study the effect of subject contrast on film sensitivity is the purpose of this lesson and its relative importance is self evident.

II. PRESENTATION (of the information)

Instructional Topics	Things to Remember to Do or Say
A. Subject contrast	1. Write the definition of subject contrast on the chalkboard: "The ratio of radiation intensities transmitted by different portions of the specimen." 2. Explain the definition and illustrate with a chalkboard sketch such as Fig. 10 in Radiography in Modern Industry.

	3. Explain the independence of subject contrast from time, milliamperage, distance, and film type, pointing out that subject contrast depends basically upon specimen thickness and density variations.
B. Factors affecting subject contrast 1. Thickness difference in specimen	1. Using an exposure chart, illustrate by a chalkboard sketch the range of intensities which can be produced from a specimen with a thickness difference of 2 to 1. See page 49 of Radiography in Modern Industry. 2. Display sample film showing the subject contrast obtainable from different thicknesses.
2. Radiographic quality	1. Define radiographic quality and write on the chalkboard: "The relationship between the specimen geometry and the penetrating qualities of the radiation." 2. Using an exposure chart, illustrate on the chalkboard the ratio of intensities from a specimen with a 2 to 1 thickness ratio when different kv's are used. 3. Display film showing the change in subject contrast from several different kv's.
3. Radiation scattering	1. Review the effects of scattered radiation on the overall density of the film. 2. Explain why scattering reduces contrast. 3. Explain the benefits from the use of masks and diaphragms: a. Scatter fogs film, undercuts thin parts of specimen, reduces overall contrast. b. Tends to cause a fog or haze over image. c. Masks and diaphragms absorb scatter. d. Filters absorb soft radiation that causes scatter.

4. Describe the action of filters in the radiation beam.
5. Review the actions of intensifying screens:
   a. Reduce exposure time at high kvp.
   b. Improve radiographic quality at low kv.
   c. Reduce scatter in both cases.
6. Display sample radiographs which show proper and improper control of scattered radiation.

III. APPLICATION (drill, illustrations, analogies, oral questions or assignments)

To promote discussion, invite the group to consider various questions. Give one or more individuals opportunity to answer, however, in the event an improper or incorrect answer is given the instructor must hasten to correct the matter and avoid such questions as reflects unexplored subject matter.

A. What are the factors which affect subject contrast?

B. What is subject contrast?

C. What is radiation quality?

D. How does scattered radiation affect subject contrast?

E. What effect does a difference in section thickness within a specimen have on subject contrast?

F. What are some of the methods of reducing radiation scattering?

IV. TEST (final check on students' comprehension of material presented)

NOTE: Written Test

Indicate the correct answer by writing in one of the four suggested answers.

A. Subject contrast is the ratio of the ______________ transmitted by different portions of the specimen.
   1. Gamma rays
   2. X-rays
   3. Radiation intensities
   4. Density levels

B. When the subject contrast increases, the film will respond by __________.

1. Fogging
2. Increasing contrast
3. Decreasing contrast
4. Decreasing exposure time

C. If two radiographs are made of the same test piece using different kilovoltages, the radiation intensity ratio from area of different thicknesses will be ____________ for the higher kilovoltage.

1. Higher
2. The same
3. Lower

D. Radiographic quality is the relationship between the specimen geometry and _____________.

1. The gamma ray source strength
2. The intensity of the radiation
3. The exposure factor
4. The penetrating qualities of the radiation

E. Scattered radiation reduces subject contrast by __________.

1. Reducing exposure time
2. Producing a coherent uniform radiation
3. Intensification of the primary radiation
4. Creating a haze or fog over the image

V. SUMMARY

A. Subject contrast is the ratio of radiation intensities transmitted by different portions of the specimen.

B. The factors affecting subject contrast are: Thickness variation in specimen, radiation quality, and radiation scattering.

C. Radiation scattering effects can be reduced with filters, diaphragms and masks.

The Next Lesson is: Radiographic Film Contrast

INSTRUCTOR'S LESSON PLAN
Related Technical Information

Unit 20
Lesson 3
Time 2 hours

SUBJECT: Radiographic Film Contrast

AIM (or purpose): To develop a basic understanding of the factors controlling radiographic sensitivity

TEACHING AIDS: Film viewer
Characteristic curves of various film
Sample radiographs

REFERENCES: Radiography in Modern Industry, Eastman Kodak Co., 1958, Rochester, N. Y.

I. PREPARATION (of the learner)

The purpose of the radiographic inspection is generally speaking the detection of small discontinuities in a material. The radiographer is hired to perform the necessary functions to detect these small irregularities and this lesson is to help him understand the factors which affect the sensitivity of the procedure, and his ability to achieve the desired results.

II. PRESENTATION (of the information)

Instructional Topics	Things to Remember to Do or Say
A. Film contrast	1. Write the definition of film contrast on the chalkboard: "The slope of the characteristic curve; i. e., the ratio of density to the relative exposure of the film." 2. Explain the definition and illustrate with a chalkboard sketch of the curve. 3. Outline the independence of film contrast from the quality of the radiation. Film contrast is an inherent part of each type film

B. Factors affecting film contrast
   1. Exposure time
   2. Temperature
   3. Agitation
   4. Developer activity

1. Explain the necessity of controlling the development time to achieve full development.
2. Display films developed at various times at the same temperatures. Discuss the differences.
3. Caution against over development to achieve greater speed. Overdevelopment causes fog.
4. Remind the student of the relationship between time and temperature in developing. As developer temperature rises, development time decreases.
5. Recommend the control of temperature or adjustment of time to achieve uniform results, by controlling darkroom temperature or developer chemical temperature.
6. Display sample film developed at the same time but at various temperatures. Discuss.
7. Explain the need for maintaining fresh chemicals and compare the effects of depleted chemicals to insufficient developing time. Fresh chemicals increase production and quality.
8. Invite questions.

C. Density

1. Review the relationship between the slope of the characteristic curve and the difference in film density for various exposures. A linear relationship exists only between the heel and the toe of the characteristic curve.
2. Show by a chalkboard sketch, the method of calculating a density gradient.
3. Explain by use of the chalkboard the difference in densities obtained for an equivalent exposure of a part in an area of the curve with a low and a high density gradient. (See Fig. 75 of Radiography in Modern Industry) Heel and toe areas of a characteristic curve offer wider density ranges.

4. Discuss the slope of the curve and density of film contrast.
   a. Compare and discuss slopes of three or four different types of film
   b. Measure the range of linear relationship for each type

III. APPLICATION (drill, illustrations, analogies, oral questions or assignments)

Oral questions following the same procedures as outline in Step III of the preceeding two lesson plans.

A. What is meant by film contrast?
   Ans. The slope of the characteristic curve

B. What are the factors affecting film contrast?
   Ans. Processing practices and density

C. List the processing practices which affect film contrast
   Ans. Time, temperature, agitation, and developer activity

D. Why should the developing time be controlled?
   Ans. Full development produces maximum film contrast, while over development reduces contrast and promotes fogging

E. Why is agitation important to control of film contrast?
   Ans. Improper agitation retards development and produces streaks which obsecure the true image contrast

F. What is meant by a density gradient?
   Ans. Density gradient is the instantaneous slope of a point on the characteristic curve

G. What value is a knowledge of the density gradient?
   Ans. Density gradient is useful in determining the film density and contrast produced by different radiation intensities.

IV. TEST (final check on students' comprehension of material presented)

NOTE: Written Test

Each statement below contains a missing word or words. Supply the missing information.

A. Film contrast is the ratio of the ____________________ to the relative exposure of the film

B. Film contrast is independent of ______________.

C. Over development of film can result in reduction of density and the production of an overall ______________________.

D. Time of development is directly related to the ______________ of development.

E. Lack of agitation reduces film contrast by reducing chemical activity at the surface of the film and by producing ______________ on the film.

F. The density gradient is the ________________ of the curve at a particular point on the characteristic curve.

G. Image contrast between two portions of a specimen is increased when the exposure is made in a region of the curve with a high ________________.

V. SUMMARY

A. Film contrast is defined as the slope of the characteristic curve or the ratio of the density to the relative exposure of the film.

B. Radiographic contrast is the product of subject contrast and film contrast.

C. Processing factors affect radiographic contrast.

D. Film contrast varies with each type of film.

The Next Lesson is: The Effects of Geometric Factors on Definition

INSTRUCTOR'S LESSON PLAN
Related Technical Information

Unit 20
Lesson 4
Time 2 hours

SUBJECT: The Effects of Geometric Factors on Definition

AIM (or purpose): To outline the factors controlling radiographic sensitivity

TEACHING AIDS: Film viewer
Samples of radiographic film

REFERENCES: Radiography in Modern Industry, Eastman Kodak Co., 1958, Rochester, N. Y.

I. PREPARATION (of the learner)

The sensitivity of a film is a function of radiographic contrast and image definition. Radiographic contrast has been treated with discussions on subject and film contrast. However, image definition is a function of geometric and graininess factors. This lesson will deal with the first of these, the geometric factors and demonstrate how they can be controlled to improve the overall film sensitivity.

II. PRESENTATION (of the information)

Instructional Topics	Things to Remember to Do or Say
A. Geometric factor	Define the geometric factor affecting definition as any factor which possesses dimensional measurements.
B. Geometric factors affecting sensitivity	
1. Focal spot size	Illustrate and explain the effects of changing the focal spot size on sensitivity by using a chalkboard illustration and a light source with a diaphragm closure. (See Fig. 10 of Radiography in Modern Industry)

2. Film-focal distance	1. Illustrate and explain the effects of film-focal distance by chalkboard sketch and light source. 2. Display sample film for student examination. 3. Invite questions.
3. Specimen-film distance	1. Illustrate and explain by chalkboard sketch and light source demonstration. 2. Display sample film for student examination. 3. Discuss results of film examination.
4. Abruptness of thickness change	1. Display sample radiographs with "defects" having rounded and sharp edges. 2. Explain why sharp edges are easier to detect than rounded edges. Use the density gradient for explanation.
5. Screen to film contact	1. Display sample film made with good and poor screen contact. 2. Explain the image distortion caused by poor screen contact. Use chalkboard sketch. 3. Invite questions.

III. APPLICATION (drill, illustrations, analogies, oral questions or assignments)

A. Promote discussion and questions by asking the group to describe the following geometric factors and explain how they affect sensitivity. Allow one or more students to treat each factor being ready to correct any misconceptions and incorrect responses. Be careful not to request information on subject matter not covered in previous work:

1. The focal spot or gamma source size
2. The film to focal spot distance
3. The film to specimen distance
4. Abruptness of thickness change
5. Intensifying screen to film contact

B. Ask individual students to demonstrate the first three factors using a visible light source.

C. Using the sample film, ask the students to elaborate on the possible causes of poor sensitivity on each film.

IV. TEST (final check on students' comprehension of material presented)

NOTE: Written Test

Each statement below contains a missing word or words. Supply the missing information.

A. The specimen image will have greater ______________ as the focal spot size is decreased.

B. The specimen image is _____________ in size as the specimen to film distance is increased.

C. The image will also have poorer _____________ as the specimen to film distance is increased.

D. As the change in section thickness becomes more abrupt, the specimen image will become _______________.

E. When the screen fails to make good contact with the film, the image is blurred because the emanation ____________ from the point where it was generated.

V. SUMMARY

A. Any factor which has dimensional measurements is called a geometric factor.

B. Focal-film distance is the distance between the source of penetrating radiation and the film that is to be exposed.

C. Distance between the near side of the specimen being radiographed and the film is called the specimen-film distance.

D. Use of density gradient explains why sharp edged defects are easier to detect than rounded defects.

E. Screen must be in intimate contact with film for optimum results.

The Next Lesson is: The Effect of Graininess Factors on Definitions

INSTRUCTOR'S LESSON PLAN
Related Technical Information

Unit 20
Lesson 5
Time 2 hours

SUBJECT: The Effect of Graininess Factors on Definition

AIM (or purpose): To develop a basic understanding of the factors that control radiographic sensitivity

TEACHING AIDS: Film viewer
Sample radiographic film

REFERENCES: Radiography in Modern Industry, Eastman Kodak Co., 1958, Rochester, N. Y.

I. PREPARATION (of the learner)

Throughout the career of a radiographer, he is confronted with one major problem. He must show the part to be inspected in sufficient detail to permit evaluation of its serviceability. This lesson and the preceeding three lessons cover the major factors that control sensitivity and are a complete outline of the problem. An understanding of each factor and its relationship to the others will help to eliminate many of the problems of maintaining a satisfactory sensitivity level in the finished product.

II. PRESENTATION (of the information)

Instructional Topics	Things to Remember to Do or Say
A. Graininess factors	1. Define a graininess factor as any influence which tends to produce a "graininess" in the image of the specimen. 2. Define graininess as the clumping of silver grains in the film to produce a visually discernable particle in the emulsion. 3. Draw a chalkboard sketch to illustrate graininess and show how it reduces film sensitivity.

B. Graininess factors affecting definition 1. Type of film	1. Explain the presence of grains in all film, all x-ray film is grainy and the faster the film the grainer. 2. Relate the speed of a film to its graininess, explaining that film speed increases with grain size. 3. Explain the desirability of using fine grain film for detecting small defects. Fine grain gives better image detail so is better for detecting small defects. 4. Display sample film. Allow students to compare grain size of various films. 5. Ask questions.
2. Types of intensifying screens	1. Describe the construction of fluorescent screens and explain how the grains in the screens cause graininess in the film image. Calcium tungstate and barium lead sulfate finely powered and mixed with a binder and coated as a thin layer on a cardboard support. 2. Compare lead and fluorescent screens and their effect on graininess. Lead screens cause no graininess when intimate contact is made with film. Calcium tungstate screens are not used with gamma rays because they cause graininess. 3. Explain the relationship between the strength of the radiation and graininess when fluorescent screens are employed. As radiation penetration increases, graininess increases when using calcium tungstate screens. 4. Display sample film for student examination to illustrate the effects of different types of screens. 5. Ask questions.

3. Radiation quality	1. Explain the effect of radiation strength in producing graininess. As penetration of radiation increases, graininess also increases. 2. Explain the rate of reaction of different types of film to high strength radiation. Graininess is increased when development time is lengthened to increase film speed. 3. Describe the use of inherent fine grain film for high energy radiation pointing out why.
4. Development	1. Explain the relation between developing time and the growth of "Clumps". A developing speed which gives a decrease in graininess will also give an appreciable loss in film speed. 2. Describe the adverse effects which accompany the practice of increasing developing time to gain film speed. Overdevelopment can cause fog and decrease contrast.

III. APPLICATION (drill, illustrations, analogies, oral questions or assignments)

To promote discussion invite the group to answer the following questions, giving one or more students an opportunity to answer each question. The instructor should be careful to quickly supply the correct answer in the event of misunderstanding or lack of knowledge. No questions should be asked if there is doubt that the subject was adequately covered or if the information is new or beyond the knowledge of the student:

A. Define the graininess factor and its effect on sensitivity.

B. What is graininess?

C. Explain why some films have more graininess than others.

D. Explain why fluorescent screens cause graininess.

E. Define radiation quality.

F. How does radiation quality affect graininess ?

G. How do film developing practices affect graininess ?

H. Select a film to be used in detecting fine casting cracks and explain why you picked that particular film.

I. Explain why you would not use a fluorescent screen with gamma rays.

IV. TEST (final check on students' comprehension of material presented)

NOTE: Written Test

Indicate the correct word or words to complete the following statements.

A. The speed and graininess of the film are increased by _____ ____.
  1. Increasing the time of development
  2. Decreasing the time of development
  3. Using a lower kilovoltage
  4. Increasing the ma and decreasing the time

B. Graininess decreases the sensitivity of a film by __________.
  1. Creating a fog on the film
  2. Decreasing the film contrast
  3. Accentuating large defects
  4. Obscuring small defects

C. Graininess is increased by ___________.
  1. Lower energy radiation
  2. Using lead intensifying screens
  3. Shorter developing times
  4. Using higher energy radiation

D. Inherent graininess is a characteristic of _______________.
  1. Fast speed film
  2. Slow speed film
  3. High contrast film
  4. Low contrast film

E. The _______________ intensifying screen has little effect on graininess.
  1. Calcuim tungstate
  2. Bariun lead sulphate
  3. Zinc sulfide
  4. Lead

V. SUMMARY

A. Any factor which tends to produce graininess in the specimen image is referred to as a graininess factor.

B. Graininess is the combining of individual silver grains in the film to produce a visible particle in the film emulsion.

C. Graininess varies with:
   1. Type of film
   2. Type of screens
   3. Radiation quality
   4. Film development techniques

The Next Lesson is: Depth Localization of Defects

INSTRUCTOR'S LESSON PLAN
Related Technical Information

Unit 20
Lesson 6
Time 2 hours

SUBJECT: Depth Localization of Defects

AIM (or purpose): To develop ability to locate flaws detected through the inspection of materials

TEACHING AIDS: Film viewer
Sample film

REFERENCES: Radiography in Modern Industry, Eastman Kodak Co., 1958, Rochester, N.Y.
Information Sheet #51

I. PREPARATION (of the learner)

Often a defective part will be found which can be salvaged in the machining process if the defect is in an area where metal is to be or can be removed. The machinist will want assurance that the defect can or will be removed before commencing operations. This lesson will cover a method of determining where a defect is located.

II. PRESENTATION (of the information)

Instructional Topics	Things to Remember to Do or Say
A. Parallax	1. Place the definition of the chalkboard: "The apparent displacement of an object as seen from two different points." 2. Explain the definition. 3. Issue information sheet #51. 4. Invite questions.
B. The parallax method	1. Draw a chalkboard sketch of the set-up as shown on the information sheet, for making a flaw depth determination. Indicate on the sketch:

    a. The position of the markers
    b. The position of the source
    c. The important distances
    d. The position of the film
2. Indicate on the chalkboard what happens to the flaw image when the two exposures are made.
3. Display for student examination a sample film from a depth determination. Explain all aspects.

C. Depth calculations

1. Illustrate and explain the method of distance measurement on the chalkboard and with the sample film.
2. Discuss the mathematical calculations on the information sheet.
3. Explain the method of determining the approximate location of the defect without making calculations.

III. APPLICATION (drill, illustrations, analogies, oral questions or assignments)

A. Promote discussion with the use of the following oral questions, being careful to observe the admonitions outlined in previous lesson plans.

1. What is the purpose of the markers on the test piece?
   Ans. A reference point for measurement of parallax.
2. What is parallax?
   Ans. The apparent displacement of an object as seen from two different points.
3. Why is the source shifted for the second exposure?
   Ans. To furnish a second point from which to observe the defect.

B. Give finite dimensions to the shift in image, the film-focal distance, and the focal spot shift on a chalkboard sketch. Ask each student to calculate the location of the defect.

IV. TEST (final check on students' comprehension of material presented)

NOTE: Written Test

A. What is parallax?

B. What dimensions must be known to be able to calculate a flaw depth by the parallax method?

C. If the shift in flaw location was less than one half of the top marker shift, where is the flaw located?

D. If the film-focal distance of a parallax exposure was 36" and the flaw moved 1/2" when the focal spot was moved 5 1/2", what is the distance from the bottom surface of the flaw to the bottom surface of the specimen?

V. SUMMARY

A. Initially a radiograph does not necessarily indicate the depth of a flaw or discontinuity.

B. Parallax is the apparent displacement of an object (flaw) as seen from two different points.

C. Depth of a flaw can be determined by the parallax method.

D. Approximate depth of a flaw can be determined without making calculations.

The Next Lesson is: Depth Localization of Defects

EXPERIMENT SHEET
Depth Localization of Defects

Unit 20
Lesson 7
Time 4 hours

SUBJECT:
Determination of the location of an internal defect in a metal part

NOTE:
Instructor performs all operations

INTRODUCTORY INFORMATION:
It is often desirable to know how far below the surface a defect in a part is located. The defect may be of little significance if located in an area of low stress or it may be desirable to remove or repair the defective area. The parallax method is a useful technique for localization of the defect position.

MATERIALS AND EQUIPMENT:
Gamma or x-ray source and exposure facilities
Film cassettes and film
Gamma ray survey meter
Sample part with known defect. (A casting about three inches thick with the defect near the center is preferable)
Lead numbers
Darkroom facilities

PROCEDURE:

A. Single load a film cassette with the selected film and screens.

B. Place lead numbers on the back of the part to be inspected near the outer edges and in a straight line which includes the defect.

C. Place a lead number on the top of the part about half the distance from the defect and the more distant edge in line with the numbers on the bottom.

D. Place the part on the film and position the source of radiation at a film-focal distance of 24 inches. Center the source over the part at a point which is displaced from the center line of the defect by two to four inches. Note: The distance the source is offset from the defect is not important and the amount is generally dictated by the size of the part; however, once the distance is established it must be measured with the best possible accuracy and recorded.

E. Energize the survey meter, wait for warmup, and zero the meter.

F. Determine the exposure time required to produce a density of approximately 1. 5.

G. Expose the film for the indicated length of time.

H. Return the equipment to the safe position.

I. Move the source of radiation two to four inches on the oppsite side of the defect maintaining the alignment with the lead markers.

J. Expose for the additional time to achieve the total density of 2. 5.

K. Return the equipment to the safe position.

L. Develop the film for 5 minutes at 68°F. fix, wash, and dry.

M. Examine the film on a film viewer. Note: If the image is not satisfactory for measurement of the defect position shift with the single exposure, the procedure must be repeated using two film; i. e., one for each exposure. The films then can be superimposed for viewing.

N. Record the amount of image shift in the defect image and record the results as dimension "b".

O. Record the image shift on the top marker and record and dimension "m".

P. Add the exact amount of the source shift from the center of the defect for each exposure and record as dimension "a".

Q. The film-focal distance should be recorded as dimension "t".

R. Calculate the distance "d" of the defect from the bottom surface of the part.

S. Determine if the image shift is more or less than one half of the top marker shift.

CONCLUSIONS:

A. The defect is closer to the ____________________ surface of the part because the defect shift is ____________ than half the marker shift.

B. The depth of the defect from the top surface of the part is ____________.

C. A film-focal distance of 48" would be ____________________ for this technique if the specimen is only 1/2" thick because of the __________ ____________ shift in the position of the defect on the radiograph.

The Next Lesson is: Procedure Qualification

EXPERIMENT SHEET
Procedure Qualification

Unit 20
Lesson 8
Time 3 hours

SUBJECT:

Qualification of the techniques for double wall pipe exposure with subsequent single wall viewing.

NOTE:

Instructor performs all operations

INTRODUCTORY INFORMATION:

Most specifications for radiography require the penetrameter to be placed on the source side of the part. This procedure may not by possible when making a double wall multiple exposure of pipe to be viewed as single wall or under other circumstances which preclude placing the penetrameter on the source side. To qualify a procedure with penetrameters on the film side, a test exposure is generally required on a sample of equal thickness. This exposure is to demonstrate the capability of achieving the desired sensitivity and to establish the equivalent penetrameter to be used to indicate the desired sensitivity.

MATERIALS AND EQUIPMENT:

Gamma ray (or x-ray) source and exposure facilities
Film cassettes and film
Gamma ray survey meter
Sample pipe
Penetrameters and lead numbers
Dark room facilities

PROCEDURE:

A. Single load film cassettes with selected film and lead screens.

B. Determine the pipe wall thickness.

C. Select a penetrameter for 2-2T sensitivity on the full wall thickness and a series of penetrameters ranging in thickness down to one fourth the wall thickness.

D. Place the film on a lead sheet or exposure table and tape all the penetrameters except the 2-2T to the film in a straight line near the center of the film. Align the penetrameters end to end in sequential order of thickness.

E. Align the pipe sample over the penetrameters. The penetrameters should be in line at the point of tangency of the pipe.

F. Place the full wall 2-2T penetrameter inside the pipe with the long axis parallel to the pipe. Position in order not to interfere with the image of the other penetrameters.

G. Attach lead numbers and letters to the film for the purpose of identifying the exposure.

H. Align the source tube directly over the pipe at a film-focal distance not less than seven times the pipe wall thickness.

I. Calculate the exposure time required to produce a density not less than 1. 5 nor more than 3. 3.

J. Attach the source tube to the camera and extend the control cables.

K. Energize the survey meter, wait for warmup, and zero meter.

L. Extend source and expose for required time.

M. Retract source, survey, and lock source in camera.

N. Remove and develop film for 5 minutes at 68°F. fix, wash, and dry.

O. Examine film on viewer.

P. If the penetrameter on the source side indicates proper sensitivity, determine the thinnest penetrameter on the film side which has a 2T hole clearly visible.

CONCLUSIONS:

A. For this exposure the ____________ penetrameter will indicate a 2-2T sensitivity when used on the film side.

B. The exposure calculation was made using a thickness of __________ to produce a film which is viewed as a thickness of ___________.

C. The sensitivity of this film will indicate 2-2T sensitivity on a thickness of ________________.

D. This qualification procedure is necessary because it is sometimes impossible to place the ____________ on the ____________ side.

The Next Lesson is: Operation of Portable Power Plants

INSTRUCTOR'S LESSON PLAN
Manipulative Skills

Unit 21
Lesson 1
Time 2 hours

JOB (or operation): Operation of Portable Power Plants

AIM (or purpose): To assist students in acquiring skill in the care, maintenance, and operation of powerplants used in field radiographic operations

TOOLS AND EQUIPMENT: Portable powerplant

MATERIALS: Fuel
Oil
Lubricants

REFERENCES: Manufacturers operating manual

I. PREPARATION (of the learner)

Many field radiographic operations rely on portable power plants to furnish power for x-ray generators and the operation of the darkroom. The success of the entire operation is dependent on the proper functioning of the power plant, therefore, the radiographer must know how to care for and operate these portable power plants to best advantage. This lesson will help to provide some basic and fundamental facts, however, it is recommended that a thorough study be made of the manufacturer's operating manual and its procedures be followed as closely as possible.

II. PRESENTATION (of the skills)

Operations or Steps	Key Points (things to remember to do or say)
A. Preparation	Place students in proper position to see and hear. 1. Check and fill crankcase with proper or recommended motor oil. 2. Check and fill oil bath air cleaner if so equipped.

3. Fill fuel tank with the correct grade of fuel.
4. Lubricate bearings which require periodic service.
5. Remove all covers from intakes and exhausts.
6. Disconnect all electrical loads from power plant.

B. Starting

1. Open fuel tank valve.
2. Close choke lever. (Some units may have automatic chokes)
3. Wind starter rope around pulley (Some units may have electrical starters and do not require hand cranking)
4. Remove ground or energize starting switch.
5. Pull starter rope with steady even motion. Repeat if engine does not start.
6. When engine starts, return choke to open position.
7. If engine is electrically cranked, return starting switch to "Run" position after engine starts.

C. Apply load

1. Turn off switches on all apparatus to be connected to power plant.
2. Engage power lines to power plant after engine has been warmed.
3. Pickup load on each apparatus as needed.
4. <u>Caution:</u> Do not apply load greater than the capacity of the power plant.

D. Stopping

1. Remove load from power plant.
2. Connect ground or push stop button to short circuit ignition of engine.
3. Turn off fuel line valve.
4. Allow engine to cool then replace covers on intake and exhaust.

E. Precautions

1. Never fuel engine while running.
2. Keep guards on flywheels and moving parts.
3. Do not restrict passage of cooling air to engine.
4. Do not overload power plant.
5. Have spare spark plugs available.
6. Caution: An x-ray generator cannot function properly with a fluctuating power supply.

III. APPLICATION (practice by learner under close supervision)

A. Have one student instruct another in the proper starting procedure under close supervision of teacher.

B. Alternate student and learner positions until all students have performed the operations.

C. Have each student tell what he is going to do, how he will do it and why he is doing it.

IV. TEST (performance of skill to acceptable standards)

NOTE: Written and performance test

A. Have each student outline in written form the procedure for starting a portable power plant.

B. Have each student start the engine, apply a load, stop and prepare engine for shut down.

V. SUMMARY

A. Power plants perform two separate functions in that they furnish power for the x-ray generator and for the portable darkroom.

B. Fluctuation of power to the x-ray generator will reduce quality of the resultant radiograph.

C. Maintaining a power plant in accordance with the manufacturer's recommendations should be adequate for outdoor operations.

The Next Lesson is: Shipping Radioactive Materials

INSTRUCTOR'S LESSON PLAN
Manipulative Skills

Unit 22
Lesson 1
Time 2 hours

JOB (or operation): Shipping Radioactive Materials

AIM (or purpose): To develop skill in the preparation of radioactive materials for shipment

TOOLS AND EQUIPMENT: Gamma ray source (simulate)
Screw driver, pliers, adjustable wrench
Shipping containers

MATERIALS: Labels (poison)
Straps, nails, tape, screws, etc.

REFERENCES: Transportation of Radioactive Materials, 1965, U.S. Atomic Energy Commission, Washington, D.C.
Information Sheet #52

I. PREPARATION (of the learner)

The shipment of radioactive materials is controlled by strict legal procedures for the purpose of avoiding injury and damage to other people. These procedures are very simple requiring only an adequate exposure to the fundamental requirements to learn them. The purpose of this lesson is to assist the individual in the development of skill in handling radioactive materials in accordance with prescribed regulations.

II. PRESENTATION (of the skills)

Operations or Steps	Key Points (things to remember to do or say)
A. Preparation of records and shipping documents	. Pass out information sheet #52 and place students so all can see and hear. 1. Enter date of shipment in source location and source inventory records.

	2. Prepare packing slip indication: a. Source type b. Source serial number c. Strength of source on shipment date 3. Enclose copy of decay chart if source is not being shipped for disposal. 4. Prepare class D label (poison)
B. Prepare gamma source	1. Transfer to shipping container 2. Secure and survey container 3. Crate or package in shipping container 4. Survey the surface of shipping container with gamma survey meter. 5. Secure all closures on shipping container
C. Label shipping container	1. Place radiation signs on outside of container 2. Fill in the surface radiation level block of the class D label (poison) 3. Attach the label to the container 4. Attach the packing slip to the container
D. Notify recipient	1. Telephone, wire, or send letter to addressee informing of the shipment indicating carrier and exact route if available. 2. Notify the transportation company to pick up container.
E. Receipt of sources	1. Reverse the procedure of survey, removal from container, and entry into records. 2. Notify the shipper of receipt. 3. Store source in approved vault.

III. APPLICATION (practice by learner under close supervision)

A. Separate the students into small groups. Have each group prepare a simulated shipping container for shipment. The group should show the necessary record entries and prepare all documents. Supervise the activity very closely.

B. Have the groups exchange containers. Ask the students to now take the necessary receiving actions. Observe all procedures for exact conformity to regulations, invite questions and supervise closely.

IV. TEST (performance of skill to acceptable standards)

NOTE: Performance Test

Have the students prepare an actual source for shipment, make entry in the record book, attach all labels, and prepare notifications. If conditions permit, have students actually ship container.

V. SUMMARY

A. Federal laws govern the transport of radioactive materials.

B. Shipping containers must be properly labeled and addressed.

C. All containers must be monitored for excessive leakage of radiation.

D. Containers must be made of an acceptable material.

E. Shipping containers must be locked.

F. Incoming shipments must be checked for leakage, quantity of material and for contamination.

VT003 624

VT 003 624
Basic Electricity Series, No. A (First Year), Related Training for Electrical Apprentices, Instructor's Manual.

Hedinger, Howard E.
North Carolina State Board of Education, Raleigh.
Pub Date - Jul64
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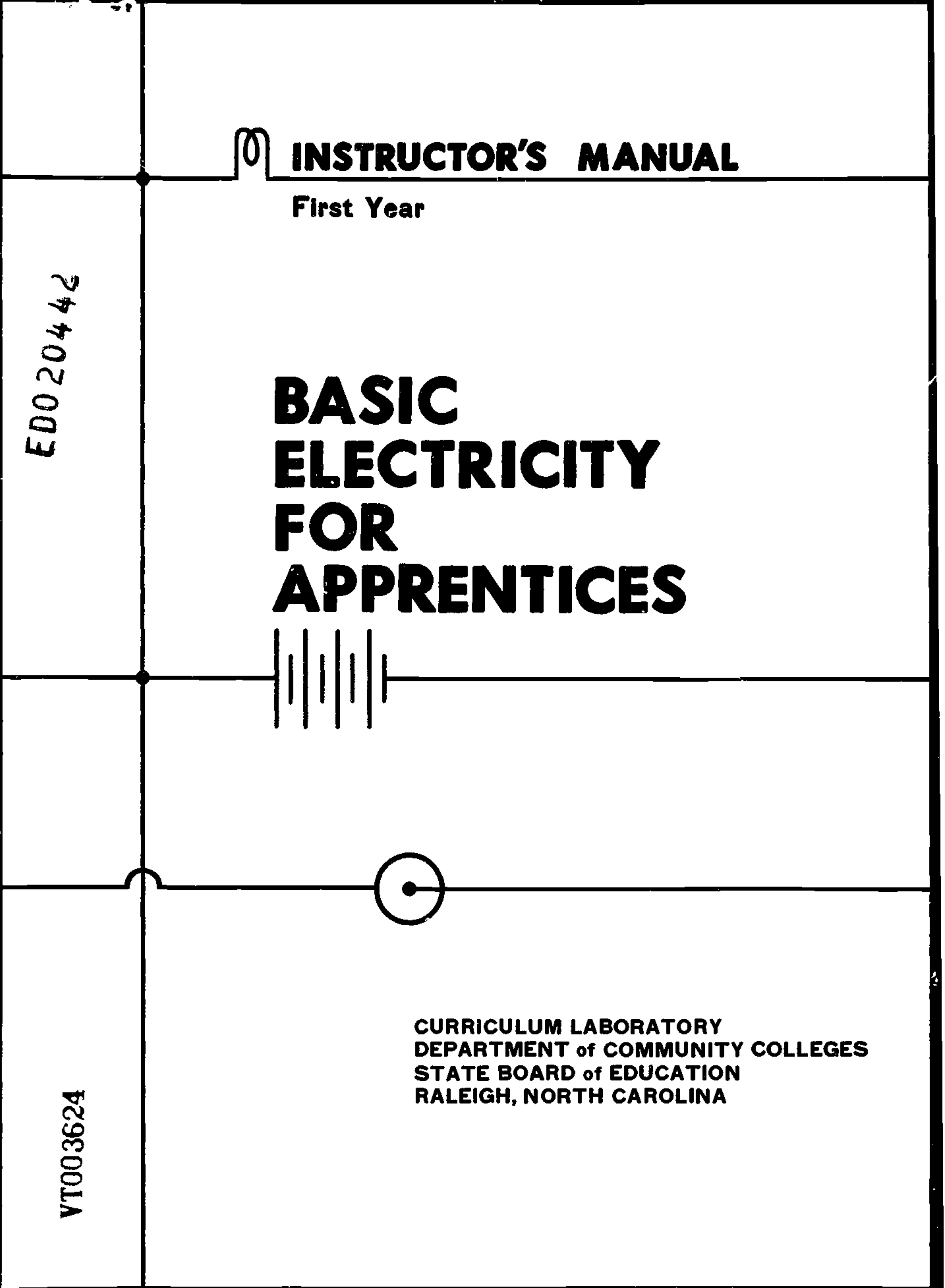
*TEACHING GUIDES, *TRADE AND INDUSTRIAL EDUCATION, *ELECTRICIANS, *ELECTRICITY, POST SECONDARY EDUCATION, *APPRENTICESHIPS,

This teaching guide is the first of a four-unit series to help the instructor plan and present course materials to electricians in the first year of the related technical phase of post-secondary apprenticeship training. It was developed by a curriculum committee of subject matter specialists and the educational committee of the National Electrical Contractors of North Carolina, tested on a small group, and used in apprenticeship programs. The 28 lesson plans in this guide cover Basic Mathematics and Orientation, Fundamentals of Electricity, and National Electrical Codes. Each lesson plan is outlined into a four-step method of instruction--introducing the lesson, presentiation, application, and checking and followup. The teacher of the 144-hour course should be a journeyman tradesman, and the students should be 18 years old and employed as apprentices in an electrical construction trade. Supplementary materials include lists of textbooks, library reference books, industrial bulletins, recommended films, and required tools. Correlated student assignments and information sheets, unit tests, and a final examination are given in VT 003 625. Documents of the series are listed as VT 003 624 through VT 003 631. (HC)



INSTRUCTOR'S MANUAL

First Year

BASIC ELECTRICITY FOR APPRENTICES

CURRICULUM LABORATORY
DEPARTMENT of COMMUNITY COLLEGES
STATE BOARD of EDUCATION
RALEIGH, NORTH CAROLINA

INSTRUCTOR'S MANUAL

BASIC ELECTRICITY

SERIES NO. A

(First Year)

Related Training
for
Electrical Apprentices

July 1964

CURRICULUM LABORATORY
DEPARTMENT OF COMMUNITY COLLEGES
STATE BOARD OF EDUCATION
RALEIGH, NORTH CAROLINA

MEMORANDUM

TO: The ERIC Clearinghouse on Vocational and Technical Education
The Ohio State University
980 Kinnear Road
Columbus, Ohio 43212

FROM: (Person) Roger G. Worthington (Agency) Department of Community Colleges

(Address) Education Building, Raleigh, North Carolina

DATE: September 6, 1967

RE: (Author, Title, Publisher, Date) Hedinger, Howard E. "Basic Electricity For Apprentices, Series A - First Year Instructor's Manual," Curriculum Laboratory, Dept. of Community Colleges, July 1964.

Supplementary Information on Instructional Material

Provide information below which is not included in the publication. Mark N/A in each blank for which information is not available or not applicable. Mark P when information is included in the publication. See reverse side for further instructions.

(1) Source of Available Copies:
Agency ERIC Only, except North Carolina Institutions.
Address
Limitation on Available Copies Price/Unit
(quantity prices)

(2) Means Used to Develop Material: National Electrical Contractors for
Development Group Curriculum committee /Carolinas - Educational committee
Level of Group State and dept. supervisor
Method of Design, Testing, and Trial Designed by subject matter specialists and tested on a small group; used with 1,200 apprentices per year for 3 years.

(3) Utilization of Material:
Appropriate School Setting Vocational (Apprentice Training)
Type of Program Post-high; Apprenticeship.
Occupational Focus A specific job (electrical construction)
Geographic Adaptability N/A
Uses of Material Course and lesson planning and student study guides.
Users of Material Instructor and student

(4) Requirements for Using Material:
Teacher Competency Journeyman instructor
Student Selection Criteria 18 year old, male (mostly), post-secondary educ. to become a journeyman electrician
Time Allotment 144 hours per year (minimum)

Supplemental Media -- Textbooks - see list
Necessary X
Desirable
(Check Which)

Describe Basic Electricity, VanValkenburgh & All, Hayden Book Co.; Amer. Electricians' Handbook, Croft, McGraw-Hill Book Co.; Basic Mathematics
Source (agency) /by Singer, McGraw-Hill Book Co.; National Electrical Code
(address) /National Fire Protection Assoc. 60 Batterlymarch Street, Boston, Mass.

ACKNOWLEDGMENTS

The Instructor's Manual and Assignment Sheets for the Electrical Apprentice Training Program have resulted from a need recognized by representatives of Trade and Technical Education and the Apprentice Council of the Department of Labor of North Carolina. They believe that an apprentice, in order to become a skilled craftsman in our times, needs not only to work hard on the job but also to study the related technical materials of his trade in an organized manner.

The Curriculum Laboratory of the Department of Community Colleges, was given the assignment of preparing materials that could be used by the instructors as a guide. The material contained in the lesson outlines is designed to help the instructor plan the lessons and to lead his classes gradually into the more complex studies of electricity.

Representatives of the Curriculum Laboratory have worked in close cooperation with a statewide Education Committee of the North Carolina Association of Electrical Contractors. Among these men are contractors, engineers, and journeymen who have not only worked as electricians but also are serving as instructors for apprentice classes.

Thanks are extended to Mr. D. J. Colter, Chairman of the Apprentice Training and Manpower Development Committee for the Electrical Contractors Association, Mr. C. L. Beddingfield, State Director of Apprenticeship and Training, and Mr. W. F. Humbert, III, Instructor of Winston-Salem who prepared the study guide questions for each lesson.

In addition, appreciation is expressed to all those instructors and apprenticeship committee members who have made themselves available for consultation regarding this course.

A. J. Bevacqua, Coordinator
Curriculum Laboratory
N. C. Department of Community Colleges

H. E. Hedinger
Curriculum Specialist

BASIC ELECTRICITY

TO THE INSTRUCTOR

The following Instructor's Manual for Basic Electricity, Series A, is the first of four units that will be developed for electrical apprentices. The lesson outlines will act as a guide for presenting materials and aids that will comprise the core for the proper related training of electricians. This manual is designed to aid both the instructor and learner in the presentation and mastery of related technical information.

The lessons are designed to give the beginner a good start in his related training. The general outline includes the following subjects: Orientation, Blueprint Reading, National Electric Code, Basic Mathematics, Job Information and Basic Electricity. The beginning lessons are basic but will be expanded in future assignments with additional technical information. For example, the first lesson on Ohm's Law will cover the very elementary facts about it, but there will be more advanced study on this subject in future assignments.

The lessons do not have a time limit attached to each class session. Some lessons that review basic mathematics may be completed in 30 minutes while other lessons may require several periods for a good understanding. In the event a lesson is completed in less time than the assigned period, start on the next assignment. Under most any method of class operation all the outlined lessons can be completed in a minimum of 144 hours each year.

The instructor should take time to become thoroughly familiar with the outlines for this course. He should follow the system of operation and also, explain it to the class. It is most important that all apprentices fully understand how to use the material and the step by step operation of the class. Use the orientation sheet with the first lesson to help you explain the material and its use.

Each lesson plan is outlined into the "four step" method of instruction and should assist you in presenting the lessons. In group instruction, it is recommended that the class period include the following:

Step I - INTRODUCING THE LESSON:
Call attention to interesting facts concerning the subject.

Step II - PRESENTING THE LESSON:
Demonstrate the use of necessary tools, materials, problems, and experiments. NOTE: When adequate equipment is provided, each student can perform the experiments individually.

Step III - APPLICATION:
Make use of the assignment sheets which correlate with each lesson. The assignments serve not only as a valuable aid to the learner, but also indicate to the instructor how well the lesson was taught. A well presented lesson will require the student to do a minimum of reading in the assigned texts.

TO THE INSTRUCTOR (Continued)

Step IV - CHECKING AND FOLLOW-UP:
Check the assignments with aid of answer sheets. This can be done quickly by the instructor or by exchange of papers in class. Return the papers to the students and give individual help to those that need it.

TESTING PROCEDURES:

1. Short tests can be given each week on the lesson or the previous assignment.

2. A thorough test should be given shortly after completing a unit or group of lessons. This test should cover six weeks work or less.

3. A good comprehensive test administered at the end of the course will act as a gage of progress for the year. Some questions using charts, tables, and National Electrical Code can be of the "open book" type.

4. All tests should be checked in detail, reviewed in class and returned to you. Tests should be retained by you and the committee as a part of the student's record. Also, you can use the test again next year.

HINTS ON CLASS OPERATION:

1. Each student should have a large three-ring notebook to keep assignment sheets, information sheets, and notes.

2. Hand out the assignment sheets at the beginning of the term. Make assignments for next week during the last session of the present week.

3. Require each student to study the assigned lessons at home, answer the questions and work problems.

4. Use the class time to present the lesson in the "four step" method.
   a. Give information on the lesson, either before or after the student studies it, or both.
   b. Discuss the lesson, ask and answer questions.
   c. In the third step, "APPLICATION", have the students study, answer questions, work problems, and perform experiments. The instructor should give individual assistance during this part of the period.

5. The completed assignment sheets should be turned in to the instructor when the class meets for the lesson. A small part of the session can be used to complete assignments when needed.

6. All required assignments should be checked, indicate the correct and incorrect answers. Do not write the correct answers on the papers. The learner should find the correct answers and write them on his paper for future reference.

7. Review parts of a lesson where several fail to have the correct answer.

8. The instructor should give individual assistance when the student needs help in finding the correct answers.

9. The completed lessons are put in the student's notebook for future reference.

10. The instructor should have a roll and record book to keep accurate attendance and grades for the related work of each apprentice.

NOTE: The responsibility of any instructor is not an easy one but it is hoped that this manual will make the results of your instruction both easier and more fruitful.

TEXTBOOKS:

It is very important that each student have his own textbooks. Other reference books should be furnished by the Local Committee or Institution and kept in a classroom or school library for use by the apprentices.

Textbooks for Instructors and Students to be used 4 years:
Order from the publisher.

			Approximate List Price
1.	Basic Electricity, by Van Valkenburgh & all (Five volumes bound in single text) John F. Rider, Inc., A Division of Hayden Publishing Company 850 Third Avenue New York 22, N. Y.		$12.75
2.	Basic Mathematics, by Singer McGraw-Hill Book Company, Inc. 330 West 42nd Street New York, N. Y. 10036		$ 5.75
3.	American Electricians' Handbook, 8th edition by Croft McGraw-Hill Book Co., Inc		$14.75
4.	National Electrical Code National Fire Protection Association 60 Batterymarch Street Boston 10, Mass.	(6-24 copies)	.95 ea.

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LESSON NO. BASIC MATHEMATICS AND ORIENTATION

FUNDAMENTALS OF ELECTRICITY

NATIONAL ELECTRICAL CODE

INSTRUCTIONAL MATERIALS

WHOLE NUMBERS

DESIRED RESULTS:

1. To review and apply the fundamental operations using whole numbers involving basic problems in electricity.
2. To stress neat work and identified answers on all mathematics assignments.

MATERIALS & REFERENCES:

1. Assignment Sheet
2. NO TEXT--Any student who has trouble with this lesson should be assigned additional problems to work from the text.
3. Chalkboard

PRESENTING THE LESSON:

Review the fundamental operations using whole numbers to represent electrical parts or money transactions. This lesson is designed to let you know how well your students can handle the simple operations involved. Stress neat work and identified answers on all mathematics assignments. Mathematics is used as a tool in the study of electrical science. If the student has the habit of doing accurate and neat work in mathematics, he will generally do the same kind of work on the job.

APPLICATION:

Using the assignment sheet, the students will work the problems listed.

CHECKING & FOLLOW-UP:

Check the problems for correct answers and neatness. Mistakes should be corrected.

COMMON FRACTIONS

DESIRED RESULTS:

1. To review the fundamental operations of mathematics using fractions.
2. To show that fractions are vital to the electrical trade in every day work.

MATERIALS & REFERENCES:

1. Basic Mathematics, by Singer, pages 13-20 Job 2-1 & 2-2
2. Assignment Sheet - Math 2
3. *Practical Mathematics, by Palmer & Bibb, pages 20-24, sec. 10-19
4. *Basic Mathematics for Electronics, by Cooke, pages 25-28, sec. 4-1 thru 4-5

INTRODUCTION:

DEFINITION: A common fraction is one or more of the equal parts into which a unit or group of units may be divided.

Illustrate how the use of fractions is important when we figure dimensions from blueprints or locating outlets, depth of boxes, etc.

PRESENTING THE LESSON:

Review the addition, subtraction, multiplication and division of fractions. Since most people have trouble handling fractions, it is essential that the student master their use. They are used in calculating speed changes, transformer ratios, parallel circuits and many more everyday problems.

APPLICATION:

Using the assignment sheet, complete the operations of fractions listed.

CHECKING & FOLLOW-UP:

Check the answers on the students' assignment sheets and have them correct the mistakes. Any student who does not do well on this lesson should be given additional work from problems in the text.

TOOLS

DESIRED RESULTS:

1. To learn the names, uses and care of the basic tools used on the job.

2. To stimulate the students' interest in the use of catalogs to learn the names of tools.

MATERIALS & REFERENCES:

1. Tool Kit of hand tools used in the trade.

2. Electrical Catalogs from local supply houses.

3. Chalkboard.

INTRODUCTION:

The lesson materials are used primarily to introduce the basic tools of the trade for discussion.

PRESENTING THE LESSON:

The value of this lesson lies in the discussion of tools in class. Be sure to allow time to discuss the proper use and care of tools. Warn the apprentice to learn the respect for the tools of others.

APPLICATION:

Using the assignment sheets, the students will fill in the common names of tools used in the area.

CHECKING & FOLLOW-UP:

Check the assignment sheets and return to learner for placing in his workbook for future reference.

ANSWER SHEET:

The names applied to tools vary with use in different areas, therefore, the answers are left for you to fill in the common name used in your area.

DECIMAL FRACTIONS

DESIRED RESULTS:

1. To review decimal fractions as another check-up and practice lesson in mathematics.

2. To show the importance of handling problems involving decimal fractions in the electrical field.

MATERIALS & REFERENCES:

1. Basic Mathematics, by Singer, pages 37-49, Job 2-8
2. Assignment Sheet
3. *Practical Mathematics, by Palmer & Bibb, pages 57-60
4. *Basic Mathematics for Electronics, by Cooke, pages 35-42

PRESENTING THE LESSON:

Review the changing of fractions to decimals and decimals to fractions. If we have a dime, we do not write the fraction 1/10 of a dollar, but .10 which is a decimal fraction. In stating the diameter of a #10 type RH wire, we write .242", not 242/1000. We must be sure that we know how to handle problems involving decimal fractions.

This is another check-up and practice lesson in basic mathematics. Use it to review the fundamental operations in the use of decimals. Train the students to do accurate and neat work in solving problems involving decimal fractions.

APPLICATION:

Use the assignment sheet MATH - 3 for check-up and practice of fundamental operations involving decimals.

CHECKING & FOLLOW-UP:

Correct the problems and note the mistakes made by the students.

MATERIALS

(Conduit and Cable Fittings)

DESIRED RESULTS:

1. To help the beginner to learn the names and uses of the more basic materials of the trade.
2. Learn to use the electrical catalogs for specifications of materials and how to order them.

MATERIALS & REFERENCES:

1. Samples of various materials; switches, boxes, connectors, clamps, conduit, etc.
2. Catalogs from various supply houses.
3. Electrical Conduit & Cable Fittings, Thomas & Betts

INTRODUCTION:

The samples of various materials and the use of catalogs will introduce a general discussion of materials as used in your area. The bulletin, Electrical Conduit & Cable Fittings, will show the picture and use of fittings for raceways and cable.

PRESENTING THE LESSON:

Best results will be achieved by introducing a general discussion of materials as used in your area. The common trade name for much of this material will vary from place to place so be sure to supply the class with the common usage name for your area. Make use of the electrical catalogs.

APPLICATION:

Using the assignment sheets, have the students list the names in the blanks of conduit and cable fittings used in a typical dwelling installation.

CHECKING AND FOLLOW-UP:

Check the assignment sheets and return to learner for placing in his workbook for future reference.

ANSWER SHEET:

The answers to these questions will vary with the catalogue used and the area of the country, therefore, no specific answers are given.

FORMULAS AND EQUATIONS

DESIRED RESULTS:

1. To determine the ability of the students to handle simple formulas and equations.

2. To determine if the students need further training in mathematics before continuing with equations.

MATERIALS & REFERENCES:

1. Chalkboard
2. Basic Mathematics, pages 24-36
3. *Practical Mathematics, by Palmer & Bibb, pages 368-382
4. *Basic Mathematics for Electronics, by Cooke, pages 122-134

INTRODUCTION:

This is probably the most important mathematics assignment in the first year lessons. Any student who cannot handle this material with reasonable ease will have trouble with most of the electrical theory lessons in the course. The students that do have trouble should be urged or required to take an outside course in elementary algebra. Present simple equations involving the Ohm's Law formula. Review positive and negative numbers and transferring of terms.

PRESENTING THE LESSON:

Demonstrate on the chalkboard several simple formulas including problems involving Ohm's Law. Assist the students with practice problems found in the text.

APPLICATION:

Distribute the assignment sheets and allow time for the students to try all the problems. Make note of the students having trouble and the problems they could not solve.

CHECKING & FOLLOW-UP:

Correct the papers and help the students that had problems incorrect. Make additional assignments of problems from the text for those that need more practice.

FRACTIONS AND DENOMINATORS

DESIRED RESULTS:

1. To have a good understanding of the rules involving the solution to fractional problems.

2. To review reciprocal numbers and least common demoniator in order to solve parallel resistance problems.

MATERIALS AND REFERENCES:

1. Chalkboard
2. Basic Mathematics, pages 104-111
3. Assignment Sheet

INTRODUCTION:

It is essential that the electrical apprentice have a good understanding of the solution to fractional problems. To find the total resistance or capacitance for parallel and series circuits we find the sum of the reciprocals of the individual resistors or capacitors.

If the students have a good understanding of the rules involving fractions, they will have very little trouble calculating electrical problems in future work.

PRESENTING THE LESSON:

Define and give examples of the term reciprocal. Example, if two resistors of 10 and 20 ohms were connected in parallel, the reciprocals are added 1/10 + 1/20. The total resistance equals the sum of the reciprocals. It is necessary to obtain the least common denominator (L.C.D.) before the reciprocals can be added.

Spend enough time on this lesson to review fractions and establish a method of setting up equations from known facts to find an unknown quantity.

Give examples on the chalkboard and have the students practice problems. Those students who have trouble with this lesson should be required to do extra work.

APPLICATION:

Using the assignment sheet for this lesson, the students should work the problems listed. Give assistance to those that need it.

CHECKING & FOLLOW-UP:

Correct the papers and assist those that had difficulty and assign extra work to them.

PERCENTAGE

DESIRED RESULTS:

1. To review percentage problems as they are applied to a great number of electrical calculations.
2. To review decimal fractions and the changing of decimals and fractions to per cents.

MATERIALS AND REFERENCES:

1. Chalkboard
2. Basic Mathematics, pages 218-226

INTRODUCTION:

In our study of electrical mathematics we find "percentage" is used in the following calculation: 1. Efficiency of an electrical device; 2. Proper fusing of motors; 3. Code requirements as to amount of wire (in area) allowed in conduit, tubing and gutters; 4. Wire sizes based on room temperature; 5. Voltage drop in electrical circuits.

PRESENTING THE LESSON:

As stated in the introduction, percentage is used to solve a great number of electrical problems. It is important that the students put forth extra effort to master this subject as applied to electrical problems. The lessons in electricity to follow will require a good knowledge of percentage. Drill in the conversion of common fractions to decimals and percentage, and vice versa. Stress the importance of solving written problems in connection with electrical work.

APPLICATION:

Have the students give answers and work out problems on the assignment sheet.

CHECKING & FOLLOW-UP:

Check the answers to questions on the assignment sheet. Discuss any questions or problems that were found incorrect and should be explained.

SQUARE ROOT

DESIRED RESULTS:

1. To review square root from "perfect squares" through large or small whole numbers or decimals.
2. To study the method of marking off the numbers into groups and finding the square root.

EQUIPMENT AND REFERENCES:

1. Chalkboard
2. Basic Mathematics, pages 163-173

INTRODUCTION:

The ability to extract "square root" is necessary in the calculations of many electrical formula that will be needed throughout this course. Square root problems are used frequently in A. C. Circuits and problems in electronics.

PRESENTING THE LESSON:

Finding the "square" of a number, we simply multiply that number by itself. For example, 10 squared, written $10^2 = 10 \times 10$ or 100. The "square root" of a number is that number which must be multiplied by itself in order to obtain the original number. The symbol for the square root is the radical sign. When a number appears under this symbol, it means that we are to find a number which can be multiplied by itself to give the number under the square root symbol.

The square root of 144 equals 12 because 12 x 12 equals 144. Such numbers under the square root radical are called "perfect squares" because the square-root is a whole number.

As the numbers get beyond the range of the ordinary multiplication table, we need a system that will help us to find the square root of any number--large or small, whole number or decimal. In the following system, it will help if we mark off the numbers into groups of two digits to a group. We start marking off the groups at the decimal point. If there is no decimal point indicated, start at the end of the number. See examples in text, p. 164 ff. Work several problems on the chalkboard and show how to check them.

APPLICATION:

Have the students work the problems on the assignment sheet.

CHECKING AND FOLLOW-UP:

Check the answers to the problems. Call attention to errors and have the students correct them.

RATIO AND PROPORTION

DESIRED RESULTS:

1. To show that the mathematical concepts of ratio and proportion enable us to compare voltage, currents, etc, and to show how they depend on each other.
2. To review the rules of ratio and proportion and apply them to electrical problems.

MATERIALS AND REFERENCES:

1. Chalkboard
2. Basic Mathematics, pages 246-258

INTRODUCTION:

To understand and solve problems dealing with transformers, gears, pulleys and even current capacity of wire, we must study ratio and proportion.

A ratio is a statement of the relationship of one value on quantity to another, they must be measured in the same units of measurement. Also, the quantities themselves must be of the same kind, like two resistors, two amperes, two volts but not amperes and volts. When two quantities depend on each other, the relationship between them may be stated as a proportion. Proportion is a comparison or equality of two ratios, these two ratios may be of different substances like amperes and volts.

PRESENTING THE LESSON:

1. DIRECT PROPORTION

When two ratios in a transformer are compared in the same order so that the items in the first situation (T_1 turns of wire and V_1 voltage) are in the numerator and the items of the second situation (T_2 and V_2) are in the denominator. The proportion is stated:

$$\frac{T_1}{T_2} = \frac{V_1}{V_2}$$

This direct proportion deals with two different items, turns of wire and voltage, but each ratio contains like items. Now, we can say that the voltage in two windings of a transformer are in direct proportion to the turns of wire in the windings. See Rule for Direct Proportion in text, page 252.

2. INVERSE PROPORTION:

This is another statement of proportion we must understand. The transformer is a good example of this statement. The voltage is in direct proportion to the ratio of turns of wire in the windings, but the current is in inverse proportion to the voltage. Sample problem: A transformer delivering 100 volt-amperes. If the primary has 100 volts, with 1 ampere flow, and the secondary has 10 volts with 10 amperes flowing. To set up the inverse proportion, we have $\frac{100V}{10V} = \frac{10A}{1\ A}$.

The same is true in figuring gears and pulleys, the diameters of the pulleys set up an inverse proportion to the speed. Examples: A 2" dia. pulley running at 1750 r.p.m. would travel the same distance as a 4" dia. pulley at 875 r.p.m. The inverse proportion would be: $\frac{2''}{4''} = \frac{875}{1750}$ See rule for inverse proportion, page 255 of text.

Be sure to drill on the fundamental ideas of ratio, direct and inverse proportion during this assignment. Use the text for examples.

APPLICATION:

Have the students to work the problems on the assignment sheet. Give assistance when needed.

CHECKING AND FOLLOW-UP:

Check the answers to questions on assignment sheet. Call attention to errors.

Lesson A-9

INTRODUCTION TO ELECTRICITY

DESIRED RESULTS:

1. To introduce basic electricity by explaining the behavior of electrons.

2. To show supplementary evidence of the electron theory by use of a film.

MATERIALS & REFERENCES:

1. American Electricians' Handbook, pages 1-20 & 21, Sec. 25-29
2. Basic Electricity, Vol. 1, pages 1-20
3. Basic Mathematics, pages 1-3
4. Film--"Basic Electrical Theory" - Local Film Library, U. S. Air Force or Modern Films, Inc.
5. Film--"What is Electricity?" - Encyclopoedia Britannica Films, Inc.
6. *Swoope's Lessons in Practical Electricity, pages 1-14

INTRODUCTION:

Some of the mystery which has veiled the subject of electricity in the past has been removed. For many years, the natural laws and observed behavior of electricity were the only available sources of information for a study of this subject. The electron theory of matter, which has been certified by these natural laws, has led to a better understanding of the nature of electricity. The knowledge gained from this lesson will be the foundation upon which many later lessons will be developed.

PRESENTING THE LESSON:

It should be stressed that no one has ever seen an atom or an electron. There has been a large amount of research time devoted to the subject, and most of the evidence accumulated from this research supports the electron theory. The behavior of electrons and most atoms generally follows a definite pattern. For this reason, it is possible to predict mathematically the results of many experiments before they are performed. These predictable results have been sufficiently stable to make it feasible to label the study of electrons a science.

There are still many unpredictable results of experiments and research problems. After the discovery of the electron in 1897, scientists finally became convinced that all matter was composed of a positive mass having a definite number of electrons in orbit around this mass. The number of electrons determined the type of matter. This idea provided a very neat package. There was only one thing wrong with the theory - it was not exactly true.

There is now supporting evidence to indicate that some atomic structures are composed of more than twenty components in addition to the originally known parts. Scientists believe there are still others not yet discovered.

Some restraint should be used in defining the electron and electricity. It appears that there is a close association between these two factors, but keep in mind that there still is not an accepted definition for electricity.

In using the sun and the orbiting planets as an analogy for the description of an atom, be very careful not to leave any erroneous impression. The planets orbit about the sun very nearly in the same place. The electrons may or may not follow this pattern. Some electrons are transients. Even though it may be possible, so far as we know there is no transient planet in our solar system.

It is suggested that the local film library be contacted for suitable film to supplement this lesson. If a film is available, it should be reviewed carefully before showing. Unless it closely parallels the lesson, it could cause some confusion rather than supplementing the lesson.

APPLICATION:

DISTRIBUTE the assignment sheets for this lesson and allow time for the students to answer the questions.

CHECKING AND FOLLOW-UP:

Correct the answers to questions and return to the students. They should find the correct answers to questions that were incorrect.

Lesson A-10

CURRENT

DESIRED RESULTS:

To inform the student of the nature of OHM'S Law, and to show how this formula is used to determine the current of a circuit. To understand that when electrons are put into motion, we have current flow.

MATERIALS, EQUIPMENT AND REFERENCES:

1. American Electricians' Handbook, pages 1-21, Sec. 31 and 37
2. Basic Electricity, Vol. 1, pages 40-50
3. Basic Mathematics, pages 4-7
4. Chalkboard
5. Film--"Current Flow, What It Is"; from United World Films, Inc.

INTRODUCTION:

The next three lessons will involve the three components of a circuit that make up Ohm's Law, namely, current, voltage and resistance. Each component is studied individually and each lesson will point out the main points for the apprentice to learn and understand.

PRESENTING THE LESSON:

We have learned that all matter is composed of various particles, one of which is an electron. Now in this lesson when we put electrons in motion there is current flow.

The main point of this lesson is to understand that current flow is the movement of electrons along the conductor. Current flow in a circuit changes as a result of resistance and voltage changes. The length, cross section, and different materials of a conductor will cause the current in a circuit to vary. Experiments show that when the voltage is decreased, the current flow is increased. The unit of measurement, symbol, and nomenclature used in conjunction with current are also pointed out.
GIVE AN EXPLANATION AND SHOW THE FILM, IF AVAILABLE.

APPLICATION:

Have the students answer the questions on the assignment sheet. Give assistance where needed.

CHECKING AND FOLLOW-UP:

Check the papers and have the students correct the errors before placing them in the notebooks.

Lesson A-11

RESISTANCE

DESIRED RESULTS:

1. To understand that RESISTANCE is an apposition offered to the flow of current in an electrical circuit.

2. To learn the unit of measurement, symbol, and names used in conjunction with the term RESISTANCE.

MATERIALS, EQUIPMENT & REFERENCES:

1. <u>American Electricians' Handbook</u>, by Croft, pages 1-22
2. <u>Basic Electricity</u>, Vol. 1, pages 98-122
3. <u>Basic Mathematics</u>, by Singer, pages 6 & 8
4. Chalkboard
5. Film--"What Controls Current Flow - Resistance" United World Films, Inc.
6. *<u>Swoope's Lessons in Practical Electricity</u>, pages 104-106; 125-126

INTRODUCTION:

Review the main points discussed about current and voltage. This lesson has one main point - resistance in an opposition offered to the flow of current in an electrical circuit.

PRESENTING THE LESSON:

Show by the use of Ohm's Law Formula the relationship of RESISTANCE to current and voltage. The unit of measurement for resistance is the OHM, and the symbol for resistance is R. Adapting the formula ($I=\frac{E}{R}$) to find resistance. EXPLAIN how to change the formula to have $R = \frac{E}{I}$. Use this formula to find the resistance in an electric circuit by substituting known values. Remember--to find the resistance in OHMS, one divides the E.M.F. in volts by the current in amperes.

Give an explanation and show the film, if available.

APPLICATION:

1. Answer questions concerning the film.
2. Have the students complete the problems on the assignment sheet.

CHECKING & FOLLOW-UP:

Check the assignment sheets and allow time for the class to correct them. Discuss the questions found to be incorrect.

Lesson A-12

ELECTROMOTIVE FORCE

(VOLTAGE)

DESIRED RESULTS:

1. To understand that voltage is the force or pressure that causes the electron to move.

2. To learn the unit of measurement, symbol, and names used in conjunction with voltage.

MATERIALS, EQUIPMENT AND REFERENCES:

1. American Electricians' Handbook, by Croft, pages 1-21
2. Basic Electricity, Vol. 1, pages 83-97
3. Basic Mathematics, pages 3 and 7
4. Chalkboard
5. Film--"What Causes Current Flow--E.M.F." United World Films, Inc.
6. *Swoope's Lessons in Practical Electricity, pages 125-126 and page 105

INTRODUCTION:

Review the difference between current and voltage and show their very close relation. Voltage is the second of the three important terms associated with Ohm's Law.

PRESENTING THE LESSON:

Voltage or electromotive force of an electric circuit is the pressure which causes the current to flow. It is measured in volts and represented in the formula by the letter "E". Show from the references the individuality of the voltage but at the same time its close relationship with the current.

The class should use time for additional study in the reference material. GIVE EXPLANATION AND SHOW THE FILM IF AVAILABLE.

APPLICATION:

Have the students to answer the questions on the assignment sheet.

CHECKING AND FOLLOW-UP:

Check the papers and have the students correct any incorrect answers. Discuss the questions that need explanation.

YOUR EMPLOYER

DESIRED RESULTS:

1. To aid the apprentice in becoming a better employee.
2. To give the apprentice an insight into the general organization, plan and function of an average contracting firm.
3. To show the importance of the Local apprentice agreement.

MATERIALS AND REFERENCES:

1. Information Sheets
2. The Local Contract (Agreement)

INTRODUCTION:

Many employees have no knowledge of the problems which must be solved by employers. In many cases, misunderstandings will be prevented and better employer-employee relations will result when an employee understands some of the problems. Where action of an employee can assist the contractor in operating his business profitably, it enables the contractor to make money and be able to stay in business and provide work for his employees.

PRESENTING THE LESSON:

The following suggestions can be incorporated into the sections under which they are listed:

Tools and Transportation: The journeyman should use the tools and transportation equipment carefully and efficiently to avoid damages and delays on the job.

Organization: The number of people in these departments will depend upon the amount of business being done by the contractor. The smaller contractor may have one person besides himself to do the work, while the larger contractor may employ one or more persons in each department.

Estimating: The major unknown factor in any estimate is labor productivity. The journeyman must work as efficiently as possible so that the labor costs remain within the estimate.

Accounting: To keep his business functioning, it is necessary for the contractor to know the costs of his operations. The journeyman can be of assistance in this respect by turning in accurate time sheets and material lists. Then the contractor will know the actual cost of the job, and in the future he will be better able to compete on similar jobs.

APPLICATION:

The class should study the information sheet entitled "Your Employer". Using the assignment sheet, the students will answer the questions.

Lesson A-13

OHM'S LAW

(Simple Circuits)

DESIRED RESULTS:

1. To understand the relationships of voltage, current, and resistance in an electric circuit.
2. To show how the formula may be used to determine the voltage, current, and the resistance of a circuit.

MATERIALS AND REFERENCES:

1. <u>American Electricians' Handbook</u>, by Croft, Div. 1-37 and 1-39
2. <u>Basic Electricity</u>, Vol. 1, page 123; Vol. 2, pages 24-41
3. <u>Basic Mathematics</u>, by Singer, pages 20-24

INTRODUCTION:

George S. Ohm, a German Physicist, discovered that the amount of current that passes through a conductor depends upon the amount of pressure (voltage) and the resistance (Ohms). Ohm's Law is expressed by the three forms of equations:

$$E = 1 \times R \qquad 1 = \frac{E}{R} \qquad R = \frac{E}{1}$$

Emphasize the fact that students who have trouble studying electrical subjects have failed to learn and apply Ohm's Law.

PRESENTING THE LESSON:

The relationship of Amperes, Ohms and Volts can be expressed by the formula $1 = \frac{E}{R}$

(1) "1" stands for the Intensity of the current flow in Amperes.
(2) "E" stands for the Electromotive Force in Volts.
(3) "R" stands for the Resistance in Ohms.

Show how Ohm's Law is so helpful in using what one learns about electricity, that the student should know how to use the formula in all its forms.

Adapt the formula to practical problems involving a house wiring circuit.

APPLICATION:

Have the students complete the assignment sheet.

CHECKING AND FOLLOW-UP:

Check assignment sheets and return to learner for correction and placing in workbook. Assign more practice problems from text.

Lesson A-14

SERIES CIRCUITS

DESIRED RESULTS:

To teach the student the relationship of voltage, current and resistance in a series circuit.

MATERIALS, EQUIPMENT AND SUPPLIES:

1. Chalkboard
2. Dry cells (1.5 volts), "B" Batteries, Auto Storage Battery
3. Voltmeter, Ammeter, Ohmmeter
4. Wire for connections

REFERENCES:

1. American Electricians Handbook, Div. 3, pages 277ff.
2. Basic Electricity, Vol. 2, pages 7-23
3. Basic Mathematics, pages 67-82 and 88-93
4. Film--"Series Circuits"--Color, No. 48506, Encyclopedia Britannica
5. *Swoope's Lessons in Practical Electricity, pages 145-148

INTRODUCTION:

Be sure that the students understand that:

1. The current is the same in any part of the circuit.
2. The total resistance is the sum of resistances in the various parts.
3. The total circuit voltage is the sum of the voltages in the various parts.

PRESENTING THE LESSON:

1. Show how cells may be connecte[illegible] , provide a high Voltage than is produced by one cell.
    - a. Dry cells supply current at a pressure of 1.5 volts. No matter what their size or shape. A single dry cell is therefore unsuitable when voltages greater than 1.5 volts are needed.
    - b. Certain devices require higher voltages for their operation and will work at its maximum when operated at its rated voltage.
    - c. Connect the cells in series.
        - (1) The voltage resulting will be the sum of the voltage of individual cells.
            - (a) Water pumps connected in series are like cells connected the same way. Each cell gives the current a "kick" and thus increases the flow of current in the circuit (Rate of Flow).

(b) Flashlights, "B" Batteries, auto storage battery are examples of series connections.

2. The Current in a series circuit is the same in all parts of the circuit.

   a. Show this by using the Ohm's Law Formula $I = \frac{E}{R}$

   b. Draw a series circuit to show a resistance of 10 Ohms, a 6 volt battery and an ammeter. Formula: $I = \frac{6}{10}$ or .6 ampere.

   c. If the ammeter is placed at any point in the circuit, it will read the same.

3. The total Resistance of a series circuit is equal to the sum of the various resistances in the circuit. Expressed as R (totals) = $R_1 + R_2 + R_3$ etc.

   a. Point out that adding resistance to a series circuit reduces the current flow.
   b. That the current flow would read the same on an ammeter placed at any point in the series circuit.
   c. To find the current flow in a series circuit, it is necessary to know two things:
      (1) The circuit Voltage
      (2) The total circuit Resistance

4. Summary of the Rules: See items 1, 2, and 3.

5. Show Film--"Series Circuits"

APPLICATION:

Have the students work and hand in the assignment sheet.

CHECKING AND FOLLOW-UP:

Check the assignment sheets against answer sheets and return to learner for placing in workbook. Where needed assign additional problems from <u>Basic Mathematics</u> by Singer, Chap. IV.

Lesson A-15

PARALLEL CIRCUITS

DESIRED RESULTS:

1. To acquaint the student with the relationship of current, voltage and resistance in a Parallel circuit.
2. To understand that the total resistance of a parallel circuit is less than the smallest resistor.

REFERENCES:

1. American Electricians' Handbook, pages 3-2 thru 3-4
2. Basic Electricity, Vol. 2, pages 55ff.
3. Basic Mathematics, pages 111-125
4. *Swoope's Lessons in Practical Electricity, pages 148-157

MATERIALS, EQUIPMENT AND SUPPLIES:

1. Chalkboard
2. Dry cells (1.5 volts) wire, resistors and lamp banks
3. Film--"Parallel Circuits" Modern Films, Charlotte, N. C.

INTRODUCTION:

The parallel circuit is another method of connecting electrical devices in a circuit. There are several ways of calculating the total resistance of a parallel circuit. To help the students to visualize the problems, it is well to require them to draw a circuit diagram for each problem. Many problems in this assignment are not long or complicated but will give the student good practice in OHM'S law calculations. Present examples of these problems on the chalkboard, and give demonstrations using various resistors or lamp banks for loads. Measure the voltage and currents at various locations throughout the circuits.

PRESENTING THE LESSON:

Show several ways of calculating the total resistance of a parallel circuit with examples on the chalkboard. Explain that the understanding of more than one method of solving the problems will help them later with control and electronic work.

Show that two or more resistors of the same size or various sizes may be connected in parallel, the total resistance of a parallel circuit is ALWAYS less than the value of the smallest resistor.

Explain that in studying the theory of electricity, we often use a resistor in the circuit to represent the load. It is easier to draw the symbol for a resistor than a picture of an appliance.

Many demonstrations may be presented in conjunction with this lesson by using resistors of different values connected in various ways. In each circuit measure the total resistance with an OHMMETER and also calculate the resistance using the formula. Show the film, "Parallel Circuits", which is a good teaching aid. It will show animated current flow in PARALLEL circuits.

SUMMARY OF RULES FOR PARALLEL CIRCUITS:

1. The total current is the sum of the currents in various parts.
2. The voltage of a parallel circuit is the same in any part of the circuit.
3. The resistance is the reciprocal of the sum of the reciprocals of the various parts.

APPLICATION:

1. Discuss questions and applications presented by the films.
2. Have the students work the problems on the assignment sheet.

CHECKING AND FOLLOW-UP:

Check the assignment sheets against answer sheets and return to learner for placing in workbook. Assign extra problems from Singer's Basic Mathematics to those that need the extra practice. Pages 98, 101, 118, 122 and 125.

Lesson A-16

COMBINATION CIRCUITS

(SERIES AND PARALLEL CIRCUIT CONNECTIONS)

DESIRED RESULTS:

1. To acquaint the learner with the elementary problems of series and parallel circuits.
2. That the student learn to think in terms of, and visualize the combination of series and parallel hook-ups.

MATERIALS, EQUIPMENT AND SUPPLIES:

1. Chalkboard
2. Supplies for demonstrations
3. Large wiring charts, mock-ups and models

REFERENCES:

1. American Electricians' Handbook, page 3-3ff.
2. Basic Electricity, Vol. 2, pages 90-103
3. Basic Mathematics, pages 127-137
4. Film--"Series and Parallel Circuits" United World Film, Inc.
5. *Swoope's Lessons in Practical Electricity, page 151, sec. 83; page 158, sec. 85 and 86.

INTRODUCTION:

Stress the understanding of the relationship of resistance, voltage and current as in other OHM'S Law lessons.

The student should be well acquainted with the various methods of interconnecting circuits when greater amounts of voltage and current are needed. Most workmen deal with circuits in terms of parallel connections and become confused when they get into a combination of series and parallel hook-ups. Electrical energy, if wrongfully directed in a circuit, will oppose the direction of the desired current flow with harmful results.

PRESENTING THE LESSON:

The use of demonstrations, models, mock-ups, and large wiring charts will help greatly in presenting this lesson.

You may draw similar circuits on the chalkboard and ask the class to tell how the current and voltage would be distributed. It is recommended that some demonstrations be used with this lesson, if possible. The demonstrations can be applied to the material at hand by setting up a SERIES - PARALLEL CIRCUIT and making various readings throughout the circuit. Then calculate the voltage, current or resistance of the circuit. This type of illustration will make a lasting impression on the student.

Remember to always work the SERIES and PARALLEL groups separately within the combined circuit and then solve for the whole combination.

Note: If you wish to use more practice problems for SERIES-PARALLEL combination, see Basic Mathematics by Singer, pages 136-138.
Show film--"Series and Parallel Circuits"

APPLICATION:

Have the students to answer questions and work the problems on the assignment sheet. Give individual suggestions where needed, but do not answer the question for the student.

CHECKING AND FOLLOW-UP:

Check the assignment sheets against the answer sheets and return to the students. Assign extra problems if required.

Lesson A-17

POWER AND WORK

DESIRED RESULTS:

1. To acquaint the student with some of the terms of electrical energy that apply to work and power.
2. To inform the learner that work is done when force accomplishes something (weight x distance). Power is the work done times the speed of doing it.
3. To solve problems involving the power formula.

MATERIALS, EQUIPMENT AND SUPPLIES:

1. Chalkboard
2. Lampbank and meters

REFERENCES:

1. American Electricians' Handbook, Div. 1, page 25 sec. 56-64; p. 40, sec. 110-111
2. Basic Electricity, Vol. 2, pages 42-54
3. Basic Mathematics, pages 148-155
4. *Swoope's Lessons in Practical Electricity, pages 168-177, 180-183

INTRODUCTION:

This lesson will introduce the students to the use of terms such as, horsepower, watts, etc. Ask the students to check the labels on electrical equipment they see on the job for horsepower, watts, KW, voltage and current rating. An electrician may be called upon to install a unit of equipment rated in horsepower, or watts or voltage only. The electrician must decide how much current the piece of equipment will demand. Knowing the current needed, he must install the proper size wire and protect the circuit and equipment with the proper fuse. The power equations studied in this lesson will be used many times to find information not given on the name plate of a piece of electrical equipment.

PRESENTING THE LESSON:

For a practical demonstration of this lesson, use a lampbank with lamps of various sizes. The ammeter and voltmeter will show a good relationship between the wattage of rating of the lamps, the applied voltage, and the current drawn by the circuit.

A thorough understanding and the ability to use the power equations should be stressed. Point out to the students the close relationship between the following Power Equation and the Ohm's Law equation.

$$P = IE \qquad E = \frac{P}{I} \qquad I = \frac{P}{E}$$

If more practice problems are necessary than given on the assignment sheet, see Basic Mathematics, by Singer, pages 150-152.

APPLICATION:

Have the students answer the questions and work the problems on the assignment sheet. Give assistance if needed, but do not give them the answer.

CHECKING AND FOLLOW-UP:

Check the assignment sheets against the answer sheet and return to the students for correction and filing in their notebooks.

Lesson A-18

WIRE CONSTRUCTION

(PATHS FOR THE ELECTRIC CURRENT)

DESIRED RESULTS:

1. To acquaint the learner with the fact that all electrical devices receive their energy from a source by means of metallic conductors.

2. These conductors are separated or supported by non-metallic materials called insulators.

MATERIALS, EQUIPMENT, AND SUPPLIES:

1. Chalkboard and chalk
2. Samples of wire and insulators to be studied
3. Experimental materials to demonstrate "Conductors and Insulation"

REFERENCES:

1. American Electricians' Handbook, pages 2-2 thru 2-13, 2-36 thru 2-38
2. Information Sheet--"Wire and Materials"
3. National Electric Code--Article 310
4. Text: *Swoope's Lessons in Practical Electricity

INTRODUCING THE LESSON:

Call attention to the fact that wires are very much like pipes in that they permit the flow of electricity, but whereas pipes are hollow, wires are a solid. It is important to know the characteristics of these "electrical pipes", called conductors, and how they are made safe within the home and in appliances.

PRESENTING THE LESSON:

A. Electrical devices are connected to a source by wires to provide a path for the electric circuit.

   1. Make a sketch:

      a. Two wires are needed to complete a circuit.

      b. Electric current must flow from the source to the device and return to the source.

B. Electrical devices are made of different materials.

   1. Show:

      a. Difference of materials in an insulated wire.

      b. Different materials in a plug.

      c. Define materials such as metallic and non-metallic.

C. Demonstrate: "Conductors and Insulation"

1. Samples of wire and insulating materials are studied.
2. Experiment showing materials that conduct current and insulate current.

APPLICATION:

Have learner work and hand in assignment sheet #A-18. Give individual help where needed.

CHECKING AND FOLLOW-UP:

Check assignment sheets against answer sheet and return to learner for placing in workbook.

Lesson A-19

WIRE SIZES

DESIRED RESULTS:

1. To acquaint the student with a number of different types of wire, according to the insulation.

2. To teach the student to identify types of wire and sizes in general use on the job.

MATERIALS, EQUIPMENT & SUPPLIES:

1. Chalkboard & Chalk

2. Sample wire up to No. 4

3. Wire Gages & a Micrometer

REFERENCES:

1. National Electrical Code, Article 310, Chapter 9

2. American Electricians' Handbook, pages 1-33, Sec. 92-94, Div. 2-4 & 2-5, 2-40 thru 2-45

INTRODUCTION:

1. The lesson should acquaint the student with the fact that there are different types of wire classed according to the insulation.

2. Call attention to the fact that the size of wire is usually expressed according to some wire gage. However, it has become standard practice in the United States to employ the American Wire Gage, also known as the Brown & Sharpe for designating copper and aluminum wire and cable used in the electrical industry.

PRESENTING THE LESSON:

1. Show the class samples of as many types of wire according to the insulation as possible. Have each student examine the types of wire so he can classify wire according to insulation. Discuss the different types of insulation with the class.

2. Demonstrate to the class how to use the gage in measuring the size of wires. Wire gages are used for the measurement of diameters of wire and thicknesses of sheet metal. Wire sizes are referred to by gage numbers, the smaller the number the larger the wire. Micrometers are gages for that purpose. Where micrometers are used, the wire diameters are expressed in thousandths of an inch.

3. The students should use the gages and micrometers to help identify wire sizes. They are expected to know sizes up to No. 4 on the job.

   Note: A circular, mil (C.M.) is the area of a circle 1/1000 in. in diameter and is the unit for all wire measurement.

APPLICATION:

Have the students complete the answers to questions on the Assignment Sheet for this lesson.

CHECKING AND FOLLOW-UP:

Check the assignment sheets against answer sheet and return to students for discussion and placing in notebooks.

Lesson A-20

VOLTAGE DROP

DESIRED RESULTS:

1. To understand what is meant by Voltage Drop.
2. To be able to use the formula to determine excessive voltage drops.

MATERIALS AND EQUIPMENT:

1. Chalkboard
2. Voltmeter, Lamp Bank

REFERENCES:

1. American Electricians' Handbook, pages 300-328
2. Basic Electricity, Vol. 1, pages 90-97
3. Basic Mathematics, pages 280-284
4. National Electrical Code, page 43, section 215-3
5. *Swoope's Lessons in Practical Electricity, pages 134-339

INTRODUCTION:

The two factors that must be considered in determining the size of wire to be used in an electrical circuit are the current-carrying capacity of the wire and the permissible voltage drop.

The electrician always determines current-carrying capacity by consulting tables in the various electrical codes. On the other hand, voltage drop is nearly always calculated by the electrician himself. The National Electrical Code recommends that voltage drop from service head to distribution center be not more than 1 per cent for lighting and 3 per cent for power loads. These voltage drops should be limited to 2 per cent. Voltage drop must be allowed when circuits are installed on commercial and industrial buildings, but is seldom considered for circuits on residential buildings.

PRESENTING THE LESSON:

In this lesson, the student will not learn all there is to be known about voltage drop. Teach them some of the basic facts so they can learn to figure Voltage Drop. Also, how voltage drop is used in calculating the sizes of wires required for certain circuits. Spend enough time on this lesson to be sure that the students understand how to use the formula for finding Voltage Drop.

Introduce the following formula by writing it on the chalkboard and explaining its use.

$$VD = \frac{K \times I \times 2L}{CM}$$

VD = Voltage Drop
K = Resistance (1 mil foot of wire)
I = Amperes
L = Distance of wire one way
CM = Circular mils

Work several problems illustrating how to solve for various unknowns.
NOTE 1: If the students have trouble rearranging the formula. It is much easier for some to substitute in the original form and solve for the unknown.

NOTE 2: By use of the formula, we find Voltage Drop, but the National Code recommendations give <u>PERCENTAGE</u> voltage drop.

APPLICATION:

The students will answer questions and work problems on Assignment Sheet A-20.

CHECKING AND FOLLOW-UP:

Correct the assignment sheet. Be sure to give assistance to those that had trouble.

INTRODUCTION TO NATIONAL ELECTRIC CODE

DESIRED RESULTS:

1. To acquaint the apprentice with the purpose and scope of the CODE.
2. To introduce the apprentice to the definitions and fundamental rules covered by the CODE.

REFERENCES:

1. National Electrical Code, Articles 90, 100, 110
2. American Electricians' Handbook, General Interior Wiring, p. 1208

INTRODUCTION:

This is the apprentice's first contact with the NATIONAL ELECTRIC CODE. He will be working by these rules for his entire life in the electrical industry. The importance of learning the purposes and organization of the CODE cannot be over emphasized.

This lesson should give the student a clear picture of how the CODE is organized so that the apprentice may find information more easily in later assignments and on the job. The CODE is not a set of laws; it is a set of rules. It is intended for use by governmental bodies exercising legal jurisdiction over electrical installations and for use by Insurance Inspectors.

Article 100 - Contains definitions of Electrical Terms.

PRESENTING THE LESSON:

In the National Electrical Code Book - Article 90, which is the Introduction, outlines the purpose and explains the scope of the CODE.

The best results will be obtained from all CODE lessons if they are used as study guides for the student. The instructor should lead a class discussion of the material contained in each section of the CODE used in the assignment.

After discussing the sections and giving illustrations from your experience, then the assignment sheet with specific questions can be distributed.

Remind the students that the Chief Electrical Inspectors usually exercise legal jurisdiction over electrical installations through city ordinances or laws based on National Electrical Code. Some communities use the CODE as it is for their local Electrical Ordinance. Most citizens realize that the CODE is only the minimum standard so they improve on certain portions for their use. If the electrician knows the National Electrical Code, he may be able to work in any locality, but he should become familiar with local ordinances.

APPLICATION:

Hand out the assignment sheets and have the students answer the specific questions using the CODE book.

CHECKING AND FOLLOW-UP:

Check the answers and return the sheets to the students for correction and placing in the workbook.

GENERAL REQUIREMENTS FOR WIRING INSTALLATIONS

DESIRED RESULTS:

To acquaint the apprentice with the general requirements for wiring methods and installations.

REFERENCES:

1. American Electricians' Handbook, Div. 9-140 thru 171
2. National Electrical Code, Article 300, 310

NOTE: This assignment may take two lesson periods to complete.

INTRODUCTION:

In the U.S.A., cable wiring is probably the most recognized wiring method, especially for residential type construction. Local ordinances in some cities may limit the extent of its use, but cable wiring in some form is recognized in almost every place where electrical power is available. The General Requirements for wiring methods are listed in the National Electrical Code, Article 30.

This assignment contains information about over-current protective devices and fuses, sizes of conductors, types of conduit, installing boxes, grounds and grounding, and various raceways. This information will be very useful to the apprentice in his daily work on the job.

The student may not realize the fact but it requires a skilled craftsman to make a concealed electrical installation in an old building. It is essential that he leave the building in good repair when he is finished.

PRESENTING THE LESSON:

The instructor should lead a class discussion of the material found in the assignment. The students should have read the assignment and have questions for discussion ready to present.

Use American Electricians' Handbook, Division 9 and National Electrical Code, Article 300 and 310 as study guides for this assignment.

There are 22 types of wiring for general use for power and light systems.

1. Call attention to the method of determining the minimum and maximum size of conduit for interior installations. The current capacity of a conductor is limited by the temperature its insulation will withstand.

2. The National Electrical Code requires that fuses or circuit breakers be provided for all ungrounded conductors to open the circuit when the current is abnormally high.

3. Conduit systems contain both junction and outlet boxes. A junction box is placed where several conduit runs intersect. It provides means for pulling in the wire and serves as an inclosure for the connections that must be made. It is possible to ground the entire system with one ground connection. Outlet boxes may be used to inclose a switch which controls the current in a circuit or fitted with outlets and special cover through which light and power loads can be connected.

4. Grounding is executed by connecting one wire from a wiring system or the metallic covering of electrical devices to a steel beam of a building, to a ground strap fastened to a water pipe or a pipe driven in the ground. Grounding is necessary to protect life and property.

APPLICATION:

Have the students find the answers to the questions on the assignment sheets. This may take two meetings.

CHECKING AND FOLLOW-UP:

Check the answers and return the sheets to the students for correction and placing in their workbooks.

RIGID METAL CONDUIT

DESIRED RESULTS:

To acquaint the apprentice with some of the techniques connected with conduit installations that must be learned through experience.

REFERENCES:

1. American Electricians' Handbook, Div. 9, par. 57 ff.
2. Local Electrical Codes and Ordinances
3. National Electrical Code, Article 346

INTRODUCTION:

Single family dwellings are seldom wired completely with rigid metal conduit because of the high cost of such an installation. However, it is widely used in industrial plants. Electrical metallic tubing is sometimes employed because the cost of labor for installation is much less than for rigid conduit. The cost is still somewhat higher than that for a knob-and-tube or a cable-type installation.

It is common practice to install a rigid-conduit or an electrical-metallic-tubing service raceway even though the bulk of the installation is carried out by some other method of wiring.

HYDRAULIC CONDUIT BENDERS

Industrial installations of Rigid Metal Conduit have routinely presented electricians with jobs of great proportions; however, with the hydraulic equipment in use today, this work is easily accomplished. Various attributes of fluid or hydraulic power equipment recommend it to the electrical industry. Hydraulic tools readily increase 100 pounds of applied effort to 200,000 pounds of output. The tools are versatile, light in weight, compact in size and completely mobile, so that one man can carry a hydraulic set capable of moving 50 tons.

In recent years, electrical installations have become larger and more complicated with the result that the electrician is called on to make many large bends in conduit. Hydraulic equipment is used to bend conduit having a diameter larger than 1". Conduit of smaller dimensions is usually bent by a hand bender. The two principal types of benders for large conduit are: 1. A "One-shot" bender which makes a full 90° bend with a single stroke and setting; and 2. A segment bender, which requires several smaller, single-stroke stages to complete a 90° bend.

PRESENTING THE LESSON:

Try to have a small Hydraulic Conduit Bender to demonstrate to the class. The student should know how the machine operates as well as its use.

Using the Information Sheet on Rigid Metal Conduit Bending as a guide, the following topics should be discussed:

1. Radius of Bend
2. Principles of Precision Bending
3. Concentric Bending
4. General Purpose Bending
5. Bending the Angle

Review important topics on Rigid Metal Conduit Wiring referred to in American Electricians' Handbook.

APPLICATION:

Have the students complete the answers to the questions on the assignment sheets.

CHECKING AND FOLLOW-UP:

Check the answers and return the sheets to the students for correction and placing in their workbooks.

ELECTRICAL METALLIC TUBING

DESIRED RESULTS:

To acquaint the apprentice with the construction and restrictions in the uses of electrical metallic tubing.

REFERENCES:

1. American Electricians' Handbook, Div. 9, 68-70
2. National Electrical Code, Article 348

INTRODUCTION:

Electrical metallic tubing (EMT) sometimes called "thin-wall conduit" has a wall thickness less than that of rigid conduit, and it bends more easily. It is connected with compression or indentation type fittings, since it is too thin to thread. A special tool is used to install indentation fittings.

PRESENTING THE LESSON:

Electrical metallic tubing is installed and has the same use for both exposed and concealed work as rigid conduit except it cannot be used where subject to sever physical damage. When used in wet locations or poured over in concrete, fittings of the type to prevent water entering the conduit shall be used.

Tubing and fittings may be obtained, made of an alloy having corrosion-resisting characteristics. This makes them especially suitable for use in many locations where there are corrosive fumes, or excessive moisture.

No tubing shall be used smaller than $\frac{1}{2}$ inch in diameter, electrical trade size, except for under plaster extensions. The maximum size tubing shall be the 2-inch electrical trade size.

Bends in the tubing shall be made that the tubing will not be injured and that the internal diameter of the tubing will not be effectively reduced. One run of conduit should preferably include not more than three "quarter" bends.

APPLICATION:

Have the students complete the answers to the questions on the assignment sheets for this lesson.

CHECKING AND FOLLOW-UP:

Check the answers and return the sheets to the students for correction and placing in their workbooks.

FLEXIBLE METAL CONDUIT

DESIRED RESULTS:

To acquaint the apprentice with the construction and restrictions in the uses of flexible metal conduit.

REFERENCES:

1. American Electricians' Handbook, Div. 9, 50-55
2. National Electrical Code, Articles 350 and 351

INTRODUCTION:

Flexible metal conduit is used in difficult places requiring a number of irregular bends or where flexibility is required. Such as connecting a motor to rigid conduit, not exceeding 24 inches in length.

Flexible metal conduit is used and installed according to the rules and practices for installation and use of armored cable. It is installed and conductors are pulled into it in the same way conductors are installed in rigid conduit. The size of flexible conduit is determined by the inside diameter.

PRESENTING THE LESSON:

Installations of flexible metal conduit shall comply with the provisions of the code listed in prargraph 3501 of the code.

Flexible metal conduit shall not be used in:

1. wet locations, unless lead-covered type
2. hoistways, except as provided in section 62-6
3. storage-battery rooms
4. any hazardous location except permitted in Sections 5054 and 5073
5. where rubber-covered conductors are exposed to oil, gasoline, etc.

MINIMUM SIZE - No flexible metal conduit less than one-half inch electrical trade size shall be used except as permitted in section 3503.

Straps or other means of securing the conduit in place should be spaced much closer together for flexible conduit than is necessary for rigid conduit. Every bend should rigidly secured so that it will not be deformed when the wires are being pulled in, thus causing the wires to bind.

LIQUID-TIGHT FLEXIBLE METAL CONDUIT

This conduit is similar in construction to the flexible metal conduit but is covered with an outer sheath of material to make a liquid tight jacket.

Connectors and grounding bushings are available for terminating the conduit and providing effective grounding connections. It is used in the wiring of machine tools, motors or portable equipment where flexibility of connection is required.

In paragraph 3512-b lists the conditions under which Liquid-Tight Flexible Metal conduit shall not be used.

1. Where it is subject to mechanical injury
2. Where it is in contact with rapidly moving parts
3. Where the temperature is above (60°C) or 140°F
4. In any hazardous location.

The maximum sizes of the conduit and conductors to be installed are listed in article 351, paragraphs 3514 and 3515.

APPLICATION:

Have the students complete the Assignment Sheet for this lesson.

CHECKING AND FOLLOW-UP:

Check the answers to the questions and return the sheets to the students for correction and placing in their workbooks.

Lesson A-26

STORAGE BATTERIES

DESIRED RESULTS:

1. To acquaint the student with the construction and operation of storage cells.
2. To acquaint the student with the chemical properties of different types of cells.
3. To teach the student to understand electrolysis, and other instances of electrochemical action.

MATERIALS, EQUIPMENT AND SUPPLIES:

1. Chalkboard
2. Supplies to make a storage cell

REFERENCES:

1. American Electricians' Handbook, Div. 4, Sections 130-178
2. Basic Electricity, Vol. 1, pages 23-29
3. National Electrical Code, Article 480
4. *Swoope's Lessons in Practical Electricity, pages 67-102

INTRODUCING THE LESSON:

The study of batteries could be a course in itself but in this lesson the student should become acquainted with the chemical properties of several types of cells. One of the major problems involved in electrical systems, depending on storage cells for part-time operation, is the proper battery care and maintenance. The facts explained in this lesson should be thoroughly understood by people who maintain this type of equipment.

PRESENTING THE LESSON:

Point out:

a. That cells, such as dry cells, that cannot be charged, are called "primary cells" to distinguish them from those that can be recharged, known as "secondary cells" or the storage battery.

b. A storage cell does not store electrical energy; it stores chemical energy and then changes the chemical energy into electrical energy as needed.

c. When the chemical energy has all been changed to electrical energy, it can be restored only by sending a current through the cell.

d. There are two main types of storage cells in use. The "lead acid" used on all motor-driven vehicles and the "Edison Cell" which is extremely rugged but has low cell voltage. The Edison Cells are not as efficient as "lead acid" cells, as they return only 60 to 65 per cent of the charging energy.

APPLICATION:

Have the students work and hand in ASSIGNMENT SHEET. Give individual help where needed.

CHECKING AND FOLLOW-UP:

Check assignment sheets against answer sheets and return to the students for correction and placing in workbook.

FUSES

DESIRED RESULTS:

1. To learn that in electrical work every circuit must be provided with over-current protection.

2. To understand the National Electrical Code standard fuse ratings and the sizes required for protection of certain devices.

MATERIALS AND EQUIPMENT:

1. Sample fuses of different types: plug, cartridge, knife-blade contact renewable fuse, etc.

2. Edison type fuse; time-lag fuse (if available).

REFERENCES:

1. Basic Electricity, Vol. II, Pages 47-48.

2. National Electrical Code, Article 240.

3. American Electricians' Handbook, Div. 4, Sec. 28-62.

4. Fuseology - Bussman Manuf. Co.

INTRODUCTION:

In electrical work every circuit must be provided with over-current protection. It may be a 132,000 volt transmission line carrying 200 amperes or it may be 110 volt lighting circuit with a load of 10 amperes. Each must have some form of protective device for the possible overload of current for the protection of both circuits and apparatus.

In this lesson we are primarily concerned with the simpler circuits requiring the common types of over-current protective devices, such as, the plug fuses and the cartridge fuses. As we advance in out study, the more complicated protective devices will be investigated.

PRESENTING THE LESSON:

The need for the use of protective devices as fuses has been discussed. You have learned that excessive current may seriously damage electrical equipment - motors, instruments, radio receivers, etc. Fuses are cheap, other equipment much more expensive. When the fuse which is connected in series with the equipment is blown, the circuit will open before the excessive current does damage to the equipment.

Demonstrate sample fuses to the class: glass cartridge fuses, solid cartridge fuses and screw-plug fuses.

It is important that you always use fuses with the proper current rating. The rating should be slightly higher than the greatest current you expect in the circuit. Example: Since the range of a ammeter is 0 to 1 ampere, a 1.5 amp fuse should be used to protect the equipment. In protecting equipment to use fuses with too low current rating will result in unnecessary blow-outs, while one with too high current rating may allow dangerously high currents to pass.

(Precautions): Fuses are used for protection. Do not jumper out a fuse. Do not increase the size of a fuse unless and until you are sure it is the right thing to do.

NOTE: The Bussman Fuse Company will be glad to put on a demonstration for this lesson. Contact their representative and arrange for him to be present. In the event that a representative of the above company is not available, try to contact a representative of another company or a specialist in this field.

APPLICATION:

Give the class time to answer the questions concerning "overcurrent protection" on the Assignment Sheet.

CHECKING AND FOLLOW-UP:

Correct the assignment sheets, discuss the results and have the student place them in their workbooks.

Lesson A-28

SAFETY AND FIRST-AID

DESIRED RESULTS:

1. To impress on the apprentice the need for him to practice SAFETY.
2. To keep the apprentice aware of the hazards of his job and to do all we can to improve SAFETY in the electrical construction work.
3. To present a film on FIRST-AID or have a specialist in FIRST-AID make a presentation with demonstrations.

MATERIALS & EQUIPMENT:

1. Safety posters and Slogans
2. 16 mm Film Projector
3. Safety and First-Aid Films

REFERENCES:

1. Information Sheet
2. Safety Manuals
3. First-Aid Manuals

INTRODUCTION:

Emphasize to the students that two of the major hazards of a construction job are falling objects and falls of workmen. The practice of good housekeeping will help to eliminate many hazards that result in accidents.

There seems to be a tendency to skip Safety as a subject that is not very important. However, if you can prevent a broken bone for yourself or a fellow workman through good housekeeping practices, it would be a very important accomplishment.

Great strides have been made in Safety and Safety Education in the construction field in recent years. There is still a great deal of room for improvement. In the Electrical Construction work, we must constantly keep ourselves aware of the hazards of our job. Each worker must continue to improve Safety in his job daily. First of all for his own benefit, as well as for the sake of his family, his fellow workmen, and his employer.

In this course, it has been left to the instructor to find out and inform the apprentice as to the particular areas of the Workman's Compensation Laws: 1. In relation to his being hurt on the job and suffering lost time injury. 2. How much money can be collected per week. 3. When the payments start and for how long? It will be necessary for the apprentice to have this information to answer some of the questions on the assignment sheet for this lesson.

Point out that many construction electricians have not only been crippled but also have died because of unsafe practices on ladders. Point out any local accidents caused by unsafe use of ladders. Experience has proven that the most effective way to reduce accidents is to concentrate on one phase of the accident problem at a time.

If there are specific Safety regulations in the local apprentice agreement, now is the time to discuss them in conjunction with this lesson.

PRESENTING THE LESSON:

The instructor should give illustrations to encourage the apprentice to develop clean personal and Safety habits. To instill in him a sense of responsibility and good will for his employer and all concerned will prove of great value.

In this and future lessons, Safe practices will be discussed on many topics such as: ladders, tools, scaffolds, protection of the eyes, and others. Careful consideration and study of such items may eliminate an accident to you or a fellow workman.

A few suggested things to do to make this lesson more effective:

1. Make it a general discussion of SAFETY.
2. Have a good many SAFETY posters available to illustrate a particular point.
3. Have men suggest SAFETY slogans - record and discuss some.
4. Have men discuss SAFETY practices they have observed on the job.
5. Have men discuss unsafe conditions they have observed on the job.
6. Have the class discuss accidents or near accidents that they have witnessed where ladders were involved. Using the ladders for demonstrations--
   a. Point out "unsafe conditions" in using ladders.
   b. Point out "unsafe acts" while using a ladder.

NOTE: 1. Show a safety film which will apply or have a specialist in first-aid make demonstrations.
2. Suggested maximum time to spend on this lesson--one hour.

APPLICATION:

Have the students answer the questions on the assignment sheet for this lesson.

CHECKING AND FOLLOW-UP:

Check the answers to the questions and return to the student for correction and placing in workbook.

INSTRUCTIONAL MATERIALS

References To Be Found In School Or Local Library

1. Electrical Principles & Practices by Adams, McGraw-Hill, 1963.
2. Elements of Electricity by Timbie, John Wiley & Sons.
3. Electric Circuits & Machines, by Lister, McGraw-Hill Book Co.
4. Practical Electricity, by Croft, McGraw-Hill Book Co.
5. Swoope's Lessons in Practical Electricity, 18th Edition, by Hausmann, D. Van Nostrand Company, Inc.
6. National Electrical Code Handbook, by Abbott and Smith, McGraw-Hill Book Co., Inc.
7. Basic Electric Principles, by Suffern, Third Edition, McGraw-Hill Book Co., Inc.
8. Basic Mathematics for Electronics, by Cooke, McGraw-Hill Book Company, Inc.
9. National Electrical Code, by Compson, Compson Code Company, P. O. Box 357, Lansing 2, Michigan.
10. Practical Mathematics, by Palmer and Bibb, McGraw-Hill Book Company, Inc.
11. Building Trades Blueprint Reading, Part I, by Dalzell, American Technical Society, 848 East 58th Street, Chicago 37, Illinois.

Bulletins From Industry To Be Kept In Classroom

1. "Fuseology", The Bussman Fuse Company (N/C)
2. Design Manual On Steel Electrical Raceways, American Iron & Steel Institute, 150 East 42nd Street, New York 17, N. Y. ($ .50 ea.)
3. How To Put Rope To Work In Industry, Plymouth Cordage Co., Plymouth, Mass. (N/C under 100 copies)
4. Electrical Catalogs - Tools & Materials
   (Secure from Local Electrical Supply Company)

Recommended Films

Lesson No.	First Year
A-9	a. Basic Electrical Theory U. S. Air Force or Modern Films, Inc. b. What is Electricity? Encyclopedia Britannica Films, Inc.
A-10	"Current Flow, What It Is" United World Films, Inc.
A-11	What Controls Flow--Resistance United World Films, Inc.
A-12	What Causes Current Flow--E.M.F. United World Films, Inc.
A-14	Series Circuits (Color, No. 48506) Encyclopedia Britannica Films, Inc.
A-15	Parallel Circuits Encyclopedia Britannica Films, Inc.
A-16	Series & Parallel Circuits United World Films, Inc.

To Obtain Films:

Some institutions in the Community College System have small film libraries. Consult "Free Film" catalogs, Local colleges, or Modern Films, Inc., Charlotte, N.C., The U. S. Air Force, Army, and Navy lend films to educational organizations. Be sure to plan ahead and book films several months in advance of showing date.

Tools Required

The following minimum tool lists were submitted by the Carolinas Chapter, National Electrical Contractors Association:

A. Apprentices should own the following tools:

1. Pocket knife (Electrician's)
2. Screwdrivers
   a. Large
   b. Small
3. 6 ft. rule
4. 2 pairs Channel Locking Pliers
5. Side Cutting Pliers

B. Journeymen should add the following tools:

1. Pipe Wrenches
   a. 10"
   b. 14"
2. Cold Chisels
3. Center Punch
4. Screw Driver Set 3" to 6"
5. Claw Hammer
6. 10" - Crescent Wrench
7. Tri-Square
8. Plumb Bob
9. 12" - Hack Saw Frame
10. Level
11. Brace & Extension Bit
12. Voltage Tester - "Square-D" or equal

VT 003 625

VT 003 625
Basic Electricity Series, No. A (First Year), Apprentice Training in Electrical Work, Related Instructional Material, Assignment Sheets and Information Sheets.

Hedinger, Howard E.
North Carolina State Board of Education, Raleigh.

Pub Date - Jun67
MF AVAILABLE IN VT-ERIC SET 102p.

*STUDY GUIDES, *TRADE AND INDUSTRIAL EDUCATION, *ELECTRICIANS, *ELECTRICITY, POST SECONDARY EDUCATION, TESTS, *APPRENTICESHIPS,

This study guide, the first of a four-unit series, is for individual student use in studying technical information in the first year of the related technical phase of post-secondary electrician apprenticeship training. It was developed by a curriculum committee and the educational committee of the National Electrical Contractors of North Carolina. The material was designed by subject matter specialists, tested on a small group, and used in apprenticeship programs. Assignment and information sheets are included for 28 lessons in the areas of basic mathematics and orientation, fundamentals of electricity, and National Electrical Code. They contain textbook references, introduction and directions, and problems. The minimum class time is 144 hours per year. The teacher should be a journeyman tradesman, and the students should be 18 years old and employed as apprentices in an electrical construction trade. Supplementary materials include unit tests to be given approximately every six weeks and a final examination. Correlated lesson plans for the instructor are given in VT 003 624. Documents of the four-unit series are listed as VT DD3 624 through VT 003 631. (HC)

RELATED INSTRUCTIONAL MATERIAL

ASSIGNMENT SHEETS AND INFORMATION SHEETS

BASIC ELECTRICITY

SERIES NO. A
(First Year)

APPRENTICE TRAINING
IN
ELECTRICAL WORK

JULY 1964

REVISED
JUNE 1967

Prepared by
Howard E. Hedinger

VOCATIONAL-TECHNICAL DIVISION
DEPARTMENT OF COMMUNITY COLLEGES
STATE BOARD OF EDUCATION
RALEIGH, NORTH CAROLINA

MEMORANDUM

TO: The ERIC Clearinghouse on Vocational and Technical Education
The Ohio State University
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FROM: (Person) Roger G. Worthington (Agency) Department of Community Colleges

(Address) Education Building, Raleigh, North Carolina

DATE: September 7, 1967

RE: (Author, Title, Publisher, Date) Hedinger, Howard E. "Basic Electricity For Apprentices, Series A - First Year Assignment and Information Sheets," Curriculum Laboratory, Dept. of Community Colleges, July 1964.

Supplementary Information on Instructional Material

Provide information below which is not included in the publication. Mark N/A in each blank for which information is not available or not applicable. Mark P when information is included in the publication. See reverse side for further instructions.

(1) Source of Available Copies:
Agency ERIC Only, except North Carolina Institutions
Address
Limitation on Available Copies Price/Unit
(quantity prices)

(2) Means Used to Develop Material:
Development Group Curriculum committee / National Electrical Contractors for Carolinas - Educational committee
Level of Group State and Dept. supervisor
Method of Design, Testing, and Trial Designed by subject matter specialists and tested on a small group; has been used with 1,200 apprentices per year for 3 years.

(3) Utilization of Material:
Appropriate School Setting Vocational (Apprentice Training)
Type of Program Post-high; Apprenticeship.
Occupational Focus A specific job (electrical construction)
Geographic Adaptability N/A
Uses of Material Course and lesson planning and student study guides.
Users of Material Instructor and student

(4) Requirements for Using Material:
Teacher Competency Journeyman instructor
Student Selection Criteria 18 year old, male (mostly), post-secondary educ. to become a journeyman electrician
Time Allotment 144 hours per year (minimum)

Supplemental Media --Textbooks - see list
Necessary X
Desirable
(Check Which)

Describe Basic Electricity, VanValkenburgh & All, Hayden Book Co.; Amer. Electricians' Handbook, Croft, McGraw-Hill Book Co.; Basic Mathematics
Source (agency) / by Singer, McGraw-Hill Book Co.; National Electrical Code
(address) / National Fire Protection Assoc. 60 Batterlymarch St., Boston, Mass.

ACKNOWLEDGMENTS

Questions and problems for the Lesson Topics in this workbook were prepared and authorized for use by:

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The Instructor's Manual, Information and Orientation Sheets keyed to the Assignment Sheets were developed by:

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PREFACE

The materials in this publication have been prepared to provide specific assignments for studying related topics necessary in the training of electrical apprentices. An effort was made to develop the schedule for the instructors to follow as the apprentice progresses with his training. It will also enable the apprentice to know what skills and knowledges will be required of him. One objective of this program is to aid the instructor and employer in providing experiences necessary to develop a competent worker in the electrical field.

This workbook includes assignment sheets and information sheets for the electrical apprentice to use in searching out related information. They contain textbook references, problems to solve and key sentences to complete, diagrams to draw, and blueprints to consult. The apprentice should study the assigned references before he attempts to answer the questions or solve the problems.

In actual use of these lessons, instructors should feel free to modify their application of the material to conform with local needs, For example, there may be certain sections of the Code to teach because the apprentices are working with special installations. Thus, the instructor will prepare additional materials to use with the course. In other classes, the instructor may need to spend more time on topics dealing with mathematics than with blueprint reading. In any event, the minimum class time for related material is 144 hours per year. It is sincerely hoped that the assignment sheets are used correctly, so that apprentices can gain maximum benefits from their related studies.

A. J. Bevacqua, Educational Director
Vocational-Technical Division
Department of Community Colleges

H. E. Hedinger
Educational Consultant

ASSIGNMENTS

FIRST-YEAR APPRENTICE TRAINING PROGRAM

BASIC ELECTRICITY

FIRST YEAR
SERIES - A

LESSON	PAGE NO.	LESSON TOPICS	ASSIGNMENT DATE
A-1	1	YOUR RELATED INSTRUCTION	
A-1	3	WHOLE NUMBERS	
A-2	5	FRACTIONS	
A-2	6	TOOLS	
A-3	7	DECIMAL FRACTIONS	
A-3	9	MATERIALS - T & B FITTINGS (F-48)	
A-4	11	FORMULAS & EQUATIONS	
A-4	13	YOUR APPRENTICESHIP	
A-5	15	FRACTIONS & DENOMINATORS	
A-5	16	HISTORY OF ELECTRICAL INDUSTRY	
A-6	17	PERCENTAGE	
A-7	19	SQUARE ROOT	
A-8	21	RATIO AND PROPORTION	
A-9	23	INTRODUCTION TO ELECTRICITY	
A-10	25	CURRENT	
A-10	26	YOUR FUTURE IN THE ELECTRICAL INDUSTRY	
A-11	27	RESISTANCE	
A-12	31	ELECTROMOTIVE FORCE	
A-12	32	YOUR EMPLOYER	
A-13	33	OHM'S LAW	
A-14	35	SERIES CIRCUITS	
A-15	37	PARALLEL CIRCUITS	
A-16	41	COMBINATION CIRCUITS (Series & Parallel)	
A-17	43	POWER & WORK	
A-18	45	WIRE CONSTRUCTION	
A-19	49	WIRE SIZES	
A-20	53	VOLTAGE DROP	
A-21	55	INTRODUCTION TO N. E. CODE	
A-22	59	GENERAL REQUIREMENTS FOR WIRING INSTALL.	
A-23	65	RIGID METAL CONDUIT	
A-24	71	ELECTRICAL METALLIC TUBING	
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A-26	75	STORAGE BATTERIES	
A-27	77	FUSES	
A-28	79	SAFETY AND FIRST-AID	

BASIC ELECTRICITY

INFORMATION SHEET

ORIENTATION

Lesson A-1

YOUR RELATED INSTRUCTION

INTRODUCTION

The lessons prepared for the electrical apprentice have been divided into four one-year courses of approximately 144 hours each. Each lesson is designed to give you fundamental related information that will help you progress in your work. Basic electrical theory, mathematics, job information, National Electric Code and blueprint reading will comprise the subjects to be studied during the four years. It will be impossible for you to learn all you need to know in class, but these courses should give you a good basic foundation.

If you are to make proper progress in the electrical wiring trade, it is necessary to understand how this related instruction is organized. Also, how to get the most out of your work on each assignment. The following information explains how to make the most efficient use of this course.

WHY YOU ARE TAKING THIS COURSE

Apprentice training is an educational program in which the apprentice learns a skilled trade through a combination of work experiences on the job and related technical instruction in class. On the job, the apprentice learns how to do many of the skilled operations of the craft while working with experienced journeymen.

In the electrical wiring trade, the beginner must learn the related information as well as the job operations. This technical knowledge is easier to learn in an organized class than on the job. The related information is available only in books, manuals, and films that can best be used in schools, with the aid of a teacher. The mechanic who knows the technical phase of his craft is better prepared to plan work, understand the plans of others, and "trouble-shoot" or solve problems. A mechanic can sometimes "get by" with a small amount of technical information, but rarely does such a man become a successful foreman, supervisor, or electrical contractor. The related information you can learn through regular school attendance and careful study of the assignments in this course will prepare you for advancement in your trade.

THE COURSE AND HOW TO USE IT

The Assignment Sheets provided for each lesson are study guides to use in searching out related information. They contain textbook references, problems to solve and key sentences to complete, diagrams to draw and blueprints to consult. Be sure that you study the assigned references before attempting to answer the problems or fill in the blanks.

It will be necessary to study the assignments outside of class, so be sure you understand what is required. Each lesson will have a number, as A-4, which is Mathematics - Formulas and Equations. References will be found in Basic Mathematics by Singer, pages 24-36. Some references that are marked with the asterisk (*) are substitute texts or references you may use if available in the library.

The instructor will assign the information sheets and the lesson sheets to study the week before the class meets. Be sure to read the related information carefully before completing the problems in the space provided. The lesson sheets will be checked in class and returned to you. Correct the mistakes and place the sheets in your notebook for future reference.

TESTING AND EVALUATION

Special problems and tests will be worked out during class periods. There are short tests to be given weekly, and unit tests to be given approximately every six weeks. A final examination will be given at the end of each year. Many of these questions will be of the "open book" variety in order to use formulas, tables and the National Electrical Code. These tests will be given to see how well you are learning the related information. Also, they will determine to a large extent your grade in the course.

TIPS ON HOW TO STUDY

In order to make the information you study of any value, it is necessary to prepare your lessons in a way that you will remember them. This requires concentration and real effort rather than just "reading," but it pays off in the long run. Many apprentices object to being required to learn by reading, as they sometimes find it difficult to get the meaning from the printed word. The ability to read accurately and rapidly is an important advantage if you want to progress in the electrical business. The electrician who wants to get ahead or even keep up with his craft must be able to get the latest technical information by reading. Most slow readers are not aware of the handicap under which they are working. Many adults are enrolling in Reading Courses to improve their accuracy and speed. It would be wise for you to visit your local school for a reading "check-up."

The following method studying technical information has proved an excellent one:

1. Survey the entire assignment, by "skim" reading paragraph headings and key sentences. This will give you the over-all picture of the lesson.
2. Go back to the beginning of the assignment and read the first paragraph. Now, look up from your book and try to repeat to yourself, in your own words, the meaning of the paragraph. If you cannot do this, the information did not become "fixed," and you will have to go over it again until it does.
3. Repeat the above process with each paragraph in the assignment. As you study, try to apply the information to a practical job situation.
4. Then, you are ready to complete the problems on the Assignment Sheet for the lesson. You will quickly recognize the material and be able to find the answers in less time.

NOTE: For additional help on how to read and study profitably, find the following booklets in the library or write to the publisher for a copy.

1. How to Study, American Technical Society, Drexel at 58th St., Chicago 37, Ill.
2. Tips on How to Study, Delmar Publishers, Inc., Albany, New York
3. How to Study, Morgan & Deese, McGraw-Hill Book Co., New York, N.Y., 1957.

NAME ______________________________ Lesson A-1

DATE ______________________________ Math - Whole Numbers

REFERENCE

Review of addition, subtraction, multiplication and division.

PROBLEMS

1. Add the following:

(a) $\begin{array}{r} 472 \\ \underline{126} \end{array}$ (b) $\begin{array}{r} 529 \\ \underline{358} \end{array}$ (c) $\begin{array}{r} 1741 \\ \underline{1902} \end{array}$ (d) $\begin{array}{r} 741 \\ \underline{889} \end{array}$

(e) $\begin{array}{r} 333 \\ \underline{667} \end{array}$ (f) $\begin{array}{r} 420 \\ 945 \\ 441 \\ 584 \\ \underline{715} \end{array}$ (g) $\begin{array}{r} 637 \\ 58 \\ 297 \\ 708 \\ \underline{899} \end{array}$ (h) $\begin{array}{r} 935 \\ 354 \\ 796 \\ 253 \\ \underline{460} \end{array}$

2. Subtract the following:

(a) $\begin{array}{r} 7418 \\ \underline{-6356} \end{array}$ (b) $\begin{array}{r} 5747 \\ \underline{-1856} \end{array}$ (c) $\begin{array}{r} 7904 \\ \underline{-5738} \end{array}$ (d) $\begin{array}{r} 4408 \\ \underline{-994} \end{array}$ (e) $\begin{array}{r} 9906 \\ \underline{-3189} \end{array}$

3. Multiply the following:

(a) $\begin{array}{r} 719 \\ \underline{4} \end{array}$ (b) $\begin{array}{r} 984 \\ \underline{3} \end{array}$ (c) $\begin{array}{r} 853 \\ \underline{74} \end{array}$ (d) $\begin{array}{r} 894 \\ \underline{69} \end{array}$ (e) $\begin{array}{r} \$4.08 \\ \underline{58} \end{array}$ (f) $\begin{array}{r} \$5.76 \\ \underline{.39} \end{array}$

4. Divide the following:

(a) $4\overline{)6404}$ (b) $5\overline{)8525}$ (c) $62\overline{)3596}$ (d) $48\overline{)127,924}$

NAME ______________________________ Lesson A-2

DATE ______________________________ Math - Fractions

REFERENCE

1. *Basic Mathematics*, Pages 13-20.

PROBLEMS

1. Reducing fractions to lowest terms:

(a) 4/8 ________ (b) 4/16 ________ (c) 14/32 ________

(d) 15/75 ________ (e) 60/100 ________

2. Reducing mixed numbers to improper fractions:

(a) 5 3/8 ________ (b) 3 7/10 ________ (c) 2 1/12 ________

(d) 3 1/3 ________ (e) 10 7/8 ________

3. Changing improper fractions to mixed numbers:

(a) 9/2 ________ (b) 59/8 ________ (c) 16/9 ________

(d) 20/2 ________ (e) 43/10 ________

4. Multiplication of fractions:

(a) 8 x 1/2 = ________ (b) 2/5 x 1/3 = ________

(c) 1/4 x 3/8 = ________ (d) 1/3 x 4/7 = ________

(e) 3/8 x 16 = ________

5. Multiplication of mixed numbers:

(a) 1 7/9 x 3/8 = ________ (b) 2 1/3 x 1/7 = ________

(c) 3 3/5 x 2 1/4 = ________ (d) 3 x 3 5/6 = ________

(e) 17 x 4 1/8 = ________

6. How many nipples, 1 1/2 inches long, can be made from a piece of conduit 24 inches long? ________

NAME________________________ BASIC ELECTRICITY

DATE________________________ Lesson A-2

REFERENCE: ELECTRICAL CATALOGS

GENERAL INFORMATION:

One of the first duties of an apprentice is to learn the tools used on the job. He should not only know their names but also the proper use and care for them. In this assignment we will consider only a few of the basic tools. When you see a new tool, ask what it is called and its proper use.

ASSIGNMENT DIRECTIONS:

In the space provided, place the names for hand tools used by the electrician. As you learn about new tools, add their names to the list. Later you will learn the names of power tools and their uses.

1.________________________
2.________________________
3.________________________
4.________________________
5.________________________
6.________________________
7.________________________
8.________________________
9.________________________
10.________________________
11.________________________
12.________________________
13.________________________
14.________________________
15.________________________
16.________________________
17.________________________
18.________________________
19.________________________
20.________________________
21.________________________
22.________________________
23.________________________
24.________________________

NAME ____________________________ Lesson A-3

DATE ____________________________ Math - Decimal Fractions

REFERENCE

1. Basic Mathematics, Pages 37-49.

PROBLEMS

1. Change fractions to decimal fractions:

(a) 6/10 ________ (b) 105/1000 ________ (c) 5/100 ________

(d) 50/100 ________ (e) 15/1000 ________

2. Arrange decimals in order starting with largest:

(a) 0.07, 0.005, 0.15, 0.3 ________ ________ ________ ________

(b) 0.18, 0.002, 0.07, 0.0010 ________ ________ ________ ________

(c) 0.50, 0.15, 0.015, 0.021 ________ ________ ________ ________

(d) 0.0012, 0.15, 0.0051, 0.052 ________ ________ ________ ________

(e) 0.294, 0.790, 0.02 ________ ________ ________

3. Change mixed numbers to decimals:

(a) 2 5/10 ________ (b) 1 18/100 ________ (c) 7 99/1000 ________

(d) 3 35/100 ________ (e) 65 14/1000 ________

4. Change fractions to decimals:

(a) 1/5 _____ (b) 4/7 _____ (c) 1/3 _____ (d) 19/27 _____ (e) 25/32 _____

5. Use Table of Decimal Equivalents to change decimals into fractions:

(a) 0.0625 ________ (b) 0.1875 ________ (c) 0.21875 ________

(d) 0.734375 ________ (e) 0.4375 ________

6. Adding decimals:

(a)	(b)	(c)	(d)	(e)
8.23	90.65	0.078	45.00	0.310
5.90	41.00	6.810	0.003	2.703
.436	6.784	0.040	0.317	7.000
.870	70.094	.710	8.502	6.617

NAME ______________________________
Math - Decimal Fractions

Lesson A-3
Page 2

7. Subtracting decimals:

(a)	(b)	(c)	(d)	(e)
0.62	1.63	0.613	29.18	0.75
-0.30	-0.81	-0.045	-13.61	-1/2

8. Multiplication of Decimals:

(a) 0.005 x 28 = ____________________

(b) 3.67 x 0.092 = ____________________

(c) 45.4 x 506 = ____________________

(d) 2.6 x .004 = ____________________

(e) 100 x .037 = ____________________

9. Division of Decimals:

(a) 9.6 ÷ 0.4 = ____________________

(b) 80.8 ÷ 0.08 = ____________________

(c) 9.418 ÷ 3.95 = ____________________

(d) 38.45 ÷ 8.5 = ____________________

(e) 16 ÷ 0.008 = ____________________

10. Multiplicaiton of Fractions and Decimals:

(a) 1/5 x 4.5 = ____________________

(b) 1/8 x 3.05 = ____________________

(c) 1/16 x 0.32 = ____________________

(d) 2-4/7 x 0.91 = ____________________

(e) 0.065 x 3-1/3 = ____________________

NAME ______________________________ Lesson A-3

DATE ______________________________ BASIC ELECTRICITY

MATERIALS

(Conduit and Cable Fittings)

REFERENCE:

1. Electrical catalogs
2. Electrical Conduit and Cable Fittings, The Thomas & Betts Co.

INTRODUCTION & DIRECTIONS:

The beginning apprentice must become familiar with the materials used to install an electrical system. The sooner he acquires this knowledge the more valuable he becomes to the industry. If you are truly interested in your work, you will learn all the different materials used in the trade as soon as possible.

Look through the catalog and find the common fittings shown on the pictured sheet (Electrical Conduit and Cable Fittings). Study other materials as you look for the specified ones. You cannot learn all of them at once, but try to become acquainted with specifications and how to order the materials.

Place the proper name in the blank of common fittings and other materials needed in a small dwelling.

1 - Sheet No. 1.

1. ______________________
2. ______________________
3. ______________________
4. ______________________
5. ______________________
6. ______________________
7. ______________________
8. ______________________
9. ______________________
10. ______________________
11. ______________________
12. ______________________
13. ______________________
14. ______________________
15. ______________________
16. ______________________
17. ______________________
18. ______________________
19. ______________________
20. ______________________
21. ______________________
22. ______________________
23. ______________________
24. ______________________
25. ______________________
26. ______________________
27. ______________________
28. ______________________
29. ______________________
30. ______________________

NAME ______________________________ Lesson A-4

DATE ______________________________ Math - Formulas and Equatio

REFERENCE

1. Basic Mathematics, Pages 24 - 36.

PROBLEMS

1. What is a formula?

2. What is the meaning of the following signs:

(a) (x) ____________________ (d) (-) ____________________

(b) (÷) ____________________ (e) (=) ____________________

(c) (+) ____________________ (f) (.) ____________________

3. Substitute in the following formulas and solve for E and indicate all work:

(a) $E = IR$

(b) $E = 10 \times 12$

4. Solve for R.

(a) $E = IR$

(b) $120 = 8R$

5. Solve for I.

(a) $E = IR$

(b) $120 = I \times 40$

6. Solve for R_T.

(a) $R_T = 7 + 8 + 5$

(b) $R_T = 12 + 4$

NAME ________________________________ Lesson A-4

Math - Formulas and Equations Page 2

7. Solve for E_I

   (a) $E_1 = E_I + E_2$

   (b) $16 = E_I + 7$

8. Solve the following equations for the values of unknown letters;

   (a) $E = 7 \times 10$

   (b) $10 = .2 \times R$

   (c) $120 = I \times 1.5$

   (d) $600 = E \times 50$

   (e) $3.6 = 9 \times I$

9. Write the equations for the following rules:

   (a) Electrical power (P) is equal to the current (I) multiplied by the voltage (E). ________________________________

   (b) Maximum voltage (E_{max}) is equal to the effective voltage (E_{eff}) divided by 0.707. ________________________________

   (c) The total resistance (R_T is equal to the sum of resistors R_I R_2 and R_3. ________________________________

   (d) Impedance (Z) of a circuit is equal to the voltage (E) divided by current (I). ________________________________

NAME______________________________

DATE______________________________

ORIENTATION

Lesson 4

BASIC ELECTRICITY

Topic: Your Apprenticeship

REFERENCES:
1. Apprenticeship Agreement
2. Local Apprenticeship Standards
3. Local Agreement (Contract)

GENERAL INFORMATION:

When you discussed your apprenticeship with the Local Joint Committee, they gave you important information. You remember some of it; some has slipped your mind. Now is a good time for refreshing your mind, discussing more of the details in class so you may get a better understanding as this affects your life-time work.

QUESTIONS:

1. How many years will you be an apprentice?

2. How many hours will you attend apprentice classes each year of apprenticeship?

3. What wages will you make during apprenticeship?

4. How long is your probationary period?

5. What is the purpose of the probationary period?

NAME ______________________ Lesson 4

Your Apprenticeship Page 2

6. How many "work hours" in your term of apprenticeship?

7. Is your "apprenticeship agreement" with an employer or with the Joint Apprenticeship Committee?

Why?

8. Are the Apprenticeship Standards important to you? Why or why not?

9. What is the authority for the Joint Apprenticeship Committee's Actions?

10. How many members are on the Joint Apprenticeship Committee? How are they selected? Be specific.

NAME______________________________ Lesson A-5

DATE______________________________ Math - Fractions and Denominators

REFERENCE

1. Basic Mathematics, Pages 91 - 103

PROBLEMS

1. Addition of Fractions:

(a) 1/16 + 1/32 + 5/64 = ____________________

(b) 5/6 + 1/9 + 3/4 = ____________________

(c) 1/2 + 4/7 + 3/4 = ____________________

(d) 7/8 + 1/4 + 3/16 = ____________________

(e) 1/100 + 8/25 + 7/10 = ____________________

2. Find Least Common Denominator:

(a) 5/6 + 1/9 + 2/3 = ____________________

(b) 1/4 + 1/12 + 1/15 = ____________________

(c) 1/50 + 1/100 = ____________________

(d) 1/5 + 1/7 + 1/9 = ____________________

(e) 1/3 + 1/6 + 1/9 = ____________________

3. Find value of unknown letter:

(a) $\frac{R}{6} = \frac{2}{12}$

(b) $\frac{E}{5} = \frac{2}{3}$

(c) $\frac{2E}{5} = \frac{3}{5}$

(d) $\frac{11}{22} = \frac{R}{7}$

(e) $\frac{1}{C} = \frac{15}{20}$

MEN OF ELECTRICAL HISTORY

To appreciate the history of the Electrical Industry, we must investigate the work of great scientists in this field. The first discovery of static electricity was made in 600 B.C., when a piece of amber rubbed with a cloth attracted small bits of paper, straw, etc. Approximately 2000 years later, Dr. Gilbert discovered that other materials such as glass, sealing wax, rock crystal, and sapphire would attract light materials the same as amber. The Greek work for amber is "electrum", and our modern word "electricity" is derived from it. The word "electricity" was first used by Dr. Gilbert in 1600.

There are many other men that have contributed to the discoveries concerning electricity, although we know very little about this great form of energy. It is suggested that you visit the library or use a good encyclopedia and write out the main contributions to the electrical field by the following men. You could write a longer theme about the discoveries of one particular man.

1. Stephen Gray
2. Luigi Galvani
3. Samuel F. Morse
4. Michael Faraday
5. Z. T. Gramme
6. Alexander Graham Bell
7. M. G. Marconi
8. Thomas Alva Edison
9. Charles P. Steinmetz
10. George Westinghouse

NAME ______________________________ Lesson A-6

DATE ______________________________ Math - Percentage

REFERENCE

1. Basic Mathematics, Pages 281 - 290.

PROBLEMS

1. Change per cents into decimals:

(a) 56% = ______

(b) 7% = ______

(c) 18% = ______

(d) 125% = ______

(e) 7/8% = ______

(f) 8.5% = ______

(g) 0.7% = ______

(h) 12 1/2% = ______

(i) 27.8% = ______

(j) 3.33% = ______

2. Change decimals into per cents:

(a) 0.25 = ______

(b) 0.015 = ______

(c) 0.78 = ______

(d) 1.35 = ______

(e) 0.70 = ______

(f) 0.222 = ______

(g) 0.056 = ______

(h) 0.725 = ______

(i) 3 = ______

(j) 0.125 = ______

3. Change common fractions to per cents:

(a) 1/3 = _____

(b) 3/5 = _____

(c) 6/10 = _____

(d) 7/11 = _____

(e) 12/40 = _____

4. The voltage at a panelboard is 460V and 440V at a branch circuit motor. What is the per cent drop?

5. Out of 500 breakers, 1 1/2 per cent were defective. How many were defective?

6. If a 3% voltage drop is permitted on a power feeder, what is the voltage at the end of the line supplied by 208-volt source?

7. An apprentice received a 12.5% wage increase. What is his new weekly rate if his earnings prior to increase were $70 per week?

NAME____

DATE____

Lesson A-7

Math - Square Root

REFERENCE

1. Basic Mathematics, Pages 165 - 173.

PROBLEMS

1. Find square roots of following numbers and check:

(a) 625 = __________

(b) 17.85 = __________

(c) 4900 = __________

(d) 7.65 = __________

(e) 18.288 = __________

(f) 144 = __________

(g) 225 = __________

(h) 81 = __________

(i) 10,000 = __________

(j) 484 = __________

2. What current flows through a line supplying 1,200 watts to a toaster of 12 ohms resistance?

3. What current flows through resistor rated 1000 ohms and 0.4 watts?

0.45

4. What size resistor is required to produce 100 watts with a current of 0.05 amperes?

5. What is the voltage across a resistor rated at 100 ohms and 9 watts?

6. What is the combined resistance of three resistors across a 208-volt line and combined power of 150-watts?

NAME ____________________

DATE ____________________

Lesson A-8

Math - Ratio and Proportion

REFERENCE

1. Basic Mathematics, Pages 306 - 319.

PROBLEMS

1. Find ratio of following quantities:

   (a) 4 to 16 in.

   (b) 12 to 3 ft.

   (c) 9 ft. to 24 in.

   (d) 750 watts to 2 kw.

2. Solve the following direct proportions:

   (a) $\frac{20}{R} = \frac{5}{15}$

   (b) $\frac{E}{15} = \frac{30}{60}$

   (c) $\frac{10}{20} = \frac{I}{40}$

   (d) $\frac{6}{200} = \frac{P}{100}$

   (e) $\frac{6}{14} = \frac{E}{7}$

3. Write proportions of the following:

   (a) A 10-ft. conduit weighs 30 lbs. What is the weight of 12 feet of conduit?

   (b) A 1000 feet of cable has a resistance of 30-ohms. How many ohms of resistance are in a cable 3000 feet long?

   (c) A car traveling 60 MPH is moving at the rate of 66 ft./sec. What is the rate of a car traveling 30 MPH?

   (d) A cable carrying 75 amperes has a 2-volt drop. What is the voltage drop of the cable carrying 225 amperes?

   (e) Find the primary voltage of a transformer if $N_p = 600$ turns, $N_s = 150$ turns, and $E_s = 120V$.

NAME ______________________________ Lesson A-9

DATE ______________________________ Introduction to Electricity

REFERENCE

1. American Electricians' Handbook, Pages 1 - 20 & 1 - 21, Sec. 25 - 29.
2. Basic Mathematics, Pages 1 - 3.
3. Basic Electricity, Vol. 1, Pages 1 - 20.

PROBLEMS

1. Electricity can neither be ______________ nor ____________________.

2. Electrical energy can be generated by ________________ electrons to move in certain paths.

3. An ________________ is the smallest amount of an element which has proportions of the element.

4. An atom is electrically ____________________ because it consists of equal number of positive charges called ________________ and negative charges called ____________________.

5. Like charged particles will ____________ each other and unlike charged particles will ____________.

6. What is an insulator? Give two examples.

7. What is a conductor? Give two examples.

NAME____________________________ Lesson A-10

DATE____________________________ Current

REFERENCE

1. American Electricians' Handbook, Pages 1-21 & 1-22, Sec. 31-37.
2. Basic Mathematics, Pages 4, 5 & 7.
3. Basic Electricity, Vol. 1, Pages 40-50.

PROBLEMS

1. An electric current is measured in ________________, and has a symbol ____________.

2. Current consists of a motion of ____________, ________________ electricity.

3. Name the two general classes of electric currents:

   (a) ____________________ (b) ____________________.

4. A ________________ current flows ____________ in the same direction.

5. The flow of an ________________ current is ____________ at regular intervals.

6. List three classifications of direct currents:

   (a) ______________ (b) ______________ (c) ______________.

7. An ________________ is the rate of flow of electricity.

8. The speed of electric current is approximately ____________ miles per second.

9. An ______________ measures current in units of amperes and is connected in ________________ in the circuit.

10. The principal effects of current are ______________, ______________, and ______________.

11. One ampere is equal to a flow of ______________ electrons per second.

INFORMATION SHEET

Lesson A-10

YOUR FUTURE IN THE ELECTRICAL INDUSTRY

When you decided to sign an agreement to become an electrical apprentice, it was an important decision in your life. It was a good choice if you like the work. To be successful you must strive to be above average in your work and devote many hours to the study of technical information.

You have expressed a desire to learn this trade by signing the apprentice agreement to work for moderate wages and attend classes for at least 144 hours per year for four years. You realize that in this time you cannot learn all the "hows" and "whys" of your job. The basic technical information and the on-the-job experience will help you become a better craftsman.

The future depends entirely upon you. There are many and varied opportunities in the electrical industry for you. The wages of journeyman in the electrical trades are as good or better than those employed in other trades. A majority of the electrical contractors who operate their own businesses once worked as tradesmen. There are many jobs in maintenance and repairing of electrical equipment in industrial plants, public buildings, schools, power and light companies, and other utilities. There are many opportunities in the field of radio and television for those who know the "how" and "why" of electronics.

The electrical industry is less than one hundred years old and is expanding by leaps and bounds. The United States produces and uses about one-half of the world's supply of electricity and has only seven per cent of the population. Perhaps you can see today the many opportunities that await you tomorrow.

What are you going to do? You have the opportunity by attending the apprentice classes maintained to help you to prepare for a better life. It is the sincere hope of the committee and the school that you cooperate by working at the height of your ability.

NAME ______________________ Lesson A-11

DATE ______________________ Resistance

REFERENCE

1. American Electricians' Handbook, Pages 1-22, Sec. 38, 39, 41 & 42; 1-32-1-36, Sec. 90 - 102.

2. Basic Mathematics, Pages 5 & 273 - 280.

3. Basic Electricity, Vol. 1, Pages 98 - 108; Vol. 2, Pages 24 - 41.

PROBLEMS

1. Resistance is measured in ______________ and has a symbol ______________.

2. ______________ opposes the flow of electricity.

3. A ______________ is an object having resistance.

4. An ______________ measures the resistance in a circuit, and is connected in ______________ to the part measuring.

5. Resistance causes ______________ to be produced by a current through it.

6. A ______________ conductor has ______________ resistance than a poor conductor.

7. Write the following numbers:

   (a) Three microamperes ______________
   (b) One kilowatt ______________
   (c) Seven mi. ohms ______________
   (d) Fifteen megvolts ______________

8. List four factors affecting resistance of a conductor:

   (a) ______________ (c) ______________

   (b) ______________ (d) ______________

9. What is the cross-sectional area of conductors having diameters as follows:

   (a) 1-inch ______________
   (b) 1/8-inch ______________
   (c) 3/8-inch ______________
   (d) 5/16-inch ______________

10. What is the diameter in inches of conductors having the following cross-

NAME ______________________________

sectional areas?

(a) 13,000 CM _______________
(b) 58,000 CM _______________
(c) 210,000 CM _______________
(d) 33,100 CM _______________

11. Conductors of ____________________ resistivity are used for transmission lines and feeders.

12. Conductors of ____________________ resistivity are used for incandescent lamps and toasters.

13. What are the resistivities of the following conductors:

(a) Copper _______________
(b) Aluminum _______________
(c) Silver _______________
(d) Tungsten _______________

14. Find the resistance of 2000 feet of aluminum conductor having a cross-sectional area of 13,500 CM.

15. Find the length of copper wire having a resistance of 3.25 ohms and a diameter of 100 CM.

16. What is the cross-sectional area of 3000 feet of silver conductor having a resistance of 95 ohms?

17. Wire gauges used in this country are ___________ _____________ _____________ or ___________ ________________.

18. Express the following temperatures in degrees Fahrenheit:

(a) 0° C _______________
(b) 22° C _______________
(c) 90° C _______________
(d) 100° C _______________

19. Express the following temperatures in degrees Centigrade:

(a) 32° F _______________
(b) 75° F _______________

NAME ______________________________ Lesson A-11

Resistance Page 3

20. Resistance _________________ with an increase in temperature.

21. The resistance of a copper conductor is 45 ohms at 65° F. What is the resistance at 194° F.?

22. A _____________________ can be used to change the resistance of a circuit without interruption of circuit.

23. Loose connections on conductors will __________________ the resistance.

24. Find the resistance of 1750 feet of cable if 1000 feet has 3-ohm resistance.

25. Find the cross-sectional area and diameter of a copper conductor having a resistance of 25-ohms, if a copper conductor has a resistance of 50-ohms and diameter of 14.6 mils.

26. Define "Super-Conductivity."

27. Find the resistance of a copper conductor of the same length and cross-sectional area as an aluminum conductor having 8-ohms.

NAME ______________________________ Lesson A-12

DATE ______________________________ Electromotive Force

REFERENCE

1. American Electricians' Handbook, Pages 1-21, Sec. 29 & 30; Pages 1-24, Sec. 51; Pages 1-28, Sec. 70; 1-30, Sec. 81-82.

2. Basic Mathematics, Pages 3 & 7.

3. Basic Electricity, Vol. 1, Pages 83-97

PROBLEMS

1. Electromotive force is measured in ________________ and has a symbol of

________________ or ________________.

2. ________________ cannot be created or destroyed.

3. Voltage ________________ electrons to move.

4. List seven ways of producing an EMF.

(a) ______________________________ (e) ______________________________
(b) ______________________________ (f) ______________________________
(c) ______________________________ (g) ______________________________
(d) ______________________________

5. A ________________________ measures the voltage in units of ____________ and

is connected in ________________________ in the circuit.

6. Define potential difference.

7. List four terms which imply pressure in an electric circuit:

(a) ______________________________ (c) ______________________________
(b) ______________________________ (d) ______________________________

NAME______________________________ Lesson A-12

DATE ______________________________ YOUR EMPLOYER

QUESTIONS

1. List the basic items covered in your contract with your employer.

2. What is a contract? What advantage is it to the contractor?

3. List some common items of expense when a company is engaged in contract work.

4. How can the employer determine the accuracy of his original estimate of cost for a job?

5. What should be expected of you in regard to the tools furnished by your employer?

6. What is the difference in the method of payment of office personnel and craftsmen in the field?

7. What should be your attitude toward the electrical material delivered to the job on which you are working?

8. Why is it necessary to purchase materials and equipment for a bid job in accordance with the quality specified in the plans?

9. How does the electrical company obtain the prints and specifications to bid on a job?

10. How can you help in determining the actual cost of the job?

NAME ______________________________ Lesson A-13

DATE ______________________________ OHM's Law

REFERENCE

1. American Electricians' Handbook, Pages 1-37 - 1-39, Sec. 104 - 108.

2. Basic Mathematics, Pages 20 - 24

3. Basic Electricity, Vol. 1, Page 123; Vol. 2, Pages 24 - 41.

PROBLEMS

1. List five applications for using Ohm's Law:

   (a) ______________________ (d) ______________________

   (b) ______________________ (e) ______________________

   (c) ______________________

2. List three situations which Ohm's Law cannot be applied:

   (a) ______________________

   (b) ______________________

   (c) ______________________

3. The ____________________ expressed in ______________ causes ____________ to flow.

4. The ____________________ expressed in ______________ attempts to stop the flow of ______________.

5. The ________________ expressed in ______________ flows as a result of ________ ______________________ exceeding the ______________.

6. Express Ohm's Law for finding voltage.

7. Express Ohm's Law for finding current.

8. Express Ohm's Law for finding resistance.

NAME______________________________ Lesson A-13

Ohm's Law Page 2

9. State the seven steps to be followed in solving problems using Ohm's Law:

(a) ______________________________

(b) ______________________________

(c) ______________________________

(d) ______________________________

(e) ______________________________

(f) ______________________________

(g) ______________________________

10. How much current will flow through a resistance of 40 ohms with an applied voltage of 120 volts?

11. Find resistance required to restrict current to 8 amperes in a circuit with 240 volts applied.

12. How much pressure is required to produce 10 amperes through 12 ohms of resistance?

13. A 15-ohm resistance is connected to a 60-volt generator. What current will flow?

14. What is the maximum size resistor to be connected to a 120-volt source with a 15 ampere current?

15. A toaster draws 11.5 amperes on a 115-volt line. What is the resistance in this toaster?

NAME ______________________________ Lesson A-14

DATE ______________________________ Series Circuits

REFERENCE

1. American Electricians' Handbook, Page 3-2.
2. Basic Mathematics, Pages 67-82, 88-93.
3. Basic Electricity, Vol. 2, Pages 7-23.

PROBLEMS

1. List two simple methods of connecting electrical devices in a circuit:

   (a) ____

   (b) ____

2. In series circuit, ______________ has the same value throughout the circuit.

3. In series circuit, the sum of __________ __________ is equal to the voltage available at the source.

4. In series circuit, the total resistance is equal to the ______________ of the resistors connected in the circuit.

5. In a series circuit there is only ______________ path for the current to flow.

6. Describe the following symbols:

   (a) E_T ______________________________________
   (b) I_1 ______________________________________
   (c) R_4 ______________________________________
   (d) I_T ______________________________________
   (e) E_I ______________________________________
   (f) E_4 ______________________________________
   (g) R_T ______________________________________

7. In series circuit, Ohm's Law may be used for each ______________ part of the circuit and ______________ values of the circuit.

8. In a series circuit with a constant voltage, the ______________ must be adjusted to maintain a constant current.

9. Two voltage sources rated 90 volts and 30 volts are connected in series. What is the total voltage available in circuit?

10. Three resistors, 20-ohms, 40-ohms, and 15-ohms, are connected in series with a 24-volt source. Find the total current, total resistance and voltage drop across each resistor.

NAME________________________________ Lesson A-14

Series Circuits Page 2

11. A current of 3 amperes is flowing through a series circuit having four resistors with voltage drops across each respectively 12-volts, 15-volts, 30-volts, and 45-volts. Find the total resistance and total voltage.

12. A lamp, washer and toaster are connected in series. Voltage across the lamp is 16-volts. Resistance of the toaster is 6-ohms and current is 3.2 amperes. Voltage across the washer is 12.8 volts. Find total current, total voltage and total resistance.

13. The voltage drop across each of three resistors in series is 50-volts, 35-volts, and 12.5 volts respectively. The total resistance is 500-ohms. Find the total current and ohms in each resistor.

14. A bell is designed to operate at 0.20 amps and 2.4 volts. Find the resistance to be connected in series with the buzzer in order to operate the buzzer on an 8-volt source.

15. In a series set of Christmas lights, if one lamp burns out, the other lamps ________________ ________________ illuminate.

16. Four resistors are connected in series to a battery of 60-volts. Resistances of resistors are 4, 6, 8, and 12 ohms. Find total resistance, voltage drop across each resistor, and total current.

NAME ______________________________ Lesson A-15

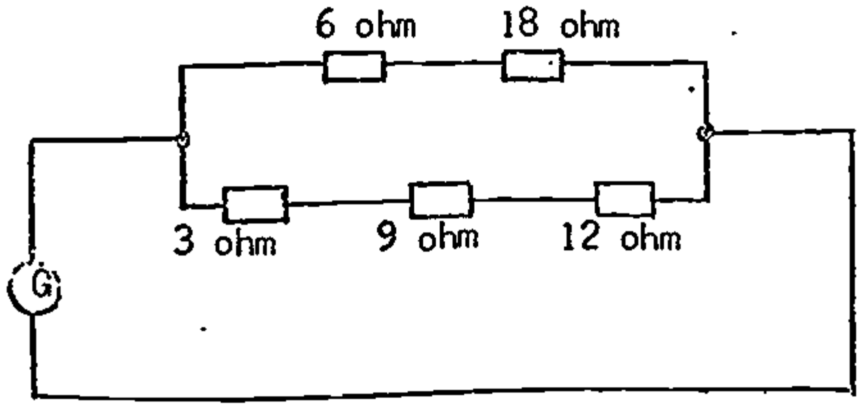
DATE ______________________________ Parallel Circuits

REFERENCE

1. American Electricians' Handbook, Pages 3-2 - 3-4.
2. Basic Mathematics, Pages 111 - 125.
3. Basic Electricity, Vol. 2, Page 55 ff.

PROBLEMS

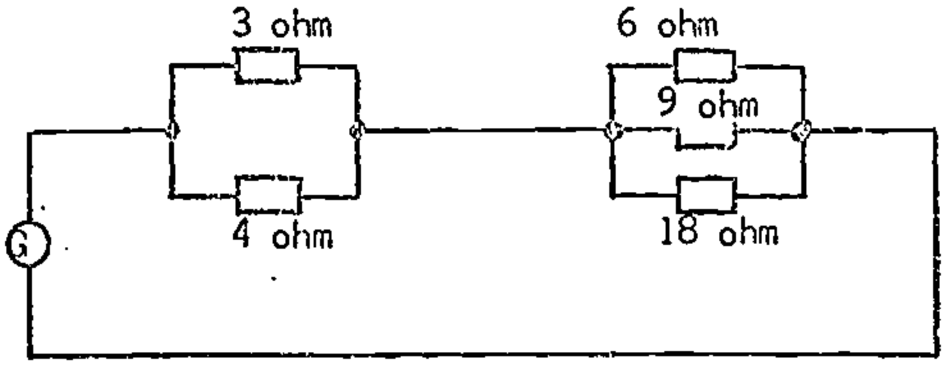
1. ______________ circuit has the resistors arranged in order that the current divides between them.
2. Parallel circuits are also identified as ________________ circuits.
3. ____________ - ______________ circuit consists of series circuits connected in parallel.
4. ____________ - ______________ circuit consists of parallel circuits connected in series.
5. In a parallel circuit, the ____________ ____________ is the same across each branch and is ____________ to the total voltage.
6. In a parallel circuit, the total current is equal to the ________________ of the currents in each branch.
7. In a parallel circuit, the total resistance is ________________ than the resistance in any branch.
8. In parallel circuits, adding resistors ________________ the total resistance and ________________ the total current.
9. Write the formula for finding total resistance in a parallel circuit.
10. Find the total resistance of a 15-, 25- and 30-ohm resistors connected in parallel.
11. Find the total resistance of the circuit below.



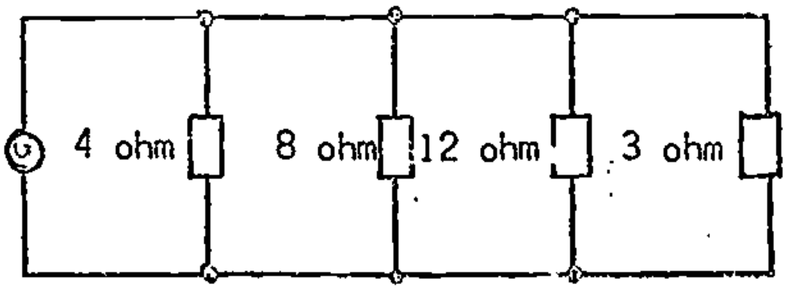
NAME ______________________ Lesson A-15

Parallel Circuits Page 2

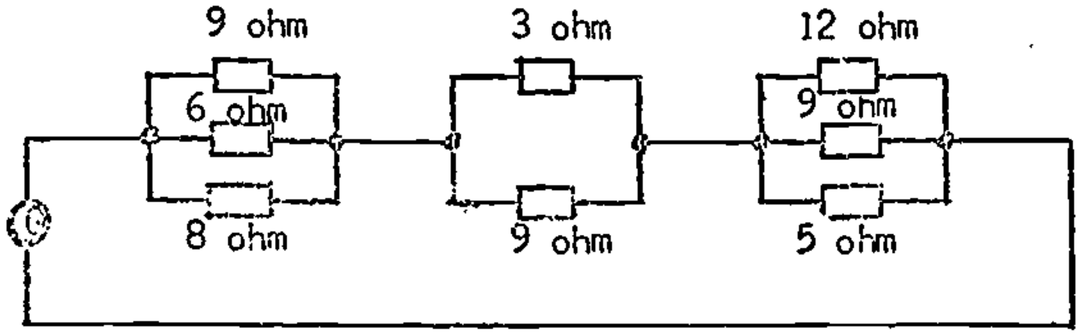
12. Find the total resistance of the circuit below.



13. Find the total resistance of the circuit below.



14. Find the resistance of each group of resistors and total resistance of the circuit below.

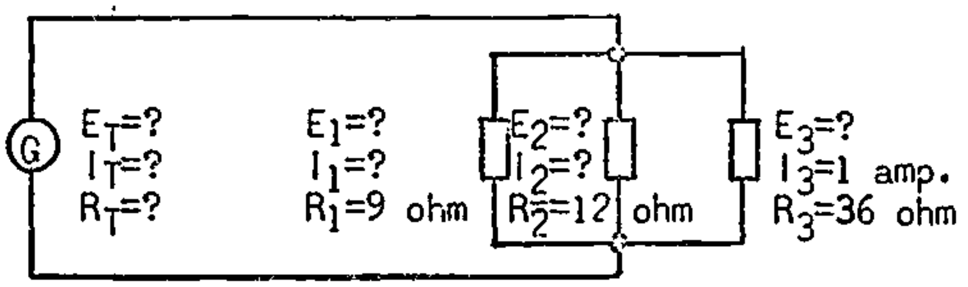


15. Find the total resistance of four lamps connected in parallel. Each lamp has a resistance of 40-ohms.

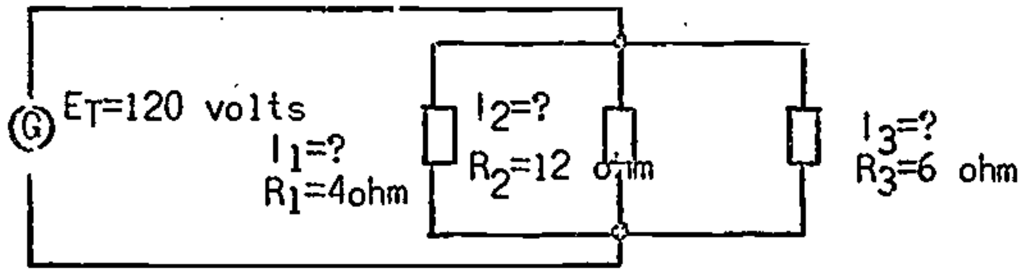
NAME ______________________________ Lesson A-15

Parallel Circuits Page 3

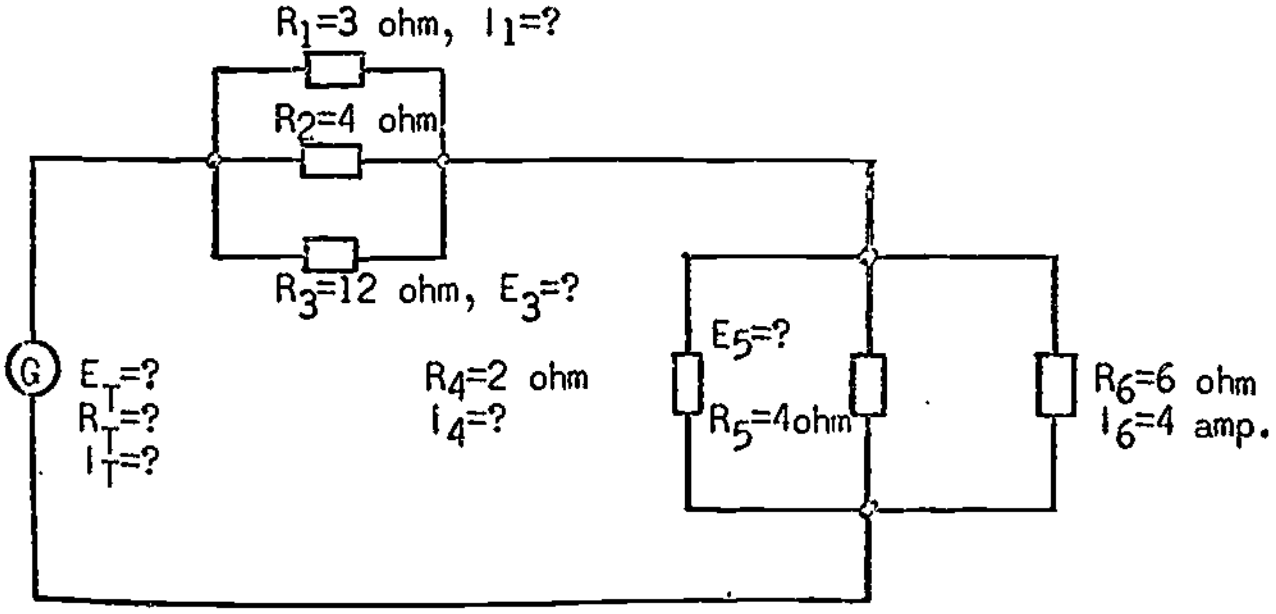
16. Find the total resistance, total current, total voltage, and current and voltage drop across each resistance in the following circuit.



17. Find the total current and current in each branch of the following circuit.



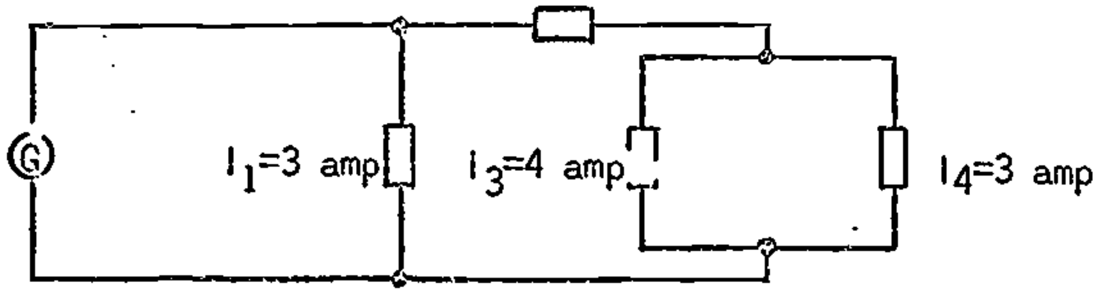
18. Find current, voltages and total resistance indicated.



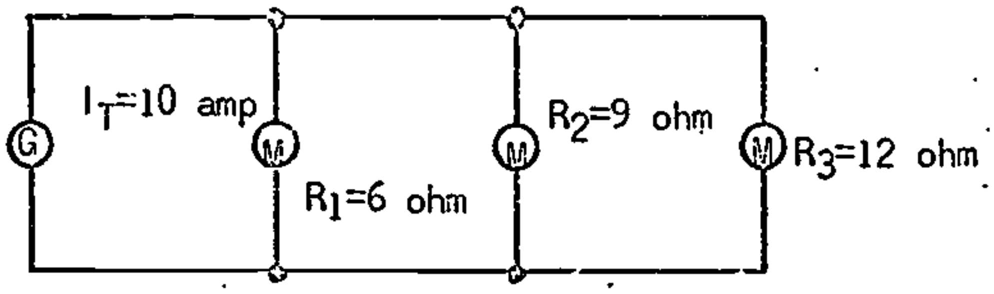
NAME ______________________________ Lesson A-15

Parallel Circuits Page 4

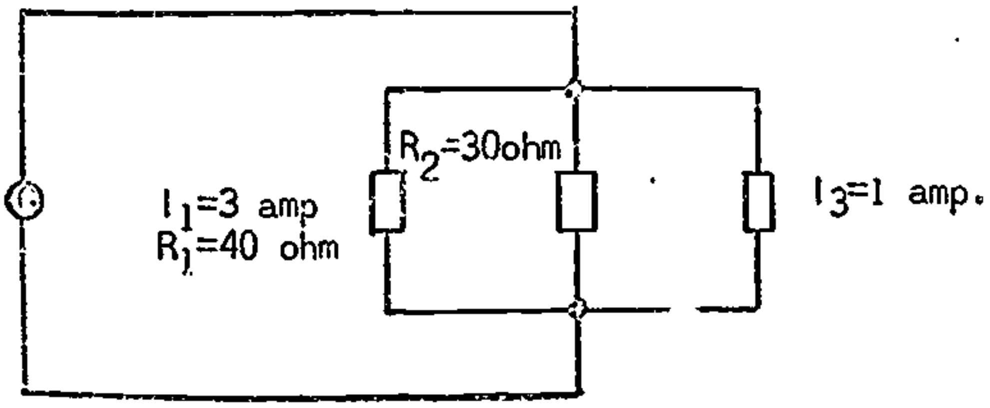
19. Find total current in the following circuit.



20. Find the current to each resistor of the following circuit.



21. Find the total voltage, total current and total resistance of the following circuit.



NAME ________________________________ Lesson A-16

DATE ______________________ ______ Combination Circuits

REFERENCE

1. American Electricians' Handbook, Page 3-3 ff.
2. Basic Mathematics, Page 127 - 137.
3. Basic Electricity, Pages 2-90 thru 2-103.

PROBLEMS

1. Series circuits provide a means for ______________ and ________________ the current by connecting _________________ in series.

2. Series circuits are used where ____________ ______________ ______________ and _______________ _________________ are needed.

3. List two disadvantages of series circuits:

   (a) ___________________________________

   (b) ___________________________________

4. Parallel circuits are used where ______________ ______________ and ___________ ______________ of ________________ are required.

5. List two advantages of parallel circuits:

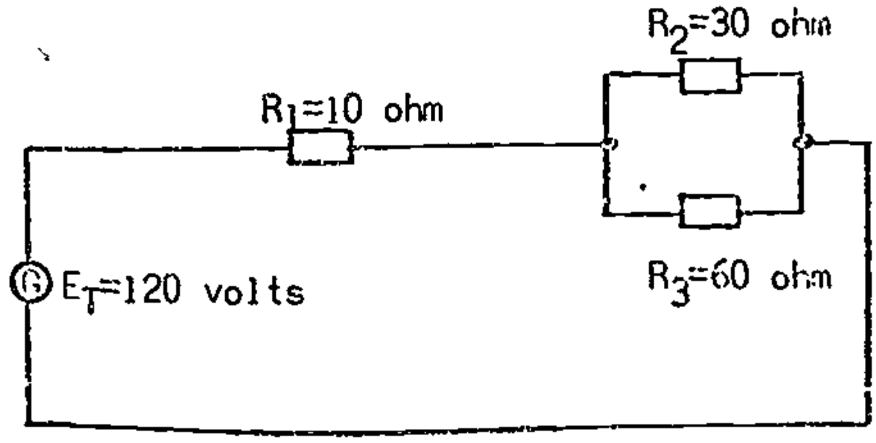
   (a) __________________________________

   (b) __________________________________

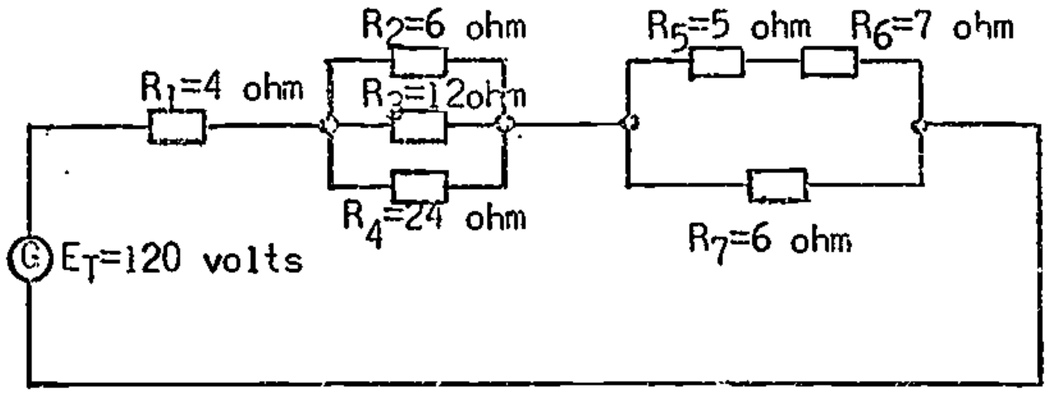
6. A ________________ - _________________ circuit is a circuit in which one or more ______________ of resistances in ______________ are connected in series.

7. A _________________ - _________________ circuit is a circuit in which one or more ________________ of resistances in series are connected in _____________ are connected in parallel.

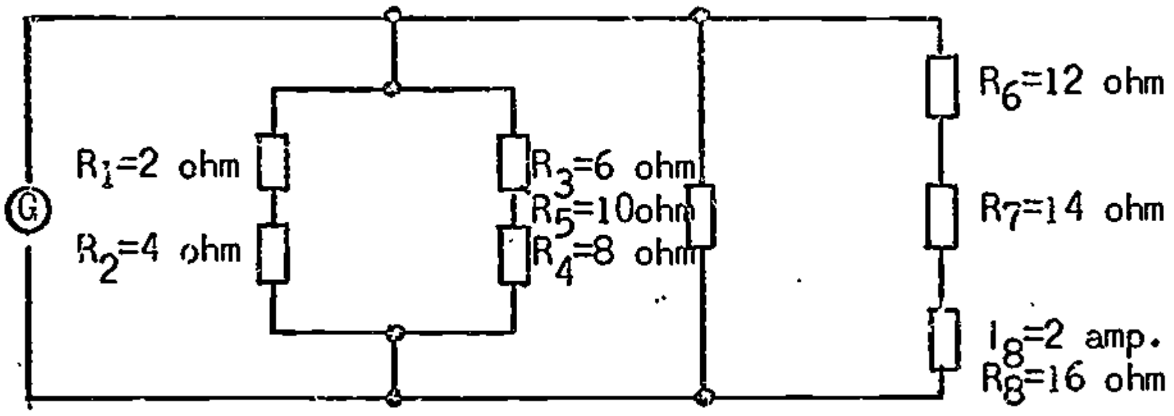
8. Solve the following circuit for all values of current, resistance and voltage.



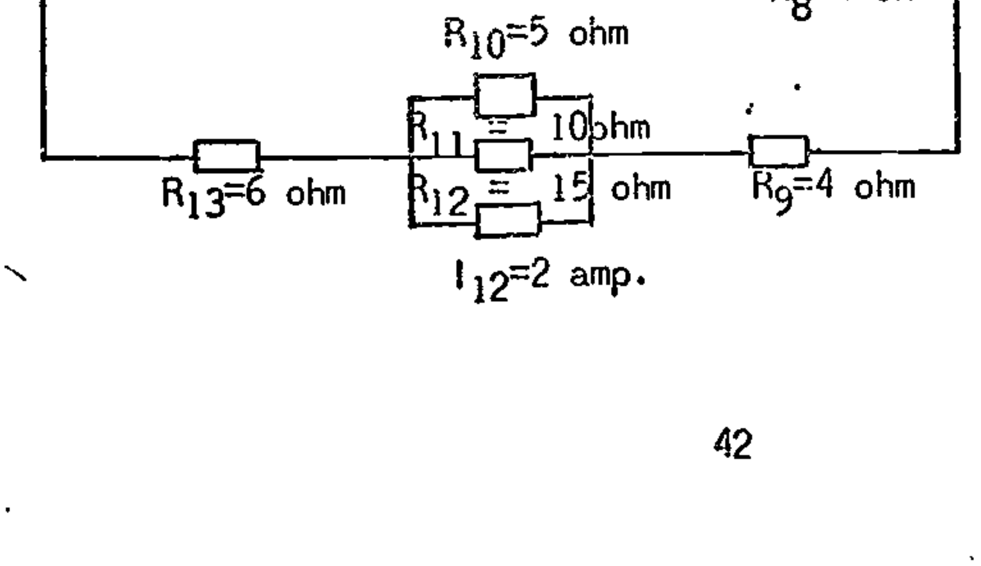
9. Solve the following circuit for all values of current, resistance and voltage.



10. Solve the following circuit for all values of current, resistance and voltage.



11. Solve the following circuit for all values of current, resistance and voltage.



NAME________________________________ Lesson A-17

DATE________________________________ Power and Work

REFERENCE

1. American Electricians' Handbook, Pages 1-24 - 1-27, 1-40.
2. Basic Mathematics, Pages 148 - 156.
3. Basic Electricity, Vol. 2, Pages 42 - 54.

PROBLEMS

1. Mechanical power depends upon ________________ and ________________.

2. Electrical power is the product of ________________ and ________________.

3. ________________ is the unit of power.

4. State the number of watts per horsepower.

5. ________________ is the capacity to do work.

6. ________________ is the ______________ rate of doing work.

7. ________________ watts equals one kilowatt.

8. ________________ is the electrical work done in one hour.

9. ________________ is the effect of rotation.

10. Express the three relationships between power, voltage and current in D. C. circuits.

    (a) ________________ (b) ________________ (c) ________________

11. ________________ is the unit of work.

12. A lamp draws 9 amperes at 110 volts. How much power is consumed?

13. An electric water cooler is rated 700 watts at 110 volts. How many amperes does it pull? What is the horsepower rating of the compressor motor?

14. A ________________ of electrical power is the power used when one volt causes one ampere of current to flow in a circuit.

15. ________________ is the ratio of output to input.

NAME ______________________________ Lesson A-17

Power and Work Page 2

16. A toaster rated 1350 watts draws 12 amperes. Find the correct voltage.

17. A motor draws 1600 amperes at 120 volts. How much power is consumed?

18. A resistor carries 2 amperes at 120 volts. What is the rating in watts?

19. How much power is drawn by a 3/4-Horsepower motor drawing 7.59 amperes from a 208-volt line?

20. Six 200-watt lamps are connected in parallel on a 120-volt line. Find the total power used and total current.

21. How many kilowatts are developed by a 22,000 Horsepower generator?

22. Find the power used by a 40-ohm resistor drawing 5 ampe

23. Find the power used by a 40-ohm resistor on a 120-volt line.

24. A floodlight is rated 1500 watts on a 115 volt line. Find the amperes used.

25. A 300- and a 150-watt lamp are connected in parallel across 115 volts. Find the total resistance of the lamps.

26. What is the maximum current carrying capacity of a toaster marked 1350-watts and 20-ohms?

NAME ______________________________ Lesson A-18

DATE ______________________________ Wire Construction

REFERENCE

1. American Electricians' Handbook, Pages 2-2 - 2-13, 2-36 - 2-38.

2. National Electrical Code, Article 310.

PROBLEMS

1. A wire is a __________ ______________ or ____________ of __________ metal.

2. A ____________ is a wire or combination of wires, not insulated from each other, suitable for carrying a single electric current.

3. ____________ ______________ is a group of twisted wires to form a conductor.

4. A cable may be a single ____________ or ____________ - ______________.

5. ______________ is one wire in a stranded conductor.

6. What is a stranded wire?

7. What is a cord?

8. _____________ cable is composed of two insulated single-conductor cables twisted together.

9. _____________ cable is composed of three insulated single-conductors, twisted together.

10. Sizes of wires in this country are expressed in ______________ ______________ ______________.

11. A ______________ may be used to determine the size of a wire or cable.

12. List six classifications of wires or cables.

(a) ______________________________
(b) ______________________________
(c) ______________________________
(d) ______________________________
(e) ______________________________
(f) ______________________________

13. ______________ conductors are protected against mechanical injury only.

NAME ______________________________ Lesson A-18

Wire Construction Page 2

14. ________________ cables are covered with electrical insulation and an outer protective covering over the insulation.

15. Types "_______" and "_______" are examples of covered cables.

16. _________________ conductors are more flexible than a solid conductor.

17. List six materials used in construction of cables:

(a) ______________________________ (d) ______________________________
(b) ______________________________ (e) ______________________________
(c) ______________________________ (f) ______________________________

18. _______________ is the most commonly used material for wires and cables due to its _____________ _____________.

19. List three grades of copper wires:

(a) ________________________
(b) ________________________
(c) ________________________

20. ______________ - ______________ wire is used for long-span transmission lines.

21. ______________ - ______________ wire is used for most insulated conductors.

22. List three advantages of multiple-conductor cable:

(a) ____________________________
(b) ____________________________
(c) ____________________________

23. List three advantages of a single-conductor cable:

(a) ____________________________
(b) ____________________________
(c) ____________________________

24. List seven characteristics for an ideal insulating material:

(a) ____
(b) ____
(c) ____
(d) ____
(e) ____
(f) ____
(g) ____

25. ________________ compounds are used more often for insulation of electrical conductors.

NAME______________________________ Lesson A-18

Wire Construction Page 3

26. All wires shall be marked indicating __________ ___________ ___________ designation.

27. Type "______" cable is insulated with mineral insulation.

28. All conductors shall be _______________ unless permitted otherwise by the code.

29. All conductors shall be rated for ___________ volts unless permitted otherwise by the Code.

30. Give the Code designation for the following types of insulation:

    (a) Moisture-Resistant Thermoplastic ______________________
    (b) Moisture and Heat-Resistant Thermoplastic ___________________
    (c) Moisture and Heat-Resistant Rubber ______________ ______________
    (d) Heat-Resistant Rubber __________ _______ ___________
    (e) Mineral Insulation __________________

31. Maximum operating temperature for Type "RHW" insulation is ____________ F.

32. Maximum operating temperature for Type "RHH" insulation is ____________ F.

33. Maximum operating temperature for Type "THW" insulation is ____________ F.

34. Maximum operating temperature for Type "TW" insulation is ____________ F.

35. Type "RHH" insulation is restricted to use in ___________ locations.

36. Type "RHW" insulation may be used in __________ and __________ locations.

37. Type "THW" insulation may be used in __________ and __________ locations.

38. Code rubber insulation is Type ______________.

39. List eight types of insulating materials:

    (a) ____________________________ (e) ____________________________
    (b) ____________________________ (f) ____________________________
    (c) ____________________________ (g) ____________________________
    (d) ____________________________ (h) ____________________________

WIRE AND MATERIALS

INTRODUCTION:

According to the electron theory, electricity has been called the movement of free electrons through a material. Thus, we can assume that unless a material contains free electrons, it will not conduct electricity.

In this lesson, we will consider the number of free electrons contained in materials associated with the use of electricity. To identify these materials, they are divided into two classes called conductors and insulators. A conductor is a material that will allow current to flow through it. An insulator is a material that will not allow current to flow through it.

CONDUCTORS OF ELECTRICITY:

Copper is used as the most common conductor of electricity. From the figures below you can see that it contains nearly as many free electrons per square inch as silver and is less expensive.

Copper contains about 1,600,000 billion billion free electrons per square inch. (In electrical mathematics, this number is written 16×10^{23} and means 1,600,000,000,000,000,000,000,000) The following list of common conductors show that as the number of free electrons decreases, the ability to conduct electricity decreases. It is a fact that when equal voltage is applied, the better materials will conduct more electricity.

Material	Free Electrons Per Cubic Inch	Material	Free Electrons Per Cubic Inch
Silver	16.4×10^{23}	Nickel	3.5×10^{23}
Copper	16×10^{23}	German Silver	3.3×10^{23}
Aluminum	9×10^{23}	Nichrome	2.5×10^{23}
		Iron	2.2×10^{23}

INSULATORS OF ELECTRICITY:

The materials considered to be the best insulators contain very few free electrons compared with metal conductors. It should be remembered that there is no material known as a perfect electrical insulator. It is evident that some electrons will flow when the material is subjected to voltage. Thus, when only a few electrons will flow, the material can be considered to be a good insulator. The following is a list of insulating materials and the amount of free electrons they contain per cubic inch:

Hard rubber	3	Waxed Mahogany	670,000
Paraffin	270	Plate Glass	1,380,000
Clear Mica	14		

NAME ______________________________ Lesson A-19

DATE ______________________________ Wire Sizes

REFERENCE

1. American Electricians' Handbook, Pages 1-32 - 1-36, 2-4 - 2-5, 2-40 - 2-45.
2. Basic Mathematics, Pages 258 - 284.
3. National Electrical Code, Article 310, Tables 8 and 9.

NOTE: Use Copper Conductors for Calculation of all Problems.

PROBLEMS

1. A good conductor has a high ____________________.
2. Insulators have a low ____________________.
3. List four factors affecting resistance:

   (a) ____________________ (c) ____________________
   (b) ____________________ (d) ____________________

4. The longer a conductor, the ______________ the resistance.
5. Increase in the diameter of a conductor ________________ the resistance.
6. Materials of ______________ resistance are used for conductors.
7. An increase in temperature will ________________ the resistance of a conductor.
8. Cross sectional area of a conductor is expressed in ____________ ____________.
9. A copper conductor 500 feet long has a resistance of 6 ohms. What is the resistance of 800 feet of this conductor?

10. A copper conductor 0.05 inches in diameter has a 6-ohms resistance. If the diameter is increased to 0.07 inch, what is the resistance of the conductor?

11. Find the resistance of a copper conductor at 110° F. if the resistance at 72° F. is 6-ohms.

12. One mil equals __________________inches.
13. ____________ is the abbreviation for circular mil.

NAME______________________ Lesson A-19

Wire Sizes Page 2

14. A wire having a diameter of 5 mils has a sectional area of ____________ circular mils.

15. A wire having a diameter of 0.007 inch has a sectional area of ____________ circular mils.

16. A wire having a sectional area of 12,450 circular mils has a diameter of ____________ mils or ____________ inch.

17. Normally diameters of wires are expressed in ____________.

18. Sizes of wires are given in ____________ ____________ ____________ (____________).

19. Find the diameter in mils and AWG number of a conductor having a diameter of 0.1285 inch.

20. Find the diameter in inches and AWG number of a conductor having a sectional area of 66,360 circular mils.

21. ____________ ____________ is the ability of a specific material to resist the flow of current.

22. The specific resistance of copper is ____________; aluminum, ____________; silver, ____________; nickel, ____________.

23. Find the resistance of 700 feet of copper wire having a cross-sectional area of 12,000 CM.

24. Find the length of aluminum wire on a distribution system having a resistance of 3-ohms and a diameter 0.80 inch.

25. Temperature coefficient of resistance for aluminum wire is ____________ per Fahrenheit degree.

26. Temperature coefficient of resistance for copper wire is ____________ per Fahrenheit degree.

27. Find the resistance of a copper wire at 170° F. if the wire has a 40-ohms resistance at 62° F.

NAME ________________________________ Lesson A -19

Wire Sizes Page 3

28. Firm, tight joint connections have a ________________ resistance.

29. The area of wire in circular mils is equal to the ________________ of the diameter in ________________.

30. Find the resistance of a Tungsten wire to replace a copper wire having a resistance of 8-ohms.

31. Find the length of nickel cable, 0.005 inch in diameter, required to make a resistor of 1000-ohms.

32. Heat is produced in a wire whenever a ________________ flows.

33. Increasing the wire size ________________ the resistance.

34. Find the maximum allowable current-carrying capacity of a No. 2/0 Type "THW" insulated conductor in conduit.

35. Find the minimum Type "THW" insulated conductor to carry a load of 77 amperes.

36. List three criteria for selecting a conductor size:

(a) ________________________________

(b) ________________________________

(c) ________________________________

37. Find the minimum size Type "THW" insulated conductor to supply a 12 kw load rated 230 volts, single phase.

38. Find the minimum size Type "THW" insulated copper conductor to supply a 50 kw lighting load from a 230 volt single phase source 425 feet away.

39. The current issue of National Electrical Code permits a ________ per cent drop in feeders for lighting loads and __________ per cent drop in feeders for power loads.

40. A well pump rated 10 HP, 220V., single phase, is connected to the panelboard by a No. 6 Type "THW" insulated feeder. What is the maximum distance the pump may be located from the panelboard? (Note: Refer to National Electrical Code, Table 430-148).

41. Six No. 10 Type "THW" conductors are installed in a 1-inch conduit. What is the maximum current-carrying capacity of the conductors?

42. A No. 4/0 Type "RH-RW" feeder is installed in a furniture factory. What is the maximum current-carrying capacity?

43. In a textile plant a dryer is installed requiring 700 amperes. What is the minimum size of Type "RHW" conductors necessary for two parallel runs to serve this load?

44. With the same load of Problem 43, what size of Type "V" conductors for two parallel runs?

NAME ______________________________ Lesson A-20

DATE ______________________________ Voltage Drop

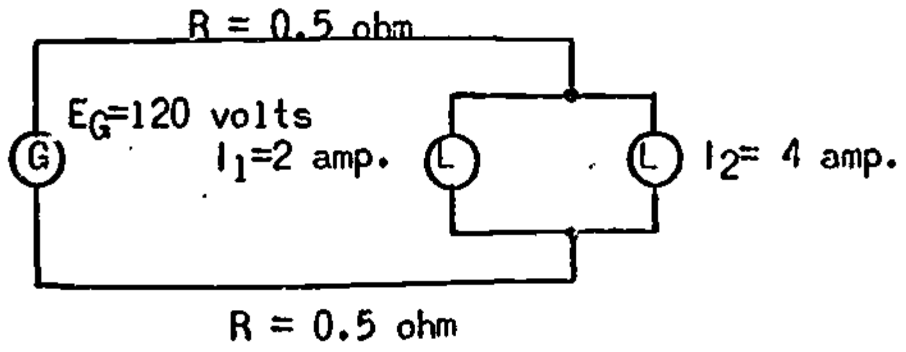
Reference

1. American Electricians' Handbook, Pages 3-20 - 3-21.
2. Basic Mathematics, Pages 138 - 147, 280 - 284.
3. National Electrical Code, Section 215-3.

PROBLEMS

1. ____________ ____________ is the total voltage supplied to the circuit from the source of voltage.
2. ____________ ____________ is the voltage available to operate the devices or loads.
3. ____________ ____________ is the voltage lost by the flow of current through the line wires.
4. ____________ ____________ is the sum of ____________ ____________ and load voltage.
5. ____________ is the symbol for line voltage.
6. ____________ is the symbol for line resistance.
7. ____________ is the symbol for line current.
8. ____________ is the symbol for load voltage.
9. ____________ is the symbol for generator, source, or supply voltage.

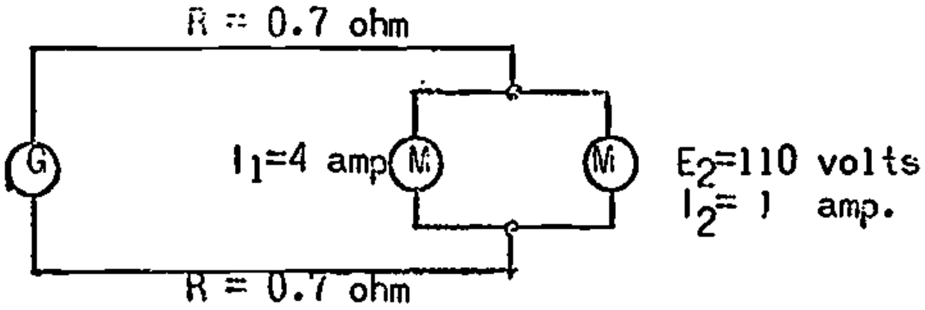
10. Find the line drop and load voltage of the following circuit.



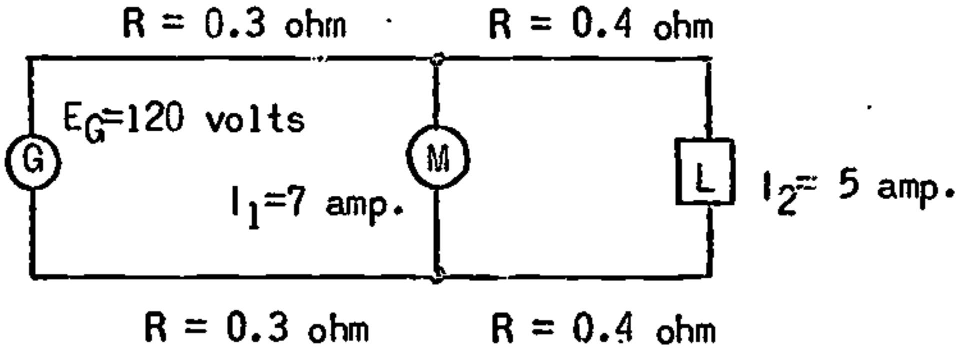
NAME ______________________ Lesson A-20

Voltage Drop Page 2

11. Find the line drop and generator voltage of the following circuit.



12. Find load voltages of the following circuit.



13. A lighting panelboard draws 60 amperes from a 220 volt source 200 feet away. Find the minimum gauge of Type "THW" permitted by the National Electrical Code.

14. A 25-Horsepower motor is operated from a 460-volt source 150 feet away. Find the minimum gauge of Type "THW" permitted by the National Electrical Code if the motor has an efficiency of 85 per cent.

15. A load 400 feet from the source requires 100 amperes. The generator voltage is 220 volts and the required load voltage is 208 volts. Find the minimum size of Type "THW" cable permitted.

16. List three unsatisfactory operating conditions which may be caused by excessive voltage drop:

(a) ______________________________
(b) ______________________________
(c) ______________________________

NAME________________________________

DATE________________________________

Lesson A-21
Introduction To
The National Electrical Code

REFERENCE

1. National Electrical Code, Articles 90, 100, 110.

PROBLEMS

1. The purpose of the Code is the __________ ________________ of persons, and of buildings and contents from dangers arising from use of electricity.

2. The Code is not intended as an __________ ____________ for untrained persons.

3. The Code covers __________ ___________ and ____________ installed within public and private buildings.

4. The Code ________ ___________ cover installations by electric utilities.

5. The Code is revised__________ __________.

6. Formal requests for interpretations of the Code should be addressed to

_____ _________ _____________ _____________ ____________.

7. The Code is intended to be suitable for ______________ application by governmental bodies and for use by ____________ _______________.

8. Equipment is _______________ if it can be removed or adjusted without disturbing the building structure or finish.

9. A ________________ ____________ is utilization equipment at a specific location installed to perform one or more functions.

10. _____________ equipment is acceptable to the authority enforcing the Code.

11. A _____________-_____________ _____________ _____________ is a circuit consisting of two or more ungrounded conductors having a p.d. between them and an ______________ grounded conductor ("______________") having equal p.d. between it and each ungrounded conductor of the circuit.

12. A _____________ ________________ is a conductor having no covering or insulation.

13. A _____________ ________________ is a device whereby the conductors of a circuit are disconnected from the source of supply.

14. __________________ equipment is surrounded by a case which will prevent a person from accidentally contacting live parts.

15. __________________ wiring is not concealed.

16. A _________________ is a conducting connection between an electrical circuit and the ____________ __.

NAME____________________ Lesson A-21
Introduction To
The National Electrical Code Page 2

17. A ____________ conductor is intentionally ____________ to the earth and is also called "____________ ____________" or "____________".

18. A ____________ conductor connects receptacles to a ground and is also called ____________ ____________.

19. A ____________ location is not normally subject to dampness or wetness.

20. A wet location is subject to saturation with ____________ or ____________ ____________.

21. A ____________-____________ ____________ is a type of raceway designed to hold conductors and receptacles.

22. A ____________ ____________ is a person who is familiar with construction and operation of the apparatus and the ____________ involved.

23. ____________ are designed for carrying cables, wires, or busways.

24. A ____________-____________ ____________ is any electrical circuit which controls another circuit through a relay or equivalent device.

25. The ____________ ____________ is the service conductors made up in the form of a cable.

26. The ____________ ____________ is the overhead service conductors between the last pole and first point of attachment to the building.

27. The ____________-____________ conductors are between the terminals of the service equipment and tap to overhead service drop.

28. Underground ____________-____________ conductors are between the ____________ of the service equipment and the point of connection to the utility transformer or line.

29. Service equipment is located near ____________ of ____________ of ____________ ____________ to a building and is intended to constitute the ____________ ____________ and means of ____________ for the power supply to the building.

30. ____________ is the value of the current at which a circuit breaker is set to trip.

31. A ____________ ____________ switch is rated in amperes and is capable of interrupting its rated current at rated voltage.

32. List three uses for the A. C. General Use Snap Switch:

(a) ______________________________
(b) ______________________________
(c) ______________________________

NAME______________________________ Lesson A-21
Introduction To
The National Electrical Code Page 3

33. A ______________ ______________ switch is horsepower rated.

34. ____________ equipment is constructed to prevent moisture entering the equipment.

35. ______________ equipment is constructed to be protected for successful operation against exposure to the weather.

36. The use of the word "____________" in the Code requires mandatory consideration.

37. Rules that are recommended are characterized by the word "____________".

38. Conductor sizes are given in ____________ ______________ ____________.

39. Electrical equipment shall be installed in a __________ and ______________ manner.

40. Working spaces adjacent to exposed live parts shall not be used for ________.

41. Equipment mounted a minimum of ____________ feet above the floor usually affords good protection.

42. All wiring shall be installed free from ____________ ____________ and ______________________.

43. The insulation resistance of a No. 12 AWG conductor shall be ______________ ohms.

NAME ____________________________

DATE ____________________________

Lesson A-22
General Requirements
For Wiring Installations

REFERENCE

1. American Electricians' Handbook, Pages 9-140 - 9 - 171.

2. National Electrical Code, Article 300.

PROBLEMS

1. Minimum size conductor for interior wiring work shall be ______________ AWG.

2. List two advantages of No. 12 AWG conductor over minimum size conductor:

   (a) ____

   (b) ____

3. Maximum size for solid conductors is ________________ AWG.

4. ________________ conductors are used for ease in handling.

5. All ____________ conductors shall be protected by __________ or __________ ________________.

6. The branch circuit over-current protective device may be located at the load-end of the conductor provided (1) ______________________________

   (2) ______________________________

   (3) ______________________________

7. ________________ ________________ circuit breakers shall be set at not more than __________ per cent of the allowable current-carrying capacity of the conductor.

8. ______________ conductors must not be fused.

9. Enclosures for overcurrent devices shall be mounted in a ________________ position.

10. Fuses shall not be mounted in ______________.

11. Fuses and circuit breakers shall be ____________ or ____________ to prevent ____________ or ____________ by their operation to persons.

12. Minimum size flexible cord shall be ______________ AWG.

13. Conductors shall not be ____________ or ____________ within the raceway or conduit.

14. Minimum size conductor permitted to be connected in parallel is __________ AWG.

15. In parallel conductors run in separate conduits, one wire of ______________ ______________ shall be installed in each conduit.

NAME ______________________________ Lesson A-22
General Requirements
For Wiring Installations Page 2

16. Grouping of conductors by phases in parallel runs in separate conduits will cause _______________ _______________ to _______________ of the metal by _______________.

17. Each outlet shall have at least ____________-inches of free conductor.

18. Ungrounded conductors, No. 4 AWG or larger, entering a cabinet shall be protected by a ___________ ____________ _________.

19. Conductors of light and power systems of 600 volts or less may occupy the same enclosure provided the _______________ are _______________ for the _______________ _______________ of any conductor within the enclosure.

20. Minimum insulation resistance for No. 14 or No. 12 AWG circuits shall be _______________ ohms.

21. The test for the insulation resistance is made with a _______________.

22. In general, all interior wiring systems shall have a ______________________ conductor.

23. The __________________ conductor must be continuously identified throughout the system.

24. In a screw shell device, the _______________ _______________ conductor shall be connected to the screw shell.

25. Equipment located __________ feet above accessible working area provides suitable protection.

26. All conduits must be __________________ from outlet to outlet.

27. All boxes shall be _______________ _______________ in place.

28. For exposed conduit, wiring conduit boxes less than ______________ cubic inches in size may not be separately fastened if the conduit is secured in threaded hubs on the box.

29. A fixture weighing more than _______________ lbs. or exceeding _______________ inches in any dimension must not be supported by the screw shell of the lamp holder.

30. A fixture weighting more than __________ lbs. must be supported independently of the outlet box.

31. The maximum No. 12 AWG conductors permitted in an outlet box, 2 1/8 x 4 11/16 square, shall be _____________.

32. All junction boxes shall be installed with the wiring _______________.

NAME ______________________________ Lesson A-22
General Requirements
For Wiring Installations Page 3

33. Boxes installed in tiled or plastered walls or ceilings shall have the front edge of the box set back flush maximum of __________ inches from the finished surface.

34. Boxes installed in wood walls shall be set ________ with finished surface.

35. The minimum size in length for straight pull junction boxes shall be ______ times the trade diameter of the largest raceway.

36. Unused openings in cabinets shall be ___________.

37. Gutters shall be supported at intervals not exceeding _________ feet.

38. List two types of grounds: (a) ______________________________
(b) ______________________________

39. Define a system ground:

40. Define an equipment ground:

41. In general, all exposed non-current-carrying metal parts of fixed equipment shall be ____________.

42. ____________ ____________ circuits are not required to be grounded.

43. ____________ ________ ____ operating over combustible fibers in Class III hazardous location shall not be grounded.

44. The __________ conductor is commonly known as "the white wire" or "____________".

45. There shall be a ground at each building service on the _________ side of the ___________ _________.

46. The minimum size service grounding conductor shall be ___________AWG.

47. The minimum size grounding conductor for a 500 mcm service conductor shall be ___________AWG. (man made electrode)

48. The grounding conductor shall not be ____________ or ____________ throughout its length.

49. Bare grounding conductors smaller than ________AWG shall be in conduit or EMT.

50. The best grounding electrode is an __________ __________ __________ system.

NAME ______________________________

51. The maximum resistance to ground shall not exceed ______________ ohms.

52. Grounding conductors shall be attached to a water piping system on the ____________ ________ __________ of the water meter.

53. Grounding connections shall not be made with ________________.

54. Grounding connections shall be made by an approved ____________________ ____________________.

55. Only ______________ grounding conductor shall be connected to the grounding electrode by a single fitting.

56. All ungrounded conductors must be finished in ______________, ____________, ______________ or any color contrasting to _________________.

57. No _______________ shall be used in a grounded conductor.

58. What are service-drop conductors?

59. What are service-entrance conductors?

60. The service equipment shall consist of ______________ __________________ ______________ ________________ and __________ ____________ ____________

61. ____________ ______________ is a service which supplies more than one building under single management.

62. ______________ service shall supply one building from another unless under the same management.

63. ______________ _______________ may require a separate service.

64. Minimum size service conductor shall be ____________ AWG.

65. List three types of insulation for overhead service drops:

(a) _________________________________
(b) _________________________________
(c) _________________________________

66. ___________________ loops shall be formed on overhead individual service conductors.

67. Where underground service raceways enter the building the ends within the building shall be _______________ to prevent the entrance of __________ or ______________.

68. Service conductors shall not be ______________.

69. Type "AA" insulated wire is limited to ____________ volts.

70. Switches rated __________ amperes at __________ volts or less cannot be used to open under load.

71. ________________ device shall be installed in raceways for refrigeration room to prevent circulation of air from warmer to cooler area.

72. Splices and taps may be made in auxiliary gutters and wireways provided cross-sectional area of the splices and taps does not exceed ____________ per cent of the cross-sectional area of the gutter or wireway.

73. Underfloor raceway shall have a maximum conductor fill of ____________ per cent of the total cross-sectional area of the raceway.

74. __________________ shall not be installed until the interior of the building has been physically protected from the ________________.

75. _______________ and ________________ may be used to lubricate conductors to be pulled through raceway system.

76. Vertical support of 250 MCM copper cable shall not exceed ______________ feet.

Lesson A-23

RIGID METAL CONDUIT BENDING

The art of conduit bending with hydraulic equipment, although still dependent upon the skills of the individual, has been simplified by workable formulas that are easily learned and applied. The principle upon which these formulas are based is safety. The NEC states that bends must be so made that the conduit is not injured and its internal diameter is not effectively reduced. It further states in a table the minimum inside radius of conduit bends.

RADIUS OF BEND

Various factors influence, and in some circumstances determine, the radius of a bend. Generally, it should be the longest radius possible. Although, the inside radius of a field bend is specified in the National Electrical Code in terms of minimum radius, the specification is intended to insure an undamaged elbow and safe passage for cable. When it comes to actually installing cable in conduit, the relative ease or difficulty of the pull becomes very important to the electrician. Experience quickly teaches you that it is easier to pull cable through a long sweeping elbow than it is through a short, more tightly bent one. Of course, the radius of the bend is the determinant here, for as the radius length increases, the sweep or arc of the bend increases.

From the experience of many electricians, the "rule of thumb" has evolved that a satisfactory elbow can be made in conduit. (1) For LEAD SHEATHED CONDUCTORS by using a radius that is 10 to 12 times the internal diameter of the conduit. (2) Elbows that do not have lead sheaths require a radius equal to 8 to 10 times the conduit's internal diameter.

PRINCIPLES OF PRECISION BENDING

In "one-shot" or "segment bending" of conduit, you must be familiar with the hydraulic benders and how they operate.

Before you can made a precision bend in conduit, you must:

1. Determine the size of conduit to be bent.
2. Determine the radius of the bend.
3. Determine total degrees in the bend.
4. Calculate the developed length.
5. Calculate the gain.
6. Locate the center of bend.
7. Determine the number of bends required.
8. Calculate and mark spacing for bends on the conduit.

All formulas and factor tables are based on measurements to the centerline of conduit.

CONCENTRIC BEND.

Concentric bends are calculated by the same formulas and made by the same processes as those used for 90° bends. Radii and segment bending spaces will differ as each bend recurs in the next-lying run of conduit.

NOTE: Students should observe concentric bending of exposed conduit in several industrial installations.

Whether these bends are to be made in the same or varying sizes of conduit, the radius of the second of two successive concentric bends is equal to the radius of the first plus one-half the sum of their outside diameters plus the width of the spacing between them. Since concentric bends have not only a common center, but also equal separation, sufficient space must be provided between all concentric bends. This will accommodate couplings and straps sized for the largest conduit in the run regardless of their diameters.

GENERAL PURPOSE BENDING

In actual practice, the electrician finds that all hydraulic bending operations do not require an equal degree of precision. While the same mathematical principles are involved, generally, on some jobs it may not be necessary to work with centerline measurements, or to consider the gain or center location of a proposed bend.

However, minimum radius length, which in effect constitutes a safety factor in any conduit installation, and the determination of a bend's developed length cannot be overlooked.

Preliminary Calculations. The electrician's rule, states that ten times the diameter of the conduit as a satisfactory bending radius for the average bending job. The next consideration is to find out the point on the conduit the bend should start. To do this, measure the required rise from the bottom of the conduit, and, from this measurement, deduct the length of the radius. The distance remaining is the starting point of the bend, measured from the end of the conduit. Now, with chalk, mark this remaining distance on the conduit as the starting point for the bend.
(Illustrate on chalkboard using a 30" radius and 50" rise.)

Now, to calculate the developed length of the bend as before, multiply the radius (30") of the bend by 1.57. Mark this distance on the conduit, measuring from the start of the elbow. Bending gain is calculated by the formula--radius of bend multiplied by gain factor (from table). The overall length equals the leg length plus the developed bend length plus the riser. It is important to find the center of bend and mark it on the conduit for reference.

BENDING THE ANGLE

Experience becomes the best teacher regardless of the procedure used for bending conduit. Although, the conduit may be divided into two-inch segments and operating instructions are provided for the hydraulic equipment, the special bending accessories may differ from bender to bender. Experience has shown that it is advantageous to reserve two bending spaces, the first and the last, until the other segments are completed and the bend has been checked in place.

It should be noted that to confine the intended bending effect within a given segment, the center of the ram and shoe of the bender should be in line with the center of each bending space (segment). This will provide better overall control and accuracy.

NAME ______________________________ Lesson A-23

DATE ______________________________ Rigid Metal Conduit

REFERENCE

1. American Electricians' Handbook, Pages 9-27 - 9 -55.
2. National Electrical Code, Article 346.

PROBLEMS

1. ____________ ____________ conduit may be used under all atmospheric conditions and all occupancies except in ____________ ____________ areas and where ____________ conduit is installed.

2. ____________ conduit may be used indoors only and areas not subject to ____________ ____________ conditions.

3. The use of ____________ metals in contact in a rigid raceway system shall be avoided to eliminate the possibility of ____________ action.

4. Standard conduit shall be installed at least ____________ inches below cinder fill unless installed in a ____________ inch minimum concrete envelope.

5. In wet locations, entire conduit system shall be installed to prevent ____________ from entering conduit.

6. In wet locations, ____________-inch air space shall be maintained between conduit and ____________ ____________.

7. In general, the minimum size of conduit shall be ____________-inch.

8. List two conditions which are exceptions to the minimum size conduit:

   (a) ____

   (b) ____

9. The maximum fill-area permitted by the current issue of National Electrical Code in existing raceways for non-lead covered conductors (3 or more) is ____________ per cent.

10. Conduit ends shall be ____________ to remove rough edges.

11. In a junction box or fitting, ____________ shall be installed on conduit to protect conductors from abrasion.

12. ____________ thread shall not be used to facilitate installation of coupling.

13. Minimum radius of bend for a 1-inch conduit is ____________ inches.

NAME ____________________ __________ Lesson A-23

Rigid Metal Conduit Page 2

14. The maximum number of bends permitted in one conduit run is ____________ quarter-bends or total ____________ degrees.

15. Standard length of rigid conduit shall be ____________ feet.

16. List four advantages of rigid-metal conduit:

(a) ____
(b) ____
(c) ____
(d) ____

17. List two types of rigid-steel conduit:

(a) ____
(b) ____

18. Each conduit run shall terminate in an ____________ outlet box.

19. All boxes shall be installed where the outer edge box will be ____________ with the plaster surface.

20. Top of a junction box shall never be ____________.

21. Conduit must be fastened securely to the box using a ____________-____________ on the outside and a ____________ on the inside of the box.

22. The use of elbows, bends and conduit crossings can be eliminated by installing ____________ ____________.

23. Conduit shall run as ____________ and ____________ as possible with a maximum of ____________ right-angle bends between ____________.

24. A vertical run of 500 MCM conductors shall be supported on a maximum of ____________ foot centers. (copper) Use current code.

25. ____________ are popular field benders.

26. ____________ ____________ is the best tool for cutting conduit.

27. ____________ ____________ is tempered rectangular steel wire.

28. Care must be taken in feeding conductors in conduit to prevent ____________ or ____________.

NAME ______________________ Lesson A-24

DATE ______________________ Electrical Metallic Tubing

REFERENCE

1. American Electricians' Handbook, Pages 9-68 - 9-70.
2. National Electrical Code, Article 348.

PROBLEMS

1. Electrical metallic tubing is commonly known as ______________.
2. EMT may be installed ____________ or ______________.
3. EMT shall not be used where it is subject to severe physical damage either ______________ or ______________ its installation.
4. EMT shall not be installed in __________ fill or fill subject to __________ ______________.
5. EMT may be installed a minimum of __________-inches below cinder fill.
6. EMT may be installed in a cinder fill if it has a ________-inch minimum concrete envelope.
7. Maximum size of EMT permitted is ________-inches.
8. If EMT is installed in wet locations, _________ connectors shall be used.
9. ____________ couplings shall be used on EMT installed in concrete to prevent __________ entering raceway.
10. In wet locations, ___________ fittings for EMT shall be the __________-__________________ type.
11. Bends in EMT shall not exceed _________ quarter bends or equivalent ______________ degrees between outlets or fittings.
12. All ends of EMT shall be ___________ to remove rough edges.
13. EMT shall not be used on electrical systems exceeding ___________ volts.
14. In wet locations, EMT shall be mounted with at least _______-inch air space between it and supporting surface.
15. The minimum allowable size of EMT is ______-inch.
16. Standard length of EMT is _________ feet.

NAME ______________________________ Lesson A-25

DATE ______________________________ Flexible Metal Conduit

REFERENCE

1. American Electricians' Handbook, Pages 9 - 50 - 9 - 55.

2. National Electrical Code, Articles 350 and 351. Current Issue.

PROBLEMS

1. ____________ and ______________ may be used to support flexible metal conduit.

2. Supports for flexible metal conduit shall be located a maximum of ________ inches from outlets or fittings.

3. Supports for flexible metal conduit shall be located a maximum of ________ feet on centers.

4. List three conditions where supports for flexible metal conduit are not required.

   (a) ____

   (b) ____

   (c) ____

5. In attics, flexible metal conduit may be run on sides of ______________ ______________ or through ______________.

6. Minimum radius bend for flexible metal conduit shall be ____________ times conduit diameter.

7. Installation of flexible metal conduit is ____________ and ____________ than the installation of rigid conduit.

8. Flexible metal conduit must be ______________ from outlet to outlet.

9. The minimum size of flexible conduit permitted is ______________ inch

10. ______________ ______________ should be used to cut flexible conduit.

11. Liquid-tight flexible conduit is similar to flexible conduit except with a ____________-____________ ____________ ____________.

12. ____________-____________ ____________ ____________ is not a general purpose raceway material.

NAME ______________________________

DATE ______________________________

Lesson A-26

Storage Batteries

REFERENCE

1. American Electricians' Handbook, Pages 4-130 - 4-178.
2. Basic Electricity, Pages 1-23 - 1-29.
3. National Electrical Code, Article 480.

PROBLEMS

1. Lead-acid battery voltage is based on ____________ volts per cell.
2. ______________-type battery voltage is based on 1.2 volts per cell.
3. List two methods of supporting lead-acid batteries:

   (a) ______________________________ (b) ______________________________

4. List two materials used in construction of racks:

   (a) ______________________________ (b) ______________________________

5. Separate battery rooms are required for batteries in __________ jars and tanks having capacity at the 8-hour discharge rate exceeding ________ KWH.
6. ______________-______________ covered conductors, Type "______", shall not be used in battery rooms.
7. Bare conductors in battery rooms shall not be ________________.
8. List four types of conductors permitted in battery rooms:

   (a) ____________________________ (c) ____________________________
   (b) ____________________________ (d) ____________________________

9. An ____________ ____________ is a device for producing a voltage by chemical means.
10. A battery may consist of a __________ cell or ____________ of cells.
11. List two classifications of batteries:

    (a) ______________________________ (b) ______________________________

12. ____________ ____________, may be charged or discharged.
13. Primary battery can be used to ________________ only.
14. The solution in a secondary battery is the ____________________.

NAME______________________________ Lesson A-26

Storage Batteries Page 2

15. A common name for a secondary battery is ______________ ________________.

16. List three fundamental materials for battery construction:

(a)__________________________ (c)______________________________

(b)__________________________

17. The charging rate is expressed in _________________________.

18. Storage battery is rated in __________________-__________________.

19. The maximum temperature of a lead-acid battery should be _____________F.

20. Batteries must be charged with _____________________current.

21. ________________ pole of charging source must be connected to positive terminal of the battery.

22. Storage batteries require adding _______________________ only.

23. In general, storage batteries require the addition of __________________ only _________________ time per week.

24. List three types of storage batteries:

(a)______________________________ (c)_____________________________

(b)______________________________

25. ________________ are usually used for emergency and portable electric power.

26. Draw and label a primary cell.

27. Draw and label a dry cell.

NAME ____________________ Lesson A-27

DATE ____________________ Fuses

REFERENCE

1. American Electricians' Handbook, Pages 4-29 - 4-49.
2. Basic Electricity, Pages 2-47 - 2-48, 2-52 - 2-53.
3. Basic Mathematics, Pages 9-11.
4. National Electrical Code, Article 240.

PROBLEMS

1. Fuses prevent __________ currents from accidentally flowing through equipment and burning it up.
2. A __________ circuit occurs when two points in circuit having low resistance are accidentally connected.
3. Fuses are rated in __________.
4. A __________-__________ fuse permits high currents in a circuit for approximately __________ to __________ seconds.
5. Fuses are __________ __________ with __________ __________ resistance.
6. __________ __________ are identified by a broken filament and darkened glass.
7. Fuses are connected in __________ with equipment.
8. List three types of fuses.

   (a) __________ (c) __________

   (b) __________
9. Fuses with too low a rating will result in unnecessary __________-__________.
10. A fuse is an electrical __________ __________.
11. Open link fuses are rated at __________ per cent of the maximum current they will carry.
12. Open link fuses are permitted in sizes exceeding __________ amperes.
13. List three types of plug fuses:

    (a) __________ (c) __________

    (b) __________

NAME______________________________ Lesson A-27

Fuses Page 2

14. Fuses are capable of carrying ______________ per cent overload before blowing.

15. Type "S" fuses are the _______________-_______________ type.

16. The maximum rating of a plug fuse is __________________ amperes.

17. Plug fuse will open a circuit in ____________ seconds at 200 per cent load.

18. _______________ ______________ ____________ ______ fuse has a maximum rating of 60 amperes.

19. ______________ ______________ __________________ fuse has ratings from 70 through 600 amperes.

20. _____________ _______________ fuses are designed for readily replacement of the fuse element.

21. Dual element cartridge fuses contain a ________________ ______________ and ___________________ ___________________.

22. List two general types of silver-sand fuses:

(a)_________________________ (b)_____________________________

23. The interrupting capacity of a silver-sand fuse is ____________ amperes.

24. The maximum rating of silver-sand fuses is ______________ amperes.

25. Plug fuses shall not be rated over ______________ volts.

26. ___________-_____________ type plug fuses are permitted only as replacement in an existing installation.

27. In new construction all plug fuses shall be ______________ _____________.

28. Maximum rating of cartridge at 250 volts is ________________ amperes.

29. ______________ _____________ fuse holders shall not permit the insertion of fuses which are not ________________ ______________.

30. The ______________ volt cartridge fuse is permitted on lower voltages.

31. _______________ fuses shall be used only by special permission.

SAFETY PRECAUTIONS

It is an accepted fact that electricity, if not handled properly, is extremely hazardous. This fact has attributed greatly to the progress that has been made in its control. Through cooperation of manufacturers of electric equipment, governmental bodies, insurance companies and others, the National Electrical Safety Code has been developed. This Code has played an important part in accident-prevention work.

Frequently, construction electricians working with the comparatively low voltage used in house wiring do not have the same respect for it as they do for the high voltage used in delivering current to transformers. They fail to realize that the relationship between the voltage and the resistance of the material serving as ground is the determining factor and therefore danger is not determined solely by the voltage. It should be thoroughly understood that the 110-volt current used in lighting circuits is sufficient to kill under many ordinary situations in which the electricians will be working. If the material to which the worker is grounded has low resistance to the flow of electricity, the amperage will be high, resulting in severe electric shock. Electric shock ranges from mild discomfort to actual stoppage of heart beat and breathing. Serious burns may also result.

The extent of the injury received from electric shock is controlled mainly by the amount of current, the path of the current through the body, and the duration of the shock. The physical condition of the victim may also have a bearing. This fact should never be interpreted to mean that a strong individual should take chances with electricity.

The frequency of the current and the type of current, direct or alternating, are also factors affecting the nature of shock. High frequency current tends to produce heat instead of shock. This is also the case with direct current. Shock hazards are less, but more severe burns can be expected from direct current accidents. Accident reports indicate minor electric shock has caused serious accidents. In these cases, involuntary contraction of the muscles has caused workmen to fall from ladders and scaffolds.

While accidents with electricity are frequently serious, there are fewer safety precautions to be considered than in many other industries. The following rules should be carefully observed by all workmen employed as construction electricians.

1. Assume a circuit is alive until tested and proved dead.
2. Test circuits with proper testing equipment. (110-volt test lamp placed across a 440-volt line will blow up)
3. Use safety equipment, such as insulated tools, rubber mats and rubber gloves.

4. Main switches should be locked open and a tag indicating workmen are working on some part of the circuit before work is started.

5. Before closing a circuit, check carefully to see that workmen are clear of the circuit.

6. Observe the rules of the National Electrical Safety Code.

7. If minor repair of a live circuit cannot be avoided, arrange to have a qualified helper present.

8. Make all parts of a job safe even though they are temporary.

Aside from the hazards of electric shock, the construction electrician is subject to accidents similar to those encountered by other workmen in the building trades, such as, falling from ladders and scaffolds, accidents in manipulation of tools, etc.

Falling is a major cause of industrial accidents. Workmen should avoid improvised steps and ladders. Dependable ladder and scaffolding equipment is available and should be used. Ladders should be inspected frequently to see that rungs or steps are not overly worn, loose, broken, or missing. Rails that are badly split should be discarded. Antislip feet are desirable for both step and straight ladders. They should be of a type designed for the particular purpose. The design of step ladders is an important factor in stability. Frequently, improper placing of ladders results in their slipping, or the workman trying to reach too far and becoming overbalanced.

NAME______________________________ Lesson A-28

DATE______________________________ Safety and First-Aid

QUESTIONS

1. List some ways that Safety habits are responsible for cash savings.
   a. To your company as the employer.

   b. To you as the employee.

2. List several pieces of wearing apparel classed as Safety Equipment generally furnished by the company.

   a.__________________________ b.______________________ c.____________________

3. In the event you are disabled, how much would you collect per week from Workmen's Compensation? $______________

4. Recall an accident that happened to you in the home or on the job. What Safety rule was broken?

5. Give five Safety habits an electrician should practice?
   a. d.
   b. e.
   c.

6. Write your favorite Safety slogan.

7. Name five hazards on any construction job.
   a. d.
   b. e.
   c.

8. List five "unsafe conditions" that may show up in the normal use of a ladder by an electrician.
   a. d.
   b. e.
   c.

9. List five "unsafe acts" that may happen on ladders.
   a. d.
   b. e.
   c.

10. Show how good housekeeping is very much a part of your job. How is good housekeeping a good indication of a safe worker?

NAME______________________________ ELECTRICAL APPRENTICESHIP

DATE______________________________ SERIES "A" TEST NO. 1

MATERIAL COVERED - LESSONS A-1 thru A-8

DIRECTIONS: Show your work on this paper or on an attached sheet with your problems numbered.

1. Add the following:

(a) $\begin{array}{r}274\\ \underline{621}\end{array}$ (b) $\begin{array}{r}925\\ \underline{583}\end{array}$ (c) $\begin{array}{r}240\\ 954\\ 144\\ \underline{485}\end{array}$ (d) $\begin{array}{r}7.40\\ .85\\ 79.20\\ \underline{8.07}\end{array}$

2. Solve the following proportions:

(a) $\frac{12}{E} = \frac{15}{5}$ (b) $\frac{14}{10} = \frac{R}{5}$ (c) $\frac{E}{100} = \frac{12}{10}$ (d) $\frac{I}{48} = \frac{8}{6}$

3. Multiply the following:

(a) $\begin{array}{r}971\\ \underline{15}\end{array}$ (b) $\begin{array}{r}358\\ \underline{47}\end{array}$ (c) $\begin{array}{r}8.04\\ \underline{.96}\end{array}$ (d) $\begin{array}{r}494\\ \underline{25}\end{array}$

4. Find the square root of the following numbers and check: (Use attached sheet)

(a) 189 = __________ (c) .04 = __________

(b) 9286 = __________ (d) 42.62 = __________

5. Divide the following:

(a) $7.25\overline{)\,14{,}500}$ (b) $85\overline{)\,188}$ (c) $55\overline{)\,4786}$ (d) $96\overline{)\,5000}$

6. Subtract the following:

(a) $\begin{array}{r}70.940\\ \underline{-14.656}\end{array}$ (b) $\begin{array}{r}278\\ \underline{-87}\end{array}$ (c) $\begin{array}{r}6.25\\ \underline{-.93}\end{array}$ (d) $\begin{array}{r}5460\\ \underline{-398}\end{array}$

NAME____________________

7. Change the following into decimals:

15/16% = ________ (b) 5½ =________ (c) 4-15/36 =________ (d)8.75%=______

8. Add the following fractions:

(a) 1/32 + 5/16 + 15/64 = ____________________

(b) 6/7 + 9/14 + 13/28 = ____________________

(c) 1/3 + 1/4 + 5/9 = ________________________

(d) 1/25 + 9/40 + 7/50 = _____________________

9. Find the voltage of the motor if a 6% voltage drop is taken in a line having a source of 575 volts.

10. What current flows through a resistor rated 500 ohms and 1000 watts?

11. The weight of conduit is 3000 lbs. per thousand feet. What is the weight of 350 feet of conduit?

12. Thirty-six relays are defective in a group of 650 tested. What is the per cent defective?

13. Change the following decimals into per cents:

(a) 0.87 = _________________ (b) 4.76 = __________________

(c) 0.0195 =________________ (d) 0.276 = __________________

NAME ______________________

DATE ______________________

ELECTRICAL APPRENTICESHIP

SERIES "A", TEST NO. 2

MATERIAL COVERED - LESSONS A-9 thru A-13

1. ________________ can neither be created or destroyed.

2. Find the resistor required to restrict the current to 10 amperes in a 440 volt circuit.

3. ____________ ____________ cannot be used in A-C circuits.

4. Copper is a good ____________.

5. ____________ ____________ are in the outer orbit of an atom and are easily moved.

6. Voltage is measured in units of ____________.

7. Find the voltage in a circuit having a 24 ohm resistor and 5 ampere current. ________V.

8. The flow of electricity is due to the movement of ____________.

9. Find the diameter in mils of a conductor having a diameter of 1¼ inches. __________ mils.

10. Resistance ____________ with a rise in temperature.

11. Find the resistance of 750 feet of copper wire 0.031 inches in diameter.

12. An ammeter is connected in ______________ in a circuit.

13. If 500 feet of No. 0 copper wire has a resistance of 0.049 ohms, find the resistance of 2000 feet. __________ ohms.

14. An ______________ is the smallest amount of an element which has all the properties of the element.

NAME ______________________

15. ______________ charge has excess electrons.

16. Resistance is measured in units of ______________.

17. Find the cross-sectional area of a conductor having a diameter of 0.07 inches. ______________________.

18. Power is measured in units of ______________.

19. Negative charges are called ______________.

20. Ohm's Law states the ______________ is the product of the ______________ and ______________.

21. 15 kilovolts is equal to __________________ volts.

22. Glass is a good __________________.

23. Current is measured in units of __________________.

24. Find the current drawn by a 20-ohm toaster connected to a 120 volt circuit. ____________________.

25. The speed of current is approximately ______________ miles per second.

26. An ______________ prevents the flow of electrons through it.

27. A length of No. 12 AWG copper wire has a resistance of 16 ohms. Find the resistance of the same length of No. 6 AWG copper wire.

28. An ______________ is used to measure current.

29. Voltage is the ______________ in potential.

30. Find the diameter in inches of a conductor having a cross-sectional area of 40,000 cir mils. __________________.

31. Voltage applied to a conductor causes the electrons to move in the ________________ direction.

(c) 0.625 = ____________ (d) 0.90625 = ____________

17. Multiply the following values:

(a) 3/5 x 3.05 = __________ (b) 9/16 x 80.16 = __________

(c) 6-1/3 x 0.32 = __________ (d) 15/16 x .128 = __________

18. Change the following fractions into per cents:

(a) 1/4 = __________ (b) 16/19 = __________

(c) 3-5/8 = __________ (d) 9/16 = __________

NAME ______________________

ELECTRICAL APPRENTICESHIP

SERIES "A", TEST NO. 5
Page 3

39. A vertical run of 350 MCM copper feeder shall be supported on a maximum ______-foot centers.

40. ____________outlet boxes shall not be installed on a conduit system requiring locknuts and bushings.

41. A right angle pull junction box with entering and exiting conduits sized: 3-inch, 3-inch and 4-inch; shall be a minimum of ______x________ inches.

42. A ____________ ____________ ____________piping system is the best grounding electrode.

43. Overhead service conductors shall form a ________ __________ at the servicehead.

44. Metal ____________shall not be used to make grounding connection to water system.

45. Insulated bushings shall be installed on raceways for No. ____AWG and larger conductors.

46. Conductors of different system may be installed in the same conduit provided

NAME ______________________

DATE ______________________

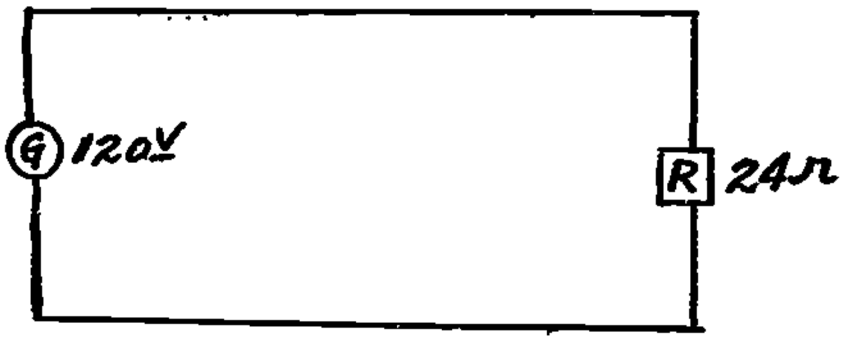
15. Parallel circuits provide a constant ______________.

16. The total current in parallel circuits is equal to the ____________ of the currents in each branch.

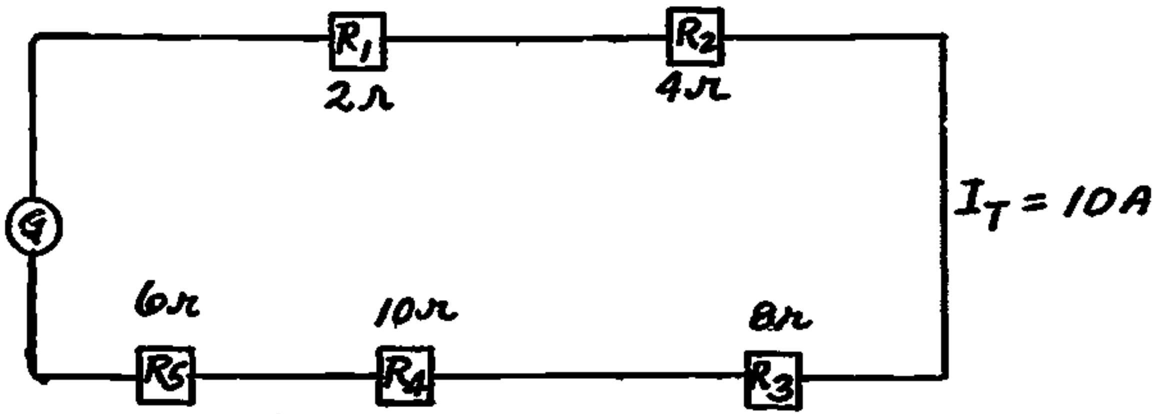
17. The ____________ ____________ in a series circuit is equal to the sum of the resistances in the circuit.

18. In parallel circuits, ___________ current flows in the branch with less resistance.

19. Find the current:



20. Find E_T, E_1, E_2, E_3, E_4, E_5, and R_T.



NAME ______________________

32. Three inches is equal to ___________ mils.

33. Current flow is from _____________ pole to _____________ pole.

34. ______________ resistivity conductors are used for transmission lines.

35. A voltmeter is connected in _____________ in a circuit.

36. ________________ charge has a lack of electrons.

37. The specific resistance of copper is __________ ohms per mil-foot.

38. An ______________ is used to measure resistance.

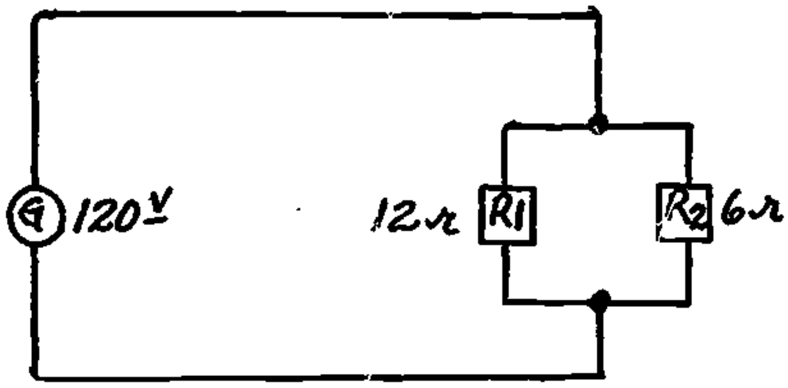
39. Find the lowest voltage required to operate a 100-ohm relay with 0.35 amperes.

40. A _______________ is a legal instrument between the Owner and Contractor.

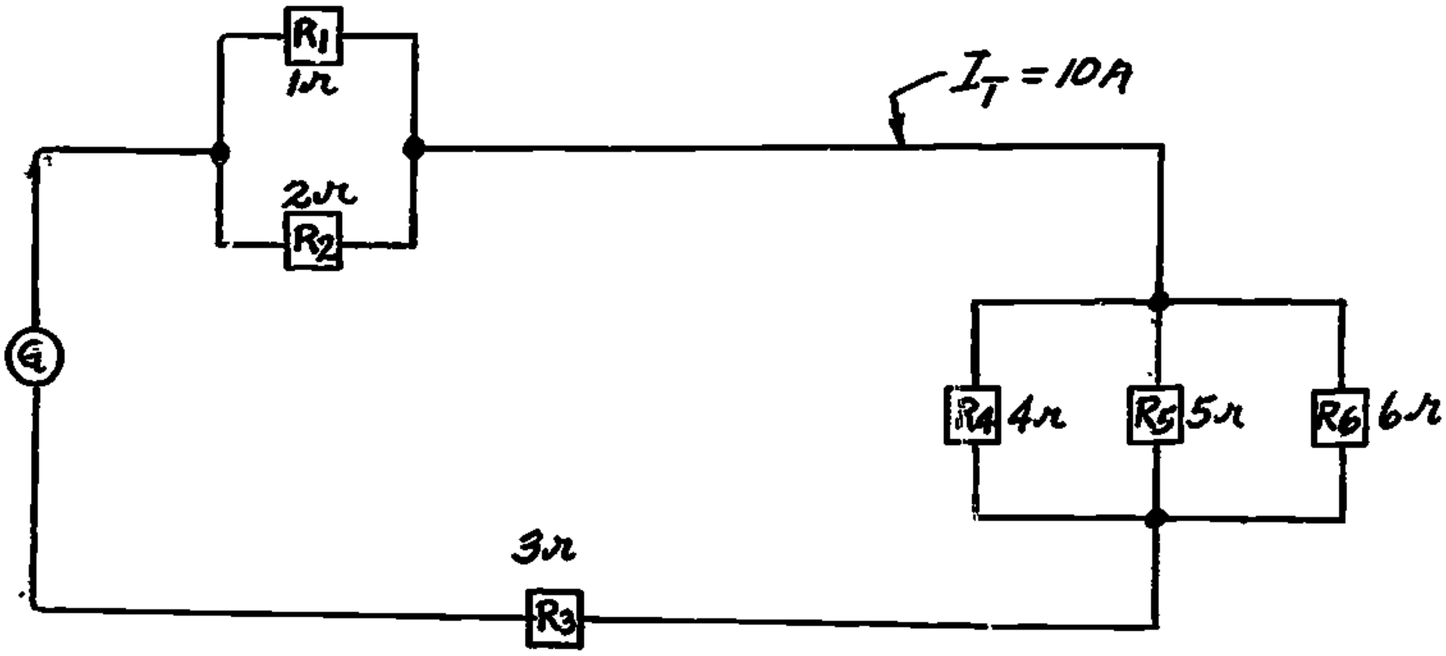
NAME ______________________

DATE ______________________

21. Find I_T, I_1, and I_2.



22. Find E_T, E_1, E_3, E_4, I_1, I_2, I_4, I_5, and I_6.



NAME ______________________ ELECTRICAL APPRENTICESHIP

DATE ______________________ SERIES "A", TEST NO. 4
Page 1

MATERIAL COVERED - LESSONS A-17 thru A-20

1. KWH is the electrical work done per ____________.

2. ______________ wire is a group of small wires used as one wire.

3. ______________ have a low conductivity.

4. ______________ ______________ in a conductor is the voltage loss due to the conductor resistance.

5. Find the efficiency of a motor receiving 50 kw and having an output of 60 HP.

6. Cables of different sizes are referred to by ____________ number.

7. An increase in temperature ______________ the resistance of a conductor.

8. The minimum size wire to be used for any installation depends upon the total ____________ ______________ and ____________ ______________ in the wire.

9. Electrical ___________ is the time rate of doing electrical work and is measured in ____________.

10. The gage standard in this country is ____________ ____________ ____________ (__________).

11. One inch equals ____________ mils.

12. Current flowing in a conductor produces ______________.

13. One horsepower equals ______________ watts.

14. ______________ conductors are more flexible than ____________ conductors.

15. ______________-__________ _____ _________________ of a conductor is expressed in circular mils.

16. Increasing the diameter of a conductor ____________ the resistance.

17. Torque is the effect of ________________.

18. The three hardness grades of copper conductors are (a) ___________-__________
(b) ___________-___________-___________, and (c) ___________-__________

NAME ______________________

19. Find the diameter in mils of a cable 5/8-inch diameter.

20. A lighting load located 600 feet from the 208 volt source requires 200 amperes. Find the minimum size Type "THW" feeder conductor permitted for this load by the NEC.

21. Efficiency is the ratio of __________ to ________________.

22. _________-____________ copper is used for all covered or insulated copper conductors.

23. Express the diameter in inches of a 105,500 cir mil cable.

24. The NEC permits a maximum of three per cent voltage drop in _____________ feeders.

25. Find the power consumed by a 208 volt motor drawing 10 amperes.

26. ________-__________ copper is used for transmission lines.

27. Find the resistance of 2500 feet of No. 6 AWG copper wire if the resistance is 0.4 ohms per 1000 feet.

28. Find the minimum size Type "TW" conductor to supply a load of 100 lamps each drawing 2.5 amperes.

NAME ______________________

29. Calculate the amperes drawn by a 1/4 Horsepower fan at 120 volts. How many watts are consumed?

30. Conductors sized No. ______AWG and larger installed in conduit shall be stranded.

31. Find the CM area of a cable having a 5/8-inch diameter.

32. The NEC permits a maximum of one per cent voltage drop in ______________ feeders.

33. Find the power used with eight lamps connected in series if each lamp is rated 15 volts and draws 0.2 amperes.

34. The minimum size conductor permitted for multiple runs is No. ______AWG.

35. Express the diameter of a No. 2 AWG conductor in inches.

36. CM is the abbreviation for ____________ __________________.

37. Find the operating voltage of a motor using 880 watts and drawing 4 amperes.

38. Provide the required information for the following cable insulations:

TRADE NAME	CODE TYPE	MAXIMUM OPERATING TEMPERATURE
Asbestos-covered, heat resistant, Fixture Wire		
Heat-resistant rubber		
Moisture-resistant thermoplastic		
Moisture and heat resistance Thermoplastic		

NAME ______________________________

ELECTRICAL APPRENTICESHIP

SERIES "A", TEST NO. 4

39. A wire has 50-ohm resistance and 200 cir mil area. Find the resistance of the same length of wire having 600 cir mil area.

40. Find the power used from a 12-volt battery by a parallel circuit of two headlamps (6 amps. each) and four taillights (1.0 amperes each).

41. Type _____ is the code designation for code rubber insulation.

42. Find the diameter and gage number of a copper heating element 240 feet long if the resistance is 40 ohms.

43. Find the current drawn by twenty 100-watt lamps, parallel connected, from a 120-volt source.

44. The maximum current carrying capacity of No. ____ AWG copper conductor in conduit with Type "THW" insulation is 200 amperes.

45. If more than ____ conductors are installed in a raceway, the current carrying capacity of the conductors shall be reduced.

46. Find the minimum size Type "RHW" conductor to supply a 75 kw load at 480 volts.

47. Type (RHH" cable is limited to use in _____ locations.

48. Find the current drawn by a 5000-watt dryer from a 220-volt source.

NAME ______________________________ ELECTRICAL APPRENTICESHIP

49. The current carrying capacity of nine No. 12 AWG Type "THW" conductors installed in the same raceway is ____________ amperes.

50. The minimum size Type "V" cable, in conduit, required for a 295 ampere circuit load is No. ____________AWG.

NAME _____________ __________

DATE ______________________

ELECTRICAL APPRENTICESHIP

SERIES "A", TEST NO. 5

MATERIAL COVERED - LESSONS A-21 thru A-22.

1. The NEC contains ____________ provisions considered necessary for safety.
2. A general purpose branch circuit supplies outlets for ____________ and ________________.
3. In general, _______________ conductors are used to conduct current.
4. The minimum size conductor permitted for general interior wiring shall be No. _____AWG.
5. A maximum of ______fusible switches or circuit breakers may be used as service equipment.
6. A motor circuit switch is _________ rated and capable of _____________ under load.
7. The ___________conductor is intentionally grounded.
8. _______ ___________ are not approved for securing equipment to masonry walls.
9. __________ conductors, No. 8 AWG and smaller, may be installed in a conduit.
10. Only Type ________ cable shall be installed for underground service entrance conductors.
11. A safety switch is an example of a ___________ means.
12. Field applied insulation over the conductor splices shall be _______________ in value to the conductor insulation.
13. All ___________conductors shall be protected by an overcurrent device.
14. All holes in outlet boxes shall be _______________.
15. The NEC is not intended as a ______________specification.
16. A _____________ is a circuit conductor between the switchboard and the branch circuit protective device.
17. The insulation resistance of No. ____AWG conductor shall be 1,000,000 ohms.
18. A minimum of ______inches of free conductor shall be provided at each outlet or switch.
19. The minimum mounting height of an overhead service drop is _________feet above grade.

NAME ____________________

20. A ________-__________ ____________ __________ consists of two or more ungrounded conductors having a potential difference between them and an identified grounded conductor having an equal potential difference between it and each of the ungrounded conductors.

21. The NEC mandatory rules are characterized by the word ____________.

22. Electrical equipment mounted a minimum of ____feet above the floor is a substitute for the required floor mounted horizontal clearances.

23. Equipment grounding conductors shall not be ____________.

24. Lath shall not be used to support ___________boxes.

25. The minimum size service entrance conductor is No.____AWG.

26. ___________switches have no interrupting rating and shall be operated only after the circuit is dead.

27. ___________-____________ conductors are located between the service drop and service equipment.

28. The minimum insulation resistance for a 500 MCM Type "THW" conductor shall be ___________ohms.

29. All conduits shall be __________from outlet to outlet.

30. The maximum number of No. 10 AWG conductors permitted in a 1½-inch x 4-inch square outlet box shall be _________.

31. The minimum size grounding conductor for three parallel 300 MCM service conductors shall be No. ____AWG.

32. Neutral conductors shall not be ___________.

33. Outlet boxes in wood walls shall be set _______with finished surface.

34. Conductor ________or___________shall not be made within raceway.

35. A general purpose switch is rated in __________and capable of __________ at its rated current and voltage.

36. __________locations are not normally subject to dampness or wetness.

37. The NEC advisory rules are characterized by the word ___________.

38. The minimum size conductor permitted for multiple or parallel runs shall be No. ____AWG.

NAME ____________________

39. A vertical run of 350 MCM copper feeder shall be supported on a maximum _____-foot centers.

40. ___________ outlet boxes shall not be installed on a conduit system requiring locknuts and bushings.

41. A right angle pull junction box with entering and exiting conduits sized: 3-inch, 3-inch and 4-inch; shall be a minimum of _____x_______ inches.

42. A ____________ ______________ ______________ piping system is the best grounding electrode.

43. Overhead service conductors shall form a ________ _________ at the servicehead.

44. Metal ___________ shall not be used to make grounding connection to water system.

45. Insulated bushings shall be installed on raceways for No. ____ AWG and larger conductors.

46. Conductors of different system may be installed in the same conduit provided all conductors are ___________ for the ___________ ___________ on any of the conductors.

47. A lighting fixture exceeding _______ pounds shall not be supported from the lampholder screw-shell.

48. A straight pull junction box with a 3-inch conduit entering and exiting shall have a minimum length of ______-inches.

49. The minimum size grounding conductor for service conductors shall be No. _____ AWG.

50. A lighting fixture exceeding _______ pounds shall be supported from the building structural members.

NAME ____________________ ELECTRICAL APPRENTICESHIP

DATE ____________________ SERIES "A", TEST NO. 6
Page 1

MATERIAL COVERED - LESSONS A-23 thru A-28.

1. Rigid metal conduit shall be installed a minimum of __________ feet below cinder fill.

2. E.M.T. shall not be installed on systems exceeding ________ volts.

3. Flexible metal conduit is _______ and __________ to install than rigid conduit.

4. Lead-acid type batteries are rated _____ volts per cell.

5. Fuses are rated in _______ and _________, and have a ________ resistance.

6. The ________ and ________ of ________ and the __________ of ____________ determine the extent of injury due to electrical shock.

7. Threaded __________-__________ couplings may be used to connect two sections of conduit.

8. E.M.T. may be installed _________ or ____________.

9. Flexible metal conduit shall not be installed in _________ locations.

10. Storage battery room shall be ______________.

11. A _________-_________ fuse will carry approximately twice its rated current for 20 to 30 seconds.

12. ___________ current causes more severe burns.

13. The standard length of rigid metal conduit is ________ feet.

14. On exposed E.M.T. installations in wet locations, __________-___________ threadless couplings and connectors shall be used.

15. ___________ ____________ should be used to cut flexible metal conduit.

16. Type ___ conductors shall not be used in storage battery rooms.

17. Fuses are used for __________ protection of a circuit.

18. Always assume a circuit to be ________ until tested and proven dead.

19. The number of bends and offsets in one run of conduit shall not exceed __________ degrees.

20. E.M.T. shall not be installed in a ___________ fill.

NAME ______________________

21. Flexible metal conduit shall be supported on maximum __________ foot centers.

22. Alkali-type batteries are rated _________ volts per cell.

23. Plug fuses have a maximum rating of ___________ amperes.

24. The minimum size conduit permitted is _________-inch.

25. The standard length of E.M.T. is ____________ feet.

26. The maximum size of liquid-tight flexible metal conduit is __________-inches.

27. A dry cell battery is an example of a _______________ cell.

28. Type "S" plug fuses shall not be ___________ with plug fuses of different ampere classifications.

29. _______________ cells cannot be recharged.

30. _______________-_______________ flexible metal conduit is not a general purpose raceway material.

31. E.M.T. installed in concrete shall be provided with _________-_____________ threadless couplings and connectors.

32. The minimum radius of bend for a 4-inch rigid conduit for Type "THW" conductors shall be ______ inches.

33. ______________ is a major cause of industrial accidents.

34. A __________ volt cartridge fuse is permitted on a lower voltage.

35. A 12-volt lead-acid storage battery consists of _________ cells.

36. The maximum size conductor permitted in a 2-inch liquid-tight flexible conduit shall be No. ____ AWG.

37. The maximum size of E.M.T. is _____-inches.

38. The supports for a horizontal run of 3/4-inch conduit should be on maximum _____-foot centers.

39. The maximum ampere rating of fuses rated 250 volts shall be ______ amperes.

40. Only __________ water should be added to storage batteries.

41. Liquid-tight flexible conduit is permitted for use in connecting __________.

42. All outlet boxes and fittings for E.M.T. shall be the __________ type.

43. The maximum fill permitted in rigid conduit on new work for Type "V" conductors is _________ per cent.

NAME ______________________

44. Alkali-type battery is an example of a __________ cell.

45. Plug fuses may be installed on circuits not exceeding _________ volts.

46. A storage battery is charged with ____________ _____________.

47. E.M.T. shall be installed a minimum of ______-inches below cinder fill.

48. A storage battery rated 6.000 amp. hours will produce 100 amperes for _________ minutes.

49. Current limiting fuses shall not be ___________ with standard fuses.

50. The cell temperature of a lead-acid battery should not exceed ___________ F.

NAME ______________________________

DATE ______________________________

ELECTRICAL APPRENTICESHIP
FIRST YEAR CLASS - 'SERIES A"
FINAL EXAM

1. Change the following fractions to decimals:

(a) 144/1000	(b) 7/10
(c) 6/100	(d) 15/60

2. Change the following mixed numbers to decimals:

(a) 7-35/100	(b) 3-3/10
(c) 3-4/5	(d) 15-49/100

3. What value of current flows through a line supplying 1800 watts to a load of 20 ohms resistance?

4. How many minutes can a 600 amp. hour battery supply 25 amps.?

5. Find the square roots of the following: (carry out to two decimal places)

   (a) 3,481

   (b) 267

   (c) 17.64

   (d) 18,769

6. A 125 KVA transformer will stand a 25% overload. What KVA load will the transformer handle?

7. What current flows through the heater of a radio tube having a resistance of 85 ohms and uses 3.4 watts?

NAME______________________________

8. A wire is 3/16 inches in diameter. What is the diameter in mils? Approximate AWG size?

9. What is the resistance of a line 1 mile long if No. 8 AWG copper wire is used? What is voltage drop across this line if the current is 0.05 amps.?

10. A 40-ohm heater draws 6 amps. What is the voltage drop across the heater?

11. Find the value of the unknown letter in the following:

(a) $\frac{8}{3} = \frac{R}{6}$

(b) $\frac{E}{18} = \frac{3}{2}$

(c) $\frac{3.6}{5} = \frac{I}{2}$

(d) $\frac{16}{P} = \frac{2}{6}$

12. Find the current drawn by a 40-ohm toaster from a 120-volt line.

13. How much power is consumed by a 50-ohm electric lamp which draws 2 amps.?

NAME______________________________

14. A load 400 feet from the generator requires 160 amps. The generator voltage is 115.6 volts. The load requires 110 volts. What is the voltage drop and the minimum size Type "THW" cable that may be installed?

15. What is the diameter in inches of a cable having a cross-sectional area of 83,690 circular mils?

16. A 50 kw load is installed 100 feet from the generator rated 240 volts. What is the minimum size Type "THW" cable that will be permitted by the NEC?

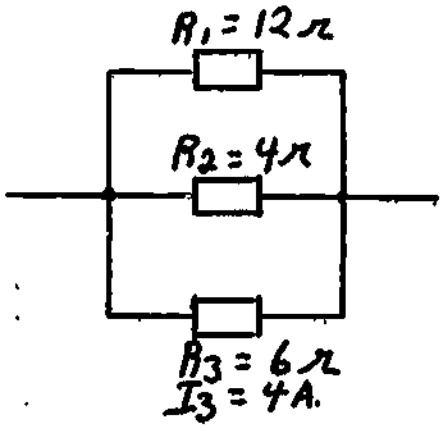
17. What is the resistance of 900 feet of No. 8 AWG copper wire?

18. A generator supplies 5.5 kw at 125 volts to a motor 500 feet away. The motor delivers 6.3 HP at an efficiency of 90%. Find (a) watts input to the motor, (b) watts loss in line, (c) current in the line, (d) voltage drop in the line, and (e) smallest size Type "THW" cable that may be used.

19. What is the resistance of a copper conductor at 200° F. if the resistance is 50 ohms at 70° F.?

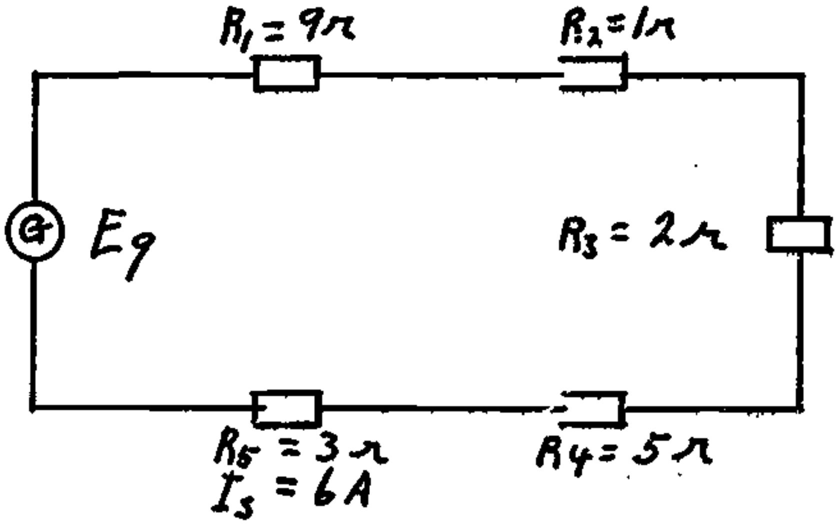
20. How many bells rated 2.5 amps., at 6-volts, can be connected in series on a 120-volt circuit?

21.



Find I_1, I_2, I_T, & V_T.

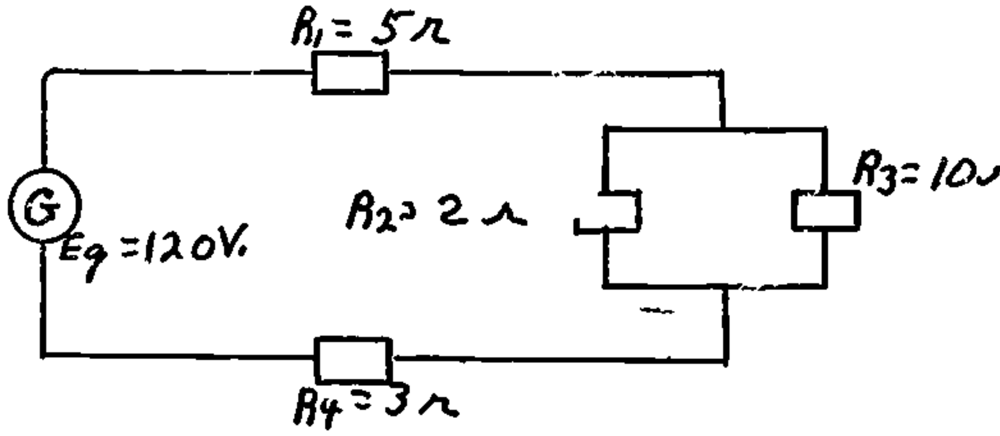
22.



Find V_1, V_2, V_3, V_4, V_T, R_T, & I_T.

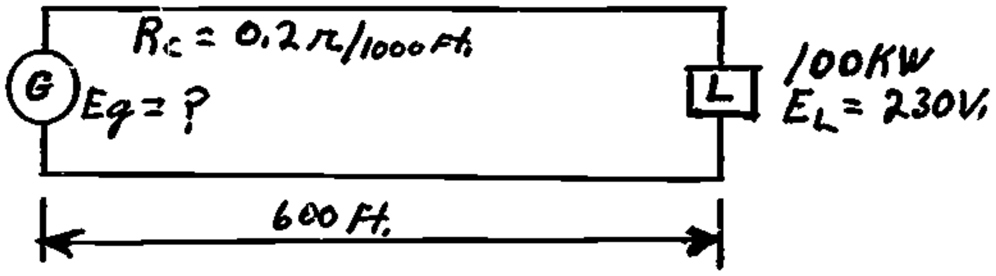
NAME ______________________

23.

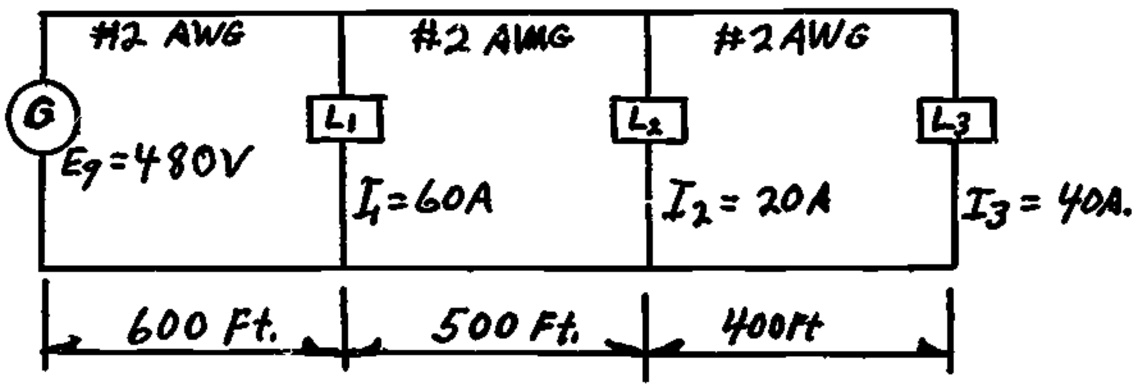


Find V_1, V_2, V_4, I_1, I_2, I_3, & R_T.

24. Find voltage at generator:



25. Find voltage across each load. Is the voltage drop between generator and L_3 within Code limitations?



26. Most building wire is insulated for __________ volts.

27. One inch equals __________ mils.

28. The ______________ part of the atom has a negative charge.

29. NEC sets up _____________ standards for electrical installations.

30. ______________ drawn copper wire is used mostly in insulated wires.

31. The word "______________" in NEC means this requirement is mandatory.

32. Copper wire is made in three grades of hardness known as _______________, _______________ and _______________.

33. Cable smaller than No. _______ AWC shall not be used on interior wiring.

34. In a series circuit, the ________________ is constant, total _____________ is equal to the sum of the ________________ _______________ across each resistor, and the total ______________ is equal to the ________________ of each resistor.

35. ________________ means 1000 watts.

36. A ________________ cell can be re-charged.

37. The resistance of a wire ________________ as the length increases.

38. The maximum voltage drop permitted by NEC for combined lighting and power loads is _______________ and ________________ for power loads.

39. In a parallel circuit, the ____________ is constant, total _______________ is the sum of the ______________ in each resistor.

40. _____________ is a better material for electrical conductor than copper.

41. Plug fuses have a maximum rating of __________ amps.

42. The resistance of a wire _________ as the area increases.

43. The cross-sectional area of a conductor is equal to the ________________ of the diameter in _____________.

44. The flow of current is limited by the _______________ with a constant voltage.

45. As a wire gets hotter the _______________ increases.

46. A 2-inch conduit shall not have less than a ________________ radius bend.

47. Voltage of several dry cells connected in ________________ is the same as the voltage of any one dry cell.

48. Conductors No. _____ AWG and larger installed in raceways shall be stranded.

49. Any number having a whole number as its square is a _______ _________.

50. The largest size of EMT is _______.

51. __________ prevent shortcircuit currents from burning up electrical equipment.

52. Torque is the effect of __________.

53. _______ watts equals one horsepower.

54. There are __________, __________ and __________ types of fuses.

55. Stranded conductors are more __________ than solid conductors.

56. Storage batteries may be __________ and __________.

57. A __________ has a high conductivity.

58. Maximum size liquid-tight flexible conduit shall be ________ inches.

59. Specific resistance is the ability of a _______ ________ to resist the __________ of __________.

60. The maximum size of EMT is _______ inches.

61. __________ and __________ joint connections have a low resistance.

62. Bushings are installed on conduits in a junction box to protect the __________ from __________.

63. A grounded conductor is _________ __________ to the earth and is also called "__________" or "__________ __________."

64. __________ is the minimum size raceway permitted by the NEC.

65. __________ quarter-bends are the maximum permitted in one conduit run.

66. A general-use switch is rated in __________ and is capable of _______ its __________ __________ at its __________ __________.

67. Vertical support of #4/0 conductor shall not exceed _______ feet.

68. A mortar-circuit switch is __________ rated.

69. Lubricants for conductors being pulled through a raceway system may be __________ or __________.

NAME______________________________

70. The insulation resistance for a No. 8 AWG conductor shall be __________ ohms.

71. ______________ ________________ are also secondary batteries.

72. _____________ sizes are given in AWG.

73. ______________ or _______________ of conductors is not permitted within a raceway.

74. ______________ can neither be created nor destroyed.

75. ______________ is used to measure current.

76. ______________ is used to measure voltage.

77. ______________ is used to measure resistance.

78. ______________ is used to test the insulation resistance of conductors.

79. Efficiency is the ratio of ______________ to _______________.

VT 003 626

VT 003 626
Basic Electricity Series, No. B (Second Year), Related Training for Electrical Apprentices, Instructor's Manual.

Hedinger, Howard E.
North Carolina State Board of Education, Raleigh.
Pub Date - Jun64
MF AVAILABLE IN VT-ERIC SET 51p.

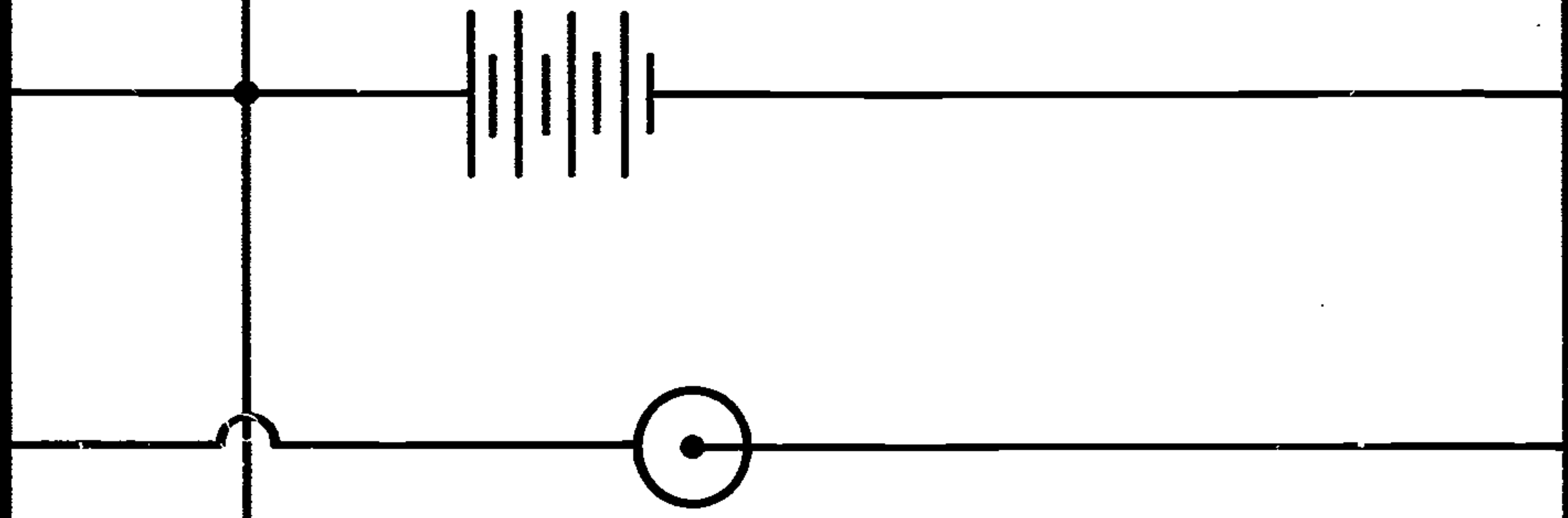
*TEACHING GUIDES, *TRADE AND INDUSTRIAL EDUCATION, *ELECTRICIANS, *ELECTRICITY, POST SECONDARY EDUCATION, *APPRENTICESHIPS,

This teaching guide, the second of a four-unit series, is to help the instructor plan and present course material to electricians in the second year of the related technical phase of post-secondary apprenticeship training. It was developed by a curriculum committee of subject matter specialists and the educational committee of the National Electrical Contractors of North Carolina, tested on a small group, and used in apprenticeship programs. The 30 lesson plans in this guide cover Lighting and Lamps, Transformers, A.C. Motors, and National Electrical Code related to wiring installation. Each lesson plan is outlined in desired results, materials, references, introduction, presentation, application, and checking and followup. The teacher of this 144-hour course should be a journeyman tradesman, and the students should be 18 years old and employed as apprentices in an electrical construction trade. Supplementary materials include lists of textbooks and recommended films. Correlated student assignment and information sheets, unit tests, and a final examination are given in VT 003 627. Documents of the series are listed as VT 003 624 through VT 003 631. (HC)

INSTRUCTOR'S MANUAL

Second Year

BASIC ELECTRICITY FOR APPRENTICES



CURRICULUM LABORATORY
DEPARTMENT of COMMUNITY COLLEGES
STATE BOARD of EDUCATION
RALEIGH, NORTH CAROLINA

MEMORANDUM

TO: The ERIC Clearinghouse on Vocational and Technical Education
The Ohio State University
980 Kinnear Road
Columbus, Ohio 43212

FROM: (Person) Roger G. Worthington (Agency) Department of Community Colleges

(Address) Education Building, Raleigh, North Carolina

DATE: September 7, 1967

RE: (Author, Title, Publisher, Date) Hedinger, Howard E. "Basic Electricity For Apprentices, Series B - Second Year Instructor's Manual," Curriculum Laboratory, Dept. of Community Colleges, July 1964.

Supplementary Information on Instructional Material

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Development Group Curriculum committee/ Carolinas - Educational committee
Level of Group State and Dept. supervisor
Method of Design, Testing, and Trial Designed by subject matter specialists and tested on a small group; has been used with 1,200 apprentices per year for 3 years.

(3) Utilization of Material:
Appropriate School Setting Vocational (Apprentice Training)
Type of Program Post-high; Apprenticeship
Occupational Focus A specific job (electrical construction)
Geographic Adaptability N/A
Uses of Material Course and lesson planning and student study guides.
Users of Material Instructor and student

(4) Requirements for Using Material:
Teacher Competency Journeyman instructor
Student Selection Criteria 18 year old, male (mostly), post-secondary educ. to become a journeyman electrician
Time Allotment 144 hours per year (minimum)

Supplemental Media -- Textbooks - see list
Necessary X } (Check Which)
Desirable ______ }

Describe Basic Electricity, VanValkenburgh & All, Hayden Book Co.; Amer. Electricians' Handbook, Croft, McGraw-Hill Book Co.; Basic Mathematics
Source (agency) / by Singer, McGraw-Hill Book Co.; National Electrical Code.
(address) /National Fire Protection Assoc. 60 Batterlymarch Street, Boston, Mass.

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ACKNOWLEDGMENTS

The Instructor's Manual and Assignment Sheets for the Electrical Apprentice Training Program have resulted from a need recognized by representatives of Trade and Technical Education and the Apprentice Council of the Department of Labor of North Carolina. They believe that an apprentice, in order to become a skilled craftsman in our times, needs not only to work hard on the job but also to study the related technical materials of his trade in an organized manner.

The Curriculum Laboratory of the Department of Community Colleges, was given the assignment of preparing materials that could be used by the instructors as a guide. The material contained in the lesson outlines is designed to help the instructor plan the lessons and to lead his classes gradually into the more complex studies of electricity.

Representatives of the Curriculum Laboratory have worked in close cooperation with a statewide Education Committee of the North Carolina Association of Electrical Contractors. Among these men are contractors, engineers, and journeymen who have not only worked as electricians but also are serving as instructors for apprentice classes.

Thanks are extended to Mr. D. J. Colter, Chairman of the Apprentice Training and Manpower Development Committee for the Electrical Contractors Association, Mr. C. L. Beddingfield, State Director of Apprenticeship and Training, and Mr. W. F. Humbert, III, Instructor of Winston-Salem who prepared the study guide questions for each lesson.

In addition, appreciation is expressed to all those instructors and apprenticeship committee members who have made themselves available for consultation regarding this course.

A. J. Bevacqua, Coordinator
Curriculum Laboratory
N. C. Department of Community Colleges

H. E. Hedinger
Curriculum Specialist

BASIC ELECTRICITY

TO THE INSTRUCTOR

The second year (Series B) of the course in Basic Electricity for apprentices is designed, as was the first, to make it easier for the instructor. The lesson outlines should help him lead his classes gradually into the more complex phases of the study of electricity.

It should be noted by the instructor that:

1. Topics on basic mathematical principles were reviewed and other applied topics were introduced during the first year (Series A). The second year (Series B) contains no topics specifically on mathematical subjects. Yet the instructor will realize that additional practice in handling equations will be necessary for most apprentices by the time they begin to study alternating current. Also, he will be aware that simple trigonometry and vector diagrams must be introduced along with A.C. theory. References on these subjects have been assigned in the appropriate topics so that the apprentice will be ready for the mathematics used in A.C. theory. It will be essential for the instructor to pay special and separate attention to these mathematical tools in order to be sure that the electrical theory will be completely understandable to the apprentices. In the event that some of the apprentices are weak in mathematics, the instructor should make additional assignments and give special individual help.

2. In this course, the topics on the National Electrical Code will be studied in terms of wiring methods. Most of these topics are presented at the end of each year's work. It is hoped that by studying the Code along with other subjects each year will help create interest and will be better applied to job situations.

3. There is a suggested list of audio-visual aids; however, the instructor should use any other aids available, but be sure to order them in ample time. It is hoped that the instructors will not have too much difficulty obtaining particular aids at the time they need them.

CONTENTS

Page

LESSON NO. LIGHTING AND LAMPS

TRANSFORMERS

A. C. MOTORS

NATIONAL ELECTRICAL CODE

INSTRUCTIONAL MATERIALS

GENERAL LIGHTING

DESIRED RESULTS:

1. To help the student understand what light is and how it is produced.
2. To help prepare the student to utilize the experience he receives on the job in relation to lighting.

MATERIALS, EQUIPMENT AND SUPPLIES:

1. Samples of lamps
2. Light meter
3. Designs of lighting installations

REFERENCES:

1. * Swoope's Lessons in Practical Electricity, Pages 548-549; 558-575.
2. American Electricians' Handbook, Div. 10, page 2-20.
3. National Electrical Code, Article 410.
4. Films: (a) How Man Made Day - 16 mm sound film - Coronet Films.
   (b) Light is What You Make It - 16 mm sound film - National Better Light and Sight Bureau.

INTRODUCTION:

The electrician should have a basic understanding of the nature and character of light. You may not be asked to design a large lighting system but you will spend much of your working time installing equipment. It will help you to know the basic things about light--what light is and how it is produced. Intensive study of applied light and its influence upon man has developed only recently. We have witnessed the development of several new light sources and the demand for safe equipment and higher illumination levels for industrial and commercial buildings.

There are four separate divisions in the development of a lighting system that must be considered.

1. Design of the lighting equipment.
2. Manufacture of the lighting fixture.
3. Design of the lighting layout and system.
4. Actual installation of the equipment.

PRESENTING THE LESSON:

A. 1. Discuss and define the following terms:

(a) light
(b) Foot-candle
(c) watt
(d) lumen
(e) reflected light
(f) refraction

2. List the three primary colors.

3. Discuss three different classes of glare.

4. Explain incandescent lamps, arc lamps and gaseous lamps.

5. Explain how lamp efficiency is found.

6. List four general classes of illumination.

B. Demonstrate the light meter by showing how the light reading varies in different parts of the room.

APPLICATION:

Have the students answer the questions on assignment sheet B-1.

CHECKING AND FOLLOW-UP:

Correct the answers and discuss any questions that the students may ask concerning the lesson.

FLUORESCENT LAMPS

DESIRED RESULTS:

1. To acquaint the student with some of the properties and characteristics of the various types and sizes of fluorescent lamps.
2. To learn the importance of using correct equipment for replacement.

MATERIALS AND EQUIPMENT:

1. A display of different lamps, fixtures and ballasts.
2. 16 mm Film Projector.

REFERENCES:

1. American Electricians' Handbook, Pages 10, 45-72, Sec. 103-138.
2. * Swoope's Lessons in Practical Electricity, Pages 556-558.
3. * Industrial Electricity (Nadon and Gelmine), Pages 666-683.
4. Film - The Magic of Fluorescence, General Electric Co.

INTRODUCTION:

This lesson is concerned with the lamp only, later lessons will deal with the ballast and starters. There are several different types of lamps, therefore, the apprentice should know which type he is working with and how it operates. Thus, he should become acquainted with some of the properties and characteristics of the various types of fluorescent lamps.

PRESENTING THE LESSON:

1. Show the film and discuss any questions that may rise.
2. Let the students examine the various samples of lamps.
3. Discussion questions.
   - (a) Why are fluorescent fixtures gaining in popularity over incandescent fixtures?
   - (b) For what types of installation would you recommend the use of fluorescent fixtures?
   - (c) In your opinion, which is the better type of lighting, fluorescent or incandescent?

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   - (c) In your opinion, which is the better type of lighting, fluorescent or incandescent?

APPLICATION:

Have the students answer the questions on Assignment Sheet B-3.

CHECKING AND FOLLOW-UP:

Check the answers on the assignment sheets against the answer sheets. Return to learner for placing in workbook.

FLUORESCENT BALLASTS

DESIRED RESULTS:

1. To study the equipment which is used to make fluorescent lamps burn.
2. To discuss the function of the ballast used on fluorescent fixtures.

MATERIALS AND EQUIPMENT:

1. Samples of ballast equipment, capacitors, and lamp fixtures.

REFERENCES:

1. American Electricians' Handbook, Pages 10-57 thru 67, Sec. 123-130.

INTRODUCTION:

In the previous lesson, we studied the fluorescent lamp and how it operates. In this lesson we will study the equipment which is used to make the fluorescent lamp burn and give off the type of light needed to illuminate a particular area. This equipment has many variations and must be correct for the type of lamp used.

PRESENTING THE LESSON:

When a decision to use fluorescent lighting has been made you should ask the following question. What kind and color of light do you want? The answer will determine the type fluorescent lamp to be used. The type lamp determines the other equipment to be used in the fixture.

Discuss the purposes of the ballast. List the functions and types of starting switches. Discuss the action of the common types of starting switches. What is a "no-blink" starter? Give its advantages. Does the surrounding air temperature effect the output of a fluorescent lamp? What difference does it make in the ballast for a fluorescent fixture when it is operated on high frequency current?

APPLICATION:

Have the students answer the questions on the assignment sheet for this lesson.

CHECKING AND FOLLOW-UP:

Correct the answers and discuss any questions that the students failed to understand.

LIGHTING INSTALLATION

DESIRED RESULTS:

To learn that the proper installation of a lighting system must be correct in order to be effective.

MATERIALS AND REFERENCES:

1. National Electric Code, Article 410.
2. American Electricians' Handbook, Pages 1572 - 1622.
3. *Industrial Electricity, by Nadon & Gelmine, pp. 676 - 683.

INTRODUCTION:

The technical details of the design of a lighting system are only a partial solution of the problems of satisfactory lighting operation. If a lighting system is to be effective, the installation must be correct in every respect. However, unless it is properly maintained, a system that is adequate at the time of installation will depreciate rapidly. This is equally true for natural and artificial lighting. Maintenance should not be entrusted to the average caretaker unless he is properly supervised. It should be based upon a regular, systematic schedule and include a system of reports and checks.

PRESENTING THE LESSON:

1. Call attention to the main items of installation included in Article 410 of the National Electrical Code.
2. Explain how the lighting unit for general illumination should be located symmetrically throughout the area to be illuminated.
3. Is complete uniformity of illumination desirable in all installations? Why?
4. What is the most common method of illumination and what is the reason for its popularity?
5. How much illumination (foot candles) is needed for the following: (See tables in Handbook)

   (a) Bakery
   (b) Cannery
   (c) Linotype room (printing)
   (d) Office (close work)
   (e) Textile (cotton spinnin

APPLICATION:

Have the students complete the questions on the assignment sheet.

CHECKING AND FOLLOW-UP:

Check the answers and discuss the common errors with the class.

ELECTRICAL TESTING

DESIRED RESULTS:

1. To determine whether or not circuits are shorted or open.
2. To become familiar with some of the many types of testing instruments and their uses.

INSTRUMENTS AND MATERIALS:

1. Volt and Ohm-meter
2. Voltage tester D.C. or A.C.
3. Test lamp outfit and others if available
4. Wire connections

REFERENCES:

1. American Electricians' Handbook, Pages 56-93.
2. * Swoope's Lessons in Practical Electricity, Pages 272-278.
3. * Industrial Electricity, Nadon & Gelmine, Pages 100-103; Pages 483-508.

INTRODUCTION:

The testing of circuits is a common practice in the industry. Volts, amperes, ohms, watts, cannot be seen, however, they can be measured by the use of proper instruments. The wireman often finds it necessary to measure the amount of electricity that is being used or the number of volts and amperes in the circuit or to determine the resistance of the circuit. The reference material in this lesson is very general and you should learn much more about this subject. As you work on the job give attention to the testing and metering equipment.

An electrical meter should be handled as carefully as a fine watch; it should not be dropped or jarred. It is important that the instrument be connected properly. When connecting meters that are furnished with switchboards, the electrician should never cut the leads sent with the meters even though they are too long. These leads are sometimes calibrated with the meter, and shortening them may cause the meter to give inaccurate readings.

PRESENTING THE LESSON:

Demonstrate how to use the Ohm and Volt meters and any other measuring instruments on hand. Review and define terms associated with this lesson such as: volts, amperes, ohms, resistance, watts, megger, etc.

Discussion Questions:

1. How would you tell A.C. from D.C. when using a voltage tester?

2. How would you tell A.C. from D.C. when using a neon-glow lamp tester?

3. Describe the following test sets:

   (a) Telephone receiver

   (b) Lamp set

   (c) Magneto set

   (d) Electric-bell

4. What testing device is best suited to locating a neutral on a 3 wire circuit?

APPLICATION:

The students will be given time to fill out the answers on the assignment sheet B-6.

CHECKING AND FOLLOW-UP:

Check the answers and return to students to find the correct answers where review is needed.

INDUCTANCE

DESIRED RESULTS:

To inform the learner how magnetism may be used to produce an electric current flow as the result of the electromotive force (E.M.F.) of induction.

MATERIALS, EQUIPMENT AND SUPPLIES:

1. Chalkboard
2. Supplies for demonstration:
   (a) Wire for coils, core material (iron and copper rods), meters
   (b) Permanent magnet and electromagnet
3. Inductance--16 mm sound film United World Films

REFERENCES:

1. American Electricians' Handbook, Pages 1-23 to 1-44.
2. Basic Electricity, Vol. 3, Pages 3-43 to 3-53.
3. *Industrial Electricity, by Nadon & Gelmine.

INTRODUCTION:

It has been learned how an electric current can produce magnetism. We can now study how it is possible to create a flow of electricity in a conductor by the use of magnetism. The extent of the inductive effect depends upon the physical nature of the circuit, the amount by which the current changes in a particular length of time, and the length of this period. Inductance opposes flow of current through a circuit by imposing a counter-voltage much like the counter-electromotive force of the D.C. motor. The value of this opposition is stated in terms of equivalent ohms and is called the inductive reactance of the circuit.

PRESENTING THE LESSON:

A. The principles studied in this assignment are the foundation upon which most of our present day electrical industry is built. Examples: motors and transformers. The student should master the formulas dealing with induced voltage and with inductive reactance. He should remember that the inductance of a coil is dependent upon the square of the number of turns of wire in that coil.

Advanced study of inductance will be presented later in the course. The student must have an insight into induction in order to understand the fundamentals of the transformer and motors, which will follow.

B. Show 16 mm Film - "Inductance" at this time.

PRINCIPLES OF TRANSFORMERS

DESIRED RESULTS:

To acquaint the student with ways that the voltage of a source of supply (primary) can be used to induce a current in another coil (secondary). This is accomplished by means of mechanical movement through the electromagnetic field or by using alternating current.

MATERIALS, EQUIPMENT AND SUPPLIES:

1. Chalkboard
2. Supplies for experiments
   (a) Induction coil
   (b) Transformers (50 and 100 turn coils)
   (c) Bar magnet

REFERENCES:

1. American Electricians' Handbook, Div. 5, Sec. 1-4.
2. Basic Electricity, Vol. 3, Pages 54-57.
3. Basic Mathematics, Pages 351-359.
4. *Swoope's Lessons in Practical Electricity, Pages 526-533.

INTRODUCTION:

The electrical principles set forth in this lesson apply specifically to transformers and indirectly to motors and electronic circuits. The transformer is an inductive device used in alternating current distribution, to change the voltage to higher or lower amounts where needed. It is quite doubtful that there would be an electrical industry if the transformer principle had not been discovered and developed. Discussion of the operating principles and simple demonstrations of the transformer action are necessary if a thorough understanding of this important device is to be acquired.

PRESENTING THE LESSON:

A. When A.C. flows through a coil, E.M.F. is induced in the coil or an alternating magnetic field is generated around the coil.

   1. E.M.F. is induced in a coil and is called self induction when:

      (a) The coil is moved through a magnetic field.
      (b) When the field is moved through the coil.
      (c) By opening and closing the circuit of the electromagnet supplying the magnetic field.

2. Another way is to vary the magnetic flux of the core in a coil.

3. Use a bar magnet to vary induced flux.

4. Explain other uses of induction coils - as telephone circuits, "neon" signs, step-up voltage supply.

B. Mutual Induction

The E.M.F. generated in the second coil is called the "E.M.F of Mutual Induction" or known as transformer action. Both induction coils and transformers operate by the principle of mutual induction.

1. Point out that:

   (a) The "induction" coil is really a kind of transformer or voltage changer.
   (b) A transformer has a primary and a secondary wound on a core of magnetic material.
   (c) The secondary of an induction coil always has more turns than the primary.
   (d) A transformer secondary may have more or fewer turns than the primary, depending on whether the voltage is to be increased o. decreased.
   (e) An induction coil has an open core. (The core ends do not form a complete magnetic path.)
   (f) A transformer has a closed core. (The core forms a complete magnetic path.)
   (g) Transformers may be used to decrease as well as increase voltage by the mutual induction of their windings.

C. Two kinds of transformers are the <u>step-up</u> and the <u>step-down</u>.

1. Point out that:

   (a) Both have a primary and a secondary winding.
   (b) The step-up transformer has more turns of wire in its secondary than in its primary winding, thus, a higher voltage is produced in the secondary.
   (c) A <u>step-down</u> transformer has fewer turns in the secondary than the primary. Thus, a lower voltage is produced in the secondary. Examples, a pole transformer, a bell transformer, or a toy transformer.

D. The voltage output of a transformer depends on ratio of primary to secondary coil turns.

1. Point out that:

   (a) The voltage of the secondary of a transformer has the same ratio to the primary voltage as the number of secondary turns has to the number of primary turns.

(a) Continued.
Stated as an equation:

$$\frac{\text{Secondary voltage}}{\text{Primary voltage}} = \frac{\text{Secondary turns}}{\text{Primary turns}}$$

(b) Demonstrate this equation in proportion by working several problems on the chalkboard.

E. A current that flows in one direction and then in another is called an alternating current.

1. A transformer ordinarily has an alternating current flow through its primary and always has an alternating current induced in its secondary.

F. Demonstrate the following experiments:

1. Induction coil
2. Bar magnet to vary induced flux
3. Make an experimental transformer or use demonstration model or mock-up.
4. Exchanging coils affects secondary voltage.

APPLICATION:

Have the students work and hand in assignment sheet. Give individual help where needed.

CHECKING AND FOLLOW-UP:

Check assignment sheets against the answer sheets and return to learner for placing in workbook.

(a) Continued.
Stated as an equation:

$$\frac{\text{Secondary voltage}}{\text{Primary voltage}} = \frac{\text{Secondary turns}}{\text{Primary turns}}$$

(b) Demonstrate this equation in proportion by working several problems on the chalkboard.

E. A current that flows in one direction and then in another is called an alternating current.

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3. Make an experimental transformer or use demonstration model or mock-up.
4. Exchanging coils affects secondary voltage.

APPLICATION:

Have the students work and hand in assignment sheet. Give individual help where needed.

CHECKING AND FOLLOW-UP:

Check assignment sheets against the answer sheets and return to learner for placing in workbook.

APPLICATION:

Have the students answer the questions on the assignment sheet.

CHECKING AND FOLLOW-UP:

Check the answers and return to the students for placing in their workbook.

APPLICATION:

Have the students answer the questions on the assignment sheet.

CHECKING AND FOLLOW-UP:

Check the answers and return to the students for placing in their workbook.

SINGLE PHASE TRANSFORMERS

DESIRED RESULTS:

To learn the basic facts needed to hook-up a single phase transformer.

MATERIALS AND EQUIPMENT:

1. Open type transformer
2. Chalkboard

REFERENCES:

1. American Electricians' Handbook, Div. 5, Sec. 16-18, Sec. 31, Sec. 46-50, Sec. 67-69, Sec. 73-79, Sec. 115-121.
2. Basic Electricity, Vol. 4, Pages 77-89.

INTRODUCTION:

Transformer connections seem to be a complicated subject to many electricians. The student must learn the basic facts of the simple single-phase connections if he expects to understand the three-phase connections later.

PRESENTING THE LESSON:

The electrician will not hook up a transformer every day and he should not ask someone else to show him how to do the work.

Demonstrate on the chalkboard and on the model transformer how to make the connections. Have the students draw transformer connections on the board and on the notebook paper without help of the book.

APPLICATION:

Have the students answer the questions on the assignment sheet. Give individual help where needed.

CHECKING AND FOLLOW-UP:

Check the assignment sheets against the answer sheet and return to the students for placing in their notebooks.

THREE-PHASE TRANSFORMER

DESIRED RESULTS:

To acquaint the student with the technical or the theory and practice of three-phase transformer connections.

MATERIALS AND REFERENCES:

1. Chalkboard
2. American Electricians' Handbook, Div. 5, Sec. 50-57, 80-90.

INTRODUCTION:

This lesson concerns itself with the technical information about transformer connections. The next lesson will deal with the actual drawing of the connections. The student will need to know the facts learned in this lesson in order to complete the lesson by drawing actual connections. Have the students pay particular attention to the voltage and current relationships in wye and delta connections. These relationships apply to other devices such as generator and motor coils.

Three-phase transformer connections have become so varied and complicated that it is impossible for a student electrician to become completely familiar with the subject or to analyze without diagrams many of the problems that arise. However, a basic knowledge and understanding of simple transformer connections is not only essential to the apprentice from a standpoint of know-how but also is necessary for personal safety when he is connecting transformers.

PRESENTING THE LESSON:

There are severa basic transformer connections that the apprentice must memorize and be able to recognize at first glance in an actual transformer set-up and in wiring diagrams. These basic connections for three-phase work are delta and wye (Y) for three and four wire systems.

Present the advantages and disadvantages of a three-phase transformer. Discuss the voltage and current on the windings of a delta-delta connected transformer. Discuss the voltage and current on the windings of a wye-wye connected transformer.

In connecting large transformers in parallel, they will operate satisfactory with their low and high-tension windings connected to the same circuits provided they have (1) the same ratio of transformation (2) the same voltage rating and (3) approximately the same regulation.

Discuss the advantages of the wye connected primary. Discuss the disadvantages of the open delta transformer connection. Discuss the relative cost of transformer connections.

APPLICATIONS:

Have the students complete the questions on the assignment sheet.

CHECKING AND FOLLOW-UP:

Correct the answers on the assignment sheet and return to the students. Discuss any questions that need to be clarified.

THREE-PHASE TRANSFORMER CONNECTIONS

DESIRED RESULTS:

To become acquainted with the basic type connections for the three-phase transformers. To be able to draw diagrams for these connections.

REFERENCE:

1. American Electricians' Handbook, Div. 5, Sec. 50-57, 80-90.

MATERIALS AND SUPPLIES:

1. Chalkboard
2. Paper to draw transformer connections

INTRODUCTION:

The instructor should establish a uniform method of drawing transformers prior to making this assignment. This procedure, if followed will make the job much easier and more effective. Have the students make practice drawings of the basic connections. It is more important for them to know why than how in the connections of transformers.

PRESENTING THE LESSON:

Review several of the basic circuits using diagrams on the chalkboard. Have several of the students draw the diagrams on the chalkboard. Should the students have trouble with these particular drawings you should refer them to their references for further reading.

APPLICATION:

The students should complete the assignment sheets and make the drawing connections required.

CHECKING AND FOLLOW-UP:

Check the drawings and return them for correction and filing in the workbook. Assign extra drawings to those that need further study.

THREE-PHASE TRANSFORMER CONNECTIONS

DESIRED RESULTS:

To become acquainted with the basic type connections for the three-phase transformers. To be able to draw diagrams for these connections.

REFERENCES:

1. *American Electricians' Handbook*, [illegible]

MATERIALS AND SUPPLIES:

1. Chalkboard
2. Paper to draw transformer connections

INTRODUCTION:

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

PRINCIPLES OF A.C. MOTORS

DESIRED RESULTS:

1. To acquaint the learner with the "Basic Principles" of A.C. Motors in order to have a good understanding of the operation of the various types of motors to be studied later.
2. To review the action of a current carrying conductor in a magnetic field.

EQUIPMENT:

1. Film - "Rotating Magnetic Fields" and 16 mm projector
2. Electric Motors and Controllers by Crow (Demonstration Equipment)

REFERENCES:

1. Basic Electricity, Vol. 5, Pages 97-112.
2. American Electricians' Handbook, Div. 7, Sec. 54-65, 118-131.
3. Basics of Fractional Horsepower Motor and Repair, Pages 1-12.
4. *Swoope's Lessons in Practical Electricity, Pages 5-6, 509-511.

INTRODUCTION:

The use of electrical energy would be very limited if means for producing rotary motion had not been discovered. The electrical device which makes this possible is the electric motor. This lesson concerns itself with only the basic principles or concepts upon which all A.C. motors operate. Future lessons on motors will require more understanding of Induction and Capacitance. Some students may wish to go deeper into these subjects, if so, discourage this at this time. They will have plenty of time to study A.C. Theory at a later date.

There are several terms used in this lesson, such as, "Phase angle" and "Induction" which may need more explanation. These terms will be studied later as individual subjects.

PRESENTING THE LESSON:

A. Show and discuss the film.

B. Any demonstration equipment which may be available such as the Crow Equipment should be used to illustrate the principles involved in this lesson. The illustrations in Basics of Fractional Horsepower Motors and Repair by Schweitzer will show some demonstrations with minimum equipment.

C. Class discussion on the Basic Principles of A.C. Motors is very important in order to determine the degree of understanding of the learners.

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C. Class discussion on the Basic Principles of A.C. Motors is very important in order to determine the degree of understanding of the learners.

DISCUSSION QUESTIONS

1. What two factors determine the strength of an electromagnet?
2. How can the polarity of an electromagnet be reversed?
3. What happens when a conductor formed into a closed circuit is moved through a magnetic field?
4. What do we call the difference in the sychronous speed and the actual speed of an induction motor?
5. What is the proper term used to indicate a twisting or turning force? (Additional questions should be used.)

APPLICATION:

Fill in the answers to assignment sheet for this lesson.

CHECKING AND FOLLOW-UP:

Check the answers and return to the students for discussion and placing in the workbooks.

SINGLE-PHASE MOTORS

DESIRED RESULTS:

To acquaint the students with the single-phase motor, how and why it operates, and its proper use on the job.

MATERIALS:

1. Sample motors
2. Film - Motor Principles. United World Films or General Electric Co., Schenectady 5, N. Y.

REFERENCES:

1. Basic Electricity, Vol. 5, Pages 97-112.
2. Basic of Fractional Horsepower Motors and Repair, Pages 13-73.
3. *Swoope's Lessons in Practical Electricity, Page 515.
4. American Electricians' Handbook, Div. 7, Sec. 99-106.

INTRODUCTION:

When it was discovered that a coil of wire induces magnetic polarity in a soft-iron core, studies were made to find out that the poles were induced into the rotor. It was discovered that two sets of poles are so induced, one by transformer action, and one by the generating action of cutting lines of force. The poles induced by transformer action were found to be the most essential to successful operation of the motor. A pole induced in the rotor through transformer action becomes active only after it has rotated far enough to be attracted toward the next stator pole ahead. This delayed action was found to be caused by the fact that induced voltages lag inducing fluxes by 90 degrees, and that current flow in a highly inductive circuit, as exists in the rotor, lags the voltage by 90 degrees.

The capacitor motor plays such an important part in the work of an electrician today that it cannot be slighted. You will be working with this motor almost daily as an electrician, so be sure to know how and why it runs. It is easy to get confused because of the different classes of capacitor motors. Learn to recognize the several classes of capacitor-start split-phase induction motors.

The repulsion motor is not nearly as popular as it was before the introduction of capacitor-start motor. Although they are being replaced in many installations today, there are a great number still in service on air compressors and other heavy starting load applications. The electrician should be familiar with this motor and its characteristics.

This lesson begins a series of study of fractional horsepower motors. These motors are named from their differences in methods of starting. One type of induction motor which incorporates a starting device is called a "split-phase" induction motor. This motor uses combinations of inductance, capacitance and resistance to develop a rotating field. Split-phase motors come only in small sizes since the special starting windings are very light, thus, the motor does not develop enough torque to start heavy loads. Remember that this type of motor is very common and you will contact it most frequently in your work.

PRESENTING THE LESSON:

1. The first type of split-phase induction motor that we will study is the capacitor-start model. Refer to the simplified schematic diagrams in your texts for a typical capacitor-start motor. There are two windings, the main winding and a starting winding which is connected in parallel with the main winding and spaced at right angles to it. The 90 degree electrical phase difference between the two windings is obtained by connecting the auxiliary winding in series with a capacitor and the starting switch. Upon starting, the switch is closed, placing the capacitor in series with the auxiliary winding. The capacitor is of such a value that the auxiliary winding is effectively a resistive-capacitive circuit in which the current leads the live voltage by approximately 45 degrees. The main winding has enough resistance to cause the current to lag the line voltage by approximately 45 degrees. The two currents are therefore 90 degrees out of phase and so are the magnetic fields which they generate. The effect is that the two windings act like a two-phase stator and produce the revolving field required to start the motor.

2. Demonstrate the sample motors to the class and be sure that the students understand how they run. The student should be able to determine whether or not a motor should be sent to a shop, be replaced, or repair it on the job.

3. The student should obtain a clear picture of the rotating magnetic field. He should be familiar with the relationships between voltage, and torque, and starting, running, and breakdown torques in the induction motor.

4. Show the film - Motor Principles.

5. Discuss items brought out by the film or any questions that arise from the students.

APPLICATION:

The students will complete the assignment sheet for this lesson.

CHECKING AND FOLLOW-UP:

Check the answers and discuss any questions the students will ask concerning split-phase motors.

7. Show how a three-phase motor can be reversed.
8. What is the starting torque of a pure synchronous motor?
9. How do you control the speed of a wound-rotor motor?
10. The formula for finding the per cent of slip of an induction motor:

$$\text{Per cent of slip} = \frac{\text{Synchronous speed} - \text{operating speed} \times 100}{\text{Synchronous Speed}}$$

APPLICATION:

Have the students answer the questions on the Assignment Sheet.

CHECKING AND FOLLOW-UP:

Check the answers and discuss any noticeable mistakes made by the students.

7. Show how a three-phase motor can be reversed.
8. What is the starting torque of a pure synchronous motor?
9. How do you control the speed of a wound-rotor motor?
10. The formula for finding the per cent of slip of an induction motor:

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APPLICATION:

Have the students answer the questions on the Assignment Sheet.

CHECKING AND FOLLOW-UP:

Check the answers and discuss any noticeable mistakes made by the students.

MOTOR CIRCUITS

DESIRED RESULTS:

To acquaint the student with the requirements in regard to motors and their installation.

MATERIALS, EQUIPMENT AND SUPPLIES:

1. Chalkboard
2. Assignment Sheets

REFERENCES:

1. American Electricians' Handbook, Div. 7, Sec. 245-260
2. National Electrical Code, Article 430

INTRODUCTION:

The Code places great importance upon the proper installation of this equipment even to the point of devoting a lengthy section to motors. Be sure that the student understands the requirements of Article 430 and how they apply on the job.

PRESENTING THE LESSON:

The students should read the reference article and class discussion should cover those sections of Article 430 not specifically touched upon by the questions on the Assignment Sheet. The student can usually answer some of the questions from general knowledge or guessing. However, if he is required to list the section number after his answer, he will read and learn more Code in studying the lesson.

APPLICATION:

Have the students look up the answers to the questions and list the section number after each.

CHECKING AND FOLLOW-UP:

Check the answers with the students and return the papers for placing in the notebooks.

GENERAL INSTALLATION PROVISIONS

DESIRED RESULTS:

To acquaint the apprentice with the general installation provisions required or permitted by the "Code" for electric wiring and equipment.

REFERENCES:

1. National Electrical Code, Article 110
2. State and Local Electrical Codes & Ordinances

INTRODUCTION:

The requirements set forth in this section of the Code are general in nature and must be considered whenever an electrical installation is made. These provisions apply to all wiring and equipment installations unless specifically exempted by other sections of the Code. Therefore, the students should learn them well. Be sure that they study the entire article and not just find the answers to the questions.

It should be clearly understood that the apprentice wireman is not expected to memorize the contents of either the National Electrical Code, State and Local Safety Orders or Ordinances.

PRESENTING THE LESSON:

A. Studying the article, 110.

1. Study the definitions of the following terms, which are listed in Article 100 of the NEC: accessible, approved, concealed, device and enclosed.
2. Study the Mandatory and Advisory Rules and the use of the words "shall" and "should".
3. Give attention to Sections concerning conductors, equipment, and connections to terminals 110-6 thru 110-15.

B. Questions for discussion.

1. Are electrical fire hazards the same in small communities as in large cities?
2. Do you think there should be a single universal electrical code? Why?
3. Would it be wise to leave the matter of electrical requirements solely to the electrical wireman? To the electrical contractor?
4. Suppose you own a large building without electrical wiring. There are no electrical laws in the state or community. Ten electrical contractors wish to bid on the job of wiring the building. (a) What problems would you face in trying to decide who should get the work?

(b) Suppose, in this case, there was a national ordinance. Would decision be made easier? (c) Suppose, again, that there are state and local ordinances covering electrical installations. How would this fact help you in making the decision?

APPLICATION:

Have the class answer the questions on the assignment sheet for this lesson.

CHECKING AND FOLLOW-UP:

Check the answers and return the sheets to the students for correction and placing in their workbooks.

GROUNDED CONDUCTORS

DESIRED RESULTS:

To acquaint the apprentice with the code concerning Grounded Conductors.

REFERENCES:

1. American Electricians' Handbook, Div. 9, Sec. 246-259
2. Design Manual on Steel Electrical Raceways, Pages 29-36
3. National Electrical Code, Articles 200 and 250

INTRODUCTION AND PRESENTATION:

The subject of "grounding" is very important in our work as electricians. Proper grounding insures safety for life and property. There are two general headings or types of grounding; namely, equipment and system grounding. This assignment will introduce you to the many rules and requirements for this subject. This section of the Code should be studied very carefully. A "system ground" is a connection to ground from one of the current carrying conductors of a distribution system or of an interior wiring system. An "equipment ground" is a connection to ground from one or more of the non-current carrying metal parts of the wiring system. The term equipment used here includes all such metal parts as metal conduit and raceways, metal armor of cables, outlet boxes, switch boxes, and metal motor frames. The grounding conductor may be attached to the nearest cold water pipe.

All interior wiring systems, except as provided in sections of the code, shall have a grounded conductor. This conductor shall be identified throughout the system except as explained in the section of Code called "Unidentified Circuits". In some hazardous locations, such as hospital operating rooms, it may be desirable to install ungrounded circuits. Such ungrounded circuits must be connected to a system which is provided with a contact indicating a device that will warn the occupants of a faulty ground.

1. Study the definitions for the following terms which are listed in Article 100 of NEC: Ground, Grounded, Grounded Conductor, Grounding Conductor, Equipment.
2. Study the assigned sections of the Code very carefully.
3. Stress any particular applications noted in sections of this article which are vital in your area.

APPLICATION:

Have the students find the answers to the questions on the assignment sheet.

CHECKING AND FOLLOW-UP:

Check the answers and return the sheets to the students.

BRANCH CIRCUITS

DESIRED RESULTS:

To acquaint the apprentice with the requirements of the Code concerning branch circuits.

REFERENCES:

1. American Electricians' Handbook, Div. 9, Sec. 375 ff.
2. Design Manual On Steel Electrical Raceways, Pages 37-41 - 100-109
3. National Electrical Code, Article 210

INTRODUCTION:

Most of the electrical work to be done on any job will be concerned with Branch Circuits. The apprentice should become familiar with the requirements of the Code concerning these circuits. To know these requirements and carry them out on the job will become the electrician's "bread and butter". The apprentice should study this section carefully before attempting to answer the questions on the assignment sheet.

PRESENTING THE LESSON:

1. Study the definitions for the following terms listed in Article 100 of the NEC: Branch Circuit, Branch Circuit (Appliance), Branch Circuit (General Purpose), Branch Circuit (Individual).

2. Discuss:
   (a) The scope of branch circuits.
   (b) Exceptions to the provisions in Article 210.
   (c) Classification of branch circuits.
   (d) What is a Multi-Wire Branch Circuit?
   (e) What "Color Code" is required for a fire-wire branch circuit?
   (f) What is a Heavy-Duty lampholder?

3. What is meant by "Adequate Wiring"?
   (a) Discuss the minimums required by the Code.
   (b) Name the two handbooks that contain data on the design of adequate wiring.

4. Review the Calculation of Load.
   (a) For General Lighting.
   (b) Other outlets supplying specific appliances and heavy-duty lampholders.
   (c) Additions to existing installations.

5. Discuss specific requirements for:
   (a) Conductors
   (b) Overcurrent Protection
   (c) Outlets Required
   (d) Maximum Load
   (e) Permissible Loads

APPLICATION:

After studying and reviewing the Code requirements, have the students complete the questions on the Assignment Sheet.

CHECKING AND FOLLOW-UP:

Check the answers and return the sheets to the class for correction and placing in their workbooks.

FEEDERS

DESIRED RESULTS:

To acquaint the apprentice with the determination of the minimum sizes of feeder conductors necessary for safety.

REFERENCES:

1. American Electricians' Handbook, Pages 3-18 to 3-54
2. National Electrical Code, Articles 215 and 220; Table 29 of Chapter 10

INTRODUCTION:

This topic is concerned largely with feeder requirements for apartment houses and for stores. Although the basic rules are the same as for the single dwelling, the additional rules are more complex. For example, it is often the job of the electrician to install the single-phase three-wire service entrance for an apartment building. He has the problem of determining the size of the conductors and conduit for the service entrance. It is also necessary to determine the size of the subfeeders for each apartment. Of particular interest in this assignment is the method for determining demand load for groups of electric ranges in an apartment house. It is not necessary to memorize the requirements listed for groups of ranges or other fixed appliances. It is wise to spend enough time studying the notes appended to the table to make certain that methods for determining service and feeder demand factors are thoroughly understood.

PRESENTING THE LESSON:

Study the following sections: Feeder size; Normal voltage and Voltage drop; Calculation of Load; Computation of Feeder Sizes and Common Neutral Feeder.

After the students have studied the above sections, the instructor should go through each topic with them and point out the important items.

DEMONSTRATIONS: Computation of Feeder Sizes--Examples.

I. Maximum Demands for Range Loads
 (Use examples in code book)
II. Single-family dwelling
 (Use examples in code book)
III. Multi-family dwellings (apartment building)
 (Use examples in code book)

APPLICATION:

Have the students fill in the answers to questions on the Assignment Sheet.

CHECKING AND FOLLOW-UP:

After checking the answers, have the students correct the errors and place the sheets in their workbooks.

SERVICES

DESIRED RESULTS:

1. To understand the connections of standard single-phase, three-wire service entrances.
2. To understand the requirements of the National Electrical Code and power utility companies for a typical single family dwelling.

REFERENCES:

1. American Electricians' Handbook, Pages 9-159 thru 171; 9-177 thru 180
2. National Electrical Code, Article 230

INTRODUCTION:

In general, a building shall be supplied through only one set of service conductors. A building may be supplied by two or more service drops when there is good reason for this arrangement. (See Sections 230-2)

The service entrance for most present day lighting installations is a single-phase, three-wire service. The middle wire is called the neutral wire and is grounded; it is identified by the white insulation. The two outside wires are known as the hot wires. The voltage between the neutral wire and either of the hot wires is 115 volts and the voltage between the two hot wires is 230 volts.

In these modern times with the many electrical appliances, it is a definite advantage to have both 115 and 230 volts available. Many types of loads such as electric water heaters, electric ranges, and fractional horsepower motors operate on 230 volts. The higher voltage is preferable because heating appliances and motors will take less current. This permits the use of smaller wires, results in less voltage drop and less wasted power.

PRESENTING THE LESSON:

After the students have read Article 230, the instructor should point out the fundamental rules of the National Electrical Code. The rules concern the calculations affecting the service entrance switch, service entrance conductors, and grounding should be called to their attention.

Using the information sheets provided the students, review how to determine the number of circuits, the rating in volts and amperes, and the wire sizes for a typical, single family dwelling. This dwelling will have three bedrooms with a living area of 1500 square feet. The modern appliances scheduled for this home are listed including six space heating units. Determine the size panel to be installed to accommodate these circuits.

APPLICATION AND CHECKING AND FOLLOW-UP:

The students will complete the answers on the assignment sheets for this lesson. Then, check the answers and return to students for correction and filing in their workbooks.

GROUNDING

DESIRED RESULTS:

1. To acquaint the apprentice with the Code regulations for the protection of electric installations by grounding.
2. To understand the difference between "system grounds" and "equipment grounds", and how to ground them.
3. To study the methods of grounding and the sizes of conductors used.

REFERENCES:

1. American Electricians' Handbook, Pages 8-94 to 8-100; 9-144 & 9-151 to 159
2. National Electrical Code, Article 250

INTRODUCTION:

Protection of electric installations by grounding is very important work for the electrician. Insulation, isolation, and guarding are suitable alternatives under certain conditions. A good example of the need in some installations for isolated or insulated ungrounded circuits is covered in the Code section for hospital operating rooms.

A "system ground" is a connection to ground from one of the current-carrying conductors of a distribution system or of an interior wiring system. An "equipment ground" is a connection to ground from one or more of the non-current-carrying metal parts of the wiring system or of apparatus connected to the system. The term "equipment" includes all the materials with metal parts used in the installation, such as: metal conduit, raceways, outlet boxes, cabinets, switch boxes, motor frames, and metal enclosures for motor controllers.

PRESENTING THE LESSON:

Circuits are grounded for the purpose of limiting the voltage upon the circuit which might otherwise occur through exposure to lightning or other voltages higher than that for which the circuit is designed; or to limit the maximum potential to ground due to normal voltage.

Give examples of grounding systems encountered:

a. Transformer grounding.

b. An interior wiring system grounded at the service entrance.

c. System with neutral ungrounded, with voltages to ground with an accidental ground on one conductor.

d. Instrument transformers, relays, and switchboards.

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Protection of electric installations by grounding is very important work for the electrician. Insulation, isolation, and guarding are suitable alternatives under certain conditions. A good example of the need in some installations for isolated or insulated ungrounded circuits is covered in the Code section for hospital operating rooms.

A "system ground" is a connection to ground from one of the current-carrying conductors of a distribution system or of an interior wiring system. An "equipment ground" is a connection to ground from one or more of the non-current-carrying metal parts of the wiring system or of apparatus connected to the system. The term "equipment" includes all the materials with metal parts used in the installation, such as: metal conduit, raceways, outlet boxes, cabinets, switch boxes, motor frames, and metal enclosures for motor controllers.

PRESENTING THE LESSON:

Circuits are grounded for the purpose of limiting the voltage upon the circuit which might otherwise occur through exposure to lightning or other voltages higher than that for which the circuit is designed; or to limit the maximum potential to ground due to normal voltage.

Give examples of grounding systems encountered:

a. Transformer grounding.

b. An interior wiring system grounded at the service entrance.

c. System with neutral ungrounded, with voltages to ground with an accidental ground on one conductor.

d. Instrument transformers, relays, and switchboards.

Lesson B-25

ALTERNATING CURRENT INSTRUMENTS

DESIRED RESULTS:

1. To review what the apprentice has found out about how current, voltage and resistance can be measured.
2. To become more familiar with the types of alternating current instruments.

REFERENCES:

1. American Electricians' Handbook, Pages 1-60 thru 69
2. Basic Electricity, Pages 1-62 thru 82; 1-88 thru 97; 1-108, 1-118 & 119

EQUIPMENT:

1. Available measuring instruments of all types
2. Materials for demonstration "hook-ups".

INTRODUCTION:

You know that an electric current is the movement of "free electrons" in a conductor. We have learned that an electric current does not begin to flow all by itself; there must be a source of electrical force to move the "free electrons" through the material. We must use instruments to measure the current, voltage and resistance. Now let us look again at what you have studied and observed concerning the units of measurement and the correct use of the instruments.

PRESENTING THE LESSON:

1. Demonstrate how a lamp current is measured with an ammeter connected in series. How small currents are measured in milliamperes and microamperes. How these units of current are changed to amperes.

2. Demonstrate meters for measuring voltage that have ranges in microvolts, millivolts, volts and kilovolts. Review of voltage units and the changing of voltage units.

3. Demonstrate the ohmmeter and how it measures resistance. Review the various units of resistance. Review the various units of resistance and their relation to the basic unit--ohm.

APPLICATION:

Have the students complete the Assignment Sheet for this lesson.

CHECKING AND FOLLOW-UP:

Check the answers on the Assignment Sheet and return to the student for correction.

Lesson B-26

ELECTRICAL SYSTEMS

DESIRED RESULTS:

1. To review reasons for providing separate circuits for lamps and motors.
2. To be able to sketch various three-wire Delta and four-wire Wye systems.

REFERENCES:

1. American Electricians' Handbook, Pages 3-8 thru 18

INTRODUCTION:

There are several systems that may be used for distributing electrical energy over the various arrangement of circuits. It is generally not good practice to supply lamps and motors from the same circuit unless the motors are small, fractional horsepower sizes. Most power utility companies require a three-phase service installation when the connected motor load is in excess of 5 horsepower. Most three-phase motors of one horsepower or larger are cheaper than single-phase motors of equal rating. Furthermore, the three-phase motor is easier to maintain than a single-phase motor. The three-phase motor does not have a centrifugal switch or a commutator that require a great deal of maintenance.

PRESENTING THE LESSON:

Demonstrate:

1. A Wye connection on the chalkboard.
2. A Delta system on the chalkboard.
3. Discuss line and phase voltages and current relationships of each system.
4. Give applications of Wye and Delta connections
   a. Generators, motors, and transformers.
   b. The three and four wire transmission lines.

APPLICATION:

Have the students complete the Assignment Sheet.

CHECKING AND FOLLOW-UP:

Check the answers and return to the students for correction.

ELEVATORS

DESIRED RESULTS:

1. To study the Code requirements for electrical equipment and wiring used in connection with elevators, dumbwaiters, escalators, and moving walks.

REFERENCES:

1. National Electrical Code, Article 620

INTRODUCTION:

The provisions of this article apply to electrical equipment and wiring used in connection with elevators, dumbwaiters, escalators, etc. They will also apply to console lifts, equipment for raising and lowering or rotating portions of theater stages and all similar equipment.

All wiring in the raceways and in or on the cars of elevators, etc. shall be flame-retardant and moisture-resistant insulation. The thickness of the insulation of all wiring shall be suitable for the voltage to which the wiring is subjected.

NOTE: A distinction is made here between the heavy connections carrying the power current and the smaller wires of operating circuits, such as wire connected to the magnet coils of contactors. The operating current passing through the magnet coils may be quite small and a small current leaking through damp slow-burning insulation where two insulated wires are in contact might be sufficient to operate a contactor.

PRESENTING THE LESSON:

Have the students review the Article 620 and then study it in detail. They should note the minimum size of conductors and the installation of them. The different systems in one raceway or cable and the requirements for this installation. The requirements for motor circuit conductors should be discussed.

There should be disconnecting means, overcurrent protection, grounding and overspeed control provided.

A machine room shall be provided to secure all moving motor generator sets, driving machines, controllers and auxiliary control equipment.

APPLICATION:

Have the students complete the questions on the Assignment Sheet using the Code book.

CHECKING AND FOLLOW-UP:

Check the answers and return to the students for correction and placing in their notebooks.

ELEVATORS

DESIRED RESULTS:

1. To study the Code requirements for electrical equipment and wiring used in connection with elevators, dumbwaiters, escalators, and moving walks.

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PRESENTING THE LESSON:

Have the students review the Article 620 and then study it in detail. They should note the minimum size of conductors and the installation of them. The different systems in one raceway or cable and the requirements for this installation. The requirements for motor circuit conductors should be discussed.

There should be disconnecting means, overcurrent protection, grounding and overspeed control provided.

A machine room shall be provided to secure all moving motor generator sets, driving machines, controllers and auxiliary control equipment.

APPLICATION:

Have the students complete the questions on the Assignment Sheet using the Code book.

CHECKING AND FOLLOW-UP:

Check the answers and return to the students for correction and placing in their notebooks.

SWIMMING POOLS

DESIRED RESULTS:

To study the Code requirements for installing electric wiring for equipment and lighting at swimming pools.

REFERENCES:

1. National Electrical Code, Article 680

INTRODUCTION:

The provisions of this Article apply to the construction and installation of electric wiring for equipment in or adjacent to swimming pools, and to the auxiliary equipment such as pumps, filters, and similar equipment. No electric wiring or apparatus shall be installed in the water or enclosed walls of a swimming pool, except as provided for in this article.

PRESENTING THE LESSON:

Have the students study this short Article and look up any references. Discuss any questions that may arise.

APPLICATION:

Have the students complete the Assignment Sheet for this lesson.

CHECKING AND FOLLOW-UP:

Check the answers to the questions and return the sheets to the students for correction.

Lesson B-29

EMERGENCY SYSTEMS

DESIRED RESULTS:

1. To study the reasons for providing separate power and light emergency systems in places of assembly.
2. To acquaint the student with the requirements of the National Electrical Code that apply to emergency systems.

REFERENCES:

1. National Electrical Code, Article 700

INTRODUCTION AND PRESENTATION:

Emergency systems are generally installed in places of assembly where artificial illumination is required, such as buildings subject to occupancy by large numbers of persons, hotels, theaters, sports arenas, hospitals, and similar institutions. Storage batteries have been used for emergency power for short periods of time. Diesel powered generator sets are generally installed for use when the normal service fails.

Emergency systems may provide power for such functions as: 1. Essential refrigeration; 2. Ventilation when essential to maintain life; 3. Operation of mechanical breathing apparatus; 4. Illumination and power for hospital operating rooms; 5. Fire pumps; 6. Industrial processes where current interruption would produce serious hazards; 7. Public address systems and similar functions.

DISCUSSION OF THE LESSON:

1. Discuss the emergency system needed for a hospital. How is the system approved for use? Who makes periodical tests and maintenance checks to insure proper operating conditions?

2. What current supply systems are available for installation where emergency lighting and power may be needed?

3. List some of the requirements for emergency circuits for lighting and power. Will independent wiring be required?

4. Discuss some of the controls for emergency lighting circuits. Who is responsible for overcurrent devices?

5. Explain what is meant by individual unit equipment.

APPLICATION:

Have the students complete the Assignment Sheet for this lesson.

CHECKING AND FOLLOW-UP:

Check the answers and return to the class for correction and discussion.

INSTRUCTIONAL MATERIALS

Recommended Films

Lesson No.	Second Year
B-1	1. How Man Made Day, 16mm Sound, Coronet Films 2. Light Is What You Make It, 16 mm Sound National Better Light and Sight Bureau or Carolina Power and Light-Advertising Department Raleigh, North Carolina
B-2	Incandescent Lamp Carolina Power and Light-Advertising Department
B-3	1. The Magic of Fluorescence, 16 mm Sound General Electric Co. 2. Principles of Gas-Filled Tubes ($39--purchase price) Production No. OE353 Norwood Studios, Inc., Film Division 926 New Jersey Ave., N.W. Washington, D. C.
B-7	Inductance, 16 mm Sound United World Films
B-14	"Rotating Magnetic Fields", 16 mm Sound Production No. OE384 ($34--purchase price) Norwood Studios, Inc., Film Division
B-16	"Squirrel-Cage Rotor Principles" Production No. OE836 ($27--purchase price) Norwood Studios, Inc., Film Division

NOTE: These are suggested films with the names of the producer, or where they can be obtained. Be sure to check the "Free Film" catalogs for the same titles. Any other appropriate teaching aids may be used with specific topics.

Textbooks

All textbooks listed for the First Year plus the following:

Basics of Fractional Horsepower and Repair, by Gerald Schweitzer John F. Rider, Publisher 116 West 14 Street New York 11, N. Y.	$3.90

VT 003 627

VT 003 627

Basic Electricity Series, No. B (Second Year), for Apprentices Employed in Electrical Work, Assignment Sheets and Information Sheets.

Wedinger, Howard E.
North Carolina State Board of Education, Raleigh.
Pub Date - Jun67
MF AVAILABLE IN VT-ERIC SET 107p.

*STUDY GUIDES, *TRADE AND INDUSTRIAL EDUCATION, *ELECTRICIANS, *ELECTRICITY, POST SECONDARY EDUCATION, TESTS, *APPRENTICESHIPS,

This study guide, the second of a four-unit series, is for individual student use in acquiring technical information in the second year of the related technical phases of post-secondary electrician apprenticeship training. It was developed by a curriculum committee of subject matter specialists and the educational committee of the National Electrical Contractors of North Carolina, tested on a small group, and used in apprenticeship programs. Assignment and information sheets for 30 lessons cover lighting and lamps, transformers, A.C. motors, and the National Electrical Code in terms of wiring methods. They contain textbook references and problem exercises. The teacher of this 144-hour course should be a journeyman of the trade, and the students should be 18 years old and employed as apprentices in an electrical construction trade. Supplementary materials include unit tests to be for approximately every 6 weeks and a final examination. Correlated lesson plans for the instructor are given in VT 003 626. Documents of the series are listed as VT 003 624 through VT 003 631. (HC)

ASSIGNMENT SHEETS AND INFORMATION SHEETS ,

BASIC ELECTRICITY

SERIES NO. B
(Second Year)

FOR APPRENTICES

EMPLOYED IN ELECTRICAL WORK

JULY 1964

Revised

JUNE 1967

VOCATIONAL-TECHNICAL DIVISION
DEPARTMENT OF COMMUNITY COLLEGES
STATE BOARD OF EDUCATION
RALEIGH, NORTH CAROLINA

RELATED INSTRUCTIONAL MATERIAL

ASSIGNMENT SHEETS AND INFORMATION SHEETS

BASIC ELECTRICITY

SERIES NO. B
(Second Year)

APPRENTICE TRAINING

IN

ELECTRICAL WORK

JULY 1964

Revised

JUNE 1967

Prepared By
Howard E. Hedinger

VOCATIONAL-TECHNICAL DIVISION
DEPARTMENT OF COMMUNITY COLLEGES
STATE BOARD OF EDUCATION
RALEIGH, NORTH CAROLINA

MEMORANDUM

TO: The ERIC Clearinghouse on Vocational and Technical Education
The Ohio State University
980 Kinnear Road
Columbus, Ohio 43212

FROM: (Person) Roger G. Worthington (Agency) Department of Community Colleges

(Address) Education Building, Raleigh, North Carolina

DATE: September 7, 1967

RE: (Author, Title, Publisher, Date) Hedinger, Howard E. "Basic Electricity For Apprentices, Series B - Second Year Assignment and Information Sheets," Curriculum Laboratory, Dept. of Community Colleges, July 1964.

Supplementary Information on Instructional Material

Provide information below which is not included in the publication. Mark N/A in each blank for which information is not available or not applicable. Mark P when information is included in the publication. See reverse side for further instructions.

(1) Source of Available Copies:
Agency ERIC Only, except North Carolina Institutions
Address
Limitation on Available Copies
Price/Unit
(quantity prices)

(2) Means Used to Develop Material: National Electrical Contractors for
Development Group Curriculum committee / Carolinas - Educational committee
Level of Group State and Dept. supervisor
Method of Design, Testing, and Trial Designed by subject matter specialists and tested on a small group; has been used with 1,200 apprentices per year for 3 years.

(3) Utilization of Material:
Appropriate School Setting Vocational (Apprentice Training)
Type of Program Post-high; Apprenticeship.
Occupational Focus A specific job (electrical construction)
Geographic Adaptability N/A
Uses of Material Course and lesson planning and student study guides.
Users of Material Instructor and student

(4) Requirements for Using Material:
Teacher Competency Journeyman instructor
Student Selection Criteria 18 year old, male (mostly), post-secondary educ. to become a journeyman electrician
Time Allotment 144 hours per year (minimum)

Supplemental Media -- Textbooks - see list
Necessary X)
Desirable) (Check Which)

Describe Basic Electricity, VanValkenburgh & All, Hayden Book Co.; Amer. Electricians' Handbook, Croft, McGraw-Hill Book Co.; Basic Mathematics
Source (agency)/ by Singer, McGraw-Hill Book Co.; National Electrical Code
(address)/ National Fire Protection Assoc. 60 Batterymarch St., Boston, Mass.

ACKNOWLEDGMENTS

Questions and problems for the Lesson Topics in this workbook were prepared and authorized for use by:

W. F. Humbert, III
Instructor for Electrical Apprentices
Winston-Salem-Forsyth County
Technical Institute

The Instructor's Manual, Information and Orientation Sheets keyed to the Assignment Sheets were developed by:

Howard E. Hedinger
Vocational-Technical Division

PREFACE

The materials in this publication have been prepared to provide specific assignments for studying related topics necessary in the training of electrical apprentices. An effort was made to develop the schedule for the instructors to follow as the apprentice progresses with his training. It will also enable the apprentice to know what skills and knowledges will be required of him. One objective of this program is to aid the instructor and employer in providing experiences necessary to develop a competent worker in the electrical field.

This workbook includes assignment sheets and information sheets for the electrical apprentice to use in searching out related information. They contain textbook references, problems to solve and key sentences to complete, diagrams to draw, and blueprints to consult. The apprentice should study the assigned references before he attempts to answer the questions or solve the problems.

In actual use of these lessons, instructors should feel free to modify their application of the material to conform with local needs. For example, there may be certain sections of the Code to teach because the apprentices are working with special installations. Thus, the instructor will prepare additional materials to use with the course. In other classes, the instructor may need to spend more time on topics dealing with mathematics than with blueprint reading. In any event, the minimum class time for related material is 144 hours per year. It is sincerely hoped that the assignment sheets are used correctly, so that apprentices can gain maximum benefits from their related studies.

A. J. Bevacqua, Educational Director
Vocational-Technical Division
Department of Community Colleges

H. E. Hodinger
Educational Consultant

ASSIGNMENTS

SECOND-YEAR APPRENTICE TRAINING PROGRAM

BASIC ELECTRICITY

SECOND YEAR
SERIES - B

ASSIGNMENTS

SECOND-YEAR APPRENTICE TRAINING PROGRAM

BASIC ELECTRICITY

SECOND YEAR
SERIES - B

NAME ______________________________ Lesson B-1

General Lighting Page 2

14. Any brightness within the field of vision which causes discomfort, annoyance, interference with vision or eye fatigue is called ______________________.

15. List three different classes of glare: (a) ____________________, (b) ____________________, (c) ____________________.

16. Incandescent lamps are rated by input ____________________.

17. The output of incandescent lamp ____________________ as the applied voltage decreases.

18. Lamp efficiency is the ratio of the ______________ ______________ to ______________ ______________.

19. What is the lamp efficiency of a 200-watt lamp with 3700 lumens?

20. List four general classes of illumination: (a) ________________, (b) ________________ (c) ________________, (d) ________________.

NAME ______________________________ Lesson B-2

DATE ______________________________ Incandescent Lamps

REFERENCE

1. Croft's American Electricians' Handbook, Pages 10-21 - 10-44, Sec. 48-102.
2. National Electrical Code, Article 410.

PROBLEMS

1. List four essential parts of an incandescent lamp: (a) ____________________,

   (b) ______________________________, (c) ______________________________,

   (d) ______________________________.

2. List six ways incandescent lamps are classified: (a) ____________________,

   (b) __________________, (c) ____________________, (d) __________________,

   (e) __________________, (f) ____________________.

3. In a Type "B" lamp, the filament operates in a ____________________________.

4. Type "C" lamps are __________________________________.

5. What are the common uses for the following bulbs?

   (a) Inside Frosted __________________________

   (b) Clear ________________ ________________

   (c) Silvered ________________________________

   (d) Daylight ________________________________

6. List three types of filaments: (a) ____________________________________,

   (b) ______________________________, (c) ______________________________.

7. List four ordinary uses of general lighting service lamps: (a) ____________,

   (b) ______________, (c) ____________________, (d) ____________________.

NAME ______________________________ Lesson B-2

Incandescent Lamps Page 2

8. List four uses of special lighting service lamps: (a) ________________,
(b) ________________, (c) ________________,
(d) ________________.

9. List five types of miscellaneous lighting service lamps: (a) ________________,
(b) ________________, (c) ________________, (d) ________________,
(e) ________________.

10. In general, general service lamps may be burned in ____________ position.

11. Rough-service lamps sacrifice ____________ for strength.

12. The life of an incandescent lamp is the number of burning hours before the ________________ drops to ____________ per cent of the initial.

13. Lamps operated at less than rated voltage will have ____________ life.

14. Lamps operated at above rated voltage will have ____________ life.

15. ____________ voltage on a lamp decreases the ____________ output.

16. A lamp rated at 95 per cent of rated voltage will emit ________________ per cent of rated lumens.

NAME ______________________________ Lesson B-3

Flourescent Lamps Page 2

14. Cold Cathode starting is called ______________ __________ ____________.

15. Instant-start lamps are constructed with ____________ _______________

or __________________ ___ - ___________ bases.

16. Instart Start lamps are ___ __________-____________________ when starting.

17. List five methods of operating fluorescent lamps:

(a) ____________________________________

(b) ____________________________________

(c) ____________________________________

(d) _________________ ____________ _____

(e) ____________________________________

18. Give types of lamp bases for following operating methods:

(a) Pre-heat start ______________________________

(b) Rapid start ________________________________

(c) High-output rapid start _______________________

(d) Powergroove ________________________________

19. Cool white lamps have _________________ efficiency, good _____________,

_____________________ and blends with ____________________________.

NAME ______________________________ Lesson B-3

Fluorescent Lamps Page 3

20. Warm white lamps have the ____________ efficiency.

21. Deluxe cool lamps simulate the appearance and color properties of ____________ ________ __________.

22. List the approximate life and initial lumens of the following lamps:

Lamp	Life, Hrs.	Initial Lumen
(a) T-5- Cool White - 13 watts		
(b) T-8- Daylight- 30 watt		
(c) T-12- Cool white - 20 watt		
(d) T-12- Cool white-rapid start-40w		
(e) T-12- Warm white-rapid start- 40 watts		
(f) T-12- Cool white-HO - 105 watts		
(g) PG-17- Cool white- PG- 200 watts		

23. Rated average life of a fluorescent lamp is ____________ based on ____________ burning hours per start.

24. Life of fluorescent lamp is affected by:

(a) ____________________________

(b) ____________________ ________

(c) ____________________________

25. Efficiency of a fluorescent lamp is highest at ________ to ________°.

26. Efficiency of fluorescent lamp ___________ ___________ as temperature increases and ___________ ___________ as temperature decreases below normal.

27. Line voltage in ____________ of 125 volts ___________ the ballast.

28. List three means a fluorescent lamp may interfer with a radio:

(a) ____________________________
(b) ____________________________
(c) ____________________________

29. List four reasons for inferior operation of fluorescent lamps on D.C. circuits:

(a) ____
(b) ____
(c) ____
(d) ____

30. (Cont.)

(c) ______________________________________
(d) ______________________________________

31. List five advantages for high-frequency operation of fluorescent lamps:

(a) ______________________________________
(b) ______________________________________
(c) ______________________________________
(d) ______________________________________
(e) ______________________________________

32. What is the cause of swirling and spiraling in a fluorescent lamp?

33. ____________________ ____________________ lamps have cathodes designed for high-voltage starting.

NAME ______________________________ Lesson B-4

DATE ______________________________ Fluorescent Ballasts

REFERENCE

1. American Electricians' Handbook, Pages 10-57 - 10-67, Sec. 123-130.

PROBLEMS

1. Operation of fluorescent lamps requires a ________________________.

2. List two purposes of a ballast:

   (a) ________________________________

   (b) ________________________________

3. The power-factor of a ballast is __________________.

4. __________________ are added in the ballast circuit to raise the power-factor.

5. In the preheat-start method, a ________________ ________________ is required.

6. ________________ must be properly designed for starting method.

7. List two functions of the starting switches for the pre-heat method:

   (a) ________________________________

   (b) ________________________________

8. List four types of starting switches:

   (a) ________________________________

   (b) ________________________________

   (c) ________________________________

   (d) ________________________________

9. Describe the advantage of a "No-Blink" or "Watch-Dog" starter.

10. Describe the action of the thermal-switch starter.

NAME ______________________ Lesson B-4

Fluorescent Ballasts Page 2

11. Describe the action of the manual starting switch.

12. Thermal-switch starters give the ______________ __________________.

13. Excessive temperatures in a ballast causes the ____________ to fail.

14. The maximum safe operating temperature of a capacitor ballast is __________.

15. Noise rating of ballasts are indicated by letters; ____________ for the quietest; ____________________ for noisiest.

16. A ballast with an ________________ rating is suitable for residential use.

17. Study the fluorescent lamp circuit with a No-Blink starter. Discuss in class

18. Study the fluorescent lamp circuit with a thermal-switch starter.

19. Study wiring diagram for two 40-watt lamps with medium bipin bases and circuits using starters, 118V., "A" sound rating. (Indicate Diagram No. also.)

11. Describe the action of the manual starting switch.

12. Thermal-switch starters give the ______________ ______________.

13. Excessive temperatures in a ballast causes the ______________ to fail.

14. The maximum safe operating temperature of a capacitor ballast is ______________.

15. Noise rating of ballasts are indicated by letters; ______________ for the quietest, ______________ for noisiest.

16. A ballast with an ______________ rating is suitable for residential use.

17. Study the fluorescent lamp circuit with a No-Blink starter. Discuss in class

18. Study the fluorescent lamp circuit with a thermal-switch starter.

19. Study wiring diagram for two 40-watt lamps with medium bipin bases and circuits using starters, 118V., "A" sound rating. (Indicate Diagram No. also.)

NAME ______________________________ Lesson B-5

DATE ______________________________ Lighting Installation

REFERENCE

1. National Electrical Code, Article 410.

PROBLEMS

1. Lamp-holders, receptacles and switches which have exposed accessible terminals shall not be installed in ______________ ______________ canopies or in open bases of portable table or floor lamps.

2. Fixtures installed in ____________________ or ______________ ____________ shall be approved for such locations.

3. Fixtures shall be equipped with shades or guards so that combustible material will not be subject to ____________________ in excess of ______________°C.

4. Fixtures in clothes closets shall be installed on the __________________ or on the ______________________ above the ____________________.

5. Each outlet box shall be provided with a ______________________.

6. Fixtures weighing in excess of ______________________ shall not be supported screw shell of a lampholder.

7. Fixtures weighing in excess of ___________________ shall be supported independently of ________________________ ______________________.

8. Fixture conductors shall be No. 18 AW or ______________________.

9. Branch circuit conductors within 3-inches of a fluorescent ballast shall be ________________ ________________ or other types of conductors recognized for use at temperatures not lower than ____________________.

10. Fixtures without an approved raceway may be used as a raceway for a ___________ ______________ or ______________ single branch circuit.

11. The ______________________ conductor shall be connected to the lampholder screw shell.

12. Pull type canopy switches shall be mounted within _________________ of the center of canopy.

13. All wiring shall be free from ___________ ___________ and _____________ and shall be ________________ for these defects prior to being connected to ____________________.

NAME ______________________________ Lesson B-5

Lighting Installation Page 2

14. Weatherproof lampholders shall be installed in ______________ or ______________ locations.

15. Lamps shall be equipped with a __ ________ ____________ when rated 300 watts or less.

16. Mogul bases shall be on lamps rated above ____________ watts but not larger than ________________ watts.

17. Receptacles located in floors shall be ________________ in ____________ ______________ ________________.

18. Weatherproof recaptacles shall be installed in __________ or __________ locations.

19. The terminal for connection to grounding conductor shall be designated by ________________-colored finish.

20. Grounding type receptacles shall be rated __________ amperes at a potential between ______ and ________ volts, or ____________ or ____________ amperes at a potential not over ______________ volts.

21. Grounding type attachment plug shall have one separate fixed grounding member designated by a green colored finish and so designed to prevent it from being capable of touching any __________________-____________ ____________________________________ of the receptacle.

22. At lease __________ ________________ of flexible metal raceway shall be installed between outlet box and recessed fixture.

23. Fixture shall be marked indicating ______________________ lamp wattage.

24. Fluorescent fixture is an example of an ______________-______________ lighting equipment.

25. Electric-discharge lighting equipment having an open circuit voltage of more than ____________________ volts shall not be installed in a dwelling.

26. Exposed ballasts shall not be in contact with ______________________ ____________________.

NAME ______________________________ Lesson B-5

Lighting Installation Page 3

27. A fluorescent fixture shall be mounted __________ inches from surface of fibreboard unless ________________ for installation directly on fibreboard.

28. Snap switches for controlling florescent equipment shall be approved for ________________ ____________.

29. Mercury vapor lamps are an example of an ______________ ____________ lighting system of more than 1,000 volts.

30. On equipment of more than 150 volts to ground, all metal fixtures, parts, etc., shall be ____________________.

31. All metal electrical equipment near plumbing fixtures unless grounded shall maintain clearances ________________ feet horizontally and ____________ feet vertically.

NAME ______________________ Lesson B-6

DATE ______________________ Electrical Testing

REFERENCE

1. American Electricians' Handbook, Pages 1-56 - 1-64, Sec. 160 - 180; Pages 1-73 - 1-75, Sec. 201 - 212.

2. Basic Electricity, Pages 3-22ff, 5-75 ff.

PROBLEMS

1. What is an ohmmeter?

2. What is a megger?

3. A megger consists of ______________ ______________ and ______________ ______________

4. One purpose of the megger is to test ______________ of ______________.

5. The direction of current flow in a D.C. circuit can be determined by a ______________.

6. The polarity of a D.C. circuit may be determined by holding the ______________ conductors in a ______________ of ______________ ______________.

7. A voltmeter may be used for testing light fixtures for ______________, ______________ ______________ and ______________.

8. Study the method of identifying concealed conductors with an electric-bell tester.

9. Discuss methods for testing connection for three-way switches. (In Class).

10. Very small resistances may be measured using an ______________ and a ______________.

11. Insulation resistance may be measured using a ______________ and ______________.

12. Current can be measured using a known resistance, ______________ and ______________ ______________.

NAME________________________________ Lesson B-6

Electrical Testing Page 2

13. "Tong Test" ______________________ is a convenient instrument for measuring current without breaking the circuit.

14. Install ammeters in __________________ and voltmeters in ______________ in measuring currents and voltages.

15. For protection of an ammeter a ________________ ________________________ shall be installed.

16. A __________ ________ ________________ lamp tester is a convenient

and compact device for determining ____________ ____________, ____________

of _______ ________ and ________________ or ______________________ circuits.

17. Study the magneto test set and method of use.

18. List three advantages of the telephone receiver test set over the magneto tester.

(a) ________________________________

(b) ________________________________

(c) ________________________________

19. Study the telephone receiver test set and method of use.

20. What is one advantage of the telegraph sounder?

21. Describe an electric-bell testing outfit and method of use.

22. Describe a test lamp set.

23. What are two items to be considered in construction of a test lamp set?

(a) ________________________________

(b) ________________________________

NAME______________________________ Lesson B-6

Electrical Testing Page 2

13. "Tong Test" ____________________ is a convenient instrument for measuring current without breaking the circuit.

14. Install ammeters in ________________ and voltmeters in ____________ in measuring currents and voltages.

15. For protection of an ammeter a ____________ ________________ shall be installed.

16. A ________ ______ ______________ lamp tester is a convenient

and compact device for determining ____________ __________, __________

of ______ _______ and ________________ or ____________________ circuits.

17. Study the magneto test set and method of use.

18. List three advantages of the telephone receiver test set over the magneto tester.

(a) ______________________________

(b) ______________________________

(c) ______________________________

19. Study the telephone receiver test ser and method of use.

20. What is one advantage of the telegraph sounder?

21. Describe an electric-bell testing outfit and method of use.

22. Describe a test lamp set.

23. What are two items to be considered in construction of a test lamp set?

(a) ______________________________

(b) ______________________________

NAME ______________________________ Lesson B-7

Inductance Page 2

13. List eight factors that affect inductance:

(a) ______________________________

(b) ______________________________

(c) ______________________________

(d) ______________________________

(e) ______________________________

(f) ______________________________

(g) ______________________________

(h) ______________________________

14. Iron core is a better path than ____________.

15. Air is a better path than a ____________________ core.

16. Define mutual induction.

17. A transformer is an excellent example of ______________________________.

NAME ______________________________

DATE ____ ________________________

Lesson B-8

Principles of Transformers

REFERENCE

1. American Electricians' Handbook, Pages 5-2 - 5-3, Sec. 1-4.
2. Basic Electricity, Pages 3-54 - 3-57.
3. *Basic Mathematics, Pages 351 - 359.
4. Swoope's Lessons in Practical Electricity, Pages 526 - 533.

PROBLEMS

1. A ____________ ____ is a device for changing ______________ energy from one potential to another.
2. The ____________ windings of a transformer are ______________ and secondary.
3. Secondary windings are connected to the ______________ side.
4. The line side is connected to the ____________ windings.
5. A ____________________________ transformer delivers energy at a higher potential than it receives.
6. List three types of losses in a transformer:
   (a) ______________________________
   (b) ______________________________
   (c) ______________________________
7. A transformer which delivers energy at a lower potential than it receives is called a ______________________________.
8. Find the secondary voltage of a transformer having 2400 volt primary, 250 secondary turns and 25 primary turns.
9. Find the primary turns of a transformer having 120 volt on primary, 24 secondary voltage and 100 secondary turns.
10. Basic construction of a transformer consists of the following:
    (a) ______________________________
    (b) ______________________________
    (c) ______________________________

NAME ______________________________ Lesson B-8

Principles of Transformers Page 2

11. Transformers are rated in ________________.

12. Primary currents flow ________________ to secondary currents because of ________________ of ________________ ________________.

13. Find the secondary current in a transformer having 2400 volt primary, 240 volt secondary, and 5 amperes in primary.

14. Find the primary voltage of a transformer having 40 amperes in secondary, 5 amperes in primary and 550 volt secondary.

15. Describe the principle operation of a transformer.

16. A bell transformer draws 40 watts from a line. Find the secondary current if the secondary voltage is 20 volts.

17. Find the secondary current of a transformer that draws 180 watts from the line operating at 95% efficiency and delivers 80 volts from the secondary.

18. Find the efficiency of a transformer drawing 180 watts from 120 volt primary and delivers 24 volts at 5 amps.

19. The ________________ is the magnetic circuit upon which the windings are wound.

20. Define regulation of a transformer.

21. Find the regulation of a transformer having a rise of potential difference at the secondary terminals from 550 to 575 volts when the rated load is removed.

22. List two advantages of Spirakore core construction:

(a) ______________________

(b) ______________________

23. In general, the ____________ input of a transformer is __________ to the power output.

NAME ____________________________________ Lesson B-9

DATE ____________________________________ Types of Transformers

REFERENCE

1. American Electricians' Handbook, Pages 5-4 - 5-13, Sec. 5 - 21; Pages 5-38- 5-46, Sec. 57 - 72.

PROBLEMS

1. List five conditions under which a transformer should deliver its rated load:

(a) ____________________________________

(b) ____________________________________

(c) ____________________________________

(d) ____________________________________

(e) ____________________________________

2. The efficiency of a transformer is the ratio of the output to the sum of the output, ____________________________________ and ____________________ ____________________.

3. List six main classifications of transformers:

(a) ____________________ (d) ____________________

(b) ____________________ (e) ____________________

(c) ____________________ (f) ____________________

4. Non-flexibility is the main disadvantage of a ____________________ transformer.

5. Transformers are built in ____________- and ____________- phase units.

NAME ______________________________ Lesson B-9

Types of Transformers Page 2

6. List four methods of mounting transformers:

(a) ______________________________

(b) ______________________________

(c) ______________________________

(d) ______________________________

7. The function of a ________________ ________________ transformer is to change the voltage of a system.

8. A ________________ transformer is designed for changing the current of a system.

9. A ________________ ________________ transformer is designed to vary the secondary-voltage with load on a constant-potential supply.

10. Transformers for many gaseous-discharge lamps are of the ____________-

____________ type and are ________________ air-cooled.

11. Constant current transformer is designed to supply a __________ value of secondary current.

NAME ______________________________ Lesson B-10

DATE ______________________________ Single Phase Transformers

REFERENCE

1. American Electricians' Handbook, Pages 5-16 - 5-18, Sec. 31; Pages 5-46 - 5-50, Sec. 73 - 79; Pages 5-67 - 5-69, Sec. 115-117.
2. Basic Electricity, 4-77 thru 89.

PROBLEMS

1. An ____________ has only one coil used both for primary and secondary windings.
2. The autotransformer is the most ____________ and ____________ method of operating a stationary transformer.
3. Autotransformers require less ____________ and ____________ for construction.
4. ________________ of a transformer is an indication of flow of current from a terminal at one instant.
5. Study transformer terminal connections for additive polarity.
6. Study transformer terminal connections for sub-tractive polarity.
7. Discuss a method of testing the polarity of a transformer and explain the results and precautions to be taken.

NAME ______________________ Lesson B-10

Single Phase Transformers Page 2

8. Study connections for distribution transformer having single primary winding and dual secondary windings for 2400 volt primary and 240 volt secondary.

9. Review connections for distribution transformer having single primary winding and dual secondary windings for 2400 volt primary and 120/240 volt secondary.

10. Review connections for distribution transformer having dual primary and dual secondary windings for 2400 volt primary and 120/240 volt secondary.

11. Review connections for distribution transformer having dual primary and dual secondary windings for 4800 volts primary and 120/240 volt secondary.

NAME ______________________________ Lesson B-10

Single Phase Transformers Page 3

12. Single phase transformers may be connected in parallel but care should be taken to insure that the load is ______________ and each transformer should have a capacity equal to ________ ______ ____ of the ______________ load.

13. Single phase transformer connected on an unbalanced 3-wire system should be designed in order for each transformer to have a capacity to the __________ on its side of the circuit.

14. On two phase, four wire systems transformers should be designed for ______ ____________ and ________ ____________.

15. Two transformers connected in parallel on two phase, four wire systems should be designed in order that each transformer will carry ________________ __________________ of the total KVA load.

16. The center conductor on a two phase, three wire system with a balanced load will carry ____________ times the current in either of the other legs.

17. List the three conditions which use of autotransformers are permitted by the National Electrical Code:

(a) ____

____

(b) ___ ____

______________ ________________________________

(c) ____

____

18. Coils of __________ and __________ phase transformers may be connected for operating as an autotransformer.

NAME ______________________________ Lesson B-11

DATE ______________________________ Three Phase Transformer

REFERENCE

1. American Electricians' Handbook, Pages 5-50 - 5-57, Sec. 80 - 90.

PROBLEMS

1. List five advantages of a three-phase transformer:

   (a) ______________________________

   (b) ______________________________

   (c) ______________________________

   (d) ______________________________

   (e) ______________________________

2. List five disadvantages of a three-phase transformer:

   (a) ______________________________

   (b) ______________________________

   (c) ______________________________

   (d) ______________________________

   (e) ______________________________

3. The voltage on the windings of a delta-delta connected transformer is equal to the ______________ ______ voltage.

4. The current on the winding of a delta-delta connected transformer is equal to ______________ times the ______________ ______________.

5. The voltage on the windings of a wye-wye connected transformer is equal to ______________ times the ______________ ______________.

6. The current on the windings of a wye-wye connected transformer is equal to the ______________ current.

7. List two reasons for connecting the neutrals in wye-wye connected transformers:

   (a) ______________________________

   (b) ______________________________

8. A bank of three transformers connected wye-wye are to supply a load of 300 KVA. What is the size of each transformer?

NAME ______________________ Lesson B-11

Three Phase Transformer Page 2

9. A bank of three transformers connected delta-delta are to supply a load of 300 KVA. What is the size of each transformer?

10. Bank of transformers may be connected __________ __________ or __________ __________.

11. In a delta-wye connected transformer bank, the secondary voltage is __________ larger than a delta-delta connected bank.

12. What are the advantages of a 2400/4160 volt wye-connected primary?

(a) ______________________

(b) ______________________

13. List two disadvantages of the open delta transformer connection:

(a) ______________________

(b) ______________________

14. In an open delta bank connection, the transformer's capacities must be ________ larger than delta or wye connected bank.

15. The relative cost of transformer connections indicates __________ __________ __________ connections to be most inexpensive.

NAME ______________________________ Lesson B-12

DATE ______________________________ Three Phase Transformer Connections

REFERENCE

1. American Electricians' Handbook, Pages 5-50 - 5-57, Sec. 80 - 90.

PROBLEMS

1. Discuss a transformer bank with delta-delta connections.

2. Discuss a transformer bank with wye-wye connections.

3. Discuss a transformer bank with delta-wye connections.

4. Discuss a transformer bank with a wye-delta connection.

5. Discuss a transformer bank with an open delta connection.

6. Discuss a transformer bank with dual primary and secondary windings connected delta-wye.

7. Discuss a transformer bank with dual primary and secondary windings connected wye-wye.

NAME ____________________ Lesson B-12

DATE ____________________ Three Phase Transformer Connections

REFERENCE

1. American Electricians' Handbook, Pages 5-50 - 5-57, Sec. 80 - 90.

PROBLEMS

1. Discuss a transformer bank with delta-delta connections.

2. Discuss a transformer bank with wye-wye connections.

3. Discuss a transformer bank with delta-wye connections.

4. Discuss a transformer bank with a wye-delta connection.

5. Discuss a transformer bank with an open delta connection.

6. Discuss a transformer bank with dual primary and secondary windings connected delta-wye.

7. Discuss a transformer bank with dual primary and secondary windings connected wye-wye.

NAME ______________________________ Lesson B-13

DATE ______________________________ Transformer Installation

REFERENCE

1. National Electrical Code - Article 450.

PROBLEMS

1. List six installations of transformers which are not covered by this article:

   (a) ______________________________
   (b) ______________________________
   (c) ______________________________
   (d) ______________________________
   (e) ______________________________
   (f) ______________________________

2. Transformers shall be __________ __________ to __________ personnel for __________ and __________.

3. The word "transformer" means __________ or a bank of __________ or __________ __________ phase transformers or __________ __________ phase transformer.

4. Overcurrent protection on the primary side of the transformer shall not exceed __________ of the __________ __________ current.

5. Overcurrent device for a transformer may be approved __________ or __________ __________.

6. Secondary overcurrent protection of the transformer shall not exceed __________ of the __________ __________ current.

7. Find the maximum primary and secondary overcurrent protection for a transformer rated 37 1/2 KVA, 440/220 volts, single phase.

8. Transformers with exposed live parts shall be in a __________ or __________ accessible only to __________ __________.

9. In general indoor dry type transformers rated 112 1/2 KVA or less shall have a clearance of __________ inches from combustible material.

10. In general indoor dry type transformers rated larger than 112 1/2 KVA shall be installed in a __________ __________ of __________-__________ construction.

11. List two exceptions to the installation of indoor dry type transformers rated 112 1/2 KVA or less:

    (a) ______________________________
    (b) ______________________________

125

NAME ______________________________ Lesson B-13

Transformer installation Page 2

12. List two exceptions to the installation of indoor dry type transformers rated larger than 112 1/2 KVA.

(a) ______________________________

(b) ______________________________

13. Indoor dry type transformers rated over 35,000 volts shall be installed in a ______________________________.

14. Exposed non-current carrying metal parts of a transformer shall be ____________.

15. Walls and roof shall have a minimum thickness ____________ inches of concrete.

16. All transformer vaults shall be ____________________.

17. Pipe or duct system ______________________________ be installed in vaults.

18. Pumps, valves, etc., ______________________________ be installed in vaults.

19. Foreign materials shall not be stored in ______________________________.

20. Vault door sills shall be at least ____________________ inches high.

21. Drains shall be provided in vaults rated over ____________________ KVA.

22. Askarel-insulated transformers rated more than ______________ volts shall be installed in a vault.

23. Indoor oil-insulated transformers shall be installed in a ____________________.

24. Four exceptions to the vault installation of oil-insulated transformers.

(a) ______________________________

(b) ______________________________

(c) ______________________________

(d) ______________________________

25. Net ventilation area for vaults shall not be less than ________________ sq. in. per KVA.

26. Minimum net ventilation area shall be ____________________ sq. ft.

NAME ______________________________ Lesson B-14

DATE ______________________________ A. C. Motors

REFERENCE

1. American Electricians' Handbook, Pages 7-54 - 7-65, Sec. 118 - 131.
2. Basics of Fractional Horsepower Motor & Repair, Pages 1-12.

PROBLEMS

1. Nikola Tesla invented the induction motor in ______________________.

2. ________________ is the stationary member of the induction motor.

3. ________________ is the rotating member of the induction motor.

4. The principle of the induction motor is based on a ____________ ______________ ________________.

5. An electric motor converts ______________ ________________ into mechanical energy.

6. Find the synchronous speed for a 60-cycle induction motor having eight poles.

7. Find the per cent slip of a six pole 60-cycle induction motor rotating at 1150 revolutions per minute.

8. Slip of an induction motor is the difference between ___________ ______________ and ____________ _______________.

9. The direction of rotation of an induction motor is the same as the ____________ ____________________.

10. List three factors affecting the actual speed of a motor:

    a. ____

    b. ____

    c. ____

11. The ____________________ is a permanent magnet having a ______________________ and _______________ poles.

12. North and South poles of a permanent magnet are connected by an ______________ ______________________ of ______________ ____________________.

13. __________________ poles attract and ______________________ poles repel.

14. List two factors affecting the strength of an electromagnet.

(a) ______________________

(b) __________ __________

15. List three advantages of the electromagnet:

(a) ______________________

(b) ______________________

(c) ______________________

16. A conductor forming a closed circuit is moved through a magnetic field cutting the magnetic lines of force causing a __________ to be induced in the conductor and an __________ __________ to flow through the conductor.

17. A rotor of a squirrel-cage motor consists of slotted sections containing base __________, __________ or __________ bars.

18. The slip of a motor is normally __________ or __________ per cent below the __________ speed.

19. The two starter windings in two-phase motors are placed __________ degrees apart.

20. The applied voltage of the two started in two-phase motors are __________ degrees __________ of phase.

21. In three-phase motors, the generated magnetic fields are __________ degrees out of phase with each other.

22. In three-phase motors the windings are located __________ degrees apart.

23. List five speed classifications of motors and describe each:

(a) __________ ______________________

(b) __________ ______________________

(c) __________ ______________________

(d) __________ ______________________

(e) __________ ______________________

NAME ______________________ Lesson B-14

A.C. Motors Page 3

24. List three service classifications of motors and describe each:

(a) ______ ______ ____________

(b) ____________ ____________

(c) ____________ ____________

25. Bearings for motors are __________ or ______ ________ types.

26. Describe an open motor.

27. Describe a dripproof motor.

28. Describe a splashproof motor.

29. Describe a totally enclosed motor.

30. Describe a totally enclosed fan-cooled motor.

31. Describe an explosionproof motor.

32. The starting torque or ________ ________ ________ is the turning effort in starting a motor or load from rest.

33. ____________ current is the first inrush current that occurs as a motor starts.

34. ____________ is the term used to describe turning or twisting force.

NAME______________________________ Lesson B-15

DATE______________________________ Single Phase Motors

REFERENCE

1. American Electricians' Handbook, Pages 7-99 - 7-106.
2. Basic Electricity, Pages 5-97 - 5-112.
3. Basics of Fractional Horsepower Motors and Repair, Pages 13 - 73.

PROBLEMS

1. ____________ ____________ has a ____________ resistance than the running winding of a split-phase motor and provides a ____________ ____________ for the motor.

2. The purpose of the ____________ ____________ is to get a ____________ ____________ between the windings.

3. The angular phase displacement in a split-phase motor is approximately ________ to 30 degrees in time.

4. The ____________ ____________ opens the circuit to the starting winding as the rotor speed reaches approximately ____________ per cent of the synchronous speed.

5. Overheating of the winding insulation may be caused by ____________ ____________, ____________ ____________ and ____________ ____________ currents.

6. Describe the action of the kilixon type split-phase motor protector.

7. Draw a schematic diagram of split-phase motor and label each major part.

8. NEMA has adopted a system for marking the terminals of a split-phase motor; running windings, ________ and ________; starting winding, ______ and ______.

9. The standard direction of rotation is ____________ as viewed from the ____________ ____________.

10. Two-speed split-phase motors have __________sets of windings, ____________for each speed.

NAME________________________________ Lesson B-15

Single Phase Motors Page 2

11. List five reasons a split-phase motor may fail to start:

(a) ________________________________
(b) ________________________________
(c) ________________________________
(d) ________________________________
(e) ________________________________

12. The starting winding of a split-phase motor is wound with ____________ ____________ and ____________ ____________ than the running.

13. List five classifications of the capacitor motor:

(a) ________________________________
(b) ________________________________
(c) ________________________________
(d) ________________________________
(e) ____________ ____________________

14. The capacitor motor is ____________ ________________ than the split-phase motor.

15. ____________ ________________ have a higher torque than ________-________ ____________.

16. Capacitor-start motor rated ________ HP and larger are generally the ____________-________________ type.

17. List the two types of capacitors used in a single-voltage capacitor-start motor:

(a) ____________________
(b) ____________________

18. ________________ capacitor has a capacitance of ____________ to ____________ microfarads and a maximum voltage of ____________ volts.

19. ____________ capacitor has a capacitance in excess of ________________. microfarads.

20. Draw schematic diagram of Reversible Capacitor-Start Motor and label each major part.

NAME______________________________ Lesson B-15

Single Phase Motors Page 3

21. Draw the schematic diagram for a two-capacitor type capacitor motor and label major parts.

22. What is the difference between the two-value capacitor motor and capacitor-start motor?

23. Draw schematic diagram for a permanent-split capacitor motor and label major parts.

24. The permanent-split capacitor motor has a ____________ __________ torque.

25. There is no _______ _____ ____ _________ in the permanent-split capacitor motor.

26. __________-________________ _____________ motors are used for fans and blowers.

27. Draw schematic diagram for two-speed capacitor motor and label major parts.

NAME ______________________________ Lesson B-15

Single Phase Motors Page 4

28. Why are electrolytic capacitors used almost exclusively in capacitor-start motors?

29. List six causes of a rotor or starter to burn out in a capacitor-start motor:

(a) ______________________________
(b) ______________________________
(c) ______________________________
(d) ______________________________
(e) ______________________________
(f) ______________________________

30. List four types of repulsion motors:

(a) ______________________
(b) ______________________
(c) ______________________
(d) ______________________

31. Repulsion motors have a __________ __________ torque.

32. As the load increases in the repulsion motor, the __________ decreases.

33. Repulsion motors may be reversed by ____________ ______________ to the ______________ side of neutral.

34. In a repulsion motor, the ___________ poles are repelled by the _______ poles causing the _____________ to rotate.

35. In a repulsion motor, the __________ windings are _________ __________ to the line input.

36. Draw schematic diagram of a straight repulsion motor and label major parts.

37. The difference between straight repulsion motor and compensated repulsion motor are __________ _____________ and _________ ____________ ____________.

38. In compensated repulsion motor, ________ ________ are wound on the starter.

39. In compensated repulsion motor, ________ ________ and ________ ________ ________ are maintained.

40. In repulsion motor. lap windings require a ________ for each ________ ________.

41. Field windings in a repulsion motor may be ________ or ________ wound.

42. List two major types of repulsion-start induction motors:

(a) ________________
(b) ________________

43. The purpose of the ________-________ in the repulsion-start motor is to cut off all ________ flow through the ________ and is actuated at approximately ________ per cent of synchronous speed.

44. The ________-________ is not in the repulsion-induction motor.

45. ________-________ motors have a very low starting torque and high slip.

46. Each pole in a shaped-pole motor is ________________.

47. List two methods of reversing a shaded-pole motor:

(a) ________________________________
(b) ________________________________

48. List three methods used for making a varying-speed shaded-pole motor:

(a) ________________________________
(b) ________________________________
(c) ________________________________

49. Describe the construction of a "consequential-pole" shaded-pole motor.

50. The ________ motor operates on A.C. or D.C. circuits.

51. The ________ is connected in series with the ________ in a universal motor.

52. In a universal motor operating on an A.C. source, the ________ windings are arranged so the ________ of the magnetic poles changes causing the ________ to turn.

APPLICATIONS:

Have the students complete the questions on the assignment sheet.

CHECKING AND FOLLOW-UP:

Correct the answers on the assignment sheet and return to the students. Discuss any questions that need to be clarified.

NAME______________________________ Lesson B-15

Single Phase Motors Page 6

53. What is the purpose of a commutator on the universal motor?

54. The no-load speed of universal motors is ________________.

55. A ______________ ________________ may be used to vary the speed of the universal motor.

56. List two types of universal motors:

(a) ____
(b) ____

57. The __________________ universal motor has an extra winding embedded in the poles of the starter.

58. The __________________ in the universal motor maintains a more constant speed.

59. The starter is made up of laminated pieces in the ____________-______________ universal motor.

60. The ____________-______________ universal motor is a low-horsepower motor operating at ________________ speeds.

61. A _______________ must be installed in series with one of the power lines to the concentrated-pole universal motor at speeds less than ____________RPM.

62. List three methods used to control the no-load speeds of the universal motor:

(a) ____
(b) ____
(c) ____

NAME_____________________________ Lesson B-16

DATE_____________________________ Three-Phase A. C. Motors

REFERENCE

1. *American Electricians' Handbook*, Pages 7-76 - 7-99.
2. *Basics of Fractional Horsepower Motors and Repair*, Pages 74 - 85.
3. *Basic Electricity*, Vol. 5, Page 92 ff.

PROBLEMS

1. List the three major types of three-phase motors:

   (a) ________________________

   (b) ________________________

   (c) ________________________

2. The ____________-____________ and ____________-____________ types of motors use induction for starting and running.

3. The ____________ motor is started with a D.C. source for rotor excitation and operates on the ____________-____________ principle.

4. In three-phase motors, the three starter windings are spaced ____________ electrical degrees apart.

5. List the two methods to connect the three-phase motor starter to a three-phase source:

   (a) ______________________________________

   (b) ______________________________________

6. Draw schematic diagram for each method in Problem 5.

7. List two methods of starting a synchronous motor:

   (a) ______________________________

   (b) ______________________________

NAME______________________________ Lesson B-16

Three-Phase A.C. Motors Page 2

8. The __________-__________ motor operates on the induction principle.

9. The squirrel-cage motor never reaches __________ speed.

10. List the four conditions which regulate the speed of a squirrel-cage motor:

(a) ______________________________

(b) ______________________________

(c) ______________________________

(d) ______________________________

11. __________ is the difference between the speed of the rotating field and the __________.

12. The squirrel-cage motor is considered to be a __________-__________ type.

13. The squirrel-cage rotor has __________ or __________ bars the entire length which is permanently __________-__________.

14. If the synchronous speed of a squirrel-cage motor is 4500 RPM and the operating speed is 3750 RPM, what is the percentage of slip?

15. The currents produced in the rotor are fed to __________ __________ of a wound-rotor motor.

16. In a wound-rotor motor, the starting __________ and __________, __________ __________ and __________ of the motor can be controlled.

17. In a wound-rotor motor, loss of speed results in a __________ of __________.

18. The wound-rotor motor is used for equipment having __________ __________ __________ and __________ __________ up to full-rated load.

19. The rotation of a three-phase motor may be reversed by __________ and __________ __________ to the motor.

20. The two windings of three-phase induction motors are located in the __________ and __________.

21. The __________ windings are embedded in slots.

22. The rotor windings may be of the __________-__________ or __________-__________ type.

23. Find the synchronous speed of a 6-pole motor at 60 cycles.

NAME________________________________ Lesson B-16

Three-Phase A. C. Motors Page 3

24. List six methods of controlling the speed of an induction motor:

(a) ________________________________

(b) ________________________________

(c) ________________________________

(d) ________________________________

(e) ________________________________

(f) ________________________________

25. List two important characteristics of a synchronous motor:

(a) ________________________________

(b) ________________________________

NAME _____________ ____________________

DATE ________________________________

Lesson B-17

Motor Circuits

REFERENCE

1. American Electricians' Handbook, Pages 7-245 - 7-260.
2. National Electrical Code, Article 430.

PROBLEMS

1. Distance more than __________ feet is considered out of sight by the Code.
2. List three types of motor branch circuits:
   (a) ______________________________
   (b) ______________________________
   (c) ______________________________
3. Motor switch shall have a minimum continuous-duty rating of ___________ per cent of the motor full-load current.
4. Motor circuit wires shall have a minimum capacity of ____________ per cent of motor full-load current.
5. Branch-circuit overcurrent device is a suitable controller for a stationary motor rated __________ horsepower or less.
6. Plug and receptacle is a suitable controller for a portable motor rated ________________ horsepower or less.
7. Remote-control circuit shall be disconnected from supply source when the motor disconnect switch is open. True or False.
8. Motor terminals shall be ___________________.
9. Enclosures for motor controllers and motor disconnect means ______________ ______________ be used as a junction box or auxiliary gutter for feed-through conductors.
10. Conductors connecting the wound-rotor motor secondary to the controller shall have a minimum capacity of ________________per cent of full load secondary current of motor.
11. Conductors supplying several motors shall have a minimum current capacity as follows:
    (a) ____
    (b) ____

NAME ______________________ Lesson B-17

Motor Circuits Page 2

12. Conductors supplying a combination load of lighting, heating, and several motors shall have a minimum current capacity as follows:

(a) ____

(b) ____

(c) ____

13. "Over-Load" is another term for motor-running ________________ protection.

14. Internal thermal protectors are acceptable ________________ ________ ____________ protection for motors rated over 1 Horsepower.

15. Motor rated 1 Horsepower or less, automatically started, shall have motor-running overcurrent protection rated __________ to __________ per cent of full-load current rating.

16. For motor-running overcurrent protection, fuses shall be installed in each ______________ conductor.

17. Motor-running overcurrent device shall be installed in the ____________ line only of a single phase grounded system.

18. List three conditions when three running overcurrent protected unit shall be installed in a three-phase motor circuit.

(a) ____

(b) ____

(c) ____

19. Motor running overcurrent device shall ______________ open a sufficient number of ____________ conductors to ______________ current flow to motor.

20. Circuit overcurrent devices must open each ______________ conductor.

21. The control circuit of control equipment carries the __________ __________ directing the ______________ of the controller but does not carry the ____________ __________ circuit.

22. Maximum overcurrent protection rating of the motor control circuit shall not be over ____________ per cent of the control circuit conductors.

23. Primary leads of control transformer shall be connected to the ____________ ______________ of the disconnecting means.

24. A controller shall have a ____________________ horsepower rating equal to horsepower rating of the motor.

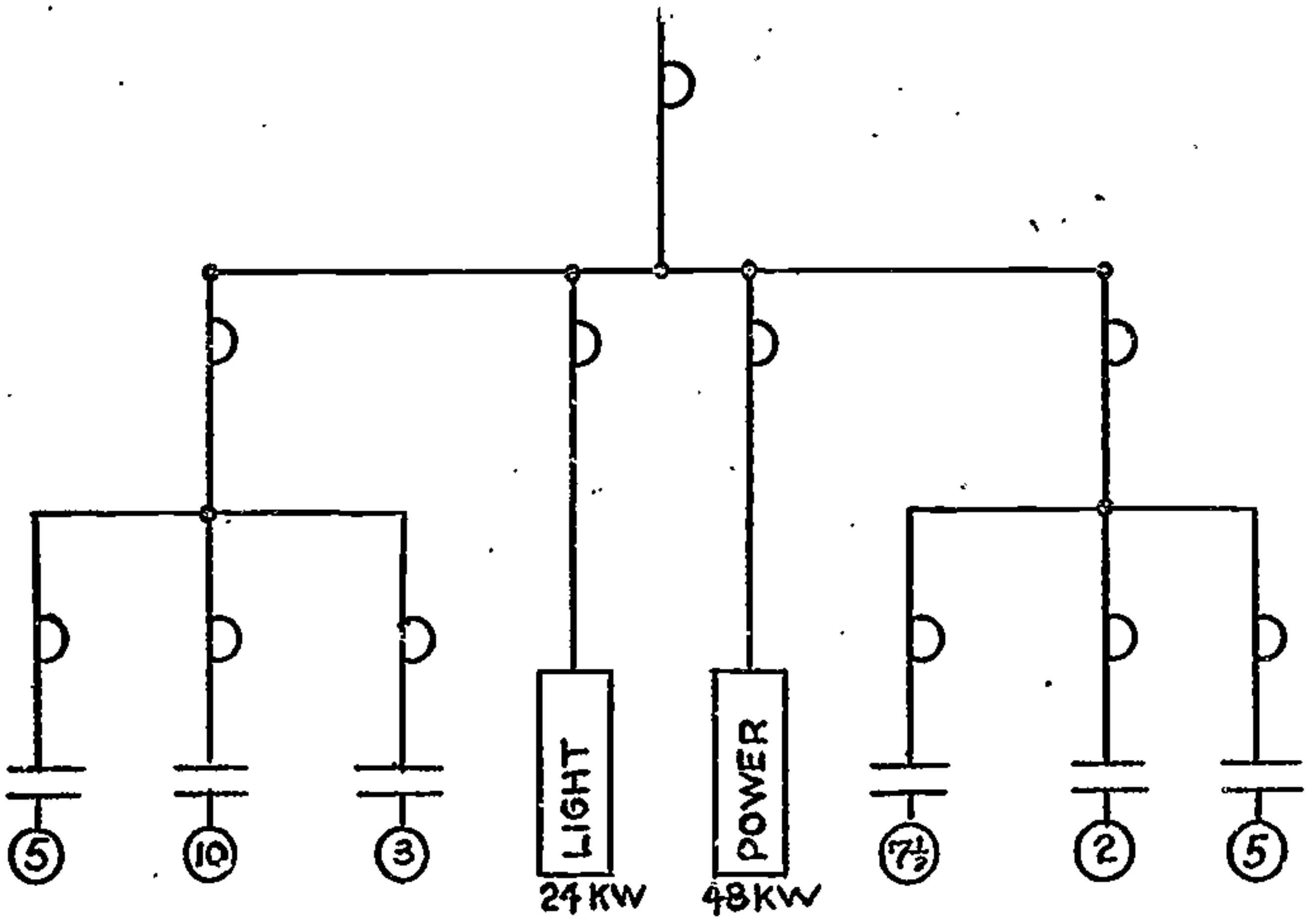
NAME ______________________________ Lesson B-17

Motor Circuits Page 3

25. General use A.C. snap switch is acceptable as a controller for a stationary motor rated 2 Horsepower or less, provided the motor full load current does not exceed ____________ per cent of the ampere rating of the switch.

26. Using the National Electrical Code as reference, find the following for the electrical system below rated 120/240 volts, single phase, three wire:

(a) Minimum feeder size.
(b) Maximum feeder overcurrent protection.
(c) Minimum branch circuit conductors.
(d) Maximum branch circuit overcurrent protection.
(e) Maximum motor-running overcurrent protection.



NOTE: Information required for an office building

Use Code letter "F" for 5 HP motors and Code "A" on other 4 motors
Use fuses not breakers
75° centigrade temperature

NAME ______________________ Lesson B-18

DATE ______________________ General Installation Provisions

REFERENCE

1. National Electrical Code, Article 110.

PROBLEMS

1. The scope of this article covers the installing of __________ __________ and __________.

2. The __________ and __________ required by this Code are __________ only when acceptable to the __________ enforcing this Code.

3. Manditory rules are indicated by the word "__________".

4. Advisory rules are indicated by the words "__________" or "__________."

5. Circuit voltage is the voltage at which the circuit __________.

6. Conductor sizes are given in __________ __________ __________ (__________).

7. Copper conductors are normally used to carry __________.

8. The __________ methods of wiring may be installed in any type of building or occupancy except as noted otherwise by the Code.

9. All current breaking devices ahall have __________ __________ sufficient for the system voltage and current to be interrupted.

10. Conductors and equipment shall not be installed in areas which may have __________ effect not in __________ temperatures.

11. All electrical equipment shall be installed in a __________ and __________ manner.

12. Do not depend upon wooden plugs to __________ fasten equipment.

13. Terminals for more than one conductor shall be __________ for the purpose.

14. Conductors shall be __________ or __________ with approved splicing devices.

15. All __________, __________ and __________ __________ of conductors shall be covered with an insulation __________ to that on the conductors.

16. Suitable working space around electrical equipment shall be __________ and __________.

NAME________________________________ Lesson B-18

General Installation Provisions Page 2

17. Working spaces around electrical equipment shall not be used as ______________

or ____________________ areas.

18. Electrical equipment elevated a minimum of ___________ feet above the working area affords proper protection.

19. When the wiring system is completed, all wiring shall be free from ____________

_______________ and _______________________.

20. Circuits using No. 12 AWG conductors shall have an insulation resistance of

_________________________ohms.

21. Circuits using No. 14 AWG conductors shall have an insulation resistance of

_________________________ ohms.

22. Circuits using 500 MCM conductors shall have an insulation resistance of

_________________________ ohms.

23. All electrical equipment shall be identified by ______________ name or

_____________________ symbol.

NAME______________________________ Lesson B-19

DATE______________________________ Grounded Conductors

REFERENCE

1. National Electrical Code, Article 200.

PROBLEMS

1. All interior wiring systems shall have a ________________ conductor.

2. The ________________ conductor shall be identified ________________ the system.

3. A 240 volt, three-phase ungrounded power system may feed a three-phase ________________ interior system.

4. A 120/240 volt, three wire grounded system must be installed for a three-wire ________________ interior wiring system.

5. A 240 volt, two wire ungrounded system may be installed for an ____________ interior wiring system feeding only 240 volts, single phase equipment.

6. Switching devices in each tapped circuit shall have a pole in each ____________ conductor and the poles shall operate ____________.

7. Outer identification of No. 6 AWG or smaller insulated conductors shall be ____________ or ____________ ____________ ____________.

8. Outer identification of insulated conductors larger than No. 6 AWG shall be ____________ or ____________ ____________ ____________ or ____________ ____________ ____________.

9. Grounded conductor shall be connected to ____________-____________ terminal.

10. Identified conductor shall be connected to identified ________________ terminal to screw-shell.

11. Grounded terminal shall be identified by ____________ ____________ coating.

12. The equipment grounding conductor terminal on the receptacle shall be ____________ color.

13. The grounded circuit conductor terminal on the receptable shall be ____________ color.

14. Terminals on ____________ ____________ or ____________ ____________ do not require identification.

NAME ____________________________________ Lesson B-20

DATE ____________________________________ Branch Circuits

REFERENCE

1. National Electrical Code, Article 210.

PROBLEMS

1. This article applies to branch circuits supplying ______________ or ___________ loads or __________________ of such loads.

2. In a circuit containing lighting and motors, Article __________ shall also apply.

3. Rating of branch circuit shall be based on maximum permitted rating or setting of ___________________ ____________________.

4. Minimum size conductor for a ____________________-ampere branch-circuit classification shall be No. 14 AWG.

5. Minimum size conductor for a ____________________-ampere branch circuit classification shall be No. 12 AWG.

6. Minimum size conductor for a ____________________-ampere branch-circuit classification shall be No. 10 AWG.

7. Minimum size conductor for a ____________________-ampere branch-circuit classification shall be No. 6 AWG.

8. A multi-wire branch circuit on a 120/208 volt, three phase, four wire system contains ____________________ phase wires and _________________ neutral wire.

9. When more than three current carrying conductors are installed in a raceway, the _________ _____________ of _____________ shall be derated.

10. Internal wiring of equipment may utilize conductors having a green covering for other than ______________ _________________.

11. All two-wire branch circuits from _____-phase main feeders shall be ___________-_______________.

12. In general, voltage to ground for a 15-ampere receptacle shall not exceed _____________ volts.

13. Fixtures above 250 volts to ground shall be mounted a minimum of ________ feet above the floor.

14. Lighting fixtures rated 300 watts or less shall be equipped with ____________ base.

15. Grounding type receptacles shall be installed in ____________ ____________ of a dwelling.

16. Lighting fixture in a swimming pool shall be connected to a ____________ conductor.

17. ____________ or ____________ are not acceptable as a grounding conductor in swimming pool installations.

18. Heavy duty lampholder shall have a minimum rating of ____________ watts except ____________ lampholder rated ____________ watts is acceptable.

19. Branch-circuit conductors shall not have a current carrying capacity less than:

(1) ____

(2) ____

20. In general, minimum size conductor for range rated 8-3/4 kw. or larger shall be No. ____________ AWG.

21. Minimum tap on a 50-ampere branch-circuit conductor shall be No. ____________ AWG.

22. Branch-circuit protection for an appliance rated 12 amperes shall not exceed ____________ per cent of appliance rating.

23. The lampholder on a 30-ampere branch circuit shall be of the ____________-____________ type.

24. Receptacles on 15- or 20-ampere branch circuits shall be the ____________ type.

25. The maximum load for portable appliances on a 20-ampere branch circuit served by receptacles shall be ____________ amperes.

26. In dwellings, maximum distance between receptacles on walls shall not exceed ____________ feet.

27. Floor outlets in center of area ____________ ____________ count for a required wall receptacle.

28. Receptables required in a dwelling shall include wall space occupied by ____________ ____________ in exterior walls.

29. Maximum load on branch circuits shall not exceed ____________ per cent of branch-circuit rating.

30. Maximum fixed appliance rating shall not exceed ____________ per cent of the branch-circuit when lighting units are also supplied.

NAME ______________________________ Lesson B-21

DATE ______________________________ Feeders

REFERENCE

1. American Electricians' Handbook, Pages 3-18 - 3-54.
2. National Electrical Code, Articles 215 and 220.

PROBLEMS

1. This Article deals with the ______________ of the conductors needed to supply power to the loads.
2. Minimum size feeder for two-wire feeder for two or more 2-wire branch circuits shall be No. _________ AWG.
3. Voltage drop for power feeders should not exceed ________ per cent.
4. Voltage drop for lighting feeders should not exceed ______ per cent.
5. List five basic items that should be included in a feeder diagram:

   (a) ____
   (b) ____
   (c) ____
   (d) ____
   (e) ____

6. Unit loads for lighting circuits operating for long periods shall be increased __________ per cent.
7. The floor area for a building shall be computed from the _____________ dimensions.
8. In general, each residential receptacle outlet shall be rated ______ amperes.
9. Show window lighting is not considered a part of the ______ _______ lighting.
10. Show window lighting shall be based on ______ watts per linear feet.
11. Each __________ foot length of fixed multi-outlet assemblies with receptacles on 1-foot centers shall be rated ________ amperes.
12. A minimum of ________ appliance branch circuits shall be installed in kitchens.
13. Small appliance circuits shall be rated __________ amperes.
14. Find the minimum Type "THW" lighting feeder size permitted by the Code to serve six floors of an office building, 75 feet by 125 feet floor area. The service is 4-wire, 3-phase, 208 volts.

15. Find the minimum Type "THW" lighting feeder size permitted by the Code to serve a fifteen story hospital, 125 feet by 175 feet floor area. The service is 4-wire, 3-phase, 277 volts.

16. Lighting sub-feeders to ballrooms shall have ________ per cent capacity of branch circuit claculations.

17. On a 120-volt, two-wire branch circuit, the neutral carries the ________ current as the "hot" wire.

18. On a 120/208 volt, three phase, four wire system with a balanced load, the neutral current will be equal to ______________.

19. One branch circuit per _______ square feet should be the minimum for general illumination in a dwelling.

20. On a three phase, four wire, A. C. system, the neutral-feeder conductor may be reduced for loads above _______ amperes; the capacity being equal to _______ amperes plus ________ per cent of excess above _______ amperes.

21. Capacity of Neutral shall not be reduced on that portion of load consisting of _________ fixtures.

22. In general, the feeder capacity for fixed electrical space heating shall be __________ per cent of total connected load.

23. Small appliance outlets in dwellings shall be rated __________ watts.

24. The feeder kw. load for twelve ranges rated 11 kw. is _____________ kw.

25. The feeder capacity for four or more appliances in a dwelling is ________ per cent of the load.

26. Calculate the minimum service required for a dwelling of 1800 square feet having one 12-kw. range, 5-kw. water heater, 1.5-kw. dishwasher, 5-kw. dryer, two 1.5-kw. bathroom space heaters, and 3 Horsepower air conditioning unit using standard method and optional method of calculations. Voltage to be 120-230.

INFORMATION SHEET BASIC ELECTRICITY

NEC Lesson B-22

SERVICES FOR A TYPICAL DWELLING

A typical application for a 115/230 volt, single-phase, three wire service installation in a single family dwelling will be considered. It is the intent to give the apprentice the fundamental rules of the National Electrical Code insofar as they concern the calculations that affect the service entrance switch, service entrance conductors, and grounding. The branch circuits supplying the various items of electrical equipment will be discussed briefly. Since the metering of the electrical space heating equipment as well as electric water heaters varies with different power companies, the apprentice should check the requirements in the area.

The building under consideration will be a three-bearoom residence with an area of 1500 square feet.

A. THE FOLLOWING APPLIANCES ARE SCHEDULED FOR THIS HOME:

1. 3-kw water heater
2. 4.7-kw clothes dryer
3. 8 ampere-230-volt air conditioner
4. 11.1 ampere-115-volt dishwasher
5. 4-kw wall-mounted oven
6. 6-kw counter-mounted cooking unit
7. 7.5 ampere-115-volt garbage disposal
8. 12-kw space heating unit in each of 6 rooms

B. CALCULATIONS:

1. Determine The Number of Lighting Circuits

Calculate the load based on the "watts per square foot" method. 1500 sq. ft. x 3 watts per sq. ft. = 4500 watts

$$\text{Amperes} = \frac{\text{watts}}{\text{volts}} = \frac{4500}{115} = 39.1 \text{ or } 40 \text{ amperes.}$$

Generally, 15-ampere lighting circuits are installed in residential buildings using No. 14 AWG conductors. Some electrical specifications require No. 12 AWG conductors as a minimum on all circuits. Then $\frac{40}{15} = 2$ plus or 3

Note: In a residence of this type, there may be as many as 60 outlets. Most electricians prefer to limit the number of outlets per circuit to 8 or 10, thus there would be 6 circuits installed.

2. Small Appliance

Most electricians prefer to run three 20 ampere circuits for small appliances to be used in the kitchen, laundry, pantry, dining room, and breakfast room areas. It is a code requirement to install a spearate 20 ampere circuit for the laundry outlet and divide the outlets in the kitchen and dining room area.

between two other 20 ampere circuits. The use of No. 12 wire instead of No. 14 wire to minimize the voltage drop, improves the performance of the appliances and lessens the danger of overload.

3. Clothes Dryer

The electric clothes dryer is rated 4.7 kw at 230 volts. The load value in watts is 4700.

$$\text{Amperes} = \frac{\text{watts}}{\text{volts}} = \frac{4700}{230} = 20.4 \text{ amperes}$$

The circuit to the dryer will be a 30 ampere 115/230 volt, 3 wire circuit of two No. 10 AWG conductors and one No. 12 AWG for the neutral conductor. The neutral may be smaller than the phase wires because it carries only the current of the motor and the light.

4. Air Conditioning

The load is 8 amperes x 230 volts - 1840 watts. It will be connected to a 15 ampere, 230 volt circuit with No. 14 AWG conductors. Circuits for air conditioners must conform to the provisions of the Code.

5. Dishwater

The load is 11.1 amperes x 115 volts = 1276 watts. This unit will be supplied by a separate 15-ampere circuit using No, 14 AWG wire.

Note: It is possible to supply the garbage disposal unit and the dishwater with one 115/230 volt, 3 wire circuit.

6. Garbage Disposal

The load is 7.5 amperes x 115 volts = 852 watts. This circuit will be supplied by a separate 15-ampere circuit which requires No. 14 AWG wire.

7. Wall-Mounted Oven

The oven is rated 4-kw at 115/230 volts and will be connected to a separate circuit. The load value in watts is 4000.

$$\text{Amperes} = \frac{\text{watts}}{\text{volts}} = \frac{4000}{230} = 17.4 \text{ amperes}$$

According to the table No. 12 AWG conductor may be used for this circuit.
NEC - 250-260, Ground with No. 10.

8. Counter-Mounted Cooking Unit

The surface cooking unit is rated 6 kw at 115/230 volts and will be connected to a separate circuit consisting of three No. 10 AWG conductors supplied by a 30-ampere, 2 pole overcurrent device.

$$\text{Amperes} = \frac{\text{watts}}{\text{volts}} = \frac{6000}{230} = 26 \text{ (approx.) amperes}$$

Note: The Code permits the use of one 50-ampere circuity to supply these two units, provided the individual taps to the 50-ampere circuit are not longer than necessary for servicing.

9. Electric Space Heating

Six 2 kw. electric space heating units will be installed with a thermostate which provides individual room control for heating purposes. Also, it is necessary that there be four or more individually controlled electric space heating units in order to apply certain demand factors permitted by the Code used in calculating service-entrance capacity. Each of these units is rated at 2 kw and 230 volt circuit.

$$\text{Amperes} = \frac{\text{watts}}{\text{volts}} = \frac{2000}{230} = 8.7 \text{ amperes}$$

Each separate unit will be connected to a separate 15-ampere, 230 volt circuit using No. 14 AWG wire.

10. Water Heater

The water heater in this residence is rated at 3-kw.

$$\text{Amperes} = \frac{\text{watts}}{\text{volts}} = \frac{3000}{230} = 13 \text{ amperes}$$

Connected for unlimited demand, the maximum current would be 13 amperes and No. AWG could be used. However, for a load that so closely approaches the maximum current-carrying capacity of No. 14 AWG, most electricians would install No. 12 AWG (20 ampere) and connect it to a 15-ampere, 230 circuit.

Note: Consult local utility for proper connections of water heaters because some require a special "off-peak" meter and others use special methods to cover the power consumption.

SUMMARY OF SERVICES FOR 1500 SQ. FT. DWELLING

Use of Circuits	No. of Circuits	Rating		Wire Size
		Volts	Amperes	AWG
General Lighting	6	115	15	14
Small Appliances	3	115	20	12
Garbage Disposal	1	115	15	14
Dishwasher	1	115	15	14
Dryer	1	115/230	30	10
Oven	1	115/230	20	12
Counter Cook Top	1	115/230	30	10
Air Conditioner	1	230	15	14
Water Heater	1	230	15	12
Space Heat	6	230	15	14

Service Entrance Switch

To accommodate the number of circuits listed in the summary, a 200-ampere panel will be installed. This panel will contain all of the required branch circuits plus a 200-ampere main pullout in one enclosure. This type of enclosure is approved by Underwriters' Laboratories, Inc. and should meet the Code requirements in most localities.

Ground Connection

The Code requires interior-alternating-current systems to be grounded. This is done by running a wire from the neutral connection in the main service switch or meter to a water pipe. Exceptions to the rule are specified in the Code.

NAME ______________________ Lesson B-22

DATE ______________________ Services

REFERENCE

1. American Electricians' Handbook, Pages 9-159 - 9-171, 9-177 - 9-180.
2. National Electrical Code, Article 230.

PROBLEMS

1. Service entrance for the electrical system of a building may be by __________ or __________ service conductors.

2. A service includes the service, entrance and __________, __________.

3. Service conductors are the conductors which supply electrical energy to a building from the utility power system outside the building and consist of that portion of the supply conductors which extend from the street distribution __________ or distribution __________ to the __________ __________ of the building.

4. Service-drop conductors are the __________ conductors from the last utility pole to the _____ _____ of attachment to a building.

5. Service-entrance conductors of an overhead service are the service conductors between the point of attachment to the building and the _____ _____.

6. Disconnect means shall consist of an __________ operated disconnecting device and __________ protective device.

7. A service switch shall be assessible and shall disconnect all the service conductors from the __________ __________.

8. Service equipment may consist of __________ or a maximum of __________ manually operated circuit breakers or switches.

9. A service switch shall be located as close as possible to the point of entrance of _____ _____ to the building.

10. Means shall be provided at the service entrance for disconnecting the __________ conductor of the supply from the interior wiring.

11. Each occupant in a multiple-occupancy building shall have __________ to his __________ means.

12. Each __________ service conductor shall be provided with __________ protection.

13. A __________ service is a service supplying more than one building under single management.

14. Fire pumps require a ________ service.

15. In general, the minimum size service drop conductor is No. ________ AWG.

16. The minimum size service conductor recommended for residence is ________ amperes, three-wire.

17. Service drops shall be a minimum of _______ above a roof.

18. Service drops shall maintain a minimum clearance of _______ feet from windows, doors, etc.

19. The point of attachment to a building for a service drop shall be a minimum of ________ feet above grade.

20. The minimum clearance for service entrance conductors shall be ________ feet above grade.

21. Service raceways shall be equipped with _________ service head.

22. Drop loops shall be formed on _________ _________ conductors.

23. Service conductors shall not be ____________.

24. Underground service raceways shall be ________ where terminated in the building to prevent entrance of _______ of __________.

25. Exit lights and fire alarm systems may be connected to the ______________ side of the service equipment.

26. Grounded service conductors may be ________ provided the nominal voltage to ground does not exceed ___________ volts.

27. List six conditions which permit more than one service drop to a building:

(a) ____

(b) ____

(c) ____

(d) ____

(e) ____

(f) ____

28. Underground service conductors shall be rubber, cambridge, _____________ or _______________ insulated.

29. Underground spare service raceways shall be _____________ in the building at the termination point.

30. Service entrance conductor shall tap service drop at a point _____________ service head.

31. Metallic raceways exposed to the weather shall be ____________ and shall ____________ to the service head.

32. Service equipment enclosures shall be ______________.

33. Service raceway shall be _____________.

34. The disconnecting means may be __________ or __________ the building wall.

35. The minimum rating for service equipment shall be _______ amperes for circuit breaker and ___________ amperes for switch.

36. Pressure connectors shall be used for terminating __________ conductors in disconnect means.

37. In general, overcurrent protective device shall not be installed in _______________ conductor.

38. Service entrance conductors of more than 600 volts shall be installed in _____________ _______________.

39. Minimum size service entrance conductors of more than 600 volts shall be No. _______________ AWG.

40. Service conductors of more than 600 volts enclosed in a minimum ________ - inch thick concrete or brick envelope shall be considered outside of the building.

NAME ______________________________ Lesson B-23

DATE ______________________________ Overcurrent Protection

REFERENCE

1. American Electricians' Handbook, Pages 4-28 - 4-62.
2. National Electrical Code, Article 240.
3. Basic Electricity, Pages 2-47 and 48.

PROBLEMS

1. The purpose of the overcurrent protection device is to _______ circuit if current value causes excessive or dangerous temperatures in the _________ or ____________ insulation.
2. All equipment shall be protected against _____________.
3. In residential occupancies, all overcurrent protective devices with maximum rating of 20 amperes shall be the ______________ ____________ type.
4. Conductors shall be projected to prevent currents above _________ per cent of allowable current carrying capacity of the conductor.
5. Where adjustable-trip circuit-breakers are used as overcurrent protection, the maximum setting shall be ___________ per cent of allowable current carrying capacity of the conductor.
6. Temperature will affect the operation of ________ ____________ circuit breakers and must be considered in the application and sizing.
7. Motor circuit overcurrent protective devices may be rated from _____________ per cent to _________ per cent of motor full-load current.
8. Plug fuses and fuse holders shall be used on circuits rated _______________ volts or less.
9. Plug-fuseholders screw shall be connected to _________ side of circuit.
10. Overcurrent device shall be installed in each _____________ conductor.
11. In general, overcurrent device shall not be installed in _____________ conductor.
12. Fuses may be installed in ___________ where capacity of conductors exceeds rating of largest approved cartridge-type fuse.
13. Overcurrent devices shall be located where conductors receive ___________.
14. Overcurrent device is not required on a feeder tap to a panelboard located within _____________ feet of feeder.
15. Overcurrent device is not required on a feeder tap to a panelboard located within ___________ feet of feeder provided the current carrying capacity of tap conductors is equal to _________ of feeder current carrying capacity.

16. Overcurrent devices shall be in __________ __________ locations.

17. Service overcurrent devices locked or sealed are not __________ __________.

18. Overcurrent devices shall not be __________ to physical damage.

19. Overcurrnet devices shall not be located in the vicinity of easily __________ materials.

20. Overcurrent devices shall be installed in __________-__________ __________ or __________.

21. Overcurrent devices located in damp or wet locations shall be mounted a minimum of __________-inch off wall.

22. Fuses shall be located on the __________ side of disconnect switch.

23. Edison-Base plug fuses are recognized in the Code only as __________ items in __________ installations.

24. There are __________ classifications of Type "S" plug fuses.

25. Fuses shall be usable only in __________ of same classification.

26. The standard cartridge fuse has a maximum rating of __________ amperes.

27. There are __________ classifications of the high capacity cartridge fuse.

28. The 600-volt fuse may be installed for __________ voltages.

29. Minimum rating of link fuse shall be __________ amperes.

30. Link fuse rating shall be __________ per cent of maximum current carrying capacity of fuse.

31. Circuit breaker shall be capable of being __________ opened or closed.

32. Circuit breaders with a maximum rating of 30-amperes shall be of the __________-__________ type.

33. Ampere rating shall be visible after __________ of breaker.

34. A circuit breaker in excess of __________ amperes shall be indicated on the breaker.

NAME ____________________________ Lesson B-24

DATE ____________________________ Grounding

REFERENCE

1. American Electricians' Handbook, Pages 8-94 - 8-100, 9-144, 9-151 - 9-159.
2. National Electrical Code, Article 250.

PROBLEMS

1. All ______________ ______________ systems shall have a grounded conductor which must be continuously ____________ throughout the system.
2. List two types of grounds in an interior wiring system:

   (a) ____________________________

   (b) ____________________________
3. An ______________ ground connects the non-current-carrying metal parts of the wiring system or equipment to __________ which keeps the metal parts exposed to contact by people at or near ____________ ______________.
4. In general, all metallic conduits and enclosures shall be ________________.
5. Study five types of wiring systems requiring a system ground.
6. Electric crane circuits over combustible fibers in Class III hazardous location shall not be ____________________.
7. On A. C. systems, the system ground shall be located at the ______________ ______________ supply the system and on the line side of the ______________ ________________ at each building service.
8. In A. C. interior wiring systems, the ________ conductor shall be grounded.
9. Study six methods of grounding non-current-carrying parts of fixed equipment.
10. Study three methods of grounding non-current-carrying parts of portable equipment.

NAME ______________________________ Lesson B-24

Grounding Page 2

11. Study six methods of assuring the continuity of the ground of metal enclosures for conductors.

12. The equipment ground should be located as close as practicable to the
______________ __________ or __________ ______________.

13. Bonding jumpers shall be used to connect isolated equipment to ____________ equipment.

14. The minimum copper grounding conductor for an A.C. system shall be No. ____AWG.

15. The maximum copper grounding conductor required for an A.C. system is No. ____AWG.

16. The minimum copper grounding conductor for an A.C. system with 250 MCM service entrance conductors shall be No. ____AWG.

17. The minimum copper equipment ground conductor for a 60-ampere circuit shall be No. ____AWG.

18. The grounding conductor of a wiring system shall be of ______ material (in general) and may be ________ or __________, __________ or
__________, without__________ or __________ throughout its length.

19. Study five types of grounding electrodes.

20. The best grounding electrode is an ____________ ____________ ____________ system.

21. The resistance of made electrodes shall not exceed _______ ohms.

22. The minimum length of buried metallic water piping system permitted as a grounding electrode shall be __________ feet.

23. In general, underground water pipes have a resistance to ground of less than
____________ ohms.

24. Splice connections on the ____________ conductor is not permitted.

25. The equipment ground conductor shall be __________ color or __________.

26. Sheet-metal straps shall not be used for connecting ______________
______________ to water pipe or made electrodes.

27. Grounding helps to prevent __________ to people and _________ by fire to property.

28. The purpose of grounding conductor is to provide a ________ ____________ electrical path to ground.

NAME ______________________________ Lesson B-24

Grounding Page 3

29. Study four methods of reducing ground resistance.

30. Grounding limits circuit __________ upon accidental contact of primary and secondary distribution lines or breakdown in transformers.

31. The ______________ conductor shall be run to each individual service where the secondary system may be grounded at any point.

32. In general metal enclosures for conductors shall be located a minimum of ___________ feet from lighting rod grounding conductors.

33. Switchboard frames shall be __________ regardless of ______________.

34. All portable tools shall be ______________.

35. Service entrance conduit shall be ________________.

36. A grounding conductor in cord shall be provided for cord-connected __________________ equipment.

37. Metal frame constructed building shall be ________________.

38. Frames of electric ranges and clothes dryer shall be ________________.

39. Aluminum grounding conductors shall not be installed in direct contact with ___________ or ______________ or subject to ___________ conditions or with ______________ inches of the ______________ on the exterior of a building.

40. The minimum size copper grounding conductor for a parallel No. 4/0 copper service entrance shall be No. ____________ AWG.

41. The maximum size copper ground conductor connected to a "made electrode" for a No. 4/0 service is No. ______________ AWG.

42. All service equipment shall be __________ to grounding conductor using minimum size conductor for service entrance conductor.

NAME ____________________ Lesson B-25

DATE ____________________ A.C. Instruments

REFERENCE

1. American Electricians' Handbook, Pages 1-60 - 1-69.
2. Basic Electricity, Pages 1-62 - 1-82, 1-88 - 1-97, 1-108, 1-118 - 1-119.

PROBLEMS

1. A __________ is an instrument used to measure voltage.
2. An __________ is an instrument used to measure current.
3. An __________ is an instrument used to measure resistance.
4. A __________ is an instrument used to measure power.
5. A ________ ________ ________ is an instrument used to measure power consumed over a period of time.
6. The voltmeter is ______ connected in a circuit.
7. The ammeter is ______ connected in a circuit.
8. A ________ is an instrument used to measure high resistance.
9. The wattmeter consists internally of a ______ coil and ______ coil.
10. The accuracy of a meter varies with the ________ of the meter.
11. The ________ of a meter should not be exceeded.
12. Understand the term "parallax".
13. What is the meaning of the term "interpolation"?
14. Basically all meter movements use the ________ ________ ____ ____.
15. The galvanometer works on the principle of magnetic ________ and ________.
16. The ranges in a multi-range ammeter are changed by use of ______ ______.
17. The ranges in a multi-range voltmeter are changed by use of ______- ________ ________.
18. When using the ohmmeter the circuit should be ________.
19. The most important use of the meggar is to measure and test ______ ______.
20. The full-scale deflection reading of an ohmmeter is ________.

NAME ______________________________ Lesson B-26

DATE ______________________________ Electrical Systems

REFERENCE

1. American Electricians' Handbook, Pages 3-8 - 3-18.

PROBLEMS

1. List four reasons for providing separate circuits for lamps and motors:

   (a) ______________________________

   (b) ______________________________

   (c) ______________________________

   (d) ______________________________

2. Incandescent lamps for __________ to __________ volts are more economical than lamps for higher voltages.

3. Draw a diagram for a 120/240 volt single phase, three wire system.

4. Study a 220-volt, three phase, three wire Delta system.

5. Study a 120/208 volt, three phase, four wire, Wye system.

6. Study a 440-volt, three phase, three wire Delta system.

NAME ______________________________ Lesson B-26

Electrical Systems Page 2

7. Study a 480/277 volt, three phase, four wire, Wye system.

8. The two frequencies that are standard in this country are __________ and ______________ cycles.

9. At 25 cycles, __________ of an electric lamp is noticeable and causes ______________ ______________.

10. Study ten common distribution systems and give an example of its use.

NAME ______________________________ Lesson B-27

DATE ______________________________ Elevators

REFERENCE

1. National Electrical Code, Article 620.

PROBLEMS

1. Equipment included under this Article is:

   (a) ______________________________
   (b) ______________________________
   (c) ______________________________
   (d) ______________________________

2. The maximum voltage permitted on A.C. system for control and signal circuits is __________ volts except where the maximum current is ______________________.

3. The maximum voltage permitted for machine motors is __________ volts.

4. Travel cables shall be Type ______, ________ or ________.

5. Type __________ conductor is suitable for installation in raceways on an elevator.

6. The minimum gauge traveling conductor permitted for lighting circuit is No. ________ AWG.

7. In general, conductors located in hoistway shall be installed in ______________________.

8. Raceway shall terminate a minimum of ________ inches above the floor.

9. Conduits installed in hoistway shall be securely fastened to the ______________________ or ____________ construction.

10. Conductors of different systems may be installed in the same conduit provided the conductors are insulated for the ____________ ____________.

11. Main feeder supply power to the elevator shall be installed ____________ the hoistway.

12. No ____________ conduits or wires shall be installed in the hoistway.

13. A ____________ ____________ shall be provided at the elevator machine for disconnecting all circuit conductors to the elevator motor.

14. Wiring and equipment located under the car platform of a garage elevator shall be considered in a ____________ ____________.

NAME ____________________ Lesson B-27

Elevators Page 2

15. Elevator equipment shall be installed in area secured against ______________ ______________.

16. A minimum working space of __________ inches shall be provided in the rear of an elevator control panel.

17. Electric elevator machines shall be __________.

NAME ______________________________ Lesson B-28

DATE ______________________________ Swimming Pools

REFERENCE

1. National Electrical Code, Article 680.

PROBLEMS

1. All ______________ shall be approved for swimming pool installation.

2. Maximum voltage permitted for lighting fixtures is __________ volts.

3. All non-current-carrying metal parts of a lighting fixture shall be __________.

4. Fixtures may be installed ____________ the pool walls in ______________ ______________.

5. Metal parts of lighting fixtures installed below grade shall be __________ or suitable ____________ ______________.

6. All conduits installed below grade shall be __________ or suitalbe ______________ ______________.

7. Circuits supplying underwater fixtures shall be ______________.

8. Junction boxes located within four feet of the pool perimeter and within eight inches above ground shall be constructed of __________ or suitable ______________ ______________.

9. Standard 15 ampere receptacle shall not be installed within __________ feet of the inside walls of the pool.

10. Metal parts of _________ and __________ ______________ shall be grounded.

11. No _______________________ wiring shall installed in the pool area.

12. Service drop conductors shall not be installed above swimming pools or within __________ feet of _________ __________, ____________ ____________, __________ ____________, _________ or ____________.

13. Metal wiring enclosures shall be ______________.

14. All pool equipment shall be _____________ to a common pool ground.

15. Metallic raceways shall not be depended upon for ________________.

16. An ______________ No. ________ conductor shall be installed from deck box to distribution panel ground.

NAME ______________________________

DATE ______________________________

Lesson B-29

Emergency Systems

REFERENCE

1. National Electrical Code, Aritcle 700.

PROBLEMS

1. Emergency systems are generally installed in places of assembly such as ___________ ___________ and ___________.

2. Emergency systems may provide power for ___________, ___________, ___________ pumps and ___________ rooms.

3. All equipment shall be approved for use on ___________ systems.

4. Emergency systems shall be ___________ periodically.

5. A ___________ ___________ shall be kept of tests and maintenance of emergency systems.

6. List three means of providing emergency power:

(a) ___________________________ (c) ___________________________

(b) ___________________________

7. Storage batteries shall maintain voltage to a minimum of _______ per cent system voltage and supply power to all emergency circuits for a minimum period of ___________ minutes.

8. In a hospital, the transition time from power failure on normal source to emergency generator shall not exceed ________ seconds.

9. Two separate services shall be widely separated electrically and physically to minimize the possibility of ___________ ___________ of supply.

10. A connection ahead of service disconnecting means is permitted to prevent ___________ ___________ of supply through an ___________ within the building.

11. Audible and visual signals shall be provided to give warnings of functioning of ___________ ___________ ___________.

12. In general, ___________ and ___________, not specifically required for emergency use, shall not be supplied by emergency lighting circuits.

13. Emergency illumination shall include all ___________ ___________ and other ___________ required to provide sufficient illumination.

14. Emergency lighting system should be designed and installed to prevent any ___________ being in total ___________.

NAME ______________________________ Lesson B-29

Emergency Systems Page 2

15. Emergency circuit wiring shall be kept ________ of all other wiring.

16. Three and four-way switches ________ ________ be used on emergency lighting circuits.

17. The control switch for emergency lighting in a theater shall be located in the lobby or in a ___________ ______________ _______________.

18. Emergency lighting circuits shall be installed to provide service _____________ upon interruption of normal supply.

19. Exterior lights may be controlled by a ____________ ____________.

20. Branch-circuit overcurrent devices shall be accessible to _________ _________________ only.

21. Storage batteries shall maintain total lamp load at a minimum of _________ per cent of rated lamp voltage and for a minimum period of ___________ minutes.

22. Emergency battery lights shall be installed __________ in place.

NAME________________________________ Lesson B-30

DATE________________________________ Outside Branch Circuits

REFERENCE

1. American Electricians' Handbook, Pages 8-45 - 8-49.
2. National Electrical Code, Article 730.

PROBLEMS

1. This Article does not apply to equipment or wiring of an ______________ or ______________ utility.

2. List three types of open conductors permitted to be installed within ten feet of a building:

(a) ______________ (b) ______________ (c) ______________

3. List two types of conductors permitted for festoon lighting:

(a) ______________ (b) ______________

4. Minimum size conductor for overhead spans up to fifty feet shall be No. ____ AWG.

5. Minimum size conductor for festoon lighting shall be No. _______ AWG.

6. Minimum size overhead conductors for system exceeding 600 volts shall be No. _______ AWG for open conductors,

7. List four methods for supporting open conductors:

(a) ______________ (c) ______________

(b) ______________ (d) ______________

8. Conductors or messenger cables shall not be attached to any ______________, ______________ or ______________.

9. Festoons having spans in excess of forty feet, shall be supported by ______________ and approved ______________.

10. Minimum separation for open conductors exposed to weather shall be ____________ inches with supports on fifteen feet intervals.

11. Minimum clearance above alleys shall be ______________ feet.

12. Minimum clearance for lights over a car lot shall be ______________ feet.

13. Minimum horizontal clearance for open conductors not attached to a building shall be ______________ feet.

14. Minimum clearance of service drops near windows shall be ______________ feet.

NAME ______________________________

DATE ______________________________

ELECTRICAL APPRENTICESHIP
SERIES "B" - TEST NO. 1

MATERIAL COVERED - LESSONS B-1 thru B-5

1. Find the average foot-candle illumination in an office having 235 sq. ft. area and 35,000 lumens of light flux.

2. What is the speed of light?

3. An increase in voltage ______________ the output of an incandescent lamp.

4. There are ______________ and ____________ cathodes used in fluorescent lamps.

5. Flurescent fixtures shall not be mounted less than ________ feet above the floor on a 277 volt system.

6. Incandescent lamps rated over ___________ watts have a mogul base.

7. The "T-" rating of a lamp refers to the diameter in __________ inches.

8. Ballast temperatures should not exceed _________°F.

9. _______________ _______________ is provided by fluorescent ballast for starting lamp.

10. __________________ determines the color of fluorescent lamps.

11. Draw circuit connections for an instant start lamp.

12. What is the total flux of a light source having 750 mean spherical candlepower?

13. What are the three primary colors of light?

14. ___________________ of light is the redirecting of light rays by a reflecting surface.

NAME ____________________

15. Draw wiring diagram for a two lamp, 8-foot, high output rated fluorescent ballast.

16. The efficiency of a fluorescent lamp ______________ as the temperature decreases below normal.

17. Define the term "foot-candle".

18. ________________ rating is the best ballast noise rating.

19. ________________ of a light source is stated in lumens per watt.

20. _______-________ __________-__________ lamps have recessed double-contact-type bases.

21. ___________ ___________ ___________ fluorescent lamp most closely stimulates natural daylight.

22. An instrument for measuring illumination in foot-candles is __________-

____________ ____________.

23. At temperatures _______° to _______°, the efficiency of a fluorescent lamp is highest.

24. _____________ _____________ fluorescent lamps have the highest efficiency.

25. ______________ lamps are classified as Type "B" or Type "C".

26. The fluorescent lamp is an ________________ device.

27. Type "___" incandescent lamps are gas-filled.

28. Match the following incandescent bulb classifications:

(a) PAR _____	(1) Reflector
(b) T _____	(2) Standard Line
(c) PS _____	(3) Parabolic
(d) R _____	(4) Pear Shaped
(e) A _____	(5) Tubular

NAME ____________________

29. ______________ base is used for general service indandescent lamps _______ watts and less.

30. __________-__________ incandescent lamps are designed for excessive shocks.

31. Decrease in voltage on an incandescent lamp __________ the life and __________ the light output.

32. Hot cathode lamps are ______________ efficient than cold cathode lamps.

33. General-purpose fluorescent lamps are operated with _____________ cathodes.

34. List five principal methods of operating fluorescent lamps:

(a)____

(b)____

(c)____

(d)____

(e)____

35. A fluorescent fixture shall be mounted ___________ inches from surface of ceiling fiberboard.

36. All metal electrical equipment near plumbing fixtures shall be grounded unless they are located with clearances _____ feet horizontally and _______ feet vertically.

37. Fluorescent ballasts shall not be in contact with ___________ material.

38. Grounding conductor terminal in a fixture shall be designed by ____________-colored finish.

39. At least ________ feet of flexible metal raceway shall be installed between recessed fixture and outlet box.

40. Branch circuit conductors within 3-inches of a fluorescent ballast shall be Type "______" conductor or a type approved for temperatures in excess of ____________.

NAME ____________________ ELECTRICAL APPRENTICESHIP

DATE ____________________ SERIES "B", TEST NO. 2

MATERIAL COVERED - LESSONS B-6 thru B-13

1. Transformer coil connected to the primary source of supply is called the ____________________.

2. ____________________ coil delivers energy to the load.

3. ______________ ______________ ______________ ______________ incorporates a DC meter movement with a rectifier and is commonly used as an AC voltmeter.

4. The unit of measure of inductance is ________________.

5. An ammeter is used to measure ________________

6. The polarity of a single-phase transformer may be ____________ or ______________.

7. A ______________ is used to measure voltage.

8. Inductance is caused by a ___________ ____________ expanding and contracting with ______________ current.

9. Draw a single phase transformer with additive polarity and label the terminals.

10. In a coil a change in current produces an ____________ ______________.

11. The voltage on the windings of a ____________-____________ connected transformer is equal to the line voltage.

12. To test the insulation resistance of a conductor use a ______________.

13. The current on the windings of a ___________-____________ connected transformer is equal to 0.58 times the line current.

14. Draw a bank of three transformers with wye-wye connections.

NAME ____________________ ELECTRICAL APPRENTICESHIP

SERIES "B", TEST NO. 2
Page 2

15. Draw a bank of three transformers with wye-delta connections.

16. A ________-__________ transformer delivers energy at a lower voltage than it receives.

17. Find the number of primary turns in a transformer having E=240 volts, I_p = 10 amps., N_S = 1600 turns, I_S = 40 amps.

18. L is the letter symbol for ____________.

19. A ___________current flow produces a small magnetic field.

20. _________________are used for boosting the voltage a small amount.

21. The word "transformer" in the NEC may mean a __________transformer or a bank of _________or__________transformers.

22. Ammeters with a __________ ____________for protection, are connected in _____________in a circuit.

23. Draw connections for a distribution transformer having a single primary winding and dual secondary windings for 4800 volt primary and 120/240 volt secondary.

NAME ______________________________

24. Draw and label the materials needed to make an electric-bell testing outfit.

25. Voltmeters are connected in ______________ in a circuit.

26. A low resistance reading on a conductor indicates a ______________.

27. Overcurrent protection for a transformer shall not exceed ______________ of the primary current.

28. The __________ is the magnetic circuit on which the windings are wound.

29. Find the primary voltage of a transformer having $E_s = 240$ volts, $N_s = 50$ turns and $N_p = 500$ turns.

30. Find the maximum primary and secondary overcurrent protection for a transformer rated 250 KVA, 240/120 volts, single phase.

31. _______________ shall be installed in vaults having oil transformers rated above 100 KVA.

32. Dry type transformer enclosures shall be ____________ and _________ ____________.

33. Pole mounted distribution transformers shall be mounted a minimum of _______ feet above grade.

34. Minimum clearance of combustible materials around a transformer rated 100 KVA shall be ________ inches.

NAME ____________________

35. Draw a bank of three transformers with delta-delta connections.

36. The __________ on the windings of a wye-wye connected transformer is 0.58 times the ____________ ______________.

37. A bank of three transformers is connected delta-delta to supply a load of 800 KVA. What is the minimum size of each transformer?

38. The ____________ in the windings of a wye-wye connected transformer is the same as the ___________ ____________.

39. ____________ or ______________ ____________ may be used as over-current protective devices for transformers.

40. The transformer efficiency is the ratio of the ____________ to the ____________ plus ____________ and _______ ______ losses.

NAME ____________________ ELECTRICAL APPRENTICESHIP

DATE ____________________ SERIES "B", TEST NO. 3
Page 1

MATERIAL COVERED - LESSONS B-14 thru B-17

1. The control circuit conductors of a motor circuit may be protected by the branch-circuit protective device provided the device rating does not exceed ________ per cent of the current capacity of the ________________ ________________ conductors.

2. Like poles ____________ and unlike poles ________________.

3. Use a ____________ to measure the resistance of motor windings.

4. Motor branch-circuit protection devices may be ____________ or ____________ ________________.

5. The speed of a constant speed induction motor is determined by the __________ and ____________ of ________________.

6. The ______________ motor is series-wound.

7. Electrolytic capacitors, in capacitor-start motors, have a higher ____________ rating and ____________ ____________ of ____________ rating.

8. Motor circuit conductors shall be a minimum of ______ per cent of the ______________ full-load current rating.

9. The ____________ ____________ in a split-phase motor provides the starting torque.

10. The __________ motor cannot start by itself.

11. Manually started portable motors rated 1 HP. and less do not require __________.

12. An induction motor consists of a ____________ and a ____________.

13. Torque is the term used to describe the motor _________ or ___________ force.

14. In general the running protection of the motor shall not exceed ________ per cent of the ____________ full-load current rating.

15. Find the synchronous speed of an induction motor having 12 poles on a frequency of 60 cycles.

NAME ______________________

16. The heaters in the controller provide __________protection for the motor.

17. Maximum ratings of overcurrent devices for motors with high starting currents shall not exceed _____per cent of the motor full-load current rating.

18. The speed of a constant speed squirrel-cage motor is determined by the _______, __________of ____________and ____________of ____________.

19. The speed of a squirrel-cage motor depends upon the ________ _____, applied ___________, _____________and ___________of____________.

20. The earth is a ____________magnet.

21. Current carrying capacity of motor circuit conductors supplying three motors shall be a minimum of _________per cent of the full-load current rating of the __________motor plus the ___ ________of the full-load current ____________of the remaining motors.

22. Bearings for motors may be the __________ or ________-____________ type.

23. In a three-phase motor, the windings are __________electrical degrees apart.

24. Motor circuit switches shall disconnect all _____________conductors to the motor.

25. Split-phase motors are _____________for use on 115-volt or 230-volt power source.

26. All motor terminals shall be _________-_____________or____________.

27. __________type motor protector is a snap-acting, bimetallic disc.

28. A motor located ______feet from the controller is considered out of sight.

29. Motor-circuit switch shall be _________rated.

30. The most widely used types of single phase motors are __________-___________ motors.

31. The power factor of a repulsion motor increases with the ____________.

32. Overheating of winding insulation may be caused by lack of ____________, ___________ ____________or ___________ ______________currents.

NAME ____________________________

33. List the three major types of three-phase motors:

(a) ______________________________
(b) ______________________________
(c) ______________________________

34. Squirrel-cage motors do not have a ______________ ______________torque.

35. A split-phase motor consists of a __________ ______________, __________-__________ ________, ____________ ______________, ______________ ______________switch and an ______________protector.

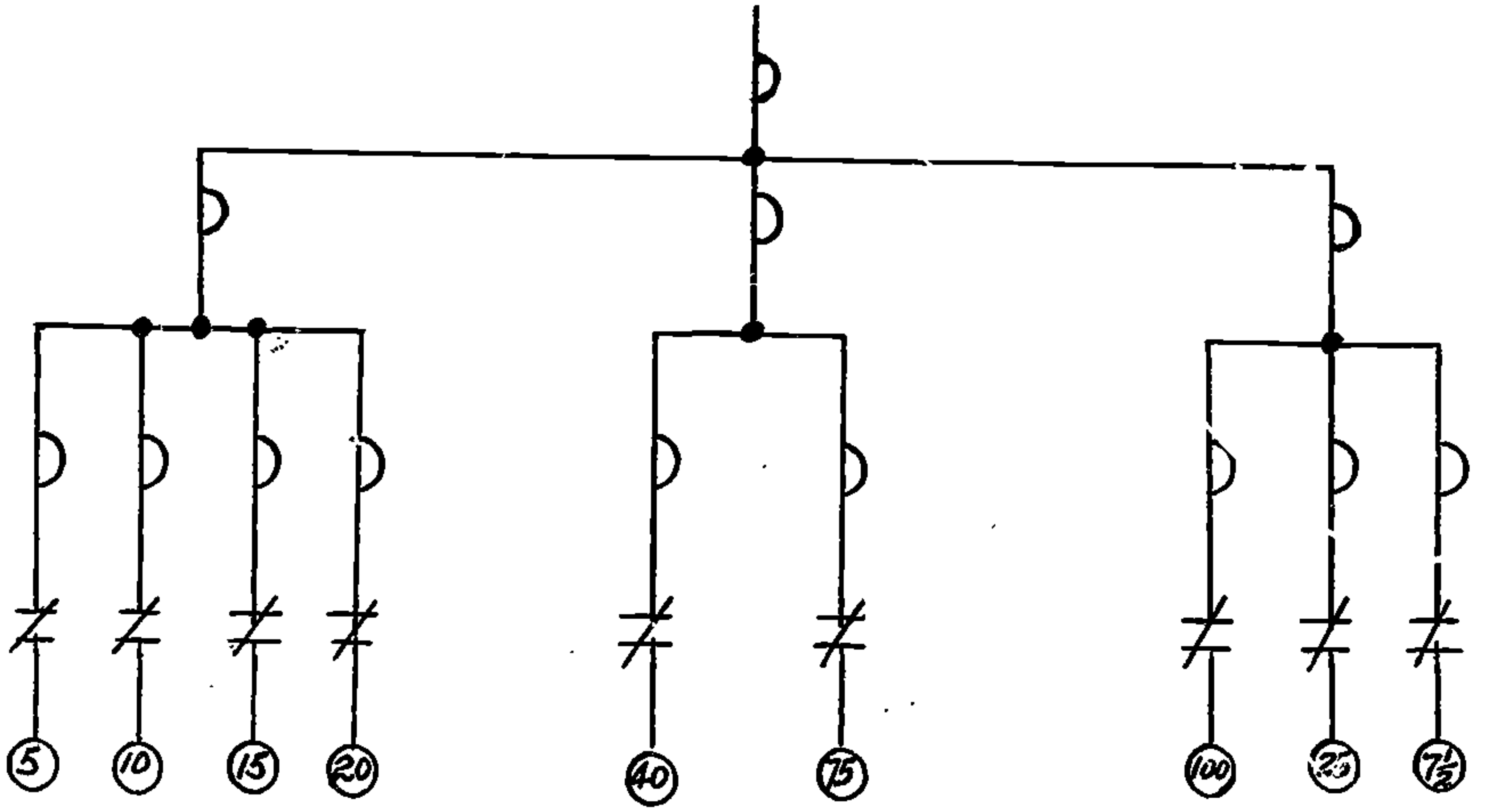
36. ____________-____________ torque is the starting torque of a motor.

37. A capacitor-type motor is more ____ __________than a split phase motor.

38. Induction motors are known as ______________speed motors.

39. ____________ is used in a universal motor to keep the armature turning.

40. Give proper sizes for running protection, conductor sizes, branch circuit overcurrent protection, feeder overcurrent protection and feeder sizes. Voltage is 220V, 3 phase. Use Type "THW" conductors.



NAME ______________________

DATE ______________________

ELECTRICAL APPRENTICESHIP

SERIES "B", TEST NO. 4
Page 1

MATERIAL COVERED - LESSONS B-18 thru B-23

1. Article __________ covers provisions applicable generally in installation of electrical wiring and equipment.

2. The general lighting load for a school is ______ watts per square foot.

3. A feeder tap having _______ the current carrying capacity of the feeder and terminating in a fusible switch within _____ feet of the feeder does not require ________ protection.

4. Terminals on __________ __________ or __________ __________ do not require identification.

5. No. ________ AWG conductors shall be installed on a 15-ampere branch circuit.

6. Service drops shall be a minimum of ________ above roads.

7. Each ungrounded conductor shall have __________ protection.

8. The identified grounded conductor shall be color-coded ______________.

9. In general, a grounded conductor shall be installed on all ____________ wiring systems.

10. The maximum distance between receptacles in a dwelling shall be _____ feet.

11. All 15-ampere receptacles in a dwelling shall be the __________ type.

12. Overcurrent protection shall be provided for each _____________ service conductors.

13. The voltage at which the circuit operates is the __________ __________.

14. The _________ conductor shall be connected to the screw-shell terminal.

15. Four-wire branch circuits shall be color-coded __________, red, __________, and _____________.

16. The maximum voltage drop permitted on a 480 volt system for power feeders is __________ volts.

17. Never install the __________ conductor and ____________ conductors of a circuit in separate conduits.

18. The point of service drop attachment on a building shall be a minimum of _________ above finish grade.

19. __________ space adjacent to electrical equipment shall not be used for storage.

20. Multi-pole switching devices shall __________ operate on each __________ conductor.

21. The grounding conductor shall be color-coded ______________.

22. The minimum size feeder shall be No. ______ AWG.

23. A maximum of ________ manually operated overcurrent devices shall be provided as service equipment.

24. _________ __________ should not be used for securing electrical equipment on masonry block walls.

25. A white colored terminal is for the ___________ (identified) circuit conductor.

26. The overcurrent device rating determines the __________ ______________ rating.

27. Office lighting branch circuit load shall be increased ______ per cent.

28. A 2000-square foot dwelling shall have a minimum of __________ lighting branch circuits.

29. _________ ___________ are the power supply conductors between the utilities transformer and the Owner's service equipment.

30. A feeder tap terminating in a circuit breaker within ______ feet of the feeder does not require _______ protection.

31. An enclosed switchboard rated 550 volts requires a minimum of ________ feet for working space provided there is no live or grounded parts on the other side of the working space.

32. The insulation for the identified conductors of No. _____ AWG or smaller shall be color-coded ____________.

33. The maximum load on a portable appliance branch circuit shall not exceed _______ per cent of the branch circuit rating.

34. The maximum voltage drop permitted on a 120/208 volt system for lighting and heating loads is ________ volts.

35. A separate ________ drop shall be provided for a fire pump.

36. Small appliance outlets for a dwelling shall be installed in the __________, ___________, ___________, _______________ and _______________.

NAME ______________________________

37. "__________" indicates a mandatory rule in the NEC.

38. A green colored terminal is for the ______________ ______________ conductor.

39. The maximum load on a 15-ampere receptacle shall not exceed ______________ amperes.

40. The _______________ dimensions shall be used for computing the building area.

41. Underground service raceways shall be ____________ at the termination point in the building.

42. Miscellaneous receptacle outlets shall be computed at __________ amperes.

43. Service _____________ and service ______________ shall be grounded to a cold water line.

44. Store-window loads shall be computed at __________watts per linear foot.

45. A _____________-______________ shall be provided at the service-head.

46. Circuits of 350 MCM Type "THW" conductors shall have an insulation resistance of ___________ ohms.

47. Throughout a system, the _______________ conductor shall be identified.

48. If four or more conductors are installed in a raceway, the conductor _____________-_________________ capacity shall be derated.

49. In a system with a balanced load, ___________ current will flow in the neutral conductor.

50. The maximum voltage drop permitted on a 550 volt system for power and heating loads shall be _______ volts.

51. _____________ small appliance outlets shall be installed in a kitchen and shall be rated ___________watts each.

NAME ______________________

52. Determine the minimum Type "THW" service conductors and size of service equipment for a 2300 square-foot residence with 115/230 volt, single phase, 3-wire service, having the following appliances:

(a) 5.0 kw Electric Water Heater (230v)
(b) 5.0 kw Dryer (230v)
(c) 5.1 kw Cooking Unit (230v)
(d) 4.0 kw Oven (230v)
(e) 1.2 kw Dishwasher (115v)
(f) 5 Horsepower Air Conditioner (230v)
(g) 12 - 2.0 kw Space Heaters (230v)
(h) 1/4-Horsepower Washer (115v)
(i) 1/3-Horsepower Disposal (115v)

NAME ______________________ ELECTRICAL APPRENTICESHIP

DATE ______________________ SERIES "B", TEST NO. 5
Page 1

MATERIAL COVERED - LESSONS B-24 thru B-30

1. Grounding helps to prevent ________________ to persons and _____________ to property.

2. Draw a diagram for a 120/240 volt, single phase, three-wire system.

3. Frames of elevators shall be ______________.

4. Emergency __________ includes exit lights.

5. Lamps for outdoor lighting shall be located below all __________ conductors.

6. Frames of electric clothes dryers and ranges shall be ______________.

7. Receptacles shall not be installed within ______ feet of the interior swimming pool walls.

8. The maximum control voltage for an elevator shall not exceed ________ volts.

9. The secondaries of transformers shall be ____________.

10. The standard frequency for this country is _________cycles.

11. The grounding conductor shall be color-coded _____________.

12. The minimum size copper service ground conductor shall be No. ________AWG.

13. The deflection reading of an ohmmeter ____________ the value of the resistance.

14. Indicate opposite each of the distribution systems below the area or areas in which it may be used (residential, commercial, school, industrial).

    (a) 120/240 volts, single phase, three wire ________________________

    (b) 120/208 volts, three phase, four wire ________________________

    (c) 480 volts, three phase, three wire ________________________

    (d) 1277/408 volts, three phase, four wire ________________________

15. Emergency wiring shall be ____________ of other wiring.

NAME ____________________________ ELECTRICAL APPRENTICESHIP

16. Outdoor lighting lampholders shall be of molded ____________________.

17. Switchboard frames shall be ____________________.

18. ____________________ is used to test the cable insulation.

19. Draw a diagram for a 220 volt, three phase, three wire, Delta system.

20. A sheet-metal-strap type clamp is not approved as a _______________ clamp.

21. _____________ lights in an auditorium shall not be controlled from the stage.

22. The minimum size copper grounding conductor for a parallel 500 MCM copper service entrance shall be No. _________ AWG.

23. An ____________ ground connects the non-current carrying metal parts of a wiring system to ground.

24. _____________ lights and specified _____________ lights shall be included in the emergency system.

25. Installing multiple driven ground rods is effective in _____________ ground resistance.

26. ____________________ conductors shall not be installed in a pool area.

27. The minimum size conductor for lighting on an elevator shall be No. _______ AWG.

28. The ground resistance shall not exceed __________ ohms for a water-pipe ground and _________ ohms for a driven ground.

29. ____________ measures electrical power.

30. Increasing the system voltage ____________ the cable size for a determined load.

31. Disconnect means required for an elevator are (a) _____________ supply and (b) ________________ circuit.

32. All circuits to underwater fixtures shall be ________________.

NAME ______________________________

ELECTRICAL APPRENTICESHIP

SERIES "D", TEST NO. 5

33. _______________ systems may be connected ahead of the main service disconnect switch.

34. Type "THW" conductors may be used for outdoor _______________ lighting.

35. The metallic underground water piping used as a grounding electrode shall have a minimum buried length of ________ feet.

36. The maximum operating voltage for a lighting fixture at a swimming pool shall be ________ volts.

37. Draw a diagram for a 277/480 volt, three phase, four wire, Wye system.

38. The main feeders supplying power to elevators shall not be installed in the ____________________.

39. All metal parts of a swimming pool shall be __________________.

40. Open conductors over automobile parking lots shall be a minimum of ____________ feet above grade.

41. The minimum size grounding conductor for a 400 ampere service using Type "THW" conductors shall be No. _________ AWG.

42. ________________ measures circuit voltage.

43. _______________ __________________ shall be installed from each deck distribution box in a swimming pool to the common ground panel.

44. ___________ and _______________ ____________________ switches shall not be installed on emergency lighting circuits.

45. The deflection reading of an ammeter ___________ the value of current.

46. The minimum size equipment grounding conductor for a 200 ampere branch circuit shall be No. _________ AWG.

47. An ohmmeter is used on a ___________ circuit.

48. Grounding conductors shall be connected to the __________________ ________________ of the water meter.

49. Ammeters are ________________ connected in a circuit.

NAME ____________________

50. Service entrance conduit shall be ______________.

51. ____________ measure circuit current.

52. All portable tools shall be ________________.

53. Voltmeter is ____________ connected in a circuit.

54. Generally, all metallic __________ and ___________ shall be grounded.

55. All service equipment shall be __________________.

56. It is more ____________ to operate lighting fixtures and motors on ______________ circuits.

57. Elevator raceways shall terminate a minimum of _____ inches above the floor.

58. _____________ ____________ in a swimming pool shall not be depended upon as a ground.

59. All emergency systems shall be _____________ periodically.

60. Article _________ does not apply to the exterior electrical installation of a power company.

NAME ____________________

DATE ____________________

ELECTRICAL APPRENTICESHIP
SECOND YEAR CLASS - "SERIES B"
FINAL EXAM

1. How many recessed troffers (No. 31) having four rapid start lamps rated 3100 lumens are required to produce 175 footcandles in an office area 85 ft. x 150 ft., 8'-6" ceiling, reflective values 80% ceiling, 10% floor, 50% walls, 75% maintenance factor?

2. Find the winding current in a delta connected single phase transformer rated 150 KVA, 240 volts.

3. Draw ballast wiring diagram for two 40-watt rapid start lamps and label each component.

4. Draw a diagram indicating two 3-way and three 4-way switches for controlling three light outlets and identify each part. All lamps turn on and off together.

NAME ____________________________

ELECTRICAL APPRENTICESHIP
SECOND YEAR CLASS - "SERIES B"
FINAL EXAM

5. Draw a diagram indicating the connections two single phase transformers rated 4160 - 120/240 volts, to supply a 120/240 volt load and identify each component.

6. Find the total flux of a light source having 750 mean spherical candlepower.

7. Find (a) secondary current, (b) secondary voltage, and (c) power output of a 5:1 transformer drawing 0.5 amps, from a 120 volt line.

8. Draw 3-phase transformer connections for primary delta, lower voltage; secondary wye, higher voltage. Transformer has dual windings in both primary and secondary sides.

9. What is the per cent slip of a 4 pole, 60 cycle motor operating at 1710 RPM?

NAME ______________________

10. An office building requires an incoming service of 785 amps. on a 120/208 volt, 3-phase, 4-wire system. What is the minimum size of each transformer if a bank of three is installed?

11. Find the luminous intensity of a light source producing 15,000 lumens.

12. A substation transformer reduces the voltage from 175 KV to 4400 volts. Find the secondary current if the primary current is 30 amps.

13. Twelve poles are installed in a parking area to provide 5 foot-candles of illumination. Each pole is equipped with four 40,500 lumen lamps. How large is the parking area in square feet?

14. How many poles are required for a motor to operate at 7200 RPM on 120 cycles?

NAME ______________________________

15. Draw 3-phase transformer connections for primary wye, higher voltage; secondary delta, lower voltage and identify each connection. Transformer has dual windings in both primary and secondary sides.

16. Draw and properly identify the leads of a single phase transformer for additive polarity.

17. Draw a circuit diagram for 460/265 volt, 3-phase, 4-wire, lighting and power system indicating voltages, light and single and three phase power connections and ground where required. Identify each major part or connection.

18. Find the winding current of a delta connected transformer having 25 amps. line current.

19. A transformer has 7200 volt primary, 460 volt secondary, 1000 primary turns, 10 amps. secondary current. Find primary amps. and secondary turns.

NAME ______________________________

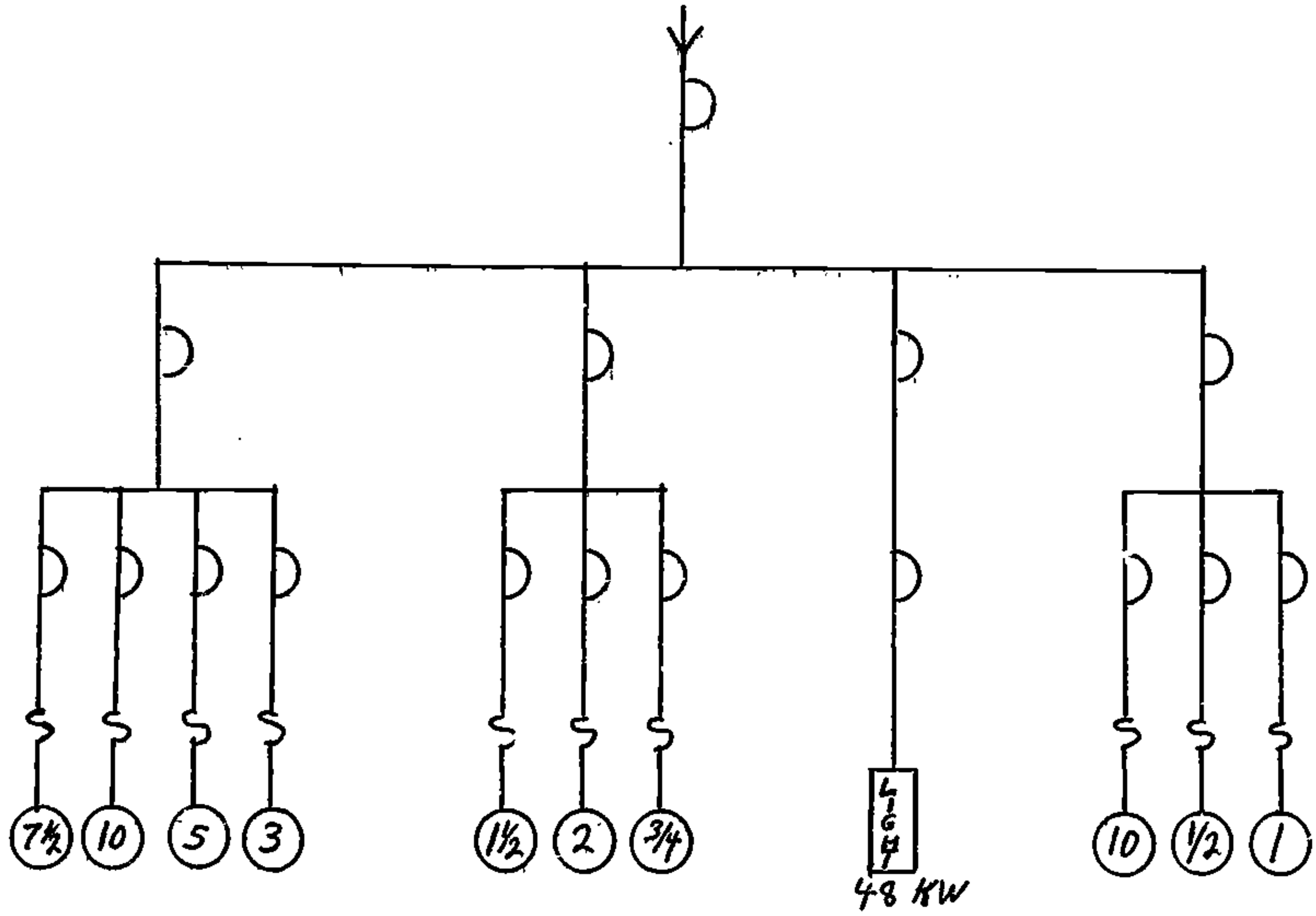
20. What size transformers are required for a 3 transformer wye-wye connected bank for 1250 KVA load?

21. Find the primary winding voltage of a wye-wye connected transformer having 440 volt line.

NAME ______________________

22. Using the National Electrical Code as reference, find the following for the electrical system below rated 240 volts, single phase, three wire, using Type "THW" conductors:

(a) Maximum motor-running overcurrent protection.
(b) Minimum feeder size.
(c) Maximum branch circuit overcurrent protection.
(d) Minimum branch circuit conductors.
(e) Maximum feeder overcurrent protection.



NAME ______________________________

23. Find the minimum Type "THW" lighting feeder permitted by the Code to serve ten floors of a store having 125 ft. x 200 ft. floor area.

24. Find the minimum Type "THW" lighting feeder permitted by the Code to serve a hospital having three floors of office area and eight floors for hospital, 150 ft. x 175 ft. floor area.

25. Calculate the minimum service required for a residence of 2400 sq. ft. having one 12-kw range, one 5-kw water heater, 1.5 kw dishwater, 5 kw dryer, 7½ HP air conditioning unit, 15 kw space heating, 1½ HP water pump, 1/3 HP disposal three 1/6 HP exhaust fans and 4.5 kw shop equipment.

13. "Tong Test" ____________ is a convenient instrument for measuring current without breaking the circuit.

14. Install ammeters in ____________ and voltmeters in ____________ in measuring currents and voltages.

15. For protection of an ammeter a ________ ____________ shall be installed.

16. A ____________ ____________ lamp tester is a convenient

and compact device for determining ________ ________, ________

of ______ ______ and ____________ or ____________ circuits.

17. Study the magneto test set and method of use.

18. List three advantages of the telephone receiver test set over the magneto tester.

(a) ____________________

(b) ____________________

(c) ____________________

19. Study the telephone receiver test set and method of use.

20. What is one advantage of the telegraph sounder?

21. Describe an electric-bell testing outfit and method of use.

22. Describe a test lamp set.

23. What are two items to be considered in construction of a test lamp set?

(a) ____________________

(b) ____________________

NAME ______________________________ Lesson B-8

DATE ______________________________ Principles of Transformers

REFERENCE

1. American Electricians' Handbook, Pages 5-2 - 5-3, Sec. 1-4.
2. Basic Electricity, Pages 3-54 - 3-57.
3. *Basic Mathematics, Pages 351 - 359.
4. Swoope's Lessons in Practical Electricity, Pages 526 - 533.

PROBLEMS

1. A ______________ is a device for changing ______________ energy from one potential to another.

2. The ____________ windings of a transformer are ______________ and secondary.

3. Secondary windings are connected to the ______________ side.

4. The line side is connected to the ____________ windings.

5. A ______________________ transformer delivers energy at a higher potential than it receives.

6. List three types of losses in a transformer:

   (a) ______________________________

   (b) ______________________________

   (c) ______________________________

7. A transformer which delivers energy at a lower potential than it receives is called a ______________________________.

8. Find the secondary voltage of a transformer having 2400 volt primary, 250 secondary turns and 25 primary turns.

9. Find the primary turns of a transformer having 120 volt on primary, 24 secondary voltage and 100 secondary turns

10. Basic construction of a transformer consists of the following:

    (a) ______________________________
    (b) ______________________________
    (c) ______________________________

NAME ______________________________

26. The universal motor has the armature winding and field winding connected in ________________.

27. Three-phase delta system over 300 volts are not required to be ____________ except when feeding ______________ _______________ at over 300 volts.

28. A motor located __________ feet from the starter is within sight if there are no ________________ between the motor and starter.

29. A three-phase motor may be reversed by ______________ any ________________ _______________ leads to motor.

30. The "T-"rating of a lamp refers to the ________________ in _________ inches.

31. There are ______________ and ________________ cathodes used in fluorescent lamps.

32. On 277 volt systems, lighting fixtures shall not be mounted less than ______ feet above the floor.

33. Running protection for a motor having less than 40° C. temperature rise shall not exceed _____________ per cent of the full load current.

34. A 460-265 volt system requires approximately __________per cent less copper as a 120/208 v. system with the same load.

35. ______________ _______________ type starting is for instant-start lamps.

36. Indoor dry type transformers shall be mounted not less than __________ inches from combustible material.

37. ________________ determines the color of fluorescent lamps.

38. Line current is ________________ to winding current in wye connected transformers.

39. Windings on three-phase motors are spaced ________________ electrical degrees apart.

40. The _______________ winding of a transformer is connected to the load.

41. Distance between receptacles in a dwelling shall not exceed __________ feet of wall space.

42. _______________ type outlets shall be installed in the kitchen.

43. Transformers are rated in _______________.

44. Branch circuits are classified as _____, _____, _____, and _____ amps.

NAME ______________________________

45. Efficiency of a transformer is the ratio of the __________ to __________.

46. Slip is the difference between __________ speed and __________ speed.

47. Primary protection of a transformer shall not exceed __________ per cent of its rated current.

48. The capacitor motor provides a __________ torque.

49. ______________, ______________ and ______________ types of open conductors are permitted to be installed within ten feet of a building.

50. Circuit ______________ ______________ must open each ungrounded conductor.

51. ______________ systems shall be tested periodically.

52. ______________ ______________ conductors shall have an insulation resistance of 25,000 ohms.

53. ______________ ______________, ______________ and ____________ ____________ are suitable means of providing emergency power.

54. The identified conductor shall be connected to the ____________-____________ terminal.

55. ____________ ____________ and other ____________ required to provide ____________ ____________ shall be provided for emergency illumination.

56. A multi-wire branch circuit on a 120/240 volt, single phase, three wire system contains __________ __________ wires and __________ __________ wire.

57. All swimming pool ______________ shall be grounded to a ______________ pool ______________.

58. Minimum size conductors for a 20-amp. branch circuit shall be No. _____ AWG.

59. __________ __________ or __________ shall not be installed in an elevator shaft.

60. ___________ ___________ in the center of a dwelling area floor does not count as a required wall outlet.

61. In a swimming pool, a grounded conductor shall be installed from ____________ box to ______________ ______________ ground.

62. ____________ ____________ lighting shall be based on 200 watts per ____________ ____________.

63. Separate circuits are provided for lights and motors because ____________ and ____________ - ____________ are more common as ________________ ________________.

NAME ______________________________

64. Two ______________ ______________ ______________ shall be provided in kitchens.

65. Megger measures the ______________ ______________ of a ______________.

66. The minimum size copper grounding conductor for a parallel 500 MCM copper service entrance shall be No. ______ AWG.

67. The minimum size copper grounding conductor for a service entrance shall be No. ______ AWG.

68. Service equipment shall consist of a maximum of ______ manually operated ______________ ______________ or ______________ ______________.

69. The ______________ of ______________-______________ electrodes shall not exceed __________ ohms and __________ ohms for underground ______________ ______________.

70. Service conductors shall not be ______________.

71. Overhead service crop shall be attached a minimum of __________ feet above grade.

72. Maximum rating of motor circuit overcurrent protective devices shall be _____ percent of motor full-load current.

73. In transformer vaults, the floor shall be __________ inches thick and door sills shall be __________ inches high.

74. ______________ is the rotating part of an induction motor.

75. All ______________ tools shall be grounded.

VT 003 628

VT 003 628
Basic Electricity Series, No. C (Third Year), Related Training for Electrical Apprentices, Instructor's Manual.

Hedinger, Howard E.
North Carolina State Board of Education, Raleigh
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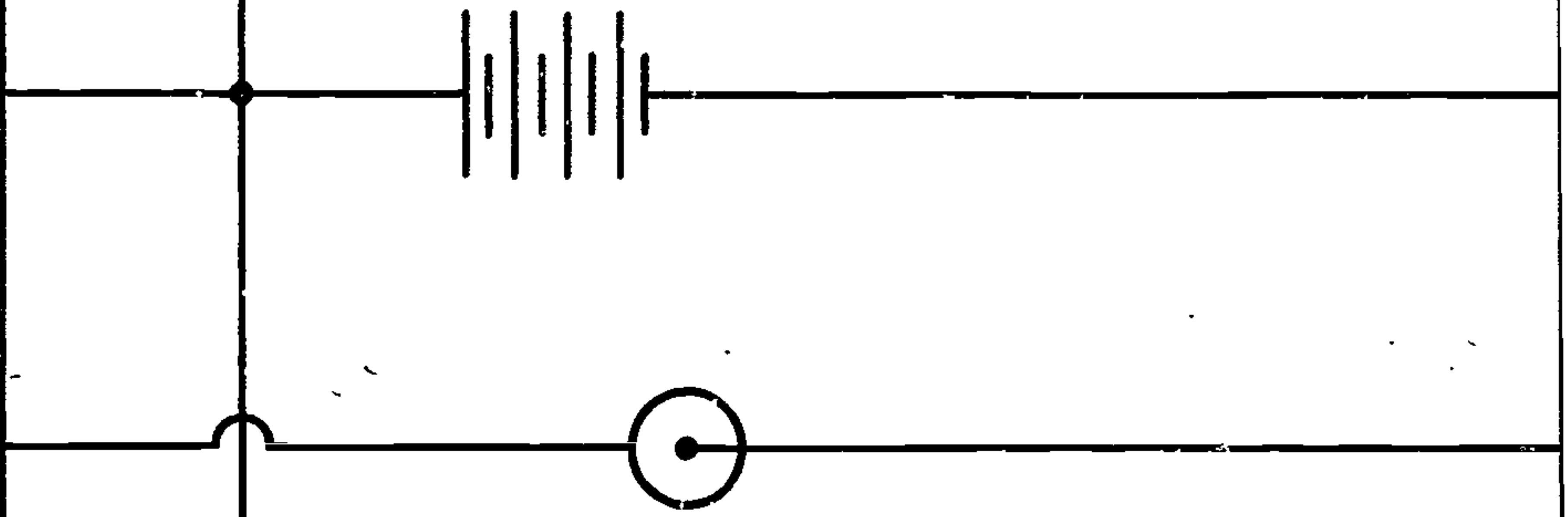
*TEACHING GUIDES, *TRADE AND INDUSTRIAL EDUCATION, *ELECTRICIANS, *ELECTRICITY, POST SECONDARY EDUCATION, *APPRENTICESHIPS,

This teaching guide, the third of a four-unit series, is to help the instructor plan and present course materials to electricians in the third year of the related technical phase of post-secondary apprenticeship training. It was developed by a curriculum committee of subject matter specialists and the educational committee of the National Electrical Contractors of North Carolina, tested on a small group, and used in apprenticeship programs. The 28 lesson plans in this guide cover Fundamentals of A.C. Electricity, National Electrical Code, related to installation in hazardous areas, and Motor Controls. Each lesson plan is outlined in desired results, equipment and materials, references, introduction, presentation, application, and checking and followup. The teacher of the 144-hour course should be a journeyman tradesman, and the students should be 18 years old and employed as apprentices in an electrical construction trade. Supplementary materials include lists of textbooks and recommended films. Correlated student assignment and information sheets, unit tests, and a final examination are given in VT 003 627. Documents of the series are listed as VT 003 624 through VT 003 631. (HC)

INSTRUCTOR'S MANUAL

Third Year

BASIC ELECTRICITY FOR APPRENTICES



CURRICULUM LABORATORY
DEPARTMENT of COMMUNITY COLLEGES
STATE BOARD of EDUCATION
RALEIGH, NORTH CAROLINA

INSTRUCTOR'S MANUAL

BASIC ELECTRICITY

SERIES NO. C

(Third Year)

Related Training
for
Electrical Apprentices

July 1964

CURRICULUM LABORATORY
DEPARTMENT OF COMMUNITY COLLEGES
STATE BOARD OF EDUCATION
RALEIGH, NORTH CAROLINA

MEMORANDUM

TO: The ERIC Clearinghouse on Vocational and Technical Education
The Ohio State University
980 Kinnear Road
Columbus, Ohio 43212

FROM: (Person) Roger G. Worthington (Agency) Department of Community Colleges

(Address) Education Building, Raleigh, North Carolina

DATE: September 7, 1967

RE: (Author, Title, Publisher, Date) Hedinger, Howard E. "Basic Electricity For Apprentices, Series C - Third Year Instructor's Manual," Curriculum Laboratory, Dept. of Community Colleges, July 1964.

Supplementary Information on Instructional Material

Provide information below which is not included in the publication. Mark N/A in each blank for which information is not available or not applicable. Mark P when information is included in the publication. See reverse side for further instructions.

(1) Source of Available Copies:
Agency ERIC Only, except North Carolina Institutions.
Address
Limitation on Available Copies Price/Unit
(quantity prices)

(2) Means Used to Develop Material:
Development Group Curriculum committee/ National Electrical Contractors for Carolinas - Educational committee
Level of Group State and Dept. supervisor
Method of Design, Testing, and Trial Designed by subject matter specialists and tested on a small group; has been used with 1,200 apprentices per year for 3 years.

(3) Utilization of Material:
Appropriate School Setting Vocational (Apprentice Training)
Type of Program Post-high; Apprenticeship
Occupational Focus A specific job (electrical construction)
Geographic Adaptability N/A
Uses of Material Course and lesson planning and student study guides.
Users of Material Instructor and student

(4) Requirements for Using Material:
Teacher Competency Journeyman instructor
Student Selection Criteria 18 year old, male (mostly), post-secondary educ. to become a journeyman electrician
Time Allotment 144 hours per year (minimum)

Supplemental Media -- Textbooks - see list
Necessary X
Desirable ____ (Check Which)

Describe Basic Electricity, VanValkenburgh & All, Hayden Book Co.; Amer. Electricians' Handbook, Croft, McGraw-Hill Book Co.; Basic Mathematics
Source (agency) / by Singer, McGraw-Hill Book Co.; National Electrical Code
(address)/ National Fire Protection Assoc. 60 Batterlymarch Street, Boston, Mass

ACKNOWLEDGMENTS

The Instructor's Manual and Assignment Sheets for the Electrical Apprentice Training Program have resulted from a need recognized by representatives of Trade and Technical Education and the Apprentice Council of the Department of Labor of North Carolina. They believe that an apprentice, in order to become a skilled craftsman in our times, needs not only to work hard on the job but also to study the related technical materials of his trade in an organized manner.

The Curriculum Laboratory of the Department of Community Colleges, was given the assignment of preparing materials that could be used by the instructors as a guide. The material contained in the lesson outlines is designed to help the instructor plan the lessons and to lead his classes gradually into the more complex studies of electricity.

Representatives of the Curriculum Laboratory have worked in close cooperation with a statewide Education Committee of the North Carolina Association of Electrical Contractors. Among these men are contractors, engineers, and journeymen who have not only worked as electricians but also are serving as instructors for apprentice classes.

Thanks are extended to Mr. D. J. Colter, Chairman of the Apprentice Training and Manpower Development Committee for the Electrical Contractors Association, Mr. C. L. Beddingfield, State Director of Apprenticeship and Training, and Mr. W. F. Humbert, III, Instructor of Winston-Salem who prepared the study guide questions for each lesson.

In addition, appreciation is expressed to all those instructors and apprenticeship committee members who have made themselves available for consultation regarding this course.

A. J. Bevacqua, Coordinator
Curriculum Laboratory
N. C. Department of Community Colleges

H. E. Hedinger
Curriculum Specialist

BASIC ELECTRICITY

TO THE INSTRUCTOR

The third year (Series C) of the course in Basic Electricity for apprentices is designed to make it easier for the instructor to present the work in a systematic manner. The lesson outlines continue the study of alternating current and circuits.

It should be noted by the instructor that advanced mathematical principles are stressed in order to understand alternating current and the application of vectors. In this course, there is a continued study of the National Electrical Code in terms of wiring methods in hazardous locations. References are made to the National Electrical Code and Blueprint Reading to help clarify the Code in making installations in hazardous areas. Also, presented in this course is the technical subject of motor controls and their applications. These topics are given in language as non-technical as possible and will continue in the fourth year (Series D).

It has been found from experience that many instructors have had difficulty obtaining particular visual aids at the time they need them. It is suggested that each instructor find his own sources of appropriate aids. The brief list included in this manual will act as a guide until a more comprehensive list of audio-visual and other aids can be prepared.

CONTENTS

LESSON NO. FUNDAMENTALS OF A. C. ELECTRICITY

NATIONAL ELECTRICAL CODE

MOTOR CONTROLS

INSTRUCTIONAL MATERIALS

Lesson C-1

ALTERNATING CURRENT

DESIRED RESULTS:

1. To acquaint the apprentice with the importance of alternating current.
2. To know the basic fundamentals of alternating current.
3. To know the terminology used in working with alternating current circuits.

EQUIPMENT AND MATERIALS:

1. Oscilloscope
2. Lamps
3. Motor
4. Relay
5. Transformer (Bell)
6. Capacitor

REFERENCES:

1. American Electricians' Handbook, p. 1-40 to 1-45; Sec. 112-129 & 134
2. Basic Electricity, Vol. 3, pages 1-21, 31-34; 43-57 and 77-92
3. Basic Mathematics, Singer, pages 294-310; 319-335
4. Film--"Alternating Currents"--35 MM slide film - Jam Handy
5. *Swoope's Lessons in Practical Electricity, pages 340-360

INTRODUCTION:

Alternating currents have been refe-red to briefly in other lessons. As you know, most all of the electric power generated and transmitted in the United States is alternating current.

Five reasons are listed for using electrical energy as alternating current rather than direct current:

1. The A.C. Generators have no commutators. Therefore, units having larger power ratings and resultant heavier current ratings can be used without the problem of brush arcing and heating.

2. Because alternators or A. C. generators have no commutators, they can generate at comparatively high voltages such as 11,000 to 13,000 volts.

3. Because alternating current can be transmitted economically over great distances. It is possible to generate electrical energy in large quantities in a single station and distribute it over a comparatively large territory.

4. By the use of the transformer, alternating current can be increased or decreased easily without much power loss.

5. For constant speed work, the A. C. squirrel-cage induction motor is less expensive than the direct current motor, both in cost and in maintenance.

PRESENTING THE LESSON:

I. The Cycle:
Since we know that alternating current flows back and forth in a conductor at regular intervals, going first in one direction and then the other.

- A. Develop the concept of the cycle using the four positions of a loop in an elementary generator.

- B. Define cycle--Draw a waveform or sine wave and mark the points of maximum, average and effective values. Have the students give definitions of Cycle.

II. Discuss and define Mechanical and Electrical Degrees

- A. Compare two and four pole A. C. generators
  - 1. Calculate the mechanical and electrical degrees in each generator per turn of rotor coil.

- B. Arrive at the definitions

III. Frequency

- A. Compare the number of cycles generated per turn of rotor in two and four pole A. C. generators.
  - 1. Calculate the number of cycles generated per second in each generator at a given speed.

- B. Arrive at a definition of frequency

IV. Phase

- A. Definition of Single-phase
- B. In-phase
  - 1. Give definition
  - 2. Illustrate VOLTAGE and CURRENT relationship using SINE WAVES
    - a. Draw Waveform or SINE WAVE
    - b. Illustrate with OSCILLOGRAPH
- C. OUT OF PHASE - LAG
  - 1. Definition
  - 2. Illustration of sine waves showing the current lagging the voltage.
- D. OUT OF PHASE - LEAD
  - 1. Definition
  - 2. Illustration of SINE WAVES showing current leading the voltage.

V. Demonstrations with Cathode Ray Oscillograph

- A. Cycle of line voltage sine waves
- B. Waves of at least two different frequencies
- C. Current and Voltage
  - 1. Connect a lamp to the line
- D. Current lagging voltage
  - 1. Connect a relay, a transformer, or a motor to the line
- E. Current leading the voltage
  - 1. Connect a capacitor to the line

VI. Visual Aids

Show "Alternating Currents"
35 MM Slide Film
Jam Handy Organization

APPLICATION:

The students should complete the assignment sheet for this lesson.

CHECKING AND FOLLOW-UP:

Check the answers and return the sheets to the students for placing in notebooks.

Lesson C-2

RESISTANCE IN A.C. CIRCUITS

DESIRED RESULTS:

1. To acquaint the student with the affect of resistance only in A. C. Circuits.

2. To understand the meaning of the term "power factor".

EQUIPMENT AND MATERIALS:

1. Oscilloscipe
2. Lamp bank
3. Switches
4. Meters
5. A. C. Generators
6. Capacitor

REFERENCES:

1. American Electricians' Handbook, pages 1-43, Sec. 122

2. Basic Electricity, pages 3-31 to 35

INTRODUCTION:

The effect of resistance in alternating current circuits which contains resistance only is the same as its effect in direct-current circuits. It causes a loss or drop in voltage, with a specified voltage, the greater the resistance the smaller the current and vice-versa. Remember that some materials have much less resistance than others. Pure resistance circuits are made up of electrical devices such as resistors, lamps and heating elements which have negligible inductance or capacitance. When only such devices are used in an A. C. circuit, Ohm's Law, and the circuit rules for voltage, current and power can be used as in D. C. Circuits.

Power in the A. C. circuit is determined in a similar manner as in a D. C. circuit by multiplying volts and amperes. When the power factor is other than unity, all A. C. voltage and current are given in effective valves. Effective valves are determined by considering the angle of lag or lead between voltage and current.

The power represented by the product of volts, amperes, and cosine is registered on a wattmeter or a watt-hour meter. It represents the power you pay for when furnished by the electric company.

PRESENTING THE LESSON:

1. Review the fundamental concepts of power.
    a. A. C. resistance circuits
    b. Draw voltage and current wave
        (1) Sine waves of voltage and currents are "in phase" whenever they are the same frequency and pass through zero simultaneously, both going in the same direction.
        (2) Demonstrate on the oscilloscope
        (3) Set up a circuit of incandescent lamps to A. C. Power supply. Measure the volts, amps, and watts. Show that volts x amps equals watts.
2. Determination of Power
    a. Circuit having resistance only - measure the volt-amps and power supplied to:
        (1) A reactor of negligible resistance
        (2) A capacitor
    b. Circuit having inductive or capacitive reactance
        (1) Measure the power supplied to a single-phase induction motor.
    c. Present the General Formula for Single phase or A. C. Power factor.

APPLICATION:

Have the students answer all questions; show all formulas used on the assignment sheet.

CHECKING AND FOLLOW-UP:

After checking the papers, return the sheets to the students for correction and placing in their notebooks.

Lesson C-3

INDUCTANCE IN A.C. CIRCUITS

DESIRED RESULTS:

To acquaint the apprentice with the effects of inductance in an alternating current circuit.

EQUIPMENT AND SUPPLIES:

1. Resistors, coils, capacitors, lamps
2. Oscilloscope
3. Connecting wire
4. 16 MM Projector and film

REFERENCES:

1. American Electricians' Handbook, Div. 1- p. 23, Sec. 45; p. 44, Sec. 125 & 126
2. Basic Electricity, Vol. 3, pages 49-52
3. Basic Mathematics, pages 336-351
4. Electric Circuits & Machines, Lister, pages 63-71 and pages 152-154

INTRODUCTION:

INDUCTANCE, which is treated in this assignment, is the electrical property that in an A. C. circuit imposes a counter or back voltage. When the current increases, inductance tries to hold it down and when the current decreases, inductance tries to hold it up. While you cannot see inductance, it is present in every electrical circuit and has the above effects on the circuit whenever the circuit current changes.

Inductance of a circuit is measured in a unit called "henrys." It is expressed by the symbol L. A circuit has an inductance of 1 henry when, if the current is changed at the rate of 1 ampere per second, 1 volt is induced into the circuit. You must understand inductance and inductive reactance in order to learn the basics of alternating current.

PRESENTING THE LESSON:

Remember that an alternating current is continuously changing so that the circuit inductance affects A. C. current flow at all times. Because a coil of wire has more inductance than a straight length of the same wire, the coil is called an "inductor."

Resistors, coils, and capacitors may be connected in series in several combinations. A circuit which contains a resistor connected in series with a coil will be considered.

Resistors and coils offer opposition to alternating current. The voltage and current relationship in a resistor will be in phase while in a coil; the current lags the voltage drop across the coil by 90 degrees. The combined opposition is called <u>impedance</u> and is measured in ohms.

DEMONSTRATIONS:

1. Analysis of a series circuit containing two resistors, or lamps.
2. Analysis of series circuit containing a resistor in series with a coil.
3. Set up a series circuit consisting of a resistor and a coil, each having corresponding resistance and reactance of about the same value.
4. Show the actual relationship of voltage and current in each part of the circuit by using an oscilloscope.
5. Show film--"Inductance in A. C. Circuits"

APPLICATION:

A. Check-up on Basic Mathematics:

   1. Work problems No. 2, 3, and 5, page 340.
   2. Work problems No. 1, 6, and 12, pages 342-343.

B. Answer questions on the Assignment Sheet

CHECKING AND FOLLOW-UP:

Check the answers to questions and return to the students for correction and filing in notebooks.

Lesson C-4

INDUCTIVE REACTANCE

DESIRED RESULTS:

To acquaint the apprentice with the effects of Inductive Reactance in an alternating current circuit.

EQUIPMENT AND SUPPLIES:

1. Oscilloscope
2. Resistors
3. Core Materials
4. Bell Transformer
5. Light Bulbs, for batteries & 60-watt, 110 V (white & red)
6. Coils
7. Wire connectors
8. Meters

REFERENCES:

1. <u>American Electricians' Handbook</u>, Div. 1, page 23, Sec. 46
   Div. 1, page 44, Sec. 126 & 127
2. <u>Basic Electricity</u>, Vol. 3, pages 61-64
3. <u>Basic Mathematics</u>, pages 340-366
4. *<u>Swoope's Laws in Practical Electricity</u>, pages 365-366

INTRODUCTION:

Inductive reactance is the opposition to current flow offered by the inductance of a current. As you know, inductance only affects current flow while the current is changing, since the current change generates an induced EMF Reactance is expressed in Ohms as in resistance. In the formula inductive reactance is represented by the letters X_L.

Because an understanding of inductance and inductive reactance is fundamental to an understanding of alternating current, be sure that the students master this material including the use of formulas.

PRESENTING THE LESSON:

I. Show the following waveforms on the chalkboard:
   1. A. C. Voltage and current waveforms in an inductive circuit
   2. How frequency affects current
   3. Voltage and currents are in phase in a circuit of pure resistance.
   4. Voltage and currents are 90° out of phase in a circuit of pure inductance.

II. Demonstrations:
1. How inductance varies with core material.
2. Determining the starting voltage of a neon lamp.
3. Observing A. C. and D. C. cirrent flow in a resistive circuit.
4. How inductive reactance affects the total circuit current.

APPLICATION:

Have the students answer the questions and work the problems on the assignment sheet.

CHECKING AND FOLLOW-UP:

Check the answers and help any of the students that had trouble with the problems.

Lesson C-5

CAPACITANCE IN A.C. CIRCUITS

DESIRED RESULTS:

- To help clarify the concept of capacitance by showing that when the voltage across an electric circuit changes, the circuit opposes this change.

EQUIPMENT AND SUPPLIES:

1. Two-plate capacitor
2. Knife switch
3. Dry cell
4. Ammeter
5. Various types of capacitors
6. Wire connections
7. 16 MM projector
8. 16 MM Film--"Capacitance in A. C. Circuits"

REFERENCES:

1. American Electricians' Handbook, Div. 1, p. 23, Sec. 47; p. 44, Sec. 128
2. Basic Electricity, Vol. 3, pages 77-92
3. Basic Mathematics, pages 366-376 and 383
4. *Swoope's Laws in Practical Electricity, pages 331-336

INTRODUCTION:

Capacitance exists in an electric circuit because certain parts of the circuit are able to store electric charges. Capacitance is dependent on the area of the metal plates, the characteristics of the dielectric, and the distance between the plates. The effectiveness of a dielectric for use in a capacitor is described by a number called the "dielectric" constant. The number is based on the assumption that air has a dielectric of 1. Bakelite varies from 4.0 to 10.0, rubber compounds from 3.0 to 7.0 and paper from 2.0 to 2.6.

PRESENTING THE LESSON:

A. What factors determine the reactance?

1. The size of the capacitor is one factor. The larger the capacitor, the greater the number of electrons that may be accumulated on its plates.
2. Increasing the distance between the plates decreases capacitance.
3. Changing the Dielectric material changes the capacitance. Example, using Mica as a dielectric increases the capacitance.

B. What is working voltage?

The working voltage is the largest voltage that may be placed across a capacitor before it breaks down. The working voltage in a parallel circuit is the working voltage of the weakest capacitor. The working voltage in series circuit is the sum of the working voltages of the series capacitor. See formulas--Basic Mathematics, pages 377 and 394.

DEMONSTRATIONS: (See Basic Electricity)

1. Charging a plate NEGATIVELY AND POSITIVELY.
2. D. C. current flow stops when the capacitor becomes charged. Switch closed--capacitor charges Switch open-capacitor remains charged. Switch reversed--capacitor discharges and then charges with reversed polarity.
3. A. C. current in a capacitive circuit--charge and discharge currents cause a deflection on the A. C. ammeter.
4. To prove that capacitors appear to block D. C. but permit A. C. to pass.

C. Show the film--"Capacitance in A. C. Circuits"

REVIEW of Capacitance in A. C. Circuits by having the students explain the terms and items brought out in the film:

1. Capacitance
2. Capacitor
3. Capacitor charge
4. Capacitor discharge
5. Farad
6. Microfarad
7. Micromicrofarad
8. Dielectric

APPLICATION:

Have the students answer the questions on the assignment sheet for this lesson.

CHECKING AND FOLLOW-UP:

After checking the papers, return them to the students for correction and placing in their notebooks,

Lesson C-6

CAPACITANCE REACTANCE

DESIRED RESULTS:

To acquaint the apprentice with the effects of Capacitive Reactance in an alternating current circuit.

EQUIPMENT AND SUPPLIES:

1. Lamps
2. Resistors
3. Capacitors
4. Voltmeter
5. Batteries
6. Power supply or Transformer

REFERENCES:

1. American Electricians' Handbook, Di. 1 - page 24, sec. 49
   page 44, sec. 129
2. Basic Electricity, Vol. 3, pages 107-111
3. Basic Mathematics, pages 376-381
4. *Swoope's Laws in Practical Electricity, pages 368-371

INTRODUCTION:

Capacitive Reactance is the opposition to current flow offered by the capacitance of a circuit. It is measured in ohms, the same as resistance and inductive reactance. Capacitive Reactance is designated by the symbol X_C Alternating Current continuously varies in value and polarity, therefore the capacitor is continuously charging and discharging, resulting in a continuous circuit current flow and a finite value of capacitive reactance.

Inductive reactance and capacitive reactance have exactly opposite effects in a circuit. Inductive reactance opposes change of current in a circuit; capacitive reactance opposes change in voltage. In a series circuit the inductive reactance tends to neutralize the capacitive reactance.

PRESENTING THE LESSON:

A. Show by drawing on the chalkboard and in the text Basic Electricity:
   1. Charging and discharging currents of a capacitor.
   2. How frequency affects the flow of A.C. current through a capacitor.
   3. How capacitance values affect capacitive resistance.
   4. In a pure capacitive circuit, the current leads the voltage.
   5. Show the Power Wave of a circuit containing only capacitance.

B. Demonstrate (See Basic Electricity, Vol. 3, pages 113-118)
   1. A voltmemter connected across a capacitor acts as a RESISTOR
   2. A neon lamp is an open circuit until its starting voltage is reached.
   3. Observe the time delay of an R. C. time constant.
   4. Show that a change in resistance changes the R. C. time constant.
   5. Show that a change in capacitance changes the R. C. time constant.
   6. Observe the charging current of a capacitor.
   7. Observe the capacitance reactance as the capacitance changes.

APPLICATION:

Answer questions and solve problems on the assignment sheet for this lesson. See Basic Mathematics for formulas to use with problems.

CHECKING AND FOLLOW-UP:

After checking the assignment sheets, return them to the students for correction and placing in the notebooks.

Lesson C-7

TRIGONOMETRY FOR A.C. ELECTRICITY

DESIRED RESULTS:

1. To study the relationships that exist among the sides and angles of a right triangle.
2. To know that these relationships form a basic mathematical tool used in the solution of A. C. electrical problems.

EQUIPMENT AND MATERIALS:

1. Chalkboard
2. Chalkboard Tools

REFERENCES:

1. Basic Mathematics, pages 294-307

INTRODUCTION:

Trigonometry is the study of the relationships that exist among the sides and angles of a triangle. It is one of the most useful forms of mathematics, which treats of the measurement of triangles. A study of trigonometry and its methods is important to students of technical subjects. The students will find its use necessary in the solution of many problems in alternating-current circuits, mechanics, surveying, etc.

In solving alternating current problems, it is necessary that the student know the functions of the SINE, COSINE, and TANGENT of an angle and how to use them.

PRESENTING THE LESSON:

1. Review ANGLES--NAMING ANGLES, MEASURING OF ANGLES and KINDS OF ANGLES.

2. TRIANGLES--a closed plan figure of three sides.
   a. A Right Triangle
   b. Naming the sides of a Right Triangle

3. The Trigonometric Formulas
   a. Sine of an angle
   b. Cosine of an angle
   c. Tangent of an angle

4. Using the Table of Trigonometric Functions
   a. How to find the decimal values of the functions of angles from the table of natural functions.
   b. How to find the angles corresponding to the decimal values of the functions.

5. Demonstrate
   a. Finding the Acute Angles of a Right Triangle.
   b. Finding the sides of a Right Triangle.
   c. How to use the Right Triangle to solve alternating current problems by substituting electrical values.

APPLICATION:

The students will answer the questions and work the problems on the Assignment Sheet for this lesson.

CHECKING AND FOLLOW-UP:

Check the answers and return the sheets to the students for correction and placing in their notebooks.

Lesson C-8

VECTORS

DESIRED RESULTS:

1. To study the term VECTOR as it represents a straight line having a definite LENGTH & DIRECTION.
2. To learn that VECTORS are commonly used to show the amount and direction of a quantitiey like 100-lb. force which acts straight up.
3. Vectors are used to show the amount and time at which a voltage or current is acting.

EQUIPMENT & MATERIALS:

1. Chalkboard
2. Chalkboard Tools

REFERENCE:

1. Basic Mathematics, pages 399-404

INTRODUCTION:

In a circuit containing only resistance, we have seen that the voltage and current occur at the same time or are in phase. To indicate this condition by means of vectors, draw the vectors for the voltage and the current in the same direction. Vectors which are drawn in different directions will indicate that the voltage and current are happening at different times.

PRESENTING THE LESSON:

1. Draw a line representing vectors for the voltage and the current acting in the same direction. The angle between the vectors is 0° and is called the phase angle; it is demoted by the Greek letter, theta ~~(θ)~~. (See figure 17-2, p. 399 of Basic Mathematics). Work the examples on the chalkboard.
2. Draw a vector Diagram showing the voltage Vector "leading" the current vector by 90° in a purely inductive circuit. (See fig. 17-4, page 401 of Basic Mathematics). We must show which vector is the "leading" vector and which is the "lagging" vector. To show these quantities, we must use the numbers on a clock. Let us use the hour hand of a clock as a vector. A vector pointing to 3 o'clock occurs after a vector pointing to 12 o'clock, and are 90° apart. Similarly, a vector pointing to 3 o'clock occurs before a vector pointing to 6 o'clock.

3. The amount of current that will flow in a "pure" inductive circuit is found by Ohm's Law. (See p. 401, Basic Mathematics) Demonstrate with several problems.

APPLICATION:

The students will answer the questions and work the problems on the Assignment Sheet.

CHECKING AND FOLLOW-UP:

Check the answers and return the sheets to the students for correction and placing in their notebooks.

Lesson C-9

SERIES A.C. CIRCUITS

DESIRED RESULTS:

1. To show the effects of a combination of resistance, inductance, and capacitance connected in series.

2. To show the relationship of voltage and current in a series circuit containing R, L, and C.

3. To acquaint the apprentice with the problem of resonance in an alternating current series circuit.

EQUIPMENT AND SUPPLIES:

1. A. C. Power Supply or Transformer
2. Knife-edge switches
3. Resistors (1500-OHM)
4. A. C. Voltmemter (0-250 volt)
5. Filter Choke (5-Henry)
6. Capacitors (1-mfd & .25-mfd)
7. 16 MM Projector - A. C. Series Circuits

REFERENCES:

1. <u>Basic Electricity</u>, pages 4-26 thru 4-42
2. <u>Basic Mathematics</u>, pages 408-432
3. *<u>Swoope's Lessons in Practical Electricity</u>, pages 391-394

INTRODUCTION:

An electrical AC circuit may be completely inductive or capacitive. It may also include resistance, inductance and capacitance in series. When the inductive reactance equals the capacitive reactance, a condition called <u>resonance</u> exists.

Since the capacitive reactance opposes inductive reactance, they will cancel each other and the resistance of the circuit will be the only remaining opposition. Illustration--AC Series Circuit Current Flow, pages 4-26, <u>Basic Electricity</u>.

PRESENTING THE LESSON:

I. Characteristics of the Series Circuit having R, L, and C.
   A. Circuit having X_L greater than X_c
   B. Circuit having X_c greater than X_L
   C. Resonant circuit, X_L equal to X_c
   D. Summarize the characteristics with respect to impedance, total voltage, and phase relation to the total voltage and current.

II. Demonstrations
   A. Set up a R and L series circuit voltage as shown on pages 4-37, Basic Electricity.
   B. Set up a R & C series circuit voltage; see pages 4-38.
   C. Set up the L & C series circuit voltages; see pages 4-39
   D. Series resonance
      1. Set up and observe the voltages and current flow in an R, L, and C series circuit. See pages 4-40
      2. Observe the circuit voltages and current change as the capacitance value is changed.

III. Visual Aid
Use a cathode ray oscilloscope to show the phase relationship of current and voltage across each part of each circuit used in the demonstration.

APPLICATION:

Using the Assignment Sheets for this lesson, the students should answer the questions and solve the problems.

Note: This is a lengthy assignment and it may require more than one meeting to complete.

CHECKING AND FOLLOW-UP:

Correct the questions and problems, and return the sheets to the students for correction and filing in their notebooks.

Lesson C-10

PARALLEL AC CIRCUITS

DESIRED RESULTS:

1. To determine the current and voltage relations in an alternating current circuit containing resistance and capacitance in parallel.
2. To determine the current and voltage relations in an alternating current circuit containing resistance, inductance, and capacitance in parallel.
3. To find the inductance or capacitance needed to produce resonance in an AC parallel circuit.

EQUIPMENT AND SUPPLIES:

1. AC Power Supply or Transformer
2. Knife edge switches
3. AC milliammeter (0-50 MA)
4. Voltmeter (0-250 volt)
5. Resistors (24 MA)
6. Capacitors (32 MA & 1-Mfd)
7. Filter Choke (5-Henry)
8. Wire connections

REFERENCES:

1. <u>Basic Electricity</u>, pages 4-41 thru 4-62
2. <u>Basic Mathematics</u>, pages 433-467

INTRODUCTION:

The majority of industrial power distribution lines have currents lagging the voltage. Power companies have found it advantageous to offset this condition by connecting banks of capacitors in parallel with the load. In this assignment the study is first limited to a circuit containing a resistor connected in parallel with a capacitor.

The second consideration is given to the parallel circuit containing three branches; resistance, inductance, and capacitance. When the reactor current is equal to the capacitor current, a parallel resonance or anti-resonance exists. This condition has a very practical application in the industrial electrical field.

PRESENTING THE LESSON:

I. Parallel Circuit with Capacitor and Resistance
    A. Current and voltage relations in resistance branch
    B. Current and voltage relations in capacitor branch
    C. Resultant current taken by the combining of these two branches into a parallel circuit
    D. Line voltage and current relations

II. Parallel Circuit Containing Resistance, Inductive Reactance, and Capacitive Reactance in Parallel
    A. Current and voltage relationship in each branch
    B. Obtaining the line current using vectors
        1. Current in capacitive reactance branch 180 degrees out of phase with current in inductive reactance

    2. Reactor current greater than capacitor current
    3. Capacitor current greater than reactor current

III. Resonance in a Parallel Circuit
  A. Review of resonance in a series circuit
  B. Effect of line current
    1. Current is equal in inductive reactance branch and in capacitive reactive branch
    2. Line current is equal to current taken by resistance branch
    3. Line current is equal to minimum value

IV. Demonstrations
Wire up a parallel circuit consisting of three branches, R, L, and C.
  1. Observe the total current of an R and L parallel circuit.
    a. Measure the branch currents of R and L
  2. Observe the total current of an R and C parallel circuit
    a. Measure the branch currents of R and C
  3. Observe the total current of a C and L parallel circuit
    a. Measure the branch currents of C and L
  4. Find the total current of the R_1 and L and C parallel circuit
    a. Measure the branch currents I_r, I_c, and I_L
  5. Show the current flow in a parallel resonant circuit
    a. Varying values of capacitance through resonance varies the currents I_c and I_L
    b. Check the value of circulating current in a parallel resonant circuit.

APPLICATION:

Complete the Assignment Sheets containing questions and problems. Lend assistance with the problems where needed.

CHECKING AND FOLLOW-UP:

Check the answers and return the sheets to the students for corrections and filing in their workbooks.

POWER IN AC CIRCUITS

DESIRED RESULTS:

1. To understand the meaning of the term "Power Factor".
2. To show the apprentice how power in an AC circuit is determined.

EQUIPMENT AND MATERIALS:

1. Voltmeter
2. Ammeter
3. Wattmeter
4. AC Power Supply
5. Motor or Industrial Power Load
6. Lamp banks
7. Capacitors
8. Resistors

REFERENCES:

1. American Electricians' Handbook, pages 1-45 & 48; 3-38
2. Basic Electricity, pages 3-33 thru 35; 3-72 thru 76 & 3-112
3. Basic Mathematics, pages 402, 405, 468-490
4. *Swoope's Lessons in Practical Electricity, page 398

INTRODUCTION:

The power in a DC circuit is the product of volts and amperes. In an AC circuit, the voltage and current are seldom in phase. Incandescent lighting and heating are the exceptions. The apparent power or product of volts and amperes must be multiplied by a "power factor" to determine the true or real power.

See AC Power Waveform, pages 3-33, Basic Electricity.

For "in phase" voltage and current waves, all of the instantaneous powers are above the zero axis and the entire curve is above the zero axis. This is determined when two positive values are multiplied together, the result is positive, and whenever two negative values are multiplied together, the result is also positive.

PRESENTING THE LESSON:

I. Fundamental Concepts of Power
   - A. AC Resistance Circuits
   - B. AC Inductive Circuits
   - C. AC Capacitive Circuits

II. Determination of Power
  A. Circuit having resistance only
  B. Circuit having inductive reactance or capacitive reactance
  C. Circuit having a reactive load (capacitive or inductive)
  D. General Formula for "single phase" or AC Power
  E. Measurement of AC Power

III. Power Factor
  A. Concept, definition and determination of power factor

IV. Demonstrations
  A. Set up circuits of incandescent lamps connected to an AC supply. Measure the volts, amperes, and watts. Show that volts x amperes equals watts.
  B. Measure the volt-ampere and power supplied to:
    1. A reactor of small resistance
    2. A capacitor
  C. Measure the volts, amperes, watts or the power supplied to a single-phase induction motor.

APPLICATION:

The students will answer the questions and solve the problems on the Assignment Sheet. Give assistance with the problems where needed.

CHECKING AND FOLLOW-UP:

After checking the answers return the sheets to the students for corrections and placing in their workbooks.

Lesson C-12

POWER FACTOR CORRECTION

DESIRED RESULTS:

To acquaint the student with the method and importance of power factor correction.

EQUIPMENT AND MATERIALS:

1. Chalkboard
2. A capacitor (large kva) for demonstration

REFERENCES:

1. American Electricians' handbook
2. Basic Mathematics, pages 490-500
3. Library

INTRODUCTION:

Power is the rate of doing work. A watt is the unit of power or equal to the work done by the current of one ampere under the pressure of one volt. A wattmeter is not constructed with the basic meter movement. It uses field coils with no permanent magnet to furnish the magnetic field. Since wattmeters work differently than other meters and are easily damaged if connected incorrectly, they must be operated properly.

Measurement of Power Factor can be done by using a power factor meter. The exterior of the single-phase power factor meter is identical to the wattmeter. While a source may produce volts and amperes, the power in watts may be small or zero. The ratio between the power in watts of a circuit and the volt-amperes of a circuit is called "power factor". In a pure resistive circuit the "power factor" is equal to power in watts divided by volt-amperes which equals one (1).

PRESENTING THE LESSON:

The ideal power transmission occurs when the current is in phase with the voltage or when the "power factor" is one (1). This can be accomplished by connecting a capacitor or a bank of capacitors across the line or in parallel with the inductive equipment. Show the students a capacitor.

The size of the capacitor is determined from tables showing the relationship between "power-factor", load Kva and Kva capacitors needed for any desired new power-factor. The size of capacitor necessary to raise the power factor of a given load to a higher value can be found as follows:

Assume a 500 kva load at 60 per cent power factor; 500 kva x 0.60 = 300 kw. It is desired to raise the power factor to 90 per cent. The capacitor kva necessary is found by multiplying 300 kw by the factor taken from the power factor correction table, which is 0.85. The capacitor needed would be 255 kva.

The power-factor correction theory is not in the realm of apprentice work or the electrical maintenance department. It is an engineering problem and engineers should calculate the problems with the actual correction being made with capacitors or synchronous motors. The maintenance electrician should be familiar with the dangers in working with capacitors. A capacitor can maintain a charge sufficient to produce a fatal shock for a long time after it is disconnected from a charged line. A capacitor should be fully discharged before any maintenance work is done to it or around it.

APPLICATION:

The students will complete the questions and solve the problems on the assignment sheet.

CHECKING AND FOLLOW-UP:

The answers should be checked and the papers returned to the students for correction and filing in their workbooks.

CAPACITORS

DESIRED RESULTS:

To acquaint the apprentice with construction, installation, use, markings, and protection of capacitors needed for industrial use.

MATERIALS:

1. A C Supply, meters and oscilloscope
2. 100 W. lamp, 10 and 5 mfd capacitors, switches
3. a. 16 mm. sound film - Capacitance - U. S. Navy - Castle No. 15402
   b. 35 mm. - Filmstrip - Capacitive Reactance - U. S. Navy, Castle No. SN648
4. Samples: Industrial Capacitor & Motor Capacitor

REFERENCES:

1. <u>American Electricians' Handbook</u>, pages 4-126 thru 130
2. <u>Basic Electricity</u>, pages 3-93 thru 105
3. <u>National Electrical Code</u>, Article 460

INTRODUCTION:

Practically all electrical apparatus is composed of a combination of resistors or coils. Some industrial equipment such as capacitor motors, capacitor banks, and automatic switchgear use capacitors. Many kinds of capacitors are used in electricity and electronics. In order to choose the best type for a particular job, you should know how they are made and operate. You should be familiar with the symbols used to indicate certain special types of capacitors. Capacitors consist of two plates of electricalconducting material such as aluminum or tin, separated by an insulating material called the "dielectric", such as air, waxed paper, mica, glass, etc.

PRESENTING THE LESSON:

I. The meaning of capacitance

  A. Physical construction of a capacitor

    1. Two conductors with insulation between them

  B. Characteristics of a capacitor

    1. Will not pass current

    2. Will hold a current

  C. Demonstration of the action of a capacitor

  (show diagram) and set up circuit

Test 1 - Close the switch and note the ammeter reading. Instantaneous current indication is followed by zero reading.

Test 2 - Open the switch and connect a suitable scale voltmeter to the terminals of the capacitor about one minute after the switch is opened. The voltmeter will read instantaneously and fall to zero as the charge is absorbed by the meter.

II. Measurement of Capacitive Reactance Effect

A. Demonstrate the effects of capacitive reactance in a lighting current.

Test 1 - Insert a capacitor of about 10 mfd capacity in the circuit. Note the brilliancy of the lamp.

Test 2 - Replace the 10 mfd capacitor with 5 mfd capacity. Note the brilliancy of the lamp. Current decreases with a decrease of capacity. Reactance effect increases with decrease of capacity.

B. Review the characteristics of capacitive reactance .

1. Review the formula for capacitive reactance.
2. Calculate the reactance of each capacitor used in the demonstration.
3. Calculate the current for each demonstration.

III. Effect of the Capacitor on Voltage - Current Relationship

A. Connect a cathode ray oscilloscope in the circuit of a capacitor which is across an AC line.

IV. Visual Aids

A. Show samples of models of an industrial capacitor and a motor capacitor.

B. Show the films. Discussion of the films.

APPLICATION:

Have the students complete the assignment questions based on the NEC, Article 460.

CHECKING AND FOLLOW-UP:

After checking the answers, return the papers to the students for corrections and filing in their notebooks.

HAZARDOUS LOCATIONS

DESIRED RESULTS:

1. To acquaint the student with the three classes of hazardous locations and the general type of wiring permitted in each place.

2. To be able to recognize a hazard and develop the ability to classify the hazard involved.

REFERENCES:

1. American Electricians' Handbook, pages 9-180 & 181
2. Local Electrical Codes and Ordinances
3. National Electrical Code, Articles 500 and 510
4. National Electrical Code & Blueprint Reading, Graham, Unit 5, p. 121 ff

INTRODUCTION:

The assigned material for the next lessons deals with wiring in areas where there is danger of explosion or fire, resulting from operation of the electrical installation. The CODE breaks down the various types of hazardous locations into three classes. Each of these three main divisions is subdivided into two smaller divisions. Various types of wiring and equipment have been specified for the different kinds of hazards. Class I deals with activities in which fire or explosion may result from gases or vapors. Class II deals with dusts and Class III is reserved for combustible fibers. There are two small divisions under each class. In the first section, the particular danger is imminent at any or all times during the normal course of operation. In the second section, the danger is not believed present under ideal conditions. It is likely to arise from a reasonably foreseeable accident.

PRESENTING THE LESSON:

First, the students should review the particular kinds of hazards covered by the three main divisions and the general type of wiring permitted in each location.

Second, the detailed requirements for each sub-class should be carefully read.

The main benefits to be derived from this study are the ability to recognize a hazard and the ability to decide upon a rough classification of the hazard involved. After the wireman has accomplished this much, he should then study the more detailed rules concerning installation.

DISCUSSION ITEMS:

1. What is the principle of operation of a dielectric point spray unit? What precautions would you suggest for preventing spark-over?

2. In a booth where lacquers are sprayed on small machine parts, which is the greater hazard, explosion or fire?

3. A motor is installed in the basement of a three-story garage building. This motor drives a blower which draws gasoline fumes out of the garage through a sheet-metal duct system to the outside of the building.

    a. What type of induction motor is required for the operation?

    b. Suppose the blower were installed on the roof instead of in the basement. Would this change in location after you reply?

4. Gasoline in closed containers is stored in a large room. Through the upper part of the room, a 2-inch pipe carries high-test gasoline from a pump located outside the room to a tank located on the other side of the room.

    a. What type of hazard exists in the room?

5. A certain industrial building has quantities of dry dust suspended in the air.

    a. What class of hazard does this constitute?

    b. Can you suggest a simple expedient for reducing the hazard inside the building?

VISUAL AIDS:

Show 16 mm Film--"Preventing Fires through Electrical Safety" Employers Mutual Liability Insurance Co. of Wisconsin, Wausan, Wis.

APPLICATION:

Have the students answer questions on the Assignment Sheet.

CHECKING AND FOLLOW-UP:

Check the answers and return the sheet to the student to be placed in their workbooks.

CLASS I INSTALLATIONS

(HAZARDOUS LOCATIONS)

DESIRED RESULTS:

To acquaint the apprentice with the safety devices used in hazardous locations called Class I.

REFERENCES:

1. National Electrical Code, Article 501
2. National Electrical Code and Blueprint Reading, Graham, Unit 5, page 121 ff; b/p page 123

INTRODUCTION:

The next three lessons are concerned with locations that, because of their nature, call for higher standards with respect to materials or for methods of installation, than are thought necessary in the general run of electrical wiring.

Class I deals with activities in which fire or explosion may result from gases or vapor.

METHODS OF REDUCING HAZARDS:

1. Placing seals between safe areas and perilous ones. Seal fittings are inserted in conduits to arrest sparks, using a suitable compound to accomplish the purpose. In some areas, where non-conductive dusts are present, a length of conduit may serve in place of the fitting.

2. Sparking devices are sealed off from runs of conduit which enter them. In some cases, the safety rule is met by placing sparking contacts in an oil bath or a hermetically sealed chamber.

3. Rigid conduit or mineral-insulated cable are prescribed as the only acceptable wiring methods in the majority of hazardous locations. Continued grounding must be assured by means of bonding and not by locknuts and bushings. Fittings must be explosion proof, dust-ignition proof, depending upon the nature of the particular hazard.

4. Motors within the scope of Class I, Division I, must be explosion proof. Under Class I, Division 2, standard motors can be used if they have no sliding contacts. Motors within Class II and III must be totally enclosed or pipe-ventilated.

   Extension cords are prohibited in certain occupancies, and allowed in others only if approved for the particular service.

ESPECIALLY LISTED OCCUPANCIES:

1. In <u>Commercial Garages</u>, the NEC requires that plug receptacles within 18 inches of the floor be treated as subject to Class I, Division 2 requirements.

2. Unventilated Garage Pits, Aircraft Hangars, Gasoline Dispensing Island are devoted as Class I, Division 1, to a height of 4 feet above grade.

3. Finishing Processes, where paints, lacquers, or other flammable coatings are applied by spraying, dipping, brushing, or similar means, must be carried out under prescribed safeguards for electrical wiring and equipment. Of particular interest here, are electrostatic units which incorporate high-voltage transformers.

4. Anesthetizing Locations of Hospitals are deemed to be Class I, Division 1 to a height of 5 feet above the floor. Gas Storage Rooms are in the same designation.

   Special Rules apply to lighting and surgical equipment within the operating room.

5. Theatres and Motion Picture Studios are given adequate consideration in the NEC.

   Fires may occur suddenly from temporary wiring in connection with stage scenery, projection room equipment, arc lamps, and other portable devices.

6. Radio or Television Studios and Receiving Stations must be guarded from danger offered by high-voltage electronic wiring systems or equipment.

VISUAL AIDS:

Appropriate Films or Models

APPLICATION:

The students answer the questions on the assignment sheet.

CHECKING AND FOLLOW-UP:

Check the answers on the sheets and return to the students for correction and placing in workbooks.

CLASS II INSTALLATIONS

(HAZARDOUS LOCATIONS)

DESIRED RESULTS:

To acquaint the apprentice with the safety devices used in hazardous locations, called Class II.

REFERENCES:

1. National Electrical Code, Article 502
2. National Electrical Code and Blueprint Reading, Graham, Unit 5, See p. 125 b/p

INTRODUCTION:

If approved electrical devices of high quality are used, but installed in a haphazard fashion and with no regard to the relation of one device to the other, the total load, or the hazardous operating conditions, the complete installation may be dangerous. It is necessary that standardized methods be set up which have been found in practice to be safe.

These standardized methods that experiment and experience have shown to be correct are set down in a form which has come to be known as the National Electrical Code. "NEC"

Class II is concerned with the possibility of fire or explosion from dusts.

THE PURPOSES OF THE CODE:

It is well to review the purposes of the CODE as outlined in the following quotation from the INTRODUCTION of the Code.

a. The purpose of this Code is the practical safeguarding of persons and of buildings and their contents from hazards arising from the use of electricity for light, heat, power, radio, signaling, and for other purposes.

b. This Code contains basic minimum provisions considered necessary for safety. Compliance therewith and proper maintenance will result in an installation, essentially free from hazard, but not necessarily efficient, convenient, or adequate for good service or future expansion of electrical uses.

c. The Code is not intended as a design specification or an instruction manual for untrained persons.

The Code is revised from time to time but not necessarily at regular intervals. Usually the Code is reissued every two or three years. Each new Code carries changes in the rules as compared with the previous issue. New Sections or even New Articles are added from time to time.

Give examples of installations that must be made in Dust areas. Show how the fittings must be explosion-proof, dust-ignition proof, or dust tight, depending upon the nature of the hazard.

APPLICATION:

The students will answer the questions on the Assignment Sheet for this lesson.

CHECKING AND FOLLOW-UP:

Check the answers and return the sheets to the students for correction and placing in their workbooks.

CLASS III INSTALLATIONS

(HAZARDOUS LOCATIONS)

DESIRED RESULTS:

To acquaint the apprentice with the safety devices used in hazardous locations, called Class III.

REFERENCES:

1. National Electrical Code, Article 503
2. National Electrical Code & Blueprint Reading, Graham, b/p, page 126

INTRODUCTION:

Class III deals with activities in which fire or explosion may result from combustible fibers.

Electricity is a powerful force. Under control, it safely performs an endless variety of work for us; uncontrolled, it can lead to harm and damage. It is under control when the right kinds of materials are installed in the right way. It becomes uncontrolled when the wrong kinds of materials are used or when the right kinds of materials are wrongly installed.

Uncontrolled electric power can cause fires that can kill people and lead to a multitude of costly results. When these things happen, individuals and companies are the greatest sufferers. Insurance companies also suffer losses, which can result only in higher rates which individuals are called upon to pay. Insurance companies have led the way in setting up of minimum standards of quality in electrical materials as well as uniform methods of installation.

PRESENTING THE LESSON:

In the state of North Carolina, there are many examples of mills that store, process, and weave cloth that have hazardous locations that may cause fibers to burn. Locations in which ignitable fibers are merely stored or handled, other than in the actual process of manufacture are assessed to Class III, Division 2. This classification applies mostly to warehouses in which manufactured goods, materials in bales, are held for shipment to consumers.

Study the Article 503 of the NEC for this assignment. Help the students to interpret the rules set up for wiring methods in the areas where combustible fibers are stored or processed.

APPLICATION:

Have the students to answer questions on the assignment sheet for this lesson.

CHECKING AND FOLLOW-UP:

The answers will be checked and the sheets will be returned to the students for placing in the workbooks.

COMMERCIAL GARAGES, REPAIR AND STORAGE

RESIDENTIAL STORAGE GARAGES
(Special Occupancies)

DESIRED RESULTS:

To become acquainted with the National Fire Protection Association Standards in certain hazardous locations:

a. Used for service and repair operations in connection with self-propelled vehicles (automobiles, busses, trucks, tractors, etc.) in which volatile flammable liquids or gases are used for fuel or power.

b. Used for a residential storage garage of not more than three vehicles.

REFERENCES:

1. National Electrical Code, Articles 511 & 512
2. National Electrical Code & Blueprint Reading, Graham, B/p, page 127

INTRODUCTION & PRESENTATION:

The provisions of this article shall apply to occupancies which may be hazardous because of atmospheric concentrations of explosive gases or vapors, or deposits of materials which may be readily ignitable.

The general rules of this Code shall apply to the installation of electrical wiring and equipment in occupancies within the scope of this article except as such rules are modified. Where unusual conditions exist, the Code enforcing authority shall judge with respect to the application of specific rules. The Code enforcing authority shall be familiar with National Fire Protection Association standards applying to occupancies included within the scope of this article.

a. Commercial Garages, Repair and Storage. This classification shall include locations used for service and repair operations in connection with self-propelled vehicles in which volalite flammable liquids or gases are used for fuel or power. In these locations there are or may be more than three such vehicles stored at one time.

b. Residential Storage Garages. This classifies a residential storage garage as a building or room in which not more than three vehicles of the types described may be stored. The building will not normally be used for other than minor repairs or service operations on such stored vehicles.

Have the students study the articles assigned and give individual help where needed.

APPLICATION:

Have the students complete the answers to the questions on the Assignment Sheet for this lesson.

CHECKING AND FOLLOW-UP:

Check the answers to the questions and return them to the students for correction and placing in their workbooks.

AIRCRAFT HANGARS

(Special Occupancies)

DESIRED RESULTS:

To acquaint the student with the classification that includes locations used for storage and servicing of aircraft.

REFERENCES:

1. National Electrical Code, Article 513, Section 5115
2. National Electrical Code & Bluepring Reading, Graham, B/p, page 127

INTRODUCTION:

Aircraft hangars are assigned similar regulations as commercial garages, but stricter protection. This classification shall include locations used for storage and servicing of aircraft in which gasoline, jet fuels, or other volatile flammable liquids are used.

PRESENTING THE LESSON:

Call attention to the following areas and have the students read each subject in the Code reference.

a. Hazardous Areas
b. Wiring and Equipment within Hazardous Areas
c. Wiring not within Hazardous Areas
d. Equipment not within Hazardous Areas
e. Stanchions, Rostrums, and Docks
f. Approved Seals
g. Aircraft Electrical Systems
    (1) De-energizers
    (2) Energizers
h. Aircraft Battery
    (1) Charging and control Equipment
i. Mobile Servicing Equipment
j. Grounding

APPLICATION:

The students will answer the questions on the Assignment Sheet.

CHECKING AND FOLLOW-UP:

Check the answers to the questions, return the sheets to the students for corrections and placing in their workbooks.

GASOLINE DISPENSING AND SERVICE STATIONS

(Special Occupancies)

DESIRED RESULTS:

To acquaint the apprentice with the classification that includes locations used for Gasoline Dispensing and Service Station work.

REFERENCES:

1. National Electrical Code, Article 514, Section 5120
2. National Electrical Code & Blueprint Reading, Graham, page 128

INTRODUCTION AND PRESENTATION:

Space in the immediate vicinity of a gasoline dispensing island is denoted as Class I, Division 1, to a height of 4 feet above grade. Bulk storage plants for gasoline are subject to comparable restrictions.

This classification shall include locations where gasoline or other volatile flammable liquids are transferred to the fuel tanks of self-propelled vehicles. Dispensing islands are areas extending 18 inches in all directions from the base of the pump. Where an individual pump or dispensing device is not mounted on an elevated island, an area extending 18 inches in all directions from the base of the pump shall be considered to be in dispensing island.

Call attention to the following areas and have the students read the restriction for each subject in the code reference.

a. Hazardous Areas
b. Wiring and Equipment within and not within Hazardous Areas
c. Circuits Disconnects
d. Sealing
e. Grounding

APPLICATION:

Have the students answer the questions provided on the Assignment Sheet for this lesson.

CHECKING AND FOLLOW-UP:

After checking the answers, return the sheets to the students for corrections and placing in their workbooks.

BULK STORAGE PLANTS
(Special Occupancies)

DESIRED RESULTS:

To acquaint the apprentice with the classification that includes locations where gasoline or other volatile flammable liquids are stored in tanks of one carload or more.

REFERENCES:

1. National Electrical Code, Article 514, Section 5125
2. National Electrical Code & Blueprint Reading, Graham, page 128

INTRODUCTION AND PRESENTATION:

Bulk storage plants for gasoline are subject to comparable restricitions as Aircraft Hangars. The products stored in these large tanks are usually distributed by tank truck.

Call attention to the following areas and have the students read the rules for each subject in the Code reference.

a. Hazardous Areas
b. Wiring and Equipment within and above Hazardous Areas
c. Underground Wiring
d. Sealing
e. Gasoline Dispensing
f. Grounding

APPLICATION:

Have the students answer the questions provided on the Assignment Sheet for this lesson.

CHECKING AND FOLLOW-UP:

After checking the answers, return the sheets to the students for correction and placing in their workbooks.

FLAMMABLE ANESTHETICS

(Special Occupancies)

DESIRED RESULTS:

To acquaint the apprentice with the classification that includes locations where combustible anesthetics are or may be administered to patients in hospitals.

REFERENCE:

1. National Electrical Code, Article 514, Section 5135

INTRODUCTION AND PRESENTATION:

Combustible anesthetics are gases or vapors which may form flammable or explosive mixtures with air, oxygen or nitrous oxide.

Anesthetizing locations are areas in hospitals in which combustible anesthetics are or may be administered to patients. Such locations will include any area that may be used for the above purpose as operating rooms, delivery rooms, anesthesia rooms, any corridors or utility rooms. Recovery rooms are not classed as anesthetizing locations unless used for the purpose.

Call attention to the following areas and have the students read the Code references for each subject:

a. Hazardous Areas

Anesthetizing locations of hospitals are deemed to be Class I, Division 1 to a height of 5 feet above floor level.

b. Wiring and Equipment With Hazardous Areas

In hazardous areas, all fixed wiring and equipment including lamps and appliances shall conform to the requirements. All such equipment shall be specifically approved for the hazardous atmospheres involved.

c. Wiring and Equipment Above Hazardous Areas

Wiring above hazardous areas shall be installed in metal raceways or Type MI cable. Equipment which may produce sparks such as lamps, switches, generators, motors, etc. should be totally enclosed type or provided with suitable guards.

d. Sealing

Approved seals shall be provided in conformance with the Code.

e. Circuits in Anesthetizing Locations

Each circuit shall be controlled by a switch having a disconnecting pole in each circuit conductor supplied from an ungrounded distribution system. This circuit shall be isolated from any distribution system supplying areas other than anesthetizing locations by special transformers.

f. Low Voltage Equipment and Instruments

Electrical apparatus and equipment used within hazardous area, and which has current-carrying elements or which is frequently in contact with the bodies of persons, shall be designed to operate at 8 volts or less unless it is entirely surrounded by a metallic casing.

g. Other Equipment

Suction, pressure, or other equipment located or used within hazardous area shall be approved for Class I locations. X-ray equipment operated in these areas shall be provided with approved means for preventing accumulation of electrostatic charges.

h. Grounding

In any hazardous area, all metallic raceways, and all non-current carrying metallic portions of fixed or portable equipment (except the 8 volts) should be grounded.

APPLICATION:

The students will answer the questions on the Assignment Sheet for this lesson.

CHECKING AND FOLLOW-UP:

After checking the answers, return the sheets to the students for corrections and placing in their workbooks.

FUNDAMENTALS OF MOTOR CONTROL

DESIRED RESULTS:

To study the meaning of motor control and the basic differences in manual, semiautomatic, and automatic controls.

REFERENCES:

1. American Electricians' Handbook, pages 7-124 to 7-128
2. A-C Motor-Control Fundamentals, pages 1-9

INTRODUCTION:

Much of the inside wireman's work is concerned with motors and controllers. It is essential that he acquire a general knowledge of motor types, controls, and other characteristics.

With the advent of mass production, down came the line shaft and the electric motors were installed on individual machines. This change allowed more frequent and more rapid starts, stops, and reversals of the machine. Once the drive motor was put on the machine, with the sole function of operating one piece of equipment, it was possible to introduce some automatic operations.

Now, in our industrial plants, the operator sets up the original process and the operations are carried out automatically. These automatic operations are dependent upon motor and machine control. Thus, the modern machine consists of three divisions: 1. The machine, 2. The motor, and 3. The controls.

PRESENTING THE LESSON:

A. Discussion:
   1. What is the meaning of motor control?
   2. What is an electric controller?
   3. Discuss the basic differences in manual, semiautomatic, and automatic controls.

B. Demonstration:
   1. Show the construction and demonstrate how several controllers operate.
   2. Visit the machine shop and observe the work of motor controls on several machines.

APPLICATION:

Have the student complete the assignment sheets for this lesson.

CHECKING AND FOLLOW-UP:

Check the answers and return the papers for correction and placing in their notebook.

CONTROL OF MOTOR STARTING

DESIRED RESULTS:

To acquaint the student with the basic principles and general types of automatic motor controls in a simplified manner.

REFERENCE:

1. A-C Motor-Control Fundamentals, pages 11-32

INTRODUCTION:

The subject of motor controllers is of great importance to the industrial electrician. He is often called upon to connect, disconnect or troubleshoot them. It is necessary that he have a sound knowledge of the principles upon which they operate.

The most common of the controllers is the magnetic switch or across-the-line starter. This starter, combined with pilot devices, can give full protection to the motor and be fully automatic in operation. The student should make sure he understands the purpose of each component. Circuits containing plugging relays should be analyzed and the essential ones memorized. It is not advisable to try memorizing the complicated circuits of reversing or multi-speed motors. However, the material relating to these components should be read carefully.

PRESENTING THE LESSON:

A. Discuss the following types of motor starting with the use of diagrams:
   1. Full-voltage starting
   2. Reduced-voltage starting
   3. Starting Squirrel-cage motors
   4. Starting Wound-rotor motors
   5. Starting Synchronous motors

B. Discuss the selection of starting controllers:
   1. Name the two types of starting control.
   2. How many types of protection are there for motors?
   3. Do the running conditions of the motor affect the type of control to be used on a motor?
   4. What is the difference between an automatic and a semiautomatic controller?
   5. Summarize the factors needed to be considered when selecting starting controllers.

C. Problem for illustration:
   It is desired that four motors start in the sequence 1, 2, 3, and 4, the start button being depressed only once to establish the sequence of operations. A second requirement is that if one motor stops because of operation of its overload device, or for other reasons, the others will continue to operate. Standard magnetic switches are to be used. Draw the diagram of the circuit on the chalkboard.

APPLICATION:

The students will complete the assignment sheets for this lesson.

CHECKING AND FOLLOW-UP:

Check the answers and return the sheets for correction and placing in notebooks.

CONTROL COMPONENTS

DESIRED RESULTS:

To give the student an insight into the many variations in devices used to control the functions of motors.

REFERENCES:

1. A-C Motor-Control Fundamentals, pages 33-70
2. Catalogs on Control Components

INTRODUCTION:

The selection of control components is carefully made after it has been decided what functions of control are needed for a machine. It should be remembered that a motor can perform only as well as the components in its control circuit. The fact that a certain component is a high quality product does not necessarily mean that it will perform well in a particular circuit. The component must be selected to fit the motor to be controlled and the function to be performed.

PRESENTING THE LESSON:

Discussion Questions:

1. What functions of control are intended to be performed by switches and breakers?
2. Compare a contactor and an across-the-line motor starter.
3. What is meant by a relay? What is required to operate a voltage relay?
4. What is meant by the terms pull-in current, drop-out current, and differential used in connection with current relays.
5. Name two uses for a frequency relay. What are the two basic methods of delaying the closing or opening of the time-delay relays.
6. What is the chief advantage to using an automatic motor starter instead of a manual motor starter? What is meant by clapper-type and solenoid type contact arrangements?
7. Name the three basic magnetic shapes used on modern motor starters.
8. What is the basic difference between a motor starter and a motor controller?
9. What is the common name for a manual reduced-voltage starter? Name three basic methods of obtaining reduced-voltage starting.
10. What is meant by the following:
    a. Definite time control
    b. Current-limit control
    c. Sequence speed control
    d. Selective speed control
    e. Automatic speed control
    f. Reversing starter

APPLICATION:

The students should complete the assignment sheets.

CHECKING AND FOLLOW-UP:

Check the answers with the Instructor's Answers. Help those that have trouble finding the correct answers.

PILOT DEVICES

DESIRED RESULTS:

1. To acquaint the student with the basic types of control components.
2. The student should be able to look at a strange control device and analyze its function both mechanically and electrically.

REFERENCE:

1. A-C Motor Control Fundamentals, pages 71-87

INTRODUCTION:

All components used in motor-control circuits are classed as either primary control devices or pilot control devices. A primary control device connects the load to the power line, such as a motor starter or controller; they may be manual or automatic. Pilot control devices are those which control or regulate the primary control devices. Pilot devices are such components as push buttons, float switches, pressure switches, limit switches, and thermostats. We will cover the most common and frequently used types in this lesson.

PRESENTING THE LESSON:

1. Describe various pilot devices and their uses. The requirements of pilot devices vary greatly with their function and their proposed use.
2. Demonstrate samples of pilot devices available. Show how they are installed and ways to "trouble-shoot" when the unit will not function.
3. Invite a specialist that deals with motor controls and pilot devices to give a demonstration to the class.
4. Use Review Questions, pages 86-87 of A-C Motor-Control Fundamentals for discussion.

APPLICATION:

Have the students complete the questions on the Assignment Sheets.

CHECKING AND FOLLOW-UP:

Check the answers on the Assignment Sheets and return to the students for correction.

CONTROL-CIRCUIT DIAGRAMS

DESIRED RESULTS:

To learn the basic symbols that are used on prints to express the meaning and purpose of the circuit.

REFERENCE:

1. A-C Motor-Control Fundamentals, pages 89-105.

INTRODUCTION:

Until the electrician masters the control diagrams, he will be dependent upon someone else for most of his information. This lesson deals with the written language of control and control circuits. It will be necessary for the apprentice to learn the basic symbols in order to understand the details of the schematic control diagrams. When we learned to read English, we first learned the 26 letters of the alphabet that are used to form all the words and sentences. The same thing is true in learning a graphical language. There are only a few basic symbols that are used to express the meaning and purpose of the control circuit.

PRESENTING THE LESSON:

1. Use Fig. 5-1, page 91 for a drill on recognizing the basic symbols.
2. The control diagram is the written language of control circuits and it takes several different forms to fit the needs. Study the three general types of control diagrams used in the text.
3. Show how a schematic diagram is developed from a wiring diagram. Wiring diagram from the schematic.
4. If possible, have available control-circuit diagrams used in the local area for review by the class.
5. Discuss the adding of circuit elements, such as a limit switch, float switch, or push button to an existing circuit.
6. Summarize the use of schematic and wiring diagrams as presented in this lesson.

APPLICATION:

Have the students complete the questions on the Assignment Sheets.

CHECKING AND FOLLOW-UP:

Check the sheets and return to the students for correction and filing.

DEVELOPMENT OF CONTROL CIRCUITS

DESIRED RESULTS:

1. To acquaint the student with the principles involved in the development of control circuits.
2. To have the student practice the development of a circuit adding one function at a time.

REFERENCE:

1. A-C Motor Control Fundamentals, pages 107-131

INTRODUCTION:

In the development of control circuits, they are seldom drawn or designed as a complete unit. They are developed one step at a time, adding only the components necessary to perform that function. The designer of a circuit should have all of the control functions in mind when he starts. He should analyze the circuit after each addition to check that it does not interfere with previous operations and that it will perform the function intended. The greatest danger in developing control circuits is to attempt to draw a complete circuit at one time. Therefore, it cannot be overstressed that the step-by-step method of developing control circuits will lead to very few errors. It will save many hours of "trouble-shooting" trying to find out why a circuit did not function after it was wired.

PRESENTING THE LESSON:

1. Discuss the basic two-wire and three-wire circuits in the development of control circuits.
2. Using a schematic diagram, show the simplest method for the development of a control circuit by starting with the coil and the overloads.
3. Review with the students the development of illustrated circuits No. 1-8 given in the text.
4. Using the review questions, assign the problems for the students to develop. One problem for each student or one problem for two students to work together.

APPLICATION:

Have the students complete the problems on the Assignment Sheet.

CHECKING AND FOLLOW-UP:

Check the assignment sheets and return to the student for correction and placing in their workbooks.

INSTRUCTIONAL MATERIALS

Recommended Films

Lesson No.	Third Year
C-1	Alternating Current, 35 mm slide film Jam Hardy Corp.
C-3	"Inductance in A. C. Circuits", 16 mm Sound Production No. MN 8018-B ($16.75--List Price) Norwood Studios, inc., Film Division 926 New Jersey Ave., N.W. Washington, D. C.
C-5	"Capacitance in A. C. Circuits" Production No. MN 8018-B ($12.50--List Price) Norwood Studios, Inc.
C-9	"A. C. Series Circuits" Production No. MN 8018-C ($11--List Price) Norwood Studios, Inc.
C-10	"A. C. Parallel Circuits" Production No. MN 8018-D ($11--List Price) Norwood Studios, Inc.
C-11	1. "Capacitance", 16 mm Sound Castle Film No. 15402 U. S. Navy 2. "Capacitance Reactance" Castle Film No. SN648 U. S. Navy

NOTE: These are suggested films; any other appropriate film may be used with specific topics. Be sure to check the "Free Film" catalogs for the same titles.

Textbooks

All textbooks listed for the First and Second years plus the following:

	(Approx.) List Price
<u>A. C. Motor Control Fundamentals</u> by R. L. McIntyre McGraw-Hill Book Co.	$ 5.95
National Electrical Code and Blueprint Reading by K. C. Graham American Technical Society	$ 4.90

VT 003 629

VT 003 629
Basic Electricity Series, No. C (Third Year), Apprentice Training in Electrical Work, Related Instructional Material, Assignment Sheets and Information Sheets.

Hedinger, Howard E.
North Carolina State Board of Education, Raleigh
Pub Date - Aug67
MF AVAILABLE IN VT-ERIC SET 89p.

*STUDY GUIDES, *TRADE AND INDUSTRIAL EDUCATION, *ELECTRICIANS, *ELECTRICITY, POST SECONDARY EDUCATION, TESTS, *APPRENTICESHIPS,

This study guide, the third of a four-unit series, is for individual student use in acquiring technical information in the third year of the related technical phase of post-secondary electrician apprenticeship training. It was developed by a curriculum committee of subject matter specialists and the educational committee of the National Electrical Contractors of North Carolina, tested on a small group, and used in apprenticeship programs. Assignment and information sheets for 28 lessons cover fundamentals of A.C. electricity, the National Electrical Code, in terms of installation in hazardous areas, and motor controls. They contain textbook references and problem exercises. The teacher of the 144-hour course should be a journeyman tradesman, and the students should be 18 years old and employed as apprentices in an electrical construction trade. Supplementary materials include unit tests for approximately every six weeks and a final examination. Correlated lesson plans for the instructor are given in VT 003 626. Documents of the series are listed as VT 003 624 through VT 003 631. (HC)

RELATED INSTRUCTIONAL MATERIAL

ASSIGNMENT SHEETS AND INFORMATION SHEETS

BASIC ELECTRICITY

SERIES NO. 8
(Third Year)

APPRENTICE TRAINING
IN
ELECTRICAL WORK

JULY 1964
Revised August, 1967

Prepared by
Howard E. Hedinger

CURRICULUM LABORATORY
DEPARTMENT OF COMMUNITY COLLEGES
STATE BOARD OF EDUCATION
RALEIGH, NORTH CAROLINA

MEMORANDUM

TO: The ERIC Clearinghouse on Vocational and Technical Education
The Ohio State University
980 Kinnear Road
Columbus, Ohio 43212

FROM: (Person) Roger G. Worthington (Agency) Department of Community Colleges

(Address) Education Building, Raleigh, North Carolina

DATE: September 7, 1967

RE: (Author, Title, Publisher, Date) Hedinger, Howard E. "Basic Electricity For Apprentices, Series C - Third Year Assignment and Information Sheets," Curriculum Laboratory, Dept. of Community Colleges, July 1964.

Supplementary Information on Instructional Material

Provide information below which is not included in the publication. Mark N/A in each blank for which information is not available or not applicable. Mark P when information is included in the publication. See reverse side for further instructions.

(1) Source of Available Copies:
Agency ERIC Only, except North Carolina Institutions
Address
Limitation on Available Copies Price/Unit
(quantity prices)

(2) Means Used to Develop Material: National Electrical Contractors for
Development Group Curriculum committee / Carolinas - Educational committee
Level of Group State and Dept. supervisor
Method of Design, Testing, and Trial Designed by subject matter specialists and tested on a small group; has been used with 1,200 apprentices per year for 3 years.

(3) Utilization of Material:
Appropriate School Setting Vocational (Apprentice Training)
Type of Program Post-high; Apprenticeship.
Occupational Focus A specific job (electrical construction)
Geographic Adaptability N/A
Uses of Material Course and lesson planning and student study guides.
Users of Material Instructor and student

(4) Requirements for Using Material:
Teacher Competency Journeyman instructor
Student Selection Criteria 18 year old, male (mostly), post-secondary educ. to become a journeyman electrician
Time Allotment 144 hours per year (minimum)

Supplemental Media -- Textbooks - see list
Necessary X)
Desirable ___) (Check Which)

Describe Basic Electricity, VanValkenburgh & All, Hayden Book Co.; Amer. Electricians' Handbook, Croft, McGraw-Hill Book Co.; Basic Mathematics
Source (agency) / by Singer, McGraw-Hill Book Co.; National Electrical Code
(address) / National Fire Protection Assoc. 60 Batterlymarch St., Boston, Mass.

ACKNOWLEDGMENTS

Questions and problems for the Lesson Topics in this workbook were prepared and authorized for use by:

W. F. Humbert, III
Instructor for Electrical Apprentices
Winston-Salem-Forsyth County
Technical Institute

The Instructor's Manual, Information and Orientation Sheets keyed to the Assignment Sheets were developed by:

Howard E. Hedinger
Curriculum Laboratory

PREFACE

The materials in this publication have been prepared to provide specific assignments for studying related topics necessary in the training of electrical apprentices. An effort was made to develop the schedule for the instructors to follow as the apprentice progresses with his training. It will also enable the apprentice to know what skills and knowledges will be required of him. One objective of this program is to aid the instructor and employer in providing experiences necessary to develop a competent worker in the electrical field.

This workbook includes assignment sheets and information sheets for the electrical apprentice to use in searching out related information. They contain textbook references, problems to solve and key sentences to complete, diagrams to draw, and blueprints to consult. The apprentice should study the assigned references before he attempts to answer the questions or solve the problems.

In actual use of these lessons, instructors should feel free to modify their application of the material to conform with local needs. For example, there may be certain sections of the Code to teach because the apprentices are working with special installations. Thus, the instructor will prepare additional materials to use with the course. In other classes, the instructor may need to spend more time on topics dealing with mathematics than with blueprint reading. In any event, the minimum class time for related material is 144 hours per year. It is sincerely hoped that the assignment sheets are used correctly, so that apprentices can gain maximum benefits from their related studies.

A. J. Bevacqua, Coordinator
Curriculum Laboratory
Department of Community Colleges

H. E. Hedinger
Curriculum Specialist

ASSIGNMENTS

THIRD-YEAR APPRENTICE TRAINING PROGRAM

BASIC ELECTRICITY

THIRD YEAR
SERIES - C

LESSON	PAGE NO.	LESSON TOPICS	ASSIGNMENT DATE
C-1	1	ALTERNATING CURRENT	
C-2	5	RESISTANCE IN A.C. CIRCUITS	
C-3	7	INDUCTANCE	
C-4	9	INDUCTIVE REACTANCE	
C-5	11	CAPACITANCE (in A.C. circuits)	
C-6	15	CAPACITIVE REACTANCE	
C-7	17	PRINCIPLES OF TRIGONOMETRY	
C-8	19	VECTORS	
C-9	21	SERIES A.C. CIRCUITS	
C-10	25	PARALLEL A.C. CIRCUITS	
C-11	29	POWER IN A.C. CIRCUITS	
C-12	31	POWER FACTOR CORRECTION	
C-13	33	CAPACITORS	
C-14	35	HAZARDOUS LOCATIONS	
C-15	37	CLASS I - INSTALLATIONS	
C-16	39	CLASS II - INSTALLATIONS	
C-17	43	CLASS III - INSTALLATIONS	
C-18	45	COMMERCIAL & RESIDENTIAL GARAGES, REPAIR & STORAGE	
C-19	47	AIRCRAFT HANGARS	
C-20	49	GASOLINE DISPENSING AND SER. STATIONS	
C-21	51	BULK STORAGE PLANTS	
C-22	53	FLAMMABLE ANESTHETICS	
C-23	55	FUNDAMENTALS OF MOTOR CONTROL	
C-24	57	CONTROL OF MOTOR STARTING	
C-25	61	CONTROL COMPONENTS	
C-26	65	PILOT DEVICES	
C-27	67	CONTROL-CIRCUIT DIAGRAMS	
C-28	69	DEVELOPMENT OF CONTROL CIRCUITS	

NAME ______________________________

DATE ______________________________

Lesson C-1

Alternating Current

REFERENCE

1. Croft's American Electrician's Handbook, Pages 1-40 - 1-44, Sec. 112-129, 1-45, Sec. 134.
2. Basic Electricity, Pages 3-1 - 3-21, 3-31 - 3-34, 3-43 - 3-57, and 3-77 - 3-92.

PROBLEMS

1. An alternating current or voltage is one which is ____________ at ____________ intervals.
2. Alternating voltages and currents follow a curve known as the ____________ law (curve).
3. A ____________ is a complete set of values through which an ____________ current passes.
4. Frequency of an alternating current is the ____________ of cycles completed in ____________ second.
5. One cycle is equal to ____________ electrical degrees.
6. Phase is a term used to express ____________.
7. Two phase current is two different ____________ ____________ 90 degrees out of phase.
8. Three-phase current is ____________ different alternating currents ____________ degrees out of phase.
9. The maximum value of alternating current or voltage is ____________ ____________ ____________ ____________.
10. The average value of alternating current or voltage is ____________ ____________ ____________ ____________ and ____________ times ____________ ____________.
11. The ____________ value of alternating current or voltage is ____________ times ____________ ____________.

NAME ______________________________ Lesson C-1

Alternating Current Page 2

12. Resistance ______________ and ________________ may affect the current in an a-c circuit.

13. List two factors which affect the resistance in an a-c circuit:

(a) ____________________ (b) _________________________

14. Ohms Law applies to a-c circuits containing ________________ only.

15. Voltage and _________________ are in phase in resistive circuits.

16. Average power is equal to product of ______________________________ and ______________________________.

17. Inductance produces _______________ to flow of current and makes the current _____________ the ______________.

18. Pure inductive circuit causes the _____________ to _____________ the _________________ by __________________ degrees.

19. Inductance exists because electric current produces a ____________ field.

20. Unit of inductance is ____________________.

21. Unit of inductive reactance is ____________________.

22. Inductive _______________ is the opposition to alternating current produced by inductance.

23. Magnetic field expanding and contracting with a __________ __________ produces inductance.

24. Capacitance produces _____________ to flow of current and makes the current _________________ the _________________.

25. Pure capacitive circuit causes the ______________ to ______________ the _______________ by ______________ degrees.

26. Unit of capacitance is ______________________.

NAME ______________________________ Lesson C-1

Alternating Current Page 3

27. Unit of capacitive reactance is ________________________.

28. Symbol for inductance is ____________________________.

29. Symbol for capacitance is ____________________________.

30. Symbol for inductive reactance is _______________________.

31. Symbol for capacitive reactance is ______________________.

32. Iron ____ increases inductance.

33. Copper ______________________________________ decreases inductance.

34. List eight items that affect inductance:

(a) ______________________________

(b) ______________________________

(c) ______________________________

(d) ______________________________

(e) ______________________________

(f) ______________________________

(g) ______________________________

(h) ______________________________

35. When are DC circuits affected by capacitance?

36. Capacitors and ____________________________________ are electrical devices which are used to add capacitance to a circuit.

37. Capacitance exists because certain parts of the circuit are able to _________________________ electric charges.

38. What is a capacitor charge?

39. What is a capacitor discharge?

40. What is the frequency of a generator having 12 poles and revolving at 720 RPM?

NAME ______________________________ Lesson C-2

Resistance in A-C Circuits Page 2

13. Resistance is expressed in terms of _________________________.

14. Power factor is expressed in ______________ or _________________.

15. Power factor in a resistive circuit has a value of _________________.

16. Power factor is the ratios of ______________________ of the circuit and ______ of the circuit.

17. Find the power and the power factor of a resistive circuit with impressed voltage of 220-volts and current of 10 amperes.

18. A water heater rated 5000 watts is connected on a 220-volt system. Find the current in the A-C circuit.

NAME ________________________ Lesson C-2

Resistance in A-C Circuits Page 2

13. Resistance is expressed in terms of ____________________.

14. Power factor is expressed in ____________ or ________________.

15. Power factor in a resistive circuit has a value of ______________.

16. Power factor is the ratios of ____________ ____________ of the circuit and ______ of the circuit.

17. Find the power and the power factor of a resistive circuit with impressed voltage of 220-volts and current of 10 amperes.

18. A water heater rated 5000 watts is connected on a 220-volt system. Find the current in the A-C circuit.

NAME ______________________________ Lesson C-3

DATE ______________________________ Inductance

REFERENCE

1. American Electricians' Handbook, Pages 1-23, Sec. 45; 1-44, Sec. 125, 126.
2. Basic Electricity, Pages 3-49 - 3-52.
3. Basic Mathematics, Pages 336 - 339.

PROBLEMS

1. ____________________ is the unit of inductance.
2. ____________________ is the symbol of inductance.
3. What is inductance?
4. What effect does inductance have in an A.C. circuit?
5. Pure inductive circuit causes the current to ________________ the voltage by ______________°.
6. Increase in ________________ of a coil or increase in ________________ affects the inductance in a circuit.
7. ____________________ cone increases inductance.
8. ____________________ cone decreases inductance.
9. List eight factors on which inductance depends.
   (a) ________________________ (e) ________________________
   (b) ________________________ (f) ________________________
   (c) ________________________ (g) ________________________
   (d) ________________________ (h) ________________________
10. As voltage and current increases, inductance __________ the increase.
11. As voltage and current decreases, inductance __________ the decrease.

NAME ____________________________ Lesson C-4

DATE ____________________________ Inductive Reactance

REFERENCE

1. American Electricians' Handbook, Pages 1-23, Sec. 46; 1-44, Sec. 126 & 127.
2. Basic Electricity, Pages 3-61 - 3-64.
3. Basic Mathematics, Pages 340-343.

PROBLEMS

1. Unit of inductive reactance is _________________________.
2. Symbol of inductive reactance is _______________________.
3. Inductance _________________ is the opposition to the flow of changing current due to inductance.
4. In D.C. circuits ____________ _________________ occurs only when current is turned on or off.
5. In 60 cycle A.C. circuits, inductive reactance occurs _______________ times per second.
6. An increase in _______________ or _______________ will increase _________ _________________________.
7. Phase ______________________ is the amount in degrees by which the current logs the voltage.
8. The phase angle depends on _______________ and _________________.
9. Inductive reactance is proportioned to the product of the __________ __________ and ____________________.
10. Find the inductive reactance of a coil with an inductance of 15 henrys at 60 cycles.

NAME ______________________________ Lesson C-4

Inductive Reactance Page 2

11. Find the inductive reactance of a 15-henry coil at 120 cycles.

12. A coil has an inductive reactance of 755 ohms at a frequency of 60 cycles. What is the inductance of the coil?

13. At what frequency will a 2.5 henry coil produce an inductive reactance of 1884 ohms?

14. Find the voltage drop across a coil having an inductive reactance of 942 ohms and a 2-ampere current flow.

15. Find the current flowing in an A. C. circuit having a 120-volt source and 5-henry coil at 50 cycles.

16. Find the inductive reactance of a 3-henry coil with a 120-volt A.C. source and a flow of 4 amps. in the circuit.

NAME ________________________________ Lesson C-5

DATE ________________________________. Capacitance

REFERENCE

1. American Electricians' Handbook, Pages 1-23, Sec. 47, 48; 1-44, Sec. 128.
2. Basic Electricity, Pages 3-77 - 3-92.
3. Basic Mathematics, Pages 366-376, 383.

PROBLEMS

1. The letter symbol for capacitance is ________________________.
2. The unit of capacitance is ________________________.
3. Capacitance is the ________________ of a circuit to store electrical energy.
4. Two conducting materials separated by an insulating material are called ________________________ or ________________________.
5. In an A.C. circuit, a capacitor is constantly ________________________ and ________________________.
6. The effect of capacitance in an A.C. circuit is that it produces ____________ to the flow of ________________________.
7. In a pure capacitive circuit, the ________________ will lead the ____________ by ________°.
8. A ________________ charged plate stops the flow of electrons from the plate.
9. A ________________ charged plate stops the flow of electrons to the plate.
10. What is capacitor charge?

11. What is capacitor discharge?

NAME ______________________________ Lesson C-5

Capacitance Page 2

12. One microfarad is ____________ farad.

13. One ____________ is $\frac{1}{1,000,000,000,000}$ farad.

14. The capacitance of a capacitor depends on the ____________ ____________ and the ____________ of the dielectric.

15. The larger the plate area, the larger the ____________________.

16. The thicker the dielectric, the larger the ____________________.

17. The total value of capacitors connected in parallel is the ____________

18. Capacitor plates are made of ____________ ____________ or ____________ ____________.

19. Dielectric materials are ____________, ____________ and ____________ ____________.

20. Series connection of capacitors increases the ____________ of the dielectric and ____________ the capacitance.

21. Parallel connection of capacitors increase the ____________ area and ____________ the capacitance.

22. What is the working voltage of a capacitor?

23. Find the total capacity in parallel of 15-uf, 45-uf and 10-uf capacitors.

NAME ______________________________ Lesson C-6

DATE ______________________________ Capacitive Reactance

REFERENCE

1. American Electricians' Handbook, Pages 1-24, Sec. 49; 1-44, Sec. 129.
2. Basic Electricity, Pages 3-107 - 3-111.
3. Basic Mathematics, Pages 376 - 381.

PROBLEMS

1. The symbol for capacitive reactance is ________________________.
2. The unit of capacitive reactance is ________________________.
3. The ______________ to alternating current produced by capacitance is ____________________ ______________________.
4. Capacitive reactance is affected by the ________________ and ______________.
5. Capacitive ____________________ is inversely proportioned to the product of the frequency and capacitance.
6. In a pure capacitive circuit the current ________________ the voltage by ____°.
7. In D.C. circuit _____________ _____________ is considered infinite because there is no continuous flow of __________°.
8. Increase in frequency or capacitance will decrease _____________ ___________.
9. Phase _______________ is the amount in degrees by which the current leads the voltage.
10. The phase angle depends on ________________ and ______________________.
11. Small ______________ has a large reactance.
12. Large capacitor has a _____________ reactance.

NAME ______________________________ Lesson C-9

DATE ______________________________ Series A.C. Circuits

REFERENCE

1. Basic Mathematics, Pages 408 - 432.
2. Basic Electricity, Pages 4-26 - 4-42.

PROBLEMS

1. In A. C. circuits containing resistance only, the current is ______________ ______________ with the voltage.

2. In A. C. circuits containing inductance only, the current is ______________ ______________ with the voltage and __________ the voltage by _____ degrees.

3. In A. C. circuits containing capacitance only, the current is _____ ________ ________ with the voltage and ________ the voltage by ________ degrees.

4. In series A.C. circuits containing resistance and inductance, the current ______________ the voltage.

5. In series A.C. circuits containing resistance and capacitance, the current ______________ the voltage.

6. In series A.C. circuits containing resistance, inductance and capacitance, the current may ____________ or ____________ the voltage depending on the values of the ________ __________ and __________ ______________.

7. In series A.C. circuits, the _________ is the same throughout the circuit.

8. The term "in phase" indicates a ____________ A.C. circuit.

9. The term "lag" indicates an ______________ A.C. circuit.

10. The term "load" indicates a ______________ A.C. circuit.

NAME ______________________________ Lesson C-11

DATE ______________________________ Power in A. C. Circuits

REFERENCE

1. American Electricians' Handbook, Pages 1-45 - 1-48, 3-38
2. Basic Electricity, Pages 3-33 - 3-35, 3-72 - 3-76, 3-112
3. Basic Mathematics, Pages 402, 405, 468 - 490

PROBLEMS

1. The ______________ in any electrical circuit is the product of ____________ and ________________ flowing at that time.

2. In a resistive circuit, power is found by multiplying the __________________ __________________ by ________________ ______________.

3. In a reactive circuit, power is found by multiplying the ______________ ________________ by only that portion of the __________ ____________ which is ______________ __________________ with the voltage.

4. Average ________________________ is the product of the voltage and current.

5. Apparent ________________________ is the product of the voltage and reactive current.

6. Apparent power units are in ____________ ______________.

7. Reactive power units are in ____________________.

8. True power units are in ______________________.

9. Write the formula for finding true power in watts.

10. Power __________________________________ is the ratio of true power to apparent power.

11. Power factor is equal to cosine of the angle of ______________.

12. Find the power factor of a motor drawing 500 watts and 5 amps from a 120-volt 60-cycle line.

13. Lights and motor loads of a stove draw 32 kw. The power factor of this load is 75 per cent. Find the apparent power delivered to the stove.

NAME ________________________________ Lesson C-11

14. A motor drawing 10 amps at 80 per cent power factor lagging is connected in parallel with a motor drawing 12 amps at 80 per cent lagging from a 120-volt line. Find the total true power, total pf, total current, and total apparent power; and draw vector diagram.

15. A motor drawing 30 kva at 60 per cent lagging power factor is connected in parallel with a motor drawing 45 kva at 50 per cent lagging power factor. Find total true power, total power factor, and total apparent power.

16. In an inductive circuit, the reactive power ______________ the true power.

17. In a capacitive circuit, the reactive power ______________ the true power.

18. An incandescent load of 4 kw is connected in parallel with an inductive motor drawing 8 kw at 75 per cent power factor from a 208 volt, 60-cycle line. Find the total true power, total apparent power, total pf, and total current; and draw vector diagram.

19. An induction motor drawing 20 kva at 70 per cent power factor is connected in parallel with synchronous motor drawing 10 kva at 65 per cent from a 440 volt, 60-cycle line. Find total current, total pf, total true power, and total apparent power; and draw vector diagram.

NAME ______________________________ Lesson C-12

DATE ______________________________ Power Factor Correction

REFERENCE

1. American Electricians' Handbook, Page 7-93.
2. Basic Mathematics, Page 490 -500.

PROBLEMS

1. A synchronous condenser is a synchronous motor used to correct power factor only and does not pull any __________ __________.
2. Synchronous motors may be used to correct ______ __________ factor of a system.
3. Lower power factors __________ the total current of a circuit.
4. Low power factor may be due to large power consumption by __________ __________ motors.
5. The __________ __________ is the actual power which may be measured by a watt meter.
6. Power factor is the ratio of __________ __________ to __________ __________.

NAME ______________________________ Lesson C-13

DATE ______________________________ Capacitors

REFERENCE

1. American Electricians' Handbook, Pages 4-126 - 4-130
2. Basic Electricity, Pages 3-93 - 105
3. National Electrical Code, Article 460

PROBLEMS

1. What installations of capacitors are covered by this article?

2. What type of capacitor installation requires a vault?

3. How shall capacitors be protected against mechanical damage?

4. Capacitors shall be provided with ________________ cases or supports.

5. Component transformers to capacitor installations shall have a KVA rating not less than __________ per cent of the KVAR rating.

6. For capacitors rated 600 volts or less, the time it takes to discharge to 50 KVA or below shall be a maximum of ____________ minutes.

7. List two means of capacitor discharge:

   (a) ____

   (b) ____

8. In correcting the power factor of a motor circuit, the KVAR rating shall not exceed the value to raise the ____________ lead power factor of the motor to ____ ________________.

9. The current-carrying-capacity of conductors in a capacitor circuit shall not be less than __________ per cent of the rated current of the capacitor.

10. In a motor circuit, the current-carrying-capacity of the capacitor conductors shall not be less than ___________ ___________ the motor circuit conductors but a minimum of ____________ per cent of the rated current of the capacitor.

11. The current-carrying-capacity of a disconnecting device shall be a minimum of ________________ per cent of the rated current of the capacitor.

12. An overcurrent device shall be installed in each ____________ conductor.

13. Is it necessary for the disconnecting means to open all ungrounded conductors simultaneously?

14. Are capacitor cases required to be grounded?

NAME ______________________________ Lesson C-14

DATE ______________________________ Hazardous Locations

REFERENCE

1. American Electricians' Handbook, Pages 9-180 - 9-181.
2. National Electrical Code, Article 500.

PROBLEMS

1. Define the three classes of hazardous locations:

(a) ______________________________

(b) ______________________________

(c) ______________________________

2. List the group classification for the following areas:

(a) Ethylene ____________
(b) Starch ____________
(c) Gasoline ____________
(d) Acetylene ____________
(e) Benzol ____________
(f) Hydrogen ____________
(g) Coal ____________
(h) Aluminum Dust ____________
(i) Lacquer Solvent Vapors ____________
(j) Flour ____________

3. Where may hazardous materials be found in a Division 1 area?

4. Where may hazardous materials be found in a Division 2 area?

5. What type hazardous location requires the installation of wiring in threaded rigid metal conduit with explosion-proof fitting or Type "MI" cable?

6. What type wiring installation is required in a Class III, Division I location?

7. What type wiring installation is required in a Class II, Division I location?

8. Electrical metallic tubing may be used in Class ________, Division ________ location.

9. What type wiring installation is required in a Class I, Division 2 location?

NAME ______________________________ Lesson C-14

DATE ______________________________ Hazardous Locations

REFERENCE

1. American Electricians' Handbook, Pages 9-180 - 9-181.
2. National Electrical Code, Article 500.

PROBLEMS

1. Define the three classes of hazardous locations:

(a) ____
____

(b) ____
____

(c) ____
____

2. List the group classification for the following areas:

(a) Ethylene ____________________
(b) Starch ____________________
(c) Gasoline ____________________
(d) Acetylene ____________________
(e) Benzol ____________________
(f) Hydrogen ____________________
(g) Coal ____________________
(h) Aluminum Dust ____________________
(i) Lacquer Solvent Vapors ____________________
(j) Flour ____________________

3. Where may hazardous materials be found in a Division I area?

4. Where may hazardous materials be found in a Division 2 area?

5. What type hazardous location requires the installation of wiring in threaded rigid metal conduit with explosion-proof fitting or Type "MI" cable?

6. What type wiring installation is required in a Class III, Division I location?

7. What type wiring installation is required in a Class II, Division I location?

8. Electrical metallic tubing may be used in Class ________, Division ____________ location.

9. What type wiring installation is required in a Class I, Division 2 location?

NAME ______________________________ Lesson C-14

Hazardous Locations Page 2

10. Where it is impractical to make a threaded joint tight, ____________________

____________________ should be utilized.

11. What is the intent of Article 500 through 503?

12. Define "Explosion-Proof Apparatus".

13. What type of electrical equipment shall be used in Class I, Divisions I and 2 locations?

14. What type of electrical equipment shall be used in Class II, Divisions I and 2 locations?

NAME ____________________________________

Class I Installations

13. Explosion-____________________ flexible motor fittings shall be used in Class I, Division I locations.

14. The thickness of compound in seal fittings shall not be less than ________ inch.

15. Splices and __________ shall not be made in sealing fittings.

16. In Class I, Division 2 locations, a disconnecting switch may be of the ____________________ type.

17. List the four conditions under which a panelboard with a general purpose enclosure may be installed in a Class I, Division 2 area.

(a) ________________________________
(b) ________________________________
(c) ________________________________
(d) ________________________________

18. Flexible cord with a ground conductor may be used in Class I, Division ________ wiring.

19. Motors shall be _________ _________ or __________ __________-Type for Class I, Division I locations.

20. Lighting fixtures in Class I, Division I locations shall be approved as a ____________________.

21. Stems for pendant fixtures in Class I, Division I and 2 locations shall not exceed ______________ inches without permanent bracing.

22. List two required methods of protecting lighting fixtures in Class I, Division I areas:

(a) ____
(b) ____

23. Flexible cords may be used for connection to portable ________ in Class I, Divisions I and 2 locations.

24. List two requirements for using receptacles in Class I, Divisions I and 2 locations

(a) __________________________ (b) ________________________________

25. In Class I, Divisions I and 2 locations, conductor insulation shall be ________ of ____________ where condensed vapors or liquids may collect on conductors.

26. All exposed non-current-carrying metal parts of electrical equipment shall be ______________ in Class I, Divisions I and 2 locations.

27. In Class I, Divisions I and 2, there shall be ____________ live parts.

NAME ______________________________ Lesson C-15

Class I Installations Page 2

13. Explosion-_________________ flexible motor fittings shall be used in Class I, Division I locations.

14. The thickness of compound in seal fittings shall not be less than ______ inch.

15. Splices and _________ shall not be made in sealing fittings.

16. In Class I, Division 2 locations, a disconnecting switch may be of the _______ ___________ type.

17. List the four conditions under which a panelboard with a general purpose enclosure may be installed in a Class I, Division 2 area.

(a) ____________________________
(b) ____________________________
(c) ____________________________
(d) ____________________________

18. Flexible cord with a ground conductor may be used in Class I, Division _______ wiring.

19. Motors shall be _______ _______ or _________ _________-Type for Class I, Division I locations.

20. Lighting fixtures in Class I, Division I locations shall be approved as a _______ ____________.

21. Stems for pendant fixtures in Class I, Division I and 2 locations shall not exceed ____________ inches without permanent bracing.

22. List two required methods of protecting lighting fixtures in Class I, Division I areas:

(a) ____
(b) ____

23. Flexible cords may be used for connection to portable _______ in Class I, Divisions I and 2 locations.

24. List two requirements for using receptacles in Class I, Divisions I and 2 locations

(a) _______________________ (b)___________________________

25. In Class I, Divisions I and 2 locations, conductor insulation shall be _______ of __________ where condensed vapors or liquids may collect on conductors.

26. All exposed non-current-carrying metal parts of electrical equipment shall be ___________ in Class I, Divisions I and 2 locations.

27. In Class I, Divisions I and 2, there shall be __________ live parts.

NAME ______________________________ Lesson C-16

Class II Installations Page 2

14. List two wiring methods where seals may be omitted in Class II, Divisions I and 2 areas:

    (a) ______________________________
    (b) ______________________________

15. Circuit breaker enclosures in Class II, Division I areas shall be __________-__________-__________.

16. Motors in Class II, Division I areas shall be __________ __________ nonventilated and shall be approved as __________-__________-__________ for __________ __________ locations.

17. Motors in Class II, Division 2 areas __________ __________.

18. Ventilating piping for electrical equipment shall be constructed of metal having lightest gauge of No. __________.

19. Lighting fixtures for Class II, Division I areas shall be __________-__________-__________ __________ for Class ______ installation.

20. Maximum pendant length for lighting, fixtures in Class II, Division I areas shall be ________ inches.

21. On chain-mounted pendant fixtures, __________ shall be installed at the entrance of cord with outlet box and fixture.

22. List two conditions which a lighting fixture is acceptable in a Class II, Division 2 areas even though it is not approved for a Class II installation:

    (a) ______________________________ ______________________________
    (b) ______________________________ ______________________________

23. Fluorescent lamps conforming to requirements may be installed in Class ________, Division __________ areas.

24. List two requirements for installing receptacles and plugs in Class II, Division I areas:

    (a) ______________________________
    (b) ______________________________

25. What is the difference between the requirements for installing a receptacle in a Class II, Division 2 area and a Class II, Division I area?

26. Is it necessary to always install communication wiring in a metal raceway or use Type MI cables?

NAME ______________________________ Lesson C-16

Class II Installations Page 2

14. List two wiring methods where seals may be omitted in Class II, Divisions I and 2 areas:

(a) ______________________________

(b) ______________________________

15. Circuit breaker enclosures in Class II, Division I areas shall be __________-__________-__________.

16. Motors in Class II, Division I areas shall be __________ __________ nonventilated and shall be approved as __________-__________-__________ for __________ __________ locations.

17. Motors in Class II, Division 2 areas __________ __________.

18. Ventilating piping for electrical equipment shall be constructed of metal having lightest gauge of No. __________.

19. Lighting fixtures for Class II, Division I areas shall be __________-__________-__________ __________ for Class ______ installation.

20. Maximum pendant length for lighting, fixtures in Class II, Division I areas shall be ______ inches.

21. On chain-mounted pendant fixtures, ________ shall be installed at the entrance of cord with outlet box and fixture.

22. List two conditions which a lighting fixture is acceptable in a Class II, Division 2 areas even though it is not approved for a Class II installation:

(a) ______________________________
____

(b) ______________________________
____

23. Fluorescent lamps conforming to requirements may be installed in Class ______, Division ________ areas.

24. List two requirements for installing receptacles and plugs in Class II, Division I areas:

(a) ______________________________

(b) ______________________________

25. What is the difference between the requirements for installing a receptacle in a Class II, Division 2 area and a Class II, Division I area?

26. Is it necessary to always install communication wiring in a metal raceway or use Type MI cables?

NAME ______________________________ Lesson C-16

Class II Installations Page 3

27. There shall be no _________ ____________ parts in Class II, Division 1 and 2 areas.

28. In Class II, Divisions 1 and 2, all exposed non-current-carrying metal parts shall be ____________.

29. Bonding _________________ shall be installed for bonding purposes in Class II, Division 1 and 2 installations.

NAME ______________________________

DATE ______________________________

Lesson C-17

Class III Installations

REFERENCE

1. National Electrical Code, Article 503

PROBLEMS

1. Class III locations are hazardous due to the presence of ______ ______.

2. Rigid ______________ or Type ______ cable shall be installed in Class III, Division 1 areas.

3. Flexible connections shall be made with ______-______ connectors in Class III, Division ______ areas.

4. Open ____________ may be installed in Class III, Division 2 locations.

5. Partially enclosed type or ____________ ____________ motors shall not be installed in Class III locations.

6. Maximum pendant length on a lighting fixture is ______ inches in a Class III location.

7. Electric-____________ lighting fixtures with guard may be installed in Class III locations.

8. In Class III locations, the power supply for cranes shall be ______ from all other systems and ____________.

9. Recording ______ ______ shall be installed on crane systems in Class III locations.

10. Storage battery charging equipment shall be installed in ______ ______ in Class III locations.

11. In Class III installations, all exposed non-current-carrying metal parts shall be ____________.

12. There shall be no exposed live parts in Class III areas except for ______-______ installations.

13. List two conditions for receptacles and plugs for Class III areas:

(a) ______________________ (b) ______________________

14. In general, ______ ______ motors shall be installed in all Class III areas.

15. List two requirements for construction of lighting fixtures in Class III areas:

(a) ______________________________________

(b) ______________________________________

NAME ________________________________ Lesson C-18

Commercial Garages, Repair and Storage
Residential Storage Garages

Page 2

15. Define a residential storage garage.

16. An area below grade used for storage of an automobile is classified as Class __________, Division ______ up to a level _______ inches above the floor.

NAME ______________________________ Lesson C-18

Commercial Garages, Repair and Storage Page 2
Residential Storage Garages

15. Define a residential storage garage.

16. An area below grade used for storage of an automobile is classified as Class __________, Division ______ up to a level _______ inches above the floor.

NAME ______________________________ Lesson C-19

DATE ______________________________ Aircraft Hangers

REFERENCE

1. National Electrical Code, Article 513.

PROBLEMS

1. The entire hangar floor up to a level _______ inches above the floor is considered to be Class _______, Division _________ area.

2. The area 4'-6" above an aircraft wing is considered a Class ______, Division ______ area.

3. Any area within ________ feet of an aircraft is considered as hazardous.

4. Fixed wiring in the non-hazardous area of a hangar shall be installed in _______, _________, Type __________ cable or Type _________ cable.

5. Seals shall be installed on _________ passing from hazardous areas.

6. Aircraft _______________ should not be charged while the aircraft is located in the hangar.

7. All metallic raceways and non-current-carrying parts of fixed equipment or portable equipment regardless of voltage shall be ____________________.

8. Service equipment not equipped for Class I, Division 2 locations shall not operate within hazardous locations and within ____________ feet of aircraft.

9. What type of permanent warning sign should be attached to mobile energizers and service equipment?

NAME ______________________________ Lesson C-21

DATE ______________________________ Bulk Storage Plants

REFERENCE

1. National Electrical Code, Article 515

PROBLEMS

1. List locations included under this Article:

   (a) ____
   (b) ____

2. In ventilated modern area containing a gasoline pump, the classification shall be Class _____, Division _____ for _____ feet horizontally and ______ feet vertically above the floor.

3. The immediate area within _________ feet horizontally and vertically above the above pump shall be classified as Class _____, Division _____.

4. List restrictions and classification for an unventilated area containing a gasoline pump.

5. List restrictions and classifications for an outdoor pump installation.

6. Office buildings outside the 25-feet radius of the storage tank have a ______-______________ classification.

7. All electrical equipment within the hazardous area shall conform to Article______.

8. Underground plastic conduit or duct may be installed in a hazardous area if buried _____________ feet or more below grade.

9. Where shall seals be installed?

10. What type of grounding is required under this Article?

NAME ______________________________ Lesson C-21

DATE ______________________________ Bulk Storage Plants

REFERENCE

1. National Electrical Code, Article 515

PROBLEMS

1. List locations included under this Article:

   (a) ____
   (b) ____

2. In ventilated modern area containing a gasoline pump, the classification shall be Class _____, Division _____ for _____ feet horizontally and _____ feet vertically above the floor.

3. The immediate area within _________ feet horizontally and vertically above the above pump shall be classified as Class _____, Division _____.

4. List restrictions and classification for an unventilated area containing a gasoline pump.

5. List restrictions and classifications for an outdoor pump installation.

6. Office buildings outside the 25-feet radius of the storage tank have a ______-______________ classification.

7. All electrical equipment within the hazardous area shall conform to Article______.

8. Underground plastic conduit or duct may be installed in a hazardous area if buried _____________ feet or more below grade.

9. Where shall seals be installed?

10. What type of grounding is required under this Article?

NAME ______________________________ Lesson C-22

DATE ______________________________ Flammable Anesthetics

REFERENCE

1. National Electrical Code, Article 517

PROBLEMS

1. What are flammable anesthetics?

2. List five gases or vapors which are flammable anesthetics:

   (a) ________________________
   (b) ________________________
   (c) ________________________
   (d) ________________________
   (e) ________________________

3. List five areas in a hospital where anesthetics may be administered:

   (a) ________________________
   (b) ________________________
   (c) ________________________
   (d) ________________________
   (e) ________________________

4. What hazardous classification is given to areas used for storing flammable anesthetics or volatile flammable disinfecting agents?

5. The entire anesthetics area up to _______ feet above the floor is classified as Class _______, Division _______ location.

6. Raceways in masonry walls are considered to be in ____________ area.

7. Conduits in block walls in an anesthetics area are in a ___________ area.

8. Boxes in a masonry wall in an anesthetics area are in a ___________ area.

9. MI cables may be installed in ____________________ areas.

10. List three types of wiring permitted in a hazardous area.

   (a) ________________________
   (b) ________________________
   (c) ________________________

11. Seals shall be installed in _________________ passing from anesthetics area.

12. In anesthetics area, each circuit shall have a switch to disconnect each ________ conductor.

NAME ______________________________ Lesson C-22

Flammable Anesthetics Page 2

13. Each circuit shall be supplied from an __________ distribution system.

14. List three methods used for circuit isolation:

(a) ____________________________
(b) ____________________________
(c) ____________________________

15. Secondary voltage of an isolation transformer shall not exceed ______ volts.

16. Primary voltage to isolation transformer shall not exceed __________ volts.

17. Overcurrent ___________ shall be installed in secondary neutral of isolation transformer.

18. Isolation transformer shall be mounted in __________ area.

19. Ground __________ shall be installed on each ungrounded system.

20. Current through the ground indicator shall not exceed ________ __________-amperes.

21. Grounded branch circuits and ungrounded branch circuits shall be installed in

____________ raceways in anesthetics area.

22. Fixed lighting fixtures in anesthetic area shall be mounted at least _____ feet above floor.

23. Switches for grounded circuits shall be located _________ of anesthetics area.

24. Electrical apparatus used in the hazardous area shall operate at a maximum of

___________ volts.

25. Low-voltage supply from a common source for electrical apparatus in hazardous

area shall be located in ______________ location.

26. Motors used in hazardous area shall be approved for Class ____ locations.

27. Overcurrent devices for low voltage equipment shall be installed in __________ area.

NAME ______________________________ Lesson C-23

Fundamentals of Motor Control Page 2

15. Automatic motor control of equipment provides more ____________________.

16. Automatic operation of a machine is dependent upon the ____________ and ____________ ________________.

17. List the three divisions of a machine:

(a) __________________________
(b) __________________________
(c) __________________________

18. The operating requirements of the motor and machine dictates the _________-_______________ design.

19. Motor ___________ means the governing or regulating the functions of a motor or machine.

20. A __________ _____________ is equipment used to govern or regulate the function of a machine.

21. The most popular manual controller is the ___________ __________-__________ motor starter.

22. The manual starter does not provide __________-__________ protection.

23. The __________ is a manual reduced-voltage starter and provides ____________ protection, __________-__________ protection and ________ ____________ release.

24. The __________ is used on large horsepower motors.

25. With the addition of a __________ _____________ with the compensator, speed and flexibility are provided for a wound-rotor motor.

26. Semi-automatic control is provided by a magnetic starter and remote ___________ operated devices.

27. Automatic control is provided by a magnetic starter and __________ or ______________ and ___________ operated devices.

28. Semi-automatic controls provide flexibility in _________ of manual controls.

29. Automatic controls eliminate the necessity of manual control.

NAME ______________________________ Lesson C-24

DATE ______________________________ Control of Motor Start

REFERENCE

1. A-C Motor-Control Fundamentals, Pages 11 -32.

PROBLEMS

1. Synchronous motors are sometimes stopped by the use of ________ braking.

2. An ____________ load is the term used when the load has a tendency to turn the motor.

3. Plugging is the term used when the motor is momentarily __________ to abruptly stop the motor.

4. Motors may be stopped either _______________ or ________________.

5. Thermal relay is connected across the line during ______________ of a reduced-voltage starter to prevent damaging the motor windings or auto transformer.

6. Phase-failure protection is provided by using ___________ ___________ relay units.

7. Squirrel-cage motors can be damaged by excessive currents at ____________ per cent of load without affecting the second overload relay unit.

8. Single ____________ occurs when a three-phase motor has current interrupted on one phase.

9. Under voltage protection requires the motor to be started ________________.

10. Under voltage _____________ permits starting the motor automatically provided the power is restored to its proper value.

11. Momentary-_______________ pilot devices provide under-voltage protection.

12. Maintained-_______________ pilot devices provide under-voltage release.

13. List four general types of speed control:

    (a) ________________________________

    (b) ________________________________

    (c) ________________________________

    (d) ________________________________

14. The most versatile a-c motor with speed control is the ___________-____________ motor (_______________-_______________ motor).

T F 23. A faceplate is used to hold straight-shank twist drills to the spindle of the drill press.

T F 24. To hold round work, V-blocks are used during the drilling operation.

T F 25. Where several pieces of work have to be drilled alike, a device called a jackscrew is used so that all holes will be drilled at the same location on each piece of work.

T F 26. Drill press operators should wear goggles.

T F 27. The drill press operator should wear protective gloves.

T F 28. Chips should be removed from the drill press table by use of a brush.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. The machinist should learn to tell whether or not a drill or other cutting tool is working properly, by the ______________, by the ____________________, and by the ____________________.

2. The standard drill press has a separate motor which drives the drill spindle and chuck by means of a ________________.

3. For most quantity production work, the work is held in a ________________.

4. In production work where two or more different sizes of holes are to be drilled, it is customary to use a ____________________ drill.

5. The process of laying out work for drilling consists of indicating by means of ________________ ______________, the positions of centers of the holes to be drilled.

6. If the surface on which the layout is to be made has been machined, a coating of ________________ ________________ solution or ________________ ________________ solution may be used before scribing or marking.

7. The reversing mechanism on a back-geared drill press enables the operator to do ________________.

8. Small diameter, straight-shank twist drills are held in a ________________ to do drilling.

9. Taper-shank drills are removed from the taper hole by means of a ______________________.

10. If the taper hole in the spindle is too large for the taper shank of the drill or chuck, the taper-shank tool is held in a ________ ________.

11. Vises, V-blocks, angle plates, and other holding devices are fastened to the drill press table by means of ________.

12. To protect the eyes from chips and other flying particles, the drill press operator should always wear ________.

List

Directions: List the items called for in each of the following. Select your answers carefully.

1. Types of clamps used for holding work to be drilled:

(A) ________

(B) ________

(C) ________

(D) ________

(E) ________

(F) ________

2. The principal parts of the bench-type sensitive drill press are:

(A) ________

(B) ________

(C) ________

(D) ________

(E) ________

(F) ________

(G) ________

(H) ________

(I) ________

3. Some of the work-holding devices used for mounting and supporting the workpiece in the drill press are:

(A) ________

(B) ________

(C) ________

(D) ________

(E) ________

(F) ________

(G) ________

(H) ________

(I) ________

T F 6. Drill chucks are made in various sizes, and a series of three or four are needed to hold drills from the smallest size up to one inch in diameter.

T F 7. The drills most commonly used in the machine shop are flat fluted drills.

T F 8. The twist drill is probably the least used and the least efficient cutting tool in the shop.

T F 9. If small drills are not marked, the size is found by the use of a drill gage.

T F 10. In shops where considerable amounts of drilling are done, it is economical to sharpen drills by hand.

T F 11. When sharpening carbon-steel drills, dip them in water frequently to prevent overheating and loss of temper.

T F 12. The clearance on a drill at the cutting edge should be 25 degrees.

T F 13. The edges of a drill should be ground at an angle of 59 degrees with the axis to obtain the best results in most metals.

T F 14. For drilling brass, bronze, or other soft metals, a drill with rake is considered best.

T F 15. To strengthen a drill, the web is made thicker toward the shank.

T F 16. When sharpening or selecting a drill, there is a tendency for the beginner to give insufficient lip clearance toward the center of the drill.

T F 17. When a drill squeaks, it is usually an indication of a crooked hole or dullness.

T F 18. Cutting oils tend to dull the cutting edge of the drill.

T F 19. Lard oil is the original cutting oil and is still highly recommended.

T F 20. Sulphur added to lard oil is recommended for drilling hard or tough metals.

T F 21. Since a drill will follow a hole already made, many times it is a good plan to drill a small hole about one-fourth inch deep to keep the larger drill from running.

T F 22. If a power feed is used when drilling steel, it should be thrown in after the feed has been started by hand.

T F 23. A lead hole, when used, should be as large as possible to prevent undue strain on the machine.

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T F 24. It is the usual practice to follow the drill with the reamer under the same conditions that the drilling was done.

T F 25. On reamers larger than one-half inch in diameter, the recommended amount of stock to leave for ferrous metals is 1/32 of an inch.

T F 26. The taper reamer should always be turned by machine.

T F 27. In production work, it is usually not economical to use high-speed reamers.

T F 28. Oil is used as a cutting lubricant when reaming cast iron.

T F 29. At no time, nor under any circumstances, should a reamer be turned backward.

T F 30. The larger size counterbores are usually made with removable cutters.

T F 31. Countersinking and counterboring are two words used for the same operation.

T F 32. To avoid chattering, countersinks are run at slow speeds.

T F 33. Fractional drills over one-half inch in diameter are made with a straight shank only.

T F 34. To drill tool steel with a one inch high speed drill, the cutting speed should be fron 50 to 60 surface feet per minute.

T F 35. Alloys and hard steels can usually be drilled with a heavier feed than can cast iron, brass, or aluminum.

T F 36. Kerosene or lard oil are recommended cutting fluids for drilling aluminum.

T F 37. Adjustable reamers are designed so that the blades may be expanded or contracted by means of an adjusting nut.

T F 38. Before drilling is done, a center punch is used to make an indentation at the center to help start the drill.

T F 39. The reamer should revolve at approximately twice the speed of the drill press.

T F 40. The drill press cannot be used for buffing and grinding.

2. The parts of a drill as given in Reference A are:

(A) ____________________ (F) ____________________

(B) ____________________ (G) ____________________

(C) ____________________ (H) ____________________

(D) ____________________ (I) ____________________

(E) ____________________

3. Types of drills are:

(A) ____________________ (C) ____________________

(B) ____________________ (D) ____________________

4. Points to consider in grinding a drill properly are:

(A) ____

(B) ____

(C) ____

5. Six types of reamers are:

(A) ____________________ (D) ____________________

(B) ____________________ (E) ____________________

(C) ____________________ (F) ____________________